ADVANTEST

ADVANTEST CORPORATION

TR4171

SPECTRUM ANALYZER

OPERATION MANUAL

VOL. 1

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MANUAL CHANGES

ADVANTEST

ADVANTEST CORPORATION

Date	(発行日)	Apr 2 /96 (96.4.2)	
Product	(機種名)	TR4171	TR4171
Manual No.	(適用ﾏﾆｭｱﾙ No.)	－EG 9509 and after	～0JY00 以降
Manual Change No.	(ﾏﾆｭｱﾙ・ﾁｪﾝｼﾞ No.)	EMC-09	JMC-17

Parts of the Instruction Manual was changed as follows.
(本取扱説明書の一部を以下のように変更しましたので、訂正してお読み下さるようお願い申し上げます。)

TR4171 (English Manual)	TR4171 (Japanese Manual)
The following option were modified into the standard configuration. Refer to each item for using the options. ● QP Measurement (Option 01) ● Occupied Bandwidth Display (Option 04) ● Impedance Measurement (Option 05) ● Adjacent Channel Leakage Power Calculation Software (Option 06) ● Extension Plotter Interface (Option 07) ● Gated Sweep Function (Option 12)	下記のオプションは、標準装備になりました。御使用の際は、各項目を参照して下さい。 ● QP値測定 (ｵﾌﾟｼｮﾝ 01) ● 占有帯域幅表示 (ｵﾌﾟｼｮﾝ 04) ● ｲﾝﾋﾟｰﾀﾞﾝｽ 測定 (ｵﾌﾟｼｮﾝ 05) ● 隣接ﾁｬﾝﾈﾙ 漏洩電力 (ｵﾌﾟｼｮﾝ 06) ● ｴｸｽﾃﾝｼｮﾝ・ﾌﾟﾛｯﾀ・ｲﾝﾀﾌｪｰｽ(ｵﾌﾟｼｮﾝ 07) ● Gated Sweep 機能 (ｵﾌﾟｼｮﾝ 12)
Production of X-Y Recorder Output(Option 03) was discontinued.	X-Y レコーダ出力 (オプション 03)は、廃止になりましたので御了承下さい。
3-19 Page The item (8) was changed as follows.	3-20ページ ⑧を変更しました。
(8) X,Y and GATE IN Connector X,Y Connector : This connector is unused. GATE IN Connector : This connector is input of the gate control for the Gated Sweep.	⑧ X,Y,GATE IN コネクタ X,Y コネクタ: 本コネクタは、未使用です。 GATE IN コネクタ: Gated Sweep ゲート・コントロール信号入力端子です。

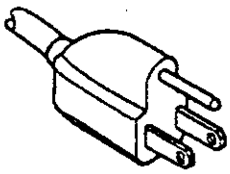
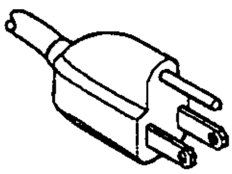
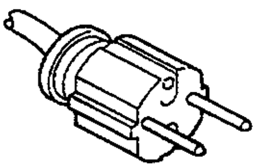
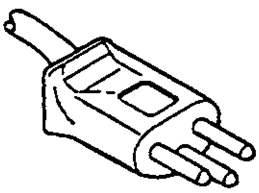
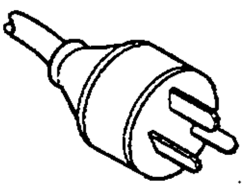
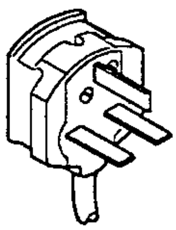
TR4171 (English Manual)	TR4171 (Japanese Manual)
4-94 Page The function display of the option switch was changed as follows.	4-104 ページ OPTIONスイッチの機能表示を変更しました。

```
<OPTION>

 '1'  SMITH CHART
 '2'  OBW
 '3'  OBW & ADJB
 '4'  PLOT
 '0'  QUIT
```

Table of Power Cable options

There are six power cable options (refer to following table).
Order power cable options by Accessory Codes.

	Plug Configuration	Standards	Rationg, Color and Length	Accessory Codes (Option Number)
1		JIS: Japan Law on Electrical Appliances	125V at 7A Black 2m (6ft)	Straight: A01402 (Standard) Angled: A01412
2		UL: United States of America CSA: Canada	125V at 7A Black 2m (6ft)	Straight: A01403 (Option 95) Angled: A01413
3		CEE: Europe VDE: Germany OVE: Austria SEMKO: Sweden DEMKO: Denmark KEMA: Holland FIMKO: Finland NEMKO: Norway CEBEC: Belgium	250V at 6A Gray 2m (6ft)	Straight: A01404 (Option 96) Angled: A01414
4		SEV: Switzerland	250V at 6A Gray 2m (6ft)	Straight: A01405 (Option 97) Angled: A01415
5		SAA: Australia, New Zealand	250V at 6A Gray 2m (6ft)	Straight: A01406 (Option 98) Angled: ———
6		BS: United Kingdom	250V at 6A Black 2m (6ft)	Straight: A01407 (Option 99) Angled: A01417

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GENERAL INFORMATION

1-1. GENERAL

The TR4171 Spectrum Analyzer is microprocessor-controlled, digital, intellignet test equipment with a frequency range of 10 Hz to 120 MHz and an amplitude range of +30 dBm to -150 dBm. With a highly accurate and stable built-in synthesized local oscillator, TR4171 has realized a maximum resolution bandwidth of 3 Hz to enable the analysis of even spurious components such as power supply ripple and low-frequency noise superimposed on signals. The TR4171 ensures a wide dynamic range of at least -90 dB for input signal level of -40 dBm, so that higher harmonics and cross-modulation spurious components can be analyzed. In addition to the normal spectrum analysis function, the built-in tracking generator of the TR4171 enables testing of the amplitude characteristics of filters, amplifiers, etc. It also provides a normalizing function to eliminate errors in the test system. In addition, the TR4171 can be used as a network analyzer because it can measure phase response and group delay at resolutions down to 0.2°/div. and 0.1 ms respectively. High-precision measurement of phase response and group delay is ensured by the offset function and electrical length adjustment function available with the TR4171. The GPIB interface, provided as a standard function, enables interfacing with automatic measurement systems, and also allows direct connection of the TR4171 to plotters made by Takeda Riken to provide hard copies of measured data. The TR4171 also provides various convenient features to enhance automatic testing, such as automatic tuning, automatic range, automatic peak search, and next-peak search.

1-2. FEATURES

(1) A highly accurate and stable (2×10^{-8}/day) built-in synthesized local oscillator provides a noise sideband analysis capability with a high C/N ratio.

(2) A maximum resolution bandwidth of 3 Hz (3 dB) enables analysis of adjacent noise.

(3) A higher-harmonic distortion of 90 dB or less (for -40 dBm input) enables rapid measurement of higher harmonics and 2-signal tertiary intermodulation distortion.

(4) A maximum input sensitivity of -140 dBm enables measurement of extremely low level signals.

(5) Built-in amplitude, phase, and group delay measurement capabilities enable evaluation of filters, etc., with a single piece of test equipment.

(6) The automatic calibration function provides various error corrections for enhanced precision measurement.

(7) The automatic tune function enables automatic location of peaks in the input signal and automatic setting of specified span.

(8) The automatic range function automatically maintains the input signal at the highest level to provide the widest dynamic range at all times.

(9) The automatic peak-search function enables automatic determination of the peak value from a trace displayed on the screen and digital display of its level and frequency. In addition, the next-peak search feature can automatically search for the next highest peaks in sequence and display their level and frequency.

(10) The GPIB interface, provided as a standard feature, enables direct interfacing with various types of peripheral devices.

1-3. ACCESSORIES

The standard accessories supplied with the TR4171 are listed below. Check their quantity and specifications against this list.

Model name	Model number	Q'ty	Remarks
Power cable	MP-43	2	For display and RF units
Input cable	A01036-1500	2	50 Ω BNC cable, 1.5 m
RF connection cable	DCB-SS1560X01-1	1	For connecting rear of display unit and rear of RF unit
RF connection cable	57FE-350-2P31W	1	For connecting rear of display unit and rear of RF unit
RF connection cable	MI-78	1	For connecting rear of display unit and rear of RF unit
Slow-blow fuse	MDX-1.6A	2	For 100 VAC
Slow-blow fuse	MDA-2.5A	2	For 100 VAC
Instruction manual	E4171	1	English manual

Note : Order the addition of the accessory etc. with model number.

1-4. SPECIFICATIONS

Frequency specifications

Frequency range : 10 Hz to 120 MHz (50 Ω, 75 Ω, and 1 MΩ inputs)
100 Hz to 120 MHz (50/75 Ω high sensitivity mode)

Frequency span : 20 Hz to 120 MHz, with 10 division along the horizontal axis of CRT
Enterable with DATA knob or DATA numeric/units keyboard to three significant figures
Controllable with DATA step keys in 1, 2, or 5 steps
In zero frequency span mode, the analyzer functions as fixed-tuned receiver

Frequency span accuracy: Within ±3% for span > 50 kHz
Within ±5% for span ≤ 50 kHz

Center frequency : 0 Hz to 120 MHz
Settable with DATA knob or numeric/units keyboard
The center frequency step size can be controlled with the numeric/units keyboard or the MKR/Δ STEP SIZE key
Also settable with the MKR → CF, SIGNAL TRACK, or AUTO TUNE key

Center frequency accuracy:

Display accuracy: ± (1% of frequency span) + (standard oscillator accuracy x tuned frequency) + 1 Hz after error correction, or ± {(1% of frequency span) + (standard oscillator accuracy x tuned frequency) + 1 Hz} ± {(10% of resolution bandwidth) ± 20 Hz} before error correction

Zero span display accuracy: ± {(1% of resolution bandwidth) + (standard oscillator accuracy + tuned frequency) + 1 Hz)} after error correction, or ± {(10% of resolution bandwidth) + (standard oscillator accuracy x tuned frequency) + 20 Hz} before error correction

Start/stop frequency: Controllable with the DATA knob, DATA step keys, or DATA keyboard

Start/stop frequency accuracy: (center frequency accuracy) + (frequency span accuracy x 1/2)

Marker displays:

MARKER : Provides frequency display of active marker point

T.G. CNTR : Provides direct display of marker frequency

FREQ. CNTR : Provides direct display of frequency of signal whose level is as least +15 dB higher than the noise level, when in frequency counter mode

MARKER display accuracy:

MARKER : ± {(center frequency accuracy) + (frequency span accuracy)}
The frequency span is the difference in frequency between the marker and the center frequency

T.G. CNTR : ± {(standard oscillator accuracy) x (display frequency) + (2 counts) + (frequency span/1000)}

FREQ. COUNT : ± {(standard oscillator accuracy) x (display frequency)} ±2 counts, for signal frequencies from 10 Hz to 120 MHz

Standard oscillator stability:

Aging rate : 2×10^{-8}/day, 8×10^{-8}/month

Long-term stability: 1×10^{-7}/year

Temperature characteristic (+25°C ±25°C): Within $\pm 5 \times 10^{-8}$

Resolution:

Resolution bandwidth (3 dB bandwidth): 3 Hz to 100 kHz, switchable between 1 - 3 steps

Bandwidth selectivity: <11:1 (resolution bandwidth ratio of 60 dB:3 dB)
<18:1 (resolution bandwidth ratio of 80 dB:3 dB)

Resolution bandwidth accuracy: ±20% (in 3 dB bandwidth)

Stability (at constant temperature after 1 hour warm-up):

When frequency span > 50 kHz:

Drift : 1 kHz/minute or less, 10 kHz/30 minutes or less

Residual FM component: 200 Hz p-p/second or less

When 50 kHz ≥ frequency span > 5.0 kHz:

Drift : 20 Hz/minute or less, 200 Hz/30 minutes or less

Residual FM component: 1 Hz p-p/second or less

When frequency span ≤ 5.0 kHz:

Drift : 1 Hz/minute or less, 10 Hz/30 minutes or less

Residual FM component: 0.2 Hz p-p/second or less

Noise sideband:

-125 dBc/Hz : Average at 20 kHz away from the carrier

-100 dBc/Hz : Average at 100 kHz away from the carrier

SIGNAL TRACK : Varies center frequency in each sweep so that the peak of the signal specified by the marker is positioned at the center of the screen

Δ : Displays the frequency difference between two markers

MKR/Δ → CF/SPAN:

MKR : Makes the marker frequency the center frequency

Δ marker : Makes the left and right marker frequencies the start and stop frequencies on the screen

MKR/Δ → STEP SIZE : Makes the marker frequency or the frequency between markers the FREQ. STEP SIZE

ZOOM : DATA step down key narrows the frequency span centered on the marker

AUTO TUNE : Expands frequency resolution to the specified span while keeping the maximum signal, in the 3 MHz to 118 MHz range, at the center of the screen.

Amplitude specifications

Measurement range: −135 dBm to +30 dBm (50 Ω and 75 Ω inputs)
−150 dBm to +30 dBm (50/75 Ω high sensitivity mode)
−148 dBV to +29 dBV (1 MΩ input)

Display range : Ten scale divisions in the vertical axis, with the reference level at the top of the CRT

Display modes:

Logarithmic mode: With respect to the reference level:
95 dB (95 dB) at 10 dB/div.
50 dB (48 dB) at 5 dB/div.
20 dB (19 dB) at 2 dB/div.
10 dB (9.5 dB) at 1 dB/div.
5 dB at 0.5 dB/div.
1.8 dB at 0.2 dB/div.
0.8 dB at 0.1 dB/div.
The values in parentheses are those after linearity error correction.

Linear mode : 10% of the reference level per division when the scale is calibrated for voltage

Linearity:

Logarithmic mode: 10 dB/div. to 1 dB/div., without error correction:
±0.2 dB/dB over 0 dB to 95 dB
Max. ±1.0 dB over 0 dB to 95 dB, 20°C to 30°C
Max. ±1.5 dB over 0 dB to 95 dB, 0°C to 40°C
Within ±3% of the magnitude of attenuation from the reference level from 0.5 dB/div. to 0.1 dB/div.

With respect to the reference level after linearity error correction:

10 dB/div.

0 dB – 80 dB	80 dB – 95 dB
Max. ±0.4 dB (typical value ±0.3 dB Max.)	Max. ±0.8 dB (typical value ±0.5 dB Max.)

5 dB/div.

0 dB – 48 dB
Max. ±0.25 dB (typical value ±0.15 dB Max.)

2 dB/div.

0 dB – 10 dB	10 dB – 19 dB
Max. ±0.15 dB (typical value ±0.10 dB Max.)	Max. ±0.20 dB (typical value ±0.12 dB Max.)

1 dB/div.

0 dB – 9.5 dB
Max. ±0.12 dB (typical value ±0.08 dB Max.)

Linear mode : ±3% of the reference level

Reference level:

Logarithmic mode: Settable to values within the range of +60.0 dBm to -105.0 dBm, or equivalent values in dBV, dBmV, dB V, or V

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Linear mode : 223.6 V to 1.257 μV
(The input specifications apply to a maximum input level)

Reference level display accuracy:

After error correction: Max. ±0.5 dB with center frequency at 10 MHz
For other frequencies, frequency response is added.

Before error correction: Sum of IF gain error, resolution bandwidth changeover accuracy, logarithmic scale changeover accuracy, RF gain error, input attenuator accuracy, and frequency response

IF gain error : Max. ±1.0 dB (±0.1 dB) when reference level is changed while input attenuator is fixed. The value in parenthesis is that after error correction.

Resolution bandwidth changeover accuracy:

±1.0 dB (±0.1 dB) at +20°C to +30°C
±2.0 dB (±0.1 dB) at 0°C to +40°C
} 3 Hz to 30 kHz with respect to resolution bandwidth of 100 kHz

±0.5 dB (±0.1 dB) at 0°C to +40°C: Total level variation error of analyzer at 0°C to 40°C with respect to reference temperature of 25°C, while resolution bandwidth and center frequency are 100 kHz and 10 MHz, respectively, and the input attenuator and reference level are fixed.
The values in parentheses are those after error correction

Logarithmic scale changeover error: ±0.5 dB (±0.1 dB)
The value in parenthesis is that after error correction.

RF gain error : ±0.2 dB (generated when center frequency is changed when frequency span ≤ 50 kHz)

Frequency response: With respect to input attenuator of 0 dB to 65 dB, 10 MHz,
±0.7 dB (50 Ω, 75 Ω, and 1 MΩ inputs)
±1.0 dB (50/75 Ω high sensitivity mode)

Marker:

MARKER : Provides display of amplitude at active marker

Marker display accuracy: Sum of errors in reference level accuracy, vertical scale linearity between reference level and marker point, and frequency response

PEAK SEARCH : Positions the marker at the peak of maximum signal displayed

NEXT PEAK : Moves the marker to the peak of next largest signal

MKR → REF : Makes reference level equal to marker level

Δ : Provides display of level difference between two markers

Δ marker display accuracy: Sum of errors in vertical scale linearity between two markers, and frequency response

DISPLAY LINE (DL): Moves horizontal display line so as to trace amplitude displays

Number of marker points: Up to 10 points

Spurious response:

Higher harmonic distortion:

-80 dB or less	at -30 dBm input, after attenuation by input attenuator
-90 dB or less	at -40 dBm input, after attenuation by input attenuator
-60 dB or less	at -60 dBm input, after attenuation by input attenuator in 50/75 Ω high sensitivity mode

2-signal tertiary intermodulation distortion:

-75 dB or less	when the levels of two signals below 200 kHz are both -30 dBm after attenuation by input attenuators
-80 dB or less	when the levels of two signals of 200 kHz or more are both -30 dBm after attenuation by input attenuators
-70 dB or less	when the levels of two signals are both -55 dBm after attenuation by input attenuators in 50/75 Ω high sensitivity mode

Video bandwidth : 1 Hz to 1 MHz, switchable in 1 - 3 steps

Digital video averaging: Provides display of average value in sweep. The number of sweeps can be set to up to 4096, in binary steps (2^N).

Average noise level:

-140 dBm or less at resolution bandwidth of 3 Hz, video bandwidth of 1 Hz, and input attenuation of 0 dB

-155 dBm or less at resolution bandwidth of 3 Hz, video bandwidth of 1 Hz, and input attenuation of 0 dB in 50/75 Ω high sensitivity mode

Gain compression: 0.5 dB or less at 1 MHz or above, and 2 dB or less below 1 MHz, at input attenuation of 0 dB, applied to 0 dBm input

0.5 dB or less at 1 MHz or above, and 2 dB or less below 1 MHz, at input attenuation of 0 dB, applied to -30 dBm input in 50/75 Ω high sensitivity mode

Residual response: -110 dBm or less with 0 dB attenuation by input attenuator

Sweep specifications

Sweep time : 50 ms to 1000s per sweep (10 div.)

100 µs to 1000s in zero-span mode

Trigger : FREE RUN, LINE, VIDEO, EXT

Trigger modes : Continuous mode and single mode, with stop/reset capability for each mode

Input specifications

RF inputs : Two inputs for 50/75 Ω and 1 MΩ.

BNC connector, key-selectable

Maximum input level: +30 dBm (1 watt), Max. ±15 Vdc for 50 Ω and 75 Ω inputs, 30 Vrms, Max. ±100 Vdc for 1 MΩ input

OVERLOAD is displayed on the front panel and the CRT screen when a signal of more than +30 dBm (1 watt) is input in 50 Ω or 75 Ω input mode

Damaging input level: +35 dBm (approx. 3 watts), Max. ±16 Vdc at 50 Ω and 75 Ω inputs
35 Vrms, Max. ±110 VDC at 1 MΩ input

Input impedance:

50 Ω/75 Ω : 26 dB or more return loss at 10 Hz to 30 MHz
20 dB or more return loss at 30 MHz to 120 MHz

50 Ω/75 Ω high sensitivity mode: 16 dB or more return loss

1 MΩ : ±3%, parallel capacitance approx. 25 pF

Input attenuator: 0 dB to 65 dB, in 5 dB steps
Controllable manually or automatically with respect to the reference level, consists of two separate attenuators, one for 50 Ω/75 Ω mode and the other for 1 MΩ mode

Input attenuator accuracy: ±0.1 dB for 50 Ω/75 Ω inputs
±0.5 dB for 1 MΩ input
at 10 MHz with 0 dB reference

AUTO RANGE : Automatically sets the input attenuator to obtain -30 dBm to -35 dBm after attenuation by the input attenuator, when the input level to the analyzer exceeds -30 dBm

Local emission : -80 dBm or less at input attenuation of 0 dB

Isolation between two inputs: 80 dB or more

Display specifications

CRT : Display area of 100 mm x 124 mm (7.5 in.), rectangular P31

Display : Waveform, setting conditions, graticules, and label

Trace : Traces A and B have separate signal response memories and each provide approximately 1000 data points along the horizontal axis and 0.1% vertical resolution. The contents of the memories are displayed at a rate independent of the analyzer sweep rate. When trace memories A' and B' are used, the number of data sampling points along the horizontal axis is approximately 500

WRITE : Stores and displays analyzer's response for each sweep

MAX HOLD : Stores and displays the maximum signal level obtained at each horizontal point since start of sweep

VIEW : Displays trace data stored in memory, but inhibits update of memory contents

BLANK : Erases trace data on the CRT, but holds data stored in memory and stops update of memory contents

Trace arithmetic:

A-B → A : Subtracts contents of trace memory B from current trace memory A contents and writes the result into trace memory A simultaneously with sweep rate

A ⇄ B : Exchanges contents of trace memories A and B

B-DL → B : Subtracts display line level from contents of trace memory B, and writes the result into memory B

Output specifications

Output signal for calibration: -10 dBm ±0.3 dB, 50 Ω (20 dB or more return loss)

10 MHz ± (10 MHz x master oscillator accuracy)

Probe power supply: ±15 V, Max. 120 mA each, 4-pin connector

IF output : 3.3 MHz, -12 dBV to -14 dBV at reference level

Reference oscillator output: 10.000 MHz. approx. 50 Ω, -5 dBm ±2 dB

GPIB data output and remote control:

The built-in GPIB, provided as a standard feature, enables remote control and data input and output. The remote control enables the setting of all keys except the MASTER RESET key. The GPIB also enables the input and output of display data for the CRT, marker frequency/level, traces A, A', B, and B', scale, and CRT display characters. In addition, it allows direct connection of the analyzer to a plotter (TR9834R/9831), bypassing the controller, to enable the recording of all data displayed on the CRT.

Tracking generator specifications

Frequency range : 10 Hz to 120 MHz

Output level : +10 dBm to -60 dBm, selectable in 1 dB steps

Output level accuracy: Within 0.5 dB at 10 MHz

Frequency response: At 10 MHz level

$\pm$0.5 dB at 20°C to 30°C

$\pm$1.0 dB at 0°C to 40°C

Spurious response: With respect to fundamental frequency:

25 dB or less for harmonic spurious response

30 dB or less for non-harmonic spurious response

Output connector: BNC

Output impedance: 50 Ω or 75 Ω, switchable

Output level of +10 dBm to 0 dBm:

23 dB or more return loss at 10 Hz to 30 MHz

17 dB or more return loss at 30 MHz to 120 MHz

Output level below 0 dBm:

26 dB or more return loss at 10 Hz to 30 MHz

20 dB or more return loss at 30 MHz to 120 MHz

Phase measurement specifications

Frequency range : 10 Hz to 120 MHz

Measurement range: $\pm$180°

Display range : 80°, 40°, 20°, 8°, 4°, 2°, 0.8°, 0.4°, or 0.2° per division

Resolution : 1/10 or more of display range per division

Offset : Approx. $\pm$250°

Frequency response: Correctable with the DISPL LINE and NORM keys

Measurement accuracy: $\pm$3% $\pm$0.25° of displayed value

Group delay measurement specifications

Frequency range : 10 Hz to 120 MHz

Measurement range: 160 ms/div. to 1 ns/div.

Display range : $\frac{16}{\text{(frequency span)}}$ to $\frac{1}{\text{(200 x frequency span)}}$ (s/div.)

Resolution : $\frac{1}{50} \times \frac{1}{\text{(frequency span)}}$ or more

Maximum resolution: 0.1 ns

Electrical length correction range: $8 \times \frac{1}{\text{(frequency span)}}$ or more

Frequency response: Correctable with DISPL LINE and NORM keys

Measurment accuracy: After electrical length correction and normalization:

$\pm$6% of displayed value when frequency span > 50 kHz

$\pm$8% of displayed value when frequency span $\leq$ 50 kHz

General specifications

Operating environment: Temperature 0°C to 40°C

Relative humidity 85% or less

Storage temperature: -20°C to 60°C

Warm-up time : 15 hours required for balanced internal temperature

Power requirements: 100 Vac (120 Vac, 220 Vac, or 240 Vac selectable, according to specification)

50 Hz/60 Hz, approx. 330 VA

Dimensions : Approx. 424(W) x 550(D) x 311(H) mm

1-5. OPTIONS AND ACCESSORIES

The following options and accessories are available for the TR4171 spectrum analyzer. Factory options must be ordered when ordering the analyzer.

1-5-1. Options

- Option 03 : X-Y recorder output
  - X output : 0 V to approx. 5V
  - Y output : 0 V to approx. 5V
  - Z output : 0 V to approx. 5V
- Option 04 : Occupied bandwidth measurement

  Performs operations on measured data displayed on the CRT screen to obtain a bandwidth representing 99% of the emitted radio power, and displays that bandwidth in digital form.

- Option 06 : Adjacent channel leakage power measurement
  Calculates the ratio of total transmitted power (full spectrum) of a transmitter to power leakage to adjacent channels, and displays the result.
- Option 07 : Extension plotter interface
  Enables direct connection of the analyzer to an HP7470A/7225B/9872A plotter to enable A4-size recording of data displayed on the CRT screen.

1-5-2. Accessoires

TR1720 loop antenna (150 kHz to 30 MHz, 7 bands)

TR1711 log-periodic antenna (80 MHz to 1000 MHz)

TR1722 half-wave dipole antenna (25 MHz to 1000 MHz)

TR9834R plotter (used with TR13201 GPIB interface)

TR9831 plotwriter (used with TR13207 GPIB interface)

TR16903 dolly

TR1821 dolly

Photorgaphing system (camera M-085D + hood #85-27)

Photographing system (camera M-75d + close-up device 5R32 + attachment 71L)

TR16035 transportation case

A02603 + A02602 rack mount set

A02611 + A02610 front handles

A02613 vertical joint

SECTION 2

PREPARATION AND GENERAL PRECAUTIONS

2-1. INTRODUCTION

This section describes the general handling procedure for the TR4171 Spectrum Analyzer, including preparation, general precautions, and storage method. To ensure the correct operation of the analyzer, first read the following instructions carefully.

2-2. UNPACKING

After unpacking, carefully inspect the analyzer for any transportation damage, paying special attention to the panel switches, CRT, and terminals. If the analyzer is damaged or fails to operate properly, immediately notify your nearest ADVANTEST representative.

2-3. REPACKING FOR SHIPMENT

If it is necessary to repack the analyzer for shipment, use the original packing materials or equivalents.

2-4. OPERATING ENVIRONMENT

(1) The analyzer must be placed in a position where it will not be exposed to direct sunlight, corrosive gases, or excessive dust. The ambient temperature should be between 0°C to 40°C, and the relative humidity not more than 85%.

(2) Ventilation
The analyzer uses two exhaust cooling fans. Make sure that a space of at least 10 cm is provided behind the analyzer for adequate ventilation. Do not place the analyzer on its side or back.

(3) Although the analyzer is protected from AC power line noise, the local line noise environment must be considered. If excessive noise is anticipated, use a line noise filter in the primary circuit.

(4) The site must be free of excessive vibration.

(5) The storage temperature range is from -20°C to +60°C. If the analyzer is to be left unused for a long period of time, cover it with a plastic sheet or put it in a carton and store it in a dry place where it will not be exposed to direct sunlight.

2-5. CLEANING THE CRT DISPLAY

Clean the CRT screen and the inner surface of the filter at regular intervals with a soft cloth dampened with alcohol. Never use any chemical solvent other than alcohol for cleaning. Use the following procedure to remove the filter, referring to Figure 2-1.

① Remove the belt cover with a screwdriver.

② Remove the two screws from the upper panel.

③ Remove the two screws from the CRT bezel adapter.

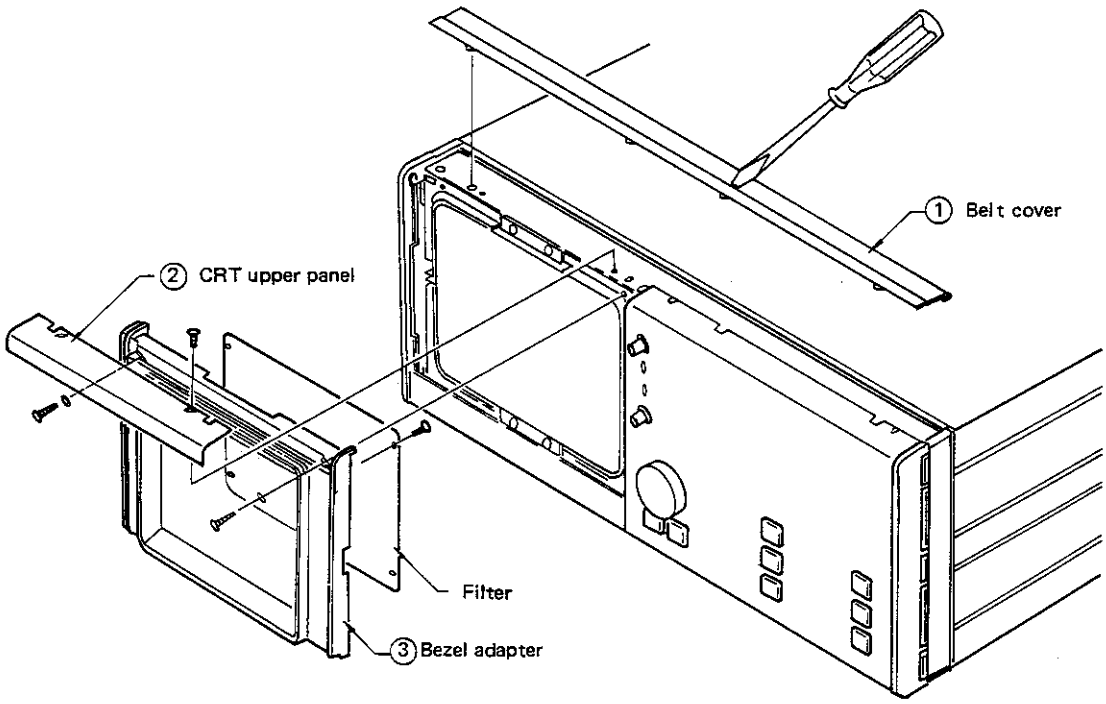


Fig. 2-1 Removal of CRT Filter

2-6. PREPARATION

2-6-1. Connecting Display and RF Units

The analyzer consists of display unit and an RF unit. Follow the procedure given below to assemble the two units.

(1) Mount the display unit (with the CRT) directly onto the input unit.

(2) Pull the display unit forward until the joints engage.

(3) Push the display unit back until the front surfaces of the two units are aligned. Use a coin to fasten the two joint screws on the back of the analyzer.

(4) Make electrical connections between the two units with the three interconnection cables supplied with the analyzer.

(5) Three connectors J1, J2, and J3 are provided on the rear of each unit. Connect them with the corresponding interconnection cables (J1 to J1, etc.) as shown in Figure 2-2. Use stoppers and screws when fixing the cable to the connectors, J1 and J2 respectively.

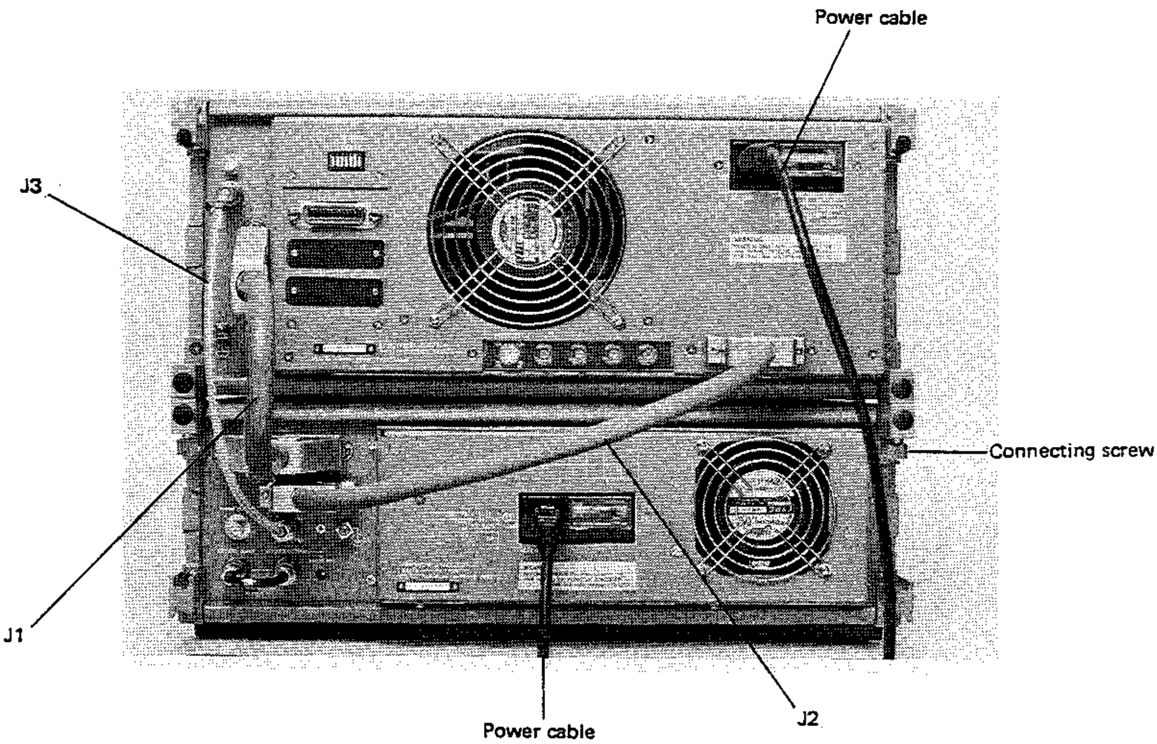


Fig. 2-2 Power and Signal Connections on the Rear Panels

2-6-2. Power Connection and Fuse

After establishing the signal connections between the two units as described in Section 2-6-1, connect the supplied power cables to each unit as follows.

(1) Make sure that the POWER switch on the front panel of the RF unit is at the STANDBY position.

(2) An AC LINE connector is provided on the rear panel of each unit. Plug the female ends of the supplied power cables into the corresponding AC LINE connectors (see Figure 2-2).

(3) Power cable
The male plug at the other end of each power cable has three conductors, the center, round conductor being ground. If the only available AC outlet has no ground receptacle, use a plug adapter for power connection. In this case, make sure that the ground lead of the adapter (see Figure 2-3 (a)) or the ground terminal on the rear panel of the analyzer is connected to ground. As shown in Figure 2-3 (b), the widths of the two conductors of adapter A09034 differ (A is wider than B). Remember this when plugging the adapter into an AC outlet. Note that this adapter cannot be used for supplies of more than 125 Vac.

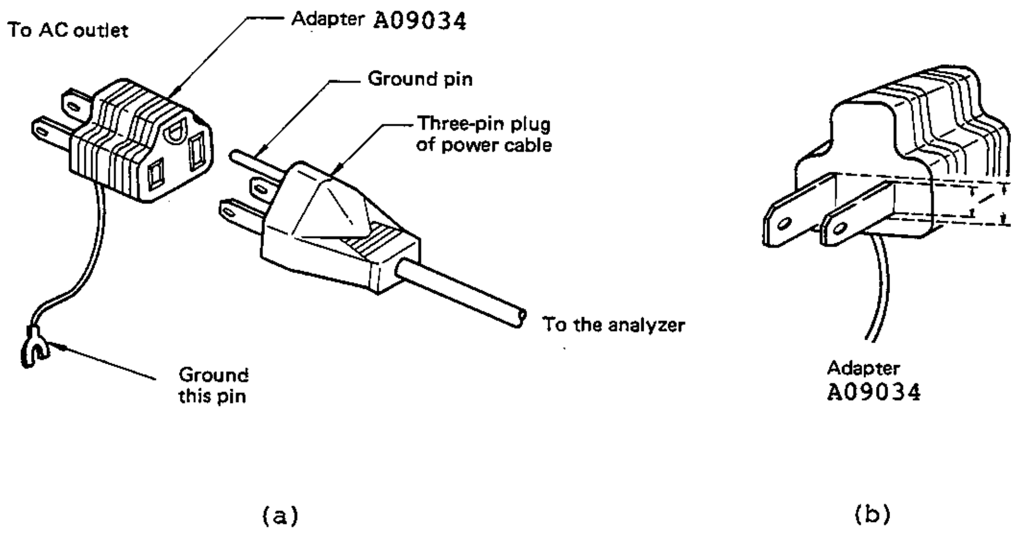


Fig. 2-3 Plug and Adapter for Power Cable

(4) When the analyzer is plugged into an electrical outlet, the STANDBY indicator lamp on the front panel of the RF unit lights to indicate that thermostatic oven for the internal reference crystal oscillator is turned on.

CAUTION

The analyzer is partially energized even when the POWER switch is at the STANDBY position, if either of the power cables is connected to an electrical outlet. To turn off the analyzer completely, always disconnect both power cables from their electrical outlets.

(5) When replacing the fuse, unplug the power cable from the rear AC LINE connector of that unit. Then slide the clear plastic cover of the fuse box on the right of the AC LINE connector to its left stop. Pull the FUSE PULL lever forward to remove the fuse from the fuse box. The replacement fuse must conform to the ratings given in Table 2-1.

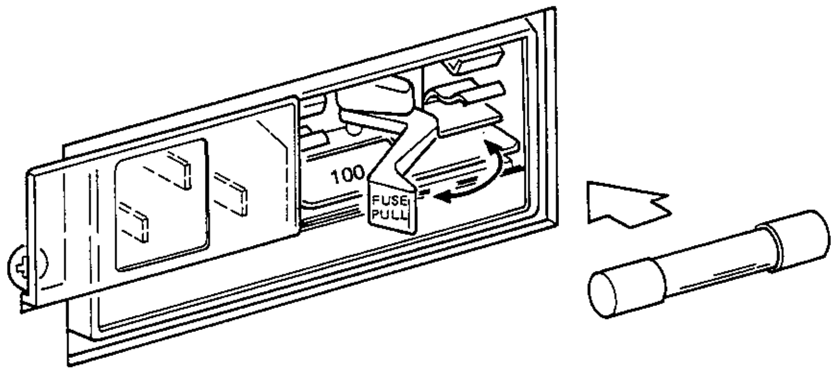


Fig. 2-4 Fuse Replacemnt

The line voltage setting can be changed by resetting the voltage setting card inserted just below the fuse holder. The voltage setting card below the FUSE PULL lever indicates selected voltage, as shown in Figure 2-4. Pull out the card and you will see voltage labels of 100V, 120V, 220V, and 240V on both sides of the card. Insert the card back into the card slot so that the voltage label corresponding to the desired local line voltage is on the top left side. The visible voltage indication is the set voltage.
The fuse rating depends on the local line voltage, always select the right fuse shown in Table 2-1.

Table 2-1. Fuse rating versus line voltage

	Display unit (upper)	RF unit (lower)
100 Vac or 120 Vac	2.5A, slow blow	1.6A, slow-blow
220 Vac or 240 Vac	1.25A, slow blow	0.8A, slow blow

SECTION 3
PANEL DESCRIPTION

3-1. INTRODUCTION

This section first describes the basic operating procedures for the TR4171 Spectrum Analyzer, then presents the functions and setting ranges of each key and control. Each function will be described in detail in Section 4. Operating details on the tracking generator for amplitude measurement, phase measurement, and group delay measurement are described in Section 5, 6, and 7, respectively.

3-2. OPERATING PROCEDURE

The analyzer's CRT display provides direct readout of the center frequency, reference level (level at the top graticule of the CRT), and so forth, as well as signal response trace and graticule display. The operation of the analyzer consists basically of setting various measurement functions with the front panel controls and key switches, and observing the resultant signal response trace and data readouts on the CRT for analysis. When the analyzer's POWER switch is set to ON, or the MASTER RESET key is pressed, the measurement functions on the CRT display are automatically initialized to the following state.

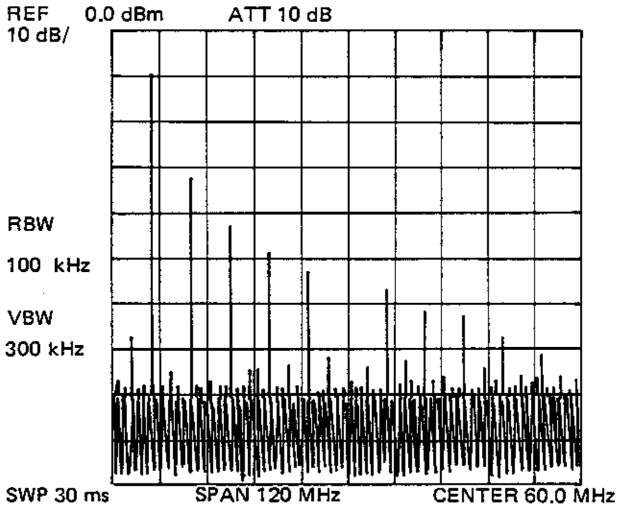
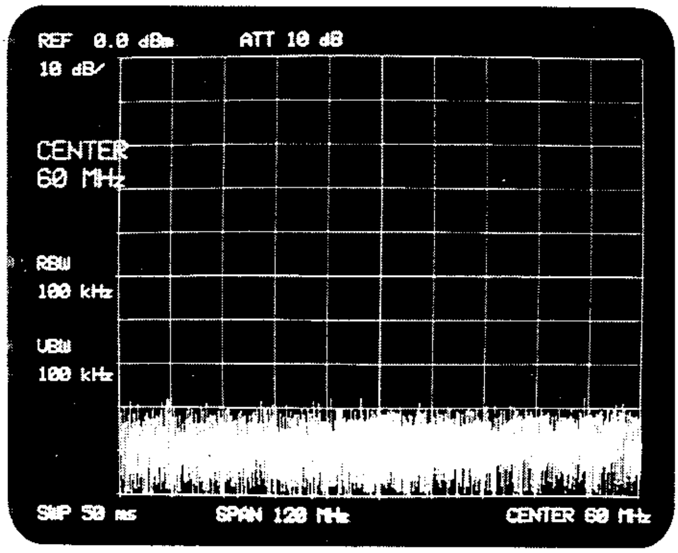
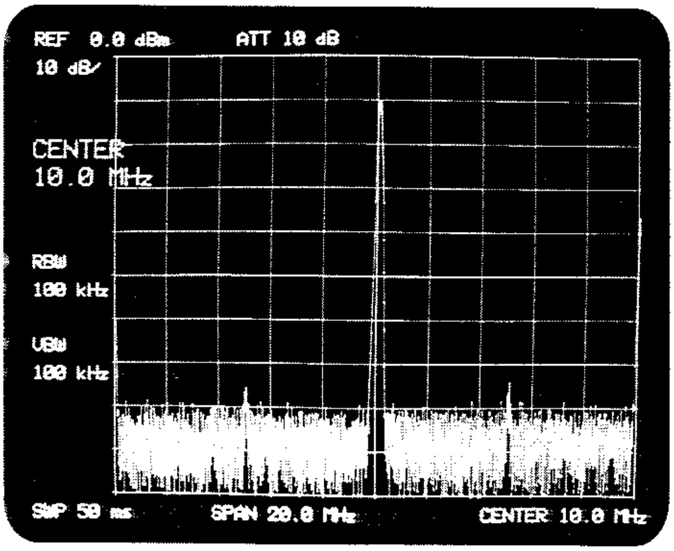


Fig. 3-1 Initial Function Settings at Power-on or Reset

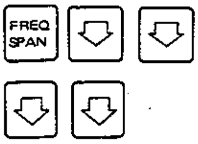
To change the function settings, first press the appropriate function key and then adjust the DATA knob until the desired setting is obtained. The DATA step keys or the DATA numeric/units keyboard may be used instead of the DATA knob. For example, to move a signal to the center of the display, first press the [CENT FREQ] key to activate the center frequency. The activated function is displayed enlarged at the left of the screen. Since the center frequency is always provided in the bottom right corner of the display, there are now two identical center frequency readouts on the screen. The center frequency remains active until another function key is operated.

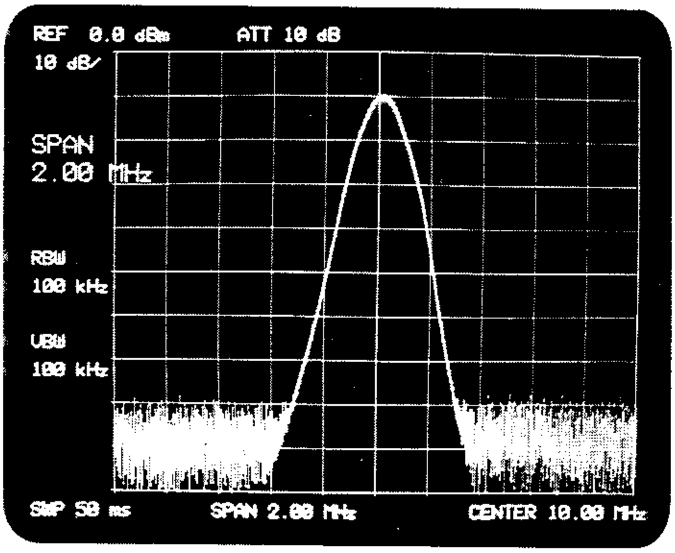


Use the DATA knob to position the signal at the center of the display. For quicker control, first use the DATA step keys to bring the signal near to the center, the fine-tune with the DATA knob. This method can also be used for quick positioning of the marker (described later). The frequency of the signal can now be read out as the center frequency of the display.

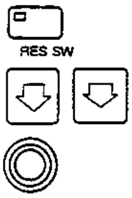


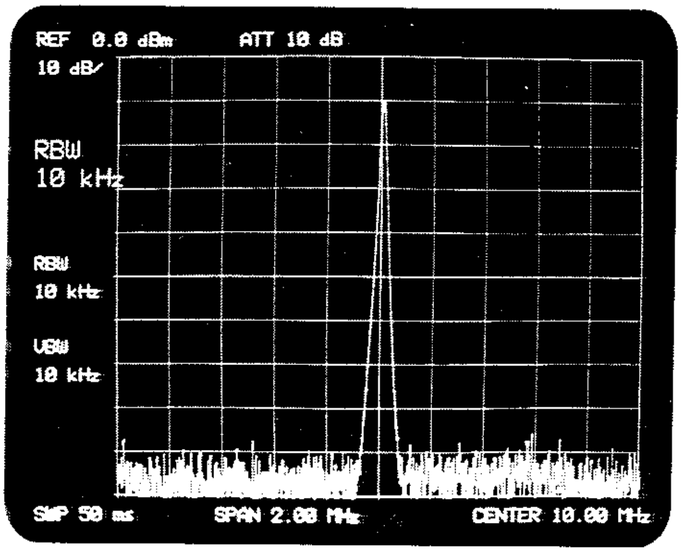
For better frequency resolution, narrow the frequency span (frequency spread from the left to right sides of the display) with the  key.



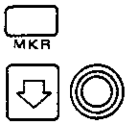


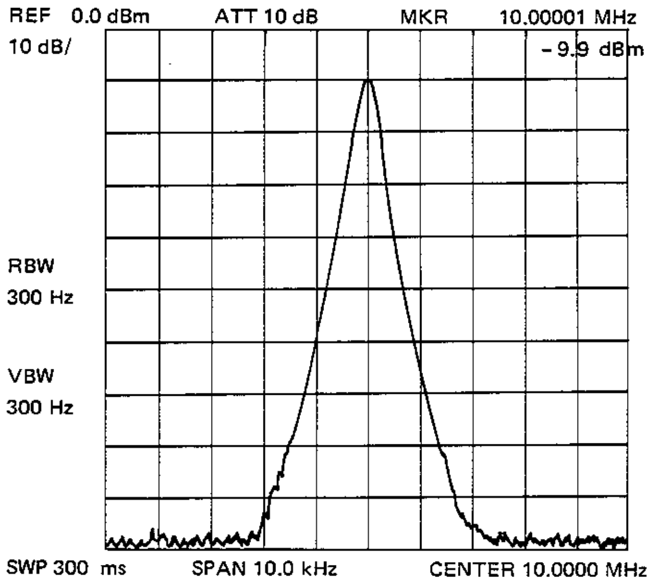
To increase the signal resolution, the resolution bandwidth can be narrowed by using the RES SW key and the DATA step down key. Since the sweep time is normally set to AUTO, a narrowed bandwidth results in a lower sweep rate.





The signal frequency and level can be read out by using a marker (bright spot) without bringing the signal to the center of the display.
The [MKR] key activates a single marker. Turning the DATA knob moves the marker along the trace. Tune the marker with the DATA knob to position it at the signal peak. The signal's amplitude and frequency are read out directly. While the marker is on the screen, the amplitude and frequency at the marker are always displayed in the top right corner of the screen.





The simplified operating procedures described above are intended to help you understand the following basic key and control operations.

(1) Press the desired function key.

(2) The activated function will be displayed in enlarged characters.

(3) Change the function setting, or move the marker with the DATA controls.

3-3. PANEL DESCRIPTION

3-3-1. Front Panel Description (See Figure 3-2)

(1) POWER pushbutton

(2) STANDBY/ON indicator lamps

The STANDBY lamp lights when the analyzer is plugged into an electric outlet and the POWER key is at the STANDBY (out) position. The ON lamp lights when the POWER key is pressed to the ON position.

(3) MASTER RESET key

Clears all panel key settings to the initial state shown on page 4-3.

(4) LCL (local) key

Returns the analyzer from remote operation mode in which the analyzer is externally controlled through the GPIB interface, to local operation mode in which the analyzer can be operated by the front panel keys and controls.

(5) RMT (remote) indicator lamp

Lights when the analyzer is being externally controlled through the GPIB interface in remote operation mode.

(6) LEVEL key

Enables setting of tracking generator output level over a range of +10 dBm to -60 dBm in 0.1 dB steps.

(7) 50 Ω key

Sets the tracking generator output impedance to approx. 50 Ω. When set to 50 Ω, the LED above the key is lit.

(8) 75 Ω key

Sets the tracking generator output impedance to approx. 75 Ω When set to 75 Ω, the LED above the key is lit.

(9) TRACKING GENERATOR OUTPUT connector

Output terminal for the tracking generator. The frequency range is 10 Hz to 120 MHz.

(10) GROUP DELAY key

Activates group delay measurement. Operation of the shift key sets dual trace mode in which amplitudes and group delay can be measured simultaneously.

(11) PHASE key

Activates phase measurement. Operation of the shift key sets dual trace mode in which amplitudes and phase can be measured simultaneously.

(12) MAG (magnitude) key

Activates amplitude measurement.

(13) SPECT (spectrum) key

Enables the analyzer to operate as a normal spectrum analyzer, in which case the tracking generator does not function.

(14) DELAY SCALE, APERTURE key

Enables a change of vertical scale using the DATA step keys and the DATA knob during group delay measurement. The shift key enables a change of aperture with the DATA step keys and the DATA knob.

(15) DELAY OFFSET, FINE key

Enables a change of group delay offset with the DATA step keys and the DATA knob. The shift key enables fine tuning of group delay offset with the DATA step keys and the DATA knob.

(16) PHASE SCALE, DUAL OFF key

Enables a change of vertical scale with the DATA step keys and the DATA knob during phase measurement. Operation of the shift key clears the dual trace mode set by key operations (10) or (11).

(17) PHASE OFFSET key

Enables a change of phase offset with the DATA step keys and the DATA knob.

(18) 1 MΩ KEY

Activates measurement of a signal input through the INPUT-2 connector (25) (input impedance of approx. 1 MΩ). The LED lamp above the key lights to indicate this setting.

(19) 50 Ω key

Sets the input impedance of the INPUT-1 connector (26) to approx. 50 Ω to activate measurement of a signal input through this connector. The LED lamp above the key lights to indicate this setting.

(20) 75 Ω key

Sets the input impedance of the INPUT-1 connector (26) to approx. 75 Ω to activate measurement of a signal input through this connector. The LED lamp above the key lights to indicate this setting.

(21) HIGH SENSITIVITY, OFF key

Improves measurement sensitivity of the INPUT-1 connector using the built-in preamplifier. The shift key clears this mode.

(22) AUTO RANGE key

Automatically controls the input attenuator to obtain a -30 dBm to -35 dBm input level after attenuation by the input attenuator, when the input level before attenuation exceeds -30 dBm. Pressing the INPUT ATT key (23) or AUTO key (24) clears this mode.

(23) INPUT ATT (input attenuator) key

Controls input attenuation level from 0 dB to 65 dB in 5 dB steps. Attenuation by the INPUT-1 and INPUT-2 connectors can be set separately.

(24) AUTO key

Automatically controls input attenuation level from 10 dB to 65 dB, according to the reference level.

(25) INPUT-2 connector

Input impedance: 1 MΩ. Pressing the 1 MΩ key (18) activates measurement. The frequency range is 10 Hz to 120 MHz, and the maximum input level is 30 Vrms, ±100 Vdc.

(26) INPUT-1 connector

Pressing the 50 Ω key (19) or the 75 Ω key (20) activates measurement with the corresponding input impedance. The frequency range is 10 Hz to 120 MHz, and the maximum input level is +30 dBm (1 watt), ±15 Vdc.

(27) OVER (overload) indicator lamp

Lights when a signal of more than +30 dBm is input to the INPUT-1 connector. The CRT also displays OVERLOAD at the same time. Immediately reduce the signal level to below +30 dBm.

(28) PROBE POWER connector

Four-pin connector used for supplying ±15 V to an activated probe.

(29) CAL OUT (calibration output) connector

Outputs a calibration signal of 10 MHz, -10 dBm $\pm$0.3 dB.

(30) INTENSITY knob

Controls intensity of CRT display.

(31) FOCUS control

Adjusts focus of the CRT display.

(32) TRACE ALIGN control

Adjusts tilt of the CRT display.

(33) TRIG LEVEL (trigger level) control

Controls trigger level for video waveform. If the sweep is not triggered when the VIDEO key (38) is pressed, adjust with this control to provide a suitable trigger level.

(34) SWEEP IND (sweep indicator) lamp

Lit during sweep.

(35) FREE RUN key

Automatically repeats internally-triggered sweep.

(36) LINE key

Triggers sweep start in synchronism with line frequency.

(37) EXT (external) key

Triggers sweep start by an external (TTL leve) trigger signal applied to the EXT. TRIG connector on the rear panel. Trigger occurs at each high-to-low transition of the external trigger signal.

(38) VIDEO key

Triggers sweep start by a detected IF signal.

(39) CONT START (continuous start) key

Resumes automatic repeat of internally-triggered sweep after the STOP/RST key (41) has been pressed.

(40) SINGLE START key

Sets single-sweep mode. Each pressing of this key triggers a single sweep.

(41) STOP/RST (reset) key

One press of this key stops the sweep. Subsequent pressing of the CONT START key (39) or SINGLE START key (40) restarts the sweep in the corresponding trigger mode, starting from the point at which the sweep was stopped by the STOP/RST key. Pressing this key twice, followed by the CONT START key or the SINGLE START key, restarts the sweep at the leftmost point on the CRT display, which is useful for comparatively long sweeps.

(42) AUTO CALL (calibration) key

Reads in various error correction values to improve measurement accuracy. When this operation is completed, error correction is performed automatically on measured values before display. For further details, see subsection 4-18.

(43) PLOT key

Plots data on screen.

(44) NORM (normalization), OFF key

Automatically corrects frequency response of the measuring system with respect to the display line.

(45) WRITE A, MAX key

Updates and displays contents of trace memory A in each sweep. Operation of the shift key sets MAX mode to display and hold the maximum value in memory A.

(46) VIEW A, BLANK key

Inhibits update of trace memory A and displays the latest data. Operation of the shift key erases the display of trace memory A from the screen.

(47) WRITE B, MAX key

Updates and displays contents of trace memory B in each sweep. Operation of the shift key sets MAX mode to display and hold the maximum value in memory B.

(48) VIEW B, BLANK key

Inhibits update of trace memory B and displays the latest data. Operation of the shift key erases the display of trace memory B from the screen.

(49) A-B → A ON key

Subtracts contents of trace memory B from those of trace A in each sweep, and writes the result into trace memory A.

(50) A-B → A OFF key

Clears the mode setting actuated by the A-B → A ON key (49).

(51) A' VIEW, A' BLANK key

Displays the contents of trace memory A'. Operation of the shift key inhibits this display memory A'.

(52) B' VIEW, B' BLANK key

Displays the contents of trace memory B'. Operation of the shift key inhibits this display of trace memory B'.

(53) A → A', A ⇄ B key

Writes the contents of trace memory A into trace memory A'. Operation of the shift key exchanges the contents of trace memories A and B.

(54) B → B', B-DL → B key

Writes the contents of trace memory B into trace memory B'. Operation of the shift key subtracts data corresponding to the display line level from the contents of trace memory B, and writes the result into trace memory B.

(55) MKR (marker), MULTI MKR (marker) key

Activates a single marker. Operation of the shift key enables generation of up to 10 markers.

(56) MKR (marker)/Δ → CF (center frequency)/SPAN key

Substitutes the marker frequency for the center frequency, and moves the marker to the center of the display. In delta (Δ) mode, the frequencies at two markers act as start frequency and stop frequency, respectively.

(57) FREQ CNTR (frequency counter), CNTR RESOLN (counter resolution) key

Measures signal frequency with a counter. Operation of the shift key changes frequency counter resolution.

(58) PEAK SRCH (search) key

Positions the marker at the peak of the largest signal displayed.

(59) Δ, NOISE/Hz ON key

Activates two markers and provides a readout of the frequency difference and level difference between the two markers. Operation of the shift key displays the noise levels at the two markers, converted with respect to a 1-Hz bandwidth.

(60) MKR (marker)/Δ → STEP SIZE key

Substitutes the marker frequency for step size. In delta (Δ) mode, the frequency difference between the two markers is substituted for the step size.

(61) TG CNTR (tracking generator counter) key

Measures the frequency at the marker with a counter

(62) NEXT PEAK key

Moves the marker to the peak of the next largest signal displayed.

(63) ZOOM, NOISE/Hz OFF key

Used for narrowing frequency span to expand signal display. Press the ZOOM key to identify the signal to be zoomed in on with the marker, then press the DATA step down key to expand the signal with the marker acting as the center. The shift key clears the NOISE/Hz mode set by the shift key operation with the Δ, NOISE/Hz key (59).

(64) MKR (marker) REF (reference level) key

Substitutes the marker level for the reference level to position the marker at the top of the display.

(65) SIGNAL TRACK key

Automatically positions a drifting signal at the center of the display

(66) MKR (marker) OFF, LABEL CLR (clear) key

Erases all marker from the display. Operation of the shift key erases label characters from the display.

(67) AVG (averaging), OFF key

Displays an average value of display data obtained by a given number of sweeps. The shift key clears the averaging mode.

(68) DISPL (display) LINE, OFF key

Provides a display line (a horizontal cursor line). Operation of the shift key erases the display line from the display.

(69) OPTION key

Used when selecting an optional function.

(70) LABEL key

Enables the input and display of alphanumeric characters and various symbols along the top line of the screen.

(71) SEQ (sequence) key

Calls functions stored in memories 1 to 8 in a sequence specified by the user. Operation of the shift key enables sequence setting.

(72) SAVE key

Enables storage of functions set with the various keys on the front panel.

(73) RECALL, HELP key

Calls functions set with the various keys and stored by the operation of the SAVE key operation (72), and resets those functions. The shift key displays a list of shift functions not explicitly printed on the front panel. Double shift key operation, in which operation of the SHIFT or LABEL key is followed by that of a predetermined key displays a list of all double-shift functions.

(74) SHIFT key

When this key is pressed once, the LED lamp on this key lights to indicate that shift key mode is set, enabling the other functions printed in yellow above the keys. Subsequent operation of any key or the shift key turns off the LED lamp to indicate that shift key mode has been cleared.

(75) DATA knob

Continuously changes or moves function data and markers.

(76) and (77) Step keys

Changes or moves function data and markers, not continuously but in predetermined steps.

(78) PANEL LOCK indicator lamp

Lights when the operation of the HOLD, PANEL LOCK key (80) has been used to lock the panels.

(79) ENABLE indicator lamp

Lights when data update or entry is enabled. Goes out when the HOLD key is pressed to inhibit data update or entry.

(80) HOLD, PANEL LOCK key

Inhibits data update or entry using the DATA knob, step keys, and DATA keyboard. Operation of any one of the FUNCTION keys clears the hold state. Pressing the shift key locks the panel.

Double shift key operation clears this state. When the panel is locked, all key operations except the double shift key operation, operation of the keyboard's 0 to 9 keys, and master-reset key operation are ignored. Operation of the keyboard's 0 to 9 keys enables RECALL 0 to RECALL 9 functions.

(81) SWEEP TIME key
Enables setting of sweep time between 50 ms (30 ms) and 1000s.

(82) AUTO (SWEEP TIME) key
Automatically sets sweep time according to frequency span, resolution bandwidth, and video/bandwidth settings.

(83) RES BW (resolution bandwidth) key
Enables setting of resolution bandwidth between 3 Hz and 100 kHz in steps of 1 or 3.

(84) AUTO (RES BW) key
Automatically sets resolution bandwidth according to frequency span setting.

(85) VIDEO BW (video/bandwidth) key
Enables setting of video/bandwidth between 1 Hz and 1 MHz in steps of 1 or 3.

(86) AUTO (VIDEO BW) key
Automatically sets video bandwidth according to frequency span setting.

(87) STEP SIZE key
Enables setting of center frequency step size for DATA step key operation.

(88) AUTO (STEP SIZE) key
Automatically sets step size to 1/10 of the frequency span.

(89) CENT. FREQ. (center frequency) key
Enables setting of center frequency between 0 Hz and 200 MHz

(90) FREQ. SPAN (frequency span) key
Enables setting of frequency span between 20 Hz and 120 MHz in 1-2-5 sequence.

(91) REF. LEVEL (reference level) key
Enables setting of the reference level between +60 dBm and -105 dBm, with 0.1 dB resolution.

(92) START F (Start frequency) key
Enables setting of start frequency between 0 Hz and 120 MHz.

(93) STOP F (stop frequency) key

Enables setting of stop frequency between 0 Hz and 120 MHz.

(94) FULL SPAN key

Sets the frequency span to 120 MHz and the center frequency to 60 MHz.

(95) AUTO TUNE key

Expands frequency resolutin to the specified span while holding the largest signal (excluding local feedthrough) at the center of the display.

(96) 7, 10 dB/DIV (division) key

Enters the numeric 7. Operation of the shift key sets the vertical scale to 10 dB/DIV.

(97) 4, 1 dB/DIV (division) key

Enters the numeric 4. Operation of the shift key sets the vertical scale to 1 dB/DIV.

(98) 1, dBm key

Enters the numeric 1. Operation of the shift key sets the level units to dBm.

(99) 0, dBV key

Enters the numeric 0. Operation of the shift key sets the level units to dBV.

(100) 8, 5 dB/DIV (division) key

Enters the numeric 8. Operation of the shift key sets the vertical scale to 5 dB/DIV.

(101) 5 key

Enters the numeric 5.

(102) 2, dBμV key

Enters the numeric 2. Operation of the shift key sets the level units to dBμV.

(103) ., V key

Enters the decimal point. Operation of the shift key sets the level units to V.

(104) 9, 2 dB/DIV (division) key

Enters the numeric 9. Operation of the shift key sets the vertical scale to 2 dB/DIV.

(105) 6, LIN (linear) key

Enters the numeric 6. Operation of the shift key sets a linear vertical scale.

(106) 3, dBmV key

Enters the numeric 3. Operation of the shift key sets the level units to dBmV.

(107) BACK SPACE key

Used when a mistake is made when inputting numeric values with keys (96) to (106). The most-recently entered data is erased by pressing this key so that the correct number can be entered.

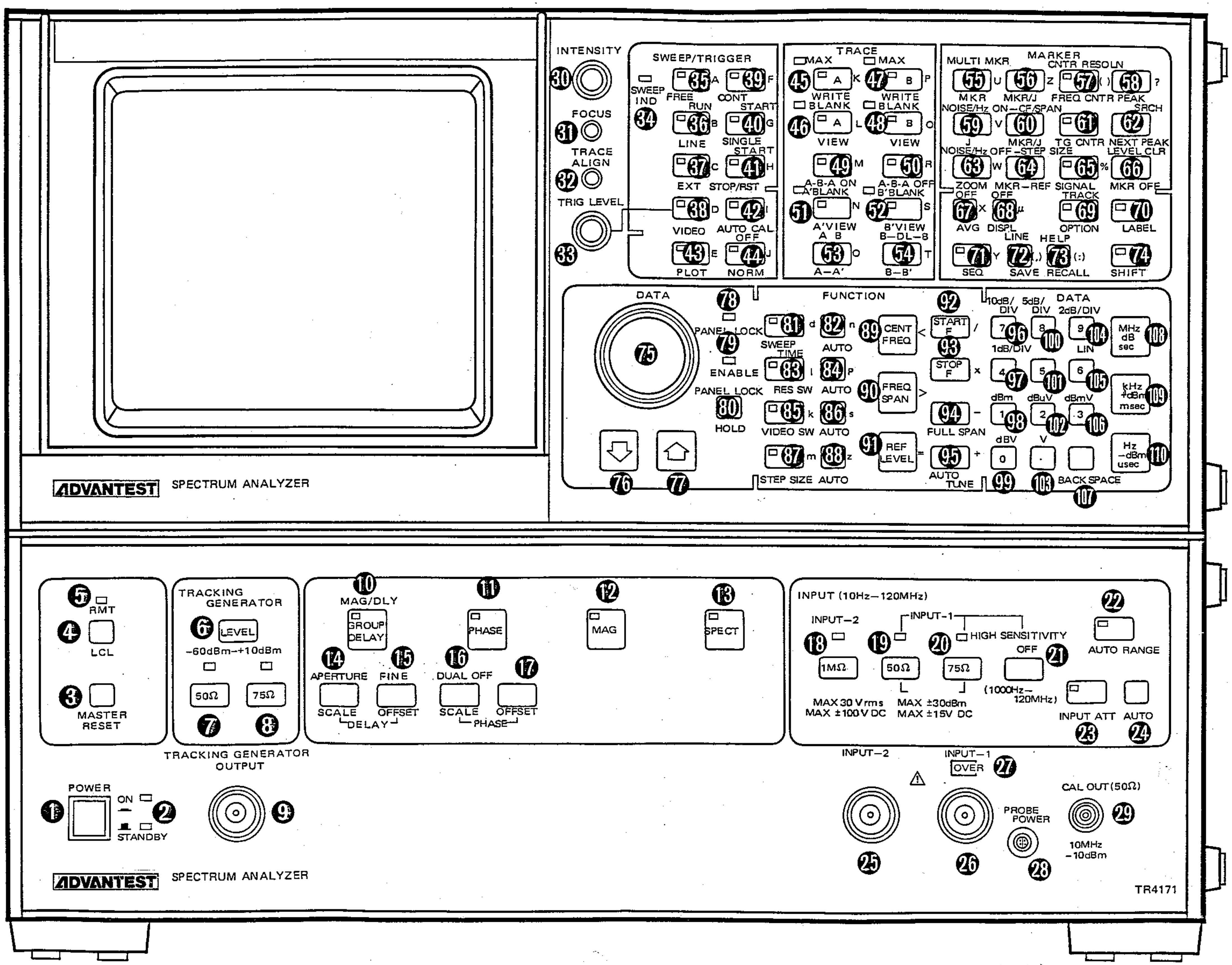


Fig. 3-2 Front Panel

(108) MHz, dB, sec key

Enters data units and is used after a numeric value has been entered with keys (96) to (106).

(109) kHz, +dBm, msec key

Enters data units, and is used after a numeric value has been entered with keys (96) to (106). To enter a positive reference level, press this key after entering a numeric value through the DATA keyboard.

(110) Hz, -dBm, μ sec key

Enters data units, and is used after a numeric value has been entered with keys (96) to (106). To enter a negative reference level, press this key after entering a numeric value through the DATA keyboard.

3-3-2. Rear Panel Description (See Figure 3-3)

(1) Ground terminal

Terminal for grounding. The plug of the power cable has three pins, the center, round pin being ground. If a two-pin adapter is used, make sure that the ground wire of the adapter or this ground terminal is grounded. This is not necessary if the ground terminal (19) is already connected to an earth ground.

(2) J3 IF INPUT connector

Connect to the J3 IF OUTPUT connector (15) with the supplied cable.

(3) J4 IF OUTPUT connector

Outputs signals processed through the last-stage IF filter.

(4) J1 BUS connector

Connect to the the J1 BUS connector (12) with the supplied bus cable.

(5) ADDRESS switch

Used to designate addresses 1 to 5 for the GPIB interface.

(6) GPIB connector

Accepts a GPIB cable from an external controller or X-Y plotter.

(7) SWEEP OUT connector

Outputs a sweep voltage ranging from approx. 0V to 8V.

(8) X, Y, Z connectors

For optional X, Y, and Z outputs.

(9) EXT TRIG connector

Accepts an external trigger signal. When the EXT trigger key on the front panel is set, the analyzer is triggered by the falling edge of an external TTL trigger signal.

(10) J2 connector

Connect to the RF unit's J2 connector (13) with the supplied cable.

(11) AC LINE connector

Accepts a power cable.

(12) J1 BUS connector

Connect to the J1 BUS connector (4) with the supplied bus cable.

(13) J2 connector

Connect to the J2 connector (10) with the supplied cable.

(14) 10 MHz OUTPUT connector

Outputs the 10 MHz component of the internal master oscillator signal (5 MHz) or of an external reference signal input through the EXT STD connector (16). The output level after crystal filter processing is -5 dBm $\pm$2 dB, and the output impedance is approx. 5 Ω,

(15) J3 IF OUTPUT connector

Connect to the J3 IF INPUT connector (2) with the supplied cable.

(16) EXT STD INPUT connector

Normally connected to the INT STD OUTPUT connector (17) with a BNC-BNC cable. Accepts an external reference signal when the analyzer is being operated by such signals.

(17) INT STD OUTPUT connector

Outputs the internal reference oscillator signal (5 MHz). The supplied BNC-BNC connector must be plugged into this connector when the EXT STD INPUT connector (16) is inputting an external reference signal.

(18) FREQ ADJ control

Adjusts the output frequency of the 10 MHz OUTPUT connector (14) to exactly 10 MHz.

(19) Ground terminal

Terminal for grounding. The plug of the power cable has three pins, the center, round pin being ground. If a two-pin adapter is used, make sure that the ground wire of the adapter or this ground terminal is connected to an earth ground. This is not necessary when the RF and display units are connected and the ground terminal (1) is connected to an earth ground, because grounding is automatically provided for the RF unit.

(20) AC LINE connector

Accepts a power cable.

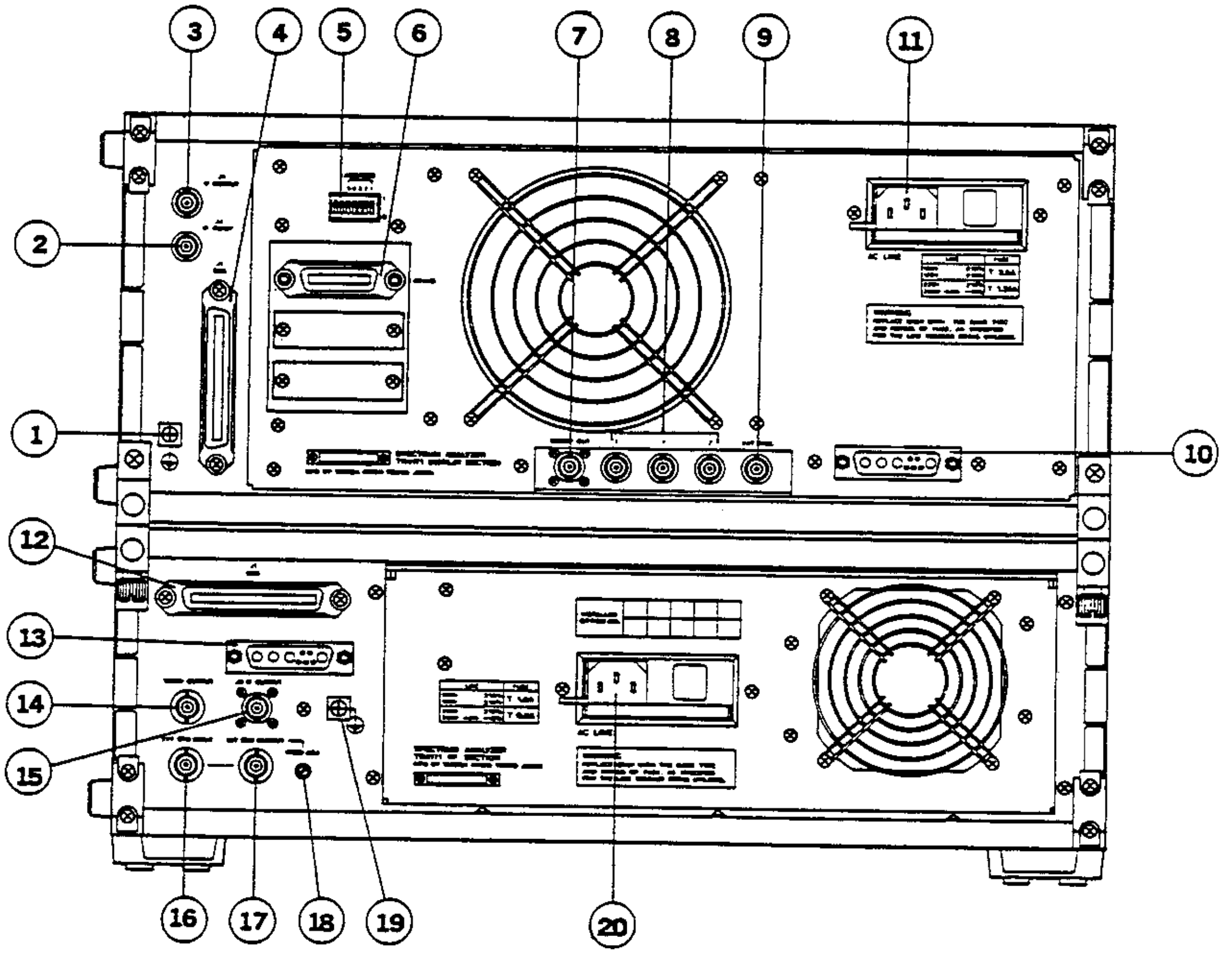


Fig. 3-3 Rear Panel

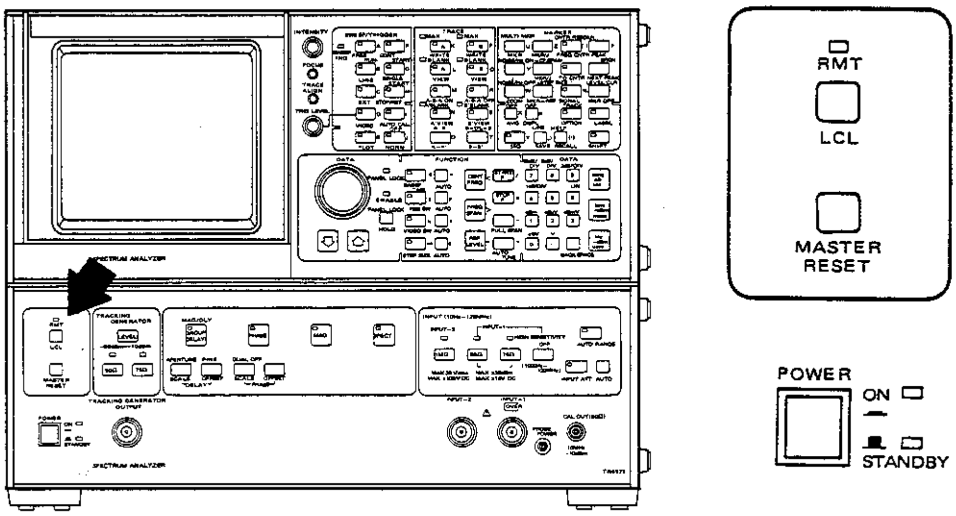
SECTION 4

OPERATION

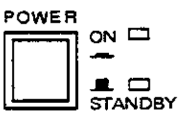
4-1. INTRODUCTION

This section describes the versatile measuring functions of the TR4171 Spectrum Analyzer in more detail. Set the instrument correctly in accordance with SECTION 2 before reading this chapter.
Abbreviations are given in SECTION 3.

4-2. POWER, MASTER RESET, AND LCL KEYS



4-2-1. POWER Switch



Make signal and power connections for the analyzer by plugging the power cables into outlets after connecting the J1, J2, and J3 connectors with the special cable, as shown in Figure 2-2. The analyzer is immediately turned on.
When using a two-conductor plug adapter for the power connection, always connect the ground lead from the adapter or the ground terminal on the rear panel of the analyzer to an earth ground.

Table 4-1 POWER Switch Setting

Power Cables Unplugged	Instrument Completely Turned Off
Power cables plugged in STANDBY	Master crystal oscillator and back-up Ni-Cd battery turned on
ON	Analyzer completely turned on

When the power cables of the analyzer are plugged into electrical outlets, the STANDBY indicator lamp lights to indicate that the internal reference crystal oscillator oven and the back-up Ni-Cd battery for the memory are turned on. When the POWER key is pressed to the ON position, the ON indicator lamp lights to indicate that the analyzer is completely turned on and measuring can start.
To use the analyzer within its accuracy specifications, approximately 24 hours of warm-up time in STANDBY or ON state is required.
The contents of the internal memory saved by the SAVE switch and correction values acquired by the automatic calibration function remain intact for approximately two weeks even if the analyzer is unplugged, provided that the back-up battery is fully charged beforehand. The Ni-Cd battery requires a charging time of two to three days.
Unless the analyzer is to be left unused for a long period of time, it is recommended that it be left in STANDBY state with the POWER switch set at the STANDBY position and the power cables plugged in.

4-2-2. MASTER RESET

Pressing the MASTER RESET key clears the settings of all the keys and the analyzer's functions to their initial states. The functions affected by the MASTER RESET key and their initial states are listed below.
The analyzer's functions are also set to the following initial states when the POWER switch is ON.

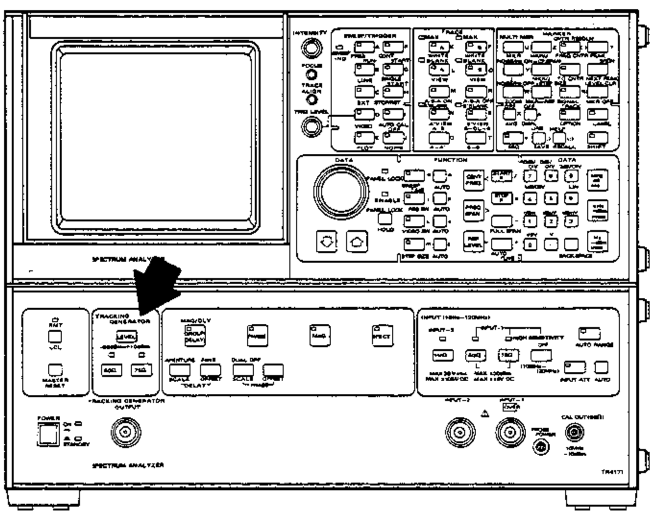
Initial States of Functions Affected by MASTER RESET

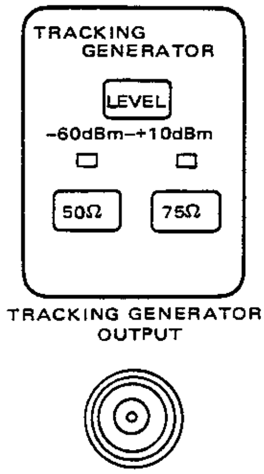
CENT. FREQ	60 MHz
FREQ. SPAN	120 MHz
Reference level	0 dBm
SWEEP TIME	AUTO (30 ms)
RES BW	AUTO (100 kHz)
VIDEO BW	AUTO (300 kHz)
STEP SIZE	AUTO
INPUT ATT	AUTO (10 dB)
AUTO RANGE	OFF
INPUT MODE	INPUT-1, 50 Ω
SPECT	ON
MAG	OFF
PHASE	OFF
GROUP DELAY	OFF
T.G.	OFF
TRIGGER	FREE RUN
TRACE	A WRITE
	A' BLANK
	B BLANK
	B' BLANK
	Other keys OFF
MARKER	All OFF
DISPLAY LINE	OFF
LABEL	OFF
SHIFT	OFF
INT STD OUTPUT	OFF
Vertical scale	10 dB/DIV.

4-2-3. LCL

The Local (LCL) key is operative when the analyzer is being remote-controlled by an external GPIB controller.
When the analyzer is being remote-controlled by the external GPIB controller, the RMT indicator lamp just above the LCL key lights to indicate that front panel control of the analyzer is disabled, except for the MASTER RESET key operation.
When the LCL key is pressed, the RMT lamp goes off to indicate that front panel control of the analyzer is enabled.
If a Local Lockout command is sent from the GPIB controller, however, the LCL key remains inoperative.

4-3. TRACKING GENERATOR LEVEL, 50 Ω, 75 Ω

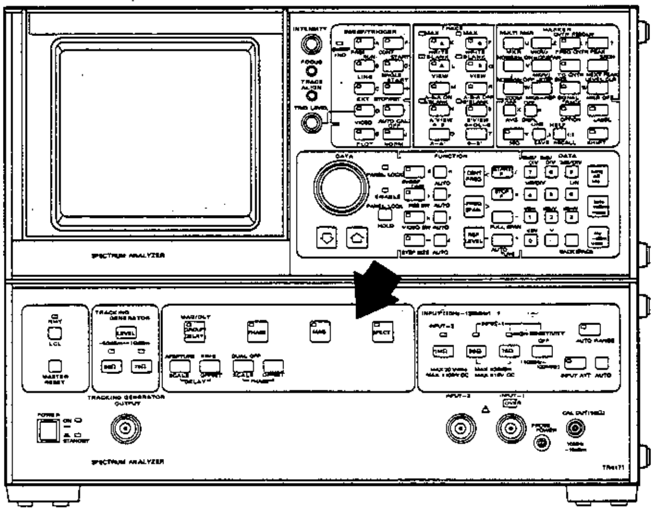


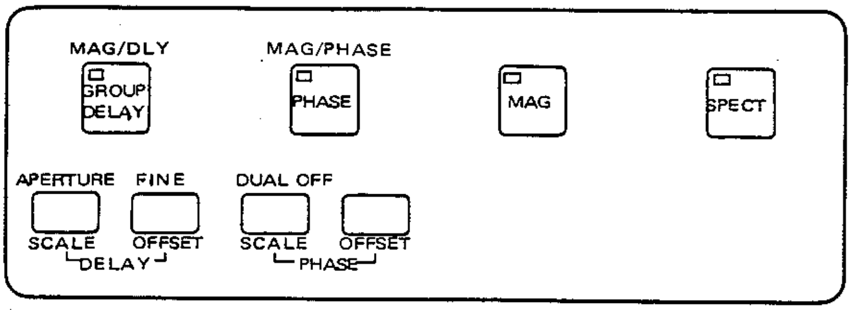


Press the [MAG] key (see Section 4-4) to activate the tracking generator.
When the [PHASE] or [GROUP DELAY] key is pressed, the tracking generator is also activated.
The tracking generator is initialized so that its output impedance is 50 Ω and its output level is -10 dBm. Use the [LEVEL] key to set the output level and the [50Ω] and [75Ω] keys to set the output impedance according to measurement conditions.

The output level can be set in 1 dB steps within the range of +10 dBm to -60 dBm. 50 Ω or 75 Ω can be selected as the output impedance. The lamp above the selected key lights.
A more detailed description of the operations of the tracking generator will be given in SECTION 5.

4-4. MEASUREMENT MODE SELECTION





These keys are used to select the measurement mode of the analyzer and set the scale of the vertical axis and the offset for group delay or phase measurement.

4-4-1. SPECT, MAG, PHASE, GROUP DELAY, MAG/PHASE, MAG/DLY

MAG/DLY [GROUP DELAY] MAG/PHASE [PHASE] [MAG] [SPECT]

Pressing the [GROUP DELAY], [PHASE], [MAG], or [SPECT] key selects and sets the corresponding group delay, phase, amplitude, or spectrum measurement mode. The indicator lamp on that key lights to indicate the selected measurement mode.

For spectrum measurement, press the [SPECT] switch. The tracking generator is automatically turned off and measurement can be performed with the maximum input sensitivity.

To measure the amplitude characteristics of an amplifier or filter, press the [MAG] switch. The tracking generator will be turned on automatically. For details concerning amplitude measurement with a tracking generator, see SECTION 5.

For phase measurement, press the [PHASE] key. The tracking generator will be turned on automatically. See SECTION 6 for details of phase measurement.

For group delay measurement, press the [GROUP DELAY] key. The tracking generator will be turned on automatically. See SECTION 7 for details of delay measurement.

Pressing the [SHIFT] and [MAG/DLY GROUP DELAY] keys enables simultaneous measurement of amplitude and group delay characteristics (dual trace mode). Press the [SHIFT] and [DUAL OFF] keys to release this mode.

Pressing the [SHIFT] and [MAG/PHASE PHASE] keys enables simultaneous measurement of amplitude and phase characteristics (dual trace mode). Press the [SHIFT] and [DUAL OFF] keys to release this mode.

4-4-2. DELAY SCALE, APERTURE, DELAY OFFSET, DELAY OFFSET FINE

APERTURE [DELAY SCALE] FINE [DELAY OFFSET]

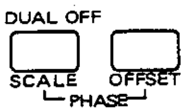
Pressing the [DELAY SCALE] key during group delay measurements enables alteration of the scale along the vertical axis by the step keys and the DATA knob.

Pressing the [SHIFT] and [APERTURE] keys enables aperture changes by the step keys and the DATA knob.

Pressing the [OFFSET (DELAY)] key enables adjustment of the offset for group delay by the step keys and the DATA knob.

Pressing the [SHIFT] and [FINE] keys enables fine adjustment of the offset for group delay by the step keys and the DATA knob.

4-4-3. PHASE SCALE, DUAL OFF, PHASE OFFSET

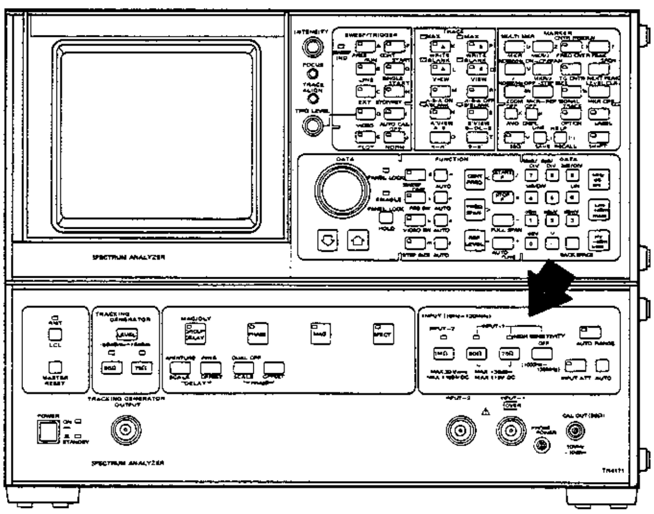


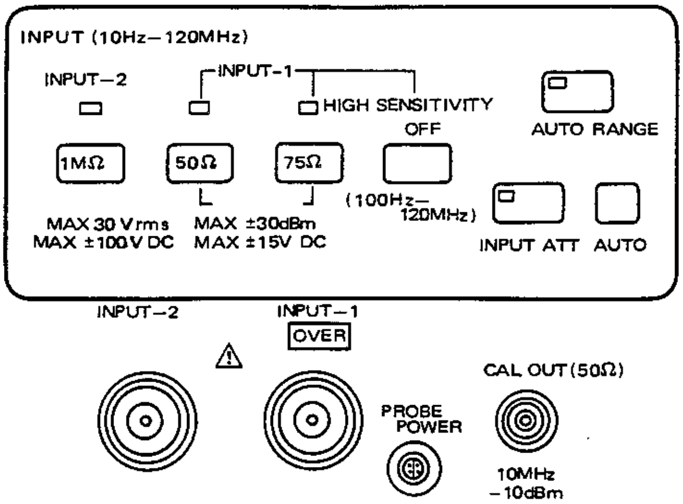
If the [SCALE (PHASE)] key is pressed during phase measurements, the scale along the vertical axis can be changed by the step keys and the DATA knob.

Pressing the [SHIFT] and [DUAL OFF] keys releases the dual trace mode, as described in Section 4-4-1.

If the [OFFSET (PHASE)] key is pressed, the phase offset can be changed by the step keys and the DATA knob.

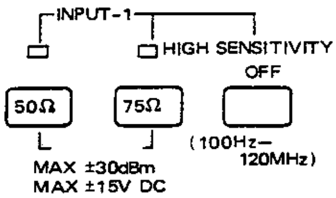
4-5. INPUT





These keys are used to select INPUT-1 or INPUT-2, set the input attenuator, select auto range, and select the HIGH SENSITIVITY mode if INPUT-1.

4-5-1. INPUT-1 (50 Ω, 75 Ω), HIGH SENSITIVITY



If the [50Ω] key is pressed, the indicator lamp above the key lights and measurement using the input terminals of INPUT-1 is enabled, and the input impedance is 50 Ω (nominal).
If the [75Ω] key is pressed, the indicator lamp above the key lights and measurement using the input terminals of INPUT-1 is enabled, and the input impedance is 75 Ω (nominal).
In this way INPUT-1 can provide measurements with an input impedance of either 50 Ω or 75 Ω. The indicator lamp above the 50 Ω or 75 Ω key lights to indicate the selected input impedance.

The frequency range for INPUT-1 is 10 Hz to 120 MHz, and the maximum input level is +30 dBm, ±15 Vdc. If a signal of more than +30 dBm is input, the [OVER] lamp on the INPUT-1 connector lights and the message "OVERLOAD" is displayed on the CRT display. When this happens, reduce the input level to below +30 dBm. Since dc voltages are not detected, note that dc voltages must not exceed ±15 V.

When the [HIGH SENSITIVITY OFF (100Hz–120MHz)] key is pressed, the built-in preamplifier is connected to the input system of INPUT-1, and high sensitivity measurement is enabled. The average noise level is improved from less than -140 dBm to less than -155 dBm (with a resolution bandwidth of 3 Hz, a video bandwidth of 1 Hz, and an input attenuation of 0 dB). Use the [50Ω] or [75Ω] key to select input impedance. The frequency bandwidth is 100 Hz to 120 MHz.

Press the [SHIFT] and [HIGH SENSITIVITY OFF] keys to release the HIGH SENSITIVITY mode.

CAUTION

> The HIGH SENSITIVITY mode cannot be used with INPUT-2 (1 MΩ).

When the analyzer is turned on or the MASTER RESET key is pressed, an input impedance of 50 Ω is automatically selected for INPUT-1.

4-5-2. INPUT-2 (1 MΩ)

INPUT-2

[1MΩ]

MAX 30 Vrms
MAX ±100 V DC

If the [1MΩ] key is pressed, the indicator lamp above the key lights and measurement by the input terminals of INPUT-2 is enabled: The input impedance is 1 MΩ ±3% and the parallel capacitance is 25 pF. The frequency range for INPUT-2 (1 MΩ) is 10 Hz to 120 MHz, and its maximum input level is 30 Vrms, ±100 Vdc max.

4-5-3. INPUT ATT

[INPUT ATT] [AUTO]

The [INPUT ATT] key sets the RF attenuator.

This key sets the level of the RF attenuator between the INPUT connector and the 1st Mixer between 0 dB and 65 dB, in 5 dB steps. Normally, the input attenuator is controlled in AUTO mode in which the attenuation level is automatically set between 10 dB and 65 dB according to the REF. LEVEL key setting. 0 or 5 dB attenuation can not be selected when in AUTO mode.

The currently-selected attenuation level is always displayed at the top of the CRT screen, e.g., "ATT XXdB". When manual setting of the input attenuator is desired, press the [INPUT ATT] key; the key indicator lamp will light. The current attenuation level "ATT XXdB" will be displayed in the active function display area of the CRT screen. Set the attenuation to the desired level with the DATA knob, or the STEP keys, or the DATA keyboard. The data display on the CRT screen changes according to the setting of the attenuation level.

To return the attenuator to AUTO control mode, press the [AUTO] key. The key indicator lamp on the [INPUT ATT] key will go out, and the attenuator will be automatically controlled according to the reference level setting.

Attenuation level can be set independently for INPUT-1 and INPUT-2.

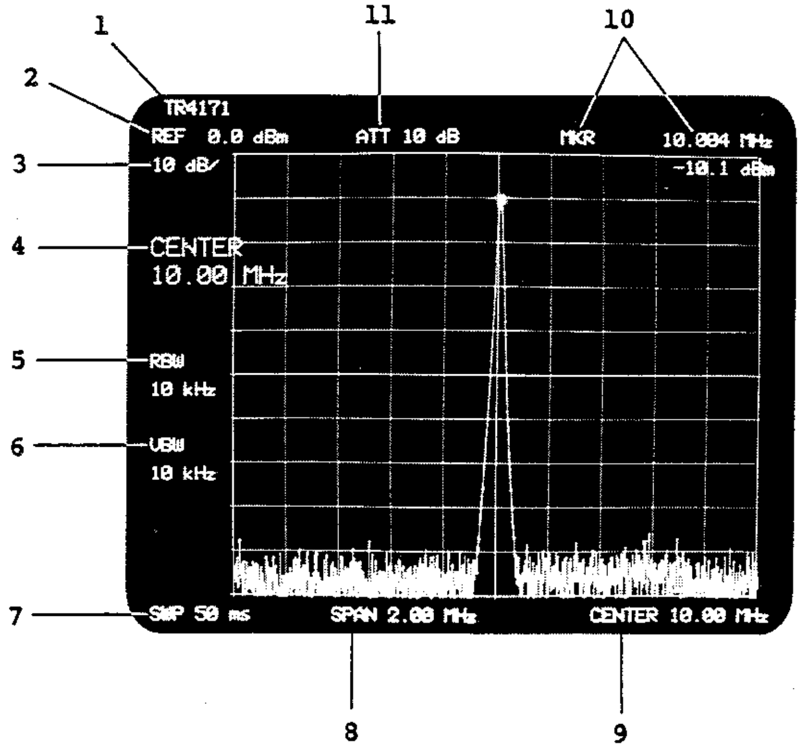
4-5-4. AUTO RANGE

[AUTO RANGE]

When the [AUTO RANGE] key is pressed, if the input level is not -30 dBm, the input attenuator's level is automatically set so that the value obtained by subtracting the input attenuator's level from the input level is between -30 dBm to -35 dBm. If this mode is selected, harmonic distortion of the dynamic range of the analyzer is -80 dB or less, and two-signal third intermodulation distortion is -80 dB or less, regardless of input level.

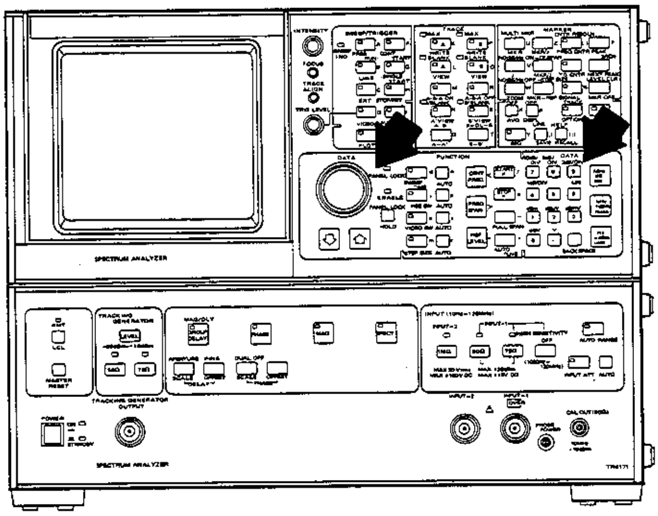
4-6. CRT DISPLAY

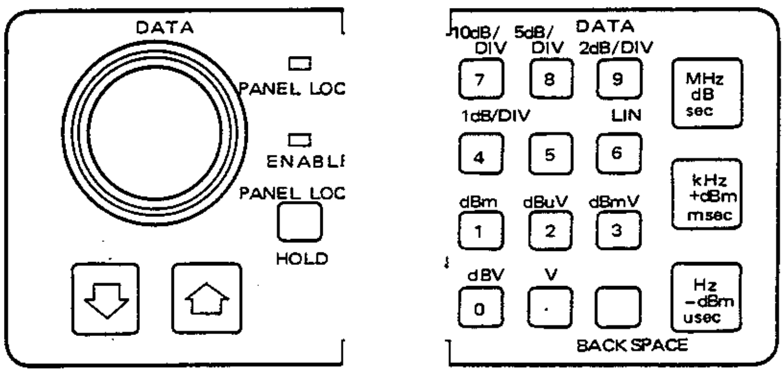
The CRT displays the signal response trace, graticules, measurement data, and labels.



(1)	TR4171	Optional label written by the user (Paragraph 4-13.)
(2)	REF	Reference level (Paragraph 4-8-3.)
(3)	10 dB	Vertical scale per division (Paragraph 4-8-4.)
(4)	(CENTER)	Active function (Paragraph 4-8.)
(5)	RBW	Resolution bandwidth (Paragraph 4-8-6.)
(6)	VBW	Video bandwidth (Paragraph 4-8-7.)
(7)	SWP	Sweep time (Paragraph 4-8-5.)
(8)	SPAN	Frequency span (Paragraph 4-8-2.)
(9)	CENTER	Center frequency (Paragraph 4-8-1.)
(10)	MKR	Marker (Paragraph 4-9.)
(11)	ATT	Input attenuator level (Paragraph 4-5-3.)

4-7. DATA



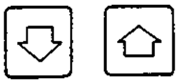


Any function can be selected by pressing the appropriate front panel function key, and can be changed by using any of the DATA controls. The DATA controls consist of the DATA knob, DATA step keys, and the DATA keyboard. Use the appropriate control according to current conditions.

4-7-1. DATA Knob

Turning the DATA knob clockwise increases the function data which is currently active. In marker mode, clockwise rotation of the DATA knob moves the marker to the right. In the display line mode it moves the display line upwards. Turning the DATA knob counter-clockwise decreases function data, moves the marker to the left, or moves the display line downward, as appropriate.

4-7-2. DATA Step Keys



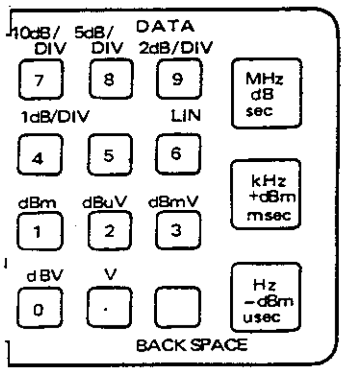
The DATA step keys change function data in predetermined steps each time they are pressed. In market mode, each operation of a step key moves the market one division along the horizontal axis of the CRT display.

Step size can be changed by using the 

or 

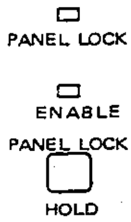
key. A more detailed description of these keys will be given in the sections on FUNCTION and MARKER.

4-7-3. DATA Keyboard



The DATA keyboard enables direct entry of numerical data. Function data is input by pressing a units key after operating the numeric data keys. If you make a mistake when inputting numerical data, press the [BACK SPACE] key, then enter the correct data.

4-7-4. HOLD, PANEL LOCK



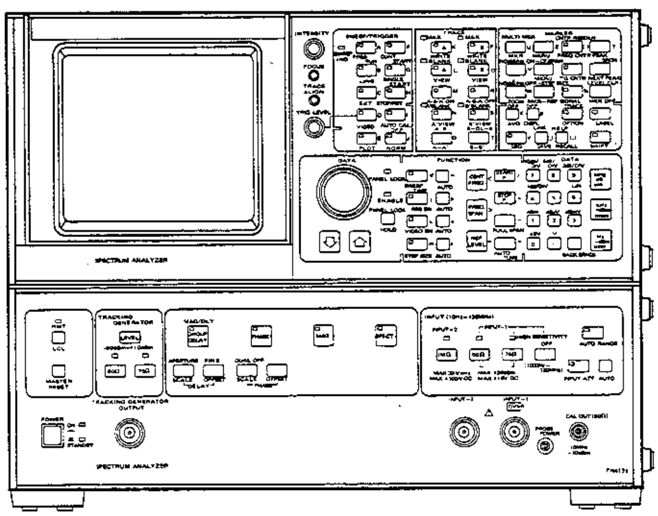
Data input using the DATA controls (the DATA knob, DATA step keys or DATA keyboard) is inhibited by pressing the [HOLD] key (The ENABLE indicator lamp above the [ENABLE] key goes out).

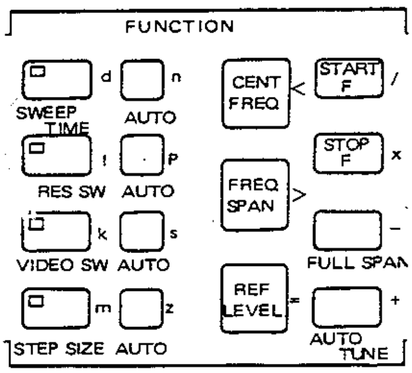
The HOLD state is cleared by operating a key other than the DATA controls or keys, the ENABLE indicator lamp lights to indicate that data input is enabled again.

Pressing the [SHIFT] and [PANEL LOCK] keys locks the panel, and enables the operations of keys which unlock the panel (the [SHIFT], [LABEL], and [PANEL LOCK] keys) and data entry using the numeric keys 0 to 9 or the MASTER RESET key.

If one of the numeric keys, 0 to 9 is pressed when the panel is locked, the corresponding operation RECALL0 to RECALL9 is executed.

4-8. FUNCTION





When the POWER key is pressed on ON, center frequency, frequency span, reference level, etc., are automatically set to the initial values shown in Section 4-2-2.
These values can be changed by using the FUNCTION keys and DATA controls. Sweep time, manual setting of bandwidth (normally set automatically), or vertical scale can also be changed by the FUNCTION keys and DATA controls.
To change function data, first press the appropriate function key. The activated function will be displayed in the active function area on the left side of the CRT screen. Change the data with the DATA knob, DATA step keys or DATA keyboard. The function remains active until another FUNCTION key or the MARKER key is operated, enabling any number of changes for one function.
The functions of the individual FUNCTION keys are described below.

4-8-1. CENT. FREQ.

[CENT FREQ]

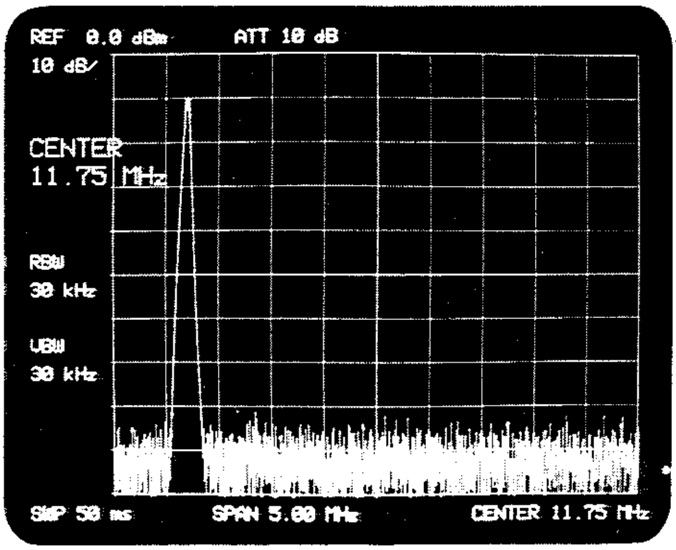
This key, used to set the center frequency, can be set over a range of 0 Hz to 120 MHz. The maximum number of digits (resolution) of the center frequency setting is 1% of the selected frequency span (FREQ. SPAN).
The DATA knob allows fine control of the center frequency by gradually moving the trace horizontally. The DATA step keys shifts the frequency in steps (normally 1/10 of the selected frequency span) by moving the trace in fixed jumps. The DATA keyboard enables direct entry of numerical center-frequency data. The actual input of data occurs when one of the units keys, MHz, kHz or Hz, is pressed after numerical data has been entered.
The center frequency is always displayed in the bottom right corner of the screen (except in Log. Display mode).

4-8-2. FREQ. SPAN

[FREQ SPAN]

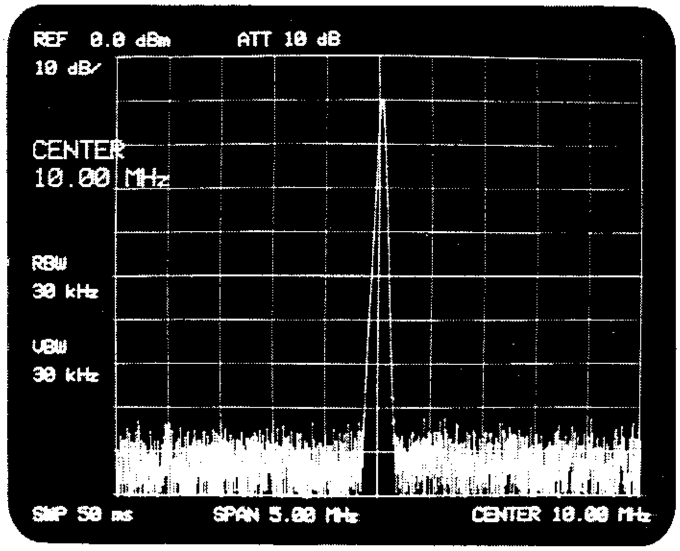
This key is used to determine the frequency span.
Frequency is displayed from the left to the right of the CRT screen.
The frequency span can be set over a range from 20 Hz to 200 MHz in 1-2-5 sequence. Each graticule along the axis represents a frequency which is 1/10 of the frequency span.
FREQ. SPAN can be changed with the DATA knob or the DATA step keys; the DATA keyboard enables direct entry of numerical frequency-span data.
The display always shows frequency span data at the bottom of the screen (except in Log. Display mode).
When the RES BW and VIDEO BW functions are set in AUTO mode, resolution bandwidth (RBW) and video bandwidth (VBW) are automatically set to optimum values with changes in frequency span.

Example of [CENT FREQ] and [FREQ SPAN] usage:

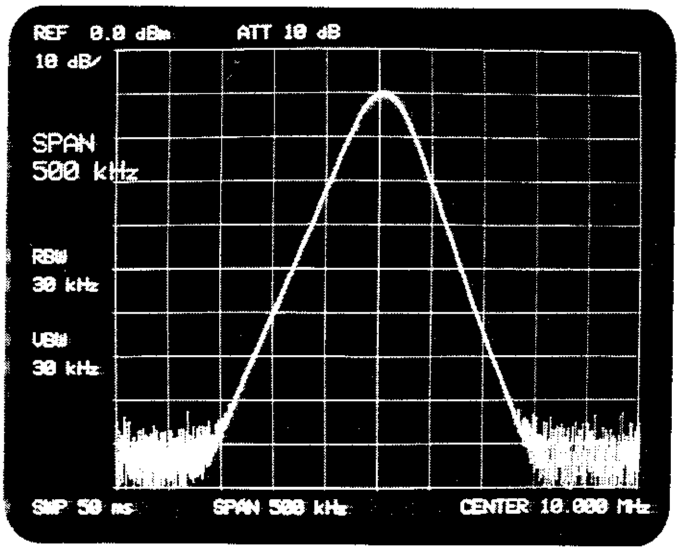


The signal being measured is to the left of center of the display. Reduce the center frequency by pressing the CENT. FREQ key once and the DATA step-down key twice, to move the signal to the right.

Move the signal to the exact center of the display with the DATA knob.



For better frequency resolution narrow the frequency span by pressing the FREQ. SPAN key once and the DATA step-down key twice.



If the signal deviates from the center of the CRT display when the frequency span is being narrowed, return the signal to the center by using the CENT. FREQ. key and the DATA knob.

Zero Frequency Span:

When the [FREQ SPAN], [0] and [Hz -dBm usec] keys are pressed, the horizontal display axis becomes a time axis, and the frequency of the spectrum analyzer can be fixed by pressing the CENT. FREQ. key. As a result, the analyzer operates as a receiver tuned to the fixed center frequency. Setting a frequency other than 0 Hz restores the normal spectrum analyzer function with the horizontal display axis calibrated for frequency.

4-8-3. REF. LEVEL

[REF LEVEL]

This key is used to set a reference level at the top graticule of the CRT display.

The reference level can be specified over a range of -105 dBm to +60 dBm in 0.1 dB steps. The DATA step keys control the reference level in 10 dB steps, while the DATA knob controls it in 0.1 dB steps.

The DATA keyboard enables direct input of reference level values. To input a positive value, press the [kHz +dBm msec] key; and to input a negative value, press the [Hz -dBm usec] key; after keying in numerical data.

The specifiable range of the reference level may be reduced to less than -105 dBm to +60 dBm, depending on the input attenuator setting.

The reference level can be displayed in dBμV, dBmV, or V units.

For dBμV display, press the [SHIFT] and [2 (dBμV)] keys.

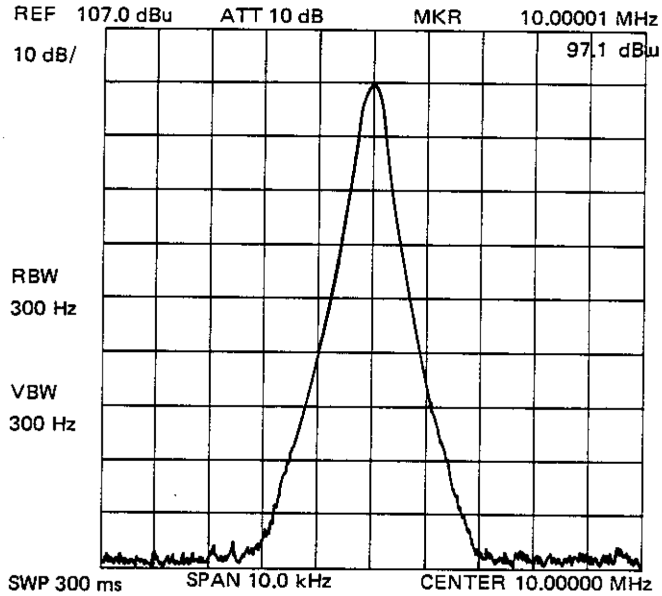
For dBmV display, press the [SHIFT] and [3 (dBmV)] keys.

For dBV display, press the [SHIFT] and [0 (dBV)] keys.

For V display, press the [SHIFT] and [. (V)] keys.

To return to dBm display, press the [SHIFT] and [1 (dBm)] keys.

[SHIFT] [2] (dBuV)



4-8-4. Vertical Scale Control

The scaling of the vertical graticule divisions of the CRT display is normally set at 10 dB/div.

Look at the top left corner of the display. "REF XX dBm" indicates that the reference level is being displayed in dBm, and "10 dB/" indicates that the scaling of the vertical graticule divisions is 10 dB/div.

The scaling can also be selected from 5, 2, 1, 0.5, 0.2 and 0.1 dB per division, and linear scaling.

To select 5 dB/div, press the [SHIFT] and [8] (5dB/DIV) keys; to select 2 dB/div., press the [SHIFT] and [9] (2dB/DIV) keys; and to select 1 dB/div., press the [SHIFT] and [4] (1dB/DIV) keys.

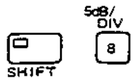
The following will be displayed at the left side of the display:

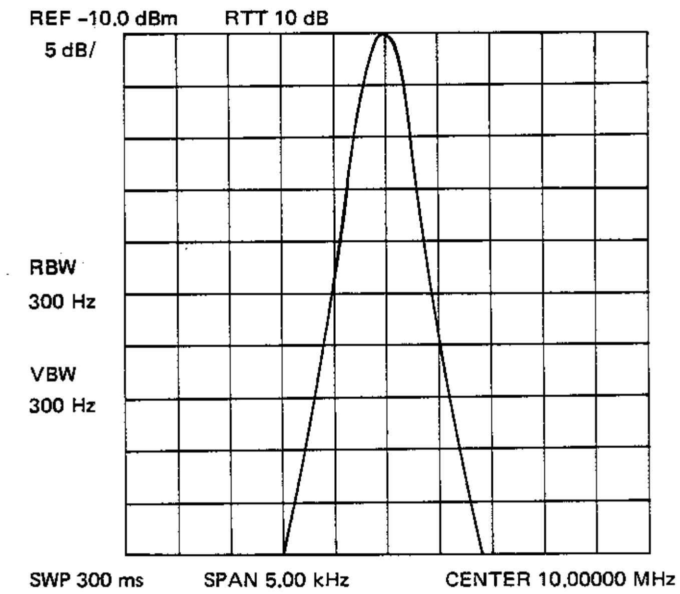
LOG
1dB/
, 1, 0.5, 2, 0.2
, 3, 0.1

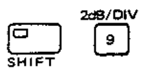
To select 0.5 dB/div., press the [1] key; to select 0.2 dB/div., press the [2] key; and to select 0.1 dB/div, press the [3] key.

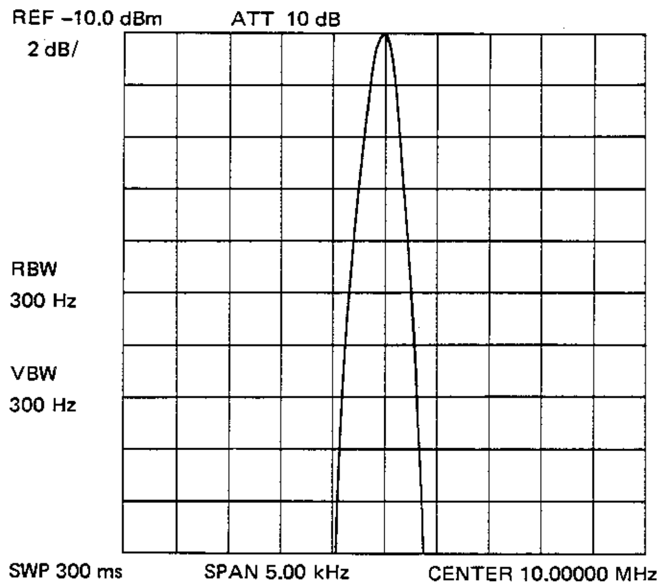
To change 0.5 dB/div. to 0.1 dB/div., press the [SHIFT] and [4] keys, then press the [3] key.

Note: With 0.2 dB/div., the effective range of the vertical scale is reduced to 9 divisions below the reference level; and with 0.1 dB/div., it is reduced to 8 divisions below the reference level.









The scale can be set up for linear units to enable reading of proportional input signal power.

Pressing the [SHIFT] and [6] (LIN) keys selects linear scale; the top and bottom graticules are assigned to the reference and 0 V levels, respectively.

4-8-5. SWEEP TIME

[SWEEP TIME] d [AUTO] n

This key is used to set the sweep time with a range of 50 ms (30 ms) to 1000 s.

When the POWER switch is pressed to the ON position, sweep time control is set to AUTO mode in which it is automatically set according to frequency span, resolution bandwidth or video bandwidth to minimize level errors.

The [SWEEP TIME] key clears the AUTO mode to enable manual setting of sweep time with the DATA knob, DATA step keys, or DATA keyboard (the indicator lamp on the key lights). Sweep time must be set manually for phase or group delay measurement.

Pressing the [AUTO] n key selects AUTO mode again for sweep time control; the indicator lamp on the SWEEP TIME key goes out.

If a too-long sweep time is set in AUTO mode, it can be temporarily reduced by pressing [SWEEP TIME] [⇩] [⇩].
for quick observation of signal response. In this case, if the error in the level reading exceeds 0.5 dB, the message "UNCAL" will be displayed on the screen.

Once the outline of the signal response has been checked, restore AUTO mode so the UNCAL message is cleared.

In zero span mode, sweep time can be set between 100 μs and 1000s.

4-8-6. RES BW

[RES BW] l [AUTO] P

This key is used to activate the resolution bandwidth which can be set within a range of 3 Hz to 100 kHz in 1-3 sequence.

AUTO automatically sets the resolution bandwidth according to the selected frequency span.

The [RES SW] key enables manual setting of resolution bandwidth with the DATA controls. A signal response can be separated from adjacent noise or two or more signal responses can be separated from each other, by narrowing the resolution bandwidth and increasing resolution. The DATA step key can be conveniently used to narrow the resolution bandwidth. When the SWEEP TIME key is in AUTO mode, sweep time is increased as the resolution bandwidth is narrowed.

4-8-7. VIDEO BW

[VIDEO SW] k [AUTO] s

This key is used to set the video bandwidth within a range of 1 Hz to 1 MHz in steps of 1 or 3.
AUTO automatically sets the video bandwidth to the optimum value according to the selected frequency span.
Signal responses near the noise level of the analyzer will be visually masked by the noise. The video filter can be narrowed to smooth this noise, although a longer sweep time will be necessary. With the video averaging feature, which digitally averages the signal response for each sweep, a better signal-to-noise ratio can be expected with a shorter sweep time.
For more details, see Section 4-16.

4-8-8. STEP SIZE

[STEP SIZE] m [AUTO] z

This key is used to determine the center frequency step size for center frequency control using [CENT FREQ] and [⇩] [⇧] keys.
AUTO automatically sets the step size to one tenth the frequency span.
It is not possible to observe all of a wide frequency span with a high resolution. One method of solving this problem is to use the frequency span as a step size for raising the center frequency from the lowest frequency in steps. This technique is described below.

(1) Set the center frequency and frequency span for the lowest frequency range of the signal response being measured.

(2) Press the [STEP SIZE] key, and then use the DATA keyboard to input the same value as the frequency span. Activate the center frequency with the [CENT FREQ] key.

(3) Each pressing of the [⇧] key will now set the center frequency to the next span. The center frequency step size can also be specified with the [MKR/Δ-STEP SIZE] key. For more details, see Section 4-9.

4-8-9. START F, STOP F

[START F] [STOP F]

These keys set the frequencies at the right and left sides of the display, respectively.

Pressing the [START F] key and inputting frequency data sets the start frequency.

Pressing the [STOP F] key and inputting frequency data sets the stop frequency.

Start and stop frequencies can be set within a range of 0 Hz to 120 MHz. However, the condition; start frequency < stop frequency must be satisfied.

4-8-10. FULL SPAN

[FULL SPAN]

Pressing this key sets the following values: [FULL SPAN]

Center frequency	:	60 MHz
Frequency span	:	120 MHz
SEEP TIME	:	AUTO
RES BW	:	AUTO
VIDEO BW	:	AUTO

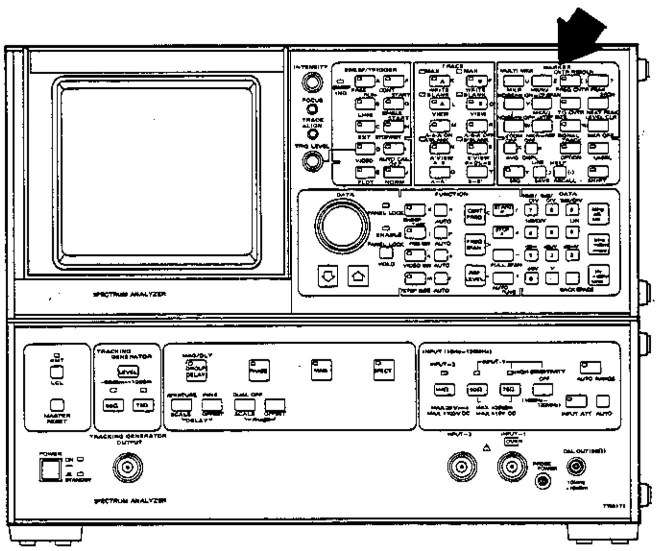
4-8-11. AUTO TUNE

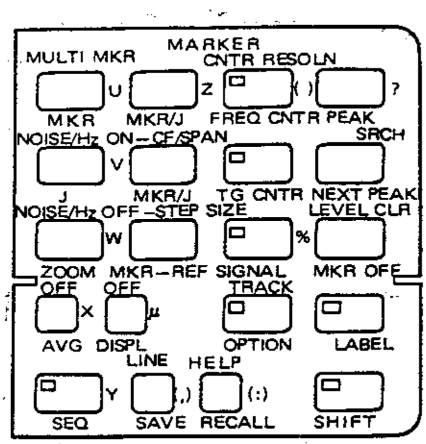
[AUTO TUNE]

This key is used to fix the maximum signal, other than local feedthrough, at the center of the screen and expand it to the specified span.

Press the [AUTO TUNE] key, then input frequency span data for the desired setting with the DATA keyboard. This key automatically locates the maximum signal, moves it to the center of the display, fixes it in position, and expands it to the specified span.

4-9. MARKER





Use of the MARKER controls enables digital reading of data on the display. The multi-marker mode sets up to 10 markers on the display.

4-9-1. MKR, MULTI MKR

MULTI MKR [ ] MKR

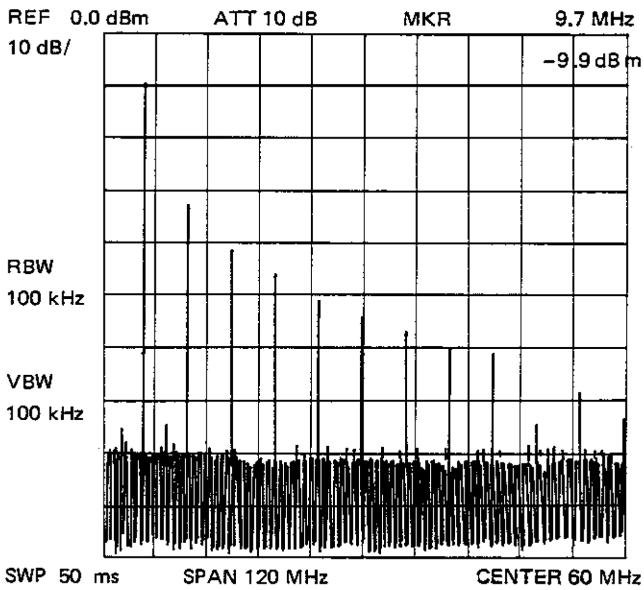
(1) Marker mode

The [MKR] key activates a single marker (a bright spot) at the center of the display or at its last position before it was turned off.

The frequency and level at the marker are displayed in the active function display area on the left of the CRT screen. The same data readouts are displayed in the top right corner of the screen as well. The marker is normally displayed as "MARKER" or "MKR".

An active marker can be moved horizontally along the frequency axis with the DATA controls.

The DATA knob can control the marker position continuously for fine tuning.
Each operation of the DATA step keys moves the marker in steps of one division for faster control.
Use of the DATA keyboard enables direct specification of the frequency at which the marker is positioned. If a frequency outside the frequency range on display is entered with the DATA keyboard, the marker is positioned at the corresponding leftmost or rightmost graticule.
The readouts of marker frequency and level change with the movement of the marker.



When another function key (such as CENT. FREQ.) is pressed, the marker remains on the screen but is deactivated so that it cannot be moved along the frequency axis.
To activate the marker again, press the MKR key. A marker which can be controlled with the DATA controls is called an active marker.
When a marker is active, it can be positioned on the desired trace by operating the VIEW or WRITE key for the memories for the trace functions A, A', B, or B'. (See Section 4-10-1 (6).)

(2) Multi marker mode

The multi marker mode enables the generation of between two and ten markers at the same time.

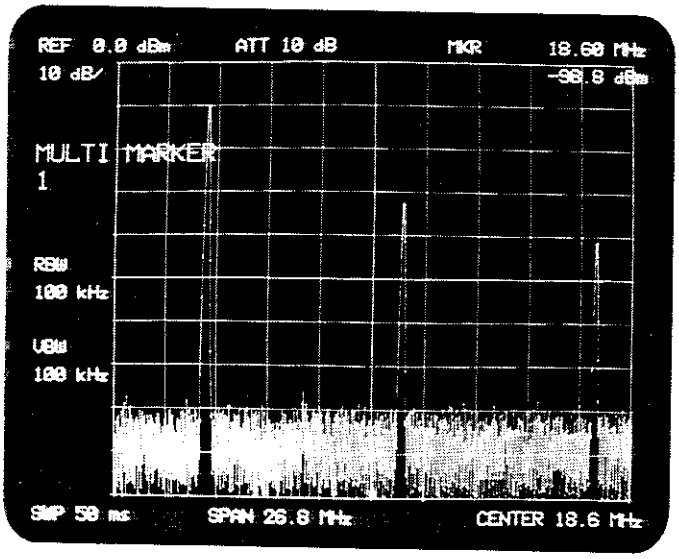
If the SHIFT and MULTI MKR keys are pressed, "MULTI MARKER" will be displayed in the active function display area. Use the DATA keyboard to enter the number of markers required.

Then press the Hz key to register the data as the number of markers. Markers are generated one-by-one on the display up to the programmed number every time the MKR key is pressed.

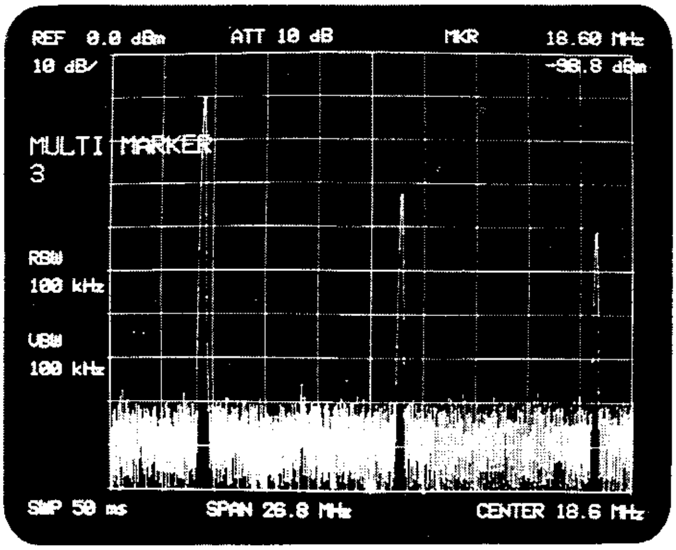
The following example illustrates the generation of three markers.

Press the SHIFT and MULTI MKR keys, then press the 3 and Hz/-dBm/usec keys. When the MKR key is pressed the first time the first marker (marker 1) appears on the display. This marker can be handled in the same way as the normal marker. Position the desired signal response trace. The frequency and level at marker 1 are displayed in the active function display area and at the top right corner of the screen. Markers 2 and 3 appear on the display when the MKR key is pressed a second and third time, respectively.

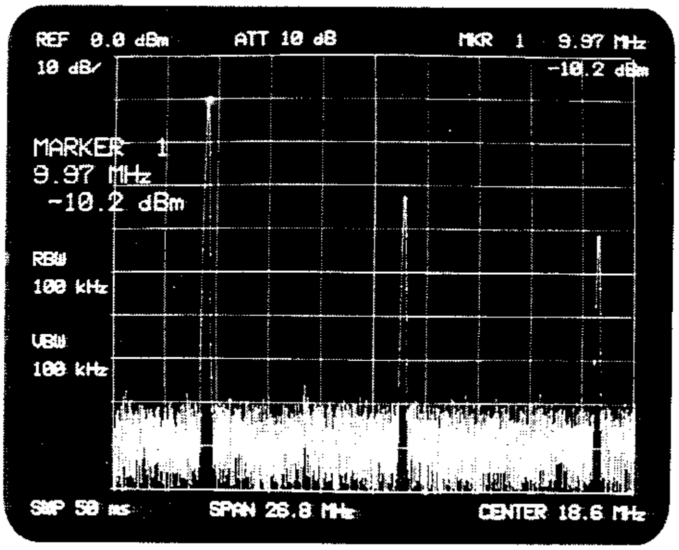
Set the analyzer for multi-marker mode by pressing the SHIFT and MULTI MKR keys.



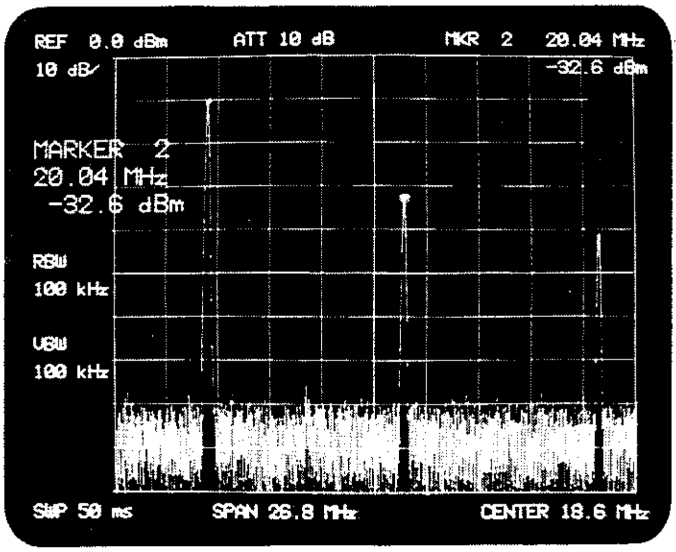
Set the number of markers by pressing [3] and [Hz -dBm usec]



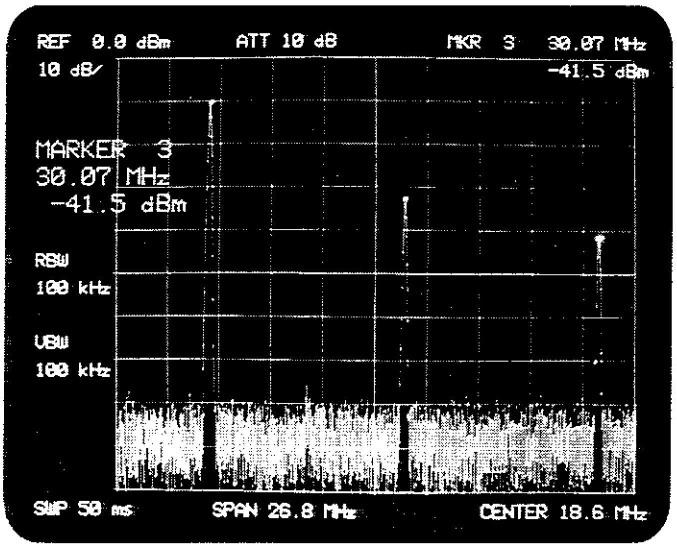
Activate the first marker (marker 1) with MKR and the DATA knob.



Generate the second active marker (marker 2) at the center with MKR and the DATA knob of the display.
Marker 1 is deactivated.



Generate the third active marker (marker 3) with MKR and the DATA knob.



Now there are three markers set on the display.
In multi-marker mode, one of several markers is activated, and readouts of the frequency and level at the marker can be displayed.
Pressing the [MKR] key again deactivates marker 1.
Subsequent operations of the [MKR] key will activate marker 2, marker 3, and marker 1 in sequence.
The active marker is highlighted.
Operation of the MKR OFF key erases all markers from the display, but the last positions of the markers and the programmed number of multi-markers are left in the internal memory. The markers can be recalled to the display one after another each time the MKR key is pressed.
To change the programmed number of multi-markers, press the [SHIFT] and [MULTI MKR] keys, then enter the new number of markers (between 1 and 10) from the DATA keyboard before pressing the Hz key. The new number is set, and each time the MKR is pressed subsequently, markers appear on the display and are activated in sequence.
To return the analyzer from multi-marker mode to the normal marker mode, set the number of multi markers to 1 by pressing the [SHIFT] , [MULTI MKR] , [1] , and [Hz -dBm usec] keys.

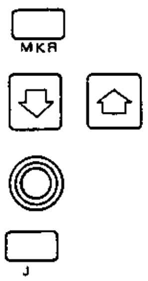
4-9-2. Δ, NOISE/Hz ON

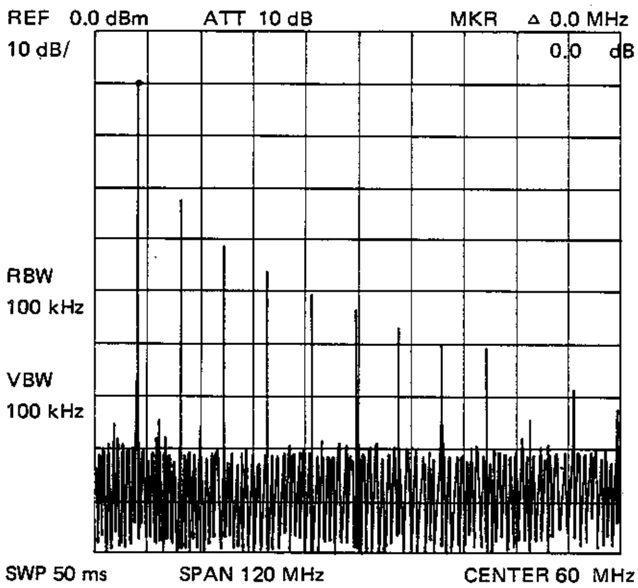
NOISE/Hz ON [J]

(1) Delta marker

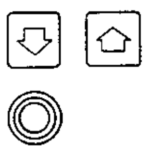
The [J] key operates two markers on the display. Only one of the two markers is activated; the differences in frequencies and levels of the two markers are displayed.
The following example illustrates the measurement of frequency and amplitude differences between two signal responses.
Press the [MKR] key to obtain the normal marker mode in which a marker is activated. Position the marker to the peak of one signal response with the DATA step keys and the DATA knob.

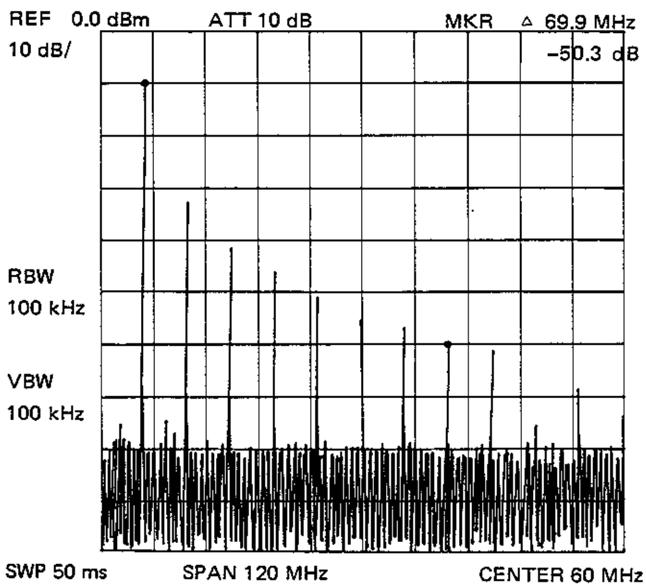
Press the J key. The display will generate a second marker which is active. The first marker is deactivated and remains at the peak of the first signal response. The two markers overlap each other and are seen to be a single marker.





Position the second marker at the peak of the second signal response trace with the DATA step keys and the DATA knob.
The differences in frequencies and levels between the two signal responses will be displayed.
To return the analyzer from delta mode to normal marker mode, press the MKR key. Only one active marker will be left on the display.



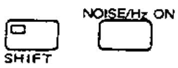


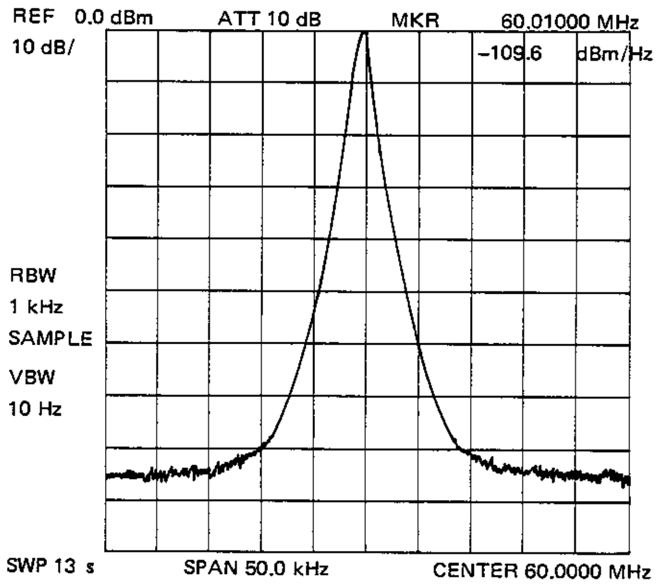
(2) Noise level measurement (noise/Hz)

When noise level measurement is activated and the marker is placed on the noise, the rms noise level is read out normalized to 1 Hz noise power bandwidth. To activate the noise level measurement, press the [SHIFT] and [NOISE/Hz ON] keys. The marker level display on the screen will read XX dBm/Hz, indicating noise level measurement mode. To obtain a noise level over a bandwidth other than 1 Hz, add the following value to the displayed value;

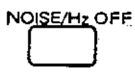
$$10 \log_{10} \left(\frac{\text{bandwidth}}{1\ \text{Hz}}\right)$$

To return the analyzer from noise level measurement mode to normal marker mode, press the [SHIFT] and [NOISE/Hz OFF] keys.





4-9-3. ZOOM, NOISE/Hz OFF



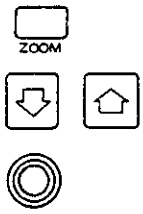
Use of the ZOOM key with the DATA step keys enables zooming into a signal specified by a marker. In other words, the zoom operation narrows the frequency span and positions the marker at the center of the CRT display.

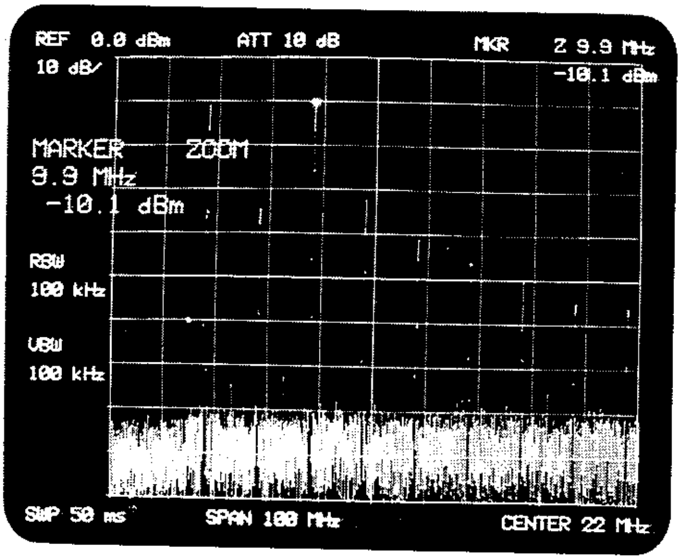
In ZOOM mode, the DATA knob, DATA steps, and DATA keyboard have functions different from those in other modes.

- The DATA knob and DATA keyboard move the marker horizontally.
- The DATA step keys position the marker at the center of the display while changing the frequency span.

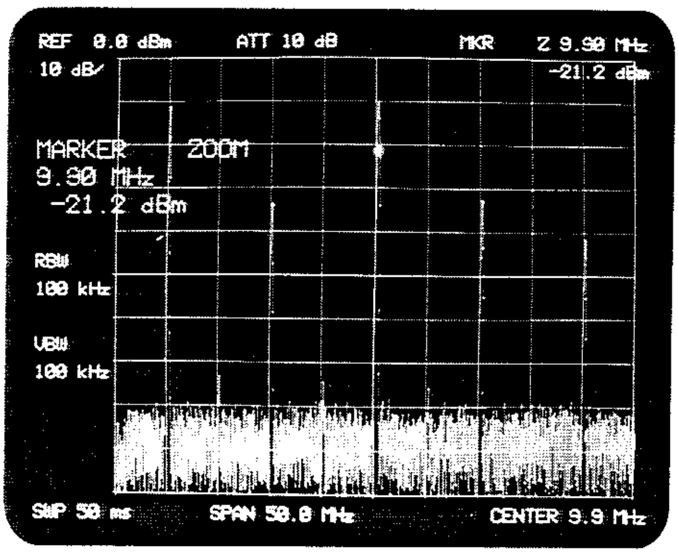
The following describes how to use the ZOOM function.

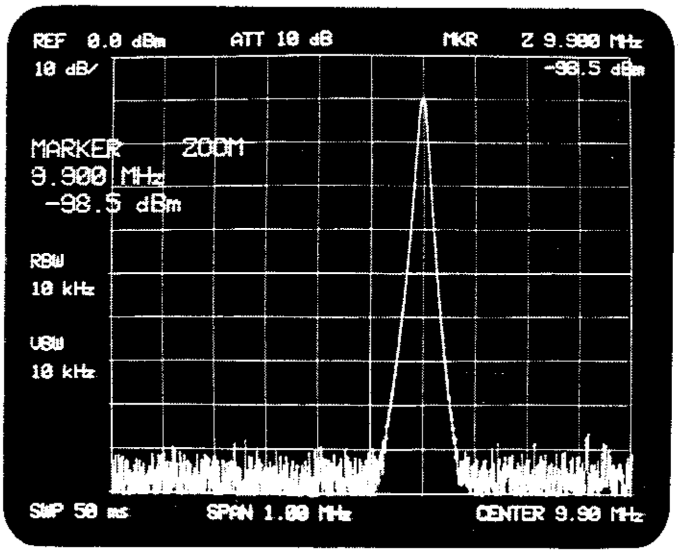
The ZOOM key provides an active marker on the display. Position this marker at the peak of the signal response trace being measured.





Each time the  key is pressed, the frequency span is narrowed in 1-2-5 sequence, while the marker moves towards the center of the display.

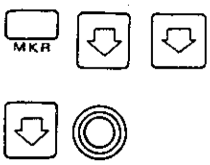


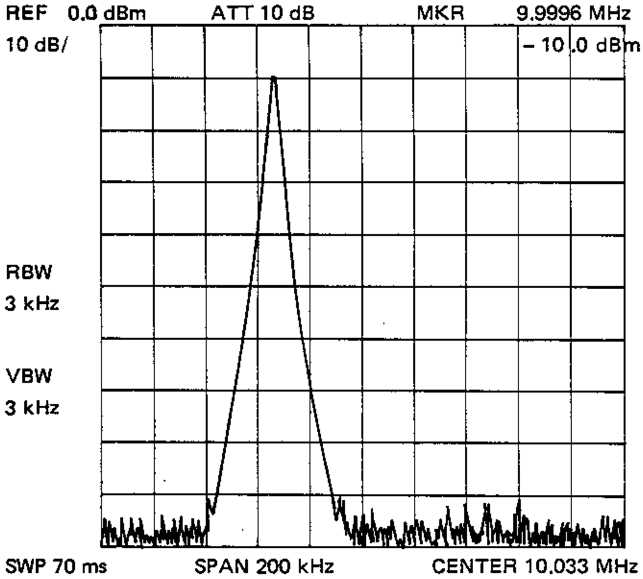


If the marker deviates from the signal peak as shown above, reposition it at the peak with the DATA controls.
To return the analyzer from ZOOM mode to normal marker mode, press the MKR key.

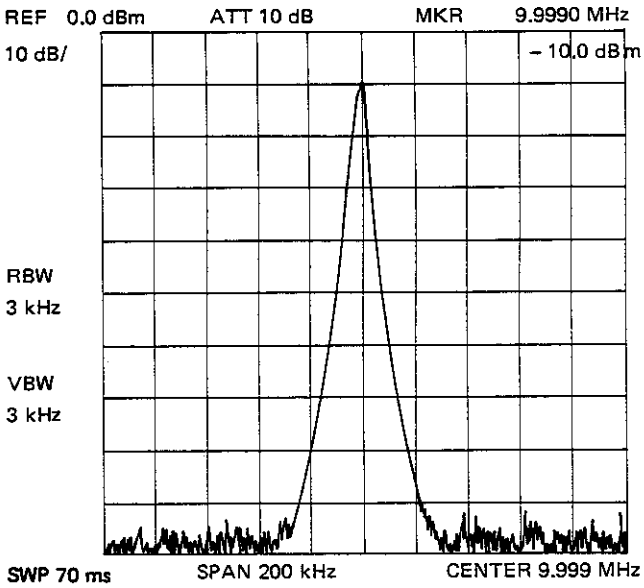
4-9-4. MKR/Δ→CF/SPAN (MKR → CF, Δ→SPAN)

(1) MKR→CR [MKR/Δ →CF/SPAN]
Operation of the [MKR/Δ →CF/SPAN] in normal marker mode key substitutes the marker frequency for a center frequency. An example is given below.
Press the [MKR] key to activate a single marker and then position the marker at the peak of the signal response trace with the DATA knob.





The signal frequency will be read out as 9.9996 MHz.



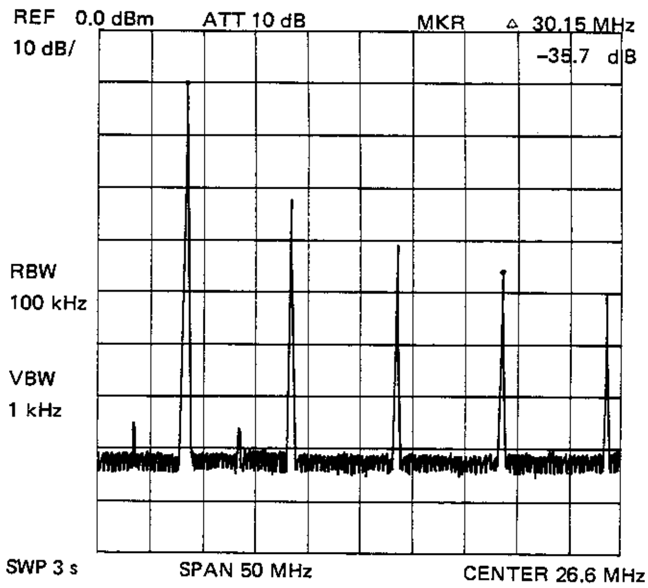
Press the 

key. The center frequency will be set at 9.999 MHz and the signal response trace will be positioned at the center of the display along with the marker.

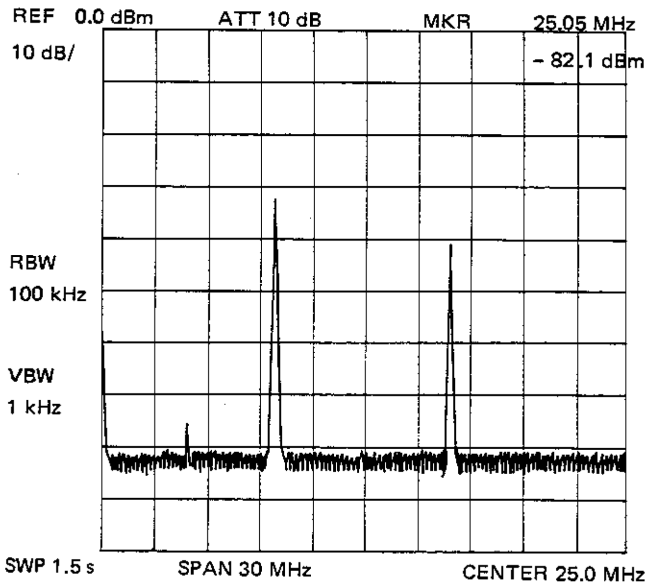
When pressing the MKR/Δ→CF/SPAN more than once, wait until the first marker repositioning is finished before pressing the MKR/Δ→CF/SPAN key again. If the MKR/Δ→CF/SPAN key is pressed before the completion of the repositioning, the center frequency will not be set correctly.

(2) Δ → SPAN

Pressing the [MKR/Δ →CF/SPAN] key in delta marker mode sets the center frequency and frequency span so that the frequency range between the two markers expands to fill the whole display. In this case, the two markers need not be active.



MKR/Δ →CF/SPAN



4-9-5. MKR/Δ → STEP SIZE

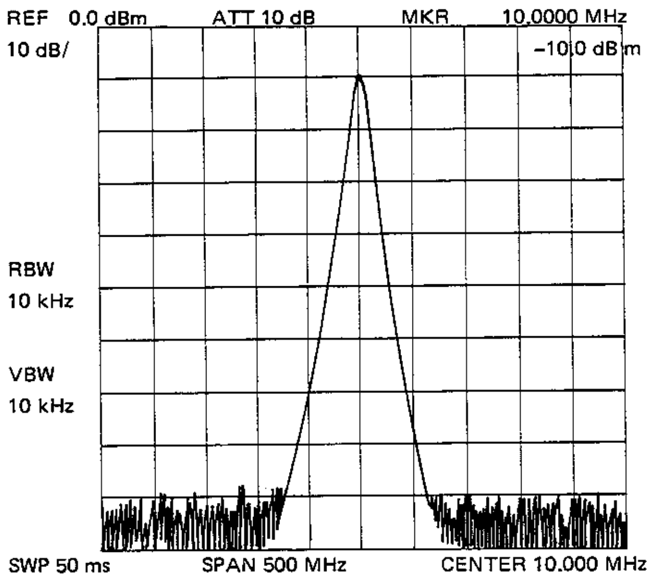
[MKR/Δ -STEP SIZE]

(1) In normal marker mode set by the [MKR] key operation of the [MKR/Δ -STEP SIZE] key substitutes the marker frequency for center frequency step size.

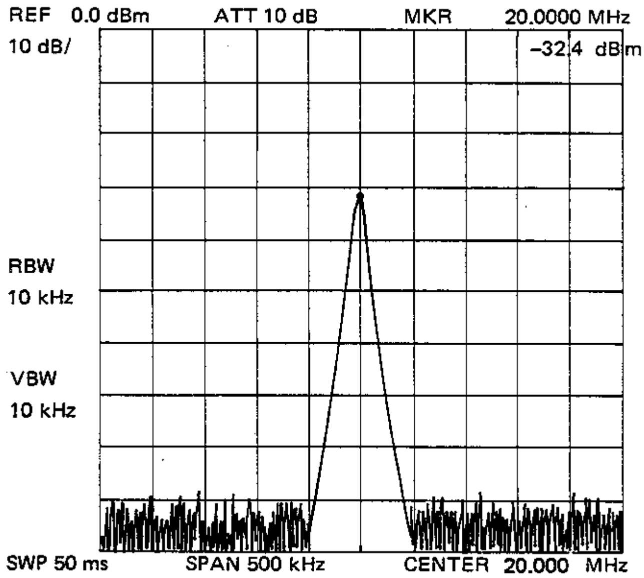
(2) In delta marker mode set by the [Δ] key operation of the [MKR/Δ -STEP SIZE] key substitutes the frequency difference between two markers for center frequency step size.

(3) The center frequency can be controlled in steps with the [CENT FREQ], [⇩], [⇧] with the step size determined in (1) or (2) above. For example, when measuring a fundamental and its higher harmonics, press the MKR key to activate the single marker and position it at the peak of the fundamental wave. Then use the [SIGNAL TRACK] and FREQ. SPAN, and DATA step keys to zoom in on the fundamental wave at the center of the display.

[MKR/Δ -STEP SIZE]

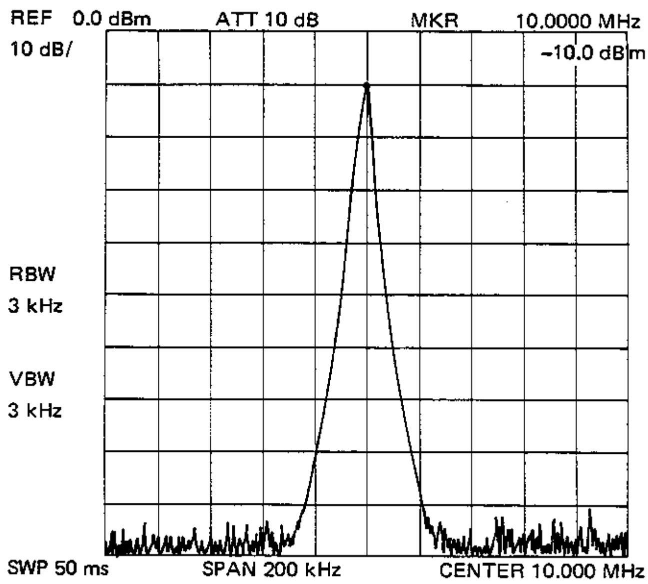


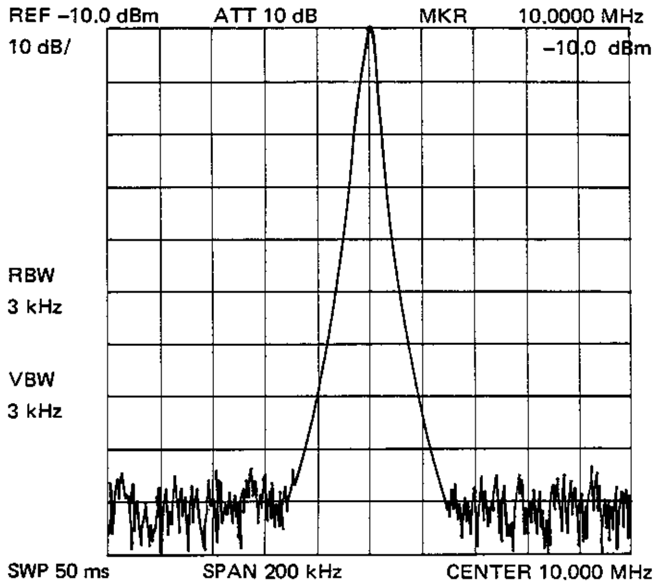
Next press the MKR/Δ → STEP SIZE key to substitute the marker frequency (fundamental wave frequency) for the center frequency step size; the indicator lamp on the STEP SIZE key will light. Press the CENT. FREQ. key to activate the center frequency, then press the step up key. The center frequency is doubled and the second harmonic can now be observed.



4-9-6. MKR → REF.

This key is used to substitute the amplitude at a marker for the reference level.



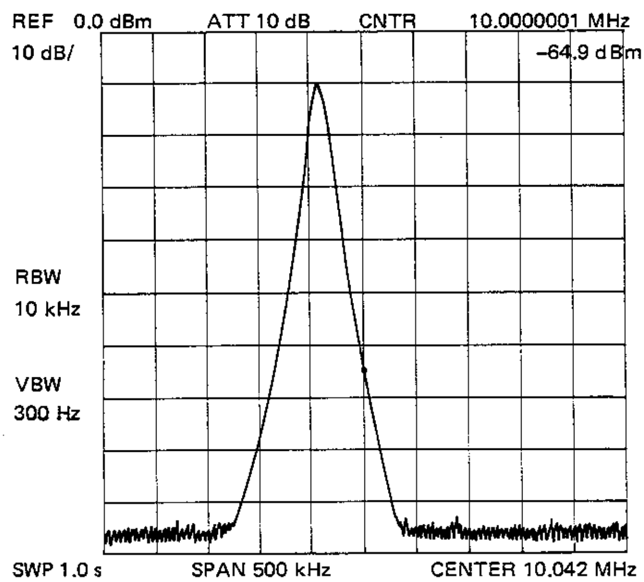


4-9-7. FREQ CNTR, CNTR RESOLN

Operation of  key activates the frequency counter mode; the indicator lamp on the key will light.

The frequency counter mode enables precision measurement of the frequency of a signal at which the marker is positioned, and which has a level more than 15 dB higher than the noise level.

For the measurement the marker need not be positioned at the signal peak, because it is not the frequency of the marker itself but the frequency of the signal indicated by the marker which is measured.



To change the resolution of the frequency counter, press the [SHIFT] and [CNTR RESOLN] keys. The message "COUNTER RESOLN" will appear on the display. Input the desired resolution data (least-significant digit to be read) through the DATA keyboard.

The maximum resolution of the frequency counter during manual setting varies according to the frequency being measured. The maximum setting is 1 μHz, but the actual maximum resolution is limited by the range of frequencies being measured as shown in Table 4.2.

Pressing the [SHIFT], [CNTR RESOLN], [0], and [Hz -dBm usec] keys activates the automatic setting mode, and automatically sets the resolution of the frequency counter according to the frequency span beng set.

Table 4-2 Correspondence between Measurement Frequency and Maximum Resolution

Measurement Frequency	Maximum Resolution	Measurement Time
> Approx. 12 MHz	0.1 Hz	Approx. 10 s
> Approx. 2 MHz	0.1 Hz	Approx. 2.5 s
> Approx. 1 MHz	0.1 Hz	Approx. 1 to 2 s
> Approx. 100 kHz	0.01 Hz	Approx. 9 to 90 s
> Approx. 10 kHz	1 mHz	Approx. 9 to 90 s
> Approx. 1 kHz	1 mHz	Approx. 9 to 90 s
> Approx. 100 Hz	1 mHz	Approx. 9 to 90 s
> Approx. 10 Hz	1 mHz	Approx. 9 to 90 s

4-9-8. TG CNTR

[TG CNTR]

To activate the TG counter mode, press the [TG CNTR] key; the indicator lamp on the key will light.

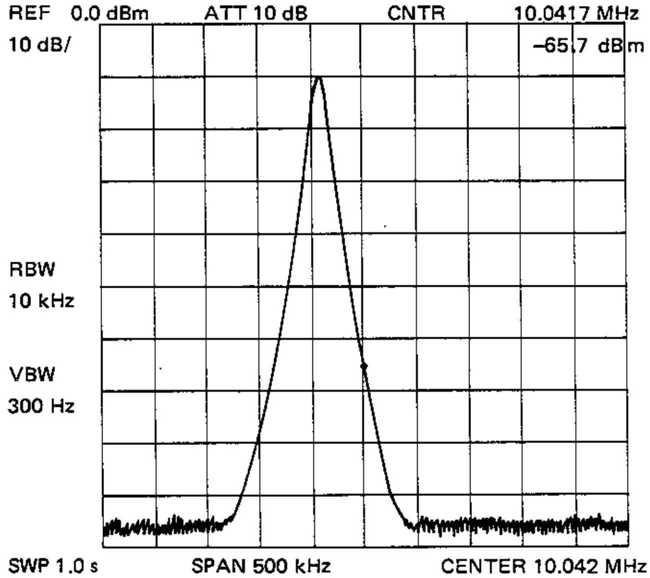
In the normal marker mode, marker frequency is calculated from the marker position along the frequency axis and the center frequency.

In TG counter mode, marker frequency is counted directly by a built-in counter.

The marker frequency is displayed as CNTR XXX Hz in the top right corner of the screen.

To return the analyzer to normal marker mode, press the TG CNTR key a second time; the indicator lamp on the key will go out.

TG CNTR



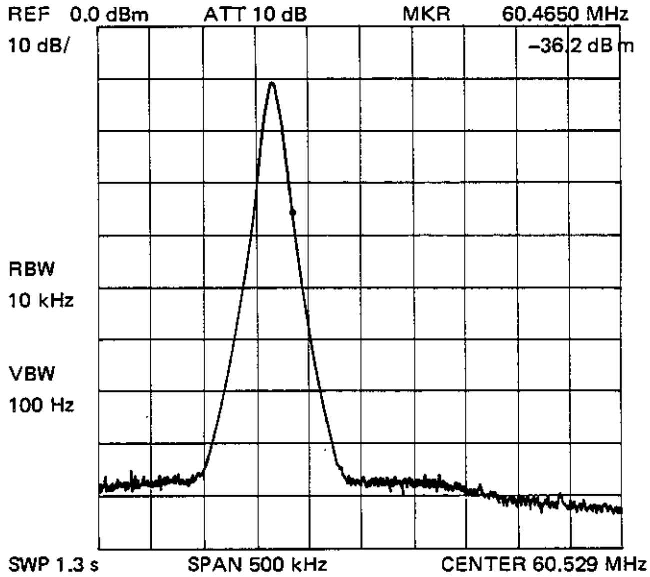
To change the resolution of the TG counter, press the SHIFT and CNTR RESOLN keys and set the resolution as described in Section 4-9-7.

4-9-9. SIGNAL TRACK

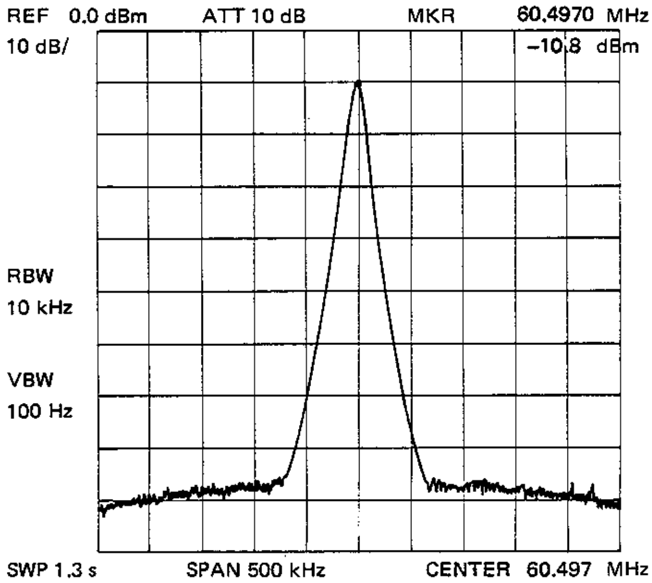
SIGNAL TRACK

When this key is pressed, the marker follows the signal on which it is positioned. The analyzer can automatically maintain a drifting signal at the center of the display.

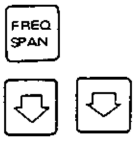
To operate signal tracking, press the SIGNAL TRACK key; the indicator lamp on the key will light to indicate that signal tracking mode is enabled. Pressing the SIGNAL TRACK key again turns off the key indicator lamp and returns the analyzer to the normal marker mode. Operation of any of the MKR, MKR OFF, Δ, or PEAK SRCH keys also clears the signal track mode, and also activates the corresponding mode.

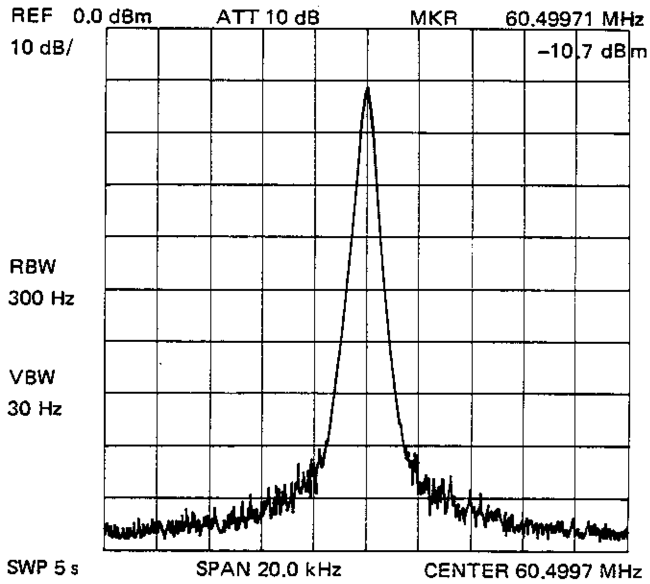


SIGNAL TRACK



A drifting signal can be zoomed in on by narrowing the frequency span.

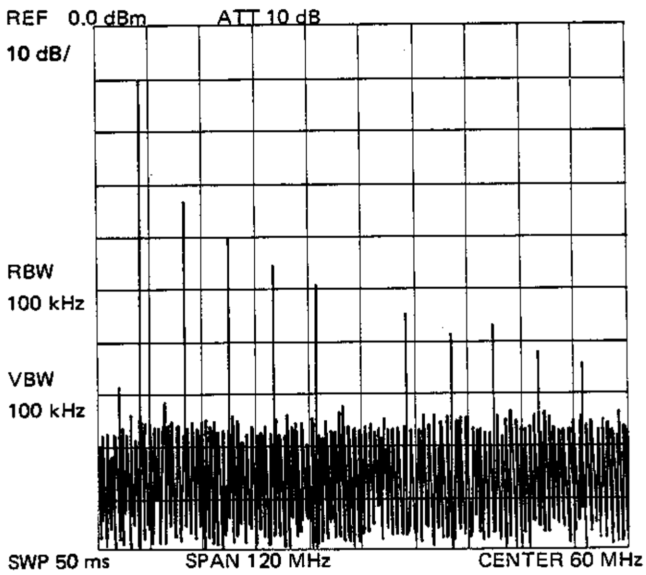


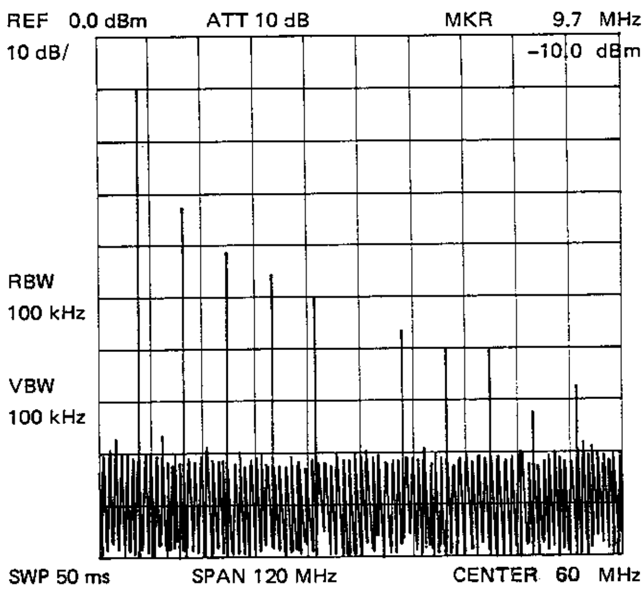


Instead of using the  key to narrow the frequency span, a desired frequency span can be directly input from the DATA keyboard. After the entry of a narrower frequency span through the DATA keyboard the TR4171 zooms in on the step-by-step, tracking the signal at the center of the display.
During this zooming in signal tracking mode, "AUTO ZOOM" is displayed in the active function area, and all the keys but the SIGNAL TRACK and MKR OFF keys are disabled until the zooming stops. To stop the auto zoom in signal tracking mode, use either of these two keys.

4-9-10. PEAK SRCH

Operation of the PEAK SRCH key places the marker at the peak of the maximum signal response.





(1) Auto peak search

When the [SHIFT] , [LABEL] and [PEAK SRCH] keys are pressed, the analyzer enters auto peak search mode in which the active marker keeps repeating a peak search in each sweep.

Pressing the MKR OFF key cancels the auto peak search mode and erases the marker.

(2) Negative peak search

When the [SHIFT] and [PEAK SRCH] keys are pressed, the analyzer enters negative peak search mode in which the active marker moves to the lowest part of the trace.

4-9-11. NEXT PEAK, XdB DOWN WIDTH

[NEXT PEAK]

Pressing the [NEXT PEAK] key when in marker mode puts the analyzer in XdB down width mode. Pressing the NEXT PEAK key when in delta marker mode puts the analyzer in next peak mode.

If the [NEXT PEAK] key is pressed with the markers off, next peak mode is enabled with delta markers displayed at the right and left ends of the displayed signal response trace.

If several traces are currently displayed, the trace with the highest priority becomes the object of next peak mode, according to the following priority:

Trace A > Trace B > Trace A' > Trace B'

(1) Next peak mode

In next peak mode, any segment of a signal response trace can be specified by delta markers and the maximum and minimum values in that segment can be detected.

Values are displayed in one of the following three sequences:

i) Local maximum and minimum values within the segment are displayed alternately from the left in the order in which they appear,

ii) Local maximum values within the segment are displayed in descending order, or

iii) Local minimum values within the segment are displayed in ascending order.

The operating procedure is given below.

① Set the analyzer to view mode and freeze the signal response trace.

② Specify the desired segment with delta markers.

③ Press the [NEXT PEAK] key to set next peak mode.
The following display will appear in the active function area in the center of the left part of the screen:

NEXT PEAK

'1' LOCAL MIN. MAX.

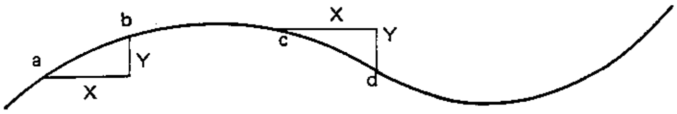
'2' LOCAL MAX.

'3' LOCAL MIN.

Press the numeric key corresponding to the desired operation.

④ If the [1] key is pressed, a marker is placed at the point of the leftmost peak between the delta markers, and the frequency and level at the marker are displayed. Press the [PEAK SRCH] key. The local maximum and minimum points between the delta markers will be displayed sequentially from the left each time the [PEAK SRCH] key is pressed.
The number of the displayed peak point is displayed concurrently in the active function area as "+N" or "-N".
If the [2] key is pressed, a marker is placed at the maximum peak between the delta markers, and the frequency and level at the marker are displayed. Press the [PEAK SRCH] key. The local maximum points between the delta markers will be displayed sequentially each time the [PEAK SRCH] key is pressed. The number of the displayed peak point is displayed concurrently in the active function area.
If the [3] key is pressed, a marker is placed at the minimum peak point between the delta markers, and the frequency and level at the marker are displayed. Press the [PEAK SRCH] key. The local minimum points between the delta markers will be displayed sequentially each time the [PEAK SRCH] key is pressed. The number of the displayed minimum point is displayed concurrently in the active function area.

⑤ With this program, to obtain a positive peak value, for example, a point a at which the slope of the signal trace is at least Y/X and a point d at which the slope of the signal trace is - Y/X or less are obtained, and the maximum value between the two points is obtained.



Therefore the sensitivity of peak detection can be varied by changing ΔX and ΔY. During execution in next peak mode, ΔX and ΔY can be changed as follows:
For example, pressing the [ ]X (AVG) , [3] , [0] , and [Hz/-dBm/usec] keys sets the value X=30 points, and pressing the [ ]Y (SEQ) , [2] , [0] , and [Hz/-dBm/usec] keys sets Y=20 points.
The number of points for ΔX and ΔY can be specified within the range from 1 to 255. ΔX and ΔY must be set before the selection in Step ④.
The initial value for X is 20 points and that for ΔY is 5 points when the resolution of the display is 1001 x 1001 points.

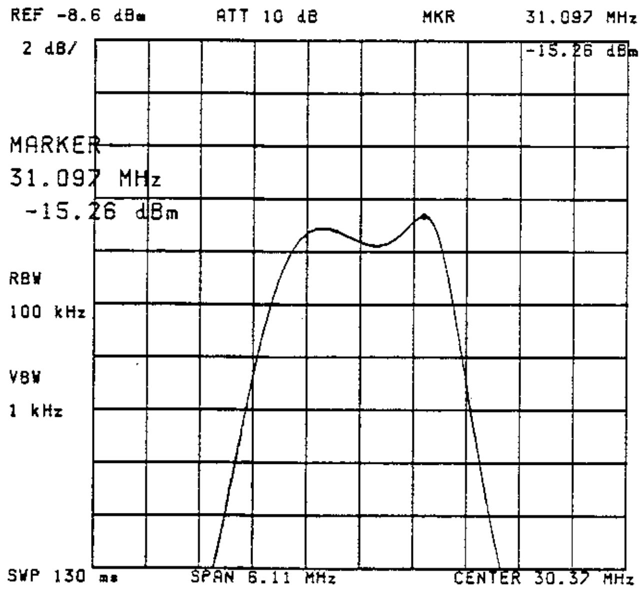
(2) XdB down width mode

In XdB down width mode, two markers are displayed X dB below the marker points set on a signal trace, and the difference in frequencies between the two markers and the differences in frequencies between those of the two markers and the center frequency are displayed. The frequency and level at the left marker are displayed in the marker display area in the top right corner of the display.
The operating procedure is given below.

① This mode can be used when the vertical graticules are set at LOG 10 dB/div. to LOG 1 dB/div.

② Set the analyzer in view mode and freeze the signal trace. Then set a normal marker at any peak on the screen.

[PEAK SRCH]

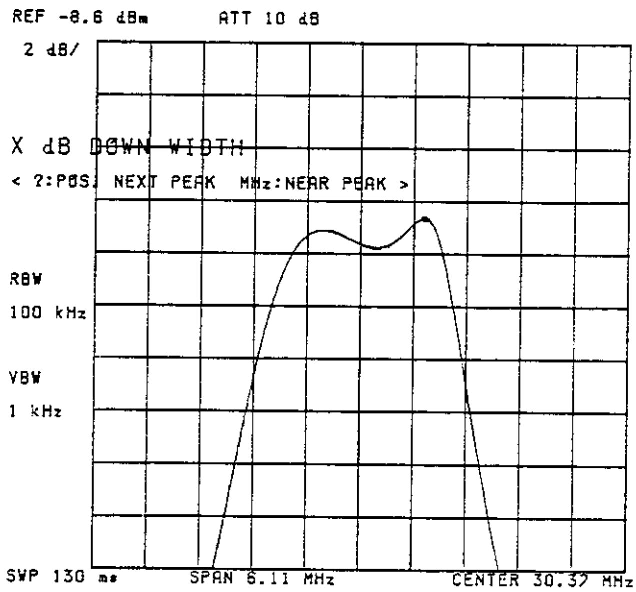


③ Press the [MKR] and [NEXT PEAK] keys to set the analyzer in XdB down width mode. The following message is displayed in the active function area in the center of the left part of the screen.

XdB DOWN WIDTH

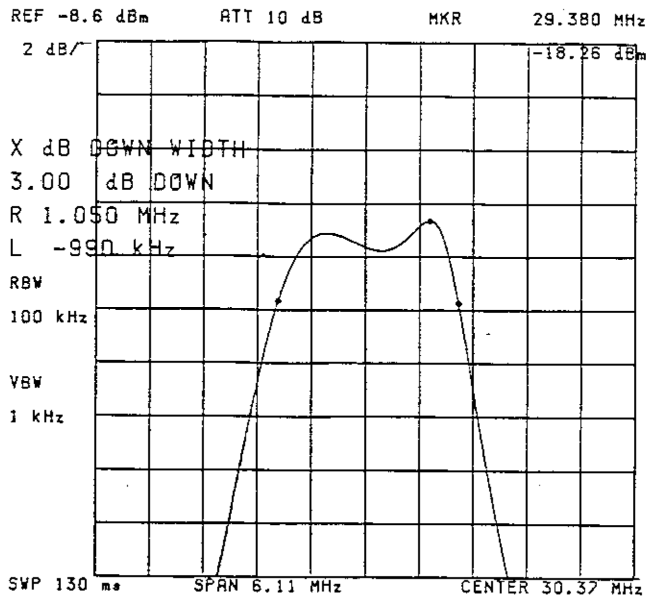
<?: POS. NEXT PEAK MHz: NEAR PEAK>

[NEXT PEAK]



(4) To execute the ordinary XdB down width mode, input the desired attenuation value with numeric keys.
If the [PEAK SRCH] switch is pressed instead of numeric keys, the operation enters the local max mode of the next peak. Then each pressing of the [PEAK SRCH] switch causes the display of maximal values between delta markers in descending order.
If [MHz dB sec] switch is pressed, the marker moves to the maximum point on the trace in the section starting from 50 points to the left of a marker point, set on the trace, to 50 points to the right of the marker point.

(5) After entering numeric data, press the [MHz dB sec] or [kHz +dBm msec] key.
Two markers will appear at points which are XdB below and to either side of the first marker set on the trace.
Concurrently, when the [MHz dB sec] key has been pressed, the difference between the frequencies of the right and left markers is displayed in the active area; and when the [kHz +dBm msec] key has been pressed, the differences between the center frequency and the frequencies of the left marker (suffix L) and the right marker (suffix R) are displayed.
The frequency and level at the left marker are displayed in the marker area in the top right corner of the display in both cases.
If the level XdB below the first marker is outside the trace, "ERROR" is displayed in the active function area.
In this case, reset starting from Step 4.



(6) The procedure from Step (4) onward can be repeated.

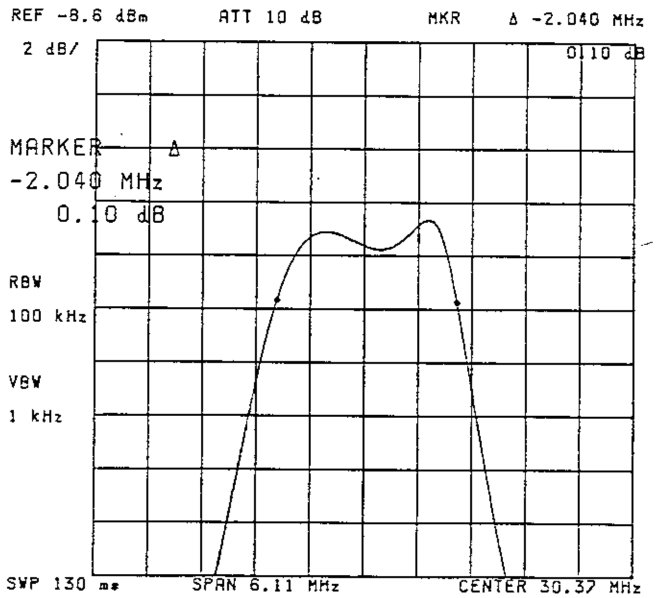
(3) Releasing next peak and XdB down width modes

When in next peak or XdB down width mode, function keys other than the [NEXT PEAK] key cannot be used. To change the setting conditions, follow the procedure below to release these modes. These modes can be released by one of the following three methods.

- Press the [MKR OFF] key to release these modes with the markers off.
- Press the [MKR] key to release these modes with the center marker active.
- Press the [J] key to release these modes with the right and left markers used as delta markers.

When next peak or XdB down width mode is released by pressing the [MKR] or [J] key, the measurement results obtained in that mode can be assigned to a normal marker, so that measurement results can be reallocated to a marker function such as MKR CF or MKR REF.

For example, to measure the ripple in filter, press the [PEAK SRCH], [NEXT PEAK], [3], [kHz +dBm msec], and [J] keys.



Measurement results are allocated to delta markers positioned at points 3 dB below the filter's minmum loss point, and XdB down width mode is released. When the [NEXT PEAK] key is pressed subsequently, next peak mode is enabled, and the local maximum and minimum peak points on the trace of the filter within the segment specified by the delta markers can be obtained.

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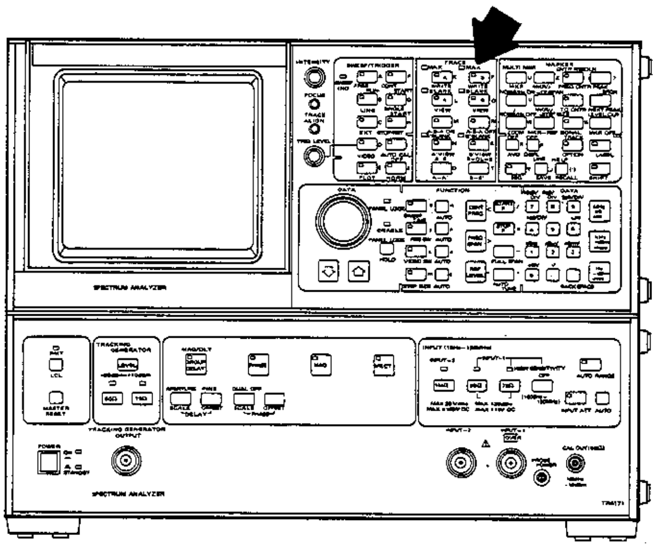
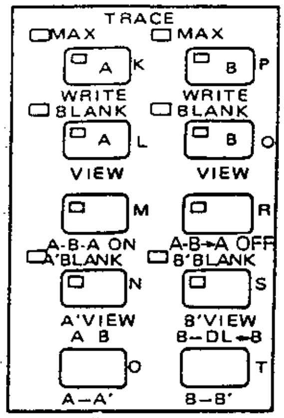
4-9-12. MKR OFF

Operation of the MKR OFF key erases all markers from the display.

4-10. TRACE



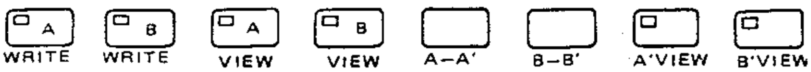


In trace mode, up to four different signal response traces can be converted into corresponding digital information and stored in internal trace memories, and any of these traces can then be transferred to the CRT display.

The trace memory consists of memories A, A', B, and B'. Memories A' and B' are auxiliary to memories A and B, respectively. This section describes the basic operating procedures in trace mode, and Section 4-10-2 presents an example of a simultaneous four-trace display.

4-10-1. Basic Operating Procedures in Trace Mode

(1) WRITE and VIEW



The WRITE and VIEW keys are provided for each of memories A and B.

When a WRITE key is pressed, the analyzer signal response is written into the corresponding trace memory during the sweep, and the memory contents are displayed on the CRT.

As a result, the signal response trace on the CRT varies with sweep rate.

When a VIEW key is pressed, no updating of the trace memory is made, and the result of the latest sweep is saved and displayed on the CRT.

WRITE mode can not be selected for both memory A and memory B at the same time.

Memories A' and B' only have VIEW keys, they do not have WRITE keys. The A → A' and B → B' keys are used to write information into memories A' and B', respectively.

a. A WRITE

When the A WRITE key is pressed, the analyzer signal response is written into trace memory A during ach sweep, and the memory contents are displayed on the CRT. The indicator lamp on the A WRITE key lights to indicate A WRITE mode. When the analyzer is switched on or the MASTER RESET key is pressed, the analyzer is automatically placed in A WRITE mode.

b. A VIEW

If the A VIEW key is pressd when in A WRITE mode, updating of trace memory A is no longer done, and the current memory data remains displayed on the CRT.

If the A VIEW key is pressed when in A BLANK mode (described later), the contents of trace memory A are recalled to the CRT.

c. B WRITE

When the B WRITE key is pressed, the analyzer signal response is written into trace memory B during each sweep, and the memory contents are displayed on the CRT. The indicator lamp on the B WRITE key lights to indicate B WRITE mode. WRITE mode cannot be selected for both memory A and memory B at the same time. The memory whose WRITE key has been pressed most recently is placed in WRITE mode. If the B WRITE key is pressed when in A WRITE mode, memory A is automatically placed in A VIEW mode and memory B is placed in B WRITE mode. In this case, the active contents of memory B are overlapped on the stationary trace of memory A.

d. B VIEW

If the B VIEW key is pressed when in B WRITE mode, updating of trace memory B is no longer done, and the current memory data remains displayed on the CRT.

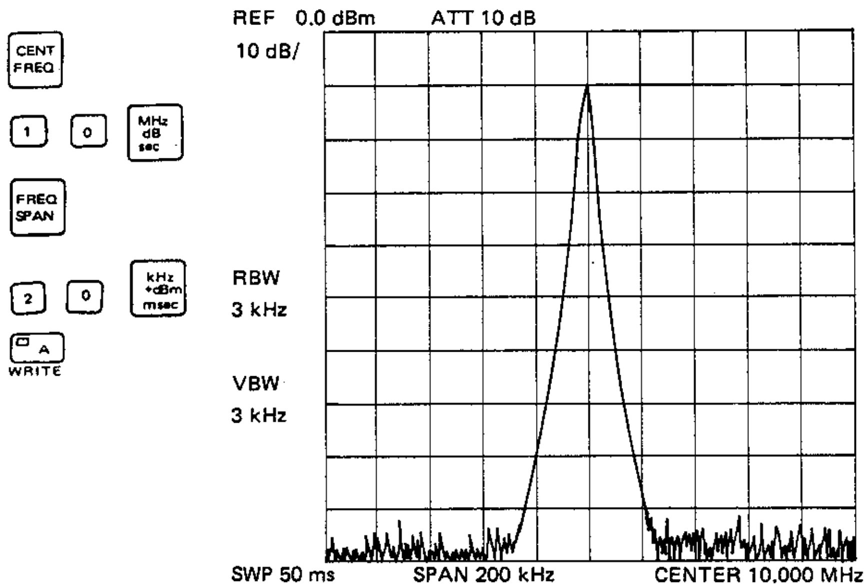
- Example of WRITE and VIEW mode usage

  A simple example of WRITE and VIEW mode usage using the CAL. OUT. signal is given below.

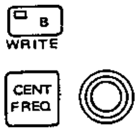
  Press the AC key for INPUT-1. Connect the CAL. OUT. connector to the INPUT-1 connector with the supplied input cable A01036-1500.

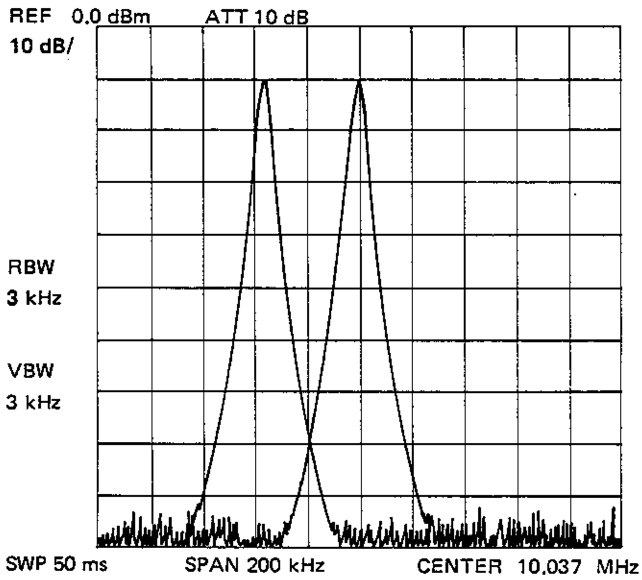
  Set the CENT. FREQ. to 10 MHz and FREQ. SPAN to 10 MHz.

  If the analyzer is not in A WRITE mode, press the A WRITE key.

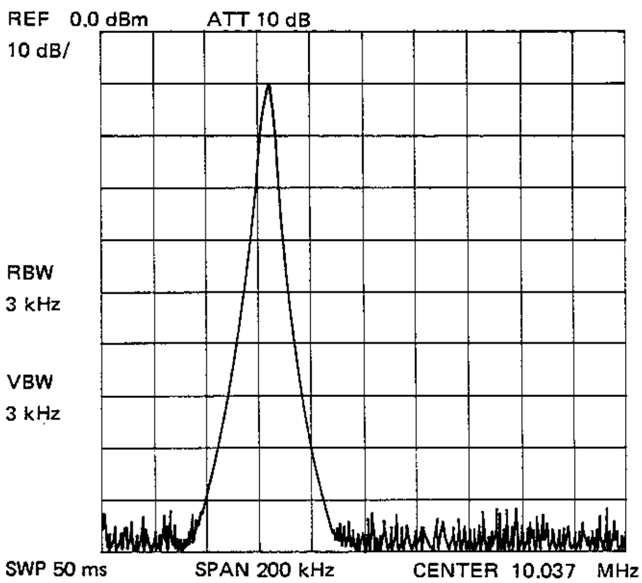


Then press the B WRITE key. Trace memory B is placed in WRITE mode and memory A is placed in VIEW mode with trace of memory A frozen. Press the CENT FREQ. key and adjust with the DATA knob. The active trace B can now be observed together with the inactive trace A.





Press the A WRITE key again to select A WRITE and B VIEW mode. Trace A, which had been frozen at the center of the display, will now overlap the frozen trace B.



e. B → B', A → A', A' VIEW, B' VIEW

These keys are used to transfer the contents of memory B to memory B', or those of memory A to memory A'.
Pressing the [B'VIEW] and [B→B'] keys transfers the contents of memory B to memory B'. Each trace is generated from 1001 points along the frequency axis. The 500 odd-numbered points out of the 1001 points of trace B are written into memory B'. The 501 even-numbered points remain in memory B.
Pressing the [A'VIEW] , [A→A'] keys stores the contents of memory A in memory A'. The 500 odd-numbered points out of the 1001 points of trace A are transferred to memory A', and the 501 even-numbered points of trace A remain in memory A.
Always press the A' VIEW or B' VIEW key before pressing the [A→A'] or [B→B'] key.

(2) MAX.

In MAX. mode the maximum signal response is held and displayed. At the end of each sweep, the new data is compared with the old data in the memory at each of the 1001 points, and the larger signal response is stored in the memory.
Operation of the [SHIFT] and [A / MAX] keys selects A MAX. mode; the MAX. indicator lamp lights.
Operation of the [SHIFT] and [B / MAX] keys selects B MAX. mode; the MAX. indicator lamp lights.
MAX. mode can be cleared by pressing the WRITE, VIEW or BLANK key for the relevant memory.

(3) BLANK

[A / BLANK] [B / BLANK] [A'BLANK] [B'BLANK]

Unwanted traces can be blanked from the CRT by using the BLANK keys.
To blank trace A from the CRT display, press the [SHIFT] and [A / BLANK] keys to place memory A in BLANK mode. The BLANK indicator lamp will light.
Since traces are blanked but the contents of the memory are saved when in BLANK mode, they can be recalled to the CRT screen by pressing the VIEW key. BLANK mode can be selected for memories B, A', and B' in a similar way.

If the BLANK key is pressed when in WRITE mode, updating of the memory is no longer made, and the current memory data is saved but is blanked from the CRT screen.
If the BLANK key is pressed when in VIEW mode, a frozen trace is blanked from the CRT screen and is saved in memory.
BLANK mode can be cleared by pressing the VIEW, WRITE or MAX. key.
If the A VIEW key is pressed when in A BLANK mode, the saved trace is recalled to screen CRT. This procedure can be applied to memories B, A', and B' as well.
If the A WRITE key is pressed when in A BLANK mode, the analyzer is placed in A WRITE mode, the saved memory data is erased from memory A, and the signal response is written into the memory at the sweep rate and is displayed on the CRT (the same applies for memory B).
As mentioned earlier, when A' VIEW mode is selected by pressing the [A'VIEW] and [A→A'] keys, only the 500 even-numbered points (out of 1001 points) of trace A are transferred to the CRT screen. To display the full 1001 points of trace A again, press the [SHIFT] and [A'BLANK] keys to blank trace A' from the CRT screen, then press the A WRITE key.

(4) Trace exchange

Pressing the [SHIFT] and [A⇄B] keys exchanges the contents of trace memories A and B. The contents of memories A' and B' are also exchanged at the same time.

(5) Trace subtraction

a. A-B→A [A-B-A ON]

Pressing the A-B→A ON key subtracts the contents of memory B from those of memory A or trace A and stores the result in memory A.
If this key is pressed when in A WRITE mode, the contents of memory B are subtracted from trace A in each sweep, and the result is displayed. The indicator lamp on the key lights to indicate A-B→A mode.

If this key is pressed when in A VIEW mode, the contents of memory B are subtracted from the frozen trace A, and the result is written into memory A and is displayed on the CRT screen. The indicator lamp on this key lights momentarily, and memory A remains in A VIEW mode.

If the A-B→A key is pressed in B WRITE mode, memory B is placed in A VIEW mode, the contents of memory B are subtraced from those of memory A, and the result is written into memory A. During this time, if memory A is in A VIEW mode, the result is displayed and memory A remains in A VIEW mode. If memory A is in A BLANK mode, the result is written into memory A but memory A remains in BLANK mode, the result is not displayed on the CRT screen. The indicator lamp on this key lights momentarily in either case.

Pressing the [A WRITE] and [A-B-A ON] keys selects A-B→A mode, and pressing the [A-B-A OFF] key clears A-B→A mode to return the analyzer to the normal A WRITE mode.

b. B-DL→B [B-DL-B]

First place memory B in B VIEW mode.

Then press the [SHIFT] and [B-DL-B] keys. The display line level (described later) is subtracted from the contents of memory B (levels at each point).

Pressing the [SHIFT] and [B-DL-B] keys when in B WRITE mode puts memory B in B VIEW mode.

(6) Markers on memories A, B, A' and B'

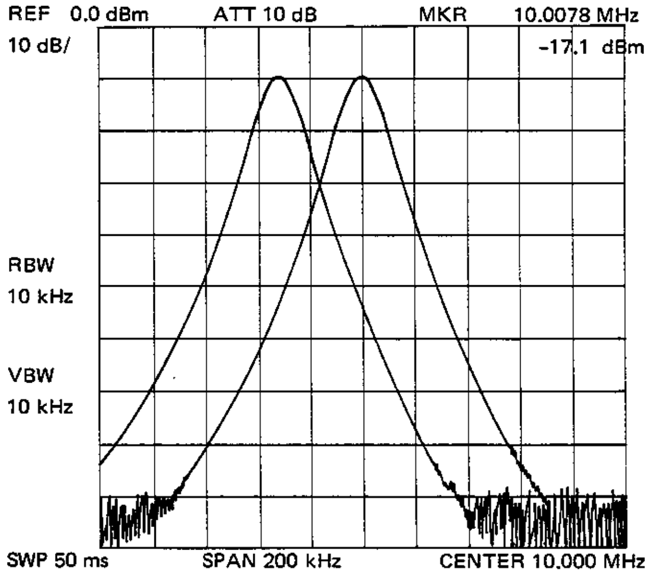
If the WRITE or VIEW key for memory A or B or the VIEW key for memory A' or B' is pressed when an active marker is currently on the CRT screen, the marker is repositioned to the memory corresponding to the pressed key. The marker position on the frequency axis remains unchanged. Inactive markers remain in their home memories when these keys are operated.

If one of memories A, B, A' or B' is placed in BLANK mode, the marker for that memory is also blanked from the CRT screen.

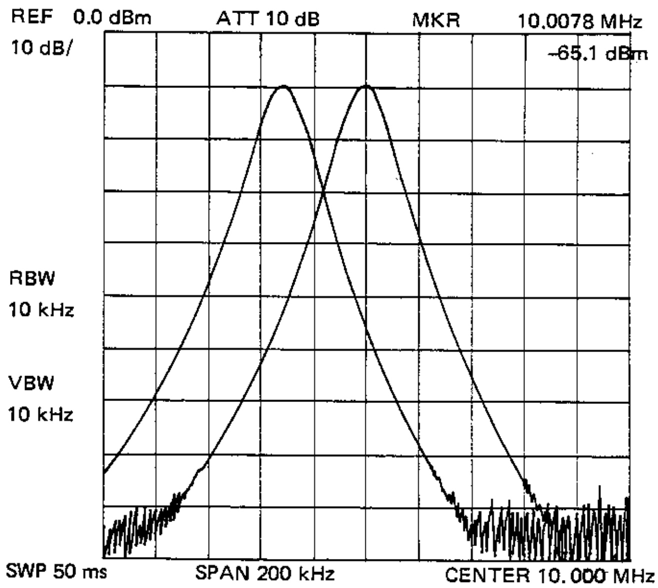
Marker repositioning is described below.

- Memory trace A (right) and memory trace B (left) are currently on the display.

Memories A and B have been placed in A WRITE and B VIEW modes, respectively, and an active marker is on memory trace A.



If the B VIEW key is pressed, the active marker is repositioned on trace B.



Turning the DATA knob moves the marker along the stationary trace B.

If the A WRITE key is pressed, the marker is again repositioned on trace A.

By utilizing this characteristic, differences in frequency and level between two traces can be read with delta markers. The procedure is described below.

First activate a marker on a trace and position it at the desired position, then press the [ ] key. Press a trace key (e.g. the [B] VIEW key) to reposition the active marker on the other trace, then move it to the desired position on that trace. The differences in frequency and level between the two traces will not be read out.

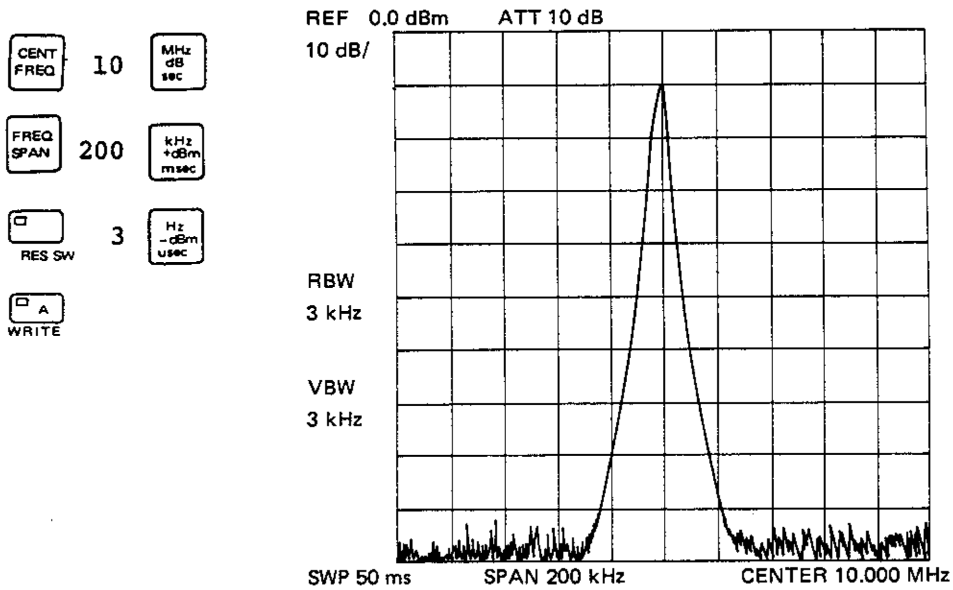
Note, however, that these frequency and level differences are calculated from the setup conditions (frequency span, dB/div., etc.) currently shown on the display.

4-10-2. Simultaneous Four-trace Display

An example of a simultaneous four-trace display using the 10 MHz calibration signal is given below.

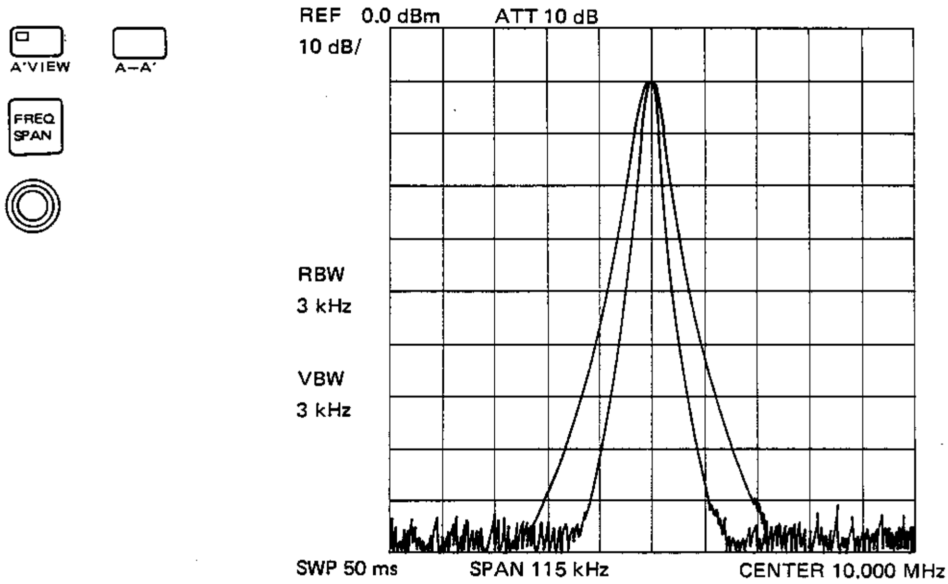
(1) Connect the CAL. OUT. connector to the INPUT-1 connector with input cable A01036-1500.

(2) Set the center frequency to 10 MHz, the calibration signal will appear at the center of the display.
Set SPAN to 10 MHz and RES BW to 100 kHz. Press the A WRITE key.

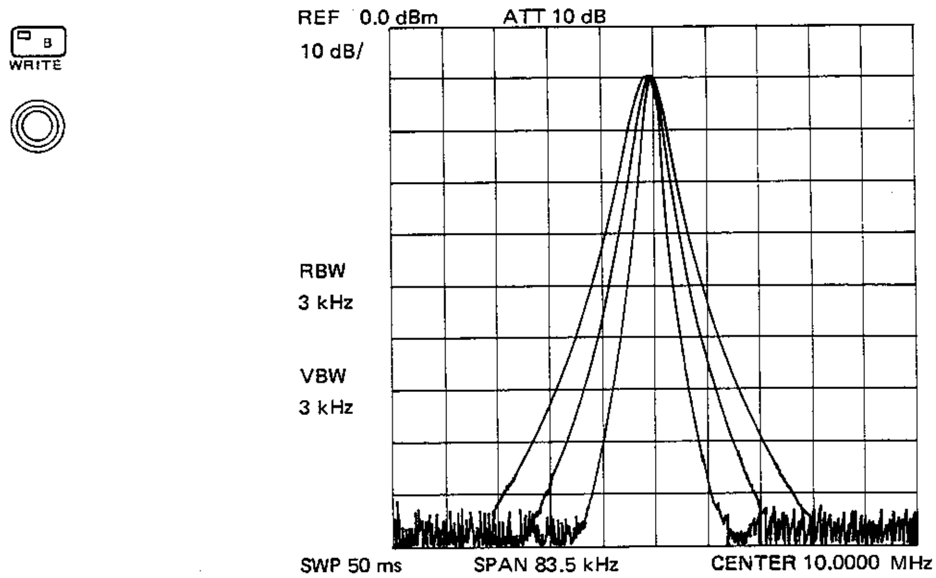


(3) Press the [A'VIEW] and [A–A'] keys, the contents of memory A will be transfered to memory A'. Traces A and A' cannot be discriminated from each other yet since the contents of memories A and A' are identical.

(4) Press the FREQ. SPAN key and then turn the DATA knob slightly counterclockwise to expand the trace.
Active trace A can now be discriminated from frozen trace A' on the display.

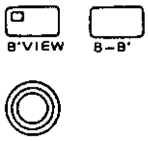


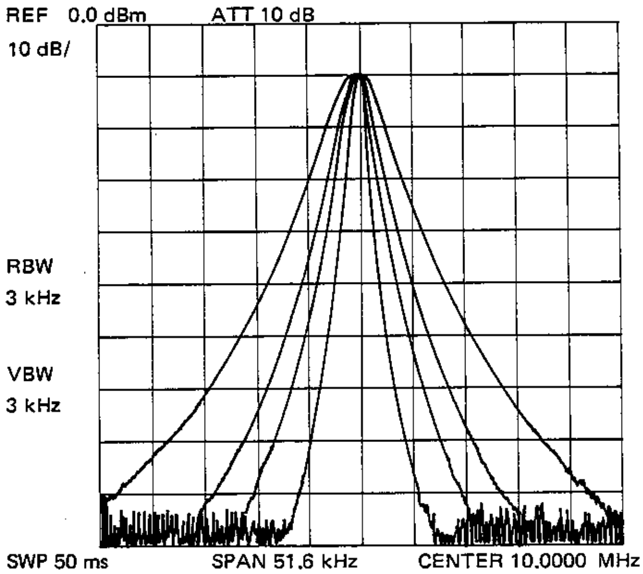
(5) Press the B WRITE key. Memory A will be automatically placed in A VIEW mode and trace A frozen. Memory B can now be updated. Turn the DATA knob to expand trace B. Now three traces, B, A, and A', are displayed.



(6) Press the [B'VIEW] and [B–B'] keys to transfer the contents of memory B to memory B'. Trace B cannot be discriminated from trace B' yet since the contents of memories B and B' are identical.

(7) Turn the DATA knob slightly counterclockwise to discriminate trace B' from trace B. Now four traces are displayed on the CRT screen at the same time.





(8) Use the BLANK keys to blank unwanted traces from the display:

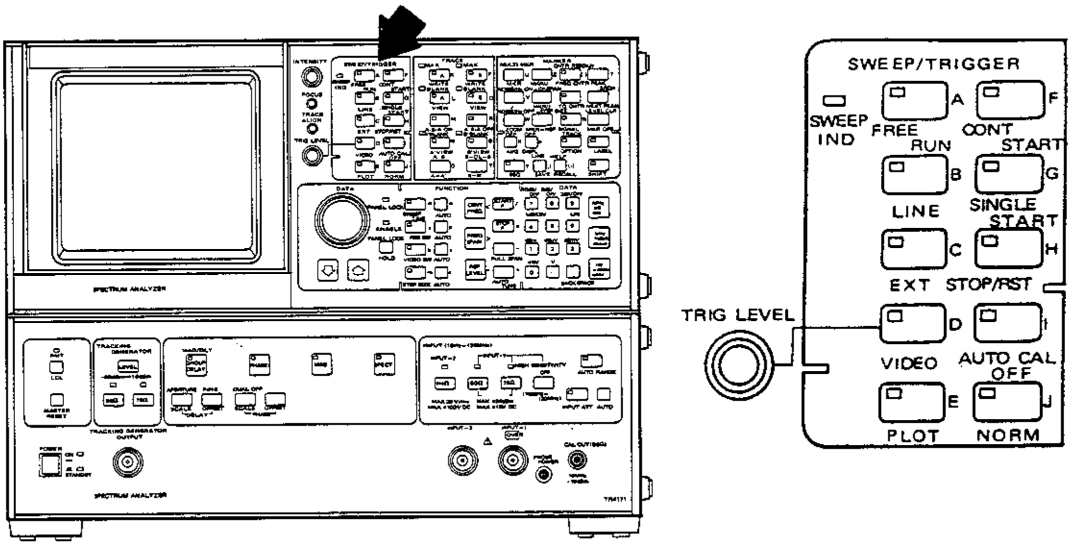
Pressing the [SHIFT] and [B'BLANK] keys blanks trace B'.

Pressing the [SHIFT] and [A / BLANK] keys blanks trace A.

Pressing the [SHIFT] and [A'BLANK] keys blanks trace A'.

To recall a blanked trace to the CRT screen, press a VIEW key (e.g, the [B'VIEW] key).

4-11. TRIGGER, SWEEP



The analyzer sweep is triggered by selection of one of the following four keys.

4-11-1. TRIGGER

(1) FREE RUN 

Pressing the FREE RUN key enables automatic repeat of internal triggering.

(2) LINE 

Pressing the LINE key enables repeated triggering in synchronism with the line frequency phase.

(3) EXT. 

Pressing the EXT. key enables the next sweep to start in synchronism with an external (TTL-compatible) trigger signal supplied to the EXT. TRIG. connector on the rear panel. Triggering occurs at each high-to-low transition of the external signal.

(4) VIDEO

Pressing the VIDEO key enables the next sweep to start if the detected IF envelope voltage rises to a level set by the TRIG. LEVEL knob.

The trigger level for video signal response traces can be changed by turning the TRIG. LEVEL knob.
If the trigger fails after the VIDEO key has been pressed, adjust by turning the TRIG. LEVEL knob.

(5) Trigger mode selection
Select one of the above four trigger modes. The indicator lamp on the selected key will light. The trigger mode should be set to FREE RUN normally.

4-11-2. SWEEP

The following keys are used to select sweep mode.

(1) CONT START

Pressing the COUNT START key after the STOP/RST key (described in (3) below) selects a mode in which sweep is repeated continuously.
Press the 

and 

keys or the 

, 

, and 

keys.

(2) SINGLE START

Pressing the SINGLE START key selects a single-sweep mode. A single sweep is executed each time this key is pressed.

(3) STOP/RST

Pressing the STOP/RST key stops the sweep.
If the COUNT START or SINGLE START key is pressed after the STOP/RST key has been pressed once, the sweep restarts from the position at which the STOP/RST key was pressed.
If the COUNT START or SINGLE START key is pressed after the STOP/RST switch has been pressed twice, sweep restarts from the left side of the display.

To enable a check on whether the STOP/RST key has been pressed once or twice:

Once : The SWEEP IND indicator lamp lights.

Twice: The SWEEP IND indicator lamp goes out.

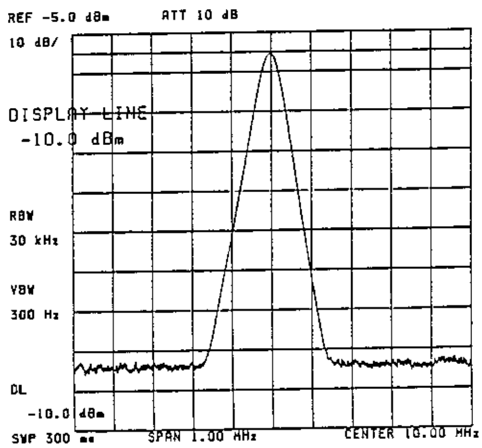
This STOP/RST key is effective when used to stop the sweep when a comparative long sweep time is set.
If the [SHIFT], [LABEL], and [SWEEP TIME] keys are pressed, the sweep can be reset in mid-sweep. In the sweep mode initiated by the COUNT START key, however, the sweep automatically restarts from the left side of the display.

4-12. DISPL LINE

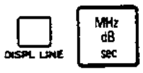
[DISPL LINE]

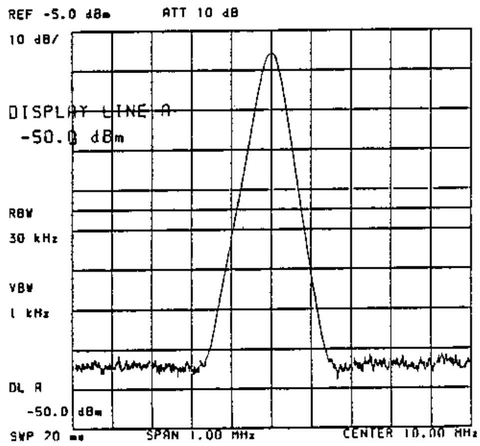
Pressing [DISPL LINE] key activates the display line (horizontal cursor line) on the display.
The display line can be positioned anywhere within the screen by the DATA knob or DATA step keys. The display line level is displayed enlarged on the left side of the CRT as "DISPLAY LINE XX dBm". The same information is always presented in the bottom left corner of the display as "DL XX dBm". The peak level of a signal response trace can be easily read out by positioning the display line at that peak level.
The DATA step keys move the display line one tenth of the vertical scale per step.
The DATA knob moves the line smoothly for finer control.

[DISPL LINE]



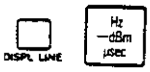
Lines A, B and Δ can be set as the display lines in addition to the normal display line. Pressing the [DISPL LINE] [MHz dB sec] keys activates the normal display line and displays line A on the display, by changing the previous display into DISPLAY LINE A, DL A. (Display line B is dimmed when it is previously displayed.)

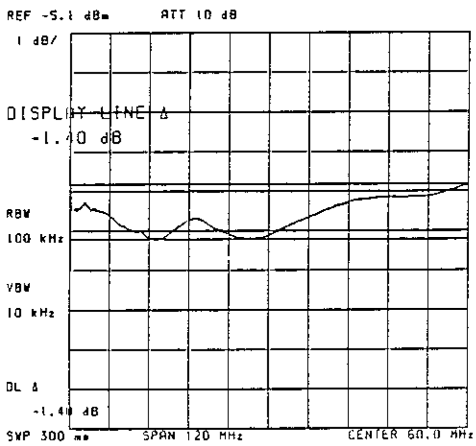




Pressing [DISPL LINE] [kHz +dBm msec] erases the normal display line and displays line Δ and activates display line B on the display, by changing the previous display into DISPLAY LINE B, DL B. (Display line A is dimmed when it is previously displayed.)

Pressing [DISPL LINE] [Hz −dBm μsec] activates display line Δ , while the currently-shown display line remains unchanged, by changing the previous display into DISPLAY LINE Δ xxdB, DL Δ xxdB. Display line Δ indicates the displacement between itself and the display line which was active immediately before it.





Display lines A, B and can be moved up and down in a similar manner as with the normal display line. Pressing [SHIFT] [DISPL LINE] erases all of the display lines and the accompanied numerical display. When [DISPL LINE] is pressed, the normal display line will reappear at the same position where it was last located.

If a marker other than the delta marker is specified when any display line is activated on the display, the displacement from that active line is displayed (unit is changed from dBm to dB).

4-13. LABEL

[LABEL]

Pressing [LABEL] key selects label entry mode; the indicator lamp above the [LABEL] key lights, a cursor (-) appears on the CRT, and the front panel keys have functions different from those in normal mode.

Label mode enables the entry of optional alphanumeric characters in the top area of the CRT screen.

The green letters printed beside each key are entered in this mode. Up to 54 characters can be entered per line.

The DATA keyboard can be used for the entry of numerics.

A space can be created between characters by pressing the [HOLD] key in the DATA section.

If an input error is made, press the BACK SPACE key on the DATA keyboard. The last character will be erased and the cursor will backspace one character.

When entry of a label is completed, press the LABEL key. This clears the label mode and returns the front panel keys to their normal functions; the indicator lamp above the LABEL key will go out. An entered label can be edited by partial deletion or insertion. For label editing, place the analyzer in label mode by pressing the LABEL key. The cursor position can be controlled horizontally with the DATA knob. To delete a label character, position the cursor at that character with the DATA knob and then press the DATA step down ([⇩]) key once.

To insert characters use the DATA knob to position the cursor at the character at which the insertion begins, and then press the DATA step up key ([⇧]). A space of five consecutive character locations will appear at the cursor position. Each time a character is inserted into this space, the five character space moves one character to the right. When insertion is complete, press the DATA step up key ([⇧]) again. A character at the cursor poition can be overwritten. The old character at the cursor position is overwritten with a new character. A character string entered in label mode can be cleared by pressing the [SHIFT] and [LEVEL CLR] keys.
It is also cleared when the MASTER RESET key is pressed or the device is switched to STANDBY.

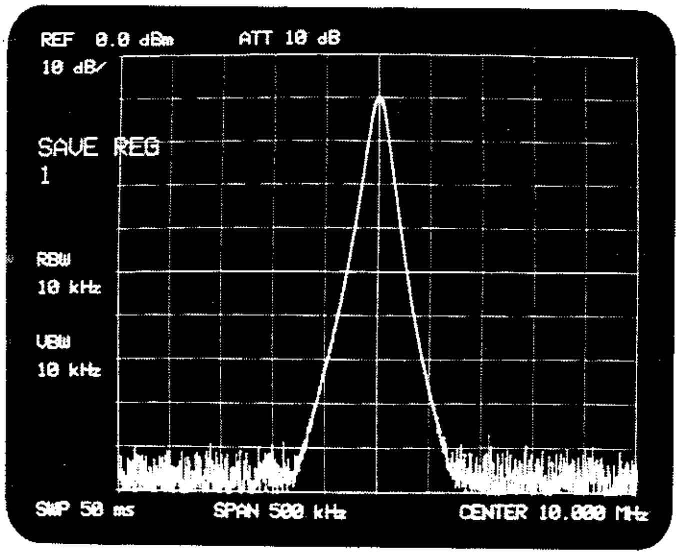
4-14. SAVE AND RECALL

[SAVE] [RECALL]

A maximum of 8 key statuses can be saved in internal registers and recalled as needed. To save the current key status press the [SAVE] key, then press a numeric key between 1 and 8. The key status is saved in the register with the corresponding number. The saved key status can be recalled by pressing [RECALL] and then the numeric key corresponding to the register holding the key status. The current key status is replaced with the saved key status.
The register contents remain intact even when the POWER switch is set to STANDBY.
If the power cables of the analyzer are unplugged from the outlets, the internal back-up battery maintains the register contents for about two weeks.
A label (character string entered in the top area of the CRT screen) cannot be saved, nor can markers, traces, signal responses, or the display line.

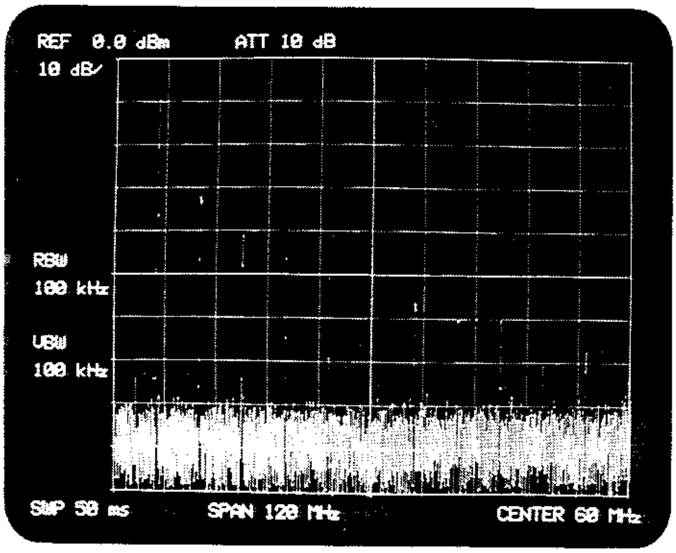
(This page has been intentionally left blank.)

SAVE · 1

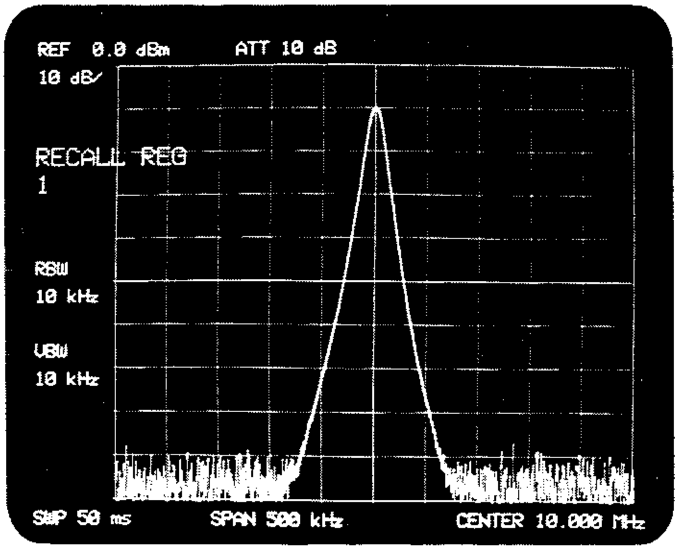


In the above example, the specified values such as the center frequency, frequency span, reference level, etc., are saved in register 1. When after the MASTER RESET key has been pressed or the power turned off, these values can be reset if register 1 is recalled.

MASTER RESET



[RECALL] [1]



Save registers 0 and 9 are also available as well as registers 1 through 8. However, the contents of save registers 0 and 9 may be changed when the MASTER RESET key is pressed, the power is turned off, autocalibration is executed, or an optional function is executed.

4-15. SEQ

[SEQ]

In SEQ (sequence) mode, measurement is done by recalling the specified conditions with the save panel keys in a specific sequence for each scan. Before setting the analyzer to this mode, save the necessary conditions in save registers 1 through 8.

When the [SHIFT] and [SEQ] keys are pressed, SEQUENCE is displayed in the active function area. Enter a sequence of save register numbers through the Data keyboard, and finally press the [Hz/-dBm/usec] key. This sets a register sequence.

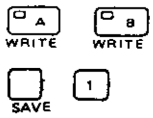
When the [SEQ] key is pressed, the LED on the key lights and the SAVE register contents are recalled in the specified sequence for each scan. The same sequence is executed repeatedly.

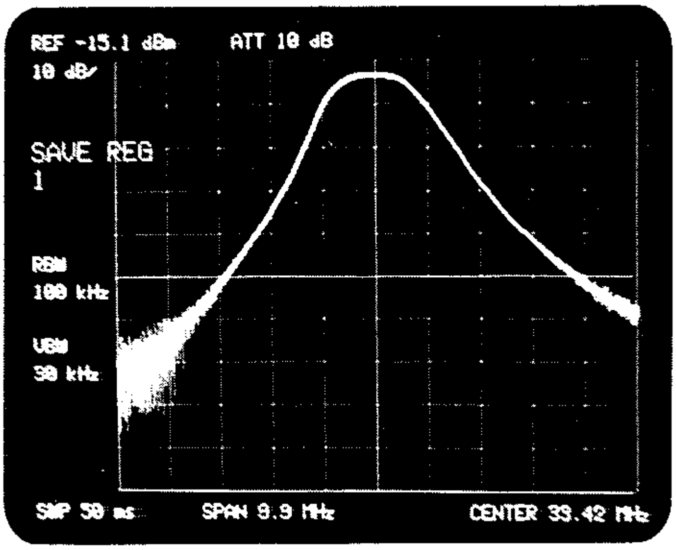
During execution in sequence mode, the ordinary panel keys, except for the [SEQ] key, are disabled. When the [SEQ] key is pressed, normal measurement mode returns. During this time, GPIB control is disabled.

The following example illustrates alternate measurements executed according to two independent sets of conditions, with the results displayed on the screen simultaneously. The vertical scale of the display is both 10 dB/DIV. and 2 dB/DIV.

① Set WRITE A, VIEW B mode by pressing the [B] (VIEW) during initialization, and specify the first measurement condition. The vertical scale is set to 10 dB/DIV. during initialization. Set the center frequency and the frequency span.

② Press the [ ] (SAVE) and [1] keys to save these conditions in save register 1.

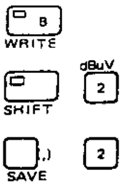


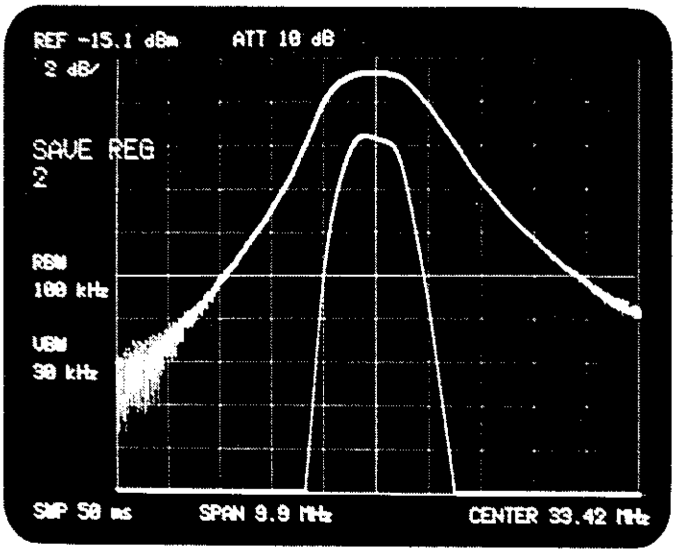


③ Press the [B] (VIEW) key to return the display to WRITE B, VIEW A mode. Press the [ ] (SHIFT) and [9] (2dB/DIV) keys to change the vertical scale to 2 dB/DIV.

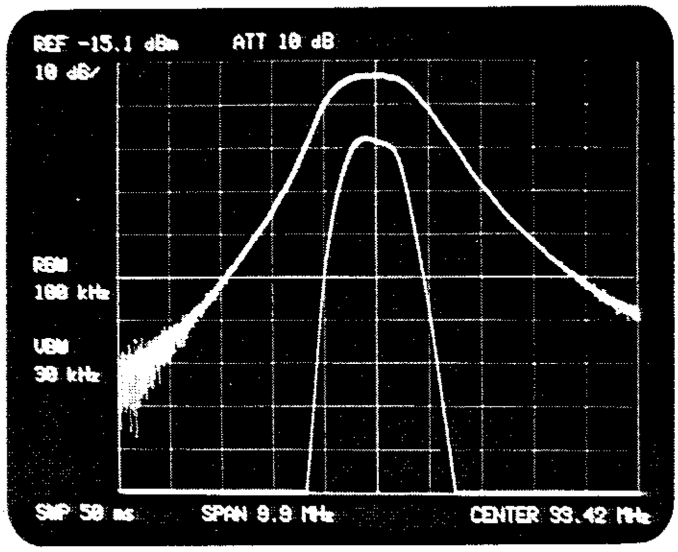
④ Other conditions can be changed, but CENT.FREQ. and FREQ.SPAN must not be changed.

⑤ Press the [ ] (SAVE) and [2] keys to enter the second measurement conditions into save register 2.





⑥ Press the [SEQ] key to return the display to sequence mode, of save register 1 and [A WRITE] of save register 2 will be [B WRITE] alternately recalled in each scan, and displayed simultaneously. Character data (such as 10 dB/) displayed on the screen gives the conditions stored in the registers which are currently being scanned. 10 dB/ of register 1 and 2 dB/ of register 2 are alternately displayed.
If the scan time is reduced, the measurement conditions will change rapidly and the characters on the screen will be hard to read.
Pressing any key releases sequence mode.



4-16. AVERAGING (AVG), AVG OFF

OFF
[ ]
AVG

In averaging mode, signal response data is averaged while it is weighted in the time domain. Averaged data is added to new data under a certain weighting according to a preset number (N). Averaging is effective only in WRITE A mode.

Averaging mode enables a good signal-to-noise ratio with a shorter sweep time than that required when using a video filter to remove noise.

The averaging of each amplitude point on the frequency axis is given by the following equation:

$$\overline{y}n = \frac{n-1}{n}\,\overline{y}n - 1 + \frac{1}{n}\,yn \qquad (n \leqq N)$$

where yn: nth data item

$\overline{y}n$: nth averaged data item

$\overline{y}n$: 1: (n - 1)th averaged data item

To activate averaging, press the [AVG] key; averaging will be started immediately.

The current averaging number is read displayed in the top left corner of the screen as "AVR XX", and the programmed number of averagings is displayed enlarged in the active function display area. (These disappear when another function key is pressed.)

When the programmed number of averagings (N) is reached, $\frac{n-1}{n}$ and $\frac{1}{n}$ in the above equation are fixed to $\frac{N-1}{N}$ and $\frac{1}{N}$, respectively.

Averaging for n > N is performed according to the following equation (but the current averaging number displayed stops at n = N):

$$\overline{y}n = \frac{N-1}{N}\,\overline{y}n - 1 + \frac{1}{N}\,yn$$

When the analyzer is first switched on (POWER key at ON), the number of averagings is preset at 128. To change this number, enter the desired number (64, for instance) through the DATA keyboard, and then press one of the units keys. This technique enables the setting of up to 4096 averagings. The averaging sequence stops temporarily, and then restarts.

To disable averaging press the [SHIFT] and [AVG] keys.
Do not change the analyzer's settings such as center frequency or frequency span when in averaging mode. To change those settings, first stop the averaging, change the function settings, then restart the averaging.

4-17. NORM, (NORM) OFF

OFF
[NORM]

This key is used to calibrate the frequency characteristics of the measurement system (e.g., the analyzer and cables) when the amplitude, phase, and group delay of an amplifier, filter etc., are being measured. For further details, see Section 5, Section 6, and Section 7.

4-18. AUTO CAL

[AUTO CAL]

Since the auto calibration routine can provide a calibration factor in advance, it enables an improvement in the accuracy of measurements by correcting results during operation.
The autocalibration routine measures the following items, when the reference signal for the measurements is 10.0 MHz and the output of the internal reference oscillator is -10 dBm $\pm$0.3 dB. Level calibration is done only at the single point, 10 MHz, and TG tracking error calibration is done only for a range of about $\pm$60 Hz.

a. Calibration-shortened
  - Switching error of IF filter for a resolution bandwidth of 100 Hz to 10 kHz, center frequency deviation of filter, and TG tracking error.
  - Linearity of vertical axis if screen for LOG 10 dB/DIV. and 1 dB/DIV.
  - Switching error in 0 to 50 dB for IF 10 dB STEP AMP.

b. Calibration-all
  - Switching error of IF filter for a resolution bandwidth of 3 Hz to 100 kHz, center frequency deviation of filter, and TG tracking error.
  - Linearity of vertical axis of screen for LOG 10 dB/DIV., 5 dB/DIV., 2 dB/DIV., and 1 dB/DIV., and switching error.

- Level error when in linear mode.
- Level error when in high sensitivity mode.
- Switching error of IF and LOG 10 dB STEP AMP.

Since the memories holding the calibration factors are backed up, if factors had been stored previously, these are used when calibration mode is set at initialization. If so, the LED lamp on the [AUTO CAL] key will light.

When the LED is off or when the previous factors cannot be used, new factors are automatically measured by the auto calibration routine according to the following procedure. If the LED is off, it shows that no calibration is provided.

(1) Press the [AUTO CAL] key. The following will be displayed on the screen.

```
AUTO CAL.
'1'  EXECUTE AUTO CAL. ROUTINE
'2'  USE AUTO CAL. FACTORS
'3'  DO NOT USE AUTO CAL. FACTORS
'0'  QUIT
```

Press the numeric key corresponding to the desired operation.

(2) Press the [0] key to return the analyzer to its state before the [AUTO CAL] key was pressed.

(3) Press the [1] key to start the AUTO CAL. routine. The followng will be displayed on the screen.

```
AUTO CAL. ROUTINE
'1'  CALIBRATION ALL
'2'  CALIBRATION SHORTENED

'0'  QUIT
```

- Pressing the [0] key returns the analyzer to its state before the [AUTO CAL] key was pressed.
- Pressing the [1] key connects the 10 MHz and -10 dBm calibration outputs internally, and all calibration factors will be measured except for TF level calibration.

- Pressing the [2] key executes part of calibration-all to save time.

When this routine is completed, the device returns to its state before the [AUTO CAL] key was pressed, the LED on the AUTO CAL switch lights, and the calibration mode is reset.

④ Press the [2] key to reset the calibration mode using all the factors measured. The LED on the [AUTO CAL] key will light.

⑤ Press the [3] key to disable the calibration. The LED on the [AUTO CAL] key will go out. In this case, the accuracy of results measured is the same as that when no calibration is done.

⑥ Press the [4] key to display the calibration value.

4-19. PLOT

[PLOT]

(1) Connection to TR9831

Connect the GPIB connector on the rear panel of the TR4171 to that of the TR9831 with a GPIB cable.

Next set the TR9831 address switch to LISTEN ONLY, and turn on the power while pressing the FEED switch of the TR9831. If all the measurement conditions have been set for the TR4171, press the [PLOT] key. The following message will be displayed on the screen.

```
PLOT
'1'  TR9831
'2'  TR9834R
'0'  QUIT
```

Press the 1 key to change the message on the screen. If the TR9834R described in (2) of Paragraph 4-19 is connected, press the 2 key. Pressing the 0 key returns the TR4171 to its state before the [PLOT] key was pressed.

```
PLOT
'1'  LARGE
'2'  SMALL
'0'  QUIT
```

Press the 1 key (LARGE) to plot the various data (waveforms, graticules, characters, markers, and labels) on A3-size paper; or the 2 key (SMALL) to plot it on A4-size paper. If the 0 key is pressed, the TR4171 returns to its state before the PLOT key was pressed.

When only a character string such as a HELP message is displayed on the screen, plotting starts immediately. When a LARGE/SMALL selection key is pressed, the following message will usually be displayed on the screen.

PLOT
'1' ALL
'2' TRACE
'0' QUIT

Press the 1 key (ALL) to plot all the data on the screen.

Press the 2 key (TRACE) to plot the waveform only and ensure previously-plotted data is not plotted again.

Press the 0 key (QUIT) to return the TR4171 to its state before the PLOT key was pressed. When an ALL/DATA selection key is pressed, the character string in the active area will be re-displayed before the above message is displayed again, and plotting will start.

Pressing the 0 key during plotting interrupts the plotting, and the first PLOT message will be displayed.

A one-page equivalent is fed on after plotting, except for waveform plotting, so when plotting several passes on the same paper, plot all waveforms first.

The TR9831 can use four pens: pen 1, pen 2, pen 3, and pen 4. Pen 1 plots the characters and graticules from the data displayed on the TR4171's screen, and pens 1 to 4 plots the contents of traces A, B, A', and B', respectively. However, blanked traces are not plotted. (See Table 4-3.)

If the screen data cannot be output to the TR9831, the following message is displayed:

<ERROR> PLOTTER DOWN OR CONNECTOR DRAWN OUT
'1' CONTINUE
'0' QUIT

Check that the address switch of the plotter is set to LISTEN ONLY and the GPIB cable connector is plugged in, switch on the power to to the plotter again, and press the 1 key. The plotter will restart at its state at which the [PLOT] key was pressed. Pressing the 0 key (QUIT) now returns TR4171 to its state before the [PLOT] key was pressed. When TR4171 is connected to the TR9831 or TR9834R and is used in this mode, the TR411 acts as a controller, so in principle no other device or controller can be connected.

(2) Connection to TR9834R

The connection procedure and operating procedure are the same as those for TR9831, except that it is not necessary to turn on the power switch of the TR9834R while pressing the FEED switch.
The plotter TR9834R has two pens: pen 1 and pen 2. pen 1 plots characters, graticules, and traces A and A'; and pen 2 plots traces B and B'.
However, blanked trace data is not plotted. (See Table 4-3.)
When two traces A and B are used for measurement, they can be plotted in different colors to make them easily identifiable, by mounting different-colored pens.
When plotting a single trace, if the waveform is allocated to trace B, the graticules and waveform are plotted in different colors.
When using two pens, refer to the reference manual of the TR9834R to see how to correct for offset.
Two kinds of recording paper are available for the TR9834R; roll paper (continuous forms) and leaf paper. When using leaf paper, the REMOTE lamp and PROMPT lamp will flash at the end of plotting, and the pen might not return to the origin automatically. In this case, press the position switch of the TR9834R to set the pen at the origin.

Table 4-3 Correspondence between screen data and pen

Screen Data of TR4171	TR9831	TR9834R
Trace A	Pen 1	Pen 1
Trace B	Pen 2	Pen 2
Trace A'	Pen 3	Pen 1
Trace B'	Pen 4	Pen 2
Graticules	Pen 1	Pen 1
Characters	Pen 1	Pen 1

4-20. SHIFT

[SHIFT]

Pressing the SHIFT key usually enables the other function of the key pressed immediately afterwards. Several shift key functions are not printed in yellow above the corresponding keys. There are also some double shift functions enabled by pressing a third key after the SHIFT and LABEL keys, such as [SHIFT], [LABEL] and [PEAK SRCH].
See the list of double shift functions in this manual.
This list gives the alphabetics and symbols on the right sides of the keys. This section describes the shift key functions.

4-20-1. DETECTION (SHIFT n, p, s, z)

One of four detection techniques can be selected for displaying trace information.

(1) Normal detection mode

[SHIFT] [AUTO] n

The normal mode is automatically selected when the analyzer is switched on.

(2) Positive peak detection mode

[SHIFT] [AUTO]

The positive peak detection mode displays local signal maximums detected during a predetermined period at each point on the frequency axis. OS PK is displayed in the active function display area.

(3) Negative peak detection mode SHIFT

[SHIFT] [AUTO]

The negative peak detection mode displays local signal minimums detected during a predetermined period at each point on the frequency axis. NEG PK is displayed in the active function display area.

(4) Sample detection mode

[SHIFT] [AUTO]

In sample detection mode, the instantaneous signal value at each point on the frequency axis is displayed. SAMPLE is displayed in the active function display area. Wen averaging mode is selected, sample detection mode is automatically selected as well.

4-20-2. REF. OFFSET

Any desired offset value can be applied to the reference level of the analyzer. First press the [SHIFT] and [REF LEVEL] keys, and ten input offset value [XX +dBm] through the DATA keyboard.
If a negative offset value is required, press the [Hz -dBm usec] key after entering the numerical value.
The input offset value is always displayed in the bottom left hand corner of the screen as OFFSET XX dB. Subsequent reference level, marker, and display line displays appear with this offset value added (or subtracted if a negative offset).
Offset input is still possible when the reference level is displayed in units of dBμ dBmV, dBV. In such a case, press the +dBm or -dBm key after entering the numerical offset value.
Note that no offset can be input when in linear mode.
The reference level offset is cancelled and the offset value reset to zero by pressing the [SHIFT] , [REF LEVEL] , [0] , and [kHz +dBm msec] keys.

4-20-3. Electrical Field Strength Measurement

① Connect an antenna to the TR4171 input terminal (50 Ω).

② Set the center frequency and frequency span.

③ Press the [SHIFT] and [2] keys to set the level units to dB V.

④ Press the [MKR] key to generate a marker on the screen, and adjust the marker to the frequency spectrum to be measured.

⑤ The relationship between the marker point display level, i.e., the TR4171 input terminal voltage ex (dBμV), and the actual electrical field strength Ex (dBμV/m), is given by the following equation:

$$Ex = ex + K$$

where K is the antenna coefficient (dB)

⑥ When using ADVANTEST's TR1722 half-wavelength dipole antenna, the antenna coefficient K is compensated for automatically.
Press the [SHIFT] and [EXT] C keys to change the marker units to dBμV/m, and the electrical field strength Ex corrected for the antenna coefficient K can be read directly.
Note, however, that this calibration necessitates the use of the supplied 5D2W 10m cable. Any other cable will introduce errors.

⑦ When using ADVANTEST's TR1711 logarithmic-periodic antenna, press the [SHIFT] and [EXT] C keys. The value of Ex (in dBμV/m) can be obtained by subtracting 5 dB from the displayed value, pressing [SHIFT], [REF LEVEL], [5], and [Hz/-dBm/usec] applies an offset of -5 dBm REF. LEVEL, to the reference level. This means that the marker value can be read off directly as the value of Ex(dBμV/m).
In this case, as well, calibration depends on the use of the 5D2W 10m cable supplied. Any other cable with introduce errors.

⑧ Pressing the [SHIFT] and [VIDEO] O keys cancels the marker electrical field strength measurement, and makes the marker units the same as those of the reference level.

⑨ If using an antenna other than TR1722 or TR1711, calibrate with the following equation:

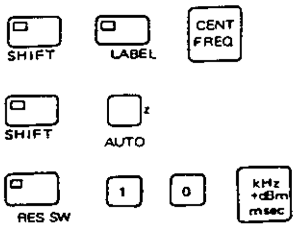
$$Ex = (ex + 6) + La - He + Ba$$
$$= ex + K$$

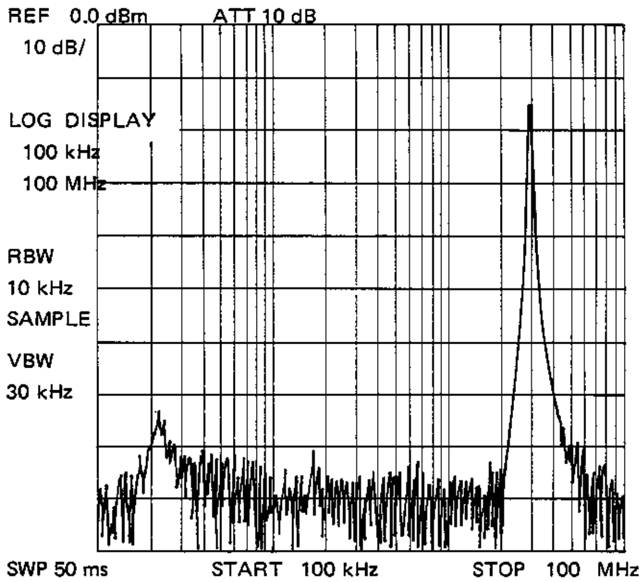
where He (dB) is the effective antenna length,
La (dB) is cable loss,
Ba (dB) is balun loss, and
K (dB) is the calibration coefficient.

4-20-4. Logarithmic Scaling for Frequency Axis (Log Display)

After blanking traces B and B' and selecting [A / WRITE] or [A / VIEW] mode, press the [SHIFT], [LABEL] and [CENT FREQ] keys to provide the frequency (horizontal) axis with a logarithmic scale. The center frequency and frequency span displays will disappear from the screen, and a start frequency (frequency at the leftmost side) and a stop frequency (frequency at the rightmost side) will be displayed instead. Select the start frequency from 10 Hz, 100 Hz, 1 kHz, 10 kHz, and 100 kHz so that the center frequency on the logarithmic scale is positioned near the center of the display. Since the frequency span extends over three decades, the stop frequency is 1000 times the start frequency. For example, when the center frequency is between 100 kHz and 900 kHz, press the [SHIFT], [LABEL] and [CENT FREQ] keys to make the start and stop frequencies 10 kHz and 10 MHz, respectively.

A sample log display is given below.





The analyzer can be returned to linear mode by pressing the [SHIFT], [LABEL], and [FREQ SPAN] keys.

When observing a noise waveform, press [SHIFT] [AUTO] to select sample detection mode before entering log display mode.

When the RES BW key is set for AUTO mode, the resolution bandwidth changes for each decade. To obtain a constant resolution bandwidth over all three decades, press the RES BW key to select manual mode, and select the desired resolution bandwidth in manual mode before setting log display mode.

A logarithmic-scaled trace in memory A can be stored in memory B by pressing the [SHIFT] and [A=B] keys. If the HOLD key is pressed to return to linear mode, information on logarithmic-scaled traces, except for vertical graticules, stored in memory B is saved.

Press the [PLOT] key immediately when plotting by TR9834R or TR9831 is desired.

4-21. WRITING UPPER AND LOWER LIMIT DATA

Upper and lower limit data can be written onto the TR4171's screen directly from the front panel. This enables the operator to see at a glance whether the signal response trace in question falls within the limits. (See Figure 4-1.)

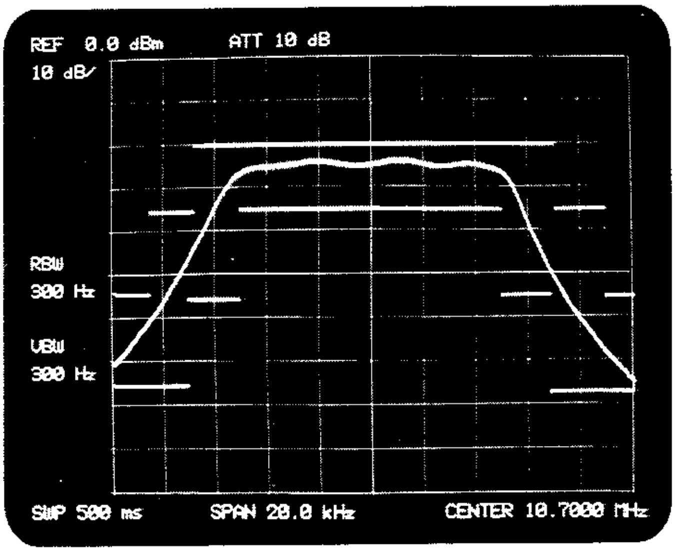


Fig. 4-1 Signal Response with Upper and Lower Limit Data Written on the Screen

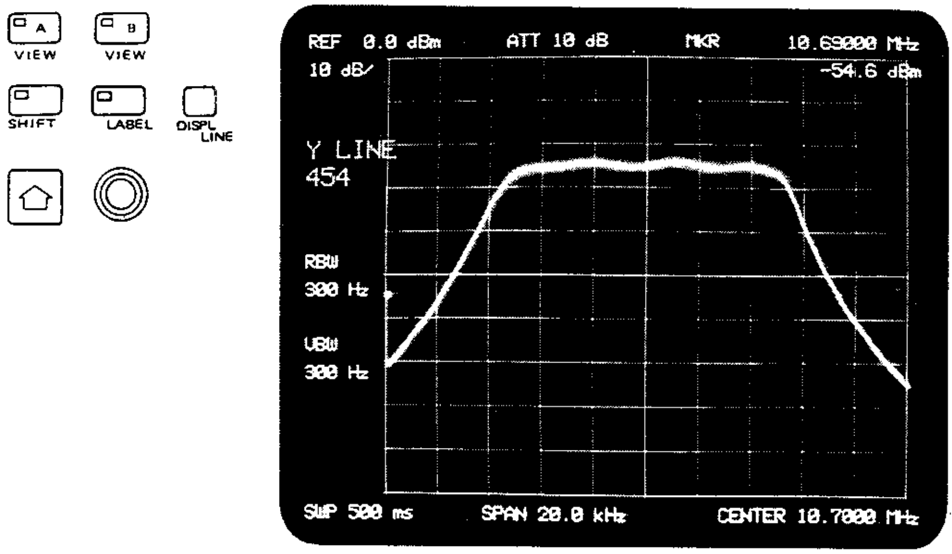
First write upper (or lower) limit data into memory B, then transfer that data to memory B'. Next write lower (or upper) limit data into memory B, then place the analyzer in WRITE A mode for observation of a DUT (Device Under Test). The procedure is described below.

① Press the VIEW B key. Place memory A into VIEW A or BLANK A mode.

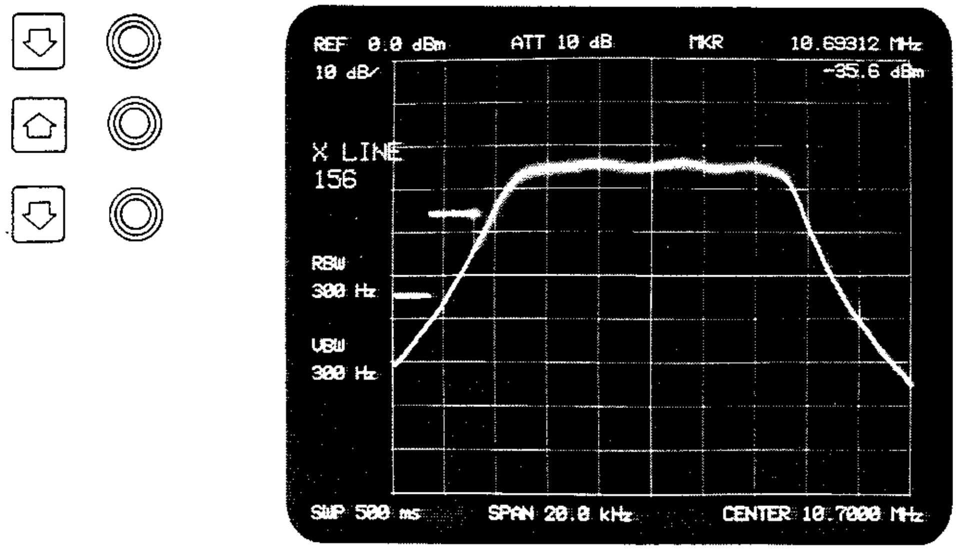
② Press the [SHIFT], [LABEL] and [DISPL LINE] keys to generate an active marker in the bottom left corner of the screen.

③ Pressing the DATA step up or step down key ([⇧] , [⇩]) specifies limit write mode.

④ If the DATA step up key ( ) is pressed, clockwise rotation of the DATA knob moves the marker upward, and counterclockwise rotation moves it downward.



⑤ If DATA STEP DOWN ( )key is pressed, operation of the DATA knob moves the marker horizontally to enable upper or lower limit writing. Then use the DATA step up or step down key (,) to write the desired upper (or lower) limit data on the screen.

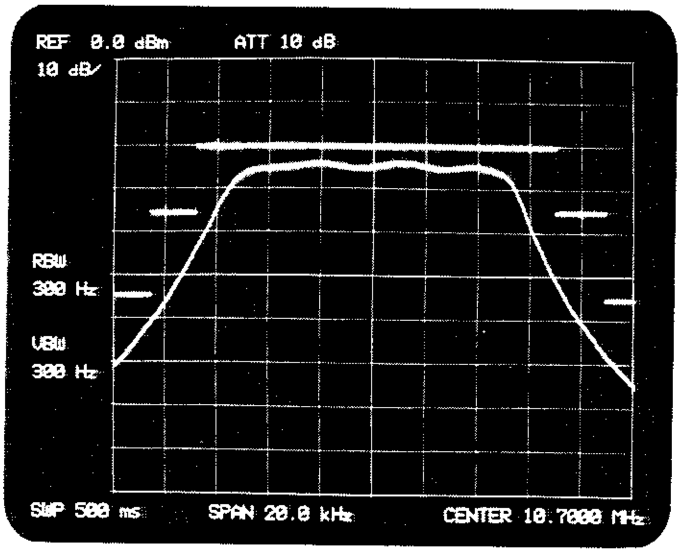


⑥ While upper or lower limit data is being written, the frequency and level at the marker are normally displayed in the top right corner of the screen.
"Y LINE"$_{XX}$ for the vertical direction, "X LINE"$_{XX}$ for the horizontal direction, and a value from 0 to 1000 are displayed in the achieve area.

⑦ If the DATA knob is operated after the [BACK SPACE] key has been pressed, limit data writing will not occur, and the marker simply moves horizontally along the upper or lower limit trace already on the screen.
Operation of the DATA step up or step down key ([⇧] , [⇩]) will again enable the limit data write mode.

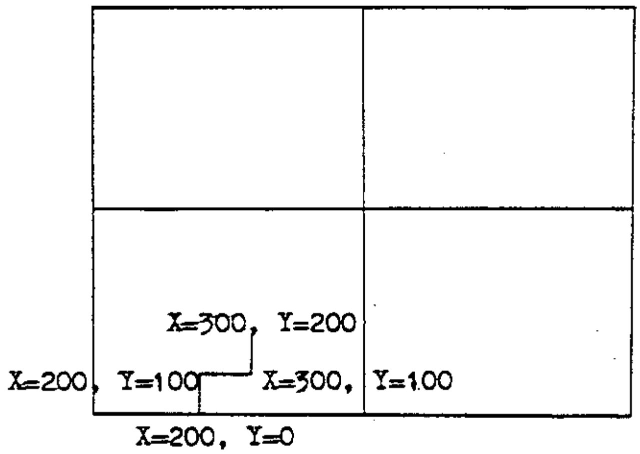
⑧ When all the upper (or lower) limit data have been written, press the SHIFT key to erase the marker from the screen and place the analyzer in normal measurement mode.

SHIFT



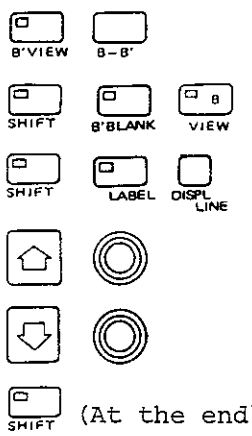
When writing the upper (or lower) limit, data can also be entered using the DATA keys.
Press the DATA step up key ([⇧]) to move the marker vertically, or the DATA step down key ([⇩]) to move it horizontally, and input a number from 0 to 1000 using the DATA keys.
Then press one of the uits keys, MHz, KHz, or Hz, and the marker will move to the specified point.

This function divides both the vertical and horizontal axes into 1000 points and sets the origin at the lower left corner of the screen.

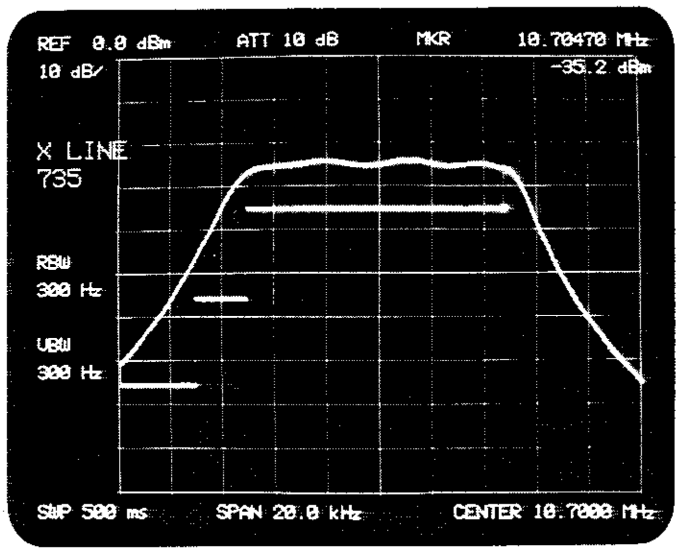


⑨ If subsequently writing lower (or upper) limit data, proceed with step (10) and (11) below. If not, go to step (12).

⑩ When writing lower (or upper) limit data after writing upper (or lower) limit data, press the [B'VIEW] [8-8'] [SHIFT] [8'BLANK] [VIEW] and keys, then press the [SHIFT] [LABEL] and [DISPL LINE] keys to generate an active marker. Next follow the procedure given in steps (3) through (7) to write the lower (or upper) limit data directly onto the screen.



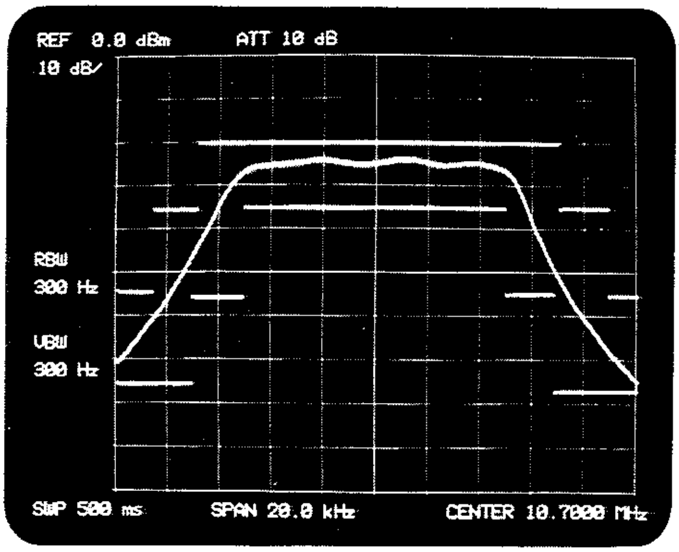
(At the end)



⑪ When all lower (or upper) limit data has been written into memory B, press the SHIFT key to erase the marker from the screen, then press the B' VIEW key. This will show the lower and upper limit traces, stored in memories B and B', on the display.
Press the WRITE A key to observe the signal response of the connected DUT.

B'VIEW

A
WRITE



⑫ Pressing the WRITE B key erases the lower (or upper) limit data from memory B, and pressing the SHIFT and B'BLANK keys erases the upper (or lower) limit data from the display, but the memory contents remain, so that the operation of the B' VIEW key displays the upper (or lower) limit again.

4-22. HELP MODE

No specific panel inscriptions or indicators are provided for the double shift functions which are activated by pressing certain keys after the SHIFT and LABEL keys. Some shift key functions are not displayed on the panel.
Press the SHIFT and HELP keys to select the help mode in which the display provides a listing of the shift key functions on the screen.
Press the SHIFT, LABEL, and HELP keys to obtain a listing of the double shift key functions on the screen.

Note that when the analyzer is in the state in which only specific key operations can be entered, such as in digital trace or log display mode, help mode cannot be activated.
Reset the mode to normal measurement mode to enable help mode.

SHIFT HELP

SHIFT FUNCTIONS

'D' dBμ/m ON
'G' dBμ/m OFF
'?' NEGATIVE PEAK SEARCH
'n' NORMAL DETECTION
'P' POSITIVE PEAK DETECTION
's' NEGATIVE PEAK DETECTION
'z' SAMPLE DTECTION
'=' REF OFFSET

SHIFT LABEL HELP

DOUBLE SHIFT FUNCTIONS

'B' 'UNCAL' ENABLE <DEFAULT>
'C' 'UNCAL' DISABLE
'μ' LIMIT
'?' AUTO PEAK SEARCH
'BLANK' PANEL LOCK OFF
'd' SWEEP RESET
'<' LOG DISPLAY ON
'>' LOG DISPLAY OFF
'4' DRIFT CANCEL ON DEFAULT
'5' DRIFT CANCEL OFF

Press the SHIFT key to clear the list and return to normal mode.
When in help mode, the analyzer is in the same state as that when the SHIFT, SHIFT LABEL and OPTION key have been pressed, so that pressing a key displayed on the screen can activate a function directly, except for the PLOT key that sets the X-Y plotter mode.

Appendix A-4 gives a list describing those shift key functions and shift key functions which are not printed or displayed on the panel.

4-23. MEASURING AND AVERAGING NOISE LEVEL ADJACENT TO OSCILLATOR

This section describes how to measure the noise level adjacent to a 50 MHz oscillator using the averaging function of the TR4171. The adjcent noise analysis range is assumed to be +50 kHz each side of the oscillation frequency.

(1) Connect the output of a 50 MHz oscillator to INPUT-1 of the TE4171, as shown in Figure 4-2.

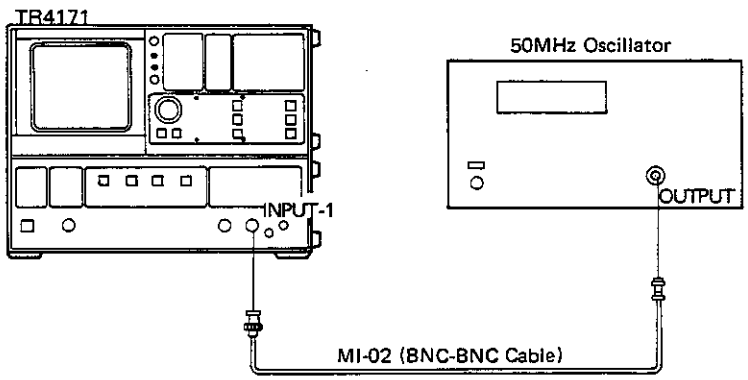


Fig. 4-2 Connection of Oscillator and TR4171

Notes:

a. When the oscillator output is connected directly to the TR4171 input, the output frequency may be subject to changes due to the input capacitance of the TR4171. If this occurs, use a probe with a smaller cable capacitance for the input connection.

b. The maximum permissible input level for the TR4171 is 30 dBm. Be careful not to apply an input level exceeding +20 dBm, or use an external attenuator if necessary.

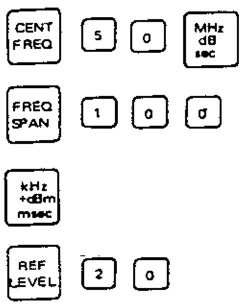
(2) While the TR4171 is in its initialize state (immediately after the MASTER RESET key has been pressed), prepare it as follows:

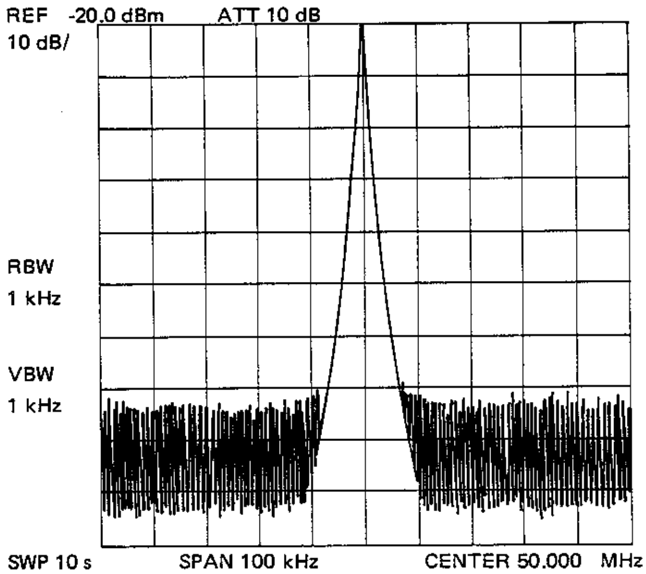
① Set the center frequency to 50 kHz.

② Set the center frequency span to 10 kHz to enable an analysis range of +50 kHz.

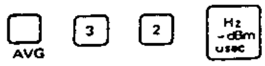
③ Set the reference level. For example, if the input signal level is -20 dBm, set the reference level to -20 dBm.

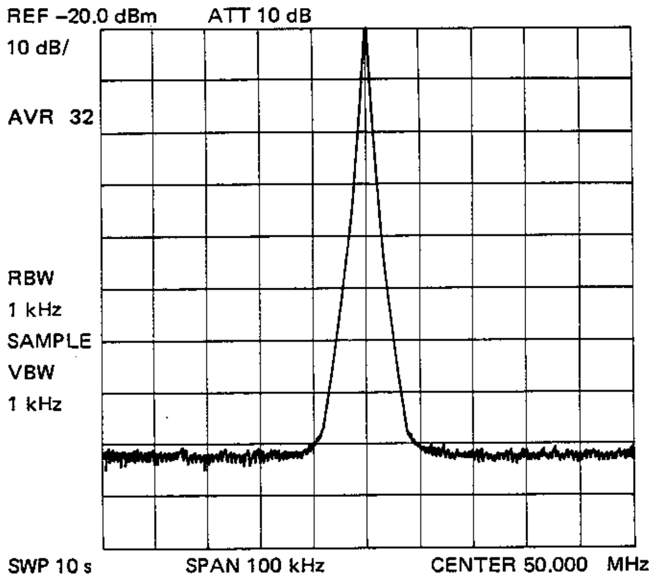
④ SWEEP TIME, RES BW, and VIDEO BW, etc., are set automatically to the optimum values according to the selected frequency span, since AUTO is the initial default selection. If manual selection of these parameters is desired, press the [RES SW] [1] [kHz +dBm msec] keys to set resolution bandwidth to 1 kHz, for example. Once manual mode is selected for a parameter, the lamp on the relevant parameter key lights. In this case, RES BW is fixed at 1 kHz. Note that RES BW remains 1 kHz even if the frequency span is subsequently changed.



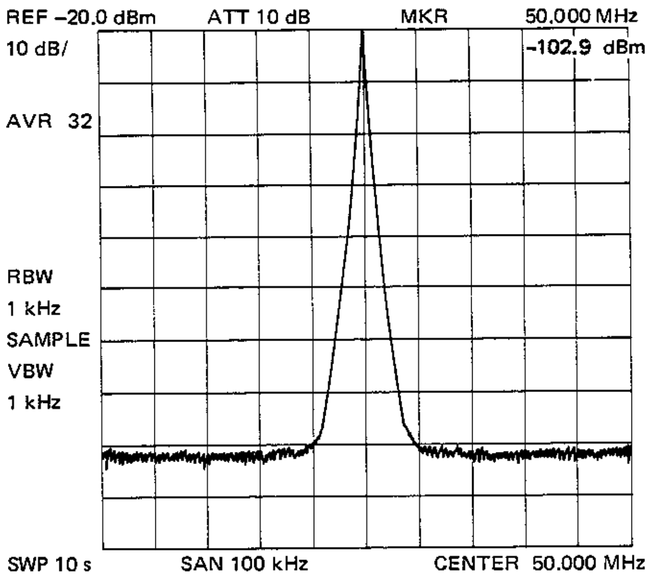


(3) Repeat averaging 32 times

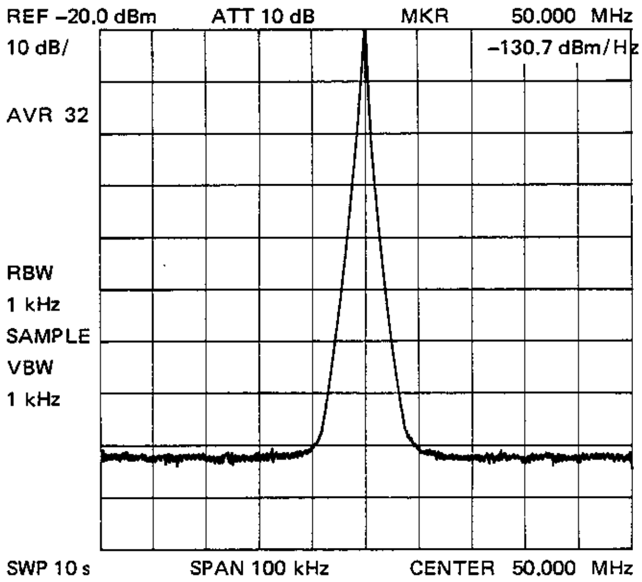




(4) Activate a marker and measure the adjacent noise level (for example 20 kHz away from the signal response).
The marker will move one division along the horizontal axis each time the step key is pressed. In this example, since the span is 10 kHz, operating the step key twice moves the marker 20 kHz.



(5) To measure the adjacent noise level (noise/Hz), press the SHIFT and NOISE/Hz ON keys. This provides bandwidth conversion for an ideal filter and level compensation for the logarithmic amplifier by the internal CPU, thereby enabling accurate measurement.



To return to the normal measurement mode, press the SHIFT and NOISE/Hz OFF keys.

4-24. SIMULTANEOUS MEASUREMENT OF 2ND AND 3RD HARMONICS OF RADIO TRANSMITTER

This section gives an example of the simultaneous measurement of the fundamental, 2nd harmonic, and 3rd harmonic outputs of a 27 MHz radio transmitter.

(1) Apply the output of the transmitter to the input of the TR4171 Spectrum Analyzer through the TR1626 RF Coupler. (See Figure 4-3.) The TR1626 RF Coupler has an attenuation level of 40 dB $\pm$1 dB over a frequency range of 0 MHz to 500 MHz. If the output power of the transmitter is 1 W, it is attenuated to 100 W/50 Ω(-10 dBm) when applied to input -1 of the TR4171.

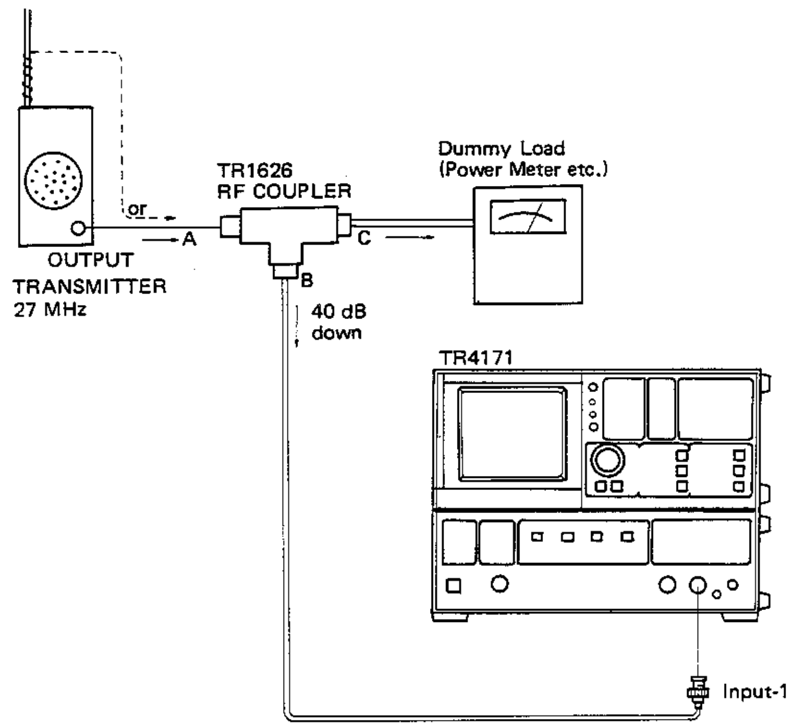
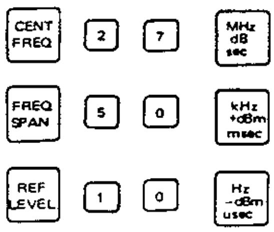
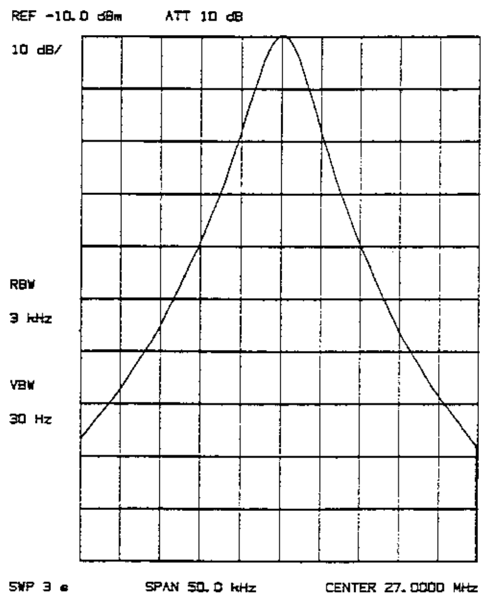


Fig. 4-3 Connection of Receiver Output

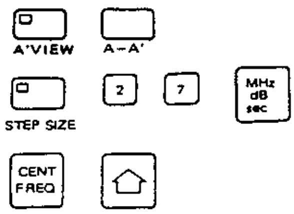
(2) While the analyzer is in its initialized state, set the center frequency to 27 MHz, the freqency span to 50 kHz, and the reference level to -10 dBm.

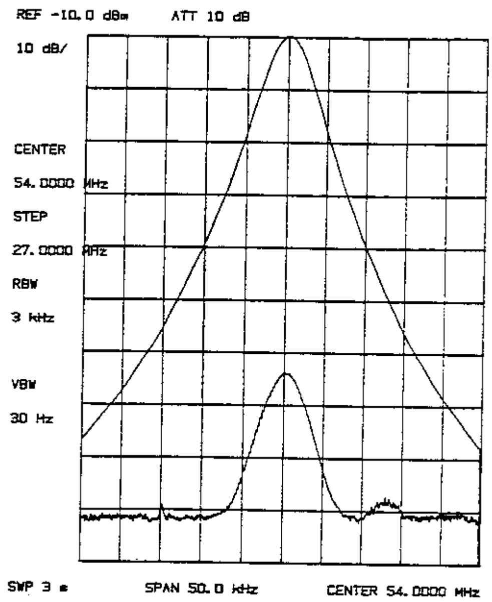




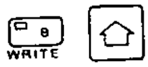
(3) Since A WRITE mode is the initial default selection, the fundamental response trace is stored in trace memory A. Transfer this trace information to memory A' by pressing the A'VIEW and A-A' keys.

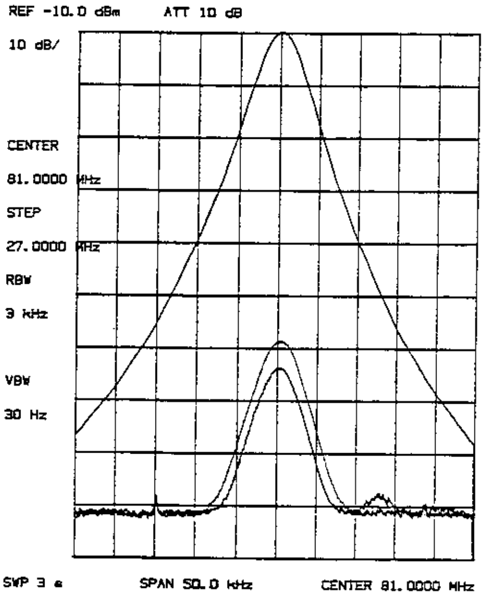
(4) Double the center frequency setting to observe the 2nd harmonic in the transmitter output. If the center frequency step size is set to 27 MHz, the center frequency will be multiplied in an integral sequence (double, triple and so on) each time the DATA step up key is pressed. Use trace memories A, A', and B to superimpose higher harmonics on the fundamental response trace.





(5) Press the WRITE B key. Memory A will be automatically placed in VIEW (quiesced) mode. Observe the 3rd harmonic response on activate display B.





(6) Three signal response traces are now displayed simultaneously on the screen. If you also wish to observe the 4th response trace press the B B' key to store the 3rd harmonic response in memory B', then store the 4th response in the activated trace memory B.

(7) To clear the fundamental response trace from the display, press the SHIFT and BLANK A keys. The other response traces can be cleared from the display by similar operations.

4-25. OPTION

OPTION

The TR4171 is provided with several software options. These optional programs can be loaded into a RAM and run by pressing the OPTION key and numeric keys specifying each option.
Press the OPTION key; a list of optional program names and specification numbers will be displayed on the screen. Check the selection number and contents, and specify the desired option with the corresponding numeric key, to activate that program.

CAUTION

> Since the RAM area for loading the optional programs overlaps the RAM area used for averaging, log display of frequency axis, and dual trace mode, no optional program can be executed when these are operating.

```
OPTION
'1'  X-Y PLOTTER
'2'  X-Y RECORDER
'3'  OCCUPIED BANDWIDTH
'4'  ADJACENT CHANNEL LEAKAGE POWER
'0'  QUIT
```

4-25-1. X-Y Recorder Output (Option 03)

This optional output provides signal response and scaling (graticule) information for recording by an X-Y recorder. The information on the screen is subjected to digital-to-analog conversion and is output to the X, Y, and Z connectors on the rear of the instrument in the form of analog signals. The operating procedure of this optional output is given below.
First, connect the X, Y, and Z connectors on the rear panel of the TR4171 to the corresponding X, Y, and Z inputs of the X-Y recorder.

Each output has an output voltage range of 0 V to approximately +5 V. The Z output provides pen lift control, the initial default setting for the Z output for pen lift control is 0 V for pen up and approximately +5 V for pen down, but this condition can be reversed by key operation. (See page4-97.) If the Z output does not match the specifications of the X-Y recorder used, use the pen-lift switch of the recorder for pen up/down control.

The operation of each key of the TR4171 is given below.

(1) X-Y recorder output mode

Press the [OPTION] and [ ] (Select No.) to select the X-Y recorder output mode. The message X-Y RECORDER will be displayed in the active function display area of the screen. In this mode, the front panel keys have functions different from those when used for normal measurement. To clear X-Y recorder mode, press the SHIFT key.

(2) Setting the image size and position

To set the size and position of the output image on the X-Y recorder, press the DATA step down key ([⇩]). This lifts the recorder's pen and moves it to the home position in the lower left corner. The LOWER LEFT will be displayed in the active function display area of the screen. Operation of the DATA step up key ([⇧]) lifts the pen and moves it to the upper right home position. The message UPPER RIGHT will be displayed in the active function display area of the screen. Determine the size and position of the output image on the recorder by adjusting the gain and offset of the recorder while operating these two keys.

(3) All trace and scale output

Press the [A / WRITE] key to make the X-Y recorder record all the traces (traces A, A', B and B') and graticules. After recording one trace, the recorder's pen lifts, returns to the lower left home position, and then starts recording the next trace or scale.

If the Z output (pen-lift signal) of the TR4171 does not match the X-Y recorder specifications, the pen-lift operation will not be done automatically. In this case, follow steps (4) through (8) below, lift the pen manually at the end of each trace output, press the DATA step down key ([⇩]) to return the pen to the lower left home position, then lower the pen again before the start of output of another trace or scale.

All keys other than [HOLD] are disabled during recording of traces.

(4) Output of scales only

Press the [B / WRITE] key to output the scales alone.

(5) Trace A output

Press the [A / VIEW] key to output trace A.

(6) Trace B output

Press the [B / VIEW] key to output trace B.

(7) Trace A' output

Press the [A'VIEW] key to output trace A'.

(8) Trace B' output

Press the [B'VIEW] key to output trace B'.

(9) Halting recorder operation

If the [HOLD] key is pressed, the X-Y recorder temporarily stops operating with its pen up. A second operation of the [HOLD] key restarts the recorder's operation from the held point.

If another trace key (e.g. the [A / WRITE] key) is pressed when the pen is stationary, the pen will automatically return to the lower left home position and then start plotting the trace selected with the trace key.

(10) Clearing the X-Y recorder

To clear the X-Y recorder output mode, press the [SHIFT] key.

(11) Recording speed selection

The frequency axis of the TR4171 usually consists of 1001 data points. Each of these points is subjected to digital-to-analog conversion at a sampling rate of approximately 100 ms, for the optional X-Y recorder output. This sampling rate can be varied between approximately 10 ms and 1000 ms with the [SWEEP TIME] key and DATA knob used together.

Operation of the [SWEEP TIME] key will display the current sampling rate 100 ms/POINT in the active function display area of the screen. Use the DATA knob to change this active readout of sampling rate to the desired rate. This newly-specified sampling rate will return to 100 ms/POINT and its display will disappear from the active function display area when the X-Y recorder output mode is cleared by pressing the SHIFT key.

(12) Pen up/down control setting

If the Z output of the TR4171 correctly matches the pen control input of the attached X-Y recorder, operation of the [RES SW] key will lift the pen, and operation of the [AUTO P] key will lower it. If the actual pen movement is the opposite of this, reverse the polarity of the Z output according to the step (13).

(13) Z output polarity reversal

Pressing the [VIDEO SW] key makes the Z output 0.0 V for pen-up and approximately +0.5 V for pen-down. The message PEN UP/DOWN = LO/HI will be displayed in the information area on the left of the screen.

Pressing the [AUTO S] key makes the Z output approximately +5.0 V for pen-up and 0.0 V for pen-down. The message PEN UP/DOWN = HI/LO will be displayed in the information area on the left of the screen.

4-25-2. Occupied Bandwidth Display (Option 04)

This option performs the calculations needed to determine the occupied bandwidth, from the data displayed on the TR4171. The calculations are done in the following way.

There are 1001 data points along the frequency axis of the TR4171's display. If the voltage at one of the points is assumed to be Vn, the total power P of the signal response on the display is determined by:

$$P = \sum_{n=1}^{1001} \frac{Vn^2}{R} \qquad \text{(R: TR4171's input impedance)}$$

If the total power between the first (leftmost) and Xth points on the frequency axis is 0.5% of P, then:

$$0.005P = \sum_{n=1}^{X} \frac{Vn^2}{R}$$

If the total power between the fist (leftmost) and Yth points on the frequency axis is 99.5% of P, then:

$$0.99tP = \sum_{n=1}^{Y} \frac{Vn^2}{R}$$

X and Y can be determined from these three equations, and the occupied bandwidth (OBW) can be determined from the following equation, using the frequency span f_{SPAN}:

$$OBW = \frac{f_{SPAN} (Y - X)}{1001}$$

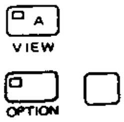
The OBW display procedure is described below.

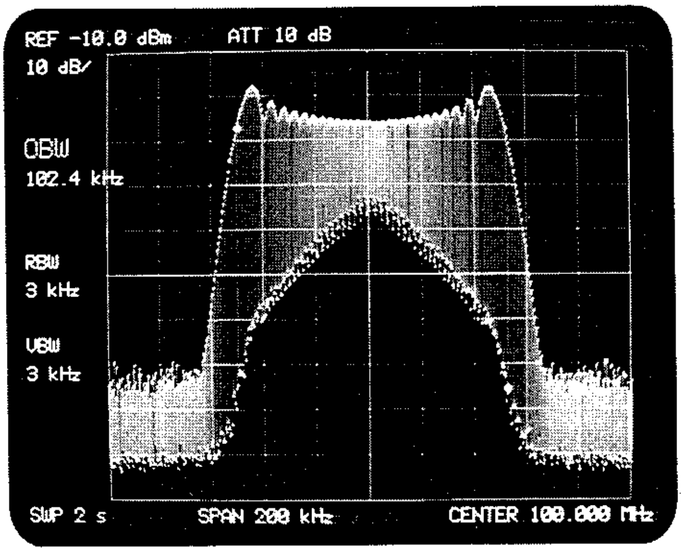
(1) Select WRITE A mode and display the desired signal response trace at the center of the screen. Set the vertical scale to 10 dB/div., and leave all markers inactive.

(2) Press the VIEW A key to hold the display, then press the ☐ OPTION and ☐ (select No.) keys. The occupied bandwidth operation will be initiated. At the end of the operation, two markers will appear at points X and Y, described above, to indicate the calculated occupied bandwidth beneath the "OBW" display at the top left corner of the CRT display.

(3) Operation of the MKR key will display the occupied bandwidth in the top left corner of the screen, together with the indicator OBW.

(4) Pressing the MKR OFF key removes the two markers and returns the TR4171 to normal measurement mode.





(5) Occupied bandwidth data can be obtained with reduced error by setting the resolution bandwidth to 1/200 of the frequency span or less. The maximum value or average value of the occupied bandwidth can also be measured by using maximum or averaging mode.

4-25-3. Adjacent Channel Leakage Power Calculation Software (Option 06)

This optional software divides the data of trace A measured by the TR4171 into 1001 points along the frequency axis, integrates the power within a width specified by delta markers, and displays the ratio of the integration result to the total power as trace B.
If Pn is assumed to be the power between each pair of points on trace A, the total power P is determined by:

$$P = \sum_{n=1}^{1001} Pn$$

If ΔX is the width between delta markers, data P_{ADJ} on trace B after calculation is:

$$P_{ADJ} = 10 \log \frac{\sum_{n-\Delta X/2}^{n+\Delta X/2} Pn}{P}$$

Two methods of integrating with the ΔX width can be selected: an ideal filter method (ΔX width) and a trapezoidal filter method (ratio of 90 dB/6 dB is set anywhere within the range of 1.0 - 9.99).
The procedure for adjacent channel leakage power calculation is as follows:

(1) Measure the waveform of trace A.

(2) Press the VIEW A key to freeze the trace. Specify the integration width with the delta markers.

(3) Press the [OPTION] and [ ] (Select No.) keys.

(4) Press the [2] key for ideal-filter integration, or press the [3] key for data only. The ratio (in dB) of the adjacent channel leakage power to the total power at the first marker is displayed under ADJ. The frequency at this point is displayed in the top right of the CRT screen.

(5) Press the [4] key for trapezoidal filter waveform integration. To obtain the value in dB, press the [5] key, then select the ratio of 90 dB/6 dB.
Press the [1] key for a ratio of 2.24.
Press the [2] key for a ratio of 1.75.
Press the [3] key for a ratio of 1.66.
Press the [4] key to set any ratio within the range from 1.0 to 9.99. In this case, input 100 X [90 dB/6 dB] through the DATA key-board, then press the [Hz -dBm usec] key.
The calculation time is increased as the delta marker width increases. It can take more than one minute.

(6) Press the [MKR OFF] key to return to ordinary measurement mode.

(7) Pressing the [MKR] and [8 VIEW] keys after the [MKR OFF] key moves the marker to the integration waveform of trace B, to enable reading of the ratio (in dB) to the total power at any marker point. In this case, press the [SHIFT] and [REF LEVEL] keys, input the offset value, and then set the reference level to 0 dB, because the integration waveform is drawn with reference to the total power. Accordingly, if the reference level is set to 0 dB, including offset, the value at the marker can be read out directly.
When an integration waveform is drawn, the waveform at both sides of the display is zero (approximately 1/2 the integration width).

4-25-4. X-Y Plotter Interface (Option 07)

This option is a software program enabling connection to the Hewlett Packard Model 9872A/7470A/7225A plotter.

This option can not be used together with option 03, but combined use with other options is possible.

Read the instruction manual for the plotter before connecting the plotter to the TR4171, switching the plotter power on, or setting the pen. Set the plotters' address to 5, and listen only.

The operating procedure of the X-Y plotter interface is as follows:

(1) Display the waveform to be plotted on the TR4171's CRT screen.

(2) Press the [OPTION] and [ ] (Select No.) keys to load the program.

(3) This will be displayed on the CRT screen:

PLOT
'1' 9872
'2' 7470, 7225
'0' QUIT

Press the [1] or [2] key according to the type of plotter connected.

Pressing the [0] key returns the analyzer to its state before the program was loaded.

(4) This message will be displayed on the CRT screen next:

PLOT
"1" ALL
"2" TRACE
"0" QUIT

To plot all the data on the CRT screen, press the [1] key. To plot only the waveform, press the [2] key.

Pressing the [0] key returns the analyzer to its state before the program was loaded.

If the message is not displayed immediately,

"<ERROR> PLOTER DOWN OR ADDRESS SW. IS NOT 5 OR
CONNECTER DRAWN OUT RERUN OR QUIT
<1 OR 0>"

is displayed. If this message is displayed, check that the plotter is powered, the plotter's address switch is set to 5 or listen only, and the connector is correctly connected.
To re-execute the plotter program, press the [1] key.
Pressing the [0] key returns the analyzer to its state before the program was loaded.

(5) The characters which were displayed in the center of the left side of the CRT screen (active area) before program loading will be displayed again, and plotting will start.

Table 4-4 Pen Numbers

Model \ Trace	TRACE "A"		TRACE "B"	
	A	A'	B	B'
9872A	1	3	2	4
7470A	1	1	2	2

CAUTION

Waveforms in log display mode cannot be plotted.

(6) Pressing the [0] key while the plotter is running halts the plotting, and displays the ploter selection menu on the CRT screen. Change the plotting paper and restart the operating procedure from step (3).

4-26. QP MEASUREMENT MODE (Option 01)

4-26-1. Outline

Option 01 is used to measure transient noise. As indicated in Table 4.5, the various constants used in the measurement comply with CISPR standards.

Table 4-5 CISPR Standards Concerning Basic QP Measurement Characteristics

	Frequency Range	6 dB BW(*1)	Charging Time Constant	Discharging Time Constant	Mechanical Time Constant
A	10kHz - 150kHz	200Hz	45ms	500ms	160ms
B	150kHz - 30MHz	9kHz	1ms	160ms	160ms

4-26-2. QP Value Measurement

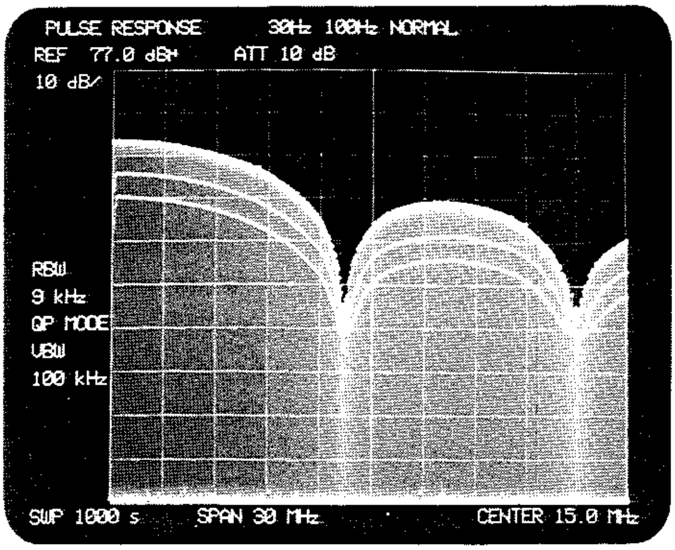
1. Set the center frequency and the desired frequency span.
2. Press the [INPUT ATT] key and change the input attenuation in 5 dB steps with the DATA knob or step keys, while observing the waveform on the screen.
3. During this time, check that the waveform level does not vary. If it varies, input to the TR4171 is saturated. To avoid saturation, increase input attenuation or insert a bandpass filter or equivalent in the input circuit.
4. If it is verified that there are no variations in the waveform level, change the reference level with the REF. LEVEL key to set the output peak level between 20 dB to 30 dB below the top of the screen, before entering one of the QP measurement modes given in Table 4-6.

Table 4-6 QP Measurement Modes

	Frequency Range	6 dB BW	QP Measurement
A	10kHz - 150kHz	200Hz	[SHIFT] [LABEL] [J]
B	150kHz - 30MHz	9kHz	[SHIFT] [LABEL] [K]
To cancel QP measurement mode, press			[SHIFT] [LABEL] [AUTO Z]

5. QP measurement involves the use of long time-constant circuits, as shown in Table 4-5, necessitating sufficiently long sweep-time settings. As a general rule, set a sweep time of
1 second/200 Hz in frequency range A (10 kHz to 150 kHz), and
1 second/10 kHz in frequency range B (150 kHz to 30 MHz).
For example, set the sweep time to 50 seconds if measuring in frequency range A with a frequency span of 10 kHz.

6. After setting the sweep time, press the MARKER switch to generate a marker. The level at the marker point will be displayed in dBμ, indicating the QP value of the input terminal at that marker-point frequency.



7. Press the [SHIFT], [LABEL], and [Z] keys to cancel QP measurement mode.

4-26-3. QP BW Check

The 6 dB BW (bandwidth) of the CISPR standards listed in Table 4-5 can be verified by following the procedure given below.

(1) Connect the CAL. OUT and INPUT-1 connectors of the RF unit, and set the center frequency to 50 MHz by pressing the [CENT FREQ], [5], [0], and [MHz dB sec] keys.

(2) Set the frequency span, depending on which frequency range is set, as shown in Table 4.7.

Table 4-7 QP BW Check

	Frequency Range	6 dB BW	Frequency Span	QP BW Check Mode
A	10kHz - 150kHz	200Hz	2kHz	[SHIFT] [LABEL] [M]
B	150kHz - 30MHz	9kHz	10kHz	[SHIFT] [LABEL] [N]
	To cancel QP BW check mode, press			[SHIFT] [LABEL] [Z]

Execute one of the QP BW check modes, depending on which frequency range has been set.

(3) Freeze the spectrum by pressing the [A VIEW] key, and then press [J] the delta key and use the DATA knob to check the 6 dB bandwidth. The specifications are:

A) 200 Hz ±20 Hz

B) 9 kHz ±1 kHz

4-27. Gated Sweep Function (Option 12)

> **Note**
>
> When this option is mounted, the X-Y recorder output (option 03) cannot be incorporated.

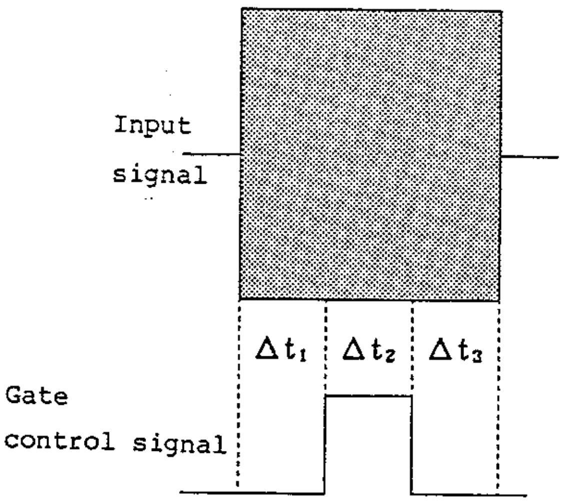
4-27-1. General

This option allows analysis of the burst signal, which is often used when magnetic tape such as VTR, 8mm video, or DAT (digital audio tape) is recorded.

4-27-2. Measurement method

Executes sweep from the gate in the terminal (BNC connector) on the rear panel of this unit at TTL level "Hi" (or open) and stops sweep at "Lo".

Input signal and gate control signal are used in the following specifications.



< Standard >

Δt_2: 15µs or above

Δt_3: 1µs or above

RBW	100kHz	30kHz	10kHz
Δt_1	20µs or above	50µs or above	180µs or above

(Note) At video BW 300kHz or above

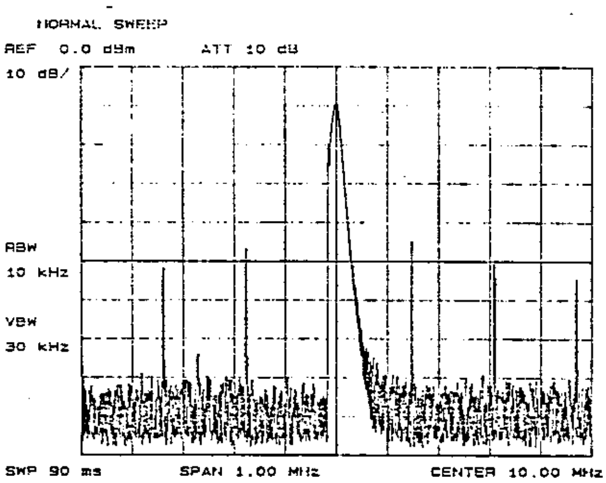
When measuring noise, select the detection mode to SAMPLE

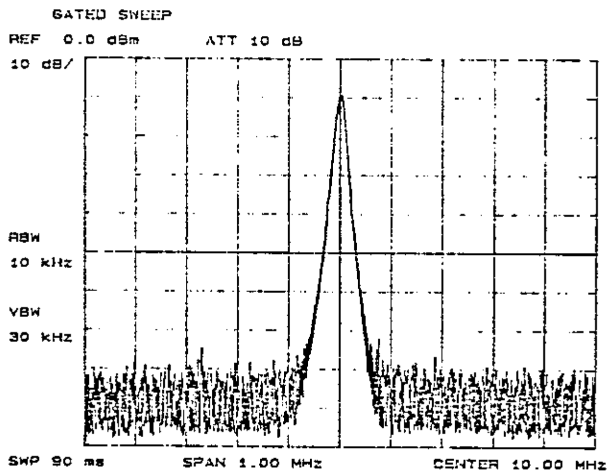
().

4-27-3. Measurement examples

The data comparison diagram between normal sweep and gated sweep is as follows:

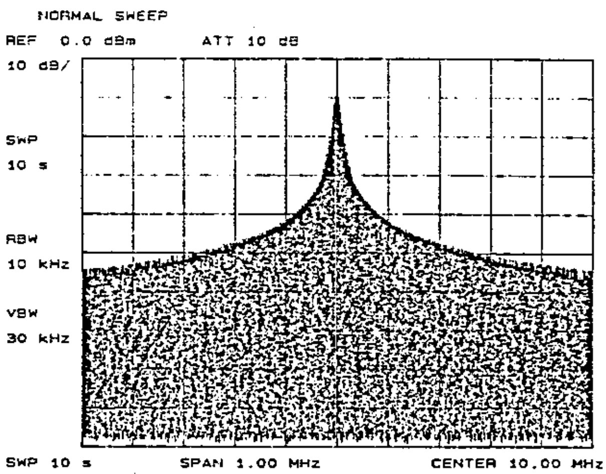
[Normal Sweep] [Gated Sweep]

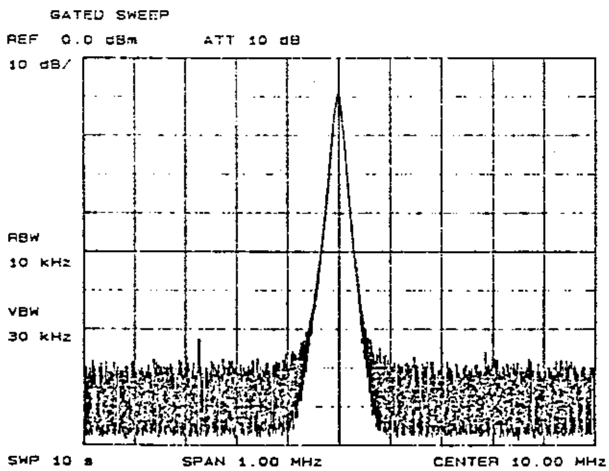




(1) On normal sweep, the pulse component in the burst part is on the data or part of data is lacking.

(2) On gated sweep, the spectrum of the signal in the burst can be analyzed the same as usual.





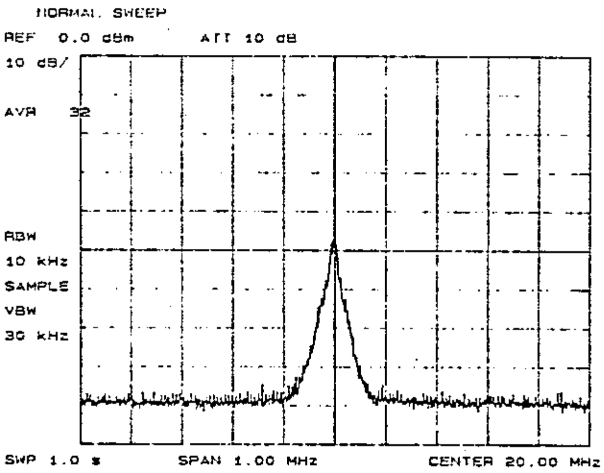
(3) On normal sweep, when sweep time slows down, the pulse component in the burst part appears as an envelope.

(4) On gated sweep, the spectrum of the burst signal part can be analyzed even if the sweep time slows and resolution increases.

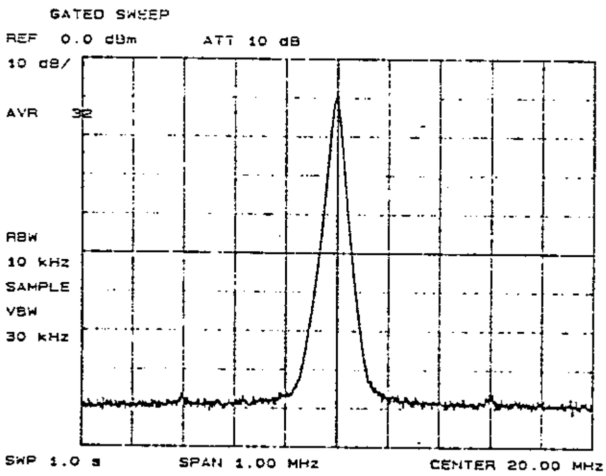
Fig. 4-4 Data comparison between normal sweep and gated sweep-(1)

(continues to the next page)

[Normal Sweep]



[Gated Sweep]



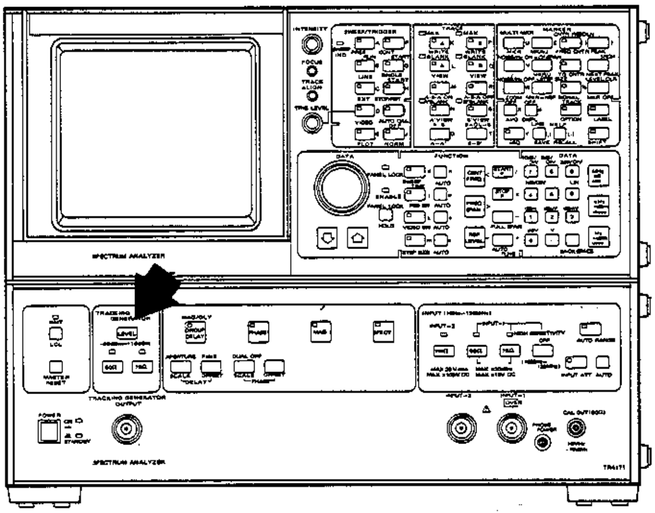
(5) If the averaging is executed when the bust signal is measured, the conventional measurement cannot be made as shown in the above diagram.

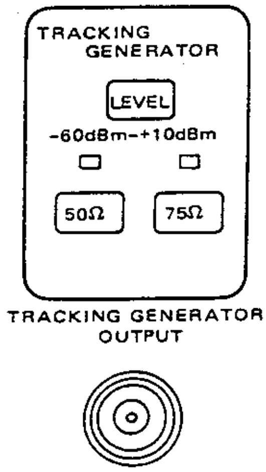
(6) On gated sweep, the C/N of burst signal can be measured even if the averaging is executed.

Fig. 4-4 Data comparison between normal sweep and gated sweep-(2)

SECTION 5

AMPLITUDE MEASUREMENT USING TRACKING GENERATOR





5-1. OPERATING THE TRACKING GENERATOR

(1) Press the [MAG] key to activate the tracking generator. The output impedance of the tracking generator when initialized is 50 Ω. To set the output impedance to 75 Ω, press the [75Ω] key; the LED lamp above the key will light to indicate that the output impedance is set to 75 Ω.

After pressing the [LEVEL] key, set the output level of the tracking generator using the data keys (the DATA keyboard, step keys, or the DATA knob).

(2) Set the most appropriate values for the center frequency, the frequency span, the reference level, the input attenuation, the input impedance, the resolution bandwidth, and the video bandwidth.

CAUTION

Before using the tracking generator with a resolution bandwidth of 300 Hz or less, press the [AUTO CAL] key to correct for tracking error (level error generated by the difference between the output frequency of the tracking generator and the tuned frequency of the spectrum analyzer unit).

(3) Connect the TRACKING GENERATOR OUTPUT connector to the INPUT connector with its cable. The CRT screen will display a through frequency response. If the error due to the through frequency response is large, correct it by the procedure given in Section 5-2 before using the tracking generator.

(4) Connect the device under test (DUT) to the tracking generator to enable its measurement.

(5) To disable the tracking generator, press the [SPECT] key.

5-2. FREQUENCY RESPONSE COMPENSATION USING DISPLAY LINE

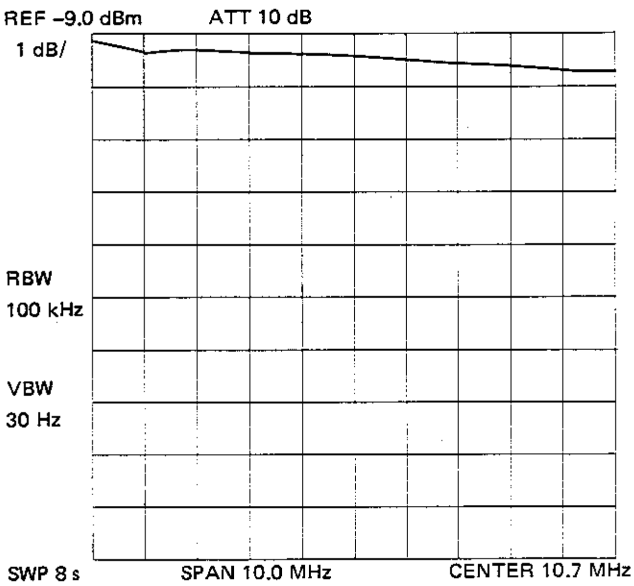
This section describes the frequency response compensation for the spectrum analyzer itself, or for a cable when measuring filter response, etc., using the trace function and a DISPLAY LINE (DL). This is called the normalize mode.

(1) Press the WRITE A key to place the analyzer in WRITE A mode.

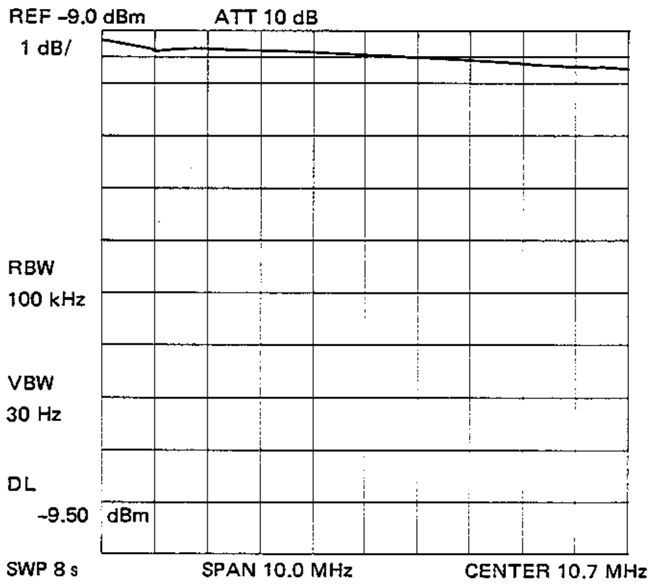
(2) Disconnect the device under test (DUT) from the measurement system, and connect the TRACKING GENERATOR OUTPUT connector directly to the INPUT connector with a cable.

(3) Press the REF. LEVEL key and adjust the reference level with the DATA knob and the step keys until the through frequency response is lowered to a level such that the waveform does not exceed the graticule at the top of the display.

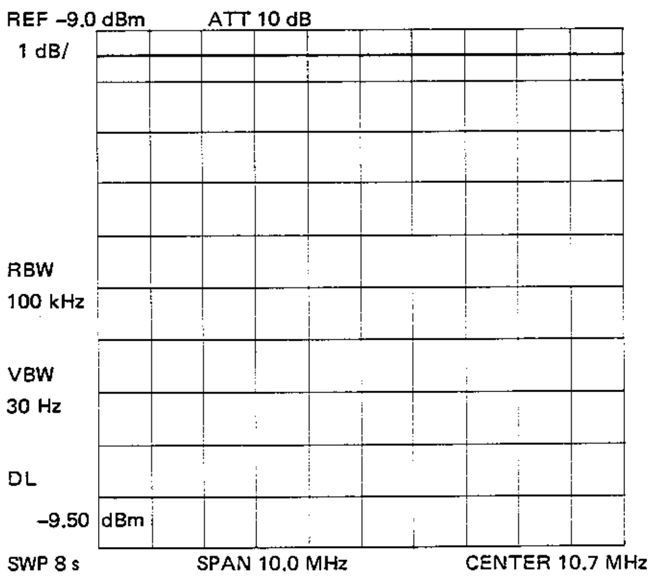
[REF LEVEL]



(4) Press the DISPLAY LINE key to activate the display line. Using the DATA step keys and the DATA knob, position the display line close to the through waveform. A broader dynamic range can be obtained by positioning the display line closer to the through waveform during measurement.



(5) Frequency response compensation is provided by pressing the NORM key.



(6) Memory B cannot be used while in frequency response compensation mode. To reset the compensation mode, press the [SHIFT] and [OFF NORM] keys.

CAUTION

If data of functions affecting the normalization standards, such as the center frequency, frequency span, and reference level, is altered during normalization, subsequent normalization may not be executed normally. Therefore execute the normalization procedure again from the beginning after function data has been altered.

5-3. MEASUREMENT EXAMPLE

This section provides an example of how to measure the insertion loss, ripple, pass bandwidth, and attenuation of a quartz filter using the tracking generator of the TR4171.

5-3-1. Connection

Connect the instruments as shown in Figure 5-1.

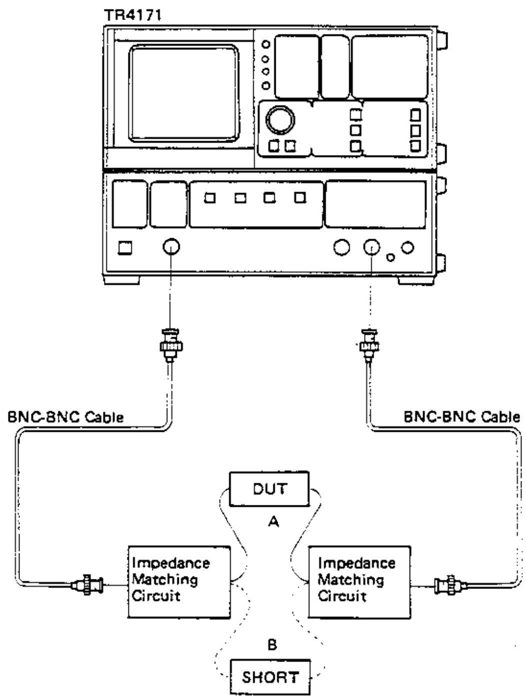


Fig. 5-1 Connection for Amplitude Measurement

5-3-2. Notes on Connection

(1) If the input and output impedance of the DUT is neither 50 Ω nor 75 Ω, use appropriate matching means for the I/O side of the DUT to provide impedance matching.

(2) If the insertion loss of the filter is too large, the dynamic range may be insufficient when measuring the attenuation. In this case, measure attenuation in high sensitivity mode.
In high sensitivity mode, gain may be compressed if the attenuation of the input attenuator from the input level of the spectrum analyzer exceeds -30 dBm.

5-3-3. Measurement Procedure

This procedure assumes that the input and output impedance is 75 Ω, under the following filter conditions:

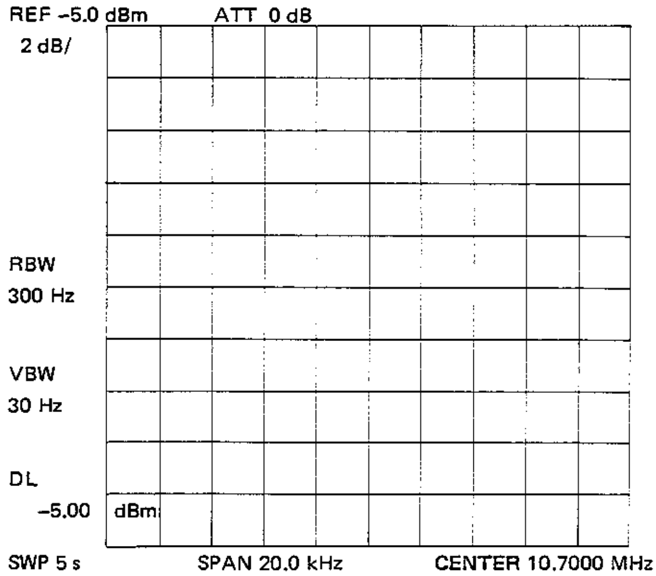
- Center frequency : 10.7 MHz
- Pass bandwidth (6dB) : 10 kHz
- Insertion loss (constant): 5 dB or less
- Ripple : ±1 dB or less
- Attenuation : 80 dB or more

(1) Press the [MAG] key to activate the tracking generator.
Press the [75Ω] key to set the output impedance of the tracking generator to 75 Ω, then press the [75Ω] key to set the input impedance of the spectrum analyzer.
Press the [LEVEL] key, then set the output level to -6 dBm using the DATA keys.
Press the [INPUT ATT] key, then set the input attenuator to 0 dB using the DATA keys.
Press the [REF LEVEL] key, then set the reference level to -5 dBm using the DATA keys.
Then adjust RES BW and VIDEO BW to reduce noise in the spectrum analyzer until the attenuation can be measured adequately.

(2) Set the frequency span to 20 kHz, the center frequency to 10.7 MHz, and the vertical scale to 2 dB/div.
Connect the DUT as shown at (A) in Figure 5-1, and set the sweep time so that the waveform does not vary.
Disconnect the DUT, as shown at (B) in Figure 5-1, and press the [DISPL LINE] key to generate the display line on the screen. Adjust the display line to the reference level using the DATA step keys and the DATA knob, then press the [NORM] key. This operation sets normalize mode, and normalizes the through waveform so that it is superimposed on the reference level. This level becomes the standard for the insertion loss measurement.

CAUTION

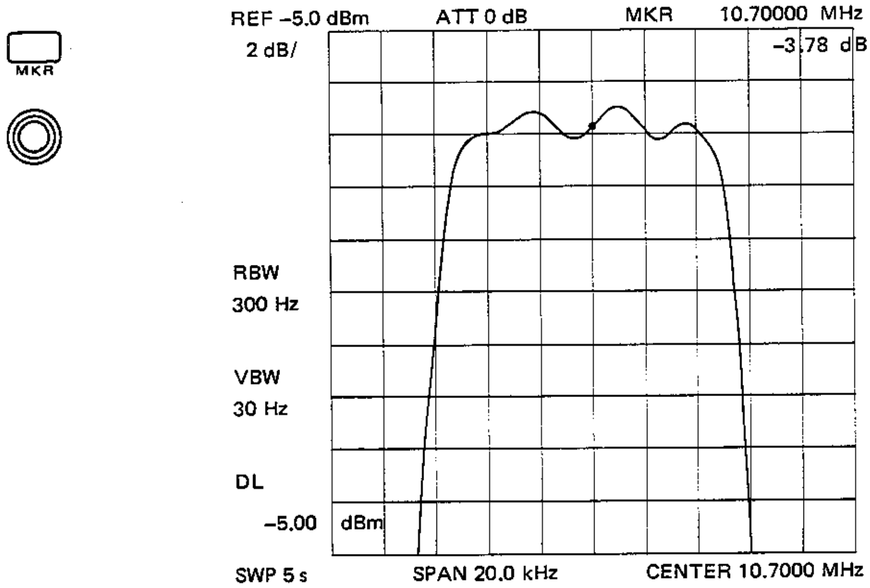
If data of functions affecting the normalization standards, such as the center frequency, the frequency span, and the reference level, is altered during normalization, subsequent normalization may not be executed normally therefore execute the normalization procedure again from the beginning after function data has been altered.



Connect the DUT as shown at (A) in Figure 5-1, and execute the measurement with the procedure described below.

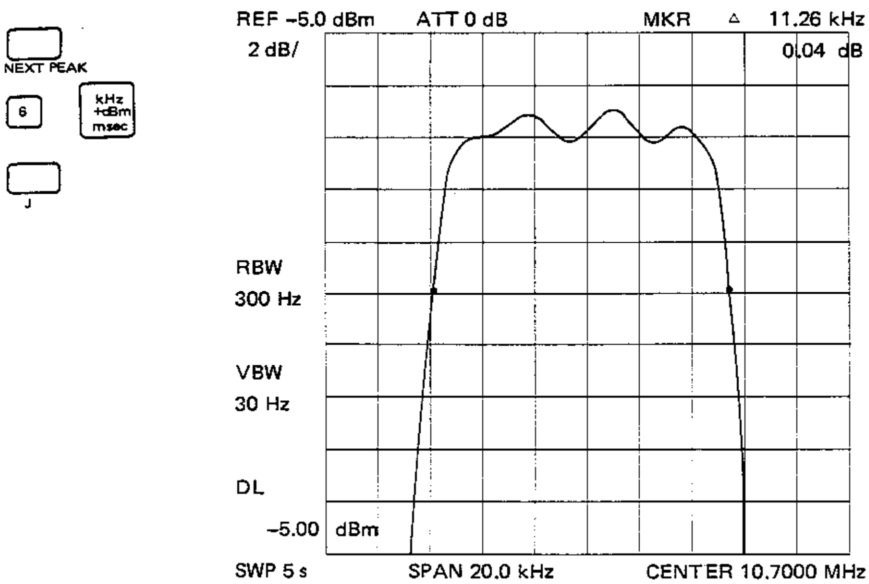
a. Insertion loss (constant loss) measurement

With the display line on the screen, press MKR key and adjust the marker point to 10.7 MHz. Since the difference in level between the display line and the marker point is displayed, the insertion loss (constant loss) can be read directly.



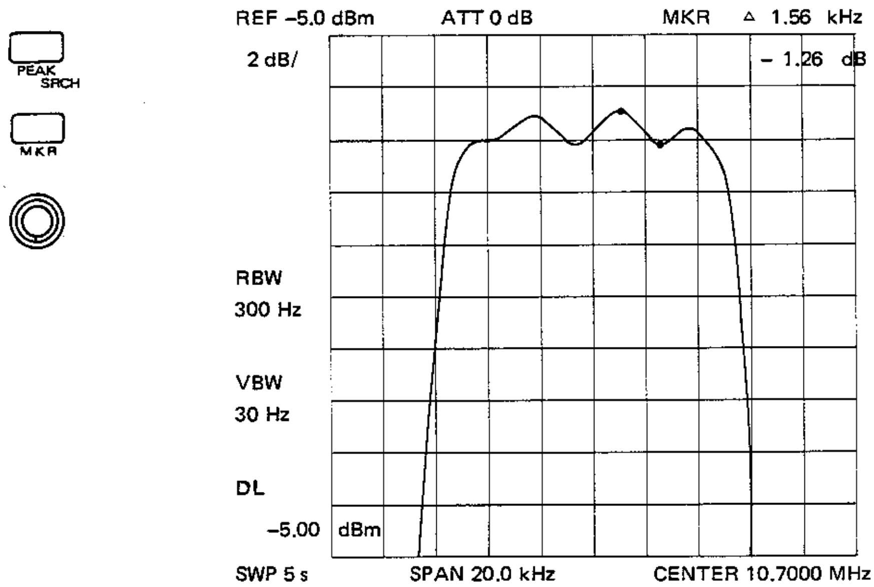
b. Pass bandwidth (6 dB) measurement

Press the [NEXT PEAK] key after measuring the insertion loss to set XdB down width mode. Press the [6] and [kHz +dBm msec] keys to input the attenuation. Two markers will appear on the trace at points 6 dB below and to either side of the marker at 10.7 MHz. The difference in frequency between the two markers is displayed when the [MHz dB sec] key is pressed, and the differences in frequencies between the center frequency and the left marker (prefix L) and the right marker (prefix R) are displayed when the [MHz dB sec] key is pressed, so that the 6 dB pass bandwidth can be read directly.



c. Ripple measurement

Press the [PEAK SRCH] key to move one marker to the minimum loss position, then press the [ ] key and shift the other marker to the minimum ripple level using the DATA knob. The difference in level between the two marker points will be displayed on the left of the screen. This is the ripple.



d. Attenuation measurement

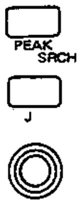
Press the [SHIFT] and [NORM] keys to cancel normalize mode. Then press the [SHIFT] and [7 10dB/DIV] keys to change the vertical scale on the screen to 10 dB/div., then set the most appropriate frequency span.

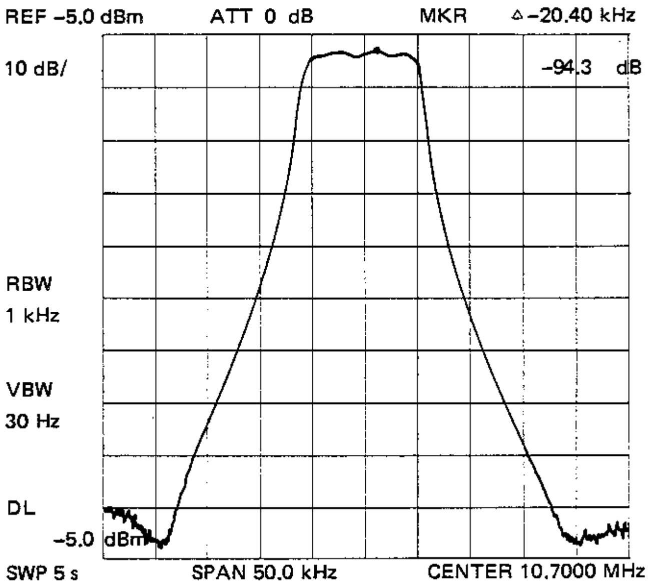
To measure the attenuation from the minimum loss, press the [PEAK SRCH] key.

To measure the attenuation from a nominal frequency position, press the [MKR] key, then input 10.7 MHz through the DATA keyboard.

Next, press the [J] key and move the marker to the desired measurement point, using the DATA step keys and the DATA knob.

The difference in level between the two markers will be displayed on the left of the screen. This is the attenuation.


PEAK SRCH
J


REF -5.0 dBm
ATT 0 dB
MKR
△-20.40 kHz
10 dB/
-94.3 dB
RBW
1 kHz
VBW
30 Hz
DL
-5.0 dBm
SWP 5 s
SPAN 50.0 kHz
CENTER 10.7000 MHz

SECTION 6

PHASE MEASUREMENT

6-1. PHASE MEASUREMENT PROCEDURE

This section describes the procedure for measuring the phase of amplifiers or filters. Before phase measurement, read Section 5 thoroughly. The phase measurement procedure is described below.

(1) Set the center frequency, the frequency span, the resolution bandwidth, and the input and output impedance of the analyzer, and other necessary conditions.

(2) Connect the TRACKING GENERATOR OUTPUT connector to the input of the DUT (amplifier or filter), and connect the output of the DUT to the INPUT connector of the analyzer.

(3) Press the MAG key to measure the passband response and select appropriate T.G. LEVEL, INPUT ATT., and REF. LEVEL values. Do not change the values set in steps (1) to (3) during subsequent measurement.

(4) Press the PHASE key to select phase measurement mode. This makes it possible to observe phase. The measurement range "XX°/" will be displayed in the top left corner of the screen, and the indicator lamp on the key will light.
Then press the PHASE SCALE key and select the range using the DATA step keys or the DATA knob.

(5) For more accurate phase measurement unaffected by phase errors in the measurement system, disconnect the device under test from the measurement system, then connect the cable terminals to each other and measure the phase response of the system itself.
When in phase measurement mode, do not use AUTO for SWEEP TIME; press the SWEEP TIME key to slow the sweep time until the waveform does not vary. (This is because AUTO is set for spectrum measurement.)

(6) If phase rotation is observed in the measurement system, as shown in Figure 6-1, press the DELAY OFFSET key to enable changing the electrical length. Using the DATA knob or DATA step keys (the DATA keyboard can not be used), adjust the electrical length until a flat phase response is obtained. (See Figure 6-2.)

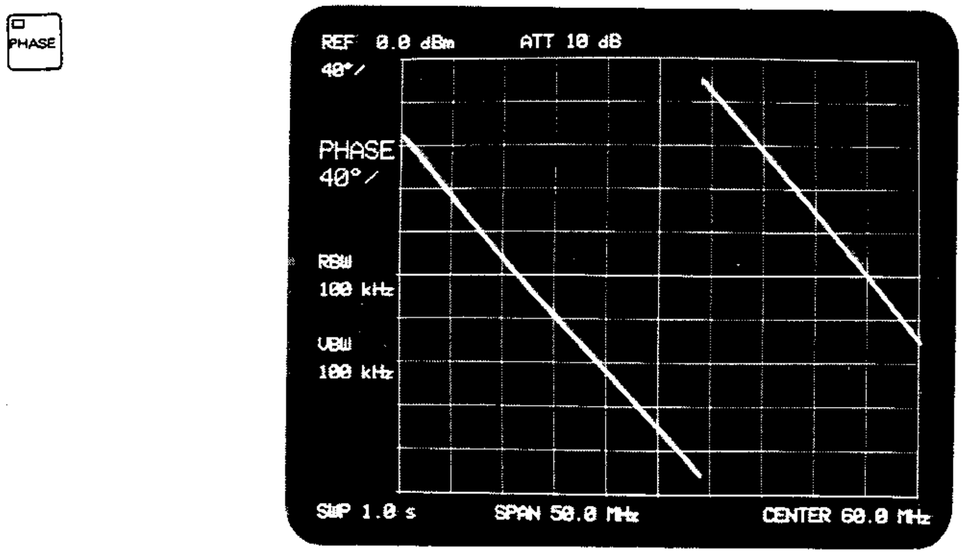


Fig. 6-1 Phase Rotation

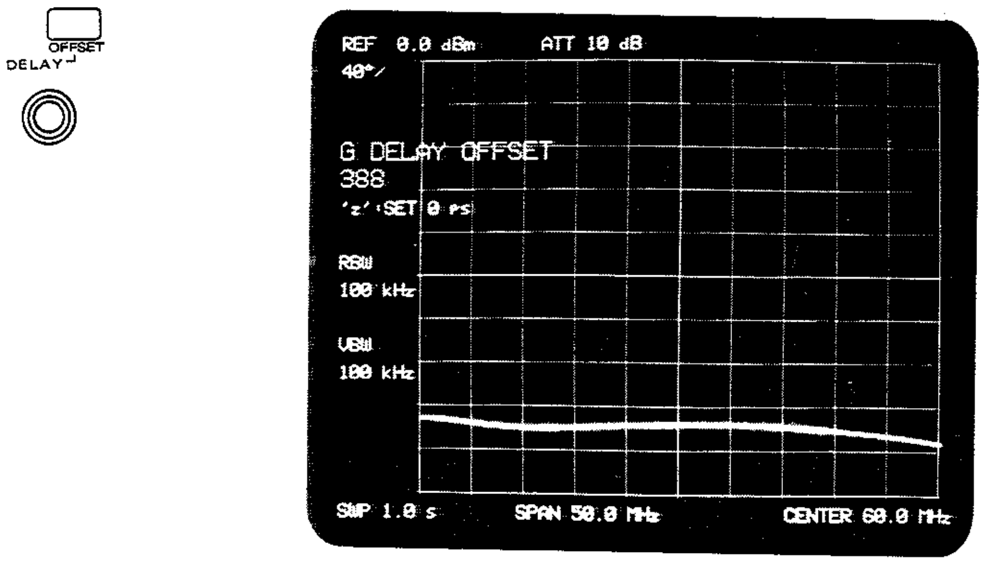


Fig. 6-2 Flat Phase Response

(7) For fine adjustment of the electrical length, press the SHIFT and FINE keys. This will activate GD offset fine to enable fine adjustment of the electrical length.

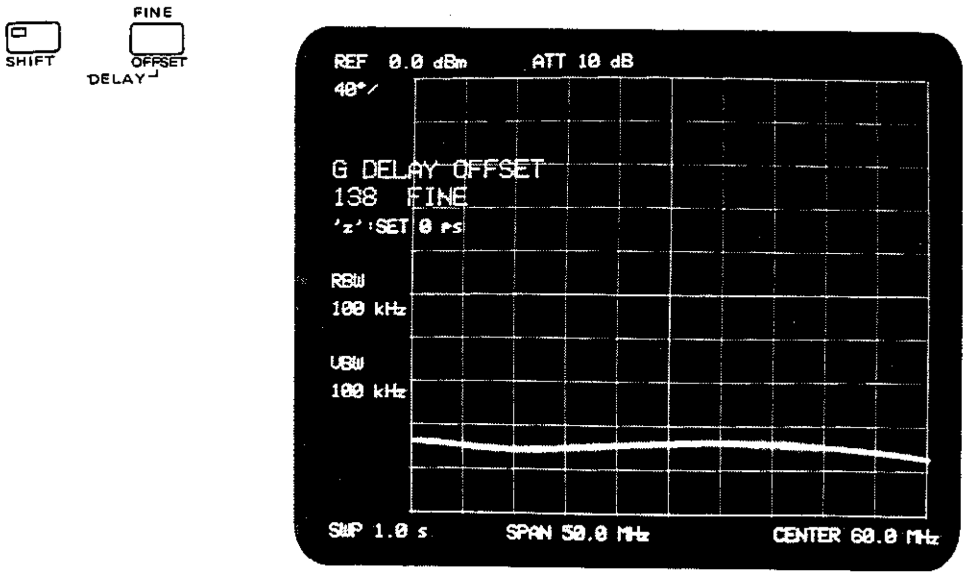


Fig. 6-3 Fine Adjustment of Electrical Length

(8) Press the PHASE OFFSET key to enable changing the phase offset, then position the trace at the center of the vertical axis using the DATA knob or the DATA step keys.

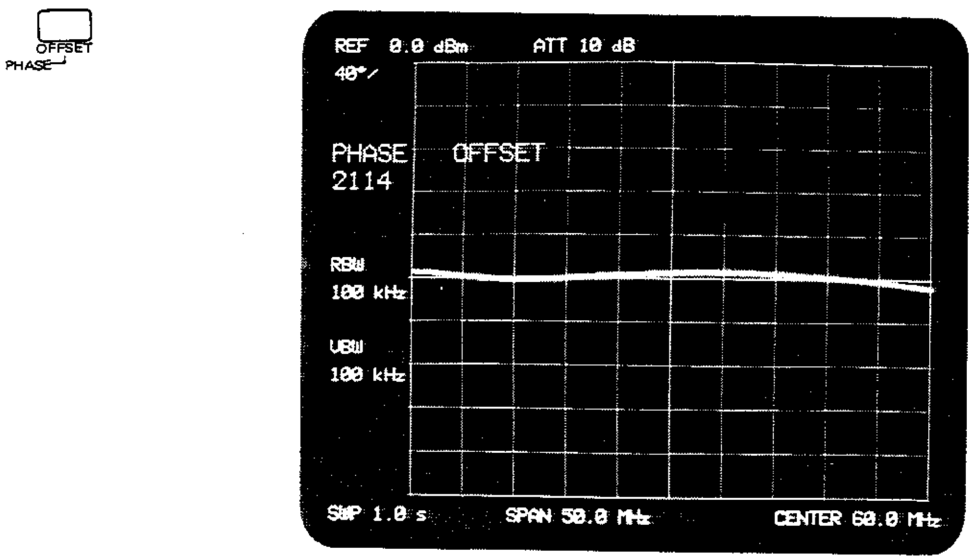
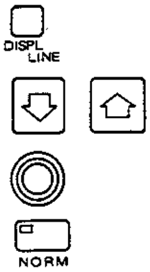
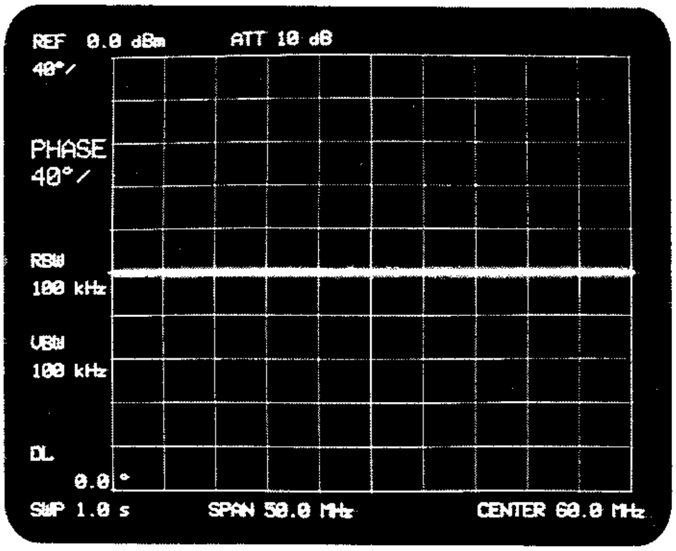


Fig. 6-4 Zero Phase Offset

Verify that an approximately straight line has come to the center of the verical axis, as shown in Figure 6-4.
To correct the frequency response of the measurement system, activate the display line, position it at the center of the vertical axis, then press the 

key.





CAUTION

> If data of functions affecting the normalization standards, such as the center frequency, the frequency span, and the reference level, is altered during normalization, the subsequent normalization may not be executed normally. Therefore, after function data has been altered, execute the normalization procedure again from the beginning.

(9) Connect the DUT to the measurement system and measure the phase of the device itself.

6-2. SIMULTANEOUS PHASE AND AMPLITUDE MEASUREMENT (Dual Trace Mode)

Pressing the [SHIFT] and [PHASE] keys provides alternate phase and amplitude measurements. The results are written into TRACE memories B and A, respectively, and are then transferred to the display simultaneously.

When this mode is selected, the indicator lamps on the WRITE A, WRITE B, PHASE, and MAG keys all light at the same time.

Pressing the [SHIFT] and [DUAL OFF] keys cancels the dual trace mode.

Note: This mode should not activate when frequency response compensation (normalize) using a display line is used.

[SHIFT] [PHASE]

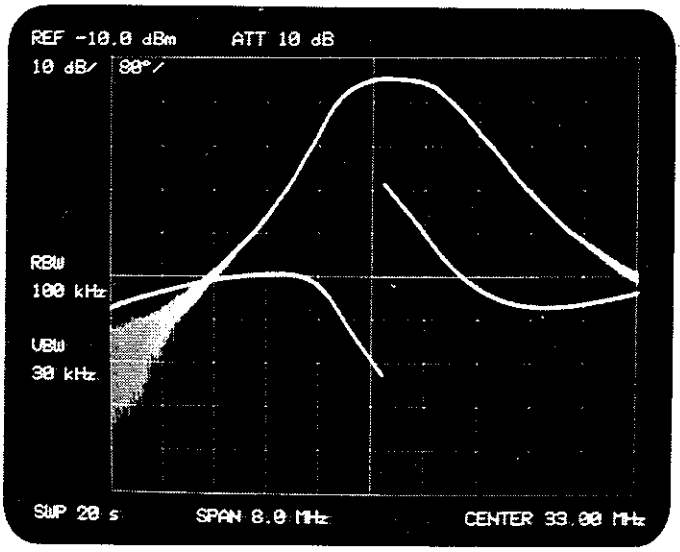


Fig. 6-6 Phase and Amplitude Dual Trace Mode

6-3. SAW FILTER PHASE RESPONSE MEASUREMENT

6-3-1. Connecting a SAW Filter to the TR4171

(1) Connect the DUT (filter) between the TRACKING GENERATOR OUTPUT and INPUT connectors of the TR4171, as shown in Figure 6-7. This connection is illustrated at (A); connection without the DUT is illustrated at (B).

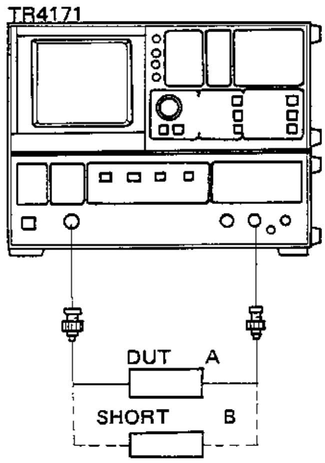


Fig. 6-7 Connection of TR4171 and SAW filter

(2) In general, various different SAW filters are available with input and output impedances of 50Ω, 75Ω, 200Ω, 300Ω, 1kΩ, and above. Before measurement, use a jig or some other appropriate means to obtain impedance matching. A schematic diagram of the recommended matching network can be obtained from the manufacturer of the SAW filter.

(3) A SAW filter usually has a 20 dB insertion loss. To compensate for this, some filters contain an amplifier. When using a filter with a built-in amplifier, be careful concerning the maximum output level of the tracking generator.

(4) Use the shortest possible cables for the DUT.

6-3-2. Measurement Procedure

(1) Set the center frequency, sweep width, input and output conditions for signals, and other necessary conditions for the analysis.

(2) Disconnect the DUT from the cables, and connect the cables to each other, as shown at (B) in Figure 6-7.

(3) Press the PHASE key, then press the PHASE SCALE key and select an appropriate range using the DATA step keys or the DATA knob.

(4) Set the sweep time as described in step (5) in Section 6-1, then press the DELAY OFFSET key to obtain a flat phase response. If fine adjustment is required, press the [SHIFT] and [FINE] keys to select the G.D. offset fine mode.

(5) Press the PHASE OFFSET key to position the phase response trace at the center of the vertical axis.

(6) Disconnect the cables from each other, and connect the filter for measurement. Figures 6-8 and 6-9 show examples of the amplitude and phase response, respectively, measured for the same filter.

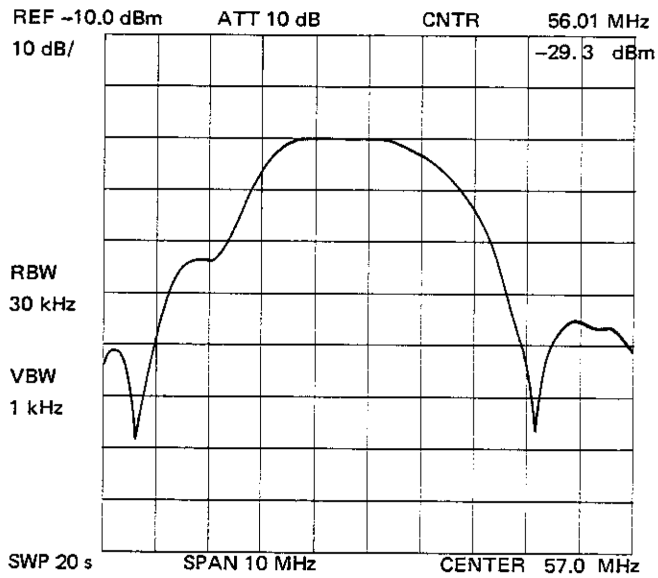


Fig. 6-8 Phase Display Example

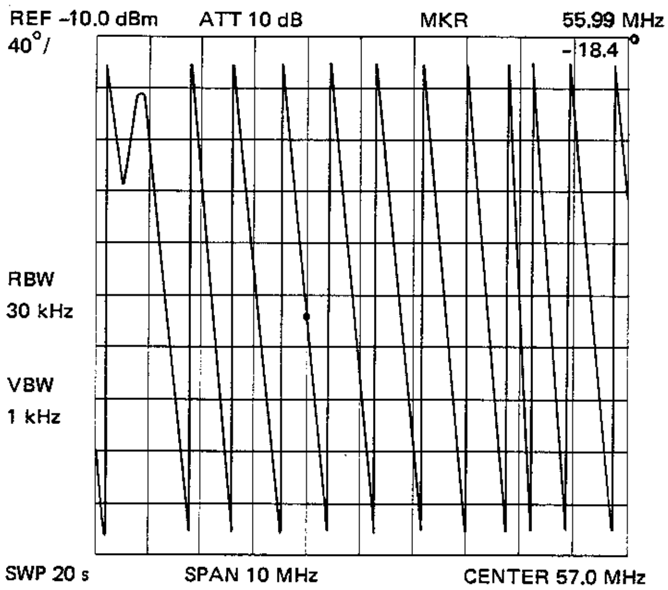


Fig. 6-9 Phase Response of Filter

6-3-3. Phase Display Example

(1) Figure 6-10 shows an example of the phase response of a SAW filter, covering a frequency range between 50 and 60 MHz. This display shows that phase lag increases with frequency.

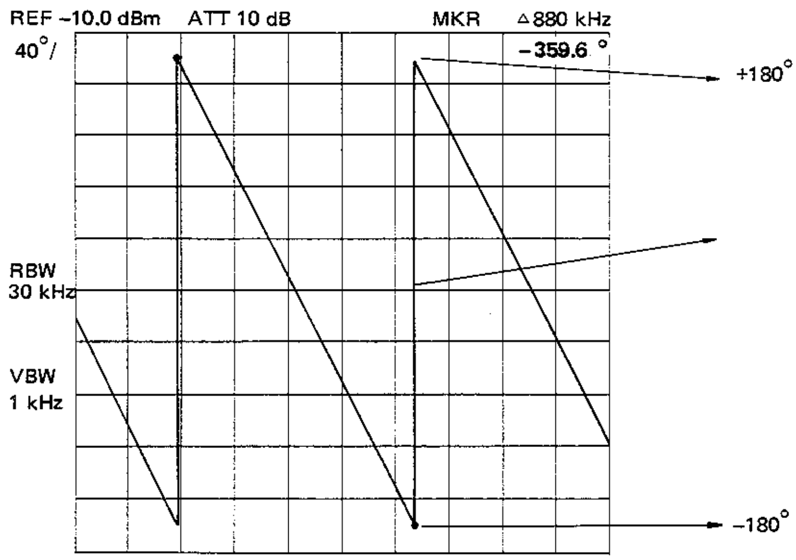


Fig. 6-10 Example of Phase Response Display

(2) The verical dotted lines indidate discontinuity points in the response at +180° and -180°.

(3) The center horizontal line (5 division lines from the top) indicates zero phase.

(4) Numeric displays indicate measurement conditions.

(5) This example shows the filter has a phase lag of about 360° over an approximately 880 kHz band.
For more accurate measurement, use delta marker mode.

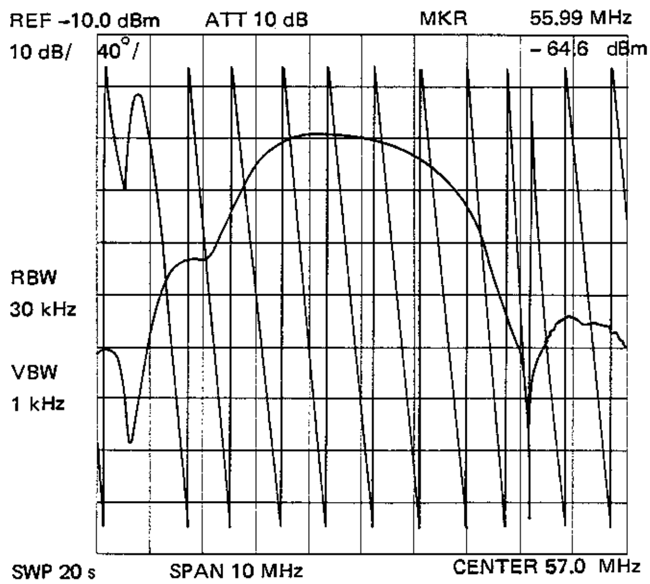
6-3-4. Usage of Dual Trace Mode

(1) Connect the DUT to the analyzer. Press the MAG key, measure the amplitude response of the DUT, and set the necessary measurement conditions.

(2) Follow the measurement procedure given in Section 6-3-2 to determine the phase resolution range and adjust the electrical length.

(3) Connecting the DUT and pressing [SHIFT] [MAG/PHASE PHASE] enables a simultaneous display of amplitude and phase responses.

[SHIFT] [MAG/PHASE PHASE]



(4) To return to normal measurement mode, press the [SHIFT] and [DUAL OFF] keys. This will put one of the trace memories A and B in WRITE mode and the other in VIEW mode. To clear unwanted information, put one of the trace memories in WRITE mode and the other in BLANK mode.

MEMO

SECTION 7

GROUP DELAY MEASUREMENT

7-1. GROUP DELAY MEASUREMENT PROCEDURE

This section describes the procedure for group delay measurement of amplifiers or filters.

(1) Set the center frequency, the frequency span, the resolution bandwidth, the input and output impedance of the analyzer, and other necessary conditions. Connect the TRACKING GENERATOR OUTPUT connector to the input of the amplifier of filter, and connect the output of the device to the INPUT connector of the TR4171.

(2) Press the MAG key to activate the tracking generator.

(3) Measure the pass-band response and select appropriate values for T.G. LEVE, INPUT ATT., and REF. LEVEL.

(4) The group delay response of the DUT can be observed by pressing the GROUP DELAY key. The screen will also display delay time per vertical division as XXns/ (or ps/ or ms/) in the top left display area. Press the DELAY SCALE key to select an appropriate range.

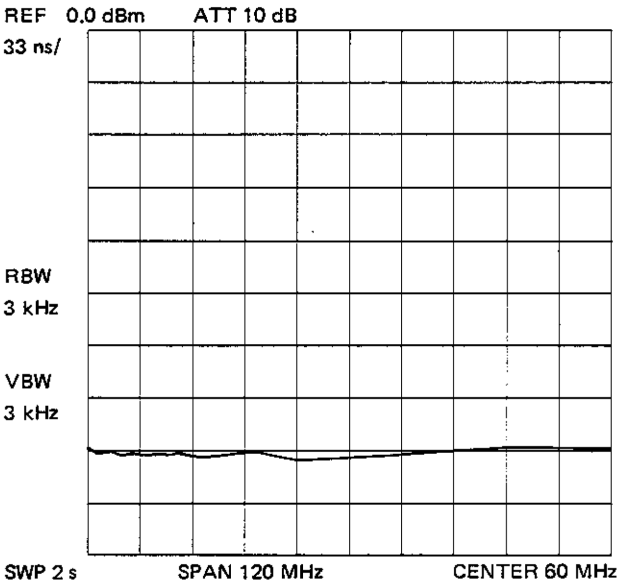
(5) For more accurate group delay measurement unaffected by the group delay of the measurement system itself, follow the procedure given below.

First, press the GROUP DELAY key to disconnect the DUT from the measurement system, then connect the cables to each other. Press the WRITE A key to write the group delay response of the measurement system into trace memory A. (If the indicator lamp on the WRITE A key is on, it is not necessary to press the key.)

When measuring with high resolution and the S/N ratio is low, press the VIDEO BW key of the FUNCTION keys to reduce the video bandwidth and increase the S/N ratio.

Do not change the conditions set in steps (1) to (5), except for that of step (4), during subsequent measurement.

(6) Press the SWEEP TIME key, then slow the sweep time until the waveform does not vary.
Then press the DISPL LINE key to generate the display line on the screen, and use DATA keys and DATA knob to position the display line on zero.



(7) To eliminate the group delay of the measurement system, press the NORM key.

> **CAUTION**
>
> If data of functions affecting the normalization standards, such as the center frequency, frequency span, and reference level, is altered during normalization, the subsequent normalization may not be executed normally. Therefore, after function data has been altered, execute the normalization procedure again from the beginning.

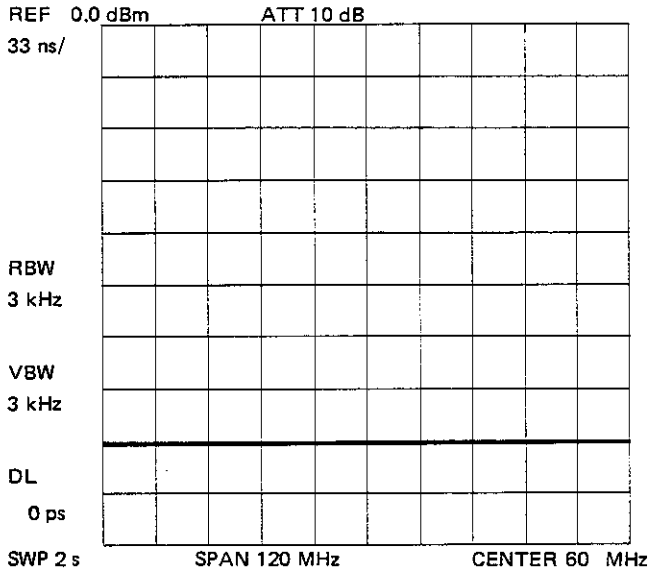


Fig. 7-1 With Measurement System Group Delay Eliminated

To cancel the group delay elimination of the measurement system, press [SHIFT] [NORM] .

(8) For more accurate measurement of group delay using this procedure, use the averaging function. (See Section 4-14.)
After pressing the WRITE A key in step (5) above, press the [AVG] key to initiate averaging.
When the programmed number of averagings is reached, follow steps (6) and (7) above, then press the [SHIFT] and [AVG] keys to cancel averaging mode.

(9) To obtain a better resolution for group delay measurement, press the DELAY SCALE key to enable resolution adjustment. The group delay resolution can be increased by turning the DATA knob clockwise because this expands the time axis. Pressing the DATA step up key has the same effect. The DATA keyboard cannot be used. A too-high resolution can result in overflow. If overflow occurs, press the DELAY OFFSET key to enable adjustment of electrical length, and then adjust the electrical length with the DATA knob or the DATA step keys to add an offset to the group delay.

(10) During group delay measurement, press the PHASE key occasionally to observe the phase response, and check whether the waveform is overflowing the screen.
The group delay of the overflowing positions will not be clear.
If phase slope is observed, press the DELAY OFFSET key and adjust the group delay offset with the DATA knob or DATA step keys until the response is flat.
For phase offset, press the PHASE OFFSET key and adjust the offset using the DATA knob or DATA step keys.

7-2. EXAMPLE OF GROUP DELAY MEASUREMENT

This section provides a specific example of the group delay measurement of a filter.

(1) Connect the TRACKING GENERATOR OUTPUT connector to the input of an amplifier or filter and connect the output of the amplifier or the filter to the INPUT connector of the TR4171.

(2) Press the MAG key to activate the tracking generator.

(3) Measure the passband response and select appropriate values for T.G. LEVEL, INPUT ATT., and REF. LEVEL. (See Figure 7-2.)

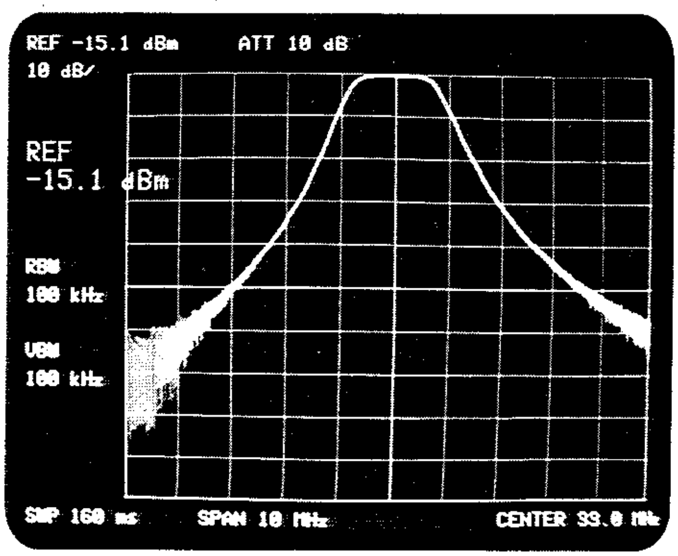


Fig. 7-2 Normal-mode Signal Response

(4) Disconnect the filter from the measurement system and connect the cables to each other to check the through frequency response.

(5) The through phase response can be observed by pressing the PHASE key. (See Figure 7-3.)

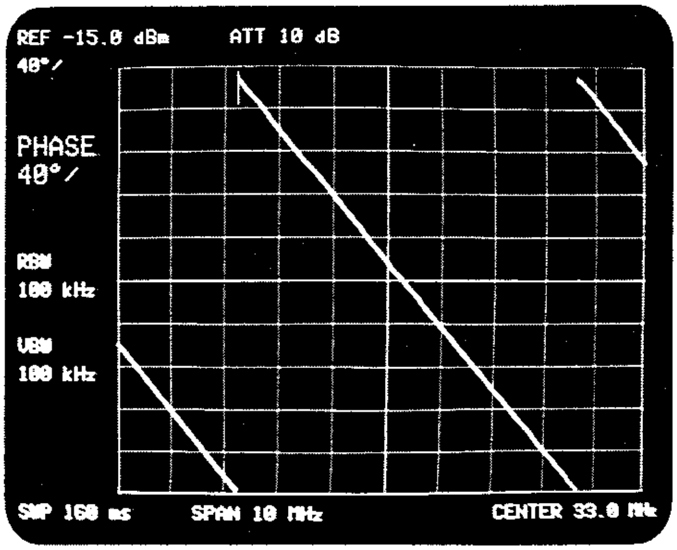
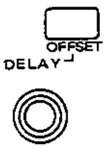


Fig. 7-3 Through Phase Response

(6) If phase slope is observed, press the DELAY OFFSET key to enable adjustment of the electrical length. Then adjust the phase response until it is flat with the DATA knob or DATA step keys. (See Figure 7-4.)



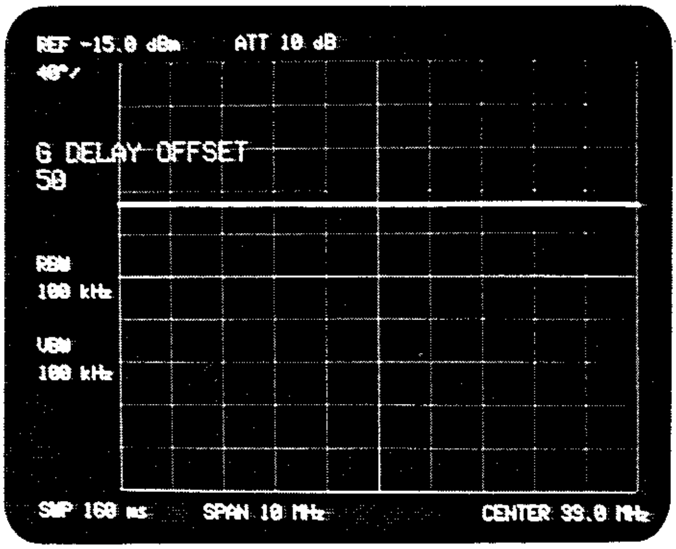


Fig. 7-4 Elimination of Phase Slope

(7) Next press the PHASE OFFSET key to enable entry of phase offset. Position the phase response trace at the center of the vertical axis on the screen with the DATA knob or the DATA step keys. (See Figure 7-5.)

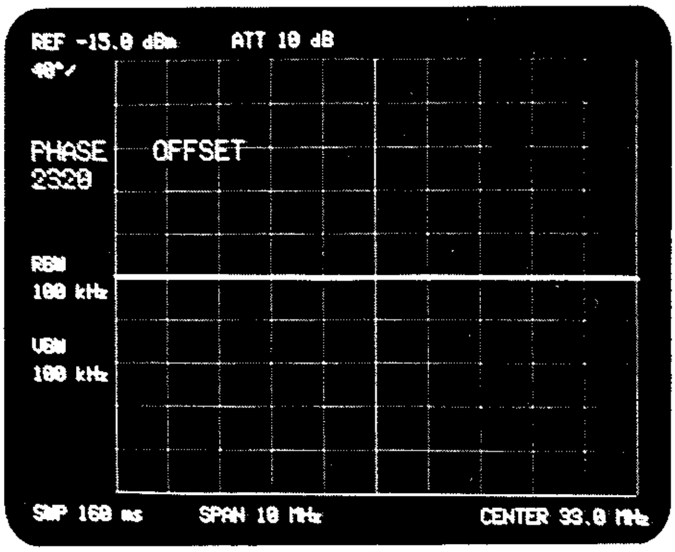


Fig. 7-5 Positioning the Phase Response Trace at the Center of the Vertical Axis

(8) The phase response of the filter can be observed by connecting it to the measurement system. (See Figure 7-6.)

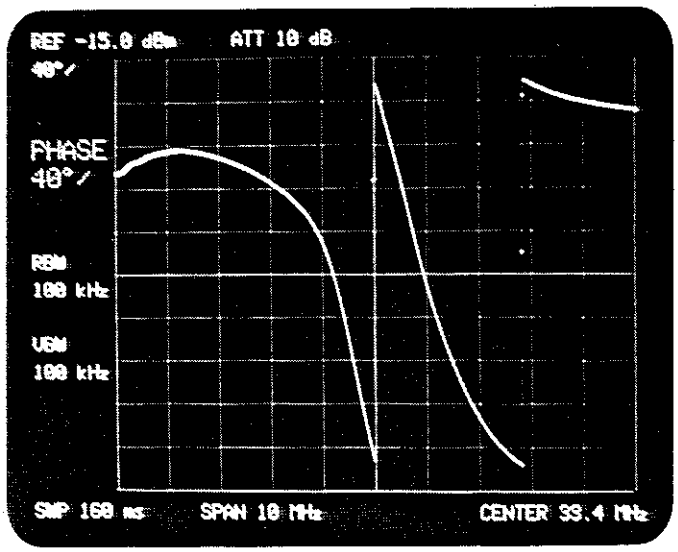


Fig. 7-6 Filter Phase Response

(9) The group delay of the filter can be observed by pressing the GROUP DELAY key. (See Figure 7-7.)

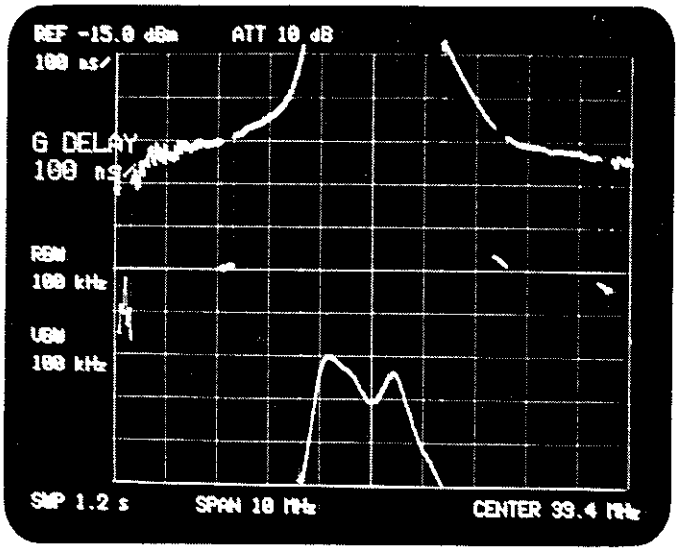
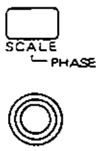


Fig. 7-7 Group Delay Observation

(10) To obtain a better resolution for group delay measuremet, it is necessary to increase the phase measurement resolution shown in Figure 7-6.

Press the PHASE SCALE key to enable phase adjustment, and turn the DATA knob clockwise to increase the phase resolution. (The phase display °/DIV. with increase.) (See Figure 7-8.)



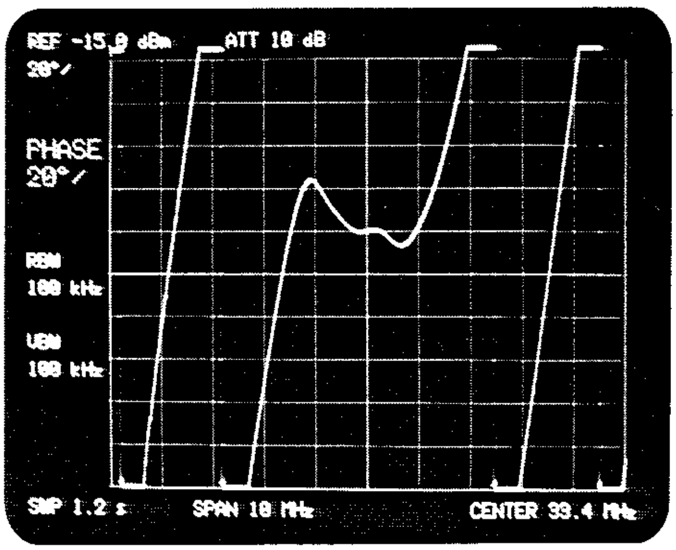


Fig. 7-8 Increasing Phase Resolution

(11) As described above, if the phase resolution is increased to increase the group delay resolution of the filter's passband to enable observation, the phase may overflow the passband.
If phase overflow occurs, press the DELAY OFFSET key to enable adjustment of the group delay offset, and then adjust the phase slope within the passband by turning the DATA knob.

(12) Group delay can be measured by pressing the GROUP DELAY key. (See Figure 7-9.)

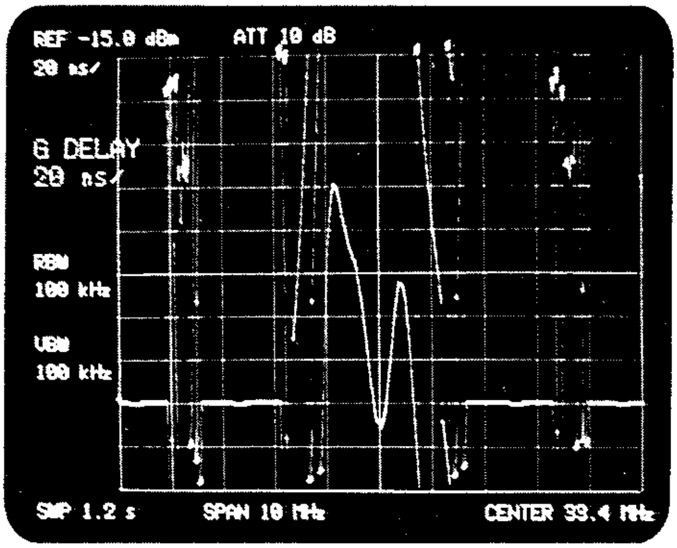


Fig. 7-9 Group Delay Measurement

(13) For more accurate group delay measurement, write the group delay of the through response into trace memory A with the same resolution, as described in Section 7-1, move the display line close to the through response trace, then press the NORM key to eliminate the group delay of the measurement system itself. Use of the averaging mode described in (8) of Section 7-1 will provide still more accurate measurement.

(14) If the S/N ratio is low, press the VIDEO BW key of the FUNCTION keys to narrow the video bandwidth and increase the ratio. For this, press the SWEEP TIME key and select a relatively long SWEEP TIME as described in (6) of Section 7-1.
A higher S/N ratio will be also obtained by selecting averaging mode by pressing [AVG] key again, after connecting the filter.

7-3. SIMULTANEOUS GROUP DELAY AND AMPLITUDE MEASUREMENT (Dual Trace Mode)

Press the [SHIFT] and [GROUP DELAY] (MAG/DLY) keys to provide alternate group delay and amplitude measurements. The results are written into trace memories B and A, respectively, and are then transferred to the display simultaneously. The indicator lamps on the GROUP DELAY, MAG WRITE A, and WRITE B keys light at the same time. To cancel dual trace mode, press the [SHIFT] and [DUAL OFF] keys. This simultaneous group delay and amplitude measurement mode can be used together with frequency response compensation mode activated by NORM key. An example of the measurement procedure for an amplifier or filter is given below.

(1) Connect the TRACKING GENERATOR OUTPUT to the input of the amplifier or filter, and connect the output of the device to the INPUT connector of the TR4171.

(2) Press the [MAG] key to measure the passband response and select appropriate values for T.G. LEVEL and INPUT ATT.

(3) Disconnect the device from the measurement system, and connect the cables to each other to check the through frequency response.

(4) Press the DISPL LINE key to generate the display line on the screen, and use the DATA step keys and the DATA knob to position the display line as close to the through frequency response as possible.

(5) Press the [SHIFT] and [GROUP DELAY] (MAG/DLY) keys to specify simultaneous group delay and amplitude measurement mode.

(6) Pressing the [NORM] key normalizes both the amplitude and group delay response traces. In this case, amplitude response trace is normalized on the display line, and the group delay response trace is normalized on the second lowest graticle line on the screen.

(7) The response traces of the device's amplitude and group delay can be observed simultaneously.

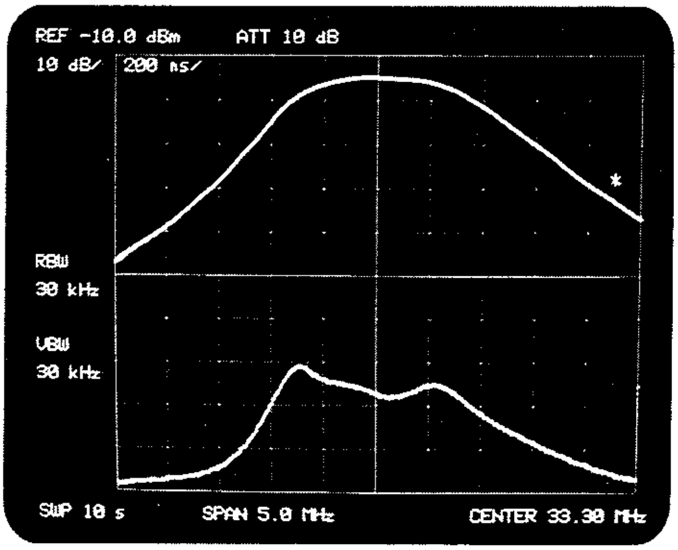


Fig. 7-10 Simultaneous Group Delay and Amplitude Measurement

7-4. APERTURE CONTROL

In general, a higher group delay resolution lowers the S/N ratio. However, the group delay resolution can be increased without sacrificing the S/N ratio by increasing the aperture. The aperture is the quantity ΔF in the group delay equation Δθ/ΔF.

In the TR4171, the aperture is normally set as follows:

$$\Delta F = \frac{24}{1000} \times \text{frequency span}$$

The constant 24/1000 in this equation can be increased as far as 192/1000 in four steps, as described below.

(1) Aperture control is possible only when the group delay measurement resolution is at least 4/(frequency span). Press the GROUP DELAY key to confirm that the current resolution satisfies this condition.

(2) Pressing the [SHIFT] and [APERTURE] keys enables adjustment of the aperture. APERTURE 24 will be displayed on the left side of the screen to indicate that the current aperture is 24/1000 x (frequency span).

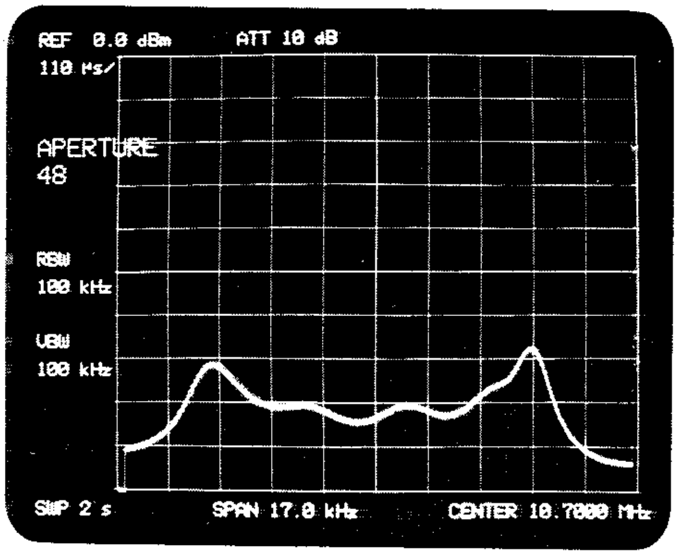
If the condition resolution <4/(frequency span) is not satisfied, the aperture can not be activated, so APERTURE 24 will not be displayed on the screen.

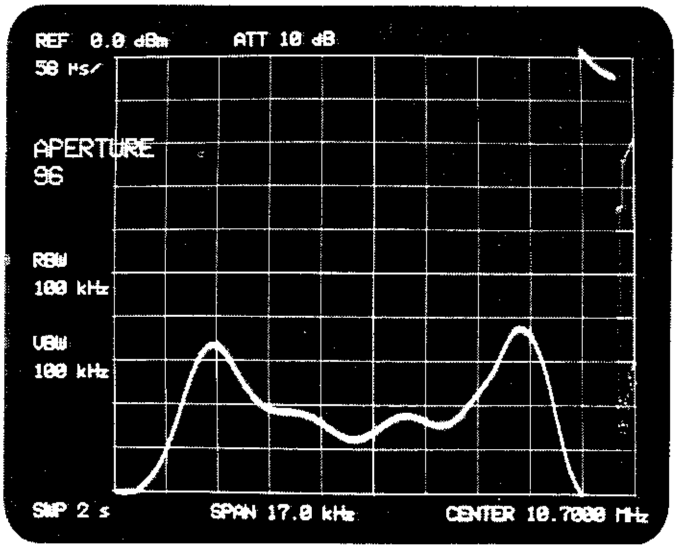
(3) Select the appropriate aperture from 24, 48, 96, or 192 with the DATA knob or the DATA step keys. The DATA keyboard cannot be used. Once aperture has been increased, the resolution can be increased without sacrificing the S/N ratio. For example, if the resolution is 100 ns/div. with an aperture of 24/1000, the resolution can be increased to 50 ns/div. by changing the aperture to 48/1000.

(4) As the aperture increases, the effective range between the graticules on the screen gradually narrows accordingly. This is because (aperture/2 - 12) points of the 1001 points along the frequency axis are lost at each side of the axis as perture increases.

For this reason, when the aperture is increased to 192, the effective range of the axis is reduced by one division at each side of the screen.

(5) Pressing the GROUP DELAY key clears active aperture mode, and returns the analyzer to active group delay resolution mode.

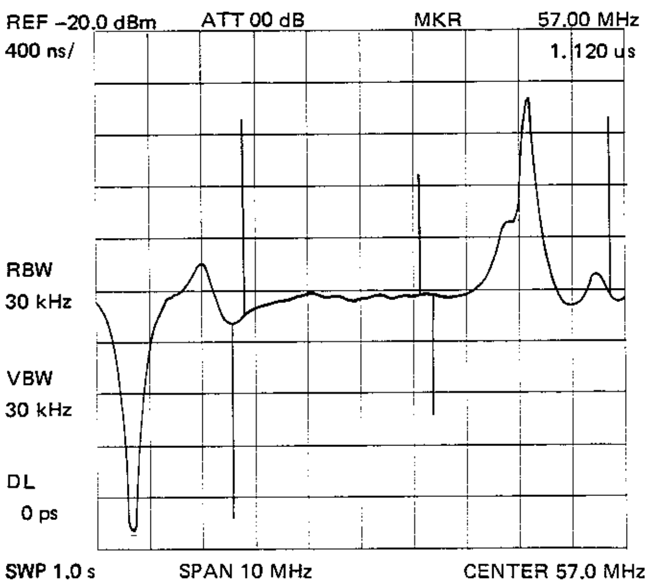




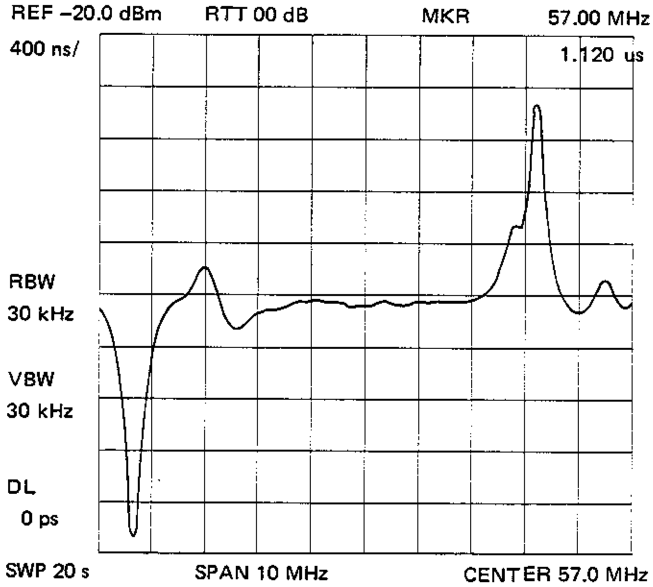
During group delay measurement, spike noise may occur in the signal response trace on the screen, as shown below. To eliminate this noise, use either of the following methods.

(1) Select a sufficiently long sweep time.

(2) Correct the electrical length to eliminate discontinuity points in the phase response, so that ripple in the group delay can be measured. Note that absolute delay time cannot be measured.




SWEEP TIME


REF -20.0 dBm
RTT 00 dB
MKR
57.00 MHz
400 ns/
1.120 us
RBW
30 kHz
VBW
30 kHz
DL
0 ps
SWP 20 s
SPAN 10 MHz
CENTER 57.0 MHz

MEMO

SECTION 8

CONNECTION AND PROGRAMMING OF GP-IB

8-1. INTRODUCTION

The standard General Purpose Interface Bus (GP-IB) interface connects TR4171 to the instrumental bus GP-IB (IEEE Standard 488-1978).
This section describes the specifications and functions of the GP-IB interface.
*GP-IB: General Purpose Interface Bus

8-2. General Description of GP-IB Interface

The GP-IB interface connects the measurement device to the controller, and peripheral equipment with a simple cable (bus line).
Compared to old interface systems, this interface has more extended functions and is easier to use. It is electrically, mechanically, and functionally compatible with other manufacturers' products. With one bus cable, it can create an advanced automatic instrumental system as well as a simple system.
To operate the GP-IB interface system, set the address for the equipment connected to the bus line. Each component of the system can act as a controller, talker, and/or listener. When the system is operating, only one talker can send out data to the bus line, and one or more listeners can receive the data. A controller specifies the address of a talker and listener, and transfers data from the talker to the listener. It (or the talker) can also specify measuring conditions to the listener.
Eight bit-parallel and byte-serial data lines are used to transfer data between the equipment.
Data is asynchronously sent in both directions; therefore, both high-speed and low-speed equipment can be connected to the system.
Data (messages) transferred between equipment is indicated in the ASCII code and includes measurement data, measuring conditions (program), commands, etc.
The GP-IB system has 3 handshake lines to control asynchronous data transfer, and 5 control lines to control the flow of data in the bus, besides the 8 data lines mentioned previously.

- The following signals are used in the handshake line:
  - Data Valid (DAV) : Indicates whether data can be received or not.
  - Not Ready For Data (NRFD) : Indicates whether data can be received or not.
  - Not Data Accepted (NDAC) : Indicates that reception is incomplete.
- The following signals are used in the controller line:
  - Attention (ATN) : Indicates whether the signal in the data line includes an address, a command, or other information.
  - Interface Clear (IFC) : Clears the interface.

End or Identify (EOI) : Indicates the end of data transfer.

Service Request (SRQ) : Requests service to the controller from equipment.

Remote Enable (REN) : Remote controls equipment that can be remote programmed.

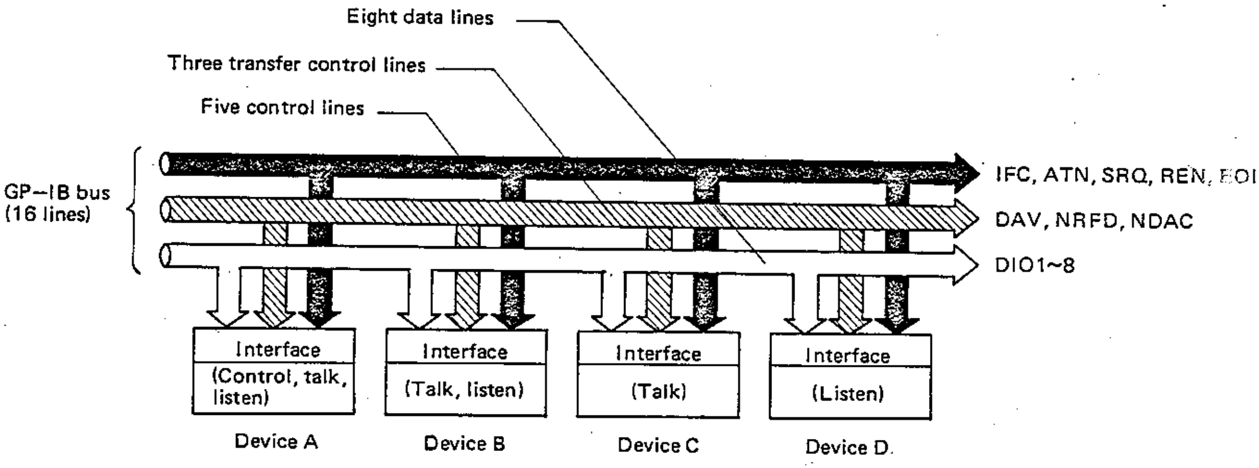


Figure 8-1. General description of GP-IB interface

8-3. STANDARD

8-3-1. GP-IB Specifications

Standard	: IEEE Standard 488-1978
Code	: ASCII Binary code is used for the packed format.
Logical level	: Logical 0 high state: Over +2.4 V Logical 1 low state : Below +0.4 V
Signal line terminal	: The 16-bus lines terminate as follows:

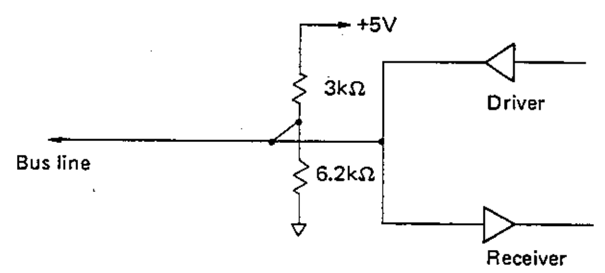


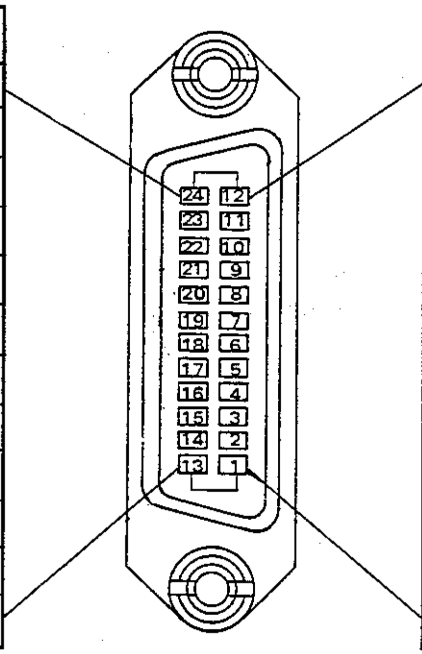
Fig. 8-2 Signal line terminal

Driver specifications	: Open-collector type Output voltage in low state: Below +0.4 V, 48 mA Output voltage in high state: Over +2.4 V, -5.2 mA
Receiver specifications	: Low state at less than +0.6 V High state at more than +2.0 V
Bus cable length	: Below the number of devices connected to the bus multipled by 2 m, and no longer than 20 m.

Addressing : Up to 31 talk and listen addresses can be set by the address selecting switch on the rear panel. Enter the MASTER RESET key after switching the address selecting switch.

Connector : 24-pin GP-IB connector
57-20240-D35A (Amphenol or its equivalent)

Signal Name	Pin No.
GND LOGIC	24
GND (ATN)	23
GND (SRQ)	22
GND (IFC)	21
GND (NDAC)	20
GND (NRFD)	19
GND (DAV)	18
REN	17
DIO8	16
DIO7	15
DIO6	14
DIO5	13



24-pin GP-IB connector

Pin No.	Signal Name
12	SHIELD
11	ATN
10	SRQ
9	IFC
8	NDAC
7	NRFD
6	DAV
5	EOI
4	DIO4
3	DIO3
2	DIO2
1	DIO1

Fig. 8-3 GP-IB connector pin assignment

8-3-2. Interface Functions

Table 8-1 Interface functions

Code	Function and Description
SH1	Source handshake
AH1	Acceptor handshake
T6	Basic listener function, serial poll, and talker unaddressing function (unaddressed to talk if addressed to listen)
L4	Basic listener function, and listener unaddressing (unaddressed to listen if addressed to talk)
SR1	Service request
RL1	Remote function
PP0	No parallel function
DC1	Device clear function
DT0	No device trigger
C0	No controller function
E1	Uses open collector bus driver. EOI and DAV use E2 (uses the three-state bus driver).

8-4. GP-IB Handling Method

8-4-1. Connecting Components

The GP-IB system should be connected with care because the system consists of a number of devices. Follow these notes when connecting the system:

(1) Check preparation and operation of each device before connecting them to the system, according to the instruction manuals for the TR4171, controller, peripheral equipment, etc.

(2) The connecting cable and the bus cable should not be longer than necessary. Be sure that the bus cable is no longer than 20 m, and is shorter than 2 m multiplied by the number of devices connected to the bus. The following table shows the standard bus cables available at Advantest:

Table 8-2 Standard bus cable (optional)

Length	Name
0.5 m	408JE-1P5 (DCB-SS1076x01-1)
1 m	408JE-101 (DCB-SS1076x02-1)
2 m	408JE-102 (DCB-SS1076x03-1)
4 m	408JE-104 (DCB-SS1076x04-1)

(3) Piggyback connectors having female and male connectors in one are used for the bus cable. They can be used on one another. When connecting the bus cable, use no more than three connecters on top of one another. Fasten the connecters tightly with the counter screws.

(4) Check the power source and earth, and setting condition where necessary, before turning on the power of each device.
Turn on the power of all devices connected to the bus, or else the system may not operate.

8-4-2. Setting GP-IB Address

The DIP switch (Figure 8-4) on the rear panel of TR4171 is used to set the addresses in the GP-IB.

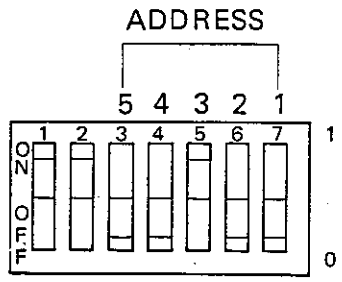


Fig. 8-4 ADDRESS switch

Set the first to the fifth bits to 0 or 1 to specify the address in GP-IB. Table 8-3 lists the setting of the switch and the address it specifies.

CAUTION

Enter the MASTER RESET key after setting the ADDRESS switch. The GP-IB will be cleared temporarily directly after the MASTER RESET key is entered.

8-5. Programming

The GP-IB controller can remote program all TR4171 functions. The following are examples of programs by the HP Series 200 Computer and the TR4511 Optional Controller.

```
Example:  Program
            Center frequency:  3.5 MHz
            Frequency span   :  500 kHz
            Reference level  :  -10 dBm
```

HP Series 200 Computer

```
OUTPUT 7 01: "CF 3.5MZ SP 500KZ RE 10DM"
                              Frequency
                              span
                        Specify 500 kHz
                            Reference level
                                          Specify -10 dBm
                        Specify 5GHz
                       Center frequency
                    GP-IB address of TR4171
                   Select the GP-IB interface
                 Address controller to talk
```

TR4511 Optional Controller

```
OUTPUT 1: "CF 3.5MZ SP 500KZ RE 10DM"
                            See the example of the HP Series 200 Computer program
                     GP-IB address of TR4171
                  Address controller to talk
```

Codes such as CF, MZ and SP in the program are GP-IB commands corresponding to the switches on the front panel of TR4171. These commands are listed in Table 8-4.

Input the program by entering with the front panel keys. Directions for key operation are shown in Figure 8-5. First, select the desired function and input the data and termination.

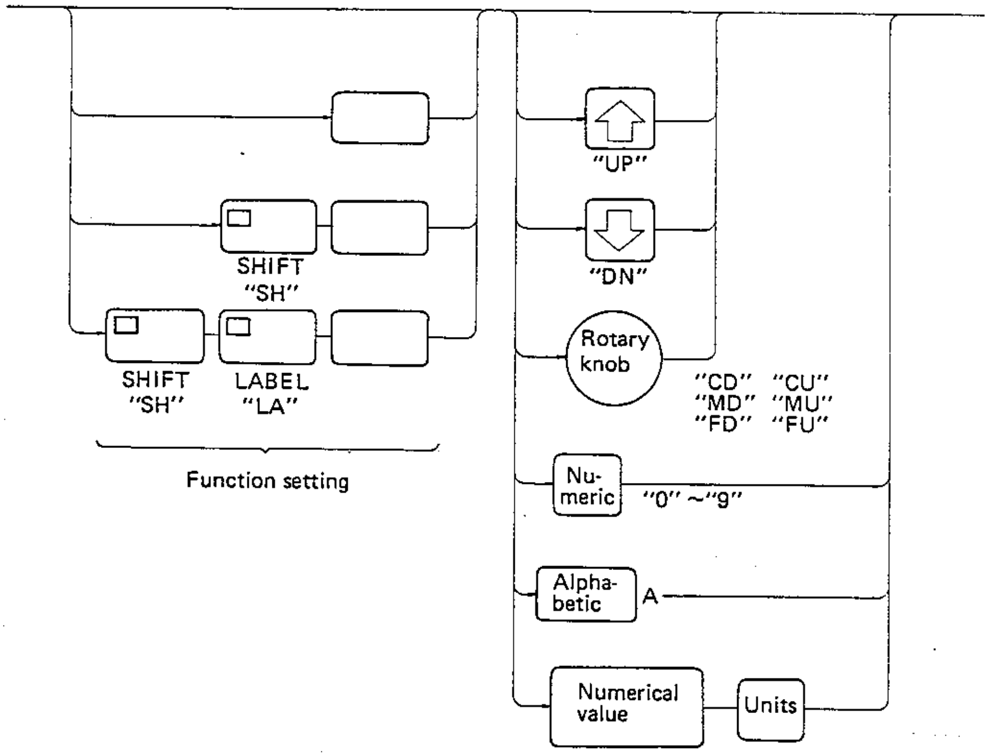


Fig. 8-5 Operation of panel switch

When using the shift or double shift key, enter the code for the main key, after SH or SHLA. Use the keys UP, DN, 0 to 9, ., and alphabet (ASCII, capital letters) to input data. For alphabetic data, input the program code corresponding to the keys.
The data amounts: COARSE, MEDIUM, and FINE, can be specified by turning the data knob. Turn clockwise to specify CU, MU, or FU, and counterclockwise to specify CD, MD, or FD.
The clockwise CU, MU and FU stand for COARSE, MEDIUM and FINE respectively; similarly, the anticlockwise CD, MD and FD stand for COARSE, MEDIUM, and FINE, respectively. These data amounts do not apply to all TR4171 functions. The following functions can use these data amounts:

CENTER FREQ., FREQ. SPAN, START FREQ., STOP FREQ., REF. LEVEL, PHASE OFFSET, GROUP DELAY OFFSET, GROUP DELAY OFFSET FINE, APERTURE, MARKER, MARKER, DISPLAY LINE

CAUTION

Use the ASCII code in capital letters for programming. Small letters, blanks, and codes other than the definition codes described in Section 8-4 will be ignored.

8-6. DATA INPUT AND OUTPUT

The basic commands listed below and their extended functions are used to output data from TR4171 to the GP-IB.

OA: Outputs active data.

MF: Outputs marker frequencies.

ML: Outputs marker levels.

TO: Outputs trace memory data in decimal notation.

RD: Outputs any TR4171 memory data.

The following basic commands are used to input data from the GP-IB to TR4171.

LD: Inputs data to any TR4171 memory.

TI: Inputs data to TR4171 trace memory in decimal notation.

Use the commands according to their purpose. The directions for using the commands and their formats are set out in the following paragraphs.

> **CAUTION**
>
> All memories in TR4171 can be accessed from the GP-IB; however, do not write data in spaces other than in the memories mentioned below because the data will not be protected and the system software may be damaged.

8-6-1. OA Command

The Output Active Data (OA) command outputs active data in numeric values when TR4171 is addressed to talk. It can be used to output data for any active function. A function is active when the function name and data are displayed largely on the left side of the TR4171 display. To specify an active function, send the command for the function to TR4171 by entering the panel keys. The following is an example of a program using the OA command to output center frequency:

HP Series 200 Computer

```
10:DIM A$ [24]
20:OUTPUT 701; "CFOA"
30:ENTER 701;A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$(24)
20:OUTPUT 1:"CFOA"
30:ENTER 1:A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 24 bytes for the string variable A$.
20	20	Activate the center frequency of TR4171. Specify output of the active data.
30	30	Address TR4171 to talk and receive the data. TR4171 will output the active data.
40	40	Display the input data. (Ex. 3.5727E + 3 ← 3.5727 kHz)
50	50	End of program.

This example can also be programmed as shown below because the OA command outputs data in numeric values.

HP Series 200 Computer

```
10:OUTPUT 701; "CFOA"
20:ENTER 701;A
30:DISP A
40:END
```

TR4511 Optional Controller

```
10:OUTPUT 1:"CFOA"
20:ENTER 1:A
30:DISP A
40:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Activate the center frequency of TR4171. Specify output of the active data.
20	20	Address TR4171 to talk and receive the data. TR4171 will output the data.
30	30	Display the input data. (Ex. 3572.7 ← 3.572 kHz)
40	40	End of program.

If the marker is activated, the marker frequency and marker level will be displayed on the left side of the TR4171 display. The display will look like this:

MARKER

50MHz

-10 dBm

The OA command will only output the frequency displayed on the second line. When two data are active at the same time like this example, the OA command will only output the data shown above.

Output data format of the OA command

```
␣DDDDDDDDDDD. DDDDDDDDE±DCRLF
|   |                   |
|   |                   |              (EOI)
|   |                   |________        |
|   |                            |     Block delimiter
|   |                            |
|    Fractional part             |
|    (Displayed on TR4171 display)    Exponent part
|__ Data code
    (Displayed on TR4171 display)
```

Up to 24 bytes can be used for the data, excluding block delimiters. Declare more than 24 bytes for the array when inputting data in string variables from the GP-IB controller. EOI will be output with bytes CR, LF, and LF for block delimiters.

In the OA mode, data is converted and output as frequency or time data. It is converted as follows:

Hz → E+0, kHz → E+3, MHz → E+6,
s → E+0, ms → E-3, μs → E-6,
ns → E-9, ps → E-12

The data code and fraction part of the data are displayed on the TR4171 display. If data other than frequency and time data is to be output, the units will not be converted, and only the data code, fraction part and block delimiter will be output. If the data is not read as numeric data, for example LIN x 1, TR4171 will only output the block delimiter and will not output the numeric data.

The following program is an example for outputting data other than frequency and time data. This program outputs the data on the vertical scale of the TR4171 display.

HP Series 200 Computer

```
10:DIM A$ [24]
20:OUTPUT 701;"SH9OA"
30:ENTER 701;A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$(24)
20:OUTPUT 1:"SH9OA"
30:ENTER 1:A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 24 bytes for the string variable A$.
20	20	Specify 2 dB/ for the vertical scale of the TR4171 display, and activate the scale data. Specify output of the active data. Address TR4171 to talk and receive the data.
30	30	TR4171 will output the scale data because the data is active.
40	40	Display the input data. (Ex. 2 ← 2 dB/)
50	50	End of program.

The output data is indicated on line 30.

TR4171 will only output the number 2 and will ignore the unit dB/ because the data is not frequency or time data.

The program can also be programmed as follows:

HP Series 200 Computer

```
10:OUTPUT 701; "SH9OA"
20:ENTER 701;A
30;DISP A
40;END
```

TR4511 Optional Controller

```
10:OUTPUT 1: ".SH9OA"
20:ENTER 1:A
30:DISP A
40:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Specify 2 dB/ for the vertical scale of the TR4171 display, and activate the scale data. Specify output of the active data.
20	20	Address TR4171 to talk and receive the data. TR4171 will output the scale data because the data is active. (Ex. 2 ← 2 dB/)
40	40	End of program.

CAUTION

The OA command checks whether the data to be output is numeric data, with character codes. It checks each character one by one and if it finds a code other than +, -, 0 to 9, H, k, M, s, m, μ, n, p, ".", ",", /, or ␣ , it stops converting, outputs the block delimiter and ends. The command ignores codes such as ␣, ",", and /, and will not output these codes.

8-6-2. OALD73C4 (A) (B) Command

This command is an extended function of the OA command. It can output any data displayed on the TR4171 display without activating the function.

The following program is an example for reading out the VBW data using the OALD73C4 (A) (B) command.

HP Series 200 Computer

```
10:DIM A$[10]
20:OUTPUT 701;"OALD73C40800A0DD"
30:ENTER 701;A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$
20:OUTPUT 1;"OALD73C40800A0DD"
30:ENTER 1;A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 10 bytes for the string variable A$.
20	20	Specify output of 0008 byte data from address DDA0 on the display, in the OA output format. (See Figures 8-6 and 8-7.)
30	30	Address TR4171 to talk and receive the data. TR4171 will output the specified data (VBW).
40	40	Display the input data. (Ex. 100E + 3 ← 100 kHz)
50	50	End of program.

This example can also be programmed in the following way because, like the OA command, the OALD73C4 (A) (B) command converts units to exponents and outputs them in numbers.

HP Series 200 Computer

```
10:OUTPUT 701:"OALD73C40800A0DD"
20:ENTER 701:A
30:DISP A
40:END
```

TR4511 Optional Controller

```
10:OUTPUT 1:"OALD73C40800A0DD"
20:ENTER 1:A
30:DISP A
40:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Specify output of 0008 byte data from address DDA0 on the display, in the OA output format. (See Figures 8-6 and 8-7.)
20	20	Address TR4171 to talk and receive the data. TR4171 will output the specified data (VBW).
30	30	Display the input data. (Ex. 100000 ← 100 kHz)
40	40	End of program.

Procedure for using the OALD73C4 __(A)__ __(B)__ command and the output data format

This command can output any data displayed on the TR4171 display while the OA command can only output active data. To output data by the OALD73C4 (A) (B) command, first find the start address and number of bytes for the data in Figures 8-6 and 8-7. Then, enter them in the positions (A) and (B). For example, in the above example the VBW data is hexadecimal data and the start address is DDA0. Enter the address A0DD in the order of lower and upper, in (B).

The data is 8 bytes including spaces, in hexadecimal notation. Enter the bytes 0800, in the order of lower and upper, in (A). As mentioned in the previous CAUTION, be sure to enter numbers for the start address.

The output data format is the same as that in the OA command. A total number of 2 bytes plus the number of bytes specified in (A) can be used in the format.

Declare extra bytes for the array if string variables are going to be input from the GP-IB controller.

The start address and bytes for the center frequency, stop frequency, marker frequency, and marker level counter frequency differ according to the setting and resolution. To output these frequencies with the OALD73C4 (A) (B) command, specify the following start addresses and bytes.

	Start Address	Bytes
Marker Frequency (Counter)	DC55	26
Marker Level (Counter)	DC97	14

Marker (counter) frequency and marker (counter) level data can easily be output by using the MF and ML commands explained in the following sections.

The counter frequency and stop frequency can easily be output by activating the function and using the OA command.

CAUTION

The OALD73C4 command is block 14 bytes and is read as a serial command; therefore, only enter valid data in the command.

A block delimiter can be used to separate OA and LD73C4 (A) (B).

For example:

```
OUTPUT 701;"OA"
OUTPUT 701;LD73C4 __(A)__ __(B)__"
```

However, it cannot be used to separate LD73C4 and (A) (B).

For example:

```
OUTPUT 701;"LD73C4"
OUTPUT 701;"__(A)__ __(B)__"
```

In old models such as the TR4171, TR4172, and TR4170, the OALD73C5 command was used. This command must not be used instead of the OALD73C4 command in the new TR4171 because it will not work properly.

When sending the command to TR4171, use EOI with bytes CR, LF, or only use CR for the block delimiter.

8-6-3. MF Command

The Marker Frequency Output (MF) command is used to output marker frequency data when TR4171 is addressed to talk. The following examples are programs for reading out marker frequency data, using the MF command.

HP Series 200 Computer

```
10:DIM A$[26]
20:OUTPUT 701:"MKMF"
30:ENTER 701:A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$ (26)
20:OUTPUT 1:"MKMP"
30:ENTER 1:A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 26 bytes for the string variable A$.
20	20	Set the marker of TR4171 to ON. Specify output of the marker frequency data.
30	30	Address TR4171 to talk, and receive the data.
40	40	Specify the input data. (Ex.␣MKR␣␣␣␣␣␣437.2895916␣MHz)
50	50	End of program.

Use string variables to input data from the GP-IB controller because the MF command can output string data.

- Output data format of the MF command

In the marker mode

```
MKR DD XYDDDDDDDD.DDDXXX CRLF
                          (EOI)
                            └ Block delimiter
                    Unit (GHz, MHz, kHz, ␣Hz)
      Mode*1
    Marker No.*2
 └Marker mode            └Data division
                          (Decimal point + Maximum of 11 digit numerals)
                  Code ("␣":"-":-)
```

In the counter mode

```
CNTR DD XY DDDDDDDD.DDD XXXCRLF
 |    |  ||           |  |  (EOI)
 |    |  ||___________|  |    └Block delimiter
 |    |  |Mode*1      |  |Unit (GHz, MHz, kHz, ␣Hz)
 |   Marker mode      | Data division
 Frequency counter    | (Decimal point + Maximum of 11 digit numerals)
 and T.G. counter     |
 mode               Code ("␣":+,"-":-)
```

*1. Mode:

d: Delta mode

z: Zoom mode

␣: Other marker modes

*2. Marker no.:

␣1 to 10: Multi marker mode

␣␣ : Single marker mode

Data in the marker and the counter modes are output in the format shown above. The array of the data is 26 bytes fixed; therefore, extra bytes should be declared for the array of string variables. The position of the decimal point and quantity of data in the data division are displayed on the TR4171 display. If the data division is less than 10 digits, 11 significant digits are shifted to the front of the marker or counter and are output as space codes.

In the MF mode, EOI is output with bytes CR, LF and LF for the block delimiter.

If the MF command is specified when the system is not in the marker or counter mode, TR4171 will only output the space codes and block delimiters. In the counter mode, the marker and counter headers, space codes, and block delimiters are included in the frequency counter, and data are output as space codes.

Non-ASCII codes, which are peculiar to TR4171, are converted into the following ASCII codes:

Ω → ␣, Δ→d, "→", 0 → *, μ → u

The MF command only outputs data in the delta, zoom, and multi modes. The directions for reading out frequency data in the counter mode and marker mode are explained in the programming examples.

8-6-4. MFLD73C4 (A) (B) Command

This command is an extended function of the MF command. It is used to output any character displayed on the TR4171 display.
The following examples are programs for outputting marker level data, using this command.

HP Series 200 Computer

```
10:DIM A$ [14]
20:OUTPUT 701;"MFLD73C40E0099DC"
30:ENTER 701;A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$ (14)
20:OUTPUT 1:"MFLD73C40E0099DC"
30:ENTER 1:A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 14 bytes for the string variable A$.
20	20	Specify TR4171 to output byte 000E (marker level) from address DC99 in the display. (See Figures 8-6 and 8-7.)
30	30	Address TR4171 to talk and receive the data. TR4171 will output the specified data (marker level).
40	40	Display the input data. (Ex. -19.7 dBm)
50	50	End of program.

Like the MF command, the MFLD73C4 (A) (B) command outputs data in strings; therefore, use string variables to input data from the GP-IB controller.

Procedure for using the MFLD73C4 (A) (B) command and the output data format

This command can output any character displayed on the TR4171 display, whereas the MF command can only output marker frequency data. To output data using the MFLD73C4 command, first find the start address and number of bytes of the data in Figures 8-6 and 8-7.

Then, enter them in positions (A) and (B).

For example, in the previous example, the marker level character is a hexadecimal digit and its start address is DC99. In this case, enter the address 99DC (in the order of lower and upper) in (B), and then enter the bytes 0E00 (in the order of lower and upper) in (A).

The data are all output in ASCII codes. Characters peculiar to TR4171 are converted into the following:

Ω → ␣, Δ →d, "→", 0 → *, μ → u

If string variables are going to be input from the GP-IB controller, declare more bytes than the amount specified in (A) because space codes will be output with the data.

CAUTION

This command is block 14 bytes and is read as a serial command; therefore, only enter valid data in the command. A block delimiter can be used to separate MF and LD73C4.

For example:

```
OUTPUT 701; "MF"
OUTPUT; "LD73C4  (A)     (B)  "
```

However, don't use it to separate LD73C4 and (A) (B).

For example:

```
OUTPUT 701 "LD73C4"
OUTPUT 701; "  (A)     (B)  "
```

In old models such as TR4171, TR4172 and the TR4170, the MFLD73C5 command was used. This command must not be used instead of the MFLD73C4 command in the new TR4171 because it will not work properly.

When sending the command to TR4171, use EOI with bytes CR, LF, or only CR for the block delimiter.

8-6-5. ML Command

The Marker Level Output (ML) command is used to output marker level data when TR4171 is addressed to talk. The following example is a program for reading out marker level data, using the ML command.

HP Series 200 Computer

```
10:OUTPUT 701;"ML"
20:ENTER 701;A
30:DISP A
40:END
```

TR4511 Optional Controller

```
10:OUTPUT 1:"ML"
20:ENTER 1:A
30:DISP A
40:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Specify TR4171 to output the marker level data.
20	20	Address TR4171 to talk and receive the data.
30	30	Display the input data. (Ex. -19.7 ← 19.7 dBm)
40	40	End of program.

String variables are not required for inputting data from the GP-IB controller because data is output in numeric values in the ML command.

Output data format of the ML command

The ML command outputs data in the same format as in the OA command. Up to 14 bytes can be used for the data output, excluding the block delimiter.

8-6-6. MLLD73C4 (A) (B) Command

This command is an extendded function of the ML command and is used to output any data displayed on the TR4171 display, in the same format as in the ML command.
The following example is a program for reading out sweep time data, using the MLLD73C4 (A) (B) command.

HP Series 200 Computer

```
10:OUTPUT 701;"MLLD73C40700F3DD"
20:ENTER 701;A
30:DISP A
40:END
```

TR4511 Optional Controller

```
10:OUTPUT 1:"MLLD73C40700F3DD"
20:ENTER 1:A
30:DISP A
40:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Specify TR4171 to output the 0007 byte data (sweep time) from address DDF3 in the display. (See Figures 8-6 and 8-7.)
20	20	Address TR4171 to talk, and receive the data. TR4171 will output the specified data (sweep time).
30	30	Display the input data.
40	40	End of program.

This command can also read out string variables, similarly to the OA command.

HP Series 200 Computer

```
10:DIM A$[9]
20:OUTPUT 701;"MLLD73C40700F3DD"
30:ENTER 701;A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$(9)
20:OUTPUT 1:"MLD73C40700F3DD" ENTER 1:A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 9 bytes for the string variable. 9 bytes are needed because 2 bytes plus the specified number of bytes will be output. This is explained in Section 8-6-2.
20	20	Specify TR4171 to output 0007 byte data (sweep time) from address DDF3 on the display. (See Figures 8-6 and 8-7.)
30	30	Address TR4171 to talk, and receive the data. The TR4171 will output the specified data (sweep time).
40	40	Display the input data. (Ex. 190E-3 ← 190 ms)
50	50	End of program.

Procedure for using the MLLD73C4 (A) (B) command and the output data format

This command can output any data displayed on TR4171 whereas the ML command can only output marker level data. To output data by the MLLD73C4 command, first find the start address and the number of bytes of the data from Figures 8-6 and 8-7. Then, enter them in positions (A) and (B). For example, in the previous example the sweep time data is a hexadecimal value and its start address is DDF3.

In this case, enter the address F3DD (in the order of lower and upper) in (B), and then enter the bytes 0700 (in the order of lower and upper) in (A).

The data will be output in the same format as that in the ML and the OA commands. Up to 2 bytes plus the number of bytes specified in (A) can be used for the output (excluding block delimiters).

The MLLD73C4 command and the OALD73C4 command can be used similarly because they are decoded and executed in exactly the same way.

CAUTION

The MLLD73C4 command is 14 bytes block and is read as a serial command; therefore, only enter valid data in the command. A block delimiter can be used to separate ML and LD73C4 (A) (B).

For example:

```
OUTPUT 701;"ML"
OUTPUT 701"LD73C4__(A)___ __(B)__"
```

However, do not use it to separate LD73C4 and (A) (B).

For example:

```
OUTPUT 701;"LD73C4"
OUTPUT 701;"__(A)___ __(B)__"
```

In old models such as TR4171, TR4172 and TR4170, the MLLD73C5 command was used. This command must is not be used instead of the MLLD73C4 command in the new TR4171 because it will not work properly.

When sending the command to TR4171, use EOI with bytes CR, LF, or only CR for the block delimiter.

8-6-7. TO Command

The Trace Data Decimal Output (TO) command is used to output waveform trace memory (A, B) data (vertical axis data from 0 to 1023 without units) in decimal notation when TR4171 is addressed to talk.

See the following section (8-6-6. RD Command) for the configuration of the trace memory.

The following examples are programs using the TO command.

HP Series 200 Computer

```
10:OUTPUT 701;"RDC0180040"
20:OUTPUT 701;"TO"
30:ENTER 701:A
40:ENTER 701:B
50:DISP A
60:DISP B
70:END
```

TR4511 Optional Controller

```
10:OUTPUT 1:"RDC0180040"
20:OUTPUT 1:"TO"
30:ENTER 1:A
40:ENTER 1:B
50:DISP A
60:DISP B
70:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Specify TR4171 to access waveform trace memory data from address C018.
20	20	Specify TR4171 to output the data from the specified address in decimal notation.
30	30	Address TR4171 to talk, and receive the data. TR4171 will convert the data from addresses C018 and C019 to decimal digits and will output them.
40	40	Address TR4171 to talk, and receive the data. TR4171 will convert the data from addresses C01A and C01B to decimal digits and will output them.
50	50	Display the input data A.
60	60	Display the input data B.
70	70	End of program.

As the example shows, the TO command outputs trace data point by point.

CAUTION

Although there are 12 bits in the trace memory only the lower 10 bits are valid. If the reference level is not set properly and the waveform is overflowing, the TO command may output data over 1023. In such cases, reset the reference level.

Procedure for using the TO command and the output data format

Enter the start address of the trace memory data in hexadecimal notation (in the order of upper and lower) in (A) of RD (A) 0040. See the note on page 8-37 for information on the trace memory address.

Be sure to enter 0040 because it is a constant.

Send the RD (A) 0040 command dividing each block (10 bytes) with block delimiters. Then, send the TO command.

After sending the commands, address TR4171 to talk. TR4171 will output the binary data (12 bits) from the address specified in (A), in decimal notation.

Four digits starting from the most significant digit will be output with DDDDCRLF.
(EOI)

If the data is smaller than 4 digits, 0 will be output in the blank position.

The number of bytes for the output is not specified.

When TR4171 is addressed to talk, it automatically adds increments of 2 bytes to the address and outputs the data of the next point on the trace memory.

The TO command can also be used to output other data in decimal notation. By entering the address of data in (A), the data will be output in decimal notation.

The data will be output in the same format as trace memory data. The most significant bit will always be 0 because 8-bit binary data is converted into decimal data. In this case, TR4171 increments 1 byte to the address when it is addressed to talk.

CAUTION

When specifying this command, separate RD (A) 0040 and TO with a block delimiter. Like this:

```
OUTPUT 701; "RD  (A)  0040"
OUTPUT 701; "TO"
```

Enter only valid data in the command because the command is read as a 10 byte block serial command.

Do not separate RD (A) and 0040 with a block delimiter, like this:

```
OUTPUT 701; "RD  (A)  "
OUTPUT 701; "0040"
```

When sending the command to TR4171, use EOI with bytes CR and LF, or only CR, for the block delimiter.

8-6-8. RD Command

The Read Memory (RD) command is used to output any memory data in TR4171, in hexadecimal image format.

The following example is a program for reading out waveform trace memory data, using the RD command.

HP Series 200 Computer

```
10:DIM A$[8]
20:OUTPUT 701;"RDC01800004"
30:ENTER 701;A$
40:DISP A$
50:END
```

TR4511 Optional Controller

```
10:DIM A$ (8)
20:OUTPUT 1:"RDC01800004"
30:ENTER 1:A$
40:DISP A$
50:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 8 bytes for the string variable A$.
20	20	Specify TR4171 to output 4 bytes of trace memory data A from address C018 in hexadecimal image format. (4 bytes in TR4171 equals 2 points of trace data.)
30	30	Address TR4171 to talk, and receive the data.
40	40	Display the input data. (Ex. 3AF139F1) data at address C019 (39F1) data at address C018 (3AF1)
50	50	End of program.

The waveform trace memory data displayed on TR4171 display consists of 1001 points each on the horizontal axis and on the vertical axis. The first point on the horizontal axis is at the left of the display, and the 1001st point on the vertical axis is at the right.
The bottom of the vertical axis indicates 0 and the top 1000. A point on the horizontal axis corresponds to data of 12 bits (only the lower 10 bits are valid) on the vertical axis. The lower 8 bits are stored in the lower even numbered address, and the higher 4 bits in the higher odd numbered address.
The following figures show which addresses in trace data A and B correspond to which points:

(1) Inputting 1 frame each trace memories A and B

Trace data A	C018, C019, ..., C7E8, C7E9 C018, C019: First point on left of the display C7E8, C7E9: 1001st point on right of the display	1001 points
Trace data B	C818, C819, ..., CFE8, CFE9 C818, C819: First point on left of the display CFE8, CFE9: 1001st point on right of the display	1001 points

(2) Inputting a total of 4 frames; 2 in each trace memory

Trace data A	C018, C019, C01C, C01D, ... C7E8, C7E9	501 points
Trace data A'	C01A, C01B, C01E, C01F, ... C7E6, C7E7	500 points
Trace data B	C818, C819, C81C, C81D, ... C8E8, C8E9	501 points
Trace data B'	C81A, C81B, C81E, C81F, ... C8E6, C8E7	500 points

To output the data in trace memory B in the previous program, rewrite C018 on line 10 to C818. When 2 frames (trace data A and A') are input in trace memory A, the trace data A is input in the numeric variable A on line 30, and trace data A' is input in the numeric variable A' on line 40. In this way, the trace data A and A' is alternatively input to each point.

o Procedure for using the RD command, and the output data format

Enter this command in the following format:

RD (A) (B)

Enter the start address and the number of bytes (not the bytes in the output but those in TR4171) of the data that you want to output in (A) and (B), in hexadecimal notation (in the order of higher and lower).

This command is a 10 bytes block and is read as a serial command; therefore, only enter valid data in the command. RD and (A) (B) cannot be separated by a block delimiter. When sending the command to TR4171, use EOI with bytes CR, LF, and LF or use only CR, for the block delimiter.

The data will be output in the following format:

$D_1D_2D_3D_4D\ D_5D_6$ ..... CRLF (EOI)

D_1 is the ASCII value of the higher digits of the data (hexadecimal) in the start address specified in (A). D_2 is the ASCII value of the higher digits of the next data, and so forth.

Two times the number of bytes specified in (B) will be used for the output, excluding block delimiters, because the number is converted into ASCII. Therefore, declare twice the number specified in (B), if string variables are going to be input from the GP-IB controller. Output data corresponding to the higher digits of an odd numbered address is always F. Ignore it because it is invalid. If the trace operation function (e.g. A → B → A or NORMALIZE) is running, the data for the lower digits of an odd numbered address may be greater than 3 because the sign bit is in a higher position than the lower 10 bits. Ignore bits 11 and 12. As explained in the section on the TO command, if data is greater than 03FF (1023 is decimal notation), reset the reference level because it is not set properly.

8-6-9. Binary Data Output (Extended function of the RD command)

This is an extended function of the RD command and is used to output trace memory data in binary notation.

It outputs 1 point of trace data consisting of 2 bytes in the order of higher and lower.

The following example is a program using this function:

HP Series 200 Computer

```
 10:DIM A(2001)
 20:DIM Dat(1000)
 30:OUTPUT 701;"RDC01803E9"
 40:OUTPUT 701;"LDBEB501"
 50:ENTER 701 USING "%, B";A(*)
 60:J=0
 70:FOR I=0 TO 2001 STEP 2
 80:Dat(J)=A(I)*256+A(I+1)
 90:J=J+1
100:NEXT I
110:END
```

TR4511 Option Controller

```
 10:DIM A(2001)
 20:DIM Dat(1000)
 30:OUTPUT: "RDC01803E9"
 40:OUTPUT: "LDBEB501"
 50:ENTER 1 USING"%, B";A(*)
 60:J=0
 70:FOR I=0 TO 2001 STEP 2
 80:Dat(J)=A(I)*256+A(I+1)
 90:J=J+1
100:NEXT I
110:END
```

CAUTION

The active function will be cleared if the RD command is executed.

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 2002 bytes for the numeric variable A.
20	20	Reserve 1001 bytes for the numeric variable Dat.
30	30	Specify TR4171 to output 1001 points of trace memory A data from address C018.
40	40	Specify TR4171 to output the data from the specified address, in binary notation.
50	50	Address TR4171 to talk, and receive the data.
60	60	Reset index J.
70	70	Specify the FOR loop to increase 1 in 2 steps from 0 to 2001.
80	80	Convert the output data (2 bytes = 1 point) so that 1 byte equals 1 point, and store the data in Dat.
90	90	Add one increment to index J.
100	100	Specify FOR loop for loop counter I.
110	110	End of program.

8-6-10. LD Command

The Load Memory (LD) command is used to write data in any of the memories in TR4171. By using this command, you can read out measurement data in TR4171 by a different command, perform operation on the data by the GP-IB controller, and display the data on TR4171 display again.

This command can also write upper level and lower level of measurement. The following example is a program using this command.

HP Series 200 Computer

```
10:OUTPUT 701;"BVSHAV"
20:OUTPUT 701;"LDC90023FAB31C"
30:END
```

TR4511 Optional Controller

```
10:OUTPUT 1:"BVSHAV"
20:OUTPUT 1:"LDC90023FAB31C"
30:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Set the trace memory to B VIEW, A BLANK.
20	20	Write data 23, FA, B3, 1C in order to the memory, starting from address C900.
30	30	End of program.

In this program, 23 will be written in C900, FA in C901, B3 in C902, and 1C in C903, in hexadecimal notation.

Procedure for using the LD command

Enter the command in the following format:

LD (A) (B)

Enter the start address of the data in hexadecimal notation (in the order of higher and lower) in (A), and the data to be written, in (B) in hexadecimal notation. This command is a 10 bytes block and is read as a serial command; therefore, only enter valid data in the command.

Don't separate LD and (A) (B) with a block delimiter, like this:

```
OUTPUT 701;"LD"
OUTPUT 701;"  (A)     (B)   "
```

When sending the command to TR4171, use EOI with bytes CR, LF, and LF, or only use CR, for the block delimiter.

8-6-11. TI Command

The Trace Data Input (TI) command is used to input data from 0 to 1023 to the waveform trace memory, in decimal notation. The following example is a program using this command.

HP Series 200 Computer

```
10:OUTPUT 701;"AVRDC0180040"
20:OUTPUT 701;"TI"
30:A=1 TO 1001
40:OUTPUT 701;A
50:NEXT A
60:END
```

TR4511 Optional Controller

```
10:OUTPUT 1;"AVRDC0180040"
20:OUTPUT 1;"TI"
30:FOR A=1 TO 1001
40:OUTPUT 1:A
50:NEXT A
60:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Set trace memory to A VIEW. Specify TR4171 to access the waveform trace memory from address C018.
20	20	Specify TR4171 to input from the specified address, in decimal notation.
30	30	Initialize variable A to 1, and substitute the incremented values.
40	40	Write data A into trace memory A.
50	50	If variable A is less than 1001, go to line 30.
60	60	End of program.

Write the data from 0 to 1000 in the trace memory, in decimal notation Data up to 1023 can be written in the memory, but if data over 1000 is written, TR4171 will indicate overflow in the display. If data over 1024 is written, the data may be discarded when it is converted.

Procedure for using the TI command

Enter the command in the following format:

OUTPUT 701;"RD (A) 0040"

OUTPUT 701;"TI"

Enter the start address of the input in (A), in hexadecimal notation (in the order of higher and lower).
Be sure to enter the constant 0040. Send the TI command after sending the RD (A) 0040 command (10 bytes in a block) with block delimiters.
TR4171 will be ready to input decimal data when it receives the commands. Then, input the data for one point. Data can be input continuously because the number of bytes that can be input is not specified.
However, be sure to input data one point at a time and use block delimiters (EIO with CR, LF, and LF, or only CR) to divide them.
Every time data is input to the trace memory, the address is automatically incremented by 1 point (2 bytes).
Data with decimal points cannot be input. If you try to input a fraction, the digits right of the decimal point will be ignored.
If TR4171 cannot read the data as decimal notation, the input mode will automatically be cancelled.

CAUTION

The active function will be cleared if the TI command is used.

8-7. LABEL INPUT

When inputting label characters from the GP-IB controller to the TR4171 display, TR4171 assumes that the character following the program code, LA, is a terminator. Attach this terminater to the beginning and end of the string that is going to be input, and input it in the label area of the display (the highest digit in the display), in ASCII code.

The following is an example of label Input:

HP Series 200 Computer

```
10:OUTPUT 701;"LA?ABCD?"
20:END
```

TR4511 Option Controller

```
10:OUTPUT1:"LA?ABCD?"
20:END
```

Line No.		Description
HP Series 200	TR4511	
10	10	Display ABCD in the label area of the TR4171 display.
20	20	End of program.

In this program, "?" is used as a terminator. TR4171 displays labels in capital alphabet letters, except for special characters. See Figure 8-7 for the codes used in the label.

8-8. LEARN MODE

Users are allowed to use save registers 1 to 8 in TR4171. Virtual save registers can be added to these by using the memory in the GP-IB controller.

To add virtual save registers, set TR4171 to the SAVE state, from the TR4171 panel key or from GP-IB.

Save this set condition to save register 0. Then, input this information into the memory in the GP-IB controller.

Save register 0 is used as a buffer for adding virtual save registers.

The information saved in the memory can be recalled by writing the information to save register 0 in TR4171, and executing RECALL 0.

The following is an example of a program for adding save registers:

HP Series 200 Computer

```
  10:DIM A$[512]
  20:OUTPUT 701;"SAO"
  30:OUTPUT 701;RD60000100"
  40:ENTER 701;A$

 100:OUTPUT 701;"LD6000";A$
 110:OUTPUT 701;"RCO"
```

TR4511 Optional Controller

```
  10:DIM A$(512)
  20:OUTPUT 1:"SAO"
  30:OUTPUT 1:"RD60000100"
  40:ENTER 1:A$

 100:OUTPUT 1:"LD6000":A$
 110:OUTPUT 1:"RCO"
```

Line No.		Description
HP Series 200	TR4511	
10	10	Reserve 512 bytes for the string variable A$.
20	20	Save the present set condition of TR4171 to save register 0.
30	30	Specify TR4171 to output 100 H bytes of data in save register 0 starting from address 6000, in hexadecimal image format.
40	40	Address TR4171 to talk, and receive the data.
100	100	Write the data of the string variable A$ (save register 0) to TR4171 starting from address 6000.
110	110	Set TR4171 to RECALL 0.

Be sure to enter address 6000 because it is the start address in save register 0.

When outputting data in hexadecimal, declare more than 100 H x 2 = 200 H = 512 bytes for the array of string variables because the save register in TR4171 consists of 100 H bytes.

8-9. BLOCK DELIMITER

If TR4171 is addressed to talk and is outputting ASCII data, use the uniline message, EOI, synchronously with the 2 bytes code CR, LF, and byte LF for block delimiters. If TR4171 is outputting binary data, use EOI synchronously with the last byte of the data. Use any of the following block delimiters for inputting program codes and data to TR4171 from the GP-IB controller.

(1) Output the 2 bytes code CR, LF, and also output EOI synchronously with byte LF.

(2) Output byte LF.

(3) Output EOI synchronously with the last byte of the data.

(4) Output CR, LF.

Note that specific block delimiters must be used for the OA, MF, ML, TO, RD, LD, and TI commands. They are specified in the sections on each command.

8-10. DATA TRANSFER SPEED

The data transfer speed is the speed for transferring 1001 points (= trace A). The following examples are programs for measuring data transfer speed in decimal, hexadecimal and binary outputs, and their measurement data. These are only some examples; they can be programmed in other ways. In these examples, the internal system software is operated by interrupt processing; therefore, the measurements may differ according to the set condition.

HP Series 200 Computer

(1) Decimal output

```
10:DIM D(1000)
20:J=TIMEDATE
30:OUTPUT 701;"RDCO01807D2
40:OUTPUT 701;"TO"
50:FOR I=0 TO 1000
60:ENTER 701;D(I)
70:NEXT I
80:PRINT TIMEDATE-J
90:END
```

(2) Hexadecimal image output

```
10:DIM H$[4003]
20:J=TIMEDATE
30:OUTPUT 701;"RDCO1807D2"
40:ENTER 701;H$
50:PRINT TIMEDATE-J
60:END
```

(3) Binary output

```
10:DIM B(2001)
20:J=TIMEDATE
30:OUTPUT 701;"RDCO1803E9"
40:OUTPUT 701;"LDBEB501"
50:ENTER 701 USING"%"B";B(*)
60:PRINT TIMEDATE-J
70:END
```

Data Transfer Speed

Trigger Mode / Output Mode	FREE RUN	SINGLE
Decimal output	3.19	2.55
Hexadecimal image output	0.27	0.26
Binary output	1.77	1.77

Unit: s

8-11. SERVICE REQUEST

The service request function is used to detect the following conditions in TR4171 from the GP-IB controller.

(1) Tracing is completed up to the end of the display.

(2) Averaging is completed for the specified number of times.

These conditions are indicated by the status bytes of the serial poll. Table 8-5 lists the configuration and operation of the status byte.

Table 8-5 Configuration of status byte

BIT#	7	6	5	4	3	2	1	0
Decimal value	128	64	32	16	8	4	2	1
Function		SERVICE REQUEST (SRQ)			AVERAGE END	TRACE END		

Bit no. 2: Is set to 1 when TR4171 completes tracing up to the right end of the display, and is set to 2 when TR4171 is tracing.

Bit no. 3: Is set to 1 when TR4171 completes averaging for the specified number of times, and is set to 0 when the averaging is incomplete.

(When averaging is set to ON, bits no. 2 and 3 are automatically set to 1. Until then, they are set to 0.)

Use the GP-IB program code, SQ, to specify the service request function.

SQ: Specifies the mode for sending the service request.

SR: Specifies the mode for not sending the service request.

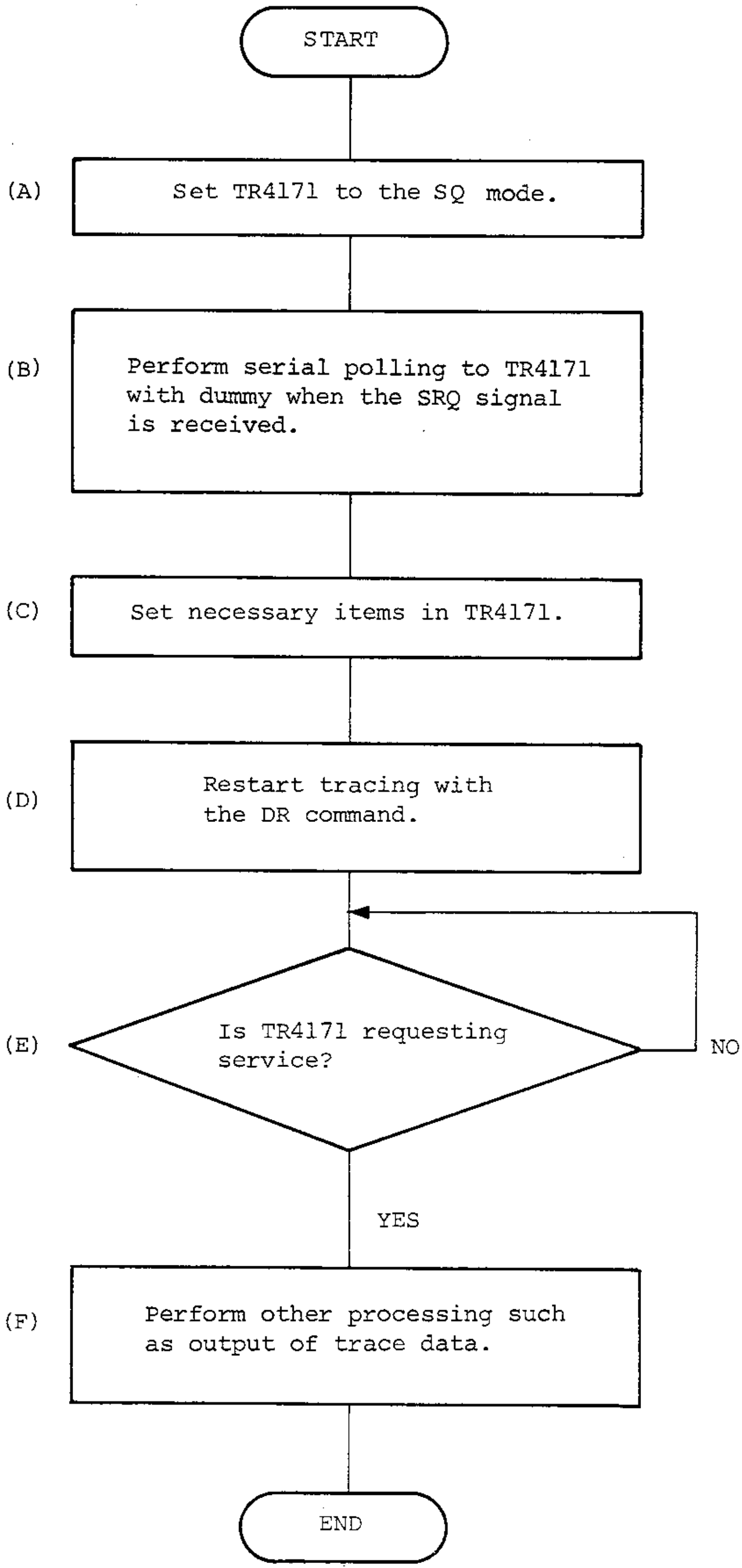
When the SQ mode is specified and there is a need for service request, TR4171 stops tracing and sends a SRQ signal to the GP-IB controller. The GP-IB controller can specify TR4171 to output the trace memory data and can perform operation processing on the data. After performing the necessary processing, reset TR4171, if required. Then send the Status Byte Reset and Trace Start (DR) command to TR4171 to restart tracing to obtain measurement data. TR4171 will stop tracing again if there is a need for service request, because TR4171 will still be in the SQ mode.

To restore TR4171 to its usual tracing state, cancel the SQ mode and specify the SR mode, and send the DR command directly after the SR command.

The trace data on the TR4171 display may be wrong if the SQ mode is specified after TR4171 is reset.

To avoid this, perform serial polling with a dummy before entering the DR command.

To obtain trace measurement data after resetting TR4171 in the SQ mode, enter the DR command to restart tracing. This procedure is shown in the following flowchart:


START
(A)
Set TR4171 to the SQ mode.
(B)
Perform serial polling to TR4171 with dummy when the SRQ signal is received.
(C)
Set necessary items in TR4171.
(D)
Restart tracing with the DR command.
(E)
Is TR4171 requesting service?
NO
YES
(F)
Perform other processing such as output of trace data.
END

TR4171 sweeps hardware and traces software independently; therefore, the trace data in (F) in the above flowchart may be wrong in some cases depending on the set condition. To avoid this, repeat procedures (D) and (E) two times.

To perform averaging, set average to ON in procedure (C) and skip (D). Note that the SRQ signal will not be output if (D) is executed.

The following example is a program for finding the peak level near 1 MHz, using the service request function:

HP Series 200 Computer

```
 10:OUTPUT 1;"SQ"
 20:ON INTR 7 GOTO 50
 30:ENABLE INTR 7;2
 40:GOTO 30
 50:S=SPOLL(701)
 60:OUTPUT 701;"CF 1MZ SP 50KZ RE 10DM"
 70:GOSUB 120
 80:OUTPUT 701;"MK PS ML"
 90:ENTER 701;A
100:DISP A
110:STOP
120:OUTPUT 701;"DR"
130:ON INTR 7 GOTO 160
140:ENABLE INTR 7;2
150:GOTO 140
160:S=SPOLL(701)
170:IF S=68 THEN 190
180:GOTO 120
190:RETURN
200:END
```

TR4511 Option Controller

```
 10:OUTPUT 1:"SQ"
 20:ON SRQ GOTO 50
 30:ENABLE INTR
 40:GOTO 30
 50:S=SPOLL(1)
 60:OUTPUT 1:"CF 1MZ SP 50KZ RE 10DM"
 70:GOSUB 120
 80:OUTPUT 1:"MK PS ML"
 90:ENTER 1:A
100:DISP A
110:END
120:OUTPUT 1:"DR"
130:ON SRQ GOTO 160
140:ENABLE INTR
150:GOTO 140
160:S=SPOLL(1)
170:IF S=68 THEN 190
180:GOTO 120
190:RETURN
```

Line No.		Description
HP Series 200	TR4511	
10	10	Set TR4171 to the SQ mode.
20	20	Specify the controller to go to line 50 if it receives a SRQ signal.
30	30	Set the controller to the mode for accepting the service request.
40	40	Specify the controller to loop until it receives a SRQ signal.
50	50	Specify the controller to perform serial polling to TR4171 when it receives a SRQ signal. (Lines 20 to 60 are the procedures for executing the service request function once with a dummy, which is requested directly after TR4171 is set to the SQ mode.)
60	60	Set TR4171 to the following: center frequency to 1 MHz, frequency span to 50 kHz, reference level to -10 dBm
70	70	Call the subroutine on line 120.
80	80	Set the marker of TR4171 to ON and specify TR4171 to search for the peak level and to output the data. Receive the data.
90	90	Address TR4171 to talk, and receive the data.
100	100	Display the input data.
110	110	Stop the program.
120	120	Reset the status byte and restart tracing.
130	130	Specify the controller to jump to line 160 if it receives a SRQ signal.
140	140	Set the controller to the mode for accepting the service request.
150	150	Specify the controller to loop until it receives a SRQ signal.
160	160	Specify the controller to perform serial polling to TR4171 when it receives a service request, and receive the status byte.
170	170	Specify the controller to jump to line 190 if TR4171 has ended tracing.
180	180	If TR4171 has not ended tracing, restart tracing and specify the controller to loop until it receives a SRQ signal.
190	190	Return from subroutine (go back to line 80)
200	200	End of program.

The following example is a program using the service request function when TR4171 is in the single trigger mode. Enter the Sweep Reset (SHSW) command before the DR command in this mode.

HP Series 200 Computer

```
 10:OUTPUT;701;"IP SW 2SC"
 20:OUTPUT 701;"SQ"
 30:ON INTR 7 GOTO 60
 40:ENABLE INTR 7;2
 50:GOTO 40
 60:S=SPOLL(701)
 70:OUTPUT 701;="SI MK"
 80:GOSUB 120
 90:OUTPUT 701;"ML"
100:ENTER 701;A
110:DISP A
120:STOP
130:OUTPUT 701;"SHSW"
135:OUTPUT 701;"DR"
140:ON INTR 7 GOTO 160
150:ENABLE INTR 7;2
160:GOTO 140
170:S=SPOLL(701)
180:S=68 THEN 190
190:GOTO 135
200:RETURN
210:END
```

TR4511 Option Controller

```
 10:OUTPUT 1:"IP SW 2SC"
 20:OUTPUT 1:"SQ"
 30:ON SRQ GOTO 60
 40:ENABLE INTR
 50:GOTO 40
 60:=SPOLL(1)
 70:OUTPUT 1:"SI MK ML"
 80:GOSUB 120
 90:OUTPUT 1:"ML"
100:ENTER 1:A
110:DISP A
120:END
130:OUTPUT 1:"SHSW"
135:OUTPUT 1:"DR"
140:ON SRQ 160
150:ENABLE INTER
160:GOTO 140
170:S=SPOLL(1)
180:IF S=68 THEN 190
190:GOTO 135
200:RETURN
```

Line No.		Description
HP Series 200	TR4511	
10	10	Set TR4171 to the instrumental preset state, and set the sweep time to 2 seconds.
20	20	Set TR4171 to the SRQ mode.
30	30	Specify the controller to jump to line 60 if it receives a SRQ signal.
40	40	Set the controller to the mode for accepting the service request.
50	50	Specify the controller to loop until it receives a SRQ signal.
60	60	Specify the controller to perform serial polling to TR4171 when it receives a SRQ signal. (lines 30 to 60 are the procedures for executing the service request function once with a dummy, which is requested directly after TR4171 is set to the SRQ mode.)
70	70	Set TR4171 to the single trigger mode and set the marker to ON.
80	80	Call the subroutine on line 120.
90	90	Specify TR4171 to output the marker label data when it is addressed to talk.
100	100	Address TR4171 to talk, and receive the data. (TR4171 will output the marker label data.)
110	110	Display the input data.
120	120	Stop the program.
130	130	Reset the sweep time and status byte.
135	135	Restart tracing.
140	140	Specify the controller to jump to line 160 if it receives a SRQ signal.
150	150	Set the controller to the mode for accepting the service request.
160	160	Specify the controller to loop until it receives a SRQ signal.
170	170	Specify the controller to perform serial polling to TR4171 when it receives the SRQ signal, and receive the status byte.
180	180	If TR4171 has ended tracing, jump to line 190.
190	190	If TR4171 has not ended tracing, restart tracing and specify the controller to loop until it receives a SRQ signal.
200	200	Return from subroutine (to back to line 90).
210	210	End of program.

CAUTION

To restore TR4171 to its usual tracing state, send the DR command directly after the SR command. If you don't send the DR command, Tr4171 will be set to the SR mode but it will not be restored to its usual tracing state. If the SRQ signal is received directly after resetting functions (center frequency, reference level, etc.) in TR4171, or directly after specifying the SQ mode, the trace memory may not trace the set condition of TR4171 properly. In this case, resend the DR command and perform tracing again, or ignore the first SRQ signal received after sending the SQ command and send the DR command after resetting TR4171.

8-12. DIRECT PLOTTING USING GP-IB CONTROLLER

The direct plotting software in TR4171 uses TR4171 as a GP-IB controller. Be careful when performing direct plotting with other GP-IB controllers.

The following example is a program for direct plotting with other GP-IB controllers.

HP Series 200 Computer

```
 10:OUTPUT 701;"SQ"
 20:OUTPUT 701;"CF50MZSP1MZ"
 30:GOSUB 130
 40:OUTPUT 701"DR"
 50:GOSUB 180
 60:OUTPUT 701;"LD783D00"
 70:OUTPUT 701;"PL111"
 80:SEND 7;UNL TALK 1 LISTEN S DATA
 90:GOSUB 210
100:DISP"PLOT END"
110:OUTPUT 701;"SRDR"
120:STOP
130:ON INTR 7 GOTO 160
140:ENABLE INTR 7;2
150:GOTO 140
160:S=SPOLL(701)
170:RETURN
175:OUTPUT 701;"DR"
180:GOSUB 130
190:IF S  68 THEN 175
200:RETURN
205:OUTPUT;"DR"
210:GOSUB 130
220:IF BIT(S, 4) THEN 240
230:GOTO 205
240:RETURN
250:END
```

TR4511 Optional Controller

```
 10:OUTPUT 1:"SQ"
 20:OUTPUT 1:"CF50MZSP1MZ"
 30:GOSUB 130
 40:OUTPUT 1:"DR"
 50:GOSUB 180
 60:OUTPUT 1:LD783D00"
 70:OUTPUT 1:"PL111"
 80:SEND UNL TALK 1 LISTEN 5 DATA
 90:GOSUB 210
100:DISP"POLT END"
110:OUTPUT 1:"SRDR"
120:END
130:ON SRQ GOTO 160
140:ENABLE INTR
150:GOTO 140
160:S=SPOLL(1)
170:RETURN
175:OUTPUT 1:"DR"
180:GOSUB 130
190:IF S  68 THEN 180
200:RETURN
205:OUTPUT:"DR"
210:GOSUB 130
220:IF BIT(S, 4) THEN 240
230:GOTO 205
240:RETURN
```

If you are using an optional plotter, replace PL on line 70 with OP. Follow the directions on the menu for the key operations after OP.

Line No.		Description
HP Series 200	TR4511	
10	10	Set TR4171 to the SQ mode.
20	20	Set center frequency to 50 MHz and frequency span to 1 MHz.
30	30	Call the subroutine on line 130. (This is to perform dummy processing on the service request received directly after specifying the SQ mode.)
40	40	Reset the status byte and restart tracing.
50	50	Call the subroutine on line 180. (This is to wait until tracing ends.)
60	60	Reset the GP-IB serial polling register in TR4171.
70	70	Select PLOT 1: TR9831, 1: BIT, and 1: ALL.
80	80	Unaddress TR4171 to listen and address it to talk. Set ATN to HI
90	90	Call the subroutine on line 210.
100	100	Send the message "PLOT END".
110	110	Set TR4171 to the SR mode. Reset the status byte and restart tracing.
120	120	Stop the program.
130	130	Specify the controller to jump to line 160 if it is interrupted by a SRQ signal.
140	140	Specify the controller to the mode for accepting the service request.
150	150	Specify the controller to loop until it receives a SRQ signal.
160	160	Specify the controller to perform serial polling to TR4171 when it receives a SRQ signal.
170	170	Return from the subroutine.
175	175	Retrace.
180	180	Call the subroutine on line 130.
190	190	If TR4171 has not ended tracing, restart tracing, and specify the controller to loop until it is interrupted by a SRQ signal.
200	200	Return from the subroutine.
205	205	Retrace.
210	210	Call the subroutine on line 130.
220	220	If TR4171 has ended plotting, jump to line 240.
230	230	If TR4171 has not ended plotting, start tracing again and loop until it is interrupted by a SRQ signal.
240	240	Return from the subroutine.
250		End of program.

Be sure to enter line 60. If it is not entered, the status of TR4171 will not indicate the end of plotting and the program will not return from the subroutine call on line 90.

8-13. NOTES ON PROGRAMMING

GP-IB programming for TR4171 is performed by entering the keys on the front panel. The following are some notes on the programming.

8-13-1. Counter Programming

Send the program codes CN, FC or TC once to set the counter to ON, and twice to set it to OFF. If you send CN or FC, or SHF or SHCN when the marker is set to OFF, the counter will be set to ON. To avoid confusion, first set the marker to OFF and then to ON, and then set the counter to ON. The counter end status is not indicated in the service request function; therefore, input the time for the counter resolution. The following are the standards. See Section 4-9-7. FREQ CNTR for the gate time.

8-13-2. Phase Mode Programming

(1) Setting the Phase Scale

Send the codes listed in the following table to directly set the phase scale data. Only "HZ" can be used for the termination.

Phase Scale	GP-IB Code	
80°/div	0HZ	1HZ
40°/div	2HZ	3HZ
20°/div	4HZ	5HZ
8°/div	6HZ	
4°/div	7HZ	
2°/div	8HZ	
0.8°/div	9HZ	
0.4°/div	10HZ	
0.2°/div	11HZ	

(2) Setting the Phase Offset

Only "HZ" can be used for the termination.

8-13-3. Group Delay Mode Programming

(1) Setting the Group Delay Scale

The group delay scale data cannot be set directly. Use the data knob or the GP-IB codes on the step key. Enter the OA command with this to output the scale data.

(2) Setting the Group Delay Offset (Fine)

Only "HZ" can be used for the termination.

8-14. NOTES ON GP-IB SPECIFICATIONS

8-14-1. MASTER RESET Key

This key acts as a power switch and works regardless of the GP-IB interface condition. The GP-IB interface will temporarily be cleared when this key is entered.

8-14-2. DEVICE CLEAR Command and IP Command

Both of these commands initialize TR4171 settings. The settings will also be initialized when the power is turned on or when the MASTER RESET key is entered.

8-14-3. Group Execute Trigger

Ignore this message because this function is not guaranteed as a function of TR4171. Indicate T in the active area of the display.

8-14-4. Interface Clear and ATN

Interface Clear and ATN are given priority when the GP-IB interface is performing hand-shake when it is addressed to talk. The data in hand-shake may be ignored in this case.

8-14-5. Talker

Hand-shake is forced to end when the NRFD and NDAC both detect a high (false) condition during hand-shake when TR4171 is addressed to talk.

8-14-6. Service Request

The service request mode cannot be cleared by the IP command (DEVICE CLEAR).

Table 8-3 Address code list

ASCII Characters		ADDRESS Switch					5 Bits
LISTEN	TALK	A5	A4	A3	A2	A1	Decimal Code
SP	@	0	0	0	0	0	0
!	A	0	0	0	0	0	1
"	B	0	0	0	0	0	2
#	C	0	0	0	1	1	3
$	D	0	0	1	0	0	4
%	E	0	0	1	0	1	5
&	F	0	0	1	1	0	6
'	G	0	0	1	1	1	7
(	HO	0	1	0	0	0	8
)	I	0	1	0	0	1	9
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

Table 8-4 Program codes

Mode	Code	Description	Initial value
DATA	0 9	0 9	
	.	.	
	MZ	MHz	
	KZ	kHz	
	HZ	Hz	
	DP	+ dBm	
	DM	- dBm	
	DB	dB	
	SC	sec	
	MS	msec	
	US	µsec	
	UP		
	DN		
	CU	COARSE UP (Turn the data knob clockwise)	
	MU	MEDIUM UP (Turn the data knob clockwise)	
	FU	FINE UP (Turn the data knob clockwise)	
	CD	COARSE DOWN (Turn the data knob counter clockwise)	
	MD	MEDIUM DOWN (Turn the data knob counter clockwise)	
	FD	FINE DOWN (Turn the data knob counter clockwise)	
	BS	BACK SPACE	
Measurement mode	SE	SPECTRUM	o
	MG	MAGNITUDE	
	PH	PHASE	
	GD	GROUP DELAY	

Table 8-4 Program codes

Mode	Code	Description	Initial value
FUNC.	CF	CENTER FREQ.	
	SP	FREQ. SPAN	
	RE	REF. LEVEL	
	FA	START FREQ.	
	FB	STOP FREQ.	
	SW	SWEEP TIME	
	AS	SWEEP TIME AUTO	o
	RB	RES. B. W.	
	BA	RES. B. W. AUTO	o
	VB	VIDEO B. W.	
	VA	VIDEO B. W. AUTO	
	CS	FREQ. STEP SIZE	
	CA	FREQ. STEP SIZE AUTO	
	GO	GROUP DELAY OFFSET	
	PO	PHASE OFFSET	
SCALE	PY	PHASE SCALE	
	GY	GROUP DELAY SCALE	
Input mode	I5	INPUT 50Ω	o
	I7	INPUT 75Ω	
	I1	INPUT 1MΩ	
	PR, HS	HIGH SENSITIVITY	
	AT	INPUT ATT	
	TA	INPUT ATT AUTO	
	RA	AUTO RANGE	

Table 8-4 Program codes

Mode	Code	Description	Initial value
TRIGGER	FR, IN	FREE RUN	o
	LI	LINE	
	EX	EXT	
	VT, VI	VIDEO	
	SI	SINGLE	
	CO	CONTINUOUS	o
	SS	STOP/RESET	
TG mode	T5	TG 50Ω	
	T7	TG 75Ω	
	TL	TG LEVEL	
TRACE	AW	A WRITE	
	AV	A VIEW	
	AZ	A'VIEW	
	AA	A → A'	
	BW	B WRITE	
	BV	B VIEW	
	BZ	B'VIEW	
	BB	B → B'	
	CH	A ⇄ B	
	AB	A-B → A ON	
	AO	A-B → A OFF	
	BD	B-DL → B	
SAVE & RECALL	SA	SAVE	
	RC	RECALL	

Table 8-4 Program codes

Mode	Code	Description	Initial value
MARKER	MK	MARKER	
	MO	MARKER OFF	
	MT	Δ	o
	PS	PEAK SEARCH	
	MC	MKR→CF	
	MR	MKR→REF	
	MP	MKR/Δ→STEP SISE	
	SG	SIGNAL TRACK	
	ZO, ZO	ZOOM	
	CN, FC	COUNTER	
	NX	NEXT PEAK SEARCH (N dB DOWN BW)	
	TC	TG COUNTER	
Other	DL	DISPLAY LINE	
	NR	NORMALIZE ON	
	AR	AVERAGE ON	
	LA	LABEL	
	PL	PLOT	
	HO	DATA HOLD	
	LC	LOCAL	
	SH	SHIFT	
	IP	INSTRUMENTAL PRESET (0 2GHz)	o
	PR	PRESET (1.8 5GHz)	
	OP	OPTION	
	FS	FULL SPAN	
	TU	AOTO TUNE	
	AC	AUTO CALIBRATION	
	SU	SEQUENCE	

Table 8-4 Program codes

Mode	Code	Description	Initial value
DATA IN/OUT	SQ	For sending service request	
	SR	For not sending service request	
	DR	Status byte reset and trace start	
	MF	MARKER FREQ OUTPUT	
	ML	MARKER LEVEL OUTPUT	
	OA	OUTPUT ACTIVE DATA	
	LD	LOAD MEMORY	
	RD	READ MEMORY	
	TO	TRACE DATA DECIMAL OUTPUT	
	TI	TRACE DATA DECIMAL INPUT	

"o" indicates that the codes are automatically set when the power is on, and the MASTER RESET key is pressed, the IP command is received or the device clear message is received. To use the shift or double shift function, enter SH or SHLA and then enter the front panel keys.

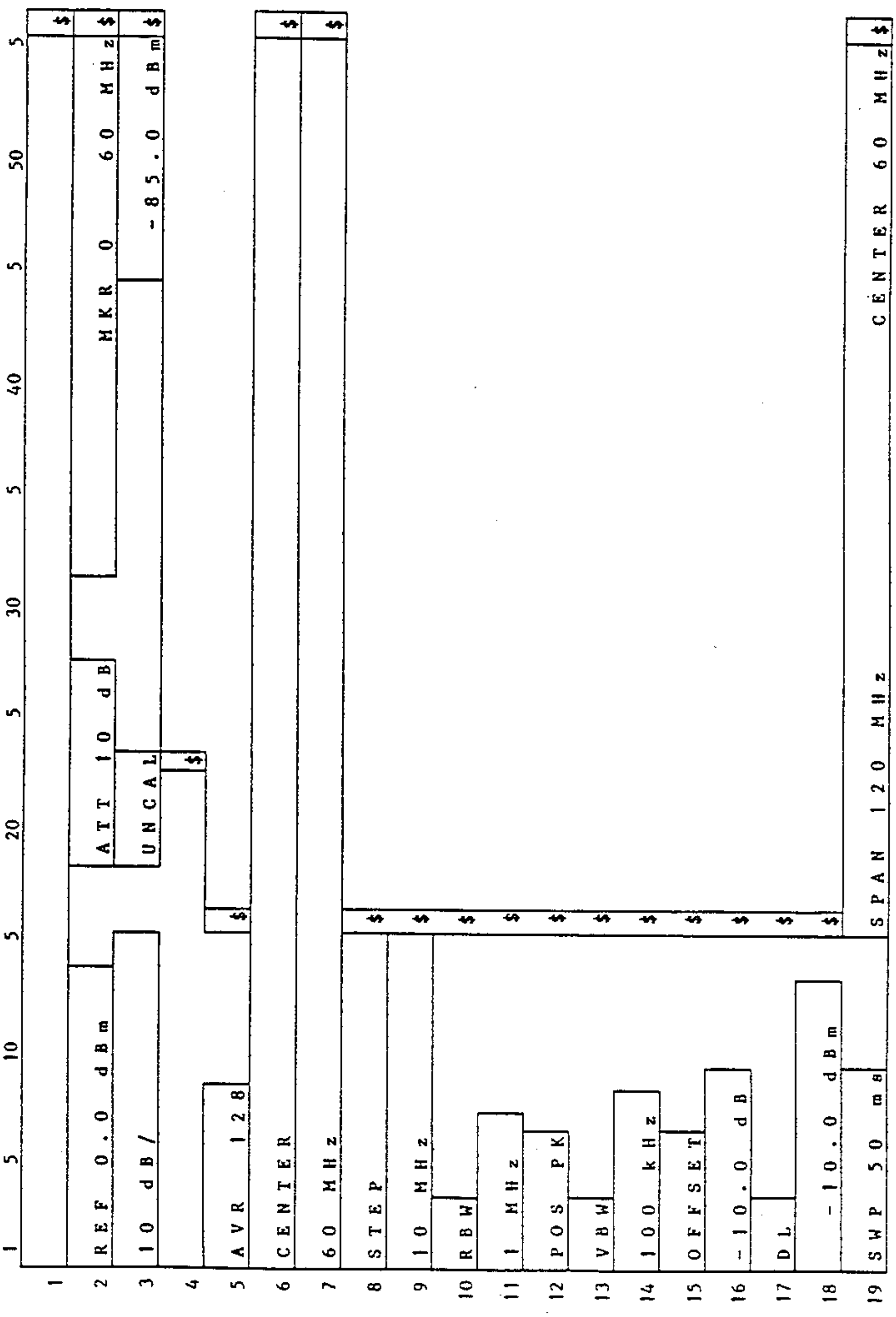


Fig. 8-6 Character position of TR4171 display

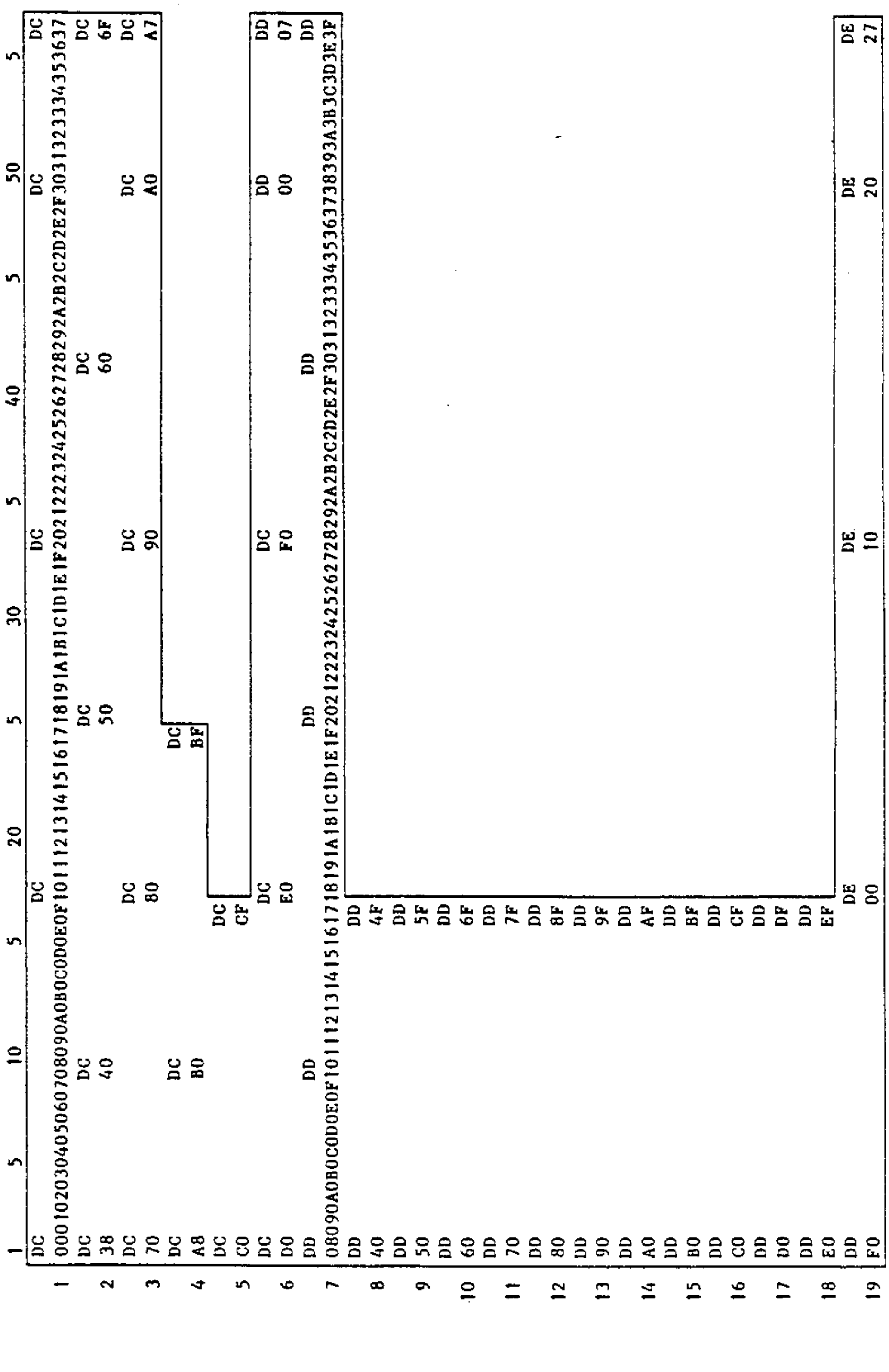


Fig. 8-7 Address of TR4171 display

Table 8-7 Comparison chart for alphanumeric and hexadecimal values

	Normal	Large	End
P	00	40	80
A	01	41	81
B	02	42	82
C	03	43	83
D	04	44	84
E	05	45	85
F	06	46	86
G	07	47	87
H	08	48	88
I	09	49	89
J	0A	4A	8A
K	0B	4B	8B
L	0C	4C	8C
M	0D	4D	8D
N	0E	4E	8E
O	0F	4F	8F
P	10	50	90
Q	11	51	91
R	12	52	92
S	13	53	93
T	14	54	94
U	15	55	95
V	16	56	96
W	17	57	97
X	18	58	98
Y	19	59	99
Z	1A	5A	9A
-	1B	5B	9B
Ω	1C	5C	9C
k	1D	5D	9D
Δ	1E	5E	9E
m	1F	5F	9F

	Normal	Large	End
blank	20	60	A0
n	21	61	A1
'	22	62	A2
#	23	63	A3
j	24	64	A4
%	25	65	A5
z	26	66	A6
0	27	67	A7
d	28	68	A8
µ	29	69	A9
*	2A	6A	AA
+	2B	6B	AB
,	2C	6C	AC
-	2D	6D	AD
.	2E	6E	AF
/	2F	6F	AF
0	30	70	B0
1	31	71	B1
2	32	72	B2
3	33	73	B3
4	34	74	B4
5	35	75	B5
6	36	76	B6
7	37	77	B7
8	38	78	B8
9	39	79	B9
:	3A	7A	BA
s	3B	7B	BB
<	3C	7C	BC
=	3D	7D	BD
>	3E	7E	BE
?	3F	7F	BF

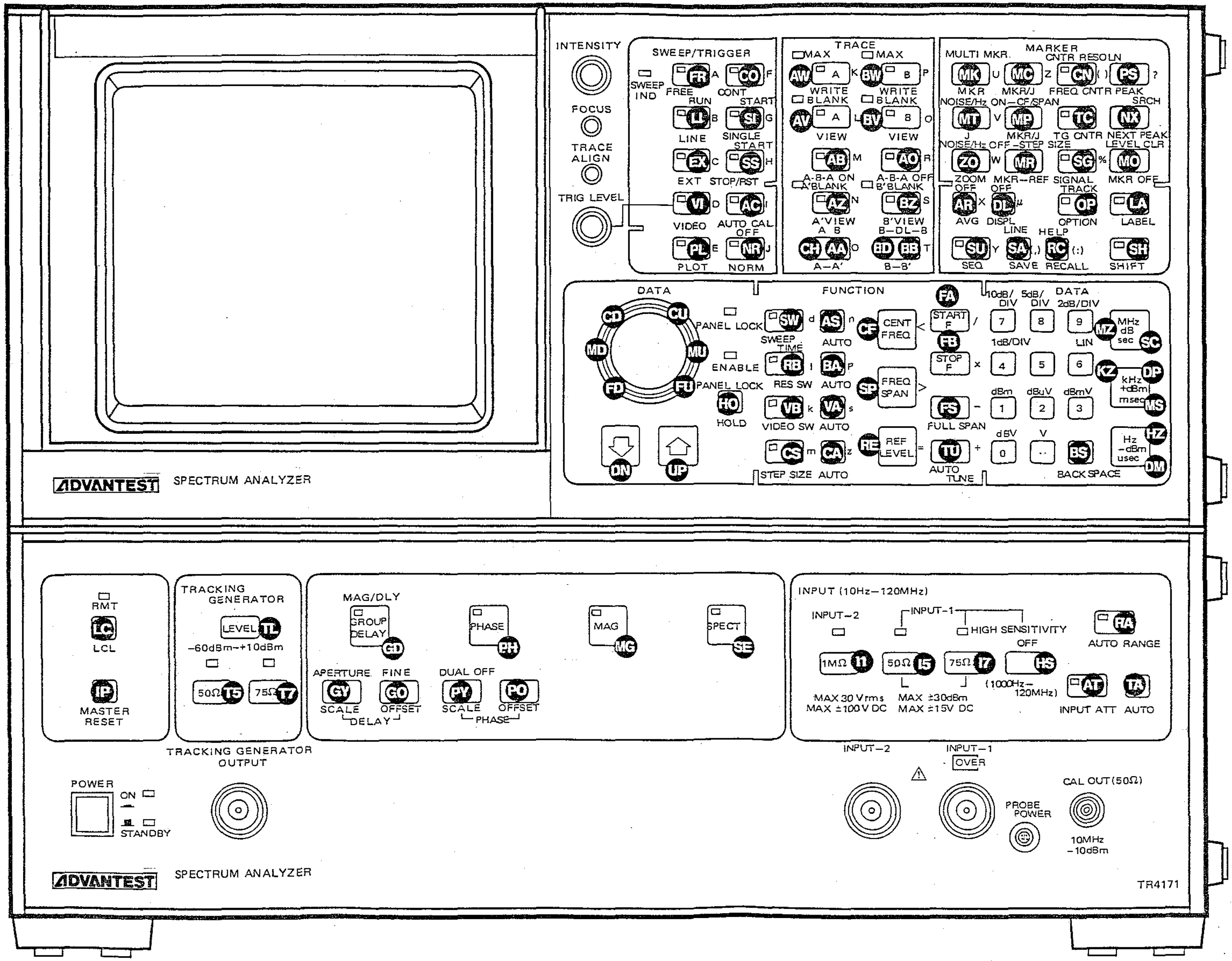


Fig. 8-4-1 GPIB Commands on Panel

SECTION 9

IMPEDANCE MEASUREMENT (OPTION 05)

9-1. GENERAL

This option, when combined with the VSWR bridge, provides a Smith chart display on the TR4171's CRT display to allow for impedance measurement. It also permits direct readout of VSWR, reflection coefficient, and normalized impedance values useful for reflection wave analysis. In addition, the option makes various arithmetic and logical operating features using the internal CPU available for impedance measurement, offering the high-stability, high-sensitivity measurement for which the TR4171 is designed.

This section describes the theory of impedance measurement, the calibration procedure required for impedance measurement, and explains the impedance measurement procedure in some detail.

The impedance measurement mode is entered by pressing [OPTION] and selecting 'SMITH CHART' from the displayed menu. Once this mode is selected, functions of the control keys on the front panel are different from the usual ones. The key functions available in this mode are listed in Figure 9-36.

9-2. THEORY OF OPERATION

When [MAG] is pressed after a VSWR bridge is connected across the TRACKING GENERATOR OUTPUT and INPUT-1 of the TR4171 Analyzer and a Device Under Test (DUT) is connected to the Analyzer via this VSWR bridge, a signal proportional to the reflection from the DUT is input to INPUT-1. If the DUT terminals on the bridge are shorted or open (full reflection), the input to the INPUT-1 is maximized; if a characteristic impedance of the bridge is connected to the DUT terminals, then the input to INPUT-1 is minimized.

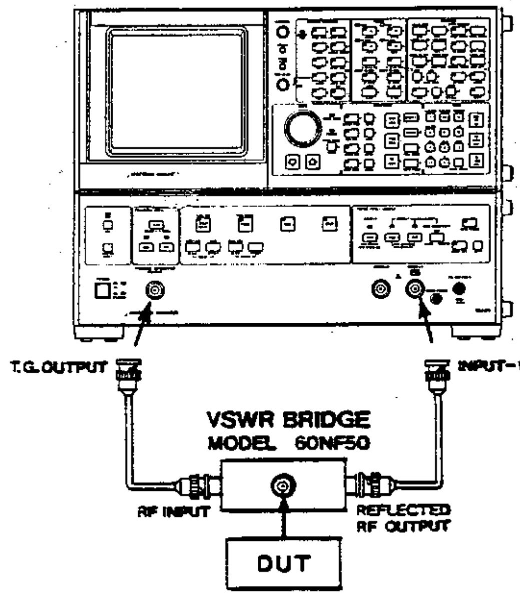


Fig. 9-1 Impedance measurement setup

The return loss of the DUT (difference between the reflection from the DUT and full reflection) can be determined by reading the input level on a logarithmic scale. If the input amplitude is displayed on a linear scale and the reference level is set to the full reflection level, the reflection coefficient can be directly read out at a resolution of 0.1 div. Furthermore, the reflection coefficient can be handled as a vector by phase measurement.
Figure 9-2 shows how the option reads phase information upon the first sweep, then reads amplitude information of linear scale upon the second sweep.

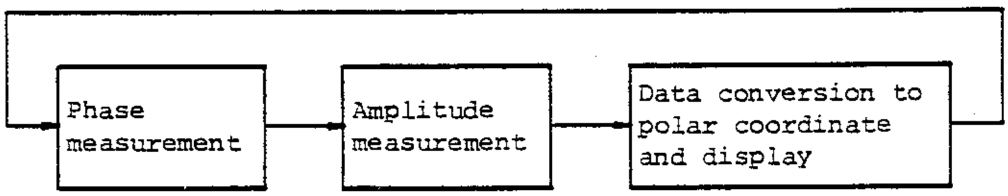


Fig. 9-2 Impedance measurement and display information flow

The information is then translated into polar coordinate data by arithmetic operation and displayed on the monitor (see Figure 9-3). Figure 9-4 shows amplitude, phase, and polar-coordinate displays for the same device under test.

A normalized impedance value can be read by superimposing a Smith chart on the reflection coefficient data displayed on a polar coordinate. Since the option can show a Smith chart on the display, approximated normalized impedance can be read from the display.

When a marker is used, the marker frequency, VSWR, reflection factor, phase, and normalization impedance are digitally displayed. For this option, transfer characteristics can be displayed with vectors using only the polar-coordinate display function. In this case, directly connect DUT between TRACKING GENERATOR OUTPUT and INPUT-1.

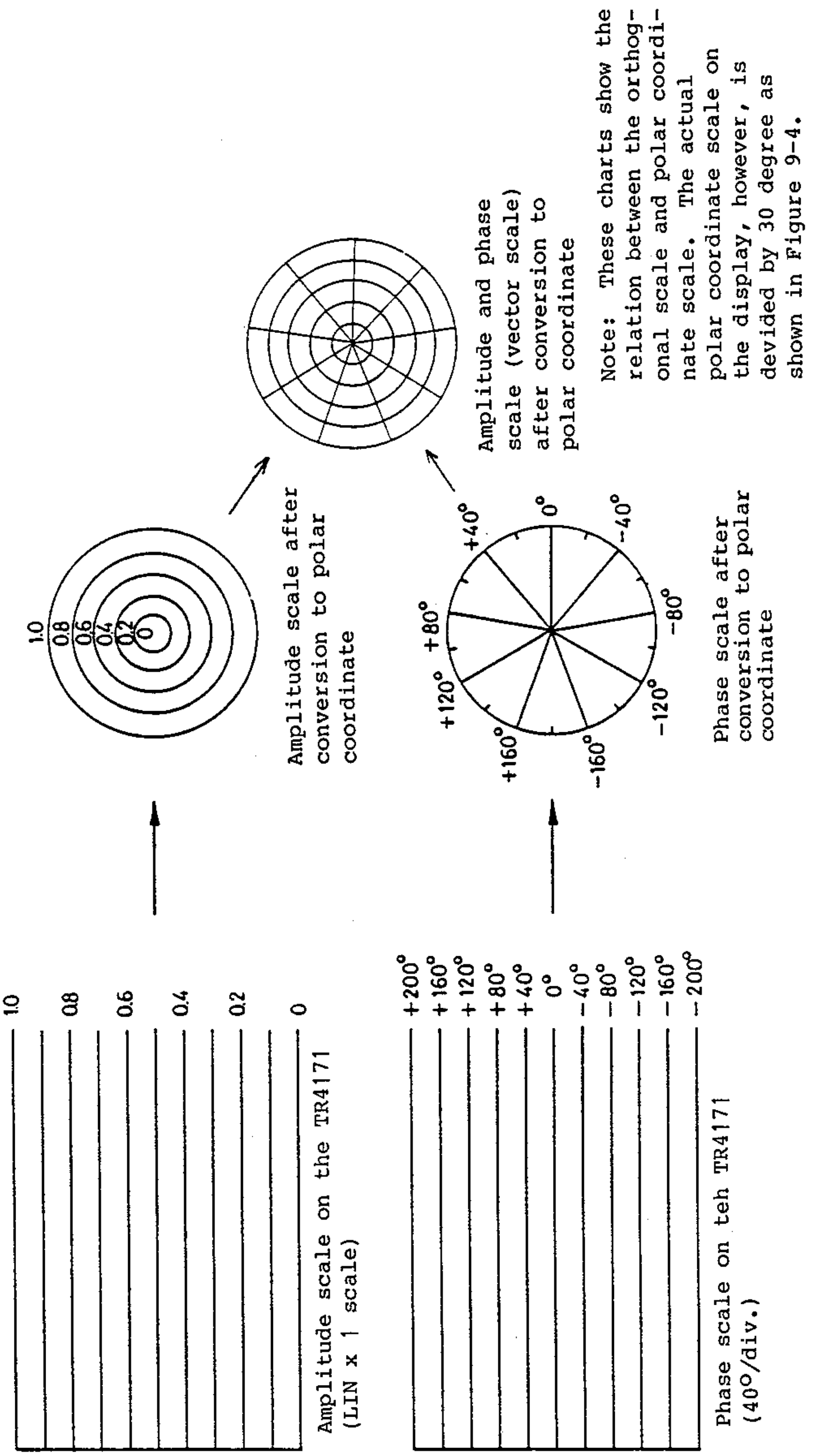


Fig. 9-3 Amplitude and phase information translated into polar coordinate data

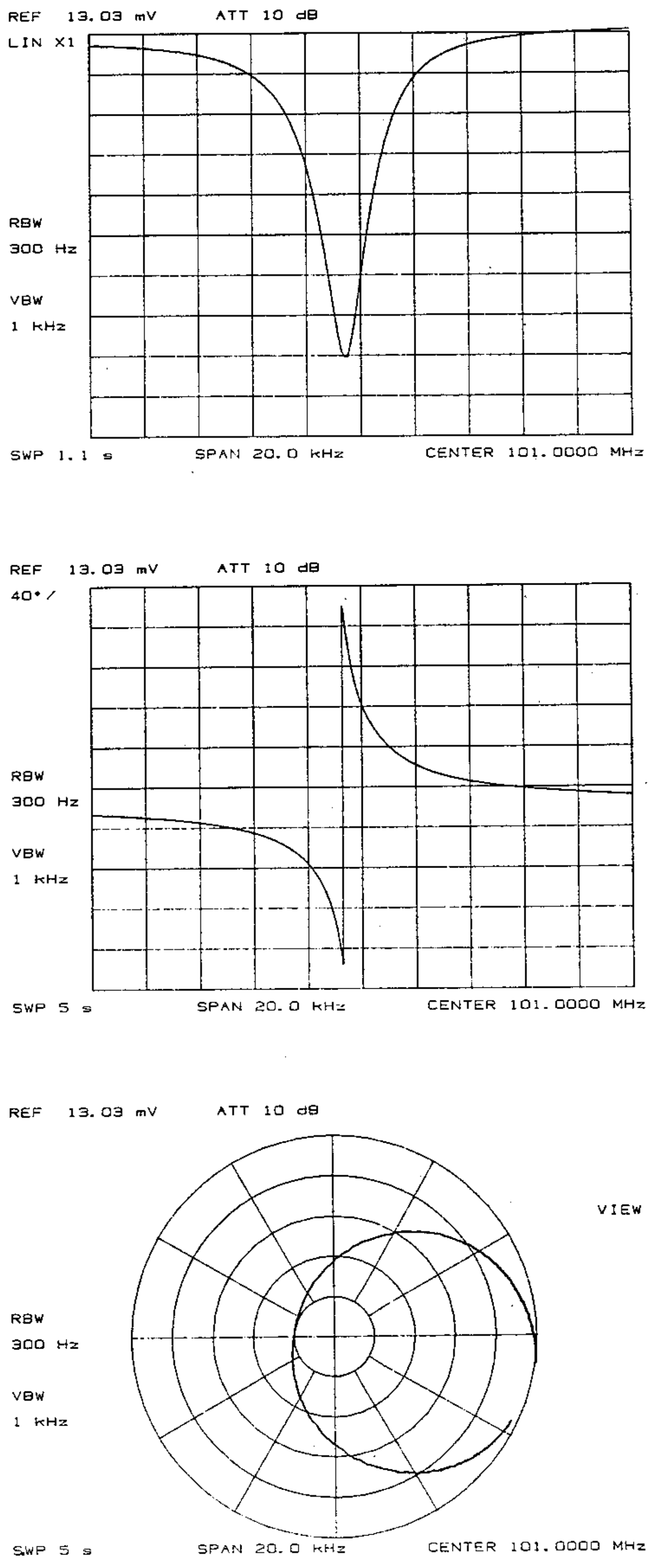


Fig. 9-4 Amplitude, phase, and polar-coordinate displays for the same DUT

9-3. CALIBRATION

9-3-1. General

When measuring impedance or reflection-coefficient using a VSWR bridge, calibration must be done to cancel the loss of the VSWR bridge, electrical length of the cable, and other error factors. For this calibration, a short or open plug is connected to the DUT terminals on the VSWR bridge instead of a real DUT, and the reference level, group delay offset, and phase offset are adjusted so the display data comes to the 0 Ω or ∞ Ω point on the Smith chart. When a frequency span of several 10 MHz or more is selected, however, satisfactory calibration may not be possible due to the nonlinear frequency response of the tracking generator or VSWR bridge. In order to solve this problem, the option contains a frequency response correction feature for both amplitude and phase. Since calibration directly affects measurement accuracy, the open or short plugs used should have nearly ideal characteristics in the given frequency range.

9-3-2. Preparation for Calibration

Connect the VSWR bridge across the TRACKING GENERATOR OUTPUT and INPUT-1 of the TR4171 by means of interconnecting cables, and press the 50 Ω or 75 Ω key for both of TRACKING GENERATOR and INPUT. (Note that this option performs operation regarding the TRACKING GENERATOR's impedance setting as the characteristic impedance of measurement system.) (see Figure 9-5).

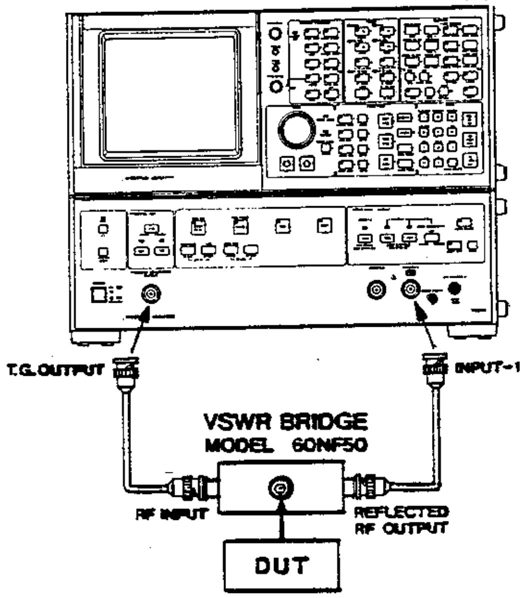


Fig. 9-5 Calibration system setup

Connect the DUT across the terminals on the VSWR bridge, then press the MAG key to activate the tracking generator output. While viewing the pass-band response of the DUT, set up the center frequency, frequency span, and other necessary parameters. Use the TG LEVEL key to adjust the signal level applied to the DUT. The signal level actually applied to the DUT is 6 dB to 7 dB lower than the tracking generator output level (when the recommended VSWR bridge is used). Since impedance measurement involves phase measurement, press the SWEEP TIME key, then manually select the appropriate sweep time with the DATA knob or other control means.

9-3-3. Calibration Procedure

Disconnect the DUT from the terminals on the VSWR bridge, and connect an short or open device to the terminals. If the DUT is connected by a cable, leave the cable connected to the terminals, and connect the short or open device to the end of that cable.

Press the PHASE key to observe phase response, then adjust group delay offset with the G.D. OFFSET key until phase rotation is cancelled out.

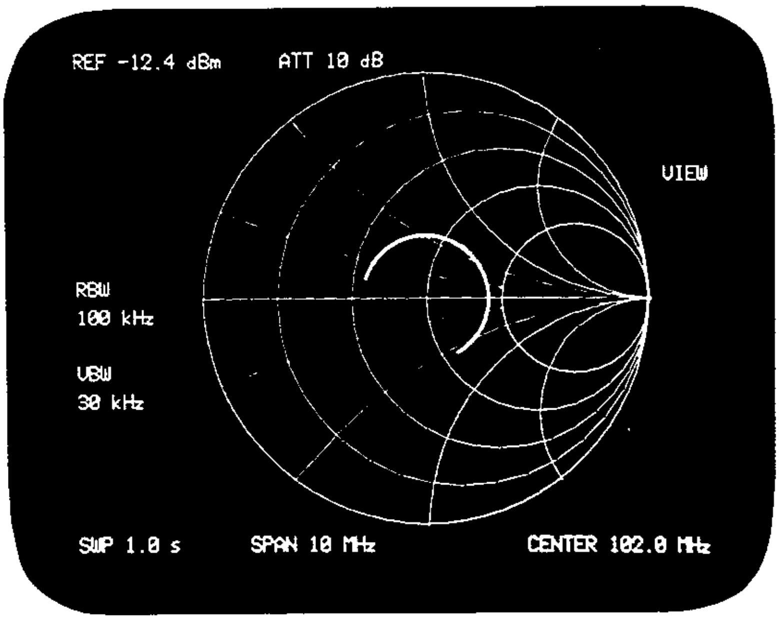


Fig. 9-6 Impedance measurement start

Press [OPTION] and select 'SMITH CHART' from the displayed menu.
Figure 9-6 shows a Smith chart on the display, and impedance measurement sweep is started to display the measurement information translated into polar coordinate data. The display information is updated every other sweep.

The center frequency, frequency span, and other parameters set up during preparation are also maintained during impedance measurement. Press the REF LEVEL key, then use the DATA knob to align the measurement information to the outermost circumference of the Smith chart.

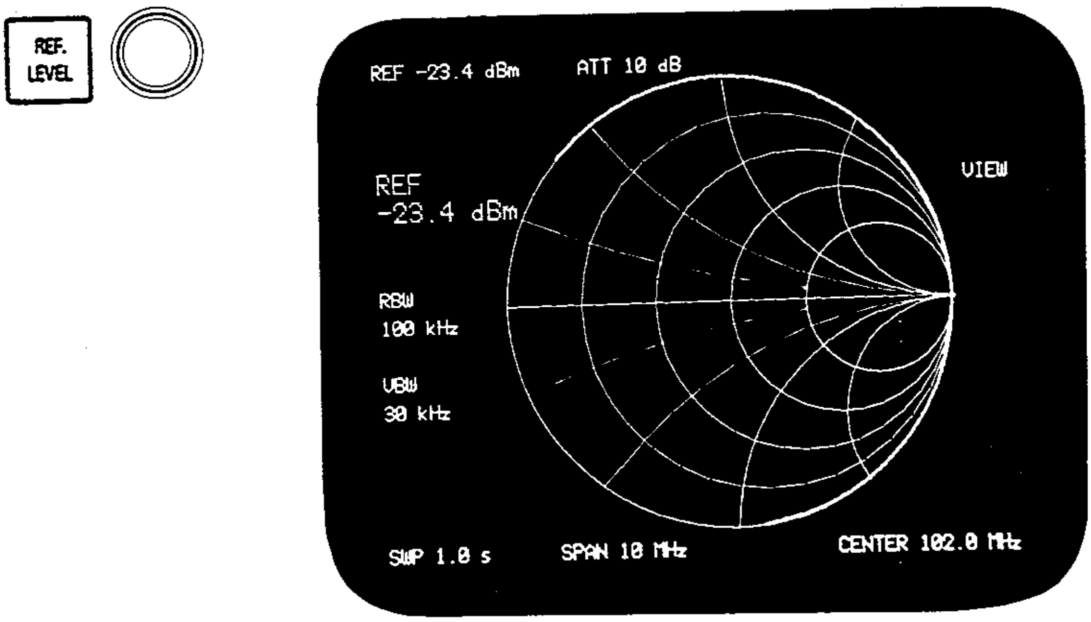


Fig. 9-7 Positioning the display information to the outermost circumference of the Smith chart

Press [OFFSET / DELAY], then use the DATA knob to converge the display data to as small a point as possible. For finer adjustment, press [SHIFT] [OFFSET / DELAY] before controlling the DATA knob. To prevent the bright data spot from burning the display screen, press the PEAK SEARCH (POINT DEC.) key several times to reduce the number of data points.

As mentioned earlier, the impedance measurement mode causes the control keys on the front panel to have functions different from their normal functions. For those functions refer to Figure 9-36.

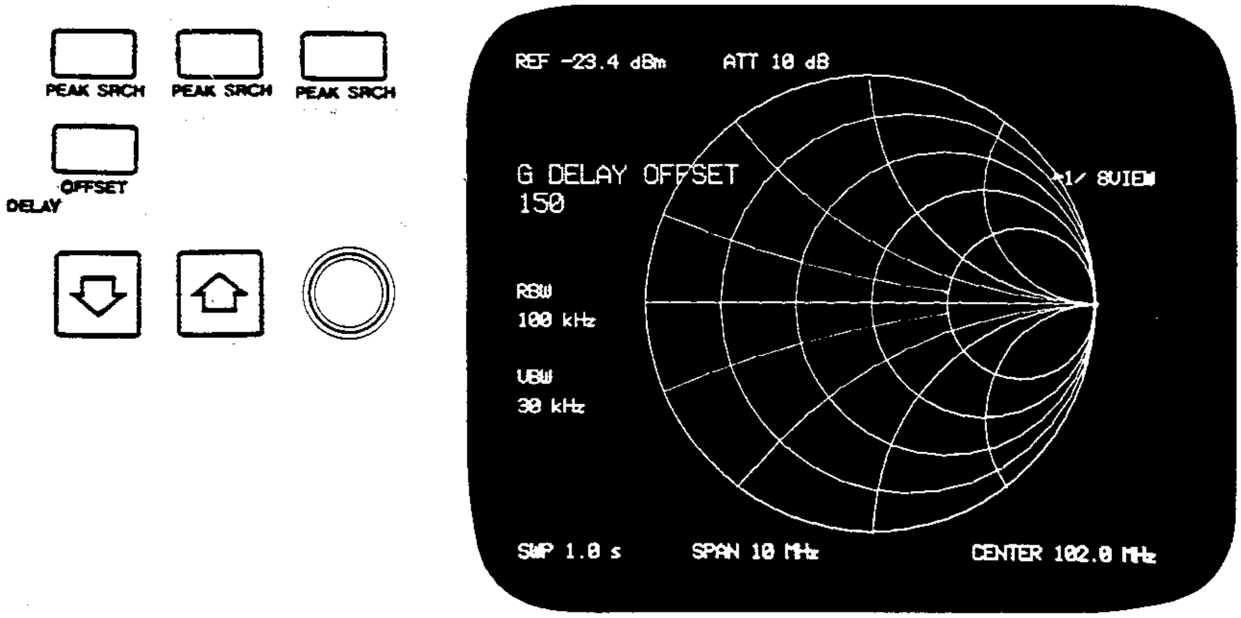


Fig. 9-8 Converging the display data to a small spot

Press 

, then use the DATA knob and step keys to cancel phase offset. If an open device is connected to the DUT terminals on the VSWR bridge, position the data spot to the ∞ Ω point (right-hand end) on the Smith chart. If a short device is connected to the terminals, position the data spot to the 0 Ω point (left side) of the Smith chart.

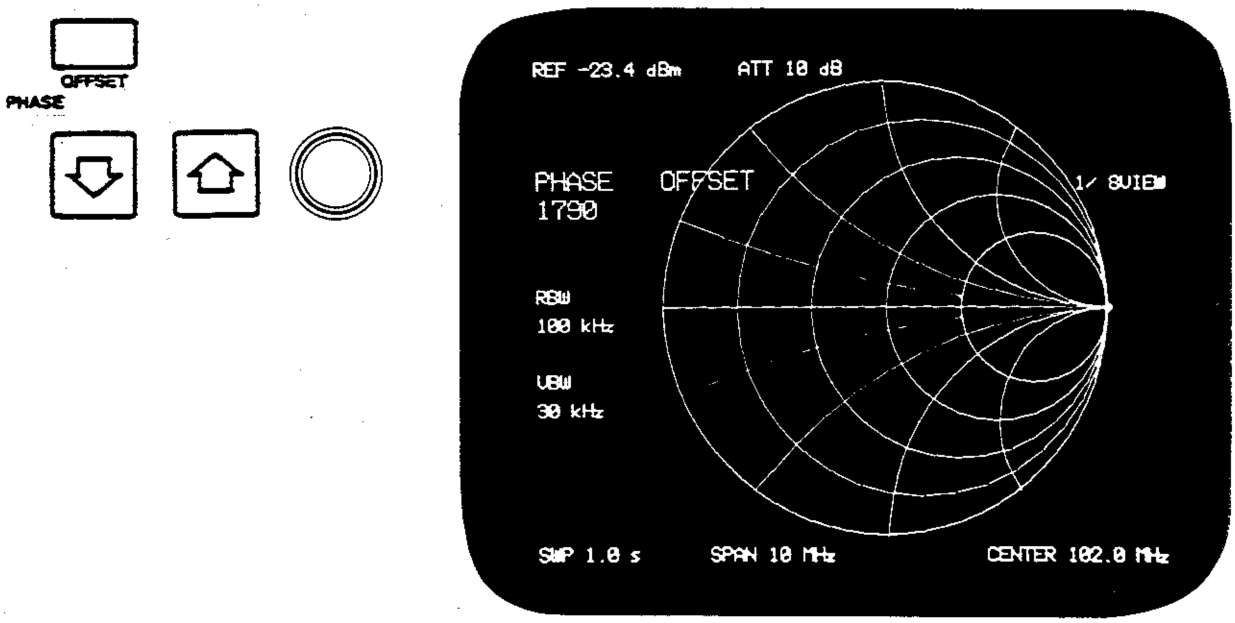


Fig. 9-9 Calibration for DUT terminal open

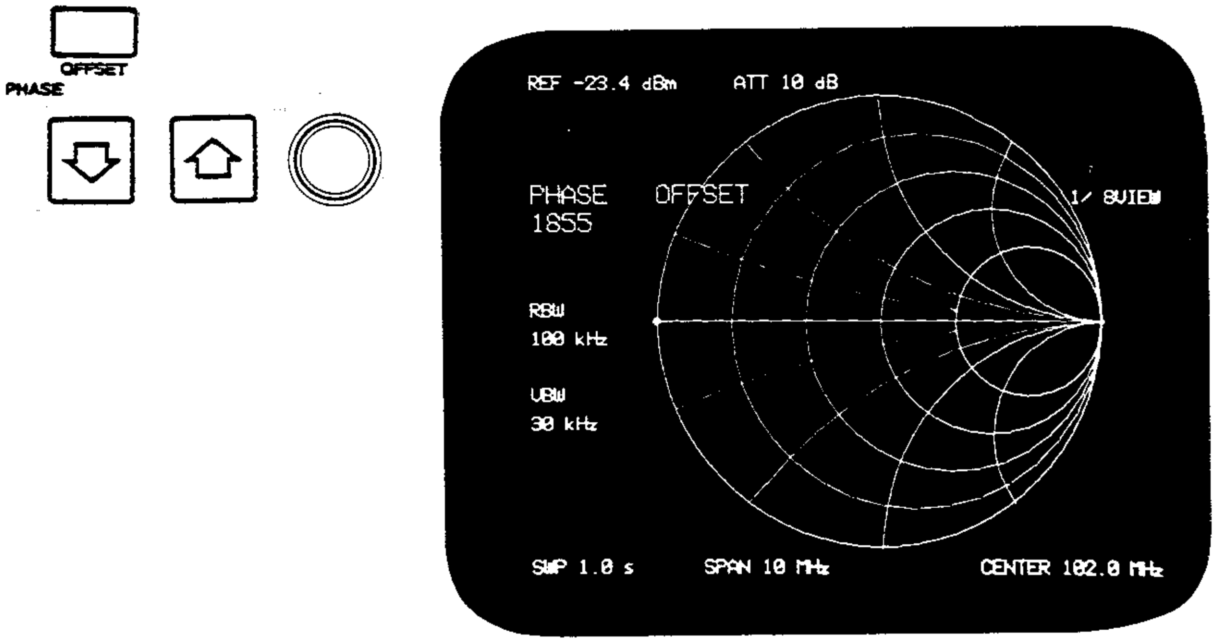


Fig. 9-10 Calibration for DUT terminal shorted

Calibration has now been completed. The same calibration procedure may be used for the amplitude and phase measurement mode while viewing the orthogonal coordinate (and by using the relationship shown in Figure 9-3). In this case, calibration time will be shortened since display updating interval for the orthogonal coordinate is shorter than that for the Smith chart.

9-3-4. Frequency Response Compensation

Calibration has been completed through the described procedure. If the data spot is not converged to the ∞ Ω or 0 Ω point on the Smith chart as shown below, proceed with the following operations. If the data spot is properly converged to the 0 Ω or ∞ Ω point, then proceed to paragraph 9-3-5.

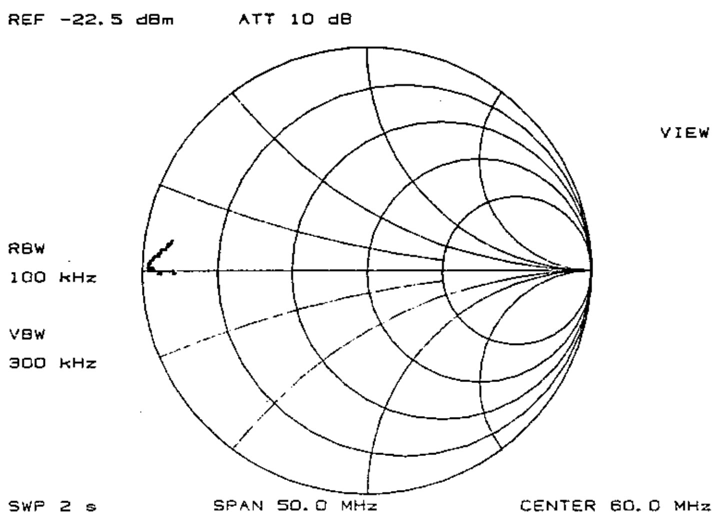


Fig. 9-11 Unconverged data spot

The unconverged data spot is due to lack of frequency-response flatness in the phase or amplitude domain. Correct the frequency response as follows:

For frequency response compensation in the phase domain, press the N (PHASE COR.) key to select the phase correction mode. The display will show "PH-COR" in its information display area. To calibrate the phase response, press O (PHASE CAL.(O)) key when an open device is connected to the DUT terminals on the VSWR bridge, or the S (PHASE CAL.(S)) key when a short device is connected to the same terminals. The frequency response in the phase domain is now corrected.

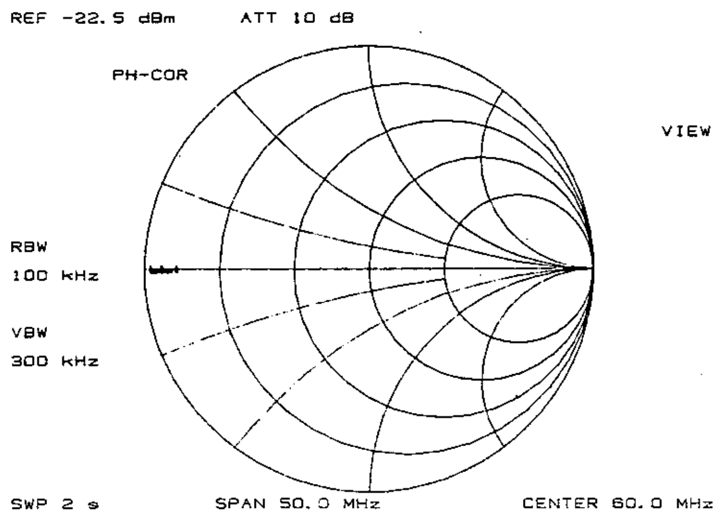


Fig. 9-12 Frequency response correction in the phase domain

For frequency response correction in the amplitude domain, press the I (MAG. COR.) key to select the amplitude correction mode. The display will show "MG-COR" in the information display area. Then press the J (MAG. CAL.) key to calibrate amplitude response. Figure 9-14 shows the correctable amplitude range. Corrections performed outside this range results in error, and the "ERROR" message will be shown just below "MG-COR" on the display. If this occurs, press the I (MAG. COR.) key again to clear the amplitude correction mode, then press the REF LEVEL key and use the DATA knob until the display data comes inside the correctable range. Press the I (MAG. COR.) key again to calibrate the amplitude response.

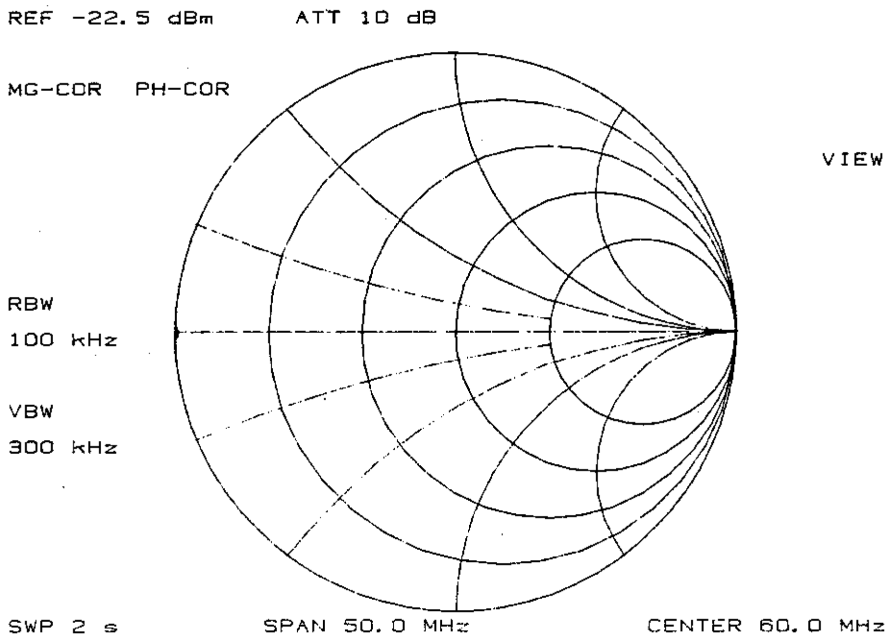


Fig. 9-13 Frequency response correction in the amplitude domain

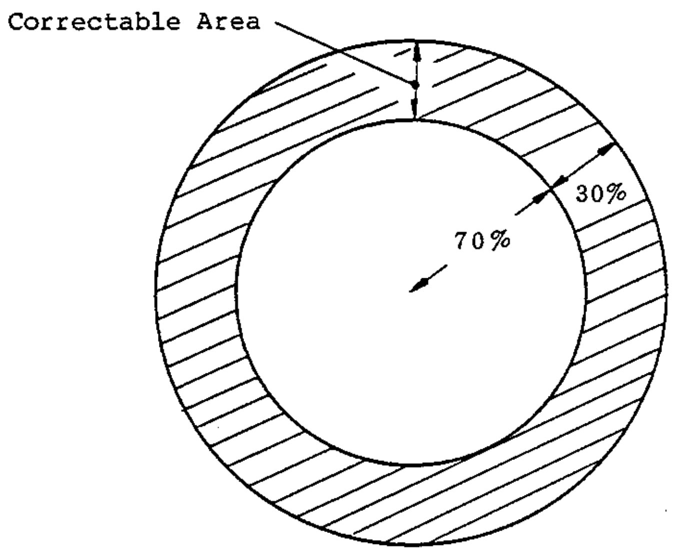


Fig. 9-14 Amplitude-frequency response correctable range

9-3-5. Calibration in Enlargement Mode

The center portion of a Smith chart display can be enlarged 10 times by pressing the R (MAG. x 10) key. The enlargement will result in a slight phase error. To cancel this phase error, connect an open or short device to the DUT terminals on the VSWR bridge, and adjust phase offset so that the phase is 0° for an open terminal or 180° for a shorted terminal. When the display data overscale, that is unimportant.
If the R (MAG. x 10) key is pressed again, the Smith chart display of normal size will be restored. In this case also, carry out phase calibration. If the slight phase error occurring in the enlargement mode is insignificant, the phase calibration may be omitted.

9-4. MEASUREMENT

9-4-1. Measuring Procedure

Accurate calibration is a vital factor for precision impedance measurement. Once calibration is completed, do not change the center frequency, frequency span, reference level, or other parameter setting. If any change is effected on these parameters, carry out calibration again.
After completing calibration, connect the DUT across the DUT terminals on the VSWR bridge. The impedance of the DUT can now be read on the Smith chart display. Figures 9-15, 9-16, and 9-17 show the three types of scales used for this option. Figure 9-15 shows a Smith chart from which a normalized impedance can be read. The normalized impedance at the point indicated by a small mark "o" in this figure is read as 0.2 Ω -j0.5 Ω. Figure 9-16 shows a polar coordinate from which a reflection coefficient can be determined. The reflection coefficient at the point identified by small mark "o" in this figure is read as $0.8 \angle 60$ deg. Figure 9-17 shows another Smith chart whose center portion is enlarged tenfold. A normalized impedance in the vicinity of 1 can be determined from this chart at a high resolution. The normalized impedance at the point indicated by a small mark "o" in this figure is read as 1.1Ω -j0.1Ω.

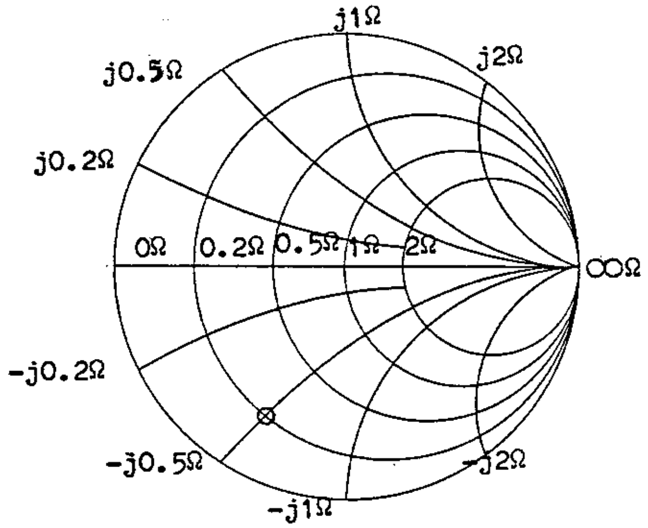


Fig. 9-15 Smith chart

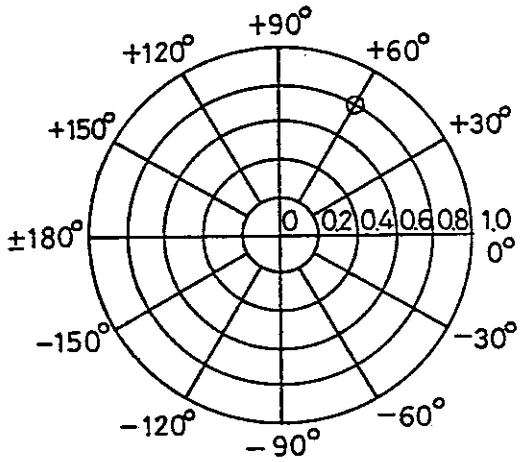


Fig. 9-16 Polar coordinate

The impedance can be determined by multiplying the real and imaginary parts of the normalized impedance each by 50 when the characteristic impedance of the bridge is 50 Ω, and by 75 when the characteristic impedance of the bridge is 75 Ω.

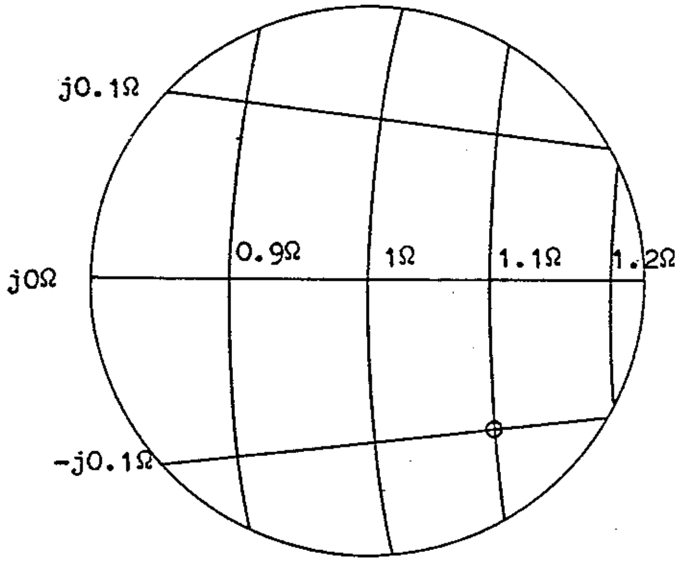


Fig. 9-17 Enlarged Smith chart

The frequency of the display data can be read with a marker activated by operating the MARKER key. In addition to the frequency, the display will also provide direct readouts for the VSWR, reflection coefficient, phase, normalized impedance, and inductance or capacitance of the equivalent serial circuit. The normalized impedance and inductance or capacitance of the equivalent serial circuit are not shown on the polar coordinate display, however. Figure 9-18 shows a data display example using a marker. Calculated data readouts for the marker point are shown on the third line on the screen. The readouts are VSWR, reflection coefficient, phase, normalized impedance, and inductance or capacitance, from left to right. The top information line on the display is reserved for user-defined Label information. If no label is written in this area, however, the titles for the data readouts shown on the third line are shown on this top line instead. If even one character of label information is entered in this line, the title will not be shown. While normalized impedance, inductance, and capacitance each have three significant digits, it shoud be noted that they may include a large error if the real or imaginary part of the impedance to be measured is extremely large or extremely small with respect to the characteristic impedance.

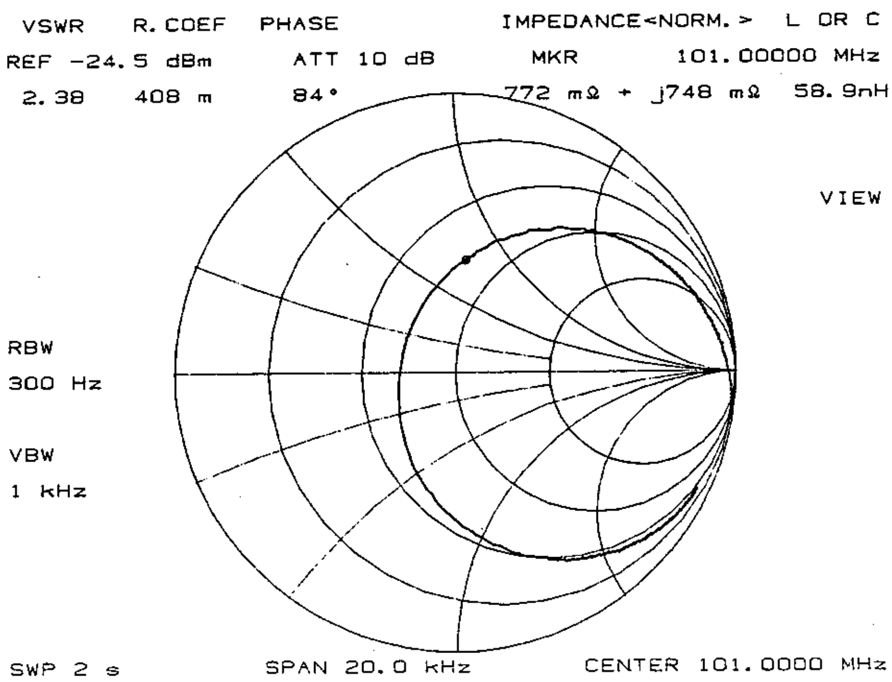


Fig. 9-18 Data readout for marker point

The data redouts for the marker point are updated every other sweep. If the measurement information is held with the G key, however the data readouts will be updated with marker movement.

The measurement information hold state can be cleared by pressing the F key.

As with the normal measurement mode, the center frequency, frequency span, reference level, and marker can be set up with any of the DATA knob, DATA step keys, and numeric data keyboard.

To clear the impedance measurement option mode, press the WRITE A (EXIT) key. At this time, the center frequency, frequency span, and other parameter setup are left intact, so that data comparison can be easily made between the normal mode and impedance measurement mode (e.g. a return loss is measured on the logarithmic scale, and the impedance is measured in the impedance measurement mode).

The basic impedance measuring procedure is described above. The following paragraphs describe various additional features available in the impedance measurement mode to facilitate measurement.

9-4-2. Usage of Additional Features

In the impedance measurement mode, there are some inoperative or unnecessary keys on the front panel. These keys are either made ineffective or assigned functions unique to this mode. (See figure 9-36.) Some keys with new function assignments are alternately activated and deactivated each time they are pressed. Some other keys are used to increment or decrement setup values (e.g. intensity) each time they are pressed. The lamps in these keys are not activated, but the setup conditions are shown on the display.
VSWR or reflection coefficient values are displayed with engineering units such as "m" or "k". For instance, 12.3 m means 0.0123.
The following paragraphs describe each additional function:

(1) Scale controlling function
Keys A and B select the Smith chart and polar coordinate scales respectively. If the R (MAG. x 10) key is pressed when the Smith chart is selected, the reference level is reduced to one-tenth, and the center portion of the chart is enlarged tenhold. (See figure 9-19.) At this time, phase offset must be canceled if necessary. (See paragraph 9-3-5.) Pressing the R key again will restore the normal Smith chart and the original reference level.

(2) VIEW mode and impedance measurement mode clear
Operation of G key stops sweep and holds measurement information on the display, so that photographing is facilitated. At this time, message "VIEW" will be shown in the right information area on the display. To clear the information hold state, press F key. Pressing WRITE A key clears the impedance measurement mode and returns the instrument to the normal measurement mode.

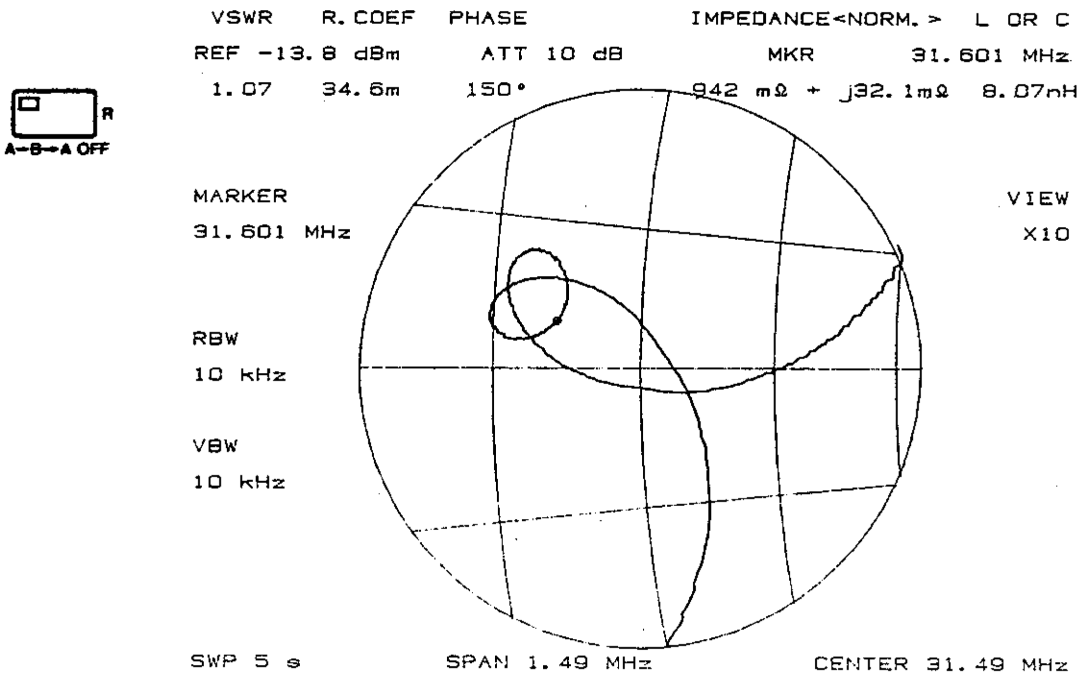


Fig. 9-19 Enlarged Smith Chart

(3) Increment and decrement of data points

Measurement data on the display usually consists of 500 data points. The number of data points can be reduced in half however, to 1/32 each time the P (POINTS DEC.) key is pressed. The reduction ratio is shown on the display as, for example, 1/16. To increase the number of data points, press the Q (POINTS INC.) key. The number of data points is doubled each time this key is pressed. (See Figure 9-20.)

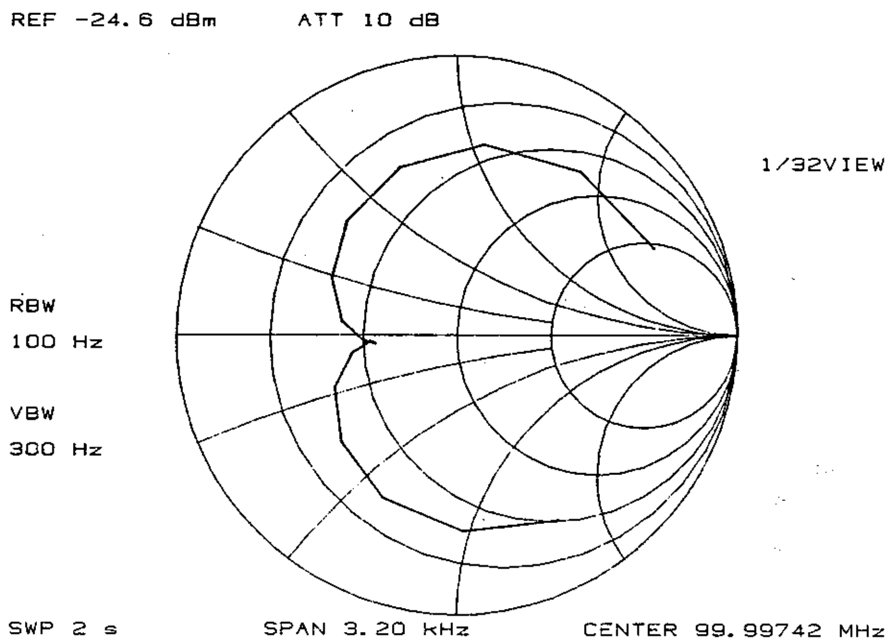


Fig. 9-20 Increment and decrement of data points

When measurement data is converged to one small spot on the display, reduce the number of data points to prevent the CRT from spot burn. If the number of data points is reduced, the time required for polar coordinate translation can be reduced accordingly.

(4) Direct numeric data readout

Direct numeric data readout can be obtained from display traced by the display circle and start-stop marker features, as well as the normal marker. Operation of the μ (DISP. CIRCLE) key shows a concentric circle of the polar coordinate on the display, along with message "DISPLAY CIRCLE". The radius of this circle can be varied by the DATA knob or DATA step keys.

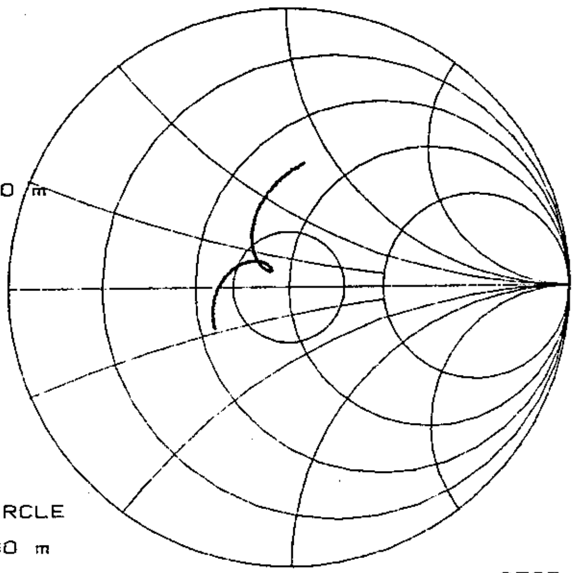


Fig. 9-21 Display circle

The VSWR and reflection coefficient values corresponding to the circle are read out on the display. They are shown on the left and right sides in the bottom left information display area. To superimpose the display circle on the marker point, press the Y (MKR→DC) key. Pressing the μ (DISP. CIRCLE) key again clears the display circle from the display. Pressing the L (START STOP) key shows the START STOP message, under which the sweep start and stop frequencies are displayed. The start and stop frequencies correspond respectively to the leftmost and rightmost graticules on the orthogonal coordinate. At the same time, triangular markers indicate the start and stop points on the display. (See Figure 9-22.) The acute-angle triangle indicates the start point, while the obtuse-angle triangle indicates the stop point. Pressing the L (START STOP) key again clears the start/stop frequency readouts.

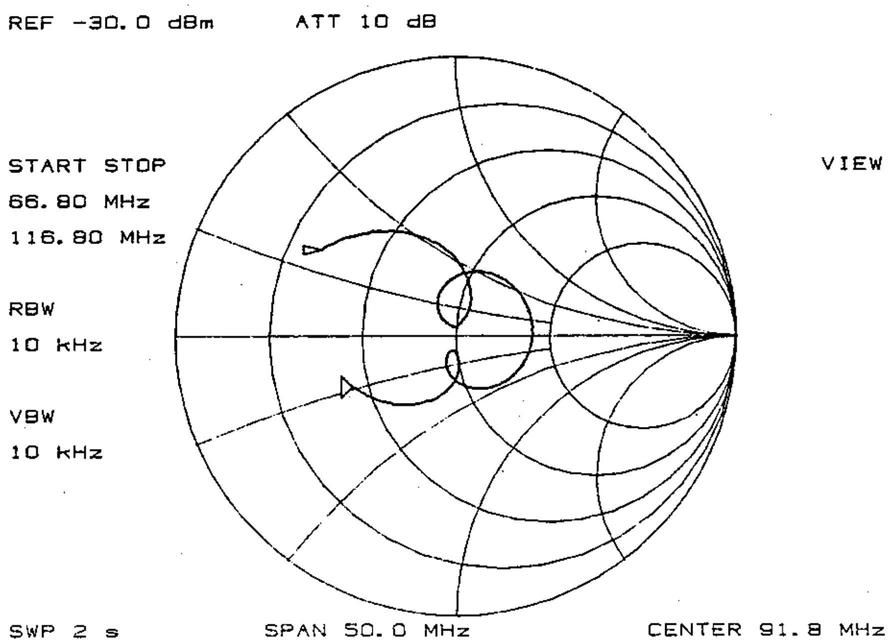


Fig. 9-22 Start and Stop markers

(5) Multimarker listing function

Multimarker setting is effected by following the same procedure as in normal mode. When a number of markers are displayed with the multimarker, pressing the [ ] M switch allows the values of the frequency, normalized impedance, and serial equivalent inductance or capacitance at up to 10 marker points to be listed on the display. The active marker is identified by an asterisk (*) to the left of its point number. If a display circle has been displayed, "IN" or "OUT" indicates whether a marker point has entered the circle or not.

Pressing the [ ] M switch here displays a list of VSWR values, reflection coefficients, and phases.

Pressing the [ ] M switch next will cancel this mode.

Be sure to press the [ ] G switch to hold measurement data
SINGLE START
before entering this mode.

MULTI MARKER LIST

NO.	MARKER FREQ.	IMPEDANCE<NORM.>	L OR C	IN/OUT
* 1	95.00 MHz	562 mΩ - j180 mΩ	186 pF	OUT
2	96.00 MHz	589 mΩ - j22.7mΩ	1.47nF	OUT
3	97.00 MHz	667 mΩ + j94.8mΩ	7.94nH	OUT
4	98.00 MHz	766 mΩ + j151 mΩ	12.6nH	IN
5	99.00 MHz	852 mΩ + j141 mΩ	11.8nH	IN
6	100.00 MHz	878 mΩ + j106 mΩ	8.89nH	IN
7	101.00 MHz	842 mΩ + j109 mΩ	9.12nH	IN
8	102.00 MHz	777 mΩ + j166 mΩ	13.9nH	IN
9	103.00 MHz	720 mΩ + j292 mΩ	24.5nH	OUT
10	104.00 MHz	699 mΩ + j498 mΩ	41.7nH	OUT

Fig. 9-23 Normalized impedance and L/C listing

MULTI MARKER LIST

NO.	MARKER FREQ.	VSWR	R.COEF	PHASE	IN/OUT
* 1	95.00 MHz	1.87	304 m	-151°	OUT
2	96.00 MHz	1.71	262 m	-176°	OUT
3	97.00 MHz	1.53	210 m	161°	OUT
4	98.00 MHz	1.38	158 m	142°	IN
5	99.00 MHz	1.25	112 m	132°	IN
6	100.00 MHz	1.19	88.0m	136°	IN
7	101.00 MHz	1.24	106 m	142°	IN
8	102.00 MHz	1.38	158 m	138°	IN
9	103.00 MHz	1.61	234 m	124°	OUT
10	104.00 MHz	1.99	332 m	105°	OUT

Fig. 9-24 VSWR, reflection coefficient, and phase listing

(6) Frequency response correction feature (See 9-3-4.)

This feature is used for pre-measurement calibration. Operation of the I (MAG. COR.) key selecters the amplitude frequency response correction mode. Pressing the J (MAG. CAL.) key effects calibration. If there is any data outside the correctable range, an error will result, with an ERROR message shown on the display. During calibration busy, the indicator "CAL" is also shown on the display. This correction mode is cleared by pressing the I (MAG. COR.) key again. (See Figure 9-23.)

Operation of the N (PHASE COR.) key selects the phase frequency response correction mode. To execute calibration, press the O (PHASE CAL. (O)) key when the DUT terminals on the VSWR are open, and press the S (PHASE CAL (S)) key when the terminals are shorted. During calibration busy, indicator CAL (O) or CAL (S) is shown on the display. This correction mode is cleared by pressing the N (PHASE COR.) key again.

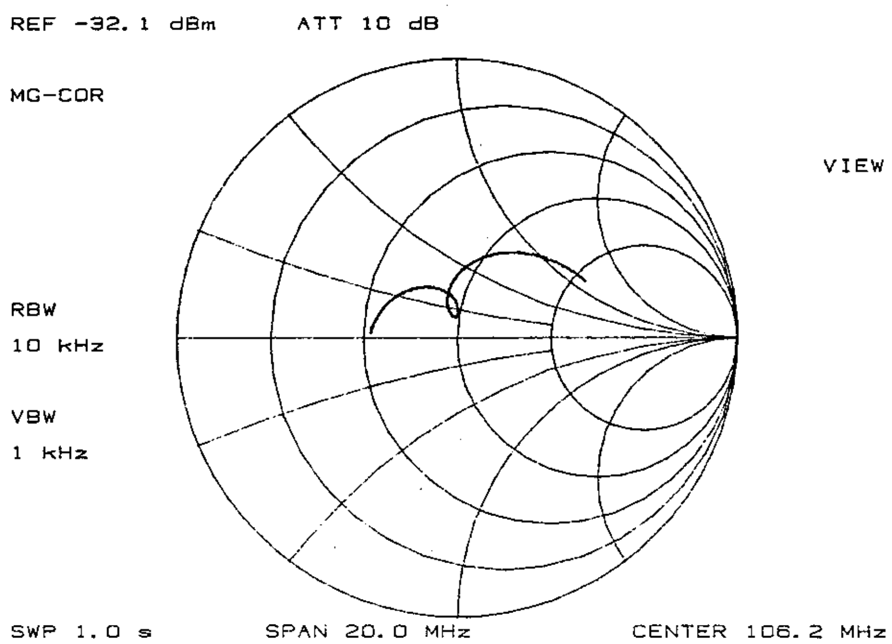


Fig. 9-25 Amplitude response correction mode

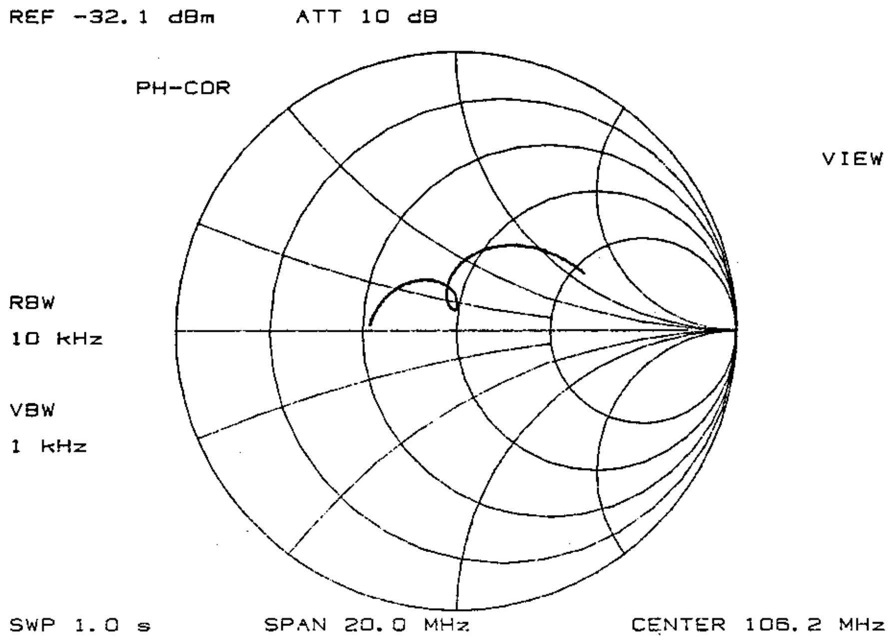


Fig. 9-26 Phase response correction mode

(7) Other features

Each operation of the T (CONTRAST) key increments only the intensity of the displayed impedance response trace or the graticule. The character information readouts remain at the same intensity. Operation of this key first increases the trace intensity in four levels; if the T (BRIGHT) key is pressed a fifth time, the intensity returns to the original level. Next, operation of this key increases the graticule brightness. This trace and graticule intensifying feature is convenient for highlighting the impedance response trace for photographing, or other occasions.

Operation of the H (HELP) key provides a listing of the special key functions used in the impedance measurement mode on the display (See Figure 9-27.)

```
**** IMPEDANCE OPTION FUNCTION SUMMARY ****
"A" SMITH CHART              "B" POLAR CHART
"R" MAG X10 ON/OFF "X10"
"F" CLEAR WRITE MODE         "G" VIEW MODE "VIEW"
"P" DATA POINTS DEC.  "1/2, --, 1/32"
"Q" DATA POINTS INC.  "1/32, --, 1/2"
"L" START STOP MARKER ON/OFF
"U" DISPLAY CIRCLE ON/OFF "DISPLAY CIRCLE"
"Y" MARKER->DISPLAY CIRCLE
"M" MULTI MARKER LIST IMP/VSWR/OFF
"I" MAG CORRECTION ON/OFF "MG-COR"
"J" MAG CAL. "CAL"
"N" PHASE CORRECTION ON/OFF "PH-COR"
"O" PHASE CAL.-OPEN "CAL<O>"
"S" PHASE CAL.-SHORT "CAL<S>"
"T" CONTRAST
"H" HELP MESSAGE ON/OFF

"K" EXIT OPTION
```

Fig. 9-27 Key function listing for impedance measurement mode

The letter enclosed in quotation marks (' ') denotes the character provided on the right side of each key, and the letters given in right denote the relevant function. Pressing the H key again restores the original display image, while maintaining all the setup parameters intact.

9-4-3. Measurement Examples

This paragraph provides an example of application of the impedance measuring option, with bandpass filter response measurement as an example.

(1) Connect the DUT (filter) across the TRACKING GENERATOR OUTPUT and INPUT-1 of the TR4171, then set up the necessary measuring parameters (such as center frequency, frequency span, etc.) observing the pass-band response in the normal mode.

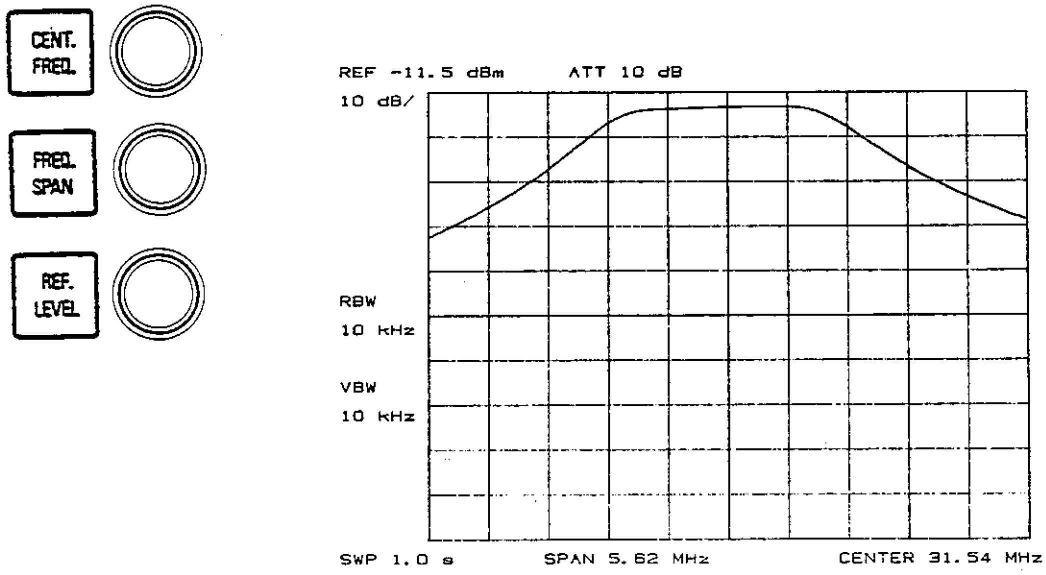


Fig. 9-28 Pass-band characteristic of band-pass filter

(2) Next, connect the VSWR bridge to the TR4171 instead of the DUT (filter) as shown in Figure 9-1, with the DUT left disconnected from the bridge. Activate a marker, and press the MARKER → REF key to position the signal response peak to the reference level.

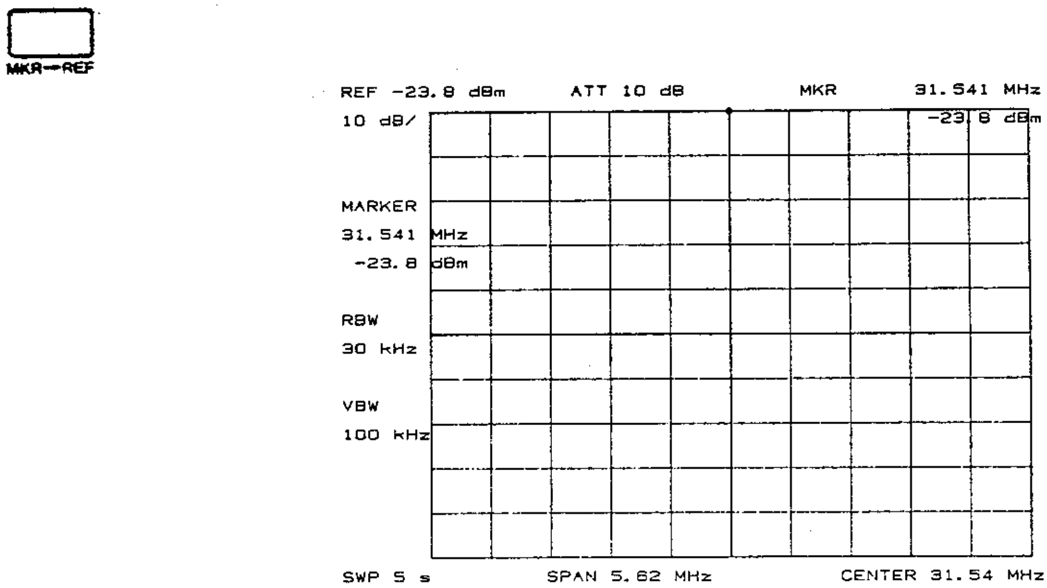


Fig. 9-29 Positioning the signal response peak to the reference level

(3) Connect the DUT to the VSWR bridge. The return loss of the DUT can be read out as the level difference from the reference level.

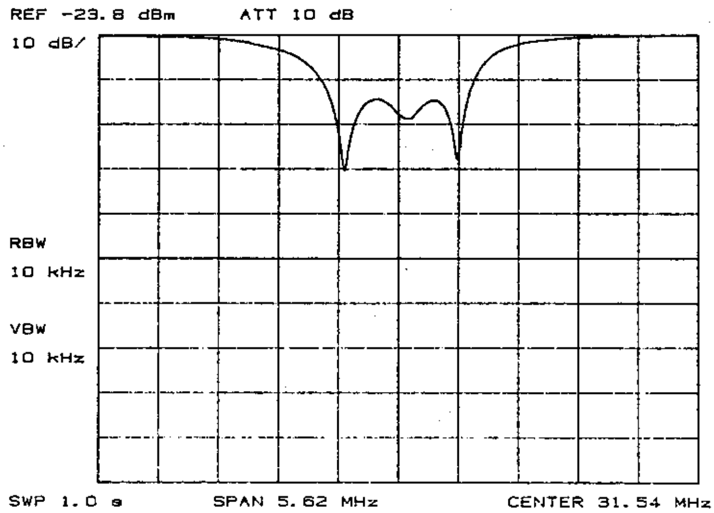


Fig. 9-30 Measurement of DUT return loss

(4) Disconnect the DUT from the VSWR bridge, and instead connect an open or shorting device to the DUT terminals on the bridge. (If the terminals are simply opened, the connector capacity will cause an error; therefore, it is preferable that a highquality open or shorting device be connected across the terminals.) Perform calibration according to the instructions in 9-3-2 and 9-3-3. Calibration in the impedance measurement mode is time consuming. To reduce this time, set the sweep time at a relatively small value to make course calibration, then set sweep time to the optimum value to perform fine calibration. It is also recommended that the P (POINTS DEC.) key be pressed several times in advance to reduce the number of data points and hence save calibration time. The calibration time may be further reduced if course calibration is done in the normal measurement mode (not in the impedance measurement mode) by utlizing the relationship shown in Figure 9-3.

(5) After completing calibration, connect the DUT to the DUT terminals on the VSWR bridge, allowing measurement on a Smith chart. While in the normal measurement mode frequencies can be read from the scale, in the normal measurement mode, on the Smith chart they are read by markers. It is recommended therefore, to use the Multi Marker mode in the impedance measurement mode. In the impedance measurement mode as well, up to 10 multi markers are available, which will be useful for photographing or copy to the plotter.

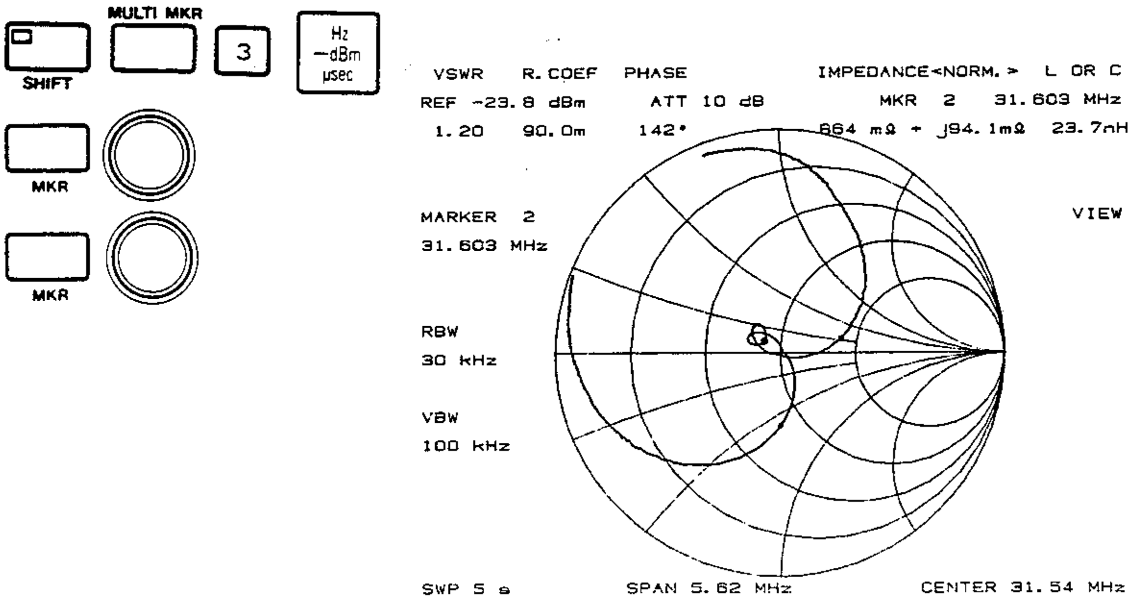


Fig. 9-31 Multi marker mode

(6) Press the K (EXIT) key to clear the impedance measurement mode; and the return loss display is restored.

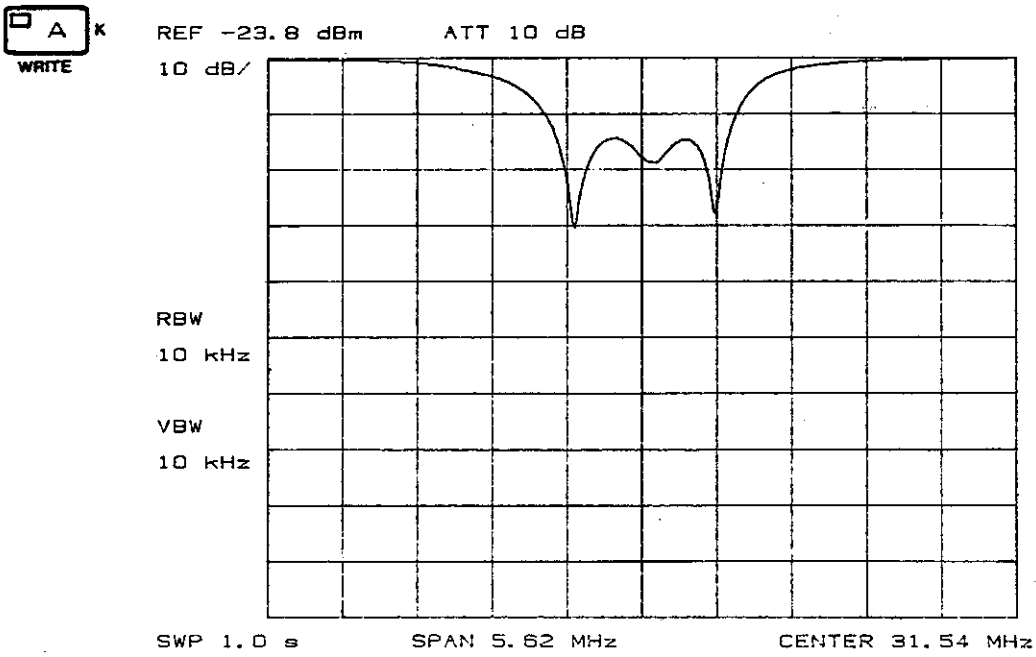


Fig. 9-32 Clearing the impedance measurement mode

9-4-4. Notes on Impedance Measurement

(1) The following keys have the same functions in both normal and impedance measurement modes:

- Function keys
- Data keys
- LEVEL key
- INPUT ATT and AUTO keys
- LABEL, MKR OFF with SHIFT (LABEL CLEAR) keys
- MARKER and MARKER OFF keys
- Δ (delta marker) key
- MARKER with SHIFT (multi marker) key
- GROUP DELAY OFFSET key (group delay offset)
- PHASE OFFSET key (phase offset)
- PLOT key (plotter)
- MASTER RESET key
- LCL key

All parameters set up with these keys are left intact, whether the impedance measurement mode is set or not. All other keys are assigned functions unique to the impedance measurement mode, or are made inoperative. In either case, the lamps in those keys are off.

The impedance measurement mode can be entered whether the preceding mode was the amplitude, phase, or group delay mode or the preceding scale was linear or logarithmic. When the impedance measurement mode is cleared, the original mode and scale are restored. For example, if the impedance measurement mode is selected with amplitude measurement of 5 dB/div. in the normal mode, the amplitude measurement mode at 5 dB/div. is restored when the impedance measurement mode is cleared. Similarly, if the phase measurement mode of 80 deg/div. was selected before the impedance measurement mode was selected, the same phase measurement mode of 80 deg/div. is restored when the impedance measurement mode is unset.

(2) When duplicating the display information on a plotter, press the PLOT key in the impedance measurement mode. All impedance measurement control functions can be remotely controlled over the GPIB. For example, the command PS PS causes the number of data points to be reduced to one-fourth, and the command BW clears the impedance measurement mode.

(3) In the impedance measurement mode, display data is stored over 500 memory locations beginning from address C818. The scale data is stored in a memory area beginning from address C018. Each data point is represented by an orthogonal coordinate point of (x, y), and is stored as X1, Y1, X2, Y2, X3, Y3, and so on in ascending order.

Data should be taken out in decimal form by pressing the G key. Meaningful data is between 0 and 1023. Data beyond 1023 is blanking data, which should be ignored.

To convert the outer circumference of the scale into data (xn, yn) which represents a circle with its center located at (0, 0) and a radius of 1, use the following conversion formulas:

$xn = (x - 512)/500$, $yn = (y - 512)/500$

A basic programming example using the Hewlett Packkard Model 9826 Controller is shown below. After executing this program, measurement information is plotted on the 9826 display.

```
10    GINIT
20    GRAPHICS ON
30    A=1.024
40    WINDOW -A*4/3,A*4/3,-A,A
50    OUTPUT 701;"RDC8180040 TO"
60    PEN -1
70    FOR I=1 TO 500
80    ENTER 701:X
90    ENTER 701:Y
100   DRAW (X-512)/500,(Y-512)/500
110   PEN 1
120   NEXT I
130   END
```

Figure 9-33, 34, 35 show plotting examples of Smith chart, Enlarged Smith chart, and polar coordinate, respectively.

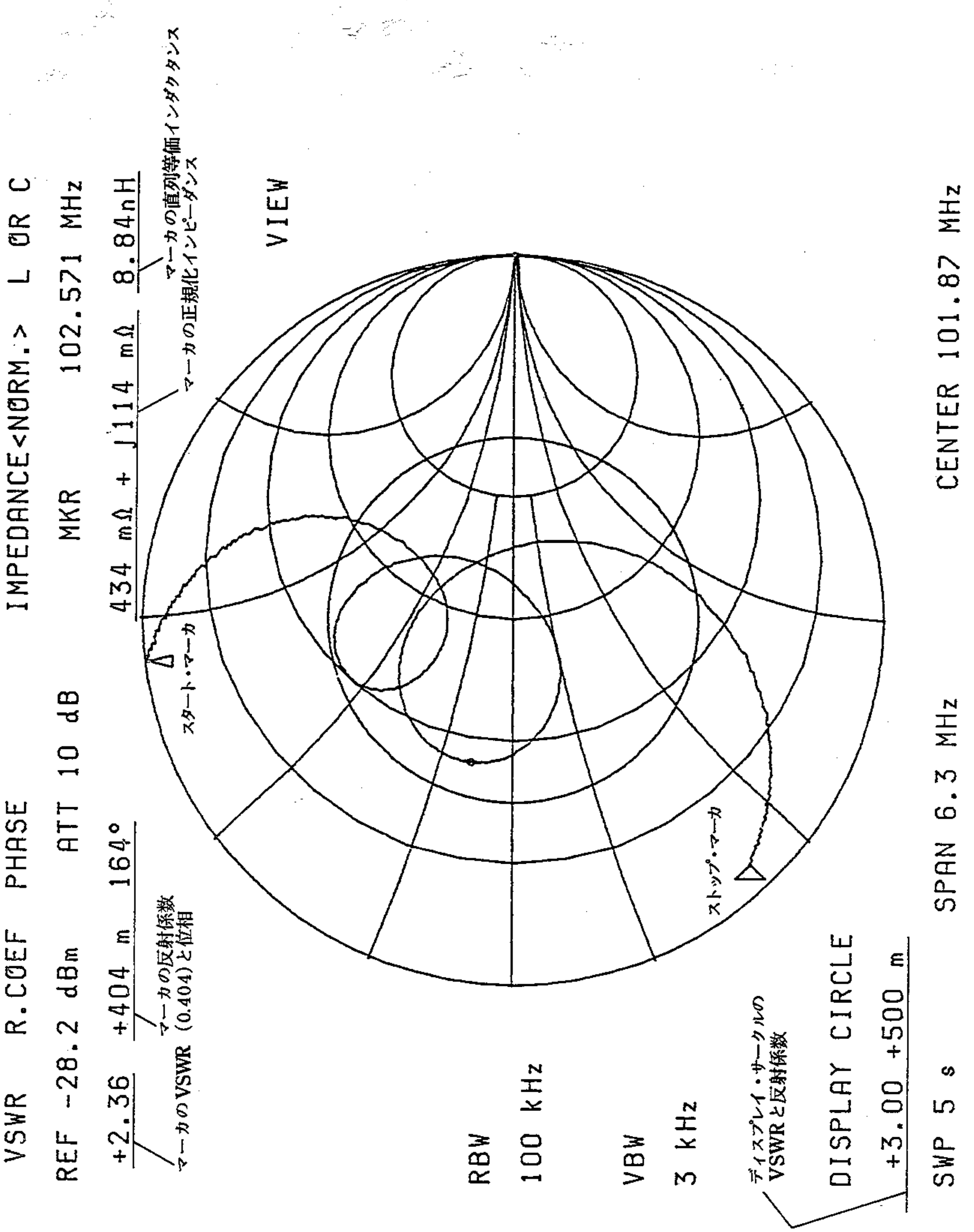


Fig. 9-33 Smith chart plotted

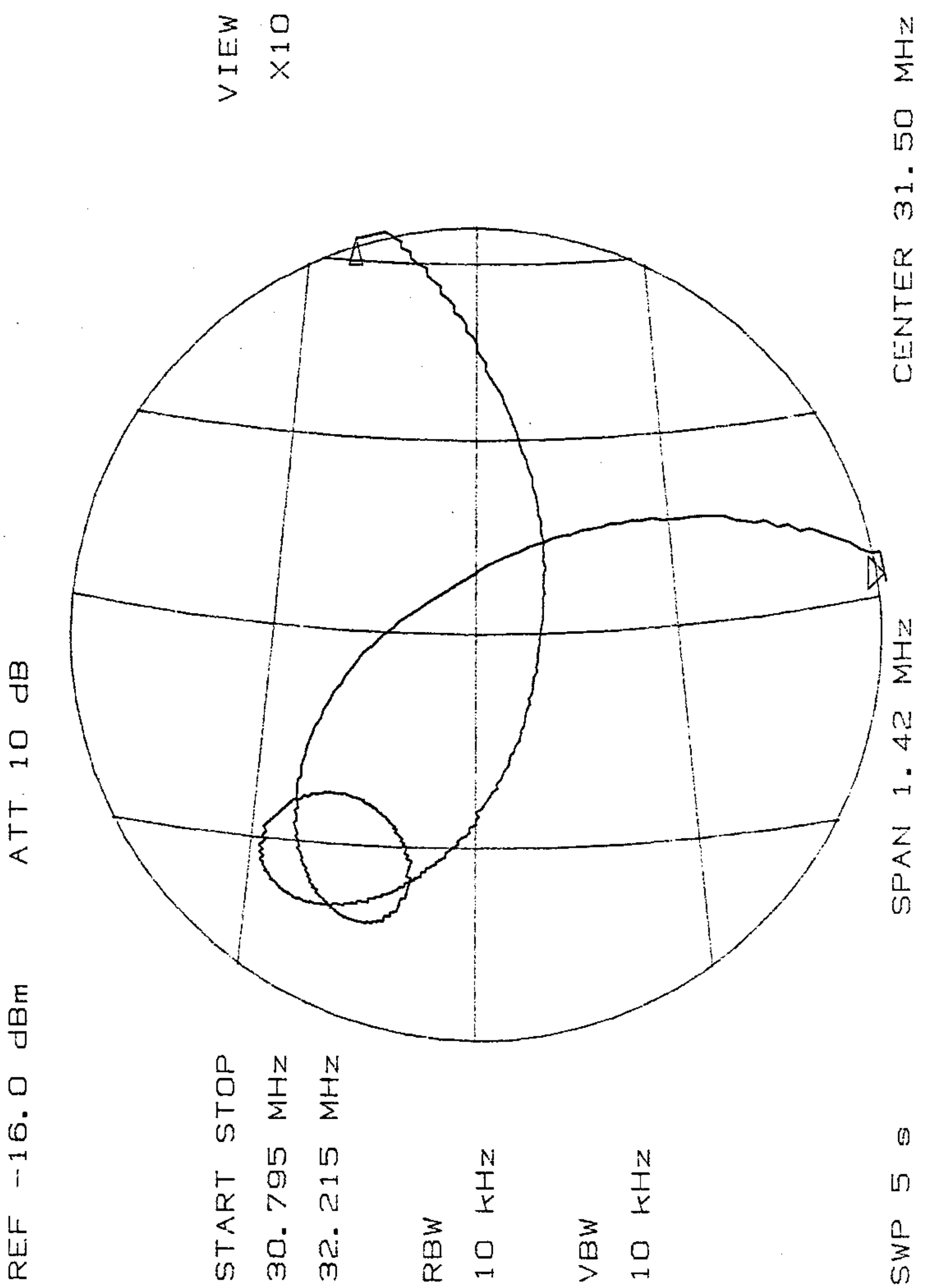


Fig. 9-34 Enlarged Smith chart plotted

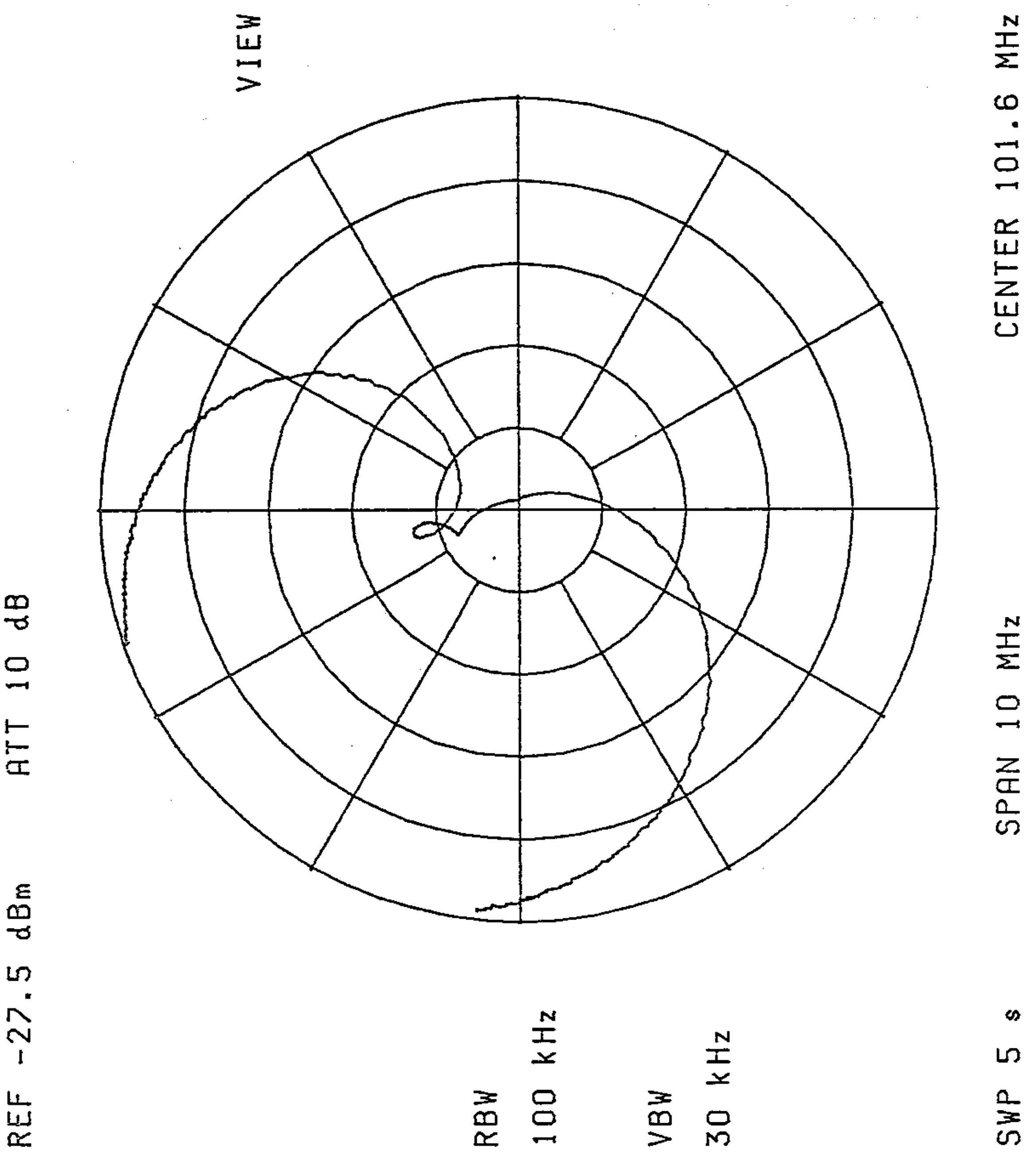


Fig. 9-35 Polar coordinate display plotted

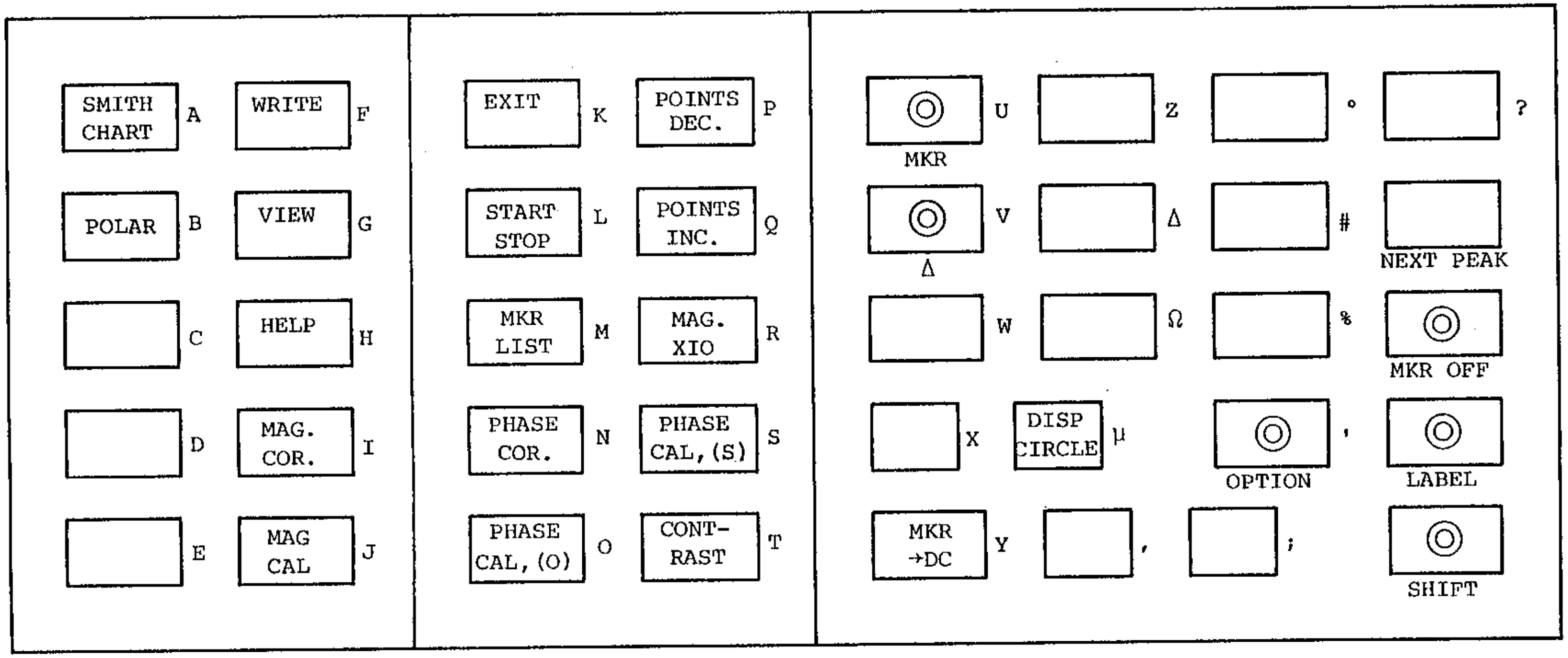


Fig. 9-36 Key functions unique to the impedance measurement mode (Keys marked ☒ are not operative. Keys marked ◎ have their original functions.)

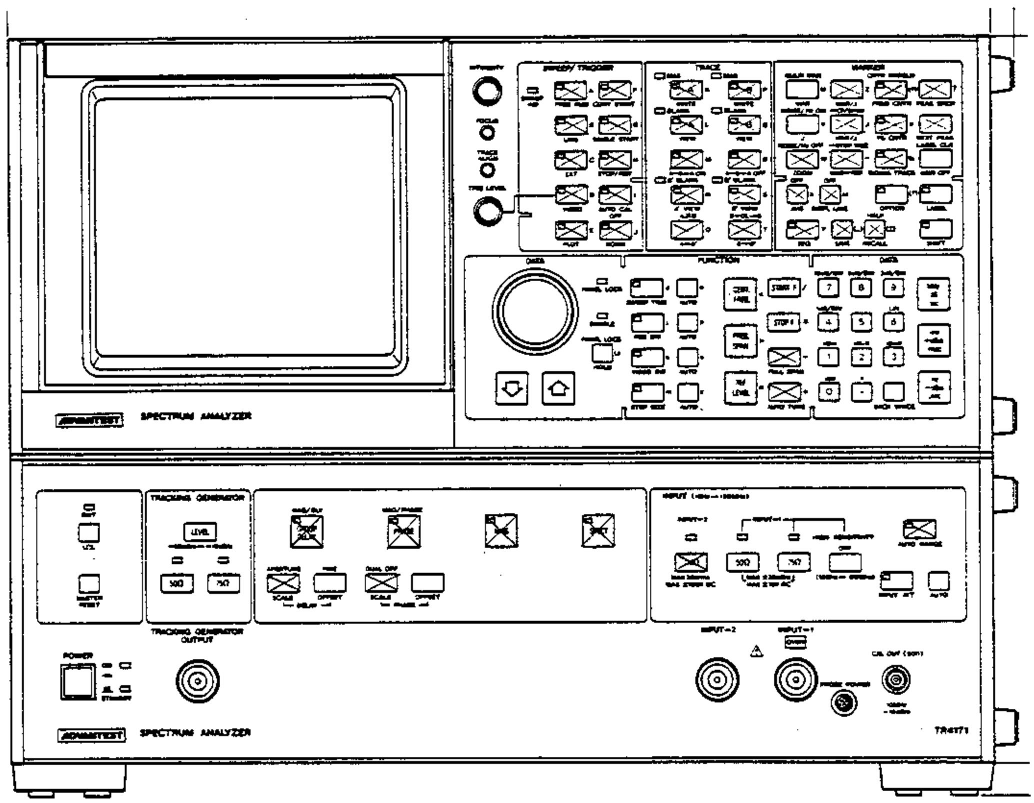


Fig. 9-37 Key functions identical with the impedance measurement mode (keys other than marked ⊠ are operative.

SECTION 10

PRINCIPLES OF OPERATION

10-1. INTRODUCTION

This section describes the TR4171 Spectrum Analyzer configuration and operational principles. For details, see circuit diagrams in Section 15. This section is provided primarily for electronics engineers.

10-2. CONFIGURATION

10-2-1. RF Section

Figure 10-1 is a simplified block diagram of the TR4171 RF Section. The signal input to the 50/75 Ω INPUT connector is transferred through an input impedance changeover circuit, an input attenuator, and an input amplifier and is fed to the first mixer. When HI-SENSITIVITY mode is selected, a preamplifier is intervened between the input attenuator and the input amplifier to improve analyzer sensitivity. The signal received on the 1 MΩ INPUT connector is fed to the first mixer via the input attenuator and amplifier.
The signal supplied to the first mixer is mixed with a local signal of 179 MHz to 299 MHz and is delivered as the 179 MHz IF signal to the second mixer.
The signal fed to the second mixer is mixed with a 150 MHz local signal and is delivered as the 29 MHz IF signal to the third mixer.
The signal received on the third mixer is mixed with a 32.33 MHz local signal and is output as a 3.33 MHz IF signal to the Display Section.
Each local signal source has high reliability and precision due to excellent time base.
The tracking generator converts the 3.33 MHz oscillator signal with respect to the frequency in a path contrary to the spectrum analyzer. It then outputs a 10 Hz to 120 MHz signal synchronized with the spectrum analyzer sweep via the output amplifier and T.G. attenuator.

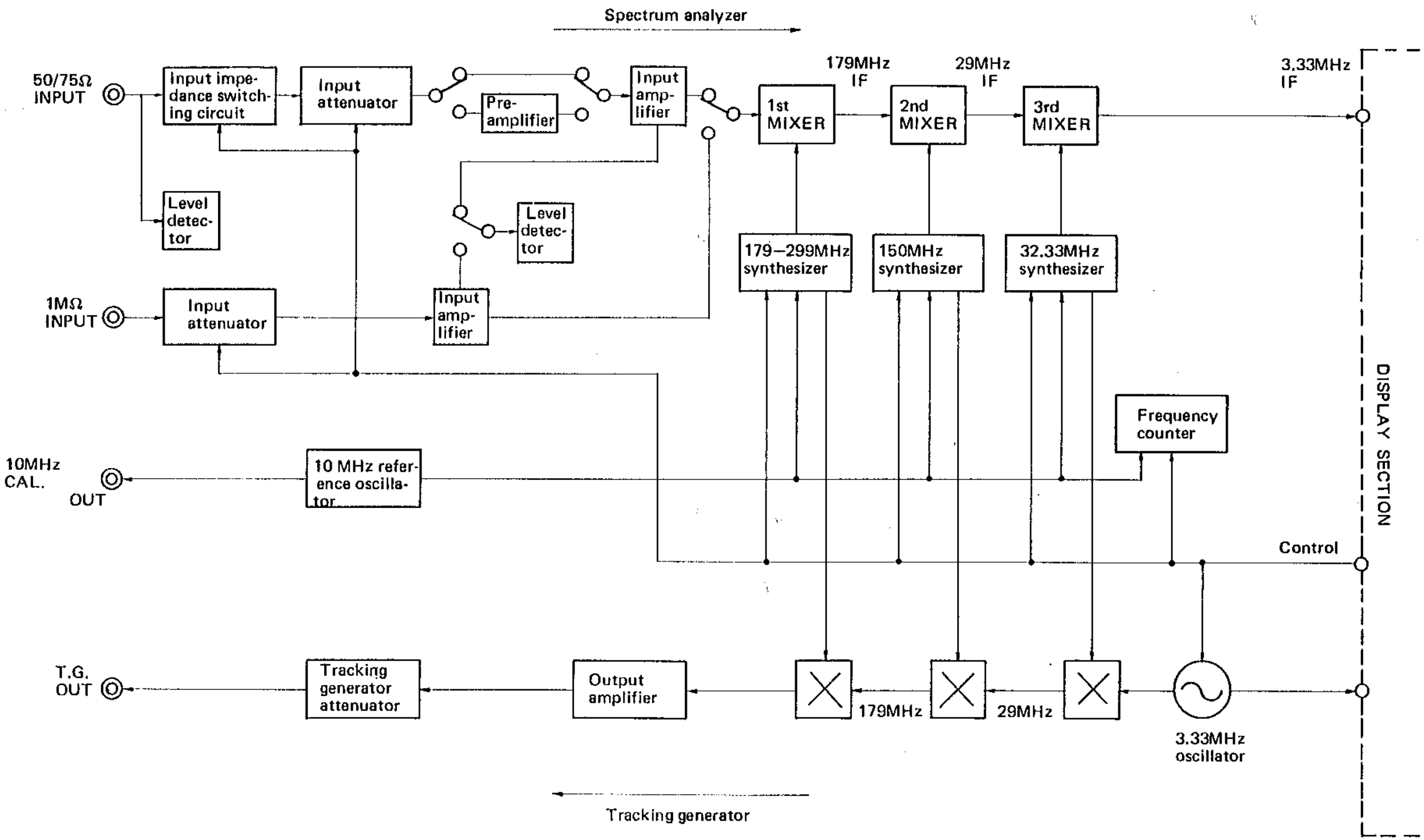


Fig. 10-1 TR4171 RF section block diagram

10-2-2. Display Section

Figure 10-2 is a simplified block diagram of the TR4171 Display Section. The 3.33 MHz IF signal passes the final IF filter and enters the logarithmic amplifier with a 100 dB dynamic range. This conducts log compression on the IF signal.

This signal is detected and subjected to A/D conversion. It then undergoes D/A conversion by the controller and is displayed on the CRT. Amplitude characteristics are thus displayed.

For phase measurement, the 3.33 MHz signal from LOG. AMP. OUT port is output via a phase multiplier circuit when it is desired to improve phase resolution. In other cases, the 30 kHz IF signal is output with the 3.30 MHz local signal.

The 3.33 MHz reference signal from the tracking generator passes through the phase offset circuit and the group delay offset circuit. It is then mixed with a 3.30 MHz local signal to produce a 30 kHz signal.

The phase of the 30 kHz signal generated by the reference signal is compared with the 30 kHz signal filtered through the IF filter. The resultant signal undergoes A/D conversion, and then D/A conversion in the controller. The obtained signal is displayed on the CRT.

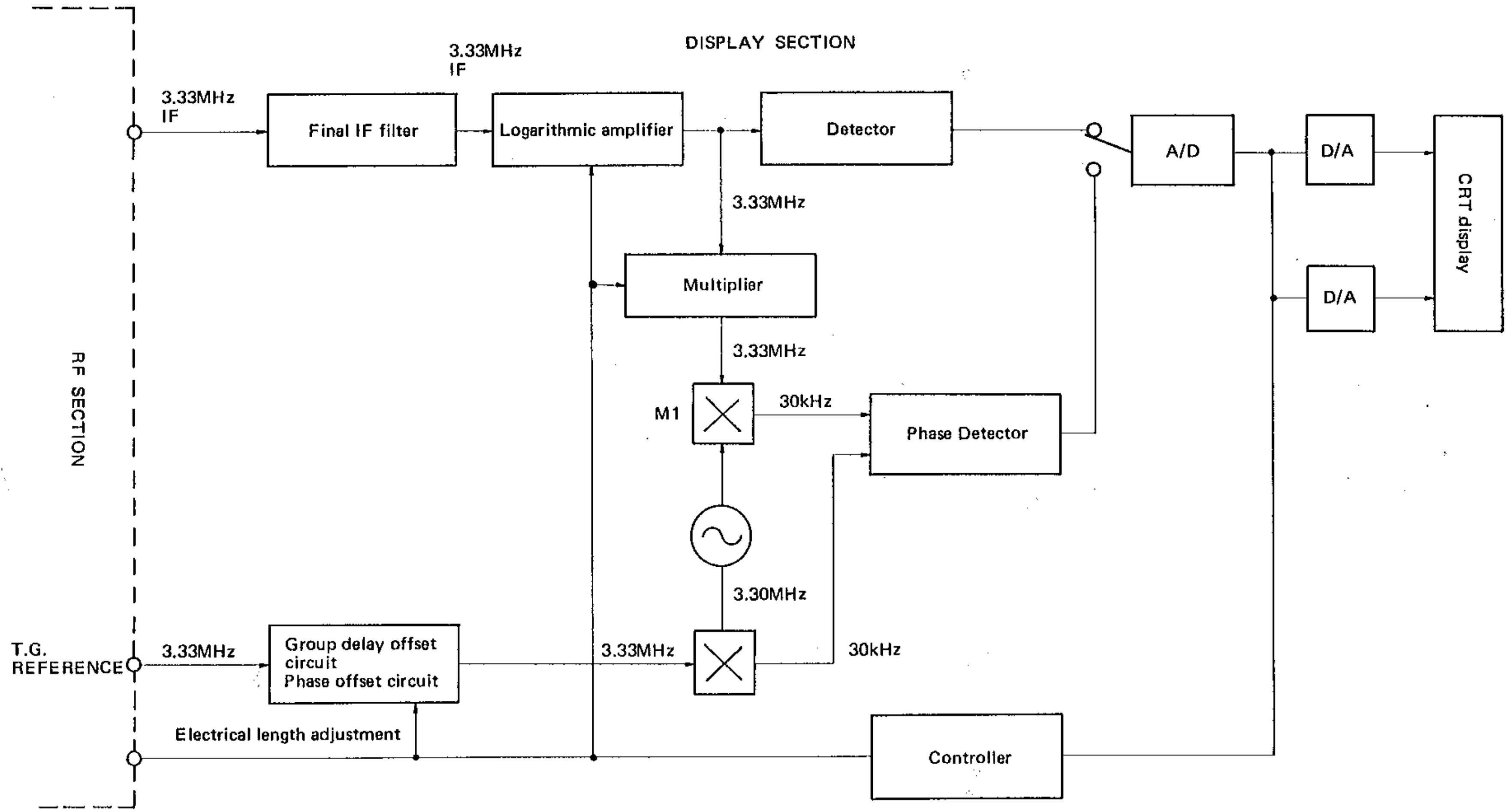


Fig. 10-2 TR4171 Display Section block diagram

10-3. BLOCK OPERATIONS OF RF SECTION

10-3-1. RF Input Block (MEP-404)

The RF input block diagram is shown in Figure 10-3. Signal input to the TR4171 is passed through a 50 Ω/75 Ω input attenuator or a 1 MΩ input attenuator and is fed to the first mixer via the respective input amplifier. This converts the received signal into the first IF signal to output to the RF block. In addition, this block includes the following circuits.

a. Overload detection circuit (50 Ω/75 Ω input only)
   On receiving a signal equal to or greater than +30 dBm, this circuit turns on the front panel OVER lamp and displays "OVERLOAD" on the CRT. It then sets the input attenuator to 65 dB.

b. AUTO CAL. switch (50 Ω/75 Ω input only)
   When automatic calibration is specified, this switch automatically and internally connects the 10 MHz calibration signal in this block.

c. Automatic range amplifier, detector, and comparator
   These circuits detect an unknown input signal level and automatically set the input attenuator to the appropriate value.

d. Preamplifier (50 Ω/75 Ω input only)
   This is used in the high sensitivity measurement mode.

To minimize grounding current influence in low-frequency operation, the input section is constructed in the floating configuration. Signal, control, and power lines are thus entirely in the floating state. +5 V power is generated from the +15 V source.

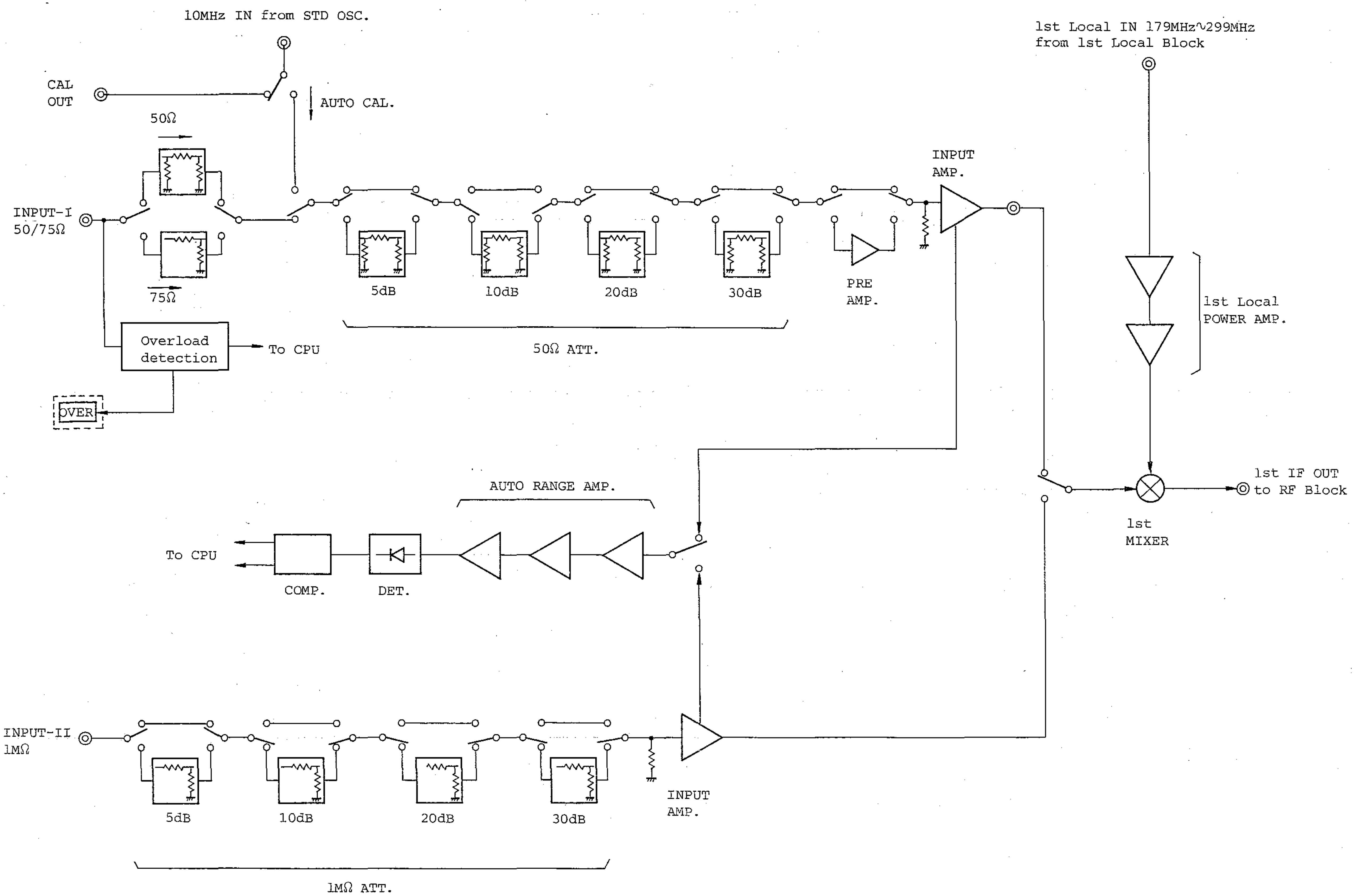


Fig. 10-3 RF INPUT block

10-3-2. RF Block (MEP-405)

Figure 10-4 shows the RF block diagram. This subsection describes the RF block for each circuit board.

a. First IF board (BLP-011245)

The signal obtained from the RF input block is filtered and amplified by the two-stage helical band-pass filter (BPF), low-pass filter (LPF), and first IF amplifier.

b. Second IF board (BLC-011246)

The first IF signal (179 MHz) is mixed with the second local signal (150 MHz) in the second mixer to produce the second IF signal (29 MHz). The signal is then filtered and amplified by the two-stage BPF and second IF amplifier.

c. Third IF board (BLF-011247)

The second IF signal (29 MHz) is mixed with the third local signal (32.33 MHz) in the third mixer to produce the third IF signal (3.33 MHz). The signal is then filtered and amplified by the BPF and two-stage third IF amplifier. The first-stage third IF amplifier also corrects the frequency characteristics of the TR4171 input section. The S_L switch controlling the third local signal functions as follows. The first local signal is generated by dividing a signal obtained through YTO signal oscillation. When division becomes impossible, noise is generated and appears on the CRT display. In synchronism with the first local signal sweep, the S_L switch is turned on or off to minimize the noise.

d. Reference attenuator board (BGJ-011248)

This is set to the through position in ordinary cases. It is changed over to the REF. ATT. (reference attenuator) side when auto-calibration is specified. The on/off switch for 3.33 MHz signal from the TG block is ordinarily set to OFF. It turns ON when auto-calibration is conducted for the tracking error, thereby delivering the 3.33 MHz signal to the final IF block. The reference attenuator performs auto-calibrations for vertical axis linearity and for acquiring 10 dB step amplifier calibration data from the final IF and logarithmic amplifier blocks.

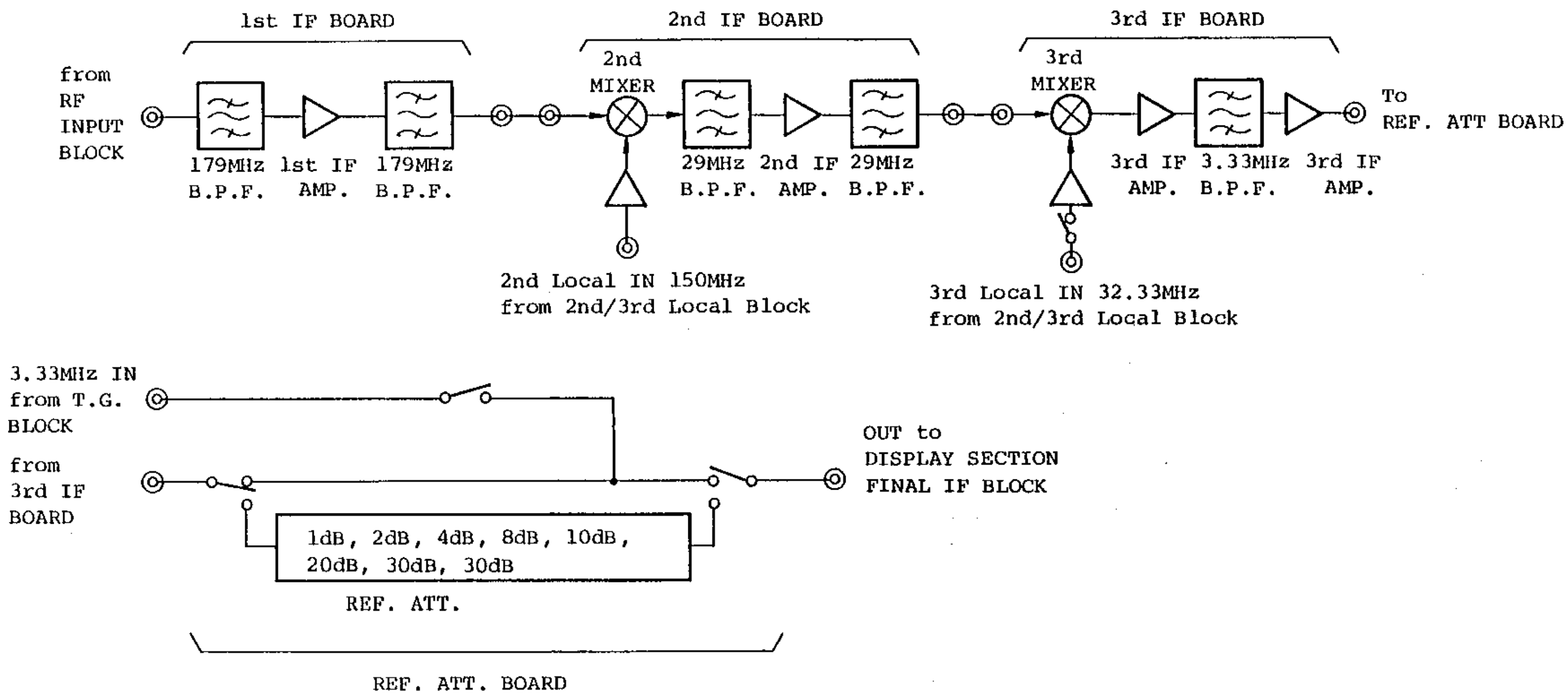


Fig. 10-4 RF block diagram

10-3-3. First Local Block (MEP-406)

Figure 10-5 shows the first local block diagram.
The 2 to 4 GHz YTO signal is divided by 12 to generate the first local signal.
When the frequency span is reduced to 50 kHz or less, the operation is affected by, for example, noise. To minimize this, the YTO output signal is stabilized using the PLL technique in the first local block.

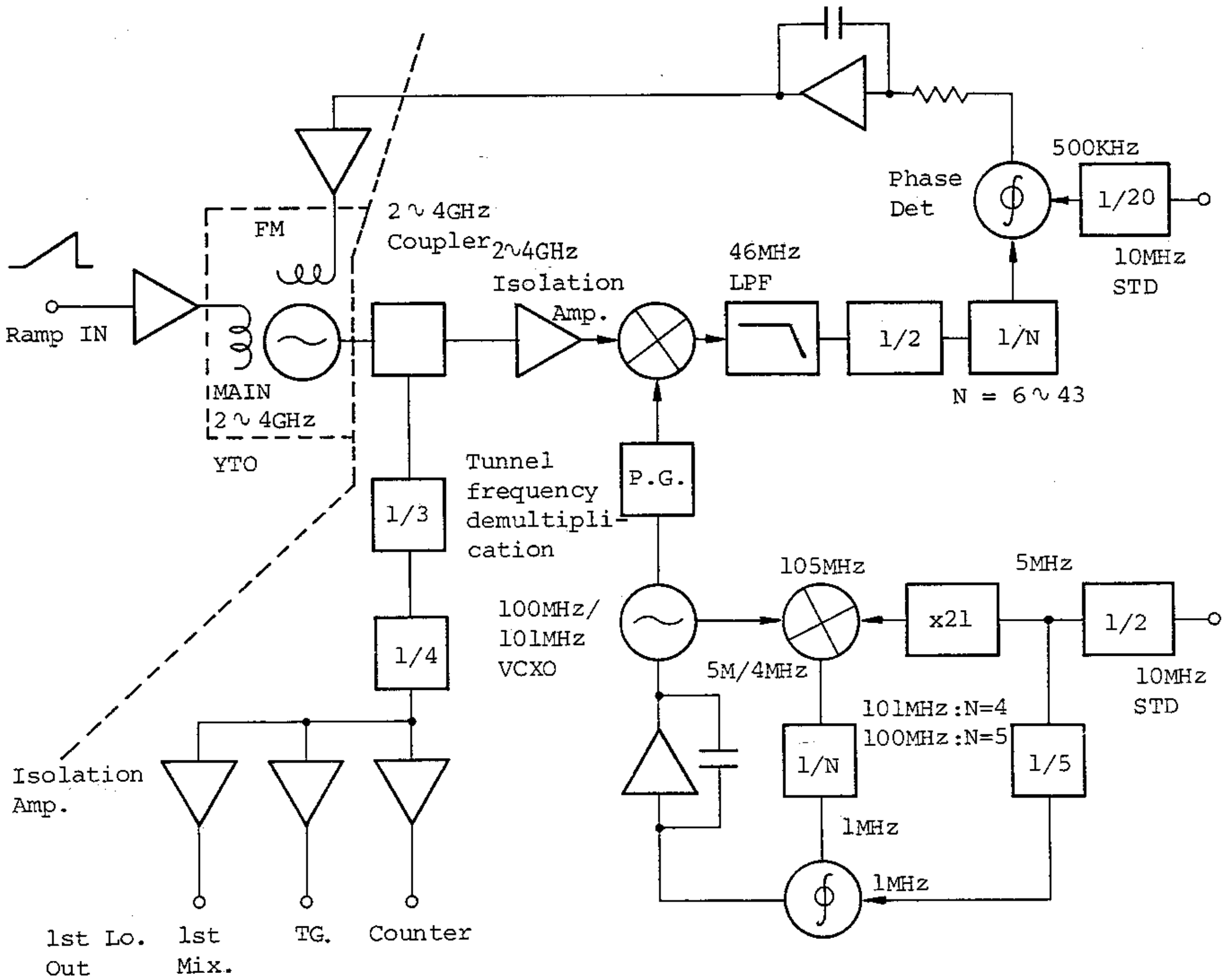


Fig. 10-5 First local block

a. YTO divider circuit

The first local signal is generated by dividing the YTO signal (2 to 4 GHz) by 12 with a tunnel diode divider (1/3) and on ECL divider (1/4).

b. First local isolation amplifier

The first local signal obtained is respectively input to the first mixer, TG, and counter via the isolation amplifier. This functions so that no interaction occurs between each circuit.

c. YTO isolation amplifier

This is a buffer amplifier for the YTO output signal (2 to 4 GHz). It includes a three-stage transistor section and an attenuator. This circuit prevents signals such as the 100/101 MHz signal from affecting the YTO and YTO divider circuits.

d. 100/101 MHz oscillator

The phase-locked loop (PLL) circuit compares the oscillator phase with the reference oscillator. It increases oscillator stability with a loop circuit. In the first PLL circuit of TR4171, a 100/101 MHz crystal oscillator is the reference oscillator. 100 MHz and 101 MHz oscillator operation is uniquely determined by setting the center frequency. Figure 10-6 illustrates the range for selecting the center frequency. In the 2 to 4 GHz range, these oscillators can be set to allow a loop for the YTO output at any frequency using the digital phase detector. Crystal osciallators are connected to the 100/101 MHz PLL circuit, thereby forming a PLL for the 10 MHz time base operation. Output is amplified to approx. +8 dBm and is delivered to the first PLL pulse generator circuit.

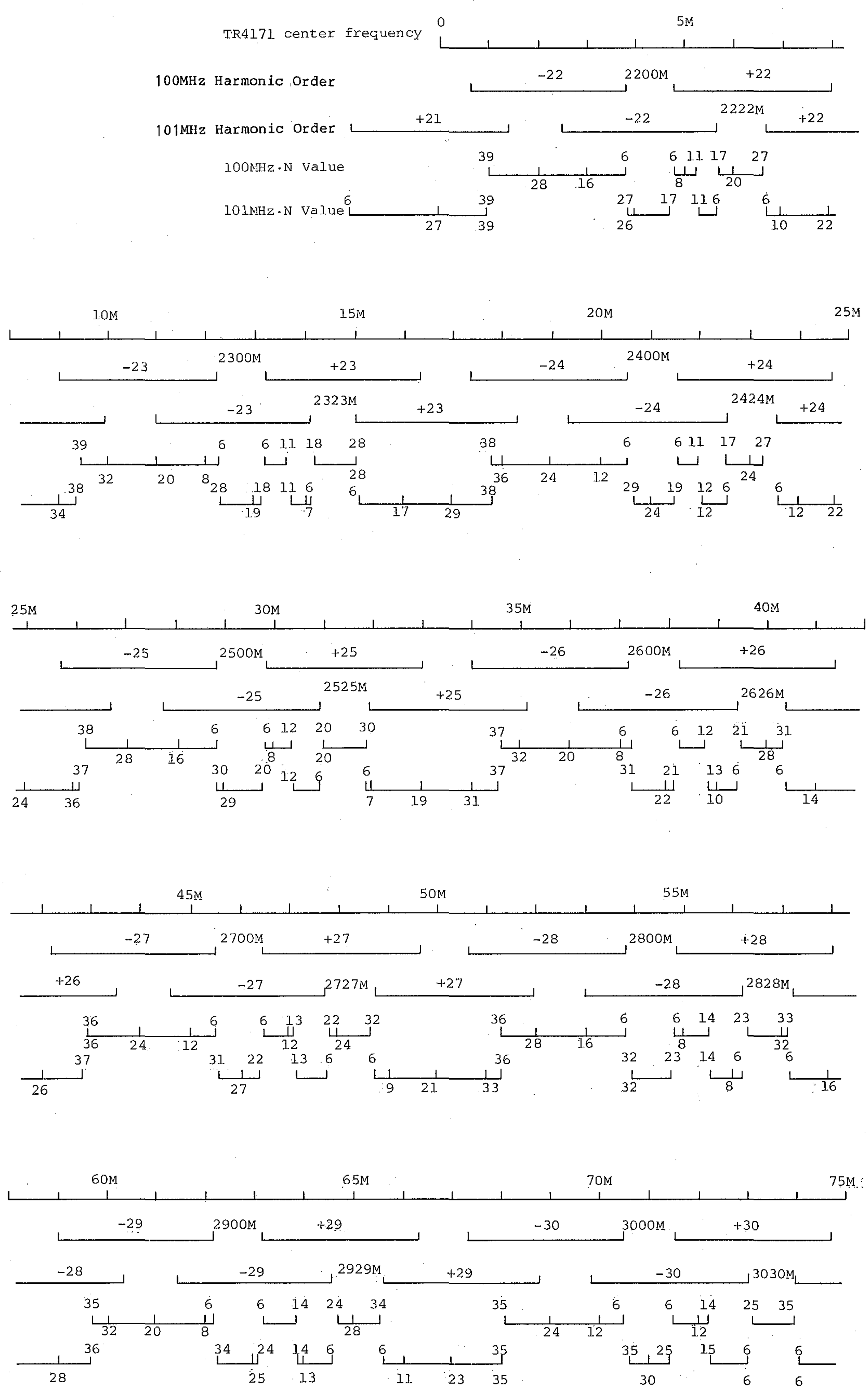


Fig. 10-6 TR4171 LOCK N value

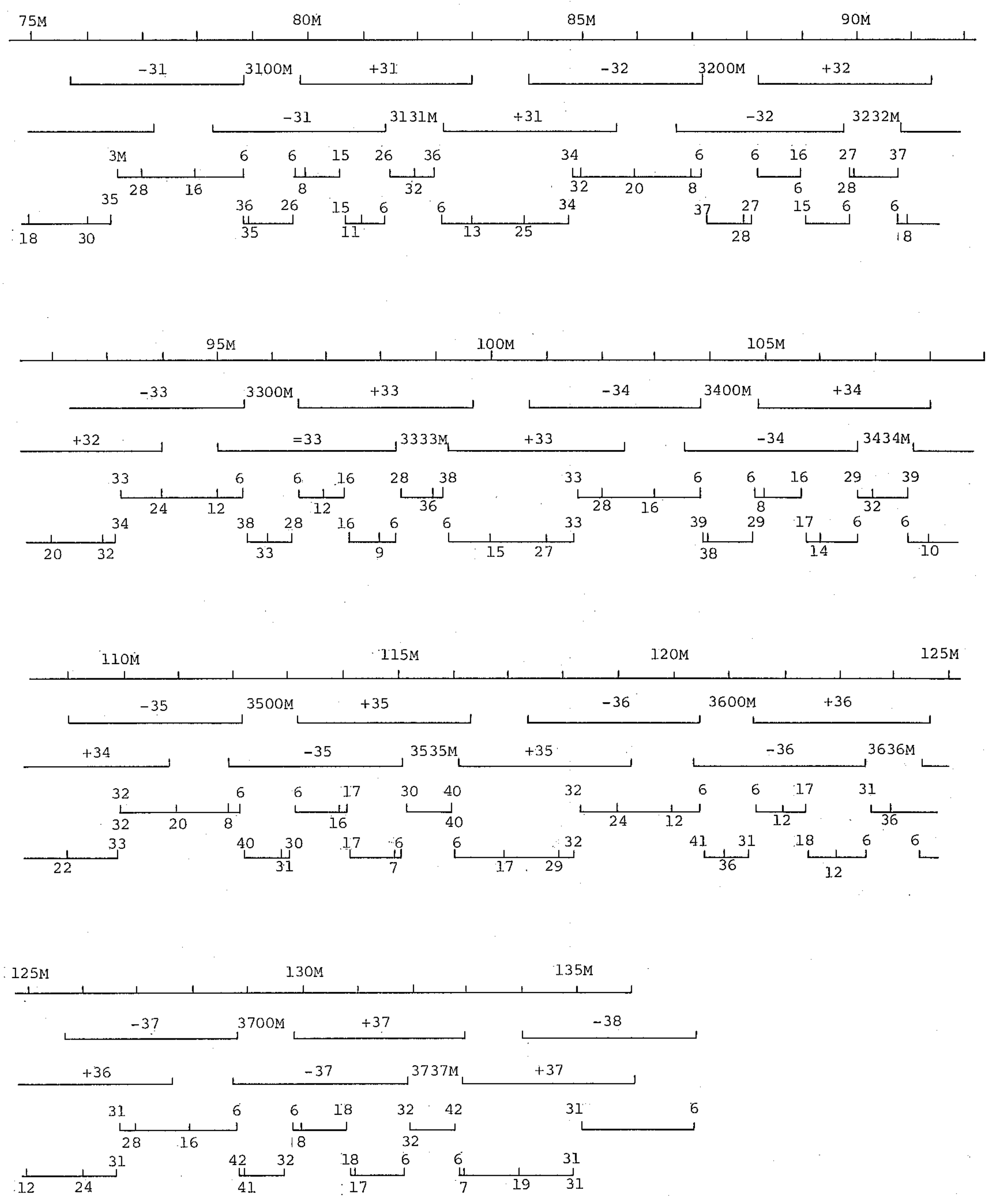


Fig. 10-6 TR4171 LOCK N value (Cont'd)

Remarks on Figure 10-6:

1. "M" in this diagram stands for "MHz".
2. Center frequencies are indicated in 1 MHz steps. The corresponding N value is shown below the respective line for the 100 MHz · N value or 101 MHz · N value.
   Example: 101 MHz · N value for center frequency 0 MHz: 27
   100 MHz · N value for center frequency 37 MHz: 8
3. The N value in each 1 MHz step is changed by one count each time the center frequency changes 83.333 kHz.
   Example: 100 MHz · N values for the center frequencies 10 MHz and 11 MHz are 32 and 20. Therefore, the 100 MHz · N value = 32 - 12/2 = 26 for the center frequency 10.5 MHz.

e. 100/101 MHz oscillator PLL

As described in item d, PLL is configured for the 100/101 MHz crystal oscillator in accordance with the 10 MHz time base. The 105 MHz signal is created by processing the 10 MHz signal first through a divider circuit (x1/2) and then a multiplier circuit (x21). This signal is combined with the 100/101 MHz signal to obtain the 5/4 MHz IF signal. This is then divided by 5 or 4. Phase comparison is conducted between the resultant signal and the 1 MHz signal (1/10 of the reference signal frequency). The obtained signal is filtered by a low-pass filter to output a control voltage. This is fed back to the 100/101 MHz oscillator, thereby configuring PLL.

f. 2 to 4 GHz pulse generator

100/101 MHz oscillator output is applied to the step recovery diode to output the 100/101 MHz COMB signal in the range of 2 to 4 GHz. The 2 to 4 GHz COMB signal is output at -35 dBm (min.).

g. YTO phase lock mixer

The 2 to 4 GHz YTO signal from the isolation amplifier is mixed with the 100/101 MHz COMB signal. The resultant signal is filtered by the 46 MHz LPF to obtain the 6 to 43 MHz IF signal.

h. Digital phase-locked loop

The 6 to 43 MHz IF signal from the YTO phase lock mixer is converted to a TTL-level signal through an isolation amplifier and a Schmitt trigger circuit. The resultant signal is divided by two. It is then input to a 1/N multiplier circuit to be divided in accordance with the CPU specified frequency. A plus or minus sign is assigned to the obtained signal. The signal is then applied to the phase detector input terminal. Since the signal is divided by two before it is input to the 1/N multiplier circuit, the YTO is phase-locked for each 1 MHz if the reference signal frequency is set to 500 kHz. (With the first local signal divided by 12, the YTO will be phase-locked for each 83.333 kHz.)
The plus/minus sign assignment means the following. Since the IF signal is set with the same frequency at two positions depending on the center frequency setting, the reference signal input is routed to one of two phase detected input terminals. This depends on if the center frequency setting is greater or smaller than the 100/101 MHz COMB signal. (See Figure 10-6.)
The phase detector output is input to the PLL filter via an LPF to be converted into a DC voltage. This voltage applied to the YTO FM terminal, thereby configuring the phase-locked loop.

10-3-4. Second/third Local Block (MEP-407)

Figure 10-7 illustrates a block diagram of the second/third local block.
The second local block generates the 150 MHz signal by multiplying by 15 the 10 MHz reference signal from the STD. OSC. block. The third local block includes two sweep oscillators. These are selectively operated depending on the frequency span setting value.

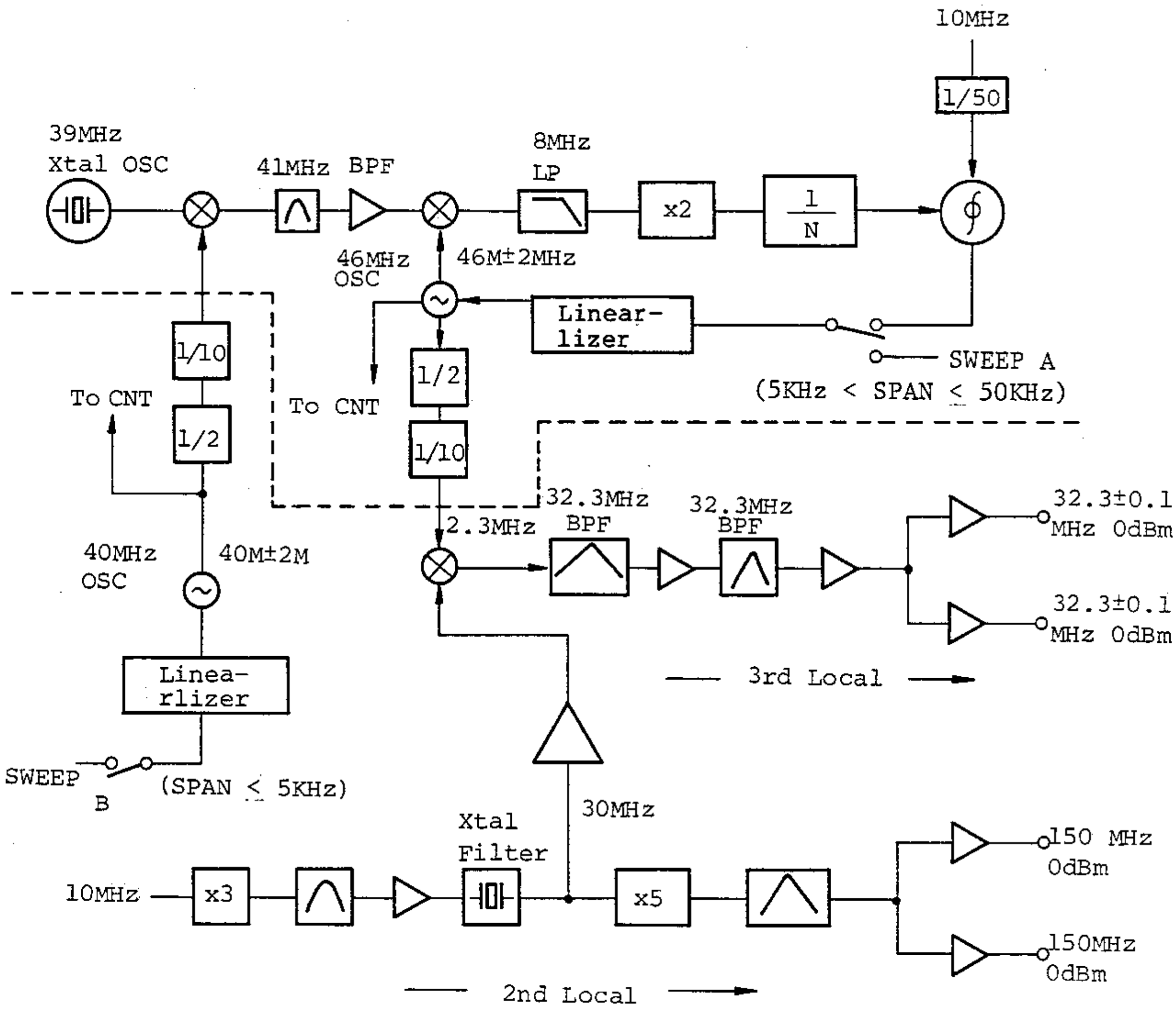


Fig. 10-7 Second/third local block

a. 46 MHz VCO

The 0 to 10 V control voltage is applied to the oscillator via a linearizer to oscillate a 46 MHz ±2 MHz signal. This signal is divided by two and is output to the counter. It is further divided by ten to produce a 23 MHz ±0.1 MHz signal. This signal is combined with a 30 MHz signal generated in the second local block to generate the third local signal.

If the frequency span is equal to or less than 5 kHz, the VCO outputs a 46 MHz signal to configure a PLL together with the 40 MHz VCO.

b. 40 MHz VCO

This circuit is quite similar to the 46 MHz VCO configuration and oscillates at 40 MHz ±2 MHz. It delivers the counter output via an amplifier. The signal is divided by 20 to produce a 2 MHz ±0.1 MHz signal, which is then mixed with a 39 MHz in a mixer.

c. 39 MHz mixer

This mixer generates a 41 MHz signal by mixing an output signal from the 39 MHz crystal oscillator and a signal obtained by dividing the 40 MHz VCO output signal by 20. Unnecessary signals are eliminated in the BPF and amplifier.

d. Third local PLL

A 5 MHz IF signal is generated by mixing a 41 MHz signal from the 39 MHz mixer and a 46 MHz signal from the 46 MHz VCO. This IF signal is multiplied by two to produce a 10 MHz signal. The signal is input to the 1/N divider. Phase comparison is performed between the output signal from the 1/N divider and a 200 kHz reference signal obtained by dividing the 10 MHz signal from the STD. OSC. block by 50. The signal is applied as the 46 MHz VCO drive voltage via an LPF. At this stage, when the 40 MHz VCO is subjected to a sweep, the 46 MHz VCO also undergoes the sweep with the PLL loop kept configured. This sweep is applicable to a frequency span not exceeding 5 kHz.

e. Second local block

The 10 MHz reference signal from the STD. OSC. block is multiplied by three and is passed to a filter to obtain a 30 MHz signal. The obtained signal is routed in two directions. One is input to a multiplier circuit (x5). The other is passed through an amplifier to be mixed with an output signal obtained by dividing the 46 MHz VCO output by 20. The former is passed through a filter. This eliminates unnecessary signal components. The obtained signal is divided by two and delivered as the second local output.

f. Third local block

When the frequency span is 5 kHz or more, the 32.3 MHz signal is generated by combining the 30 MHz signal obtained in the second local block and an output obtained by dividing the 46 MHz VCO output by 20. This generates the third local signal.

10-3-5. Local Driver Board (BGN-011225)

This section generates the fixed or ramp voltage to determine oscillation frequencies of the YTO of the first local block and the 46 MHz VCO and 40 MHz VCO of the third local block.
The correspondence between the TR4171 frequency span values and the sweeping oscillators to which ramp voltages are applied are listed in the following table.

Frequency span	Sweep oscillator
span > 1 MHz	YTO MAIN
1 MHz ≧ span > 50 kHz	YTO FM
50 kHz ≧ span > 5 kHz	3rd Local 46M VCO
5 kHz ≧ span	3rd Local 40M VCO

Note: When start and stop frequencies are specified, the frequency difference between them is set to the frequency span.

In order to generate the drive voltage, the ramp voltage from the Display Section is divided or added to an offset voltage in accordance with CPU data. The circuitry includes a D/A converter to generate offset voltage, an analog switch for changing over the division ratio for dividing the ramp voltage, and a circuit for generating -5 V and +12 V YTO power from a -15 V and +15 V source power.

10-3-6. Tracking Generator Block (MEP-409)

The tracking generator is a synchronized signal source. It processes outputs from three local oscillators in accordance with procedures differing from those applied to the spectrum analyzer. This conducts the sweep operation at the span interval centered on the specified center frequency. It delivers the 10 Hz to 120 MHz signals as its output. Figure 10-8 shows the tracking generator block diagram.

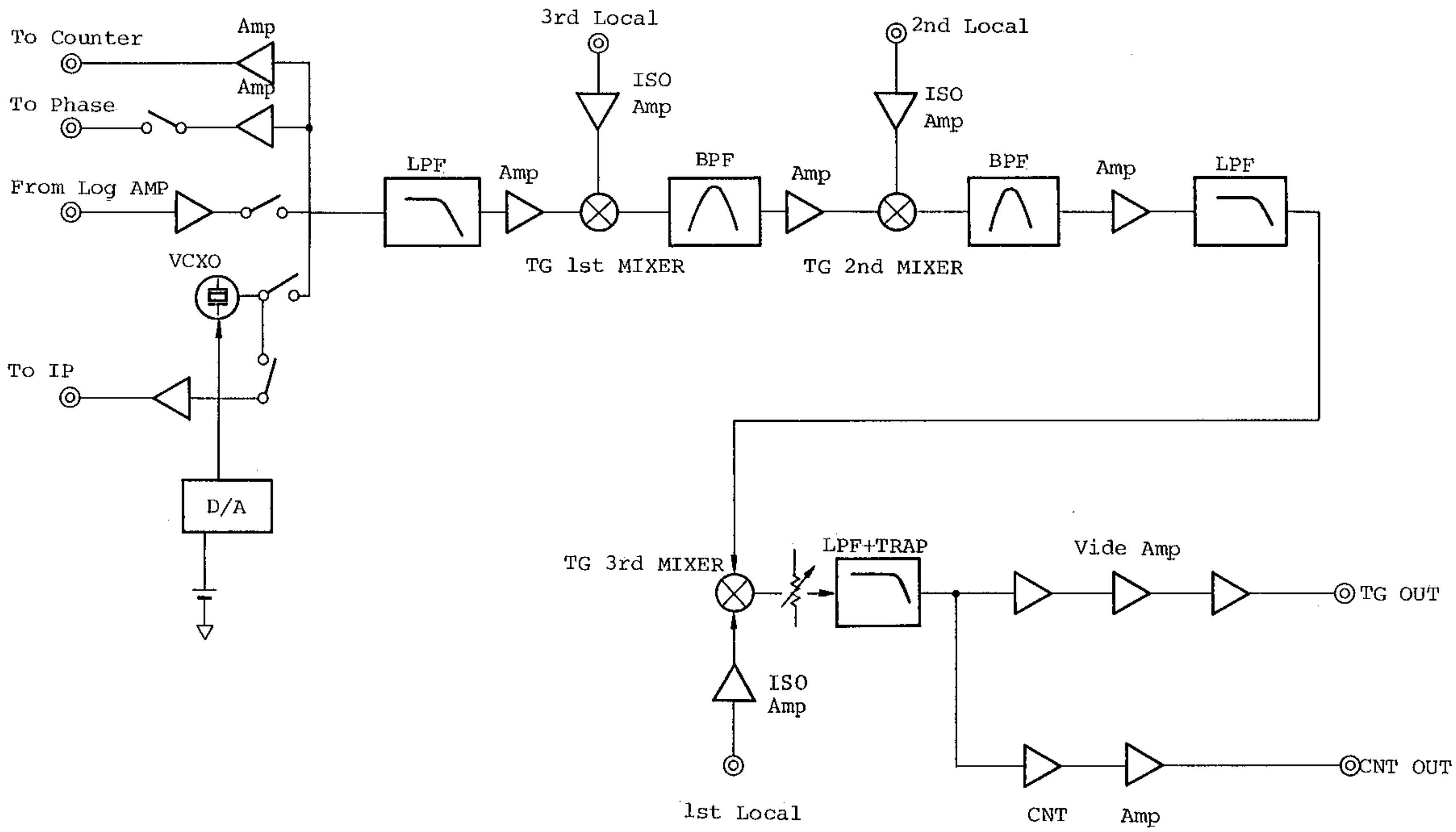


Fig. 10-8 Tracking generator block diagram

a. 3.33 MHz oscillator section

The 3.33 MHz VCXO is an oscillator which generates a signal corresponding to the IF signal in the normal spectrum analyzer operation. The oscillation frequency can be changed by use of the D/A converter to correct the tracking error which may take place when the resolution bandwidth is narrowed. The 3.33 MHz output signal is the reference signal for the phase measurement. In frequency counter mode, the 3.33 MHz signal from the logarithmic amplifier replaces this signal.

In TG counter mode, the 3.33 MHz crystal oscillator output is passed through an LPF and is mixed with the third local signal from the second/third local block to obtain the 29 MHz TG first IF signal.

b. First TG IF section

The first TG IF signal is delivered through a BPF amplifier to a mixer. This mixer also receives the second local signal via an isolation amplifier. These signals are mixed to generate a 179 MHz TG second IF signal.

c. TG second IF section

The second TG IF signal is fed to a BPF. This eliminates unnecessary components and the resultant signal is delivered to a saturation amplifier for level adjustment. The signal passes through an LPF to minimize the harmonic components and is input to the final mixer.

d. Final mixer section

The final mixer section receives the above-stated signal and one obtained by processing the first local signal from the first local block in the isolation amplifier. The signal is delivered to an attenuator for fine level adjustment. It is then passed through an LPF which is disposed as a trap filter for eliminating unnecessary signal components.

e. Video amplifier section

This section outputs a signal at +17 dBm by amplifying the output from the final mixer section by approx. 45 dB.

f. TG counter section

For counter output, the output from the final mixer section is amplified by a separate circuit.

g. Constant voltage section

This section generates the reference voltage for the D/A converter which controls the VCXO frequency.

10-3-7. STD. OSC. Block (MEP-411)

Figure 10-9 illustrates a MEP-411 block diagram.

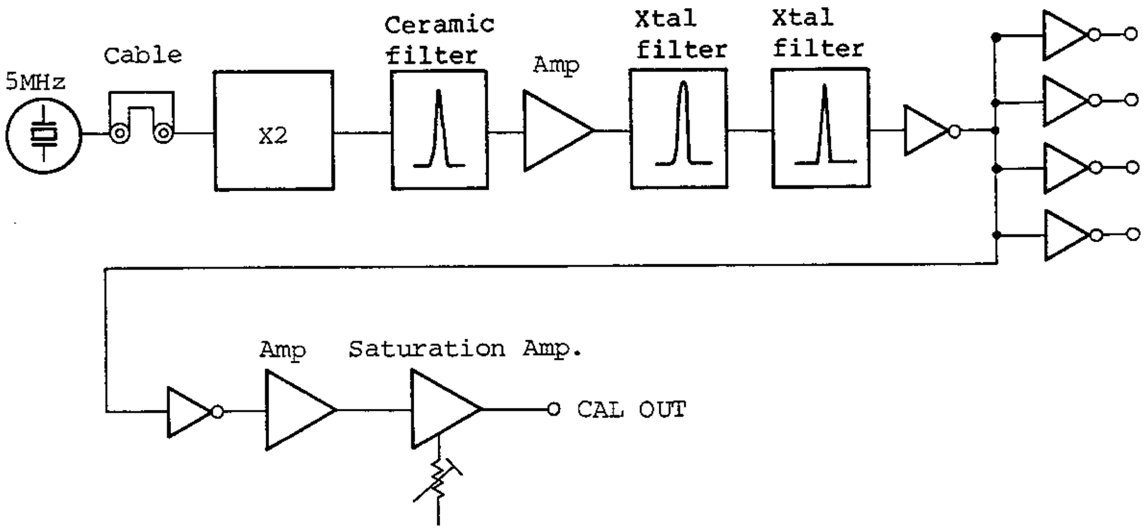


Fig. 10-9 STD. OSC. block diagram

The internally generated 5 MHz crystal oscillator signal at the 5 MHz TTL level is fed to the x2 multiplier. An external oscillator is also available. The signal frequency is converted to 10 MHz through a ceramic filter and an amplifier. Signal noise is removed by a 10 MHz crystal filter. The obtained signal is output as a TTL output signal to the respective sections. One of these signals is passed through two stages of saturation amplifiers to stabilize the signal level, thereby generating the calibration signal.

10-3-8. Frequency Counter Block (MEP-410)

The frequency counter counts frequencies from the tracking generator and each local oscillator when set to frequency counter mode, TG counter mode, and center frequency are set.

Circuits included are a divider, multiplier, switch, gate, time base generator, and control circuit for the counter LSI and switch.
The following table lists the correspondences between measurement frequencies and applicable counter systems for counting TG output frequencies in the counter mode.

Measurement frequency	Counter system
MKR FREQ. ≧ 12 MHz	TG x 1
12 MHz > MKR FREQ. ≧ 2 MHZ	TG x 4
2 MHz > MKR FREQ.	TG 1/T

10-3-9. Address Decoder Board (BGN-011226)

This section decodes the address signals from the CPU of the Display Section. It generates signals for controlling each RF block setting. Since the RF input block is electrically floated, the latches are disposed in the address decoder. The control signal is delivered through a photocoupler to the RF input block.

10-4. BLOCK OPERATIONS OF DISPLAY SECTION

10-4-1. Final IF Block (MEP-401)

The final IF block includes a Gaussian filter for implementing the respective resolution bandwidth (RBW), 10 dB-, 1 dB-, and 0.1 dB-step amplifiers, and attenuators.
The following table lists the correspondences between center frequencies for realizing the respective resolution bandwidth (RBW) and filter types.

RBW	Center frequency	Filter type
100 kHz (3 dB)	3.33 MHz	LC
30 kHz ≀ (3 dB) 1 kHz	455 kHz	LC
300 Hz ≀ (3 dB) 3 Hz	455 kHz	Xtal
9 kHz (6 dB)	455 kHz	LC
200 Hz (6 dB)	455 kHz	Xtal

Figure 10-10 shows a block diagram of the final IF block. Using the front-end mixer and 2.87833 MHz local signal, the 3.33 MHz signal from the RF Section is first converted into a 455 kHz signal. This is later converted to a 3.33 MHz signal by an output mixer. The resultant signal is fed to the logarithmic amplifier.

When resolution bandwidth (RBW) is 300 Hz to 3 Hz, the LC filter resolution bandwidth is set to 3 kHz.

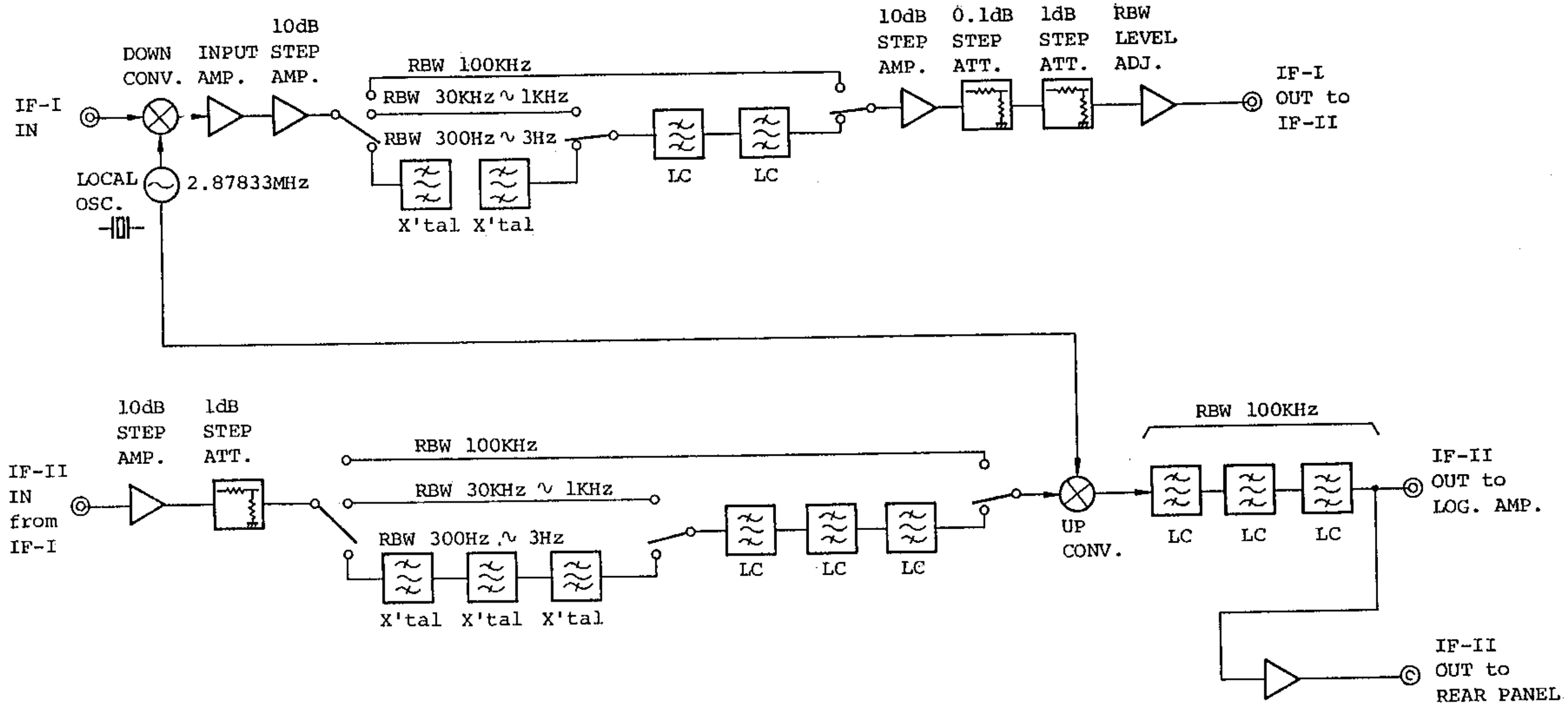


Fig. 10-10 Final IF block diagram

10-4-2. Logarithmic Amplifier Block (MEP-337)

Figure 10-11 shows the Log Amplifier block diagram.

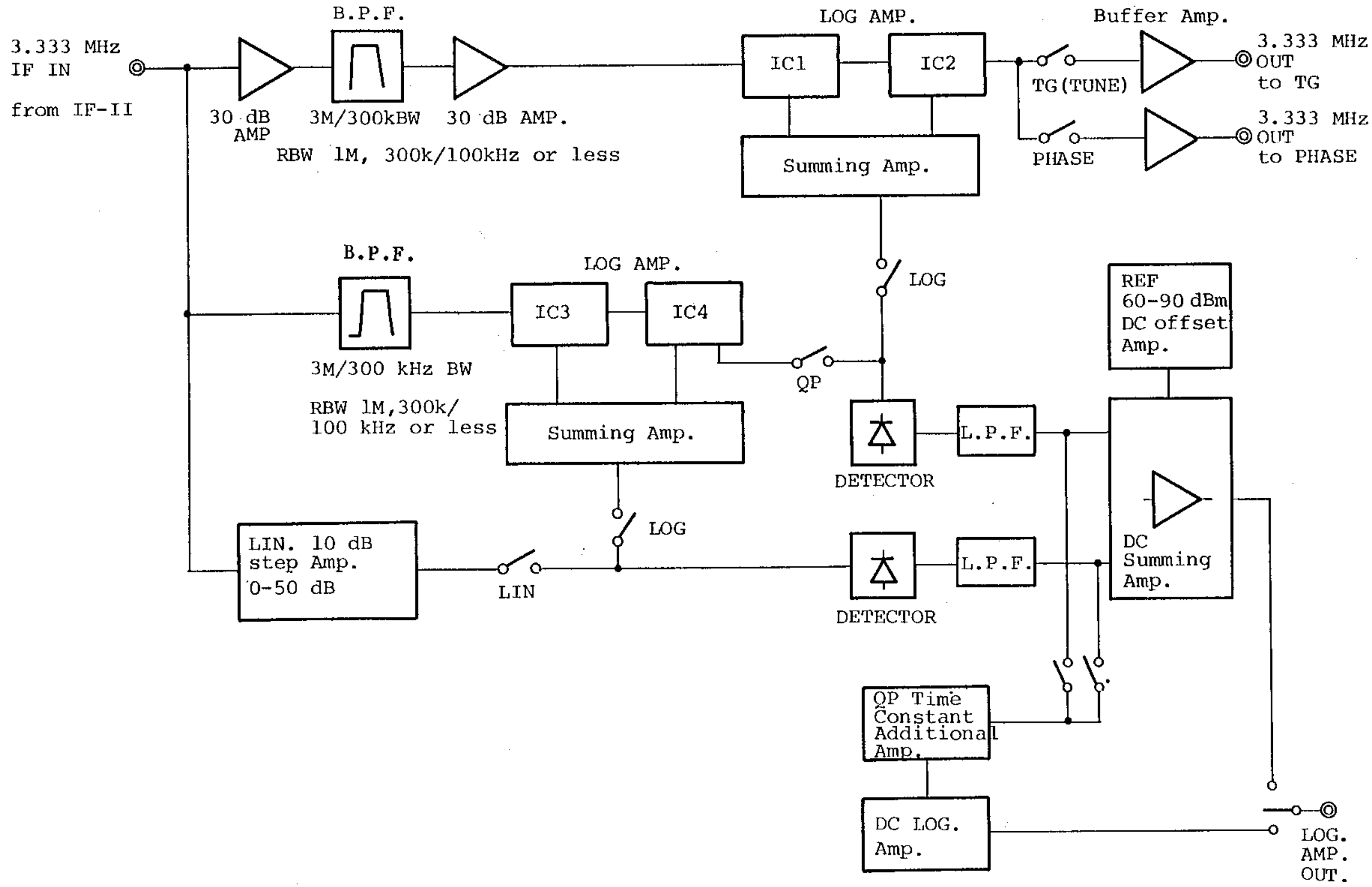


Fig. 10-11 Log. Amp. block diagram

The Log Amplifier compresses the output of the final IF block into logarithmic scale, and converts it into DC voltage.
In the Log mode, the 3.33 MHz IF signal is coupled to IC3 and IC4, where it is amplified by 60 dB. The output of these ICs are coupled to IC1 and IC2, where it is compressed into logarithmic scale. IC1 and IC2 handle signal levels between -60 and -100 dB, while IC3 and IC4 handle those between 0 and -50 dB.
The output of these IC1 and IC2 are added by IC5 and IC6, and converted to be dc voltage and output.
In the Linear mode, the 3.33 MHz IF signal is coupled to a linear amplifier with 10 dB step gain, where it is amplified, and then detected before output.
In the QP detection mode, the output voltage obtained in the Log mode is added to that obtained in the Linear mode. The resulting signal is output after adding the charging/discharging time constants specified in the C.I.S.P.L. standard.

10-4-3. Phase Block (MEP-339)

Figure 10-12 shows the phase block diagram.

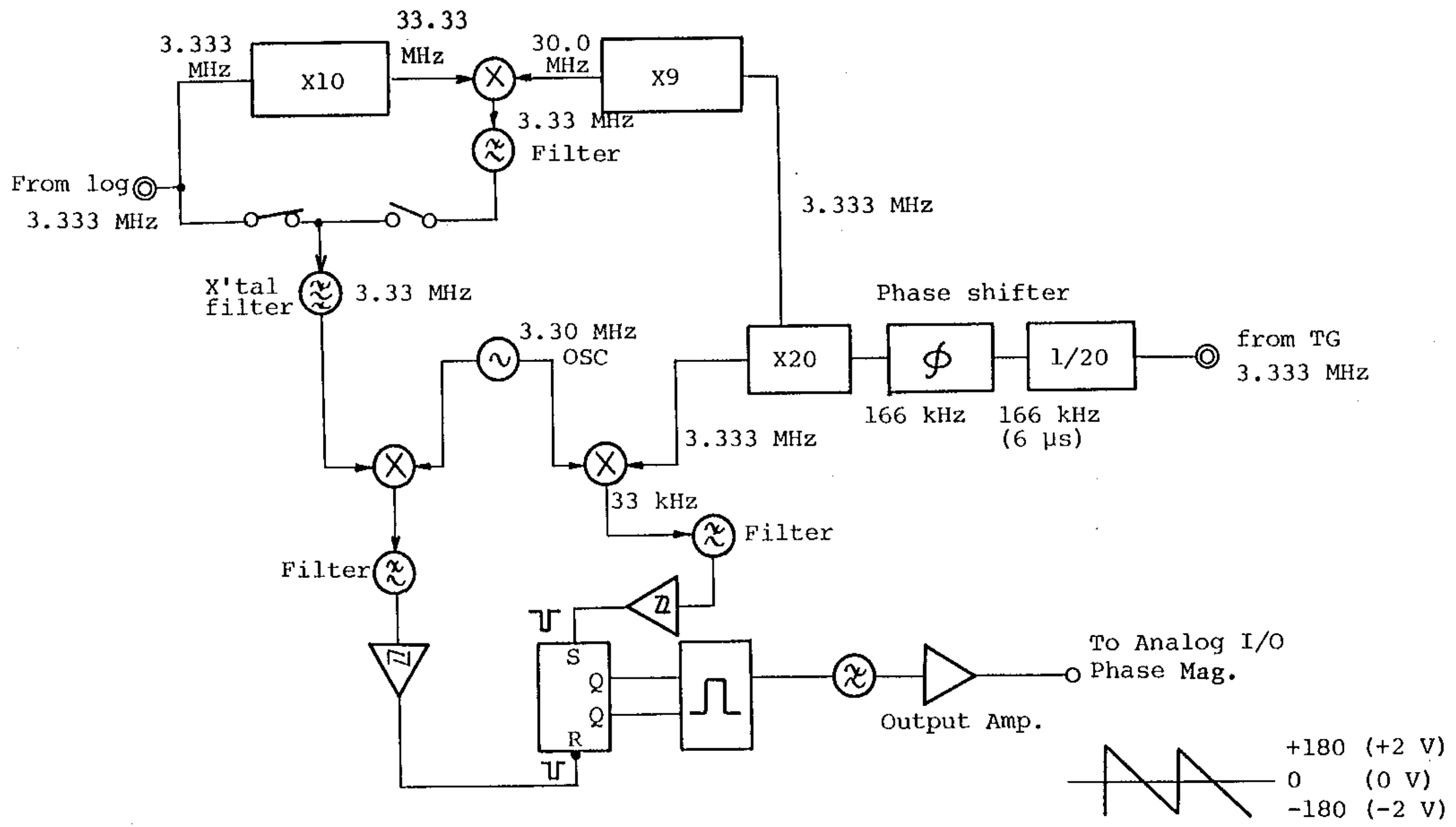


Fig. 10-12 Phase block diagram

On the TR4171, phase information is displayed on its video monitor be exercising phase comparison between the TG time base signal of 3.333 MHz and the final IF signal (i.e. the output of the Log Amp.) for the input signal.
The time base signal of 3.333 MHz furnished from the tracking generator is first divided by 20 into 166 kHz. It then goes to a phase shifter circuit for electrical length compensation, where the signal phase is made variable, before being multiplied again by 20 into 3.333 MHz. This 3.333 MHz time base signal and another 3.333 MHz IF signal from the Log Amplifier are both down-converted with a 3.30 MHz local frequency into 33 kHz, which is coupled to a phase detector. The output of the phase detector is output to the analog I/O board (to be described later) via an LPF.
To detect and display small phase differences, a 33.33 MHz (which is obtained by multiplying-by-10 the 3.333 MHz IF signal from the Log Amp.) and the 30.000 MHz time base signal (which is obtained by multiplying-by-9 the 3.333 MHz IF signal from the TG) are mixed together into 3.33 MHz when the phase range is 4 deg/div. or below. This 3.33 MHz is phase-compared with the 3.33 MHz time base signal from the tracking generator. As a result, a phase difference ten times larger can be obtained, which allows display of small phase differences.

10-4-4. CRT Driver Board (BGK-010184)

The CRT driver accepts the X and Y signals from the analog I/O board to drive the CRT. It contains a CRT bias voltage, blanking, dynamic focus, and other circuits.
Along with the blanking function, the blanking circuit also provides a function to intensify only signal response traces on the display by using the Y signal supplied from the analog I/O board, so that the traces are clearly visible in contrast with other information display (such as messages, labels, or scale).
In order to compensate for the focus characteristics of the CRT, the dynamic focus circuit uses a ramp voltage to control the focus voltage to obtain even focus over the entire screen.

10-4-5. High Voltage Board (BLC-010204)

This circuit generates high voltage for the CRT. Figure 10-13 shows the circuit configuration. Figure 10-14 shows typical CRT bias voltages.

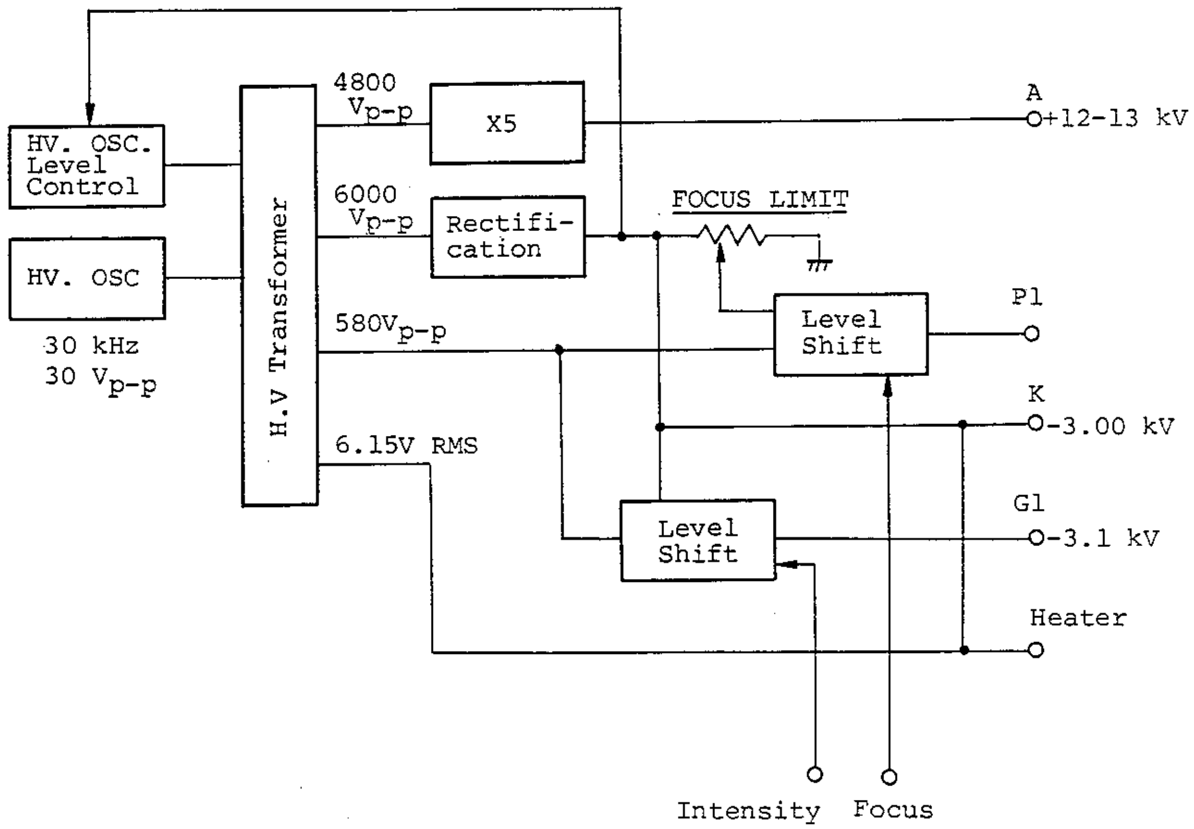
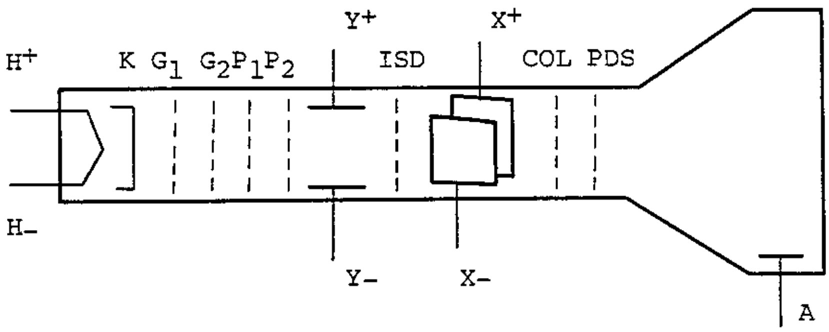


Fig. 10-13 High voltage circuit configuration



A	12 to 13 kV
k	-3 kV
G_1	-3 to -3.1 kV
G_2	68 to 88 V
P_1	-2.4 kV
P_2	0 to 135 V
ISD	0 to 135 V
COL	0 to 135 V
PDS	0 to 135 V
H	6.15 V RMS

Fig. 10-14 CRT bias voltage

A sine wave of approximately 30 kHz in frequency and 30 Vp-p in amplitude is generated by a blocking oscillator. The output of this oscillator is stepped up by a high voltage transformer into approximately -3 kV, which is used as a cathode voltage for the CRT. Part of this voltage is fed back to the oscillator to stabilize the oscillation.

An anode voltage is boosted by the booster block into +12 to +13 kV. The intensity and focus voltages furnished from the CRT driver control the potentials at G1 and P1 electrodes of the CRT, respectively.

10-4-6. Ramp Generator Board (BGP-011552)

The ramp generator consists of a saw-tooth generator for X-axis sweep and a sweep trigger circuit. Sweep time can be set up between 1 μs and 1000 s either by controlling the input current to the integrating circuit (by means of a D-A converter) or switching the integrating capacitors and input resistors. The output voltage to the Display Section is from -5 V to +5 V, while that to the RF Section is from +5 V to -5 V.

10-4-7. Analog I/O Board (BGP-010186)

The analog I/O board contains a DC amplifier section which performs A-D conversion on the input signal from the LOG AMP and Phase blocks, and line generator, character display, and scale display sections which, in combination, processes the X and Y signals furnished from the D/A board and outputs to the CRT driver.

(1) Log Mag Amp section
Consists of a DC amplifier for switching between 10, 5, 2, and 1 dB.

(2) Phase, GD Mag Amp section
Consists of a DC amplifier for switching between 80, 40, 20, ... 0.2 deg/div.

(3) Video Filter section
1 MHz to 1 Hz LPF and 1-3 step switching circuit.
The outputs of these three circuits are output to the A/D board, where they are converted into digital codes and processed by the CPU.

(4) Line generator section
This section contains an integration circuit which smoothes the step-like output of the D/A converter.

(5) Character display section
This section adds character voltage to the X and Y voltages from the D/A board to display character information, such as labels or readouts, on the display.

(6) Graticule display section

This section displays the graticule of 10 x 10 divisions on the screen.

See Section 10-4-14 for basic display operations.

10-4-8. A-D Converter Board (BGP-010187)

A-D converter section contains a peak detector (for the Y signal furnished from the analog I/O board) and A-D converter. It converts the X signal (furnished from the ramp generator) into digital code and outputs it on the data bus.

(1) Peak detector circuit

There are four detection modes: Normal, Positive, Negative, and Sample modes. The Normal mode detects whether the input voltage is increasing or decreasing. If the voltage is increasing, it automatically selects the positive detector; if the voltage is decreasing, it automatically selects the negative detector. In either case, the detector holds the peak level.

Figure 10-15 shows the circuit operation timing.

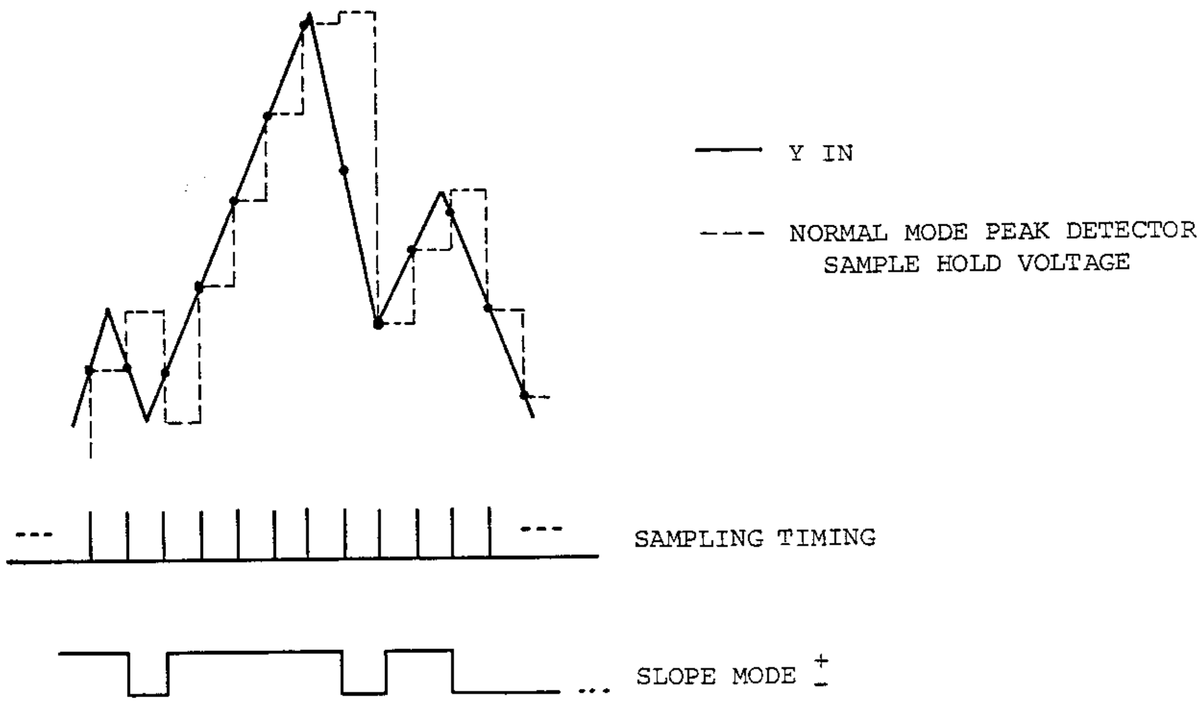


Fig. 10-15 Peak detector normal mode timing chart

(2) A/D converter circuit

The voltage held by the detector circuit is analog-to-digital converted by a successive approximation A-D converter to generate a Y signal. The ramp voltage is analog-to digital converted by a follow up approximation A-D converter to generate an X signal.

10-4-9. D/A Converter Board (BGP-010188)

The D/A converter reads data in the spectrum, character, line, and some other display modes (to be described later) by a control signal furnished from the display controller, converts it into the X and Y signals, and outputs them to the analog I/O board.

10-4-10. Display Control Board (BGP-010189)

The display control provides various display control signals and timing to display data in different display modes which will be described later.

10-4-11. I/O and GP-IB Board (BGP-010190)

The I/O and GP-IB section consists of the following five circuits:

(1) CS signal generator for each I/O in the Display and RF Sections. The CS signal is used to activate the function selected from the keyboard.
(2) Timing controller for signals control
(3) Interrupt input circuit
(4) Address bus control for D/A board memory
(5) GPIB interface (TMS9914)

10-4-12. CPU Board (BGP-010191)

The CPU section consists of a Z80 processor, ROM (8K bytes), RAMs (64K bytes dynamic RAM, which holds data after A/D conversion), clock generator, reset circuit, and others.

10-4-13. Memory & Key Control Board (BGP-010192)

This section consists of 64K byte-ROMs, 8K byte-RAM and key control circuit.
The 8K byte-RAM is used for data save and recall operations. It is backed up by an internal battery so its contents are left intact even when the instrument is switched off. The battery can hold the memory contents for approximately two weeks.
The key control provides all control over all the keys on the Display and RF Sections, LED indicators, and data read operations using the data knob.

10-4-14. Display Operation

The CRT display on the TR4171 uses the random scan system, in which information display is made by specifying the X and Y coordinate values on the screen. The display modes include the following five modes:

(1) Character display
(2) Line display
(3) Spectrum display
(4) Graphic display
(5) Analog display

Each of these modes (jobs) is illustrated in Figure 10-16.

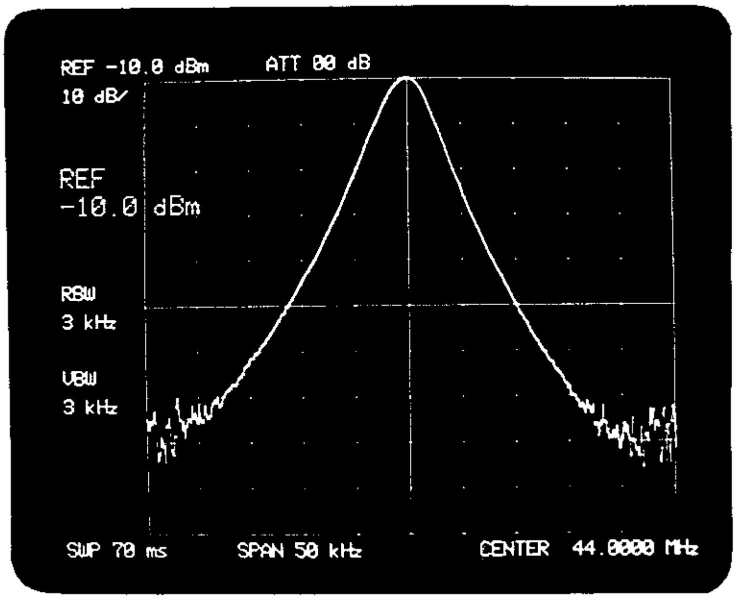


Fig. 10-16 Display modes

Display operation starts with fetching the specified job contents from the job memory in the display control. Control signals and timings are determined according to this job memory contents, and are output to the analog I/O board. Figure 10-17 shows a flowchart for display operation.

Display flowchart

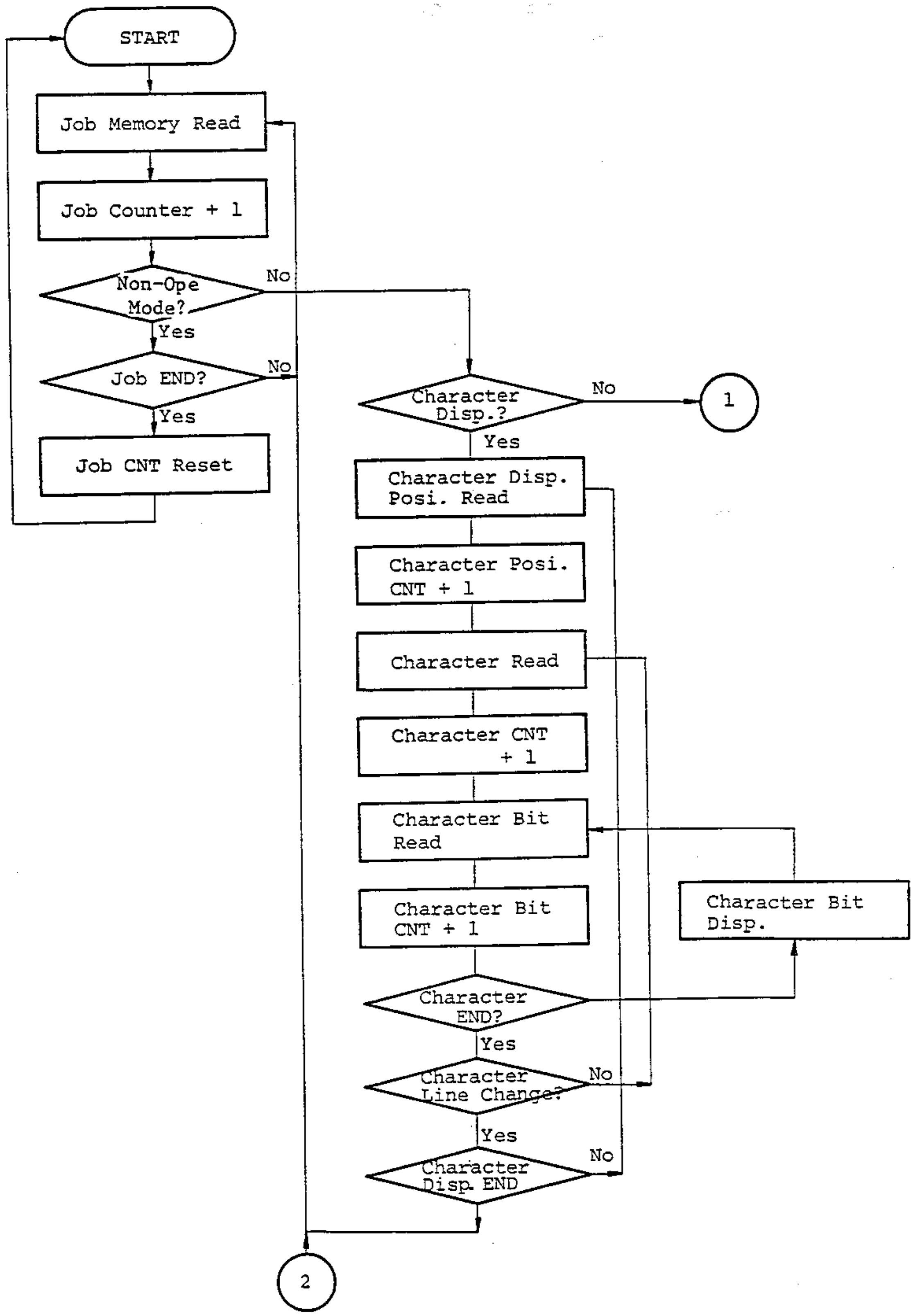


Fig. 10-17 Display operation flowchart

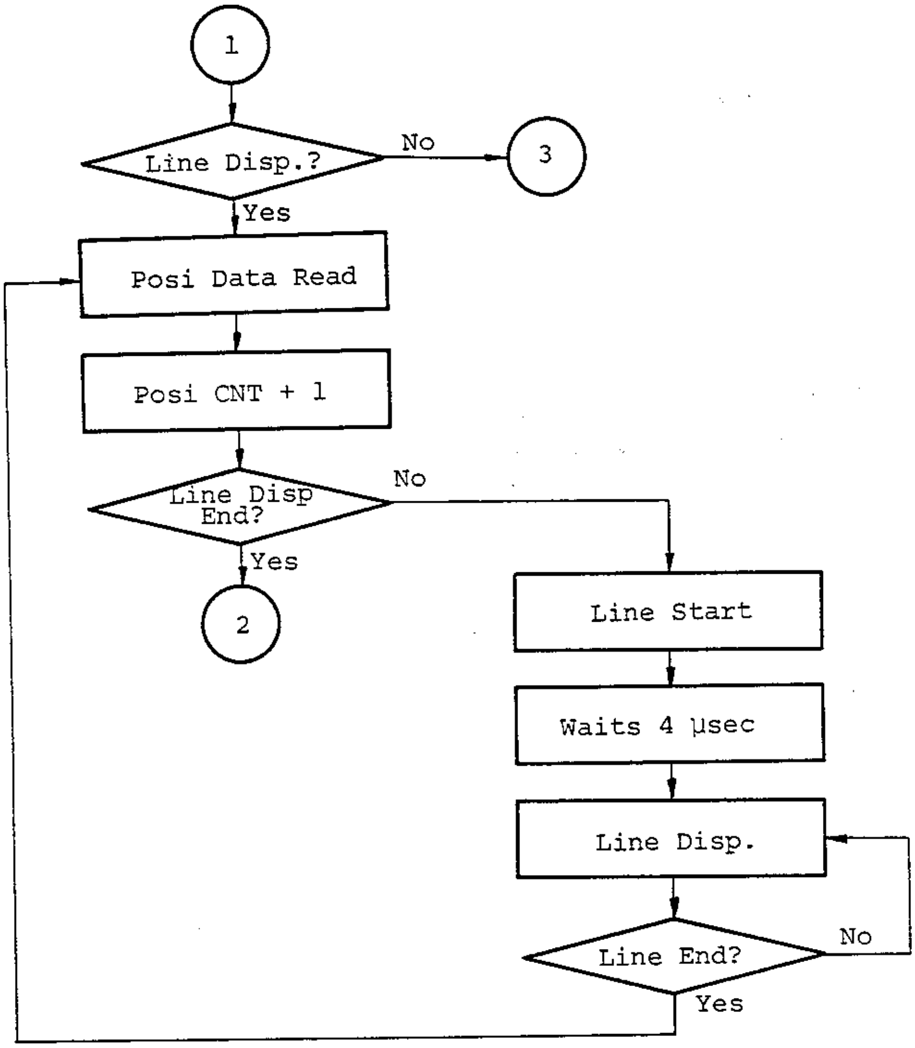


Fig. 10-17 Display operation flowchart (Cont'd)

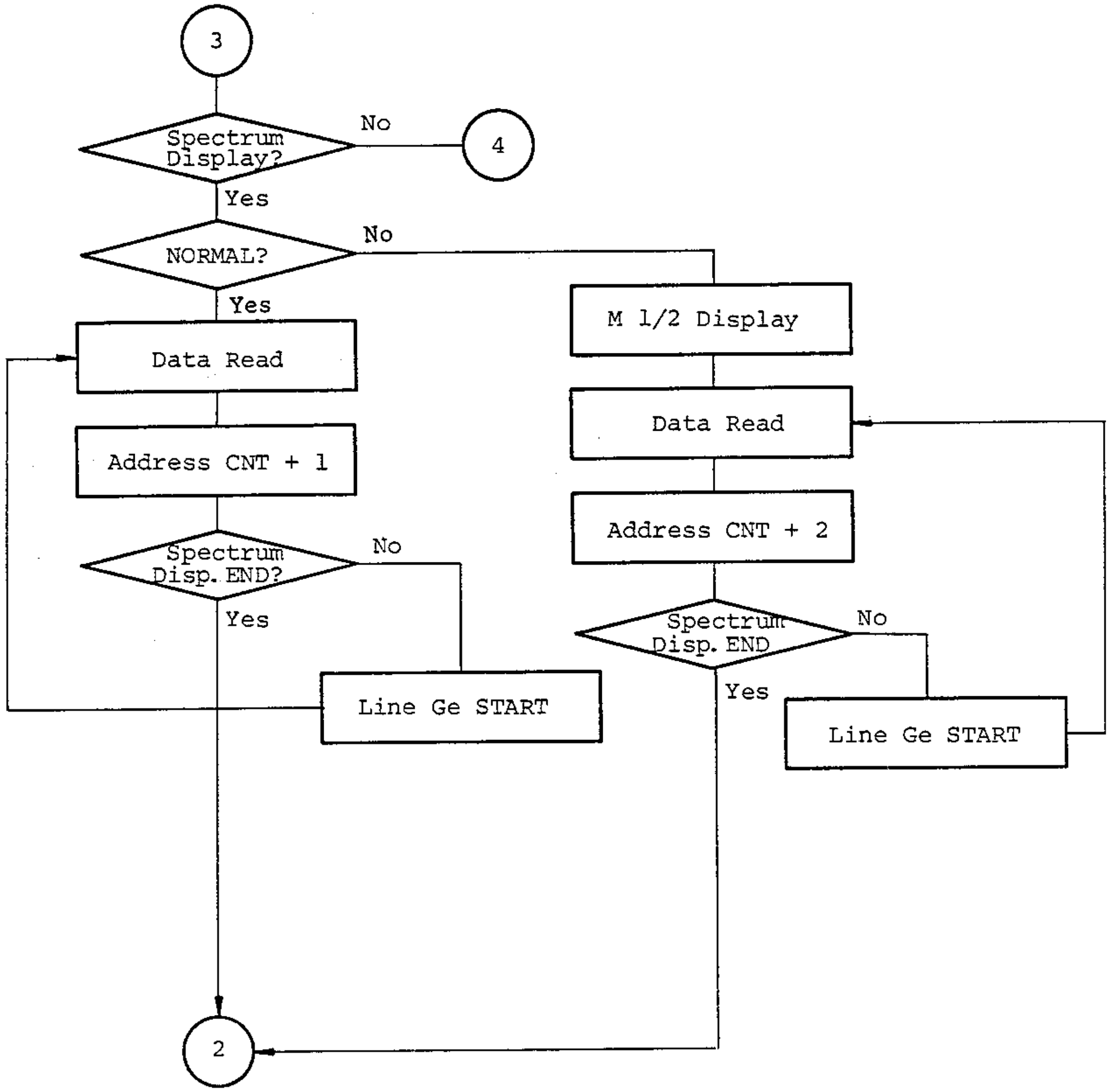


Fig. 10-17 Display operation flowchart (Cont'd)

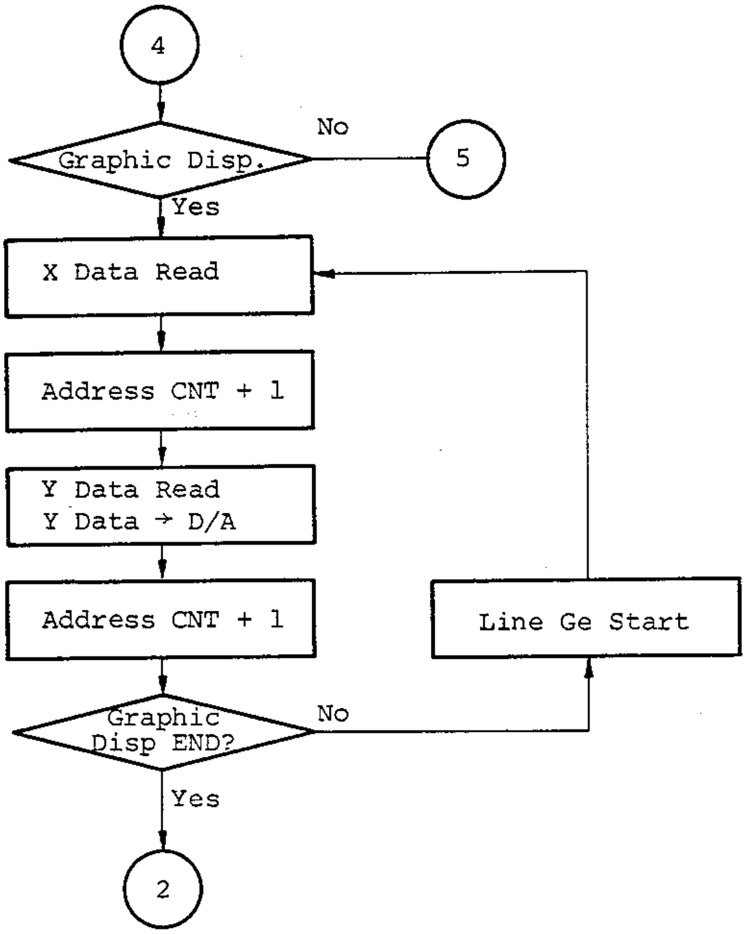


Fig. 10-17 Display operation flowchart (Cont'd)

(1) Character display

Figure 10-18 shows a block diagram relating to character display operation. Character information includes all labels, setup information, and readouts on the display operation.

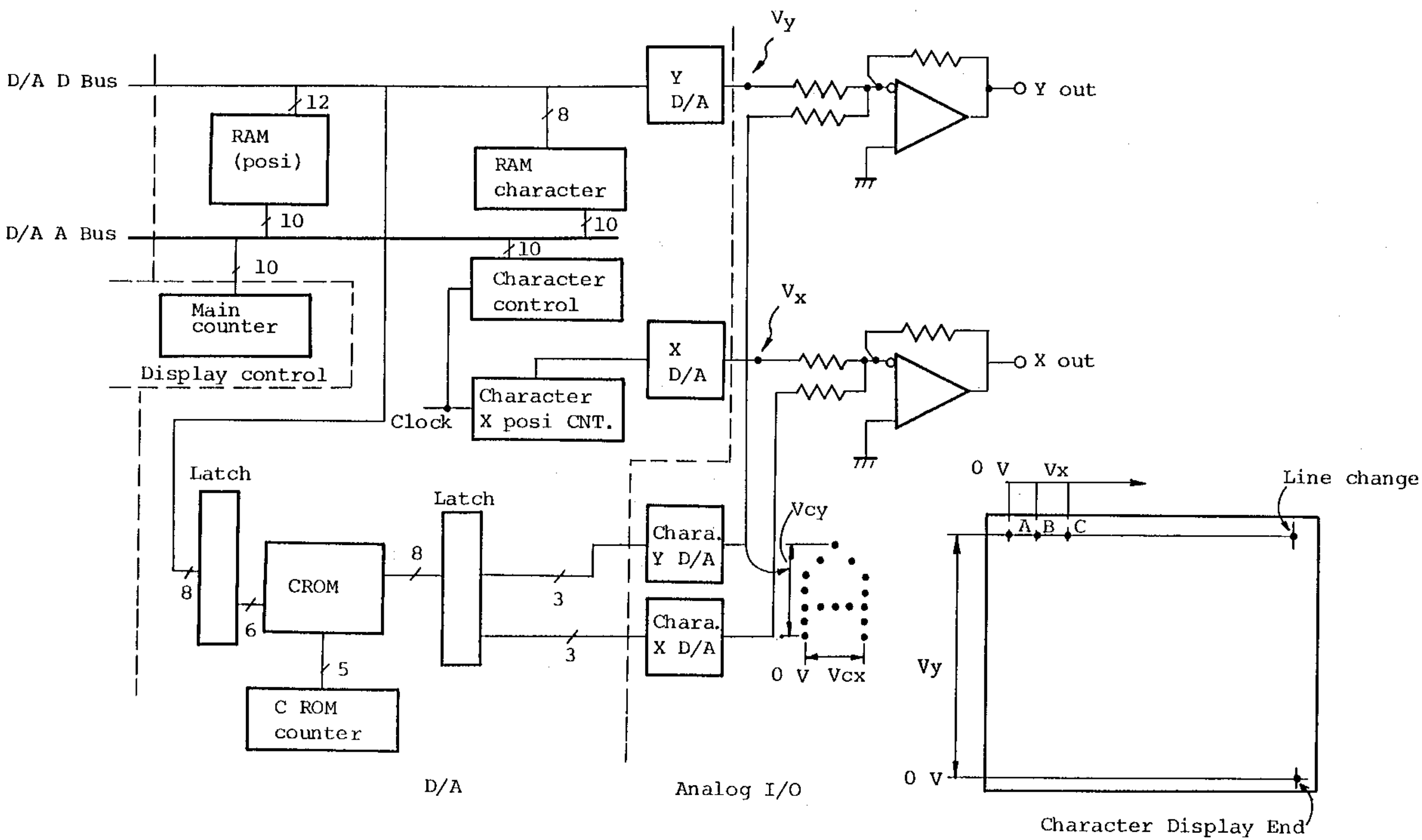


Fig. 10-18 Character display block diagram

When a character is to be displayed, the pertinent data is fetched from the RAM (position) on the D-A board to determine the Y axis position, is subjected to A-D conversion, and then output as Y OUT signal (V(y)). To determine the X axis position, output from the character X position counter output is subjected to D-A conversion, and then output as X OUT signal (V(y)). Then, the pertinent character data is fetched from the character RAM. The character data causes the pertinent character to be read from the character ROM. The CX and CY data (each 3 bits) for character display are then output to the analog I/O board, where they are each subjected to D/A conversion into Vcx and Vcy voltages, and added to Vx and Vy voltages to be shown on the display.

After this operation sequence is executed to all the characters to be displayed, the control proceeds with the next job fetch.

(2) Line display

Figure 10-19 shows a block diagram relating to line display. The line display shows the graticule (10 x 10) and display line on the CRT display.

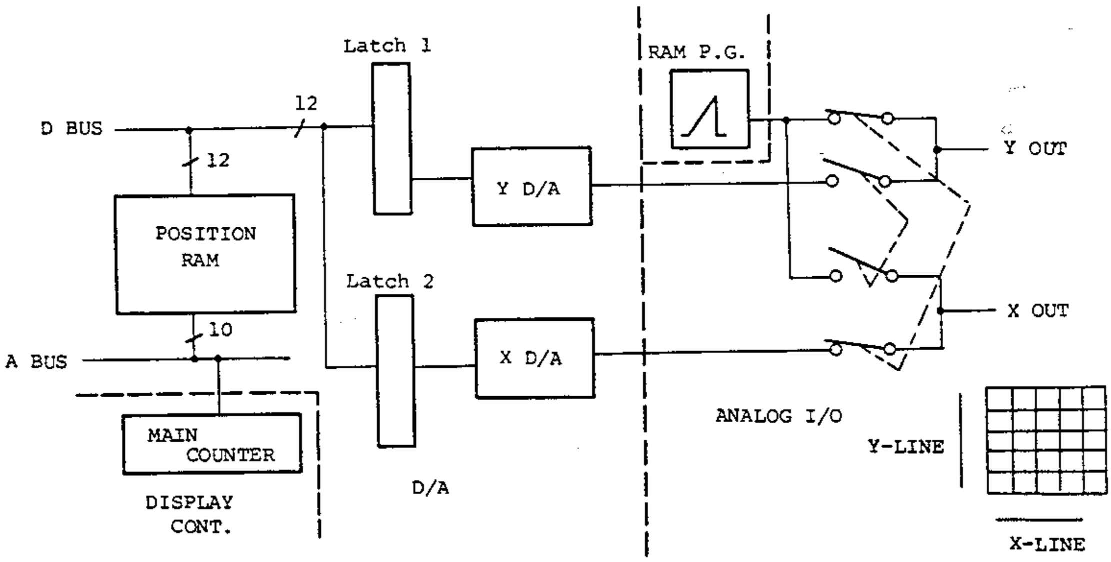


Fig. 10-19 Line display block diagram

When an X line is to be displayed, RAM (position) data is set into latch 1, is subjected to D-A conversion, and is output as Y OUT voltage to determine the Y line position. An X line can be displayed if the switch is operated so that a ramp voltage is output from the analog I/O board. The X line display sequence is repeated 10 times before the Y line is displayed. For Y line display, the RAM data is set into latch 2, is subjected to D/A conversion, and is output to X OUT to determine the Y line operation. A ramp voltage is applied to Y OUT to display a single Y line. The Y line display sequence is repeated 10 times to display the complete graticule.
The display line can be obtained in much the same way as the X line display operation.

(3) Spectrum display
Figure 10-20 shows a block diagram relating to spectrum display.

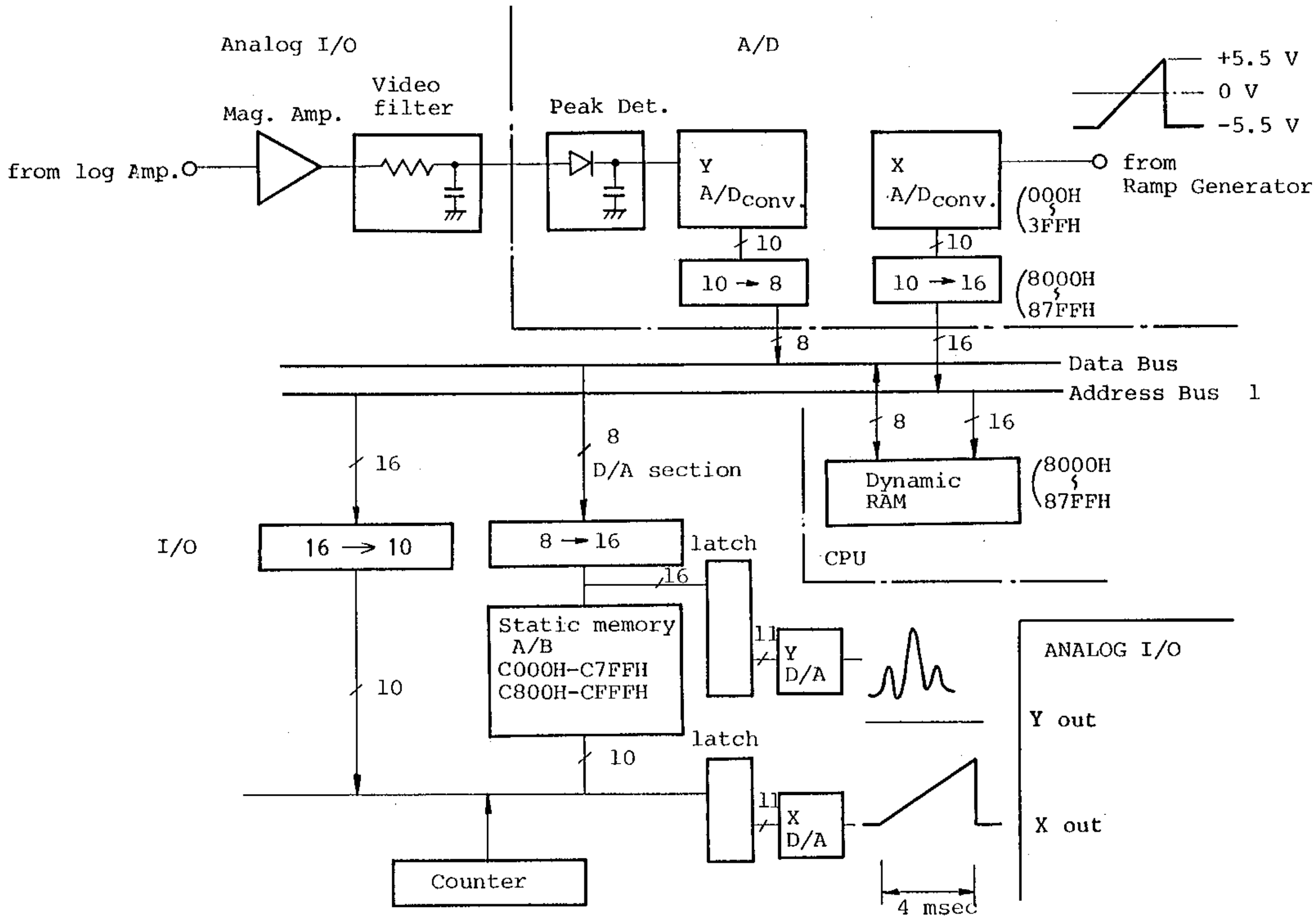


Fig. 10-20 Block diagram for spectrum display

The spectrum display mode is used for signal phase and response display. The X and Y signals which were subjected to A/D conversion on the A/D board, are first stored in the dynamic RAM on the CPU board, processed by CPU, then transferred to the static RAM on the D/A board. The static RAM includes memory A and B, either of which is selected according to panel setup. The contents of the RAM are set into X and Y latches, subjected to D/A conversion, then output to the analog I/O board to be displayed.

(4) Graphic display

Figure 10-21 shows a block diagram pertaining to graphic display.

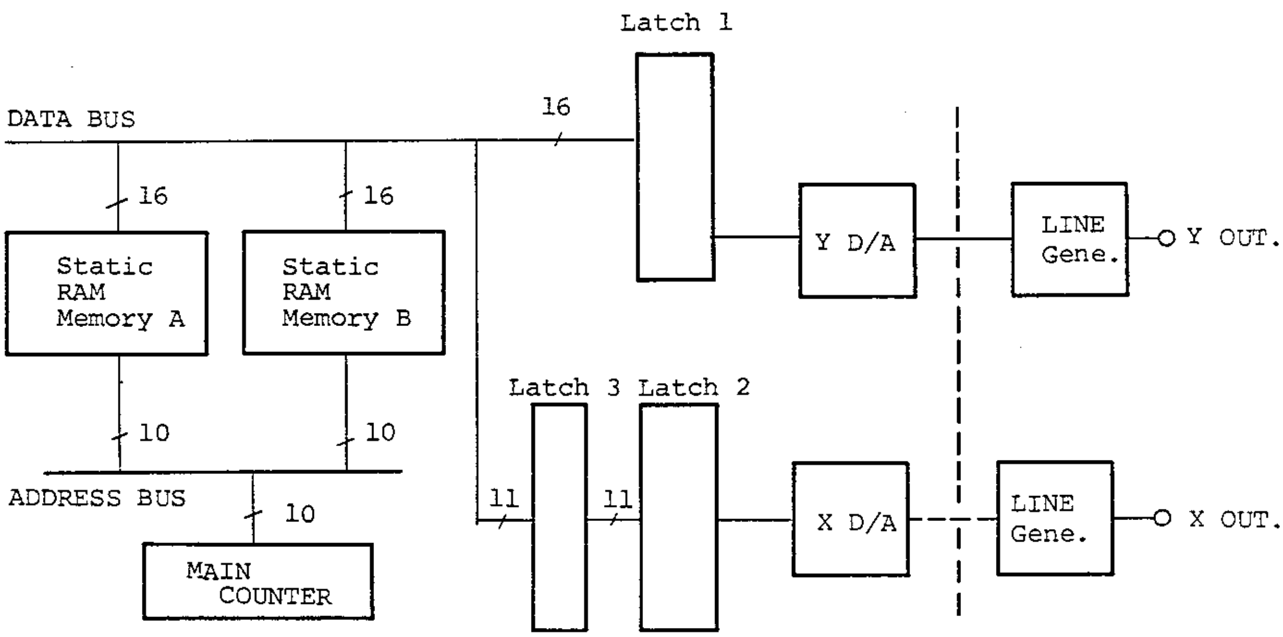


Fig. 10-21 Block diagram for graphic display

Two pages of graphic display are supported by memories A and B. Each memory holds X data at address 0=0 and Y data at address 0=1, respectively. Since each dot is assigned two bytes of data, the maximum number of data in one page is 512 points. X data is set into latch 3 when Address 0=0, while the contents of latch 3 is set into latch 2 when Address 0=1 and Y data is set into latch 2. Data set into each latch is subjected to D/A conversion to provide a single point of display on the CRT. The graphic display as shown in Figure 10-22 is obtained by repeating the above sequence.

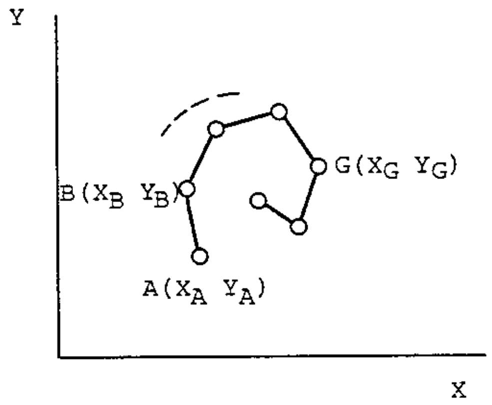


Fig. 10-22 Graphic display on the monitor

(5) Analog display

In the analog display mode, the video filter output on the analog I/O board is directly displayed on the monitor, with no digital processing performed on the display signal. This mode is effective only when zero frequency span and a sweep time of 19 ms or less is selected. It may be convenient to check the modulation signal component on the time axis.

MEMO

SECTION 11

CALIBRATION AND ADJUSTMENT

11-1. INTRODUCTION

This section describes the calibration procedure for the TR4171 Spectrum Analyzer. After the instrument is serviced, be sure to carry out performance check and calibration.
For quick part identification, the part numbers and symbols printed or inscribed on PC boards or schematic diagrams are used throughout this section.

11-2. PREPARATION AND GENERAL PRECAUTIONS

11-2-1. Tools and Instruments Required for Calibration

Use the recommended instruments in the list or their equivalents.

Table 11-1 Measuring instruments required

Instrument	Specifications	Recommended model
(1) Synthesized signal generator	Frequency range: 500 kHz to 1000 MHz Output level: +10 to -30 dBm Output impedance: 50 Ω Output level flatness: ±0.5 dB Frequency accuracy: 2×10^{-8}	
(2) Synthesized function generator	Frequency range: 1 Hz to 20 MHz Output level: +10 to -30 dBm Output impedance: 50 Ω Output level flatness: ±0.2 dB Frequency accuracy: Approx 10^{-8}	
(3) Frequency counter:	Frequency range: Up to 4 GHz Input level: +20 to -30 dBm Input impedance: 50 Ω Frequency accuracy: 2×10^{-9}	TR5211 (ADVANTEST)
(4) Spectrum analyzer with tracking generator	Input frequency range: 100 kHz to 1.8 GHz Tracking generator output: 400 kHz to 1.8 GHz T.G. output flantness: ±1 dB Impedance: 50 Ω	TR4172 (ADVANTEST)

Table 11-1 Measuring instruments required (Cont'd)

Instrument	Specifications	Recommended model
(5) Marker generator	Frequency: 1 MHz, 50 kHz, 5 kHz Full power: Approx. 0 dBm Impedance: 50 Ω	
(6) Power meter	Frequency range: 100 kHz to 1800 MHz Sensitivity: -30 to +20 dBm Accuracy: ±0.2 dB Impedance: 50 Ω	
(7) Digital voltmeter	Measurement range: 0V to ±1000 V Accuracy ±0.1%	TR6841 (ADVANTEST)
(8) High voltage probe	Voltage range: More than 20 kV Impedance: More than 1000 MΩ	TR1116 (ADVANTEST)
(9) Oscilloscope	Frequency: Approx 100MHz Sensitivity: 5mV	
(10) DC voltage standard	Output voltage: +15 V	
(11) High impedance probe	Measurement range: DC to 500MHz	
(12) Step attenuator	Frequency range: DC to 500 MHz Attenuation: 0-100 dB at 10 dB steps 0-11 dB at 1 dB steps Accuracy: ±0.2 dB at 10 dB steps ±0.02 dB at 1 dB steps Impedance: 50 Ω	
(13) Directional bridge	Measurement range: 5 MHz to 120 MHz Impedance: 50 Ω/75 Ω Directibity: 40 dB	

Table 11-2 Tools required for calibration and adjustment (Maintenance Kit: A08806)

No.	Tool	Stock No.	Qty	Remarks
1	Connection cable	DCB-FF0906-1	1	BNC-UM
2	Connection cable	DCB-FF1211x01-1	1	SMA-SMA
3	Connection cable	DCB-FF0969x16A-1	6	UM-UM
4	UM-UM adapter	JCF-AC001Jx07-1	1	
5	Extender board -1	BGP-010863	1	Double, 28 pins x 2
6	Extender board -2	CZ560	1	Double, 28 pins
7	Maintenance board -1	BGD-012450	1	For block extension
8	Maintenance board -2	BLB-012451	1	For block extension
9	Connection cable	DCB-SS0020-1	1	Amphenole 50 pins
10	Connection cable	DCB-SS1560x02-1	1	RF cable
11	Extension cable	DCB-PS1138x01-1	3	5 pins, 30 cm, for CRT
12	Standard pattern scale	MPH-20803A-1	1	
13	SMA & conhex wrench	MBZ-28734A-1	1	

11-2-2. General Precaution

(1) The local line voltage at which the instrument should be operated is 100, 120, 200 Vac ±10% or 240 Vac +4%, -10% (50/60 Hz).

(2) Before connecting the instrument to an AC outlet, be sure to set the POWER switch to STANDBY.

(3) The calibration ambient temperature should be 20 to 30°C at a relative humidity of less than 80%. The calibration site should be free from dust, vibration, and noise.

11-3. TIME BASE CALIBRATION

The time base oscillator contained in the analyzer is calibrated before shipment. The frequency standard used for calibration has an absolute accuracy of 1×10^{-10} (secondary factory standard). When checking or calibrating the time base oscillator accuracy, use a frequency standard having the frequency accuracy equivalent to or better than the above mentioned absolute value.

Aging rate	5×10^{-9}/day
	5×10^{-8}/month
Long-term stability	8×10^{-8}/year
Temperature characteristic (0°C to 50°C)	$\pm 5 \times 10^{-8}$

Instruments required: * Frequency standard (with absolute accuracy of more than 1×10^{-10})
* Frequency comparator

① The time base oscillator output has a 10 MHz frequency and a level of approximately 5 V (TTL compatible), and is output at the 10 MHz OUTPUT connector or INT STD OUTPUT connector (5 MHz) on the rear of the instrument. The frequency accuracy of the oscillator output can be adjusted by the FREQ ADJ screwdriver control next to the INT STD OUTPUT connector.

② Prepare the measuring system as shown in Figure 11-1, and adjust the FREQ ADJ control until the accuracy of the instrument is determined.

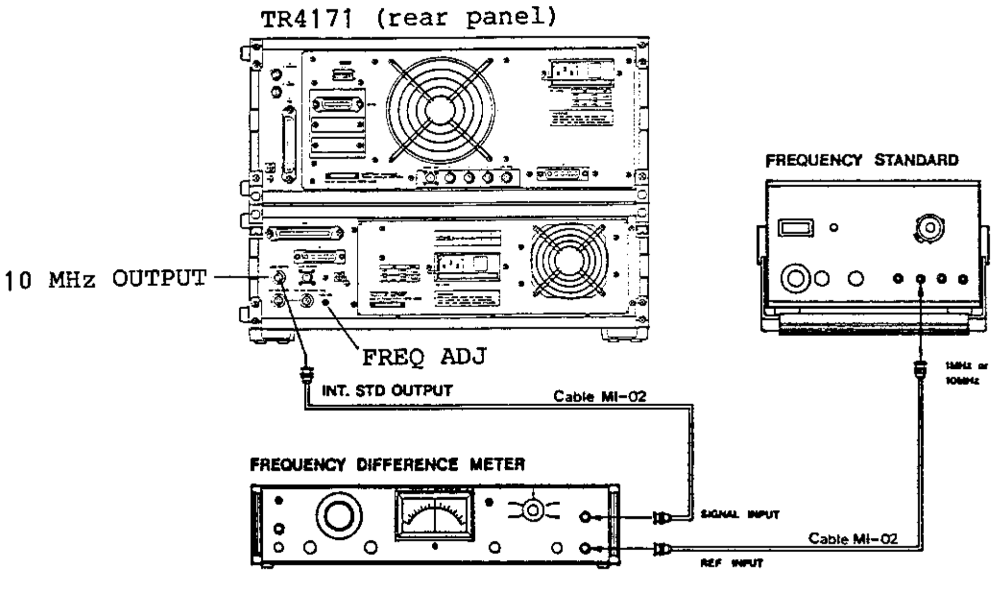


Fig. 11-1 Time base calibration

11-4. DISPLAY SECTION ADJUSTMENT

This paragraph describes the Display Section adjustment procedure.

11-4-1. Supply Voltage Adjustment (BGC-011865)

Instruments required: Digital voltmeter

① Set the POWER switch to ON, and check the supply voltage at each test point. The location of voltage adjustment controls and test points are shown in Figure 11-2.

② Using the voltage adjustment controls corresponding to each test point in the following order, adjust supply voltage until within specifications listed in Table 11-3.

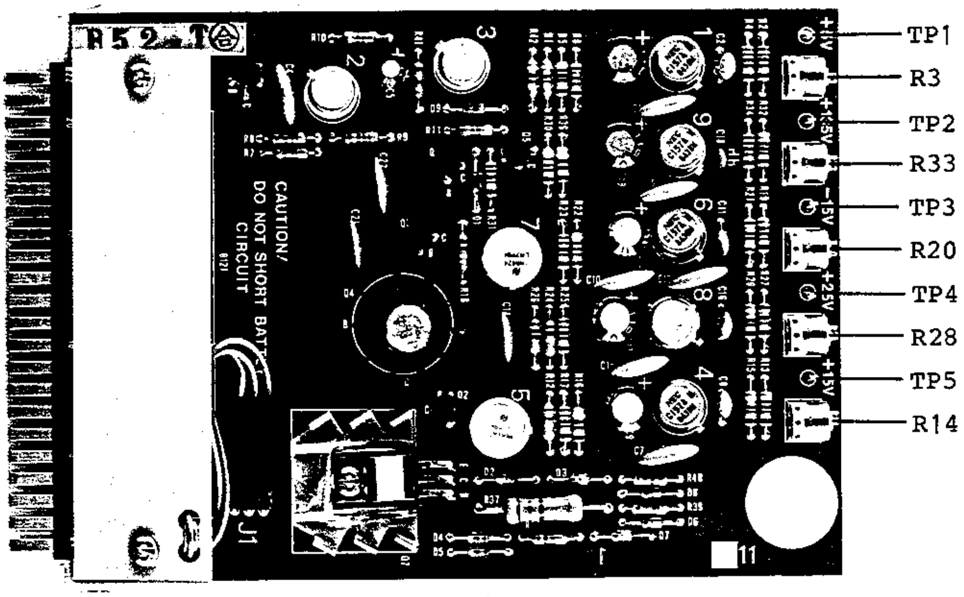


Fig. 11-2 Locations of adjustment controls and test points on the DISPLAY POWER 1 board (BGC-011865)

Table 11-3 Supply voltage adjustments

Superiority	Test point	Voltage	Adjustment
①	TP4	+25 V ±0.01 V	R28
②	TP5	+15 V ±0.01 V	R14
③	TP2	+135 V ±0.2 V	R33
④	TP3	-15 V ±0.01 V	R20
⑤	TP1	+5 V ±0.05 V	R3

11-4-2. High Voltage Unit Adjustment and Check (BLC-010204)

Instruments required: * Digital voltmeter
* High voltage probe

① Set the POWER switch to STANDBY.

② Remove Phase block (MEP-339) from the instrument. (See Figure 11-3.)

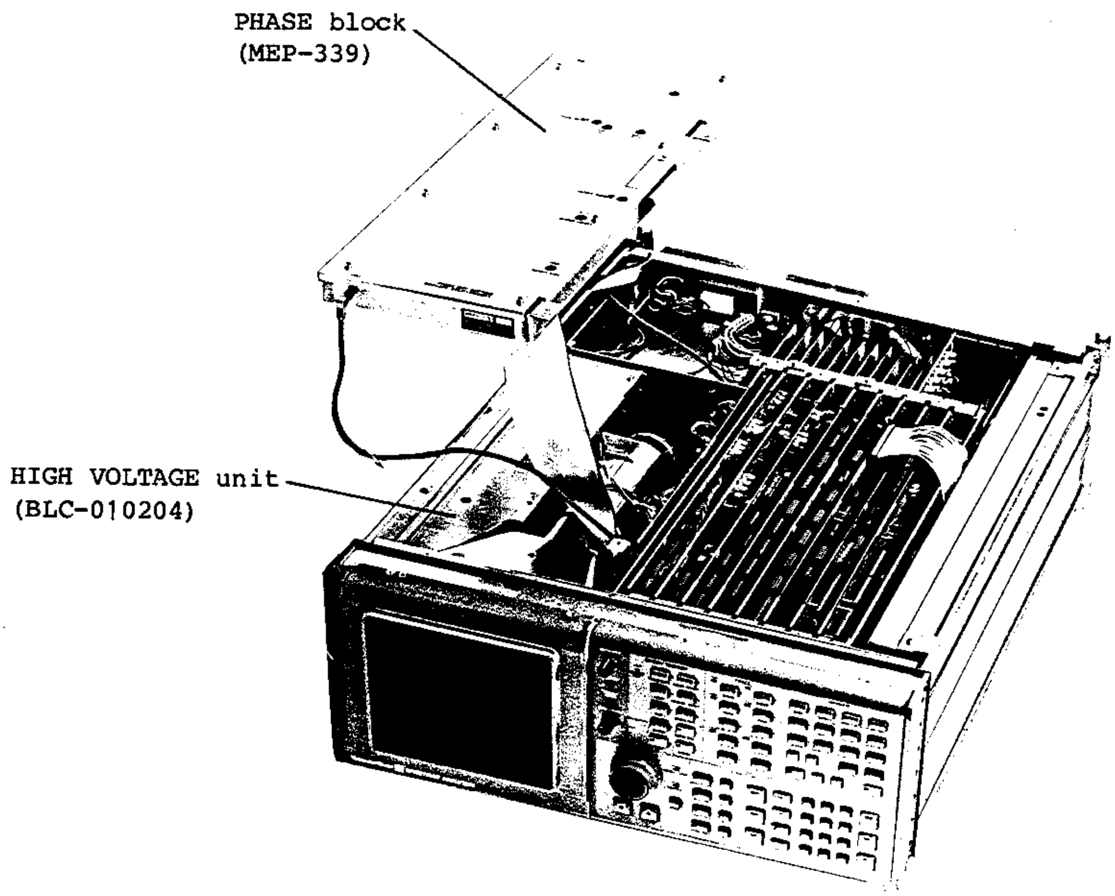


Fig. 11-3 Removing the phase block (MEP-339)

③ Remove the High Voltage Unit (BLC-010204) from the Display Section, then temporarily secure it to the top left edge of the cabinet as shown in Figure 11-4.

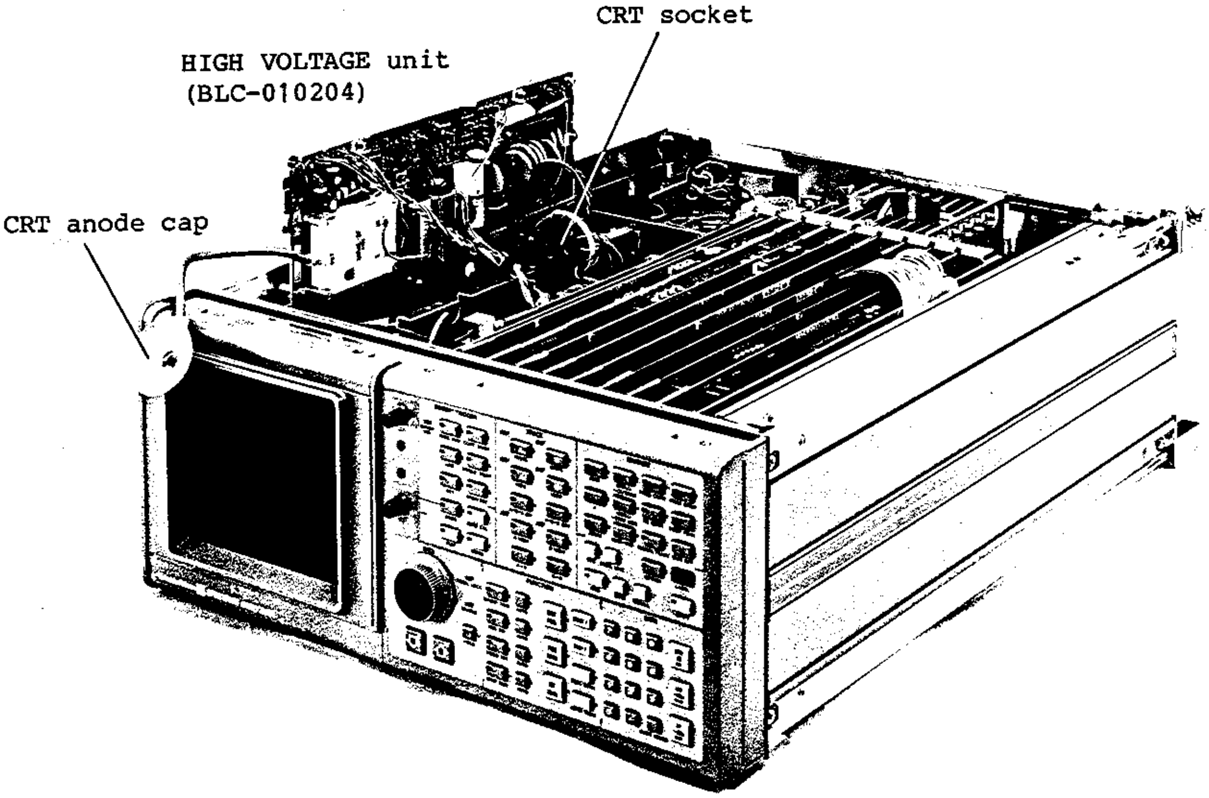


Fig. 11-4 Adjusting high voltage unit

④ Disconnect the CRT anode cap and CRT socket from the CRT. High potential charges may remain at the anode cap or CRT socket. Exercise utmost caution to avoid electrical shock. Leave all connectors other than the anode cap and CRT socket connected in their original sockets.

⑤ After verifying that neither the anode cap nor CRT socket is in contact with the chassis or other components, set the POWER switch to ON.

⑥ Adjust R62 until the voltage across the test point TP K and the GND (chassis) is -3.000 kV. Use a high voltage probe and a digital voltmeter for voltage check. Be sure that the impedance of the high voltage probe matches the input impedance of the digital voltmeter.

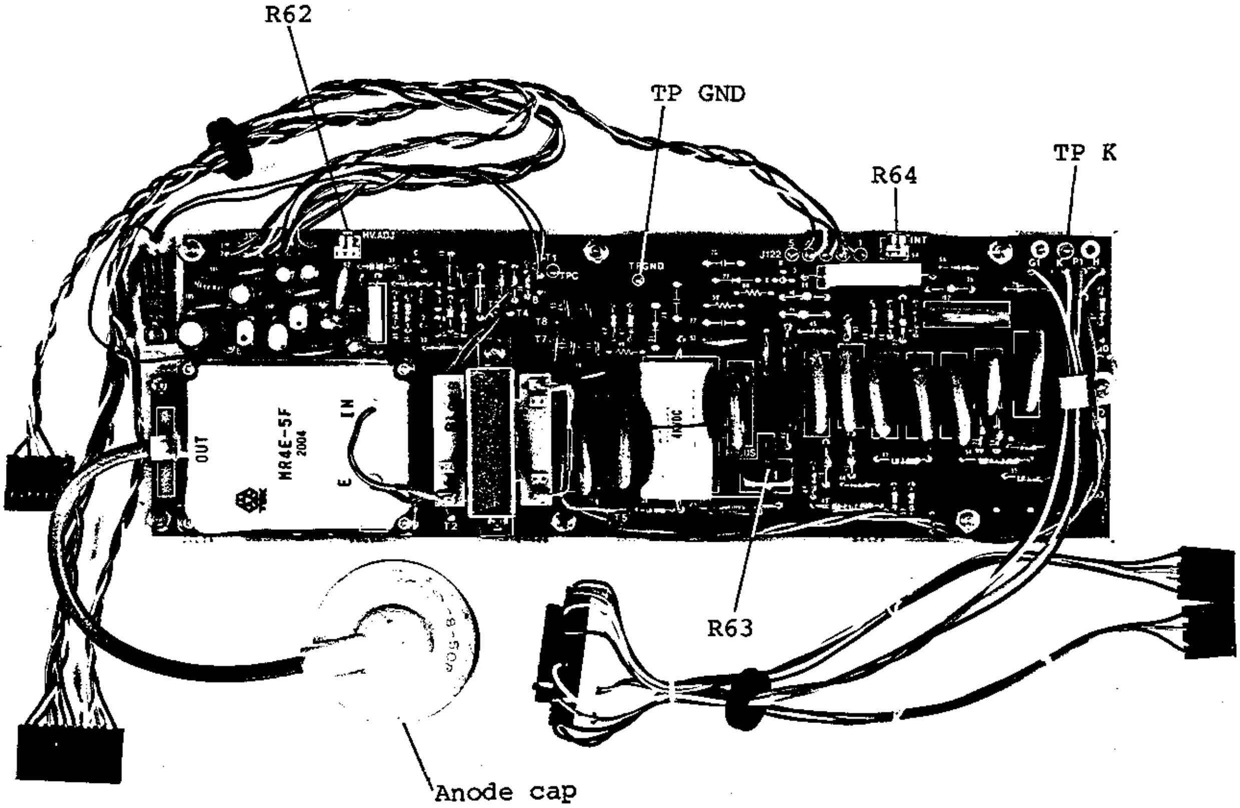


Fig. 11-5 Adjustment controls and test points on the high voltage unit (BLC-0101204)

⑦ Verify that the voltage across the anode cap and the GND (chassis) is +12 to +13 kV. While checking this voltage, exercise caution to avoid electrical shock.

⑧ Set the POWER switch to STANDBY. While monitoring the anode cap voltage with the digital voltmeter, discharge the anode cap.

⑨ After verifying that the anode cap potential is lowered to the safety voltage, connect it to the CRT.

⑩ Remount the high voltage unit (BLC-0101204) at its original position in the chassis, then connect the CRT socket to the CRT. Remount the Phase block to its original position in the chassis.

11-4-3. CRT Driver and Bias Adjustment (BGK-010184)

Instruments required: * Oscilloscope
* Digital voltmeter

① Set the POWER switch to STANDBY. Pull out the CRT Driver board (BGK-010184) and remount it in the same slot using an extender board (28 pins, single). The cables to the on-board connectors J281 and J282 should be connected to the board by extension cables. Set the POWER switch to ON.

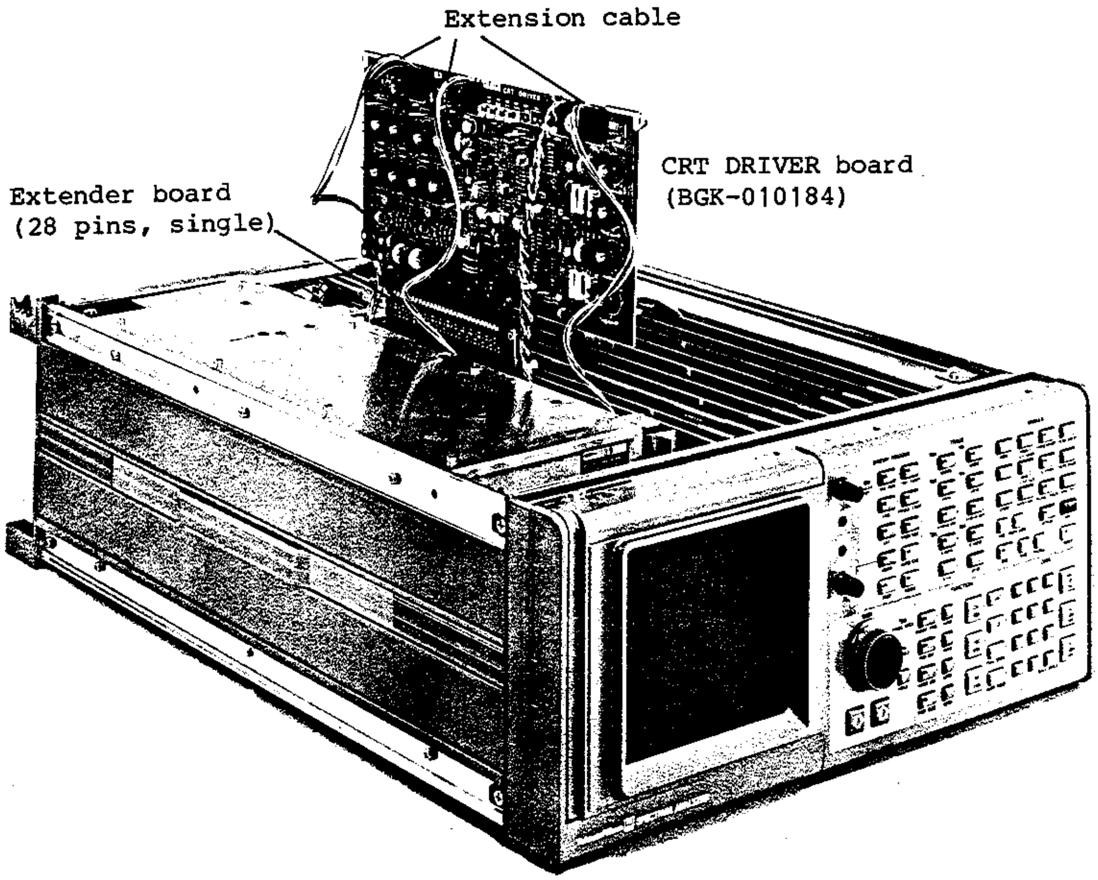


Fig. 11-6 Adjusting setup using an extension card

② Check the voltages at pins 1 and 5 of on-board connector J282 with a digital voltmeter. Adjust R203 and R199 until the voltage at each pin is +75 V.

③ Turn the INTENSITY control on the front panel of the Display Section completely clockwise to obtain maximum display intensity. Adjust R202 so the display is not subjected to halation due to secondary electron radiation.

④ Adjust R200 until pattern distortion is minimized.

⑤ Place the standard pattern scale (included in the maintenance kit) on the display screen, and adjust the display gain and position. The gain and position adjustments for the Y axis are R193 and R192 respectively, and those for the X axis are R195 and R194 respectively.

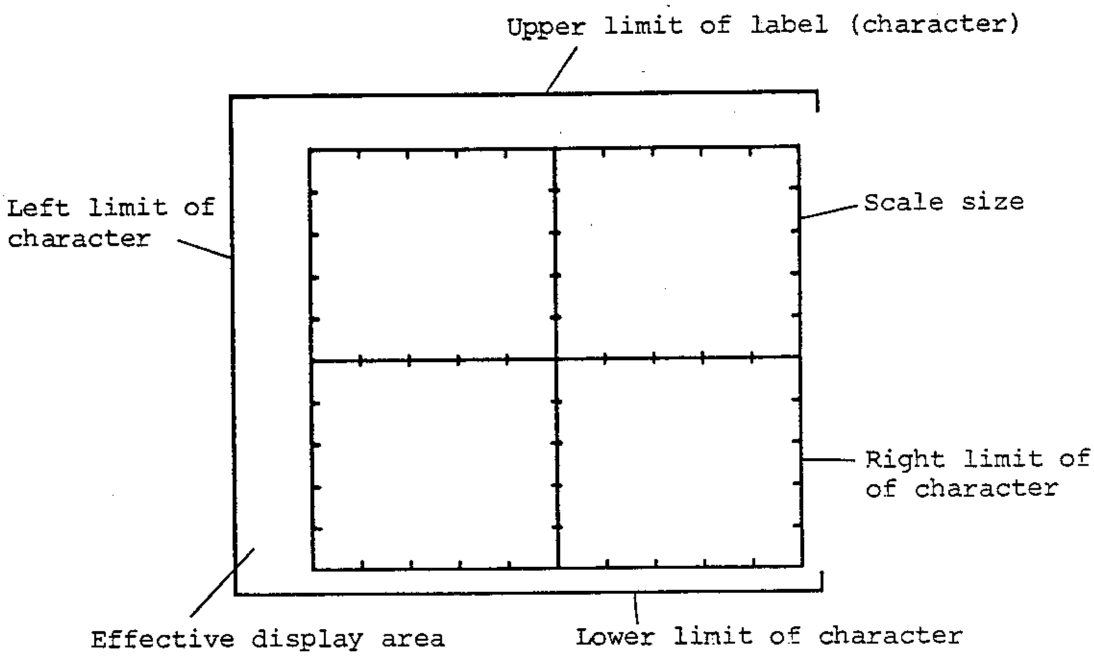


Fig. 11-7 Standard display scale (MPH-20803A)

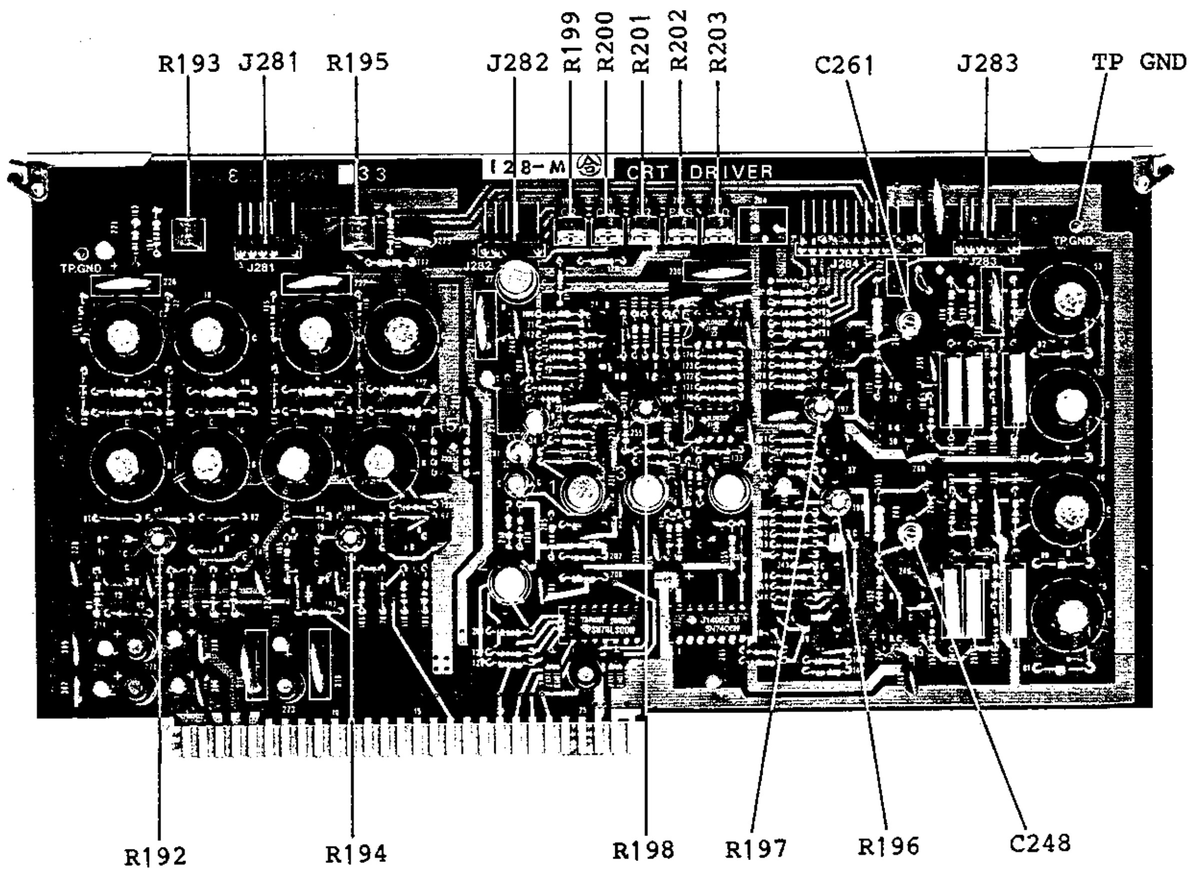
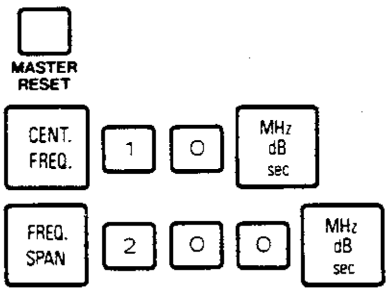


Fig. 11-8 Adjustment controls and test points on the CRT driver board (BGK-010184)

⑥ Use the following key operations to obtain a signal response with steep transient:



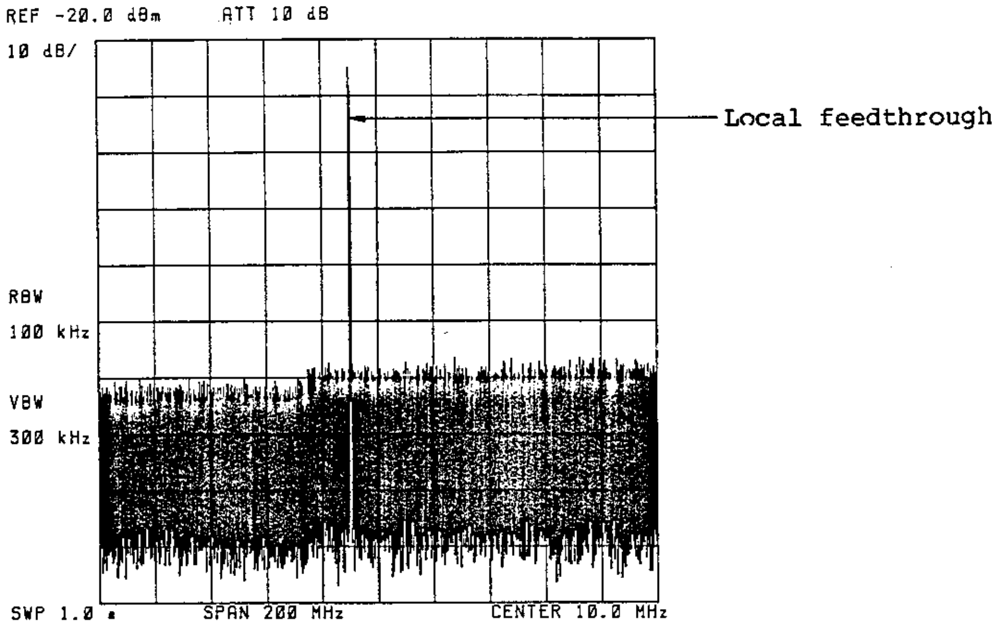


Fig. 11-9 Signal response display for intensity adjustment

⑦ Set INTENSITY control on the front panel to the ten o'clock position. Adjust R64 on the High Voltage unit (BLC-0101204) and R196 on the CRT Driver board (BGK-010184) until the signal response trace is slightly visible on the CRT display. At this time, R64 should be turned toward low intensity, while R196 should be turned toward high intensity.

⑧ Set the FOCUS screwdriver control on the front of Display Section to the center position. Adjust R63 on the high voltage unit and R201 on the CRT Driver board until the center of the display is well focused.

⑨ Adjust R197 on the CRT Driver board until a good focus is obtained for the local feedthrough on the CRT display.

⑩ Adjust R198 so a good focus is obtained for the left and right areas of the CRT display.

⑪ While observing the signal at pin 1 of J283, adjust C248 until the waveform has no overshoot. Similarly, adjust C261 until the waveform at pin 3 of J283 has no overshoot. Connect the probe ground for the oscilloscope to a TP-GND on the board.

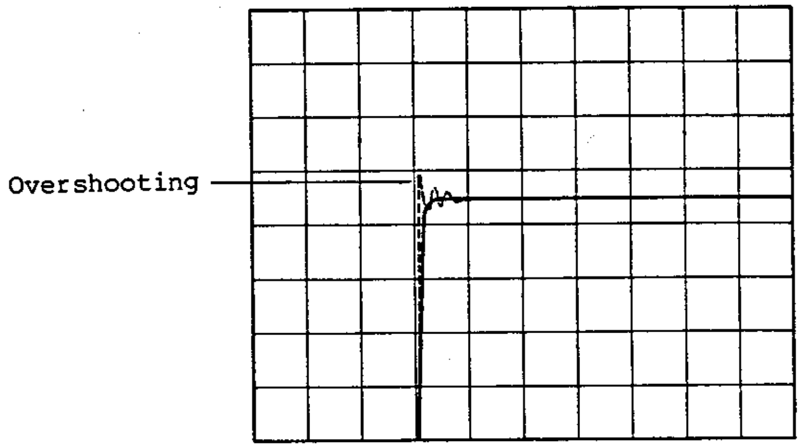


Fig. 11-10 Overshoot

⑫ Set the POWER switch to STANDBY. Return the CRT Driver board (BGK-010184) into its original slot. Set the POWER switch to ON.

11-4-4. Data Knob Adjustment (BGP-010192)

Instruments required: * Oscilloscope

① Using the oscilloscope, check the signals at TP2 and TP4 on the Memory board (BGP-010192).

② Turn the front data knob at a constant speed, and adjust R125 and R126 until the signal waveforms at TP2 and TP4 have a duty ratio of 1:1.

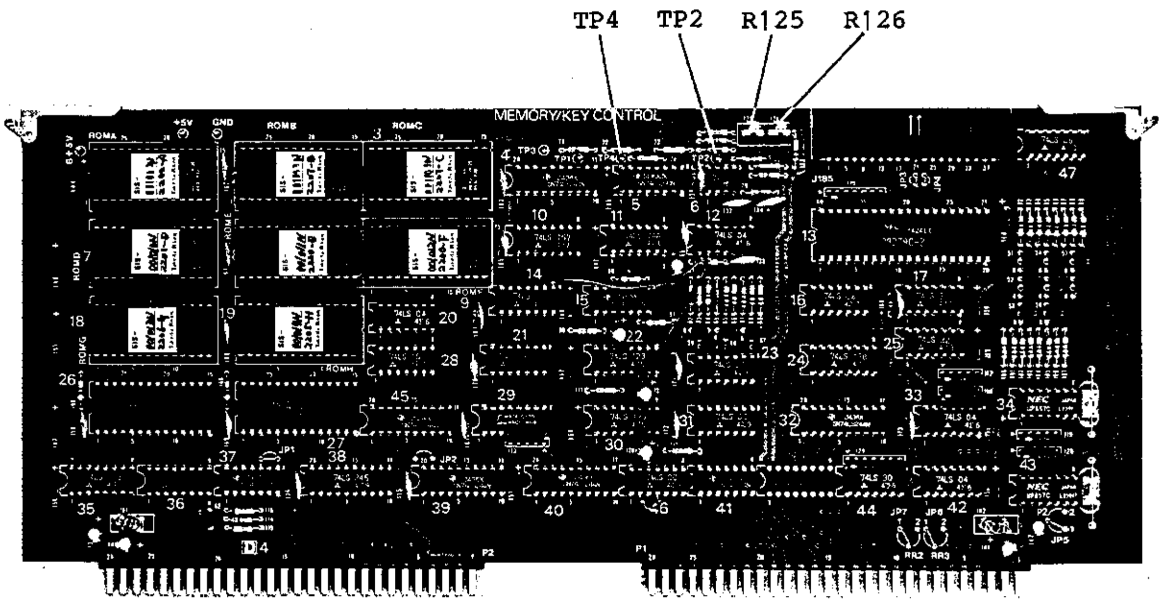


Fig. 11-11 Locations of Memory board (BGP-010192) check points

11-4-5. D-A Converter +10 V Adjustment (BGP-010188)

Instruments required: * Digital voltmeter

① Set the POWER switch to STANDBY. Pull out the D-A Converter board (BGP-010188), then remount it in the same slot using an extender board (double, 28 pins).

② Set the POWER switch to ON. Check the emitter voltage of Q61 on the board with a digital voltmeter. Adjust the collector voltage to +10 V ±10 mV with R91.

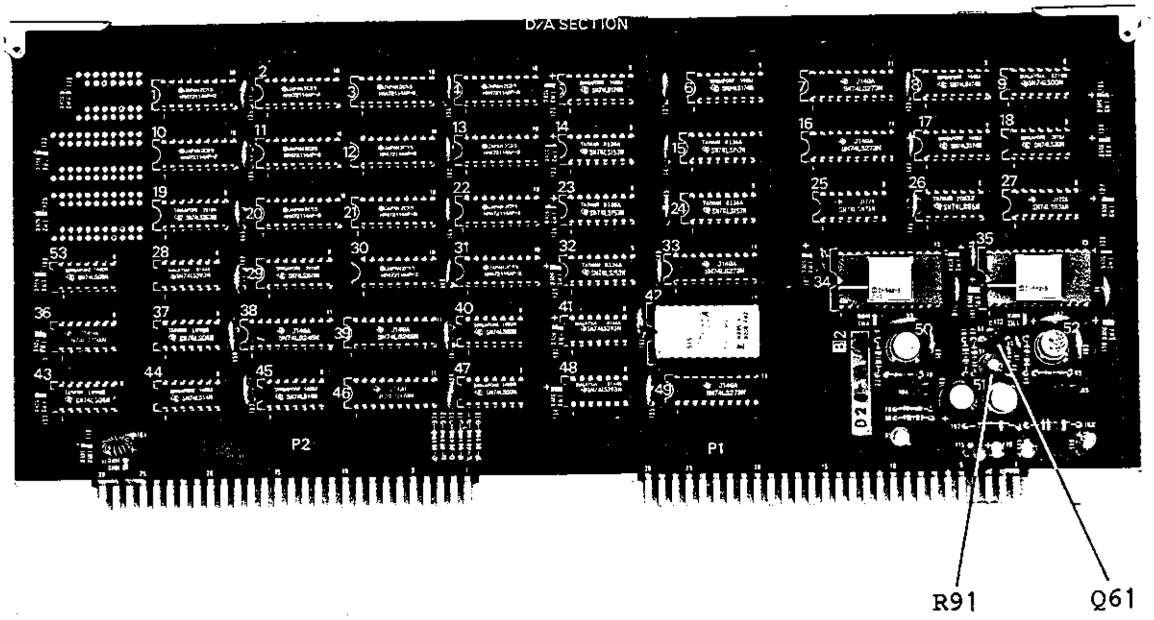


Fig. 11-12 Adjustment on the D-A converter board (BGP-010188)

③ Set the POWER switch to STANDBY, and return the board to its original slot (without extender board). Then set the POWER switch again to ON.

11-4-6. Ramp Generator Adjustment (BGP-011552)

Instruments required: * Digital voltmeter
* Function generator
* Oscilloscope

① Set the POWER switch to STANDBY. Pull out the Ramp Generator board (BGP-011552), then remount it in the same slot using an extender board (double, 28 pins).

② Set the POWER switch to ON. Connect the oscilloscope to the card-edge connector pin P1-9AB (RAMP OUT), and adjust R95 until the output ramp signal has a 0 V ±5 V amplitude.

③ Set the POWER switch to STANDBY. Pull out the Analog I/O board (BGP-010186), and remove the jumper wire from JP1. Connect the function generator output to the LOG test point.

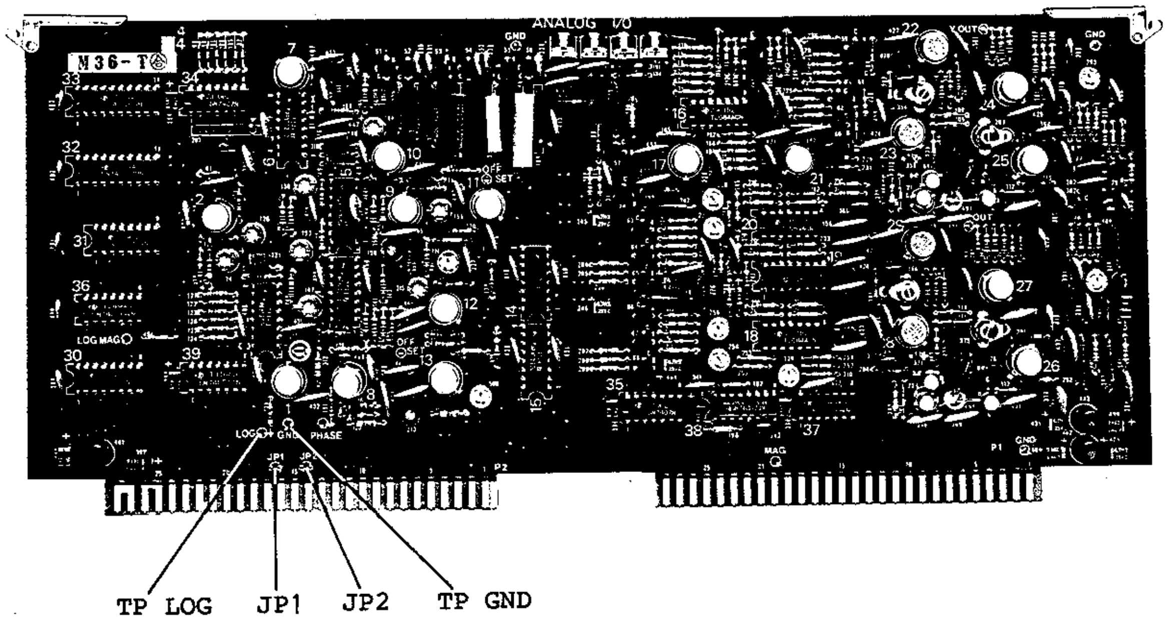


Fig. 11-13 Connecting a function generator output to the analog I/O board

④ Remount the Analog I/O board in its original slot, then set the POWER switch to ON.

⑤ Set the function generator output to 500 Hz, +2 Vp-p in level, and sine wave. Set the sweep time of the analyzer to 20 ms. Adjust R64 on the Ramp Generator board so that 10 cycles of sine wave exist within the scale span on the screen.

⑥ Set sweep time to 2 s. Set the function generator output frequency to 5 Hz. Adjust R65 on the Ramp Generator board (BGP-010185) so 10 cycles of sine wave appear within the scale span on the screen.

⑦ Press [FREQ. SPAN] [0] [Hz / −dBm / µsec] to set zero frequency span. Set sweep time to 500 µs. Set the function generator output frequency to 20 kHz. Adjust R83 so that 10 cycles of sine wave appear within the scale span on the CRT display.

⑧ When R64 is readjusted, also readjust R65 and R83.

⑨ Adjust analog sweep. Set the output frequency of the function generator to 100 Hz. Set sweep time to 19 ms. Adjust R124 until the signal response on the CRT display is centered on the vertical center graticule.

⑩ Adjust rewriting position. Set sweep time to 10 s. Adjust R130 until the trace rewriting position coincides with the blanking position at the center of the screen.

⑪ Set the POWER switch to STANDBY. Disconnect the function generator output from the Analog I/O board, and install the jumper wire at JP1. Return the Analog I/O and Ramp Generator boards to their original slots, then set the POWER switch to ON again.

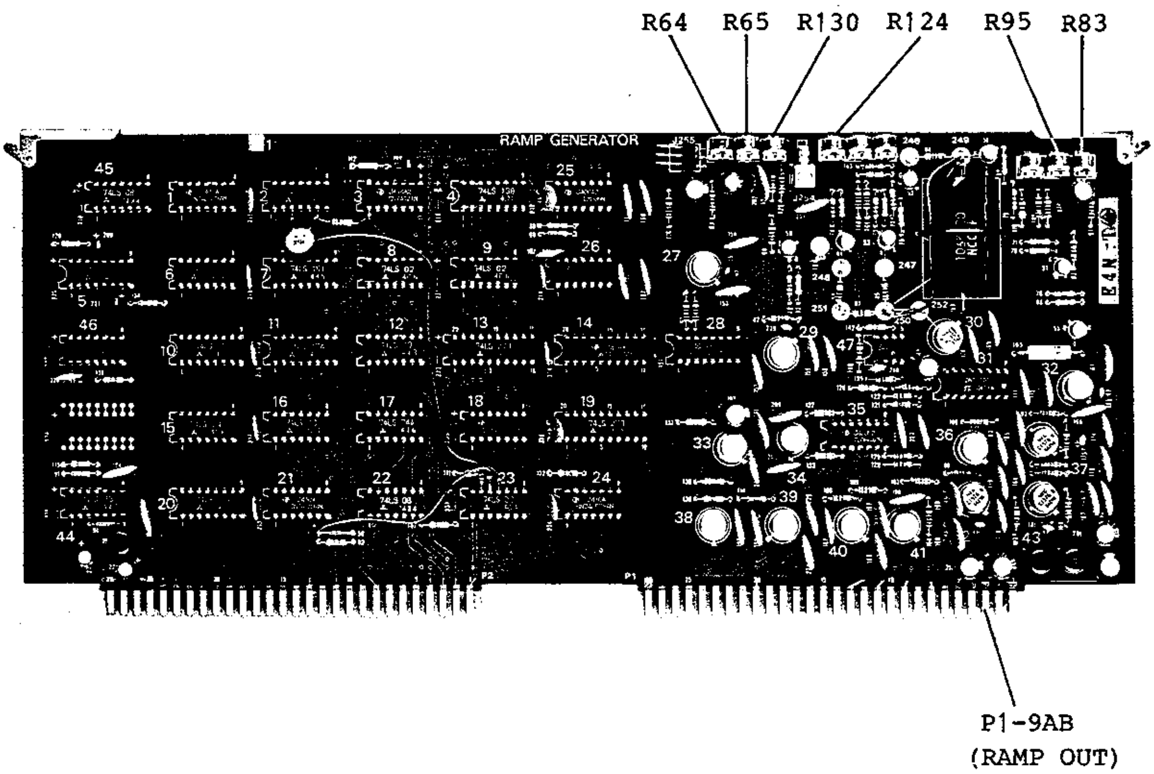


Fig. 11-14 Adjustment controls on the Ramp Generator board (BGP-010185)

11-4-7. Analog I/O Board Adjustment (BGP-010186)

Instruments required: * Digital voltmeter (4 and a half digits)
* DC voltage standard
* Function generator

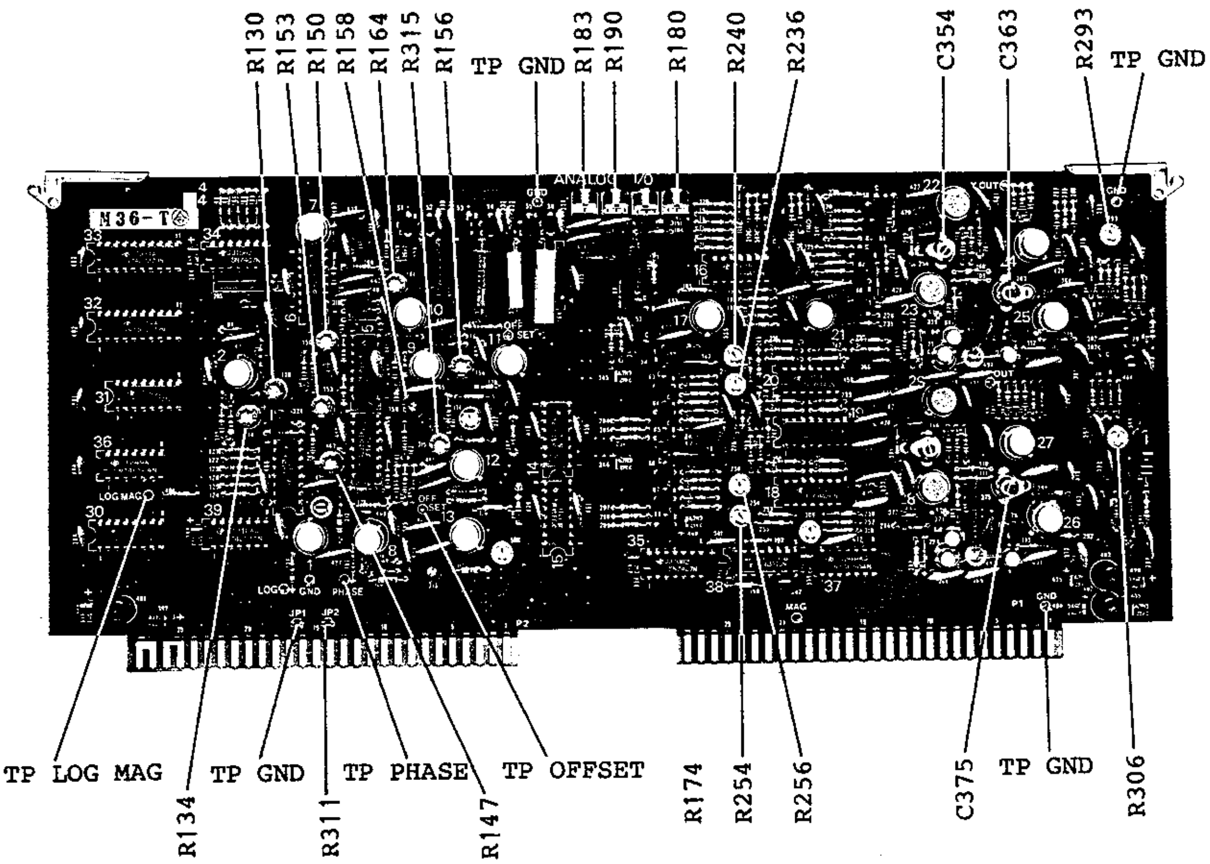


Fig. 11-15 Locations of adjustment controls and test points on the Analog I/O board (BGP-010186)

① Set the POWER switch to STANDBY. Pull out the Analog I/O board (BGP-010186), and remove jumper wires from JP1 and JP2. Remount the board in the same slot using an extender board (double, 28 pins).

② Connect the output of a DC voltage standard across the test points LOG and GND. Set the voltage generator output to 0.000 V, then set the POWER switch to ON.

(1) Adjusting the MAG. amplifier for logarithmic display

① Check the voltage across the test points LOG MAG and GND with a digital voltmeter. Press [SHIFT] [4] (1dB/DIV) to set the vertical graticule scale to 1 dB/div. Adjust R311 until the voltmeter reading (offset voltage of the first operation amp.) is less than 50 μV.

② Press [SHIFT] [7 (10dB/DIV)] to set the vertical scale to 10 dB/div. Check the voltage across the test points MAG and GND (test point). Set DC output to 2.5 V. Adjust R134 until the voltage is 2.5 V ±5 mV.

③ Set DC voltage standard output to 0.000 V. Adjust R130 until the voltmeter reading is 5.000 V ±5 mV.

④ Repeat steps ② and ③ several times.

(2) Adjusting the MAG. amplifier for phase display

① Set the output of DC voltage standard to 0.000 V. Disconnect it from the MAG test point and reconnect it to the PHASE test point.

② Press [MASTER RESET], [FREQ. SPAN] [1] [0] [MHz dB sec] and [GROUP DELAY], then use the data knob to set the vertical scale to 20 ns/div. Check the voltage across the test points OFFSET and GND (test point) (offset voltage of the first operation amp.). Adjust R315 until the offset voltage is less than 50 µV.

③ Check the voltage at the test points between MAG and GND. Adjust R164 until the voltage is +2.500 V ±5 mV.

④ Set the DC voltage standard output to +400 mV, and adjust R158 until the voltmeter reads +5.100 V ±5 mV.

⑤ Set the output of DC voltage standard to -400 mV, and verify that the voltmeter reading is -0.100 V ±5 mV.

⑥ Press [PHASE] to select 8°/div. Set the DC voltage standard output to +400 mV. Adjust R156 until the voltmeter reads +4.750 V ±5 mV.

⑦ Use the data knob to select 20°/div. Set the DC voltage standard output to +1.000 V. Adjust R147 until the voltmeter reads +4.750 V ±5 mV.

⑧ Use the data knob to select 40°/div. Set the DC voltage standard output to +2.000 V. Adjust R150 until the voltmeter reads +4.750 V ±5 mV.

⑨ Use the data knob to select 80°/div. Adjust R153 until the voltmeter reads +3.625 V ±5 mV.

(3) Graticule position adjustment

① Adjust R183 so the bottom end of the vertical scale is aligned to the bottom graticule of the horizontal scale.

② Adjust R190 until the left end of the horizontal scale is aligned to the leftmost graticule of the vertical scale.

③ Adjust R180 until the top end of the vertical scale is aligned to the top graticule of the horizontal scale.

④ Adjust R188 until the right end of the horizontal scale is aligned to the rightmost graticule of the vertical scale.

(4) Character size and position adjustment

① Place the standard pattern scale shown in Figure 11-7 (used for X-and Y-axis adjustment) on the display screen.

② Make the following adjustments until each character location is aligned to the standard pattern scale:
R236 for character position on the Y-axis.
R240 for Y-axis gain.
R256 for character position on the X-axis.
R254 for X-axis gain.

(5) Line generator adjustment

① Disconnect DC voltage standard output from test points PHASE and GND, to which it was connected during the adjustment of the MAG. amplifier for phase measurement. Connect the function generator across test points LOG and GND.

② Press [MASTER RESET], [SWEEP TIME] [1] [•] [5] [MHz dB sec] to set sweep time to 1.5 s. Set the function generator output to 500 Hz, 2 Vp-p, with DC offset of 1.3 V.

③ Press [A VIEW] [MKR], and turn the data knob slightly. The marker will move vertically. Adjust C354 so the marker traces the signal response on the CRT display.

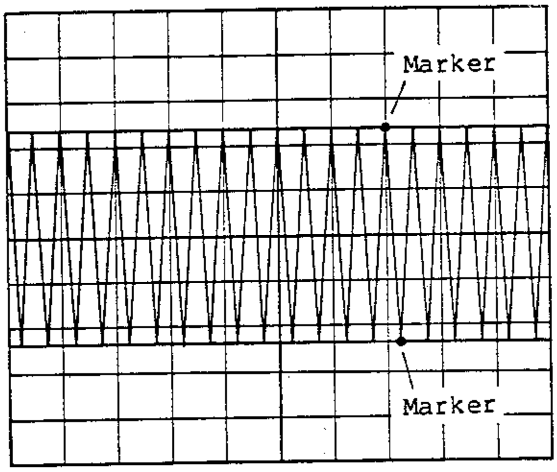
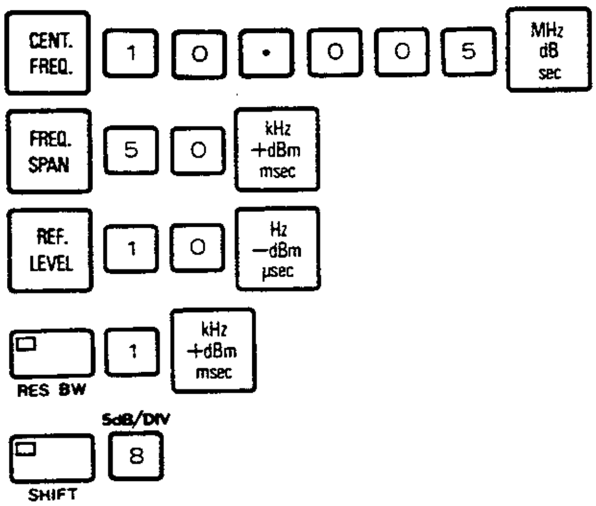


Fig. 11-16 Marker level adjustment

④ Disconnect the function generator from the LOG and GND terminals, and set the POWER switch to STANDBY. Install jumper wires on JP1 and JP2, then power the analyzer on again.

⑤ While the instrument is in the initial default state, prepare it as follows:



⑥ Connect the CAL. OUT. connector to the INPUT-1 connector to display the CAL. OUT. signal response. Adjust C375 until a smooth and straight response trace is obtained.

Adjust so the signal response
is smooth and free of ripples.

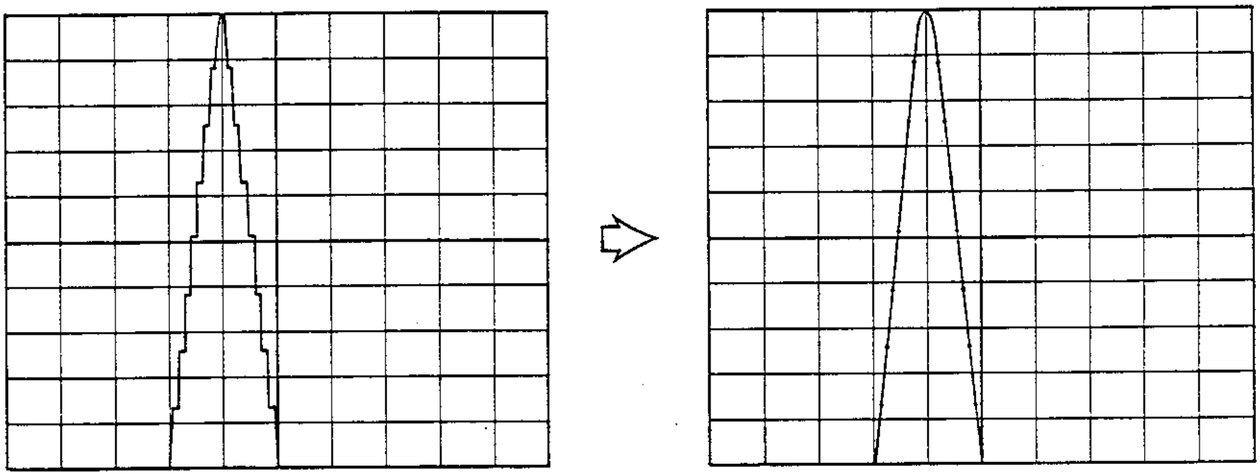
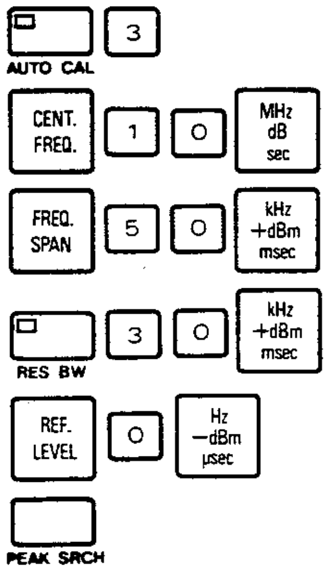


Fig. 11-17 Line generator adjustment

⑦ Update the panel setup on the instrument as follows:



⑧ Press MKR OFF key, and adjust C363 until the signal response peak is positioned on the horizontal scale at -10 dBm.

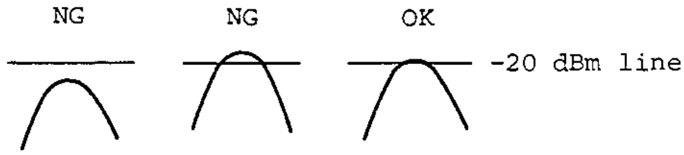


Fig. 11-18 C363 adjustment

(6) Marker size adjustment

Press [MKR] to activate the marker. Adjust R293 and R306 until around marker dot is obtained.

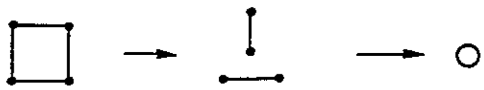


Fig. 11-19 Marker adjustment

(7) Analog sweep positional adjustment

① Press [FREQ. SPAN] [0] [MHz dB sec] to set zero frequency span.

Press [SWEEP TIME] [2] [0] [kHz +dBm msec], then use [⇩] to set sweep time to 10 ms.

② Analog sweep mode is selected instead of digital sweep mode when the step down key is pressed. The signal response trace will be verticaly displaced slightly when the sweep mode is switched from digital to analog. Adjust R174 until the trace is repositioned to its original position.

③ Set the POWER switch to STANDBY. Mount the Analog I/O board in its original slot (without extender board), then switch on the instrument again.

11-4-8. A-D Converter Board Adjustment (BGP-010187)

Instruments required: * Digital voltmeter (4 and a half digits.)
* DC voltage standard
* Function generator

1. Set the POWER switch to STANDBY. Pull out the A-D Converter board (BGP-010187), and remove the jumper wire from JP1. Remount the board in the same slot using an extender board (double, 28 pins).
2. Connect the DC voltage standard output across the test points TP1 and GND. Set DC voltage standard output to 5.000 V, then set the POWER switch to ON.
3. Use the digital voltmeter to check the voltage across test points TP4 and GND. Set sweep time to 10 s.
4. Press [SHIFT] [ ]z to select sample detection mode. Adjust R177 until the voltage at TP4 is +5.000 V ±1 mV.
5. Press [SHIFT] [ ]p to select positive peak detection mode. Adjust R178 until the voltage at TP4 is +5.000 V ±1 mV.
6. Press [SHIFT] [ ]s to select negative peak detection mode. Adjust R176 until the voltage at TP4 is +5.000 V ±1 mV.
7. Set the DC voltage standard output to 0.000 V. Set the reference level to 0 dBm. Press MARKER key, and adjust R179 until the marker reading is -100.0 dBm ±1.0 dBm.
8. Set DC voltage standard output to +5.000 V. Adjust R180 until the marker reading is 0.0 dBm +0.1 dBm. Repeat steps (7) and (8) several times since R179 and R180 affect each other.
9. Disconnect DC voltage standard from test points TP1 and GND, and instead connect the function generator output across TP1 and GND. Set the function generator output to 100 Hz per 100 Hz triangular wave 2 Vp-p, output level, and 1.3 Vdc offset.
10. Connect oscilloscope across pin 9 of IC10 and GND, and adjust R175 until observed signal waveform stops flickering.

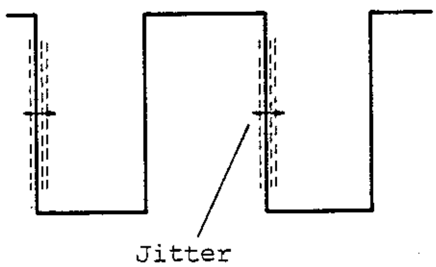
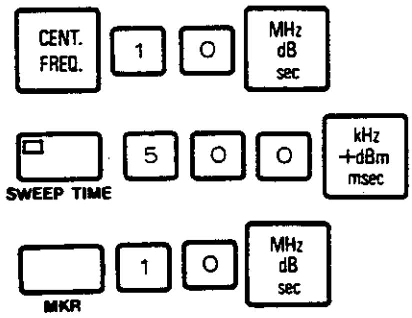


Fig. 11-20 Adjusting R175 on the A-D converter board

⑪ X-axis center adjustment. Set the POWER switch to STANDBY, and return the JP1 jumper wire. Set the POWER switch to ON again, then update the panel setup as follows:



Connect the CAL. OUT. signal to the INPUT-1 connector.

⑫ Adjust R181 so the marker is positioned to the peak of the 10 MHz signal response.

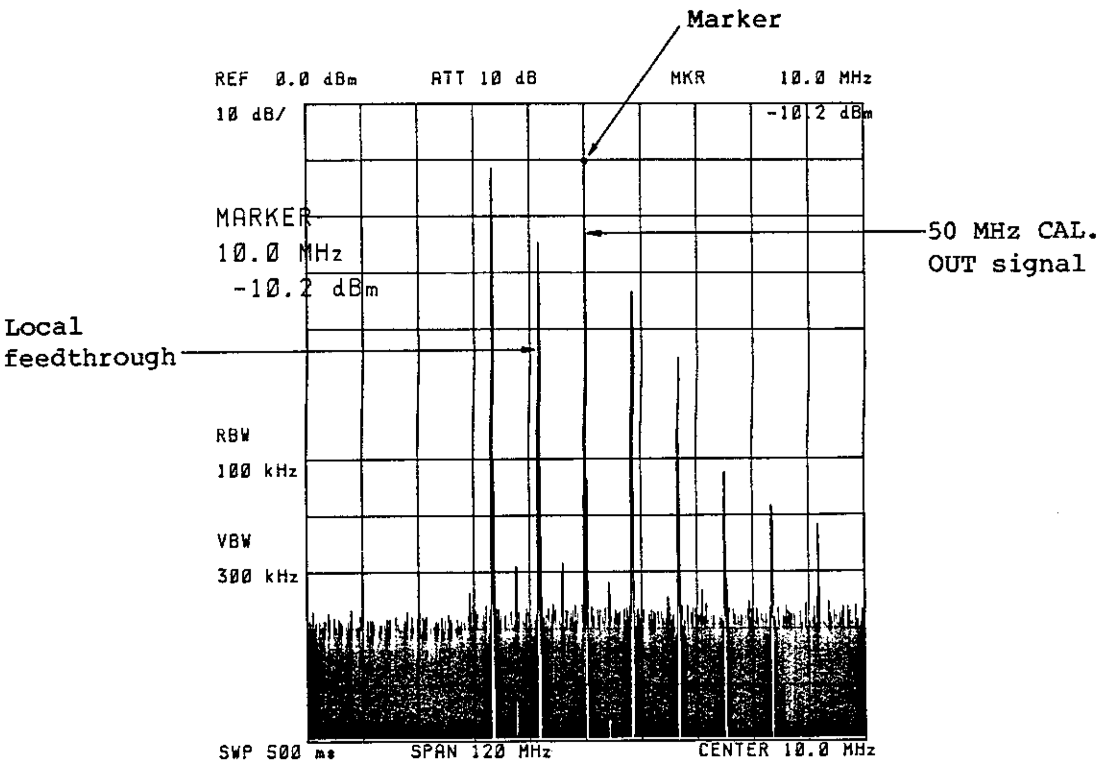


Fig. 11-21 X-axis center adjustment

⑬ Set the POWER switch to STANDBY, and return the board to its original slot (without extender board). Reset the POWER switch to ON.

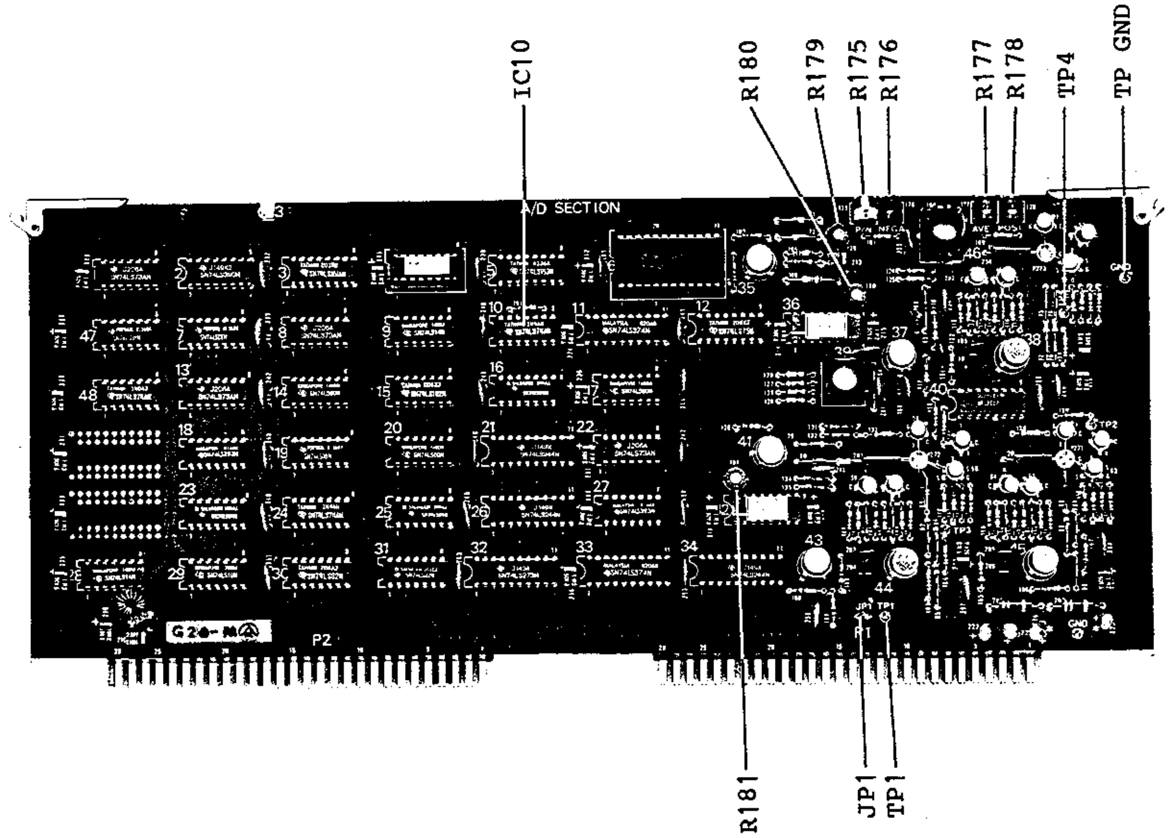


Fig. 11-22 Locations of adjustment controls and test points on the A-D Converter (BGP-010187) board

11-4-9. Log Amp. Adjustment (BLP-010231) MEP-337

Instruments required: * Digital voltmeter (four and a half digits)
* Signal generator
* Spectrum analyzer (with tracking generator)
* High-impedance probe
* Attenuator (covering 0 to 100 dB in 10-dB steps)

(1) Log. amplifier 3.33 MHz tuning

① Set the POWER switch to ON and warm up the instrument for at least 10 minutes. Connect the tracking generator output of the external spectrum analyzer to the LOG IN terminal on the LOG AMP board. Set the tracking generator output to -40 dBm. Remove the shield case over from the LOG AMP unit. Using the external spectrum analyzer with a high impedance probe attached to its input, observe the signal appearing on the board across R152 and GND.

② Set resolution bandwidth to 100 kHz. Adjust L672 until the signal response peak on the external spectrum analyzer is 3.333 MHz.

③ Set the tracking generator output connected to the LOG IN terminal to -10 dB. Set resolution bandwidth to 100 kHz. Connect the external spectrum analyzer input to R213. Adjust L679 until the peak signal response observed on the external analyzer is positioned at 3.333 MHz.

(2) LOG AMP gain and offset adjustment

① Connect a signal generator output to the LOG IN terminal using an external attenuator. Set the signal generator output to 3.333 MHz in frequency and 0 ±0.1 dBm in level. Check the voltage at pin 3 or 14 of IC 24 (to GND) with a digital voltmeter. Set resolution bandwidth to 100 kHz.

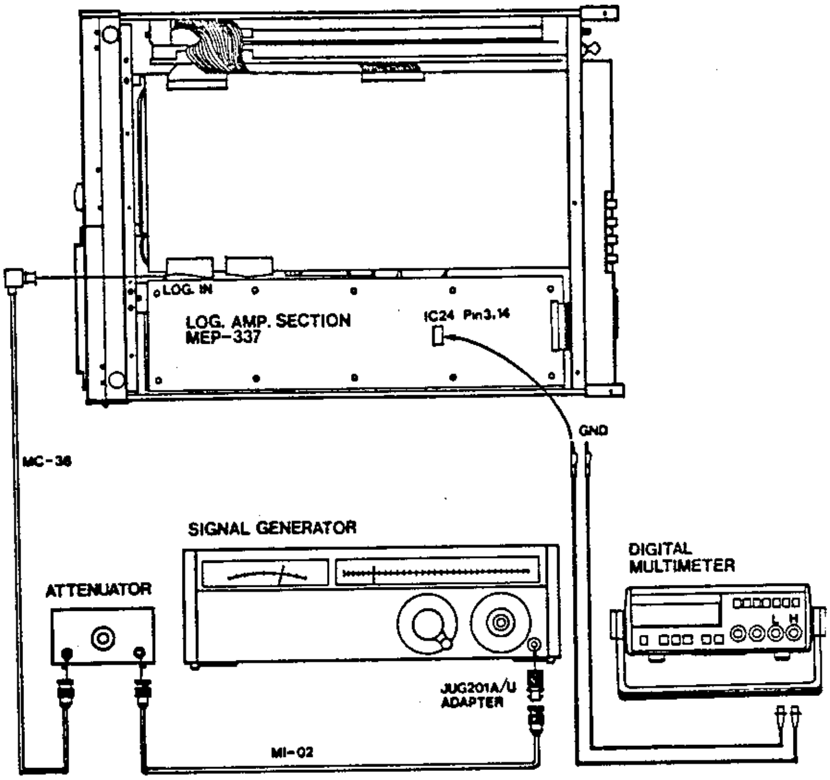


Fig. 11-23 LOG AMP gain adjustment

② While changing the external attenuator setting from 60 to 90 dB in 10dB steps, adjust R238 so the LOG AMP OUT voltage (at pin 3 or 4 of IC 24) changes at 0.500 V ±5 mV steps.

③ While changing the external attenuator setting from 0 to 40 dB in 10dB steps, adjust R301 so the LOG AMP OUT voltage changes at 0.500 V ±5 mV steps.

④ Set the external attenuator to 0 dB, and adjust R355 until the LOG AMP OUT voltage is 0.000 V ±5 mV.

⑤ Set the external attenuator to 60 dB, and adjust R157 until the LOG AMP OUT voltage is 3.000 V ±5 mV. Repeat the steps ④ and ⑤ several times since R355 and R157 affect each other.

(3) Reference level and DC offset adjustment

Press [REF. LEVEL] [1] [0] [0] [Hz −dBm µsec] to minimize the reference level (the actual reference level should be positioned at -90 dBm). Set the external attenuator to 60 dB, and adjust R335 until the LOG AMP OUT voltage is +1.000 V ±5 mV.

(4) Gain, offset, and step amplifier adjustment in LIN. mode

① Press [REF. LEVEL] [0] [kHz +dBm msec] and [SHIFT] [6 (LIN)], and adjust R352 until the LOG AMP OUT voltage is +5.000 V ±5 mV. Then set the external attenuator to 0 dB, and adjust R355 until the voltage is 0.000 V ±5 mV.

② Set the external attenuator to 10 dB. Set the analyzer reference level to -50 dBm, and adjust R254 until the voltage is 0.000 V ±10 mV. Refer to the following table when adjusting the step amplifier in the LIN. mode.

Table 11-4 Step amplifier adjustment in LIN mode

AMP. gain	Ref. Level	External attenuator	Output voltage	Adjustment
10 dB	-50 dBm	10 dB	0.000 V ±10 mV	R254
20 dB	-60 dBm	20 dB	Same as above	R263
30 dB	-70 dBm	30 dB	Same as above	R254, R263
40 dB	-80 dBm	40 dB	Same as above	R272
50 dB	-90 dBm	50 dB	Same as above	R254, R263, R272

③ Repeat the adjustment steps several times in the amplifier gain range of 10 to 50 dB since R254, R263, and R272 slightly affect each other.

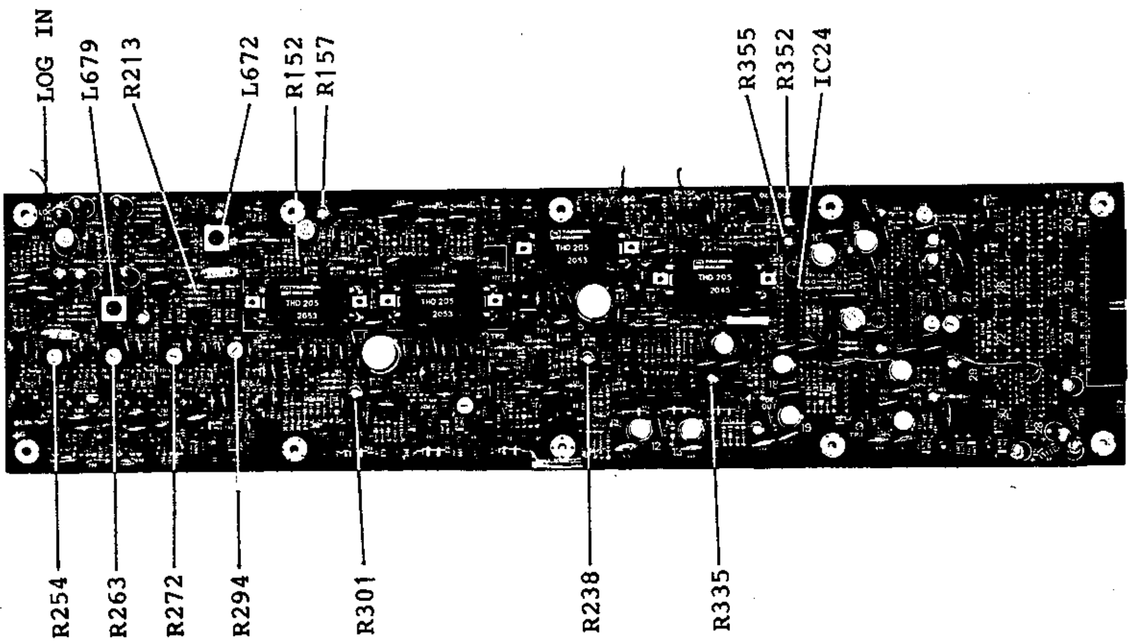


Fig. 11-24 Location of adjustments on the LOG AMP board (BLP-010231)

11-4-10. IF Adjustment [BLP-011231 (IF-I) / BLP-011232 (IF-II)] MEP-401

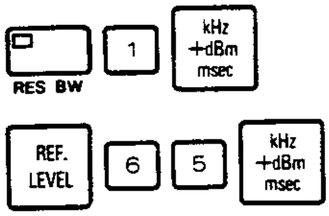
Instruments required: * Spectrum analyzer (with tracking generator)
* Function generator
* External ATT (10 dB/1 dB step)

① Set the POWER switch to STANDBY. Remove the Final IF block from the main frame, then set the POWER switch to ON.

② Connect the tracking generator output of the external spectrum analyzer to J561 on the IF-I board and set TG output level to about -20 dBm. Connect a probe to the external spectrum analyzer input.

(1) LC filter adjustment

① Set the TR4171 as follows: RBW: 1 kHz
REF level: 65 dBm



② Check TP3 (IF-I) with the probe and set the external spectrum analyzer as follows:

Center frequency: 455 kHz

Frequency span: 10 kHz

Graticule scale: 1 dB/div.

Adjust the reference level so the response waveform from the IF filter is displayed on the CRT.

③ Adjust C431, C570, and C574 (IF-I) to obtain the maximum level with center frequency 455 kHz.

④ Assuming the level obtained when the RBW of the TR4171 is set to 30 kHz to be the reference value, adjust R587 so the same level is obtained with the RBW set to 1 kHz.

⑤ Perform similar operations as follows:

TP4 (IF-I): Center adjustment with C441, C571, and C575
Level adjustment with R245

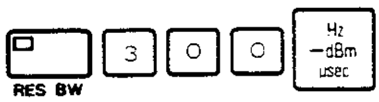
TP4 (IF-II): Center adjustment with C410, C580, and C528
Level adjustment with R327

TP5 (IF-II): Center adjustment with C420, C529, and C581
Level adjustment with R328

TP6 (IF-II): Center adjustment with C430, C579, and C582
Level adjustment with R235

(2) Crystal filter adjustment

① Set the TR4171 RBW to 300 Hz.



② Check TP1 (IF-I) with a probe and change the graticule setting of the vertical scale of the external spectrum analyzer to 10 dB/div.

③ Observe waveform and adjust L536 and C408 so the filter waveform changes as shown in Figure 11-25 and the minimum level is obtained. Then adjust C392 so the left-side and right-side of the waveform become symmetric. Set the external spectrum analyzer graticule scale to 1 dB/div. and input the 455 kHz signal from each function generator, not from the tracking generator. Adjust C577 so the maximum level is obtained.

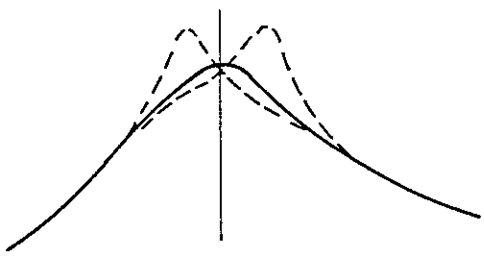


Fig. 11-25 Crystal filter adjustment

④ Since these adjustment operations affect to each other, repeat the adjustment several times.

⑤ Similarly, adjust the items listed below to properly set the crystal filter stages.

Adjustment item / Test point	Minimum level	Symmetry	Maximum level
TP2 (IF-I)	L536, C410	C405	C579
TP1 (IF-II)	L532, C361	C363	C584
TP2 (IF-II)	L533, C375	C377	C586
TP3 (IF-II)	L534	C390	C588

(3) Local frequency adjustment

Apply 3.333333 MHz signal from the function generator to the IF input, set the TR4171 RBW to 3 Hz, and adjust C359 (IF-I) to obtain the maximum IF output (3.333333 MHz).

(4) 100 kHz RBW adjustment

Set the TR4171 RBW to 100 kHz. Like item (3) above, adjust L547, L548, and L549 (IF-II) to obtain the maximum signal level.

(5) Mixer balance adjustment

Connect IF output to the external spectrum analyzer. Adjust R253 and R254 (IF-II) so the level of the 2.87833 MHz image signal in the mixer, where 455 kHz IF signal frequency is obtained, is -110 dBm max. Since these controls affect each other, adjust the controls for the appropriate positions.

(6) RBW changeover adjustment

Input an internal calibration signal (10 MHz) to the TR4171. With the RBW set to 100 kHz as the reference, adjust each controls listed in the following table so the signal level is at most ±1 dB in the range 30 kHz to 3 Hz.

30 kHz	R314 (IF-I)
3 kHz	R589 (IF-I), R235 (IF-II)
1 kHz	R315 (IF-I)
300 Hz	R316 (IF-I)
100 Hz	R318 (IF-I)
30 Hz	R319 (IF-I)
10 Hz	R320 (IF-I)
3 Hz	R321 (IF-I)

(7) IF gain adjustment

① Input calibration signal through the 10 dB- and 1 dB-step attenuators to the TR4171 as illustrated in Figure 11-26.

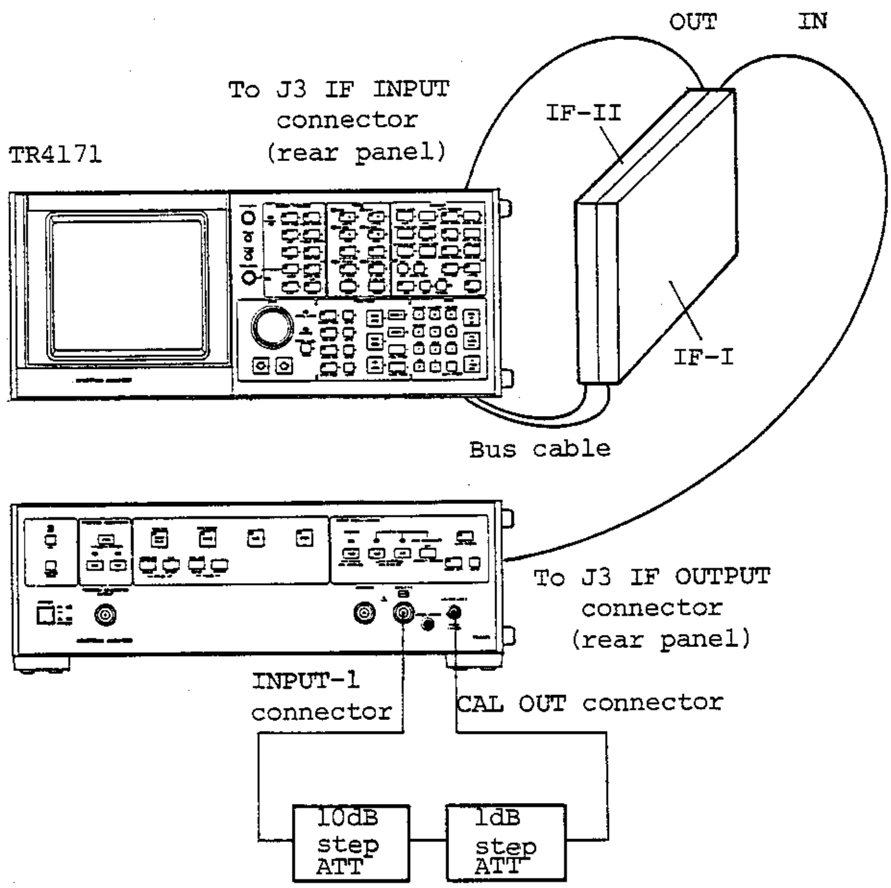
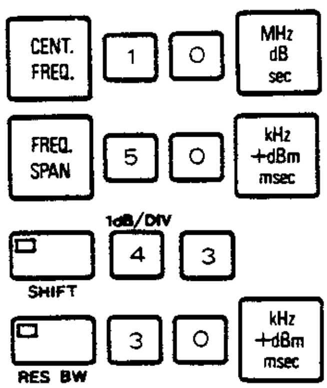


Fig. 11-26 Adjustment device setup for the IF gain adjustment

② Set the TR4171 as follows:



Set 1 dB-step attenuator to 11 dB.

③ Move waveform to the screen center by properly adjusting the REF level. Then operate key switches as follows: [SHIFT] [LABEL] [Hz/−dBm/µsec] [ZOOM] W. Here, "IF 1 DB STEP ATT" is displayed. Store waveform when the setting value is 00.

④ While changing the external attenuator setting to 10 dB, 9 dB, 7 dB, and 3 dB, key in 1 dB, 2 dB, 4 dB, and 8 dB to the TR4171 at the same time. Adjust R290, R297 (IF-I), R102, and R109 (IF-II) so the respective difference is within ±0.1 dB.

⑤ Set graticule scale of the vertical axis of the TR4171 to 1 dB/div. by operating keys [SHIFT] [4] (1dB/DIV). Set external 1 dB-step attenuator to 0 dB. Change REF level setting appropriately to move the waveform to the screen center, then key in as follows:

[SHIFT] [LABEL] [Hz/−dBm/µsec] [Δ] V

Then, "IF 10 DB STEP AMP" is displayed. Store waveform when the setting value is 00.

⑥ Change setting of the external attenuator in the range from 10 dB to 50 dB by 10 dB steps and key in 10, 20, 30, 40, and 50 to the TR4171 simultaneously. Adjust R148, R149, R265, R264 (IF-I), and R96 (IF-II) so the respective difference is at most 0.5 dB.

(8) IF total gain adjustment

① Input 3.3333 MHz signal (with amplitude 0 dBm) from the function generator to the IF INPUT connector as shown in Figure 11-27. Set the TR4171 as follows:

[INPUT ATT] [0] [kHz/+dBm/msec]

[AUTO CAL] [3]

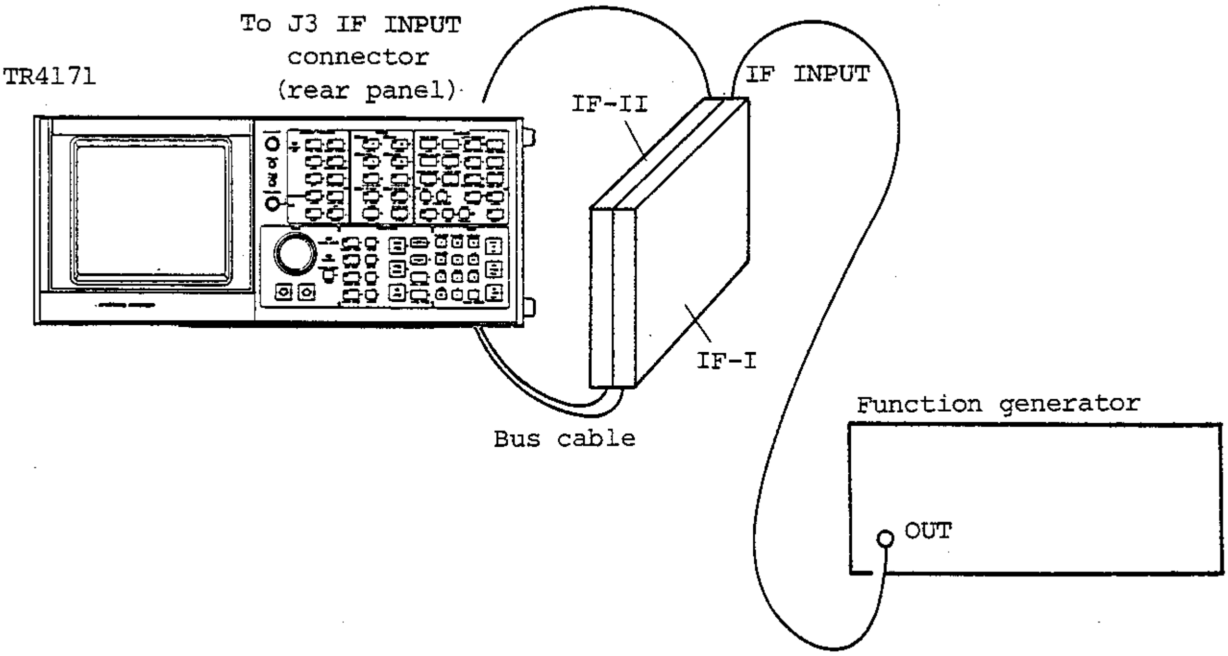
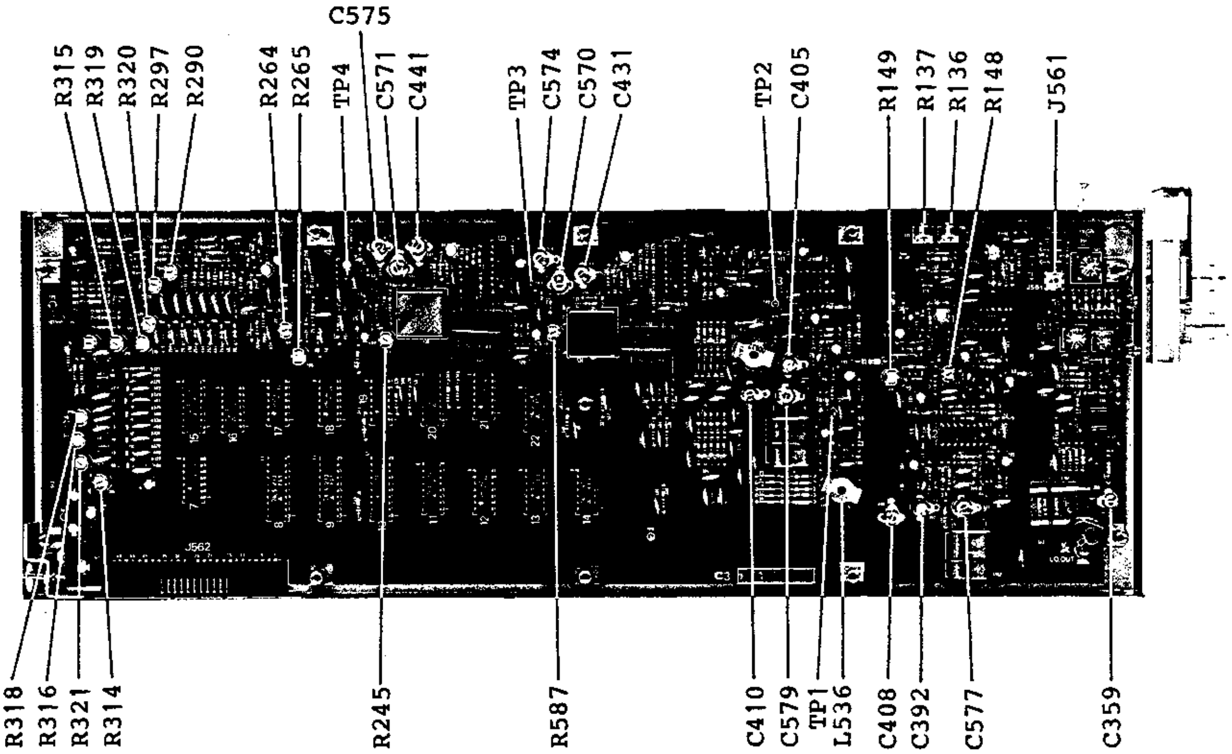


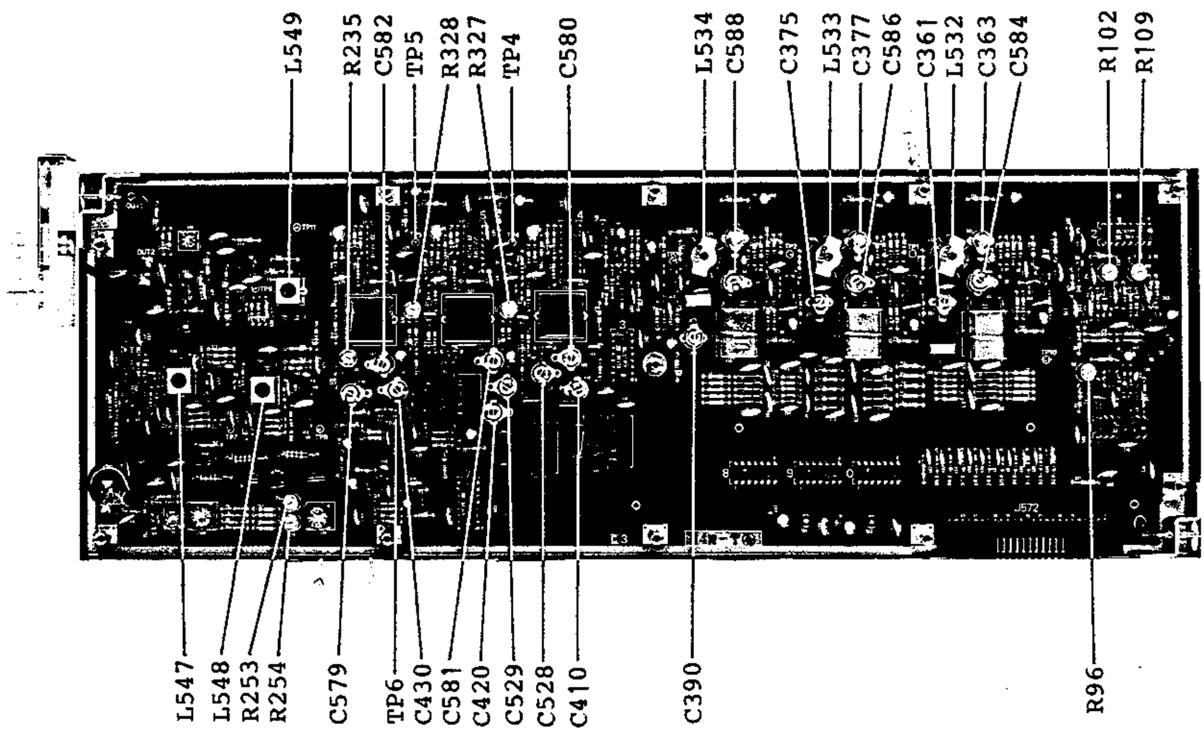
Fig. 11-27 Adjustment device setup for IF total gain adjustment

② Adjust R136 of IF-I so the marker level reading is 0 dBm.

③ Select high sensitivity mode, set ATT level to 0 dB, and adjust R137 of IF-I so the reading at the TR4171 is -37 dBm when the function generator output is set to -10 dBm.



(a) IF-I (BLP-011231)



(b) IF-II (BLP-011232)

Fig. 11-28 Adjustment locations on final IF block (MEP-401)

11-4-11. Phase and G.D. Adjustment (BLP-010205) MEP-339

Instruments required:
* Digital voltmeter
* Spectrum analyzer (with tracking generator)
* High-impedance probe

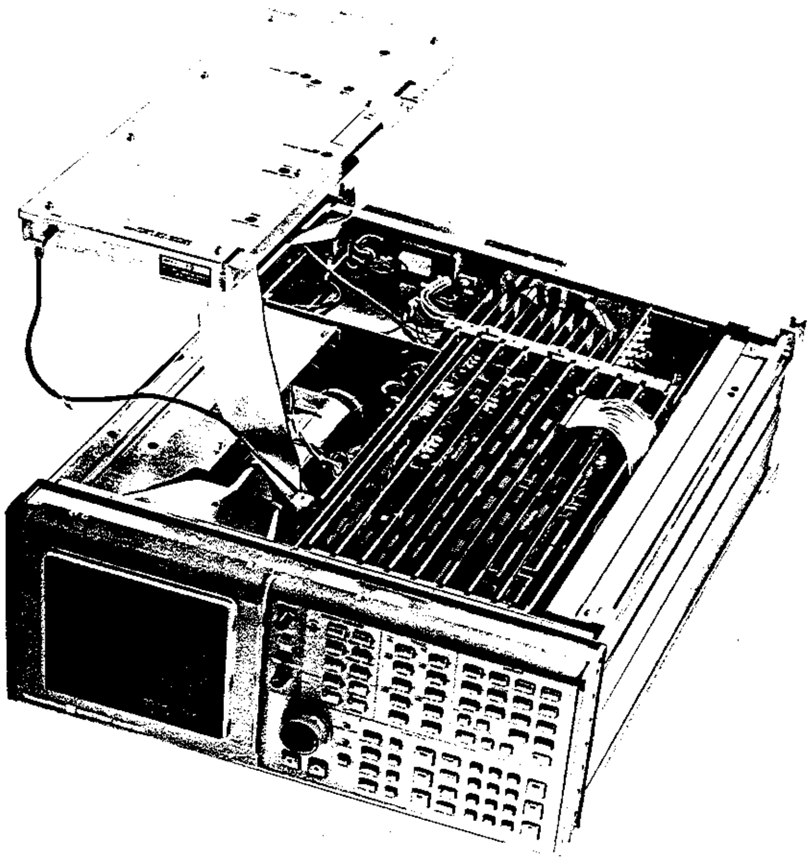


Fig. 11-29 Phase and group delay adjustment (BLP-010205, MEP-339)

(1) Reference voltage and null adjustment

① Remove the shield case cover from the MEP-339. Change jumper connection for J556 to 2 - 3 , and adjust R292 until the voltage across TP1 and TP2 is 0.00 V ±0.03 mV.

② Change the jumper connection for J556 to 1 - 2 , and adjust R295 until the voltage across TP1 and TP2 is 10.000 V ±3 mV.

③ Adjust R301 until the voltage across TP1 and TP4 is -3.30 V.

④ Press [PHASE] [OFFSET] (PHASE ⏎), and use the data knob to set phase offset to 2000. Press [OFFSET] (DELAY ⏎), then use the data knob again to set G.D. offset to 0. Press [SHIFT] [OFFSET] (FINE; DELAY ⏎), and use the data knob to set G.D. offset fine to 0. Adjust R297 until the voltage across TP1 and TP6 is 3.000 V ±5 mV.

⑤ Change the jumper connection for J555 into 2 - 3 , then adjust R307 until the voltage across TP1 and TP5 is 0.00 V ±0.03 mV.

⑥ Return the jumper connection for J555 to 1 - 2 .

(2) 3.33 MHz, 33.3 MHz, and 30 MHz filters adjustment

① Set the POWER switch to STANDBY. Disconnect C418 and TP7 on the board (by removing the appropriate side of the C418 lead).

② Connect the output of the tracking generator (of the external spectrum analyzer) to the lead of C418 just removed. The ground connection for the tracking generator output should be located as near to C418 as possible. Set the tracking generator output level to around -30 dBm.

③ Set the POWER switch to ON. Observe the signal response at the emitter of Q56 with the high-impedance probe attached to the input of the spectrum analyzer. Adjust C422 until the filter response is symmetrical at 3.333 MHz.

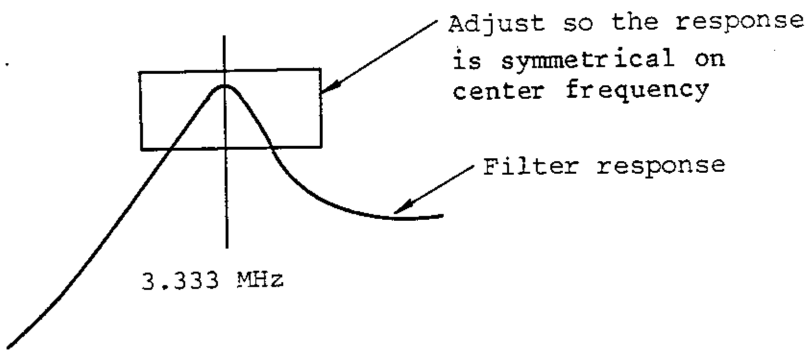


Fig. 11-30 Filter adjustment - 1

(4) Observe the signal at the Q57 collector. Adjust C425 until the filter response is symmetrical at 3.333 MHz.

(5) Set POWER switch to STANDBY. Reconnect the lead of C418 to its original pattern location. Reset the POWER switch to ON.

(6) Apply the output of the tracking generator (contained in the external spectrum analyzer) to J553 (PHASE INPUT). Set the tracking generator output to about 0 dBm. Press PHASE then use the data knob to set the phase scale to 40°/div.

(7) Observe the signal waveform at the Q47 emitter. Adjust C386 until the filter response is symmetrical at 3.333 MHz.

(8) Observe the signal waveform at the Q48 collector. Adjust C391 until the filter response is symmetrical.

(9) Reduce the tracking generator output from 0 to -30 dBm. Observe the signal waveform at the Q42 collector. The center frequency for observation is 33.33 MHz.

(10) Adjust C351 until the signal response is symmetrical at 33.33 MHz. Adjust C505 so the level of the signal resolution is reduced with its bandwidth broadened.

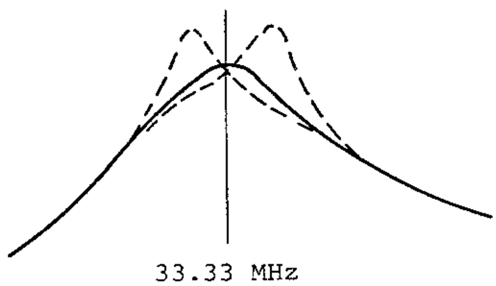


Fig. 11-31 Filter adjustment - 2

(11) Set the POWER switch to STANDBY, and disconnect C369 and C433 on the board (by removing the appropriate side of the C369 lead).

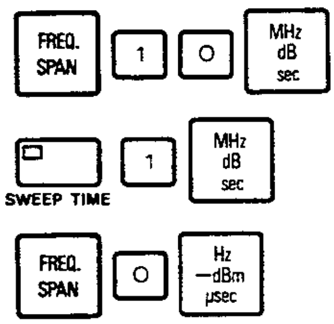
⑫ Connect the output of the tracking generator (contained in the external spectrum analyzer) to the lead of C369 just removed. The ground connection for the tracking generator output should be taken as near to C369 as possible. Set the tracking generator output to about -30 dBm.

⑬ Set the POWER switch to ON. Connect the spectrum analyzer high impedance probe to the Q44 collector. Adjust C371 until the signal response observed is symmetrical at 30.0 MHz. Adjust C506 so the level of the signal response is reduced, and its bandwidth broadened.

⑭ Set the POWER switch to STANDBY, and reconnect the lead of C369 to its original pattern location. Set the POWER switch to ON again.

(3) Output gain and offset adjustment

① Connect the TR4171 tracking generator output to its RF input. Press PHASE key then use the data knob to set the phase scale to 40°/div. Set up the TR4171 panel as follows:



② Press PEAK SEARCH key, then adjust R273 until the marker readout is within +180 ±0.4°. Press PEAK SEARCH key again to confirm the readout.

③ Press [SHIFT] [PEAK SRCH], then adjust R265 until the marker readout is within -180° ±0.4°. Press [SHIFT] [PEAK SRCH] again to confirm the readout.

④ Press [DELAY OFFSET], then use the data knob to set G.D. offset to 2000. Press [SHIFT] [DELAY OFFSET] (FINE), then set G.D. offset fine to 0 with the data knob.

⑤ Adjust R281 so there are 7.5 sawtooth waveforms (2700°) within the horizontal scale span on the TR4171. To shift the signal trace in the horizontal direction, press [PHASE OFFSET], then use the data knob.

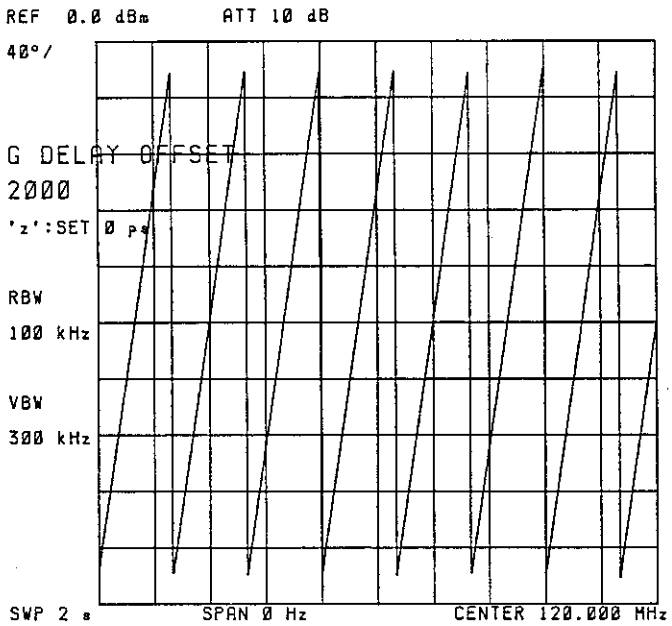


Fig. 11-32 G.D. offset adjustment

⑥ Press PHASE key, then set the phase scale to 8°/div. with the data knob. Press [DELAY OFFSET], then set G.D. offset to 0 with the data knob. Press [SHIFT] [DELAY OFFSET] (FINE), then set G.D. offset fine to 250 with the data knob.

⑦ Press [PHASE OFFSET], and adjust phase offset with the data knob until the signal response trace is centered on the display screen.

⑧ Press [PEAK SRCH], [Δ], [SHIFT] [PEAK SRCH], and read the phase value with the delta marker. Adjust R285 until the phase readout is 50.8 ±0.5°.

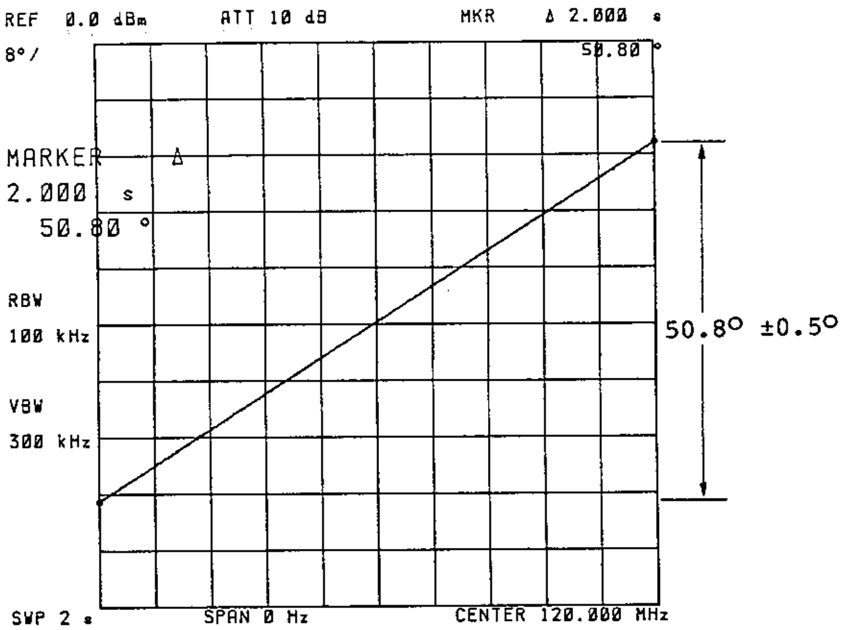


Fig. 11-33 G.D. offset fine adjustment

⑨ Proceed with phase offset adjustment. Set up the TR4171 as follows:

[PHASE]	40°/div. (with the data knob)
[OFFSET] (DELAY ↵)	G.D. offset to 0 (with the data knob)
[SHIFT] [OFFSET] (FINE, DELAY ↵)	G.D. offset fine to 0 (with the data knob)
[OFFSET] (PHASE ↵)	Phase offset to 0 (with the data knob)
[MKR]	

⑩ While increasing phase offset from 0 to 4000° with the data knob, adjust R283 so the marker readout increases from 0 to 500° as shown below:

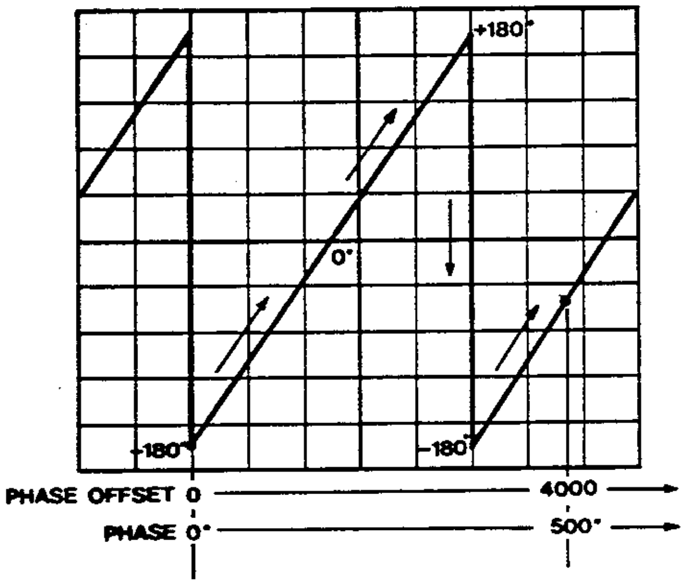


Fig. 11-34 Phase offset adjustment

(11) Remount the shield case cover on the Phase block (MEP-339).

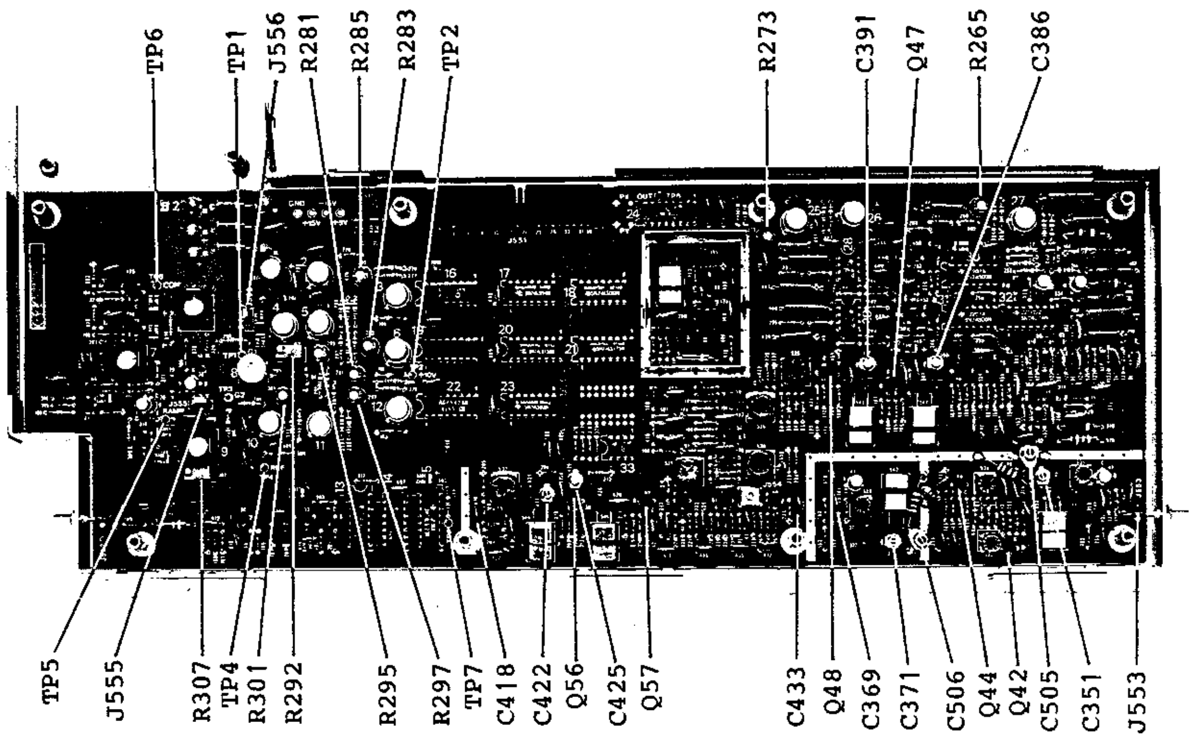


Fig. 11-35 Location of adjustments of Phase Block (BLP-010205)

11-5. RF SECTION ADJUSTMENT

This subsection describes the procedures for adjusting the RF section. See Section 13-3-3 for removing each block from the instrument.

11-5-1. RF Power Adjustment (BGF-011218)

Instruments required: * Digital voltmeter

① Set the POWER switch to ON, and measure voltages at each test point. Figure 11-36 shows locations of test points and adjusting controls.

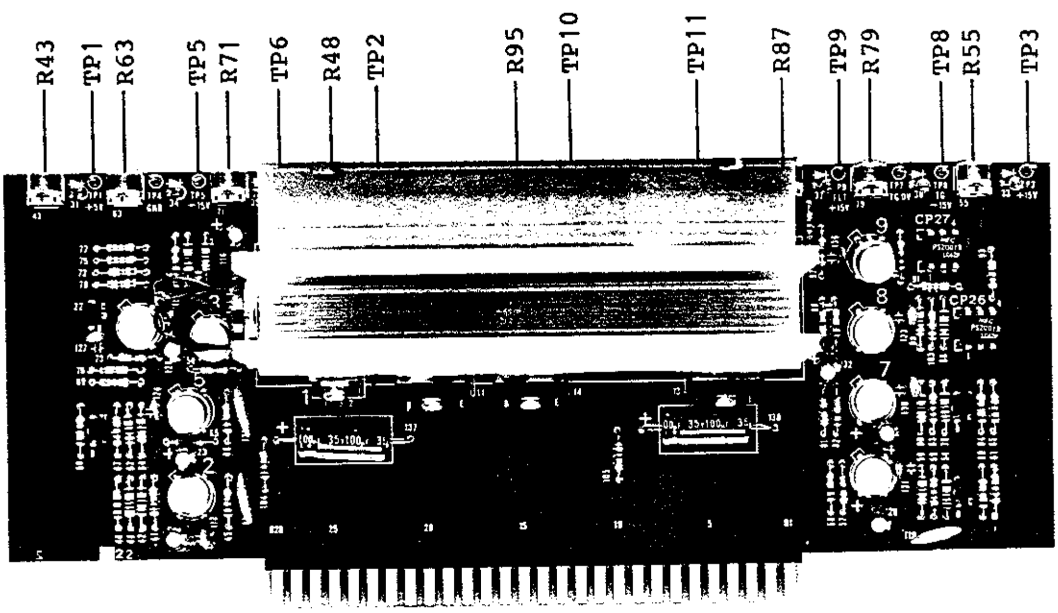


Fig. 11-36 Adjustment locations of power control board (BGF-011218)

② Adjust control volumes corresponding to the respective test points in accordance with the adjustment procedures to obtain voltage values listed in Table 11-5.

Table 11-5 RF power adjustment

Adjusting priority	Test point	Voltage value	Adjusting control	Remarks
1	TP3	+15 V ±0.01 V	R55	GND is connected to the main frame chassis.
2	TP8	-15 V ±0.01 V	R79	
3	TP2	+12 V ±0.01 V	R48	
4	TP6	+15 V ±0.01 V	R71	
5	TP5	-15 V ±0.01 V	R63	
6	TP1	+5 V ±0.01 V	R43	
7	TP9	+15 V ±0.01 V	R87	GND is connected to TP10.
8	TP11	-15 V ±0.01 V	R95	

11-5-2. 10 MHz Standard (Calibration) Signal Tuning and Output Level Adjustment (BLB-011219) MEP-411

Instruments required: * Spectrum analyzer
* Wattmeter
* Oscilloscope

① Signal tuning cannot be conducted with the system in the mounted state. Remove STD. OSC. block (MEP-411) from the main frame, and start adjustment in the convenient condition.

② Check signal at the INT. STD. output of the BLB-011570 board with the oscilloscope. A 5 MHz TTL-level signal waveform with a duty ratio of about 6:4 must be obtained.

③ Connect INT. STD. OUTPUT connector to the EXT. STD. INPUT connector, and remove shielding case cover from the STD. OSC. board.

④ While monitoring a 10 MHz signal using a probe on the R41 signal side with the spectrum analyzer, adjust C91 to maximize the 10 MHz signal.

⑤ Monitor signal similarly on the R46 signal side and adjust C78 to maximize the signal.

⑥ Mount shielding case cover and install the STD. OSC. block in the original location.

⑦ Connect wattmeter to 10 MHz CAL. output, and adjust STD output level with R56 of the STD. OSC. block (operable on the block front side to set output to -10 dBm ±0.3 dBm.

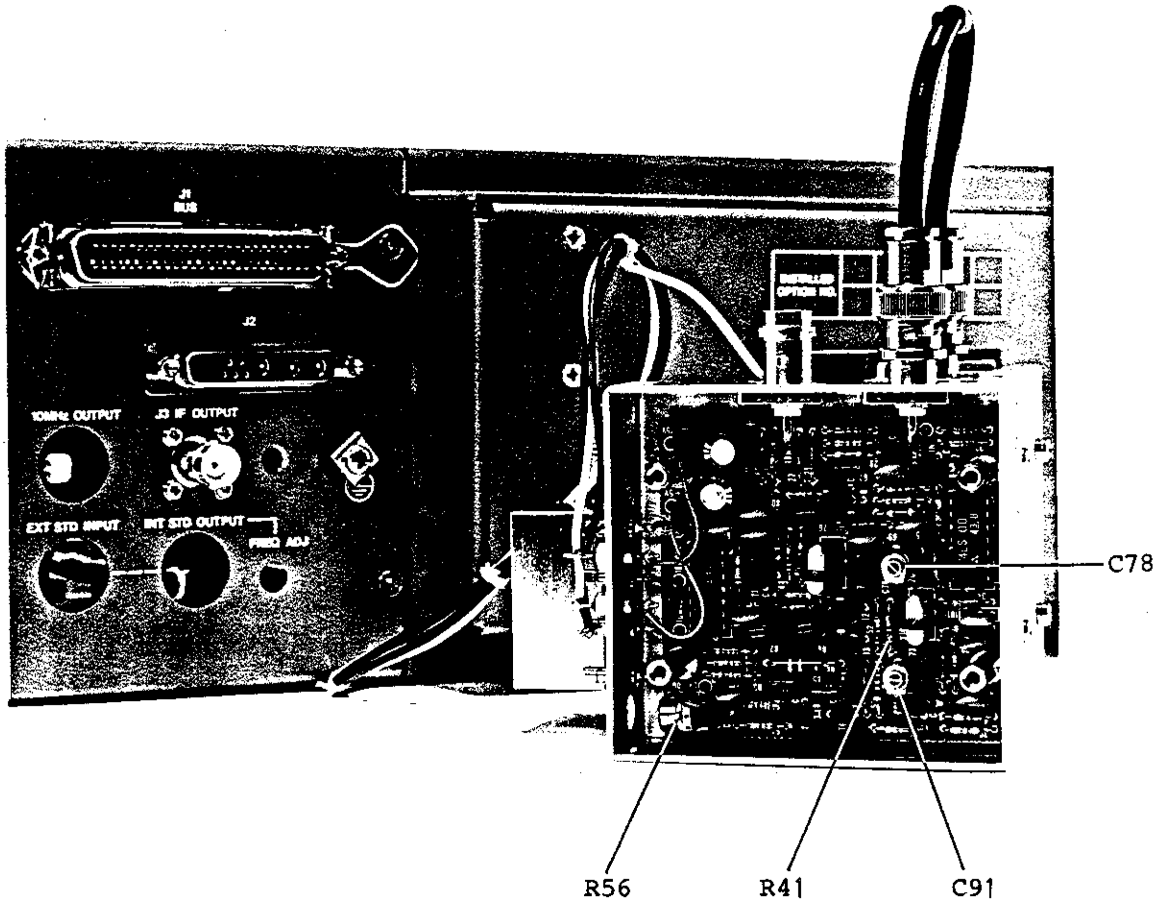


Fig. 11-37 10 MHz STD. output adjustment

11-5-3. RF INPUT Block Adjustment [BLP-011227 (INPUT-I) / BLO-011228 (INPUT-II)] MEP-404

Instruments required: * Network analyzer (or TR4172 + VSWR bridge)

① Before adjustment, remove RF INPUT block from the main frame and connect respective connecting points with cables for the adjustment to set the system to the mounted state.

② Set the measurement system to be adjusted as follows:

Center frequency: 60 MHz

Frequency span : 120 MHz

TG : ON

Display line : -10 dBm

Connect VSWR bridge as shown in Figure 11-38, and perform normalizing to correct the measurement system characteristics.

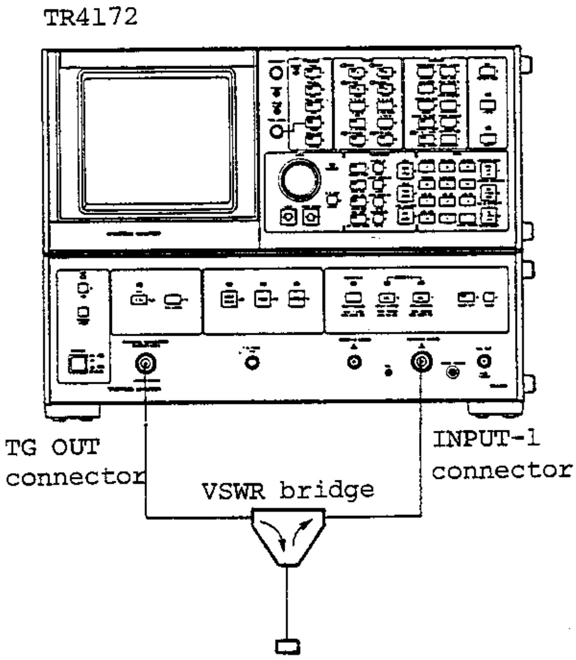


Fig. 11-38 I/O VSWR adjustment setup

③ Connect INPUT-1 input connector to the bridge and measure return loss.

Adjust C231, C315, L320, and L333 for the input impedance of 50 Ω, and adjust C232 and L321 for the input impedance of 75 Ω to obtain:

26 dB or greater: 10 Hz to 30 MHz

20 dB or greater: 30 MHz to 120 MHz

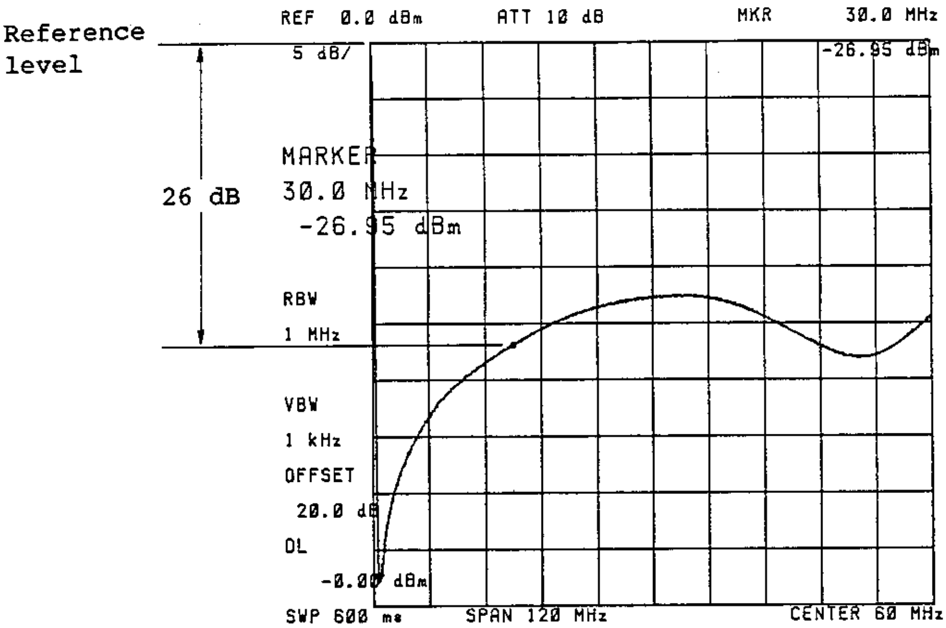
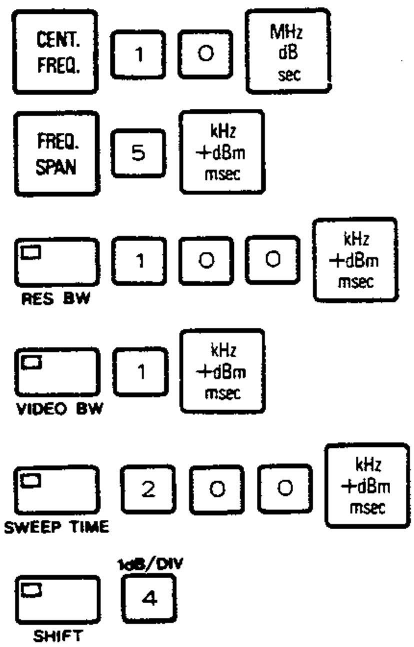


Fig. 11-39 Return loss measurement example

(2) Internal calibration signal adjustment

Connect CAL OUT signal (10 MHz, -10 dBm) to the INPUT-1 connector and set the TR4171 as follows:



Key in [A VIEW] [B WRITE], and store waveform level obtained at this time in A memory.

Press keys as follows:

[SHIFT] [LABEL] [Hz -dBm μsec] [ ] N [ ] M [7] [8] [5] [0] [ ] W [0] [1]

and adjust R60 so the waveform level displayed on the CRT screen becomes equal to the characteristics stored in A memory.

(3) Adjustment of INPUT-II input attenuator frequency characteristics and accuracy

Instruments required: 50 Ω through terminator

① Set the TR4171 as follows:

[CENT. FREQ.] [6] [0] [MHz dB sec]

[FREQ. SPAN] [1] [2] [0] [MHz dB sec]

[LEVEL] [1] [0] [Hz -dBm μsec]

[INPUT ATT] [0] [MHz dB sec]

[1MΩ]

[SHIFT] [4 (1dB/DIV)]

[REF. LEVEL] [5] [Hz -dBm μsec]

Connect INPUT-2 and the TG-OUT connectors via a 50 Ω terminator.

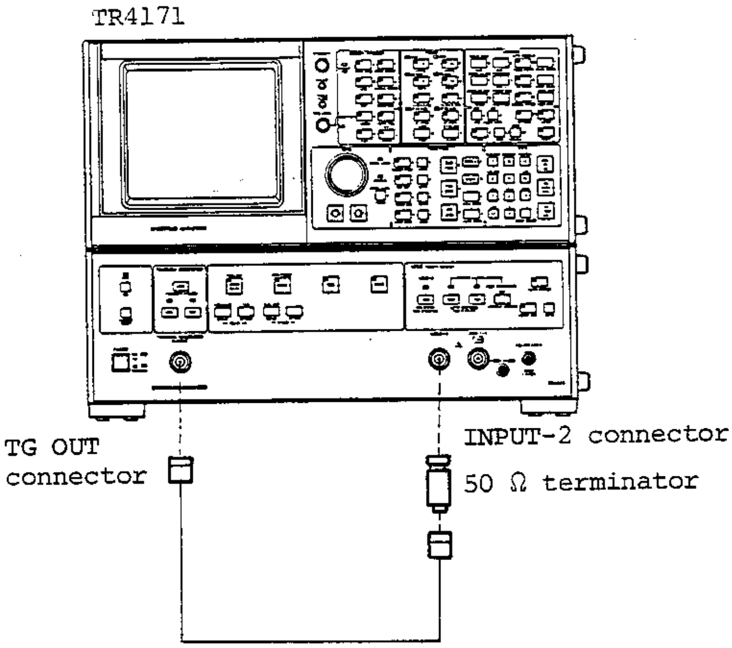
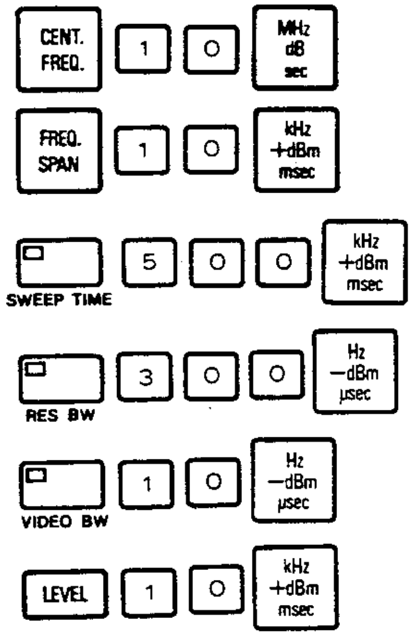


Fig. 11-40 INPUT-II input attenuator adjustment setup

Press [A / VIEW] key to store the frequency characteristics obtained at this time in A memory. While changing the input attenuator setting to 5 dB, 10 dB, 20 dB, and 30 dB, adjust the following trimmer controls so the obtained waveforms become similar to those stored in A memory.

5 dB	C115
10 dB	C122
20 dB	C130
30 dB	C137

② Next, change the TR4171 panel settings as follows:



Press [A] (VIEW) key to feeze the waveform. While changing the input attenuator setting to 5 dB, 10 dB, 20 dB, and 30 dB, adjust the following trimmers so the changeover accuracy is set within ±0.2 dB when the center frequency is 10 MHz.

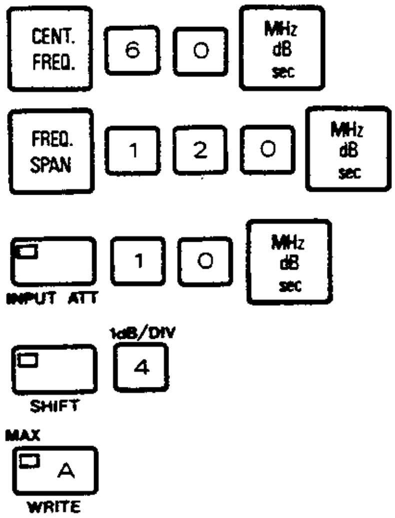
5 dB	C116
10 dB	C124
20 dB	C132
30 dB	C139

(4) Input frequency characteristics adjustment

Instruments required: Signal generator

a. 50 Ω INPUT-I adjustment

Set the TR4171 as follows:



Adjust the TR4171 INPUT-I frequency characteristics within the range 10 Hz to 120 MHz using the signal generator subjected to level calibration. Adjust C285 (BLP-011227) and C179 (BLP-011228) so the characteristic value is within ±0.7 dB in reference to the value developed for a frequency of 10 MHz.

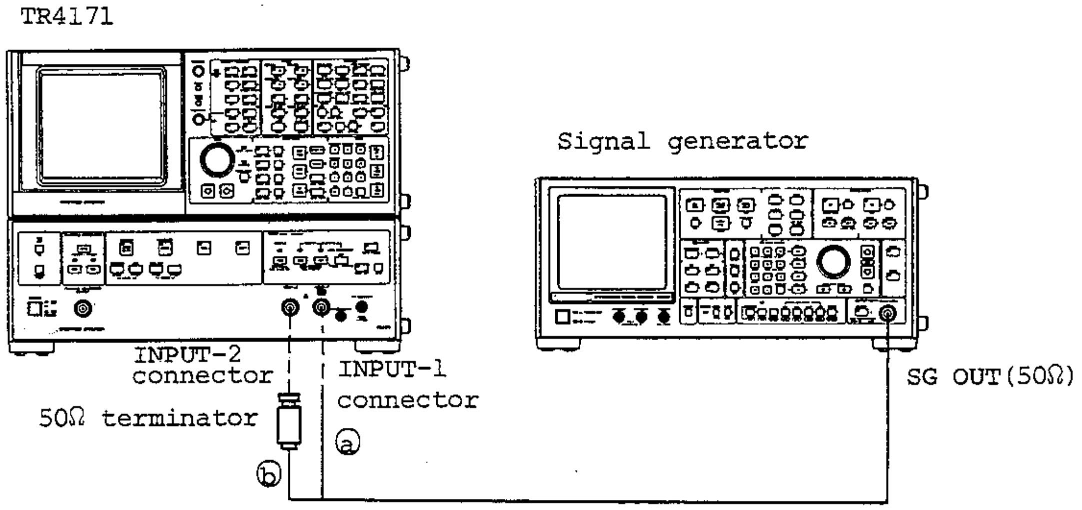


Fig. 11-41 Input frequency characteristics adjustment setup

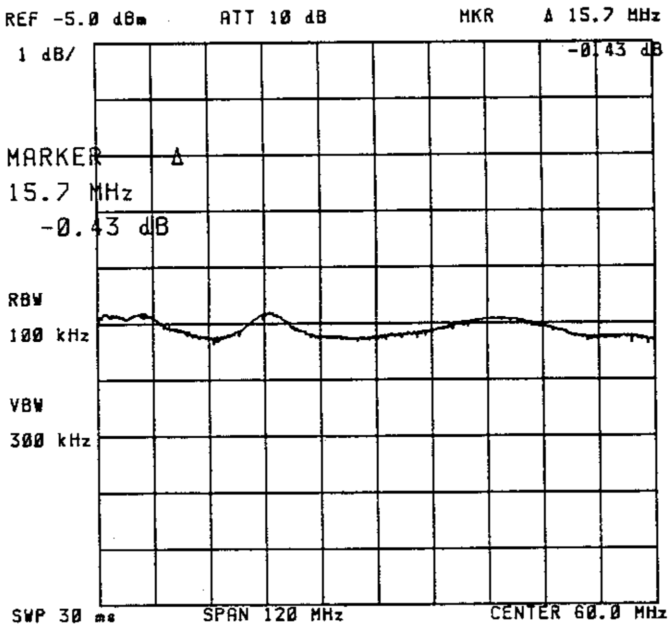


Fig. 11-42 Input frequency characteristics measurement example

b. 1 MΩ INPUT-II adjustment

Adjust C146 (BLP-011228) to obtain the desired value of the INPUT-II frequency characteristics the same way as for item (a) described above.

(Use a 50 Ω through terminator for the 1 MΩ input terminal.)

(5) Auto-range frequency characteristics and sensitivity adjustment

Instruments required: * Spectrum analyzer (with tracking generator)
* FET probe

① Set the equipment as illustrated in Figure 11-43.

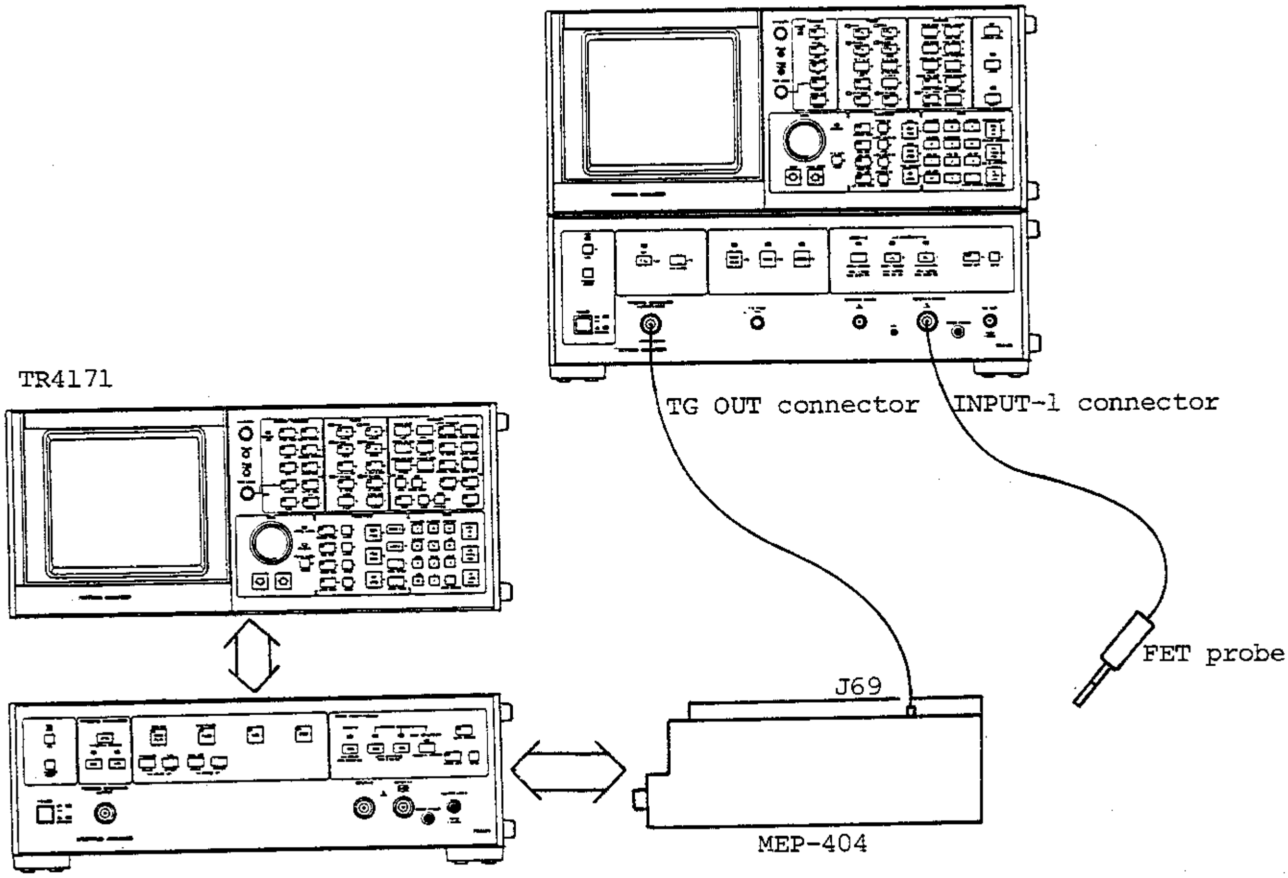
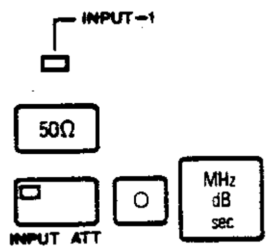


Fig. 11-43 Auto-range adjustment setup

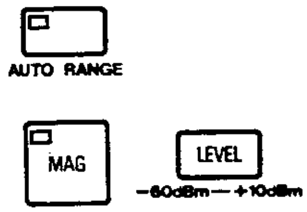
Set the TR4171 as follows:



Monitor R176 signal line using the FET probe. Adjust C297, C298, and L332 (INPUT-I) so the Auto-range circuit frequency characteristics is obtained as 2.0 dB_{p-p}. Also make sure the circuit gain is in the range 35 dB to 37 dB.

② Next, press [A / VIEW] key to store the frequency characteristics for 50 Ω input. Change input setting to INPUT-2 by pressing [1MΩ] key. Adjust R69 (INPUT-II) so the same characteristics is obtained. Do not forget to end the INPUT-2 connector with a 50 Ω through terminator.

③ Connect INPUT-1 connector to the TG OUTPUT connector, press [50Ω] key, and use data knob to change the TG output level.

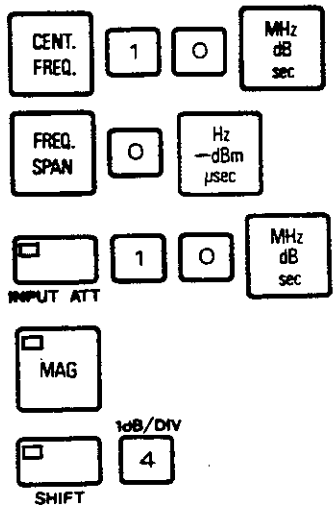


Adjust as described in the right columns for the setting conditions in the left columns.

TG LEVEL -29 dBm	INPUT ATT 5 dB	Adjust R184.
TG LEVEL -32 dBm	ATT 0 dB	Adjust R189 (INPUT-I)
TG LEVEL -37 dBm		Make sure "OUT OF RANGE" is displayed for 0 dB ATT level.

(6) Adjustment of level difference between INPUT-I and INPUT-II

Set the TR4171 as follows:



Connect TG OUT and INPUT-1 connectors and press [A (VIEW)] key to freeze the waveform. Connect INPUT-2 and TG OUT connectors via a 50 Ω through terminator, and adjust R63 (INPUT-II) so the INPUT-I and INPUT-II levels are equal to each other when the center frequency is 10 MHz.

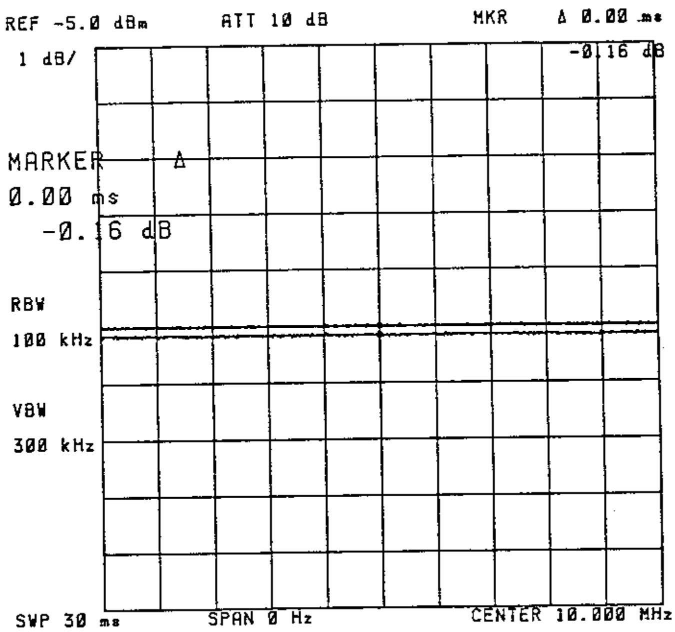
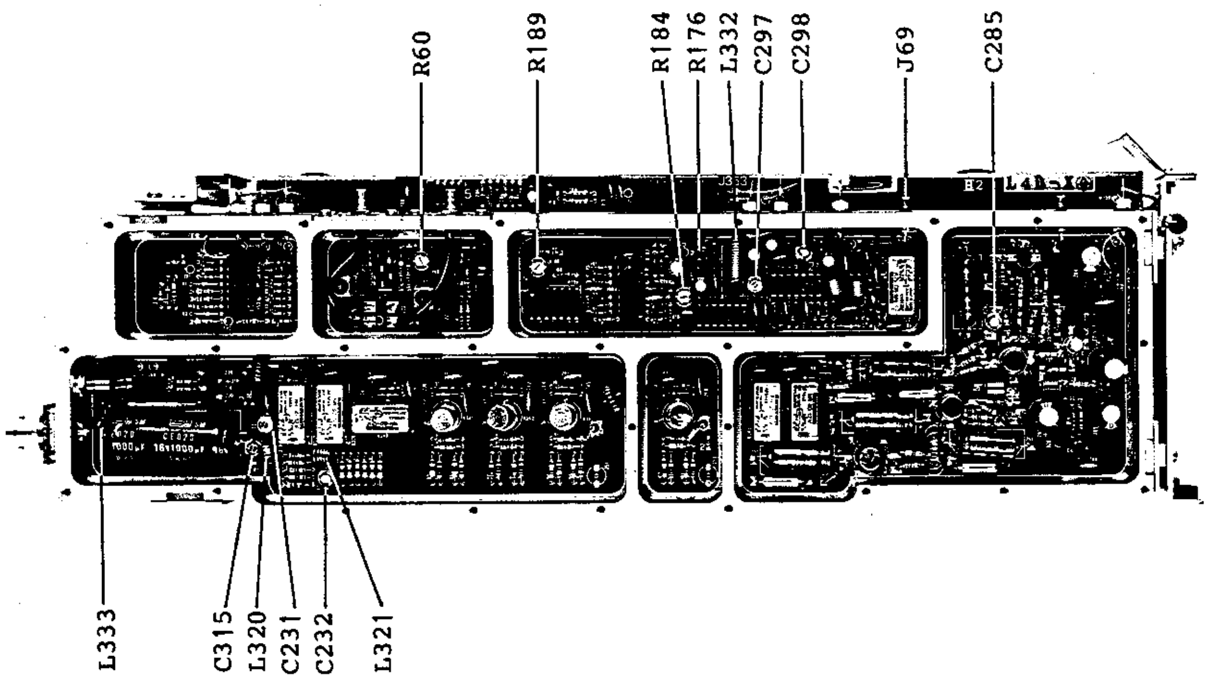
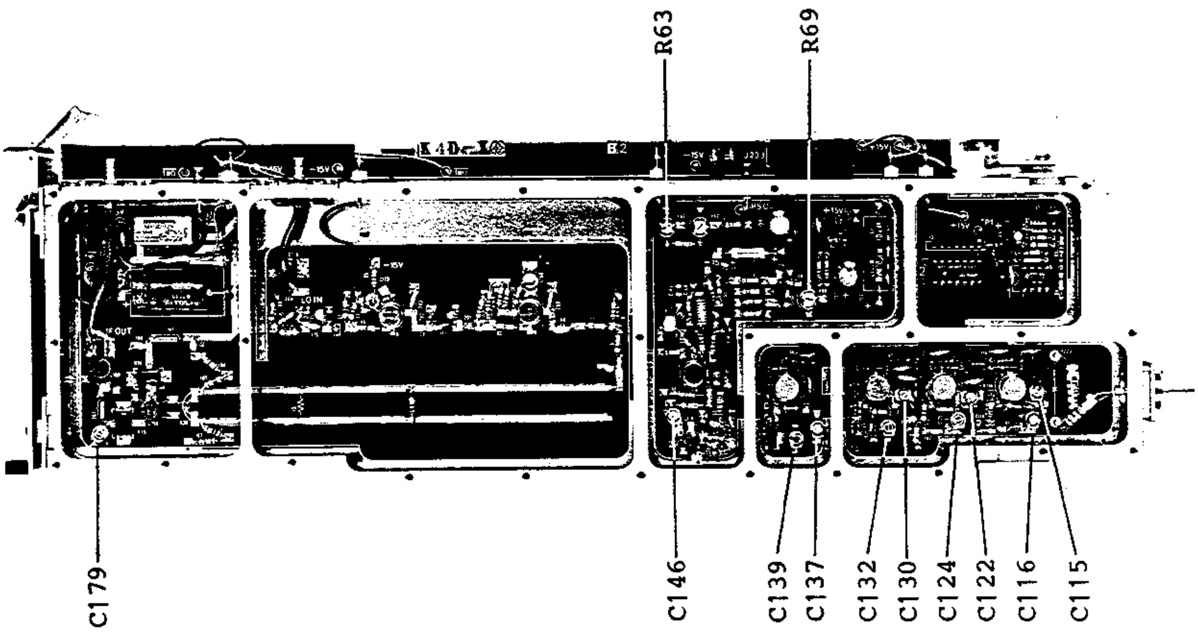


Fig. 11-44 Measurement example for input level adjustment



(a) INPUT-I (BLP-011227)



(b) INPUT-II (BLP-011228)

Fig. 11-45 RF INPUT block (MEP-404) adjustment locations

11-5-4. RF Block (MEP-405) Adjustment

Instruments required: * Spectrum analyzer (with tracking generator)
* Signal generator
* External ATT (10/1 dB step)

(1) REF ATT adjustment (BGJ-011248)

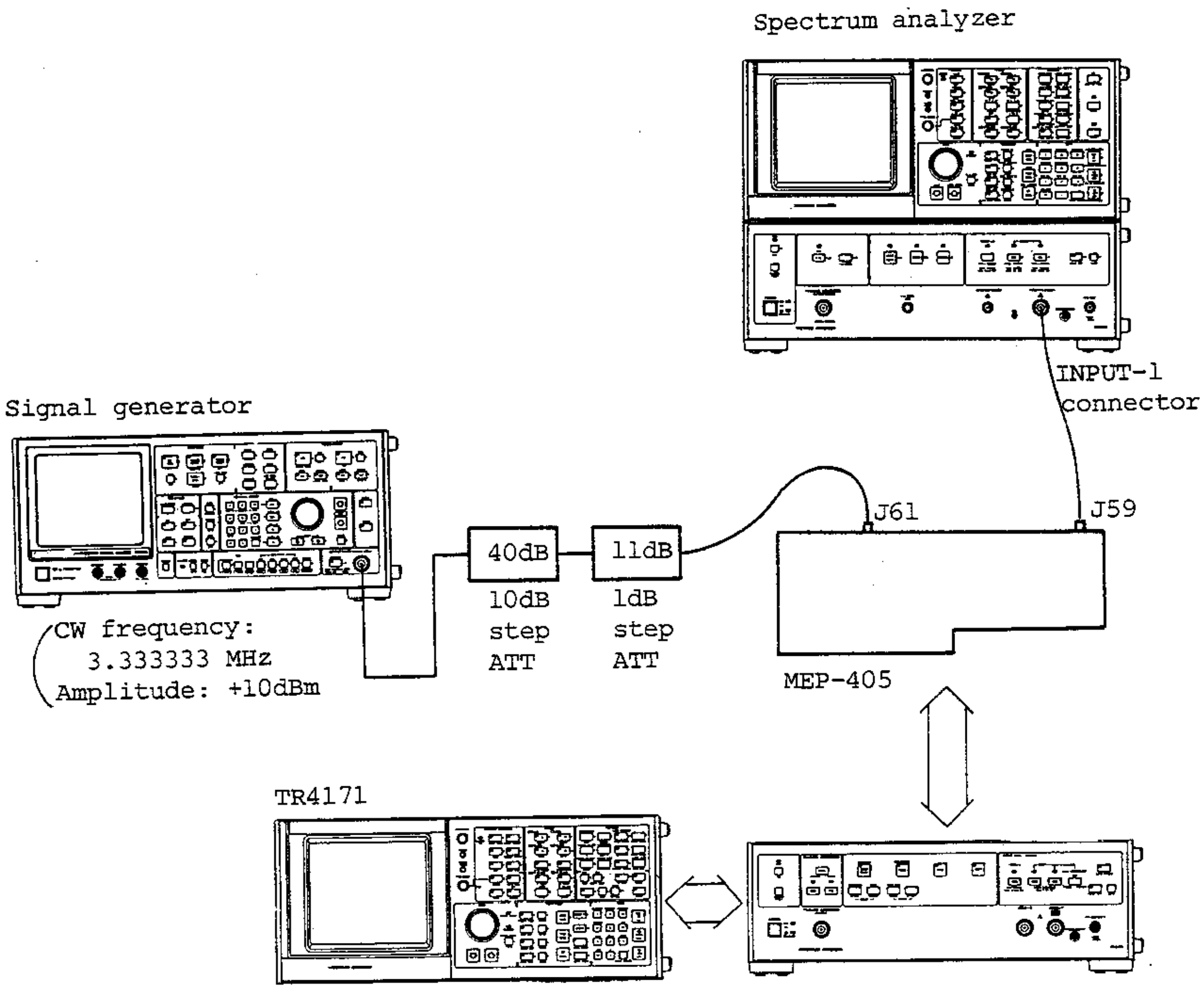


Fig. 11-46 REF attenuator adjustment setup

① Connect the equipment as shown in Figure 11-46. Set external spectrum analyzer as follows:

Center frequency	: 3.333333 MHz
Frequency span	: 200 Hz
Resolntion bandwidth	: 300 Hz
Video bandwidth	: 300 Hz
Sweep time	: 200 ms
Input attenuator	: 10 dB
Graticule scale	: 0.1 dB/div.
Reference level	: Adjust so the spectrum peak is located at the CRT display center.

② Set the TR4171 as follows:

Keys	
[SHIFT] [LABEL] [Hz/−dBm/µsec] [N]	"<BUG 72> COMMAND SUMMARY" is displayed.
[M]	<BUG 72>
[7] [8] [5] [2]	Input an address.
[W]	
[0] [2]	Input data to address at 7852.

③ Change address to be "7853" using the data knob. Input data corresponding to the ATT settings using numerical keys.

Table 11-6 REF ATT adjustment

TR4171	10 dB step	1 dB step	VR
00	40	11	Reference value → A VIEW
01	40	10	R63
02	40	9	R70
04	40	7	R77
08	40	3	R84
10	30	11	R93
20	20	11	R102
40	10	11	R111
80	10	11	R120

Change ATT setting as listed in Table 11-6 and change data. Adjust respective controls so the level of the spectrum analyzer matches the reference value. The ATT used must have been subjected to the calibration at 0.01 dB level and to correction with the calibration data.

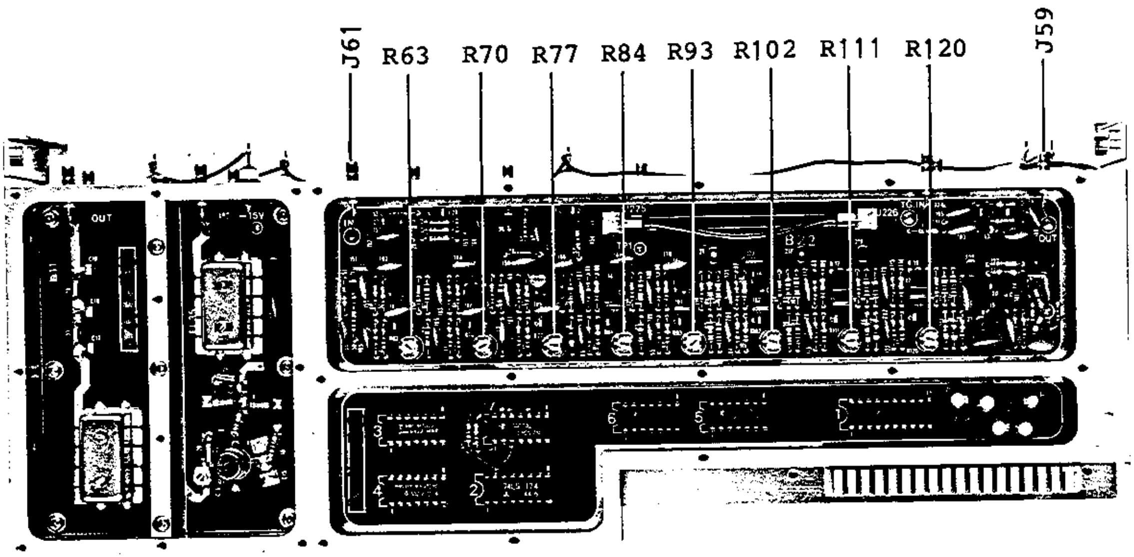


Fig. 11-47 Adjustment locations on BGJ-011248 board

(2) First IF adjustment (BLB-011245)

Spectrum analyzer

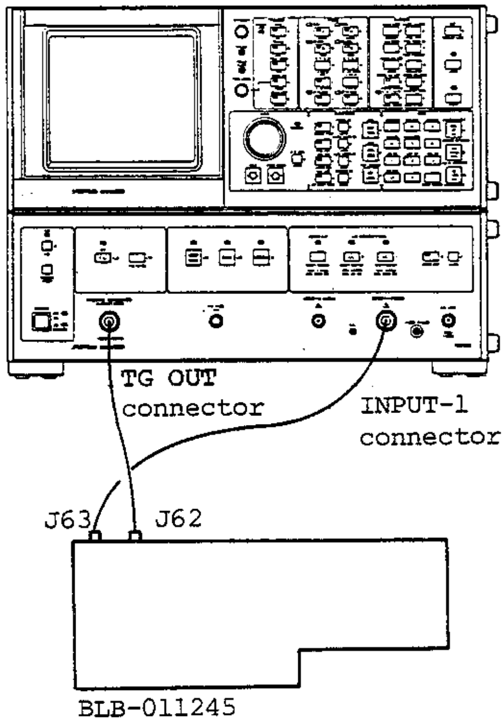


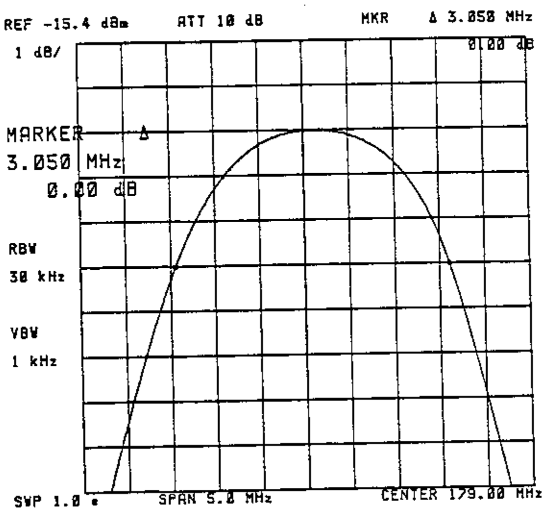
Fig. 11-48 First IF adjustment setup

Set up the system as shown in Figure 11-48. Then adjust C16, FL35, and FL36 so a -37 dB decrease is obtained for 179 +6.6 MHz under the following conditions:

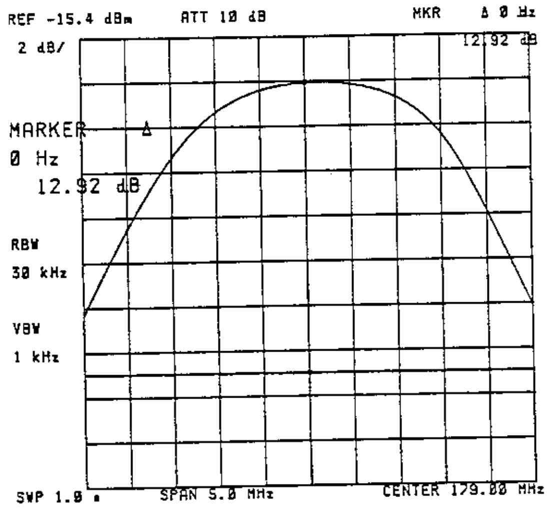
Center frequency: 179 MHz

3 dB width : 3 MHz ±0.5 MHz

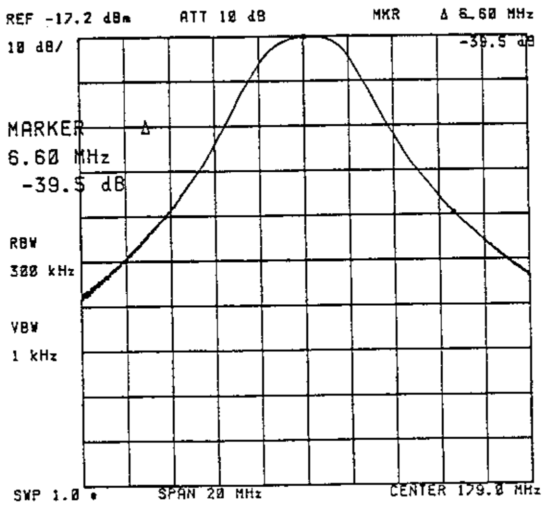
Gain : 13.5 dB ±1.0 dB



(a) 3 dB bandwidth



(b) Gain



(c) +6.6 MHz

Fig. 11-49 First IF characteristics measurement example

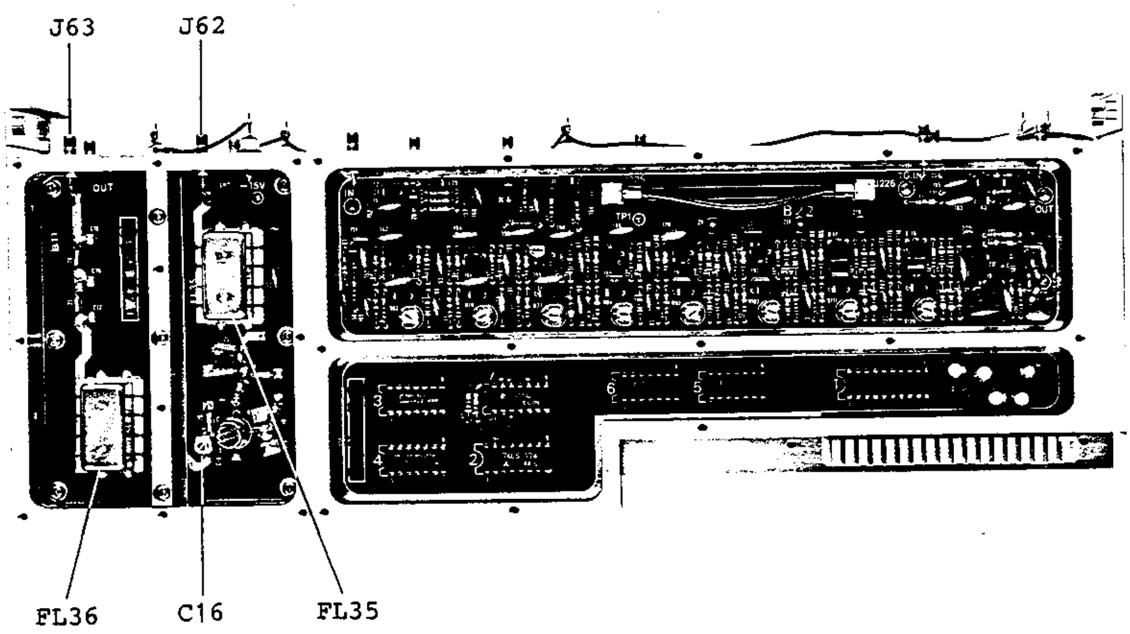


Fig. 11-50 First IF board (BLB-011245) adjustment locations

(3) Second IF adjustment (BLB-011246)

a. Second local level adjustment

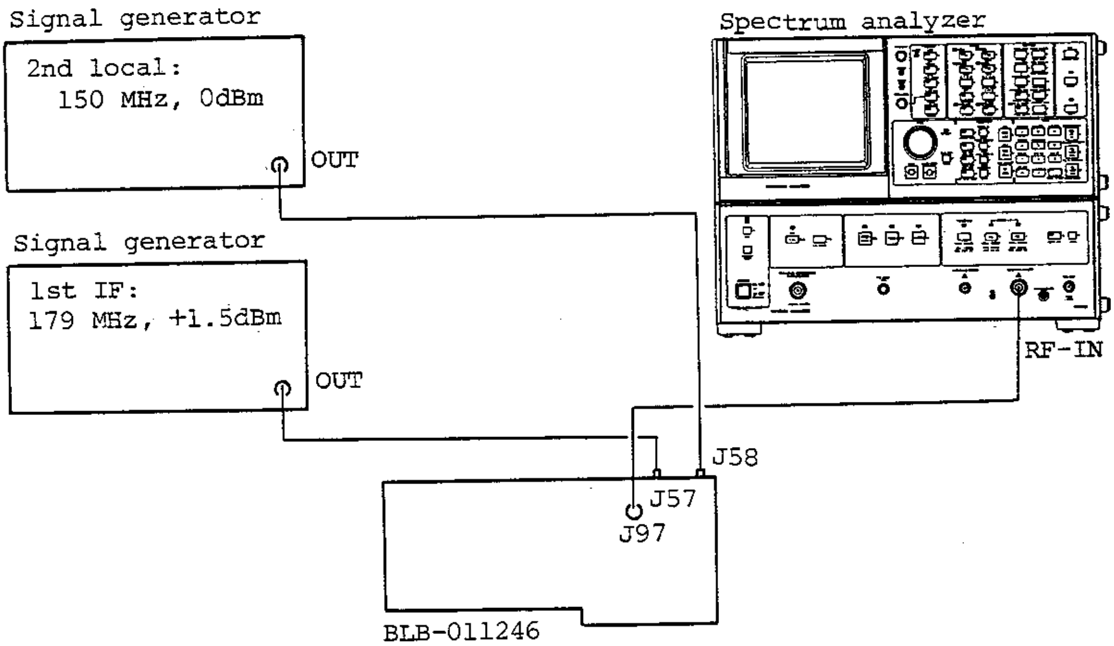


Fig. 11-51 Second local level adjustment setup

Input the following signals from the signal generator:

Second local: 150 MHz, 0 dBm

First IF : 179 MHz, +1.5 dBm

Monitor J97 with the external spectrum analyzer, and adjust C46 so the 150 MHz signal becomes maximum.

b. Second IF filter adjustment

Set the external spectrum analyzer as follows:

Center frequency : 29 MHz

Frequency span : 2 MHz

Resolution bandwidth: 30 kHz

Graticule scale : 1 dB/div.

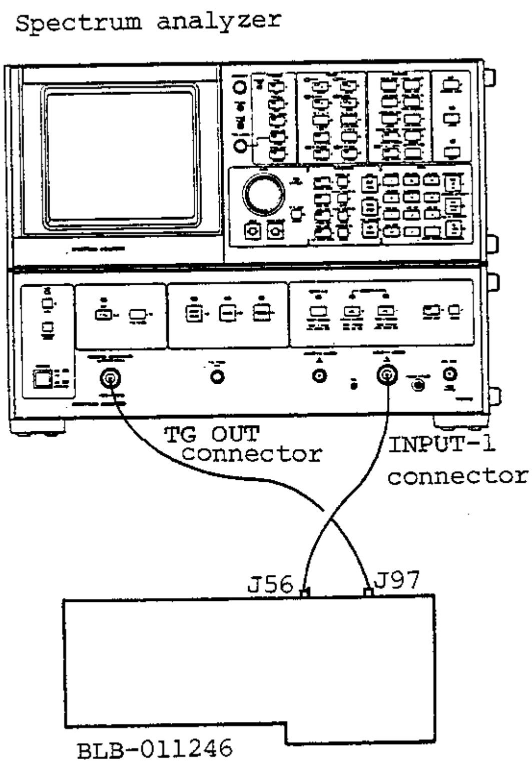


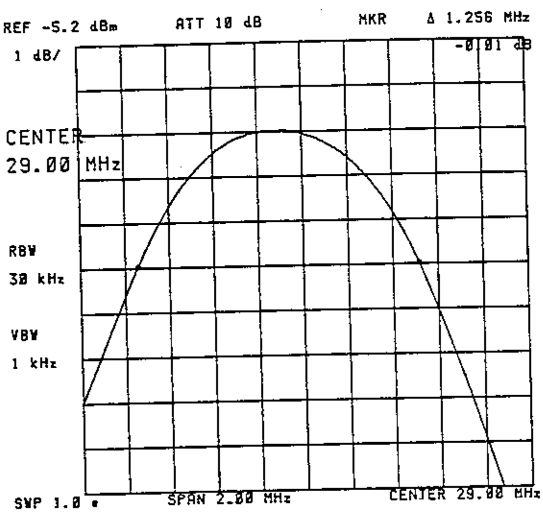
Fig. 11-52 Second IF filter adjustment setup

Adjust C58, C60, C68, and C70 so the following conditions are obtained:

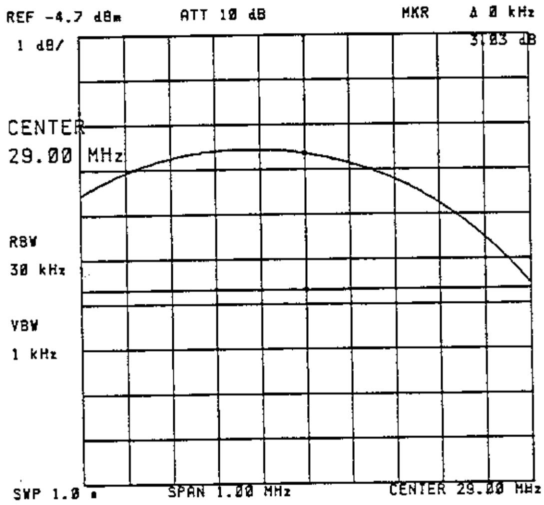
3 dB bandwidth : 1.3 MHz ±0.1 MHz

29 MHz ±100 kHz: 1 dB or less.

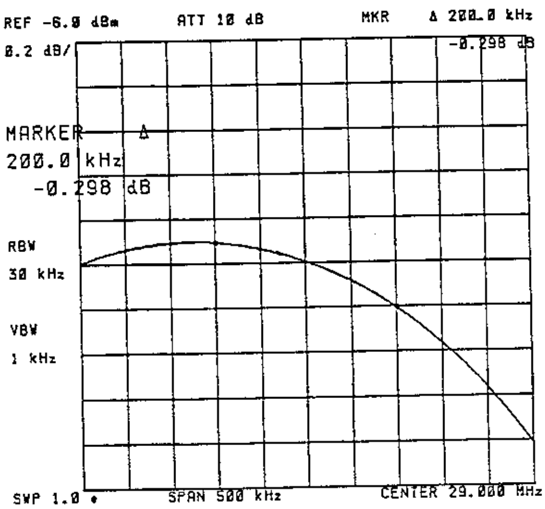
Gain : 2 dB min.



(a) 3 dB bandwidth



(b) Gain



(c) ±100 kHz

Fig. 11-53 Second IF filter characteristics example

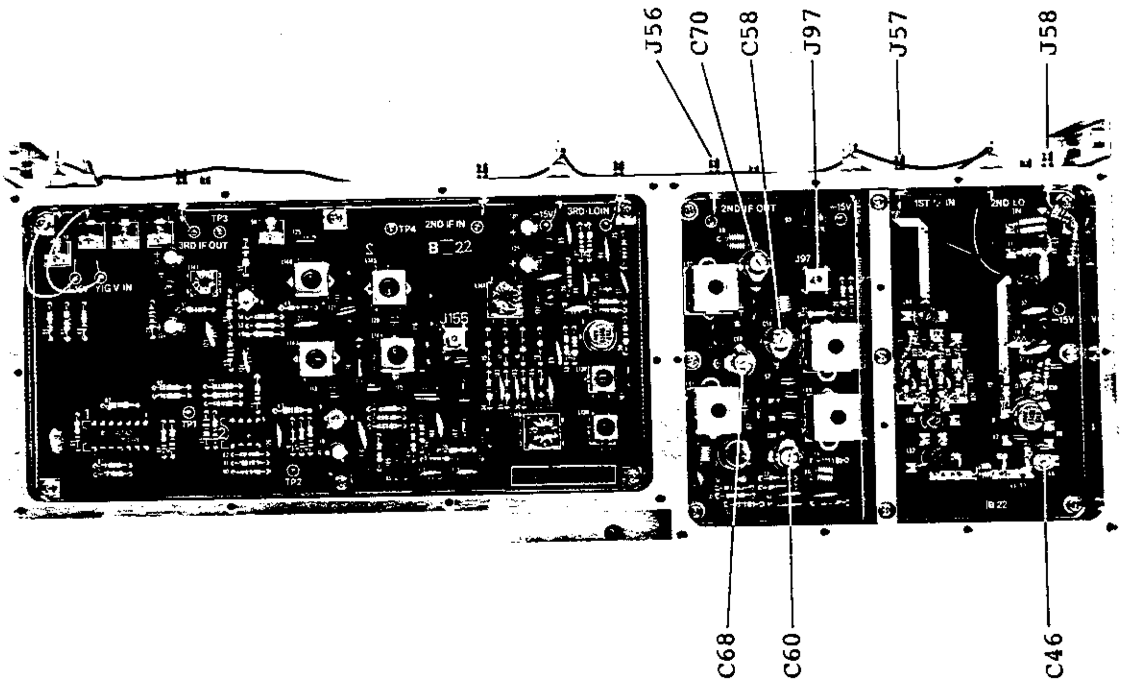


Fig. 11-54 Adjustment locations on second IF board (BLB-011246)

(4) Third IF adjustment (BLF-011247)

a. Third local level adjustment

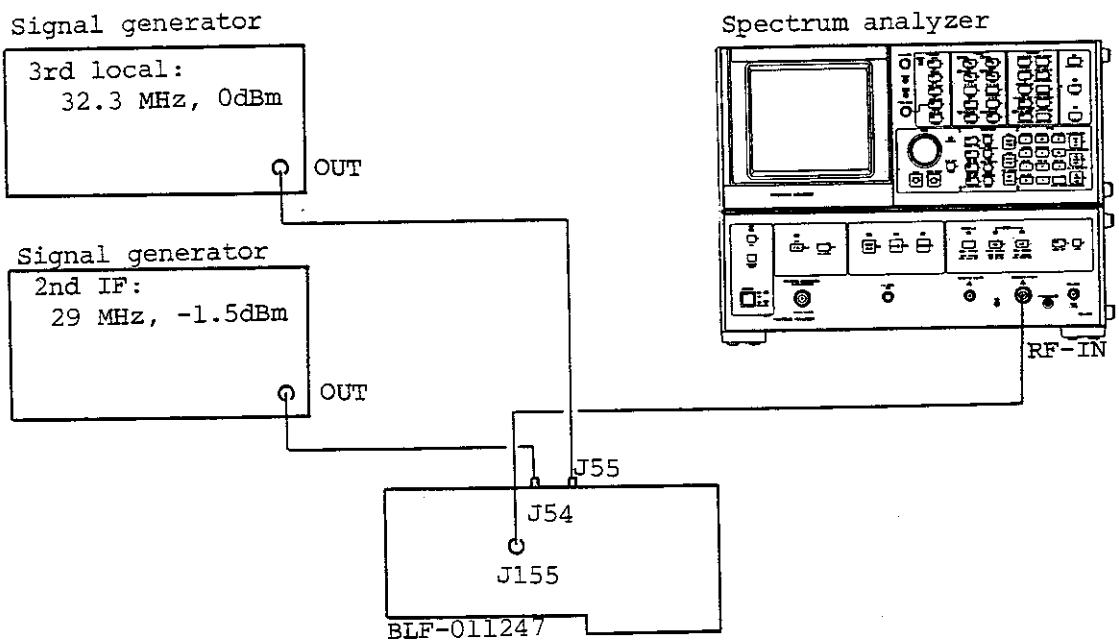


Fig. 11-55 Third local level adjustment setup

Input the following signals from the signal generator, monitor J155 with the external spectrum analyzer, and adjust L138 so the 32.3 MHz signal becomes maximum:

Third local: 32.3 MHz, 0 dBm

Second IF : 29 MHz, -1.5 dBm

b. Third IF filter adjustment

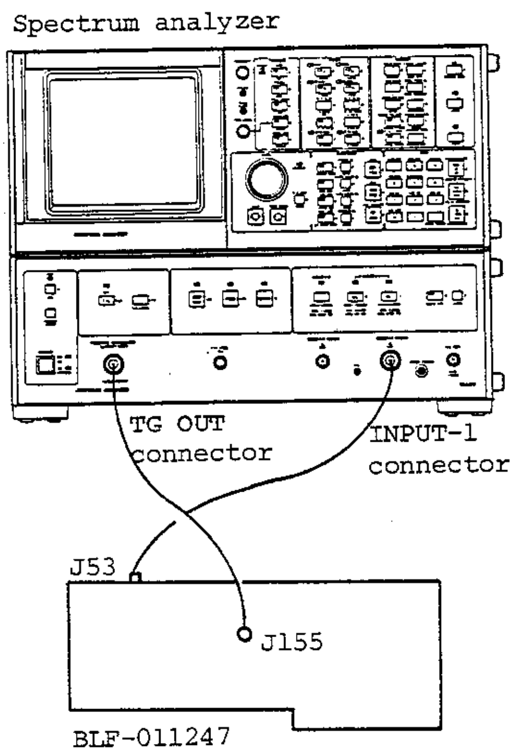


Fig. 11-56 Third IF filter adjustment setup

Set the external spectrum analyzer as follows:

Center frequency: 3.3333 MHz

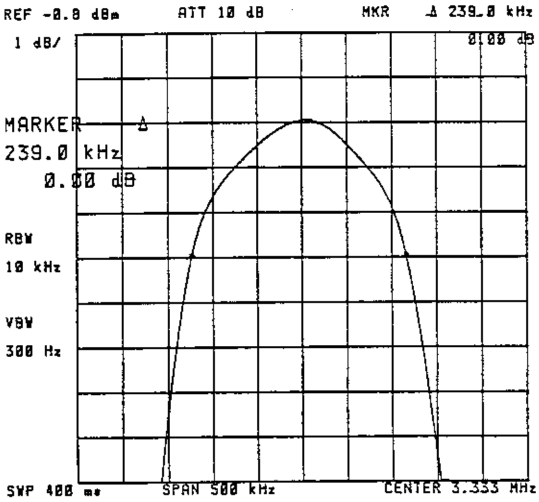
Frequency span : 500 kHz

Graticule scale : 1 dB/div.

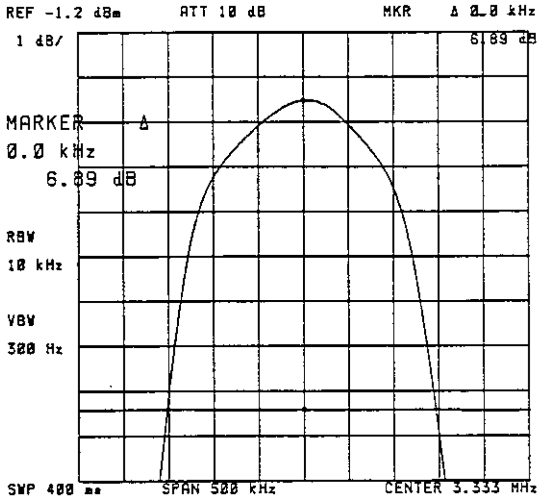
Adjust L143, L144, L145, and L146 so a change of -80 dB or greater is obtained when the 3.333333 MHz signal is decreased by 910 kHz under the following conditions:

3 dB bandwidth: 240 kHz ±100 kHz

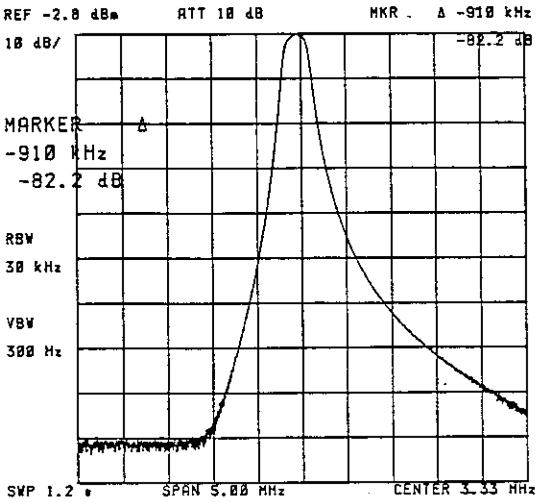
Gain : 6 dB or greater



(a) 3 dB bandwidth



(b) Gain



(c) -910 kHz

Fig. 11-57 Third IF filter characteristics example

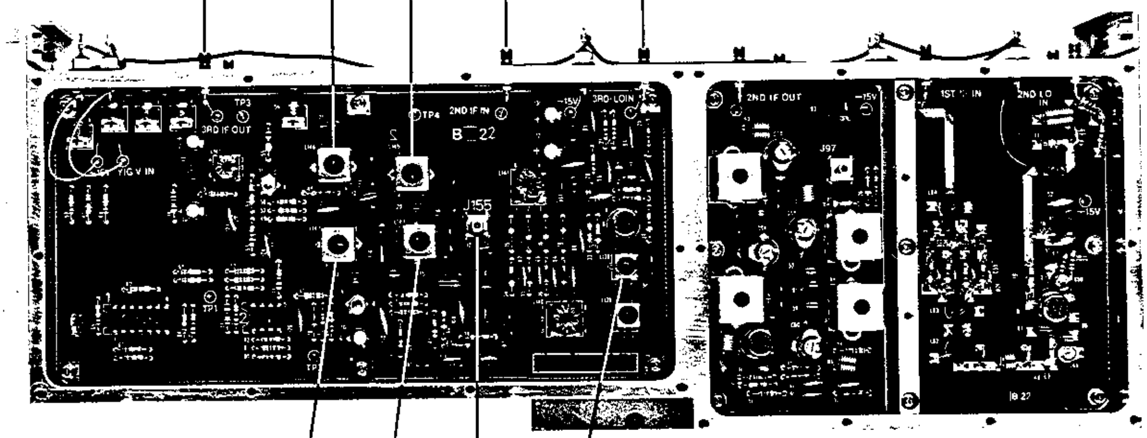


Fig. 11-58 Adjustment locations on third IF board (BLF-011247)

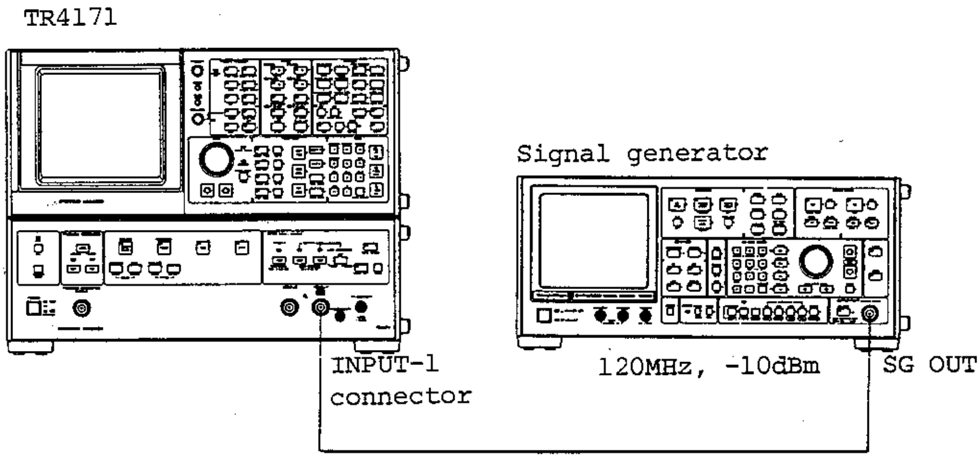
11-5-5. Local Driver Board (BGN-011225) Adjustment

Instruments required: * Digital voltmeter
* Marker generator

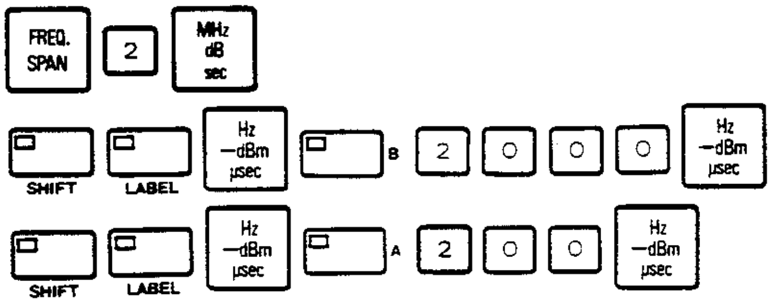
(1) +10 V power voltage adjustment
Adjust R86 to set the voltage between TP2 and GND to +10 V ±1 mV.

(2) -5 V power voltage adjustment
Adjust R120 to set the voltage between TP14 and GND to -5 V ±1 mV.

(3) Main Tune adjustment



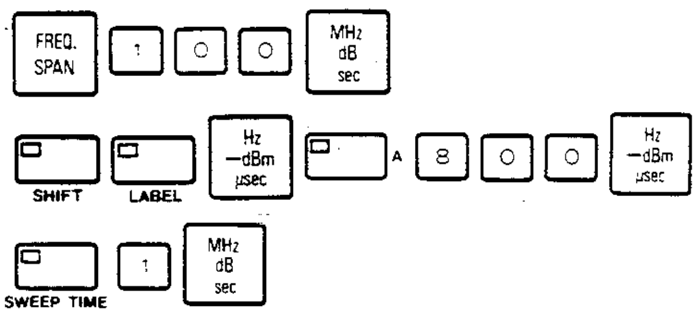
Input 120 MHz signal (-10 dBm) from the signal generator to INPUT-1 connector. Set the TR4171 as follows:



Adjust R92 so the 0 MHz (feedthrough) signal is located at the CRT display center. Key in [1] [4] [0] [0] [Hz −dBm μsec]. Adjust R61 so the 120 MHz signal is located at the CRT display center. Repeat R92 and R61 adjustment operations several times to set frequency equal to or less than 200 kHz.

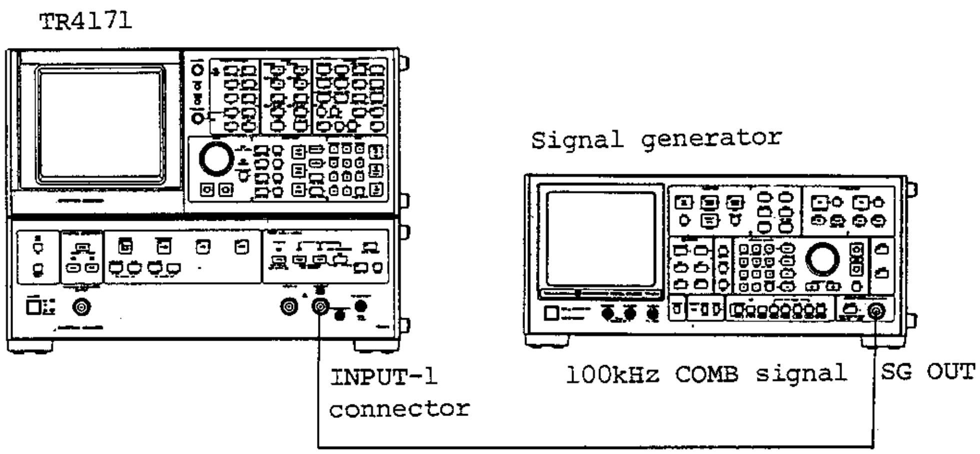
(4) Main Sweep adjustment

Connect calibration signal to the INPUT-1 connector. Set the TR4171 as follows:



Key in [SHIFT] [LABEL] [Hz/−dBm/μsec] [ ]B . While moving the spectrum with the data knob, adjust SPAN GAIN control (R104) so the 10 MHz COMB signal matches the graticule interval on the CRT display.

(5) Sweep FM adjustment



Input 100 kHz COMB signal. Key in as follows:

[FREQ. SPAN] [1] [MHz/dB/sec]

[SHIFT] [LABEL] [Hz/−dBm/μsec] [ ]C

Adjust data knob so the COMB signal with an 100 kHz interval matches the center graticule on the CRT display. Adjust R142 so the signal matches the graticule scale.

(6) Tuning FM adjustment

① Input 10 MHz calibration signal to INPUT-1 connector and set the TR4171 as follows:

[CENT. FREQ.] [1] [0] [MHz dB sec]

[FREQ. SPAN] [1] [MHz dB sec]

[SHIFT] [LABEL] [5]

[SHIFT] [LABEL] [Hz −dBm μsec] [B] [0] [Hz −dBm μsec]

[SHIFT] [LABEL] [Hz −dBm μsec] [A]

Key in [SHIFT] [LABEL] [Hz −dBm μsec] [A] , and adjust the data knob so the 10 MHz spectrum appears in the neighborhood of the graticule in the left-hand side on the CRT display.

Key in [SHIFT] [LABEL] [Hz −dBm μsec] [C] , and adjust the data knob to match the signal with the graticule scale.

Next, key in as follows to shift the spectrum by 800 kHz.

[SHIFT] [LABEL] [Hz −dBm μsec] [B] [4] [0] [0] [0] [Hz −dBm μsec]

Adjust R127 so the signal matches the graticule in the right-hand side on the CRT display. Repeat this procedure several times to obtain 800 kHz for data input ranging from zero to 4000.

(7) Third local tuning adjustment

Set the TR4171 as follows:

[FREQ. SPAN] [1] [MHz dB sec]

[SHIFT] [LABEL] [5]

[SHIFT] [LABEL] [Hz −dBm μsec] [C]

[3] [1] [2] [5] [Hz −dBm μsec]

Adjust R82 so TP7 is 10 V ±1 mV.

Confirm simultaneously the potential on TP8 is 10 V ±50 mV.

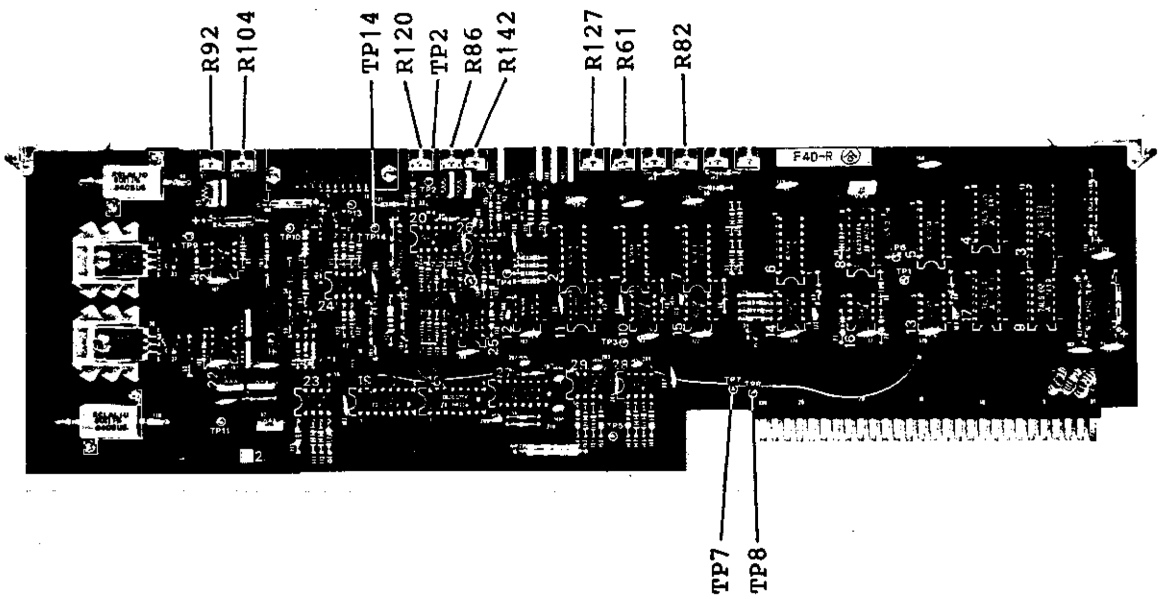


Fig. 11-59 Adjustment locations on Local Driver board (BGN-011225)

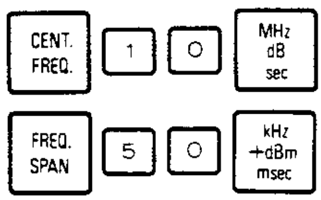
11-5-6. Local Block (MEP-406) Adjustment

Instruments required: * DC voltage standard
* Oscilloscope
* Spectrum analyzer
* Digital voltmeter

(1) 100/101 MHz OSC adjustment (BLC-011282)

① Remove the First Local block from the main frame. Set the POWER switch to STANDBY. Remove jumper wire disposed in the TP5 vicinity and connect to an output from the DC voltage generator. Set output voltage to 10 V.

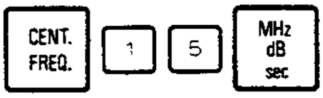
② Turn the power on and set the TR4171 as follows.



Then, the 100 MHz oscillator starts.

③ Adjust C123 and C129 so a 100 MHz signal is output to J46 with a level equal to or greater than +7 dBm.

④ Similarly, remove jumper wire disposed in the TP6 neighborhood and apply 10 V from the DC voltage generator. See the TR4171 as follows.



⑤ Adjust C132 and C138 so 101 MHz signal is output to J46.

⑥ Restore these two jumper wires to the original state as described in step 2 above. Monitor TP7 with the oscilloscope. Adjust L156, L157, C103, and C105 to maximize the output signal. Make sure the output signal develops a maximum equal to or greater than 2 V_{p-p} for 100/101 MHz (the frequency is 5 MHz and 4 MHz).

⑦ While measuring the voltages at TP5 and TP6, adjust C129 and C138 to obtain 10 V ±0.5 V.

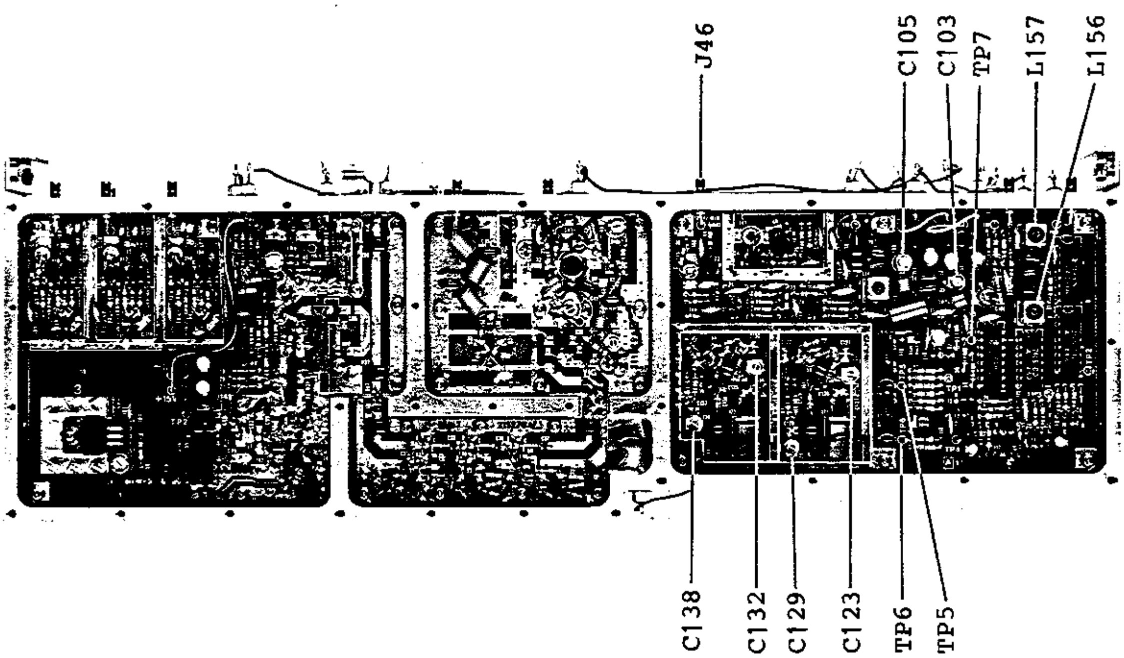


Fig. 11-60 Adjustment locations on 100M/101M OSC board (BLC-011282)

(2) YIG IF adjustment (BLB-011279)

① Connect YTO to the First Local block (J49) and J47-46. Monitor J48 (YIG IF OUT) with the external spectrum analyzer.

② Set the TR4171 as follows:

[CENT. FREQ.] [1] [0] [MHz dB sec] (for 100 MHz)

[FREQ. SPAN] [1] [2] [0] [MHz dB sec]

[ ] SWEEP TIME [5] [0] [Hz −dBm μsec]

Adjust C46, C38, and R19 so the IF output signal in the range 6 MHz to 44 MHz is output in accordance with the TR4171 sweep operation with a level not below -30 dBm in the sweep bandwidth.

③ Change the TR4171 setting as [CENT. FREQ.] [1] [5] [MHz dB sec] (for 101 MHz), and confirm the same result obtained in step ② above.

(3) YIG divider adjustment (BLC-011281)

① Divider bias

Adjust R57 to set the voltage between Q3 and Q2 to -6.8 V.

② Adjustment of offset and tunnel diode gain

Input 120 MHz signal to the TR4171 from the signal generator, and adjust gain and offset using R46 and R48.

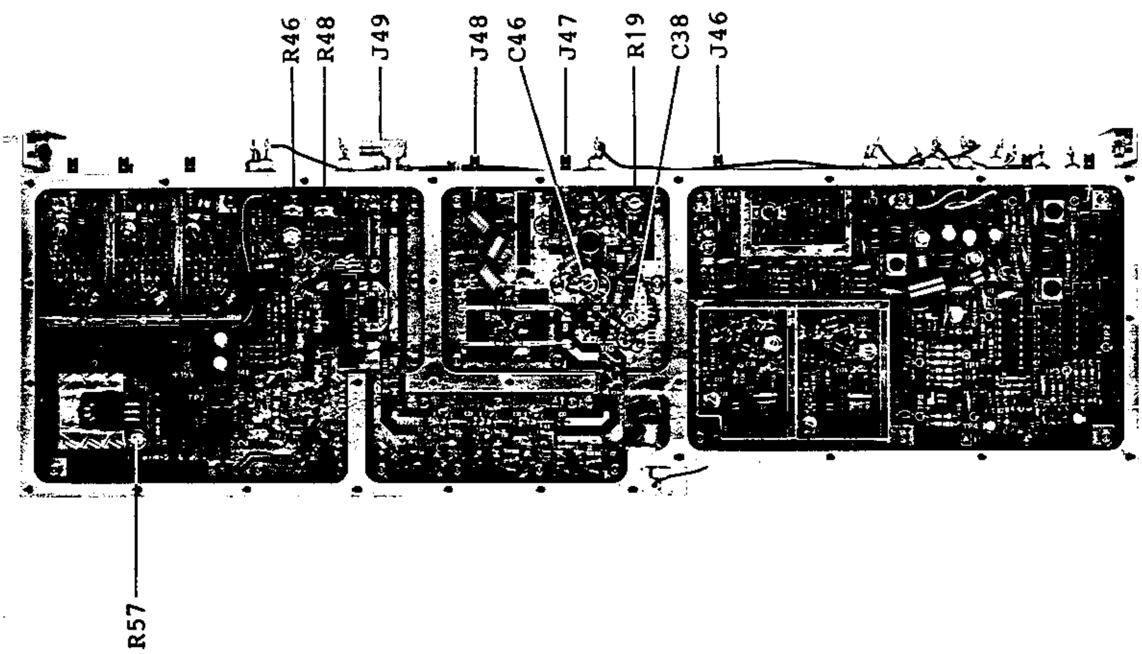


Fig. 11-61 Adjustment locations on YIG IF board (BLB-011279) and YIG divider board (BCL-011281)

11-5-7. Second/third Local Block (MEP-407) Adjustment

Instruments required: * Spectrum analyzer (with tracking generator)
* Frequency counter

Remove the Second/third Local block from the TR4171 and connect power and control lines using extension cables. The signal cables must be connected in the mounted state.

(1) Second local block adjustment (BLN-011224)

① Change J385 insertion setting and connect J384 to the external spectrum analyzer. Multiply 10 MHz signal from the STD. OSC. block, and adjust C206, C208, and C214 to maximize the output level of the 30 MHz output signal.

② To adjust the X376 crystal filter symmetry, remove plated J36 jumper wire, remove C210 on the coil side, and connect J36.

Input a signal from J36. While checking the characteristics between J36 and J384 with the spectrum analyzer having an tracking generator, adjust C216 so the waveform becomes symmetric with respect to the 30 MHz center.

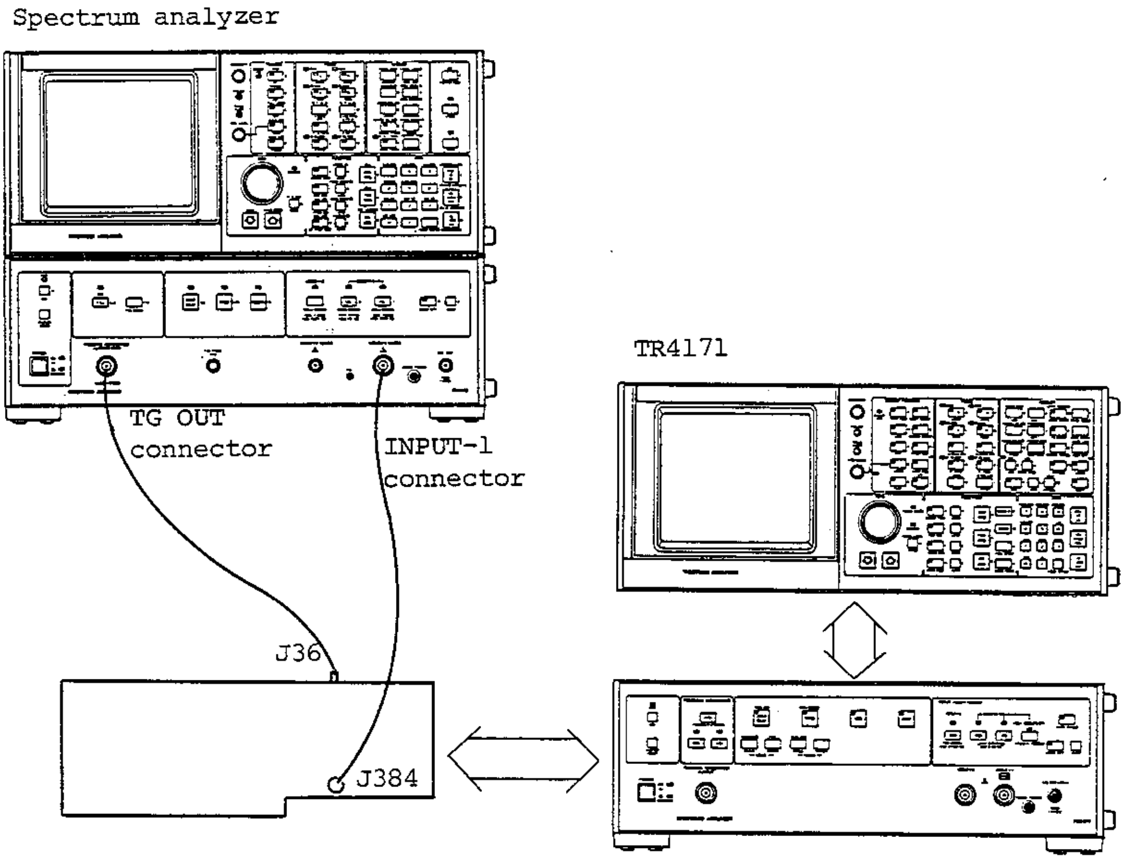


Fig. 11-62 Second local block adjustment setup

③ Restore connections of J36 plated wire and C210. Confirm the output level of the 30 MHz signal is at least +8 dBm at J384.

④ Restore J385 to the original state.

⑤ Connect J38 and J39 to the spectrum analyzer, adjust C230, C232, and F381 so the 150 MHz signal is maximized. Adjust F381 to confirm the output levels are equal to or greater than 0 dBm.

(2) Third local block adjustment

a. 46M VCO adjustment (BGN-011223)

① Adjust R165 to set TP1 to 11 V ±1 mV.

② Set the TR4171 as follows:

[SHIFT] [LABEL] [Hz/−dBm/µsec] [ ]c

[0] [Hz/−dBm/µsec]

Adjust R211 to set TP2 to 0 V ±1 mV.

③ Connect J388 to the frequency counter and set the TR4171 as follows:

[3] [1] [2] [5] [Hz/−dBm/µsec]

Adjust R161 to set the frequency to 48 MHz ±1 kHz. Set the TR4171 to 0 Hz and adjust R204 to set the frequency to 44 MHz ±1 kHz.

Key in [1] [5] [6] [2] [Hz/−dBm/µsec], and adjust R158 to set the frequency to 46 MHz ±1 kHz.

Since these adjustment controls affect each other, repeat procedures several times.

④ Confirm output levels at J388, J29, and J30.

J388, J29: 0 dBm or greater (23 MHz)

J30 : -20 dBm or greater (2.3 MHz)

b. 39 MHz oscillator adjustment

While monitoring J31 with the external spectrum analyzer, adjust L351 to set the output level to -2 dBm.

c. 41 MHz BPF adjustment

Set J389 to reversed value, connect J387 to the external spectrum analyzer, and adjust C244, C246, C249, C254, C256, and C259 to maximize the 41 MHz signal.

Confirm the output level at J387 is -13 dBm ±2 dB.

Restore J389 setting to the original position.

d. 40 MHz oscillator adjustment (BLN-011224)

① Set the TR4171 as follows:

[SHIFT] [LABEL] [Hz/-dBm/µsec] [ ] I

[5] [0] [Hz/-dBm/µsec]

[SHIFT] [LABEL] [Hz/-dBm/µsec] [ ] C

[0] [Hz/-dBm/µsec]

Then, "STEP 3RDA 0" is displayed.

Adjust R166 to be the voltage at TP1 to 0 V ±1 mV.

② Connect J40 (40 MHz output) to the frequency counter and measure the frequency.

Key is as [3] [1] [2] [5] [Hz/-dBm/µsec] .

Adjust R127 to obtain the oscillation frequency of 42 MHz ±1 kHz.

③ Key in as [1] [5] [6] [2] [Hz/-dBm/µsec] .

Adjust R124 to obtain the frequency of 39.999 ±2.5 kHz.

④ Key is as [0] [Hz/-dBm/µsec] .

Adjust R160 to obtain the frequency of 38 MHz ±1 kHz.

⑤ Since R127, R124, and R160 affect to each other, repeat these procedures several times.

⑥ Confirm the output levels at J40 and J41:

J40: 0 dBm (40 MHz)

J41: -20 dBm (2 MHz)

e. Third local block output BPF adjustment

Connect J34 (32.3 MHz output terminal of the third local block) to the external spectrum analyzer.

① Set the TR4171 as follows:

Adjust C284, C287, C289, C294, C297, and C299 so
32.3 MHz output (J34) is maximized.
Confirm the output level is at least 0 dBm.

② Key in [0] [Hz/−dBm/μsec].

Confirm the output level change is at most 0.5 dB.

f. Third local PLL confirmation

Connect the frequency counter to J29. Confirm the output signal frequency varies when the TR4171 setting is changed as follows:

[SHIFT] [LABEL] [Hz/−dBm/μsec] [ ]c

[1] [5] [6] [2] [Hz/−dBm/μsec]

[SHIFT] [LABEL] [Hz/−dBm/μsec] [ ]!

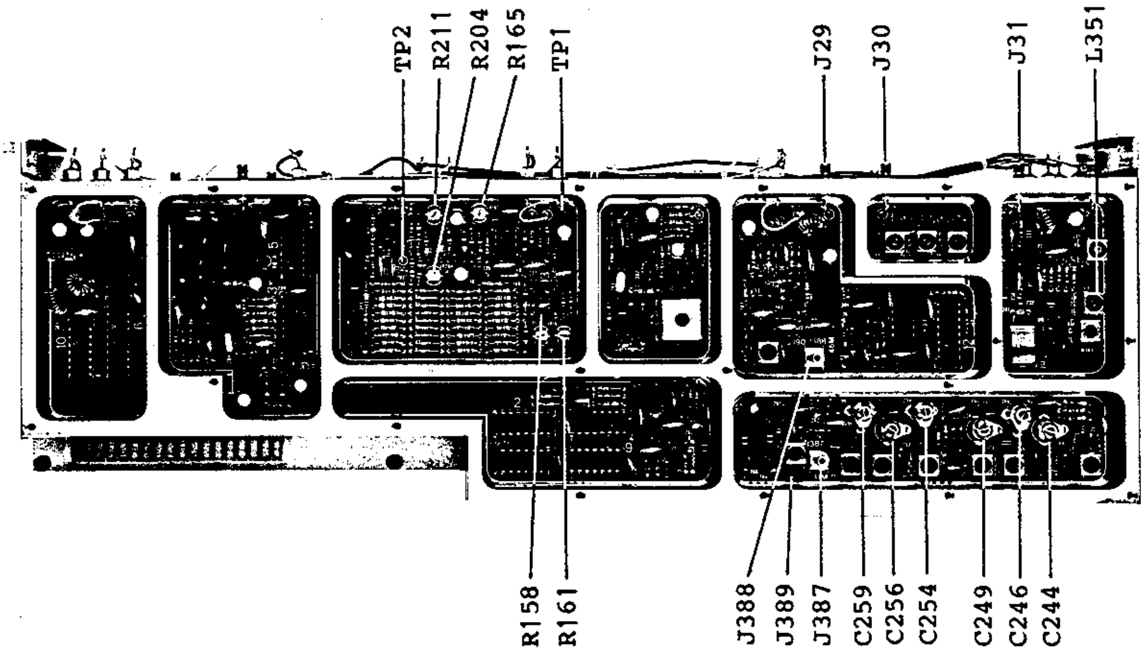
[3] [0] [Hz/−dBm/μsec] .... 22 M ±2 kHz

[4] [0] [Hz/−dBm/μsec] .... 22.5 M ±2 kHz

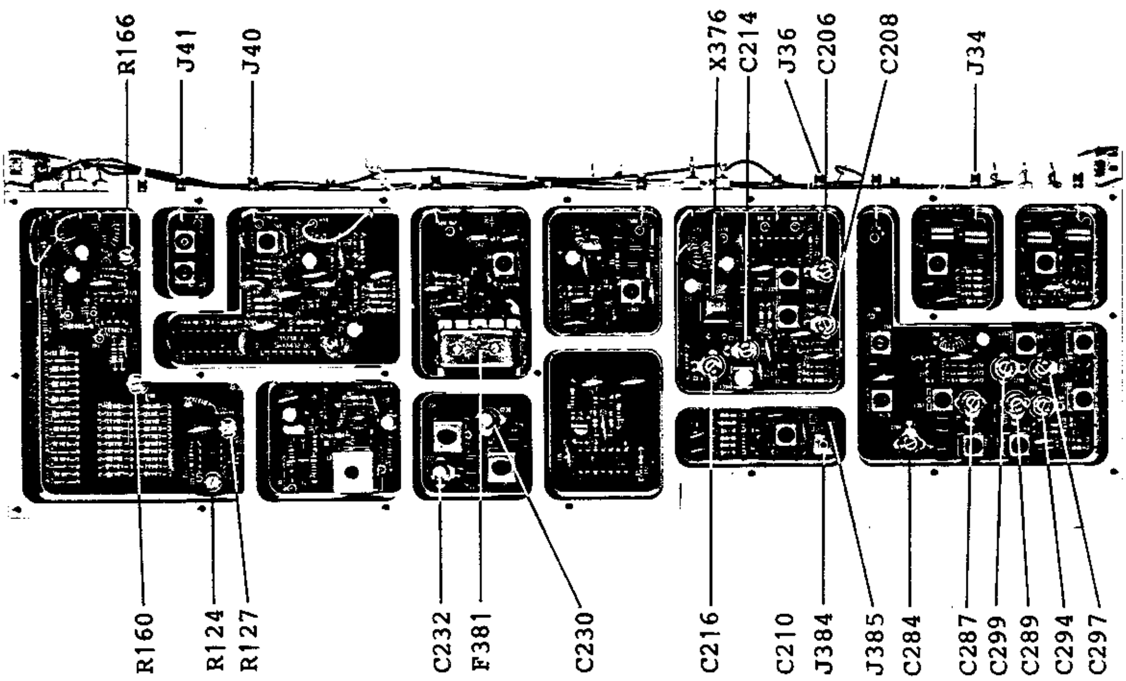
[5] [0] [Hz/−dBm/μsec] .... 23 M ±2 kHz

[6] [0] [Hz/−dBm/μsec] .... 23.5 M ±2 kHz

[7] [0] [Hz/−dBm/μsec] .... 24 M ±2 kHz



(a) 46 M PLL (BGN-011223)



(b) 2ND/3RD LO (BLN-011224)

Fig. 11-63 Second/third local block adjustment locations

11-5-8. Tracking Generator Block (MEP-409) Adjustment

Instruments required: * Spectrum analyzer
* Wattmeter

Remove tracking generator block from the TR4171 main frame, power the system through an extension cable, and connect each signal cable.

(1) 3.333 MHz OSC and switch confirmation

Check 3.33 MHz signal fed to the Counter, Phase block and Logarithmic Amplifier using the spectrum analyzer.

	Monitor pointer	Setting condition
• Output to counter block	: J21	[SHIFT] [LABEL] [Hz/−dBm/µsec] [·] [6]
• Output to phase block	: J20	[PHASE]
• Output to IF block	: J18	[AUTO CAL] When "CALIBRATING TG TRACKING" is displayed in reply to above key operation.
• Output to logarithmic amplifier	: J19	[FREQ CNTR]

(2) Third IF (29 MHZ)/second IF (180 MHz) adjustment

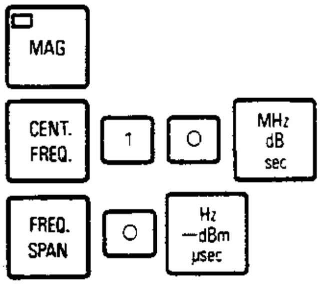
Press [MAG] key, and monitor at Q22 collector with the probe using the external spectrum analyzer.

Adjust C300, C303, C305, and F454 so the 180 MHz second IF signal is maximized.

(3) TG output level adjustment

Connect TG output to wattmeter.

Set the TR4171 as follows:



Adjust R185 to obtain the output leve of -10 dBm ±0.5 dB.

Key in [FREQ. SPAN] [1] [2] [0] [MHz dB sec] and confirm the level variation is within ±1 dBm in all bandwidths.

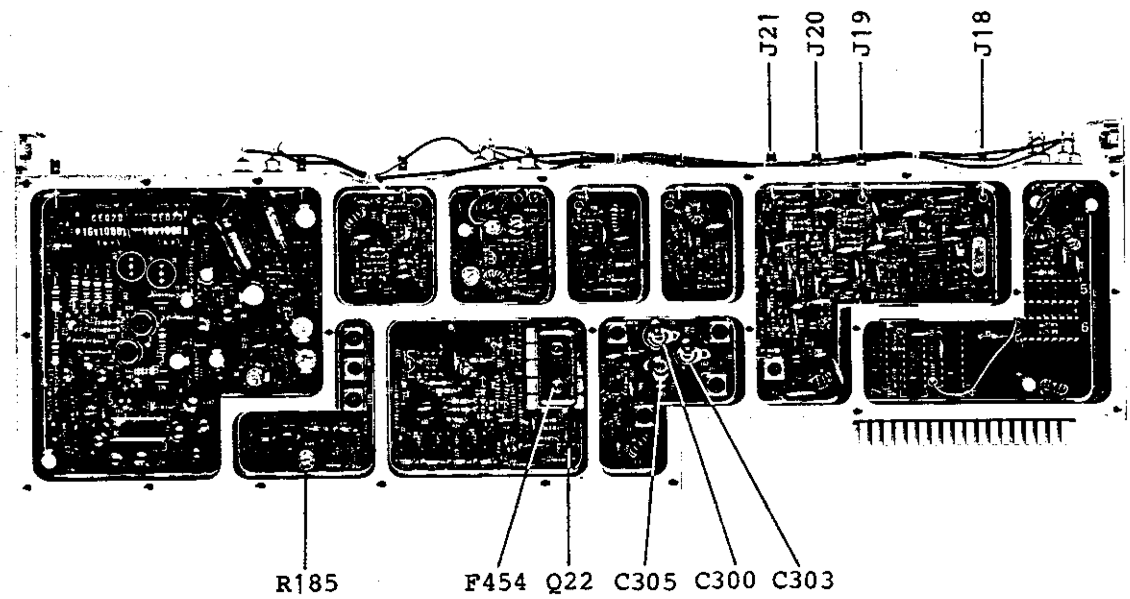


Fig. 11-64 Adjustment locations on tracking generator board (BGB-011220)

11-5-9. TG ATT Adjustment (BLJ-011222)

Instruments required: * Spectrum analyzer
* Directional bridge

Remove TG ATT block from the TR4171 main frame. Connect control and input cables to be the mounted state.

Usa a measurement instrument for measuring VSWR (TR4172 + Directional bridge or network analyzer for the adjustment).

(1) 50 Ω system VSWR adjustment

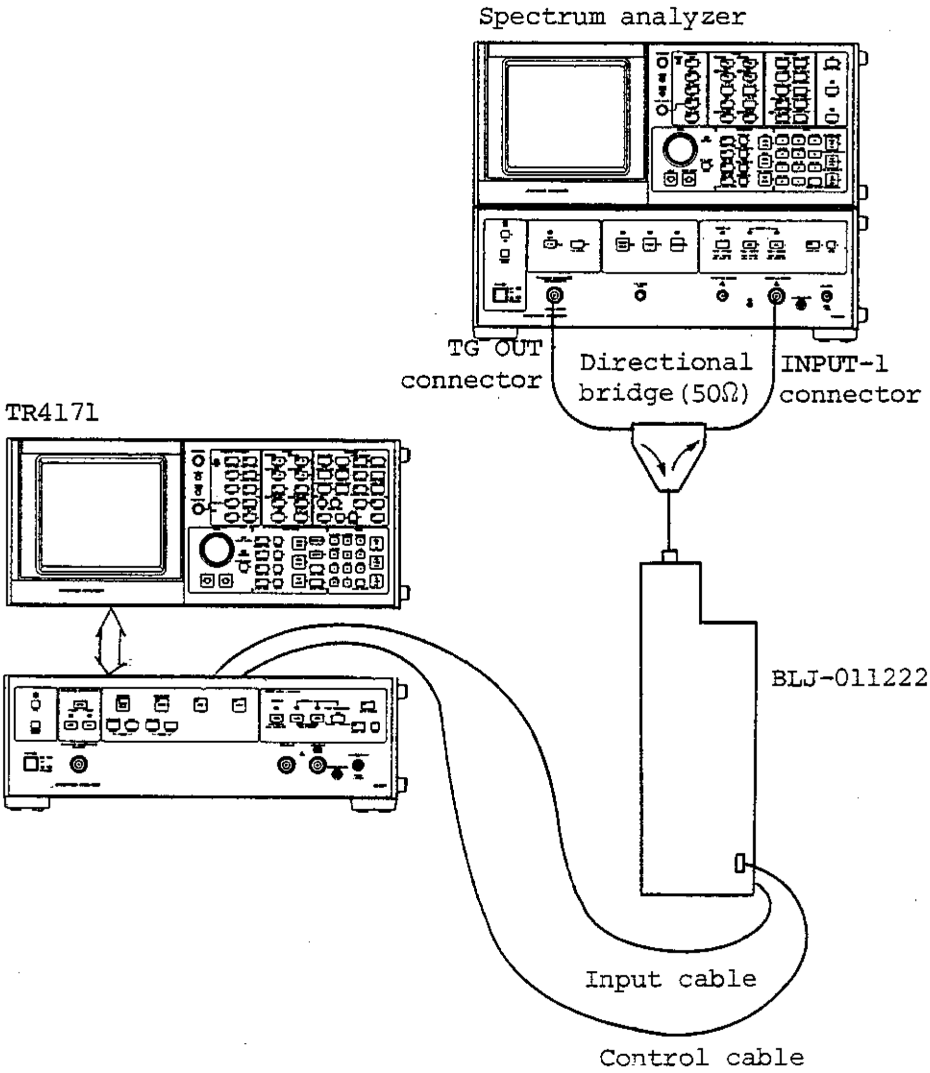


Fig. 11-65 50 Ω system VSWR adjustment setup

Set system as illustrated in Figure 11-65 and the TR4171 as follows:

[50Ω] (TG)

[LEVEL] [1] [0] [kHz +dBm msec]

Adjust C102 to obtain:

10 Hz to 30 MHz : Return loss = 23 dB or greater

30 MHz to 120 MHz: Return loss = 17 dB or greater

(2) 75 Ω system VSWR adjustment

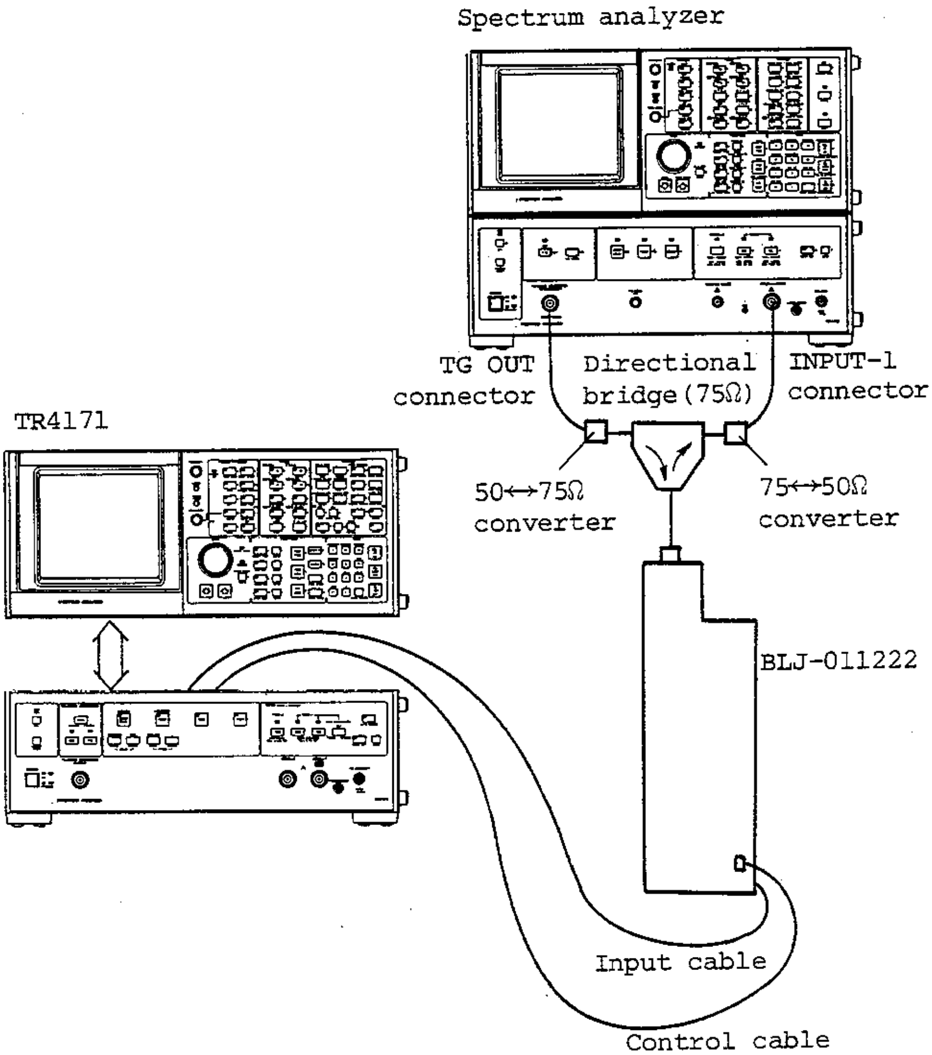


Fig. 11-66 75 Ω VSWR adjustment setup

Set system as shown in Figure 11-66 and press [75Ω] key for the TR4171 to be tested. Adjust C101 to obtain the same results as for the 50 Ω system VSWR.

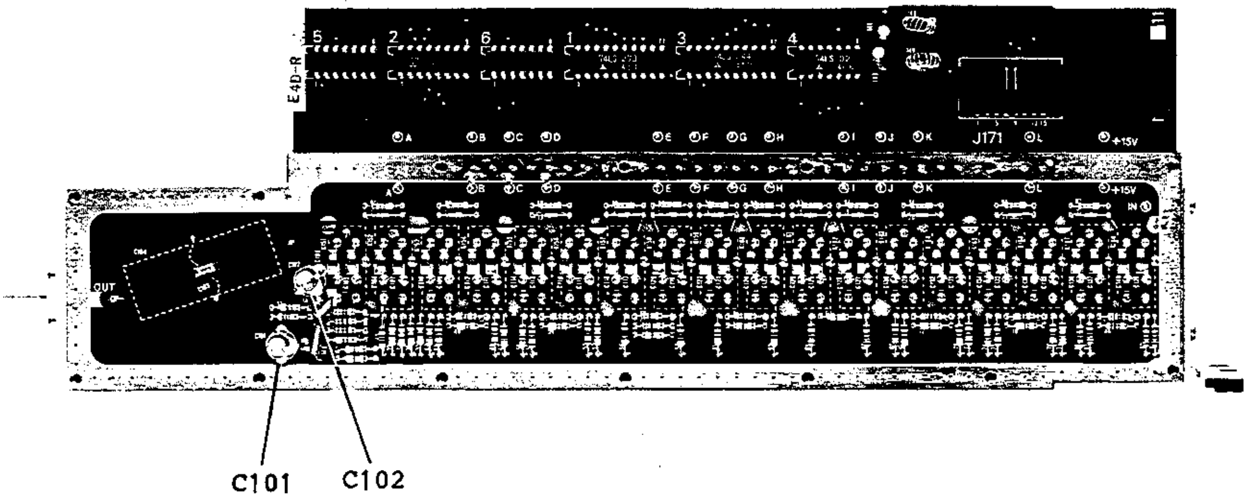


Fig. 11-67 Adjustment locations on TG ATT board (BLJ-011222)

11-5-10. Counter (MEP-410) Inspection

For the counter operation inspection, check components such as the local oscillator of the TR4171 according to the following procedure.
Set the TR4171 as follows:

[CENT. FREQ.] [1] [0] [MHz dB sec]

[FREQ. SPAN] [1] [MHz dB sec]

[FREQ CNTR] (Set to the appropriate value.)

Confirm the display listed in the following table is obtained by keying in [SHIFT] [LABEL] [Hz -dBm μsec] [·] [0] ~ [7].

Numerical key setting	Count point	Display	Remarks
0	TGx1	Approx. 10 MHz	
1	TGx4	Same as above.	
2	TG 1/T	Same as above.	
3	46MVCO	Approx. 2.3 MHz	
4	40MVCO	Approx. 100 kHz	Change counter resolution to 1 kHz.
5	1ST LO	Approx. 189 MHz	
6	3.3M	Approx. 3.3 MHz	
7	39M	Approx. 1.95 MHz	

	Block name	Adjustment location	Specification, adjust item
1	DISPLAY POWER 1	TP1 R3	+5 V ±0.05 V
	(BGC-011865)	TP2 R33	+135 V ±0.2 V
		TP3 R20	-15 V ±0.01 V
		TP4 R28	+25 V ±0.01 V
		TP5 R14	+15 V ±0.01 V
2	HIGH VOLTAGE	TPK R62	-3.000 kV
	(BLC-010204)	Anode	+12 kV to +13 kV
		R64	Adjust intensity.
		R63	Adjust focus.
3	CRT DRIVER	J182-pin 1 R203	+75 V
	(BGK-010184)	J182-pin 5 R199	+75 V
		R202	Adjust halation.
		R200	Adjust pattern distortion.
		GAIN R193	Adjust Y axis.
		POSI. R192	
		GAIN R195	Adjust X axis.
		POSI. R194	
		R196	Adjust intensity.
		R201	Adjust ASTIG.
		C261 R197	Adjust focus (center).
		R198	Adjust focus (on right and left sides).
		C248	Adjust Z-axis characteristic.
4	MEMORY	TP2 R125	Adjust data knob.
	(BGP-010192)	TP4 R126	
5	D-A CONVERTER	Q61 emitter R91	+10 V ±10 mV
	(BGP-010188)		
6	RAMP GENERATOR	P1 - 9AB R95	0 V ±5 V (adjust ramp output voltage.)
	(BGP-011552)	R64, R65, R83	Adjust scanning time accuracy.
		R124	Adjust analog sweeping.
		R130	Adjust rewrite location.
7	ANALOG I/O	R315, R311	Adjust offset null.
	(BGP-010186)	R130, R134	Adjust logarithmic amplifier.
		R164, R158, R156	Adjust phase magnitude amplifier.
		R147, R150, R153	
		R190, R188	Adjust horizontal axis scale.
		R183, R180	Adjust vertical axis scale.
		Y axis GAIN R240	Adjust characters.
		Y axis POSI. R236	
		X axis GAIN R254	
		X axis POSI. R256	
		C354, C375, C363	Adjust line generator.
		R293, R306	Adjust marker.
		R174	Adjust analog sweeping location.
8	A-D CONVERTER	TP4 R177	Adjust sample detector.
	(BGP-010187)	TP4 R178	Adjust positive detector.
		TP4 R176	Adjust negative detector.
		R179, R180	Adjust Y axis A/D converter.
		R175	Adjust slope detector.
		R181	Adjust X axis A/D converter.

	Block name	Adjustment location	Specification, adjust item
9	LOG. AMP. (BLP-010231)	L679, L672 R212 R238, R301, R355 R157 R335 R352, R294 R254, R263, R272	Adjust 3.3 MHz filter. Adjust IF bandwidth changeover level difference. Adjust logarithmic linearity and gain. Adjust DC offset. Linear adjustment. Adjust linear step amplifier.
10	IF-I (BLP-011231)	C431, C570, C574 R587 C441, C571, C575 R245 C408, C392, L536 C557 L536, C410, C405 C579 C359 R314, R589, R315, R316, R318, R319, R320, R321 R290, R297, R148, R149, R265, R264 R136, R137	Adjust LC filter. Adjust crystal filter. Adjust local frequency. Adjust RBW changeover accuracy. Adjust IF gain. Adjust IF total gain.
11	IF-II (BLP-011232)	C410, C580, C528, R327, C420, C529, C581, R328, C430, C579, C582, R235, L532, C361, C363, C584, L533, C375, C377, C586, L534, C390, C588 L547, L548, L549 R253, R254 R235 R102, R109, R96	Adjust LC filter. Adjust crystal filter. Adjust 100 kHz RBW. Adjust mixer balance. Adjust RBW changeover accuracy. Adjust the IF gain.
12	PHASE (BLP-010205)	TP2 R292 TP3 R295 TP4 R301 TP6 R297 TP5 R307 C422, C425, C386, C391 C351, C505 C371, C506 R273, R265 R281 R285 R283	Adjust the offset null. Adjust +10 V. Adjust REF. Adjust control voltage. Adjust offset null. Adjust 3.3 MHz filter. Adjust 33.3 MHz filter. Adjust 30 MHz filter. Adjust output level. Adjust group delay offset. Adjust group delay offset fine. Adjust phase offset.

	Block name	Adjustment location	Specification, adjust item
13	RF POWER (BGF-011218)	TP1 R43 TP2 R48 TP3 R55 TP5 R63 TP6 R71 TP8 R79 TP9 R87 TP10 TP11 R95	+5 V ±0.01 V +12 V ±0.01 V +15 V ±0.01 V -15 V ±0.01 V +15 V ±0.01 V -15 V ±0.01 V +15 V ±0.01 V GND -15 V ±0.01 V
14	10 MHz STANDARD (BLB-011219)	C91, C78 R56	Adjust 10 MHz tuning. Adjust output level.
15	INPUT-I (BLP-011227)	C231, C315, L320, L333 C232, L321 R60 C285 C297, C298, L332 R184, R189	Adjust I/O level (for 50 Ω). Adjust I/O VSWR (for 75 Ω). Adjust internal calibration signal. Adjust INPUT-1 frequency characteristics. } Adjust auto-range.
16	INPUT-II (BLP-011228)	C115, C122, C130, C137, C116, C124 C132, C139 C179, C146 R69 R63	} Adjust INPUT-II input ATT. Adjust INPUT-I frequency characteristics. Adjust auto-range. Adjust INPUT-I/II level difference.
17	REF ATT (BGJ-011248)	R63, R70, R77, R84, R93, R102, R111, R120	} Adjust reference attenuator.
18	1ST IF (BLB-011245)	C16, F135, F136	Adjust first IF.
19	2ND IF (BLB-011246)	C46 C58, C60, C68, C70	Adjust second local level. Adjust second IF filter.
20	3RD IF (BLF-011247)	L138 L143, L144, L145, L146	Adjust third local level. } Adjust third IF filter.
21	LOCAL DRIVER (BGN-011225)	TP2 R86 TP14 R120 R92, R61 R104 R142 R127 R82	Adjust +10 V. Adjust -5 V. Adjust main tune. Adjust main sweep. Adjust sweep FM. Adjust tuning FM. Adjust third local tuning.
22	100/101 MHz OSC (BLC-011282)	C123, C129, C132, C138, L156, L157, C103, C105	} Adjust 100/101 MHz OSC.
23	YIG IF (BLB-011279)	C46, C38, R19	Adjust YIG IF.

	Block name	Adjustment location	Specification, adjust item
24	YIG DIVIDER (BLC-011281)	R57 R46 R48	Adjust divider bias. Adjust tunnel diode gain. Adjust tunnel diode offset.
25	46M PLL (BGN-011223)	R165, R211, R161, R204, R158 L351 C244, C246, C249, C254, C256, C259	Adjust 46M VCO. Adjust 39 MHz oscillator. Adjust 41 MHz BPF.
26	2ND/3RD LO (BLN-011224)	C206, C208, C214, C216, C230, C232, F381 R166, R127, R124, R160 C284, C287, C289, C294, C297, C299	Adjust second local block. Adjust 40 MHz oscillator. Adjust third local output BPF.
27	TG (BGN-011220)	C300, C303, C305, F454 R185	Adjust third IF (29 MHz) and second IF (180 MHz). Adjust TG output level.
28	TG ATT (BLJ-011222)	C102 C101	Adjust 50 Ω system VSWR. Adjust 75 Ω system VSWR.

MEMO

SECTION 12

PERFORMANCE TEST

12-1. INTRODUCTION

This section describes the TR4171 spectrum analyzer performance testing. Important items can be tested by the calibration output (CAL. OUT.) signal.

12-2. TEST PREPARATION

12-2-1. Instruments Required for Performance Test

Use instruments listed in Table 12-1. Use tools contained in supplied maintenance kit. (See Table 11-2.)

Table 12-1 Instrument required for performance test

Instrument	Performance	Recommended model
(1) Synthesized signal generator	Frequency: 100 kHz to 120 MHz Output level: +10 dBm to -30 dBm Output impedance: 50 Ω, 75 Ω Output level flatness: ±0.5 dB Reference oscillator aging rate: 2×10^{-8}/day or less At most one day after calibration with a frequency standard unit having an accuracy of 2×10^{-9}.	TR4511
(2) Low-frequency oscillator	Frequency: 10 Hz to 100 kHz Output level: +10 dBm to -30 dBm Output impedance: 50 Ω, 75 Ω imbalanced Output level flatness: ±0.3 dB	
(3) RF wattmeter	Frequency: 10 MHz to 120 MHz Impedance: 50 Ω, 75 Ω Sensitivity: +20 dBm to -30 dBm -30 dBm to -60 dBm Accuracy: ±0.2 dB	
(4) Level meter	Frequency: 10 Hz to 10 MHz Impedance: 50 Ω, 75 Ω Sensitivity: +20 dBm to -60 dBm Accuracy: ±0.2 dB	

Table 12-1 Instrument required for performance test (Cont'd)

Instrument	Performance	Recommended model
(5) Spectrum analyzer	Input frequency: 100 kHz to 500 MHz	TR4172
(6) Step attenuator	Attenuation: 10 dB step, 90 dB or greater 1 dB step, 9 dB or greater 0.1 dB step, 0.9 dB or greater Accuracy: 10 dB : ±0.05 dB (at 10 MHz) 1 dB : ±0.02 dB (at 10 MHz) 0.1 dB: ±0.002 dB (at 10 MHz)	
(7) High isolation power combiner	Frequency: Up to 120 MHz Isolation: 30 dB or greater	
(8) Directional bridge	Frequency: 10 MHz to 120 MHz Impedance: 50 Ω, 75 Ω Directivity: 35 dB or greater	
(9) DC voltmeter	Need only measure ±15 V.	
(10) Sliding-type autotransformer	Voltage: 80 V to 250 V	

12-2-2. General Precautions

(1) AC power must be:
100 V (120 V, 220 V) ±10% or 240 V $^{+4\%}_{-10\%}$, 50 Hz or 60 Hz

(2) Before connecting power cable, confirm POWER switch is set to STANDBY.

(3) Test must be conducted at temperature +20°C to +30°C and humidity 80% or less. Test environment must be free from dust, vibration, and noise.

12-3. TEST USING CAL. OUT. AND T.G. OUT. SIGNAL

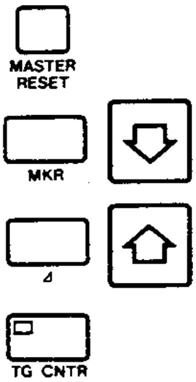
This subsection describes checking important items using the calibration output (CAL. OUT.) signal and tracking generator output (T.G. OUT.) signal.

12-3-1. Frequency Span Accuracy

Specification: ±3% for span > 50 kHz

±5% for span ≦ 50 kHz

① Key in as follows:



(Shift marker point to left end on the CRT display.)

(Shift delta marker to right end on the CRT display.)

Verify delta marker indication for frequency difference is 120 MHz ±3.6 MHz (±3%).

② Press keys [FREQ. SPAN] [1] [MHz dB sec].

Verify delta marker indication for frequency difference is 1 MHz ±30 kHz (±3%).

③ Press keys [FREQ. SPAN] [5] [0] [kHz +dBm msec].

Verify delta marker indication for frequency difference is 50 kHz ±2.5 kHz (±5%).

④ Press keys [FREQ. SPAN] [5] [kHz +dBm msec].

Verify delta marker indication for frequency difference is 5 kHz ±250 Hz (±5%).

12-3-2. Marker Indication Accuracy

Connect a cable between CAL OUT and INPUT-1 connectors.

(1) Marker mode operation

Specification: ± (center frequency accuracy) + (frequency span accuracy) , where frequency span is the discrepancy between marker and center frequencies.

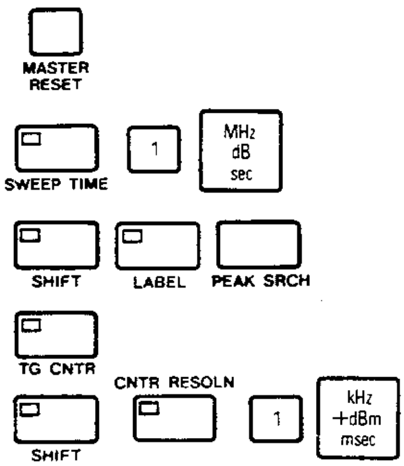
Key in as follows:

Verify frequency display at marker point is 10 MHz ±4 MHz.

(2) TG counter mode operation

Specification: ± (Reference oscillator accuracy) x (Display frequency) + (two counts) + $\frac{\text{(Frequency span)}}{1000}$

Key in as follows:



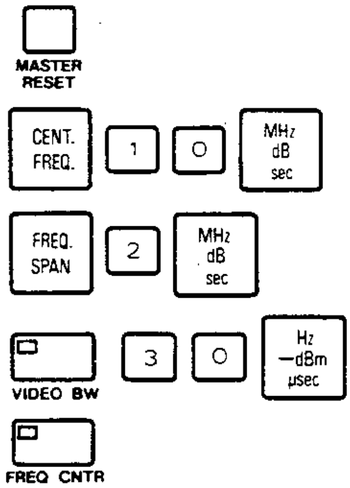
Verify frequency display at marker point is 10 MHz ±120 kHz.

(3) Frequency counter mode operation

Specification: For 10 Hz to 120 MHz signal, ± (Reference Oscillator accuracy) x (Frequency displayed) ±2 counts.

Frequency is measured and displayed in frequency counter mode for signals having a level exceeding the noise level by at least +15 dB.

Key in as follows:

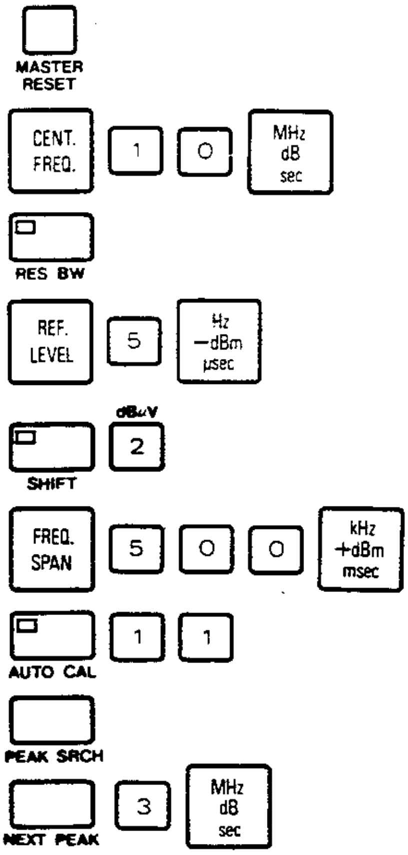


Verify frequency displayed at marker point is 10.00000 MHz ±30 Hz. Move marker point using data knob to a position 15 dB higher than noise level. Confirm displayed frequency is 10.00000 MHz ±30 Hz.

12-3-3. Resolution Bandwidth Accuracy

Specification: ±20% (for 3 dB bandwidth)

① Connect CAL OUT and INPUT-1 connectors with a cable.
Key in as follows:



Make sure frequency difference displayed at delta marker is 100 kHz ±20 kHz (±20%).

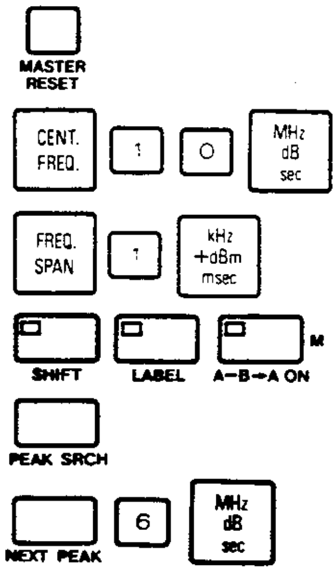
② Set resolution bandwidth to range 30 kHz to 3 Hz. Set appropriate frequency span. Press keys

. Verify results conform to specifications.

12-3-4. Resolution Bandwidth Accuracy for Measuring QP Value (with option 01 only)

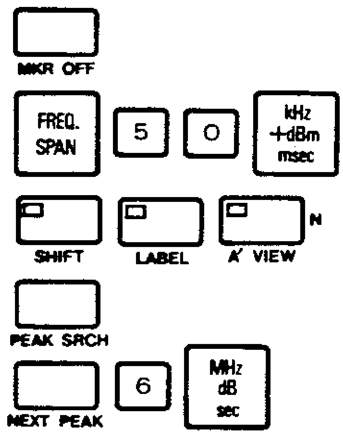
Specification: A) 200 Hz ±20 Hz (for 6 dB bandwidth)
B) 9 kHz ±1 kHz (for 6 dB bandwidth)

① Connect CAL OUT and INPUT-1 connectors with a cable. Key in as follows:



Verify frequency difference displayed at delta marker is 200 Hz ±20 Hz.

② Next, key in as follows:

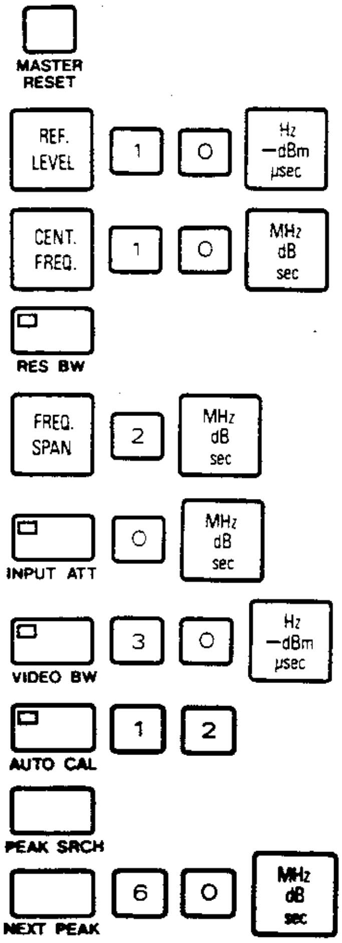


Verify frequency difference displayed at delta marker is 9 kHz ±1 kHz.

12-3-5. Resolution Bandwidth Selectivity

Specification: <11:1 max. (resolution bandwidth ratio for 60 dB:3 dB)
<18:1 max. (resolution bandwidth ratio for 80 dB:3 dB)

① Connect CAL OUT and INPUT-1 connectors by cable.
Key in as follows:



60 dB bandwidth information is then displayed. Obtain ratio between displayed value and that obtained in Section 12-3-3 for 3 dB bandwidth. Verify the ratio is less than 11:1.

② Key in as follows to display 80 dB bandwidth information [MKR OFF] [PEAK SRCH] [NEXT PEAK] [8] [0] [MHz dB sec] Obtain ratio between displayed value and that obtained in Section 12-3-3 for 3 dB bandwidth. Verify ratio is less than 18:1.

③ For resolution bandwidth 30 kHz to 3 Hz, set appropriate frequency spans and video bandwidth. Check resolution bandwidth selectivity. A key operation of [MKR OFF] is required to change frequency span or other data once "X dB down WIDTH" mode is executed.

12-3-6. Resolution Bandwidth Switching Level Accuracy and IF Gain Error

Specification: For 3 Hz to 30 kHz range with reference to 100 kHz resolution bandwidth:

Resolution bandwidth switching level accuracy:

±1.0 dB, +20°C to +30°C
±2.0 dB, 0°C to +40°C

IF gain error: ±1.0 dB when reference level is changed with input attenuator fixed.

① Press keys [AUTO CAL] [1] [1] to execute auto calibration. When it is completed, press keys [AUTO CAL] [4] [⇧]. Error data is displayed on CRT display. Verify resolution switching level accuracy is within specified values.

② Press [⇧] key again. The IF gain error data is displayed on CRT display. Verify displayed data is within specified values.

12-3-7. Frequency Stability

(1) Specification: At fixed temperature one hour after warm-up:

For frequency span > 50 kHz

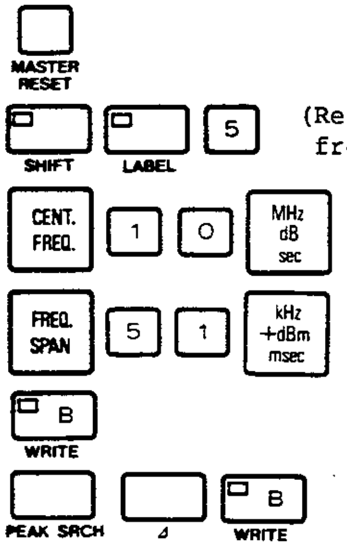
Drift : 1 kHz/minute or less, or
10 kHz/30 minutes or less

Residual FM: 200 Hzp-p/second or less

Connect CAL OUT and INPUT-1 connectors by cable.

a. Procedure for checking items for drift 10 kHz/30 m

Key in as follows:

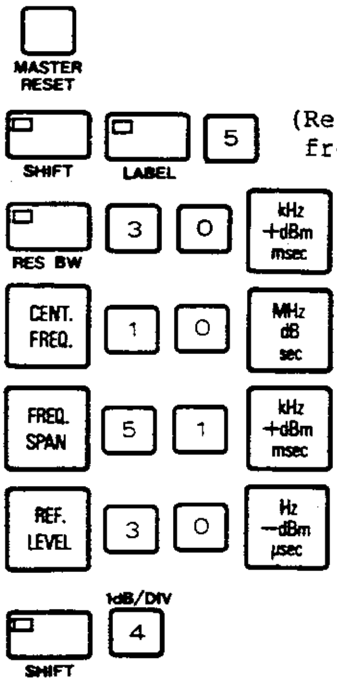


(Release routine resetting center frequency data for each sweep operation.)

Press [PEAK SRCH] key when 30 minutes has elapsed, and read frequency difference displayed at delta marker. Value is assumed the drift value.

b. Procedure for checking the drift 1 kHz/m and residual FM 200 Hzp-p/s

Key in as follows:



(Release routine resetting center frequency data for each sweep operation.)

While changing center frequency, move waveform so its slope passes through CRT display center shown in Figure 12-1. Read frequency change (kHz/dB) using delta marker.

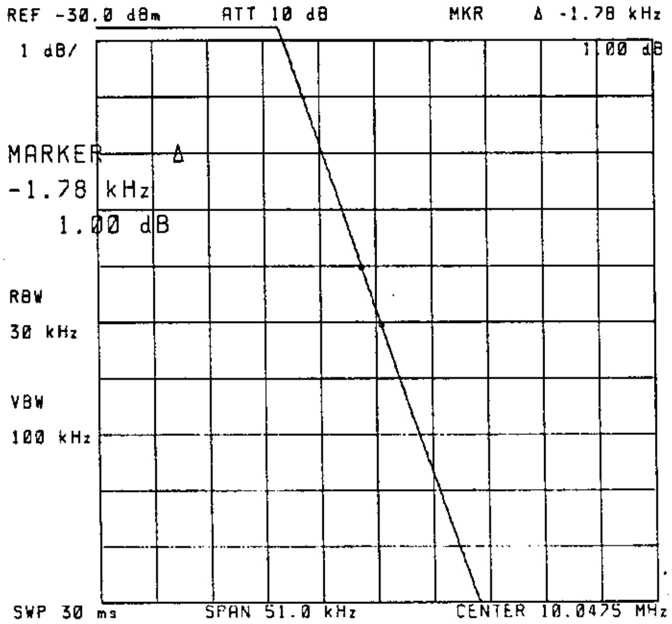
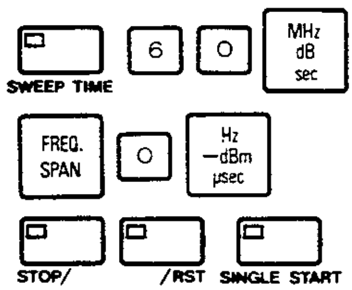


Fig. 12-1 Slope waveform

Key in as follows:



Obtain deviation (dBp-p) in resulting waveform data. Calculate drift value from this deviation and frequency discrepancy per decibel previously obtained.

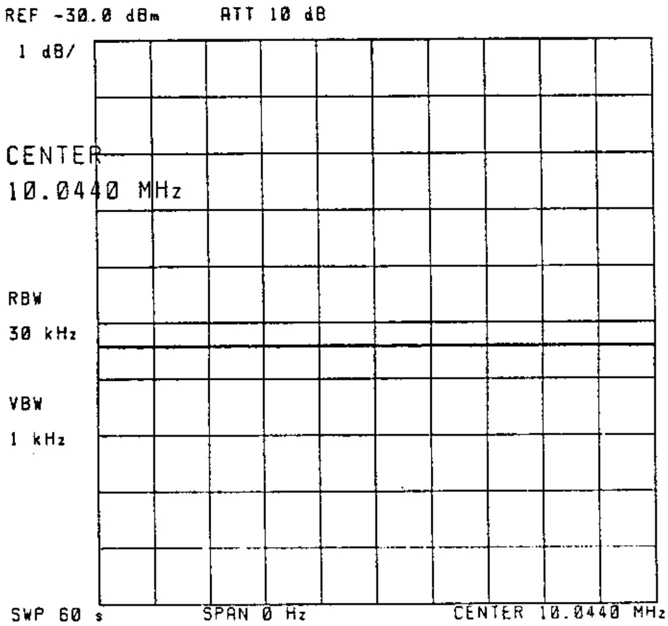


Fig. 12-2 Drift waveform

Check residual FM in the same way. Select appropriate graticule scale and video bandwidth.

(2) Specification: At fixed temperature one hour after warm-up:

For 50 kHz ≦ Frequency span > 5.0 kHz:

Drift: 20 Hz/m or less, 200 Hz/30 m or less

Residual FM: 1 Hzp-p/s or less

Frequency span ≤ 5.0 kHz

Drift: 1 Hz/m or less, or 10 Hz/30 m or less

Residual FM: 0.2 Hzp-p/s or less

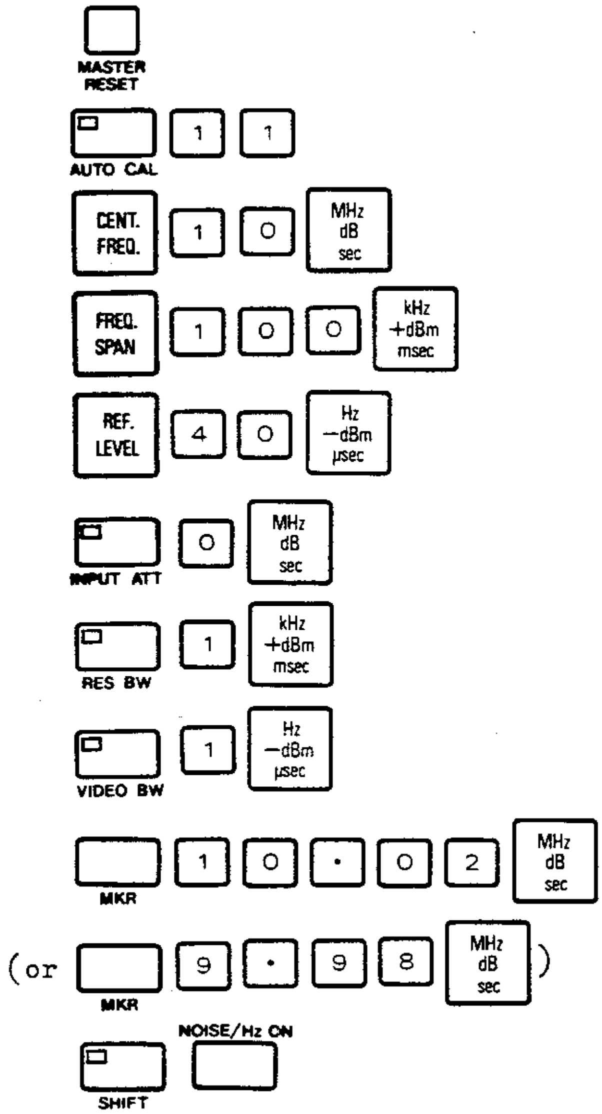
Check above-listed specification values in the same way as described in item (1) for frequency span 50 kHz.
Set frequency span to an appropriate value conforming to conditions above. Select proper value for graticule scale and video bandwidth.

12-3-8. Noise Side Band

Specification: -125 dBc/Hz: Average value at 20 kHz apart from carrier frequency.

-100 dBc : Average value at 100 Hz apart from carrier frequency.

(1) Connect CAL OUT and INPUT-1 connectors by cable.
Key in as follows:



The display is changed as follows: (Display value at marker point) + 10 dB = 20 kHz OFF noise side band (-dB/Hz). Verify obtained value is within specified values.

② Key in as follows:

[START F] [1] [0] [MHz/dB/sec]

[STOP F] [1] [0] [•] [0] [0] [0] [2] [MHz/dB/sec]

[RES BW] [3] [Hz/−dBm/μsec]

[VIDEO BW] [1] [Hz/−dBm/μsec]

[MKR] [1] [0] [•] [0] [0] [0] [1] [MHz/dB/sec]

[STOP/] [/RST] [CONT START]

Press keys [AVG] [6] [4] [Hz/−dBm/μsec] when sweep operation is once completed. When 64 averaging operations are completed, calculate noise side band in the same way as for 20 kHz OFF noise side band. Verify obtained value is within specified values.

12-3-9. Reference Level Accuracy After Error Correction

Specification: After error correction: ±0.5 dBm at 10 MHz center frequency.
For the other frequency, frequency response is to be added.

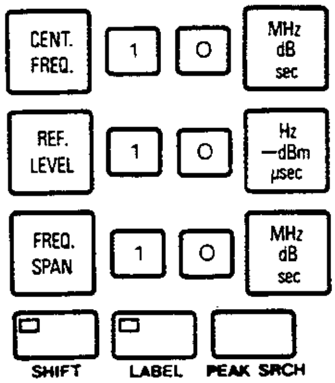
① Key in as follows:

[MASTER RESET]

[AUTO CAL] [1] [1]

Connect CAL OUT and INPUT-1 connectors by cable after auto calibration is completed.

② Key in as follows:

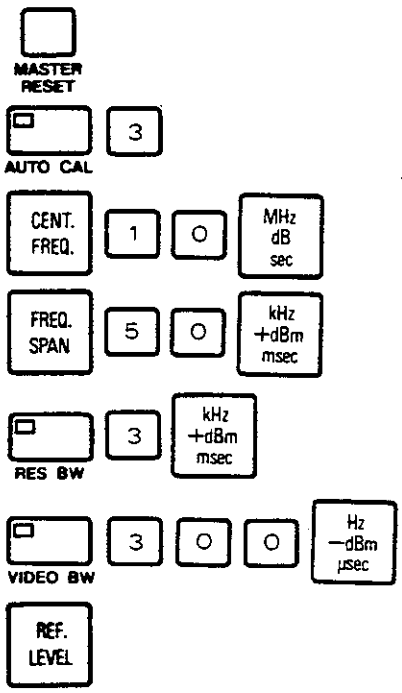


Verify level indication at marker point is -10 dBm ±0.5 dB. Set input attenuator, resolution bandwidth, and graticule scale to proper values. Verify obtained level is -10 dBm ±0.5 dB.

12-3-10. Logarithm Scale Switching Error

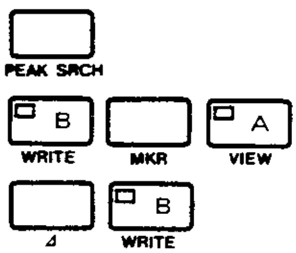
Specification: ±0.5 dB

① Connect CAL OUT and INPUT-1 connectors by cable.
Key in as follows:



Align waveform peak to reference line.

② Key in as follows:

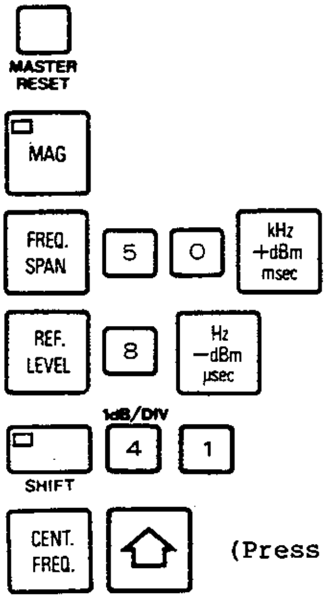


Change over graticule scale. Verify switching level difference is ±0.5 dB.

12-3-11. RF Gain Error

Specification: ±0.2 dB (occurs when center frequency is varied with frequency span ≦ 50 kHz.)

① Connect TRACKING GENERATOR OUTPUT connector and INPUT-I connector by cable.
Set up the TR4171 as follows:
(Press UP key about 20 times.)



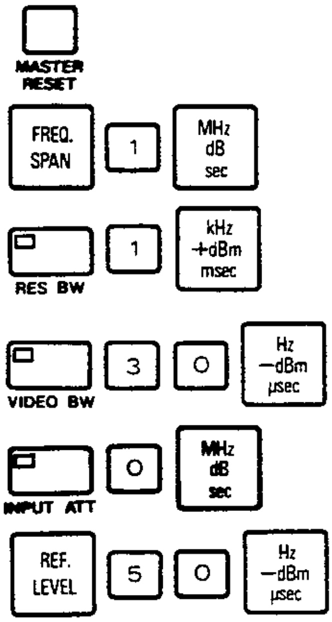
(Press UP key about 20 times.)

② Verify level variation is ±0.2 dB even at maximum.

12-3-12. Residual Response

Specification: -110 dBm or less (Input attenuator is set to 0 dB.)

① Key in as follows:



② While changing center frequency, verify no-input spurious signal equal to or greater than -110 dBm is not obtained.

12-3-13. Average Noise Level

Specification: -140 dBm or less, with 3 Hz resolution bandwidth, 1 Hz video bandwidth, and 0 dB input attenuator.
-155 dBm or less, with 3 Hz resolution bandwidth, 1 Hz video bandwidth, and 0 dB input attenuator in 50 Ω/75 Ω high sensitivity mode.

Execute master reset operation, set respective conditions to specifications, set reference level to -100 dBm, and verify noise average value (center value) is within specified values by visual inspection. Here, "UNCAL" is displayed for the normal case.

12-3-14. Auto Range

Specification: When input level to analyzer is at least -30 dBm, input attenuator is automatically adjusted so the value obtained by subtracting attenuation of input attenuator from input level is in range -30 dBm to -35 dBm.

Press master reset key, connect CAL OUT and INPUT-1 connectors by cable, and then press [AUTO RANGE] key. Input attenuator is then set to 20 dB or 25 dB. Remove cable connecting CAL OUT and INPUT-1 connectors. About three seconds later, input attenuator is set to 0 dB and "OUT OF RANGE" is displayed. This display shows the system is operating normally.

12-4. TEST BY MEASURING INSTRUMENT

12-4-1. Center Frequency Accuracy

Specification: Display accuracy: ±{(1% of frequency span) + (Reference oscillator accuracy x Tuning frequency) + 1 Hz}/After error correction.

±{(1% of frequency span) + (Reference oscillator accuracy x Tuning frequency) + 1 Hz}

±{(10% of resolution bandwidth) + 20 Hz}/When error correction is not executed.

Instruments required: * Synthesized signal generator

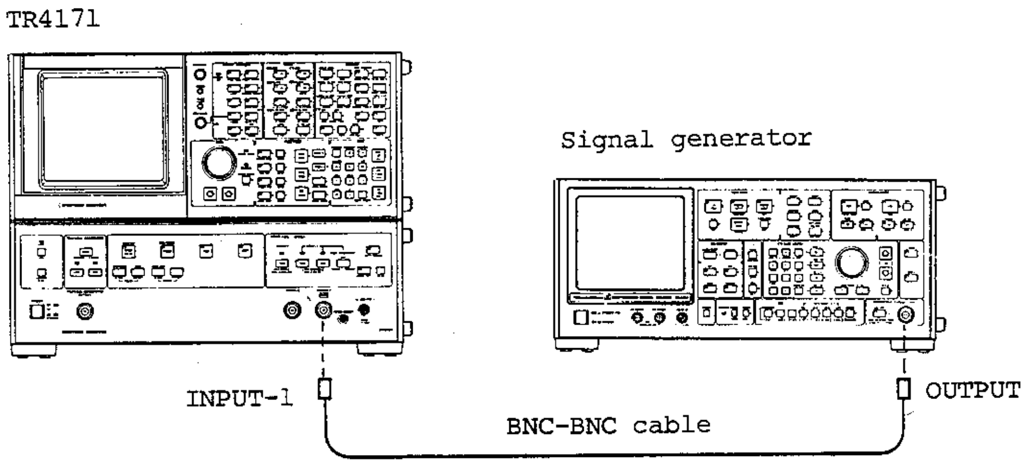


Fig. 12-3 Center frequency accuracy test setup

① Key in as follows:

[MASTER RESET]

[AUTO CAL] [1] [1]

[SHIFT] [LABEL] [5]

Input signal about -10 dBm from synthesized signal generator to INPUT-1 connector of the TR4171. Verify signal conforms to specification.

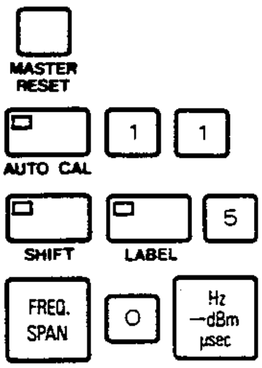
② If [AUTO CAL] [3] is keyed in, center frequency accuracy without error correction can be conducted. If [AUTO CAL] [2] is keyed in, test following error correction can be performed.

12-4-2. Zero Span Display Accuracy

Specification: ±{(1% of resolution bandwidth) + (Reference oscillator accuracy x Tuning frequency) + 1 Hz}/After error correction.
±{(10% of resolution bandwidth) + (Reference oscillator accuracy x Tuning frequency) + 20 Hz}/When error correction is not conducted.

Instruments required: * Synthesized signal generator

① Key in as follows:



(Zero frequency span.)

Input signal about -10 dBm from synthesized signal generator to INPUT-1 connector of the TR4171.

② Set center frequency to appropriate value. While changing CW frequency of synthesized signal generator, set level to maximum. Error is obtained as the discrepancy with respect to the center frequency set.
Conduct this operation for each resolution bandwidth.

③ If [AUTO CAL] [3] is keyed in ,the zero span display accuracy without error correction can be carried out. If [AUTO CAL] [2] is keyed in, accuracy after error correction can be performed.
If many digits must be set for center frequency, set zero span after reducing frequency span.

12-4-3. Start/stop Frequency Accuracy

Specification: (Center frequency accuracy) + (Frequency span accuracy x 1/2)

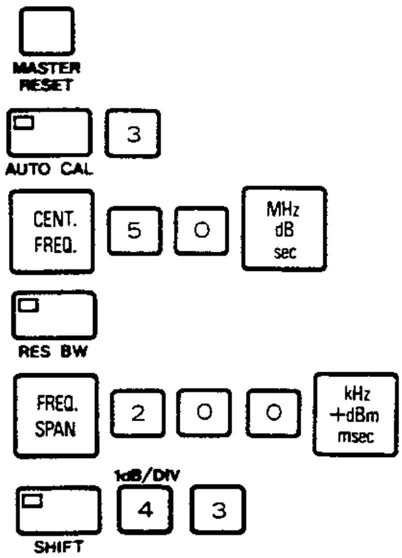
Set up system in the same way as for center frequency accuracy test described in Section 12-4-1. Verify start and stop frequencies are within specified values.

12-4-4. Vertical Scale Linearity (Logarithmic Graticule)

Specification: ±0.02 dB/div. for 0.1 dB/div. and 0 dB to 0.8 dB
±0.2 dB/div. for 1 dB/div. and 0 dB to 95 dB
±1 dB/div. for 10 dB/div. and 0 dB to 95 dB
(20°C to 30°C)
±1.5 dB/div. for 10 dB/div. and 0 dB to 95 dB
(0°C to 40°C)

Instruments required: Step attenuator: 10 dB step, 0 dB to 110 dB
1 dB step, 0 dB to 11 dB
0.1 dB step, 0 dB to 1.1 dB

① Set up the TR4171 as follows:



② Input 50 MHz signal with output level 0 dBm from the synthesized signal generator to the TR4171 input via external step attenuator.
Set external attenuator to 0 dB. While changing signal generator output, align waveform peak to top graticule line on CRT display.

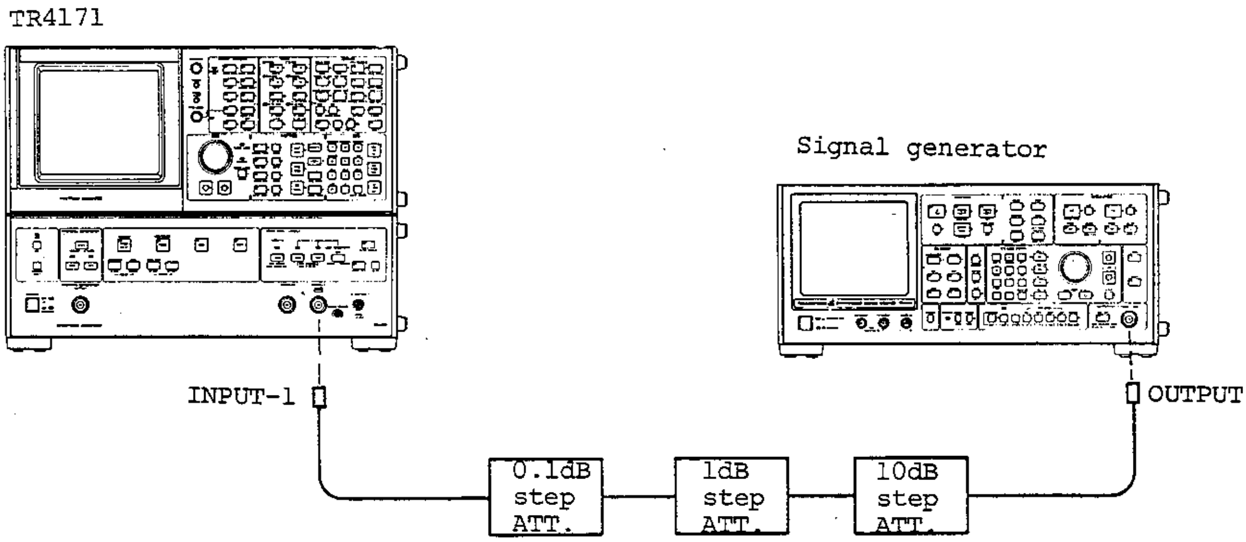


Fig. 12-4 Vertical scale linearity test setup

③ Increment attenuator value in 0.1 dB step. Verify deviation for each 0.1 dB change is within 0.02 dB (0.2 div.).

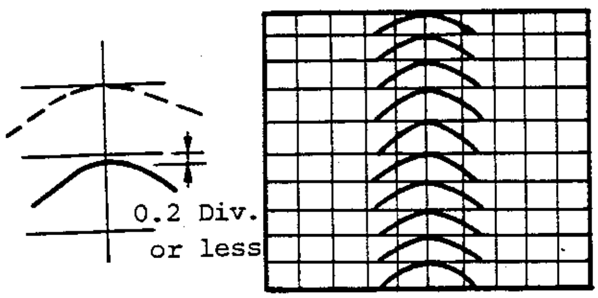


Fig. 12-5 Vertical scale linearity check

The faster check can be achieved by reading signal level with a [PEAK SRCH] key depressed each time the attenuator value is incremented.

④ Press keys [SHIFT] [4 (1dB/DIV)] . Set vertical graticule scale to 1 dB/div. Set external attenuator to 0 dB. While changing signal generator output, align waveform peak to top graticule line on CRT display.

⑤ While incrementing external attenuator setting in 1 dB step, verify level change per 1 dB (1 div.) is ±0.2 dB (±0.2 div.).

⑥ Set the TR4171 as follows and verify accuracy for 10 dB/div.

[CENT. FREQ.] [5] [0] [•] [5] [MHz dB sec]

[FREQ. SPAN] [1] [kHz +dBm msec]

[RES BW] [3] [0] [Hz −dBm μsec]

[SHIFT] [7 (10dB/DIV)]

⑦ Set frequency and output level of signal generator to 50.5 MHz and 0 dB. Input signal through external attenuator to the TR4171. Set external attenuator to 0 dB. While changing signal generator output, align waveform peak to top graticule line on CRT display.

⑧ While incrementing external attenuator setting from 0 dB to 90 dB in 10 dB step, verify level change per 10 dB (1 div.) is ±1 dB (±0.1 div.).

⑨ Restore external attenuator setting to 0 dB. Decrease signal generator output level slightly so the peak waveform read at the marker on CRT display is set to −5 dBm.

⑩ While incrementing external attenuator setting from 0 dB to 90 dB in 10 dB step, verify level change per 10 dB (1 div.) is ±1 dB (±0.1 div.).

(11) Perform operations described above in steps (6) thru (10) for temperature range 0°C to 40°C. Verify level change is ±1.5 dB.

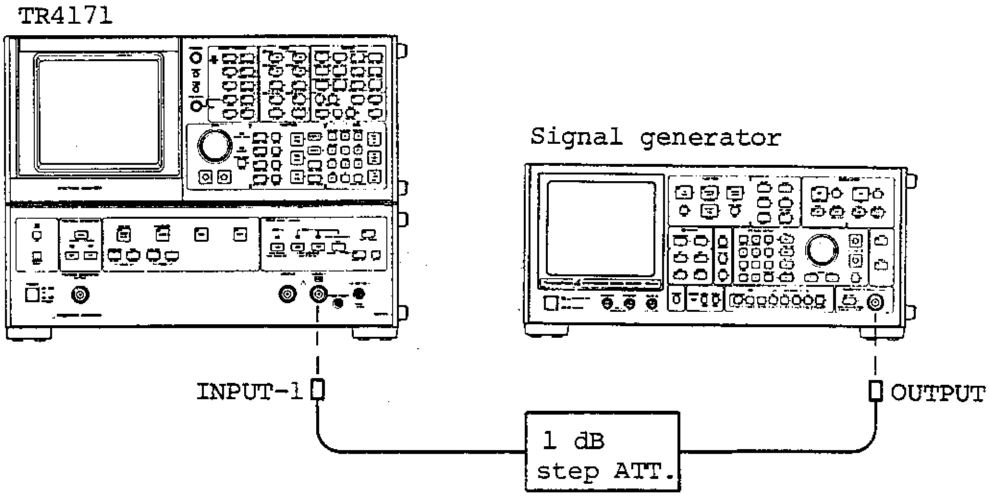


Fig. 12-6 Vertical scale linearity test setup

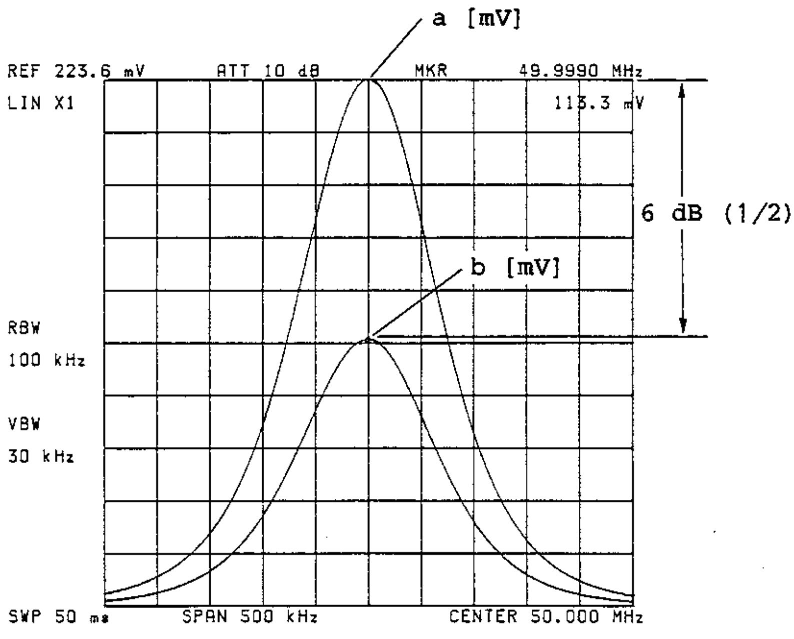


Fig. 12-7 Linear scale linearity check

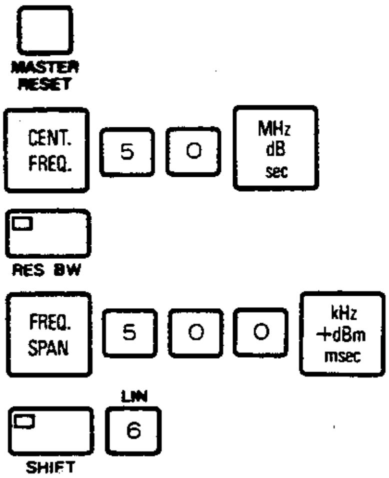
12-4-5. Vertical Scale Linearity (Linear Graticule)

Specification: ±3% of reference level

Instruments required: * Synthesized signal generator

* Step attenuator: 1 dB step (0 dB to 11 dB)

① Set up the TR4171 as follows:



② Input 50 MHz signal with output level 0 dBm via external attenuator from signal generator to the TR4171. Set external attenuator to 0 dB. While changing signal generator output, align waveform peak to top graticule line on CRT display.

③ Press [PEAK SRCH] key and record value of input waveform peak at marker. (Value is indicated in a (mV).)

④ Set external attenuator to 6 dB (1/2 with respect to linear graticule). Press [PEAK SRCH] key and record value of input waveform peak. (Value is indicated in b (mV).)

⑤ Compare b (mV) with 1/2 of a (mV) and obtain result in percent units. Verify resultant value is within specified values (2b/a x 100 = 97% to 103%).

12-4-6. Frequency Response

Specification: For input attenuator setting 0 dB to 65 dB, 10 MHz

±0.7 dB (50 Ω, 75 Ω, 1 MΩ input)

±1.0 dB (50 Ω/75 Ω high sensitivity mode)

Instruments required: * Synthesized signal generator

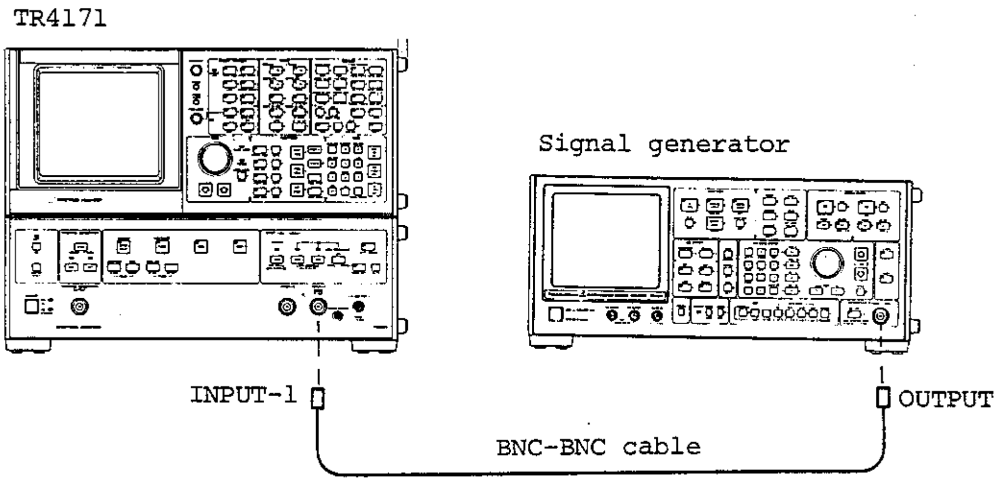


Fig. 12-8 Frequency response test setup

CAUTION

Since frequency responses of signal generator and connection cables affect measurement error, measure and calibrate the signal level at each point by wattmeter before the test.

① Key in as follows:

[MASTER RESET]
[AUTO CAL] [1] [2]
[RES BW]
[CENT. FREQ.] [1] [0] [MHz dB sec]
[FREQ. SPAN] [1] [MHz dB sec]
[SHIFT] [1dB/DIV 4]

Connect BNC-BNC cable between RF OUT connector of signal generator and INPUT-1 connector of the TR4171. Adjust signal generator output level to set signal peak to the CRT display center.

② Press keys [STEP SIZE] [1] [MHz dB sec]. Change center frequency by using [⇧] or [⇩] key. Simultaneously, change signal generator frequency and verify variation of frequency response per 10 MHz is ±0.7 dB for each input attenuator.

③ Press [HIGH SENSITIVITY OFF (100Hz — 120MHz)] key and conduct same test in high sensitivity mode.

④ Perform same test for 1 MΩ input. Terminate input with 50 Ω feed through terminator.

12-4-7. Spurious Response (Harmonic Distortion)

Specification: -80 dB or less: When value obtained by subtracting input attenuator attenuation from input level is -30 dBm.

-90 dB or less: When value obtained by subtracting input attenuator attenuation from input level is 40 dBm.

-60 dB or less: When value obtained by subtracting input attenuator attenuation from input level is -60 dBm in 50 Ω/75 Ω high sensitivity mode.

Instruments required: * Synthesized signal generator

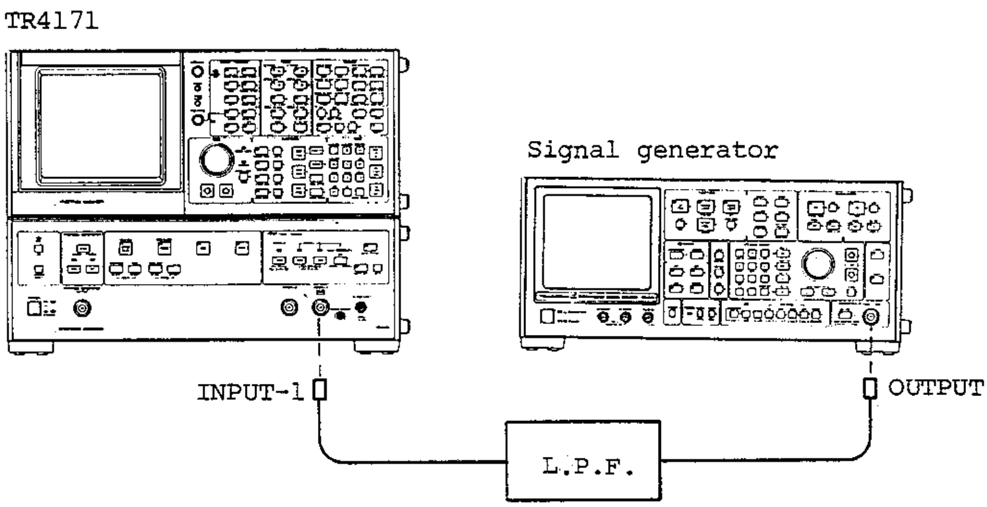


Fig. 12-9 Harmonic distortion test setup

(1) Set up test system as illustrated in Figure 12-9. Set LPF output level to -30 dBm. (Harmonic must be at most 85 dBc.) Set the TR4171 center frequency, frequency span, resolution bandwidth, and reference level to appropriate values. Set input attenuator to 0 dB. Apply signal to INPUT-1 connector and verify harmonic level is equal to or less than -110 dBm. Conduct the same check for 1 MΩ input with input terminated by a 50 Ω feed through terminator.

② For the high sensitivity mode test, set LPF output level to -60 dBm, and set the TR4171 input attenuator to 0 dB. Verify harmonic level is at most -120 dBm.

12-4-8. Spurious Response (Two-signal Tertiary Intermodulation Distortion)

Specification: -75 dB or less: When values obtained by subtracting input attenuator attenuation from two signal levels not exceeding 200 kHz are -30 dBm.

-80 dB or less: When values obtained by subtracting input attenuator attenuation from two signal levels not exceeding 200 kHz are -30 dBm.

-70 dB or less: When values obtained by subtracting input attenuator attenuation from two signal levels are -55 dBm in 50 Ω/75 Ω high sensitivity mode.

Instruments required:
* Synthesized signal generator
* Power combiner

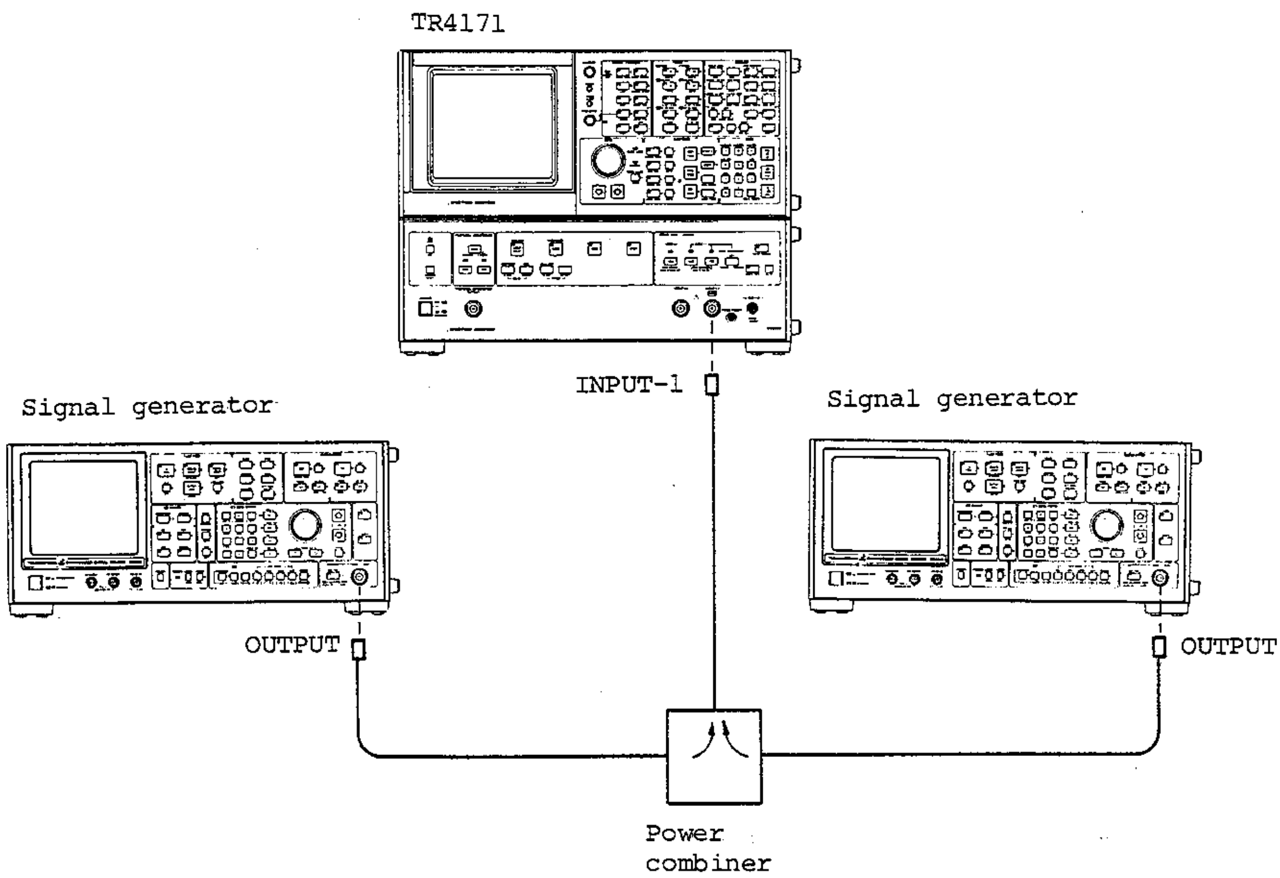


Fig. 12-10 Two-signal tertiary intermodulation distortion test setup

① Set the TR4171 input attenuators to 0 dB. Set output levels of power combiner to -30 dBm. Set frequency span and resolution bandwidth to appropriate values for frequency not exceeding 200 kHz (99 kHz and 101 kHz) and for frequency not less than 200 kHz (9.999 MHz and 10.001 MHz). Then conduct test. Measure = $2f_1 - f_2$ and $2f_2 - f_1$ shown in Figure 12-11.

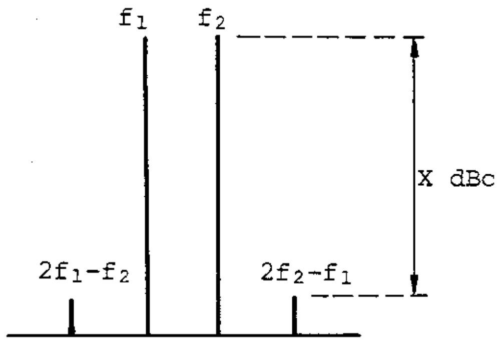


Fig. 12-11 Two-signal tertiary intermodulation distortion

② In high sensitivity mode, verify level is 70 dBc or less for -55 dBm input signal regardless of input frequency.

③ If a power combiner applicable to a low frequency is unavailable, use signal generator whose output section develops reduced distortion and a resistor power combiner.

12-4-9. Gain Compression

Specification: ≧ 1 MHz, 0.5 dB or less
< 1 MHz, 2 dB or less
For 0 dB input attenuator, 0 dBm input
≧ 1 MHz, 0.5 dB or less
< 1 MHz, 2 dB or less
For 0 dB input attenuator, -30 dBm input in 50 Ω/75 Ω high sensitivity mode

Instruments required: * Synthesized signal generator
* Step attenuator (10 dB step, 0 dB to 110 dB)

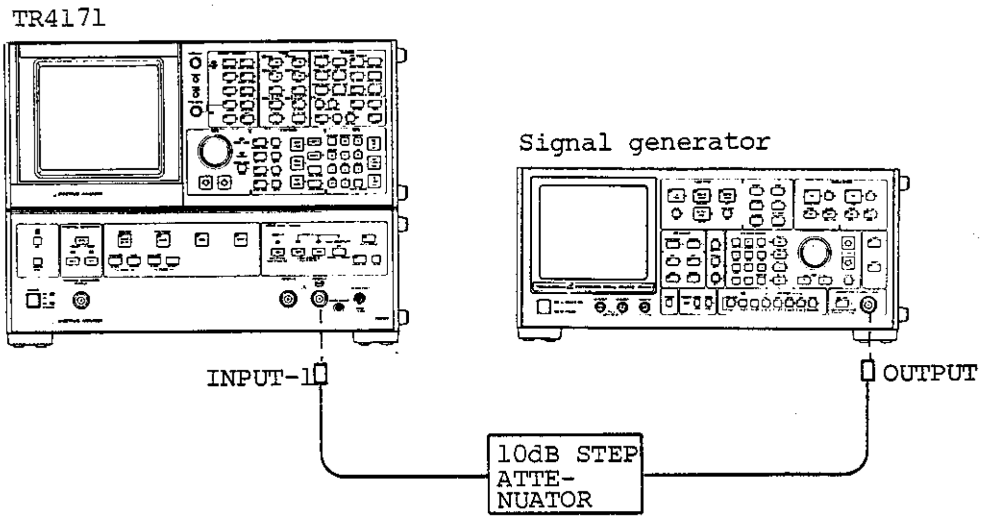
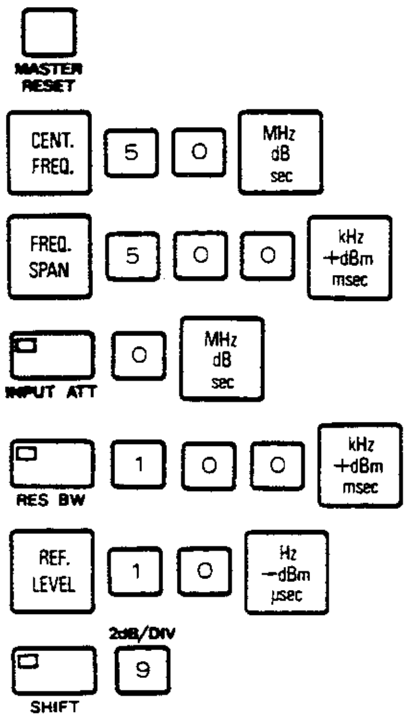


Fig. 12-12 Gain compression test setup

① Set up the TR4171 as follows:



② Input 50 MHz signal with output level 0 dBm from signal generator to the TR4171 via external step attenuator. Set external attenuator to 10 dB. Press [PEAK SRCH] key and read input signal level (-10 dBm) at marker position.

③ Set external attenuator to 0 dB. Apply a 0 dBm signal to the TR4171 input. Press keys [REF. LEVEL] [0] [MHz dB sec], [PEAK SRCH]. Read signal level.

④ Obtain level value without gain compression by adding 10 dB to the level value for -10 dBm input in step 2 above. Check if gain compression has been conducted by comparing this signal with value displayed when 0 dBm signal is applied to the TR4171 input. Verify compression level is ±0.5 dB.

⑤ Conduct compression test with a signal whose frequency is at most 1 MHz. Verify compression gain is at most 2 dB.

⑥ In 50 Ω/75 Ω high sensitivity mode, check gain compression with -40 dBm and -30 dBm signals.

12-4-10. Overload Warning

Specification: For 50 Ω/75 Ω input, the overload warning is given on the front panel LED and CRT display when input signal is at least +30 dBm (1 Watt).

Instruments required: * Synthesized signal generator

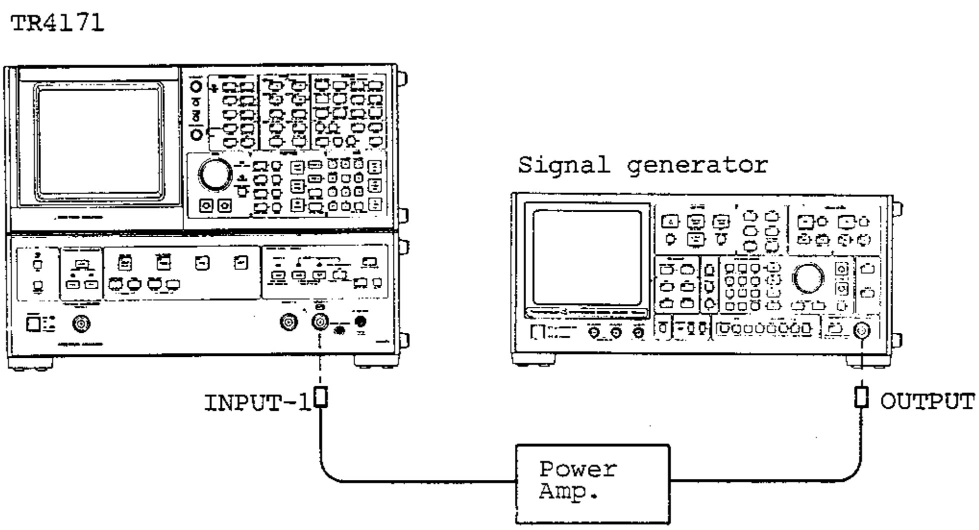
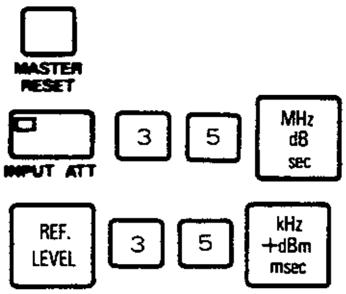


Fig. 12-13 Overload warning test setup

CAUTION

Do not input a signal of +35 dBm (approx. 3 W) or more to the TR4171, or the input circuit may be destroyed.

① Key in as follows:



Set signal generator output level to minimum and connect power amplifier output to INPUT-1 connector of the TR4171.

② While increasing signal generator output level, verify the overload warning circuit works when the input level to the TR4171 is in range +30 dBm to +35 dBm. Since the input attenuator is automatically set to 65 dB, check relay switching sound is heard near the INPUT-1 connector.

12-4-11. 50 Ω/75 Ω Input Impedance

Specifications: 50 Ω/75 Ω: Return loss is 26 dB or greater in range 10 Hz to 30 MHz.
Return loss is 20 dB or greater in range 30 MHz to 120 MHz.

50 Ω/75 Ω high sensitivity mode: Return loss is 16 dB or greater.

Instruments required: * Spectrum analyzer (with tracking generator)
* Directional bridge

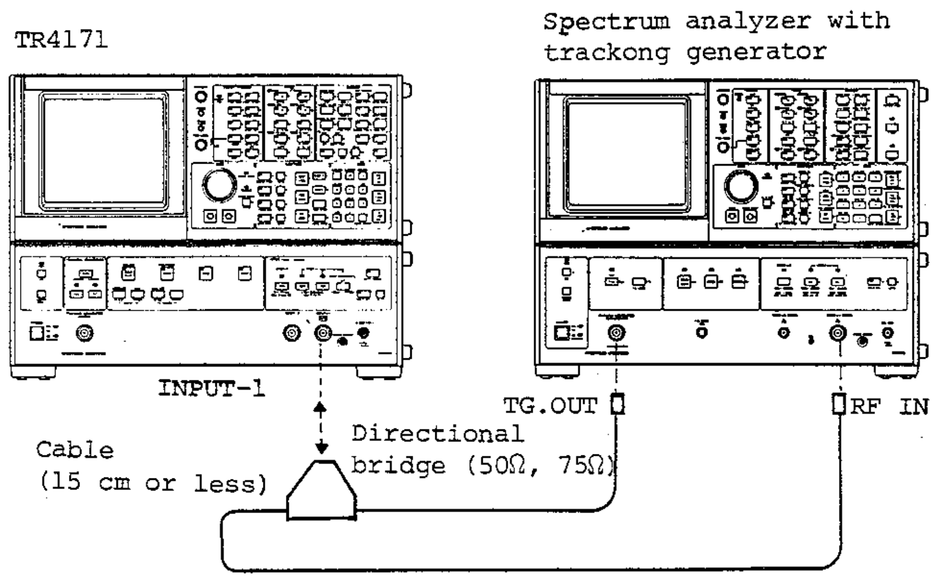


Fig. 12-14 50 Ω/75 Ω input impedance test setup

CAUTION

Length of cable connecting the TR4171 and directional bridge must not exceed 15 cm. Longer length cable produces measurement errors.

Set up test system as shown in Figure 12-14. In 50 Ω, 75 Ω, or 50 Ω/75 Ω high sensitivity mode, change input attenuator setting from 0 dB to 65 dB. Verify, resultant values are within specified values. If return loss for 10 MHz conforms to specification, other lower frequency values are guaranteed to be within specifications.

12-4-12. Input Attenuator Accuracy

Specification: For 10 MHz with reference to 0 dB:
±0.1 dB for 50 Ω/75 Ω input
± 0.5 dB for 1 MΩ input

Instruments required: * Synthesized signal generator
* Step attenuator (1 dB step)
* Step attenuator (10 dB step)

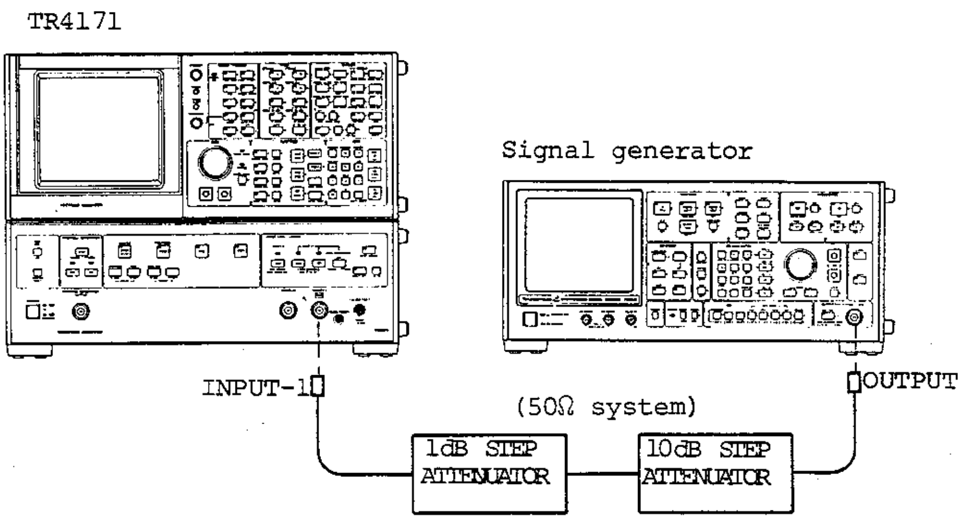
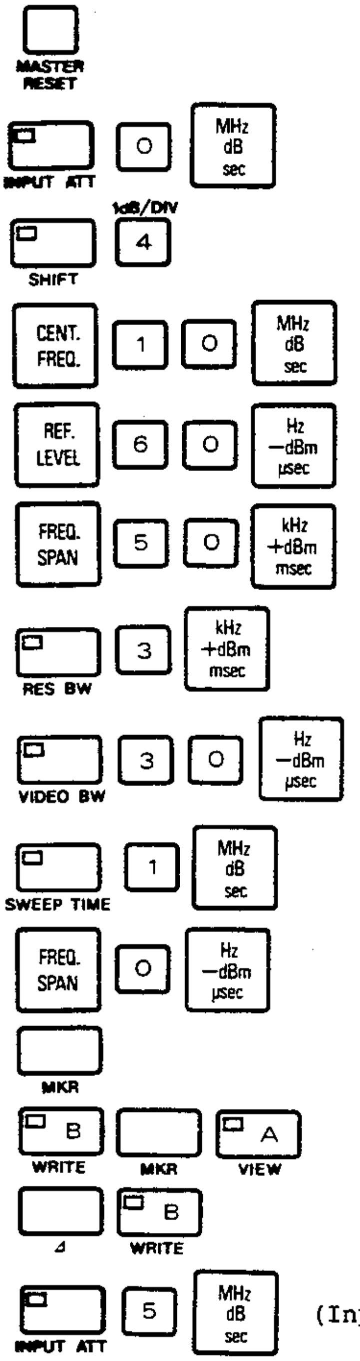


Fig. 12-15 Input attenuator accuracy test setup

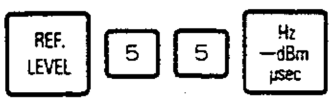
① Set signal generator output to 10 MHz, 0 dBm and external attenuator to 65 dB. Input signal to INPUT-1 connector of the TR4171. Key in as follows:



(Input attenuator is set to 5 dB.)

② Set external attenuator to 60 dB

Key in as follows:



Verify level discrepancy displayed at delta marker is ±0.1 dB.

③ While changing input attenuator, external attenuator, and reference level in 5 dB step, verify switching level error is ±0.1 dB for each input attenuator.

④ Check 1 MΩ input attenuator for INPUT-2 connector in the same way. Verify level change is ±5 dB. This check must be conducted with 1 MΩ input terminated with a 50 Ω feed through terminator.

12-4-13. Local Emission

Specification: -80 dBm or less for 0 dB input attenuator

Instruments required: * Spectrum analyzer

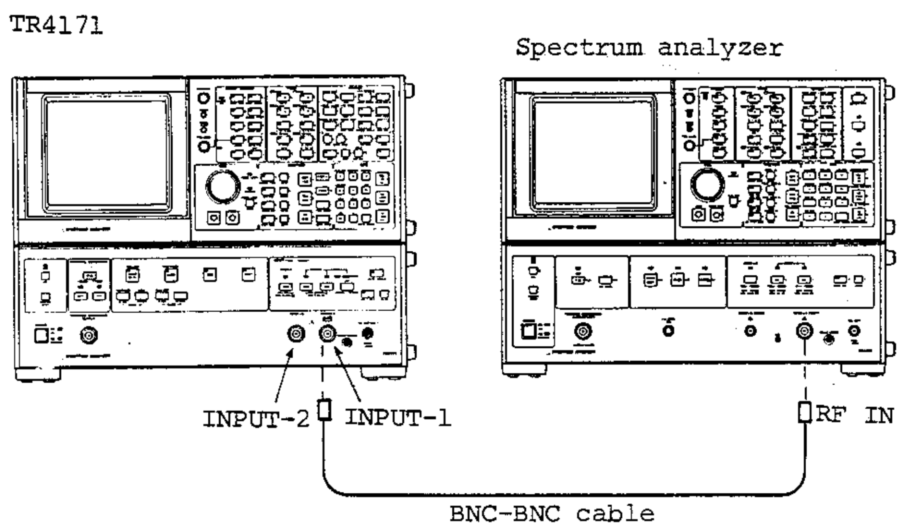


Fig.12-16 Local emission test setup

Set the TR4171 input attenuator to 0 dB. Measure first local signal from INPUT-1 or INPUT-2 connector using spectrum analyzer. Correspondences between center frequency and first local frequency of the TR4171 are as follows:

Center frequency	First local frequency
0 MHz	179 MHz
120 MHz	299 MHz

Since leakage signal is most probable in frequency range 240 MHz to 270 MHz, signal measurement need only be conducted in this range (center frequency from 61 MHz to 91 MHz).

12-4-14. Isolation Between Inputs

Specification: 80 dB or greater

Instruments required: * Synthesized signal generators

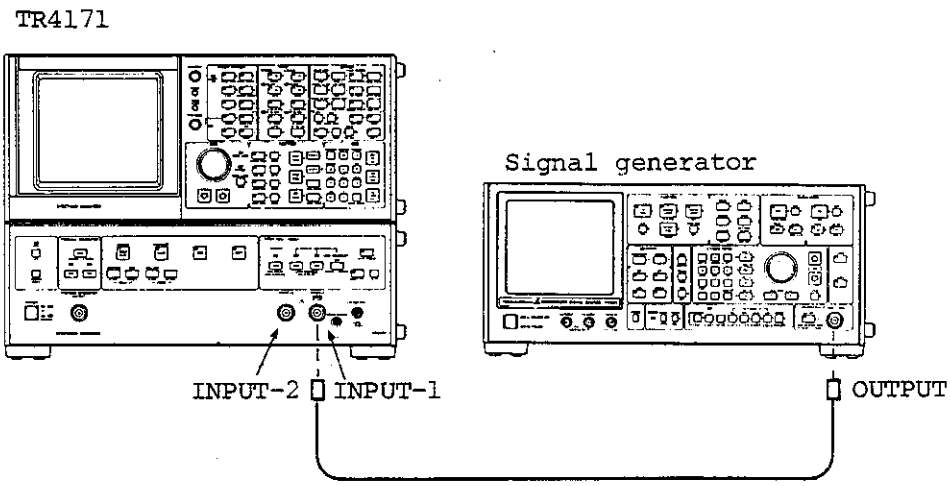


Fig. 12-17 Setup for testing isolation between inputs

Signal isolation is minimized at input frequency 120 MHz. Input a 120 MHz signal from signal generator to an input connector not selected. Measure level of 120 MHz signal displayed on the TR4171 CRT. Isolation between inputs is obtained as the difference between input signal level and level measured by the TR4171. Do not apply a signal exceeding the maximum input level (+30 dBm).

12-4-15. Calibration Output Signal

Specification: -10 dBm ±30 dB

Instruments required: * Wattmeter

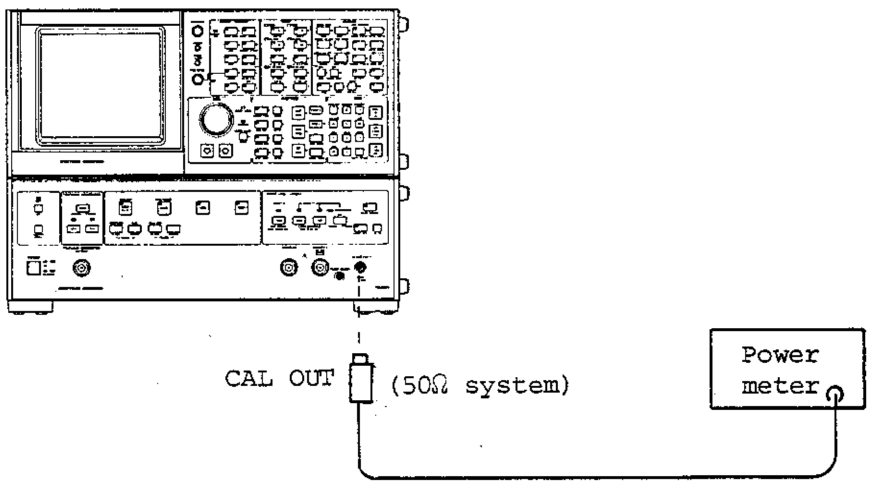


Fig. 12-18 Calibration output signal test setup

Measure the TR4171 CAL OUT signal with calibrated wattmeter. Verify output level is -10 dBm ±0.3 dB.

12-4-16. IF Output

Specification: -12 dBV to -14 dBV for 3.3 MHz at reference level

Instruments required: * Spectrum analyzer

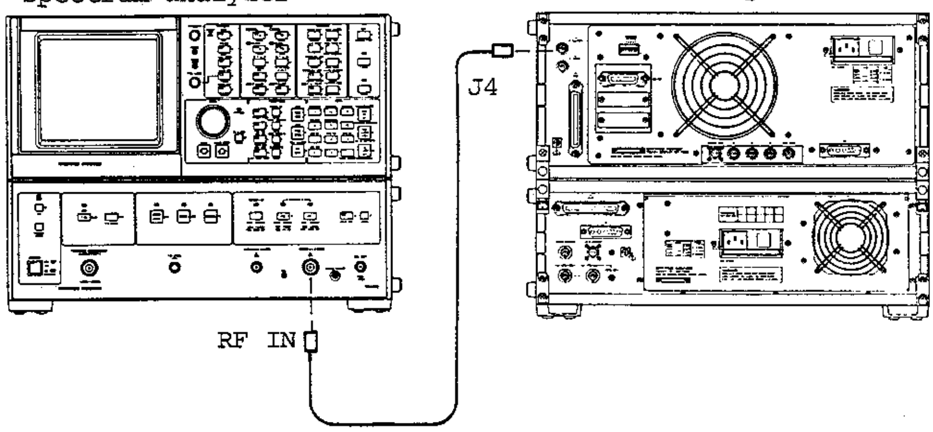
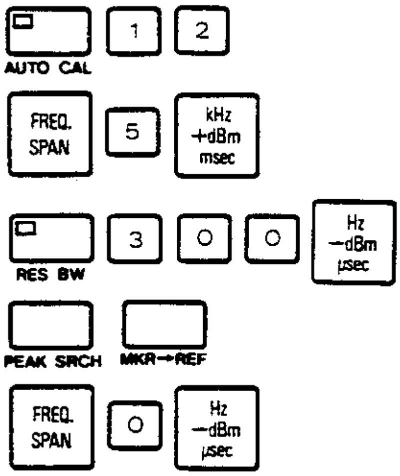


Fig. 12-19 IF output test setup

① Perform master reset operation and connect TR4171 CAL OUT and INPUT-1 connectors with a cable.

② Key in as follows:



Measure IF output (3.3 MHz) at J4 on rear panel using spectrum analyzer. Verify output level is in range -12 dBV to -13 dBV (-1 dBm to +1 dBm for 50 Ω system spectrum analyzer).

12-4-17. Reference Oscillator Output

Specification: -5 dBm ±2 dB

Instruments required: * Spectrum analyzer

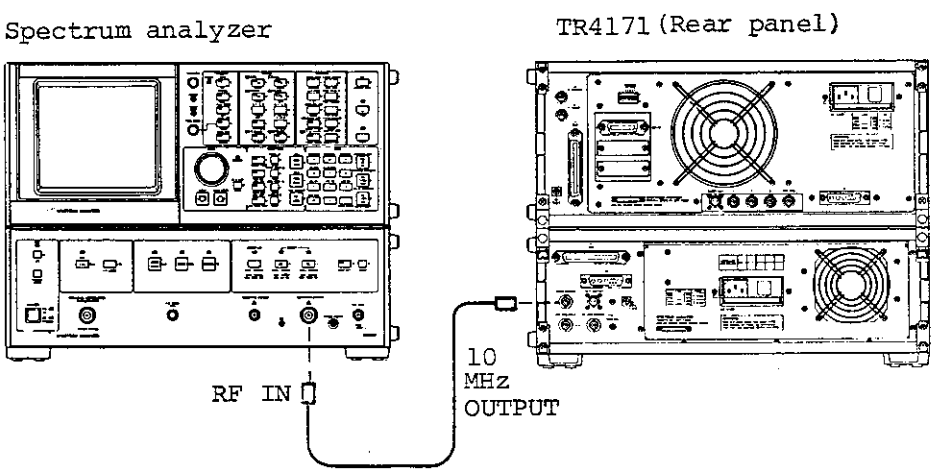


Fig. 12-20 Reference oscillator output test setup

Measure 10 MHz OUTPUT connector signal from the TR4171 using spectrum analyzer. Verify output level is -5 dBm ±2 dB.

12-4-18. Probe Power

Check PROBE POWER connector on front panel with a voltmeter. Check between floating 0 V pin and floating +15 V pin. Check between floating 0 V pin and floating -15 V pin. Do not connect +15 V and -15 V.

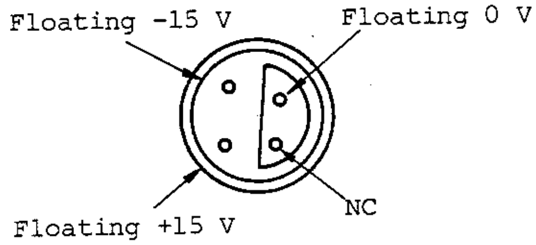


Fig. 12-21 Probe power pin assignment

12-5. TRACKING GENERATOR PERFORMANCE TEST

This subsection describes test procedures for tracking generator in the TR4171.

12-5-1. Output Level Accuracy and Frequency Response

Specification: Output level accuracy: ±0.5 dB at 10 MHz
Frequency response: For 10 MHz level;
±0.5 dB $+20^{\circ}C$ to $+30^{\circ}C$
±1.0 dB $0^{\circ}C$ to $+40^{\circ}C$

Instruments required: * Wattmeter
* Level meter

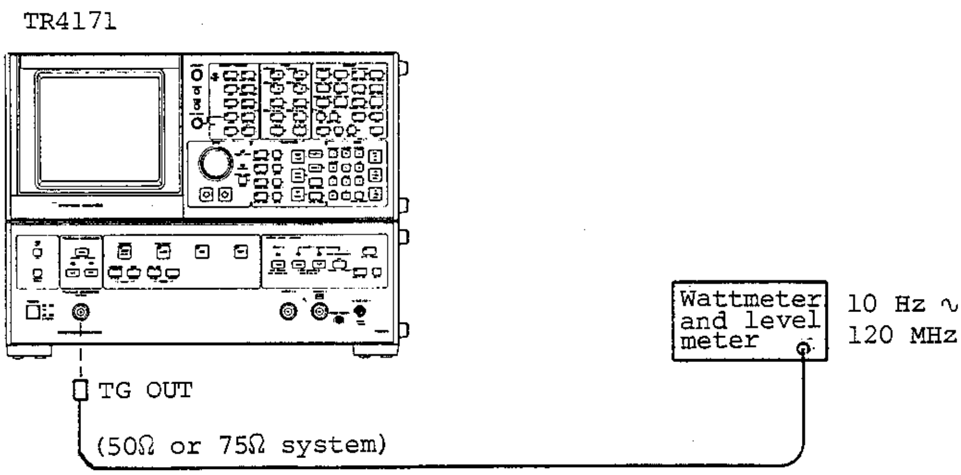


Fig. 12-22 Output level accuracy and frequency response tests setup

Press [MAG] key to activate tracking generator. Check output level level accuracy at 10 MHz and frequency response in range +10 dBm to -60 dBm. Repeat for frequency 10 Hz to 120 MHz.

12-5-2. Spurious

Specification: For fundamental wave level;
25 dB or less (Harmonic spurious)
30 dB or less (Nonharmonic spurious)

Instruments required: * Spectrum analyzer

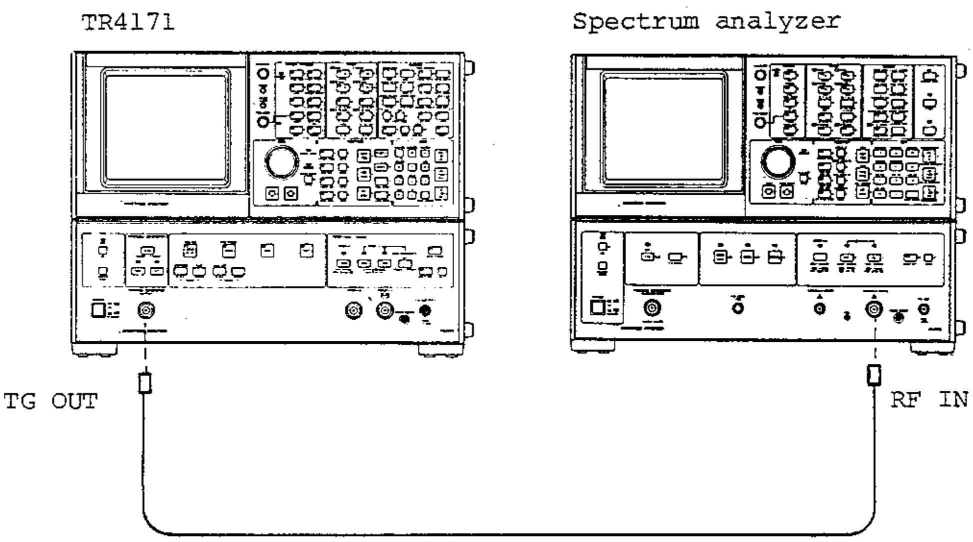
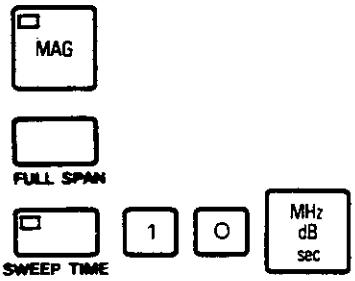


Fig. 12-23 Spurious test setup

Key in as follows:



(Although ten seconds need not be set, measurement becomes difficult for faster opration speed.)

Measure and verify TG output signal with spectrum analyzer.

Measurement need only be made up to 120 MHz x 3 = 360 MHz.

12-5-3. Output Impedance

Specification: For output level from +10 dBm to 0 dBm;

Return loss 23 dB min. in range 10 Hz to 30 MHz

Return loss 17 dBm min. in range 30 MHz to 120 MHz

For output level not exceeding 0 dBm;

Return loss 26 dB min. in range 10 Hz to 30 MHz

Return loss 20 dBm min. in range 30 MHz to 120 MHz

Instruments required: * Spectrum analyzer (with tracking generator)

* Directional bridge

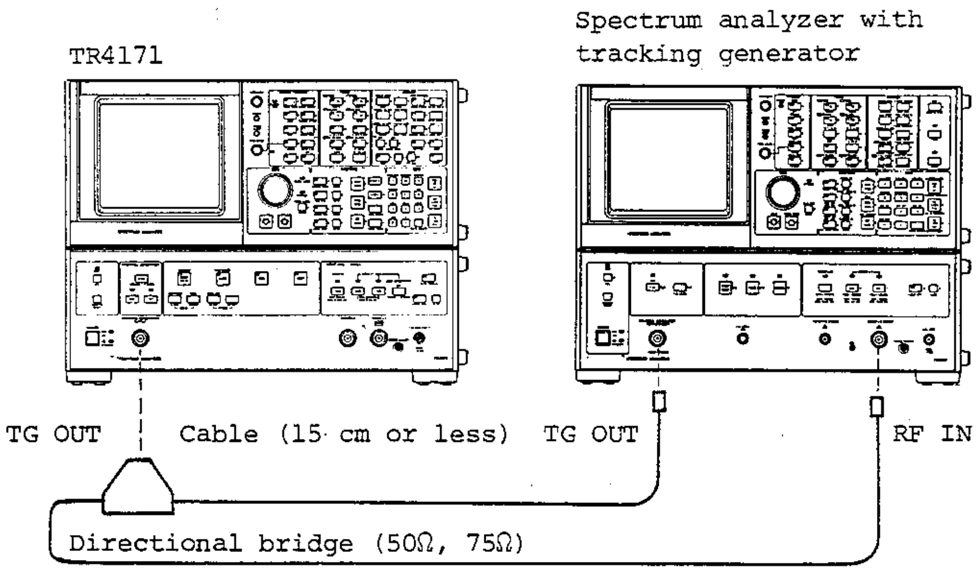


Fig. 12-24 Output impedance test setup

CAUTION

Cable between the TR4171 and directional bridge must not exceed 15 cm because accurate measurement is impossible with longer cable.

Set up test system as shown in Figure 12-24. While changing output level from +10 dBm to -60 dBm with tracking generator output impedance set to 50 Ω and 75 Ω, verify resultant values are within specified values. If return loss at 10 MHz conforms to specification, return loss at a frequency not exceeding 10 MHz is guaranteed to be in the specified range.

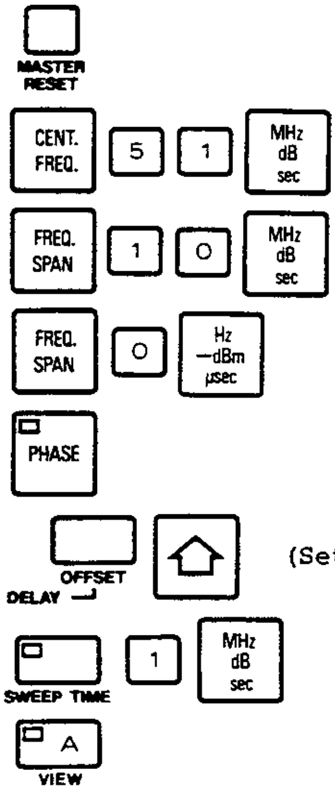
12-6. PHASE AND GROUP DELAY DISPLAY PERFORMANCE CHECK

This subsection describes check procedures for the phase and group delay (G.D.) display features contained in the instrument.

12-6-1. Phase Display Range Accuracy

Specification: ±3% at each display range (±180 ±5 deg.)

(1) Connect the TRACKING GENERATOR OUTPUT connector to the INPUT-1 connector, then key in as follows:



(Set G.D. offset to "600".)

(2) Press [PEAK SRCH] and then [SHIFT] [PEAK SRCH] to read the peak and bottom values on the CRT display. Verify that these values are within the specification of 180 ±5 deg. and −180 ±5 deg. respectively.

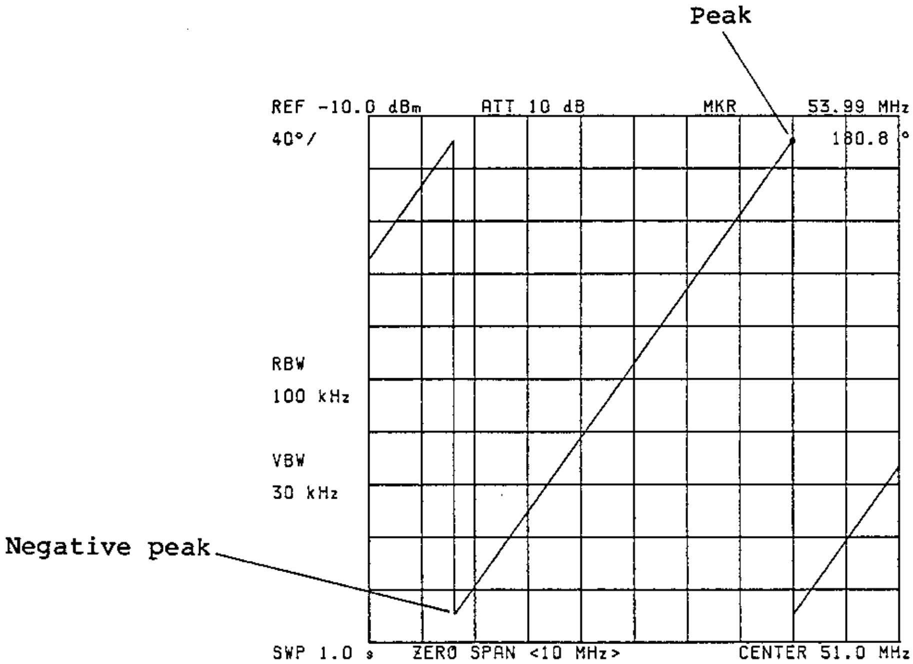
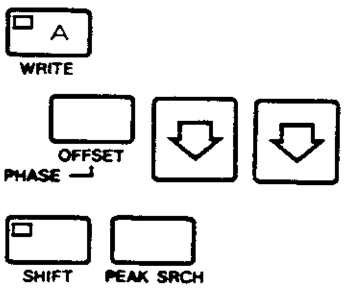


Fig. 12-25 Phase display range

12-6-2. Phase Offset

Specification: Must be variable over ±250 deg.

① After verifying the phase display range, proceed with the following panel setup:



(Set phase offset to "0".)

② While slowly turning the data knob to increase phase offset from 0 to 4096, verify that the marker on the display moves over more than 500 deg. as shown below:

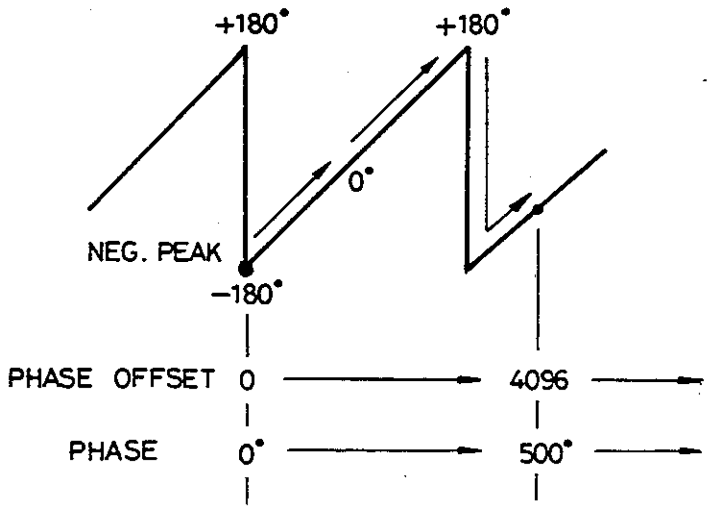


Fig. 12-26 Phase offset test

12-6-3. Group Delay Offset

Specification: Must be variable over more than 3600 deg.

① After verifying the phase offset, proceed with the following setup:
Press [OFFSET / DELAY] and then use [⇧] to set group delay offset to 2000.

② Press [SHIFT] [FINE / OFFSET / DELAY] again and then use [⇩] to set group delay offset fine to 0.

③ Now press [OFFSET / PHASE]. Adjust phase offset with the data knob so that the switching point from +180 deg. is aligned to the leftmost graticule as shown below:

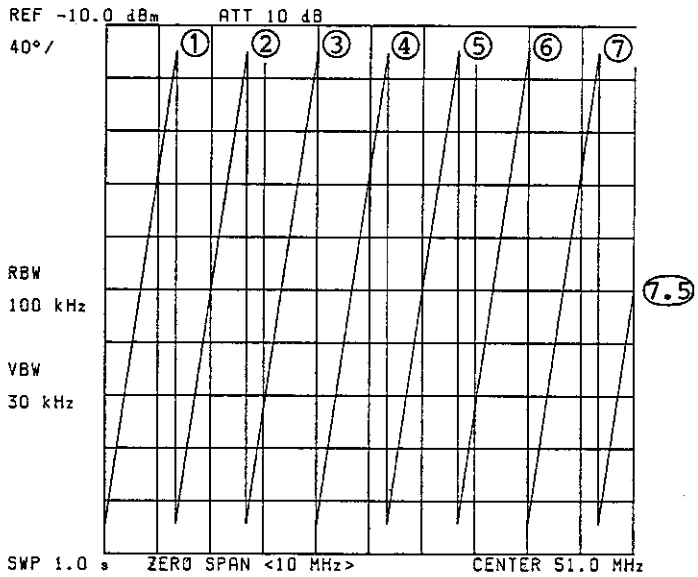


Fig. 12-27 Group delay offset test

④ Check to make sure that there are 7.5 saw-tooth waves (360° x 7.5 = 2700 deg.) between the leftmost and rightmost graticules. G.D. offset covers from 0 to 4096, which allows for phase variation of more than 5400 deg., since G.D. of 2000 corresponds to 2700 deg.

12-6-4. Group Delay Offset Fine

Specification: 50.6 deg. ±2.5 deg.

① After verifying G.D. offset, proceed with the following setup:
Press [OFFSET / DELAY] and then use [⇩] to set G.D. offset to 0.

② Press [OFFSET / PHASE]. Adjust phase offset with the data knob until the phase response is positioned to the center of the screen.

③ Press [SCALE / PHASE] . Set phase to 8 deg./div. with the data knob.

④ Press keys [SHIFT] [FINE / OFFSET / DELAY]. Adjust the data knob to set G.D. offset fine to 250.

⑤ Then press [PEAK SRCH] [Δ] [SHIFT] [PEAK SRCH] . Verify with the delta marker that the deviation read is within 50.6 ±2.5 deg.

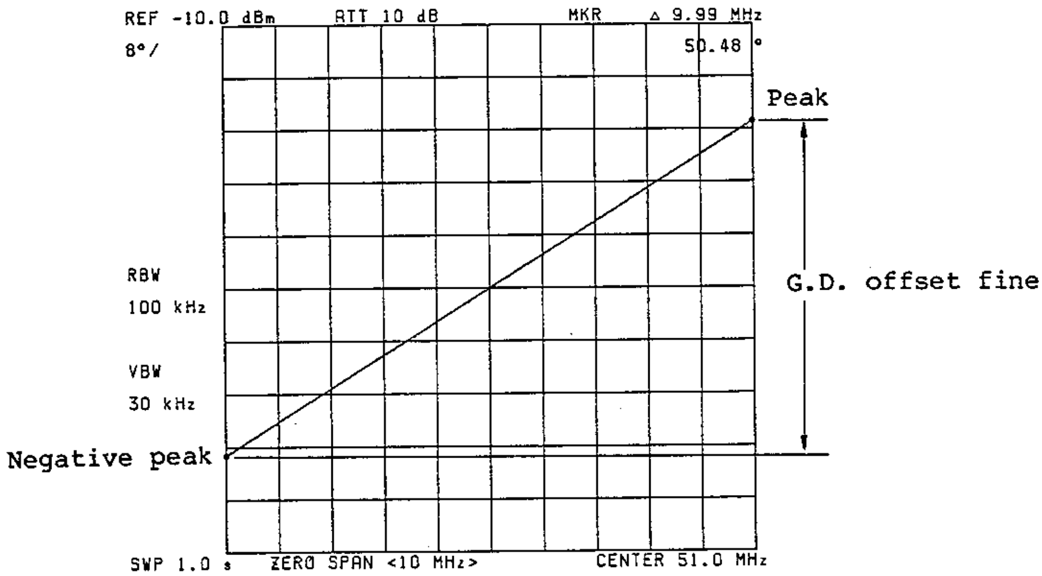


Fig. 12-28 G.D. offset fine

12-6-5. Group Delay Display Range Accuracy

Specification: ±3% at frequency span of 10 MHz, 40 deg./div. (20°C to 30°C)

① After verifying G.D. offset fine, proceed with this check. First press [SCALE └ PHASE] , then adjust the data knob to set the phase to 40 deg./div.

② Press [OFFSET DELAY ┘] and then use [⇧] to set G.D. offset to "40".

③ Press [GROUP DELAY] to obtain group delay display, then press [A VIEW] to store the waveform.

④ Use the delta marker to read the delay time shown in the following figure, and verify that the readout value is within ±3% (96 ns) of the display range.

⑤ press [A WRITE].

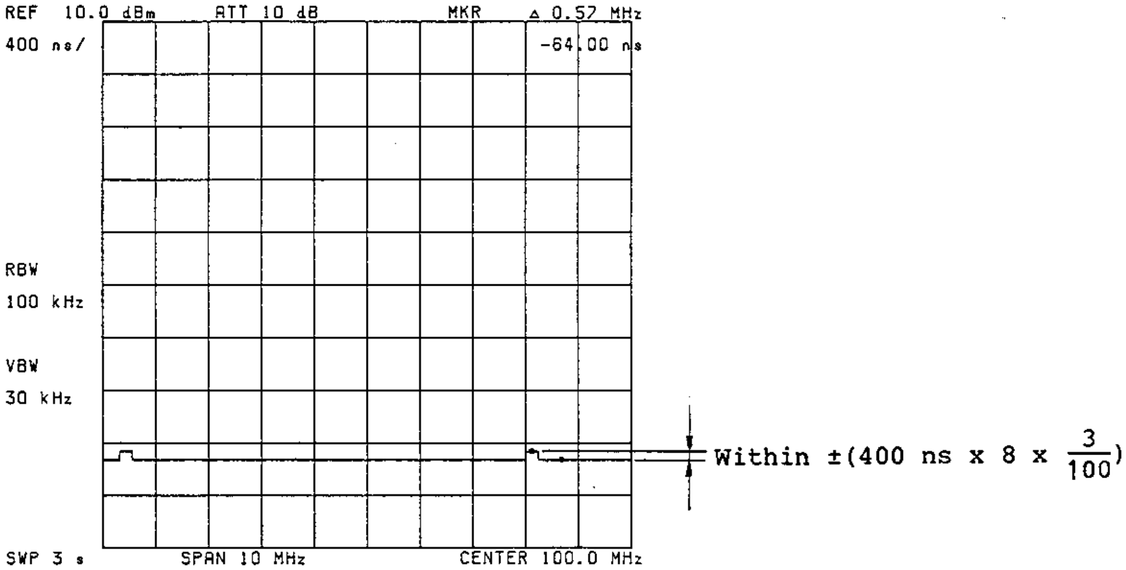


Fig. 12-29 Group Delay display range accuracy

12-6-6. Phase Stability

Specification: Less than 0.1 deg. p-p/100 ms at frequency span of 0 MHz, resolution bandwidth of 100 kHz, and video bandwidth of 30 kHz.

① After verifying G.D. display range accuracy, proceed with this check. First press [PHASE] [OFFSET / DELAY], then use [⇩] to set G.D. offset to 0.

② Press [SHIFT] [FINE / OFFSET / DELAY] and use [⇩] to set G.D. offset fine to 0.

③ Press [OFFSET / PHASE], then adjust the data knob until the signal response is positioned to the center of the vertical scale.

④ Press [SCALE / PHASE], then use the data knob to set the phase to 4 deg./div.

⑤ Press [OFFSET / PHASE], then adjust the data knob until the signal response is positioned to the center of the vertical scale.

⑥ Press [SCALE / PHASE], then use the data knob to set the phase to 0.2 deg./div.

⑦ Verify that the ripple within one division of the horizontal scale is less than 0.5 div. (0.1 deg.) as shown below.

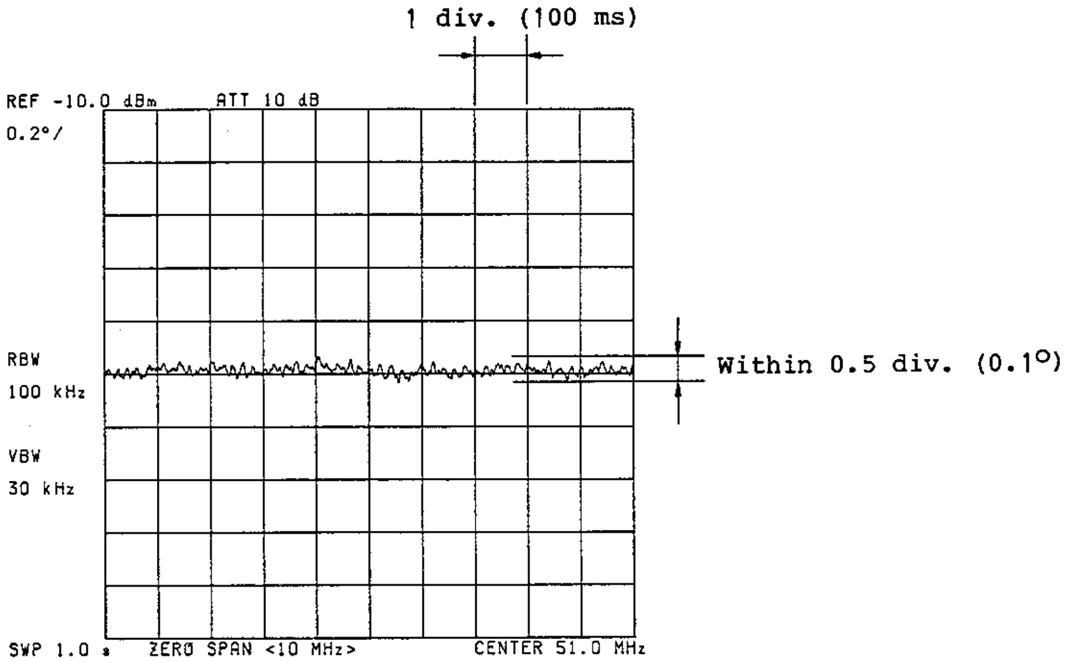


Fig. 12-30 Phase stability check

12-7. SUPPLY VOLTAGE VARIATION CHECK

Specification: ±10% (+4%, -10% for 240 Vac)

Instruments required: Slidac transformer
AC voltmeter (for voltage monitoring)

① While monitoring the AC output voltage of the slidac transformer with an AC voltmeter, set it to the specified supply voltage.

② Plug the analyzer to the AC outlet on the slidac transformer.

③ Power the instrument. While it is in the initial default condition, apply the CAL. OUT. signal to the input.

④ While varying the slidac transformer output voltage from -10% to +10% (+4% for 240 V) of the specified supply voltage, verify that nothing changes in the display information.

		Test item			Specification
Performance test not requiring measuring instrument	1	Frequency span accuracy	Frequency span > 50 kHz		±3%
			Frequency span ≦ 50 kHz		±5%
	2	Marker indication accuracy	Marker indication accuracy		±{(Center frequency accuracy) + (Frequency span accuracy)}
			TG counter mode		±{(Reference oscillator accuracy) x (Indicated frequency) + (2 counts) + $(\frac{\text{Frequency span}}{100})$}
			Frequency counter mode		±{(Reference oscillator accuracy) x (Indicated frequency)} ±2 counts
	3	Resolution bandwidth accuracy	3 dB bandwidth		±20% (100 kHz, 30 kHz to 3 Hz)
			QP value measurement 6 dB bandwidth (option)	200 Hz	200 Hz ±20 Hz
				9 Hz	9 kHz ±1 kHz
	4	Resolution bandwidth selectivity	60 dB:3 dB resolution bandwidth ratio		11:1 or less
			80 dB:3 dB resolution bandwidth ratio		18:1 or less
	5	Resolution bandwidth switching level accuracy	3 Hz to 30 kHz with reference to resolution bandwidth of 100 kHz		±1.0 dB (+20°C to +30°C) ±2.0 dB (0°C to +40°C)
	6	IF gain error			±1.0 dB (when reference level is changed with input attenuator fixed)
	7	Frequency stability	Frequency span > 50 kHz		Drift: 1 kHz/m or less, 10 kHz/30 m or less Residual FM: 200Hzp-p/s or less
			50 kHz ≦ Frequency span > 5.0 kHz		Drift: 20 Hz/m or less, 200 Hz/30 m or less Residual FM: 1 Hzp-p/s or less
			Frequency span ≦ 5.0 kHz		Drift: 1 Hz/m or less, 10 Hz/30 m or less Residual FM: 0.2 Hzp-p/s or less

		Test item		Specification
Performance test not requiring measuring instrument	8	Noise side band	Average at a position 20 kHz apart from carrier frequency	-125 dBc/Hz
			Average at a position 100 Hz apart from carrier frequency	-100 dBc/Hz
	9	Reference level accuracy after error correction	20 MHz center frequency	±0.5 dB max. (frequency response is added for other frequencies.)
	10	Logarithmic scale switching error		±0.5 dB
	11	RF gain error	When center frequency is changed for frequency span ≦ 50 kHz.	±0.2 dB
	12	Residual response	0 dB input attenuator	-110 dBm or less
	13	Average noise level	Resolution bandwidth of 3 Hz, video bandwidth of 1 Hz, input attenuator of 0/ dB	-140 dBm or less
			Resolution bandwidth of 3 Hz, video bandwidth of 1 Hz, and input attenuator of 0 dB in 50 Ω/75 Ω high sensitivity mode	-155 dBm or less
	14	Auto range	When input level to analyzer is equal to or greater than -30 dBm.	Input attenuator is automatically adjusted so the value obtained by subtracting input attenuator attenuation from input level is in a range -30 dBm to -35 dBm.
Performance tests by measuring instruments	15	Center frequency accuracy	After error correction	±{(1% of frequency span) + (Reference oscillator accuracy x Tuning frequency) + 1 Hz}
			When error correction is not conducted.	±{(1% of frequency span) + (Reference oscillator accuracy x Tuning frequency) + 1 Hz}±{(10% of resolution bandwidth) + 20 Hz}

		Test item				Specification
Performance test by measuring instruments	16	Zero span display accuracy		After error correction		±{(1% of resolution bandwidth) + (Reference oscillator accuracy x Tuning frequency) + 1 Hz}
				When error correction is not conducted.		±{(10% of resolution bandwidth) + (Reference oscillator accuracy x Tuning frequency) + 20 Hz}
	17	Start/stop frequency accuracy				(Center frequency accuracy) + (Frequency span accuracy x 1/2)
	18	Vertical scale linearity	Logarithmic scale	0 dB to 0.8 dB	0.1 dB/div.	±0.02 dB/div.
				0 dB to 95 dB	1 dB/div.	±0.2 dB/div.
				0 dB to 95 dB (20 °C to 30 °C)	10 dB/div.	±1 dB/div.
				0 dB to 95 dB (0 °C to 40 °C)	10 dB/div.	±1.5 dB/div.
			Linear scale			±3% of reference level
	19	Frequency response		Input attenuator: 0 dB to 65 dB, 10 MHz	50 Ω, 75 Ω 1 MΩ input	±0.7 dB
					50 Ω/75 Ω high sensitivity mode	±1.0 dB
	20	Spurious response	Harmonic distortion	When value obtained by subtracting input attenuator attenuation from input level is -30 dBm.		-80 dB or less
				When value obtained by subtracting input attenuator attenuation from input level is -40 dBm.		-90 dB or less

		Test item			Specification
Performance test by measuring instrument	20	Spurious response	Harmonic distortion	When value obtained by subtracting input attenuator attenuation from input level is -60 dBm.	-60 dB or less
			Two-signal tertiary intermodulation distortion	When value obtained by input attenuator attenuation from two signal levels not exceeding 200 kHz are -30 dBm	-75 dB or less
				When values obtained by subtracting the input attenuator attenuation from two signal levels not exceeding 200 kHz are -30 dBm	-80 dB or less
				When values obtained by subtracting input attenuator attenuation from two signal levels in the 50 Ω/75 Ω high sensitivity mode are -55 dBm	-70 dB or less
	21	Gain compression		Input attenuator of 0 dB, 0 dBm input	≧1 MHz, 0.5 dB or less
					<1 MHz, 2 dB or less
				Input attenuator of 0 dB, -30 dBm input in the 50 Ω/75 Ω high sensitivity mode	≧1 MHz, 0.5 dB or less
					<1 MHz, 2 dB or less
	22	Overload warning		50 Ω/75 Ω input	Overload warning is indicated on front panel LED and CRT display when a signal equal to or greater than +30 dBm (1 Watt) is input.
	23	50 Ω/75 Ω input impedance		50 Ω/75 Ω input	Return loss not less than 20 dB in range 30 MHz to 120 MHz
					Return loss not less than 26 dB in range 10 Hz to 30 Hz
				50 Ω/75 Ω high sensitivity mode	Return loss of 16 dB or greater

		Test item				Specification
Performance test by measuring instrument	24	Input attenuator accuracy	With reference to 0 dB, at 10 MHz	50 Ω/75 Ω input		±0.1 dB
				1 MΩ		±0.5 dB
	25	Local emission		Input attenuator of 0 dB		-80 dBm or less
	26	Isolation between inputs				80 dB or greater
	27	Calibration output signal				-10 dBm ±0.3 dB
	28	IF output		3.3 MHz, at the reference level		-12 dBV to -14 dBV
	29	Reference oscillator output				-5 dBm ±2 dB
TG performance test	30	TG output level accuracy		Output frequency of 10 MHz		±0.5 dB
	31	TG frequency response		With respect to reference level measured at output frequency 10 MHz	$+20^{\circ}C$ to $+30^{\circ}C$	±0.5 dB
					0 to $+40^{\circ}C$	±1.0 dB
	32	TG output spurious		With respect to fundamental wave level	Harmonic spurious	25 dB or less
					Nonharmonic spurious	30 dB or less
	33	TG output impedance		Output level of +10 dBm to 0 dBm		Return loss not less than 23 dB in range 10 Hz to 30 MHz
						Return loss not less than 17 dB in range 30 MHz to 120 MHz
				Output level not exceeding 0 dBm		Return loss not less than 26 dB in range 10 Hz to 30 MHz
						Return loss not less than 20 dB in range 30 MHz to 120 MHz
	34	Phase display range accuracy		In each display range		$\pm 180^{\circ} \pm 5^{\circ}$

		Test item		Specification
TG performance test	35	Variable range of phase offset		±250° or more
	36	Variable range of group delay offset		3600° or more
	37	Variable range of group delay offset fine adjustment		50.6° ±2.5° or less
	38	Group delay display range accuracy	Frequency span of 10 MHz, 40°/div.	±3%
	39	Phase stability	Frequency span of 10 MHz, resolution bandwidth of 100 kHz, video bandwidth of 30 kHz	0.1°p-p/100 ms or less
	40	Power fluctuation	When 100 Vac is applied.	±10%
			When 240 Vac is applied.	+4%, -10%

MEMO

SECTION 13

TROUBLESHOOTING

13-1. INTRODUCTION

This section describes TR4171 troubleshooting procedures. Conduct performance tests and calibration before using a repaired instrument. Reference numbers and symbols used in this section are the same as those in circuit diagrams and boards.

13-2. TROUBLESHOOTING PREPARATION

Instruments, tools, jigs, and general precautions are as follows. Use test instruments listed in Table 13-1.

Table 13-1 Instruments required for troubleshooting

No.	Instrument	Performance	Recommended model
1	Signal generator	Frequency: 10 MHz to 500 MHz Output level: +10 dBm to -30 dBm Output impedance: 50 Ω	TR4511 (ADVANTEST)
2	Frequency counter	Frequency: 10 MHz to 4 GHz Input sensitivity: -20 dBm Stability: 2×10^{-8}/day	TR5211A (ADVANTEST)
3	Digital multimeter	Measurement range: 0 V to ±1000 V Accuracy: ±0.1% Input impedance: 10 MΩ	TR6840 (ADVANTEST)
4	AC high-voltage probe	Measurement range: -3 kV to +12 kV	TR1116 (ADVANTEST)
5	Spectrum analyzer	Frequency: 100 kHz to 4 GHz Sensitivity: -120 dBm Resolution: 30 Hz to 300 kHz	TR4172 (ADVANTEST)
6	FET probe	Measurement range: DC, up to 500 MHz	Model P6202 (Tektronix)
7	Oscilloscope	Frequency: DC, up to 100 MHz Sensitivity: 5 mV	Model 465 (Tektronix)

Table 13-2 lists needed jigs and cables. These items are contained in a supplied maintenance kit. Table 13-3 lists required tools.

Table 13-2 Needed jigs and cables (maintenance kit: A08806)

No.	Item name	Stock No.	Quantity	Remarks
1	Connection cable	DCB-FF0906-1	1	BNC-UM
2	Connection cable	DCB-FF1211x01-1	1	SMA-SMA
3	Connection cable	DCB-FF0969x16A-1	6	UM-UM
4	UM-UM adapter	JCF-AC001Jx07-1	1	
5	Extender board 1	BGP-010863	1	28-pin, double x 2
6	Extender board 2	Z560	1	28-pin, double
7	Maintenance-1 board	BGD-012450	1	Block lead
8	Maintenance-2 board	BLB-012451	1	Block lead
9	Connection cable	DCB-SS0020-1	1	Amphenole, 50 pins
10	Connection cable	DCB-SS1560x02-1	1	RF cable
11	Extension cable	DCB-PS1138x01-1	3	5 pins, 30 cm, for CRT
12	Standard pattern scale	MPH-20803A-1	1	
13	SMA and conhex wrench	MBZ-28734A-1	1	

Table 13-3 Needed tools

(1) Philips screwdriver + (3 mm, 4 mm)
(2) Philips screwdriver - (2 mm, 4 mm)
(3) Allen wrench
(4) Soldering iron (30 W)
(5) Tweezers
(6) Radio pliers
(7) Nipper
(8) Box driver
(9) Core driver

13-2-1. General Precautions

(1) TR4171 troubleshooting procedures are prepared for electronic engineers and those experienced in repairing measuring instruments.

(2) AC power must be: 100 V, 120 V, 220 V ±10%; 240 V +4%, -10% with line frequency of 50 Hz or 60 Hz.

(3) Power cable plug includes three prongs. The center round prong is for grounding. Cable from the adapter and the grounding terminal GND on the rear panel of the TR4171 body must be connected to an external earth. This is done when the plug is connected to a receptacle using the adapter.

(4) Perform tests in a place free from dust, vibration, and noise.

(5) Set POWER switch to STANDBY before inspecting components inside the TR4171. Before changing a circuit board, set POWER switch to STANDBY.

(6) When measuring with an oscilloscope or digital voltmeter, do not bring the lead wire of a terminal or component is the area into contact with the measuring instrument.

(7) When replacing a faulty circuit board component, use 20 W to 30 W soldering iron. Solder quickly. Semiconductors and printed patterns may be damaged if soldering is too slow. Use a solder absorber when removing a component.

(8) For parts replacement, use parts list in Section 14. For parts marked with an asterisk, notify your nearest ADVANTEST representative.

(9) High voltage is applied to the TR4171. Guard against shock when troubleshooting high voltage blocks. Replace parts at least five minutes after POWER switch is set to STANDBY.

13-3. CHANGING BOARD AND BLOCK

Refer to disassembly/assembly diagrams (Section 14) and photos in this section to change a board and block correctly.

13-3-1. Separation between Display and RF Sections

Remove cables connecting display and RF sections. Remove fixing screws from rear panel.
Draw display section toward front panel side. Disconnect front panel. Separate display section from RF section.

13-3-2. Changing Board and Block in Display Section

(1) Display power 1 (BGC-011865)
Remove board (Figure 13-2) and install extender boards if necessary.

(2) Display power 3 (BGC-010369)
Remove four fixing screws (Figure 13-2). Remove board. Install extender boards if necessary.

(3) Display power 2 (BGB-010199)
Remove display power 3 board described in item (2). Release two screws fixing the connector (Figure 13-2). Remove connector. Remove board and check parts.

(4) Display power 4 (BLB-010202)
Remove left-side panel of display section. Remove board by referring to disassembly diagram.

(5) CRT driver (BGK-010184)
Remove board (Figure 13-2) and install needed extender boards if necessary. Connect respective connectors by using extension cables.

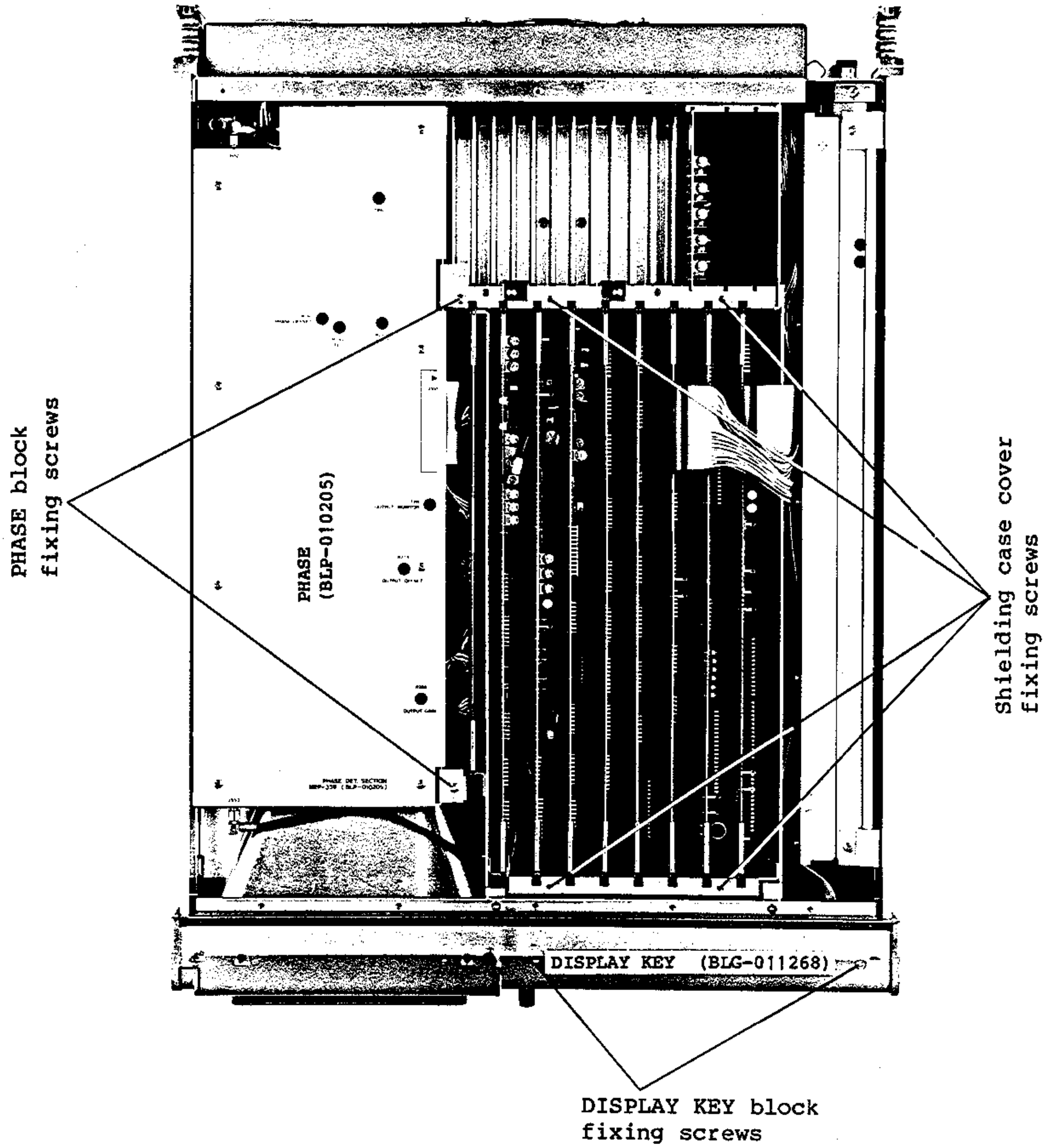


Fig. 13-1 Display section top view (1)

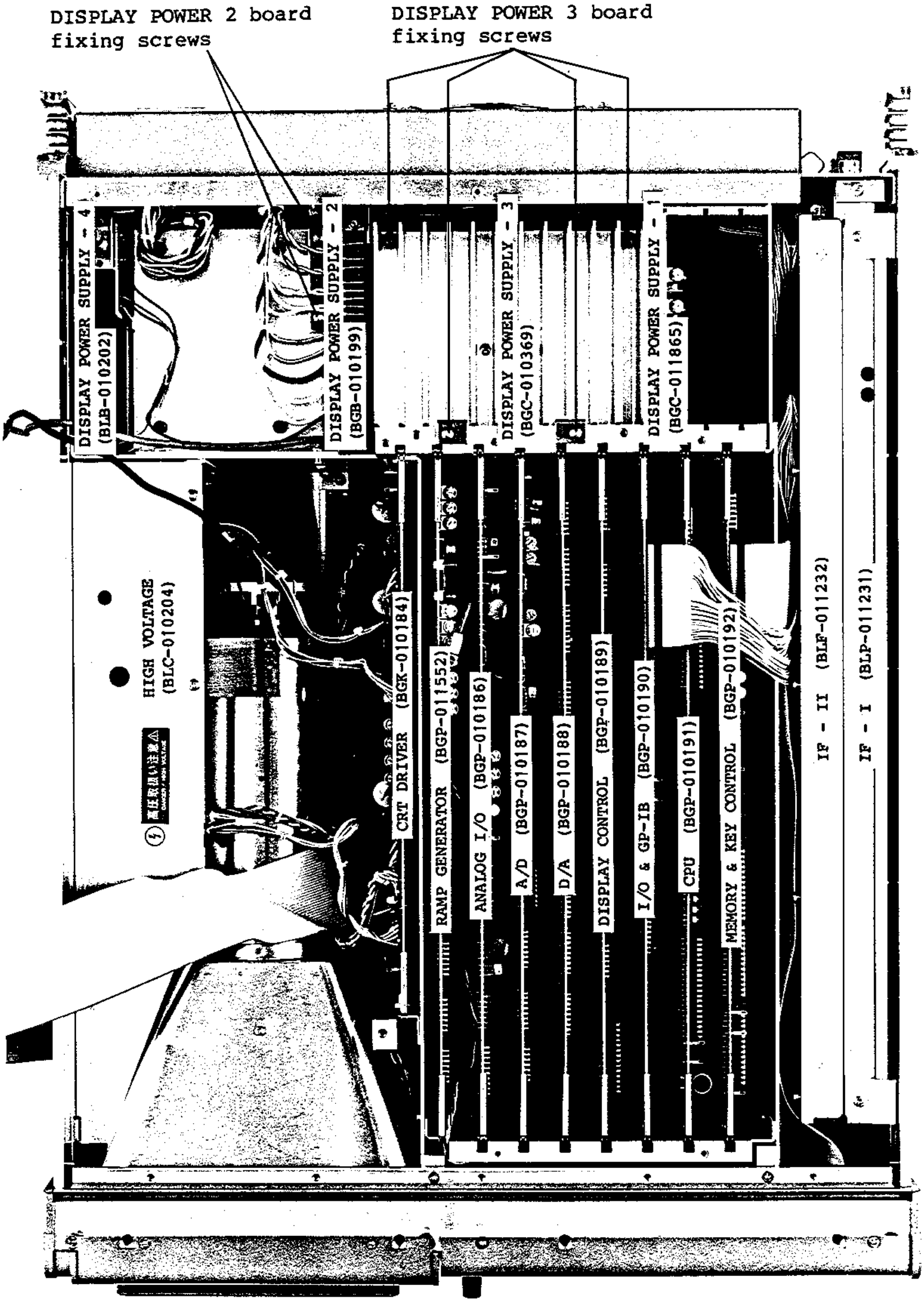


Fig. 13-2 Display section top view (2)

(6) Shielding case board

Remove GPIB and key control cables. Release four screws fixing the shielding case cover (Figure 13-1). Remove board retainer holding the board. After removing board, install extender boards if necessary.

Ramp generator board (BGP-010552)
Analog I/O board (BGP-010186)
D/A converter board (BGP-010188)
A/D converter board (BGP-010187)
I/O and GPIB board (BGP-010190)
CPU board (BGP-010191x02)
Memory board (BGP-010192x02)
Display control board (BGP-010189)

(7) MEP-401 (IF block) (Figures 13-2, 3, and 5)

Remove four fixing screws (Figure 13-3). Move IF block toward front panel side. Pull out input connector section through the installation hole. Remove MEP-401 from mainframe. Before troubleshooting the IF-1 and IF-2 boards, remove cover fixing screws.

(8) MEP-339 (phase block)

Remove MEP-339 top cover by referring to disassembly diagram. Before demounting MEP-339, remove three fixing screws (Figure 13-4) and two fixing screws (Figure 13-1).

(9) MEP-337 (logarithmic block)

Remove screws fixing the top cover and screws fixing the internal IC heat sink. Take top cover away by referring to disassembly diagram. Before demounting MEP-337, remove three fixing screws (Figure 13-4) and two fixing screws (Figure 13-5).

(10) MEP-354 (display key block)

Referring to disassembly diagram, remove belt cover and INTENSITY, VIDEO, and TRIGGER controls. Release four fixing screws (Figures 13-1 and 13-5). Take out MEP-354.

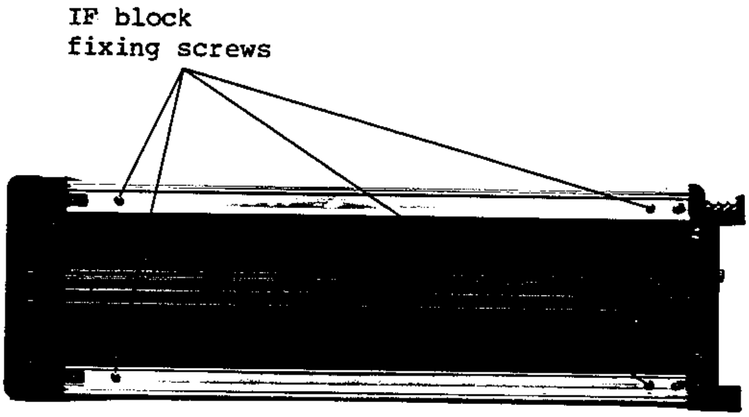


Fig. 13-3 Right-side view of display section

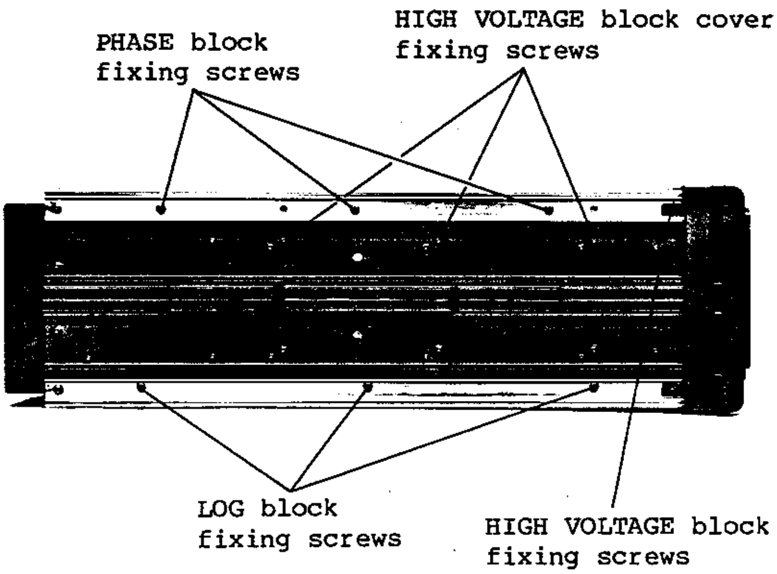


Fig. 13-4 Left-side view of display section

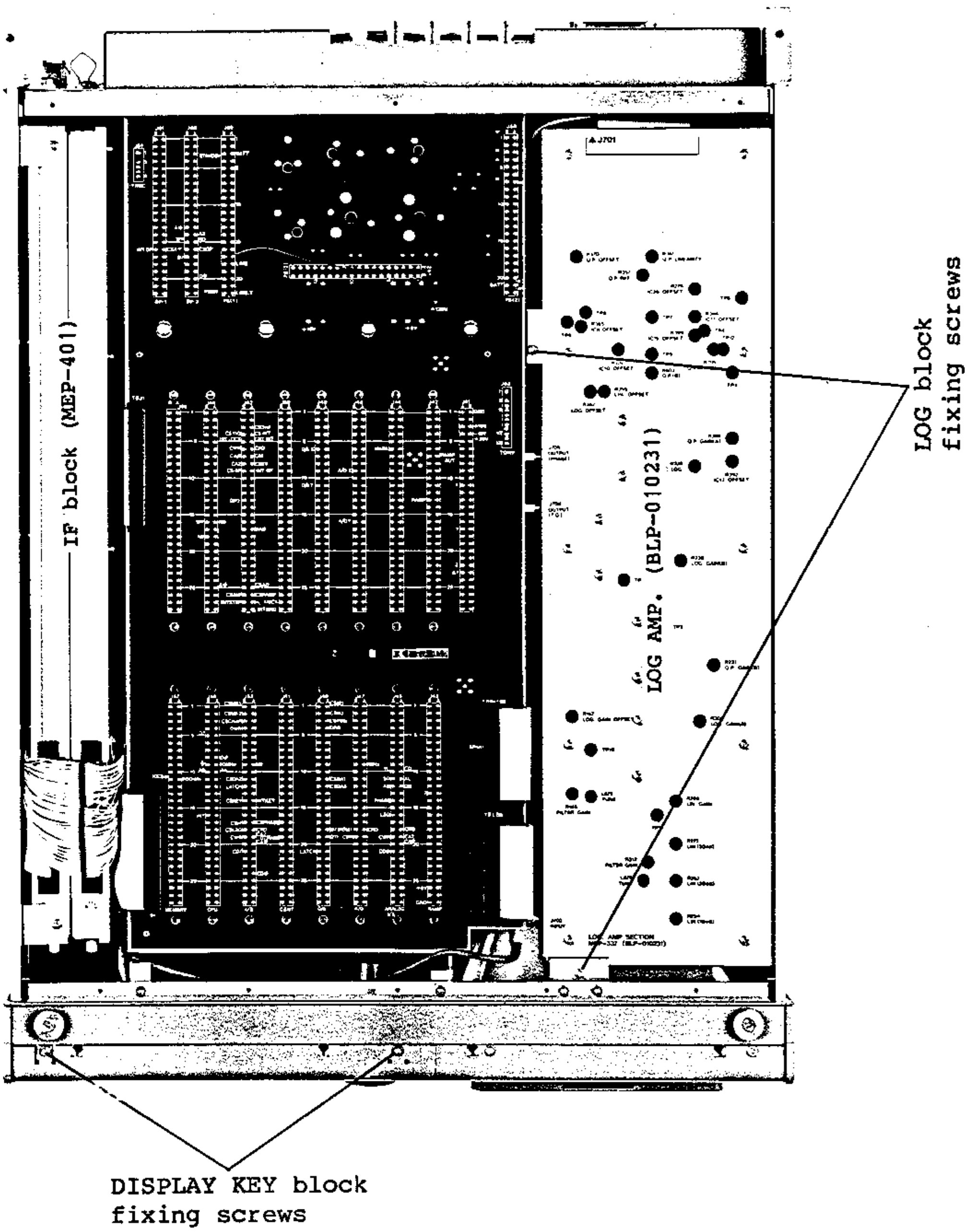


Fig. 13-5 Bottom view of display section

(11) High-voltage block (BLC-010204)

Referring to item (8), take out MEP-339.

Remove rear foot and side plate by referring to the disassembly diagram. Release six screws fixing the high-voltage block cover (Figures 13-4 and 13-6).

Remove six screws fixing the board (Figure 13-4). Take out high-voltage block. Fix it on the mainframe using these screws (Figure 13-7). Then troubleshoot devices.

High-voltage block is quite dangerous. Avoid shock during troubleshooting.

(12) CRT

Wait five minutes after the power is turned off. Referring to items (8) and (11), remove high-voltage block cover. Take away anode cap from CRT. Remove CRT socket disposed on CRT rear panel. Referring to the disassembly diagram, remove CRT filter. Release four screws fixing the CRT (Figure 13-8). Push out CRT from rear side.

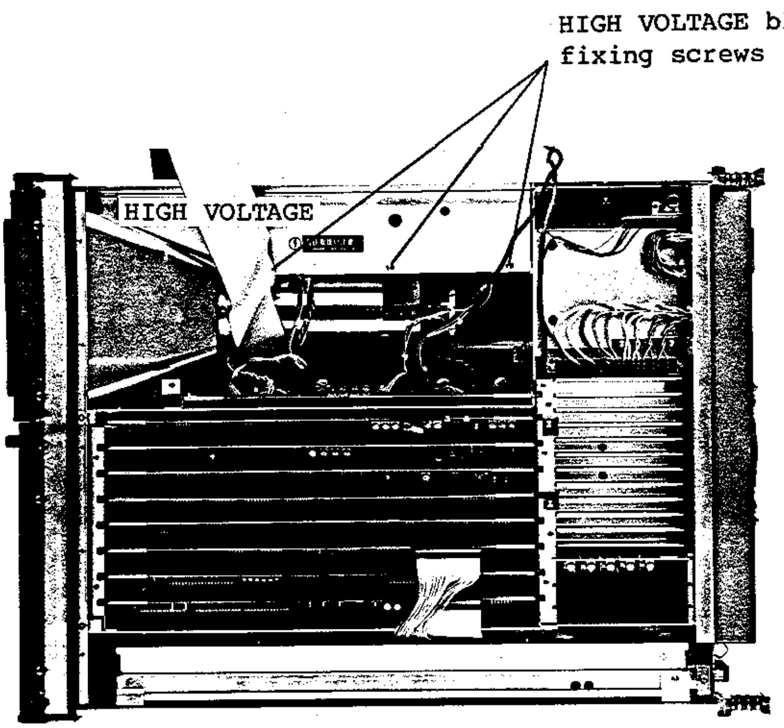


Fig. 13-6 High-voltage block

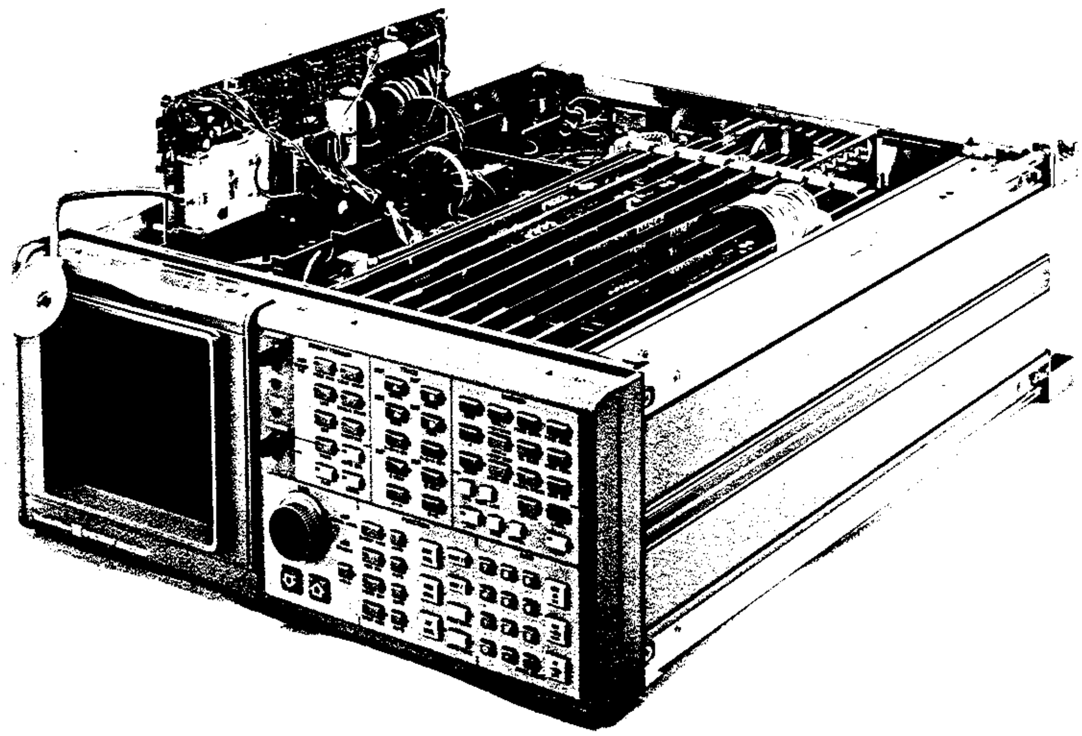


Fig. 13-7 High-voltage block reassembly

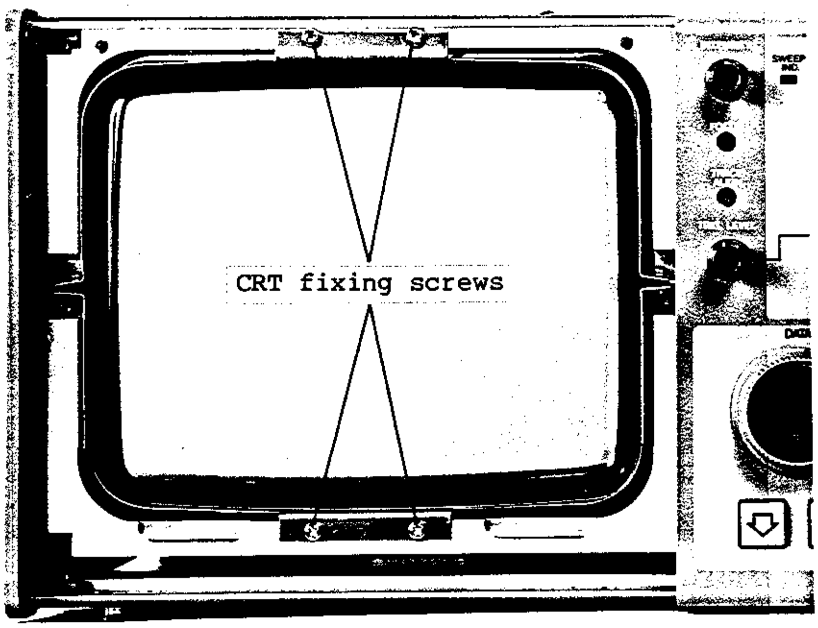


Fig. 13-8 CRT fixing screws

13-3-3. Changing Board and Block in RF Section

(1) RF power (BGF-011218) board

Remove eight screws fixing power supply cover on RF section rear side. Take away power board by holding the heat sink plate.

(2) Local driver (BGN-011225) and address decoder (BGN-011226) boards

Remove screws fixing the board supporter holding the sides of each board. Remove all connectors and take out boards.

(3) MEP-404 (input block)

Remove all cables and connectors fixed to block. Release from upper surface two fixing screws disposed on front side and two fixing screws on rear side. Take out MEP-404. Block can be removed by pulling it backward. This is similar to removing BNC connectors on INPUT-1 and INPUT-2 from the front panel.

(4) MEP-408 (TG ATT block)

Remove all cables and connectors fixed to block. Release two fixing screws disposed on the rear side of upper surface and one fixing screw disposed on front side of bottom surface. Take out MEP-408. Take out MEP-408 block like input block. This is similar to removing BNC connectors from front panel.

(5) MEP-405 (RF block), MEP-406 (first local block), and MEP-407 (second/third block)

Remove all cables connected to each block. For each block, release two fixing screws on front side and two fixing screws on rear side of upper surface and four fixing screws disposed on bottom surface. Take out block by holding brackets on block sides.

(6) MEP-409 (TG block) and MEP-410 (counter block)

Remove all cables connected to each block. Release fixing screws on front side and fixing screw on rear side of upper surface and two fixing screws disposed on bottom surface. Take out block by holding brackets on block sides.

(7) YIG

Remove MEP-405 (RF block) as described before. Release screws fixing the YIG chassis to the mainframe on upper side and two screws fixing them on bottom side. Take out YIG together with YIG chassis. Remove four screws fixing YIG to YIG chassis.

(8) MEP-411 (STD. OSC. block)

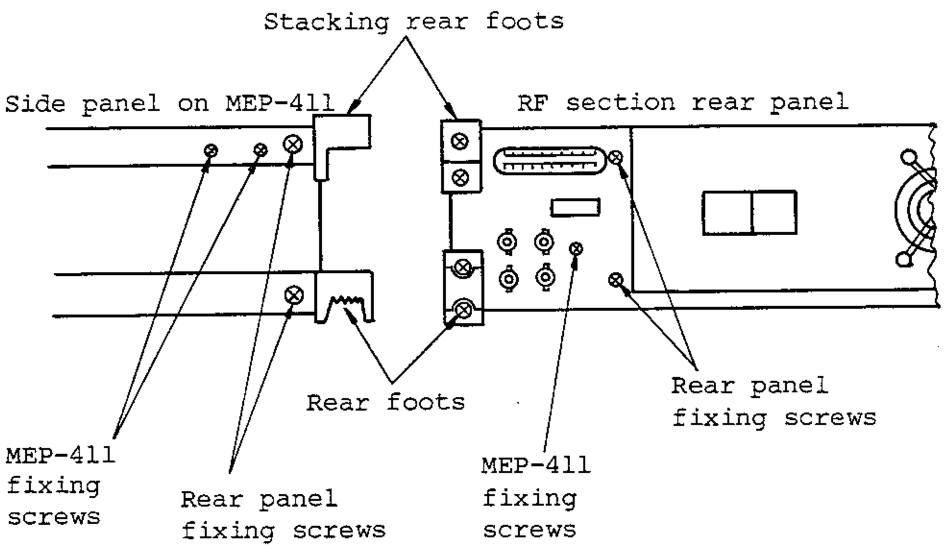


Fig. 13-9 Demounting standard oscillator block

Release two screws fixing the stacking rear foots and two screws fixing the rear foots on MEP-411 side. Remove MEP-411. Release three screws fixing MEP-411 (Figure 13-9). While pulling rear panel backward slightly to enlarge MEP-411 removing hole, take out MEP-411 downward from the main frame.

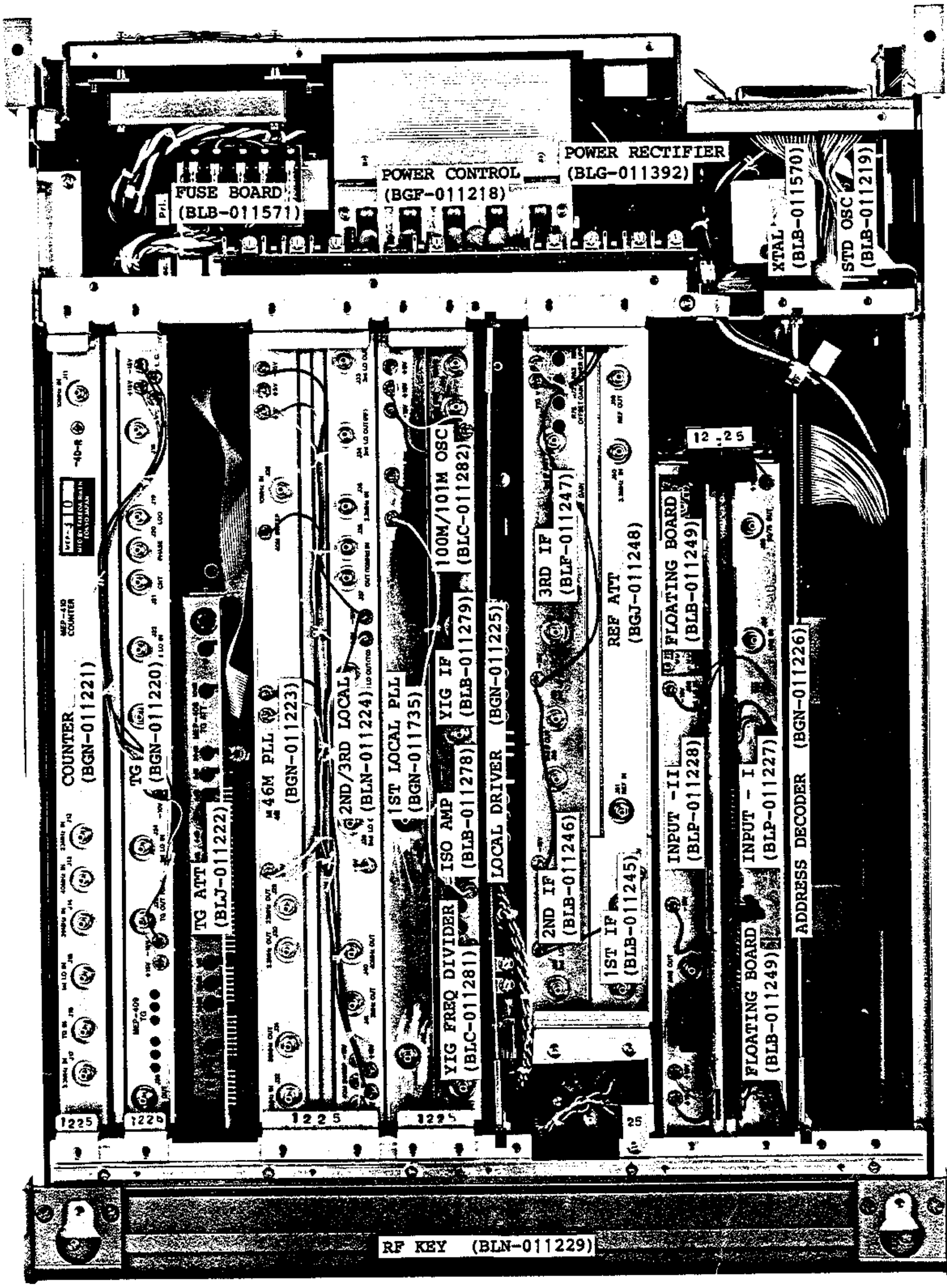


Fig. 13-10 RF section top view

13-4. FAULTY BOARD OR BLOCK JUDGEMENT

The following table lists the correspondences between faults and boards/blocks to be checked. Panel keyboard, power supply, CPU board (BGP-010191x02), and MEMORY board (BGP-010192x02) are omitted because the information is common to all.

Troubleshoot by referring to Section 10, Section 11, and Table 13-4.

<u>Faults associated with frequency</u>

Fault		Boards/blocks to be checked
Frequency span accuracy	Frequency span > 50 kHz	● YIG. OSC. ● Local driver board (BGN-011225) ● First local block (MEP-406)
	Frequency span ≦ 50 kHz	● Local driver board (BGN-011225) ● Second/third local block (MEP-407)
● Center frequency accuracy ● Start/stop frequency accuracy ● Marker indication accuracy		● YIG. OSC. ● Local driver board (BGN-011225) ● First local block (MEP-406) ● Second/third local block (MEP-407) ● CNT block (MEP-410) ● STD OSC block (MEP-411) ● TG block (MEP-409)
Reference oscillator stability		● STD OSC block (MEP-411)
Resolution		● IF block (MEP-401)
Stability	Frequency span > 50 kHz	● YIG. OSC. ● Local driver board (BGN-011225) ● First local block (MEP-406)
	Frequency span ≦ 50 kHz	● Local driver board (BGN-011225) ● Second/third local block (MEP-407)
Noise side band		● STD. OSC. (MEP-411) ● First local board (MEP-406)
● SIGNAL TACK ● Δ ● MKR/Δ → CF/SPAN ● ZOOM ● AUTO TUNE		Same as for center frequency accuracy.

Faults associated with amplitude

Fault		Boards/blocks to be checked
Linearity		• Logarithmic block (MEP-337) • Analog I/O board (BGP-010186)
IF gain error		• IF block (MEP-401) • Logarithmic block (MEP-337)
Resolution bandwdith switch level accuracy		• IF block (MEP-401)
Logarithmic scale switching error		• Analog I/O board (BGP-010186)
RF gain error		• RF block (MEP-405)
Frequency response		• RF input block (MEP-404)
Linearity (after error correction)		• RF block (MEP-405)
Spurious response	Harmonic distortion	• RF input block (MEP-404)
	Two-signal tertiary intermodulation distortion	• RF input block (MEP-404) • RF block (MEP-405) • IF block (MEP-401)
Video bandwidth		• Analog I/O board (BGP-010186)
Average noise level		• RF input block (MEP-404) • RF block (MEP-405) • IF block (MEP-401)
Gain compression		• RF input block (MEP-404) • RF block (MEP-405) • IF block (MEP-401)

Faults associated with sweep operation

Fault	Boards/blocks to be checked
• Sweep time • Trigger	• Ramp generator board (BGP-010552)

Faults associated with input

Fault	Boards/blocks to be checked
• Overload indication • Input impedance • Input attenuator accuracy • Auto range • Local emission • Isolation between inputs	• RF input block (MEP-404)

Faults associated with display

Fault	Boards/blocks to be checked
• Faults associated with characters, graticule scale, waveforms displayed on CRT	• CRT • CRT driver board (BGK-010184) • High-voltage board (BLC-010204) • Analog I/O board (BGP-010186) • A/D converter board (BGP-010187) • D/A converter board (BGP-010188) • Display control board (BGP-010189)

Faults associated with output

Fault	Boards/blocks to be checked
Calibration output signal	• STD. OSC. block (MEP-411) • RF input block (MEP-404)
Probe power	• RF section power
IF output	• IF block (MEP-401)
Reference oscillator output	• STD. OSC. block (MEP-411)
GPIB data output	• I/O & GPIB board (BGP-010190)
Faults associated with tracking generator	• TG block (MEP-409)

Faults associated with phase and group delay

Fault	Boards/blocks to be checked
Faults associated with phase and group delay	• TG block (MEP-409) • Logarithmic block (MEP-337) • Analog I/O board (BGP-010186) • Phase block (MEP-339)

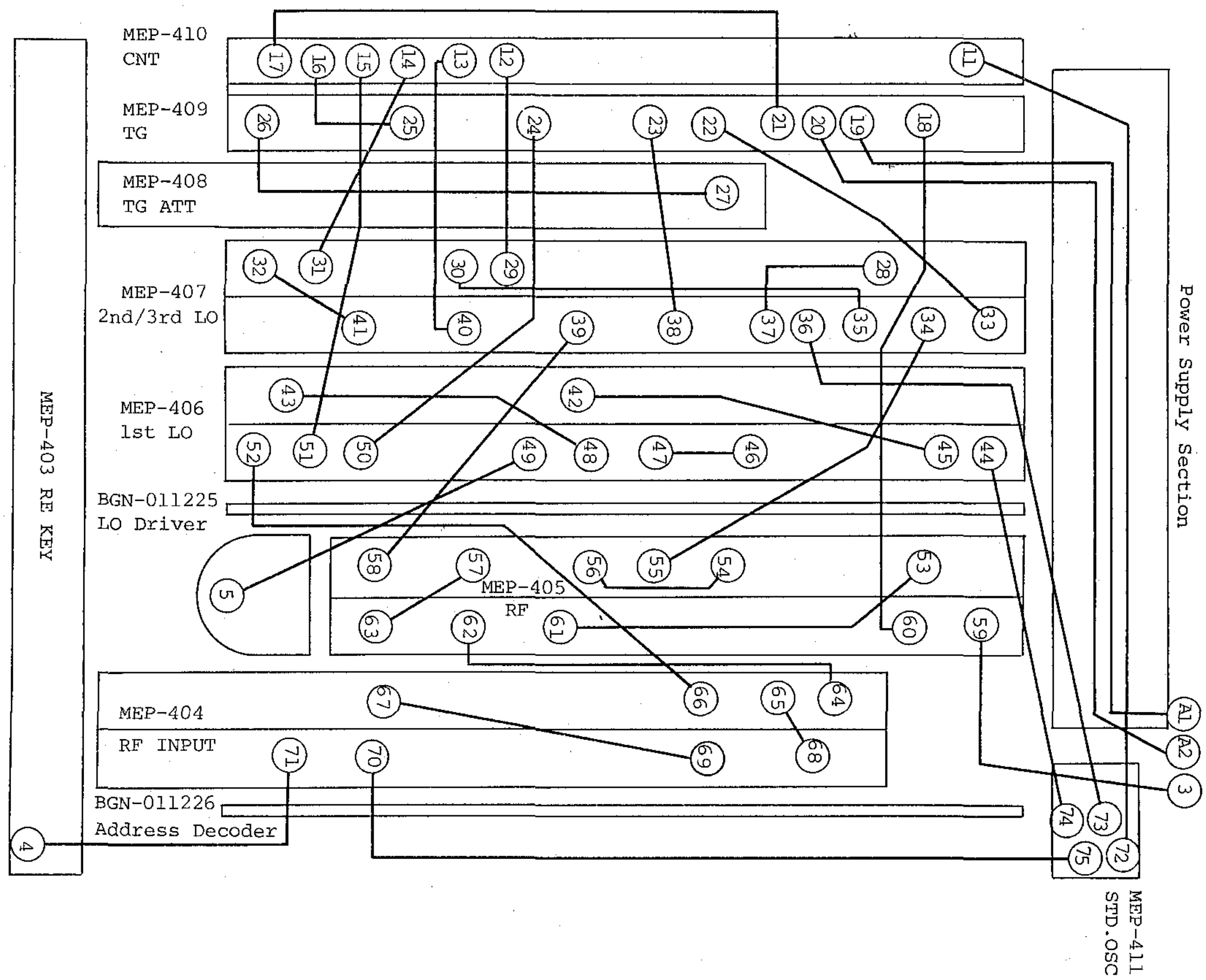


Fig. 13-11 RF section board/block arrangement

Table 13-4 Interconnection table

	Terminal	Unit		Terminal	Unit	Cable	Frequency	Level	Serial number
11	10 MHz IN	MEP-410	72	CNT	MEP-441	~CB-FF0971X13A-1	10 MHz	TTL	1
12	23 MHz IN	MEP-410	29	23 MHz OUT	MEP-407	DCB-FF0971X14A-1	23 MHz	> 0 dBm	2
13	40 MHz IN	MEP-410	40	40 MHz OUT	MEP-407	DCB-FF0971X06A-1	40 MHz	> 0 dBm	3
14	39 MHz IN	MEP-410	31	39 MHz OUT	MEP-407	DCB-FF0971X05A-1	39 MHz	> 0 dBm	4
15	1st LO IN	MEP-410	51	CNT	MEP-406	DCB-FF0971X09A-1	179 - 300 MHz	> 0 dBm	5
16	TG IN	MEP-410	25	TG OUT (CNT)	MEP-409	DCB FF0971X01A-1	10 Hz - 120 MHz	> -10 dBm	6
17	3.3 MHz IN	MEP-410	21	CNT	MEP-409	DCB-FF0971X10A-1	3.3 MHz	> -2 dBm	7
18	IF	MEP-409	60	3.3 MHz IN	MEP-405	DCB-FF0971X09A-1	3.3 MHz	> -2 dBm	8
19	LOG	MEP-409	2	(A1)	(REAR)	DCB-FF0971X05-1	3.3 MHz	> 0 dBm	9
20	PHASE	MEP-409	2	(A2)	(REAR)	DCB-FF0971X05-1	3.3 MHz	> -2 dBm	10
22	3rd LO IN	MEP-409	33	3rd LO OUT (TG)	MEP-407	DCB-FF0971X07A-1	32.3 MHz	> 0 dBm	11
23	2nd LO IN	MEP-409	38	2nd LO OUT (TG)	MEP-407	DCB-FF0971X04A-1	150 MHz	> 0 dBm	12
24	1st LO IN	MEP-409	50	TG	MEP-406	DCB-FF0971X08A-1	179 - 300 MHz	> 0 dBm	13
26	TG OUT	MEP-409	27	IN	MEP-408	DCB-FF0971X09A-1	10 Hz - 120 MHz	+16 dBm ±105 dB	14
28	10 MHz IN	MEP-407	37	10 MHz OUT	MEP-407	DCB-FF0971X01A-1	10 MHz	TTL	15
30	2.3 MHz OUT	MEP-407	35	2.3 MHz IN	MEP-407	DCB-FF0971X09A-1	2.3 MHz	> -20 dBm	16
32	2 MHz IN	MEP-407	41	2 MHz OUT	MEP-407	DCB-FF0971X02A-1	2.0 MHz	> -20 dBm	17
34	3rd LO OUT (RF)	MEP-407	55	3rd LO IN	MEP-405	DCB-FF0971X09A-1	32.3 MHz	> 0 dBm	18
36	10 MHz IN	MEP-407	73	2nd/3rd LO	MEP-411	DCB-FF0971X13A-1	10 MHz	TTL	19
39	2nd LO OUT (RF)	MEP-407	58	2nd LO IN	MEP-405	DCB-FF0971X08A-1	150 MHz	> 0 dBm	20
42	1 MHz IN	MEP-406	45	1 MHz OUT	MEP-406	DCB-FF0971X08A-1	1 MHz	TTL	21
43	YIG IF IN	MEP-406	48	YIG IF OUT	MEP-406	DCB-FF0971X05A-1	6 - 44 MHz	> -30 dBm	22
44	10 MHz IN	MEP-406	74	1st LO	MEP-411	DCB-FF0971X09A-1	10 MHz	TTL	23
46	100M/101M OUT	MEP-406	47	100M/101M IN	MEP-406	DCB-FF0971X01A-1	100M/101M	> +6 dBm	24
49	YIG IN	MEP-406	5	(OUT)	YIG OSC	DCB-FF0971X17-1	2148 - 3600 MHz	> +14 dBm	25
52	INPUT	MEP-406	66	1st LO IN	MEP-404	DCB-FF0971X10A-1	179 - 300 MHz	> 0 dBm	26
53	3rd IF OUT	MEP-405	61	REF IN	MEP-405	DCB-FF0971X08A-1	3.3 MHz	+0.5 dB ±1 dB	27
54	2nd IF IN	MEP-405	56	2nd IF OUT	MEP-405	DCB-FF0971X02A-1	29 MHz	-1.5 dB ±1 dB	28
57	1st IF IN	MEP-405	63	1st IF OUT	MEP-405	DCB-FF0971X01A-1	179 MHz	+1.5 dB ±1 dB	29
59	REF OUT	MEP-405	3	(OUT)	(REAR)	DCB-FF0971X10-1	3.3 MHz	0 dB ±1 dB	30
62	1st IF IN (INPUT)	MEP-405	64	1st IF OUT	MEP-404	DCB-FF0971X08A-1	179 MHz	-12 dB ±1 dB	31
65	50/75 IN	MEP-404	68	50/75 OUT	MEP-404	DCB-FF0971X06A-1	10 Hz - 120 MHz	-1 dB ±1 dB	32
67	ARS OUT	MEP-404	69	ARS IN	MEP-404	DCB-FF0971X07A-1	10 Hz -120 MHz	-12 dB ±2 dB	33
70	CAL IN	MEP-404	75	CAL OUT	MEP-411	DCB-FF0971X13A-1	10 MHz	≒ -6 dBm	34
71	CAL OUT	MEP-404	4	(CAL OUT)	(FRONT)	DCB-FF0971X05-1	10 MHz	-10 dBm ±0.3 dBm	35

With respect to input level for 0 dB input attenuator. (serial numbers 27–33)

ADVANTEST

ADVANTEST CORPORATION

TR4171

SPECTRUM ANALYZER

OPERATION MANUAL
VOL. 2

MANUAL NUMBER EG01 9602

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Printed in Japan

SECTION 14
PARTS LIST

14-1. INTRODUCTION

This section provides a list of electrical parts used in the TR4171 Spectrum Analyzer. For the replacement of an electrical part, check its specifications and ratings by referring to the description of the parts list before replacing the defective part. If replacement of mechanical or electrical parts marked with an asterisk (*) is required, contact your nearest ADVANTEST representative. When ordering electrical parts, write their part and stock numbers. For mechanical part ordering write their part names and stock numbers.

NOTES

Specifications of parts are subject to change without notice to meet the users' demands or the requirements of our quality control.

14-2. SYMBOLS AND ABBREVIATIONS

The symbols and abbreviations used in the parts list, schematic diagrams and text are shown in the table below. In the schematic diagrams, active low signals are identified by a prefixed asterisk (*). For quick identification of the panel features of the product all references to them in the text are written in capital letters.

Table 14-1 Abbreviations

REFERENCE DESIGNATIONS

C	Capacitor
C_a	Cable
F	Fuse
FH	Fuse Holder
IC	Integrated Circuit
J	Electrical Connector, Jack
L	Coil, Inductor
Q	Transistor
R	Resistor
S	Switch (Slide, Lever, Push Button, Rotary)
T	Transformer
TP	Test Point (Check Point)
X	Crystal

MULTIPLIERS

Abbreviation	Prefix	Multiple
G	giga	10^9
M	mega	10^6
k	kilo	10^3
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

Table 14-2 Abbreviations

ABBREVIATIONS	
A	ampere
AC	alternating current
ADJ.	adjustment
A/D	analog-to-digital
AMP.	amplifier
ATT.	attenuator
ASTIG.	astigmatism
ANT.	antenna
AUTO	automatic, -operation
A.Z.	auto zero
BATT.	battery
BCD	binary coded decimal
B.P.F.	band-pass filter
B.W.	band width
CAR	carbon
CAL.	calibrate
CER	ceramic
cm	centimeter
COM.	common
CRT	cathode-ray tube
COMP.	comparator
CONT.	control
CONV.	converter
D/A	digital-to-analog
dB	decibel
dBm	decibel referred to 1 mW
dBμ	decibel (0 dBμ = 1 μVrms.)
DC	direct current
DET.	detector
DIV. (div.)	division
DISP.	dispersion
ELECT	electolytic
EXT.	external
F	farad
FET.	field-effect transistor
FM	frequency modulation
FREQ.	frequency
FXD	fixed
FLM	film
f.s.	full scale
g	gram
GHz	gigahertz
GND	ground
H	henry
h	hour
HI	high
H.P.F.	high-pass filter
Hz	hertz
H.POSI.	horizontal position
H.GAIN	horizontal gain
IC	integrated circuit
IF	intermediate frequency
IN.	input
INT.	internal
kg	kilogram
kHz	kilohertz
kΩ	kiloohm
kV	kilovolt
LED	light-emitting diode
LEV.	level
LIN.	linear
LO	low, local oscillator
LOG.	logarithm
L.P.F.	low-pass filter
m	meter
mA	milliampere
MAX.	maximum
MΩ	megohm
mg	milligram
MHz	megahertz
MIN.	minimum
min.	minute (time)
mm	millimeter
MOD.	modulator
ms	millisecond
mV	millivolt
mVrms.	millivolt rms.
mW	milliwatt
μA	microampere
μF	microfarad
μH	microhenry
μs	microsecond
μV	microvolt
μVrms.	microvolt rms.
μW	microwatt
MANU.	manual
MIX.	mixer
NPN	negative-positive-negative
nA	nanoampere
NC	no connection
NORM.	normal
ns	nanosecond
nW	nanowatt
OPT.	option
OSC.	oscillator
Ω	ohm
OUT.	output
P	peak
pF	picofarad
PL	phase lock
PLO	phase lock oscillator
PM	phase modulation
p-p	peak-to-peak
PPM	pulse-position-modulation
PRF	pulse-repetition frequency
ps	picosecond
POSI.	position
PNP	positive-negative-positive
Q.P.	quasi peak value
REF.	reference
RF	radio frequency
rms.	root-mean-square
rdg.	reading
REG.	regulator
SI	silicon
s	second (time)
S.G.	single generator
SSB	single sideband
S.W.R.	standing-wave ratio
S	switch
T	timed (slow-blow fuse)
TTL	transistor-transistor logic
TV	television
TP	test point
VAR	variable
V	volt
VA	voltampere
VCO	voltage-controlled oscillator
VFO	variable-frequency oscillator
Vp-p	volts peak-to-peak
Vrms.	volts rms.
V.S.W.R.	voltage standing wave ratio
V.POSI.	vertical position
V.GAIN	vertical gain
W	watt
YIG	yttrium-iron-garnet
1st	the first
2nd	the second
3rd	the third

TR4171
MECHANICAL PARTS LIST
DISPLAY SECTION
FRAME & CABINET ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-1	1	MBS-22804A	PANEL, main	1
	2	MHT-18789B	SUBPANEL, lower	1
	3	MBT-18784B	BELT COVER, lower	1
	4	MCT-10164B	4U SIDE COVER	2
	5	MPX-15070A	BELT COVER, 4U side	2
	6	MHT-18788B	SUBFRAME, upper	1
	7	MMX-11091A	BELT COVER, upper	1
	8	MBT-18743A	CRT PANEL, upper	1
	9	MBS-18807A001A	CRT PANEL, lower	1
	10	MCT-20335A	BEZEL, CRT	1
	11	MPX-21621A	FILTER, CRT	1
	12	MBX-20496B	COVER, bottom	1
	13	MBX-18859B	COVER, top	1
	14	MHT-18863D	FRAME A, side	1
	15	MBX-10211A	PLATE, 4U side	4
	16	MPX-10298A	COVER, side	1
	17	MKT-18727A	FOOT, stack	2
	18	MMX-10267B	FOOT, rear	2
	19	MMX-10270A	HANDLE	1
	20	MPX-18820A	COVER, side : front	1
	21	MPX-18821A	COVER, side : rear	1
	22	MHT-18862A	FRAME B, side	1
	23	MKN-10442A	SPACER, handle	2
	24	MKN-18729A	STOPPER	2
	25	MHJ-18750A	HOLDER, MEP-337	1
	26	MMK-20403A	FOOT	4

MECHANICAL PARTS LIST
DISPLAY SECTION ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
14-2 1	MBS-18842A001A	PANEL, Display Section rear	1
2	DMF-001011-1	FAN MOTOR	1
3	MBS-18841A001A	SUBPANEL, Display Section rear	1
4	MBZ-18813A	HOLDER A, heat sink	1
5	MBZ-18772A	HOLDER B, heat sink	1
6	MKJ-18855A	HEAT SINK	1
7	MBZ-18751A	PLATE, connector	1
8	JCB-AC044JX01	CONNECTOR (J4)	1
9	MBJ-18856A	HOLDER, thyristor	1
10	SEE-SF10DH1	THYRISTOR	1
11	LTP-000486	TRANSFORMER	1
12	MBJ-18861A	FRAME A	1
13	MBJ-18865A	FRAME B	1
14	MBJ-18791A	FRAME C	1
15	MBJ-18864A	FRAME D	1
16	YEE-000151	SUPPORTER, circuit board	18
17	MKZ-10311A	SPACER BOLT	1
18	MKJ-18746A	SUPPORTER A, connector	2
19	MKJ-18747A	SUPPORTER B, connector	2
20	JCB-AC056JX02	CONNECTOR (J41 to J57)	17
21	MHJ-18748A	SUPPORTER, circuit board	1
22	MBJ-18839A	COVER, circuit boards	1

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MECHANICAL PARTS LIST
CRT & SHIELD ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-3	1	NCR-000169	CRT	1
	2	MBX-21623A	CRT BAND (Upper)	1
	3	MBX-21622A	CRT BAND (Lower)	1
	4	ZTA-000123	TAPE	1
	5	MKJ-18873A	FRAME, CRT	1
	6	MBJ-18749A	HOLDER, VR	1
	7	JTF-AF001EX02	TERMINAL	1
	8	RVR-BL5K	VR (R4)	1
	9	RVR-BA5K	VR (R3)	1
	10	RVR-BA2K	VR (R2)	1
	11	RVR-BL2K	VR (R1)	1
	12	DCB-9S0495	CONNECTOR (J5)	1
	13	DCB-9S0481	CONNECTOR (J6)	1
	14	MBX-18879A	SHIELD CASE, CRT	1
	15	MBX-18770A	CLAMP	1
	16	ZTB-000022	TUBE	1
	17	LCL-E00474	COIL, CRT	1
	18	YEE-000070	GROMMET A	1
	19	MPX-18766A	CUSHION, CRT neck, sponge	1
	20	MPX-18767A	FILM, mylar	1
	21	MBJ-18812B	COVER, HV bottom	1
	22	MBJ-18860C	CASE, HV	1
	23	MBJ-18811C	COVER, HV top	1
	24	MBJ-18854A	HOLDER, HV	1
	25	YEE-000068	GROMMET B	2
	26	MKN-12974A	SPACER BOLT	1

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MECHANICAL PARTS LIST
DISPLAY KEY BLOCK
MEP-402 ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-4	1	MBS-22804A	PANEL, Display Section main	1
	2	MEE-20313A	KNOB, DATA	1
	3	MMX-10278A	ACRYLATE, LED	1
	4	DEE-000942-1	ENCODER	1

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MECHANICAL PARTS LIST
DISPLAY SECTION
REAR PANEL ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
14-5 1	YEE-000268	GUARD A, fan motor	1
2	MBS-18842A001A	PANEL, Display Section	1
3	MBT-18732A	GUARD B, fan motor	1
4	MBJ-18781A	PLATE A, connector	1
5	JCS-AC024JX03	CONNECTOR, GPIB	1
6	MPX-16113A	BLANK PLATE	2
7	DMF-001011-1	FAN MOTOR	1
8	MBZ-28723A-1	HOLDER A, fan motor	2
9	YEE-000524	RUBBER, vibration-proof	4
10	JCD-AA003PX01	CONNECTOR (J1)	1
11	MBJ-18709A	PLATE B, connector	1

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MECHANICAL PARTS LIST
DISPLAY SECTION
REAR SUBPANEL ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-6	1	MBS-18796C	HOLDER, BNC connector	1
	2	YEE-000234	SPACER BOLT	2
	3	JCS-AE004AX02	CONNECTOR (J2)	1
	4	JCF-AB001JX02	CONNECTOR, BNC (J3, J15, J14, J13)	4
	5	MHJ-18711A	HOLDER, rear panel	4
	6	MBZ-18794A	HOLDER, transformer	1
	7	JCP-AX002JX01	CONNECTOR, plug socket (J3)	1
	8	MBS-18841A001A	SUBPANEL, Display Section rear	1
	9	MBZ-18813A	HOLDER, heat sink	1
	10	MBZ-18724A	GUIDE, circuit board	1
	11	JTE-AG001EX01	TERMINAL, GND	1
	12	JCD-AA003PX01	CONNECTOR (J1)	1

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MECHANICAL PARTS LIST
RF SECTION
CABINET ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-7	1	MPX-18820A-1	COVER, side: front	1
	2	MKN-10442A-1	SPACER, handle	2
	3	MMX-10270A-1	HANDLE	1
	4	MPX-18821A-1	COVER, side: rear	1
	5	MBX-11042A-1	PLATE, 3U side	4
	6	MKT-18726B-1	FOOT, stack: rear	2
	7	YEE-000382-1	PLUG, hole	2
	8	MKN-18728A-1	BOLT, lock	2
	9	MMX-10267B-1	FOOT, rear	2
	10	MPX-10298A-1	COVER, side	1
	11	MPX-18822A-1	BELT COVER, upper	1
	12	MPX-15096A-1	BELT COVER, 3U side	2
	13	MPX-15074A-1	BELT COVER, lower	1
	14	MKT-18730B-1	STOPPER	2
	15	MMX-11092A-1	FOOT, stack	2

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MECHANICAL PARTS LIST
RF SECTION
UNIT ASSEMBLY

Fig. & INDEX No.	Stock No.	Description	Qty
14-8 1	MBJ-23399A-1	SUPPORTER, circuit board	4
2	MPX-28702A	FILM, insulation	1
3	MBS-22801A001A-1	COVER, power supply	1

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MECHANICAL PARTS LIST
RF SECTION ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-9	1	MCT-10162B-1	3U SIDE CORNER	2
	2	MHT-22818A-1	FRAME, side: left	1
	3	MHT-22817A-1	FRAME, side: right	1
	4	MBJ-22815A-1	CHASSIS, RF front	1
	5	MBJ-22816A-1	CHASSIS, RF	1
	6	MHT-22782A-1	SUBFRAME, upper	1
	7	MHT-22781A-1	SUBFRAME, lower	1
	8	MBJ-22755A-1	SUBPANEL, right	1
	9	MBZ-28700A-1	SUBPANEL, left	1
	10	KSP-000360-1	POWER SWITCH	1
	11	MMX-11094A-1	CAP, power switch	1
	12	NLD-000002-1	ACRYLATE, LED: green	1
	13	NLD-000001-1	ACRYLATE, LED: red	1
	14	JCS-AV004JX01-1	CONNECTOR, PROBE POWER	1
	15	DCB-FF1223X05-1	CABLE, BNC-UM	1
	16	DXY-000498-1	YIG OSC	1
	17	MBJ-22780A-1	HOLDER, YIG OSC	1
	18	YEE-000151-1	SUPPORTER, circuit board	4
	19	YEE-000290-1	CLAMP, nylon	1
	20	YEE-000041-1	GROMMET	4
	21	MBJ-22783A-1	DUCT, cable	1
	22	YEE-000065-1	CLAMP, nylon	3

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MECHANICAL PARTS LIST
RF KEY BLOCK
MEP-403 ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-10	1	MBS-22803A001A	PANEL, RF Section front	1
	2	MMX-11093A-1	BEZEL	1
	3	MMX-21704A-1	ACRYLATE, LED	8
	4	MMX-21705A-1	HOLDER, LED	8
	5	MBA-22765A-1	HOLDER, indicator	1
	6	YEE-000839-1	CLIP, wire	1
	7	MPS-22764A-1	INDICATOR, level	1

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MECHANICAL PARTS LIST
RF SECTION
REAR PANEL ASSEMBLY

Fig. & INDEX No.		Stock No.	Description	Qty
14-11	1	MBS-22806B001B-1	PANEL, RF Section rear	1
	2	MBT-23299A	PANEL (B), RF Section rear	1
	3	MBS-22805B001A-1	COVER, RF Section rear	1
	4	DCB-RS1331X01-1	CABLE, flat	1
	5	JCS-AE004JX02-1	CONNECTOR (J2)	1
	6	YEE-000234-1	SCREW LOCK	2
	7	JTE-AG001EX01-1	TERMINAL, GND	1
	8	DCB-FF1223X10-1	CABLE, BNC-UM	1
	9	SEE-SW1DM1-1	THYRISTOR	1
	10	MBJ-22760A-1	HOLDER, thyristor	1
	11	YEE-000524-1	RUBBER, vibration-proof	3
	12	MBZ-28724A-1	HOLDER B, fan motor	1
	13	JCD-AA003PX01-1	FILTER, noise	1
	14	MBJ-18709A-1	HOLDER, power connector	1
	15	MBX-19737B-1	SHIELD CASE, fan motor	1
	16	MBZ-28725A-1	HOLDER C, fan motor	1
	17	DMF-001006-1	FAN MOTOR	1
	18	YEE-000271-1	GUARD, fan motor	1
	19	MNS-10528A-1	PLATE, serial number	1

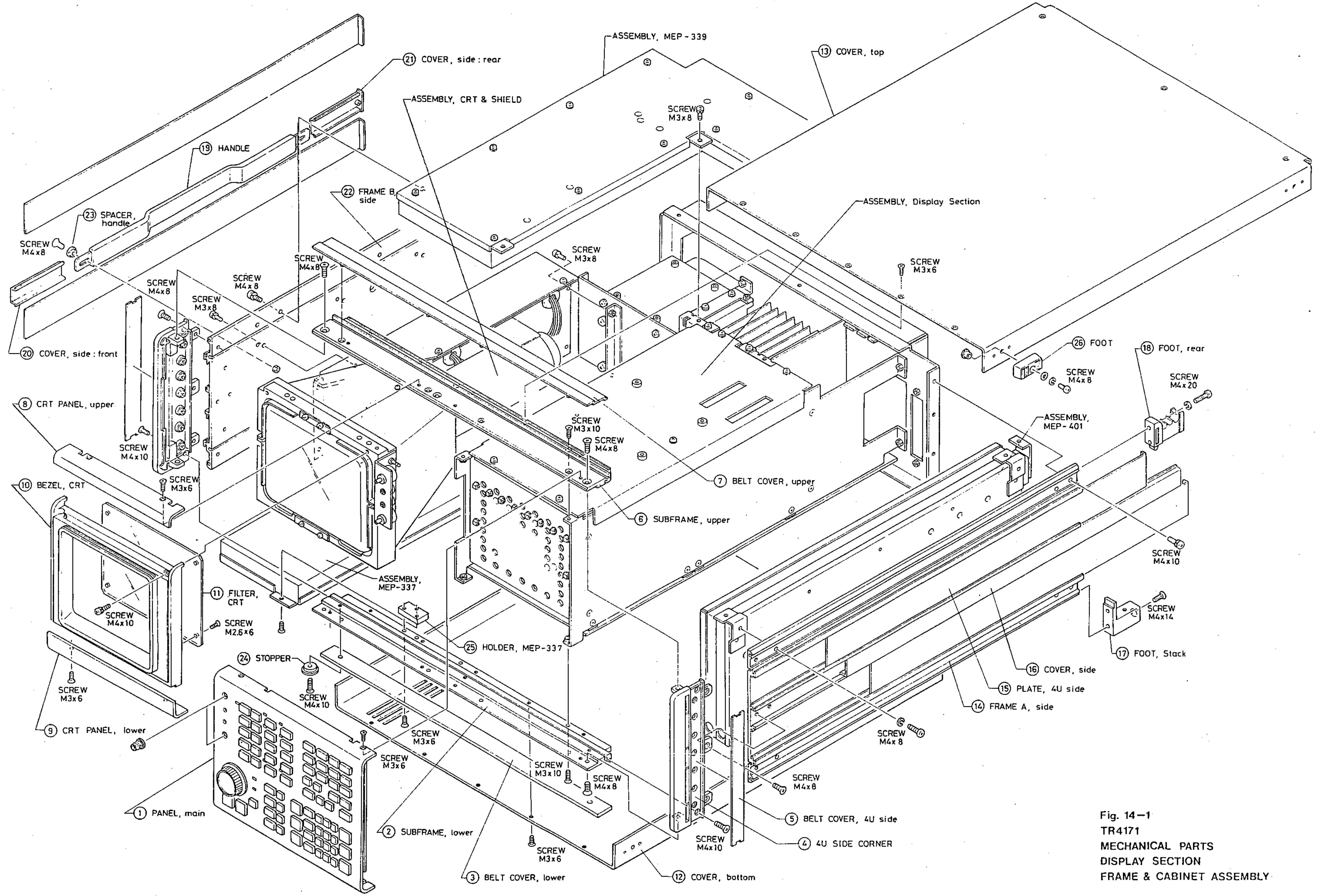

Fig. 14-1
TR4171
MECHANICAL PARTS
DISPLAY SECTION
FRAME & CABINET ASSEMBLY

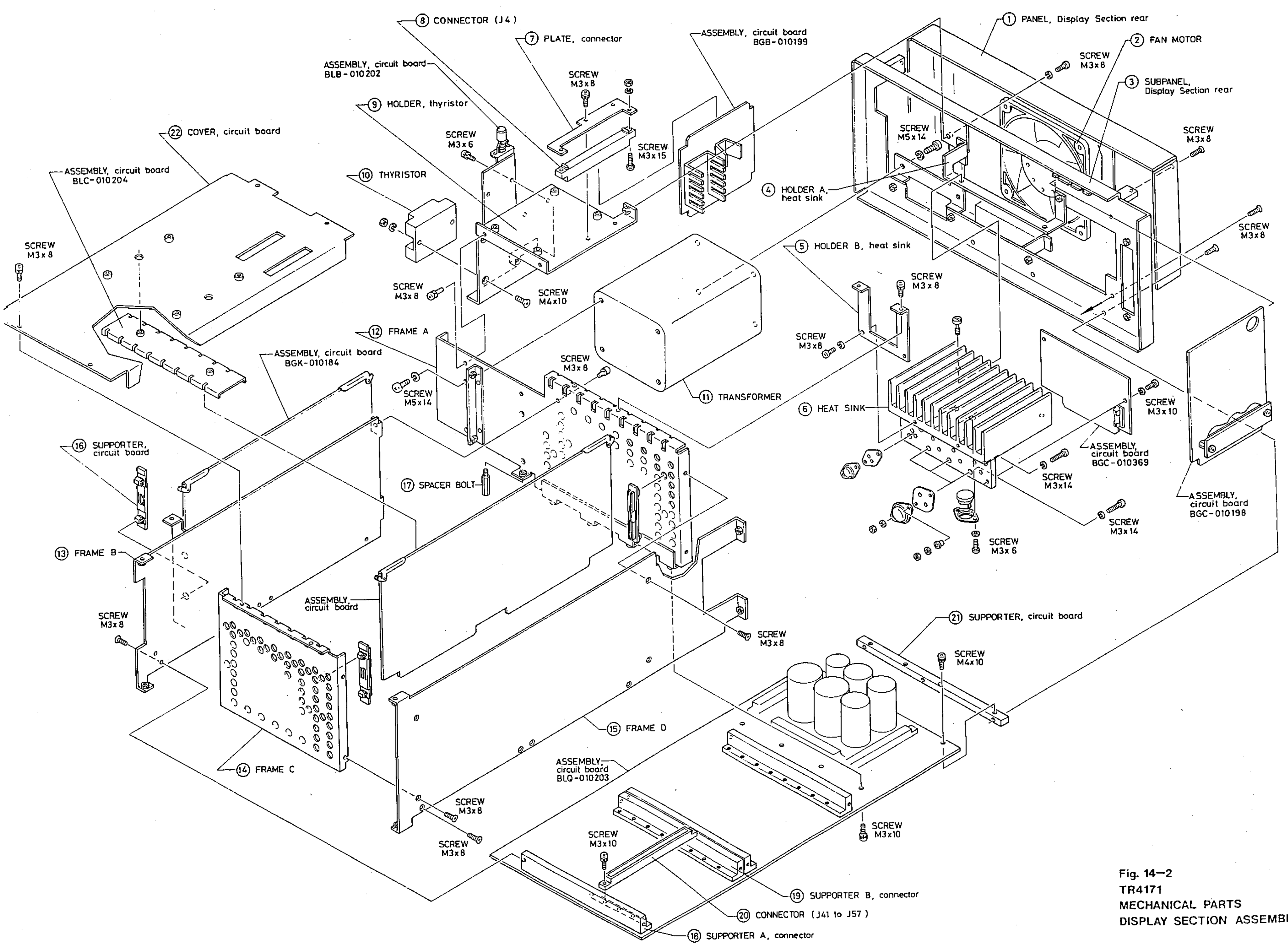

Fig. 14—2
TR4171
MECHANICAL PARTS
DISPLAY SECTION ASSEMBLY

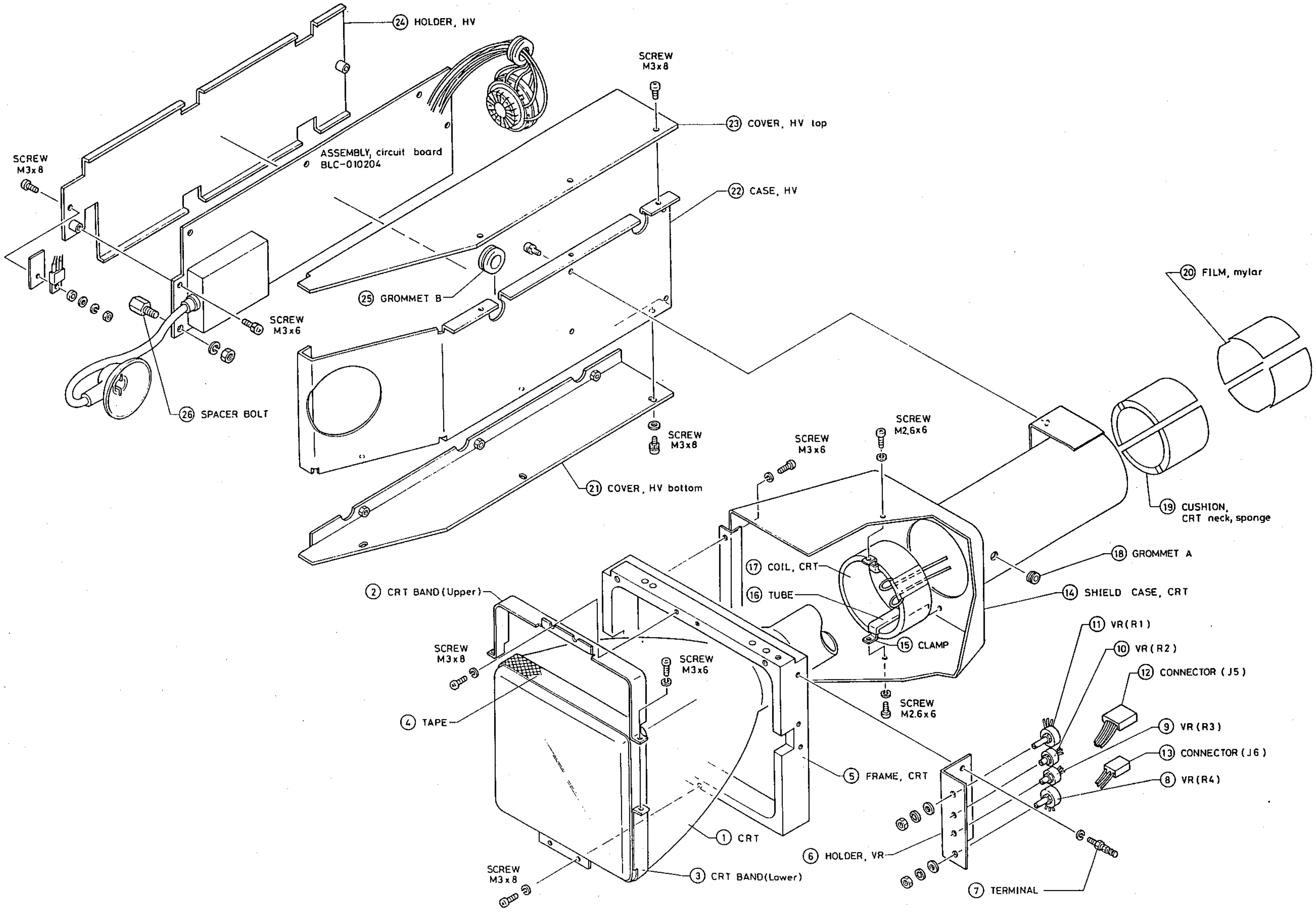

Fig. 14-3
TR4171
MECHANICAL PARTS
CRT & SHIELD ASSEMBLY

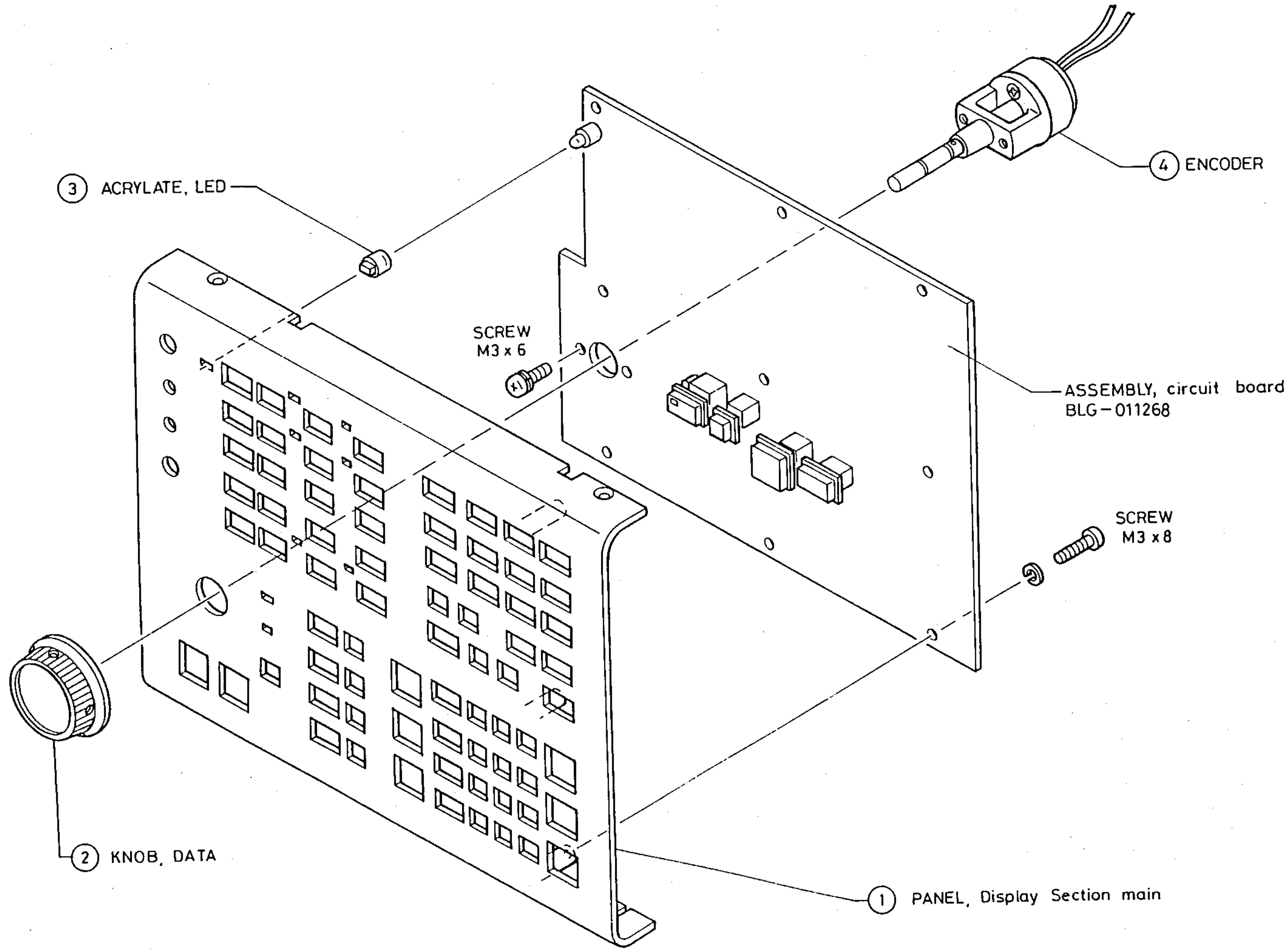

Fig. 14-4
TR4171
MECHANICAL PARTS
DISPLAY KEY BLOCK
MEP-402 ASSEMBLY

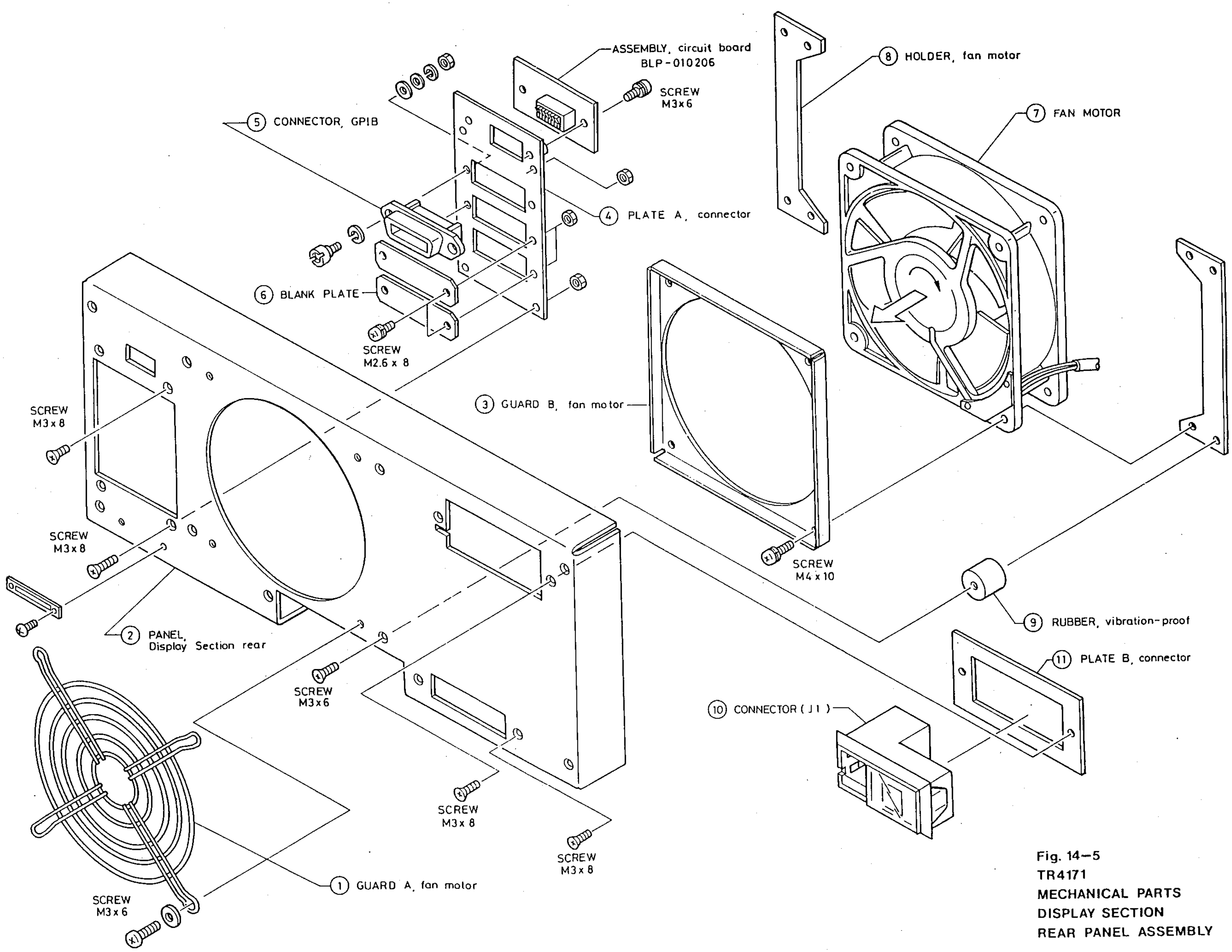

Fig. 14–5
TR4171
MECHANICAL PARTS
DISPLAY SECTION
REAR PANEL ASSEMBLY

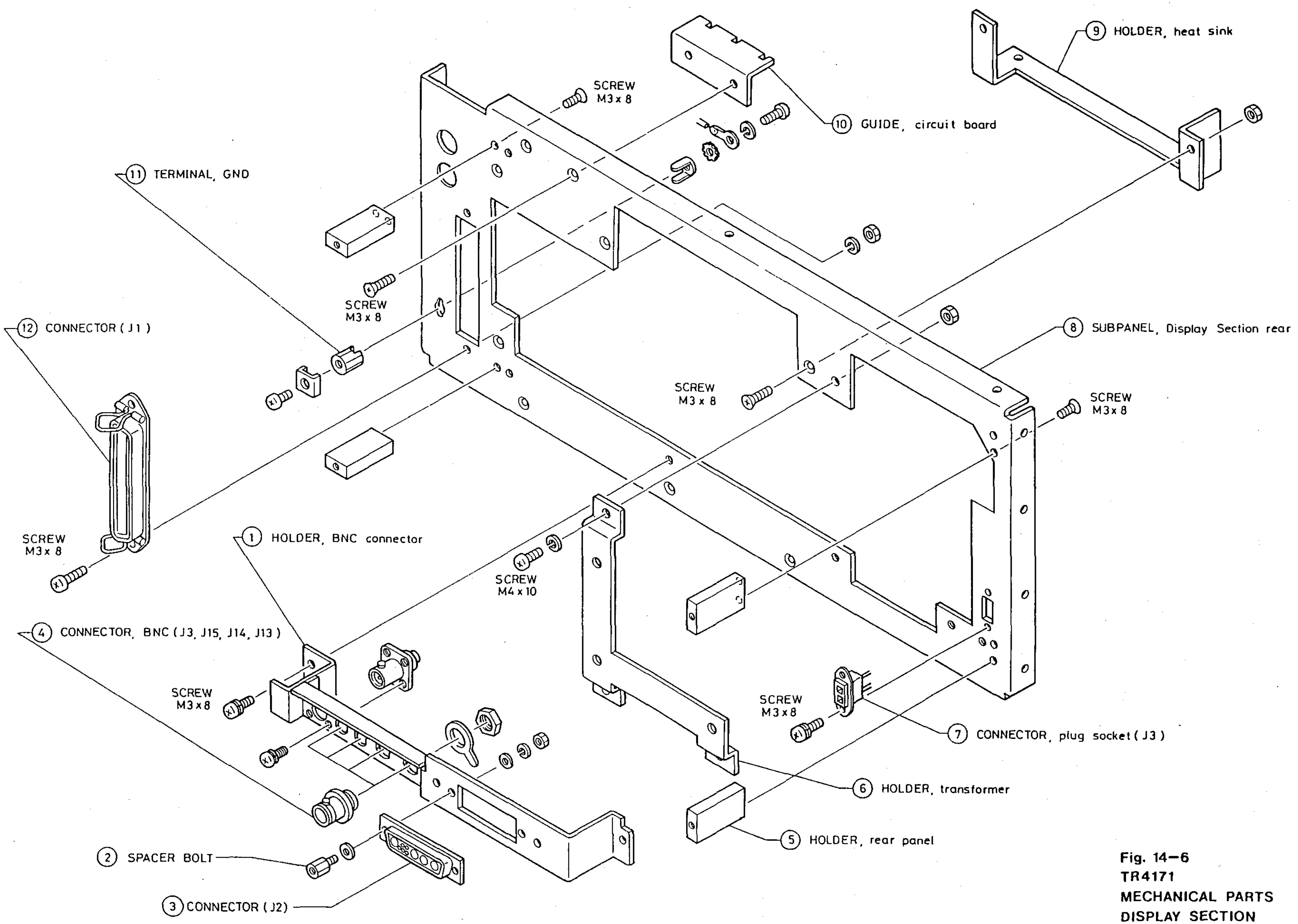

Fig. 14-6
TR4171
MECHANICAL PARTS
DISPLAY SECTION
REAR SUBPANEL ASSEMBLY

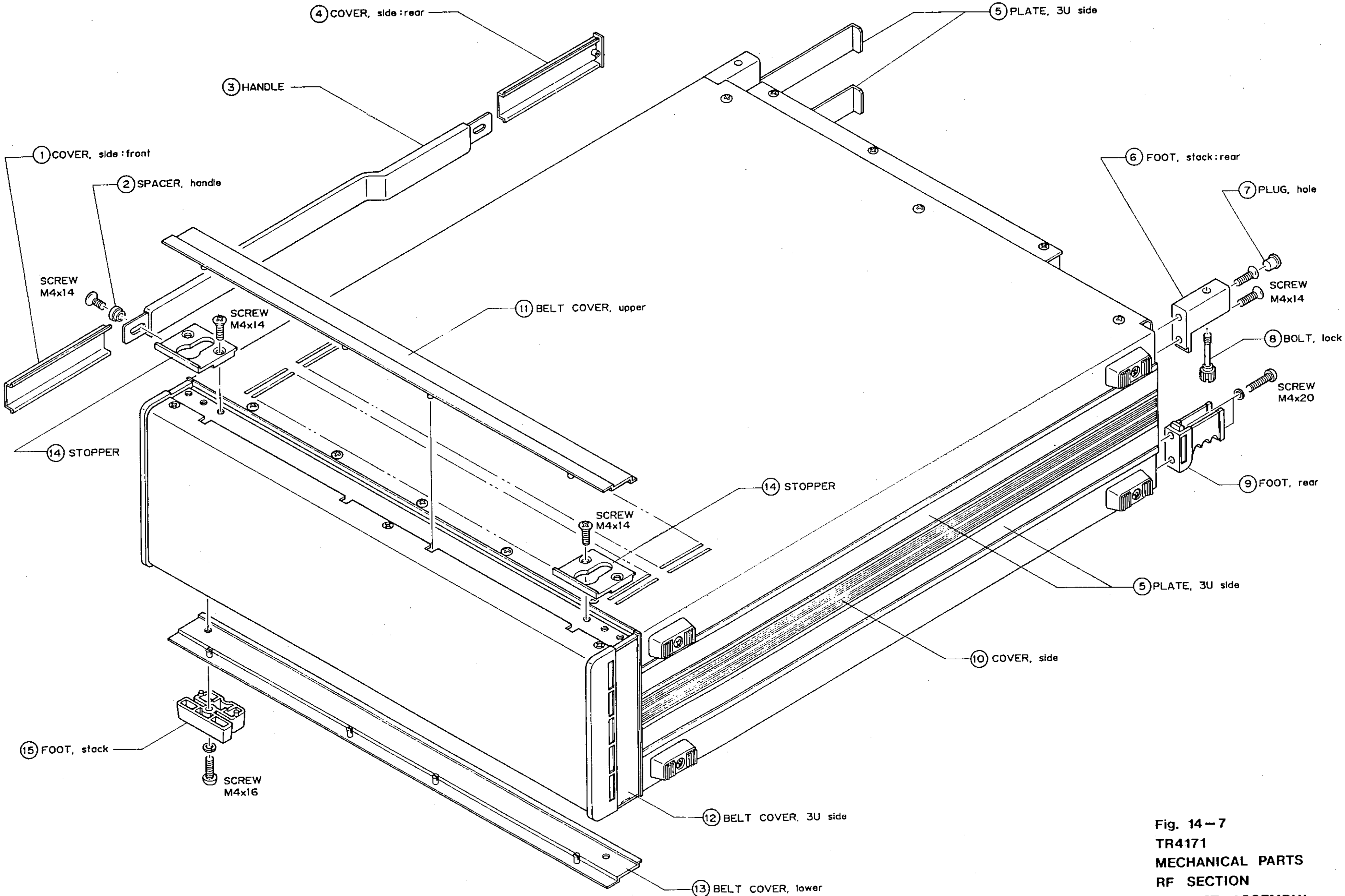

Fig. 14—7
TR4171
MECHANICAL PARTS
RF SECTION
CABINET ASSEMBLY

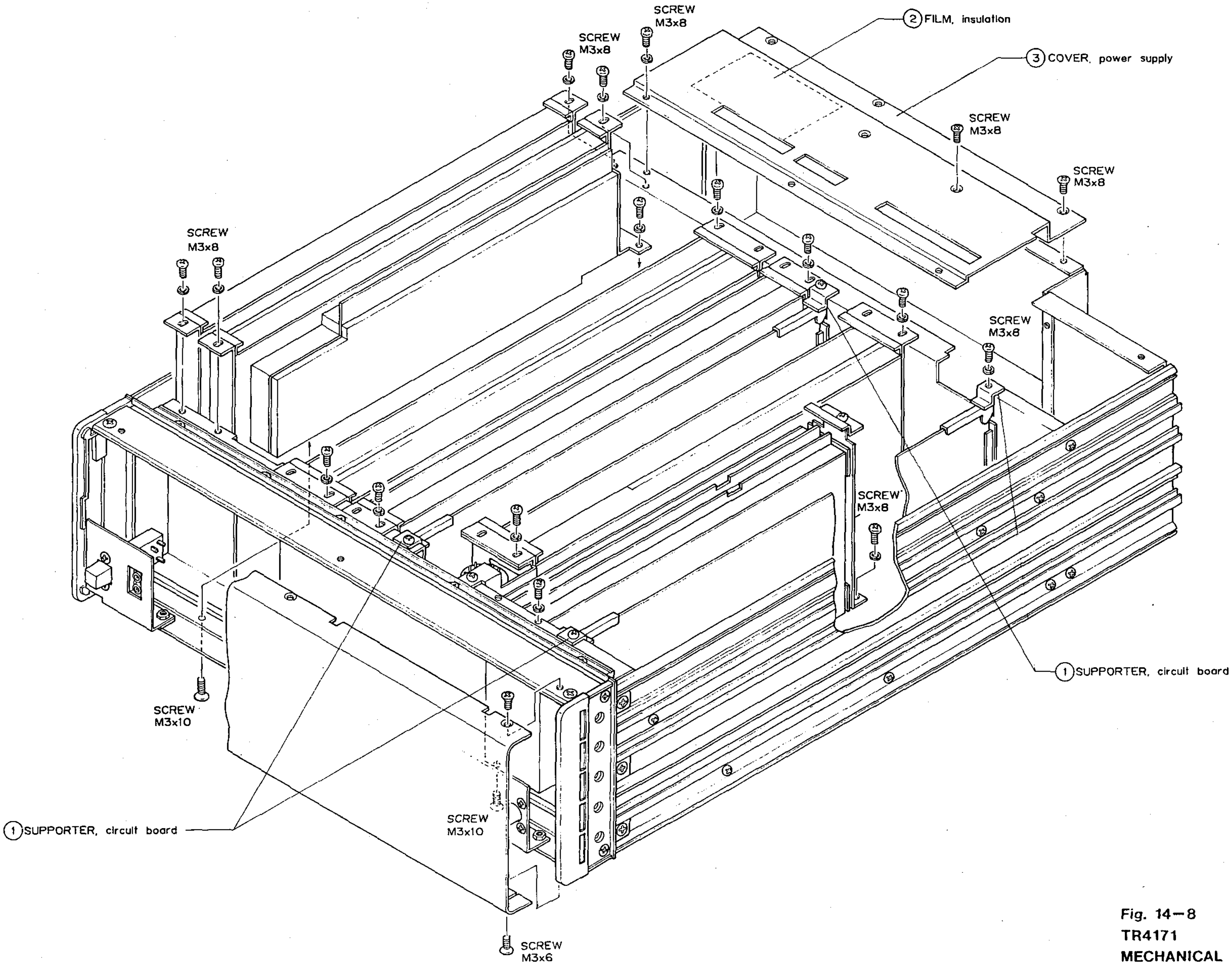

Fig. 14–8
TR4171
MECHANICAL PARTS
RF SECTION
UNIT ASSEMBLY

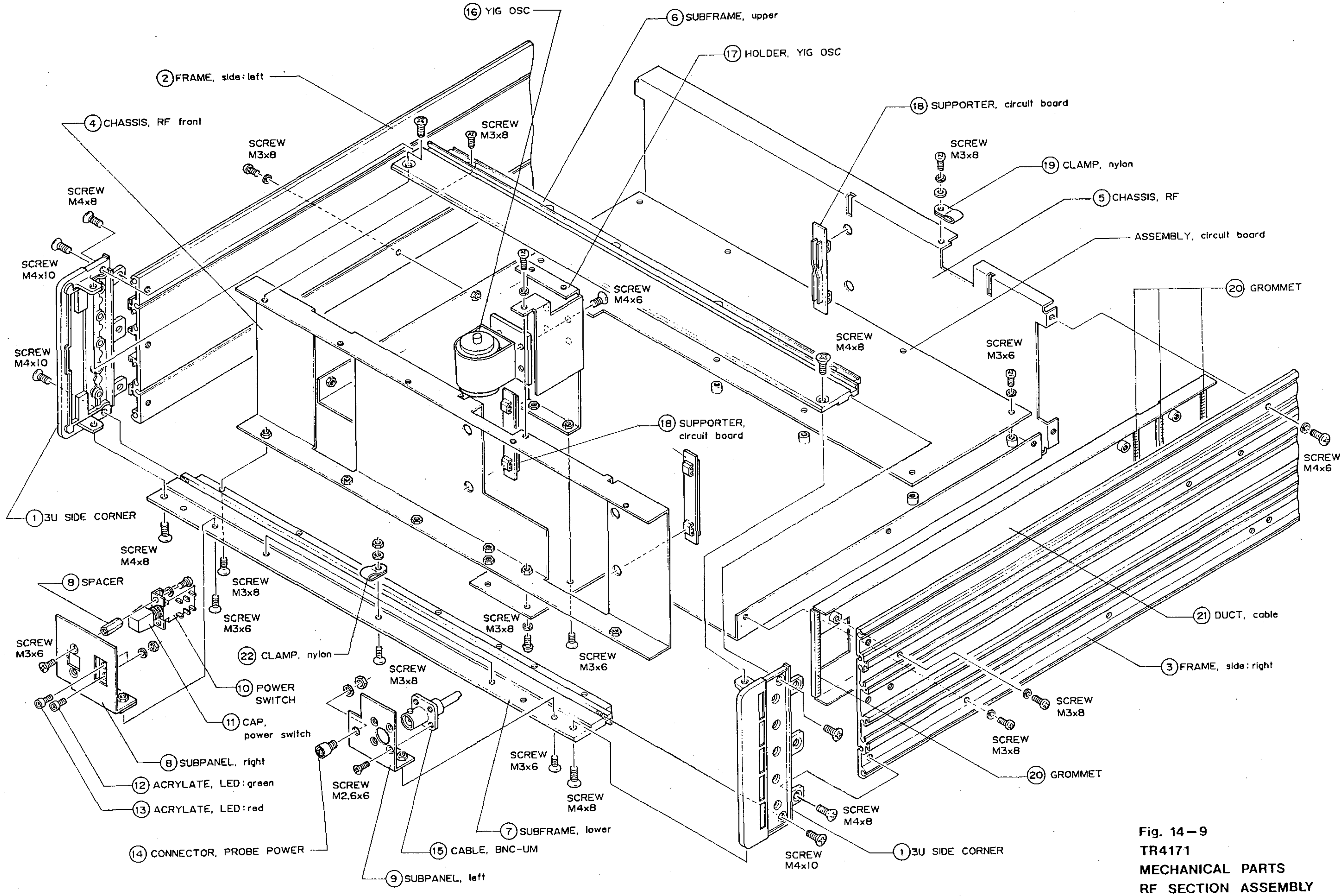

Fig. 14-9
TR4171
MECHANICAL PARTS
RF SECTION ASSEMBLY

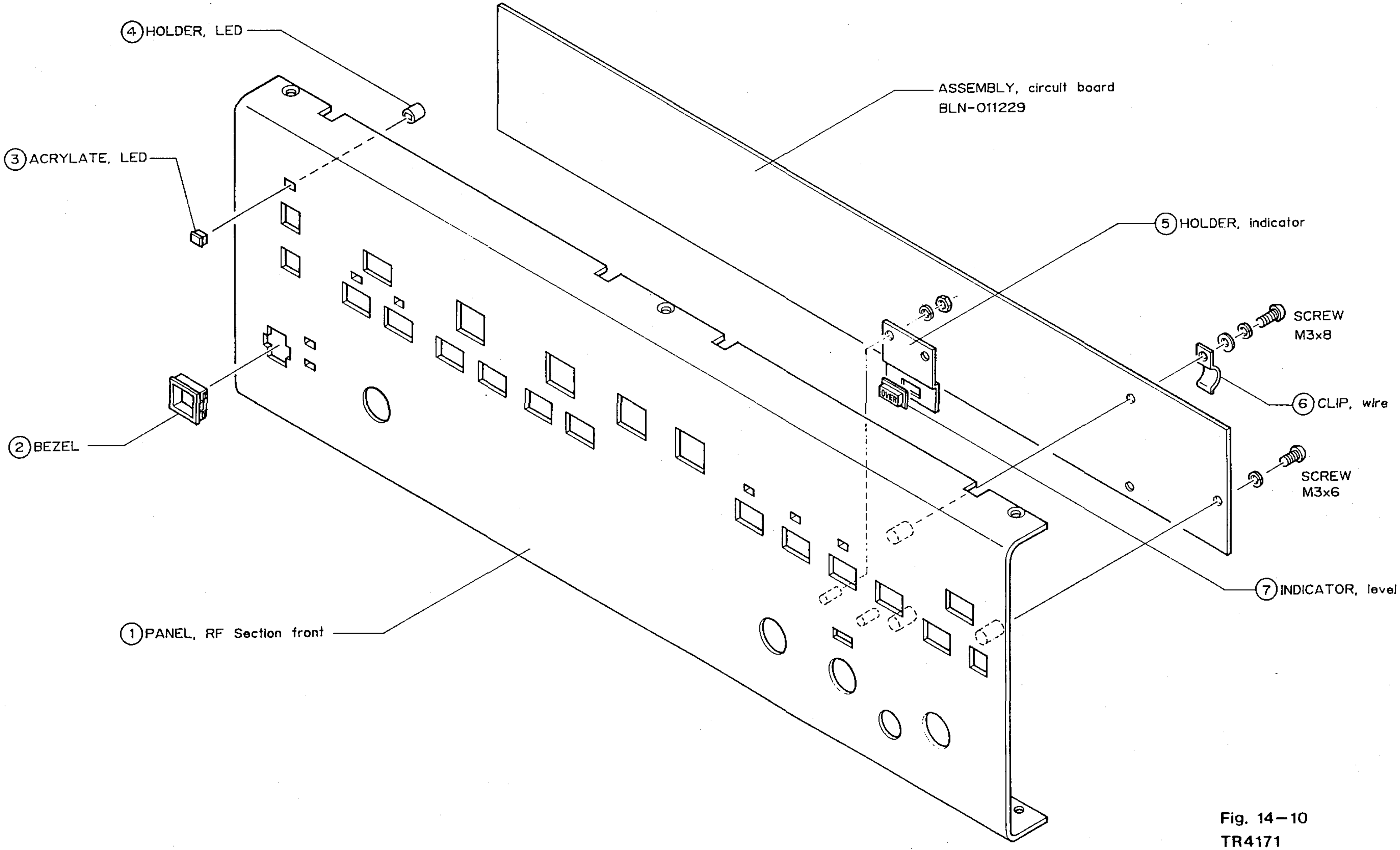

Fig. 14–10
TR4171
MECHANICAL PARTS
RF KEY BLOCK
MEP–403 ASSEMBLY

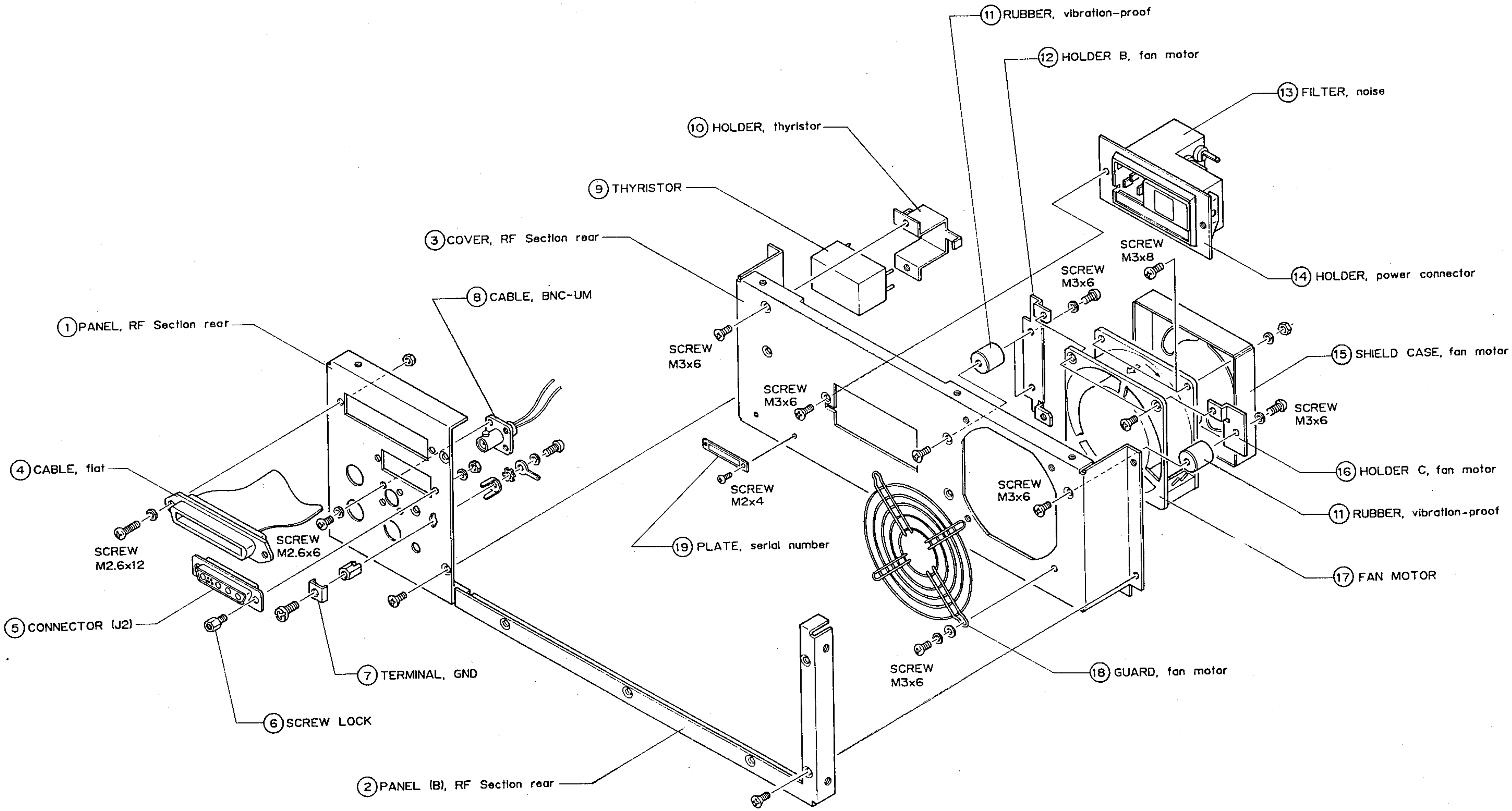

Fig. 14—11
TR4171
MECHANICAL PARTS
RF SECTION
REAR PANEL ASSEMBLY

Parts No.	ADVANTEST Stock No.	Description
C1 thru C4	CSM-AE1000P50V-1	C: FXD CER 1000pF ±10% 50V
J10	JCF-AC001JX08-1	Connector

Parts No.	ADVANTEST Stock No.	Description
Q1	STN-2SC1426-1	Transistor SI NPN
R7	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R8	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R9	RCB-AH10	R: FXD CAR 10Ω
R10	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
C14	CSM-AC680P50V	C: FXD CER 680pF ±10% 50V
C15	CEE-AB4700P50V	C: FXD EL 4700pF 50V
C16	CTM-AA20P	C: VAR CER 20pF
C17	CSM-AC8P50V	C: FXD CER 8pF ±10% 50V
C18	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C19	CSM-AC8P50V	C: FXD CER 8pF ±10% 50V
C20	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
L25	LCL-A00514-1	L: FXD Coil
L26	LCL-A00514-1	L: FXD Coil
L27	LCL-A00512-1	L: FXD Coil
L28	LCL-A00512-1	L: FXD Coil
L19	LCL-C00012-1	L: FXD Coil
FL35	DNF-000803-1	Filter
FL36	DNF-000803-1	Filter

Parts No.	ADVANTEST Stock No.	Description
Q1	STN-2SC1426-1	Transistor SI NPN
Q2	STN-2SC1426-1	Transistor SI NPN
D7 thru D10	SDS-1SS97-1	Diode SI
R17	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R18	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R19	RCB-AH33	R: FXD CAR 33Ω ±5% 1/4W
R20	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R21	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R22 thru R25	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R26	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R27	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R28	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R29	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R30	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R31	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R32	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R33	RMF-AR270QFK	R: FXD Metal FLM 270Ω ±1% 1/4W
R34	RMF-AR10QFK	R: FXD Metal FLM 10Ω ±1% 1/4W
R35	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R36	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R37	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R38	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
C46	CTM-AA10P-1	C: VAR CER 10pF
C47	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C48	CSM-AC15P50V	C: FXD CER 15pF ±10% 50V
C49	CSM-AC1500P50V	C: FXD CER 1500pF ±10% 50V
C50	CEE-AB4700P50V-1	C: FXD EL 4700pF 50V
C51	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C52	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C53 thru C56	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C57	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C58	CTM-AC10P-1	C: VAR CER 10pF
C59	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C60	CTM-AC10P-1	C: VAR CER 10pF
C61	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.5% 500V
C62 thru C66	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C67	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C68	CTM-AC10P-1	C: VAR CER 10pF
C69	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C70	CTM-AC10P-1	C: VAR CER 10pF
C71	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.5% 500V
C72	CSM-AC10P50V	C: FXD CER 10pF ±10% 50V

Parts No.	ADVANTEST Stock No.	Description
C73	CSM-AC18P50V	C: FXD CER 18pF ±10% 50V
C74	CSM-AC18P50V	C: FXD CER 18pF ±10% 50V
L79	LCL-A00069-1	L: FXD Coil
L80	LCL-A00509-1	L: FXD Coil
L81	LCL-C00012-1	L: FXD Coil
L82	LTP-000268-1	L: FXD Coil
L83	LTP-000270-1	L: FXD Coil
L84	LTP-000270-1	L: FXD Coil
L85	LCL-A00065-1	L: FXD Coil
L86	LCL-A00065-1	L: FXD Coil
L87	LCL-C00127-1	L: FXD Coil
L88	LCL-C00127-1	L: FXD Coil
L89	LCL-A00065-1	L: FXD Coil
L90	LCL-A00065-1	L: FXD Coil
L91	LCL-C00127-1	L: FXD Coil
L92	LCL-C00127-1	L: FXD Coil
L93	LCL-C00012-1	L: FXD Coil
L94	LCL-A00063-1	L: FXD Coil
J97	JCF-AC001JX04-1	Connector
FB100	ESM-000129-1	

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Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-324	IC: Quadruple Operational Amplifier
IC2	SIA-TL072-1	IC: Low Noise JFET-Input Operational Amplifier
Q8	STN-2SC1426-1	Transistor SI NPN
Q9	STN-2SC1254-1	Transistor SI NPN
Q10	SFN-2N4393-18	FET Junction N-Channel
Q11	STN-2SC1254-1	Transistor SI NPN
D15 thru D18	SDS-1SS97-1	Diode SI
D19	SDS-1S953	Diode SI
D20	SDS-1S2222-1	Diode SI
D21	SDS-1S2222-1	Diode SI
R25	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R26 thru R28	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R29	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R30	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R31	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R32	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R33	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R34 thru R37	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R38	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R39	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R40	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R41	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R42	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R43	RMF-AR470QFK	R: FXD Metal FLM 470Ω ±1% 1/4W
R44	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R45	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R46	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R47	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R48	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R49	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R50	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R51	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R52	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R53	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R54	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R55	RMF-AR33QFK-1	R: FXD Metal FLM 33Ω ±1% 1/4W
R56	RVR-CD50-1	R: VAR CERMET 50Ω
R57	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R58	RVR-CD2K-1	R: VAR CERMET 2kΩ
R59	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R60	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R61	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R62	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R63	RVR-CD1K-1	R: VAR CERMET 1kΩ
R64	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R65 thru R68	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R69	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R70	RMF-AR47KFK	R: FXD Metal FLM 47kΩ ±1% 1/4W
R71	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R72	RMF-AR10KFK	R: FXD Metal FLM 10kΩ ±1% 1/4W
R73	RVR-CD20K-1	R: VAR CERMET 20kΩ
R74	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R75	RMF-AR56KFK	R: FXD Metal FLM 56kΩ ±1% 1/4W
R76	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R77	RCB-AH33	R: FXD CAR 33Ω ±5% 1/4W
R78	RVR-CD100-1	R: VAR CERMET 100Ω
R79	RMF-AR15KFK	R: FXD Metal FLM 15kΩ ±1% 1/4W
R80	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R81	RMF-AR56KFK	R: FXD Metal FLM 56kΩ ±1% 1/4W
R82	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R83	DSP-D00015-2	Thermistor
C93 thru C100	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C101	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C102 thru C105	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C106	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C107	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C108	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C109	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C110	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C111	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C112	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C113	CMC-AB82PR3K-4	C: FXD DIPPED MICA 82pF ±5% 300V
C114 thru C117	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C118	CMC-AB56PR3K-4	C: FXD DIPPED MICA 56pF ±5% 300V
C119	CMC-AB56PR3K-4	C: FXD DIPPED MICA 56pF ±5% 300V
C120	CMC-AB68PR3K-4	C: FXD DIPPED MICA 68pF ±5% 300V
C121	CMC-AB200PR3K-4	C: FXD DIPPED MICA 200pF ±5% 300V
C122 thru C124	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C125	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C126	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C127 thru C130	CCK-AB10U25V	C: FXD ELECT 10uF 25V
L137	LCL-C00012-1	L: FXD Coil

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Parts No.	ADVANTEST Stock No.	Description
L138	LCL-C00329-1	L: FXD Coil
L139	LCL-E00484-1	L: FXD Coil
L140	LCL-C00124-1	L: FXD Coil
L141	LCL-C00124-1	L: FXD Coil
L142	LCL-B00494-1	L: FXD Coil
L143 thru L146	LCL-C00128-2	L: FXD Coil
L147	LCL-T00480-1	L: FXD Coil
L148	LCL-C00012-1	L: FXD Coil
L149	LCL-C00012-1	L: FXD Coil
J155	JCF-AC001JX04-1	Connector

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC2	SIT-74LS174	IC: Hex D-Type Flip Flop Low Power
IC3	SIT-74LS00	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC4	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC5	SIT-7406	IC: Hex Inverter Buffer/Driver with Open Collector High-Voltage output
IC6	SIT-7406	IC: Hex Inverter Buffer/Driver with Open Collector High-Voltage output
IC7	SIA-324	IC: Quadruple Operational Amplifier
Q11 thru Q19	STN-2SC1815-15	Transistor SI NPN
Q20	STP-2SA1015-1	Transistor SI PNP
D26 thru D43	SDS-1S2222-1	Diode SI
R50	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R51	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R52	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R53	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R54	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R55	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R56	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R57	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R58	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R59	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R60	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R61	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R62	RMF-AR680QFK	R: FXD Metal FLM 680Ω ±1% 1/4W
R63	RVR-CB200-1	R: VAR CERMET 200Ω
R64	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R65	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R66	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R67	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R68	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R69	RMF-AR750QFK	R: FXD Metal FLM 750Ω ±1% 1/4W
R70	RVR-CB200-1	R: VAR CAR 200Ω
R71	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R72	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R73	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R74	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R75	RMF-AR270QFK	R: FXD Metal FLM 270Ω ±1% 1/4W
R76	RMF-AR390QFK	R: FXD Metal FLM 390Ω ±1% 1/4W
R77	RVR-CB100-1	R: VAR CERMET 100Ω
R78	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R79	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R80	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R81	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R82	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W

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Parts No.	ADVANTEST Stock No.	Description
R83	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R84	RVR-CB50-1	R: VAR CERMET 50Ω
R85	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R86	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R87	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R88	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R89 thru R91	RMF-AR56QFK	R: FXD Metal FLM 56Ω ±1% 1/4W
R92	RMF-AR120QFK	R: FXD Metal FLM 120Ω ±1% 1/4W
R93	RVR-CB50-1	R: VAR CERMET 50Ω
R94	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R95	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R96	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R97	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R98	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R99	RMF-AR56QFK	R: FXD Metal FLM 56Ω ±1% 1/4W
R100	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R101	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R102	RVR-CB20-1	R: VAR CERMET 20Ω
R103	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R104	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R105	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R106	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R107	RMF-AR200QFK	R: FXD Metal FLM 200Ω ±1% 1/4W
R108	RMF-AR33QFK	R: FXD Metal FLM 33Ω ±1% 1/4W
R109	RMF-AR200QFK	R: FXD Metal FLM 200Ω ±1% 1/4W
R110	RMF-AR47QFK	R: FXD Metal FLM 47Ω ±1% 1/4W
R111	RVR-CB10-1	R: VAR CERMET 10Ω
R112	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R113	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R114	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R115	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R116	RMF-AR200QFK	R: FXD Metal FLM 200Ω ±1% 1/4W
R117	RMF-AR33QFK	R: FXD Metal FLM 33Ω ±1% 1/4W
R118	RMF-AR200QFK	R: FXD Metal FLM 200Ω ±1% 1/4W
R119	RMF-AR47QFK	R: FXD Metal FLM 47Ω ±1% 1/4W
R120	RVR-CB10-1	R: VAR CERMET 10Ω
R121	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R122	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R123	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R124	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R125	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R126	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R127	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R128	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R129	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R130	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R131	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R132	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R133	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R134	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R135 thru R142	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R143	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R144	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R145	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R146	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R147	RCB-AH180	R: FXD CAR 180Ω ±5% 1/4W
C151 thru C154	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C155 thru C174	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C175	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C176	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C177 thru C180	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C181	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C182	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C183	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C184	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C185 thru C189	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C190	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C191	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C192	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C193	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C194	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C195 thru C202	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C203 thru C206	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C207	CCK-AB22U10V	C: FXD ELECT 22uF 10V
C208	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
L216 thru L218	LCL-C00010-1	L: FXD Coil
L219	LCL-C00012-1	L: FXD Coil
L220	LCL-C00012-1	L: FXD Coil
L221	LCL-C00010-1	L: FXD Coil
L222	LCL-C00010-1	L: FXD Coil
J225	JTM-AX001JX02-1	Connector
J226	JTM-AX001JX02-1	Connector

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS390	IC: Dual Decade Counter Low Power
IC2	SIT-74LS160	IC: Synchronous 4-Bit Counter Low Power
IC3	SIT-74LS112	IC: Dual J-K Negative-Edge-Triggered Flip Flop with preset AND clear Low Power
IC4	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
Q6	STN-2SC2026-1	Transistor SI NPN
Q7	STT-AD811-2	Transistor SI NPN
Q8		Not assigned
Q9	STP-2SA991-1	Transistor SI PNP
Q10 thru Q13	STN-2SC1844-1	Transistor SI NPN
Q14	STN-2SC1815-15	Transistor SI NPN
Q15	STN-2SC1844-1	Transistor SI NPN
Q16	STN-2SC1815-15	Transistor SI NPN
Q17 thru Q19	STN-2SC1844-1	Transistor SI NPN
Q20 thru Q24	STN-2SC1730-1	Transistor SI NPN
D26 thru D29	SDS-1S953-1	Diode SI
R31	RCB-AH68-1	R: FXD CAR 68Ω ±5% 1/4W
R32	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R33	RCB-AH33-1	R: FXD CAR 33Ω ±5% 1/4W
R34	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R35	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R36	RCB-AH1R5K-1	R: FXD CAR 1.5kΩ ±5% 1/4W
R37	RCB-AH100-1	R: FXD CAR 100Ω ±5% 1/4W
R38	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R39	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R40	RCB-AH120-1	R: FXD CAR 120Ω ±5% 1/4W
R41	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R42	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R43	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R44	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
R45	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R46	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R47	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
R48	RCB-AH120-1	R: FXD CAR 120Ω ±5% 1/4W
R49	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R50	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R51	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R52	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W
R53	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R54	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R55	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R56	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R57	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R58	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R59	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R60	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R61	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R62	RMF-AR22QFK-1	R: FXD Metal FLM 22Ω ±1% 1/4W
R63	RMF-AR470QFK-1	R: FXD Metal FLM 470Ω ±5% 1/4W
R64	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R65	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R66	RCB-AH1K-1	R: FXD CAR 1kΩ ±1% 1/4W
R67	RMF-AR22QFK-1	R: FXD Metal FLM 22Ω ±1% 1/4W
R68	RMF-AR470QFK-1	R: FXD Metal FLM 470Ω ±1% 1/4W
R69	RCB-AH2R2-1	R: FXD CAR 2.2Ω ±5% 1/4W
R70	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R71	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
F72	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R73	RCB-AH390-1	R: FXD CAR 390Ω ±5% 1/4W
R74	RCB-AH10-1	R: FXD CAR 10Ω ±5% 1/4W
R75	RCB-AH22-1	R: FXD CAR 22Ω ±5% 1/4W
R76	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R77	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R78	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R79		Not assigned
R80	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R81	RCB-AH2R2-1	R: FXD CAR 2.2Ω ±5% 1/4W
R82	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R83	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
R84	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R85	RCB-AH390-1	R: FXD CAR 390Ω ±5% 1/4W
R86	RCB-AH10-1	R: FXD CAR 10Ω ±5% 1/4W
R87	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R88	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R89	RCB-AH68-1	R: FXD CAR 68Ω ±5% 1/4W
R90	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R91	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
C96	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C97	CMC-AB68PR3K-4	C: FXD DIPPED MICA 68pF ±5% 300V
C98	CMC-AB5PR5K-6	C: FXD DIPPED MICA 5pF ±5% 300V
C99	CMC-AB68PR3K-4	C: FXD DIPPED MICA 68pF ±5% 300V
C100	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C101	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C102	CMC-AB5PR5K-6	C: FXD DIPPED MICA 5pF ±10% 500V
C103	CTM-AA10P-1	C: VAR CER 10pF
C104	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.5% 500V
C105	CTM-AA10P-1	C: VAR CER 10pF
C106	CMC-AB10PR5K-6	C: FXD DIPPED MICA 10pF ±10% 500V
C107	CMC-AB51PR3K-4	C: FXD DIPPED MICA 51pF ±5% 300V
C108	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V

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Parts No.	ADVANTEST Stock No.	Description
C109	CSM-AC470P50V-1	C: FXD CER 470pF ±10% 50V
C110	CSM-AC470P50V-1	C: FXD CER 470pF ±10% 50V
C111 thru C113	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C114	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C115	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C116	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C117	CTA-AB10U25V-1	C: FXD ELECT TANTAL 10uF ±20% 25V
C118	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C119	CTA-ACR47U35V-1	C: FXD ELECT TANTAL 0.47uF ±20% 35V
C120	CTA-ACR47U35V-1	C: FXD ELECT TANTAL 0.47uF ±20% 35V
C121	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C122	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C123	CTM-AA20P-1	C: VAR CER 20pF
C124	CCP-AT10PR1K-1	C: FXD CHIP 10pF ±1% 1KV
C125	CCP-AT12PR1K-1	C: FXD CHIP 12pF ±1% 1KV
C126	CCP-AT15PR1K-1	C: FXD CHIP 15pF ±1% 1KV
C127	CCP-AV47PR1K-1	C: FXD CHIP 47pF ±1% 1KV
C128	CCP-AT43PR1K-1	C: FXD CHIP 43pF ±1% 1KV
C129	CTM-AA20P-1	C: VAR CER 20pF
C130	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C131	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C132	CTM-AA20P-1	C: VAR CER 20pF
C133	CCP-AT10PR1K-1	C: FXD CHIP 10pF ±1% 1KV
C134	CCP-AT12PR1K-1	C: FXD CHIP 12pF ±1% 1KV
C135	CCP-AT15PR1K-1	C: FXD CHIP 15pF ±1% 1KV
C136	CCP-AV47PR1K-1	C: FXD CHIP 47pF ±1% 1KV
C137	CCP-AT43PR1K-1	C: FXD CHIP 43pF ±1% 1KV
C138	CTM-AA20P-1	C: VAR CER 20pF
C139	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C140	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C141	CEE-AB4700P50V-1	C: FXD CER 4700pF 50V
C142 thru C147	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C148	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C149	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C150	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C151	CCK-AB22U16V-1	C: FXD ELECT 22uF 16V
C152	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C153	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C154	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
L156	LCL-C00329-1	L: FXD Coil
L157	LCL-C00329-1	L: FXD Coil
L158	LCL-A00064-1	L: FXD Coil
L159	LCL-A00064-1	L: FXD Coil
L160	LCL-A00073-1	L: FXD Coil
L161	LCL-B00482-1	L: FXD Coil

Parts No.	ADVANTEST Stock No.	Description
L162	LCL-B00482-1	L: FXD Coil
L163	LCL-B00483-1	L: FXD Coil
L164	LCL-B00483-1	L: FXD Coil
L165	LCL-B00371-1	L: FXD Coil
L166 thru L168	LCL-C00011-1	L: FXD Coil
X171	DXD-000804A-1	Crystal
X172	DXD-000805A-1	Crystal
FB174	ESM-000129-1	
MX176	DEE-000736-1	Mixer

Parts No.	ADVANTEST Stock No.	Description
Q1	STP-2SA1015-1	Transistor SI PNP
Q2	STN-2SC2150-1	Transistor SI NPN
Q3	STP-2SA1015-1	Transistor SI PNP
Q4	STN-2SC2150-1	Transistor SI NPN
Q5	STP-2SA1015-1	Transistor SI PNP
Q6	STN-2SC2150-1	Transistor SI NPN
R11	DHB-000333-1	R: 3dB PAD
R12	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R13	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R14	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R15	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R16	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R17	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R18	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
R19	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R20	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R21	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R22	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
R23	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R24	DHB-000332-1	R: 3dB PAD
R25	RCP-AB22-5	R: FXD CHIP 22Ω
C31	CCP-AC1P50V-4	C: FXD CHIP 1pF ±0.25% 50V
C32	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C33	CCP-AC5P50V-4	C: FXD CHIP 5pF ±0.25% 50V
C34	CCP-ADR1U50V-1	C: FXD CHIP 0.1µF +80, -20% 50V
C35	CCP-AC5P50V-4	C: FXD CHIP 5pF ±0.25% 50V
C36	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C37	CCP-AC1P50V-4	C: FXD CHIP 1pF ±0.25% 50V
C38 thru C44	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V

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Parts No.	ADVANTEST Stock No.	Description
Q1	STN-2SC1426-1	Transistor SI NPN
D6	SDS-SV14-1	Diode SI
D7 thru D10	SDS-1SS97-1	Diode SI
R16	RCP-AB51-3	R: FXD CHIP 51Ω
R17	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R18	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R19	RVR-CB5K-1	R: VAR CERMET 5kΩ
R20		Not assigned
R21	RCB-AH390-1	R: FXD CAR 390Ω ±5% 1/4W
R22	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R23	RCB-AH22-1	R: FXD CAR 22Ω ±5% 1/4W
R24	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R25	RCB-AH120-1	F: FXD CAR 120Ω ±5% 1/4W
R26	DHB-000332-1	R:
C31	CCP-AC47P50V-5	C: FXD CHIP 47pF ±10% 50V
C32	CCP-AC47P50V-5	C: FXD CHIP 47pF ±10% 50V
C33		Not assigned
C34	CMC-AB150PR3K-4	C: FXD DIPPED MICA 150pF ±5% 300V
C35	CMC-AB150PR3K-4	C: FXD DIPPED MICA 150pF ±5% 300V
C36	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C37	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C38	CCP-AA6P-1	C: FXD CHIP 6pF
C39	CCP-AC150P50V-5	C: FXD CHIP 150pF ±10% 50V
C40	CMC-AB33PR5K-4	C: FXD DIPPED MICA 33pF ±5% 500V
C41	CEE-AB4700P50V-1	C: FXD EL 4700pF 50V
C42	CMC-AB27PR5K-4	C: FXD DIPPED MICA 27pF ±5% 500V
C43	CEE-AB4700P50V-1	C: FXD EL 4700pF 50V
C44	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C45	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C46	CTM-AC20P-1	C: VAR CER 20pF
C47		Not assigned
L51	LCL-A00507-1	L: FXD Coil
L52	LCL-A00507-1	L: FXD Coil
L53 thru L55	LCL-A00069-1	L: FXD Coil
L56	LCL-A00505-1	L: FXD Coil
L57	LCL-A00063-1	L: FXD Coil
L58	LCL-A00064-1	L: FXD Coil

Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC2	SIC-8619-1	IC: High Speed 1/4 Divider
IC3	SIA-7905-5	IC: Voltage Regulator
Q5	STN-2SC2585-1	Transistor SI NPN
Q6	STP-2SA1015-1	Transistor SI PNP
Q7	STN-2SC2585-1	Transistor SI NPN
Q8	STN-2SC1815-15	Transistor SI NPN
Q9 thru Q14	STN-2SC2026-1	Transistor SI NPN
D16	SDS-TD293B-11	Diode SI
D17 thru D21	SDS-1S953-1	Diode SI
R26	DHB-000332-1	3dB PAD
R27	DHB-000332-1	3dB PAD
R28	RCP-AB51-3	R: FXD CHIP 51Ω
R29		(ADJ.)
R30	DHB-000332-1	3dB PAD
R31	RCP-AB51-3	R: FXD CHIP 51Ω
R32	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R33	RCB-AH3R3-1	R: FXD CAR 3.3Ω ±5% 1/4W
R34	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R35	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R36	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R37	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R38	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R39	RCB-AH82K	R: FXD CAR 82kΩ ±5% 1/4W
R40	RCB-AH68K	R: FXD CAR 68kΩ ±5% 1/4W
R41	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
R42	RCB-AH510	R: FXD CAR 510Ω ±5% 1/4W
R43	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R44	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R45	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R46	RVR-CD20K-1	R: VAR CERMET 20kΩ
R47	RMF-AR3R3KFK	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R48	RVR-CD100-1	R: VAR CERMET 100Ω
R49	RMF-AR510FK	R: FXD Metal FLM 510Ω ±1% 1/4W
R50	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R51	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R52	RCB-AH270-1	R: FXD CAR 270Ω ±5% 1/4W
R53	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R54	RCB-AH680-1	R: FXD CAR 680Ω ±5% 1/4W
R55	RCB-AH680-1	R: FXD CAR 680Ω ±5% 1/4W
R56	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R57	RVR-CB500-1	R: VAR CERMET 500Ω
R58	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R59	RCB-AH150-1	R: FXD CAR 150Ω ±5% 1/4W

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Parts No.	ADVANTEST Stock No.	Description
R60	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R61	RCB-AH47-1	R: FXD CAR 47Ω ±5% 1/4W
R62	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R63	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R64	RCB-AH56-1	R: FXD CAR 56Ω ±5% 1/4W
R65	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R66	RCB-AH150-1	R: FXD CAR 150Ω ±5% 1/4W
R67	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R68	RCB-AH47-1	R: FXD CAR 47Ω ±5% 1/4W
R69	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R70	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R71	RCB-AH56-1	R: FXD CAR 56Ω ±5% 1/4W
R72	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R73	RCB-AH150-1	R: FXD CAR 150Ω ±%% 1/4W
R74	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R75	RCB-AH47-1	R: FXD CAR 47Ω ±5% 1/4W
R76	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R77	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R78	RCB-AH56-1	R: FXD CAR 56Ω ±5% 1/4W
R79	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R80	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R81	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R82	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R83	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R84	RCP-AB51-3	R: FXD CHIP 51Ω
C86	CCP-AC2P50V-4	C: FXD CHIP 2pF ±0.25% 50V
C87	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C88	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C89	CEE-AB4700P50V-1	C: FXD EL 4700pF 50V
C90	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C91	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C92	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C93		Not assigned
C94	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C95	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C96	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C97	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C98 thru C100	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C101	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C102	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C103	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C104	CEE-AB4700P50V-1	C: FXD EL 4700pF 50V
C105	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C106	CEE-AB4700P50V-1	C: FXD CER 4700pF 50V
C107	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C108	CSM-AC12P50V-1	C: FXD CER 12pF ±10% 50V

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Parts No.	ADVANTEST Stock No.	Description
C109	CSM-AC12P50V-1	C: FXD CER 12pF ±10% 50V
C110	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C111	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C112	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C113	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C114	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C115	CSM-AC12P50V-1	C: FXD CER 12pF ±10% 50V
C116	CSM-AC12P50V-1	C: FXD CER 12pF ±10% 50V
C117	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C118	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C119	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C120	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
C121	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C122	CSM-AC12P50V-1	C: FXD CER 12pF ±10% 50V
C123	CSM-AC12P50V-1	C: FXD CER 12pF ±10% 50V
C124	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C125	CCK-AB10U25V-1	C: FXD ELECT 10μF 25V
C126	CCK-AB100U10V-1	C: FXD ELECT 100uF 10V
C127	CCP-ADR1U50V-1	C: FXD CHIP 0.1μF +80, -20% 50V
C128	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C129	CSM-AGR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C130	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V
L131		Not assigned
L132	LCL-A00505-1	L: FXD Coil
L133 thru L135	LCL-A00508-1	L: FXD Coil
L136	LCL-C00011-1	L: FXD Coil
L137	LCL-C00011-1	L: FXD Coil
R138	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R139	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R140	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
J141	JCP-AA003PX05-1	Connector
R142	RVR-CB10K-1	R: VAR CERMET 10kΩ
C149	CEE-AB4700P50V-1	C: FXD BL 4700pF 50V

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Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74S00	IC: Quadruple 2-Input Positive NAND Gate
IC2	SIT-74S162	IC: Synchronous 4-Bit Counter
IC3	SIT-74S162	IC: Synchronous 4-Bit Counter
IC4	SIT-74LS83	IC: 4-Bit Binary Full Adder with Fast Carry Low Power
IC5	SIT-74LS83	IC: 4-Bit Binary Full Adder with Fast Carry Low Power
IC6	SIT-74LS20	IC: Dual 4-Input Positive-NAND Gate Low Power
IC7	SIT-74S74	IC: Dual D-Type Positive-Edge-Triggered Flip-Flop with Preset AND Clear
IC8	SIT-74LS04	IC: Hex Inverter Low Power
IC9	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC10	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC11	SIT-74LS112	IC: Quad J-K Negative-Edge-Triggered Flip Flop with Preset Low Power
IC12	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC13	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC14	SIT-74LS74	IC: Dual D-Type Positive-Edge-Triggered Flip-Flop with Preset AND Clear Low Power
IC15	SIT-74LS02	IC: Quadruple 2-Input Positive NOR Gate Low Power
IC16		Not assigned
Q21	STN-2SC1426-1	Transistor SI NPN
Q22	STN-2SC1254-1	Transistor SI NPN
Q23	STN-2SC1254-1	Transistor SI NPN
Q24	STN-2SC1730-1	Transistor SI NPN
Q25		Not assigned
Q26	STN-2SC1254-1	Transistor SI NPN
Q27	STP-2SA711-1	Transistor SI PNP
Q28	STN-2SC1254-1	Transistor SI NPN
Q29	STP-2SA711-1	Transistor SI PNP
Q30	STN-2SC1815-15	Transistor SI NPN
Q31	STN-2SC1815-15	Transistor SI NPN
D36	SDS-1S953-1	Diode SI
D37	SDS-1S953-1	Diode SI
R41	RCB-AH68	R: FXD CAR 68Ω ±5% 1/4W
R42	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R43	RCB-AH8R2K	R:FXD CAR 8.2kΩ ±5% 1/4W
R44	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R45	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R46	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R47	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R48	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R49	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R50	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R51	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R52	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R53	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R54	RCB-AH8R2K-1	R: FXD CAR 8.2kΩ ±5% 1/4W
R55	RCB-AH680-1	R: FXD CAR 680Ω ±5% 1/4W
R56		Not assigned

Parts No.	ADVANTEST Stock No.	Description
R57	RCB-AH100-1	R: FXD CAR 100Ω ±5% 1/4W
R58	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R59	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R60	RMF-AR2.2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R61	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R62	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R63	RMF-AR820QFK	R: FXD Metal FLM 820Ω ±1% 1/4W
R64	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R65	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R66	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R67 thru R69	RMF-AR1R2KFK-1	R: FXD Metal FLM 1.2kΩ ±1% 1/4W
R70	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R71	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R72	RVR-CB200-1	R: VAR CERMET 200Ω
R73	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
C81 thru C88	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C89	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C90	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C91	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C92	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C93 thru C95	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C96	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C97	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C98	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C99	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C100	CMC-AC470PR3K-2	C: FXD DIPPED MICA 470pF ±5% 300V
C101	CMC-AD2000PR3K-2	C: FXD DIPPED MICA 2000pF ±5% 300V
C102	CFM-AAR047UR1K-1	C: FXD Mylar 0.047uF ±10% 1KV
C103 thru C107		Not assigned
C108 thru C118	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C119 thru C121	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C122		Not assigned
C123		Not assigned
C124	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C125	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
L126	LCL-C00120-1	L: FXD Coil
L127	LCL-C00120-1	L: FXD Coil
L128 thru L132		Not assigned

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Parts No.	ADVANTEST Stock No.	Description
L133	LCL-T00084-1	L: FXD Coil
L134	LCL-C00013-1	L: FXD Coil
L135	LCL-C00013-1	L: FXD Coil
FB137 thru FB139	ESM-000129-1	

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS160-1	IC: Synchronous 4-Bit Counter Low Power
IC2	SIT-74LS160-1	IC: Synchronous 4-Bit Counter Low Power
IC3	SIT-74LS390	IC: Dual Decade Counter Low Power
IC4	SIT-74LS112-1	IC: Dual J-K Negative-Edge-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC5	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC6	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC7	SIT-74LS74	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC8	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC9	SIT-74LS00-1	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC10	SIT-74LS02	IC: Quadruple 2-Input Positive-NOR Gate Low Power
IC11	SIT-74S74	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear
IC12	SIT-74LS160	IC: Synchronous 4-Bit Counter Low Power
IC13	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC14	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC15	SIT-74LS00	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC16	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
Q21 thru Q26	STN-2SC1730	Transistor SI NPN
Q27	STN-2SC1844	Transistor SI NPN
Q28	STN-2SC1844	Transistor SI NPN
Q29	STP-2SA991	Transistor SI PNP
Q30	STN-2SC1730	Transistor SI NPN
Q31	STN-2SC1815-15	Transistor SI NPN
Q32	STN-2SC1254-1	Transistor SI NPN
Q33 thru Q37	STN-2SC1730-1	Transistor SI NPN
Q38	STP-2SA1015-1	Transistor SI PNP
Q39	STN-2SC1815-15	Transistor SIN NPN
D51	SDS-1SS97-1	Diode SI
D52	SDS-1SS97-1	Diode SI
D53 thru D56	SDS-1S953-1	Diode SI
D57	SDS-1S1765-1	Diode SI
D58	SDS-1S1765-1	Diode SI
D59	SDS-1S953-1	Diode SI
D60	SDS-1S953-1	Diode SI
D61	SDZ-W120-5	Zener Diode
D62	SDZ-1S2191-2	Zener Diode
D63 thru D72	SDS-1S953-1	Diode SI
R81	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R82	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R83	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R84	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R85	RCB-AH680-1	R: FXD CAR 680Ω ±5% 1/4W
R86	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R87	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R88	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R89	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R90	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R91	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R92	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R93	RCB-AH15-1	R: FXD CAR 15Ω ±5% 1/4W
R94	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R95	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R96	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R97	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R98	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R99	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R100	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R101	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R102	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R103	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R104	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R105		Not assigned
R106	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R107	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R108	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R109	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R110	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R111	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R112	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R113	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R114	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R115	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R116	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R117	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R118	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R119	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R120	RMF-AR1R2KFK-1	R: FXD Metal FLM 1.2kΩ ±1% 1/4W
R121	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R122 thru R125	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R126	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R127	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R128	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R129	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R130	RMF-AR100KFK-1	R: FXD Metal FLM 100kΩ ±1% 1/4W
R131	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R132	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R133	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R134	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R135	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R136	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R137 thru R139	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R140	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R141	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R142	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R143	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R144	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R145	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R146	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R147	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R148	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R149	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R150	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R151	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R152	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R153	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R154	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R155	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R156	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R157	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R158	RVR-CB2K-1	R: VAR CERMET 2kΩ
R159	RMF-AR8R2KFK-1	R: FXD Metal FLM 8.2kΩ ±1% 1/4W
R160	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R161	RVR-CB20K-1	R: VAR CERMET 20kΩ
R162	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R163	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R164	RMF-AR8R2KFK-1	R: FXD Metal FLM 8.2kΩ ±1% 1/4W
R165	RVR-CB1K-1	R: VAR CERMET 1kΩ
R166	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W
R167	RCB-AH33K	R: FXD CAR 33kΩ ±5% 1/4W
R168	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R169	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R170	RMF-AR9R1KFK-1	R: FXD Metal FLM 9.1kΩ ±1% 1/4W
R171	RCB-AH33K	R: FXD CAR 33kΩ ±5% 1/4W
R172	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R173	RMF-AR47KFK-1	R: FXD Metal FLM 47kΩ ±1% 1/4W
R174	RMF-AR1R2KFK-1	R: FXD Metal FLM 1.2kΩ ±1% 1/4W
R175	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R176	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R177	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R178	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R179	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R180	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R181	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R182	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R183	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R184	RMF-AR20KFK-1	R: FXD Metal FLM 20kΩ ±1% 1/4W
R185	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R186	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R187	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R188	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R189	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R190	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R191	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R192	RMF-AR33QFK-1	R: FXD Metal FLM 33Ω ±1% 1/4W
R193	RMF-AR68QFK-1	R: FXD Metal FLM 68Ω ±1% 1/4W
R194	RMF-AR68QFK-1	R: FXD Metal FLM 68Ω ±1% 1/4W
R195	RMF-AR56QFK-1	R: FXD Metal FLM 56Ω ±1% 1/4W
R196	RMF-AR56QFK-1	R: FXD Metal FLM 56Ω ±1% 1/4W
R197	RMF-AR47QFK-1	R: FXD Metal FLM 47Ω ±1% 1/4W
R198	RMF-AR47QFK-1	R: FXD Metal FLM 47Ω ±1% 1/4W
R199	RMF-AR39QFK-1	R: FXD Metal FLM 39Ω ±1% 1/4W
R200	RMF-AR39QFK-1	R: FXD Metal FLM 39Ω ±1% 1/4W
R201	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R202	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R203	RMF-AR75QFK-1	R: FXD Metal FLM 75Ω ±1% 1/4W
R204	RVR-CB5K-1	R: VAR CERMET 5kΩ
R205	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R206	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R207	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R208	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R209	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R210	RMF-AR1R5KFK-1	R: FXD Metal FLM 1.5kΩ ±1% 1/4W
R211	RVR-CB10K-1	R: VAR CERMET 10kΩ
R212	RMF-AR39KFK-1	R: FXD Metal FLM 39kΩ ±1% 1/4W
R213	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R214	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R215	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R216	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R217	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R218	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
C231	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C232	CMC-AB15PR5K-6	C: FXD DIPPED MICA 15pF ±10% 500V
C233	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C234	CMC-AB12PR5K-6	C: FXD DIPPED MICA 12pF ±10% 500V
C235	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C236	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C237 thru C239	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C240	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C241	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C242	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C243	CMC-AB56PR3K-4	C: FXD DIPPED MICA 56pF ±5% 300V
C244	CTM-AC20P-1	C: VAR CER 20pF

Parts No.	ADVANTEST Stock No.	Description
C245	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.25% 500V
C246	CTM-AC20P-1	C: VAR CER 20pF
C247	CMC-AB51PR3K-4	C: FXD DIPPED MICA 51pF ±5% 300V
C248	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.25% 500V
C249	CTM-AC20P-1	C: VAR CER 20pF
C250	CMC-AB56PR3K-4	C: FXD Metal FLM 56pF ±5% 300V
C251	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C252	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C253	CMC-AB56PR3K-4	C: FXD DIPPED MICA 56pF ±5% 300V
C254	CTM-AC20P-1	C: VAR CER 20pF
C255	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.25% 500V
C256	CTM-AC20P-1	C: VAR CER 20pF
C257	CMC-AB56PR3K-4	C: FXD DIPPED MICA 56pF ±5% 300V
C258	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.25% 500V
C259	CTM-AC20P-1	C: VAR CER 20pF
C260	CMC-AB56PR3K-4	C: FXD DIPPED MICA 56pF ±5% 300V
C261 thru C263	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C264	CSM-AC680P50V	C: FXD CER 680pF ±10% 50V
C265	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C266	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C267	CSM-AC680P50V	C: FXD CER 680pF ±10% 50V
C268 thru C270	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C271		Not assigned
C272 thru C276	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C277	CCK-AB47U10V-1	C: FXD ELECT 47uF 10V
C278	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C279	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C280	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C281	CSM-ACR01U50V-1	C: FXD CER 0.01uF +80, -20% 50V
C282	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C283	CFM-ABR22U50V-1	C: FXD Mylar 0.22uF ±10% 50V
C284	CFM-AS3300P50V-1	C: FXD Mylar 3300pF ±10% 50V
C285	CMC-AD6800PR1K-2	C: FXD DIPPED MICA 6800pF ±5% 1KV
C286	CMC-AD6800PR1K-2	C: FXD DIPPED MICA 6800pF ±5% 1KV
C287	CMC-AC680PR3K-2	C: FXD DIPPED MICA 680pF ±5% 300V
C288 thru C294	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C295 thru C297	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C298	CFM-ACR033U50V-1	C: FXD Mylar 0.033uF ±10% 50V
C299	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C300	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C301	CMC-AB150PR3K-4	C: FXD DIPPED MICA 150pF ±5% 300V
C302	CMC-AB82PR3K-4	C: FXD DIPPED MICA 82pF ±5% 300V

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Parts No.	ADVANTEST Stock No.	Description
C303	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C304	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C305 thru C312	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C313	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C314 thru C319	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C320 thru C323	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C324	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C325	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C326 thru C329	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C330	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C331	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C332	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C333	CSM-ACR01U50V	C: FXD CER 0.01uF +80, -20% 50V
C334	CMC-AD6800PR1K-2	C: FXD DIPPED MICA 6800pF ±5% 100V
C335	CMC-AC6800PR3K-2	C: FXD DIPPED MICA 6800pF ±5% 300V
C336		Not assigned
C337	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C338	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C339	CMC-AD2000PR3K-2	C: FXD DIPPED MICA 2000pF ±5% 300V
L351	LCL-C00111-1	L: FXD Coil
L352	LCL-C00490-1	L: FXD Coil
L353	LCL-T00084-1	L: FXD Coil
L354 thru L359	LCL-C000116-1	L: FXD Coil
L360 thru L362	LCL-B00493-1	L: FXD Coil
L363	LCL-T00480-1	L: FXD Coil
L364	LCL-B00159-1	L: FXD Coil
L365 thru L367	LCL-T00084-1	L: FXD Coil
L368	LCL-B00369-1	L: FXD Coil
L369	LCL-C00571-1	L: FXD Coil
L370 thru L372	LCL-C00490-1	L: FXD Coil
L373	LCL-E00388-1	L: FXD Coil
L374	LCL-T00084-1	L: FXD Coil
L375	LCL-T00084-1	L: FXD Coil
L376	LCL-B00159-1	
X381	DXD-000435-1	Crystal
M383	DEE-000736-1	Mixer

Parts No.	ADVANTEST Stock No.	Description
M384	DEE-000736-1	Mixer
J387	JCF-AC001JX06-1	Connector
J388	JCF-AC001JX06-1	Connector
J389	JCP-AA003PX05-1	Connector
J390	JCP-AA003PX05-1	Connector

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS00-1	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC2	SIT-74LS00-1	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC3	SIT-74S74	IC: Dual D-Type Positive-Edge-Triggered Flip-Flop with Preset AND Clear
IC4	SIT-74LS160	IC: Synchronous 4-Bit Counter Low Power
IC5	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC6	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
Q11 thru Q16	STN-2SC1730-1	Transistor SI NPN
Q17	STN-2SC2026-1	Transistor SI NPN
Q18	STN-2SC1730-1	Transistor SI NPN
Q19	STN-2SC2026-1	Transistor SI NPN
Q20	STN-2SC1730-1	Transistor SI NPN
Q21	STN-2SC1254-1	Transistor SI NPN
Q22 thru Q30	STN-2SC1730-1	Transistor SI NPN
D41	SDS-1S1765-1	Diode SI
D42	SDS-1S1765-1	Diode SI
D43 thru D55	SDS-1S953-1	Diode SI
R61	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R62	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R63	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R64	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R65	RCB-AH33	R: FXD CAR 33Ω ±5% 1/4W
R66	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R67	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R68	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/8W
R69	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/8W
R70	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R71	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R72	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R73	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R74	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R75	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R76	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R77	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R78	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R79	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R80	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R81	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R82	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R83	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R84	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R85	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R86	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R87	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R88	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R89	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R90	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R91		Not assigned
R92	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R93	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R95	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R96	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R97	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R98	RMF-AR100KFK-1	R: FXD Metal FLM 100kΩ ±1% 1/4W
R99	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R100	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R101	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R102	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R103	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R104	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R105 thru R107	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R108	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R109	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R110	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R111	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R112	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R113	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R114	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R115	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R116	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R117	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R118	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R119	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R120	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R121	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R122	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R123	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R124	RVR-CB2K-1	R: VAR CERMET 1kΩ
R125	RMF-AR8R2KFK-1	R: FXD Metal FLM 8.2kΩ ±1% 1/4W
R126	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R127	RVR-CB20K-1	R: VAR CERMET 20kΩ
R128	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R129	RMF-AR33QFK-1	R: FXD Metal FLM 33Ω ±1% 1/4W
R130	RMF-AR68QFK-1	R: FXD Metal FLM 68Ω ±1% 1/4W
R131	RMF-AR68QFK-1	R: FXD Metal FLM 68Ω ±1% 1/4W
R132	RMF-AR56QFK-1	R: FXD Metal FLM 56Ω ±1% 1/4W
R133	RMF-AR56QFK-1	R: FXD Metal FLM 56Ω ±1% 1/4W
R134	RMF-AR47QFK-1	R: FXD Metal FLM 47Ω ±1% 1/4W
R135	RMF-AR47QFK-1	R: FXD Metal FLM 47Ω ±1% 1/4W
R136	RMF-AR39QFK-1	R: FXD Metal FLM 39Ω ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R137	RMF-AR39QFK-1	R: FXD Metal FLM 39Ω ±1% 1/4W
R138	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R139	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R140	RMF-AR75QFK-1	R: FXD Metal FLM 75Ω ±1% 1/4W
R141	RMF-AR47KFK-1	R: FXD Metal FLM 47kΩ ±1% 1/4W
R142	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R143	RMF-AR47KFK-1	R: FXD Metal FLM 47kΩ ±1% 1/4W
R144	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W
R145	RMF-AR39KFK-1	R: FXD Metal FLM 39kΩ ±1% 1/4W
R146	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R147	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R148	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R149	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R150	RMF-AR20KFK-1	R: FXD Metal FLM 20kΩ ±1% 1/4W
R151	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R152	RMF-AR33KFK-1	R: FXD Metal FLM 33kΩ ±1% 1/4W
R153	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R154	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R155	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R156	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R157	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R158	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R159	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R160	RVR-CB5K-1	R: VAR CERMET 5kΩ
R161	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R162	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R163	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R164	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R165	RMF-AR1R5KFK-1	R: FXD Metal FLM 1.5KΩ ±1% 1/4W
R166	RVR-CB10K-1	R: VAR CERMET 10kΩ
R167	RMF-AR39KFK-1	R: FXD Metal FLM 39kΩ ±1% 1/4W
R168	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R169	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R170	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R171	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R172	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R173	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R174	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R175	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R176	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R177	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R178	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R179	RCB-AH15	R: FXD CAR 15Ω ±5% 1/4W
R180	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R181	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R182	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R183	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R184	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R185	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R186	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R187	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R188	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R189	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R190	RMF-AR1KFK	R: FXD Metal FLM 1kΩ ±1% 1/4W
R191	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
C201	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C202	CMC-AB30PR5K-4	C: FXD DIPPED MICA 30pF ±5% 500V
C203	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C204	CMC-AB39PR5K-4	C: FXD DIPPED MICA 39pF ±5% 500V
C205	CMC-AB110PR3K-4	C: FXD DIPPED MICA 110pF ±5% 300V
C206	CTM-AC20P	C: VAR CER 20pF
C207	CMC-AB3PR5K-2	C: FXD DIPPED MICA 3pF ±5% 500V
C208	CTM-AC20P-1	C: VAR CER 20pF
C209	CMC-AB110PR3K-4	C: FXD DIPPED MICA 110pF ±5% 300V
C210 thru C213	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C214	CTM-AC20P-1	C: VAR CER 20pF
C215	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C216	CTM-AC6P-1	C: VAR CER 6pF
C217	CCK-AB10U25V-1	C: FXD ELECT 10μF 25V
C218	CCK-AB10U25V-1	C: FXD ELECT 10μF 25V
C219 thru C226	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C227	CMC-AB15PR5K-6	C: FXD DIPPED MICA 15pF ±10% 500V
C228	CMC-AB5PR5K-6	C: FXD DIPPED MICA 5pF ±10% 500V
C229	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C230	CTM-AC10P-1	C: VAR CER 10pF
C231	CMC-AB1PR5K-2	C: FXD DIPPED MICA 1pF ±0.5% 500V
C232	CTM-AC10P-1	C: VAR CER 10pF
C233	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C234	CMC-AB5PR5K-6	C: FXD DIPPED MICA 5pF ±10% 500V
C235 thru C238	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C239	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C240	CMC-AB47PR3K-4	C: FXD DIPPED MICA 47pF ±5% 300V
C241	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C242 thru C245	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C246	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C247	CMC-AB47PR3K-4	C: FXD DIPPED MICA 47pF ±5% 300V
C248	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C249	CCK-AB10U25V-1	C: FXD ELECT 10μF 25V
C250	CFM-ASR033U50V-1	C: FXD Mylar 0.033μF ±10% 50V
C251	CMC-AB250PR3K-4	C: FXD DIPPED MICA 250pF ±5% 300V

Parts No.	ADVANTEST Stock No.	Description
C252	CMC-AB220PR3K-4	C: FXD DIPPED MICA 220pF ±5% 300V
C253	CMC-AB82PR3K-4	C: FXD DIPPED MICA 82pF ±5% 300V
C254	CSM-ACR047U50V	C: FXD CER 0.047μF +80, -20% 50V
C255	CCK-AB10U25V-1	C: FXD ELECT 10μ 25V
C256 thru C266	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C267	CSM-ACR047U50V	C: FXD CER 0.047μF +80, -20% 50V
C268	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C269	CSM-AC2200P50V	C: FXD CER 2200pF +80, -20% 50V
C270	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C271	CCK-AB10U25V-1	C: FXD ELECT 10μ 25V
C272	CCK-AB10U25V-1	C: FXD ELECT 10μ 25V
C273 thru C276	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C277	CCK-AB10U25V-1	C: FXD ELECT 10μF 25V
C278	CCK-AB10U25V-1	C: FXD ELECT 10μF 25V
C279	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C280	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C281	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C282	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C283	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C284	CTM-AC20P-1	C: VAR CER 20pF
C285	CMC-AB2PR5K-2	C: FXD DIPPED MICA 2pF ±0.5% 500V
C286	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C287	CTM-AC20P-1	C: VAR CER 20pF
C288	CMC-AB2PR5K-2	C: FXD DIPPED MICA 2pF ±0.5% 500V
C289	CTM-AC20P-1	C: VAR CER 20pF
C290	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C291	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C292	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C293	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C294	CTM-AC20P-1	C: VAR CER 20pF
C295	CMC-AB2PR5K-2	C: FXD DIPPED MICA 2pF ±0.5% 500V
C296	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C297	CTM-AC20P-1	C: VAR CER 20pF
C298	CMC-AB2PR5K-2	C: FXD DIPPED MICA 2pF ±0.5% 500V
C299	CTM-AC20P-1	C: VAR CER 20pF
C300	CMC-AB91PR3K-4	C: FXD DIPPED MICA 91pF ±5% 300V
C301 thru C303	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C304	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C305	CMC-AB220PR3K-4	C: FXD DIPPED MICA 220pF ±5% 300V
C306	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C307 thru C309	CSM-ACR01U50V	C: FXD CER 0.01μF +80, -20% 50V
C310	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C311	CMC-AB220PR3K-4	C: FXD DIPPED MICA 220pF ±5% 300V

Parts No.	ADVANTEST Stock No.	Description
C312	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C313	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
L331	LCL-B00312-1	L: FXD Coil
L332	LCL-C00116-1	L: FXD Coil
L333	LCL-C00116-1	L: FXD Coil
L334	LCL-C00521-1	L: FXD Coil
L335	LCL-T00084-1	L: FXD Coil
L336	LCL-T00084-1	L: FXD Coil
L337	LCL-E00388-1	L: FXD Coil
L338	LCL-C00559-1	L: FXD Coil
L339	LCL-C00559-1	L: FXD Coil
L340	LCL-E00388-1	L: FXD Coil
L341	LCL-A00514-1	L: FXD Coil
L342	LCL-A00514-1	L: FXD Coil
L343	LCL-E00388-1	L: FXD Coil
L344	LCL-A00514-1	L: FXD Coil
L345	LCL-A00514-1	L: FXD Coil
L346	LCL-T00084-1	L: FXD Coil
L347	LCL-B00369-1	L: FXD Coil
L348	LCL-C00570-1	L: FXD Coil
L349	LCL-E00388-1	L: FXD Coil
L350	LCL-C00490-1	L: FXD Coil
L351	LCL-C00490-1	L: FXD Coil
L352 thru L355	LCL-T00084-1	L: FXD Coil
L356	LCL-C00490-1	L: FXD Coil
L357 thru L362	LCL-C00116-1	L: FXD Coil
L363	LCL-E00388-1	L: FXD Coil
L364	LCL-A00069-1	L: FXD Coil
L365	LCL-A00069-1	L: FXD Coil
L366	LCL-E00388-1	L: FXD Coil
L367	LCL-A00069-1	L: FXD Coil
L368	LCL-A00069-1	L: FXD Coil
L369	LCL-T00084-1	L: FXD Coil
X376	DXD-000786A-1	Crystal
MX379	DEE-000736-1	Mixer
F381	DNF-000787-1	Filter
J384	JCF-AC001JX06-1	Connector
J385	JCP-AA003PX05-1	Connector

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC2	SIT-74LS175	IC: Quad D-Type Flip Flop Low Power
IC3	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC4	SIT-74LS02	IC: Quadruple 2-Input Positive-NOR Gate Low Power
IC5	SIT-7406	IC: Hex Inverter Buffer/Driver with Open-Collector High-Voltage Output
IC6	SIT-7406	IC: Hex Inverter Buffer/Driver with Open-Collector High-Voltage Output
D11 thru D22	SDS-1S953-1	Diode SI
R31 thru R36	RMF-AR43QFK-1	R: FXD Metal FLM 43Ω ±1% 1/4WR
R37	RMF-AR330QFK-1	R: FXD Metal FLM 330Ω ±1% 1/4W
R38	RMF-AR300QFK-1	R: FXD Metal FLM 300Ω ±1% 1/4W
R39	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R40	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R41	RMF-AR120QFK-1	R: FXD Metal FLM 120Ω ±1% 1/4W
R42	RMF-AR330QFK-1	R: FXD Metal FLM 330Ω ±1% 1/4W
R43	RMF-AR300QFK-1	R: FXD Metal FLM 300Ω ±1% 1/4W
R44	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R45	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R46	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R47	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R48	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R49	RMF-AR680QFK-1	R: FXD Metal FLM 680Ω ±1% 1/4W
R50	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R51	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R52	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R53	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R54	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R55	RMF-AR680QFK-1	R: FXD Metal FLM 680Ω ±1% 1/4W
R56	RMF-AR910QFK-1	R: FXD Metal FLM 910Ω ±1% 1/4W
R57	RMF-AR910QFK-1	R: FXD Metal FLM 910Ω ±1% 1/4W
R58	RMF-AR24QFK-1	R: FXD Metal FLM 24Ω ±1% 1/4W
R59	RMF-AR15QFK-1	R: FXD Metal FLM 15Ω ±1% 1/4W
R60	RMF-AR15QFK-1	R: FXD Metal FLM 15Ω ±1% 1/4W
R61	RMF-AR430QFK-1	R: FXD Metal FLM 430Ω ±1% 1/4W
R62	RMF-AR430QFK-1	R: FXD Metal FLM 430Ω ±1% 1/4W
R63	RMF-AR15QFK-1	R: FXD Metal FLM 15Ω ±1% 1/4W
R64	RMF-AR51QFK-1	R: FXD Metal FLM 51Ω ±1% 1/4W
R65	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R66	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R67	RMF-AR24QFK-1	R: FXD Metal FLM 24Ω ±1% 1/4W
R68	RMF-AR180QFK-1	R: FXD Metal FLM 180Ω ±1% 1/4W
R69	RMF-AR330QFK-1	R: FXD Metal FLM 330Ω ±1% 1/4W
R70	RMF-AR330QFK-1	R: FXD Metal FLM 330Ω ±1% 1/4W
R71	RMF-AR180QFK-1	R: FXD Metal FLM 180Ω ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R72	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R73	RMF-AR150QFK-1	R: FXD Metal FLM 150Ω ±1% 1/4W
R74	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R75	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R76	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R77	RMF-AR82QFK-1	R: FXD Metal FLM 82Ω ±1% 1/4W
R78	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R79	RMF-AR680QFK-1	R: FXD Metal FLM 680Ω ±1% 1/4W
R80	RMF-AR150QFK-1	R: FXD Metal FLM 150Ω ±1% 1/4W
R81	RMF-AR270QFK-1	R: FXD Metal FLM 270Ω ±1% 1/4W
R82	RMF-AR270QFK-1	R: FXD Metal FLM 270Ω ±1% 1/4W
R83	RMF-AR270QFK-1	R: FXD Metal FLM 270Ω ±1% 1/4W
R84	RMF-AR200QFK-1	R: FXD Metal FLM 200Ω ±1% 1/4W
R85	RMF-AR110QFK-1	R: FXD Metal FLM 110Ω ±1% 1/4W
R86 thru R88	RCB-AH120-1	R: FXD CAR 120Ω ±5% 1/4W
R89 thru R94	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
C101	CTM-AC10P-1	C: VAR CER 10pF
C102	CTM-AC10P-1	C: VAR CER 10pF
C103	CCP-AE1U50V-1	C: FXD CHIP 1uF +80, -20% 50V
C104	CCK-BB1000U16V-1	C: FXD ELECT 1000uF 16V
C105 thru C140	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C141	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C142	CCK-AB10U16V-1	C: FXD ELECT 10uF 16V
C143 thru C145	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
L146	LCL-A00516-1	L: FXD Coil
L147	LCL-A00510-1	L: FXD Coil
L148	LCL-T00084-1	L: FXD Coil
L149	LCL-T00084-1	L: FXD Coil
K151 thru K168	KRL-000434-1	Relay
J171	JCR-AF016PX02-1	Connector
C173	CCP-AE1U50V-1	C: FXD CHIP 1uF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC2	SIA-324-1	IC: Quadruple Operational Amplifier
IC3	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC4	SIT-74LS175-1	IC: Quad D-Type Flip-Flop Low Power
IC5	SIA-DA7524-2	IC: 8 bit Buffered Multiplying D/A Converter
IC6	SIA-DA7524-2	IC: 8 bit Buffered Multiplying D/A Converter
IC7	SIT-74LS02-1	IC: quadruple 2-Input Positive NOR-Gate Low Power
IC8	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC9	SIA-733N-2	IC:
Q11 thru Q16	STN-2SC1815-15	Transistor SI NPN
Q17 thru Q19	STN-2SC1730-1	Transistor SI NPN
Q20	STN-2SC2026-1	Transistor SI NPN
Q21	STN-2SC2026-1	Transistor SI NPN
Q22 thru Q24	STN-2SC2369	Transistor SI NPN
Q25	STN-2SC1815-15	Transistor SI NPN
Q26		Not assigned
Q27	STP-2SA1015-1	Transistor SI NPN
Q28	STN-2SC2026-1	Transistor SI NPN
Q29	STN-2SC2026-1	Transistor SI NPN
Q30	STN-2SC1730-1	Transistor SI NPN
Q31	STN-2SC2026-1	Transistor SI NPN
Q32	STN-2SC1730-1	Transistor SI NPN
Q33	STN-2SC1730-1	Transistor SI NPN
Q34	STN-2SC1426-1	Transistor SI NPN
Q35	STP-2SA711-1	Transistor SI PNP
Q36	STN-2SC1275-1	Transistor SI NPN
Q37 thru Q40	STN-2SC1730-1	Transistor SI NPN
D51 thru D58	SDS-1S2222-1	Diode SI
D59	SDS-1SV50-1	Diode SI
D60	SDS-1SV50-1	Diode SI
D61 thru D63	SDS-1S2222-1	Diode SI
D64	SDS-1SS97-1	Diode SI
E65	SDS-1SS97-1	Diode SI
D66	SDZ-W050-1	Zener Diode
D67	SDS-LD1-1	Diode SI
D68	SDS-LD1-1	Diode SI
R81	RCB-AG10	R: FXD CAR 10Ω ±5% 1/8W
R82	RCB-AG51	R: FXD CAR 51Ω ±5% 1/8W
R83	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R84 thru R88	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R89	RCB-AG4R7K	R: FXD CAR 4.7kΩ ±5% 1/8W
R90	RCB-AG100	R: FXD CAR 100Ω ±5% 1/8W
R91	RCB-AG100	R: FXD CAR 100Ω ±5% 1/8W
R92	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R93	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R94	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R95	RCB-AH47	R: FXD CAR 47Ω ±5% 1/4W
R96	RCB-AG51	R: FXD CAR 51Ω ±5% 1/8W
R97	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R98	RCB-AG4R7K	R: FXD CAR 4.7kΩ ±5% 1/8W
R99 thru R103	RCB-AG10K	F: FXD CAR 10kΩ ±5% 1/8W
R104	RCB-AG10	R: FXD CAR 10Ω ±5% 1/8W
R105	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R106	RCB-AG51	R: FXD CAR 51Ω ±5% 1/8W
R107	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R108	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R109	RCB-AG10	R: FXD CAR 10Ω ±5% 1/8W
R110	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R111	RCB-AG51	R: FXD CAR 51Ω ±5% 1/8W
R112	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R113	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R114	RCB-AG100K	R: FXD CAR 100kΩ ±5% 1/8W
R115	RCB-AG100K	R: FXD CAR 100kΩ ±5% 1/8W
R116	RCB-AG15K	R: FXD CAR 15kΩ ±5% 1/8W
R117	RCB-AG18K	R: FXD CAR 18kΩ ±5% 1/8W
R118	RCB-AG6R8K	R: FXD CAR 6.8kΩ ±5% 1/8W
R119	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R120	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R121	RCB-AG1R5K	R: FXD CAR 1.5kΩ ±5% 1/8W
R122	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R123	RCB-AG4R7K	R: FXD CAR 4.7kΩ ±5% 1/8W
R124	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R125	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R126	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R127	RCB-AG56Ω	R: FXD CAR 56Ω ±5% 1/8W
R128	RCB-AG150Ω	R: FXD CAR 150Ω ±5% 1/8W
R129	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R130	RCB-AG2R7K	R: FXD CAR 2.7kΩ ±5% 1/8W
R131	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R132	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R133	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R134	RCB-AG10	R: FXD CAR 10Ω ±5% 1/8W
R135	RCB-AG33	R: FXD CAR 33Ω ±5% 1/8W
R136	RCB-AG56	R: FXD CAR 56Ω ±5% 1/8W

Parts No.	ADVANTEST Stock No.	Description
R137	RCB-AG330	R: FXD CAR 330Ω ±5% 1/8W
R138	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R139	RCB-AG2R7K	R: FXD CAR 2.7kΩ ±5% 1/8W
R140	RCB-AG33	R: FXD CAR 33Ω ±5% 1/8W
R141	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R142	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R143	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R144	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R145	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R146	RCB-AG270	R: FXD CAR 270Ω ±5% 1/8W
R147	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R148	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R149	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R150	RMF-AR4R7K	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R151	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R152	RMF-AR560QFK-1	R: FXD Metal FLM 560Ω ±1% 1/4W
R153	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R154	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R155	RMF-AR680QFK-1	R: FXD Metal FLM 680Ω ±1% 1/4W
R156	RMF-AR330QFK-1	R: FXD Metal FLM 330Ω ±1% 1/4W
R157	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R158	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R159	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R160	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R161	RMF-AR51QFK-1	R: FXD Metal FLM 51Ω ±1% 1/4W
R162	RMF-AR51QFK-1	R: FXD Metal FLM 51Ω ±1% 1/4W
R163	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R164	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R165	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R166	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R167	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R168	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R169	RCB-AG1R8K	R: FXD CAR 1.8kΩ ±5% 1/8W
R170	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R171	RMF-AR680QFK-1	R: FXD Metal FLM 680Ω ±1% 1/4W
R172	RVR-CB500-1	R: VAR CERMET 500Ω
R173	RMF-AR5R6KFK-1	R: FXD Metal FLM 5.6kΩ ±1% 1/4W
R174	RVR-CB1K-1	R: VAR CERMET 1kΩ
R175	RMF-AR5R6KFK-1	R: FXD Metal FLM 5.6kΩ ±1% 1/4W
R176	RMF-AR5R6KFK-1	R: FXD Metal FLM 5.6kΩ ±1% 1/4W
R177	RVR-CB1K-1	R: VAR CERMET 1kΩ
R178	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R179	RMF-AR15QFK-1	R: FXD Metal FLM 15Ω ±1% 1/4W
R180	RMF-AR75QFK-1	R: FXD Metal FLM 75Ω ±1% 1/4W
R181	RMF-AR15QFK-1	R: FXD Metal FLM 15Ω ±1% 1/4W
R182	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R183	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R184	RMF-AR68QFK-1	R: FXD Metal FLM 68Ω ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R185	RVR-CB100	R: VAR CERMET 100Ω
R186	RCB-AG150	R: FXD CAR 150Ω ±5% 1/8W
R187	RCB-AG39	R: FXD CAR 39Ω ±5% 1/8W
R188	RCB-AG150	R: FXD CAR 150Ω ±5% 1/8W
R189	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R190	RCB-AG2R7K	R: FXD CAR 2.7kΩ ±5% 1/8W
R191	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R192	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R193	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R194	RCB-AG120	R: FXD CAR 120Ω ±5% 1/8W
R195	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R196	RCB-AG6R68K	R: FXD CAR 6.8kΩ ±5% 1/8W
R197	RCB-AG6R8K	R: FXD CAR 6.8kΩ ±5% 1/8W
R198	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R199	RMF-AR51QFK-1	R: FXD Metal FLM 51Ω ±1% 1/4W
R200 thru R203	RCB-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R204	RMF-AR910QFK-1	R: FXD Metal FLM 910Ω ±1% 1/4W
R205	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R206	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R207	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R208	RMF-AR27QFK-1	R: FXD Metal FLM 27Ω ±1% 1/4W
R209	RMF-AS330QFK-1	R: FXD Metal FLM 330Ω ±1% 2W
R210	RMF-AS330QFK-1	R: FXD Metal FLM 330Ω ±1% 2W
R211	RCB-AG27	R: FXD CAR 27Ω ±5% 1/8W
R212	RMF-AR27QFK-1	R: FXD Metal FLM 27Ω ±1% 1/4W
R213	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R214	RMF-AR27QFK-1	R: FXD Metal FLM 27Ω ±1% 1/4W
R215	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R216	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R217	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R218	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R219 thru R222	RMF-AS220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R223	RCB-AG27	R: FXD CAR 27Ω ±5% 1/8W
R224	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R225	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R226	RMF-AR22QFK-1	R: FXD Metal FLM 22Ω ±1% 1/4W
R227	RMF-AS220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R228	RMF-AS220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R229	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R230	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R231	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R232	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R233	RMF-AR10QFK-1	R: FXD Metal FLM 10Ω ±1% 1/4W
R234	RMF-AR33QFK-1	R: FXD Metal FLM 33Ω ±1% 1/4W
R235	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W

Parts No.	ADVANTEST Stock No.	Description
R236	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R237	RCB-AG1K	R: FXD CAR 1kΩ ±5% 1/8W
R238	RCB-AG10	R: FXD CAR 10Ω ±5% 1/8W
R239	RCB-AG33K	R: FXD CAR 33kΩ ±5% 1/8W
R240	RCB-AG8R2K	R: FXD CAR 8.2kΩ ±5% 1/8W
R241	RCB-AG51	R: FXD CAR 51Ω ±5% 1/8W
R242	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R243	RCB-AH680-1	R: FXD CAR 680Ω ±5% 1/4W
R244	RCB-AG33	R: FXD CAR 33Ω ±5% 1/8W
R245	RCB-AG47	R: FXD CAR 47Ω ±5% 1/8W
R246	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R247	RCB-AH33	R: FXD CAR 33Ω ±5% 1/4W
R248	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R249	RMF-AR5R6KFK-1	R: FXD Metal FLM 5.6kΩ ±1% 1/4W
R250	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R251	RCB-AH120-1	R: FXD CAR 120Ω ±5% 1/4W
R252	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R153	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
C261	CSM-ACR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C262	CSM-ACR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C263 thru C286	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C287	CSM-AC1500P50V	C: FXD CER 1500pF ±20% 50V
C288	CSM-AC2200P50V	C: FXD CER 2200pF ±20% 50V
C289	CSM-AC1500P50V	C: FXD CER 1500pF ±20% 50V
C290	CMC-AB33PR5K-4	C: FXD DIPPED MICA 33pF ±5% 500V
C291	CMC-AC470PR3K-2	C: FXD DIPPED MICA 470pF ±5% 300V
C292	CMC-AC560PR3K-2	C: FXD DIPPED MICA 560pF ±5% 300V
C293	CMC-AC820PR3K-2	C: FXD DIPPED MICA 820pF ±5% 300V
C294 thru C298	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C299	CMC-AB120PR3K-4	C: FXD DIPPED MICA 120pF ±5% 300V
C300	CTM-AC50P-1	C: VAR CER 50pF
C301	CMC-AB5PR5K-6	C: FXD DIPPED MICA 5pF ±10% 500V
C302	CMC-AB110PR3K-4	C: FXD DIPPED MICA 110pF ±5% 300V
C303	CTM-AC50P-1	C: VAR CER 50pF
C304	CMC-AB5PR5K-6	C: FXD DIPPED MICA 5pF ±10% 500V
C305	CTM-AC50P-1	C: VAR CER 50pF
C306	CMC-AB120PR3K-4	C: FXD DIPPED MICA 120pF ±5% 300V
C307 thru C315	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C316	CCP-ADR022U50V	C: FXD CHIP 0.022uF +80, -20% 50V
C317	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C318	CCP-ADR01U50V	C: FXD CHIP 0.01uF +80, -20% 50V
C319	CSM-AGR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C320	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C321		Not assigned

Parts No.	ADVANTEST Stock No.	Description
C322	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C323	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C324	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C325 thru C327	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C328	CMC-AB15PR5K-6	C: FXD DIPPED MICA 15pF ±10% 500V
C329 thru C331	CMC-AB27PR5K-4	C: FXD DIPPED MICA 27pF ±5% 500V
C332	CMC-AB15PR5K-6	C: FXD DIPPED MICA 15pF ±10% 500V
C333	CMC-AB10PR5K-6	C: FXD DIPPED MICA 10pF ±10% 500V
C334 thru C339	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C340 thru C342	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C343 thru C346	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C347	CCK-AB10U25V-1	C: FXD ELECT 10uF 25V
C348	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C349	CCP-ADR022U50V	C: FXD CHIP 0.022uF +80, -20% 50V
C350 thru C352	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C353	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C354	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C355	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C356	CMC-AB7PR5K-6	C: FXD DIPPED MICA 7pF ±10% 500V
C357 thru C359	CMC-AB18PR5K-6	C: FXD DIPPED MICA 18pF ±10% 500V
C360	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C361	CMC-AB7PR5K-6	C: FXD DIPPED MICA 7p ±10% 500V
C362 thru C365	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C366	CMC-AB3PR5K-2	C: FXD DIPPED MICA 3pF ±0.5% 500V
C367	CTA-AB22U35V-1	C: FXD ELECT TANTAL 22uF ±20% 35V
C368	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C369	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C370	CTA-AB22U35V-1	C: FXD ELECT TANTAL 22uF ±20% 35V
C371	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C372	CMC-AB10PR5K	C: FXD DIPPED MICA 10pF ±5% 500V
C373	CSM-AC8P50V-1	C: FXD CER 8pF ±10% 50V
C374	CSM-AGR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C375	CCK-AB100U10V-1	C: FXD ELECT 100uF 10V
C376	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C377	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C378	CSM-AGR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C379	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C380		Not assigned
C381	CSM-AC3P50V	C: FXD CER 3pF ±10% 50V
C382	CSM-AGR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C383		Not assigned
C384	CCK-AB100U10V	C: FXD ELECT 100uF 10V
C385	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C386	CTA-AB47U20V-1	C: FXD ELECT TANTAL 47uF ±20% 20V
C387		Not assigned
C388	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C389	CCK-AB22U25V-1	C: FXD ELECT 22uF 25V
C390	CCK-BB1000U16V-1	C: FXD ELECT 1000uF 16V
C391	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C392	CMC-AB68PR3K-4	C: FXD DIPPED MICA 68pF ±5% 300V
C393	CCK-AB100U16V-1	C: FXD ELECT 100uF 16V
C394	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C395	CCK-AB47U25V-1	C: FXD ELECT 47uF 25V
C396	CCK-AB47U25V-1	C: FXD ELECT 47uF 25V
C397	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C398	CMC-AB100PR3K-4	C: FXD DIPPED MICA 100pF ±5% 300V
C399	CCK-AB47U25V	C: FXD ELECT 47uF 25V
C400	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C401	CCK-AB100U16V-1	C: FXD ELECT 100uF 16V
C402		Not assigned
C403	CCK-AA470U25V-1	C: FXD ELECT 470uF 25V
C404	CMC-AB3PR5K-2	C: FXD DIPPED MICA 3pF ±0.5% 500V
C405 thru C407		Not assigned
C408	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C409		Not assigned
C410		Not assigned
L411	LCL-T00084-1	L: FXD Coil
L412	LCL-B00364-1	L: FXD Coil
L413	LCL-B00364-1	L: FXD Coil
L414	LCL-T00084-1	L: FXD Coil
L415 thru L417	LCL-C00116-1	L: FXD Coil
L418	LCL-T00084-1	L: FXD Coil
L419	LCL-B00369-1	L: FXD Coil
L420	LCL-T00084-1	L: FXD Coil
L421	LCL-B00369-1	L: FXD Coil
L422 thru L425	LCL-A00511-1	L: FXD Coil
L426	LCL-A00509-1	L: FXD Coil
L427 thru L432	LCL-T00084-1	L: FXD Coil
L433	LCL-A00062-1	L: FXD Coil

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Parts No.	ADVANTEST Stock No.	Description
L434	LCL-E00484-1	L: FXD Coil
L435	LCL-E00484-1	L: FXD Coil
L436 thru L439	LCL-A00509-1	L: FXD Coil
L440		Not assigned
L441		Not assigned
X447	DXD-000143-1	Crystal
M450 thru M452	DEE-000736-1	Mixer
F454	DNF-000803-1	Filter
C463	CTA-AB2R2U35V-1	C: FXD ELECT TANTAL 2.2µF, ±20% 35V
C464	CCP-ADR47U50V-1	C: FXD CHIP 0.47µF +80, -20% 50V
C465	CSM-AGR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C466	CMC-AB27PR5K-4	C: FXD DIPPED MICA 27pF ±5% 500V
C467	CCK-AA47U25V-1	C: FXD ELECT 47µF 25V

Parts No.	ADVANTEST Stock No.	Description
IC1	SIC-1670-2	IC: Master-Slave D-Flip Flop
IC2	SIC-10H131-1	IC: Dual D-Type Master-Slave Flip Flop
IC3	SIC-10H102-1	IC: Quadruple 2-Input NOR Gate
IC4	SIC-10102-1	IC: Quadruple 2-Input NOR Gate
IC5	SIC-10102-1	IC: Quadruple 2-Input NOR Gate
IC6	SIC-10H131-1	IC: Dual D-Type Master-Slave Flip Flop
IC7	SIT-74LS390	IC: Dual Decade Counter Low Power
IC8	SIT-74LS02	IC: Quadruple 2-Input Positive-NOR Gate Low Power
IC9	SIT-74LS151	IC: 1-of-8 Data Selector/Multiplexer Low Power
IC10	SIT-15507-1	IC: LSI
IC11	SIM-60114-1	IC: LSI
IC12	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC13	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC14	SIT-74LS374	IC: Octal D-Type Flip Flop Low Power
IC15	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC16	SIT-74LS04	IC: Hex Inverter Low Power
IC17	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC18	SIA-TL080-7	IC:
IC19	SIT-74LS04	IC: Hex Inverter Low Power
Q22	STN-2SC1730-1	Transistor SI NPN
Q23	STN-2SC1730-1	Transistor SI NPN
Q24	STP-2SA1206-1	Transistor SI PNP
Q25	STP-2SA1206-1	Transistor SI PNP
D31 thru D35	SDS-1S953-1	Diode SI
D36		Not assigned
D37 thru D40	SDS-1SS97-1	Diode SI
R51	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R52	RCB-AH1R2K-1	R: FXD CAR 1.2kΩ ±5% 1/4W
R53	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R54	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R55	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R56	RCB-AH51-1	R: FXD CAR 51Ω ±5% 1/4W
R57	RCB-AH1R2K-1	R: FXD CAR 1.2kΩ ±5% 1/4W
R58	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R59 thru R62	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R63	RCB-AH470-1	F: FXD CAR 470Ω ±5% 1/4W
R64	RCB-AH1R2K-1	R: FXD CAR 1.2kΩ ±5% 1/4W
R65	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R66	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R67	RCB-AH1R2K-1	R: FXD CAR 1.2kΩ ±5% 1/4W
R68	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R69	RCB-AH100-1	R: FXD CAR 100Ω ±5% 1/4W
R70	RCB-AH100-1	R: FXD CAR 100Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R71	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R72	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R73	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R74	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
R75	RCB-AH680-1	R: FXD CAR 680Ω ±5% 1/4W
R76 thru R78	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R79	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R80		Not assigned
R81	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R82	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R83	RCB-AH180-1	R: FXD CAR 180Ω ±5% 1/4W
R84	RCB-AH390-1	R: FXD CAR 390Ω ±5% 1/4W
R85	RCB-AH15-1	R: FXD CAR 15Ω ±5% 1/4W
R86	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R87	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R88	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R89	RCB-AH180-1	R: FXD CAR 180Ω ±5% 1/4W
R90	RCB-AH390-1	R: FXD CAR 390Ω ±5% 1/4W
R91	RCB-AH15-1	R: FXD CAR 15Ω ±5% 1/4W
R92	RCB-AH330-1	R: FXD CAR 330Ω ±5% 1/4W
R93	RCB-AH1R2K-1	R: FXD CAR 1.2kΩ ±5% 1/4W
R94	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R95	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R96	RCB-AH1R2K-1	R: FXD CAR 1.2kΩ ±5% 1/4W
R97	RCB-AH3R9K-1	R: FXD CAR 3.9kΩ ±5% 1/4W
R98	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R99	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R100	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R101	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R102 thru R104	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R105	RCB-AH180-1	R: FXD CAR 180Ω ±5% 1/4W
R106	RCB-AH180-1	R: FXD CAR 180Ω ±5% 1/4W
R107	RCB-AH270-1	R: FXD CAR 270Ω ±5% 1/4W
R108	RCB-AH270-1	R: FXD CAR 270Ω ±5% 1/4W
R109	RCB-AH820-1	R: FXD CAR 820Ω ±5% 1/4W
R110	RCB-AH820-1	R: FXD CAR 820Ω ±5% 1/4W
R111	RCB-AH33-1	R: FXD CAR 33Ω ±5% 1/4W
R112	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R113	RCB-AH120-1	R: FXD CAR 120Ω ±5% 1/4W
R114	RCB-AH180-1	R: FXD CAR 180Ω ±5% 1/4W
R115	RCB-AH270-1	R: FXD CAR 270Ω ±5% 1/4W
R116	RCB-AH820-1	R: FXD CAR 820Ω ±5% 1/4W
R117	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R118	RCB-AH33-1	R: FXD CAR 33Ω ±5% 1/4W
R119	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W

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Parts No.	ADVANTEST Stock No.	Description
R120	RCB-AH120-1	R: FXD CAR 120Ω ±5% 1/4W
R121	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R122	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R123		Not assigned
R124 thru R129	RCB-AH180-1	R: FXD CAR 180Ω ±5% 1/4W
R130 thru R135	RCB-AH270-1	R: FXD CAR 270Ω ±5% 1/4W
R136 thru R141	RCB-AH820-1	R: FXD CAR 820Ω ±5% 1/4W
R142	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R143	RCB-AH1R8K-1	R: FXD CAR 1.8kΩ ±5% 1/4W
R144	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R145	RCB-AH220-1	R: FXD CAR 220Ω ±5% 1/4W
C151 thru C160	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C161		Not assigned
C162 thru C166	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C167	CCK-AA22U10V-1	C: FXD ELECT 22uF 10V
C168	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C169	CSM-AC27P50V-1	C: FXD CER 27pF ±10% 50V
C170	CCK-AA10U25V-1	C: FXD ELECT 10uF 25V
C171	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C172	CSM-ACR01U50V-1	C: FXD CER 0.01uF +80, -20% 50V
C173 thru C180	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C181	CCK-AA22U10V-1	C: FXD ELECT 22uF 20V
C182 thru C185	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C186	CCK-AA47U10V-1	C: FXD ELECT 47uF 10V
C187 thru C190	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
L191	LCL-T00084-1	L: FXD Coil
L192	LCL-C00011-1	L: FXD Coil
L193	LCL-C00011-1	L: FXD Coil
L194	LCL-C00010-1	L: FXD Coil
L195	LCL-T00480-1	L: FXD Coil
L196	LCL-T00480-1	L: FXD Coil
L197	LCL-C00010-1	L: FXD Coil

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC2	SIT-74LS04	IC: Hex Inverter Low Power
Q6	STN-2SC1815-15	Transistor SI NPN
Q7	STN-2SC1815-15	Transistor SI NPN
Q8	STN-2SC1730-1	Transistor SI NPN
Q9	STN-2SC1815-15	Transistor SI NPN
Q10	STN-2SC1730-1	Transistor SI NPN
Q11	STN-2SC1730-1	Transistor SI NPN
Q12 thru Q16	STN-2SC1815-15	Transistor SI NPN
D21	SDS-1S953-1	Diode SI
D22	SDS-1S953-1	Diode SI
R27	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R28	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R29	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R30	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R31	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R32	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R33	RCB-AH180	R: FXD CAR 180Ω ±5% 1/4W
R34	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R35	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R36	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R37	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R38	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R39	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R40	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R41	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R42	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R43	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R44	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R45	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R46	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R47	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R48	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R49	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R50	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R51	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R52	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R53	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R54	RMF-AR51QFK-1	R: FXD Metal FLM 51Ω ±1% 1/4W
R55	RMF-AR1R5KFK-1	R: FXD Metal FLM 1.5kΩ ±1% 1/4W
R56	RVR-CD200-1	R: VAR CERMET 200Ω
R57	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R58	RMF-AR22QFK-1	R: FXD Metal FLM 22Ω ±1% 1/4W
R59	RMF-AR220QFK-1	R: FXD Metal FLM 220Ω ±1% 1/4W
R60	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R61	RCB-AH68	R: FXD CAR 68Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R62	RMF-AR1R5KFK-1	R: FXD Metal FLM 1.5kΩ ±1% 1/4W
C66	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C67	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C68	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C69	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C70	CMC-AB200PR3K-4	C: FXD DIPPED MICA 200pF ±5% 300V
C71	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C72	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C73	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C74	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C75	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C76	CMC-AB3PR5K-2	C: FXD DIPPED MICA 3pF ±0.5% 500V
C77	CMC-AB22PR5K-4	C: FXD DIPPED MICA 22pF ±5% 500V
C78	CTM-AA20P-1	C: VAR CER 20pF
C79 thru C81	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C82	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C83	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C84	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C85	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C86	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C87	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C88	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C89	CCK-AB47016V-1	C: FXD ELECT 47uF 16V
C90	CCK-AB33U25V-1	C: FXD ELECT 33uF 25V
C91	CTM-AA20P-1	C: VAR CER 20pF
L96	LCL-B00566-1	L: FXD Coil
L97	LCL-C00011-1	L: FXD Coil
L98	LCL-C00011-1	L: FXD Coil
CF101	DNF-000199-2	Filter
X105	DXD-000136-1	Crystal
X106	DXD-000136-1	Crystal

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TR4171
X'tal OSC BOARD
BLB-011570

Parts No.	ADVANTEST Stock No.	Description
R1	RVR-AD10K-1	R: VAR CERMET 10kΩ
C4	CCK-AA10U25V-1	C: FXD ELECT 10μF 25V
L7	LCL-T00084-1	L: FXD Coil
J10	JCI-AS005JX01-1	Connector

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Parts No.	ADVANTEST Stock No.	Description
F1	DFT-AAR5A-1	Fuse 0.5A
F2	DFT-AAR5A-1	Fuse 0.5A
F3	DFT-AA1A-1	Fuse 1A
F4	DFT-AA1R6A-1	Fuse 1.6A
F5	DFT-AAR5A-1	Fuse 0.5A
FH11 thru FH20	MBN-10371A-1	Fuse Holder

Parts No.	ADVANTEST Stock No.	Description
D1	SEE-SF10DH1-1	Syristor
D2	SEE-SF10DH1-1	Syristor
R1	RVR-BM2K-2	R: VAR WW 2kΩ
R2	RVR-BA2K-1	R: VAR WW 2kΩ
R3	RVR-BA5K-1	R: VAR WW 5kΩ
R4	RVR-BL5K-1	R: VAR WW 5kΩ
L1	LCL-E00474-1	L: FXD Coil
B1	DMF-001011-1	Fan Motor
T1	LTP-000486A-1	Transformer
F1	DFT-AF2R5A-1	Fuse
V1	NCR-000180-1	
J1	JCD-AA003PX01-1	Connector
J2	JCS-AE004JX02-1	Connector
J3	JCP-AX002JX01-1	Connector
J4	JCB-AC044JX01-2	Connector
P5	DCB-QS0495-1	Connector
J6	DCB-QS0483-1	Connector
J7	DCB-QS0488-1	Connector
J8 thru J11	JCF-AB001JX02-1	Connector
P1	JTE-AG001EX01-1	Terminal
P2	JCP-AX002PX01-1	Terminal
P3 thru P9	JTE-AY001JX02-1	Terminal
CBL1	DCB-FF0971X01A-1	UM(L)-UM(L) Cable
CBL2	DCB-FF0971X17A-1	UM(L)-UM(L) Cable
CBL3	DCB-FF0971X15A-1	UM(L)-UM(L) Cable
CBL4	DCB-FF0985X01-1	DM-UM Cable
CBL5	DCB-FF0985X05-1	DM-UM Cable
CBL6	DCB-FF0985X01-1	DM-UM Cable
CBL7	DCB-FF1167X13-1	UM Cable

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Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-301A-1	IC: Operational Amplifier
IC2	SIA-311-1	IC: Voltage Comparator
IC3	SIA-311-1	IC: Voltage Comparator
IC4	SIA-301A-1	IC: Operational Amplifier
IC5	SDZ-6-1	IC: Precision Reference
IC6	SIA-301A-1	IC: Operational Amplifier
IC7	SDZ-6-1	IC: Precision Reference
IC8	SIA-723H-1	IC: Voltage Regulator
IC9	SIA-301A-1	IC: Operational Amplifier
Q1 thru Q3	STN-2SC1815-15	Transistor SI NPN
Q4	STN-2SC510-1	Transistor SI NPN
Q5	STN-2SC1279-1	Transistor SI NPN
Q6	STN-2SC1279-1	Transistor SI NPN
Q7	STN-2SD330-1	Transistor SI NPN
D1	SDZ-1N983-4	Zener Diode
D2	SDS-1S953	Diode SI
D3	SDS-1S953	Diode SI
D4	SDZ-W061	Zener Diode
D5	SDZ-W061	Zener Diode
D6 thru D8	SDS-1S953	Diode SI
D9	SDZ-W061-5	Diode SI
R1	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R2	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R3	RVR-CD500-1	R: VAR CERMET 500Ω
R4	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R5	RMF-AR9R1KFK-1	R: FXD Metal FLM 9.1kΩ ±1% 1/4W
R6	RMF-AR1R8KFK-1	R: FXD Metal FLM 1.8kΩ ±1% 1/4W
R7	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R8	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R9	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R10	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R11	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R12	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R13	RMF-AR8R2KFK-1	R: FXD Metal FLM 8.2kΩ ±1% 1/4W
R14	RVR-CD1K-1	R: VAR CERMET 1kΩ
R15	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R16	RMF-AR3R9KFK-1	R: FXD Metal FLM 3.9kΩ ±1% 1/4W
R17	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R18	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R19	RMF-AR6R2KFK-1	R: FXD Metal FLM 6.2kΩ ±1% 1/4W
R20	RVR-CD1K-1	R: VAR CERMET 1kΩ
R21	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W
R22	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R23	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R24	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R25	RMF-AR5R1KFK-1	R: FXD Metal FLM 5.1kΩ ±1% 1/4W
R26	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R27	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W
R28	RVR-CD1K-1	R: VAR CERMET 1kΩ
R29	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R30	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R31	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R32	RMF-AR82KFK-1	R: FXD Metal FLM 82kΩ ±1% 1/4W
R33	RVR-CD500-1	R: VAR CERMET 500Ω
R34	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R35		Not assigned
R36	RMF-AR3R9KFK-1	R: FXD Metal FLM 3.9kΩ ±1% 1/4W
R37	RCB-AF18-1	R: FXD CAR 18Ω ±5% 1W
R38	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R39	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R40	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R41	RCB-AH1R8K	R: FXD CAR 1.8kΩ ±5% 1/4W
R42	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
C1	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C2	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C3	CCK-AB22U35V-1	C: FXD ELECT 22μF 35V
C4	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C5	CCK-AB10U16V-1	C: FXD ELECT 10μF 16V
C6		Not assigned
C7	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C8	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C9	CCK-AB22U35V-1	C: FXD ELECT 22μF 35V
C10	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20%, 50V
C11	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C12	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C13	CCK-AB22U35V-1	C: FXD ELECT 22μF 35V
C14	CSM-ACR01U50V-1	C: FXD CER 0.01μF +80, -20% 50V
C15	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C16	CSM-AC100P50V-1	C: FXD CER 100pF ±10% 50V
C17	CCK-AB22U35V-1	C: FXD ELECT 22μF 35V
C18	CSM-AC1000P50V-1	C: FXD CER 1000pF ±10% 50V
C19	CCK-AB22U35V-1	C: FXD ELECT 22μF 35V
C20	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C21	CSM-ACR01U50V-1	C: FXD CER 0.01μF +80, -20% 50V
C22	CSM-AC4700PR5K-1	C: FXD CER 4700pF +80, -20% 5KV
J1	JCP-AA003PX06-1	Connector
J2	DCB-QS0481-1	Connector
B1	DBP-000470-1	Battery

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Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS73-1	IC: Dual J-K Flip Flop with Clear Low Power
IC2	SIT-74LS73	IC: Dual J-K Flip Flop with Clear Low Power
IC3	SIT-74LS121	IC: Monostable Multivibrator Low Power
IC4	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC5	SIT-74LS123	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC6	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC7	SIT-74LS151	IC: 1-of-8 Data Selector/Multiplexer Low Power
IC8	SIT-74LS02	IC: Quadruple 2-Input Positive-NOR Gate Low Power
IC9	SIT-74LS02	IC: Quadruple 2-Input Positive-NOR Gate Low Power
IC10	SIT-74LS175	IC: Quad D-Type Flip-Flop Low Power
IC11	SIT-74LS174	IC: Hex D-Type Flip Flop Low Power
IC12	SIT-74LS73	IC: Dual J-K Flip Flop with Clear Low Power
IC13	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC14	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC15	SIT-74LS04	IC: Hex Inverter Low Power
IC16	SIT-74LS00	IC: Quadruple 2-Input NAND Gate Low Power
IC17	SIT-74LS74	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC18	SIT-74LS393	IC: Dual 4-Bit Binary Counter Low Power
IC19	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC20	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC21	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC22	SIT-74LS08	IC: Quadruple 2-Input Positive-AND Gate Low Power
IC23	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC24	SIT-74LS73-1	IC: Dual J-K Flip Flop with Clear Low Power
IC25	SIA-339-1	IC: Quad Comparator
IC26	SIA-339-1	IC: Quad Comparator
IC27	SIA-301A-1	IC: Operational Amplifier
IC28	SIA-1408-4	IC: 8-Bit Multiplying D/A Converter
IC29	SIA-301A-1	IC: Operational Amplifier
IC30	SIA-356-1	IC: Junction FET Input Type Operational Amplifier
IC31	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC32	SIA-308A-1	IC: Operational Amplifier
IC33	SIA-356-1	IC: Junction FET Input Type Operational Amplifier
IC34	SIA-311-1	IC: Voltage Comparator
IC35	SIA-TL084-6	IC: JFET Input Operational Amplifier
IC36	SIA-311-1	IC: Voltage Comparator
IC37	SIA-301A-1	IC: Operational Amplifier
IC38	SIA-311-1	IC: Voltage Comparator
IC39	SIA-356-1	IC: Junction FET Input Type Operational Amplifier
IC40	SIA-311-1	IC: Voltage Comparator
IC41	SIA-311-1	IC: Voltage Comparator
IC42	SIA-301A-1	IC: Operational Amplifier
IC43	SIA-301A-1	IC: Operational Amplifier
IC44	SIT-74LS73	IC: Dual J-K Flip Flop with Clear Low Power
IC45	SIT-74LS08	IC: Quadruple 2-Input Positive-AND Gate Low Power
IC46	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC47	SIA-OP07P-2	IC: Precision Low Noise Operational Amplifier

Parts No.	ADVANTEST Stock No.	Description
Q50	SFN-2SK113-18	Transistor SI NPN
Q51	SFN-2N4393-18	Transistor SI NPN
Q52	SFN-2SK113-18	Transistor SI NPN
Q53 thru Q56	SFN-2N4393-18	Transistor SI NPN
D58	SDZ-W050-1	Zener Diode
R61	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±5% 1/4W
R62	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±5% 1/4W
R63	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±5% 1/4W
R64	RVR-CD2K-1	R: VAR CERMET 2kΩ
R65	RVR-CD200-1	R: VAR CERMET 200Ω
R66	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±5% 1/4W
R67	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±5% 1/4W
R68	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R69	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R70 thru R76	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R77 thru R81	RCB-AH33K	R: FXD CAR 33kΩ ±5% 1/4W
R82	RMF-AR18KFK-1	R: FXD Metal FLM 18kΩ ±1% 1/4W
R83	RVR-CD5K-1	R: VAR CERMET 5kΩ
R84	RMF-AR2KFK-1	R: FXD Metal FLM 2kΩ ±1% 1/4W
R85	RMF-AR20KFK-1	R: FXD Metal FLM 20kΩ ±1% 1/4W
R86	RMF-AR1MFK-1	R: FXD Metal FLM 1MΩ ±1% 1/4W
R87	RMF-AR1MFK-1	R: FXD Metal FLM 1MΩ ±1% 1/4W
R88	RCB-AH33K	R: FXD CAR 33kΩ ±5% 1/4W
R89	RCB-AH33K	R: FXD CAR 33kΩ ±5% 1/4W
R90	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R91	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R92	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R93	RMF-AR5KFK-1	R: FXD Metal FLM 5kΩ ±1% 1/4W
R94	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R95	RVR-CD2K-1	R: VAR CERMET 2kΩ
R96	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R97	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R98	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R99	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R100	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R101	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±5% 1/4W
R102	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R103	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R104 thru R106	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R107	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R108	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R109	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R110	RMF-AR3R9KFK-1	R: FXD Metal FLM 3.9kΩ ±1% 1/4W
R111	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R112	RCB-AH33K	RR: FXD CAR 33kΩ ±5%
R113	RVR-CD1K-1	R: VAR CERMET 1kΩ
R114	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R115	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R116	RMF-AR10KFK-1	R: FXD CAR 10kΩ ±5% 1/4W
R117 thru R119		Not assigned
R120	RCB-AH39K	R: FXD CAR 39kΩ ±5% 1/4W
R121	RMF-AR100QFK-1	R: FXD Metal FLM 100Ω ±1% 1/4W
R122	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R123	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R124	RVR-CD1K-1	R: VAR CERMET 1kΩ
R125	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R126	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R127	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R128	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R129	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R130	RVR-CD1K-1	R: VAR CERMET 1kΩ
R131	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R132	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R133	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R134	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R135	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R136	RCB-AH47K	R: FXD CAR 47kΩ ±5% 1/4W
R137	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R138	RCB-AH270	F: FXD CAR 270Ω ±5% 1/4W
R139	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R140	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R141	RVR-CD2K-1	R: VAR CERMET 2kΩ
R142	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R143	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R144	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R145	RVR-CD5K-1	R: VAR CERMET 5kΩ
R146	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±1% 1/4W
R147	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R148	RCB-AH560K	R: FXD CAR 560Ω ±5% 1/4W
R149	RCB-AH100	F: FXD CAR 100Ω ±5% 1/4W
C151	CMC-AB15PR5K-6	C: FXD DIPPED MICA 15pF ±10% 500V
C152 thru C154	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C155	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C156	CCK-AB47U10V-1	C: FXD ELECT 47μF 10V
C157	CSM-ACR01U50V-1	C: FXD CER 0.01μF +80, -20% 50V
C158 thru C163	CSM-ACR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V

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Parts No.	ADVANTEST Stock No.	Description
C164	CCK-AB22U35V-1	C: FXD ELECT 2.2µF 35V
C165	CFM-AAR01UR1K-1	C: FXD Mylar 0.01µF ±10% 1KV
C166	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C167	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C168	CFM-AP10UR1K-1	C: FXD Mylar 10µF ±10% 1KV
C169 thru C174	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C175	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C176	CCK-AB22U35V-1	C: FXD ELECT 22µF 35V
C177	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C178 thru C180	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C181	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C182 thru C191	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C192	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1µF +100, -0% 50V
C193	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C194	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C195	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C196	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C197	CCK-AB22U35V-1	C: FXD ELECT 22µF 35V
C198	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C199	CCK-AB22U35V-1	C: FXD ELECT 22µF 35V
C200	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1µF +100, -0% 50V
C201 thru C206	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C207 thru C210	CCK-AB22U35V-1	C: FXD ELECT 22µF 35V
C211 thru C217	CSM-ACR022U50V-1	C: FXD CER 0.022µF +80, -20% 50V
C218 thru C224	CCK-ANR33U16V-1	C: FXD ELECT 0.33µF 16V
C225	CCK-AB47U10V-1	C: FXD ELECT 47µF 10V
C226	CCK-AB47U10V-1	C: FXD ELECT 47µF 10V
C227	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1µF +100, -0% 50V
C228 thru C231	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C232 thru C234	CSM-ACR022U50V-1	C: FXD CER 0.022µF +80, -20% 50V
C235 thru C237	CCK-ANR33U16V-1	C: FXD ELECT 0.33µF 16V
C238	CSM-AC470P50V-1	C: FXD CER 470pF ±10% 50V
C239	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C240	CSM-AC2200P50V-1	C: FXD CER 2200pF ±20% 50V
C241	CCK-BA22U25V-1	C: FXD ELECT 22µF 25V

Parts No.	ADVANTEST Stock No.	Description
C242	CSM-AC470P50V-1	C: FXD CER 470pF ±10% 50V
P246 thru P252	JTF-AA001EX02	Teflon Terminal
J254	JCF-AC001JX01-1	Connector
J255	JCP-AA003PX06-1	Connector
L257 thru L259	LCL-C00013	L: FXD Coil

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS32	IC: Quadruple 2-Input Positive OR Gate Low Power
IC2	SIT-74LS139	IC: Dual 2-to-4 Line Decoder/Multiplexer Low Power
IC3	SIT-74LS75	IC: 4-Bit Bistable Latch Low Power
IC4	SIM-Z80A-1	IC: 8-Bit Microprocessor
IC5	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC6	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC7	SIT-74LS393	IC: Dual 4-Bit Binary Counter Low Power
IC8	SIT-74LS10	IC: Triple 3-Input Positive-NAND Gate Low Power
IC9	SIT-74LS00	IC: Quadruple 2-Input Positive-NAND Gate Low Power
IC10	SIT-74LS74	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC11	SIT-74LS75	IC: 4-Bit Bistable Latch Low Power
IC12	SIT-74LS32	IC: Quadruple 2-Input Positive-OR-Gate Low Power
IC13	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC14	SMM-4164B-3	KC: 64K bit Dynamic RAM
IC15	SIT-74LS08	IC: Quadruple 2-Input Positive AND Gate Low Power
IC16	SIT-74LS32	IC: Quadruple 2-Input Positive OR Gate Low Power
IC17	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC18	SIT-74LS157	IC: Quad 2-to 1-Line Data Selector/Multiplexer Low Power
IC19	SMM-2764-5	IC: Erasable and Programmable Read Only Memory
IC20	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC21	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC22	SIT-74S04	IC: Hex Inverter Low Power
IC23	SIT-74LS27	IC: Triple 3-Input Positive-NOR Gate Low Power
IC24	SIT-74LS74	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC25	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC26	SIT-74LS170	IC: 4-By-4 Register File Low Power
IC27	SMM-2764-5	IC: Erasable and Programmable Read Only Memory
IC28	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC29	SMM-4164B-3	IC: 64K bit Dynamic RAM
IC30	SIT-74LS02	IC: Quadruple 2-Input Positive NOR Gate Low Power
IC31	SIT-74LS04	IC: Hex Inverter Low Power
IC32	SIT-74LS32	IC: Quadruple 2-Input Positive OR-Gate Low Power
IC33	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC34	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC35	SIT-74LS157	IC: Quad 2-to 1-Line Data Selector/Multiplexer Low Power
IC36	SIT-74LS157	IC: Quad 2-to 1-Line Data Selector/Multiplexer Low Power
IC37	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC38	SIT-74LS08	IC: Quadruple 2-Input Positive-AND Gate Low Power
IC39	SIT-74LS157	IC: Quad 2-to 1-Line Data Selector/Multiplexer Low Power
IC40	SIT-74LS245	IC: Octal Bus Tranceiver Low Power
IC41	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC42	SMM-2764-5	IC: Erasable and Programmable Read Only Memory
IC43	SIT-74LS245	IC: Octal Bus Tranceiver Low Power
IC44	SIT-74LS245	IC: Octal Bus Tranceiver Low Power
IC45	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC46	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC47	SIT-74LS08	IC: Quadruple 2-Input Positive-AND Gate Low Power

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Parts No.	ADVANTEST Stock No.	Description
IC48	SIT-74LS04	IC: Hex Inverter Low Power
Q51	STN-2SC1815-15	Transistor SI NPN
Q52	STP-2SA1015-1	Transistor SI PNP
Q53	STN-2SC1815-15	Transistor SI NPN
Q54	STP-2SA1115-1	Transistor SI PNP
Q55	STP-2SA1015-1	Transistor SI PNP
Q56	STN-2SC1815-15	Transistor SI NPN
Q57	STN-2SC1815-15	Transistor SI NPN
D61 thru D66	NLD-000016-1	Light Emitting Diode
D67	SDS-1S953-1	Diode SI
R71	RAY-AA680Q6	R: FXD COM 680Ω
R72 thru R76	RAY-AA4R7K4	R: FXD COM 4.7kΩ
R77	RCB-AH2R2K	P: FXD CAR 2.2kΩ ±5% 1/4W
R78	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R79	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R80	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R81	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R82	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R83	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R84	RCB-AH1R2K	R: FXD CAR 1.2kΩ ±5% 1/4W
R85	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R86	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R87	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R88	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R89	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R90	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R91	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R92	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R93	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R94	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R95	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R96	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R97	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R98	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R99	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R100	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R101	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R102	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R103	RAY-AA4R7K4	R: FXD COM 4.7kΩ
R104	RAY-AA4R7K4	R: FXD COM 4.7kΩ
C106 thru C108	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C109	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C110	CSM-ACR01U50V	C: FXD CER 0.01µF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C111	CTA-AC22U16V-1	C: FXD ELECT TANTAL 22µF ±20% 16V
C112	CTA-AC10U16V-1	C: FXD ELECT TANTAL 10µF ±20% 16V
C113	CSM-ACR1U50V	C: FXD CER 0.1µF +80, -20% 50V
C114	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1µF +100, -0% 50V
C115	CTA-AC10U16V-1	C: FXD ELECT TANTAL 10µF ±20% 16V
C116	CSM-ACR1U50V	C: FXD CER 0.1µF +80, -20% 50V
C117	CCK-AB47U10V-1	C: FXD ELECT 47µF 10V
C118	CSM-ACR01U50V	C: FXD CER 0.01µF +80, -20% 50V
C119	CTA-AC10U16V-1	C: FXD ELECT 10µF 16V
C120	CTA-AC10U16V-1	C: FXD ELECT TANTAL 10µF ±20% 16V
C121 thru C150	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1µF ±20% 50V
L156	LCL-T00084-1	L: FXD Coil
L157	LCL-T00084-1	L: FXD Coil
X161	DXC-000109-1	Crystal
K164	KSA-000270-1	Switch
K165	KSA-000268-1	Switch
K166	KSE-000453-1	Switch
FL171	DNF-000199-2	Filter
DL172	DDL-AC10-1	Delay Line

Parts No.	ADVANTEST Stock No.	Description
IC1 thru IC3	SMM-27128A-1	IC: N-Ch Silicon Gate MOS Memory
IC4	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC5	SIT-74LS390	IC: Dual Decade Counter Low Power
IC6	SIA-393-1	IC: Dual Differential Comparator
IC7 thru IC9	SMM-27128A-1	IC: N-Ch Silicon Gate MOS Memory
IC10	SIT-74LS157	IC: Quad 2- to 1-Line Data Selector/Multiplexer Low Power
IC11	SIT-74LS74-9	IC: Dual D-Type Positive-Edge-Triggered Flip Flop with Preset AND Clear Low Power
IC12	CIT-74LS04	IC: Hex Inverter Low Power
IC13	SIM-8279-5	IC: Programmable Key Board/Display Controller
IC14	SIT-74LS08-9	IC: Quadruple 2-Input Positive-AND Gate Low Power
IC15	SIT-74LS12-9	IC: Triple 3-Input Positive NAND Gate with Open-Collector Output Low Power
IC16	SIT-74LS08-9	IC: Quadruple 2-Input Positive-AND Gate Low Power
IC17	SIT-74LS32-9	IC: Quadruple 2-Input Positive-OR Gate Low Power
IC18	SMM-27128A-1	IC: N-Ch Silicon Gate MOS Memory
IC19	SMM-27128A-1	IC: N-Ch Silicon Gate MOS Memory
IC20	SIT-74LS04	IC: Hex Inverter Low Power
IC21	SIT-74LS32-9	IC: Quadruple 2-Input Positive OR-Gate Low Power
IC22	SIT-74LS123-9	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC23	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC24	SIT-74LS138-9	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC25	SIT-74LS32-9	IC: Quadruple 2-Input Positive OR-Gate Low Power
IC26	SMM-4164B-5	IC: 64K bit Dynamic RAM
IC27	SMM-4164B-5	IC: 64K bit Dynamic RAM
IC28	SIT-74LS10	IC: Triple 3-Input Positive-NAND Gate Low Power
IC29	SIT-74LS170	IC: 4-By-4 Register File Low Power
IC30	SIT-74LS123-9	IC: Dual Retriggerable Monostable Multivibrator with Clear Low Power
IC31	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC32	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC33	SIT-74LS04	IC: Hex Inverter Low Power
IC34	SIT-A57-1	IC: Darington Transistor Array
IC35	SIT-74LS138-9	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC36	SIT-74LS75	IC: 4-Bit Bistable Latch Low Power
IC37	SIT-74LS12	IC: Triple 3-Input Positive-NAND Gate with Open-Collector Output Low Power
IC38	SIT-74LS245-9	IC: Octal Bus Tranceiver Low Power
IC39	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC40	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC41	SIT-74LS14-9	IC: Hex Schmitt-Trigger Inverter Low Power
IC42	SIT-74LS04	IC: Hex Inverter Low Power
IC43	SIT-A57-1	IC: Darington Transistor Array
IC44	SIT-74LS30	IC: 8-Input Positive-NAND Gate Low Power
IC45	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC46	SIT-74LS00	IC: Quadruple 2-Input Positive-NAND Gate Low Power

Parts No.	ADVANTEST Stock No.	Description
IC47	SIT-74LS08	IC: Quadruple 2-Input Positive AND Gate Low Power
Q51 thru Q58	STP-2SA642-3	Transistor SI PNP
Q59	STN-2SC1815-15	Transistor SI NPN
Q60	STN-2SC1815-15	Transistor SI NPN
Q61	STP-2SA1015-1	Transistor SI PNP
Q62	STP-2SA1015-1	Transistor SI PNP
D65	SDS-1S953-1	Diode SI
D66		Not assigned
D67		Not assigned
R71	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R72	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R73	RCB-AH22K-1	R: FXD CAR 22kΩ ±5% 1/4W
R74	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R75	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R76	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R77	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R78	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R79	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R80	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R81	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R82	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R83	RCB-AH33K	R: FXD CAR 33kΩ ±5% 1/4W
R84	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R85	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R86	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R87	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R88 thru R90	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R91	RCB-AH10K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R92 thru R99	RCB-AH47-1	R: FXD CAR 47Ω ±5% 1/4W
R100 thru R107	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R108	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R109	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R110	RAY-AA10K6-1	R: FXD COM 10kΩ
R111	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R112	RCB-AH1R5K-1	R: FXD CAR 1.5kΩ ±5% 1/4W
R113	RAY-AA4R7K4-1	R: FXD COM 4.7kΩ
R114	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R115	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R116	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R117 thru R120	RAY-AA4R7K4-1	R: FXD COM 4.7kΩ

Parts No.	ADVANTEST Stock No.	Description
R121	RCB-AH22K-1	R: FXD CAR 22kΩ ±5% 1/4W
R122	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R123	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R124		Not assigned
R125	RVR-CD10K-2	R: VAR CERMET 10kΩ
R126	RVR-CD10K-2	R: VAR CERMET 10kΩ
R127		Not assigned
R128		Not assigned
R129	RAY-AA10K6-1	R: FXD COM 10kΩ
C131 thru C134	CSM-ACR01U50V-1	C: FXD CER 0.01μF +80, -20% 50V
C135 thru C142	CCK-AB10U16V	C: FXD ELECT 10μF 16V
C143 thru C158	CCK-ANR33U16V	C: FXD ELECT 0.33μF 16V
C159 thru C175	CSM-ACR01U50V-1	C: FXD CER 0.01μF +80, -20% 50V
C176 thru C178		Not assigned
L181	LCL-T00084-1	L: FXD Coil
L182	LCL-T00084-1	L: FXD Coil
J185	JCR-AF040PX02-1	Connector

Parts No.	ADVANTEST Stock No.	Description
J3	JCF-AB001JX11-2	BNC Connector
R4	JCF-AB001JX16-1	BNC Connector
J5 thru J7	JCF-AC001JX02-2	UM Connector

Parts No.	ADVANTEST Stock No.	Description
IC1 thru IC6	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC7	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC8 thru IC10	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC11	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC12	SIA-324	IC: Quadruple Operational Amplifier
IC13	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC14	SIT-74LS30	IC: 8-Input Positive-NAND Gate Low Power
IC15	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC16	SIT-74LS02	IC: Quadruple 2-Input Positive-NOR Gate Low Power
IC17 thru IC19	SIA-324	IC: Quadruple Operational Amplifier
IC20	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC21	SIA-324	IC: Quadruple Operational Amplifier
IC22	SIT-74LS04	IC: Hex Inverter Low Power
Q31 thru Q33	STN-2SC1815-15	Transistor SI NPN
Q34	STN-2SC1254-1	Transistor SI NPN
Q35	STN-2SC1254-1	Transistor SI NPN
Q36	STP-2SA1015-1	Transistor SI PNP
Q37	STN-2SC1815-15	Transistor SI NPN
Q38	STP-2SA1015-1	Transistor SI PNP
Q39 thru Q43	STN-2SC1815-15	Transistor SI NPN
Q44	SFN-2SK33-1	FET Junction N-Channel
Q45	STN-2SC1815-15	Transistor SI NPN
Q46	STN-2SC1815-15	Transistor SI NPN
Q47	SFN-2SK33-1	FET Junction N-Channel
Q48 Thru Q50	STN-2SC1815-15	Transistor SI NPN
Q51	SFN-2SK33-1	FET Junction N-Channel
Q52	STN-2SC1815-15	Transistor SI NPN
Q53	SFN-2SK33-1	FET Junction N-Channel
Q54	STN-2SC1815-15	Transistor SI NPN
Q55	STN-2SC1815-15	Transistor SI NPN
Q56	STP-2SA1015-1	Transistor SI PNP
Q57	SFN-2N4393-18	FET Junction N-Channel
Q58 thru Q61	STN-2SC1815-15	Transistor SI NPN
Q62	STP-2SA1015-1	Transistor SI PNP
Q63	SFN-2N4859-18	FET Junction N-Channel
Q64	SFN-2N4859-18	FET Junction N-Channel
D67	SDS-1S2222-1	Diode SI

Parts No.	ADVANTEST Stock No.	Description
D68 thru D70	SDS-1S953	Diode SI
D71 thru D74	SDS-1SS97-1	Diode SI
D75	SDS-1S2222-1	Diode SI
D76	SDS-1S2222-1	Diode SI
D77 thru D88	SDS-1S953-1	Diode SI
D89 thru D103	SDS-1S2222-1	Diode SI
R107 thru R110	DSP-000015-2	Thermistor
R111	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R112 thru R115	RCB-AH33	R: FXD CAR 33Ω ±5% 1/4W
R116	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R117	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R118	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R119	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R120	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R121	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R122	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R123	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R124	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R125	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R126	RCB-AH18K	R: FXD CAR 18kΩ ±5% 1/4W
R127	RCB-AH18K	R: FXD CAR 18kΩ ±5% 1/4W
R128	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R129	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R130	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R131	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R132	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R133	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R134	RMF-AR47QFK-1	R: FXD Metal FLM 47Ω ±1% 1/4W
R135	RMF-AR33QFK-1	R: FXD Metal FLM 33Ω ±1% 1/4W
R136	RVR-CD100-1	R: VAR CERMET 100Ω
R137	RVR-CD100-1	R: VAR CERMET 100Ω
R138	RCB-AH1R8K	R: FXD CAR 1.8kΩ ±5% 1/4W
R139	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R140	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R141	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R142	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R143	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R144	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R145	RMF-AR680QFK	R: FXD Metal FLM 680Ω ±1% 1/4W
R146	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W

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Parts No.	ADVANTEST Stock No.	Description
R147	RMF-AR51QFK	R: FXD Metal FLM 51Ω ±1% 1/4W
R148	RVR-CB100-1	R: VAR CERMET 100Ω
R149	RVR-CB50-1	R: VAR CERMET 50Ω
R150	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R151	RCB-AK1K	R: FXD CAR 1kΩ ±5% 1/2W
R152	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R153	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R154	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R155	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R156	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R157	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R158	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R159	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R160	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R161	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R162	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R163	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R164	RMF-AR470QFK	R: FXD Metal FLM 470Ω ±1% 1/4W
R165	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R166	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R167	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R168	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R169	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R170	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R171	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R172	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R173	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R174	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R175	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R176	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R177	RCB-AH1R8K	R: FXD CAR 1.8kΩ ±5% 1/4W
R178	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R179	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R180	RCB-AH47K	R: FXD CAR 47kΩ ±5% 1/4W
R181	RCB-AH82K	R: FXD CAR 82kΩ ±5% 1/4W
R182 thru R186	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R187	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R188	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R189	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R190	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R191	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R192	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R193	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R194	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R195	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R196	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R197	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R198	RCB-AH1R8K	R: FXD CAR 1.8kΩ ±5% 1/4W
R199	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R200	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R201	RCB-AH47K	R: FXD CAR 47kΩ ±5% 1/4W
R202	RCB-AH82K	R: FXD CAR 82kΩ ±5% 1/4W
R203 thru R207	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R208	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R209	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R210	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R211	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R212	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R213	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R214	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R215	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R216	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R217	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R218	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R219	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R220	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R221	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R222	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R224	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R225	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R226	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R227	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R228	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R229	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R230	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R231	DSP-000015-2	Thermistor
R232	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R233	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R234	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R235	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R236	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R237	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R238	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R239	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R240	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R241	RCB-AH1R2K	R: FXD CAR 1.2kΩ ±5% 1/4W
R242	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R243	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R244	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R245	RVR-CB50-1	R: VAR CERMET 50Ω
R246	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R247	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R248	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R249	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R250	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R251	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R252	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R253	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R254	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R255	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R256	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R257	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R258	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R259	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R260	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R261	RMF-AR680QFK	R: FXD Metal FLM 680Ω ±1% 1/4W
R262	RMF-AR51QFK	R: FXD Metal FLM 51Ω ±1% 1/4W
R263	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R264	RVR-CB50-1	R: VAR CERMET 50Ω
R265	RVR-CB100-1	R: VAR CERMET 100Ω
R266	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R267	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R268	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R269	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R270	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R271	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R272	RMF-AR22QFK	R: FXD Metal FLM 22Ω ±1% 1/4W
R273	RMF-AR680QFK	R: FXD Metal FLM 680Ω ±1% 1/4W
R274	RMF-AR510QFK	R: FXD Metal FLM 510Ω ±1% 1/4W
R275	RMF-AR2KFK	R: FXD Metal FLM 2kΩ ±1% 1/4W
R276	RMF-AR1KFK	R: FXD Metal FLM 1kΩ ±1% 1/4W
R277	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R278	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R279	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R280	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R281 thru R284	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R285	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R286	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R287	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R288	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R289	RMF-AR750QFK	R: FXD Metal FLM 750Ω ±1% 1/4W
R290	RVR-CB100-1	R: VAR CERMET 100Ω
R291	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R292	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R293	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R294	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R295	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R296	RMF-AR750QFK	R: FXD Metal FLM 750Ω ±1% 1/4W
R297	RVR-CB100-1	R: VAR CERMET 100Ω
R298	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R299	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R300	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R301	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R302	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R303	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R304	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R305	RCB-AH330	R: FXD CAR 330Ω ±5% 1/4W
R306	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R307	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R308 thru R312	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R313	RCB-AH82	R: FXD CAR 82Ω ±5% 1/4W
R314 thru R319	RVR-CB500-1	R: VAR CERMET 500Ω
R320	RVR-CB200-1	R: VAR CERMET 200Ω
R321	RVR-CB100-1	R: VAR CERMET 100Ω
R322 thru R329	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R330 thru R342	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R343 thru R346	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R347	RCB-AH100K	R: FXD CAR 100Ω ±5% 1/4W
R348	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R349	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R350	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
C351	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C352	CSM-ACR047U50V-1	C: FXD CER 0.047uF +80, -20% 50V
C353	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C354	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C355	CMC-AC680PR3K-2	C: FXD DIPPED MICA 680pF ±5% 300V
C356	CMC-AC680PR3K-2	C: FXD DIPPED MICA 680pF ±5% 300V
C357	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C358	CMC-AB27PR5K-4	C: FXD DIPPED MICA 27pF ±5% 500V
C359	CTM-AC6P-1	C: VAR CER 6pF
C360	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C361	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C362	CMC-AC820PR3K-2	C: FXD DIPPED MICA 820pF ±5% 300V
C363	CMC-AC820PR3K-2	C: FXD DIPPED MICA 820pF ±5% 300V
C364 thru C367	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C368	CTA-AC2R2U35V-1	C: FXD ELECT TANTAL 2.2uF %20% 35V
C369	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C370	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C371 thru C373	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C374	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C375	CTA-AC2R2U35V-1	C: FXD ELECT TANTAL 2.2uF ±20% 35V
C376	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C377	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C378	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C379	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C380	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C381 thru C383	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C384	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C385	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C386 thru C388	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C389	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C390	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C391	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C392	CTM-AC10P-1	C: VAR CER 10pF
C393	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C394	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C395 thru C403	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C404	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C405	CTM-AC10P-1	C: VAR CER 10pF
C406	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C407	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 0.5V
C408	CTM-AC6P-1	C: VAR CER 6pF
C409	CFM-AW330P50V-1	C: FXD Mylar 330pF ±2% 50V
C410	CTM-AC6P-1	C: VAR CER 6pF
C411	CFM-AW330P50V-1	C: FXD Mylar 330pF ±2% 50V
C412 thru C420	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C421	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C422	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C423 thru C426	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C427	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C428	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C429	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C430	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C431	CTM-AC70P-1	C: VAR CER 70pF
C432	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C433	CMC-AN6800P50V-1	C: FXD DIPPED MICA 6800pF ±5% 50V
C434	CSM-AG1U50V-1	C: FXD CER 1uF +80, -20% 50V
C435 thru C437	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C438	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V

Parts No.	ADVANTEST Stock No.	Description
C439	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C440	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C441	CTM-AC70P-1	C: VAR CER 70pF
C442	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C443	CMC-AN6800P50V-1	C: FXD DIPPED MICA 6800pF ±5% 50V
C444	CSM-AG1U50V-1	C: FXD CER 1uF +80, -20% 50V
C445 thru C448	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C449	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C450	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C451	CTA-AC2R2U35V-1	C: FXD ELECT TANTAL 2.2uF ±20% 35V
C452	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C453	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C454	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C455	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C456 thru C458	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C459 thru C462	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C463 thru C469	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C470	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C471 thru C473	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C474	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C475	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C476	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C477	CTA-AC2R2U35V-1	C: FXD ELECT TANTAL 2.2uF ±20% 35V
C478 thru C483	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C484	CSM-AGR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C485	CSM-AGR1U50V	C: FXD CER 0.1uF +80, -20% 50V
C486 thru C507	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C508 thru C511	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C512	CCK-AB22U10V	C: FXD ELECT 22uF 10V
C513 thru C530	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C531	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C532	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
L534	LCL-B00348-1	L: FXD Coil
L535	LCL-C00012-1	L: FXD Coil
L536	LCL-C00613-1	L: FXD Coil
L537	LCL-C00613-1	L: FXD Coil

Parts No.	ADVANTEST Stock No.	Description
L538	LCL-C00609-1	L: FXD Coil
L539	LCL-C00609-1	L: FXD Coil
L540 thru L542	LCL-C00012-1	L: FXD Coil
L543	LCL-C00011-1	L: FXD Coil
L544	LCL-C00011-1	L: FXD Coil
L545	LCL-C00124-1	L: FXD Coil
L546	LCL-C00124-1	L: FXD Coil
L547	LCL-T00480-1	L: FXD Coil
L548	LCL-B00365-1	L: FXD Coil
L549	LCL-B00363-1	L: FXD Coil
X551	DXD-000764-1	Crystal
X552	DXD-000765-1	Crystal
X553	DXD-000765-1	Crystal
J561	JCF-AC001JX04-1	Connector
J562	JCR-AF050PX02-1	Connector
C570	CTM-AC70P-1	C: VAR CER 70pF
C571	CTM-AC70P-1	C: VAR CER 70pF
C572	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C573	CMC-AC510PR3K-2	C: FXD DIPPED MICA 510pF ±5% 300V
C574	CTM-AC70P	C: VAR CER 70pF
C575	CTM-AC70P	C: VAR CER 70pF
C576	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C577	CTM-AC70P-1	C: VAR CER 70pF
C578	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C579	CTM-AC70P-1	C: VAR CER 70pF
R585	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R586	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R588	RVR-CB50-1	R: VAR CER 50Ω
R589	DSP-000015-1	Thermister

Parts No.	ADVANTEST Stock No.	Description
IC1 thru IC7	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC8	SIA-324	IC: Quadruple Operational Amplifier
Q15	STN-2SC1815-15	Transistor SI NPN
Q16	STP-2SA1015-1	Transistor SI PNP
Q17 thru Q22	STN-2SC1815-15	Transistor SI NPN
Q23	SFN-2SK33-1	FET Junction N-Channel
Q24	STN-2SC1815-15	Transistor SI NPN
Q25	STN-2SC1815-15	Transistor SI NPN
Q26	SFN-2SK33-1	FET Junction N-Channel
Q27	STN-2SC1815-15	Transistor SI NPN
Q28	STN-2SC1815-15	Transistor SI NPN
Q29	SFN-2SK33-1	FET Junction N-Channel
Q30	STN-2SC1815-15	Transistor SI NPN
Q31	STN-2SC1815-15	Transistor SI NPN
Q32	STP-2SA1015-1	Transistor SI PNP
Q33	SFN-2N4859-18	FET Junction N-Channel
Q34	SFN-2SK33-1	FET Juntion N-Channel
Q35	STN-2SC1815-15	Transistor SI NPN
Q36	SFN-2N4859-18	FET Junction N-Channel
Q37	SFN-2SK33-1	FET Junction N-Channel
Q38	STN-2SC1815-15	Transistor SI NPN
Q39	SFN-2N4859-18	FET Junction N-Channel
Q40	SFN-2SK33-1	FET Junction N-Channel
Q41 thru Q49	STN-2SC1815-15	Transistor SI NPN
Q50	SFN-2SK33-1	FET Junction N-Channel
Q51	STN-2SC1815-15	Transistor SI NPN
Q52	STN-2SC1815-15	Transistor SI NPN
D60	SDS-1S2222-1	Diode SI
D61	SDS-1S2222-1	Diode SI
D62 thru D76	SDS-1S953-1	Diode SI
D77	SDS-1S2222-1	Diode SI
D78 thru D81	SDS-1SS97-1	Diode SI
D82	SDS-1S2222-1	Diode SI
D83 thru D85	SDS-1S953	Diode SI
R90	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R91	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R92	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R93	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R94	RMF-AR680QFK	R: FXD Metal FLM 680Ω ±1% 1/4W

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Parts No.	ADVANTEST Stock No.	Description
R95	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R96	RVR-CB100-1	R: VAR CERMET 100Ω
R97	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R98	RCB-AH8R2K	R: FXD CAR 8.2kΩ ±5% 1/4W
R99	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R100	RMF-AR270QFK	R: FXD Metal FLM 270Ω ±1% 1/4W
R101	RMF-AR390QFK	R: FXD Metal FLM 390Ω ±1% 1/4W
R102	RVR-CB100-1	R: VAR CERMET 100Ω
R103	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R104	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R105	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R106	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R107	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W
R108	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R109	RVR-CB50-1	R: VAR CERMET 50Ω
R110	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R111	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R112	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R113	RCB-AH2R7K	R: FXD CAR 3.7kΩ ±5% 1/4W
R114	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R115	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R116	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R117	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R118	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R119	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R120	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R121	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R122	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R123	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R124	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R125	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R126	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R127	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R128	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R129	RCB-AH47K	R: FXD CAR 47kΩ ±5% 1/4W
R130	RCB-AH82K	R: FXD CAR 82kΩ ±5% 1/4W
R131 thru R135	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R136	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R137	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R138	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R139	RCB-AH5.6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R140	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R141	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R142	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R143	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R144	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R145	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R146	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R147	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R148	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R149	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R150	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R151	RCB-AH47K	R: FXD CAR 47kΩ ±5% 1/4W
R152	RCB-AH82K	R: FXD CAR 82kΩ ±5% 1/4W
R153 thru R157	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R158	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R159	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R160	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R161	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R162	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R163	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R164	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R165	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R166	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R167	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R168	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R169	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R170	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R171	RCB-AH22K	R: FXD CAR 22kΩ ±5% 1/4W
R172	RCB-AH47K	R: FXD CAR 47kΩ ±5% 1/4W
R173	RCB-AH82K	R: FXD CAR 82kΩ ±5% 1/4W
R174 thru R178	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R179	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R180	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R181	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R182	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R183	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R184	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R185	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R186	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R187	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R188	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R189	RMF-AR120QFK	R: FXD Metal FLM 120Ω ±1% 1/4W
R190	RMF-AR68QFK	R: FXD CAR 68Ω ±1% 1/4W
R191	RCB-AH2R7K	R: FXD CAR 2.7kΩ ±5% 1/4W
R192	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R193	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R194	RCB-AH1R2K	R: FXD CAR 1.2kΩ ±5% 1/4W
R195	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R196	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R197	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R198	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W

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Parts No.	ADVANTEST Stock No.	Description
R199	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R200	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R201	DSP-000015-2	R: Thermistor
R202	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R203	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R204	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R205	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R206	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R207	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R208	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R209	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R210	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R211	RCB-AH1R2K	R: FXD CAR 1.2kΩ ±5% 1/4W
R212	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R213	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R214	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R215	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R216	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R217	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R218	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R219	DSP-000015-2	R: Thermistor
R220	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R221	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R222	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R223	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R224	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R225	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R226	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R227	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R228	RCB-AH1R2K	R: FXD CAR 1.2kΩ ±5% 1/4W
R229	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R230	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R231	RCB-AH100K	R: FXD CAR 100Ω ±5% 1/4W
R232	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R233	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R234	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R235	RVR-CB50-1	R: VAR CERMET 50Ω
R236	RCB-AH180	R: FXD CAR 180Ω ±5% 1/4W
R237	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R238	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R239	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R240	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R241	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R242	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R243	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R244	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R245	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R246	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R247	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R248	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R249	RCB-AH15K	R: FXD CAR 15kΩ ±5% 1/4W
R250	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R251	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R252	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R253	RVR-CB10	R: VAR CERMET 10Ω
R254	RVR-CB10	R: VAR CERMET 10Ω
R255 thru R258	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R259	RCB-AG10	R: FXD CAR 10Ω ±5% 1/4W
R260	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R261	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R262	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R263	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R264	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R265	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R266	RMF-AR220QFK	R: FXD Metal FLM 220Ω ±1% 1/4W
R267	RMF-AR68QFK	R: FXD Metal FLM 68Ω ±1% 1/4W
R268	RCB-AH390	R: FXD CAR 390Ω ±5% 1/4W
R269	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R270	RMF-AR120QFK	R: FXD Metal FLM 120Ω ±1% 1/4W
R271	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R272	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R273	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R274	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R275	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R276	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R277	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R278	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R279	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R280	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R281	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R282	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R283	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R284	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R285	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R286	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R287	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R288	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R289	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R290	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R291	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R292	RCB-AH560	R: FXD CAR 560Ω ±5% 1/4W
R293	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R294	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W
R295	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R296	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R297	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R298	RCB-AH5R6K	R: FXD CAR 5.6kΩ ±5% 1/4W
R299	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R300	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R301	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R302	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R303	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R304	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R305	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R306	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R307		Not assigned
R308		Not assigned
R309	RCB-AH680	R: FXD CAR 680Ω ±5% 1/4W
R310	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R311 thru R320	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R321	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R322	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R323	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R324		Not assigned
R325	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R326	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R327	RVR-CB50-1	R: VAR CERMET 50Ω
R328	RVR-CB50-1	R: VAR CERMET 50Ω
R329	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
R330	DSP-000015-1	R: Thermistor
C339	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C340	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C341	CTA-AC2R2U35V-1	C: FXD ELECT TANTAL 2.2uF ±20% 35V
C342	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C343	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C344	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C345	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C346	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C347 thru C349	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C350	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C351	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C352	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C353	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C354	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C355	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C356 thru C358	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C359	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C360	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C361	CTM-AC6P-1	C: VAR CER 6pF

Parts No.	ADVANTEST Stock No.	Description
C362	CFM-AW330P50V-1	C: FXD Mylar 330pF ±2% 50V
C363	CTM-AC10P	C: VAR CER 10pF
C364 thru C366	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C367	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C368	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C369	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C370 thru C374	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C375	CTM-AC6P-1	C: VAR CER 6pF
C376	CFM-AW330P50V-1	C: FXD Mylar 330pF ±2% 50V
C377	CTM-AC10P-1	C: VAR CER 10pF
C378 thru C380	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C381	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C382	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C383	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C384	CSM-AC22P50V	C: FXD CER 22pF +80, -20% 50V
C385 thru C389	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C390	CTM-AC6P-1	C: VAR CER 6pF
C391	CFM-AW330P50V-1	C: FXD Mylar 330pF ±2% 50V
C392 thru C400	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C401	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C402	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C403	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C404	CTA-AC2R2U35V-1	C: FXD ELECT TANTAL 2.2uF ±20% 35V
C405	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C406	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C407	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C408	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C409	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C410	CTM-AC70P-1	C: VAR CER 70pF
C411	CMC-AN6800P50V-1	C: FXD DIPPED MICA 6800pF ±5% 50V
C412	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C413	CSM-AG1U50V-1	C: FXD CER 1uF +80, -20% 50V
C414 thru C416	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C417	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C418	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C419	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C420	CTM-AC70P-1	C: VAR CER 70pF
C421	CMC-AN6800P50V-1	C: FXD DIPPED MICA 6800pF ±5% 50V
C422	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C423	CSM-AG1U50V-1	C: FXD CER 1uF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C424 thru C426	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C427	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C428	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C429	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C430	CTM-AC70P-1	C: VAR CER 70pF
C431	CMC-AN6800P50V-1	C: FXD DIPPED MICA 6800pF ±5% 50V
C432	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C433	CSM-AG1U50V-1	C: FXD CER 1uF +80, -20% 50V
C434 thru C436	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C437	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C438	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C439	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C440	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C441	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C442	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C443	CSM-AGR47U50V	C: FXD CER 0.47uF +80, -20% 50V
C444	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C445	CCK-AB4R7U25V	C: FXD ELECT 4.7uF 25V
C446	CMC-AC680PR3K-2	C: FXD DIPPED MICA 680pF ±5% 300V
C447	CMC-AB270PR3K-4	C: FXD DIPPED MICA 270pF ±5% 300V
C448	CMC-AB270PR3K-4	C: FXD DIPPED MICA 270pF ±5% 300V
C449	CMC-AC560PR3K-2	C: FXD DIPPED MICA 560pF ±5% 300V
C450	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C451	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C452 thru C454	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C455 thru C457	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C458	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C459	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C460	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C461 thru C465	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C466	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C467	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C468	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C469 thru C473	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C474	CMC-AC1000PR3K-2	C: FXD DIPPED MICA 1000pF ±5% 300V
C475	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C476 thru C481	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C482	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C483	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C484	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C485	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C486	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C487 thru C500	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C501	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C502	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C503 thru C517	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C518 thru C522	CSM-ACR047U50V	C: FXD CER 0.047uF +80, -20% 50V
C523	CTM-AC10P-1	C: VAR CER 10pF
C524	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C525	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C526	CSM-AC22P50V	C: FXD CER 22pF ±10% 50V
C527	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C528	CTM-AC70P-1	C: VAR CER 70pF
C529	CTM-AC70P-1	C: VAR CER 70pF
L530	LCL-C00012-1	L: FXD Coil
L531	LCL-C00012-1	L: FXD Coil
L532 thru L534	LCL-C00613-1	L: FXD Coil
L535	LCL-C00012-1	L: FXD Coil
L536 thru L538	LCL-C00609-1	L: FXD Coil
L539	LCL-C00124-1	L: FXD Coil
L540	LCL-C00124-1	L: FXD Coil
L541	LCL-T00480-1	L: FXD Coil
L542	LCL-C00012-1	L: FXD Coil
L543 thru L545	LCL-B00365-1	L: FXD Coil
L546	LCL-C00012-1	L: FXD Coil
L547 thru L549	LCL-C00549-1	L: FXD Coil
L550	LCL-T00480-1	L: FXD Coil
L551		Not assigned
L552	LCL-C00012-1	L: FXD Coil
L553	LCL-C00011-1	L: FXD Coil
L554	LCL-C00011-1	L: FXD Coil
X565 thru X567	DXD-000765-1	Crystal
J572	JCR-AF050PX02-1	Connector
C579 thru C582	CTM-AC70P-1	C: VAR CER 70pF

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Parts No.	ADVANTEST Stock No.	Description
C583	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C584	CTM-AC70P-1	C: VAR CER 70pF
C585	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C586	CTM-AC70P-1	C: VAR CER 70pF
C587	CMC-AB330PR3K-4	C: FXD DIPPED MICA 330pF ±5% 300V
C588	CTM-AC70P-1	C: VAR CER 70pF

Parts No.	ADVANTEST Stock No.	Description
D1 thru D38	NLD-000111-1	Light Emitting Diode
D39	NLD-000003-1	Light Emitting Diode
R41	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R42	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R43	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
J47	JCR-AF040PX01-1	Connector
SW51 thru SW123	KSP-000250-1	Switch

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Parts No.	ADVANTEST Stock No.	Description
NF1	JCD-AA003PX01-1	Noise Filter
P1	JTE-AG001EX01-1	Terminal
P2 thru P10	JTE-AY001JX01-1	Terminal
TP1	LTP-000582-1	Transformer
D1	SEE-SW1DM1-1	Thyristor
D2	NLD-000002-1	Light Emitting Diode
D3	NLD-000001-1	Light Emitting Diode
J6	JCP-AX002PX01-1	Connector
J7	JCP-AX002JX01-1	Connector
J8	JCS-AV004JX01-1	Connector
J9	JCS-AD010JX01-1	Connector
J10	JCS-AE004JX02-1	Connector
B1	DMF-001006-1	Fan Motor
SW1	KSP-000360	Switch
F1	DFT-AG1R6A	Fuse
X1	DXY-000498-1	Crystal
CB74	DCB-FQ1332X01-1	DM-UM Cable
CB91	DCB-FF0985X05-1	DM-UM Cable
CB92	DCB-FF0985X05-1	DM-UM Cable

Parts No.	ADVANTEST Stock No.	Description
J1 thru J4	JCB-AC036JX02-2	Connector
J5	JCB-AC056JX02-2	Connector
J6	JCB-AC036JX02-2	Connector
J7	JCB-AC056JX02-2	Connector
J8	DCB-RR1638X01-1	Connector
C14	CSM-ACR022U50V	C: FXD CER 0.022µF +80, -20% 50V

8P

Parts No.	ADVANTEST Stock No.	Description
D1	SDP-1S2764-1	Diode SI
D2	SDP-1S2764-1	Diode SI
D3	SDP-W02-1	Diode SI
D4	SDP-KBPC602-1	Diode SI
D5	SDP-KBPC602-1	Diode SI
D6 thru D9	SDP-W02-1	Diode SI
R11 thru R18	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R19	RWR-AER43QK-1	R: FXD SOLID 0.43Ω
R20	RWR-AER43QK-1	R: FXD SOLID 0.43Ω
R21	RWR-AE1QK-1	R: FXD SOLID 1Ω
R22	RWR-AER43QK-1	R: FXD SOLID 0.43Ω
R23	RWR-AER43QK-1	R: FXD SOLID 0.43Ω
R24	RWR-AE1QK-1	R: FXD SOLID 1Ω
R25	RWR-AER43QK-1	R: FXD SOLID 0.43Ω
R26	RWR-AER43QK-1	R: FXD SOLID 0.43Ω
R27	RWR-AE1QK-1	R: FXD SOLID 1Ω
R28	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
C31	CCK-BDR022F16-1	C: FXD ELECT 0.022uF ±0.5% 16V
C32	CCK-AY3300U50V-1	C: FXD ELECT 3300uF ±0.5% 50V
C33	CCK-AY6800U35V-1	C: FXD ELECT 6800uF ±1% 35V
C34	CCK-AY6800U35V-1	C: FXD ELECT 6800uF ±1% 35V
C35 thru C38	CCK-BE4700U35V-1	C: FXD ELECT 4700uF 35V
J46	JCB-AC056JX02-2	Connector

PC

Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-7824U-5	IC: Voltage Regulator
IC2 thru IC9	SIA-723H-1	IC:
Q11	STN-2SC2825-1	Transistor SI NPN
Q12	STN-2SC1983-1	Transistor SI NPN
Q13	STN-2SC2825-1	Transistor SI NPN
Q14	STN-2SC2825-1	Transistor SI NPN
Q15 thru Q18	STN-2SC1983-1	Transistor SI NPN
Q19 thru Q23	STN-2SC1815-15	Transistor SI NPN
CP26	SEC-PS2001-1	Photo Coupler
CP27	SEC-PS2001-1	Photo Coupler
D31 thru D38	NLD-000016-1	Light Emitting Diode
R41	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R42	RMF-AR1R8KFK-1	R: FXD Metal FLM 1.8kΩ ±1% 1/4W
R43	RVR-CD1K-1	R: VAR CERMET 1kΩ
R44	RMF-AR4R7KFK	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R45	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R46	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R47	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R48	RVR-CD1K-1	R: VAR CERMET 1kΩ
R49	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R50	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R51	RCB-AH12K-1	R: FXD CAR 13kΩ ±5% 1/4W
R52	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R53	RCB-AH1R8K-1	R: FXD CAR 1.8kΩ ±5% 1/4W
R54	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R55	RVR-CD1K-1	R: VAR CERMET
R56	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R57	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R58	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R59	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R60	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
R61	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R62	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R63	RVR-CD1K-1	R: VAR CERMET 1kΩ
R64	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R65	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R66	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R67	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R68	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
R69	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R70	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R71	RVR-CD1K-1	R: VAR CERMET 1kΩ
R72	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R73	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R74	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R75	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R76	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
R77	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R78	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R79	RVR-CD1K-1	R: VAR CERMET 1kΩ
R80	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R82	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R83	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R84	RCB-AH6R8K-1	R: FXD CAR 6.8kΩ ±5% 1/4W
R85	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R86	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R87	RVR-CD1K-1	R: VAR CERMET 1kΩ
R88	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R89	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R90	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R91	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R92	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R93	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R94	RMF-AR7R5KFK-1	R: FXD Metal FLM 7.5kΩ ±1% 1/4W
R95	RVR-CD1K-1	R: VAR CERMET 1kΩ
R96	RMF-AR6R8KFK-1	R: FXD Metal FLM 6.8kΩ ±1% 1/4W
R97	RCB-AH3R3K-1	R: FXD CAR 3.3kΩ ±5% 1/4W
R98	RCB-AH15K-1	R: FXD CAR 15kΩ ±5% 1/4W
R99	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R100	RCB-AH220K-1	R: FXD CAR 220kΩ ±5% 1/4W
R101	RCB-AH560-1	R: FXD CAR 560Ω ±5% 1/4W
R102	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R103	RCB-AH220K-1	R: FXD CAR 220kΩ ±5% 1/4W
R104	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R105	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
C111	CSM-ACR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C112	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C113	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C114	CSM-ACR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C115	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C116	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C117	CCK-AB3R3U50V-1	C: FXD ELECT 3.3uF 50V
C118	CCK-AB3R3U50V-1	C: FXD ELECT 3.3uF 50V
C119	CSM-ACR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C120	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C121	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C122	CSM-ACR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C123	CCK-AB4R7U25V-1	C: FXD ELECT 4.7uF 25V
C124	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C125	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C126	CCK-AB4R7U25V-1	C: FXD ELECT 4.7µF 25V
C127	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C128	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C129	CCK-AB4R7U25V-1	C: FXD ELECT 4.7µF 25V
C130	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C131	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C132	CCK-AB4R7U25V-1	C: FXD ELECT 4.7µF 25V
C133	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C134	CSM-ACR1U50V-1	C: FXD CER 0.1µF +80, -20% 50V
C135	CCK-AB4R7U25V-1	C: FXD ELECT 4.7µF 25V
C136	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C137	CCK-AA100U35V-1	C: FXD ELECT 100µF 35V
C138	CCK-AA100U35V-1	C: FXD ELECT 100µF 35V
TH141	DST-000593-1	Thermistor

Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-DA7542-1	IC: 12 Bit D/A Converter
IC2	SIA-DA7542-1	IC: 12 Bit D/A Converter
IC3	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC4	SIT-74LS175	IC: Quad D-Type Flip Flop Low Power
IC5	SIA-DA7542-1	IC: 12 Bit D/A Converter
IC6	SIA-DA7524-2	IC: 8 Bit Buffered Multiplying D/A Converter
IC7	SIA-DA7542-1	IC: 12 Bit D/A Converter
IC8	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC9	SIT-74LS02	IC: Quadruple 2-Input NOR Gate Low Power
IC10	SIA-0P07P-2	IC:
IC11	SIA-5534A-1	IC: Low Noise Operational Amplifier
IC12	SIA-5534A-1	IC: Low Noise Operational Amplifier
IC13	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC14	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC15	SIA-0P07P-2	IC:
IC16	SIA-0P07P-2	IC:
IC17	SIT-74LS04	IC: Hex Inverter Low Power
IC18	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC19	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC20 thru IC22	SIA-0P07P-2	IC:
IC23	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC24	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC25	SIA-5534A-1	IC: Low Noise Operational Amplifier
IC26	SIA-5534A-1	IC: Low Noise Operational Amplifier
IC27	SIA-DG201-1	IC: Quad Monolithic SPST CMOS Analog Switch
IC28	SIA-0P07P-2	IC:
IC29	SIA-0P07P-2	IC:
Q31	STP-2SA1015-1	Transistor SI PNP
Q32	STN-2SC1815-15	Transistor SI NPN
Q33	STN-2SC1815-15	Transistor SI NPN
Q34	STN-2SC1983-1	Transistor SI NPN
Q35	STN-2SC1815-15	Transistor SI NPN
Q36	STP-2SA1015-1	Transistor SI PNP
Q37	STN-2SC1815-15	Transistor SI NPN
Q38	STN-2SC1983-1	Transistor SI NPN
Q39	STN-2SC1815-15	Transistor SI NPN
Q40	STP-2SA1015-1	Transistor SI PNP
Q41	STN-2SC815-2	Transistor SI NPN
Q42	STP-2SA642-3	Transistor SI PNP
D46 thru D50	SDS-1SS97-1	Diode SI
D51	SDZ-W120	Zener Diode
D52	SDZ-2-1	Zener Diode
D53	SDZ-W056	Zener Diode
D54	SDS-LD1-1	Diode SI
D55	SDS-LD1-1	Diode SI

Parts No.	ADVANTEST Stock No.	Description
D56	SDS-1S953-1	Diode SI
D57	SDS-1S953-1	Diode SI
R61	RVR-CD5K-1	R: VAR CERMET 5kΩ
R62	RMF-AR5KFK-1	R: FXD Metal FLM 5kΩ ±1% 1/4W
R63	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R64	RMF-AR2KFK-1	R: FXD Metal FLM 2kΩ ±1% 1/4W
R65	RMF-AR5KFK-1	R: FXD Metal FLM 5kΩ ±1% 1/4W
R66	RMF-AE10KBG-2	R: FXD Metal FLM 10kΩ ±0.1% 1/8W
R67	RMF-AB1KFG	R: FXD Metal FLM 1kΩ ±1% 2W
R68	RMF-AR110QFK-1	R: FXD Metal FLM 110Ω ±1% 1/4W
R69	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R70	RMF-AR240QFK-1	R: FXD Metal FLM 240Ω ±1% 1/4W
R71	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R72	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R73	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R74	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R75	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R76	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R77	RMF-AR1R2KFK-1	R: FXD Metal FLM 1.2kΩ ±1% 1/4W
R78	RMF-AR11KFK-1	R: FXD Metal FLM 11kΩ ±1% 1/4W
R79	RMF-AR110QFK-1	R: FXD Metal FLM 110Ω ±1% 1/4W
R80	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R81	RVR-CD5K-1	R: VAR CERMET 5kΩ
R82	RVR-CD2K-1	R: VAR CERMET 2kΩ
R83	RMF-AR500QFK-1	R: FXD Metal FLM 500Ω ±1% 1/4W
R84	RMF-AR15KFK-1	R: FXD Metal FLM 15kΩ ±1% 1/4W
R85	RMF-AR5R6KFJ-1	R: FXD Metal FLM 5.6kΩ ±1% 1/4W
R86	RVR-CD1K-1	R: VAR CERMET 1kΩ
R87	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R88	RMF-AR1KFK-1	R: FXD Metal FLM 1kΩ ±5% 1/4W
R89	RMF-AB9R1KFJ	R: FXD Metal FLM 9.1kΩ ±1% 2W
R90	RCB-AH1K-1	R: FXD CAR 1kΩ ±1% 1/4W
R91	RMF-AB1R5KFJ	R: FXD Metal FLM 1.5kΩ ±1% 2W
R92	RVR-CD2K-1	R: VAR CERMET 2kΩ
R93	RMF-AR7R5KFJ	R: FXD Metal FLM 7.5kΩ ±1% 2W
R94	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R95	RMF-AR2R2KFK-1	R: FXD Metal FLM 2.2kΩ ±1% 1/4W
R96	RPW-AR80-1	R: VAR WW 80Ω
R97	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R98	RCB-AH10K-1	R: FXD CAR 10kΩ ±5% 1/4W
R99	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R100	RCB-AH33K-1	R: FXD CAR 33kΩ ±5% 1/4W
R101	RCB-AH15-1	R: FXD CAR 15Ω ±5% 1/4W
R102	RMF-AB12KFJ	R: FXD Metal FLM 12kΩ ±1% 2W
R103	RMF-AB10KFJ	R: FXD Metal FLM 10kΩ ±1% 2W
R104	RVR-CD5K-1	R: VAR CERMET 5kΩ
R105	RMF-AB10KFJ	R: FXD Metal FLM 10kΩ ±1% 2W
R106	RMF-AB7R5KFJ	R: FXD Metal FLM 7.5kΩ ±1% 2W

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Parts No.	ADVANTEST Stock No.	Description
R107	RMF-AB1R2KFJ	R: FXD Metal FLM 1.2kΩ ±1% 2W
R108	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R109	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R110	RPW-AR80-1	R: VAR WW 80Ω
R111	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 1/4W
R112	RMF-AR22KFK-1	R: FXD Metal FLM 22kΩ ±1% 2/4W
R113	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R114	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R115	RMF-AR2KFK-1	R: FXD Metal FLM 2kΩ ±1% 1/4W
R116	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R117	RCB-AH2R2K-1	R: FXD CAR 2.2kΩ ±5% 1/4W
R118	RCB-AK22-1	R: FXD CAR 22Ω ±5% 1/2W
R119	RMF-AR20KFK-1	R: FXD Metal FLM 20kΩ ±1% 1/4W
R120	RVR-CD1K-1	R: VAR CERMET 1kΩ
R121	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R122	RCB-AH5R6K-1	R: FXD CAR 5.6kΩ ±5% 1/4W
R123	RCB-AH1K-1	R: FXD CAR 1kΩ ±5% 1/4W
R124	RCB-AK150-1	R:FXD CAR 150Ω ±5% 1/2W
R125	RMF-AR1KFK-1	R: FXD Metal FLM 1k ±1% 1/4W
R126	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R127	RVR-CD5K-1	R: VAR CERMET 5kΩ
R128	RMF-AR27KFK-1	R: FXD Metal FLM 27kΩ ±1% 1/4W
R129	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R130	RCB-AH4R7K-1	R: FXD CAR 4.7kΩ ±5% 1/4W
R131	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R132	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R133	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R134	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R135	RCB-AH150-1	R: FXD CAR 150Ω ±5% 1/4W
R136	RCB-AK56-1	R: FXD CAR 56Ω ±5% 1/2W
R137	RCB-AK56-1	R: FXD CAR 56Ω ±5% 1/2W
R138 thru R141	RMF-AA390QFJ	R: FXD Metal FLM 390Ω ±1% 2W
R142	RVR-CD20-1	R: VAR CERMET 20Ω
R143	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R144	RVR-CD5K-1	R: VAR CERMET 5kΩ
R145	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R146	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R147	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R148	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R149	RMF-AR4R7KFK-1	R: FXD Metal FLM 4.7kΩ ±1% 1/4W
R150	RVR-CD2K-1	R: VAR CERMET 2kΩ
R151	RMF-AR10KFK-1	R: FXD Metal FLM 10kΩ ±1% 1/4W
R152	RMF-AR3R3KFK-1	R: FXD Metal FLM 3.3kΩ ±1% 1/4W
R153	RMF-AR12KFK-1	R: FXD Metal FLM 12kΩ ±1% 1/4W
R154	RCB-AH470-1	R: FXD CAR 470Ω ±5% 1/4W
R155	RCB-AH100-1	R: FXD CAR 100Ω ±5% 1/4W

Pb

Parts No.	ADVANTEST Stock No.	Description
C161 thru C165	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C166	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C167	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C168	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C169	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C170 thru C172	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C173	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C174	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C175	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C176	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C177	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C178	CCK-AA100U16V-1	C: FXD ELECT 100uF 16V
C179	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C180	CCK-AA47U25V-1	C: FXD ELECT 47uF 25V
C181	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C182	CCK-AA47U25V-1	C: FXD ELECT 47uF 25V
C183	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C184	CCK-AA10U25V-1	C: FXD ELECT 10uF 25V
C185	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C186	CCK-AA10U25V-1	C: FXD ELECT 10uF 25V
C187	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C188	CCK-AA47U25V-1	C: FXD ELECT 47uF 25V
C189	CCK-AA220U16V-1	C: FXD ELECT 220uF 16V
C190	CSM-ACR01U50V-1	C: FXD CER 0.01uF +80, -20% 50V
C191 thru C193	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C194	CCK-AA10U25V-1	C: FXD ELECT 10uF 25V
C195	CCK-AA10U25V-1	C: FXD ELECT 10uF 25V
C196	CCK-AA47U25V-1	C: FXD ELECT 47uF 25V
C197	CFM-ABR068U50V-1	C: FXD Mylar 0.068µF ±10% 50V
C198	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C199	CSM-AC33P50V-1	C: FXD CER 33pF ±10% 50V
C200	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C201	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C202	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C203	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
C204	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C205	CSM-ACR022U50V-1	C: FXD CER 0.022uF +80, -20% 50V
C206	CTA-AE2R2U20V-1	C: FXD ELECT TANTAL 2.2uF 20V
C207 thru C210	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V
L211 thru L213	LCL-T00084-1	L: FXD Coil
C214	CSM-AC1000P50V-1	C: FXD CER 1000pF +80, -20% 50V

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Parts No.	ADVANTEST Stock No.	Description
J216	JCS-AD010PX02-1	Connector
C217	CSM-AGR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V
C218	CSM-AGR1U50V-1	C: FXD CER 0.1μF +80, -20% 50V

P8

Parts No.	ADVANTEST Stock No.	Description
IC1	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC2	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC3	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC4	SIT-74LS00	IC: Quadruple 2-Input Positive NAND Gate Low Power
IC5	SIT-74LS14	IC: Hex Schmitt-Trigger Inverter Low Power
IC6 thru IC8	SIT-7406	IC: Hex Inverter Buffer/Driver with Open-Collector High-Voltage output
IC9	SIT-74LS244	IC: Octal Buffer/Line Driver/Line Receiver Low Power
IC10 thru IC12	SIT-74LS138	IC: 3-to-8 Line Decoder/Multiplexer Low Power
IC13	SIT-74LS174	IC: Hex D-Type Flip Flop Low Power
IC14	SIT-74LS273	IC: Octal D-Type Flip Flop Low Power
IC15	SIT-74LS04	IC: Hex Inverter Low Power
R21 thru R36	RCB-AH220K	R: FXD CAR 220kΩ ±5% 1/4W
R37 thru R49	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R50 thru R52	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R53 thru R55	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
C61	CCK-AB22U16V	C: FXD ELECT 22uF 16V
C62 thru C69	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C70	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C71 thru C74	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
L77	LCL-T00084-1	L: FXD Coil
L78	LCL-T00084-1	L: FXD Coil
CP81 thru CP96	SEC-PS2001-1	Photo Coupler
J101	JCR-AF016PX02-1	Connector
J102	JCR-AF016PX02-1	Connector
J103	JCR-AF030PX02-1	Connector

PP

Parts No.	ADVANTEST Stock No.	Description
D1		Not assigned
D2 thru D13	NLD-000111-1	Light Emitting Diode
D14		Not assigned
D15	NLD-000003-1	Light Emitting Diode
J17	JCR-AF020PX01-1	Connector
SW21 thru SW30	KSP-000250-1	Switch
SW31		Not assigned
SW32 thru SW41	KSP-000250-1	Switch

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TR4171
RF INPUT BLOCK
MEP-404

Parts No.	ADVANTEST Stock No.	Description
	JCF-AB001JX11-2	BNC Connector
	JCF-AB001JX11-2	BNC Connector
	JCF-AC001JX02-2	Connector
	CFT-AC1000P50V-1	C: FXD Feed -through 1000pF +100, -0% 50V
	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
	CCK-BA10U25V-1	C: FXD ELECT 10uF 25V

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Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-339	IC: Quad Comparator
IC2	SIA-733N-2	IC: Differential Video Amplifier
IC3	SIA-733N-2	IC: Differential Video Amplifier
IC4	SIA-339	IC: Quad Comparator
IC5	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC6	SIT-7406	IC: Hex Inverter Buffer/Driver with Open-Collector High-Voltage output
Q10	STP-2SA1015-1	Transistor SI PNP
Q11	STP-2SA1015-1	Transistor SI PNP
Q12	STN-2SC1426-1	Transistor SI NPN
Q13	STN-2SC1426-1	Transistor SI NPN
Q14	STN-2SC1815-15	Transistor SI NPN
Q15	STN-2SC1426-1	Transistor SI NPN
Q16	STN-2SC1275-1	Transistor SI NPN
Q17	STN-2SC1730-1	Transistor SI NPN
Q18	STN-2SC1815-15	Transistor SI NPN
Q19	STP-2SA1015-1	Transistor SI PNP
Q20	SFM-3SK74-1	FET Junction N-Channel
Q21	SFN-2N4393-18	FET Junction N-Channel
Q22	STN-2SC815-2	Transistor SI NPN
D28 thru D31	SDS-1S2222-1	Diode SI
D32 thru D36	SDS-1S953	Diode SI
D37	SDS-1SS101-1	Diode SI
D38	SDS-1SS101-1	Diode SI
D39 thru D45	SDS-1S953	Diode SI
D46	SDS-1SS97-1	Diode SI
R54	RMF-AR10QFK	R: FXD Metal FLM 10Ω ±1% 1/4W
R55	RMF-AR10QFK	R: FXD Metal FLM 10Ω ±1% 1/4W
R56	RMF-AR120QFK	R: FXD Metal FLM 120Ω ±1% 1/4W
R57	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R58	RMF-AR820QFK	R: FXD Metal FLM 82Ω ±1% 1/4W
R59	RMF-AR56QFK	R: FXD Metal FLM 56Ω ±1% 1/4W
R60	RVR-CB20-1	R: VAR CERMET 20Ω
R61	RCB-AG330	R: FXD CAR 330Ω ±5% 1/8W
R62	RCB-AG68	R: FXD CAR 68Ω ±5% 1/8W
R53	RCB-AH1R5M	R: FXD CAR 1.5MΩ ±5% 1/4W
R64	RCB-AH1R5M	R: FXD CAR 1.5MΩ ±5% 1/4W
R65	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R66	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R67	RMF-AR120QFK	R: FXD Metal FLM 120Ω ±1% 1/4W
R68	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W
R69	RMF-AR300QFK	R: FXD Metal FLM 300Ω ±1% 1/4W
R70	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R71	RMF-AR300QFK	R: FXD Metal FLM 300Ω ±1% 1/4W
R72 thru R77	RMF-AR43QFK	R: FXD Metal FLM 43Ω ±1% 1/4W
R78	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R79	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R80	RMF-AR60QFK-1	R: FXD Metal FLM 60Ω ±1% 1/4W
R81	RMF-AR56QFK-1	R: FXD Metal FLM 56Ω ±1% 1/4W
R82	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R83	RMF-AR300QFK-1	R: FXD Metal FLM 300Ω ±1% 1/4W
R84	RMF-AR390QFK-1	R: FXD Metal FLM 390Ω ±1% 1/4W
R85	RMF-AR300QFK-1	R: FXD Metal FLM 300Ω ±1% 1/4W
R86	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R88	RMF-AR110QFK	R: FXD Metal FLM 110Ω ±1% 1/4W
R89	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R90	RMF-AR270QFK	R: FXD Metal FLM 270Ω ±1% 1/4W
R91	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R92	RMF-AR270QFK	R: FXD Metal FLM 270Ω ±1% 1/4W
R93	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R94	RMF-AR390QFK	R: FXD Metal FLM 390Ω ±1% 1/4W
R95	RMF-AR680QFK	R: FXD Metal FLM 680Ω ±1% 1/4W
R96	RMF-AR82QFK	R: FXD Metal FLM 82Ω ±1% 1/4W
R97	RMF-AR240QFK	R: FXD Metal FLM 240Ω ±1% 1/4W
R98	RMF-AR82QFK	R: FXD Metal FLM 82Ω ±1% 1/4W
R99	RMF-AR240QFK	R: FXD Metal FLM 240Ω ±1% 1/4W
R100	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R101	RMF-AR1KFK	R: FXD Metal FLM 1kΩ ±1% 1/4W
R102	RMF-AR3R6KFK	R: FXD Metal FLM 3.6kΩ ±1% 1/4W
R103	RMF-AR82QFK	R: FXD Metal FLM 82Ω ±1% 1/4W
R104	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R105	RMF-AR82QFK	R: FXD Metal FLM 82Ω ±1% 1/4W
R106	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R107	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R108	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R109	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R110 thru R112	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R113	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R114	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W
R115	RMF-AR1KFK	R: FXD Metal FLM 1kΩ ±1% 1/4W
R116	RMF-AR150QFK	R: FXD Metal FLM 150Ω ±1% 1/4W
R117	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W
R118	RMF-AR10QFK	R: FXD Metal FLM 10Ω ±1% 1/4W
R119	RMF-AR10QFK	R: FXD Metal FLM 10Ω ±1% 1/4W
R120	RMF-AR390QFK	R: FXD Metal FLM 390Ω ±1% 1/4W
R121	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R122	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R123	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W

Parts No.	ADVANTEST Stock No.	Description
R124	RMF-AR62QFK	R: FXD Metal FLM 62Ω ±1% 1/4W
R125	RMF-AR390QFK	R: FXD Metal FLM 390Ω ±1% 1/4W
R126	RMF-AR2R7KFK	R: FXD Metal FLM 2.7kΩ ±1% 1/4W
R127	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R128	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R129	RMF-AR39QFK	R: FXD Metal FLM 39Ω ±1% 1/4W
R130	RMF-AR51QFK	R: FXD Metal FLM 51Ω ±1% 1/4W
R131	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R132	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R133	RMF-AR68QFK	R: FXD Metal FLM 68Ω ±1% 1/4W
R134	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R135	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R136	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R137	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R138	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R139	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R140	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R141	RCB-AG470K	R: FXD CAR 470kΩ ±5% 1/8W
R142	RCB-AG330K	R: FXD CAR 330kΩ ±5% 1/8W
R143	RMF-AR10KFK	R: FXD Metal FLM 10kΩ ±1% 1/4W
R144	RMF-AR47KFK	R: FXD Metal FLM 47kΩ ±1% 1/4W
R145	RCB-AG470K	R: FXD CAR 470kΩ ±1% 1/8W
R146	RCB-AG330K	R: FXD CAR 330kΩ ±1% 1/8W
R147	RMF-AR10KFK	R: FXD Metal FLM 10kΩ ±1% 1/4W
R148	RMF-AR47KFK	R: FXD Metal FLM 47kΩ ±1% 1/4W
R149	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R150 thru R157	RCB-AG56K	R: FXD CAR 56kΩ ±5% 1/8W
R158	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R159	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R160	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R161	RCB-AG68	R: FXD CAR 68Ω ±5% 1/8W
R162	RCB-AG47	R: FXD CAR 47Ω ±5% 1/8W
R163	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R164	RCB-AG680	R: FXD CAR 680Ω ±5% 1/8W
R165	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R166	RCB-AG220	R: FXD CAR 220Ω ±5% 1/8W
R167 thru R170	RCB-AG5R6K	R: FXD CAR 5.6kΩ ±5% 1/8W
R171	RCB-AG120	R: FXD CAR 120Ω ±5% 1/8W
R172 thru R175	RCB-AG5R6K	R: FXD CAR 5.6kΩ ±5% 1/8W
R176	RCB-AG470	R: FXD CAR 470Ω ±5% 1/8W
R177	RCB-AG820K	R: FXD CAR 820kΩ ±5% 1/8W
R178	RCB-AG1K	R: FXD CAR 1kΩ ±5% 1/8W
R179	RCB-AG100K	R: FXD CAR 100kΩ ±5% 1/8W

Parts No.	ADVANTEST Stock No.	Description
R180 thru R182	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R183	RCB-AG470K	R: FXD CAR 470kΩ ±5% 1/8W
R184	RVR-CB1K-1	R: VAR CERMET 1kΩ
R185	RMF-AR12KFK	R: FXD Metal FLM 12kΩ ±1% 1/4W
R186	RCB-AG1K	R: FXD CAR 1kΩ ±5% 1/8W
R187	RCB-AG820K	R: FXD CAR 820kΩ ±5% 1/8W
R188	RCB-AG1K	R: FXD CAR 1kΩ ±5% 1/8W
R189	RVR-CB500-1	R: VAR CERMET 500Ω
R190	RMF-AR15KFK	R: FXD Metal FLM 15kΩ ±1% 1/4W
R191 thru R193	RCB-AG56K	R: FXD CAR 56kΩ ±5% 1/8W
R194	RCB-AG15K	R: FXD CAR 15kΩ ±5% 1/8W
R195 thru R197	RCB-AG56K	R: FXD CAR 56kΩ ±5% 1/8W
R198	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R199	RCB-AH470	R: FXD CAR 470Ω ±5% 1/4W
R200	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R201	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R202	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R203	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R204	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R205	RCB-AG10K	R: FXD CAR 10kΩ ±5% 1/8W
R206	RCB-AG3R3K	R: FXD CAR 3.3kΩ ±5% 1/8W
R207	RCB-AG4R7K	R: FXD CAR 4.7kΩ ±5% 1/8W
R208	RAY-AA4R7K6	R: FXD COM 4.7kΩ
R209	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R210	RCB-AG470K	R: FXD CAR 470kΩ ±5% 1/8W
R211	RCB-AG470K	R: FXD CAR 470kΩ ±5% 1/8W
R212	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R213	RCB-AG22	R: FXD CAR 22Ω ±5% 1/8W
C218	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
C219	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
C220 thru C224	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C225	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
C226	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C227	CCK-BB1000U16V-1	C: FXD ELECT 1000uF 16V
C228	CTA-AE2R2U20V-1	C: FXD ELECT TANTAL 2.2uF 20V
C229	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
C230	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
C231	CTM-AA20P-1	C: VAR CER 20pF
C232	CTM-AA10P-1	C: VAR CER 10pF
C233	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C234	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V

Parts No.	ADVANTEST Stock No.	Description
C235 thru C237	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C238	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C239	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C240	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C241	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C242	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C243	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C244	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C245	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C246	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C247	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C248	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C249	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C250	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C251 thru C253		Not assigned
C254	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C255	CCK-AA470U10V	C: FXD ELECT 470uF 10V
C256	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C257	CCK-AA470U10V	C: FXD ELECT 470uF 10V
C258	CCP-ADR1U50V	C: FXD CHIP 0.1uF +80, -20% 50V
C259	CCK-AA470U10V	C: FXD ELECT 470uF 10V
C260	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C262	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF ±20% 50V
C263	CCK-AB100U25V	C: FXD ELECT 100uF 25V
C264	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C265	CCK-AB47U25V	C: FXD ELECT 47uF 25V
C266	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C267	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C268	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C269	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C270	CCK-AA470U10V	C: FXD ELECT 470uF 10V
C271	CTA-AA10U25V-1	C: FXD ELECT TANTAL 10uF ±20% 25V
C272	CCP-ACR01U50V-1	C: FXD CHIP 0.01uF +80, -20% 50V
C273	CCK-AA47U10V	C: FXD ELECT 47uF 10V
C274	CCP-AC10P50V-6	C: FXD CHIP 10pF ±0.5% 50V
C275	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C276	CCK-AA470U10V	C: FXD ELECT 470uF 10V
C277	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C278	CTA-AA10U25V-1	C: FXD ELECT TANTAL 10uF ±20% 25V
C279		Not assigned
C280	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C281	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF ±20% 50V
C282	CCK-AB100U25V	C: FXD ELECT 100uF 25V
C283	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C284	CCK-AB47U25V	C: FXD ELECT 47uF 25V

Parts No.	ADVANTEST Stock No.	Description
C285	CTM-AA10P-1	C: VAR CER 10pF
C286 thru C290	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C291	CSM-AC68P50V	C: FXD CER 68pF ±10% 50V
C292	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C293	CCK-AB47U10V	C: FXD ELECT 47uF 10V
C294	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C295	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C296	CCK-AB10U25V	C: FXD ELECT 10uF 25V
C297	CTM-AA6P-1	C: VAR CER 6pF
C298	CTM-AA10P-1	C: VAR CER 10pF
C299	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C300	CCK-AB47U10V	C: FXD ELECT 47uF 10V
C301 thru C303	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C304	CCK-AB22U16V	C: FXD ELECT 22uF 16V
C305	CTA-AC2R2U35V-1	C: FXD ELECT 2.2uF 35V
C306 thru C308	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C309	CCK-AB10U16V	C: FXD ELECT 10uF 16V
C310	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF ±20% 50V
C311	CMC-AB82PR3K-4	C: FXD DIPPED MICA 82pF ±5% 300V
C312 thru C314	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C315	CTM-AA4P-1	C: VAR CER 4pF
C316	CTA-AA10U25V-1	C: FXD ELECT TANTAL 10uF ±20% 25V
C317	CTA-AA10U25V-1	C: FXD ELECT TANTAL 10uF ±20% 25V
C318	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
L320	LCL-A00063-1	L: FXD Coil
L321	LCL-A00064-1	L: FXD Coil
L322	LCL-C00557-1	L: FXD Coil
L323	LCL-C00557-1	L: FXD Coil
L324	LCL-A00066-1	L: FXD Coil
L325	LCL-A00067-1	L: FXD Coil
L326	LCL-A00514-1	L: FXD Coil
L327	LCL-A00066-1	L: FXD Coil
L328	LCL-C00012-1	L: FXD Coil
L329	LCL-C00012-1	L: FXD Coil
L330	LCL-A00066-1	L: FXD Coil
L331	LCL-A00066-1	L: FXD Coil
L332	LCL-A00074-1	L: FXD Coil
L333	LCL-A00507-1	L: FXD Coil
L334	LCL-T00084-1	L: FXD Coil
L335	LCL-A00506-1	L: FXD Coil
L336	LCL-A00514-1	L: FXD Coil

Parts No.	ADVANTEST Stock No.	Description
K338 thru K340	KRL-000434-1	Relay
K341 thru K344	KRL-000350-1	Relay
K345 thru K347	KRL-000434-1	Relay
J353	JCR-AF016PX01-1	Connector

Parts No.	ADVANTEST Stock No.	Description
IC1	SIA-TL072-1	IC: Low-Noise JFET-Input Operational Amplifier
IC2	SIT-7406	IC: Hex Inverter Buffer/Driver with Open-Collector High-Voltage output
Q6	SFM-3SK74-1	FET Junction N-Channel
Q7	STN-2SC1426-1	Transistor SI NPN
Q8	STN-2SC1275-1	Transistor SI NPN
Q9	STN-2SC1730-1	Transistor SI NPN
Q10	STN-2SC1815-15	Transistor SI NPN
Q11	STN-2SC1426-1	Transistor SI NPN
Q12	STN-2SC1426-1	Transistor SI NPN
Q13	STN-2SC815-2	Transistor SI NPN
D19 thru D22	SDS-1S953	Diode SI
D23	SDS-LD1-1	Diode SI
D24	SDS-LD1-1	Diode SI
D25	SDS-1S953	Diode SI
D26	SDS-ND487C2-1	Diode SI
R31	RCB-AF82	R: FXD CAR 82Ω ±5% 1W
R32	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R33	RMF-AR75QFK	R: FXD Metal FLM 75Ω ±1% 1/4W
R34	RMF-AR437KFK-1	R: FXD Metal FLM 437kΩ ±1% 1/4W
R35	RMF-AR1R28MFK-1	R: FXD Metal FLM 1.28MΩ ±1% 1/4W
R36	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R37	RCB-AH82	R: FXD CAR 82Ω ±5% 1/4W
R38	RMF-AR681KFK-1	R: FXD Metal FLM 681kΩ ±1% 1/4W
R39	RMF-AR464KFK-1	R: FXD Metal FLM 464kΩ ±1% 1/4W
R40	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R41	RCB-AH68	R: FXD CAR 68Ω ±5% 1/4W
R42	RMF-AR909KFK-1	R: FXD Metal FLM 909kΩ ±1% 1/4W
R43	RMF-AR110KFK-1	R: FXD Metal FLM 110kΩ ±1% 1/4W
R44	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R45	RMF-AR976KFK-1	R: FXD Metal FLM 976kΩ ±1% 1/4W
R46	RMF-AR32R4KFK-1	R: FXD Metal FLM 32.4kΩ ±1% 1/4W
R47	RCB-AH10	R: FXD CAR 10Ω ±5% 1/4W
R48	RMF-AR1MFK-1	R: FXD Metal FLM 1MΩ ±1% 1/4W
R49	RCB-AH12K	R: FXD CAR 12kΩ ±5% 1/4W
R50	RCB-AH27K	R: FXD CAR 27kΩ ±5% 1/4W
R51	RCB-AH100K	R: FXD CAR 100kΩ ±5% 1/4W
R52	RCB-AH1R5K	R: FXD CAR 1.5kΩ ±5% 1/4W
R53	RMF-AR100QFK	R: FXD Metal FLM 100Ω ±1% 1/4W
R54	RMF-AR51QFK	R: FXD Metal FLM 51Ω ±1% 1/4W
R55	RCB-AH6R8K	R: FXD CAR 6.8kΩ ±5% 1/4W
R56	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R57	RCB-AH51	R: FXD CAR 51Ω ±5% 1/4W
R58	RMF-AR330QFK	R: FXD Metal FLM 330Ω ±1% 1/4W
R59	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R60	RCB-AH820	R: FXD CAR 820Ω ±5% 1/4W

10P

Parts No.	ADVANTEST Stock No.	Description
R61	RMF-AR47QFK	R: FXD Metal FLM 47Ω ±1% 1/4W
R62	RVR-CB500-1	R: VAR CERMET 500Ω
R63	RVR-CB50-1	R: VAR CERMET 50Ω
R64	RCB-AH3R9K	R: FXD CAR 3.9kΩ ±5% 1/4W
R65	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R66	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R67	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R68	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R69	RVR-CB50-1	R: VAR CERMET 50Ω
R70	RCB-AH150	R: FXD CAR 150Ω ±5% 1/4W
R71	RCB-AH1K	R: FXD CAR 1kΩ ±5% 1/4W
R72	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R73	RCB-AH100	R: FXD CAR 100Ω ±5% 1/4W
R74	DHB-000332-1	R: 3dB PAD
R75	DHB-000332-1	R: 3dB PAD
R76	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R77	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R78	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R79	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R80	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R81	RCB-AH270	R: FXD CAR 270Ω ±5% 1/4W
R82	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R83	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R84	RCB-AH2R2K	R: FXD CAR 2.2kΩ ±5% 1/4W
R85	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R86	RCB-AH22	R: FXD CAR 22Ω ±5% 1/4W
R87 thru R90	RCB-AH4R7	R: FXD CAR 4.7Ω ±5% 1/4W
R91	RCB-AH220	R: FXD CAR 220Ω ±5% 1/4W
R92	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R93	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R94	RCB-AH3R3K	R: FXD CAR 3.3kΩ ±5% 1/4W
R95	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R96	RCB-AH4R7K	R: FXD CAR 4.7kΩ ±5% 1/4W
R97	RCB-AH10K	R: FXD CAR 10kΩ ±5% 1/4W
R98	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R99	RCB-AH120	R: FXD CAR 120Ω ±5% 1/4W
R100	RAY-AA4R7K6	R: FXD COM 4.7kΩ
R101	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R102	RMF-AR22QFK	R: FXD Metal FLM 22Ω ±1% 1/4W
R103	RMF-AR180QFK	R: FXD Metal FLM 180Ω ±1% 1/4W
R104	RMF-AR22QFK	R: FXD Metal FLM 22Ω ±1% 1/4W
C111	CTA-AGR15UR16V-1	C: FXD ELECT TANTAL 15uF ±20% 16V
C112	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C113	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C114	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C115	CTM-AA2P-1	C: VAR CER 2pF

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Parts No.	ADVANTEST Stock No.	Description
C116	CTM-AA10P-1	C: VAR CER 10pF
C117	CCP-AC22P50V-5	C: FXD CHIP 22pF ±10% 50V
C118	CCP-AC2P50V-4	C: FXD CHIP 2pF ±0.25% 50V
C119	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C120	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C121	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C122	CTM-AA2P-1	C: VAR CER 2pF
C123	CCP-AC2P50V-4	C: FXD CHIP 2pF ±0.25% 50V
C124	CTM-AA4P-1	C: VAR CER 4pF
C125	CCP-AC10P50V-6	C: FXD CHIP 10pF ±0.5% 50V
C126	CCP-AC15P50V-5	C: FXD CHIP 15pF ±10% 50V
C127	CSM-AGR1U50V-1	C: FXD CER 0.1uF +80, -20% 50V
C128	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C129	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C130	CTM-AA2P-1	C: VAR CER 2pF
C131	CCP-AC5P50V-4	C: FXD CHIP 5pF ±0.25% 50V
C132	CTM-AA4P-1	C: VAR CER 4pF
C133	CCP-AC22P50V-5	C: FXD CHIP 22pF ±10% 50V
C134	CSM-AGR47U50V-1	C: FXD CER 0.47uF +80, -20% 50V
C135	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C136	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C137	CTM-AA2P-1	C: VAR CER 2pF
C138		Not assigned
C139	CTM-AA4P-1	C: VAR CER 4pF
C140	CCP-AC100P50V-5	C: FXD CHIP 100pF ±10% 50V
C141	CSM-AC1000P50V	C: FXD CER 1000pF +80, -20% 50V
C142 thru C144	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C145	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C146	CTM-AA10P-1	C: VAR CER 10pF
C147	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C148	CCK-AA47U10V	C: FXD ELECT 47uF 10V
C149		Not assigned
C150	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C151	CCP-AC22P50V-5	C: FXD CHIP 22pF ±10% 50V
C152	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C153	CCK-AA470U10V	C: FXD ELECT 470uF 10V
C154	CCK-AB100U25V	C: FXD ELECT 100uF 25V
C155	CTA-AC1U50V-4	C: FXD ELECT TANTAL 1uF +100, -0% 50V
C156	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C157	CCK-AB47U25V	C: FXD ELECT 47uF 25V
C158	CTA-AA10U25V	C: FXD ELECT 10uF 25V
C159 thru C161	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C162	CCP-ADR1U50V-1	C: FXD CHIP 0.1uF +80, -20% 50V
C163	CCK-AA1000U16V	C: FXD ELECT 1000uF 16V
C164	CTA-AA10U25V-1	C: FXD ELECT TANTAL 10uF ±20% 25V

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Parts No.	ADVANTEST Stock No.	Description
C165	CSM-AC12P50V	C: FXD CER 12pF ±10% 50V
C166	CSM-AC12P50V	C: FXD CER 12pF ±10% 50V
C167	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C168	CSM-AC4700P50V	C: FXD CER 4700pF +80, -20% 50V
C169	CEE-AB4700P50V	C: FXD EL 4700pF 50V
C170	CSM-AC10P50V	C: FXD CER 10pF ±10% 50V
C171	CSM-AC470P50V	C: FXD CER 470pF ±10% 50V
C172	CSM-AC15P50V	C: FXD CER 15pF ±10% 50V
C173	CEE-AB4700P50V-1	C: FXD EL 4700pF 50V
C174	CSM-AC12P50V	C: FXD CER 12pF ±10% 50V
C175	CSM-AC150P50V	C: FXD CER 150pF ±10% 50V
C176	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C177	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C178	CCK-AB10U16V	C: FXD ELECT 10uF 16V
C179	CTM-AA6P-1	C: VAR CER 6pF
C180	CSM-AC15P50V	C: FXD CER 15pF ±10% 50V
C181 thru C183	CSM-ACR022U50V	C: FXD CER 0.022uF +80, -20% 50V
C184	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
C185	CCP-ACR01U50V-2	C: FXD CHIP 0.01uF +80, -20% 50V
L191	LCL-A00510-1	L: FXD Coil
L192	LCL-A00512-1	L: FXD Coil
L193	LCL-A00509-1	L: FXD Coil
L194	LCL-A00064-1	L: FXD Coil
L195	LCL-A00068-1	L: FXD Coil
L196	LCL-C00012-1	L: FXD Coil
R197	LCL-A00516-1	L: FXD Coil
R198	LTP-000270-1	L: FXD Coil
R199	LTP-000268-1	L: FXD Coil
R200	LCL-A00514-1	L: FXD Coil
R201	LCL-A00506-1	L: FXD Coil
R202	LCL-A00507-1	L: FXD Coil
R203	LCL-A00514-1	L: FXD Coil
R204	LCL-A00507-1	L: FXD Coil
R205	LCL-A00509-1	L: FXD Coil
R206	LTP-000268-1	L: FXD Coil
R207	LCL-A00514-1	L: FXD Coil
K214 thru K217	KRL-000350-1	Relay
K218	KRL-000434-1	Relay
P222 thru P224	JTF-AC001EX02-1	Terminal
J233	JCR-AF016PX01-1	Connector

SECTION 15

PARTS LOCATION & CIRCUIT DIAGRAMS

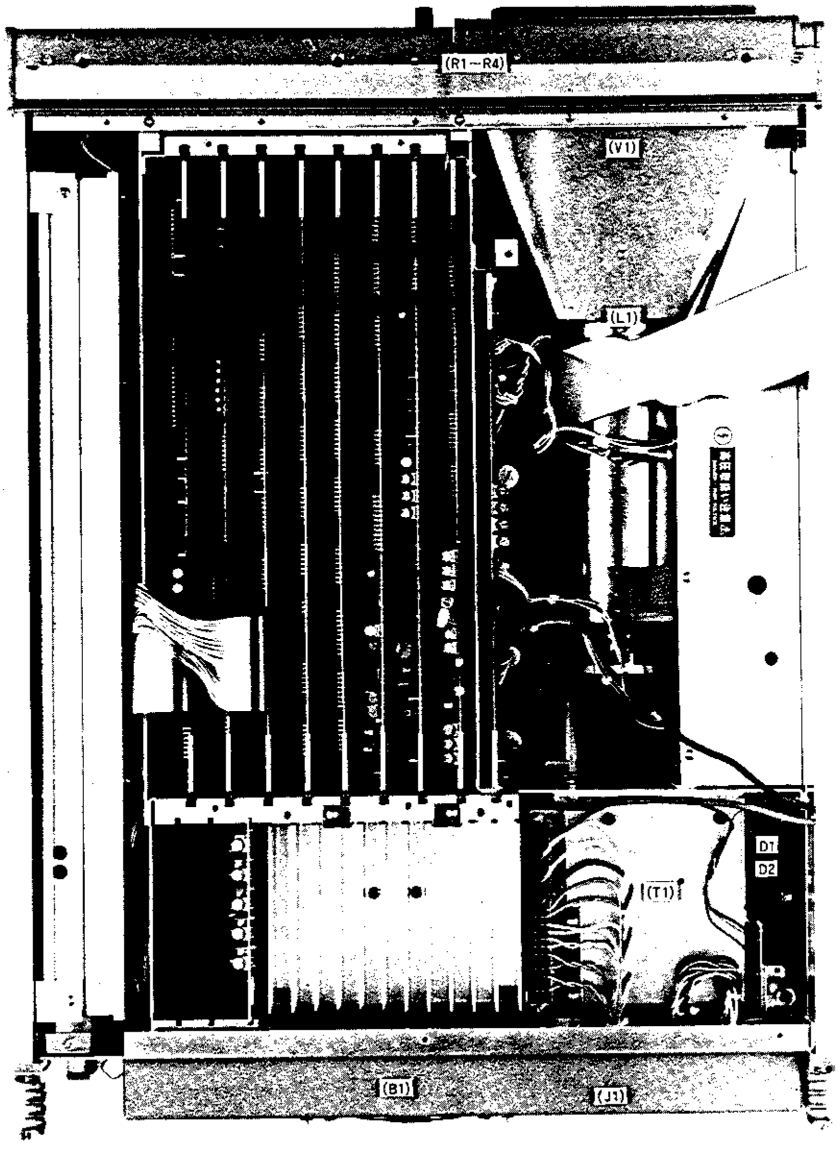


Fig. 15-1 DISPLAY schematic section

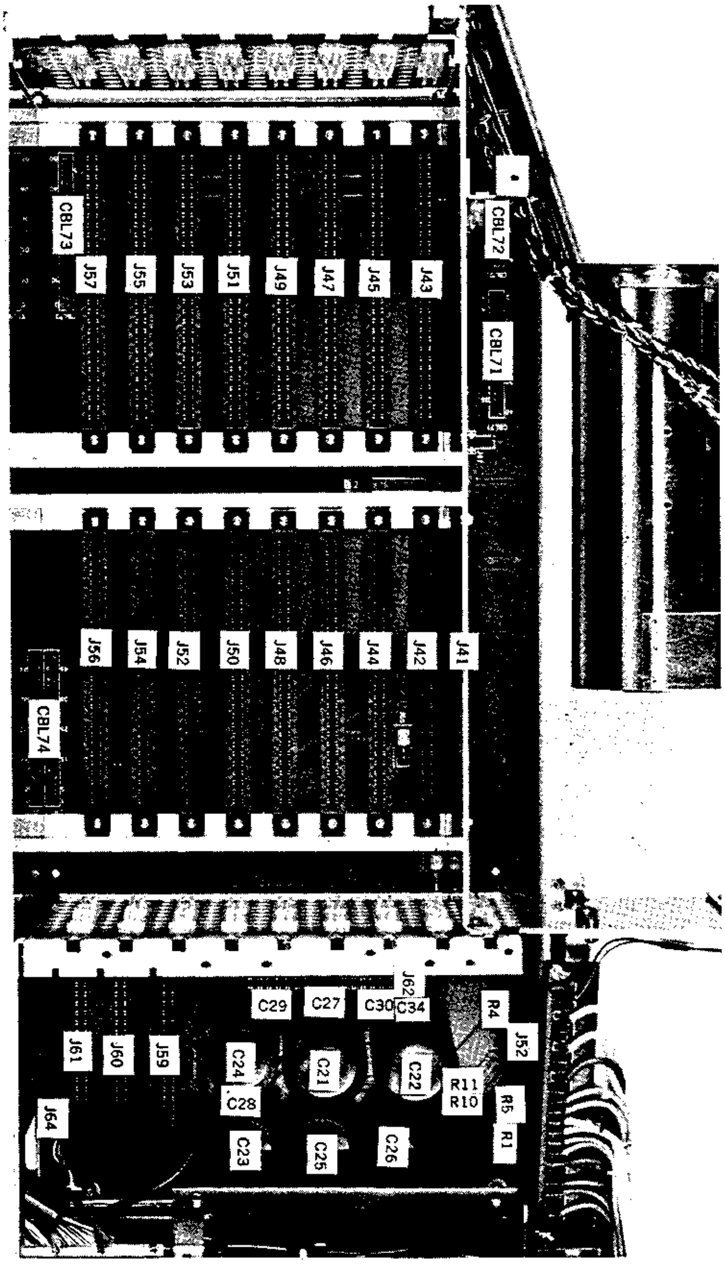


Fig. 15-2 DISPLAY MOTHER (BLQ-010203)

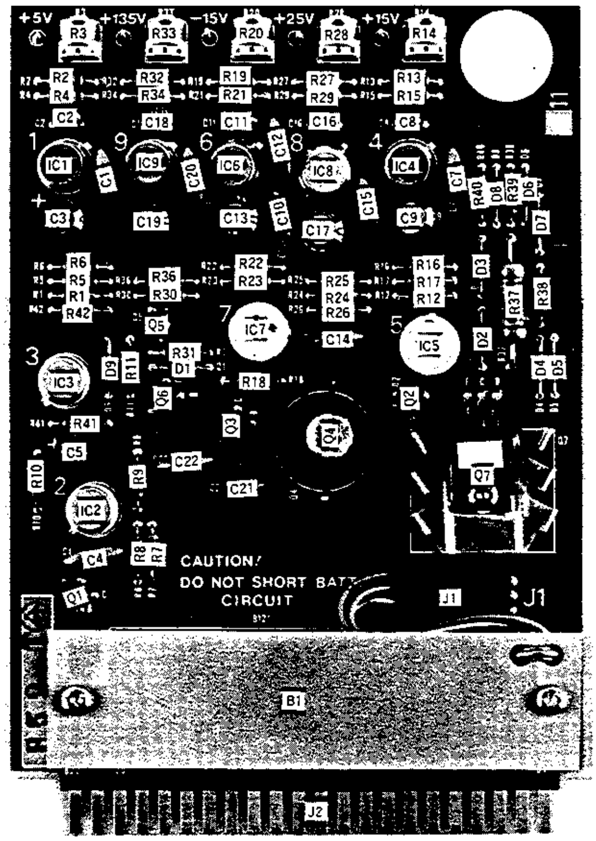


Fig. 15-3 DISPLAY POWER - 1 (BGC-011865)

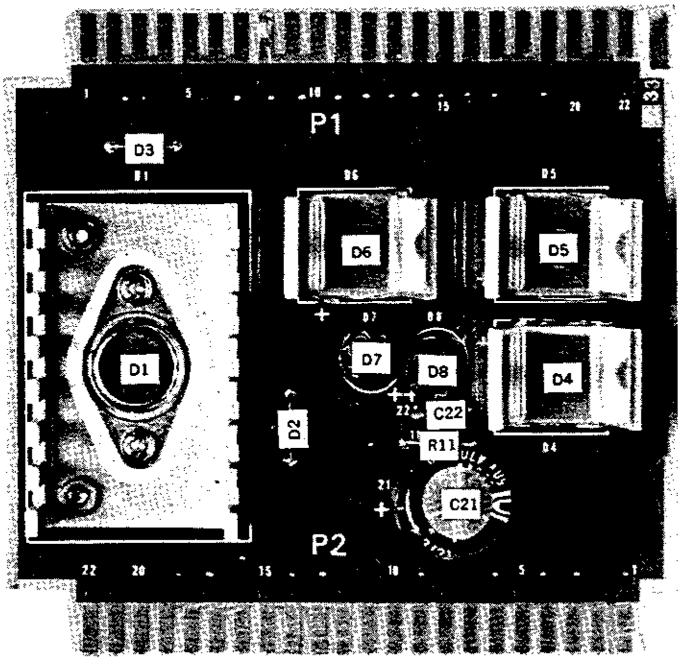


Fig. 15-4 DISPLAY POWER - 2 (BGB-010199)

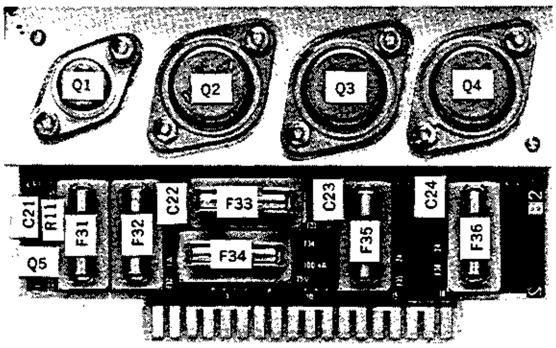


Fig. 15-5 DISPLAY POWER - 3 (BGC-010369)

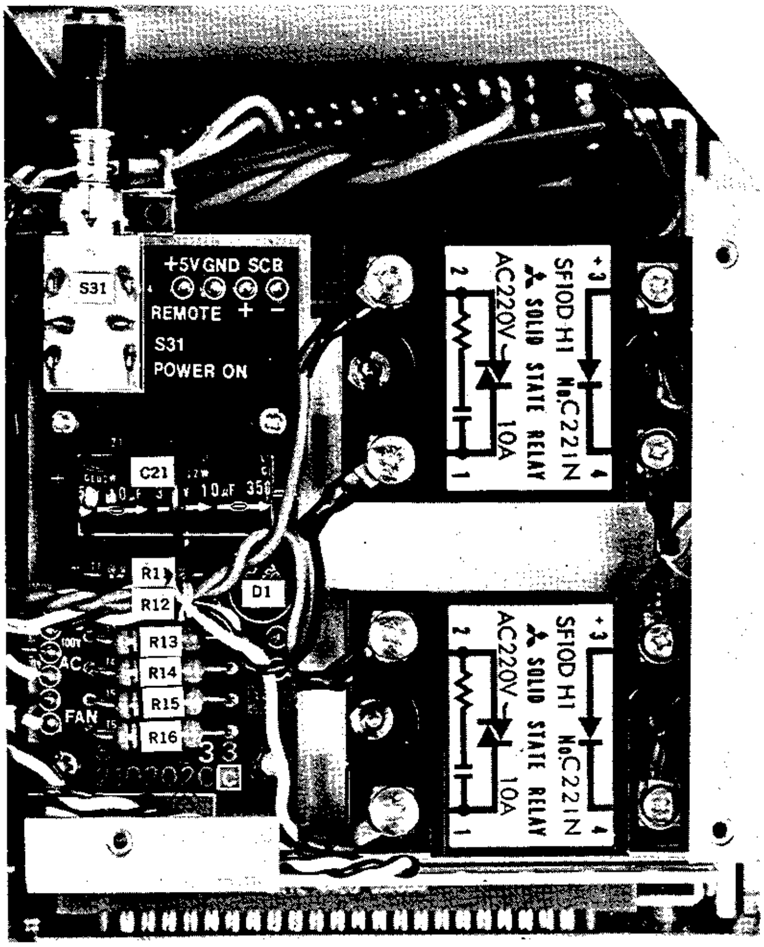


Fig. 15-6 DISPLAY POWER - 4 (BLB-010202)

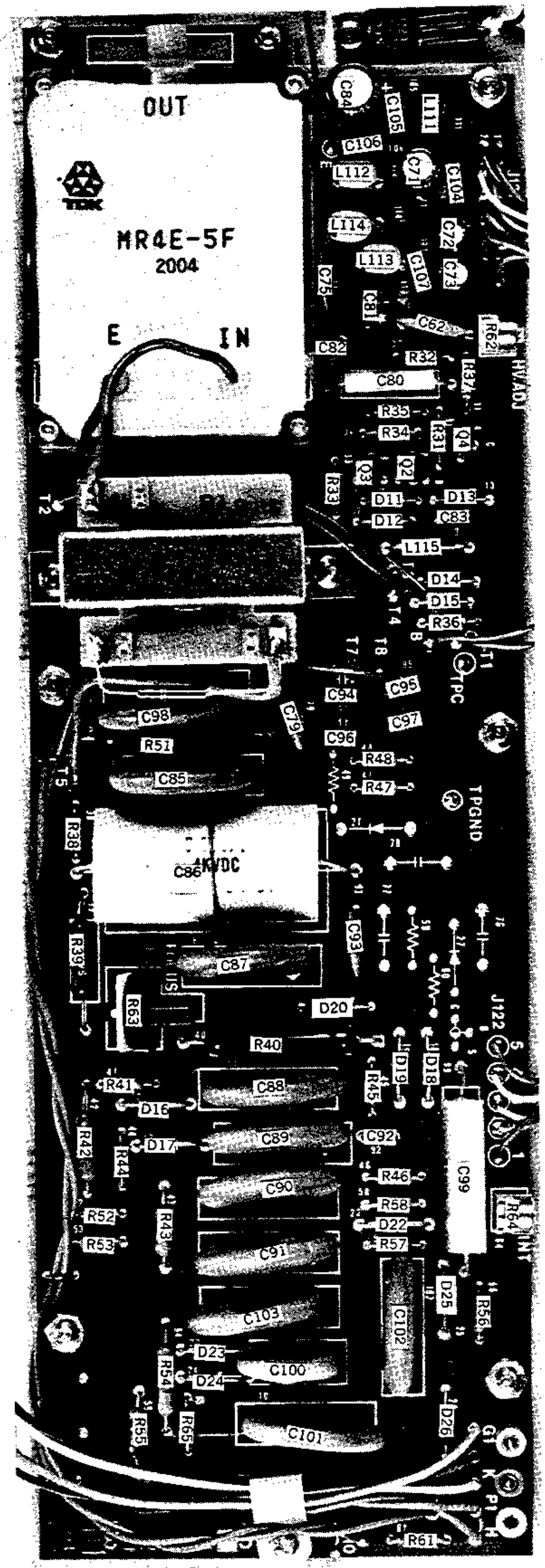


Fig. 15-7 HIGH VOLTAGE (BLC-010204)

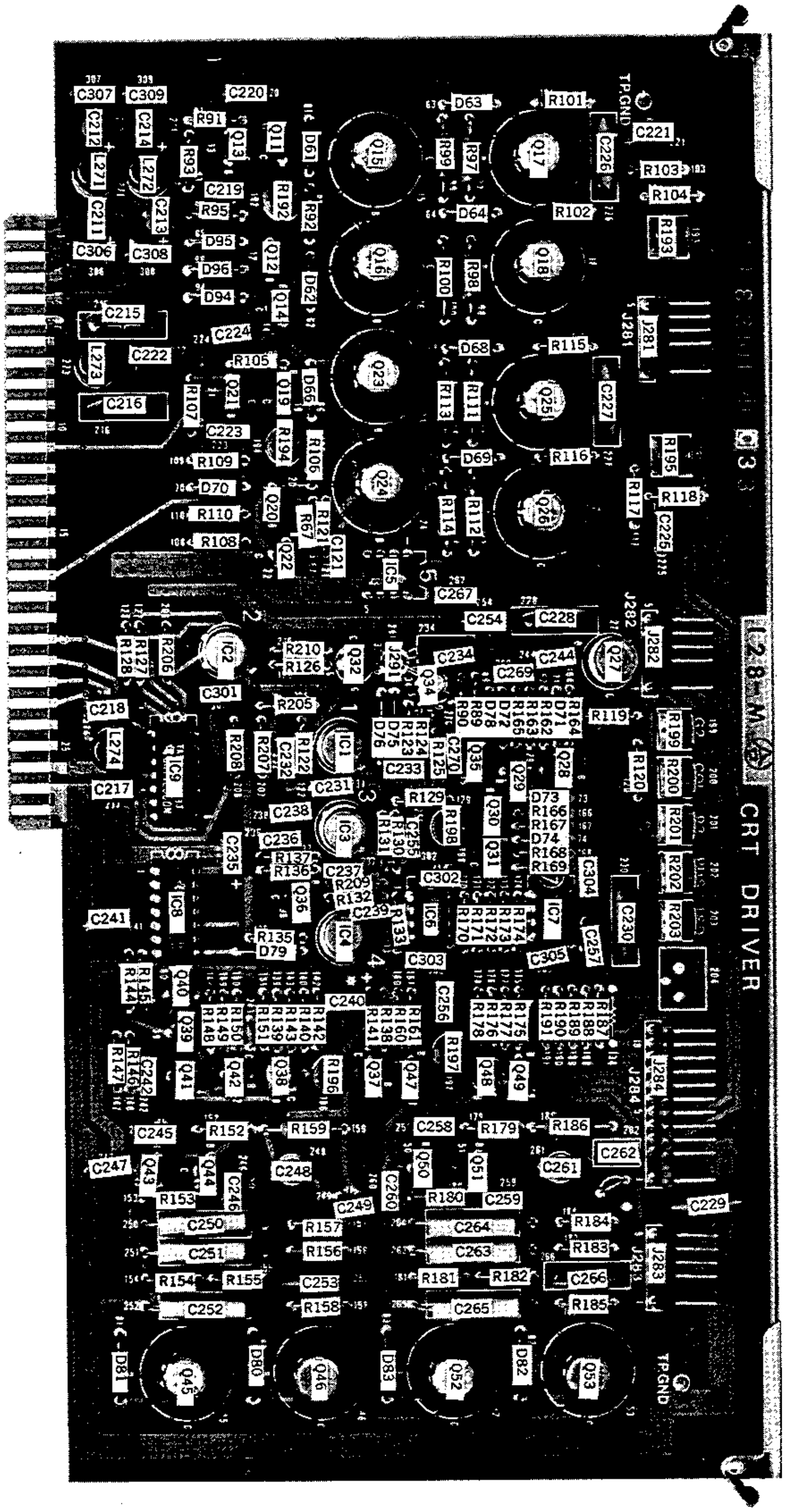


Fig. 15-8 CRT DRIVER (BGK-010184)

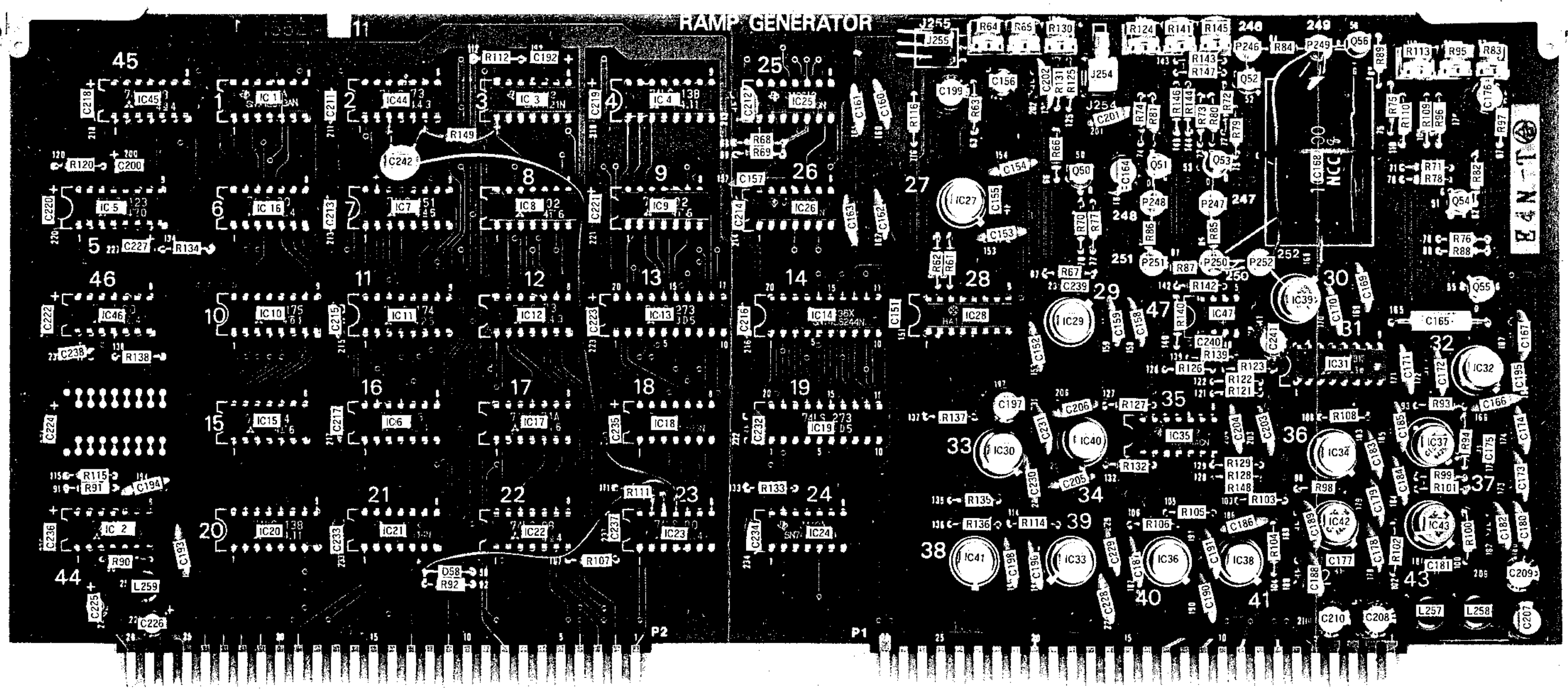


Fig. 15-9 RAMP GENERATOR (BGP-011552)

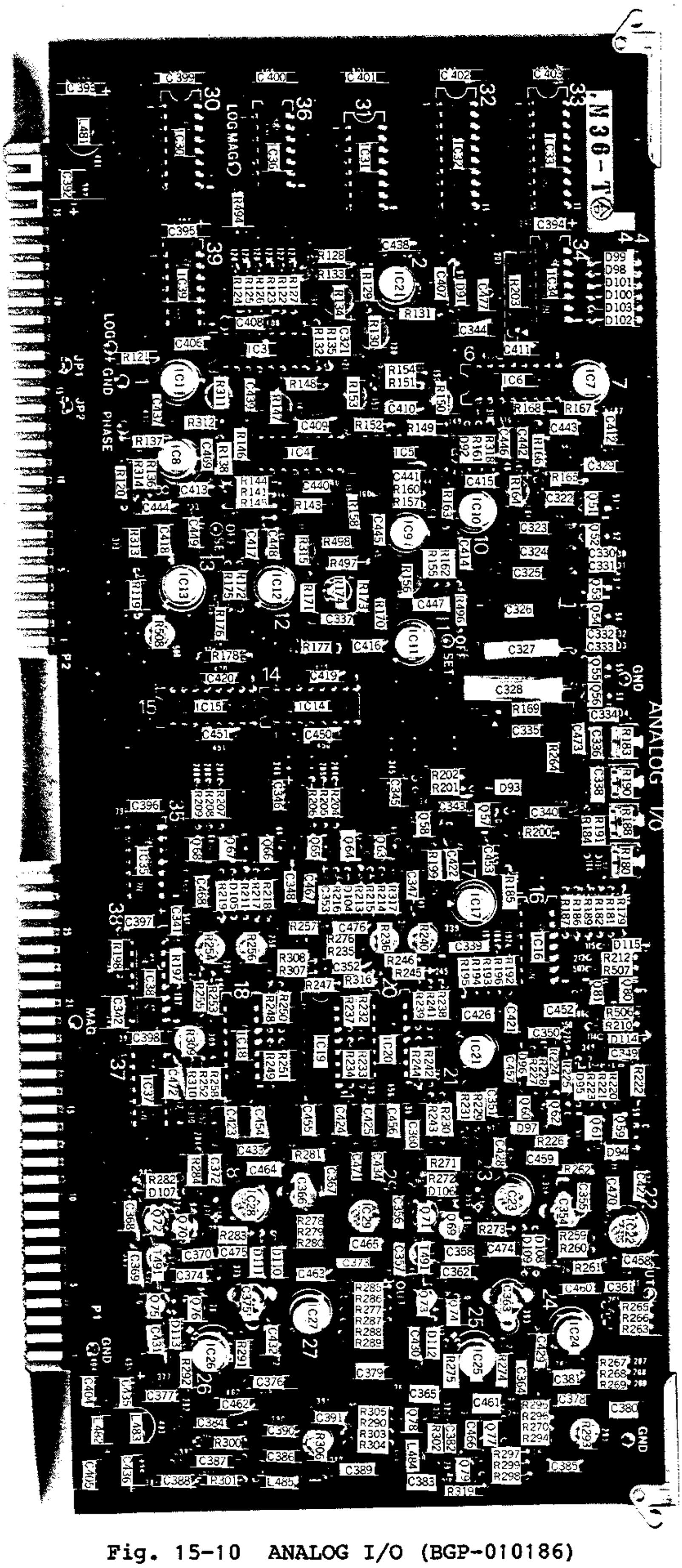


Fig. 15-10 ANALOG I/O (BGP-010186)

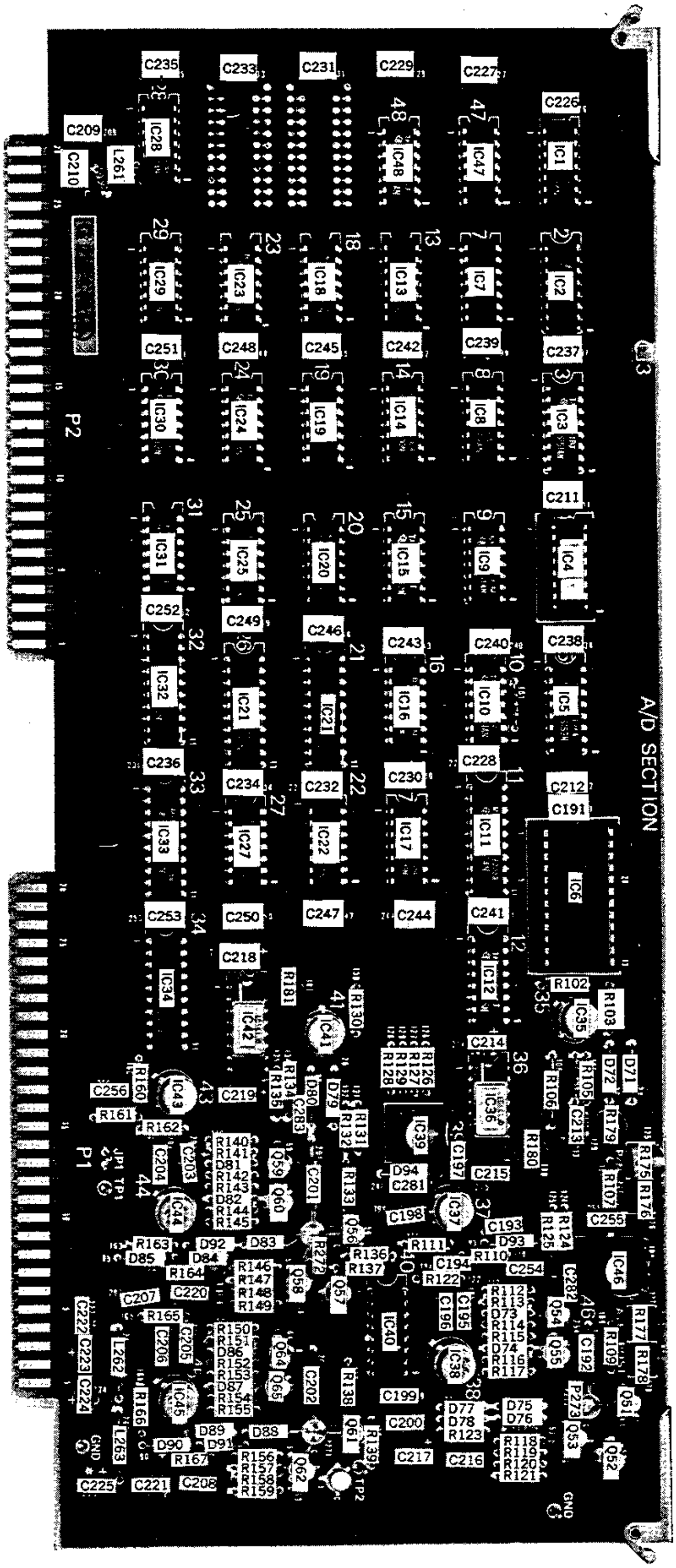


Fig. 15-11 A/D (BGP-010187)

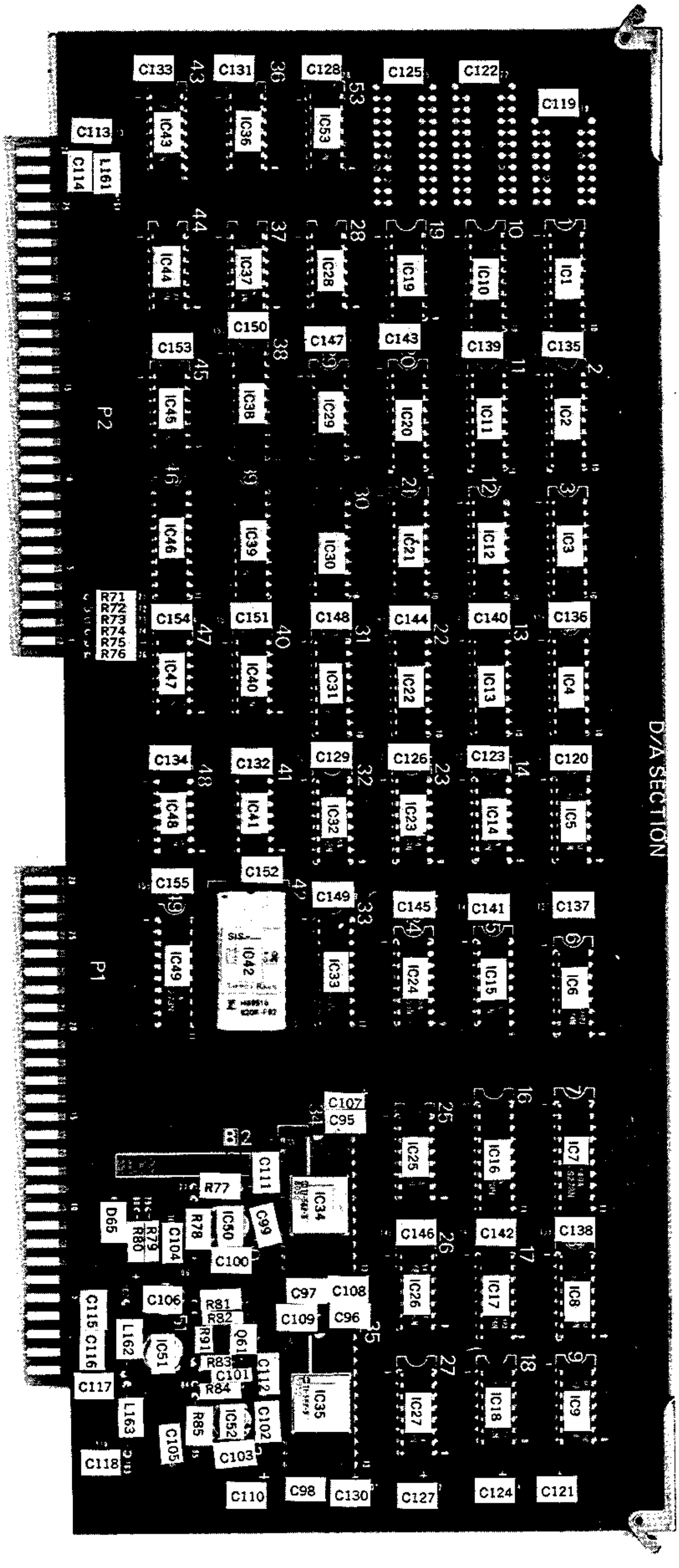


Fig. 15-12 D/A (BGP-010188)

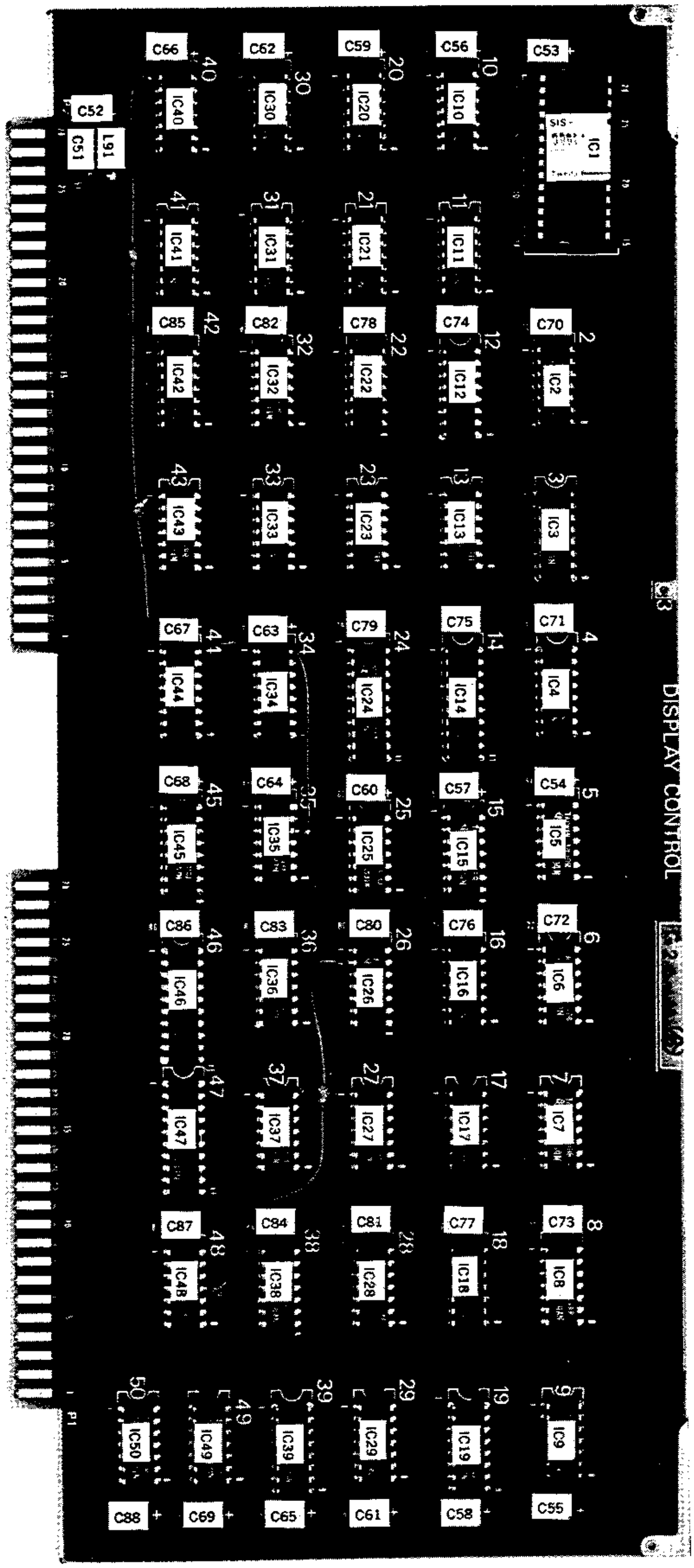


Fig. 15-13 DISPLAY CONTROL (BGP-010189)

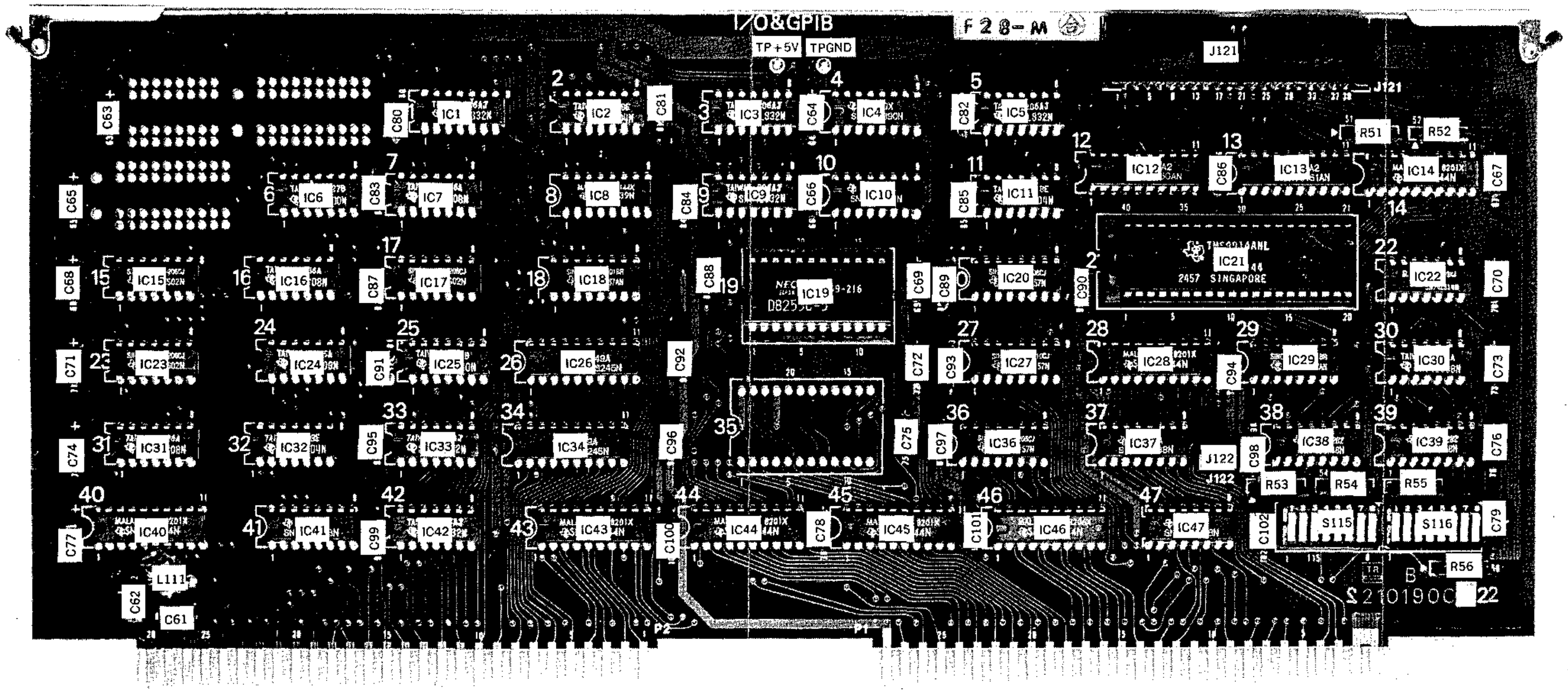


Fig. 15-14 I/O & GP-IB (BGP-010190)

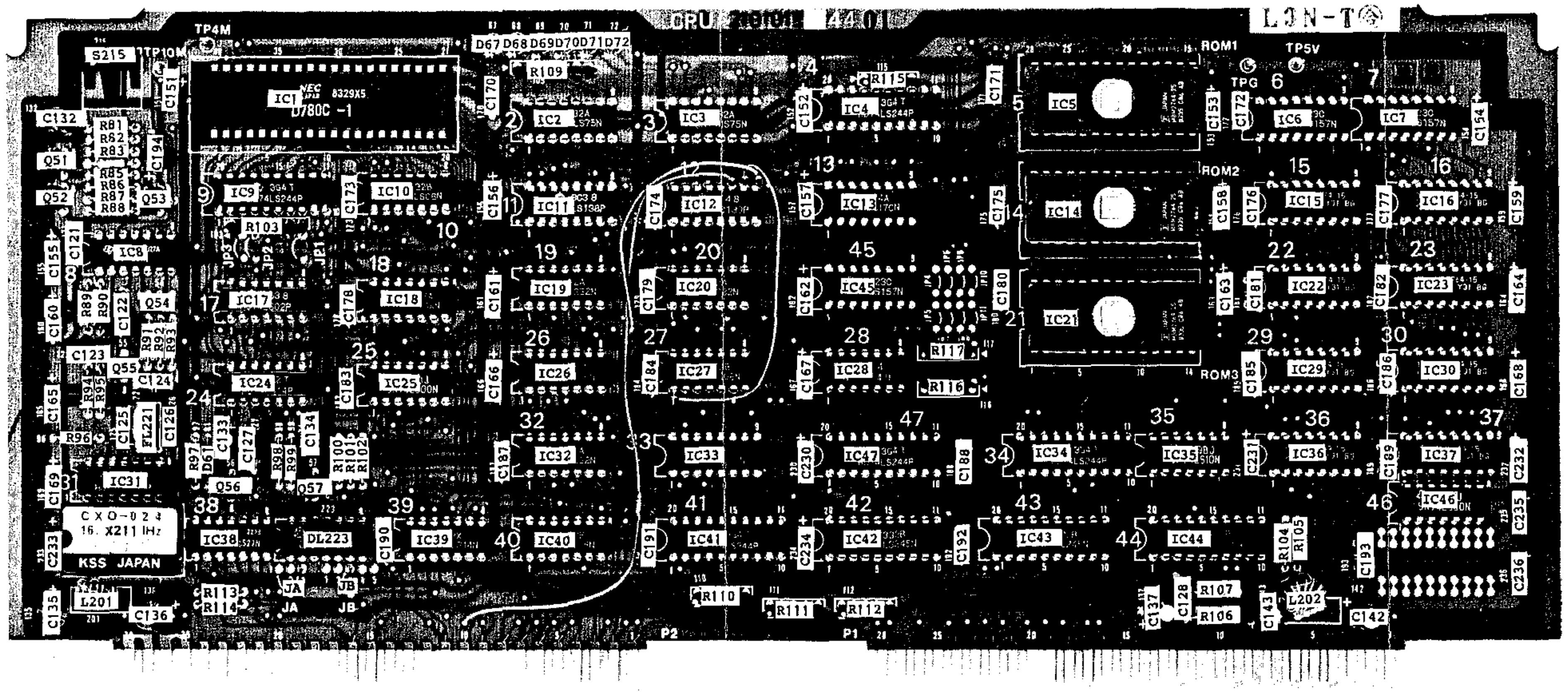


Fig. 15-15 CPU (BGP-010191)

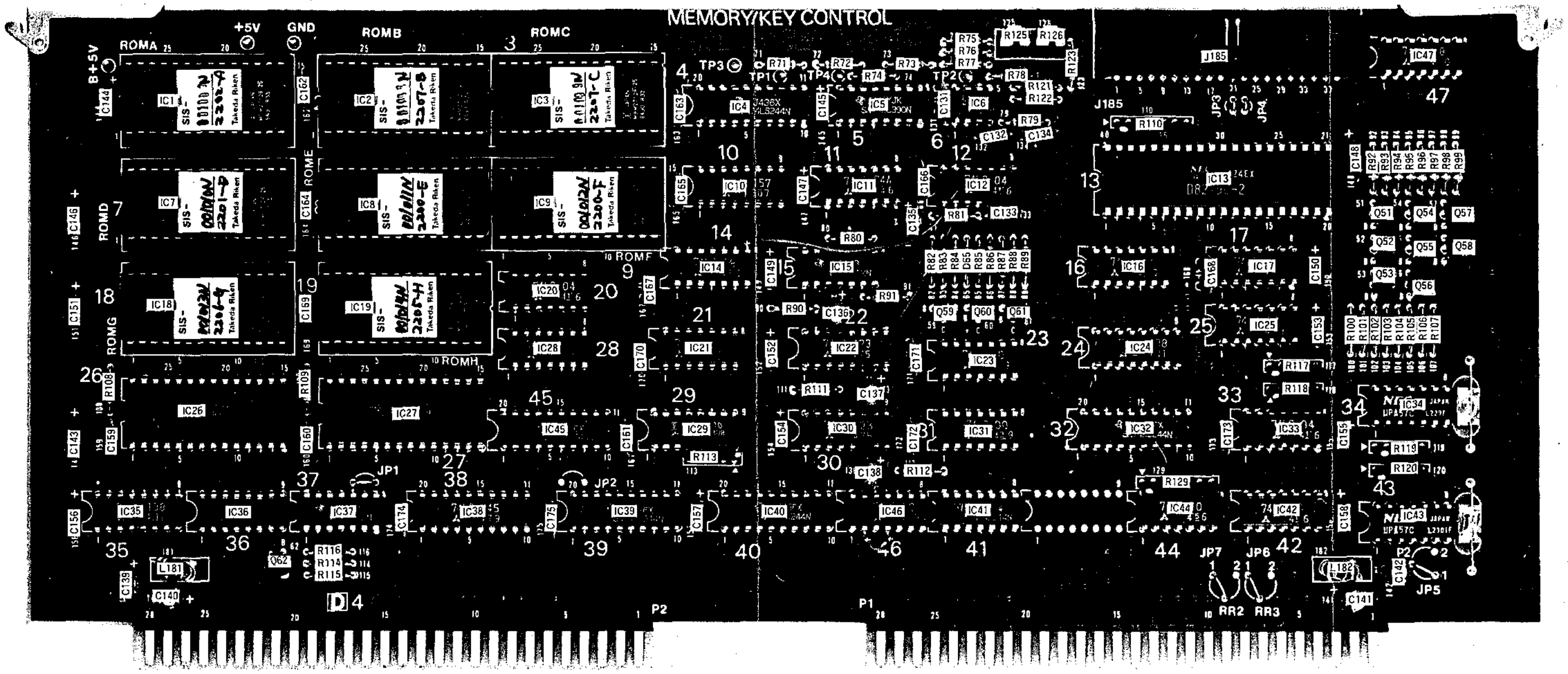


Fig. 15-16 MEMORY & KEY CONTROL (BGP-010192)

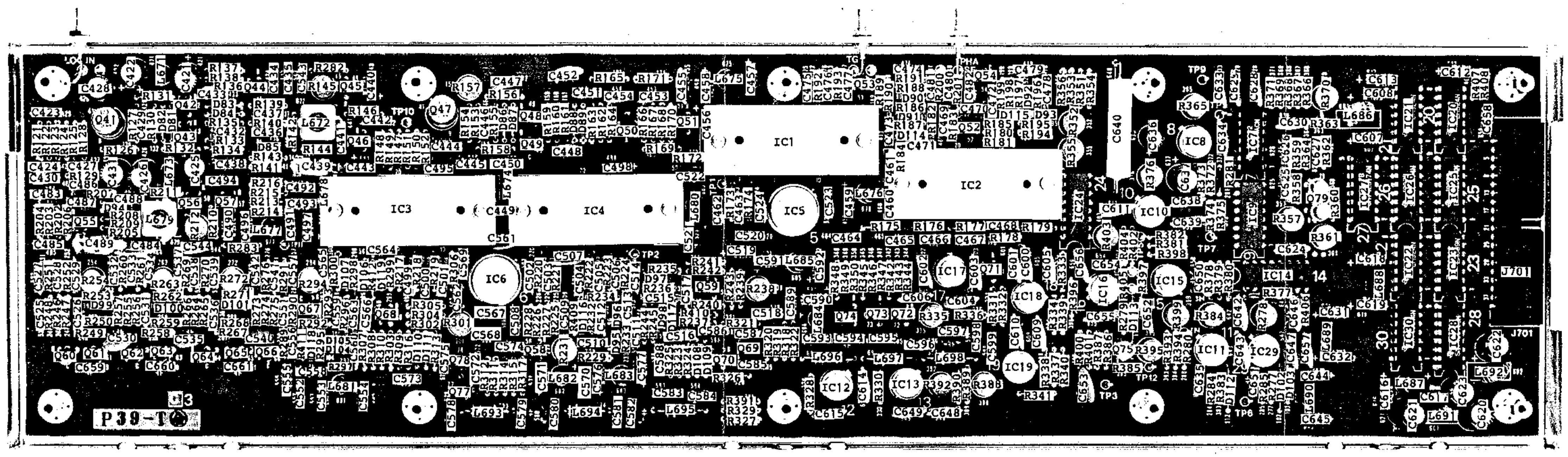


Fig. 15-17 LOG. AMP. (BLP-010231)

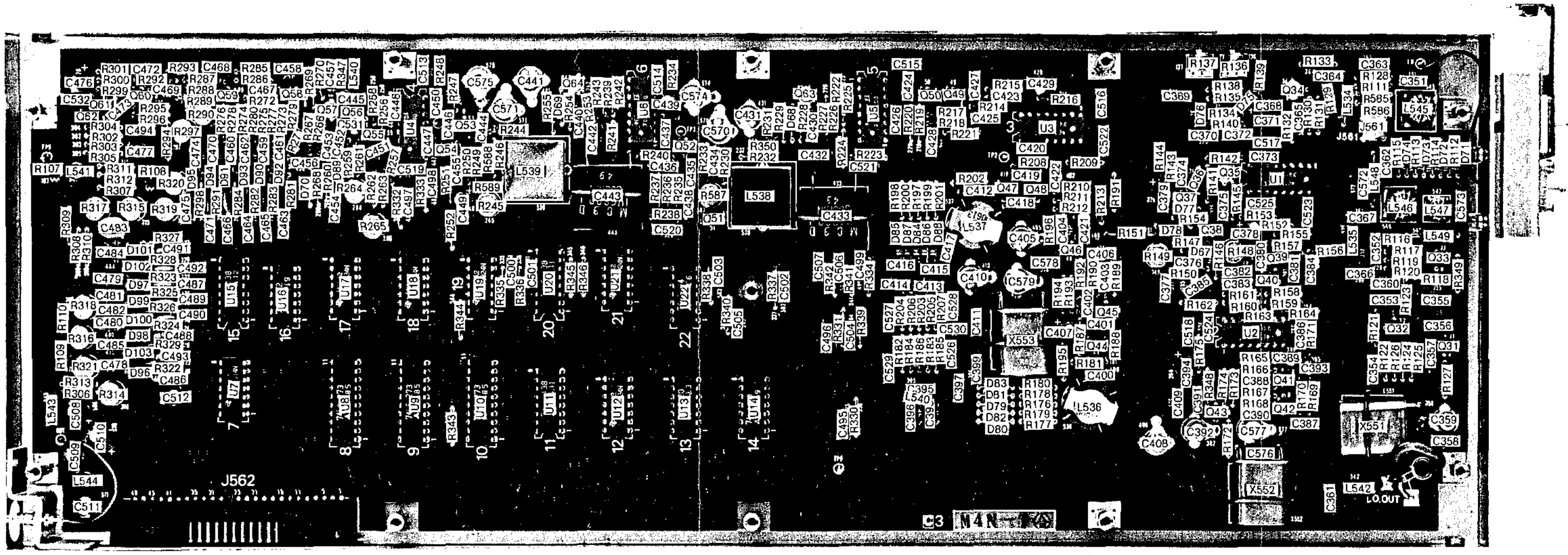


Fig. 15-18 IF - I (BLP-011231)

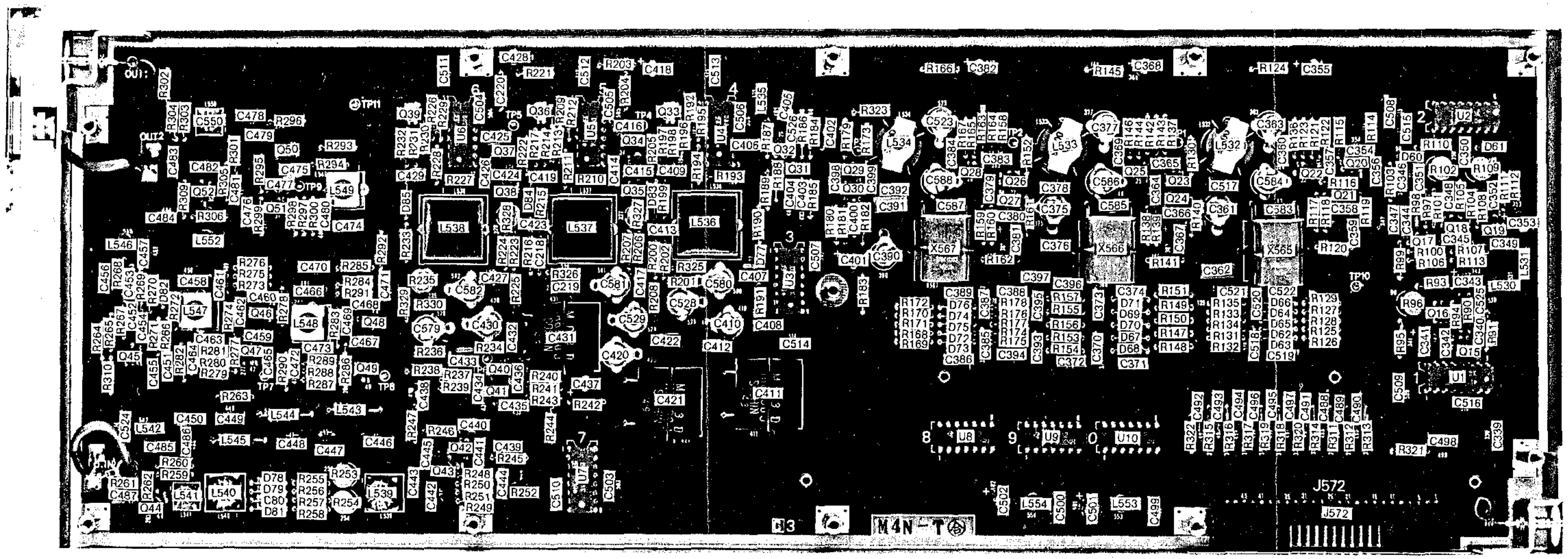


Fig. 15-19 IF - II (BLF-011232)

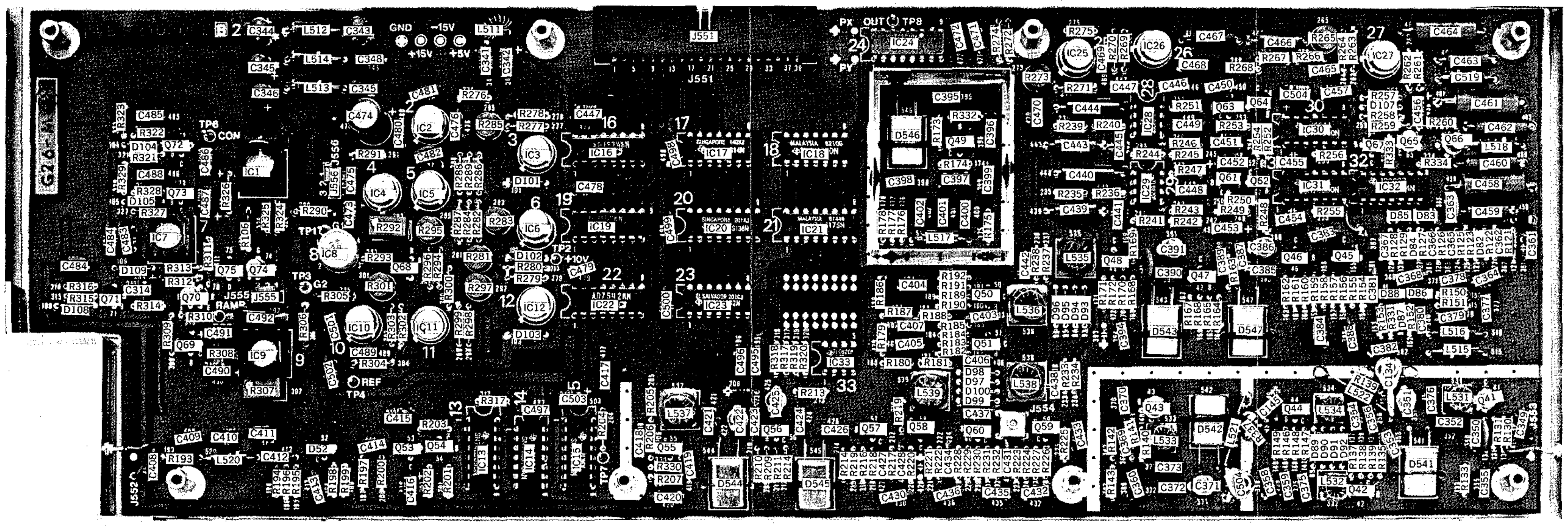


Fig. 15-20 PHASE (BLP-010205)

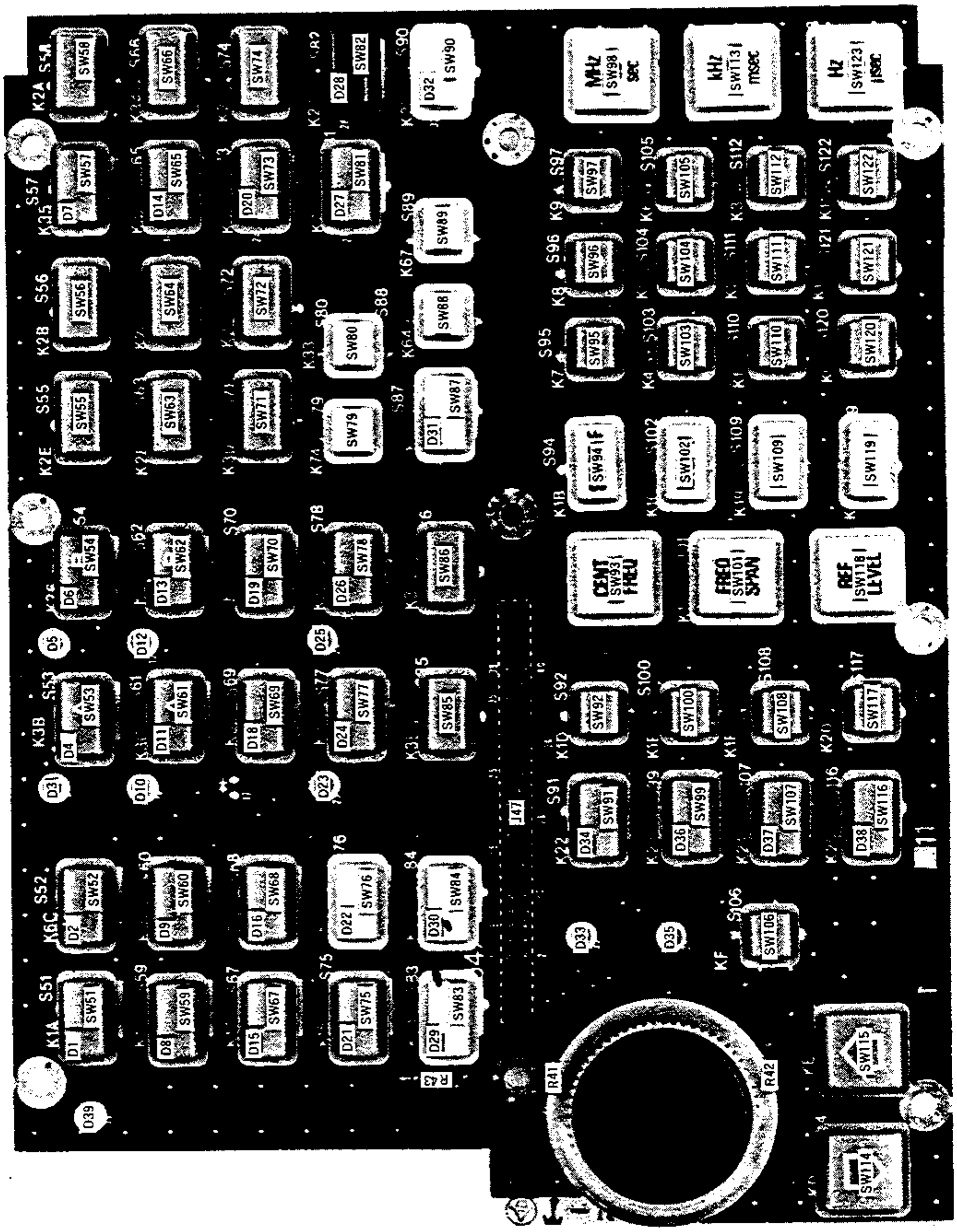


Fig. 15-21 DISPLAY KEY (BLG-011268)

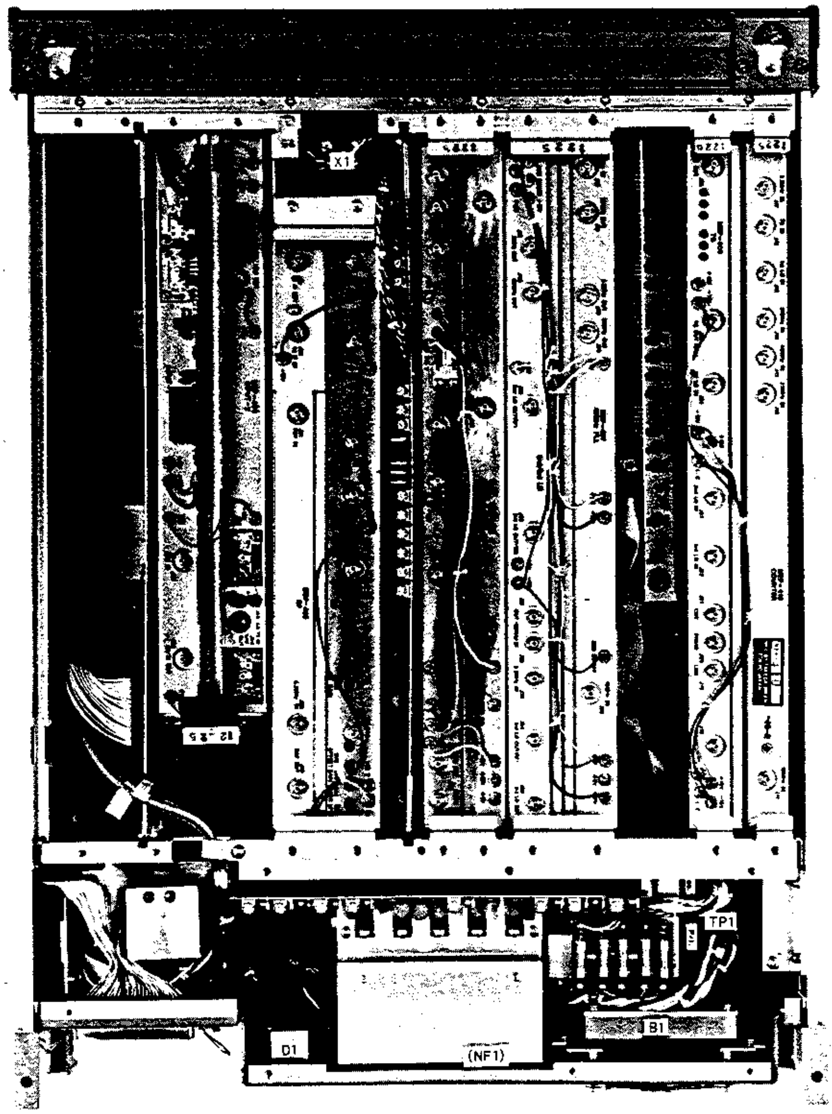


Fig. 15-22 RF schematic section

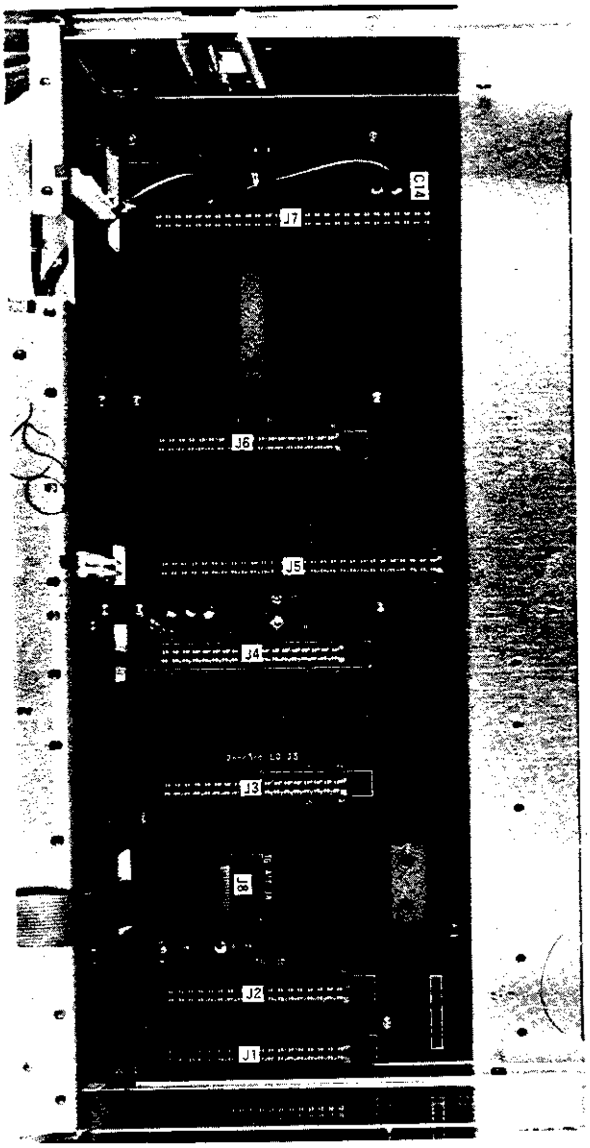


Fig. 15-23 RF MOTHER (BLP-011230)

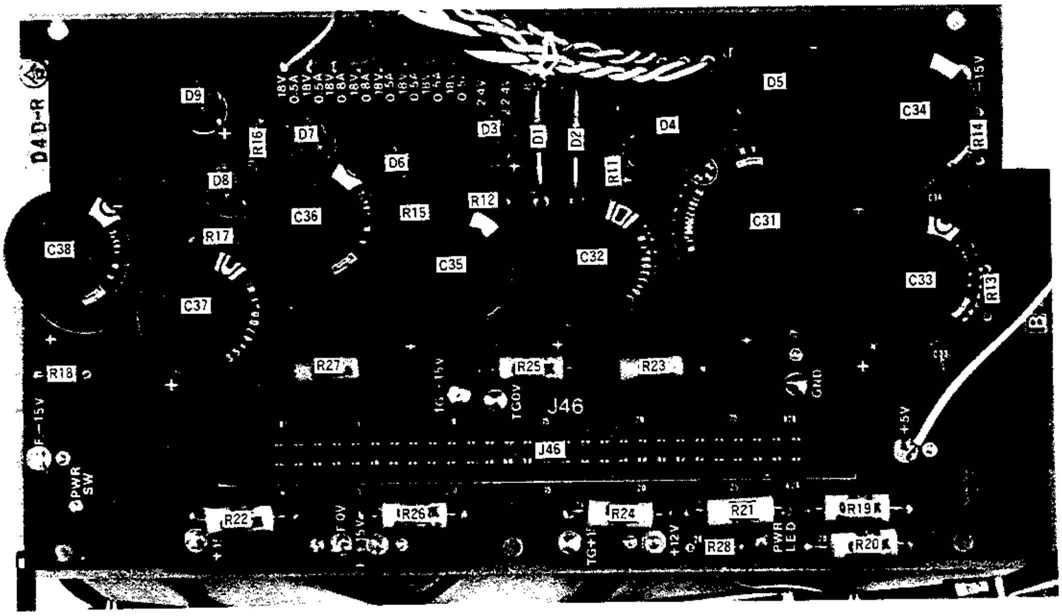


Fig. 15-24 POWER RECTIFIER (BLG-011392)

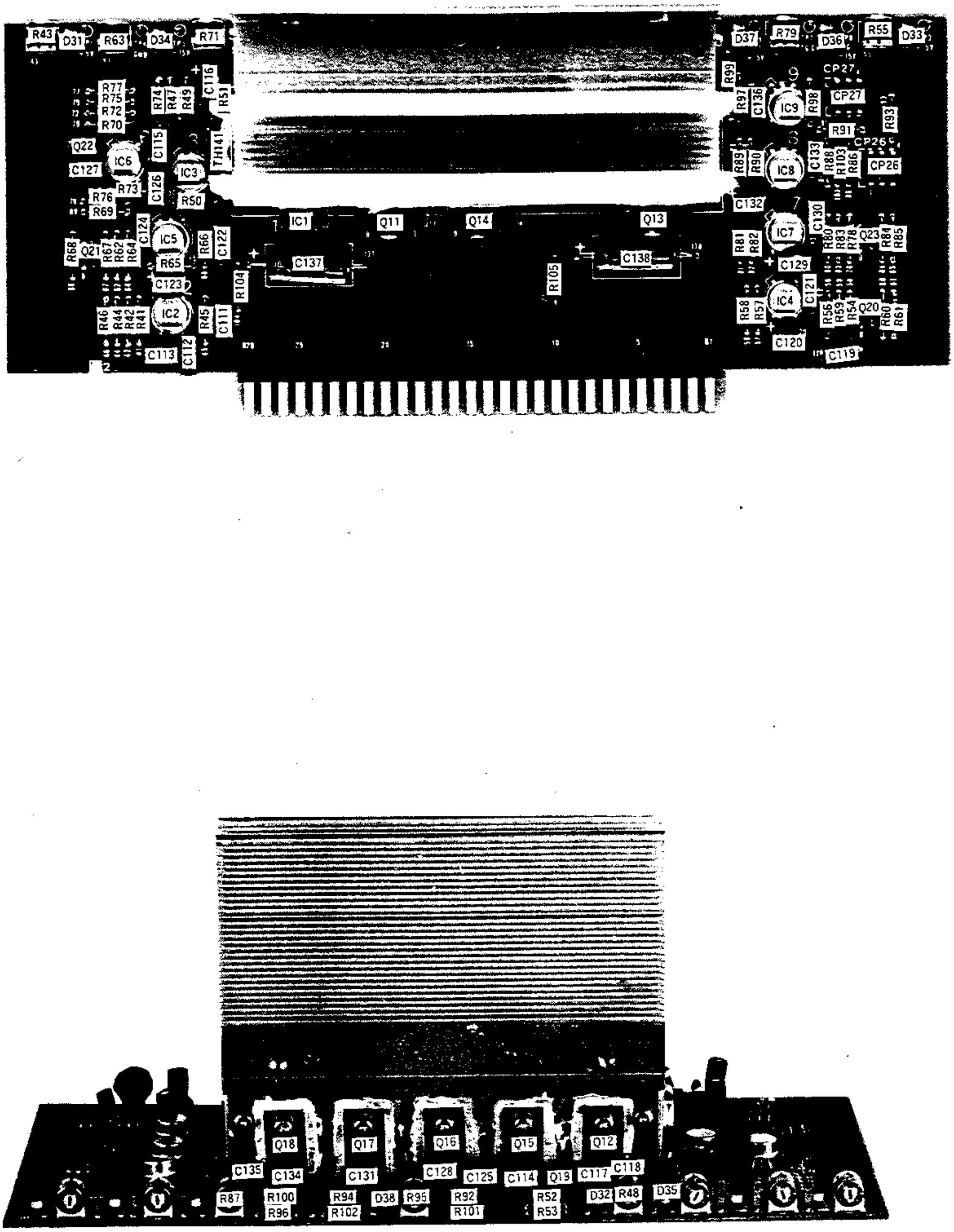


Fig. 15-25 POWER CONTROL (BGF-011218)

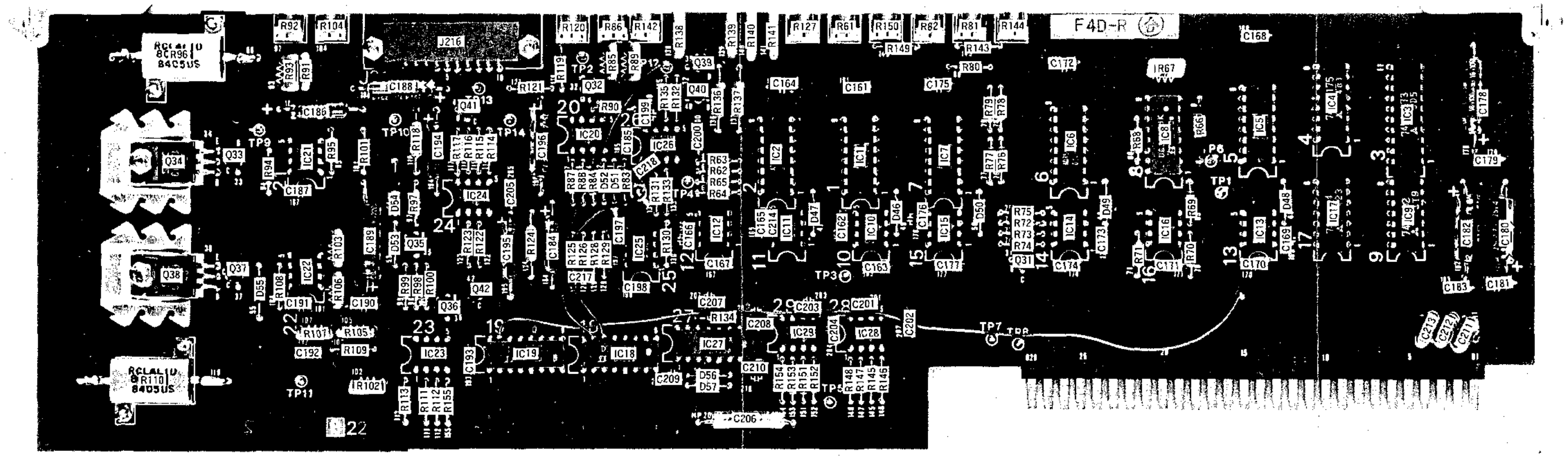


Fig. 15-26 LOCAL DRIVER (BGN-011225)

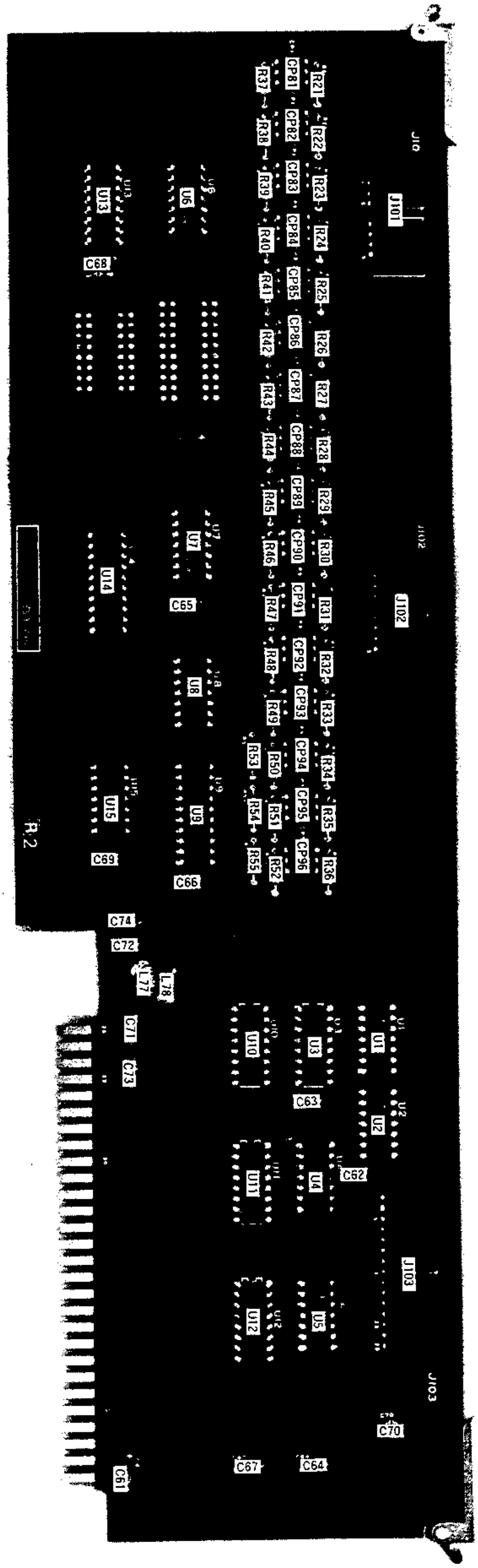


Fig. 15-27 ADDRESS DECODER (BGN-011226)

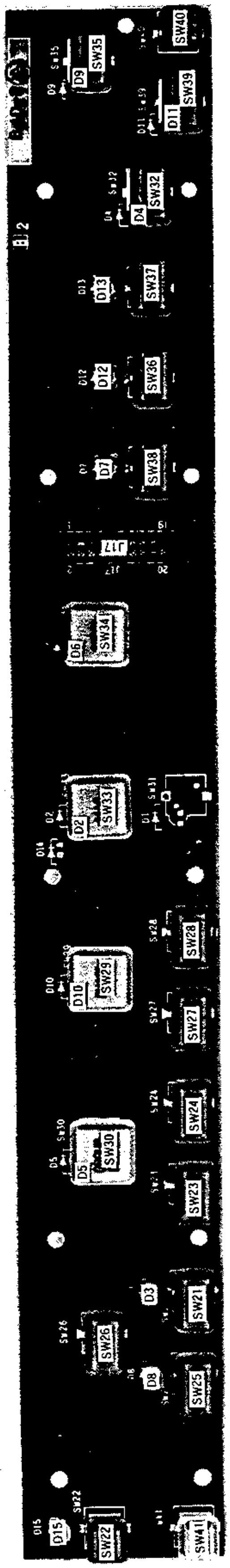


Fig. 15-28 RF KEY (BGN-011229)

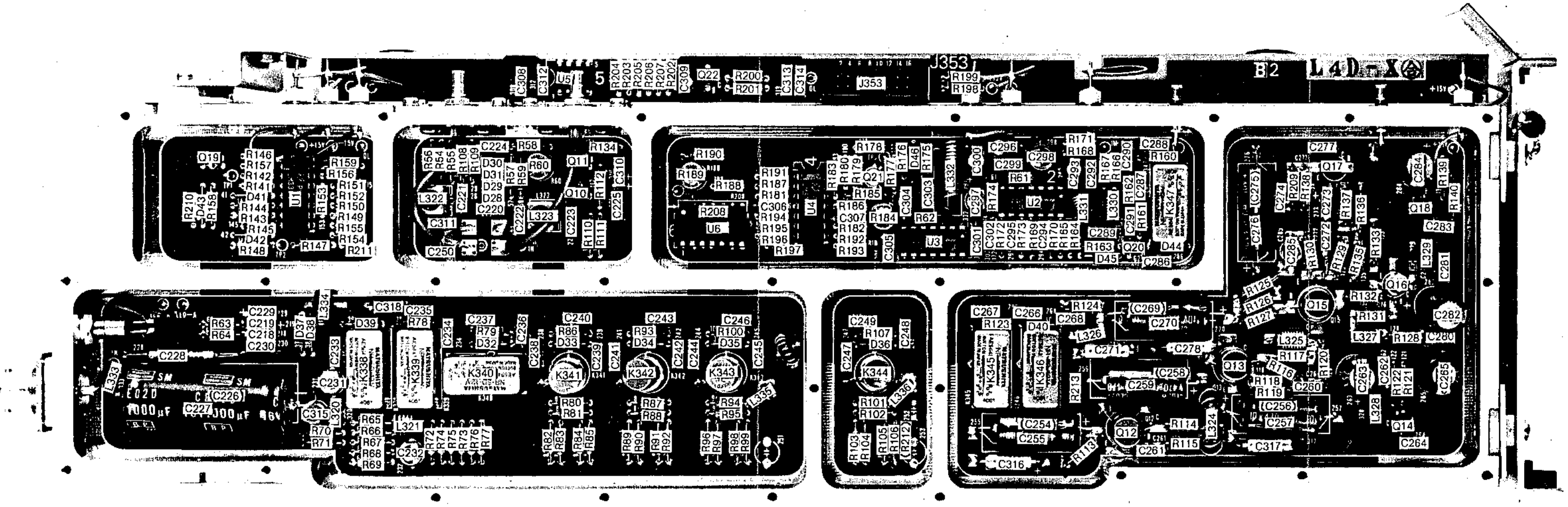


Fig. 15-29 INPUT - I (BLP-011227)

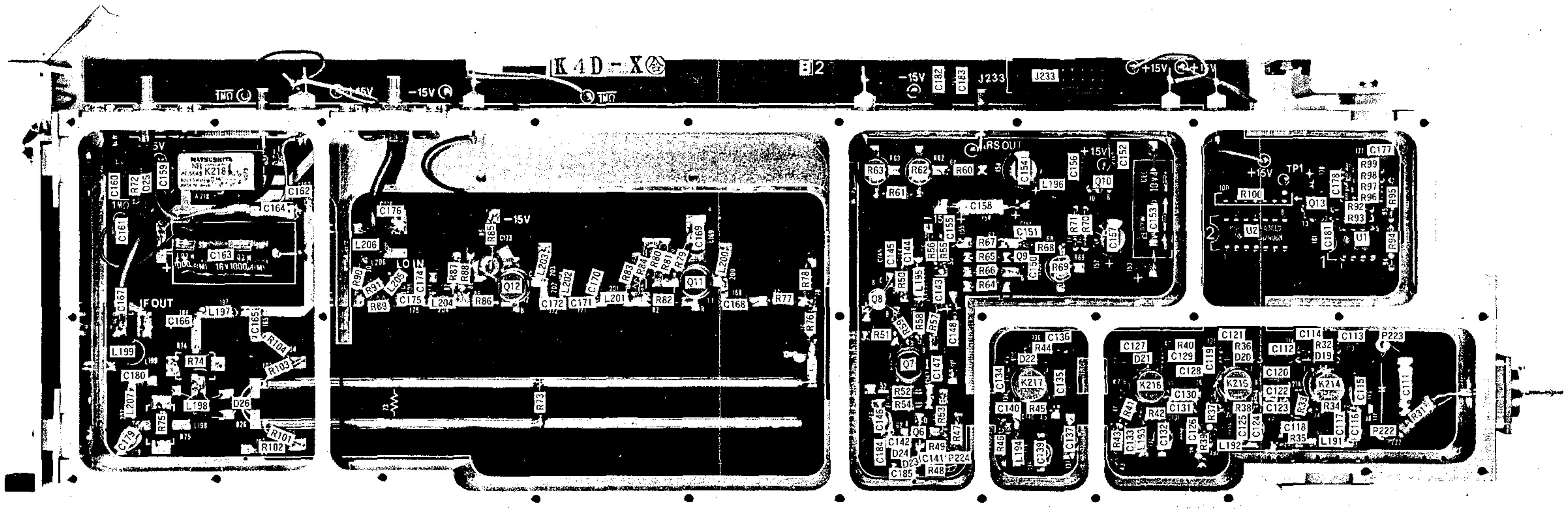


Fig. 15-30 INPUT - II (BLP-011228)

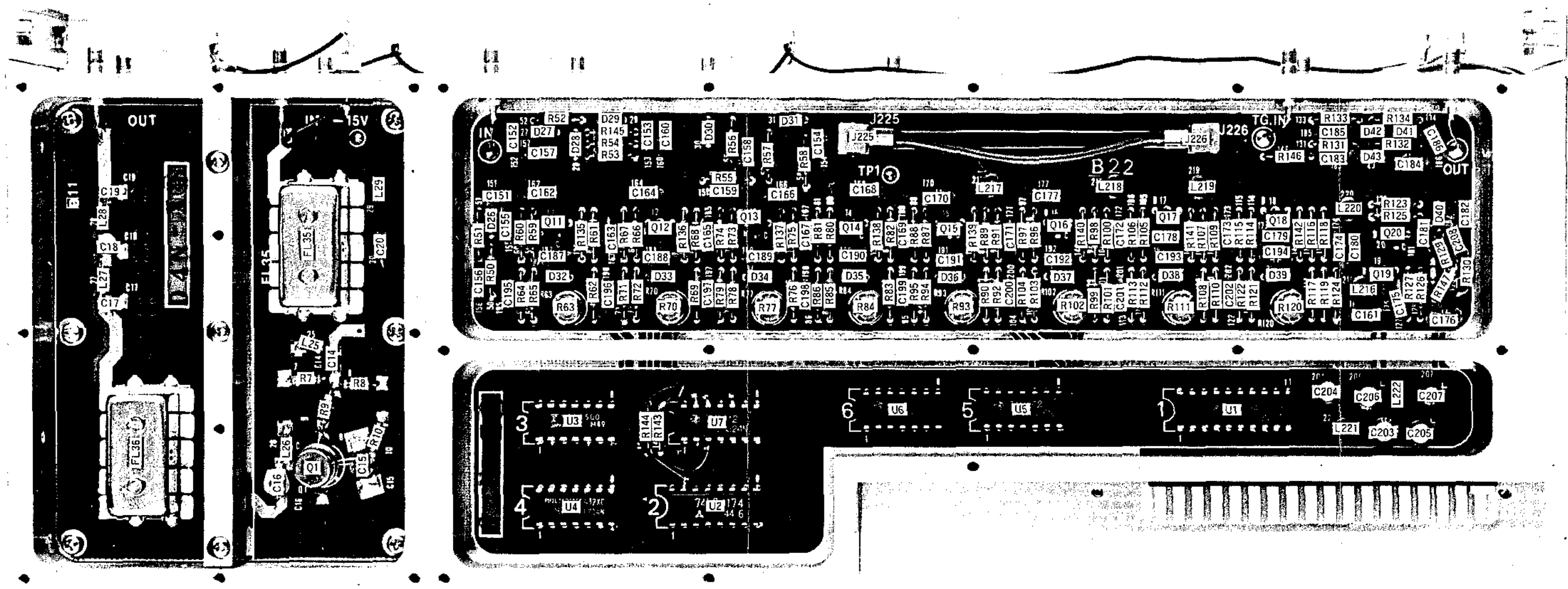


Fig. 15-31 1ST IF (BLB-011245)
REF-ATTENUATOR (BLJ-011248)

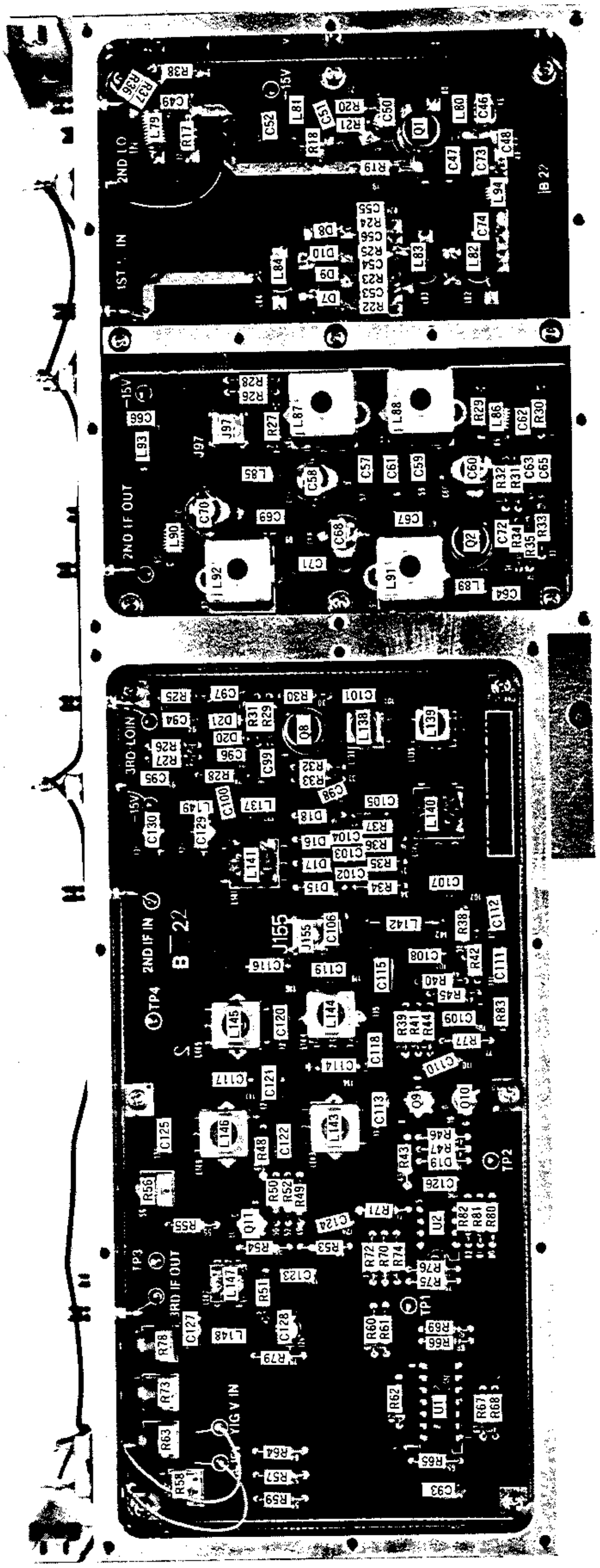


Fig. 15-32 2ND IF (BLB-011246)
3RD IF (BLF-011247)

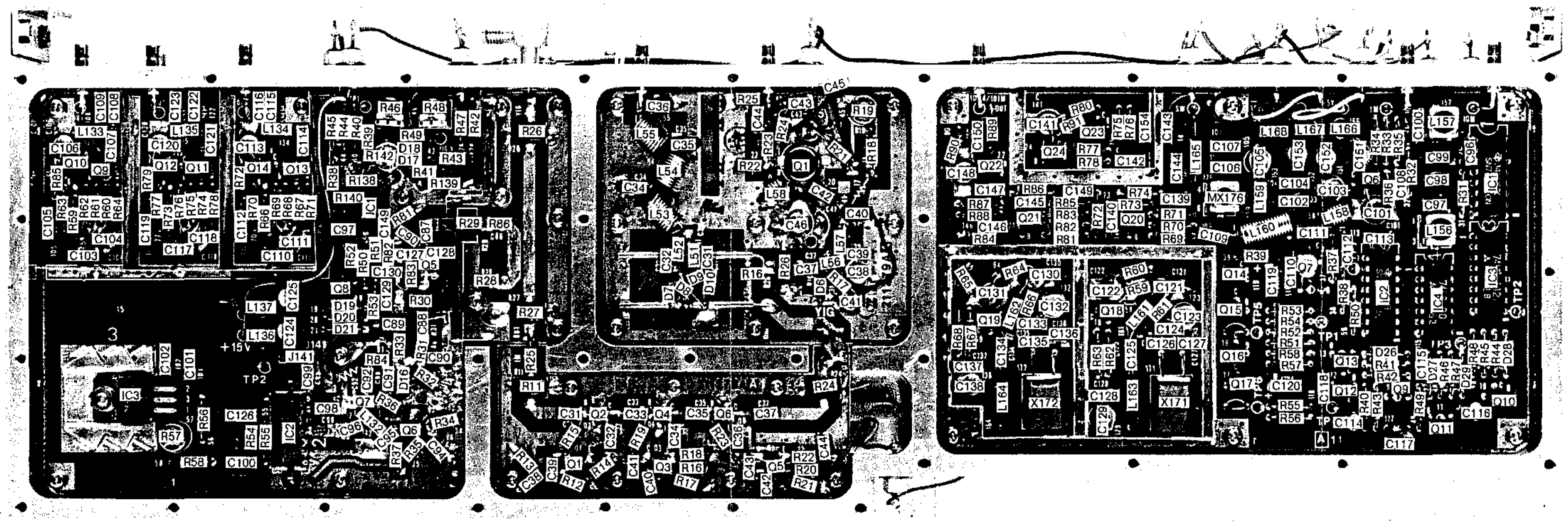


Fig. 15-33 ISO AMP (BLB-011278)
YIG IF (BLB-011279)
YIG FREQ DIVIDER (BLC-011281)
100M/101M OSC (BLC-011282)

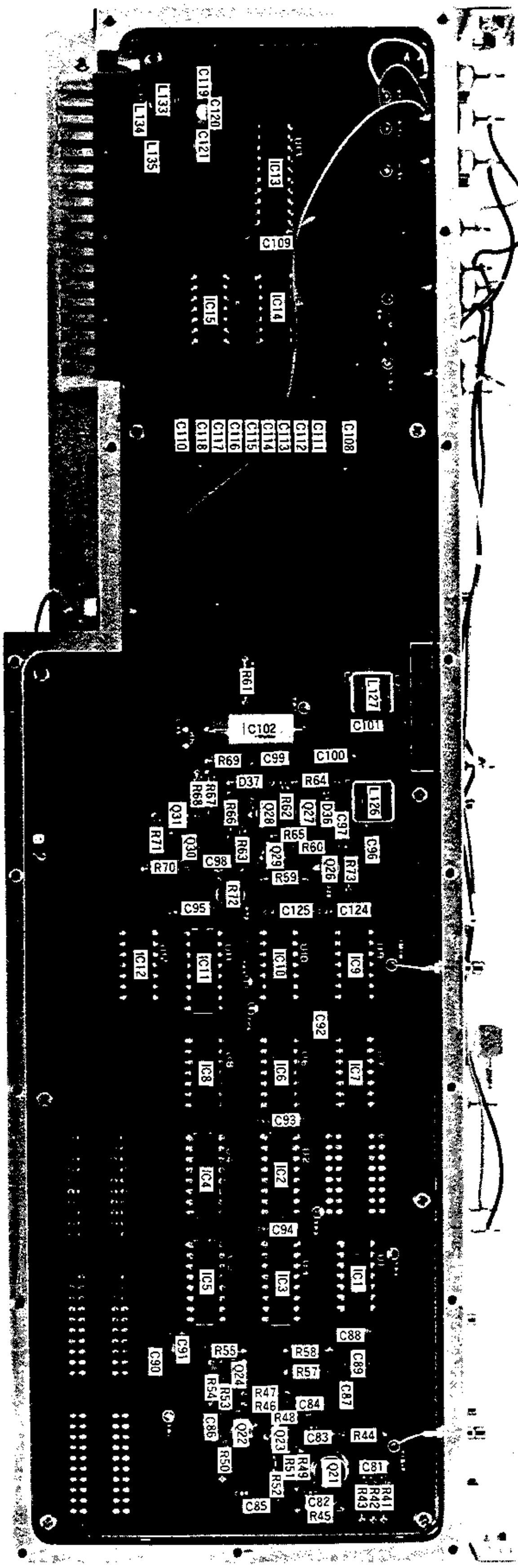


Fig. 15-34 1ST LOCAL PLL (BGN-011735)

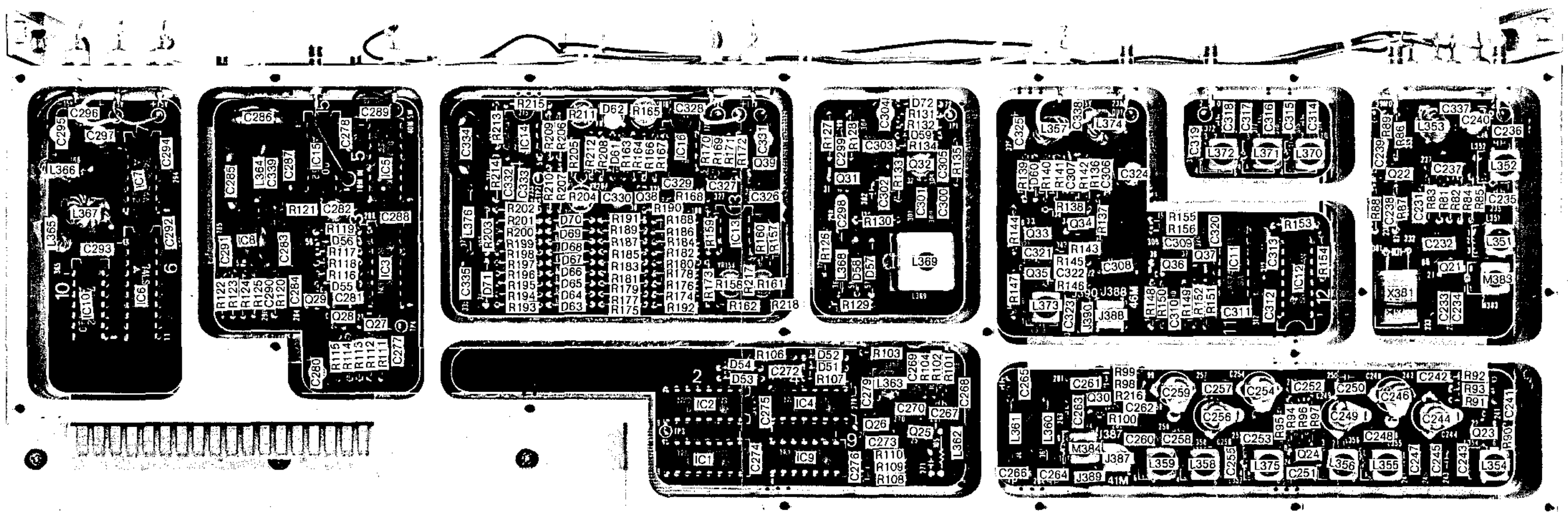


Fig. 15-35 46M PLL (BGN-011223)

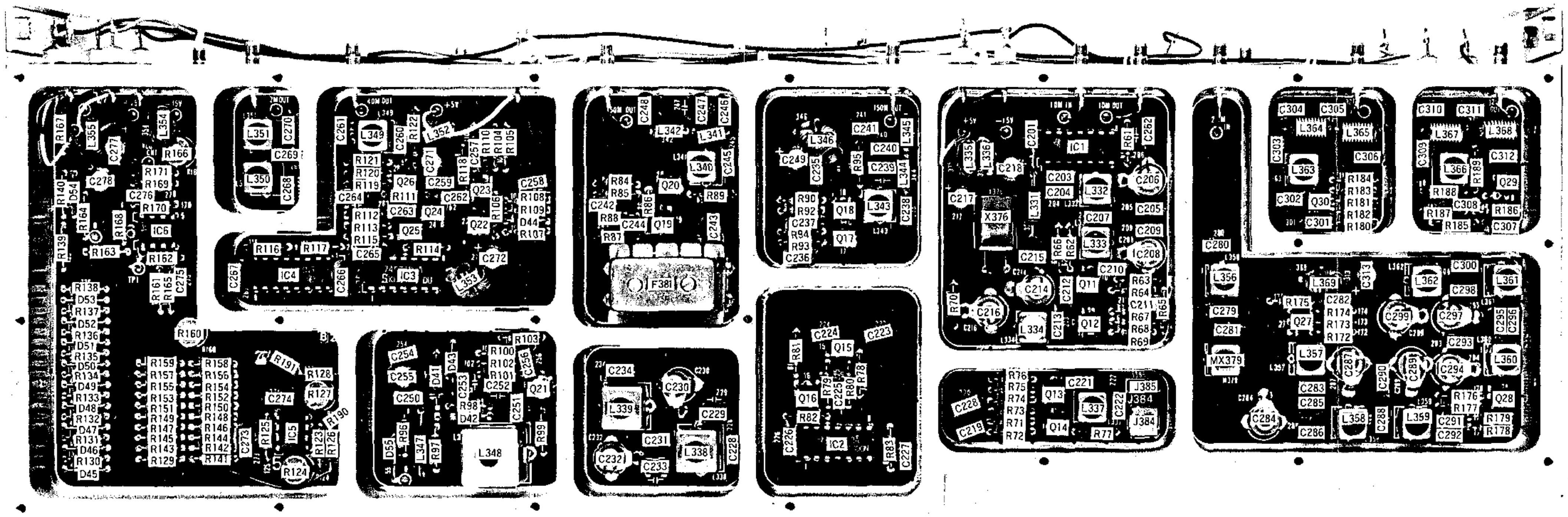


Fig. 15-36 2ND/3RD LOCAL (BLN-011224)

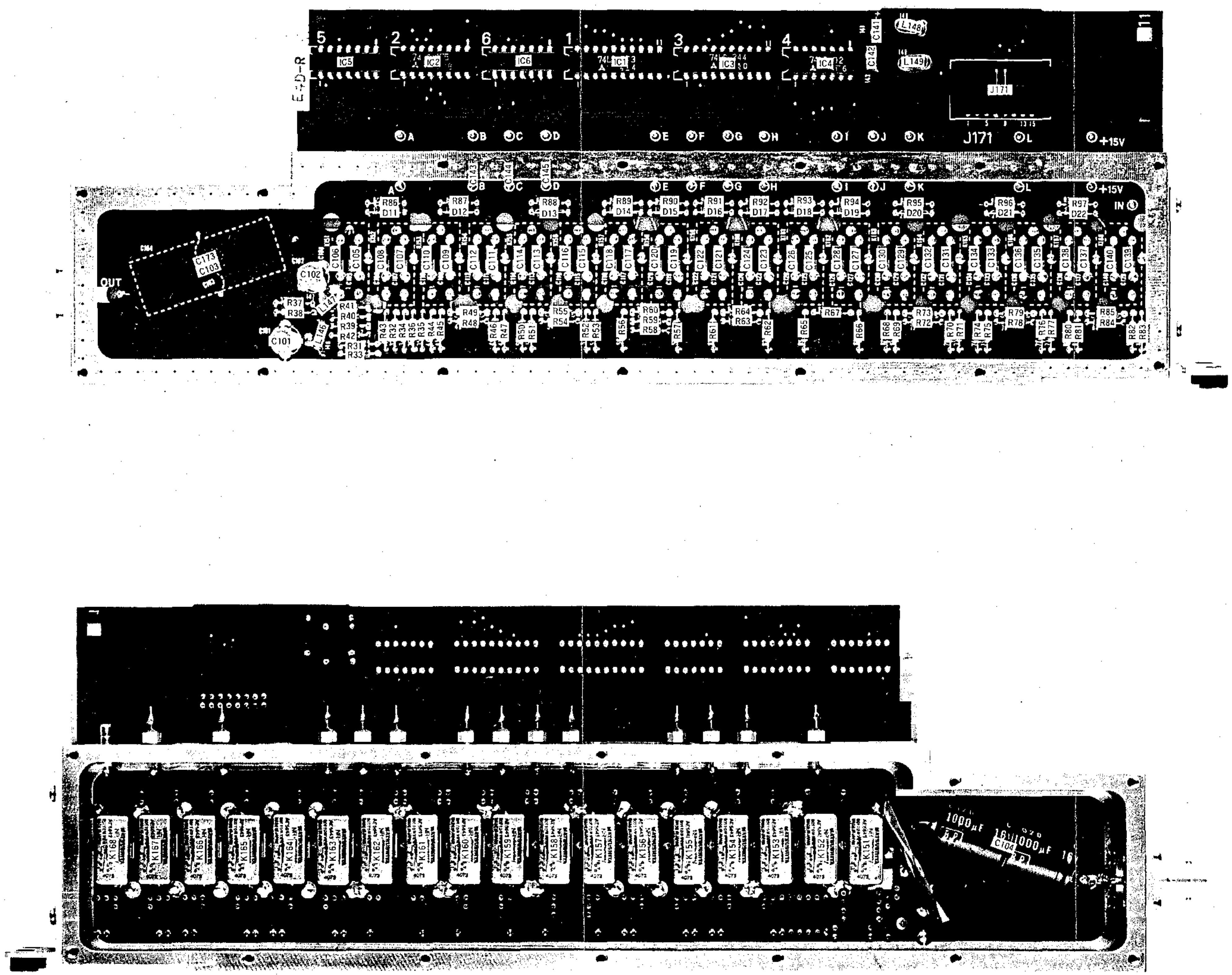


Fig. 15-37 TG ATTENUATOR (BLJ-011222)

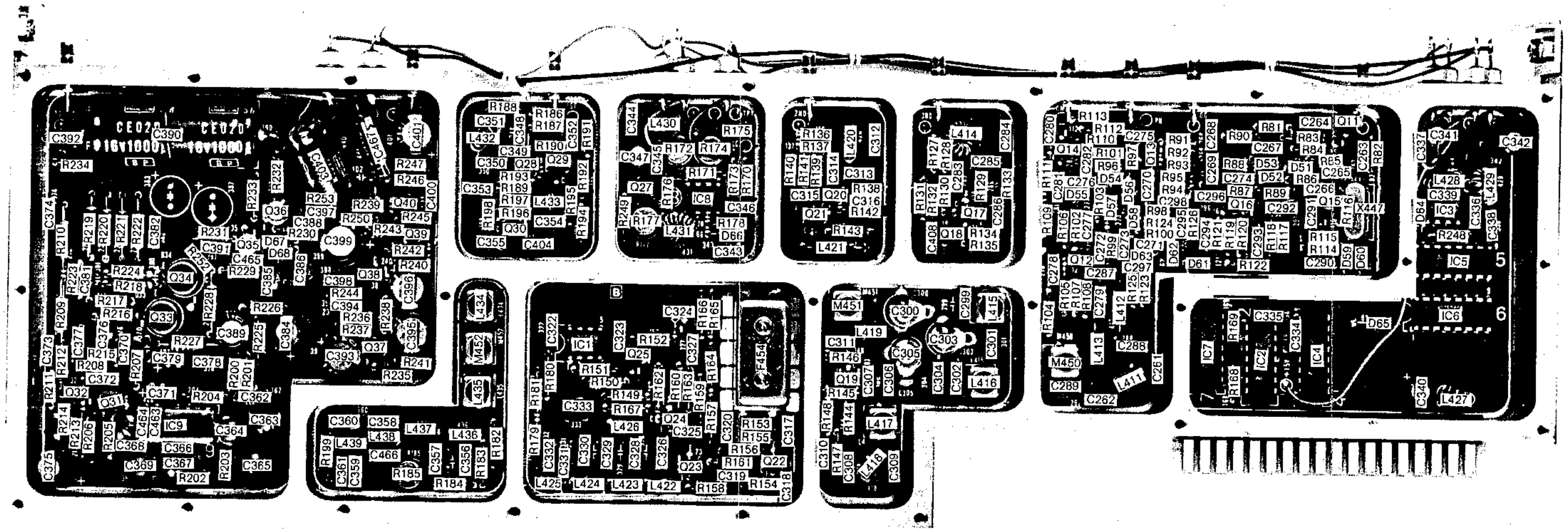


Fig. 15-38 TG (BGN-011220)

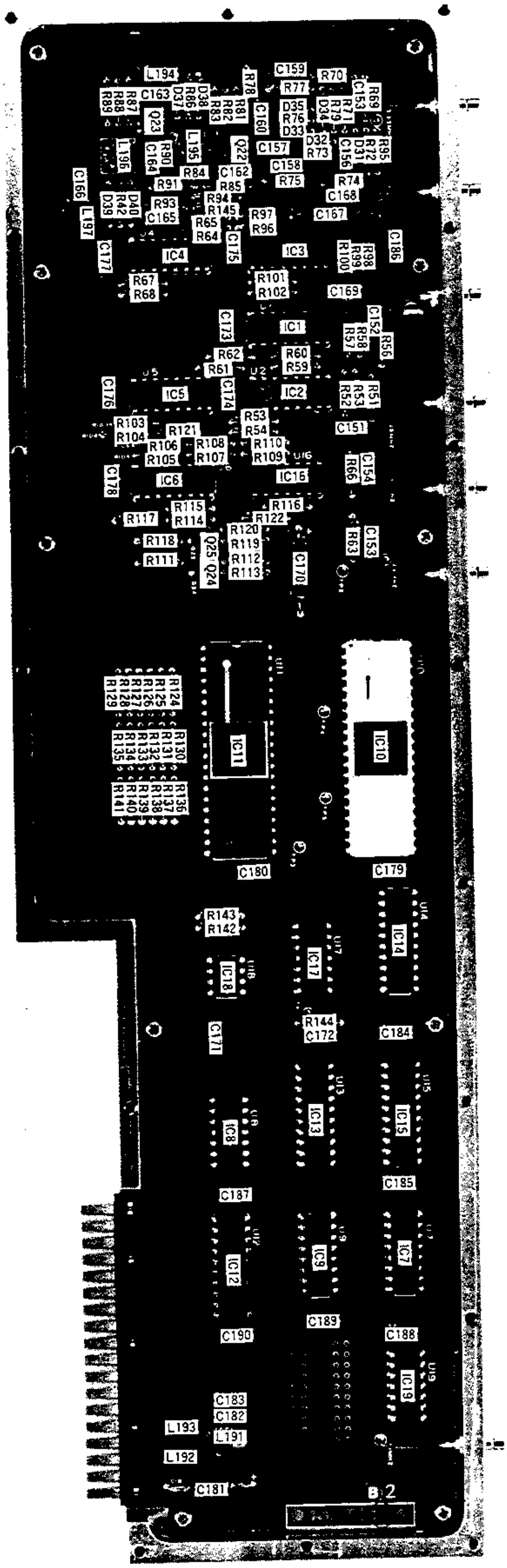


Fig. 15-39 COUNTER (BGN-011221)

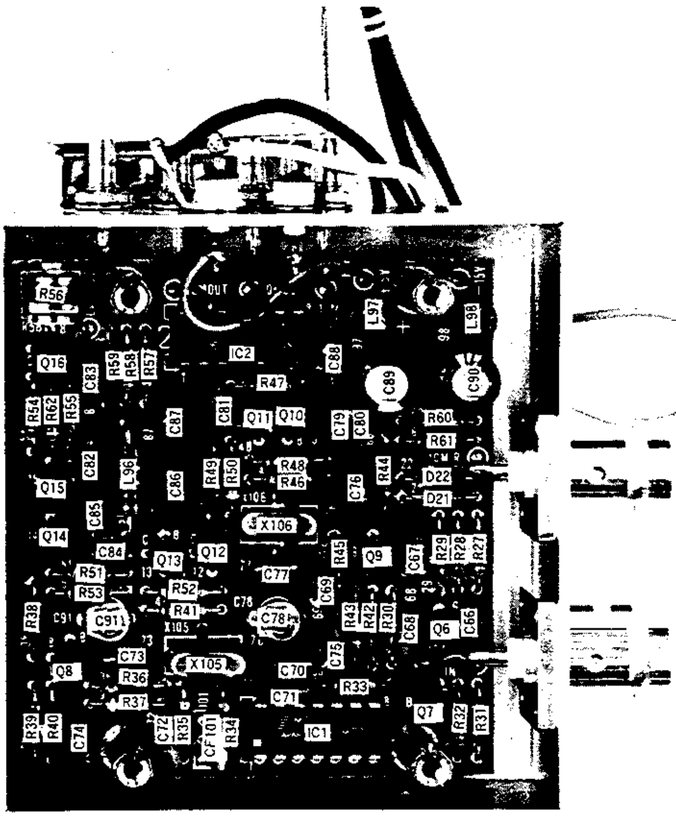


Fig. 15-40 STD OSC (BLB-011219)

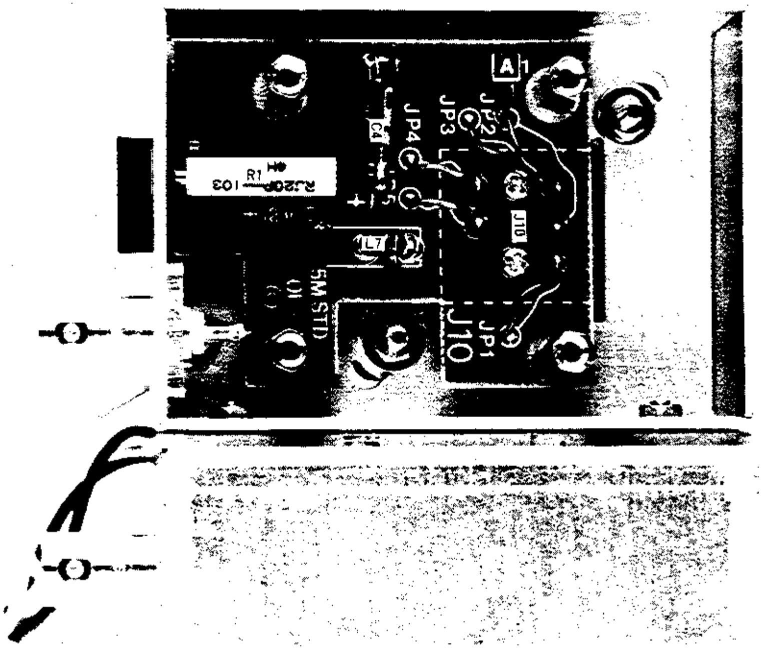
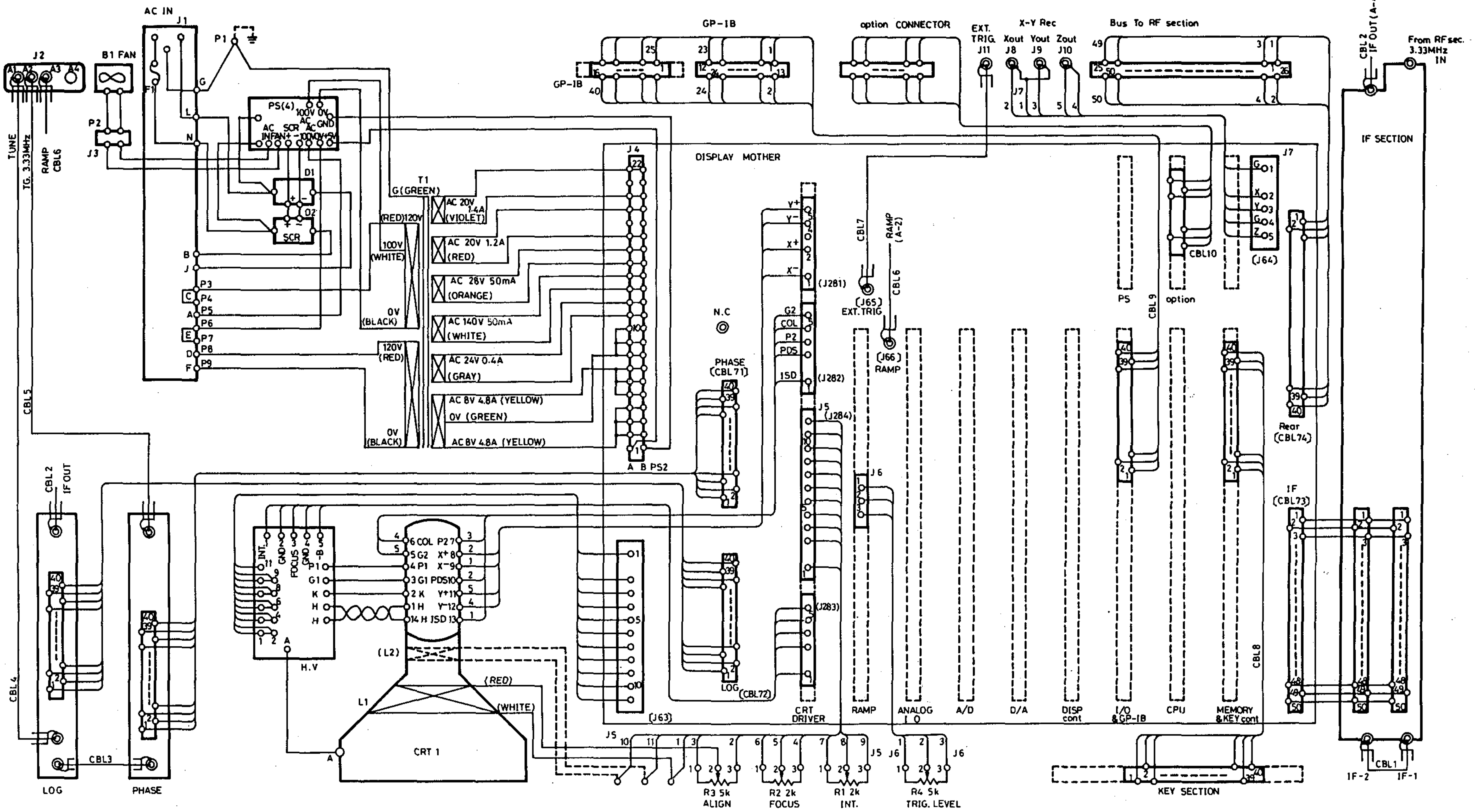


Fig. 15-41 XTAL (BLB-011570)

MEMO

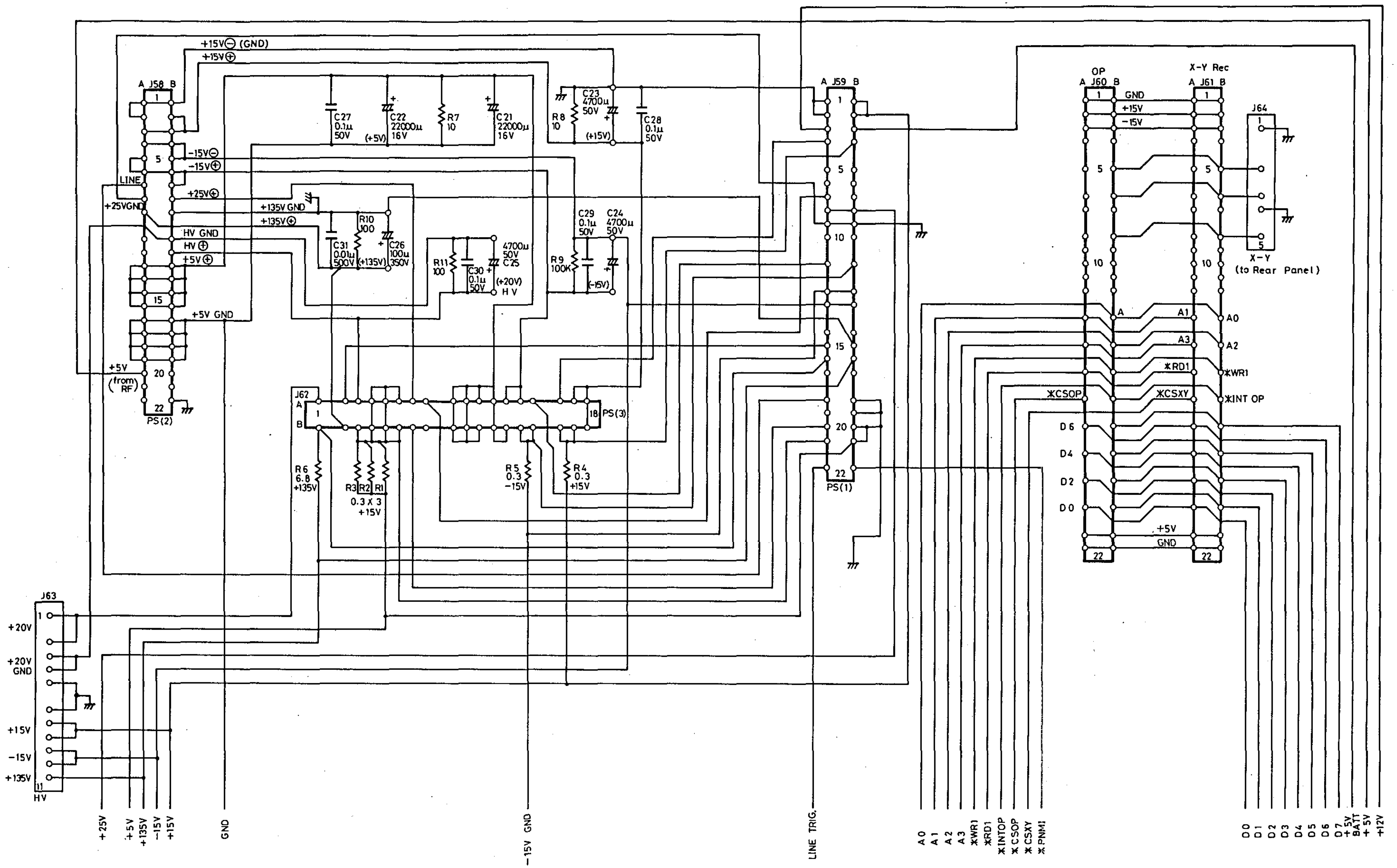


0253503-001-A

TR4171

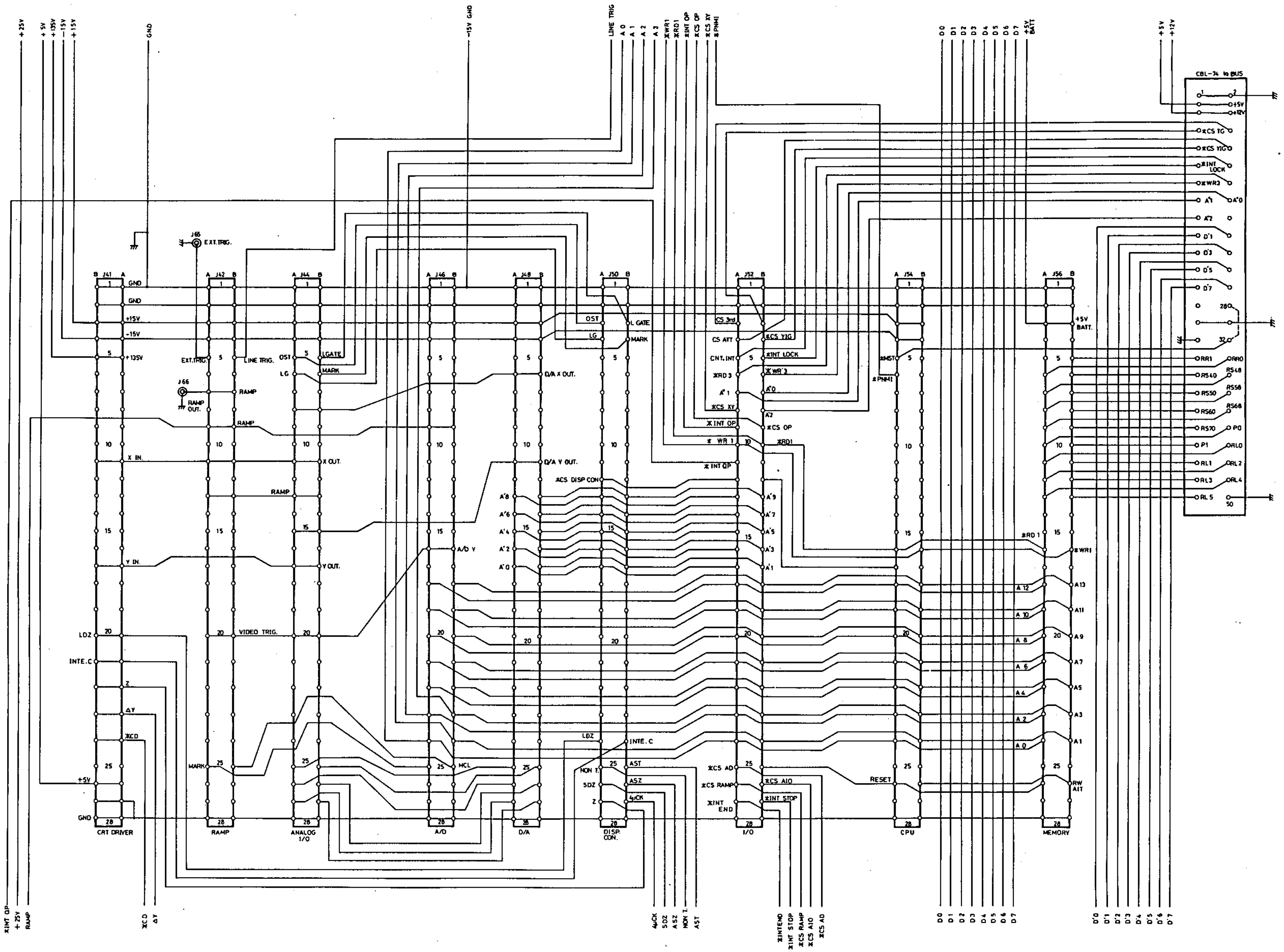
DISPLAY SCHEMATIC SECTION

TR-4171-DE



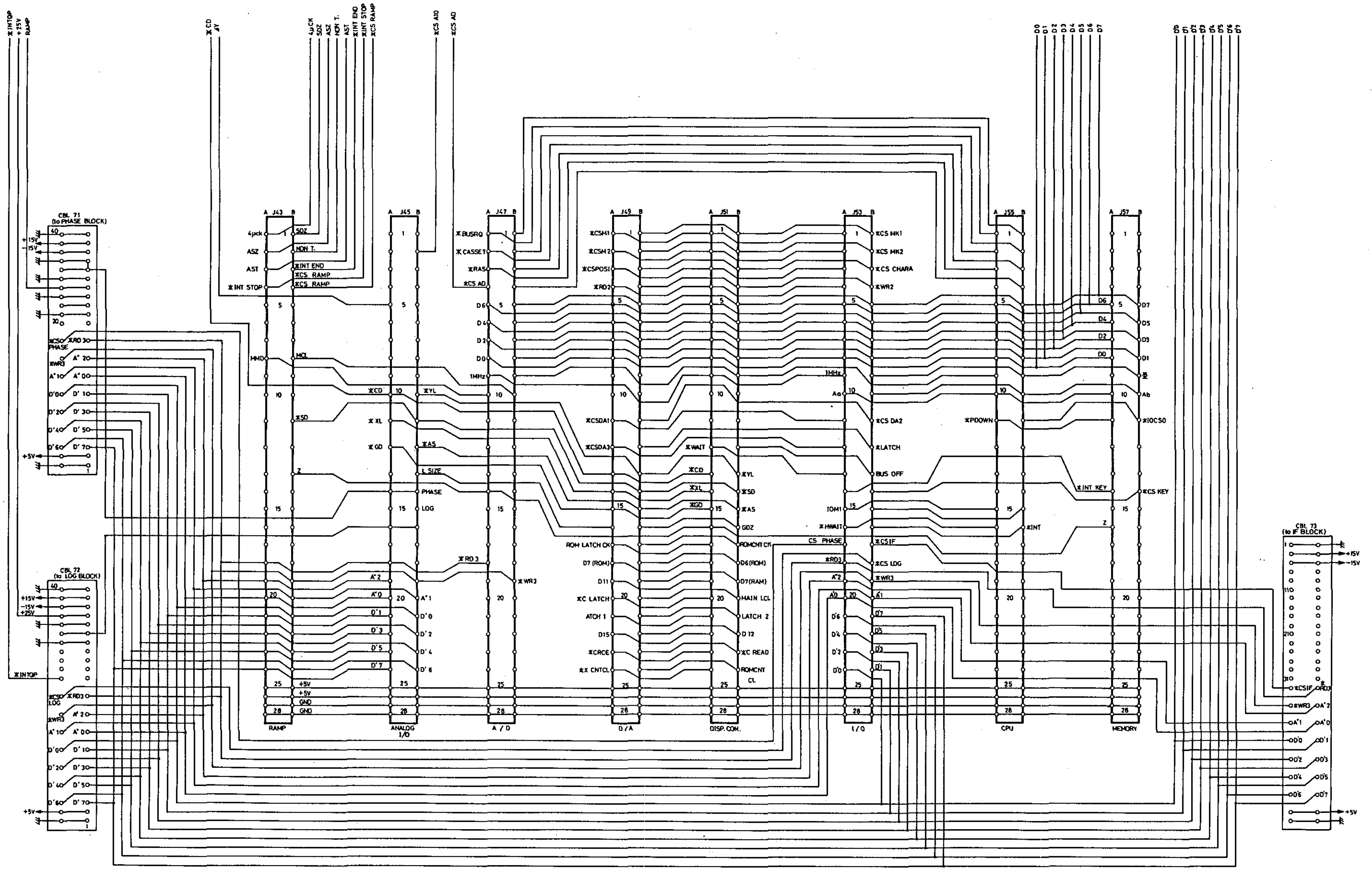
0069301-002-B
0253503-002-A

TR4172/4171
⟨2⟩ DISPLAY MOTHER
BLQ-010203 1/3



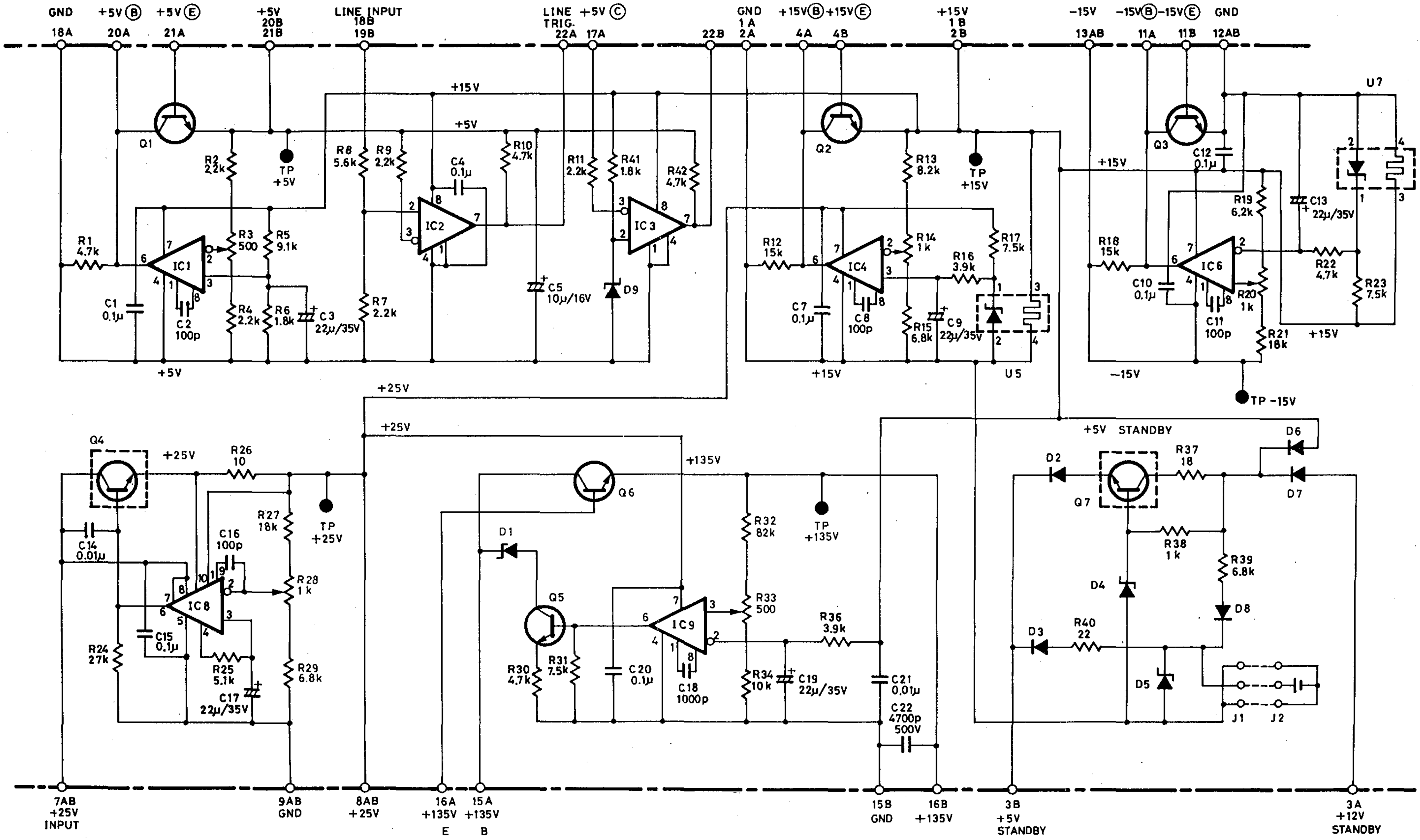
0069402-003-B
0253503-003-A

3 TR4172/4171
DISPLAY MOTHER
BLQ-010203 2/3



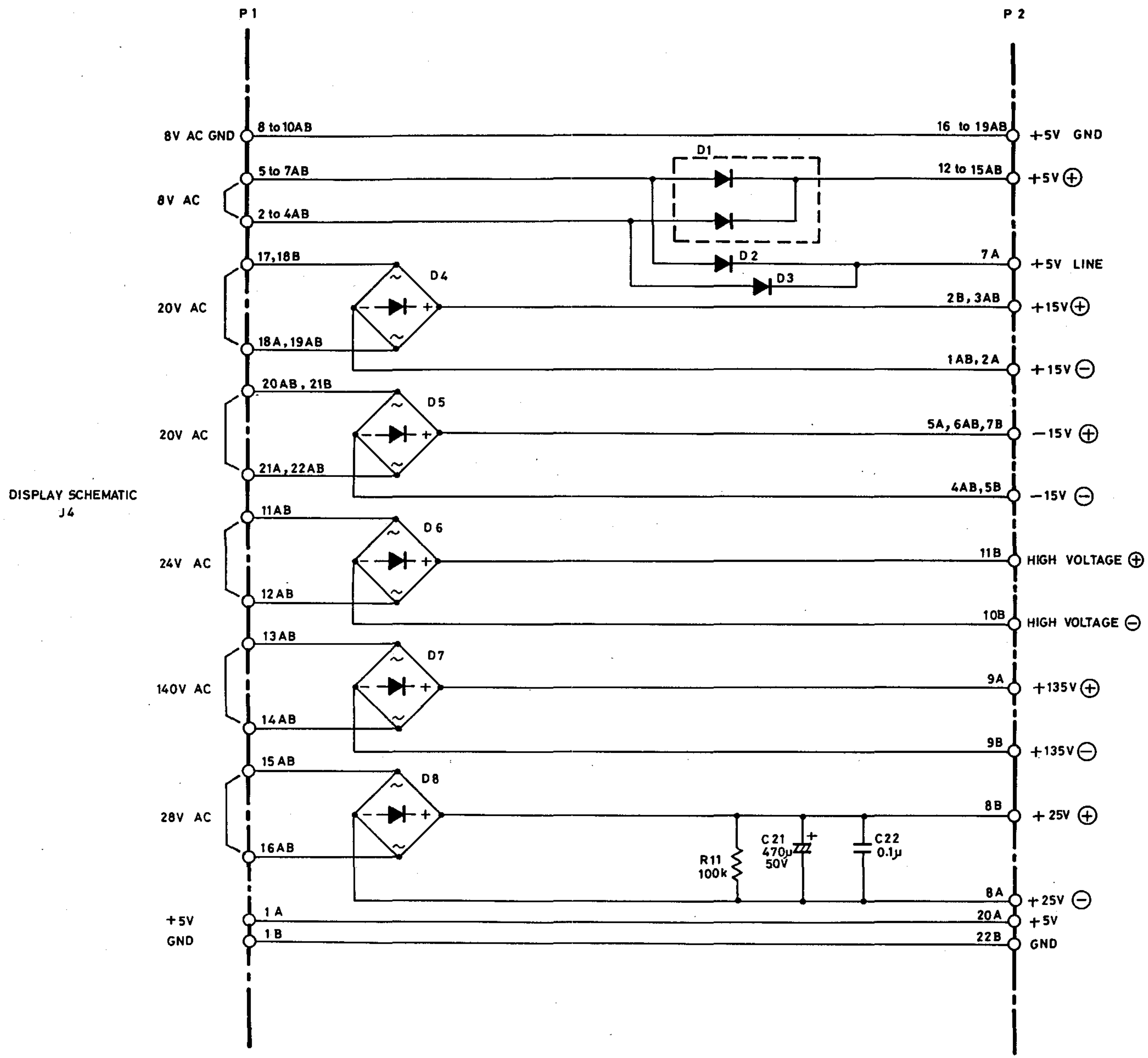
0069209-004-A
0253503-004-A

TR4172/4171
⟨4⟩ DISPLAY MOTHER
BLQ-010203 3/3



0069209 – 005 – A
0253503 – 005 – A

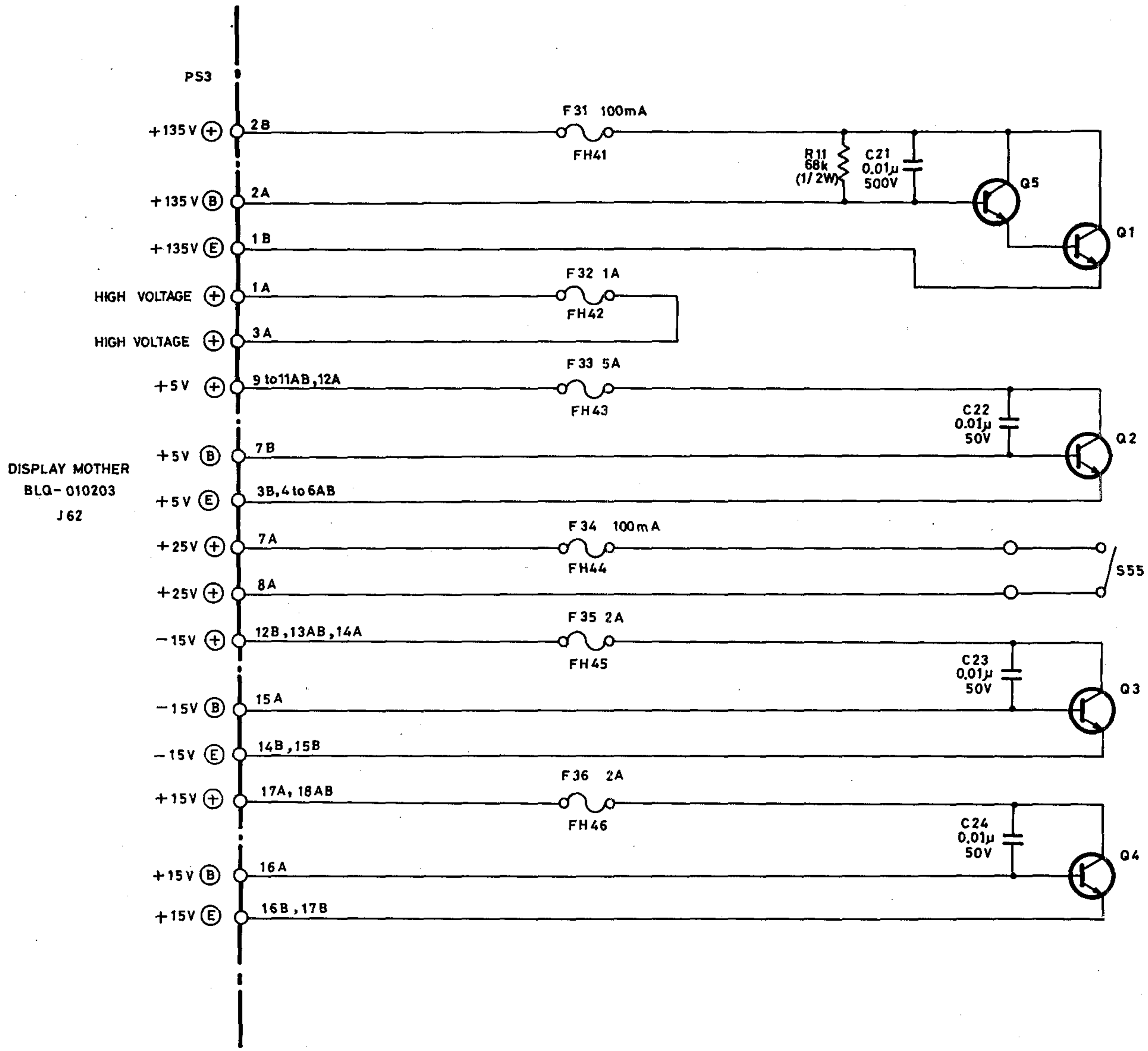
⟨5⟩ TR4171/4172
POWER SUPPLY–I
BGC–011865



0069209-006-A
0253503-006-A

6

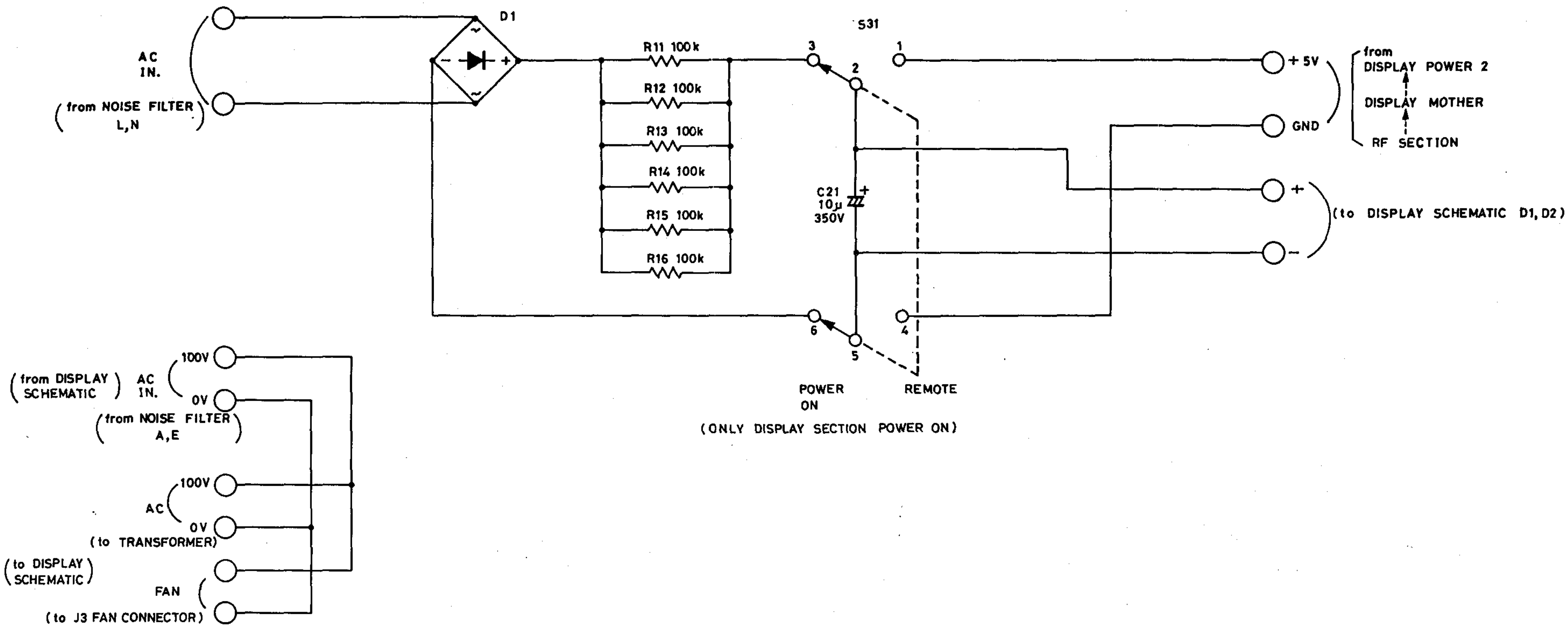
TR4172/4171
DISPLAY POWER 2
BGB-010199



0069301−007−B
0253503−007−A

7

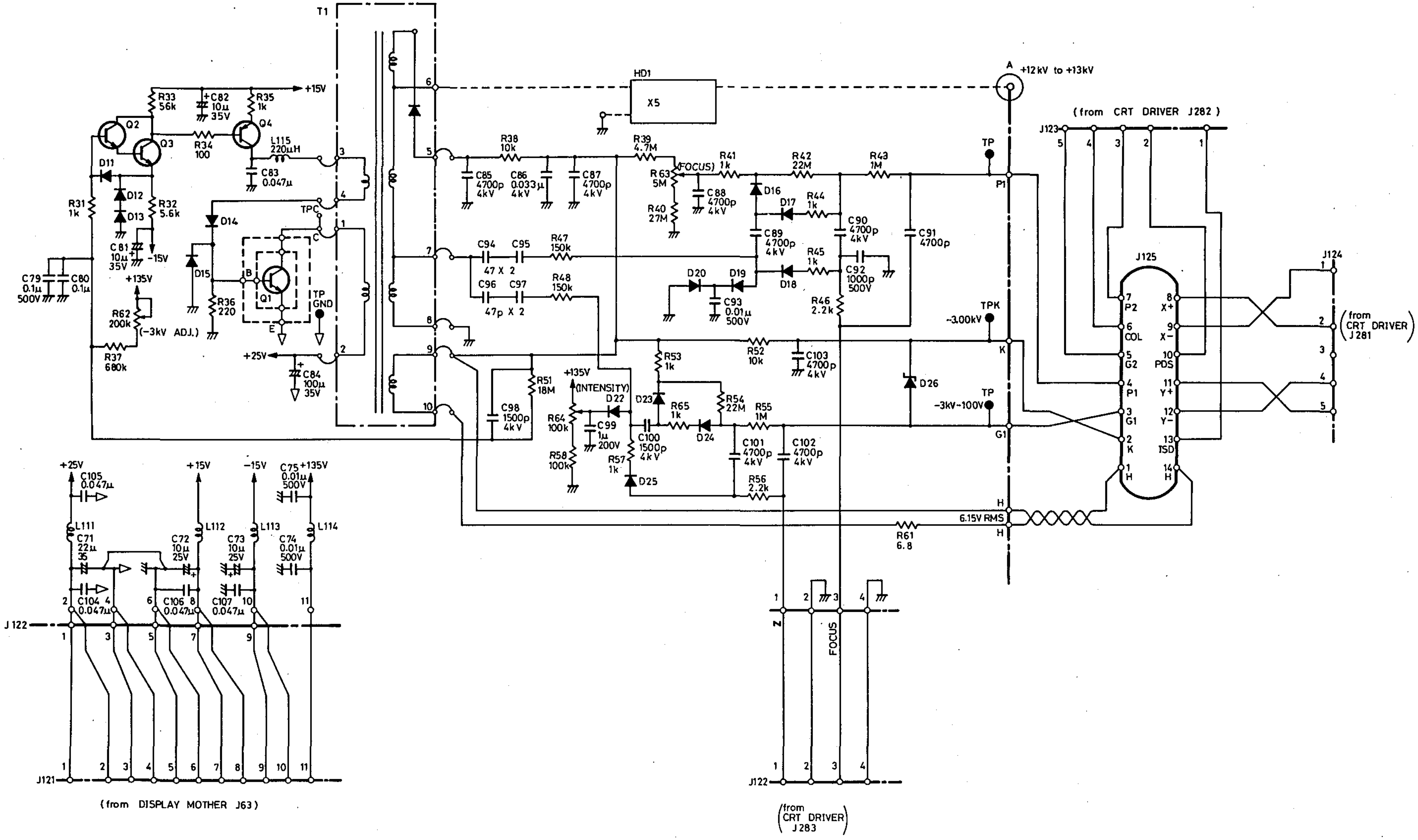
TR4172/4171
DISPLAY POWER 3
BGC−010369



0069209 – 008 – A
0253503 – 008 – A

8

TR4172/4171
DISPLAY POWER 4
BLB–010202

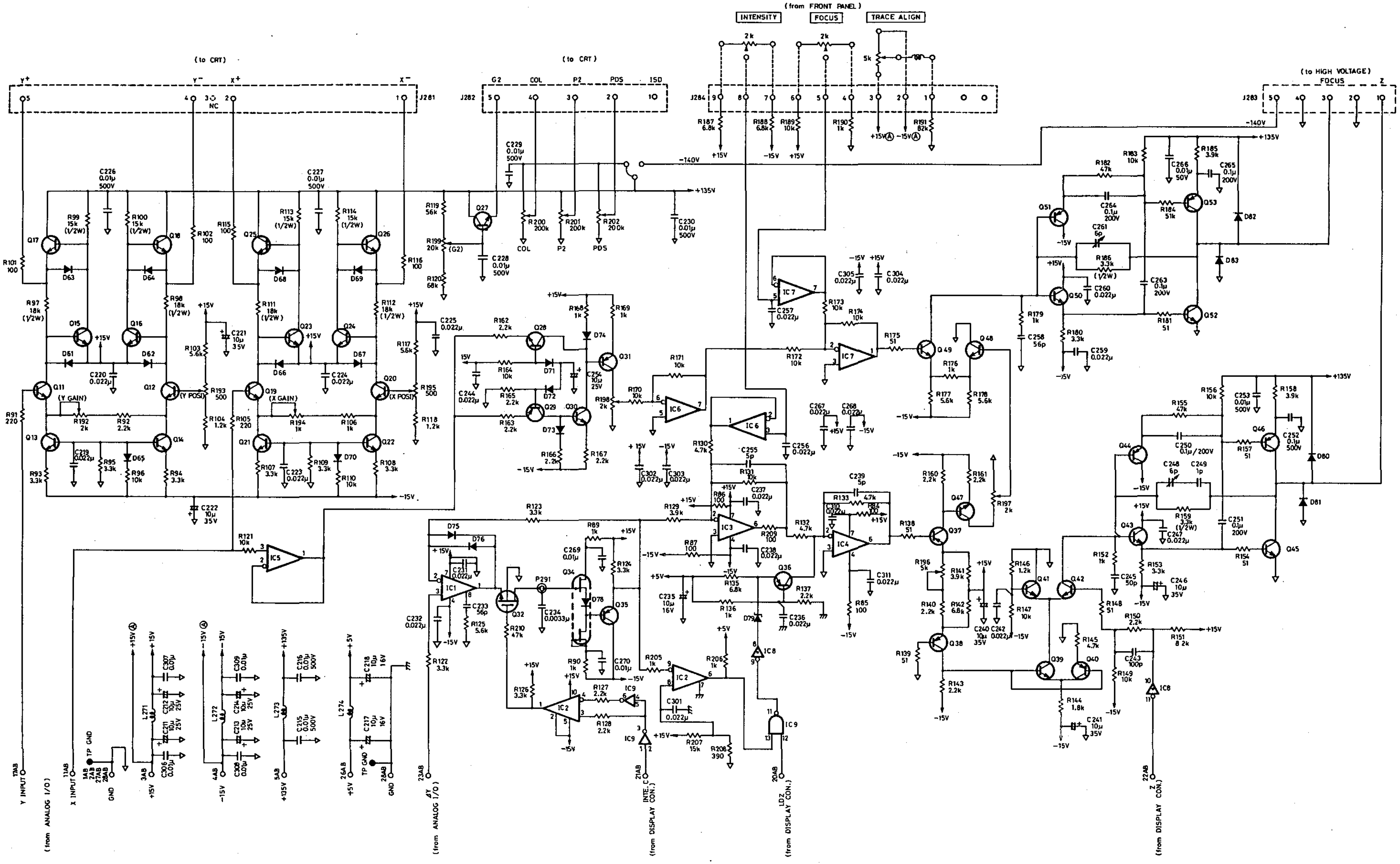


TR4172/4171

⟨9⟩ HIGH VOLTAGE

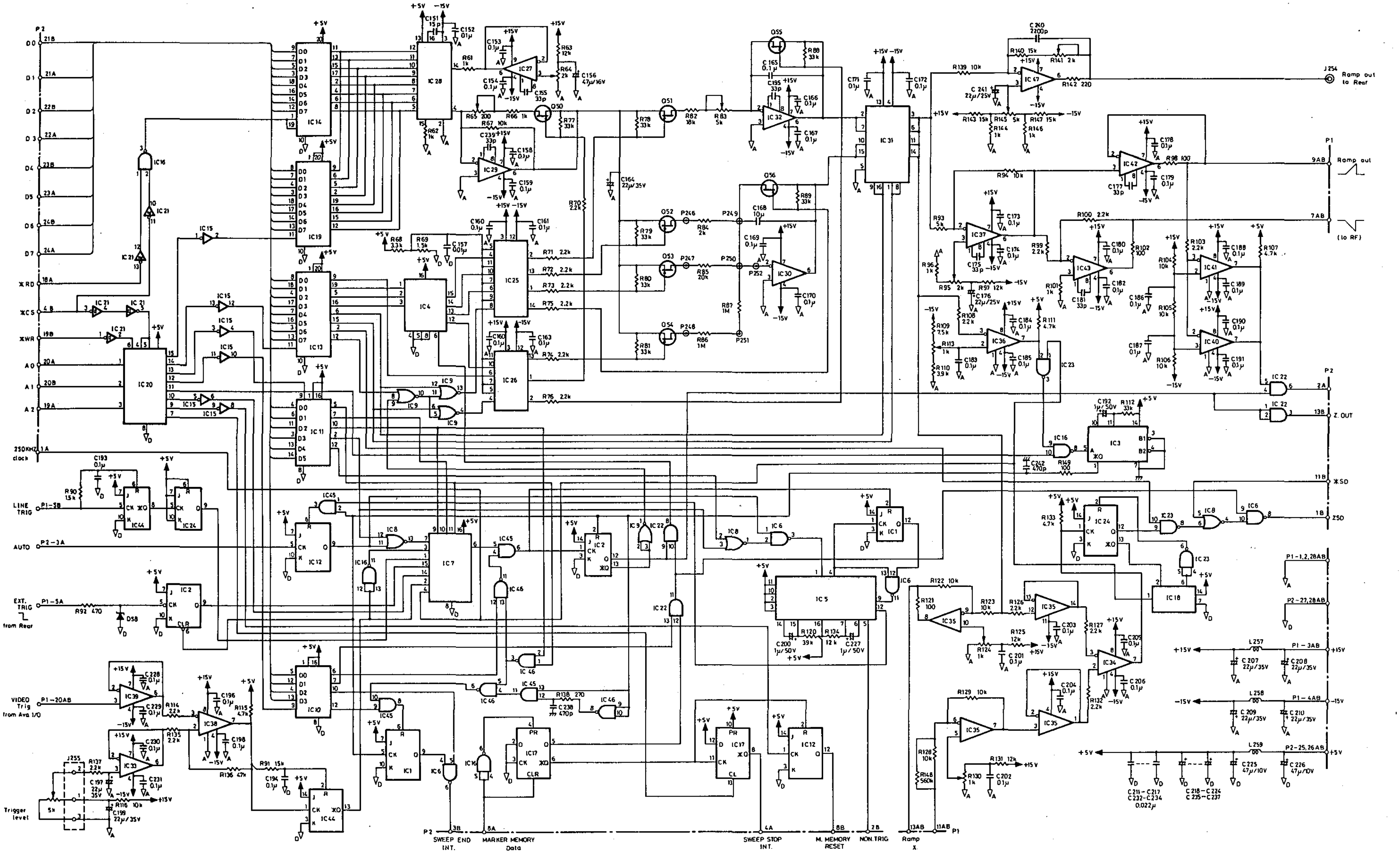
BLC-010204

0069305-009-C
0253503-009-A



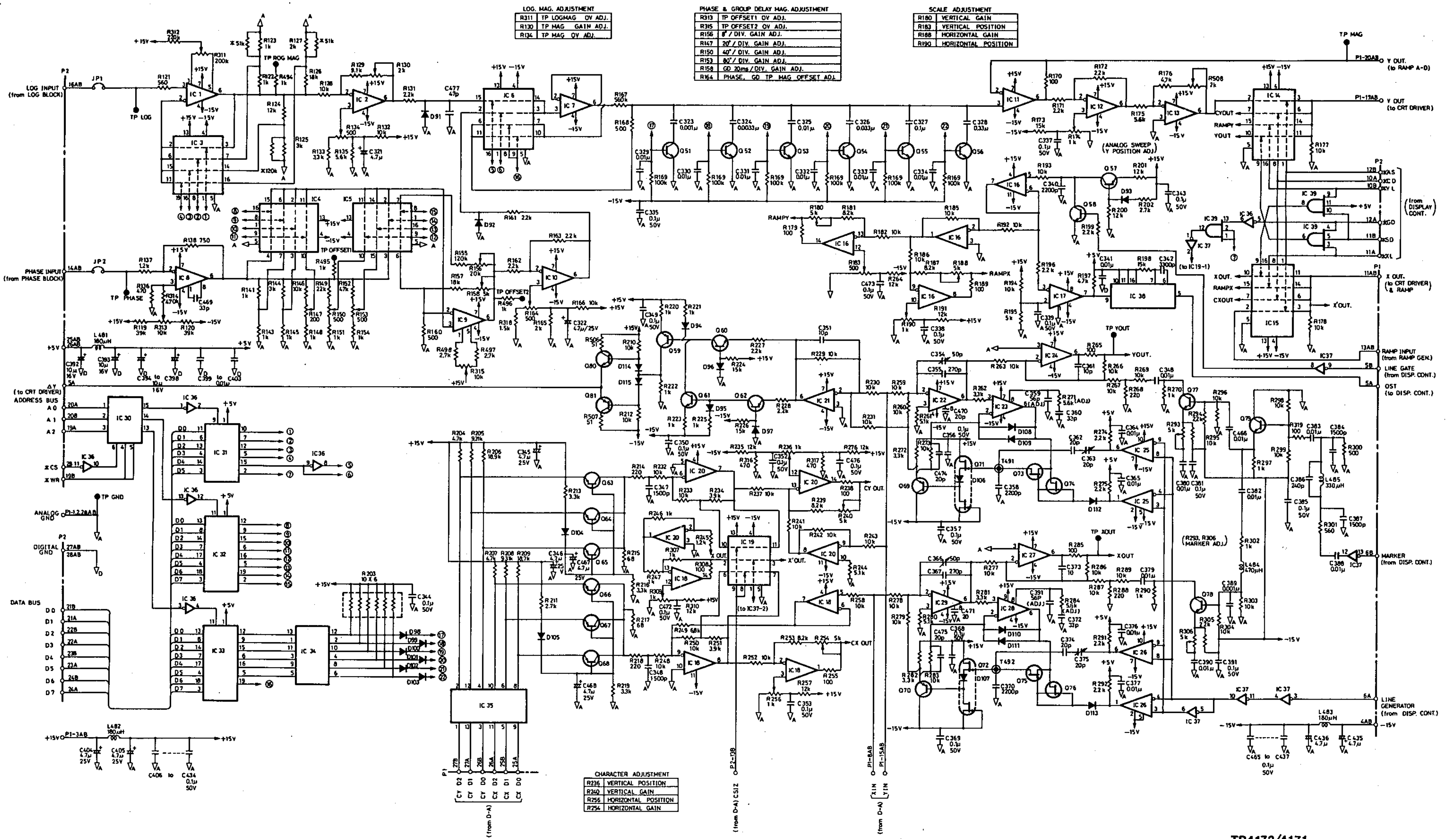
0069405 − 010 − D
0253503 − 010 − A

TR4172/4171
⟨10⟩ CRT DRIVER
BGK−010184



TR4171
RAMP GENERATOR
BGP—011552

0253503 — 011 — A



LOG. MAG. ADJUSTMENT

R311	TP LOGMAG 0V ADJ.
R130	TP MAG GAIN ADJ.
R134	TP MAG 0V ADJ.

PHASE & GROUP DELAY MAG. ADJUSTMENT

R313	TP OFFSET1 0V ADJ.
R315	TP OFFSET2 0V ADJ.
R156	8°/DIV. GAIN ADJ.
R147	20°/DIV. GAIN ADJ.
R150	40°/DIV. GAIN ADJ.
R153	80°/DIV. GAIN ADJ.
R158	GD 20ms/DIV. GAIN ADJ.
R164	PHASE, GD TP MAG OFFSET ADJ.

SCALE ADJUSTMENT

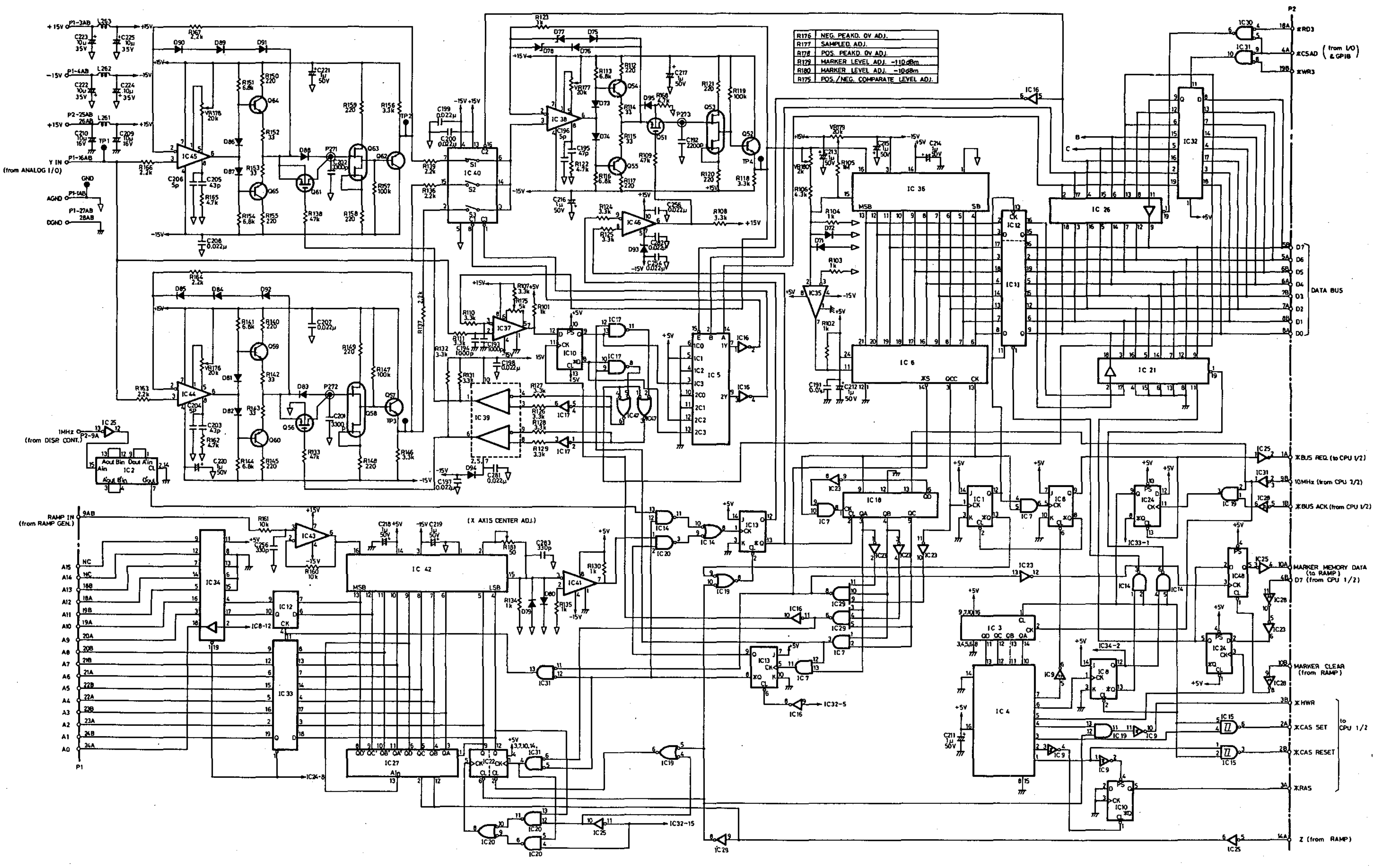
R180	VERTICAL GAIN
R183	VERTICAL POSITION
R188	HORIZONTAL GAIN
R190	HORIZONTAL POSITION

CHARACTER ADJUSTMENT

R236	VERTICAL POSITION
R240	VERTICAL GAIN
R256	HORIZONTAL POSITION
R254	HORIZONTAL GAIN

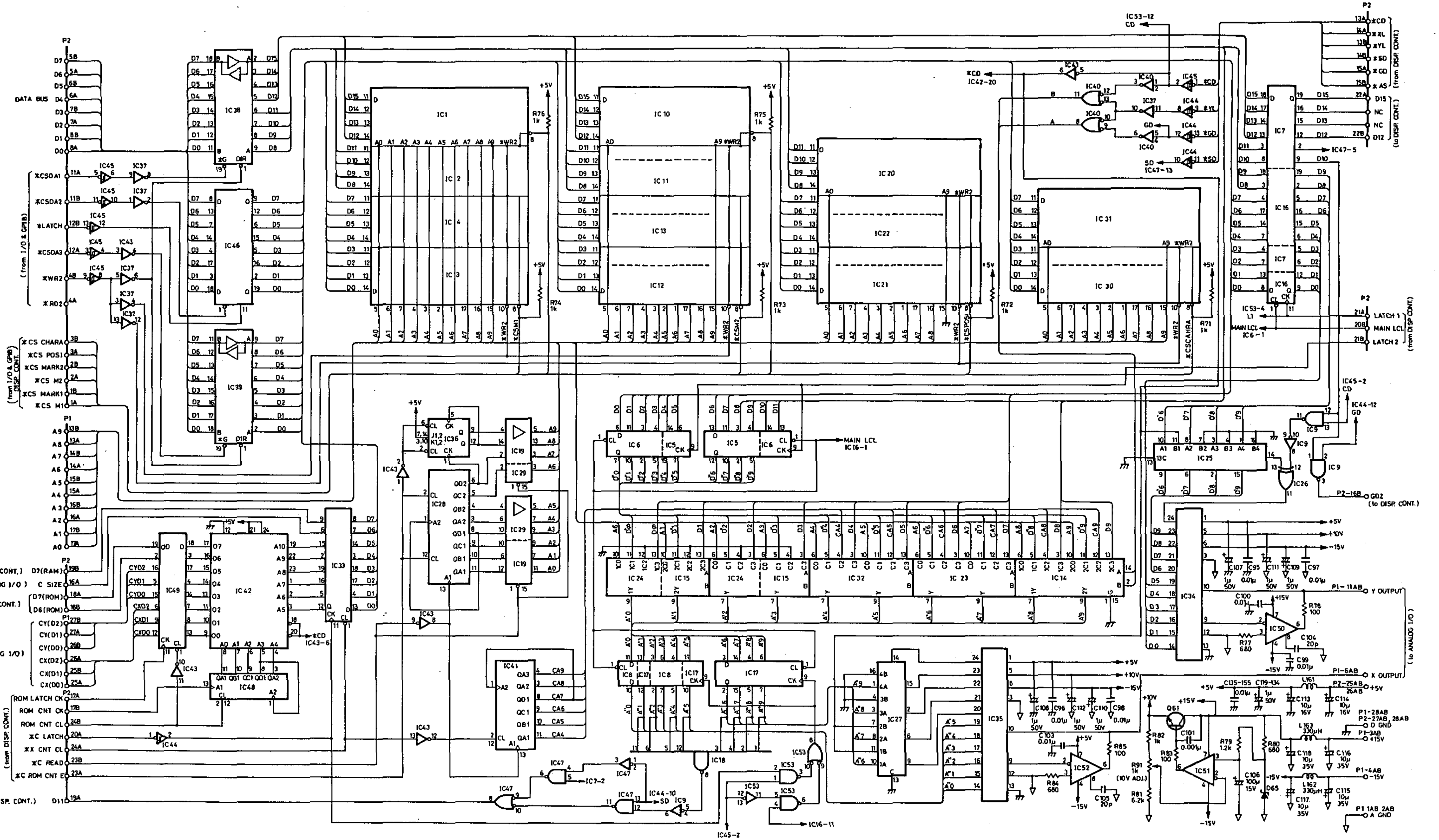
0069311 -012-D
0253503 -012-A

⟨12⟩ **TR4172/4171**
ANALOG I/O
BGP-010186



0069401-013-E
0253503-013-A

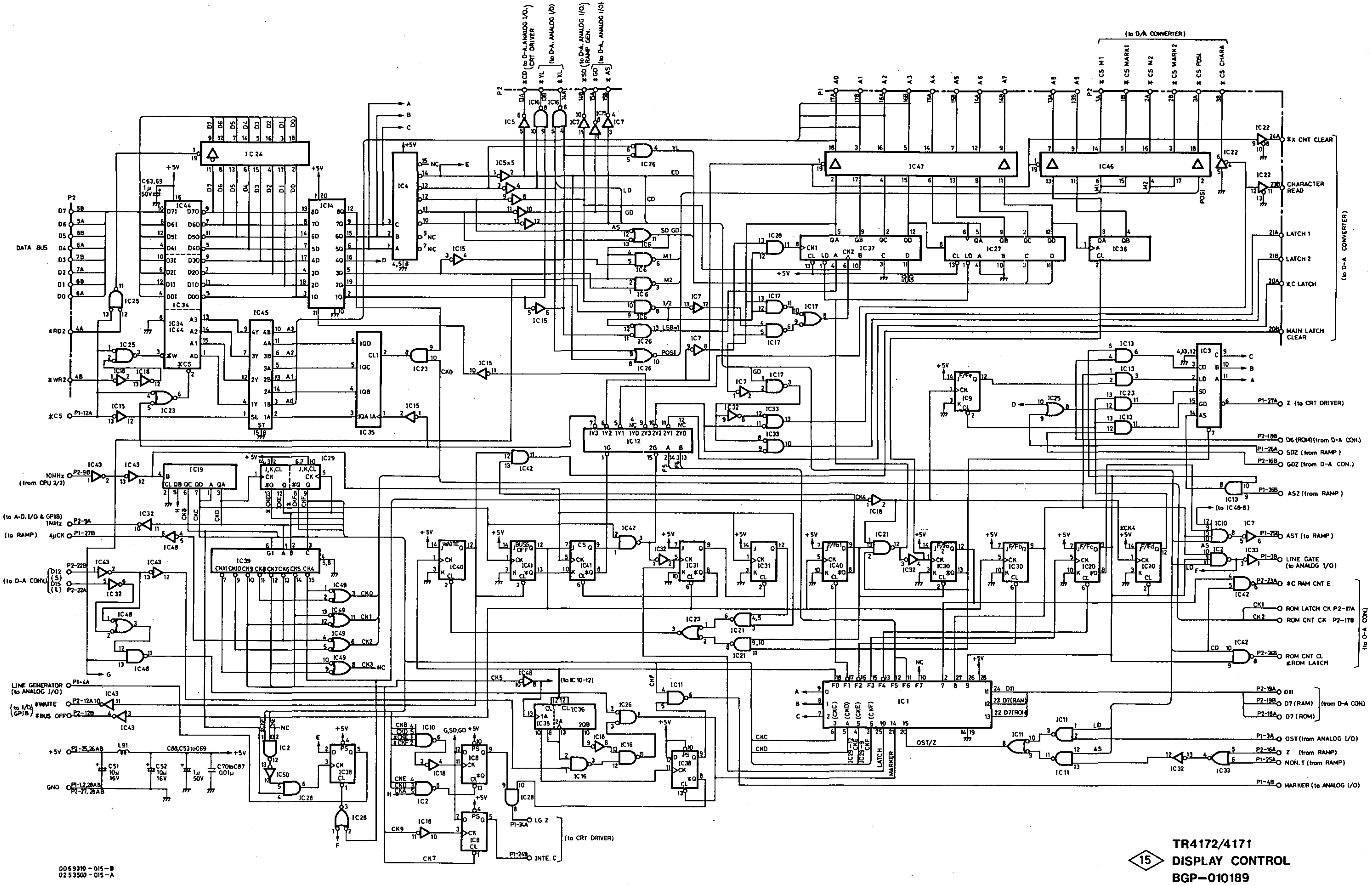
TR4172/4171
13 A-D CONVERTER
BGP-010187



0069305-014-C
0253503-014-A

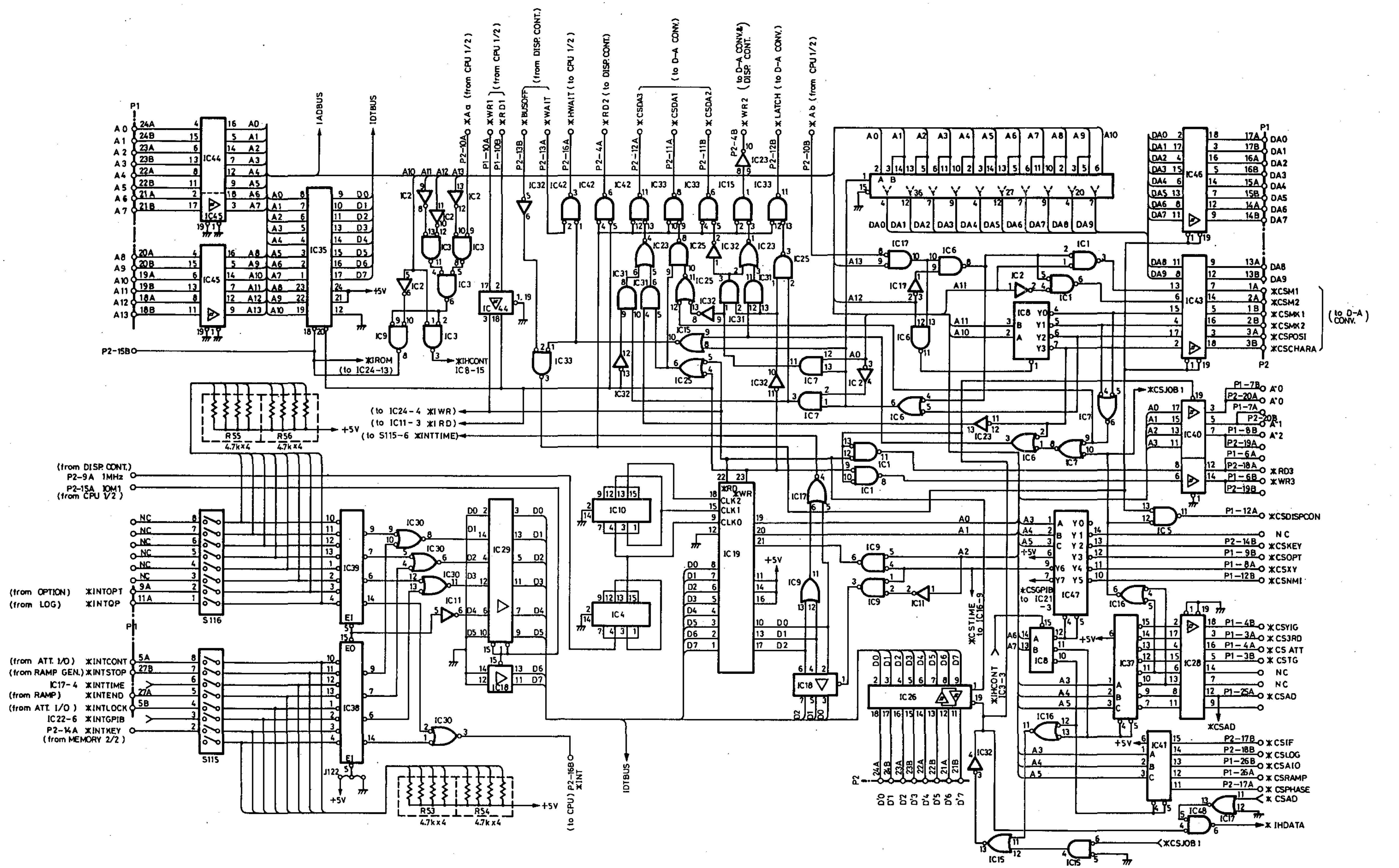
14

TR4172/4171
D-A CONVERTER
BGP-010188



0069310-015-B
0253503-015-A

TR4172/4171
⟨15⟩ DISPLAY CONTROL
BGP-010189

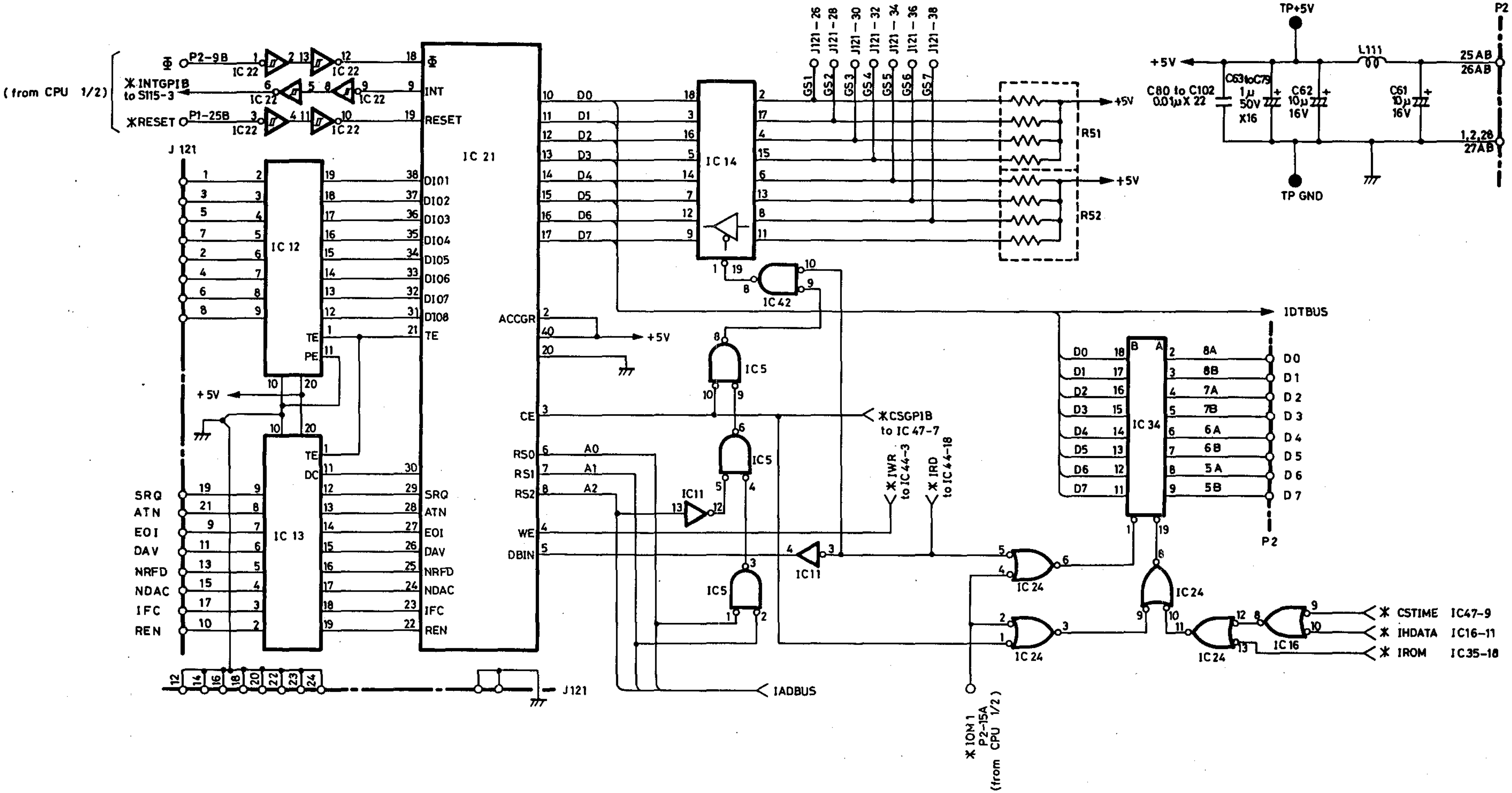


TR4172/4171

16 I/O & GP-IB

BGP-010190 1/2

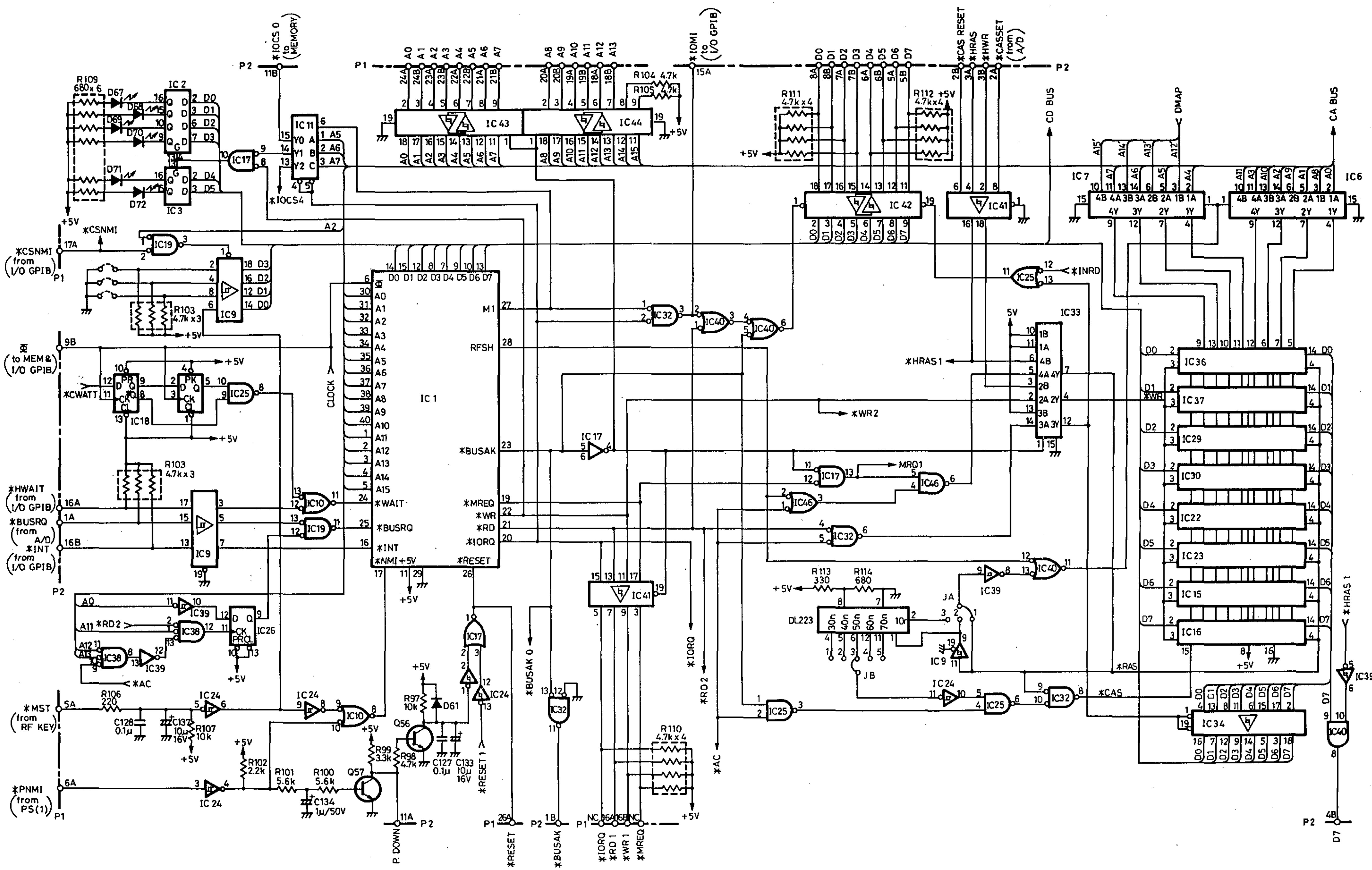
0069408-016-C
0253503-016-A



0069301 — 017 — B
02 53503 — 017 — A

17

TR4172/4171
I/O & GP-IB
BGP-010190 2/2

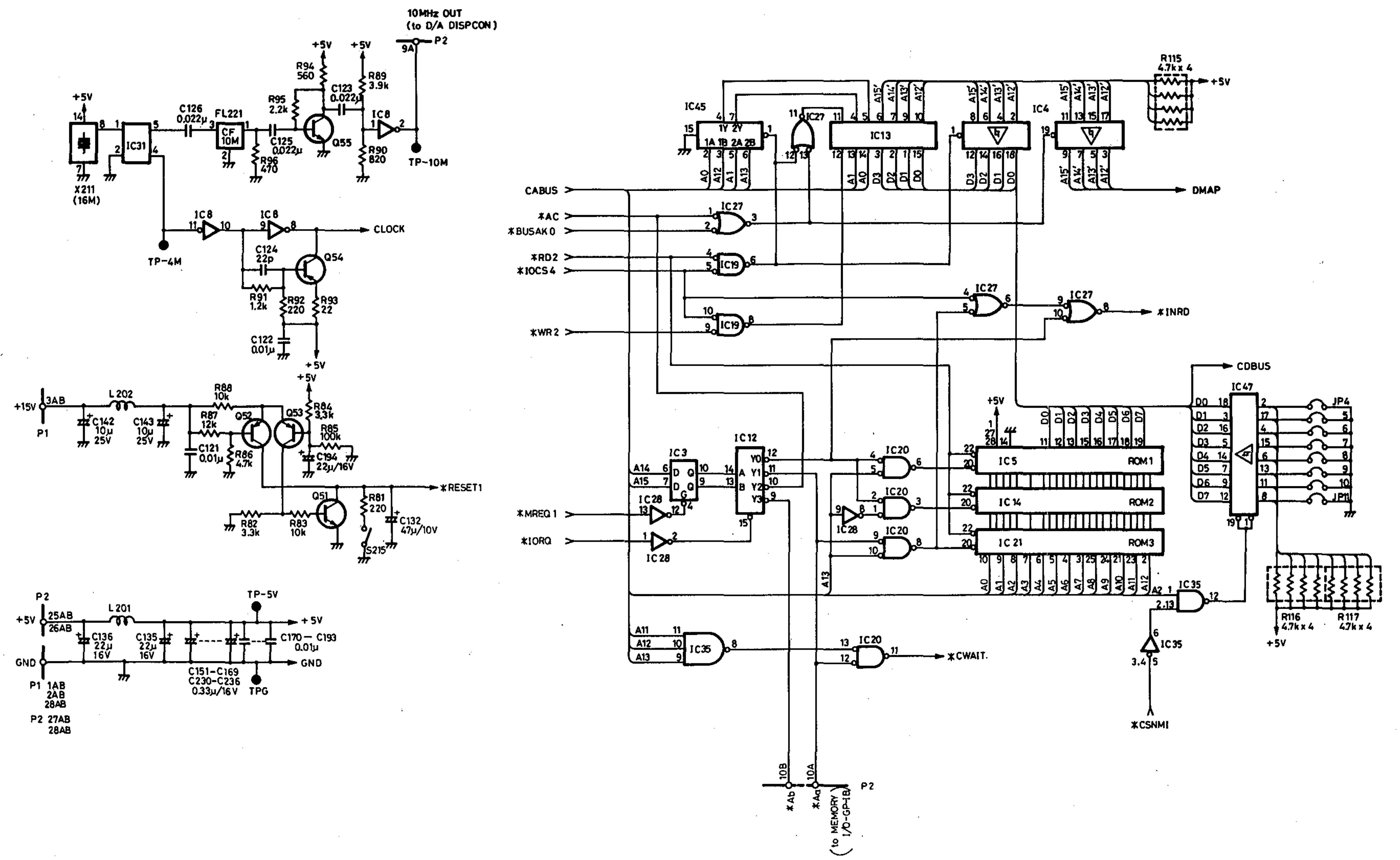


0253503-018-A

TR4171/4172

18 CPU

BGP-010191 1/2

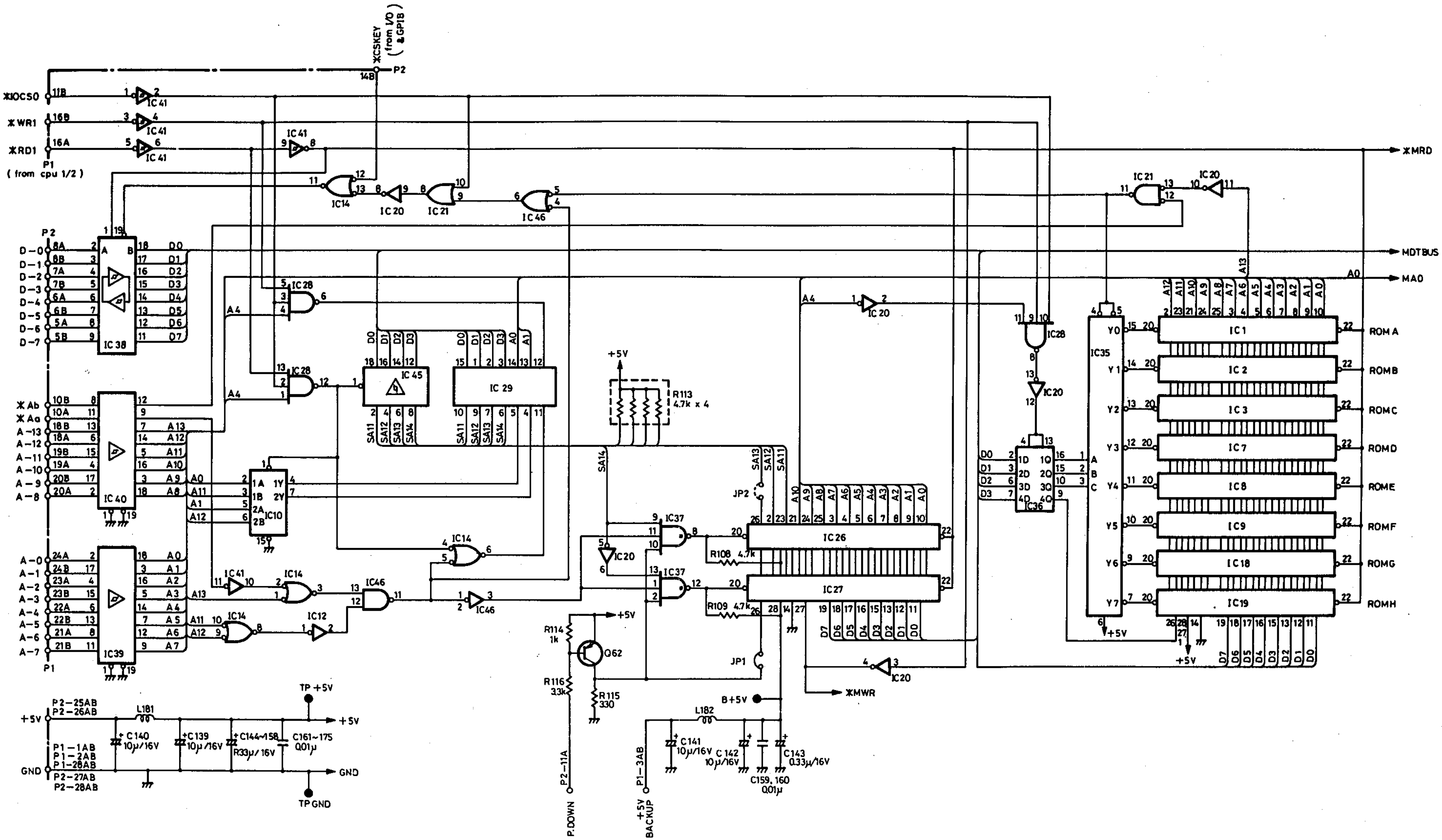


TR4171/4172

19 CPU

BGP—010191

0253503-019-A

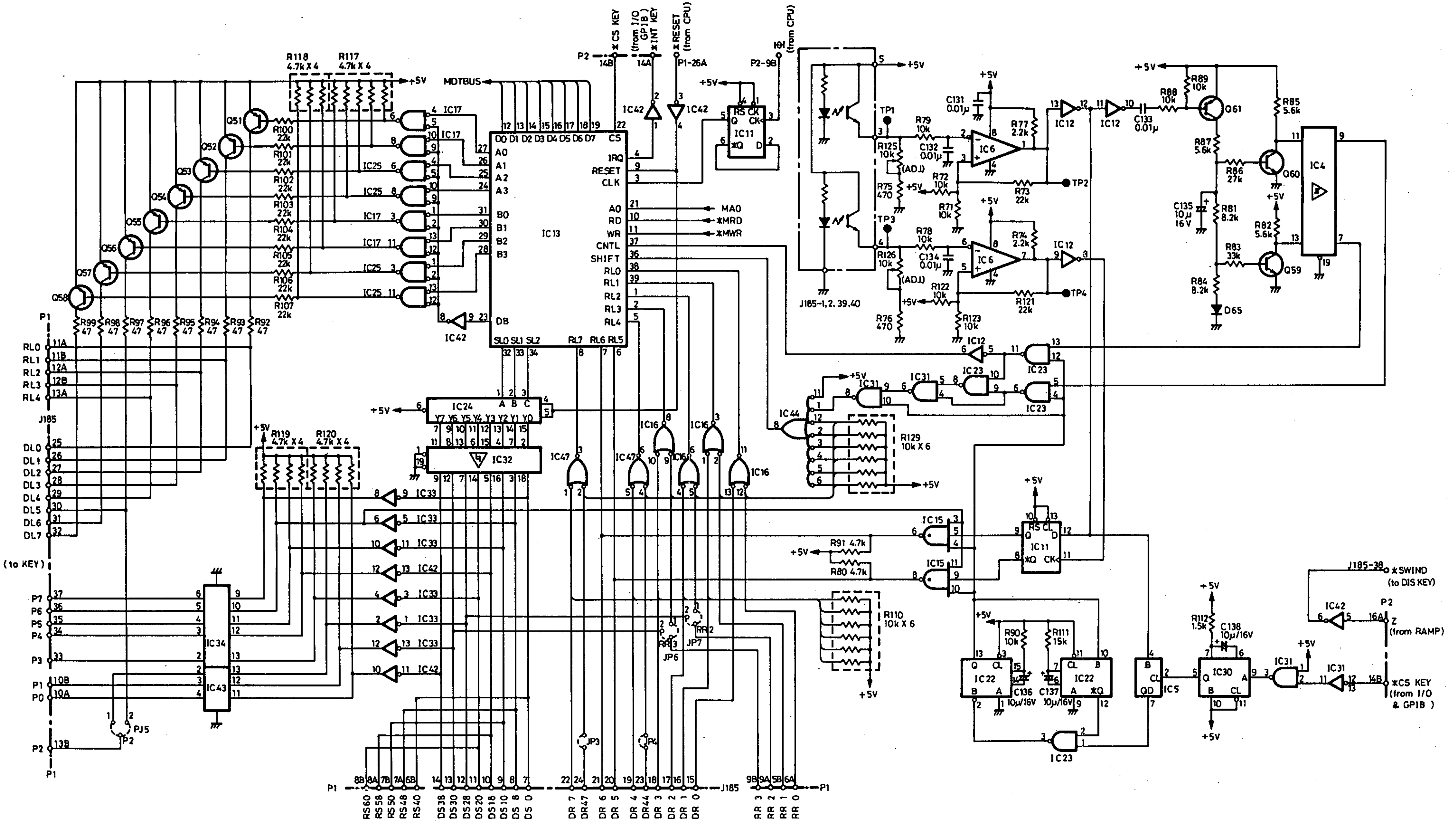


0253503-020-A

TR4171/4172

⟨20⟩ MEMORY/KEY CONTROL

BGP-010192 01/02 1/2

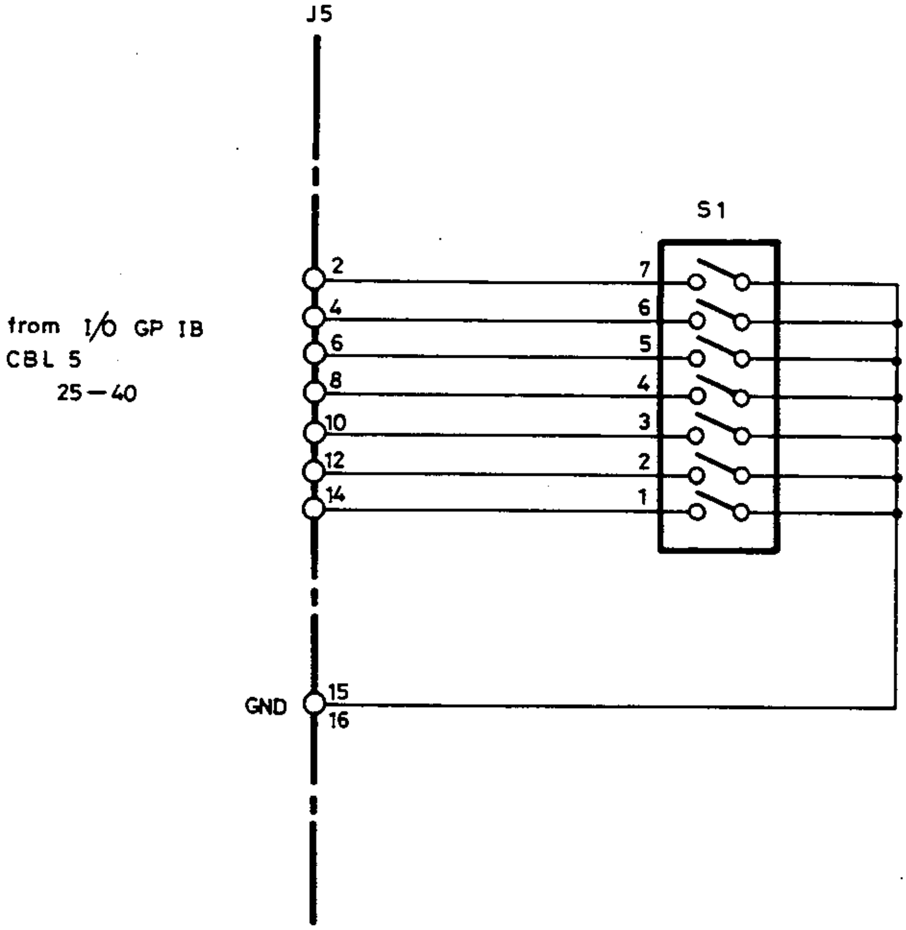


TR4171/4172

21 MEMORY–KEY CONTROL

BGP–010192 01/02 2/2

0253503–021–A

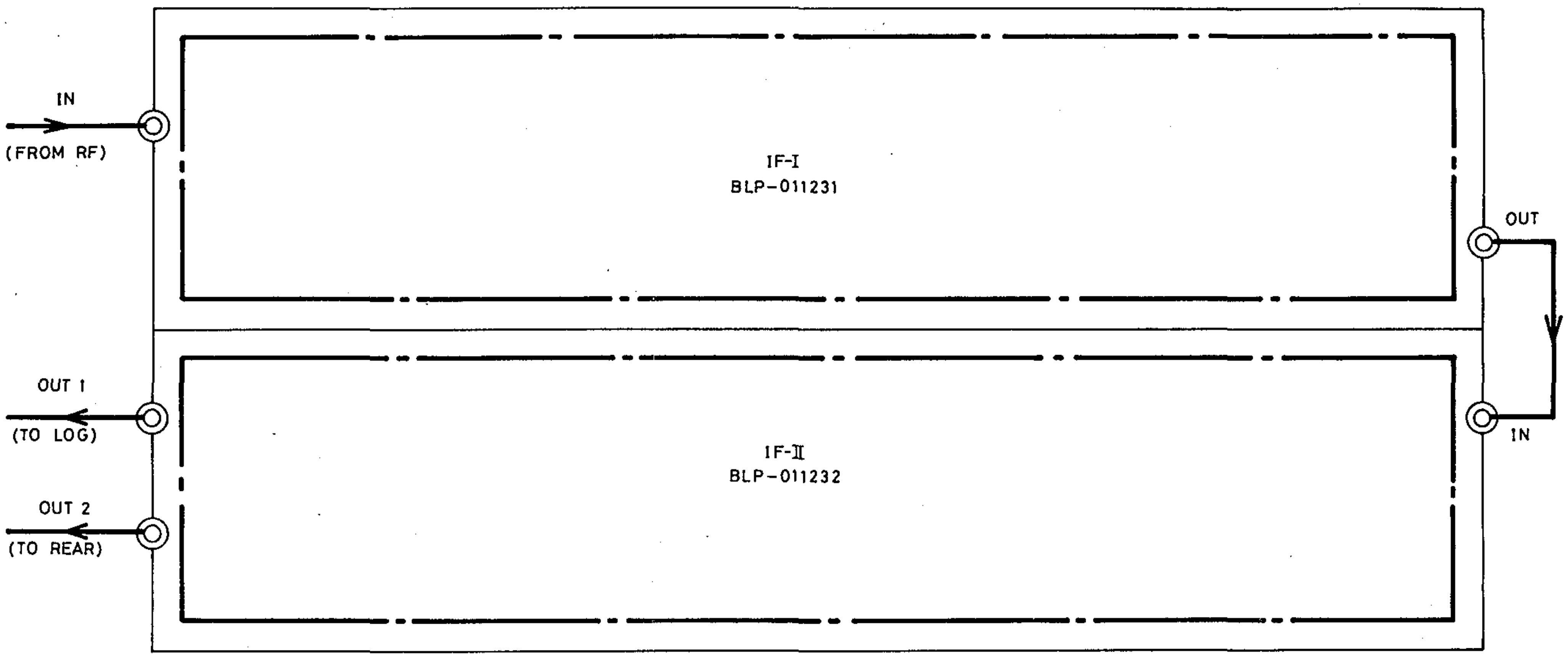


0069209 —018—A
0253503 —022—A

22
TR4171

18
TR4172

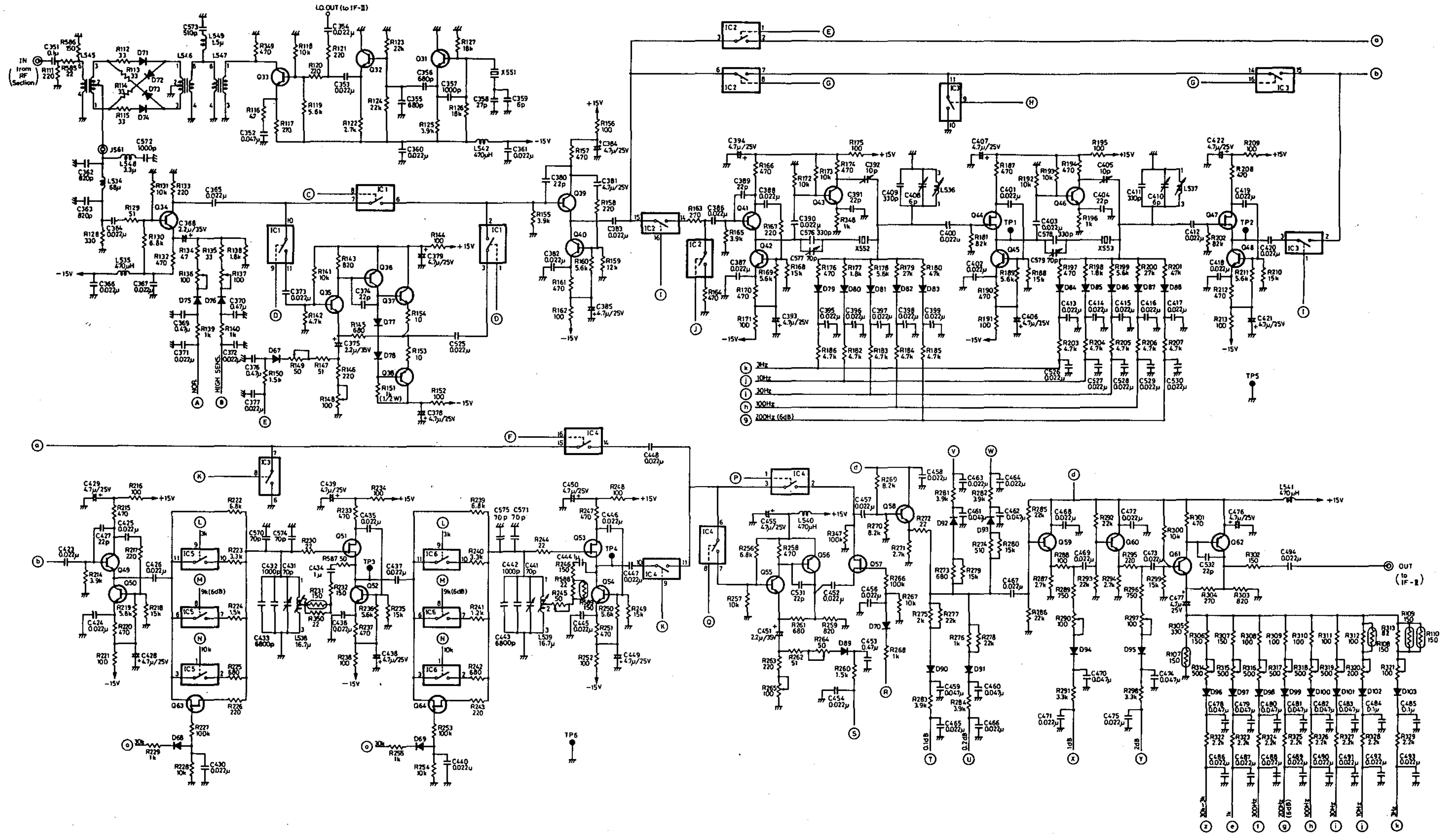
TR4172/4171
GP-IB SWITCH
BLB-010206



23

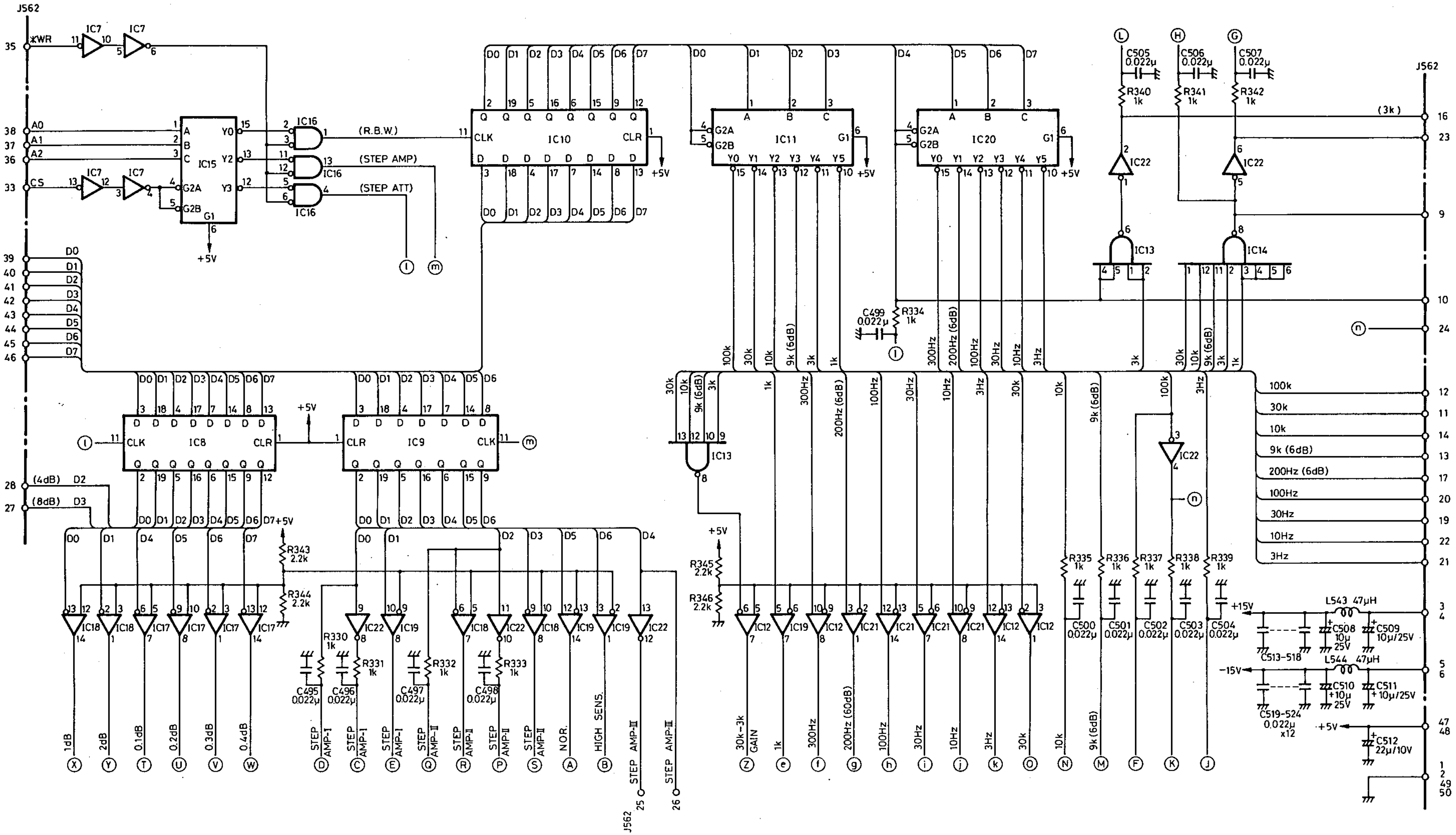
TR4171
MEP−401
IF BLOCK

0253503-023-A



0253503-024-A

TR4171
MEP-401
IF-I
BLP-011231 1/2



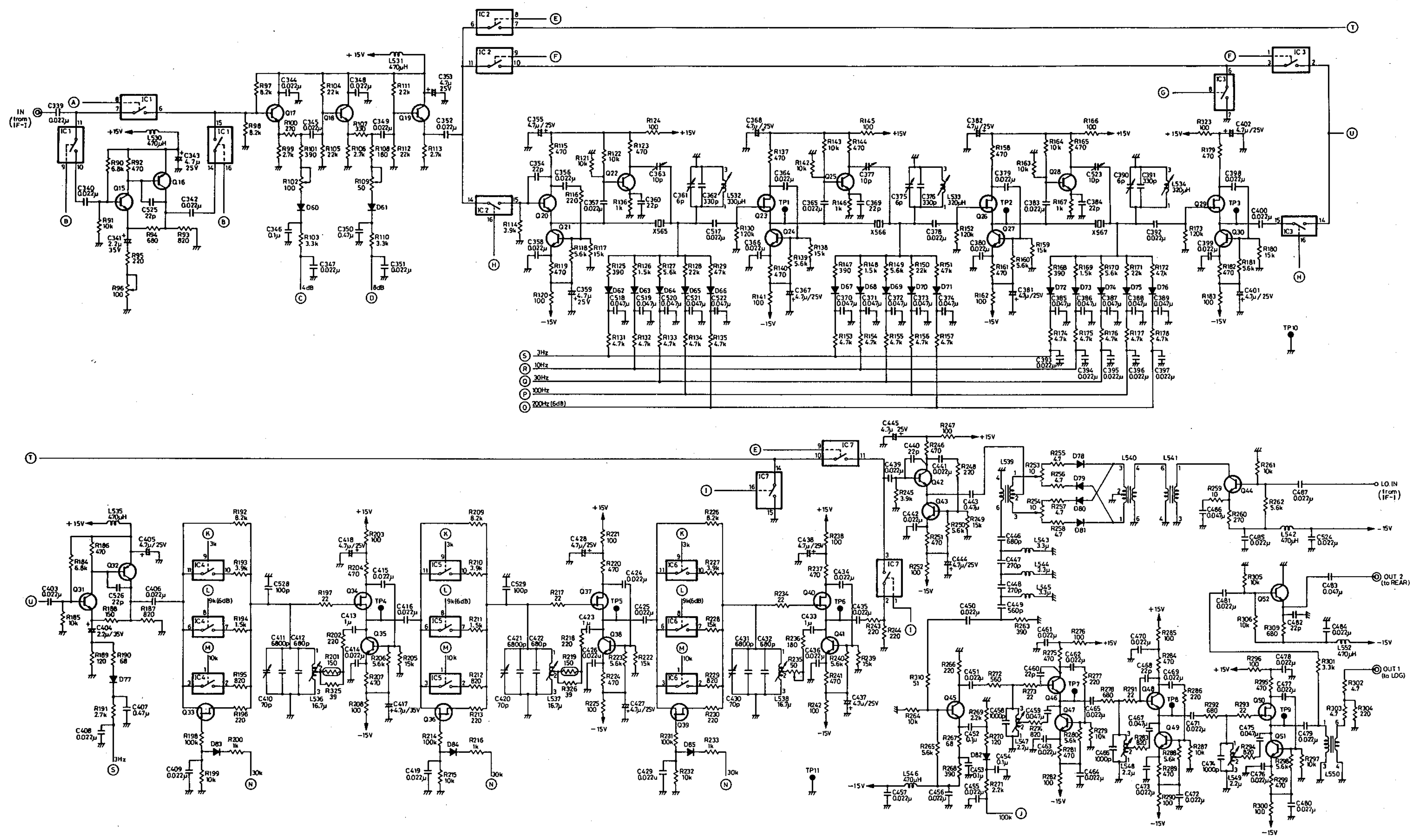
25 **TR4171**

MEP-401

IF-I

BLP-011231 2/2

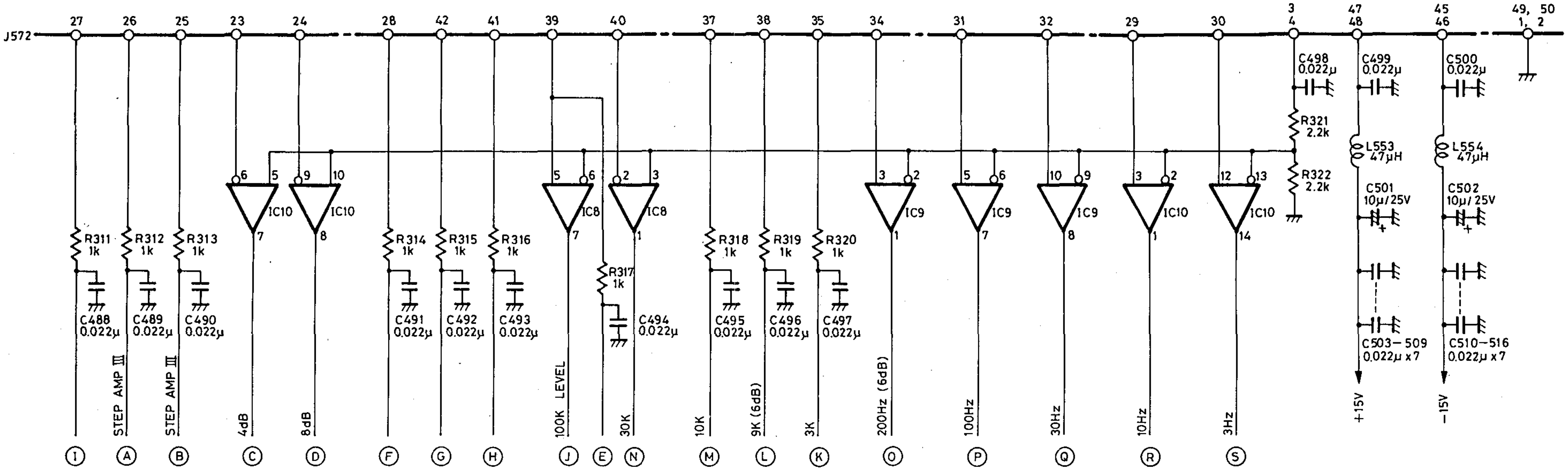
0253503-025-A



0253503-026-A

26

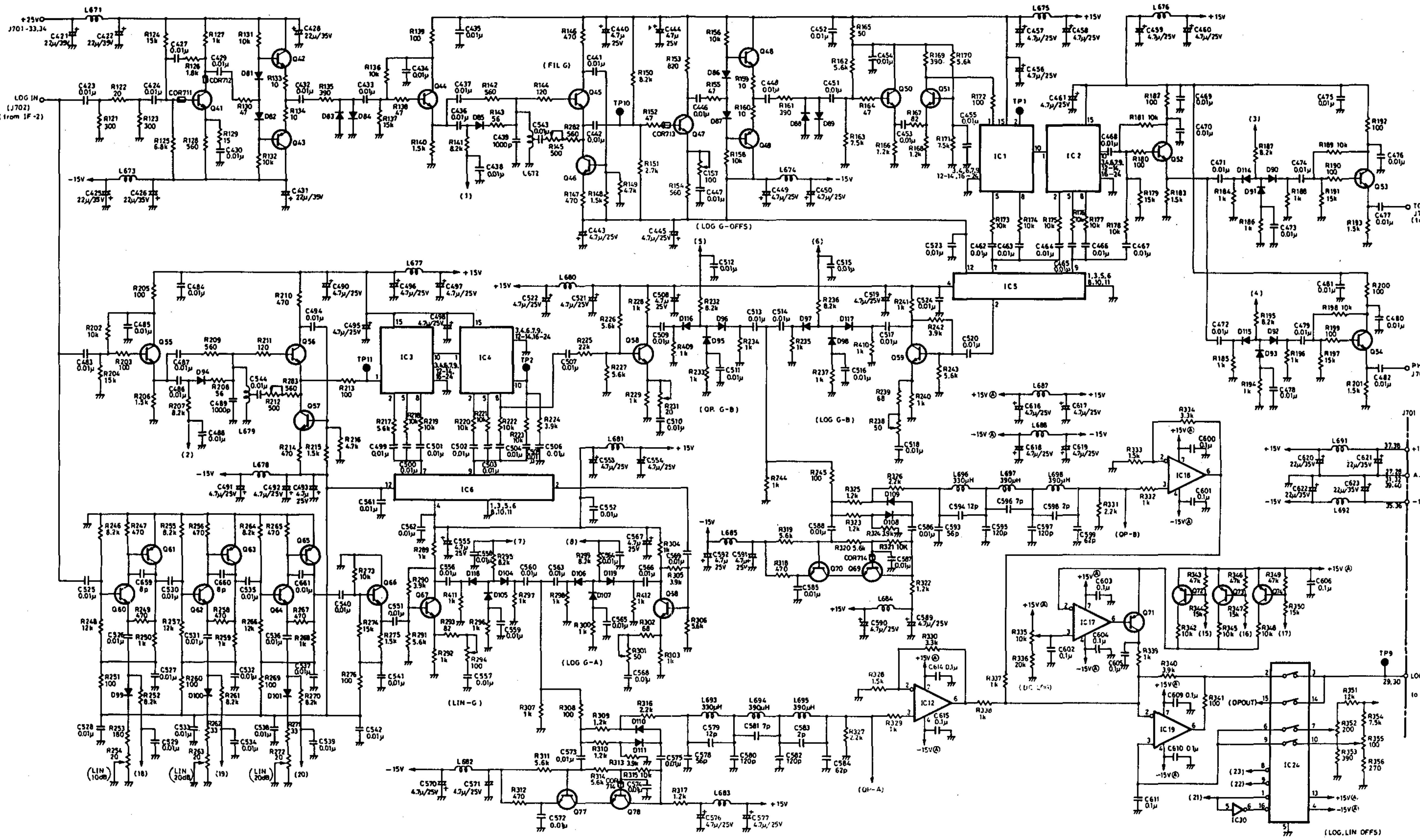
TR4171
MEP-401
IF-II
BLP-011232 1/2



27

TR4171
MEP−401
IF−II
BLP−011232 2/2

0753503-027-A

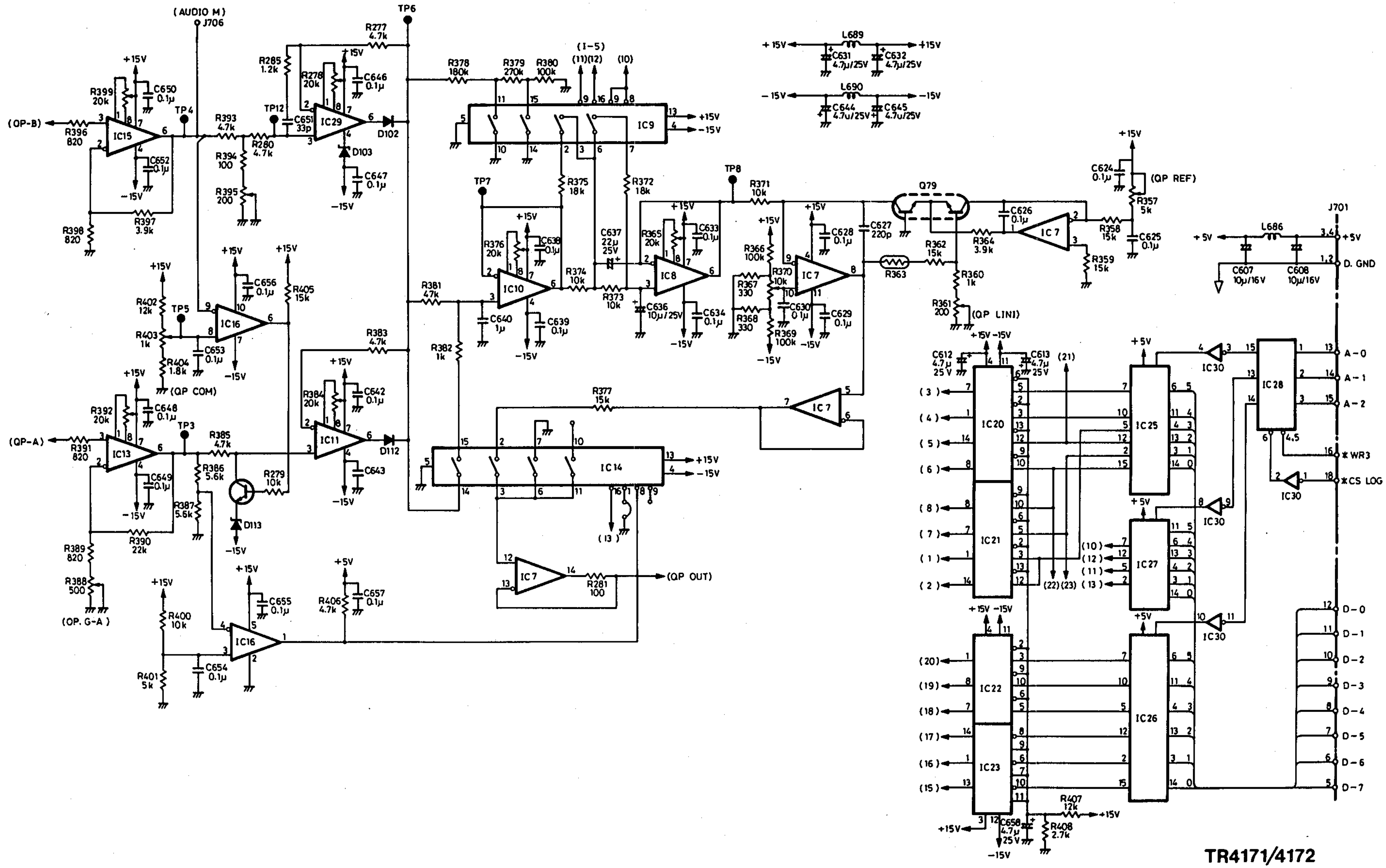


0253503-028-A

TR4172/4171

(28) **LOG AMP**

BLP-010231 1/2

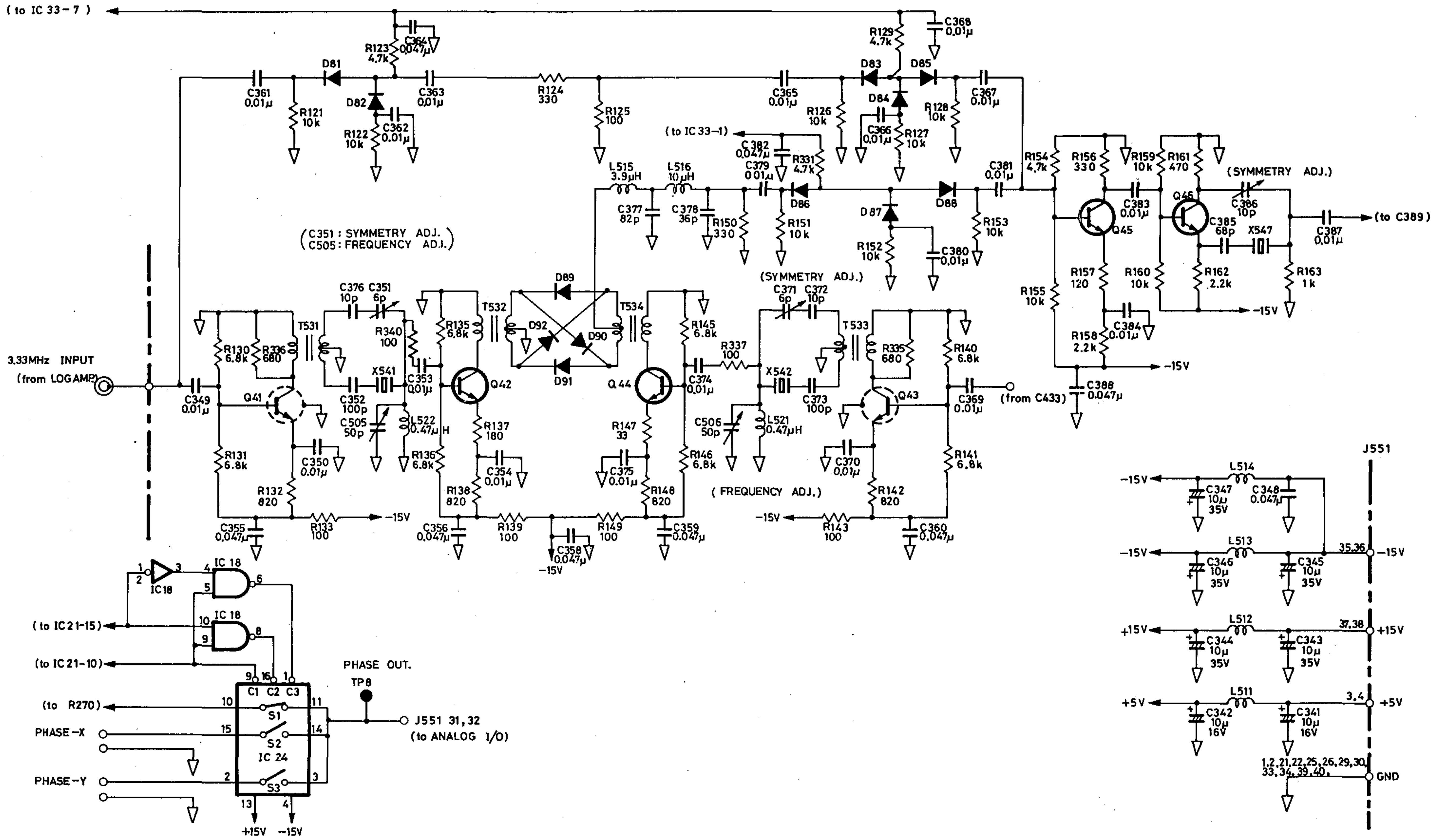


0253503-029-A

TR4171/4172

29 **LOG AMP**

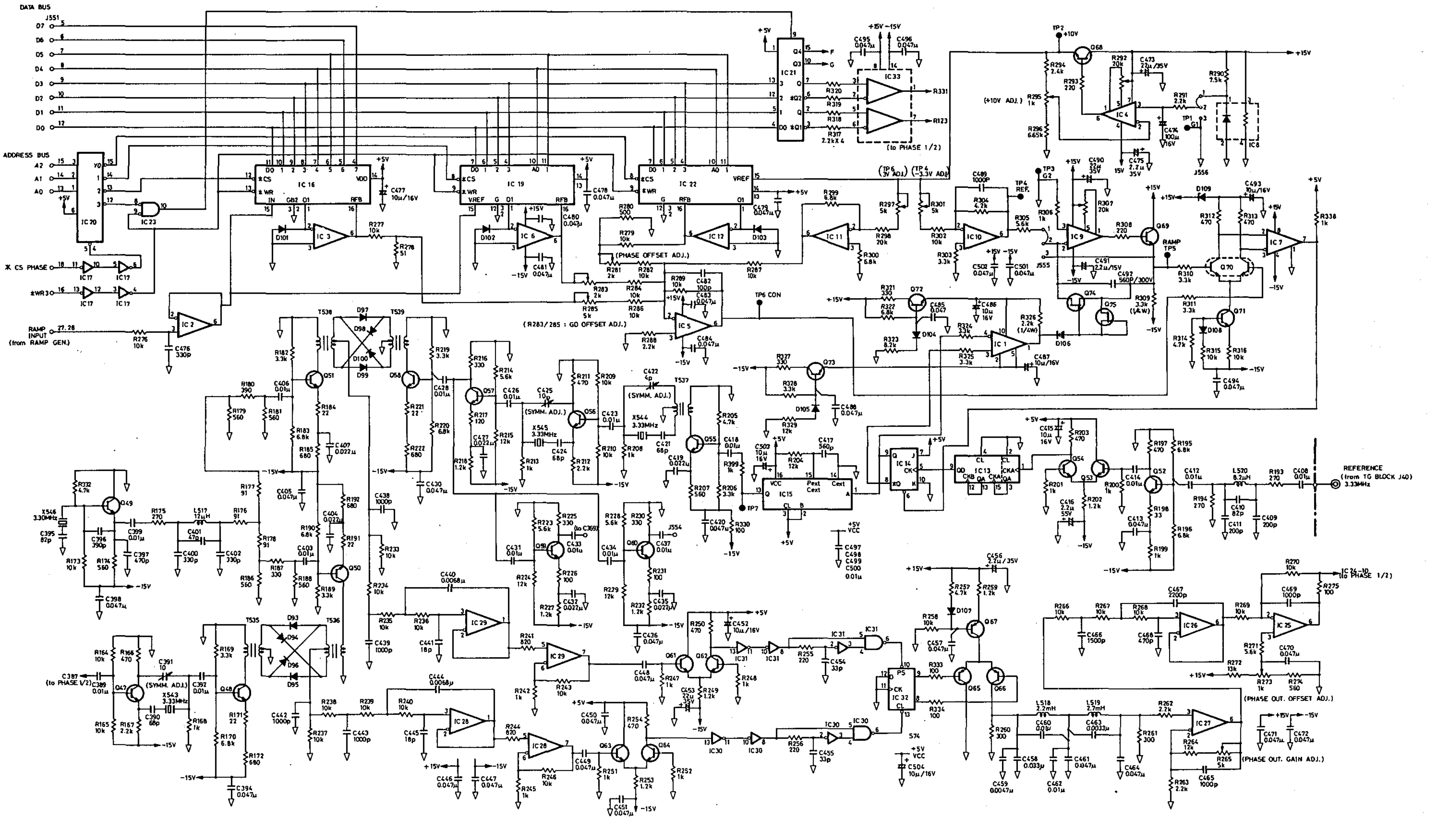
BLP-010231 2/2



0069305-031-C
0253503-030-A

30 TR4171
31 TR4172

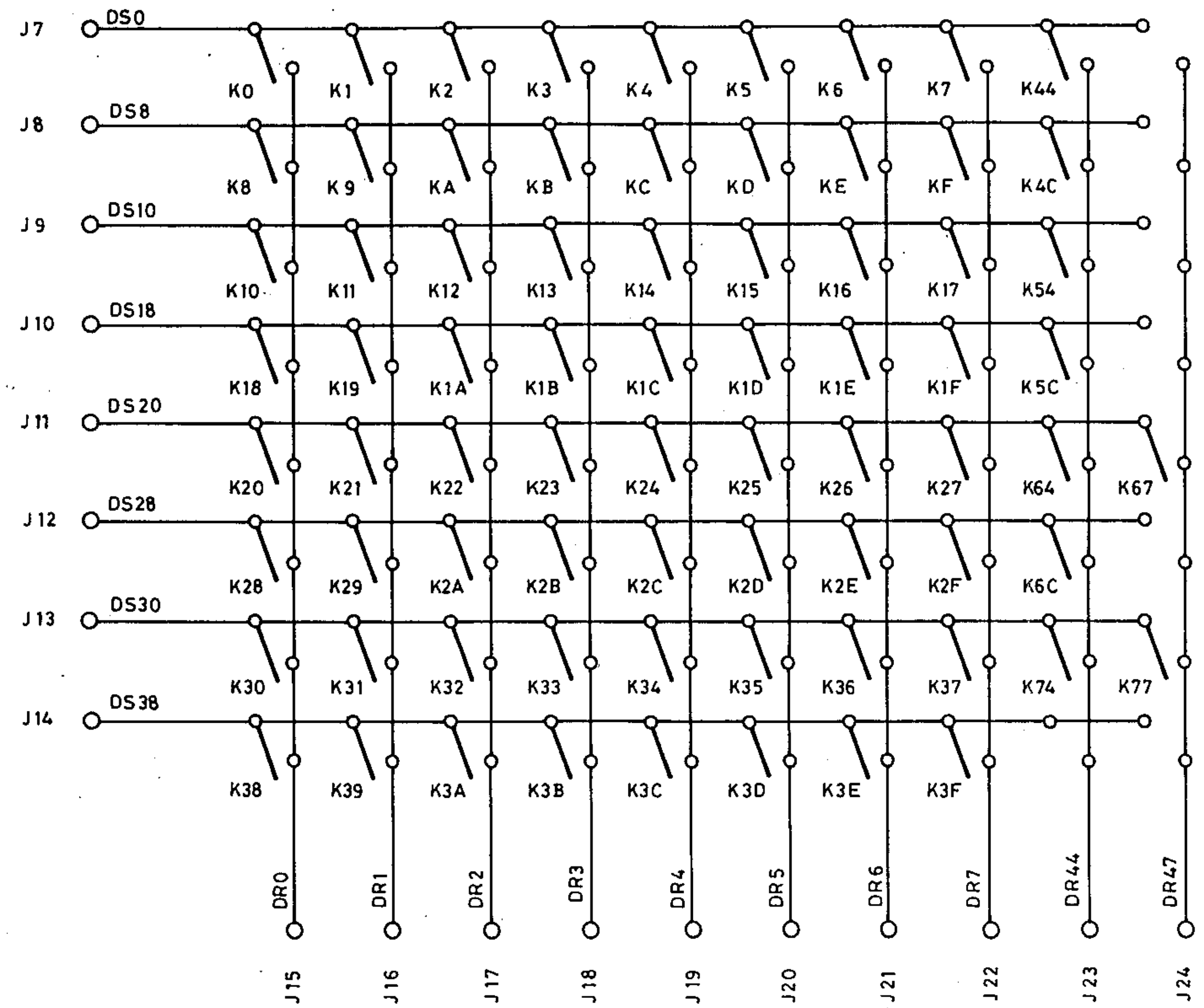
TR4172/4171
PHASE
BLP-010205 1/2

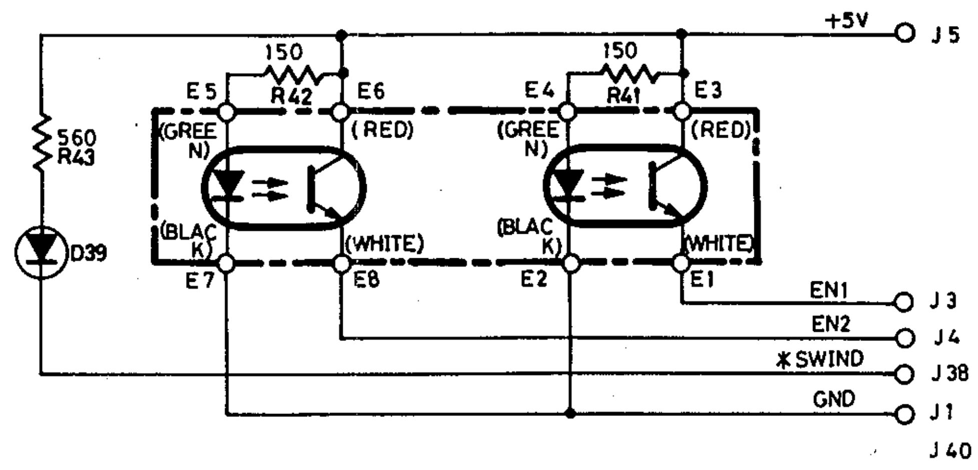


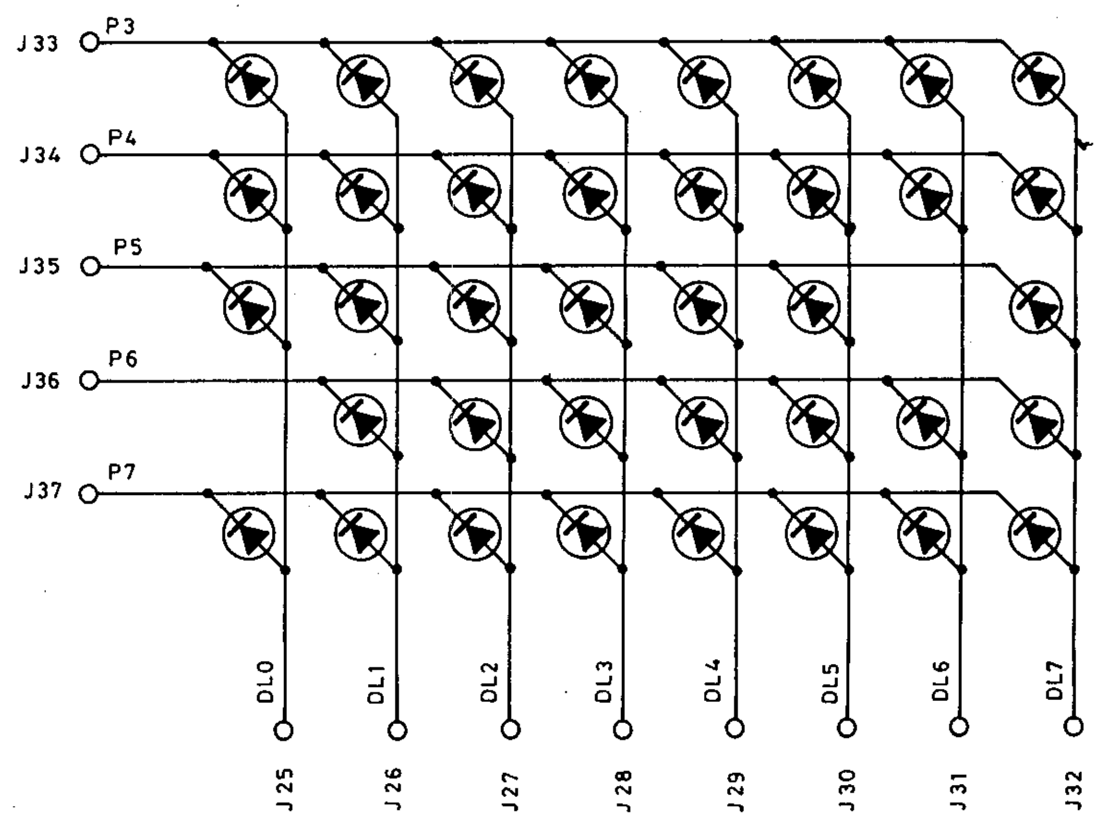
0069304-032-C
0253503-031-A

31 TR4171
32 TR4172

TR4172/4171
PHASE
BLP-010205 2/2



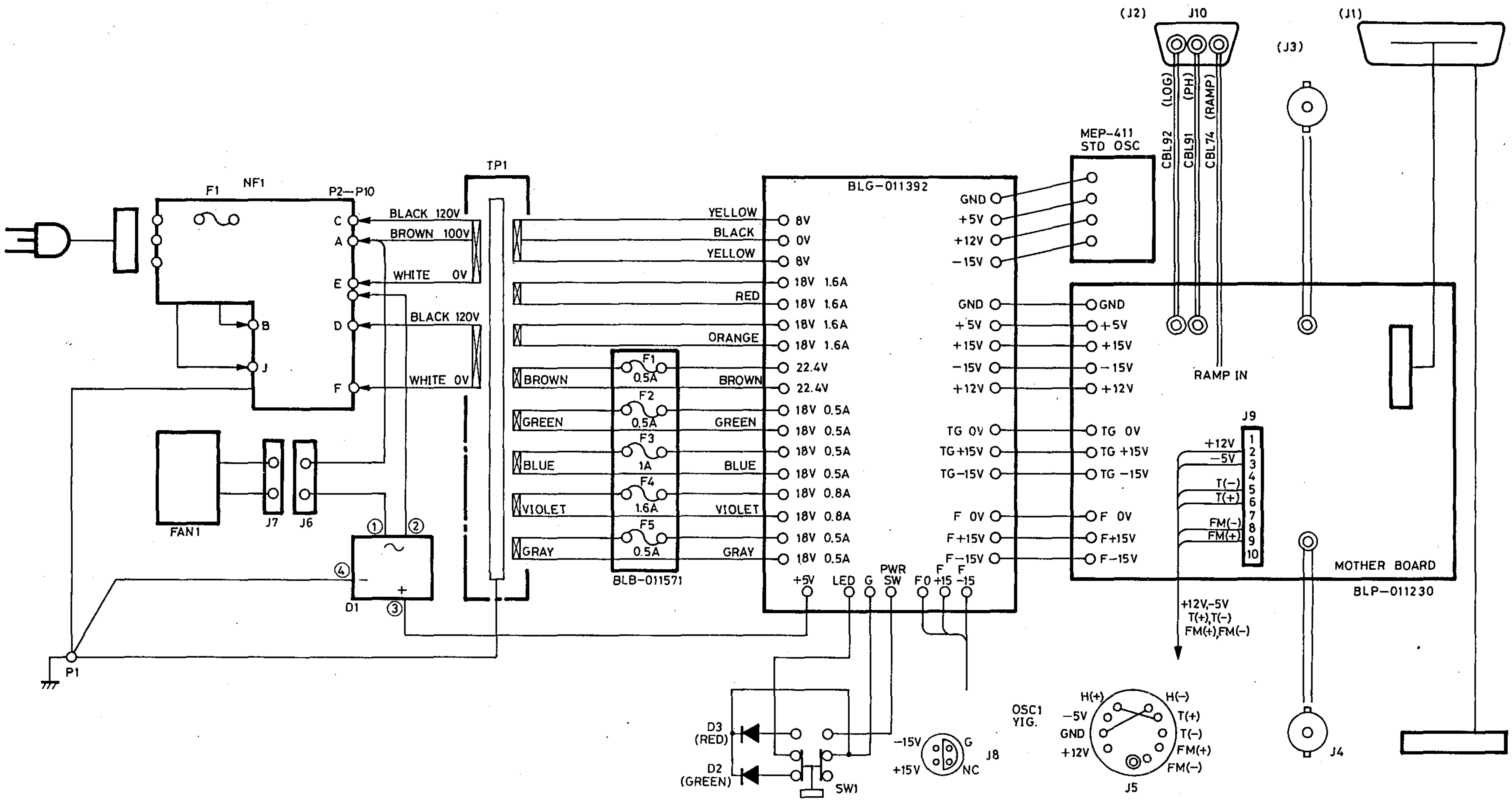




0253503 – 032 – A

32

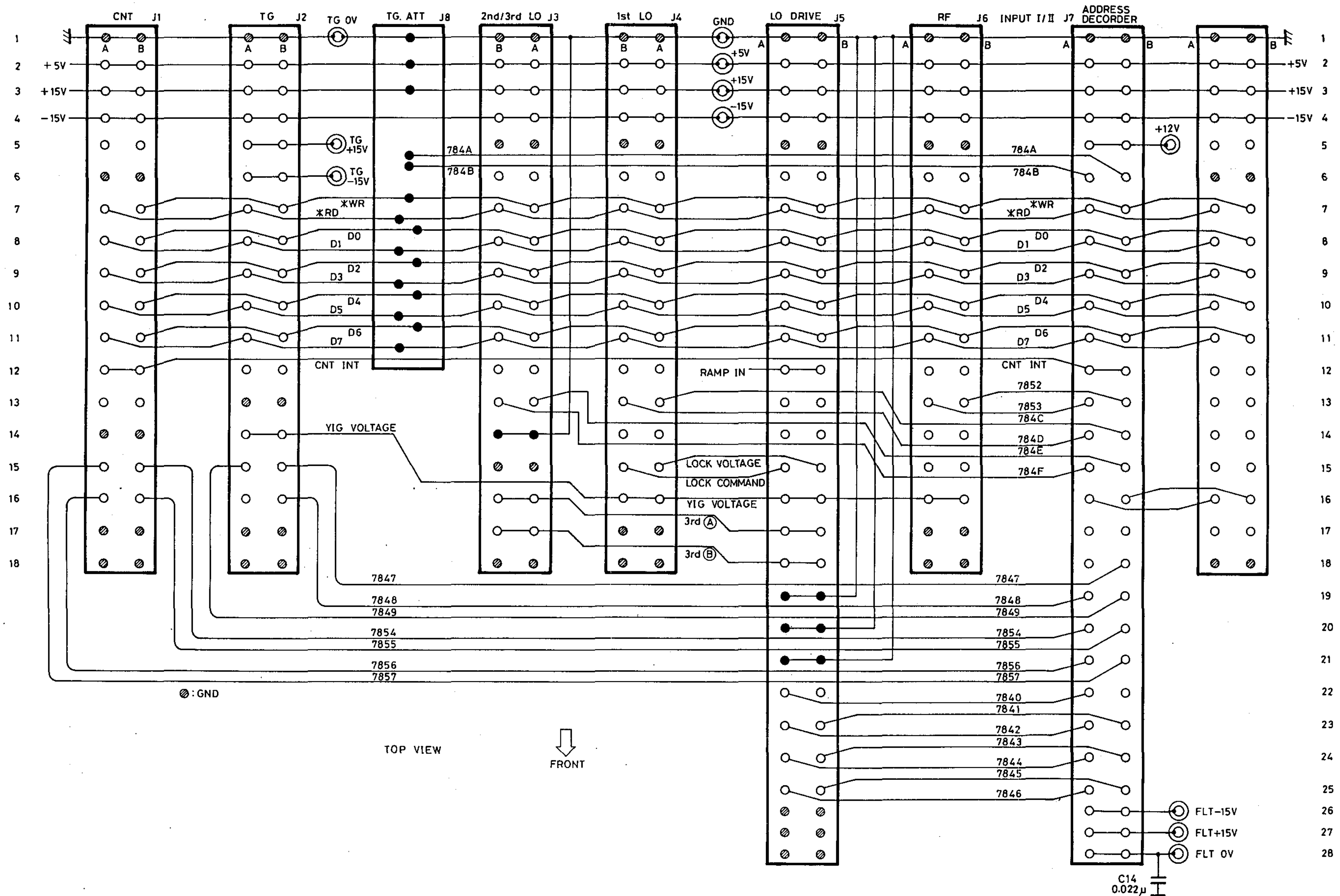
TR4171
DISPLAY KEY
BLG – 011268



0253503-033-A

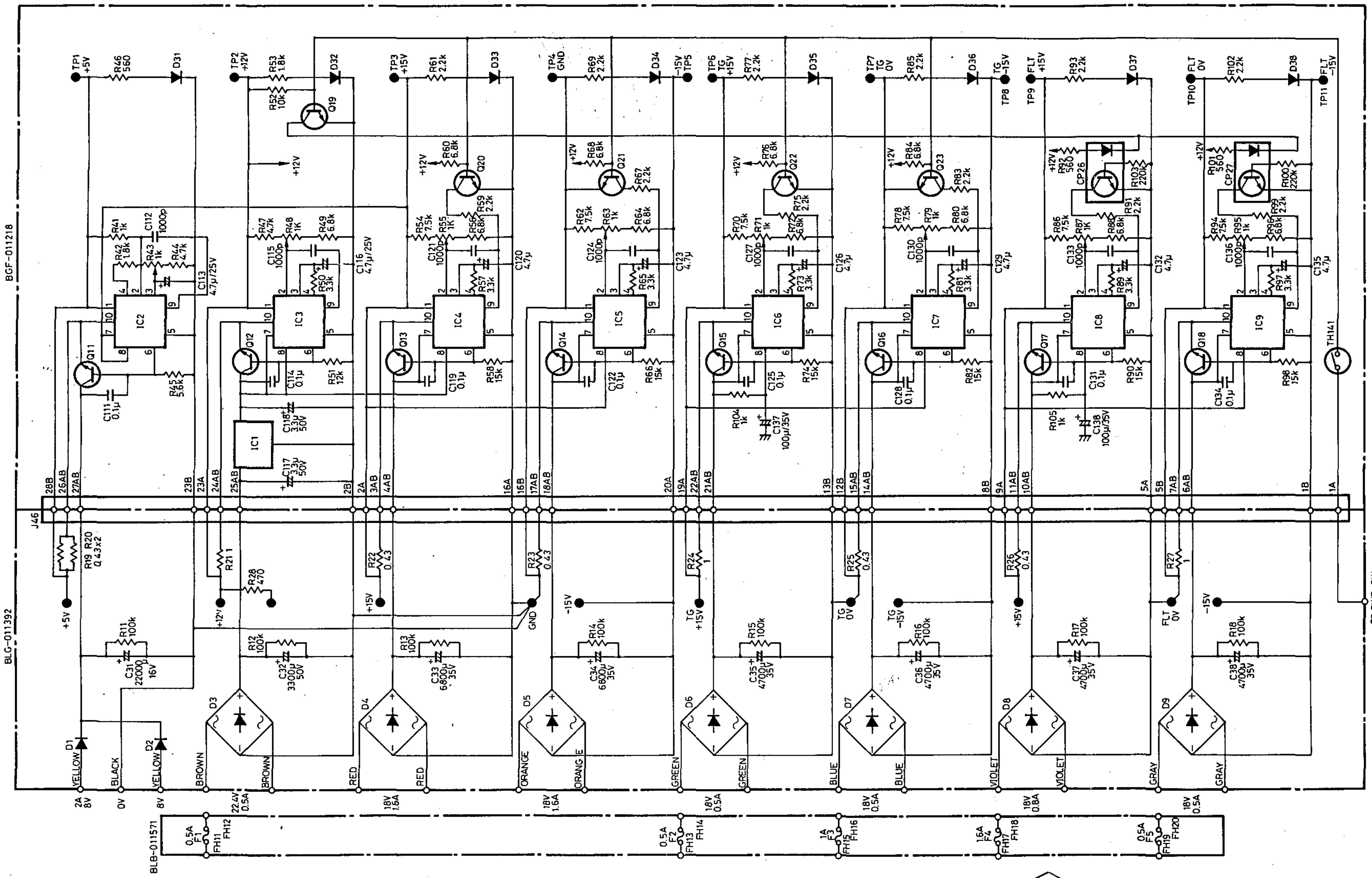
33 TR4171

RF SCHEMATIC SECTION



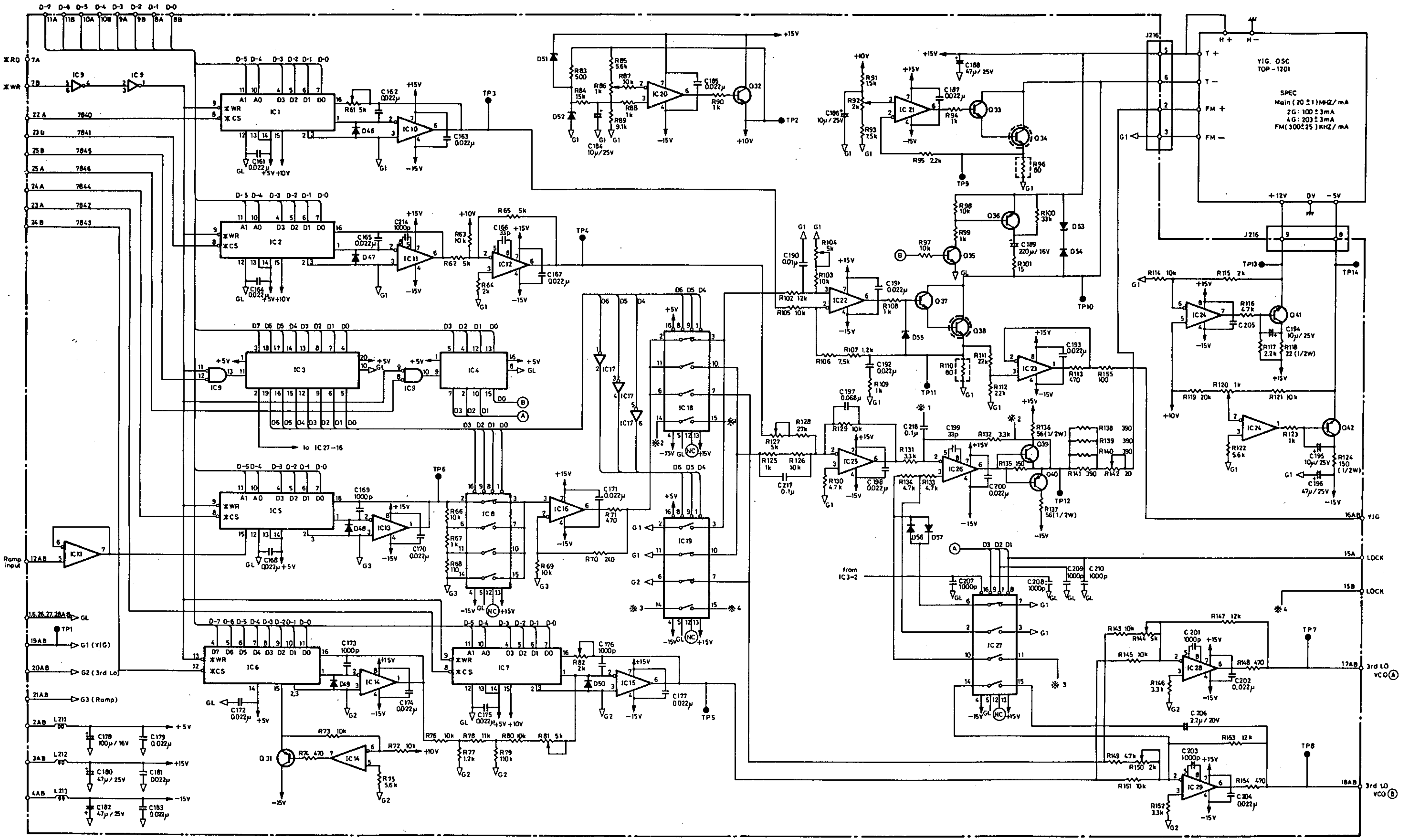
TR4171
34
MOTHER BOARD
BLP−011230

0253503-034-A



35 TR4171
POWER SUPPLY SECTION
BLB−011571 / BLG−011392 / BGF−011218

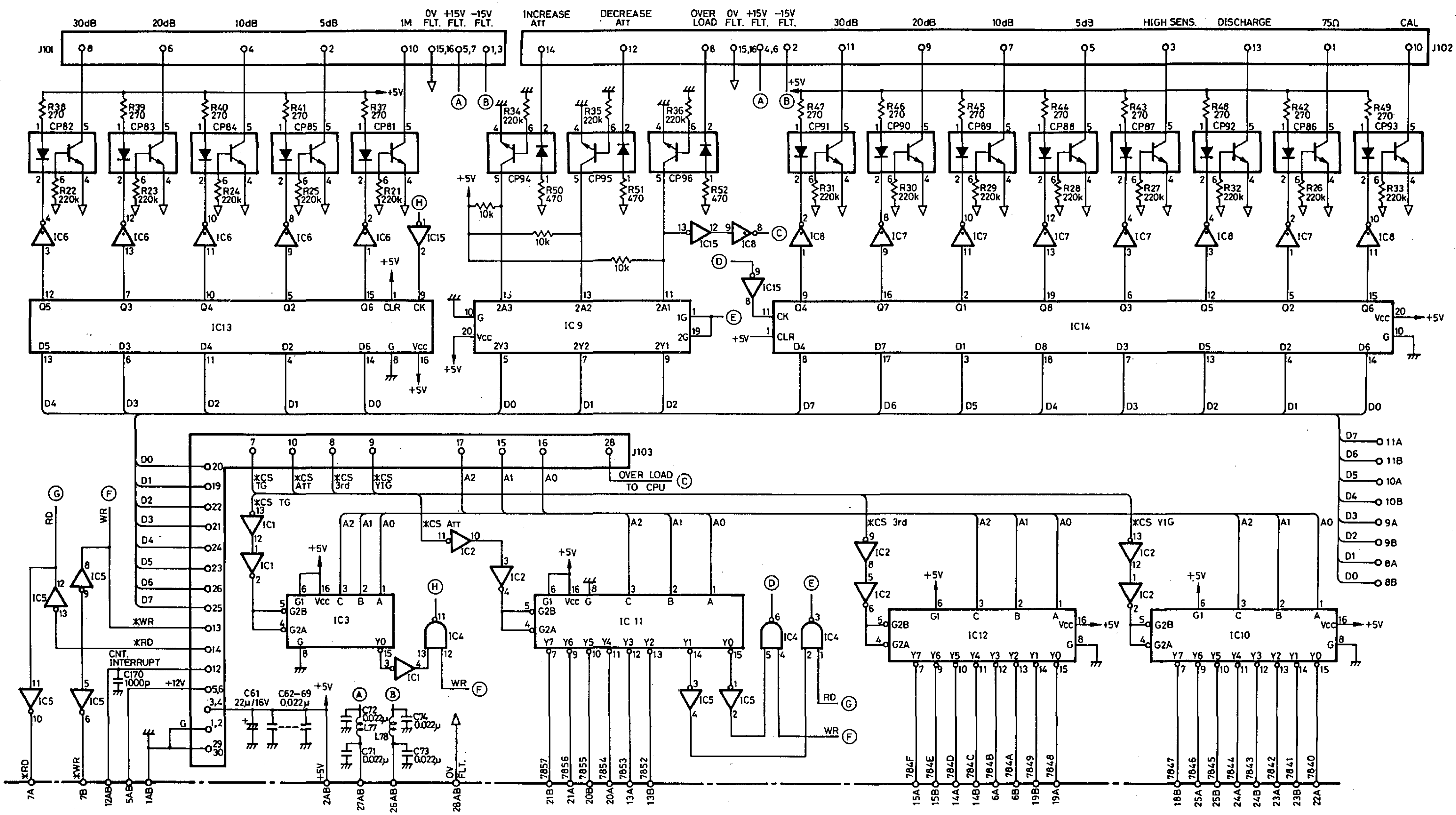
0753503-035-A



36

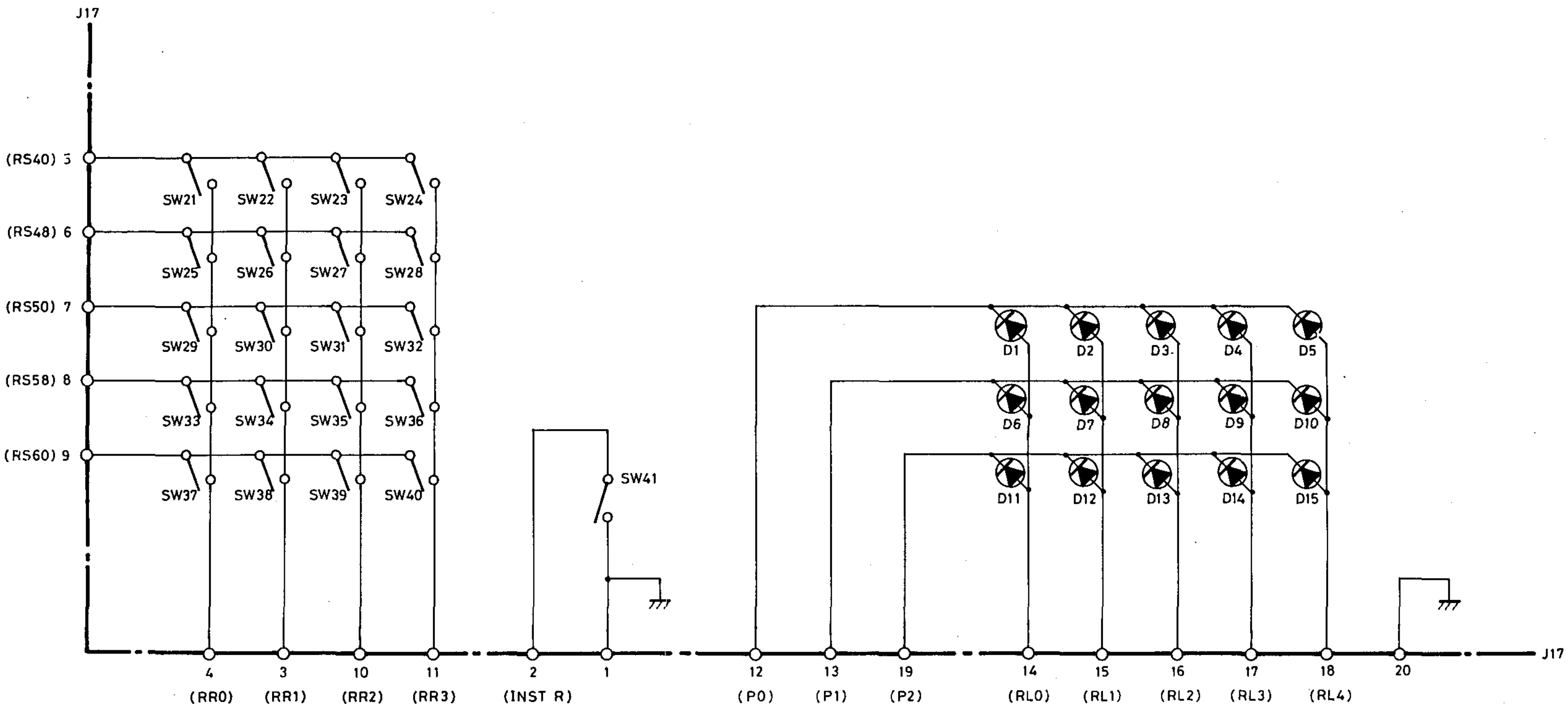
TR4171
LO DRIVE
BGN-011225

0253503-036-A



TR4171
ADDRESS DECORDER
BGN−011226

0253503-037-A



SW21 : 75Ω (TG OUTPUT)
SW22 : LCL
SW23 : NS/
SW24 : G.D. OFF SET
SW25 : 50Ω (TG OUTPUT)
SW26 : TG LEVEL
SW27 : DEG/
SW28 : PHASE OFFSET
SW29 : PHASE
SW30 : DELAY

SW31 : MA SET/MB SET
SW32 : HIGH SENS.
SW33 : MAG.
SW34 : SPA
SW35 : AUTO RANGE
SW36 : 50Ω (INPUT)
SW37 : 75Ω (INPUT)
SW38 : 1 MΩ(INPUT)
SW39 : ATT
SW40 : AUTO (ATT)
SW41 : MASTER RESET

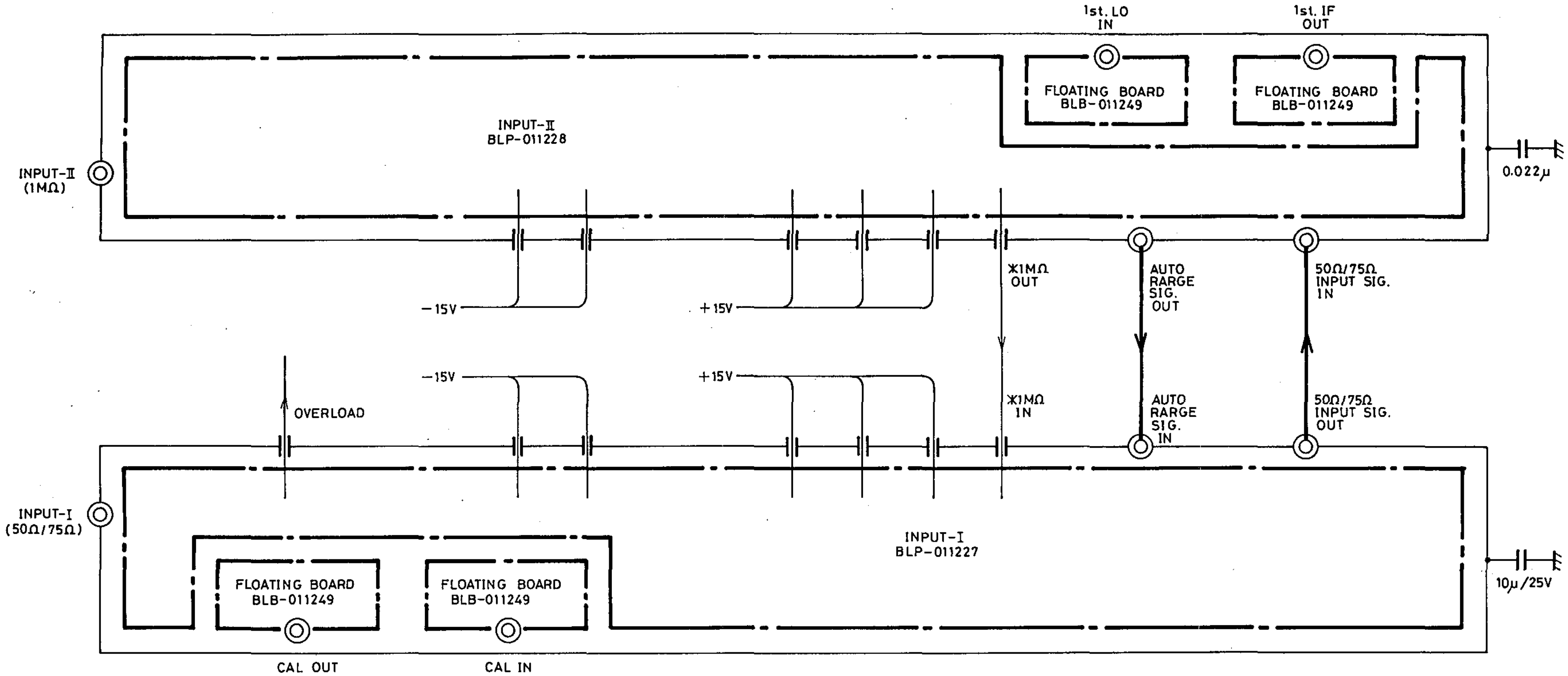
D1 : MA/MB SET
D2 : MAG
D3 : 75Ω (TG OUTPUT)
D4 : HIGH SENS.
D5 : DELAY
D6 : SPA
D7 : 1MΩ (INPUT)
D8 : 50Ω (TG OUTPUT)
D9 : AUTO RANGE
D10 : PHASE

D11 : ATT
D12 : 50Ω (INPUT)
D13 : 75Ω (INPUT)
D14 : MA/MB
D15 : REMOTE

0253503-038-A

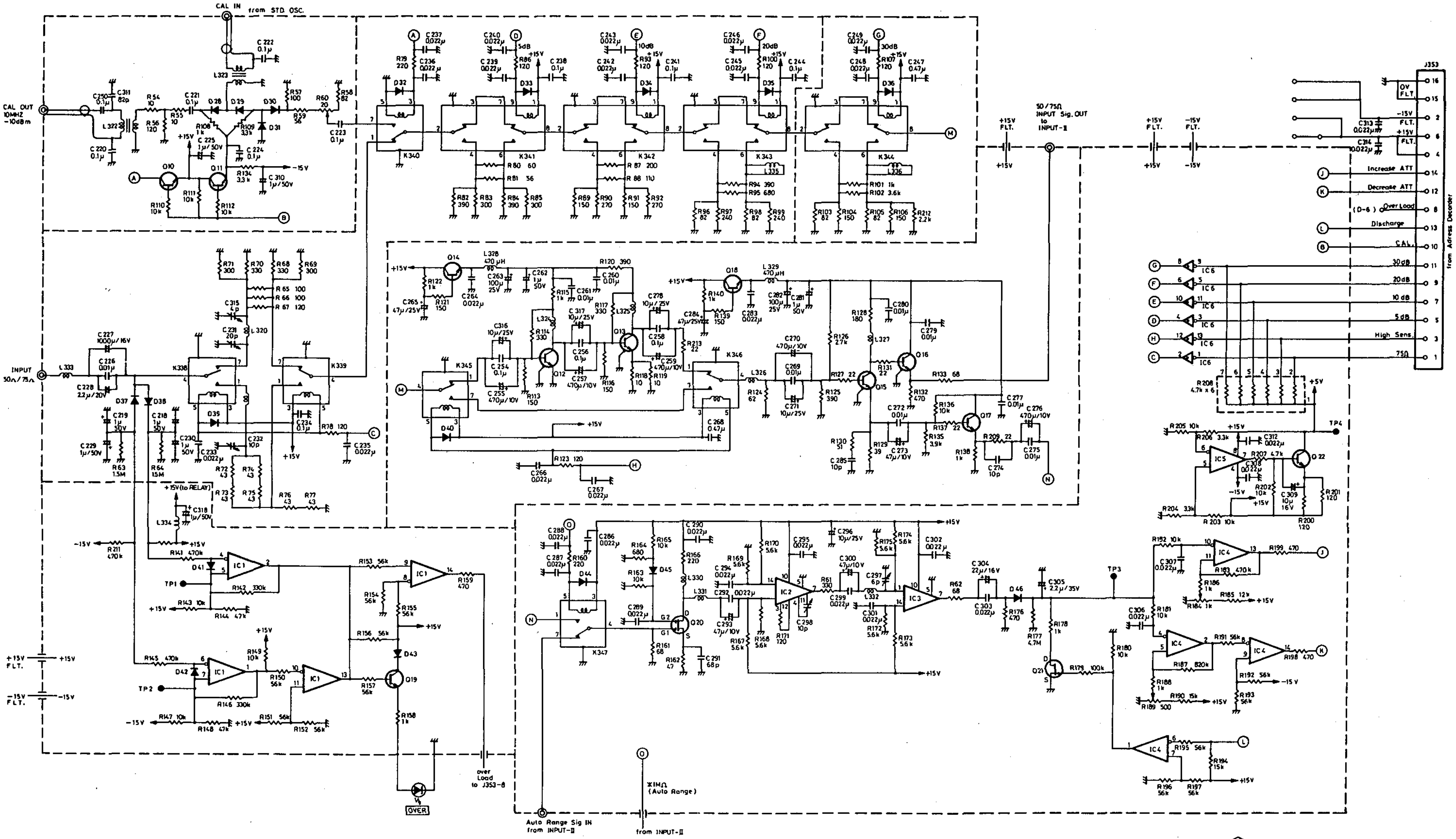
38

TR4171
MEP−403
RF KEY
BLN−011229



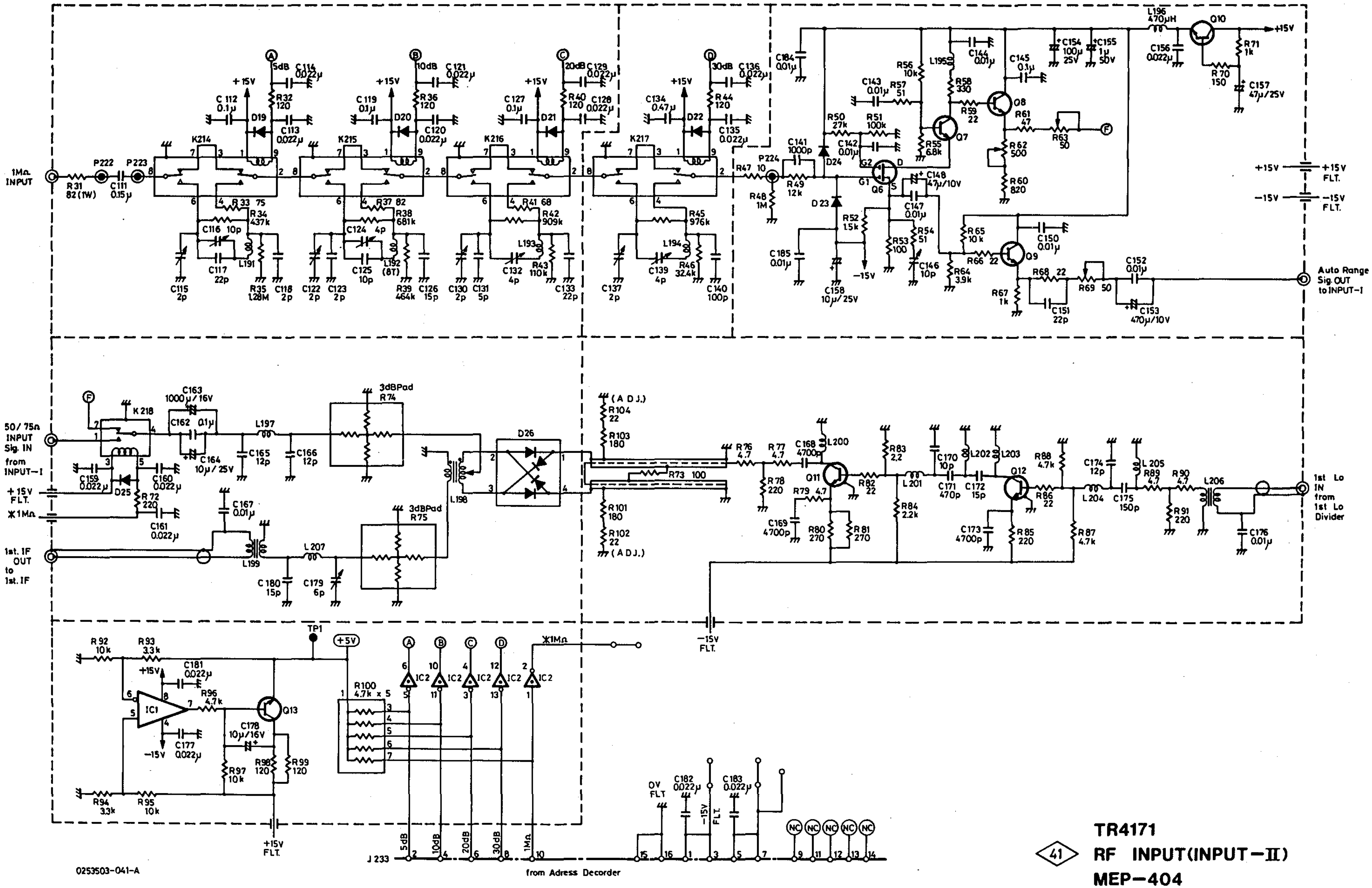
39 TR4171
MEP-404
RF INPUT BLOCK

C253503-039-A



TR4171
MEP−404
RF INPUT (INPUT−I)
BLP−011227

C253503-040-A



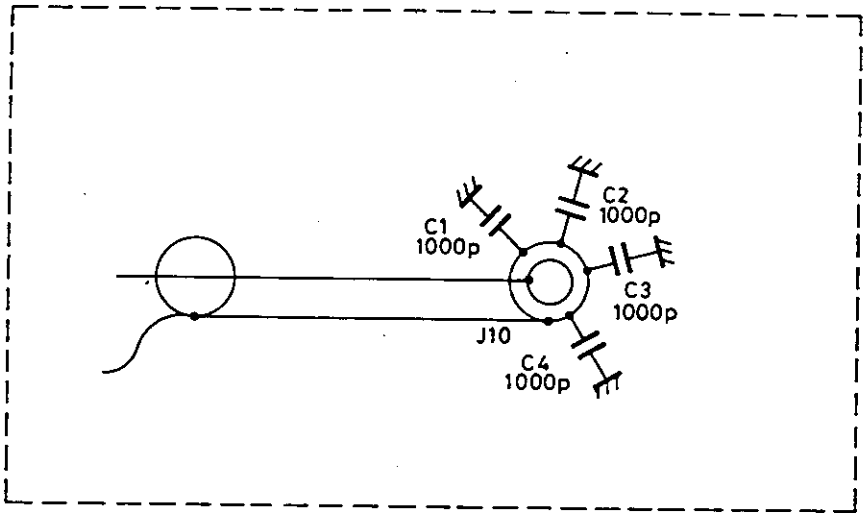
0253503-041-A

TR4171

41 **RF INPUT(INPUT-II)**

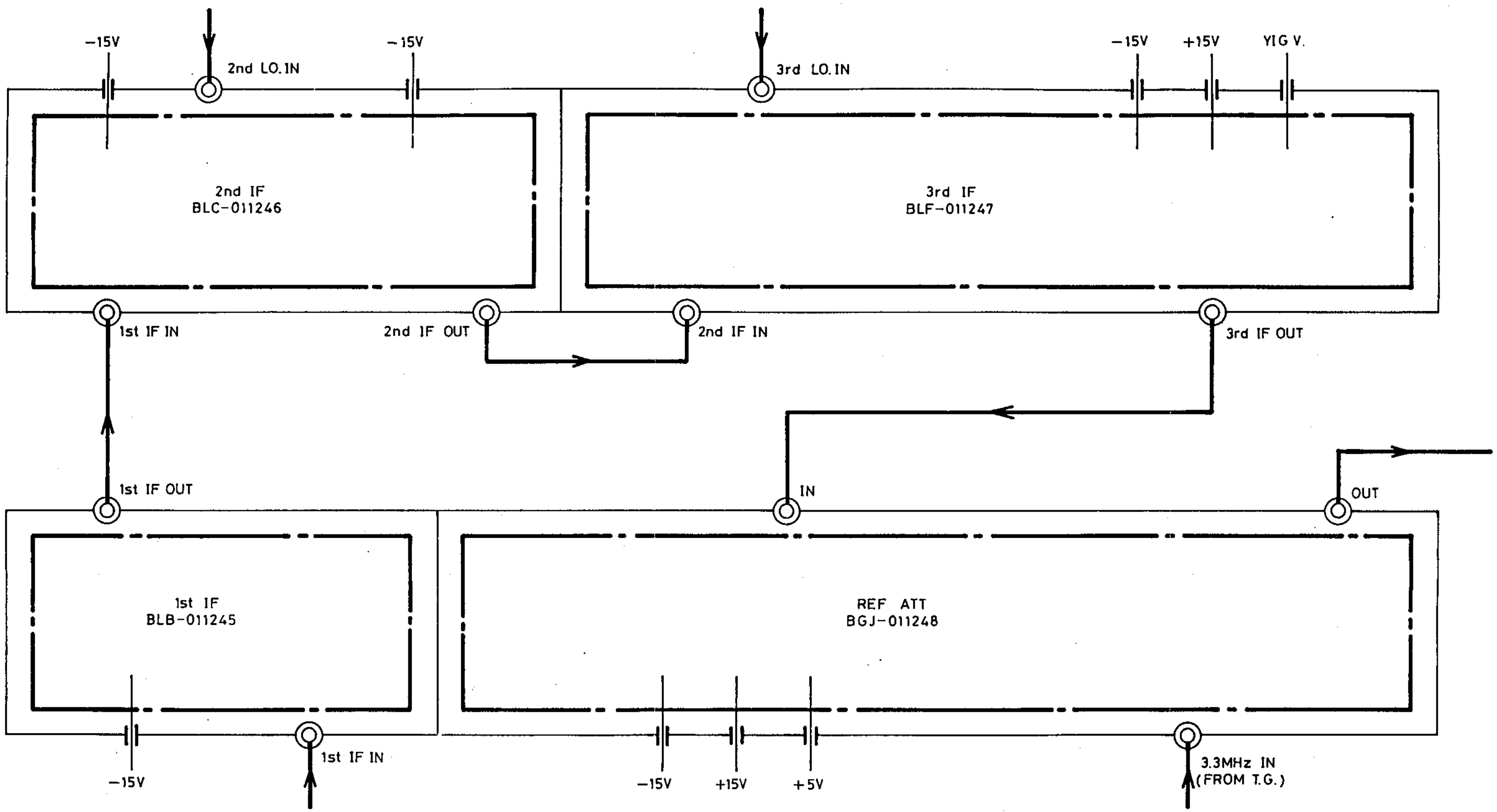
MEP-404

BLP-011228



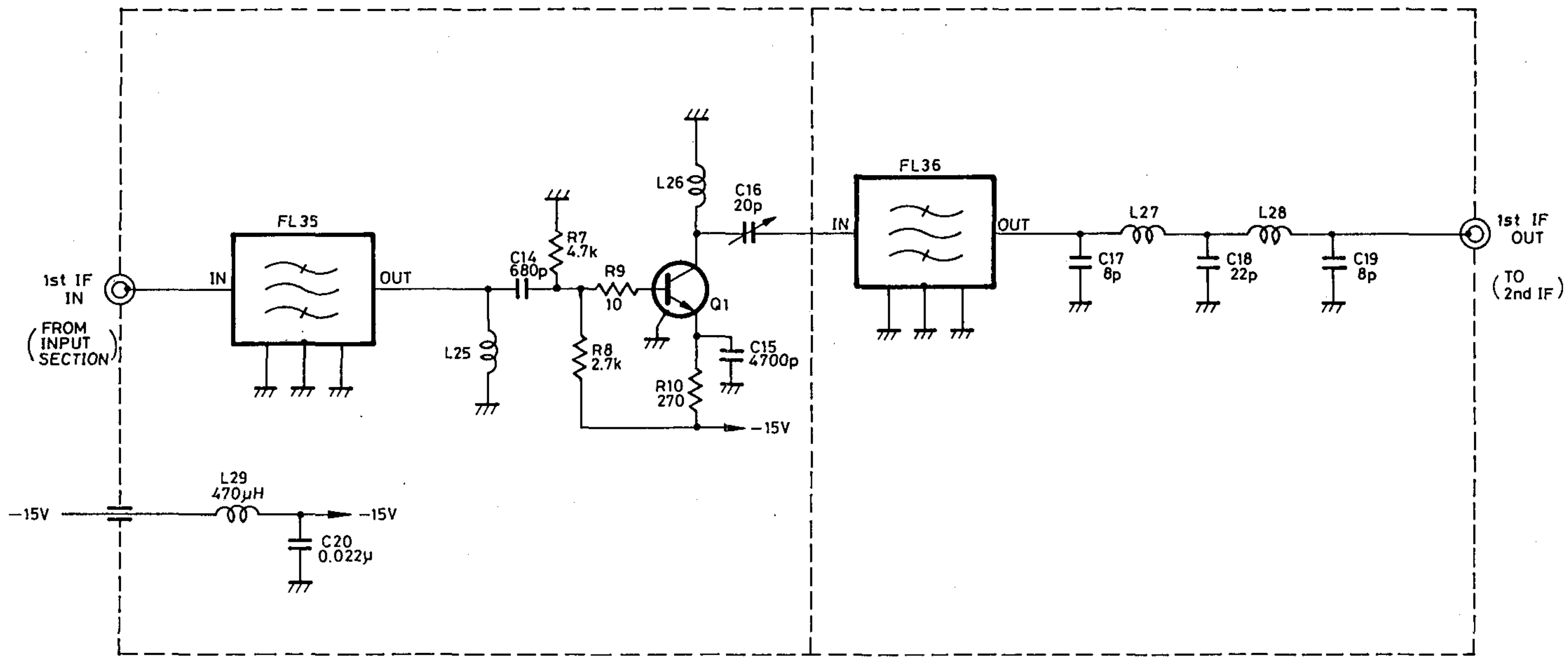
42 TR4171
MEP—404
RF INPUT
BLB—011249

0353503-042-A



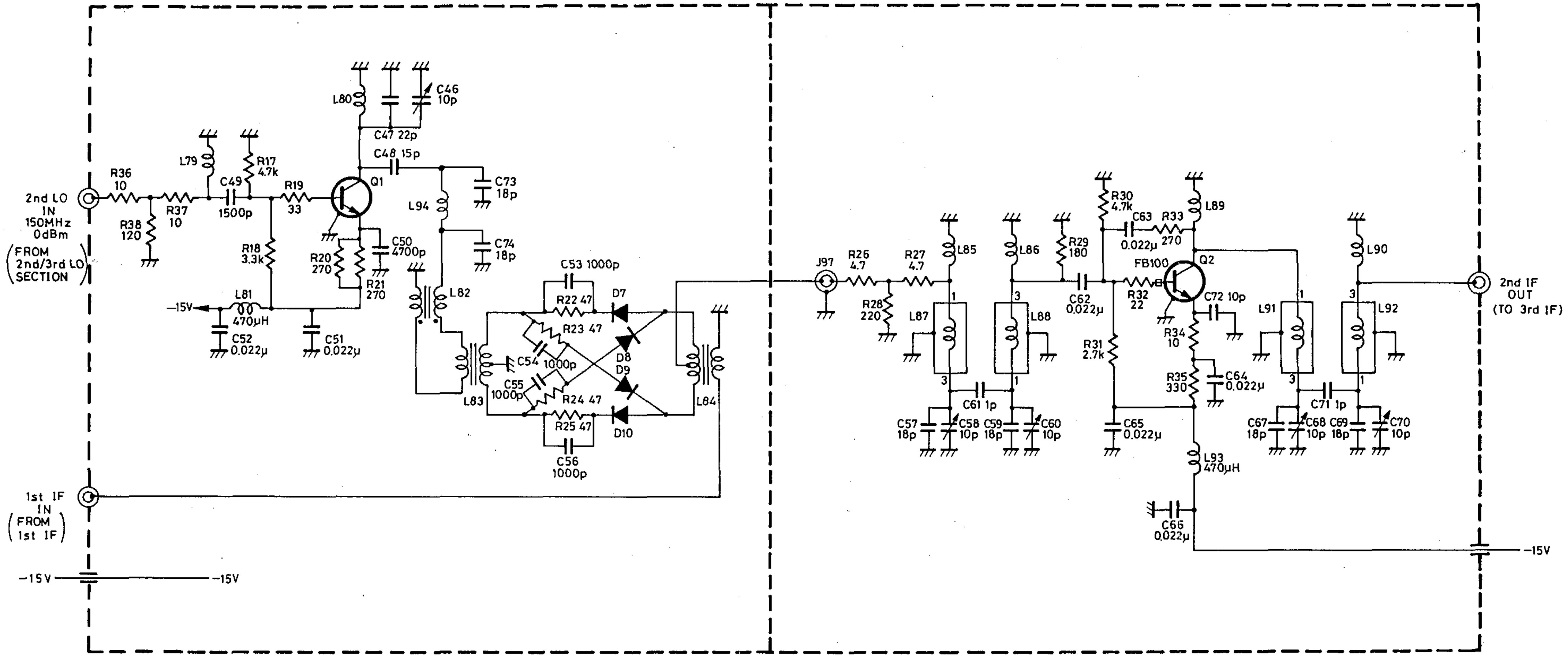
0253503-043-A

43 TR4171
MEP-405
RF BLOCK



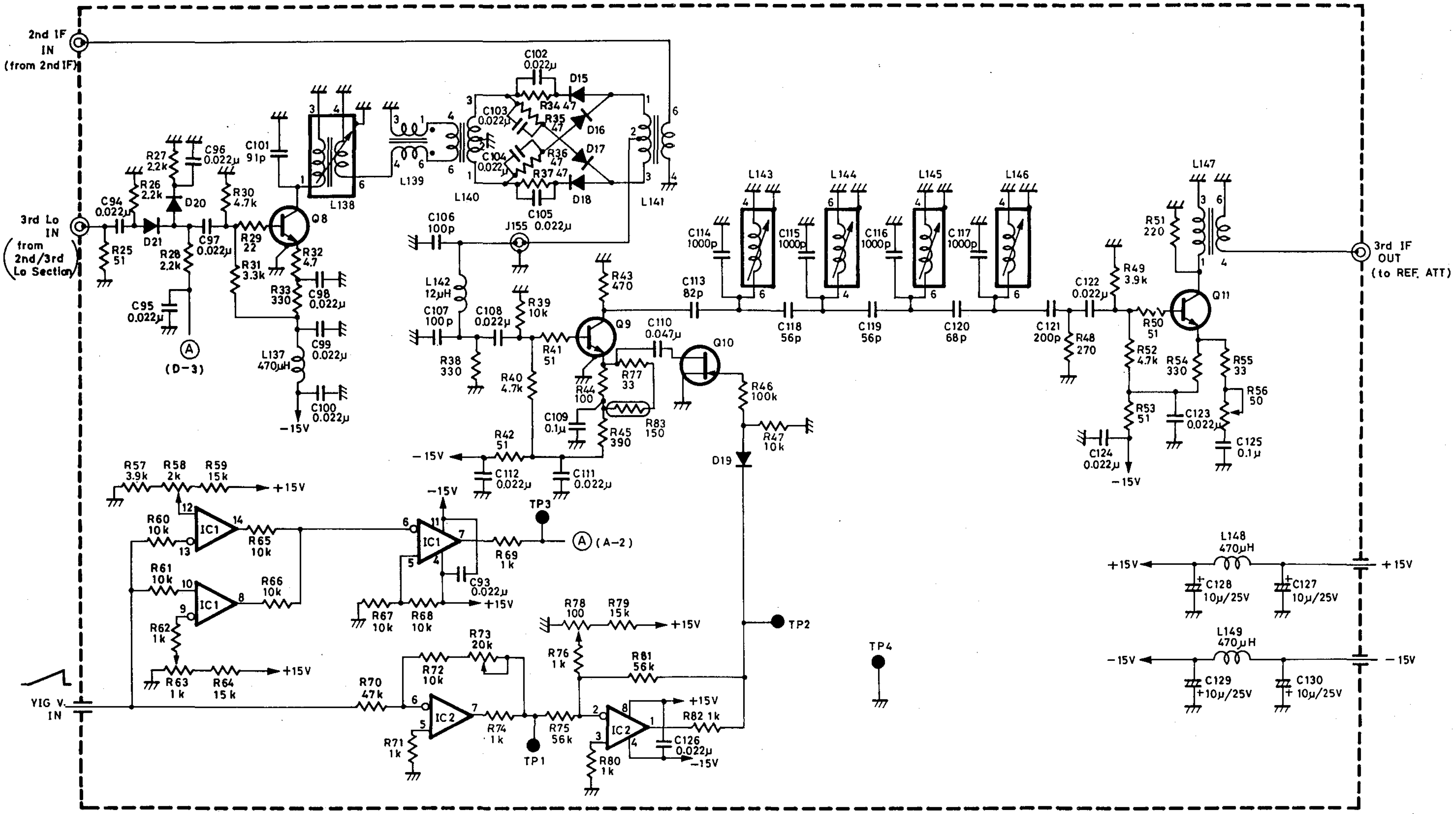
0253513-044-A

TR4171
MEP−405
RF (1st IF)
BLB−011245



0253503-045-A

45 TR4171
MEP-405
RF (2nd IF)
BLC-011246



0253503-046-A

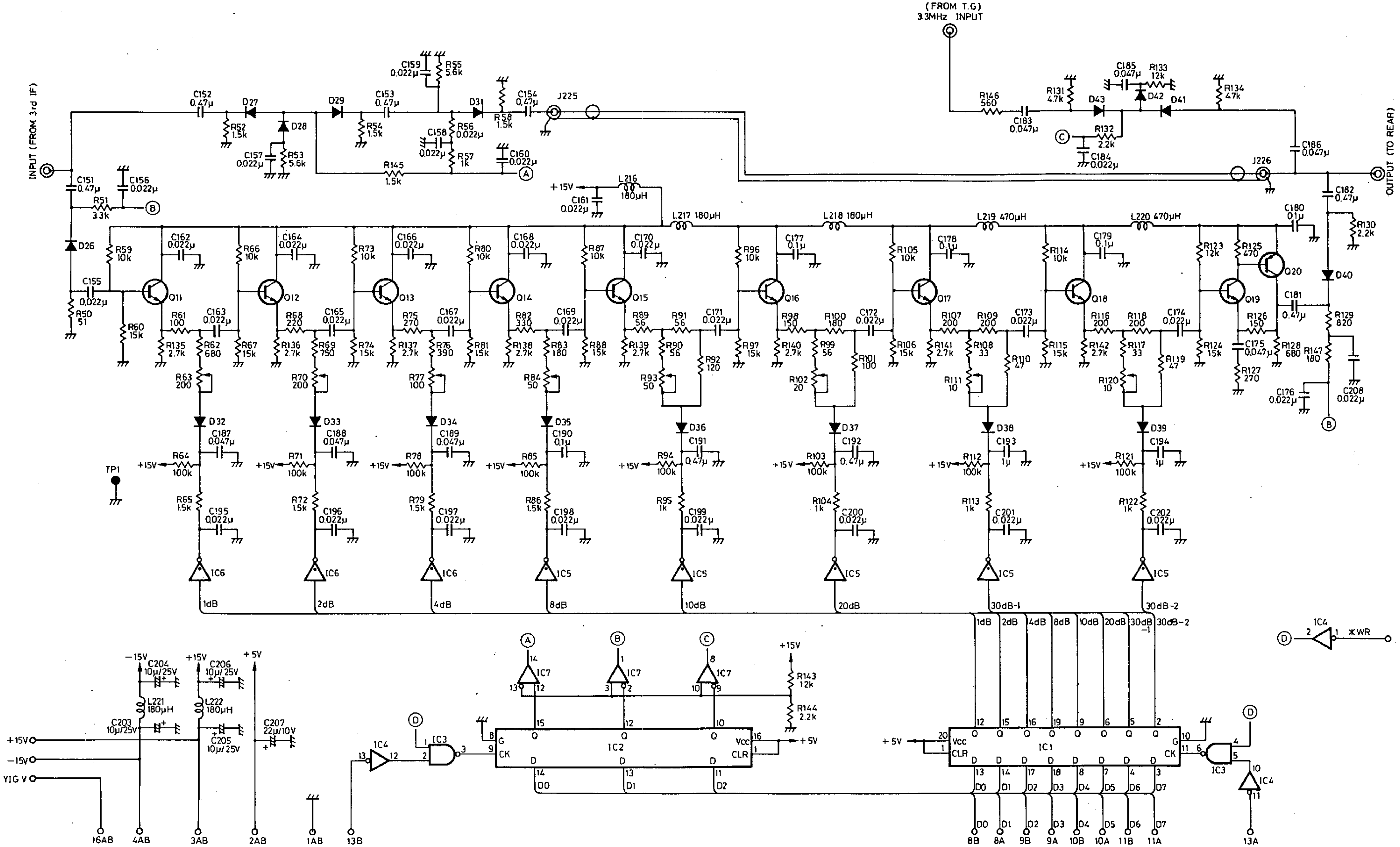
46

TR4171

RF(3rd IF)

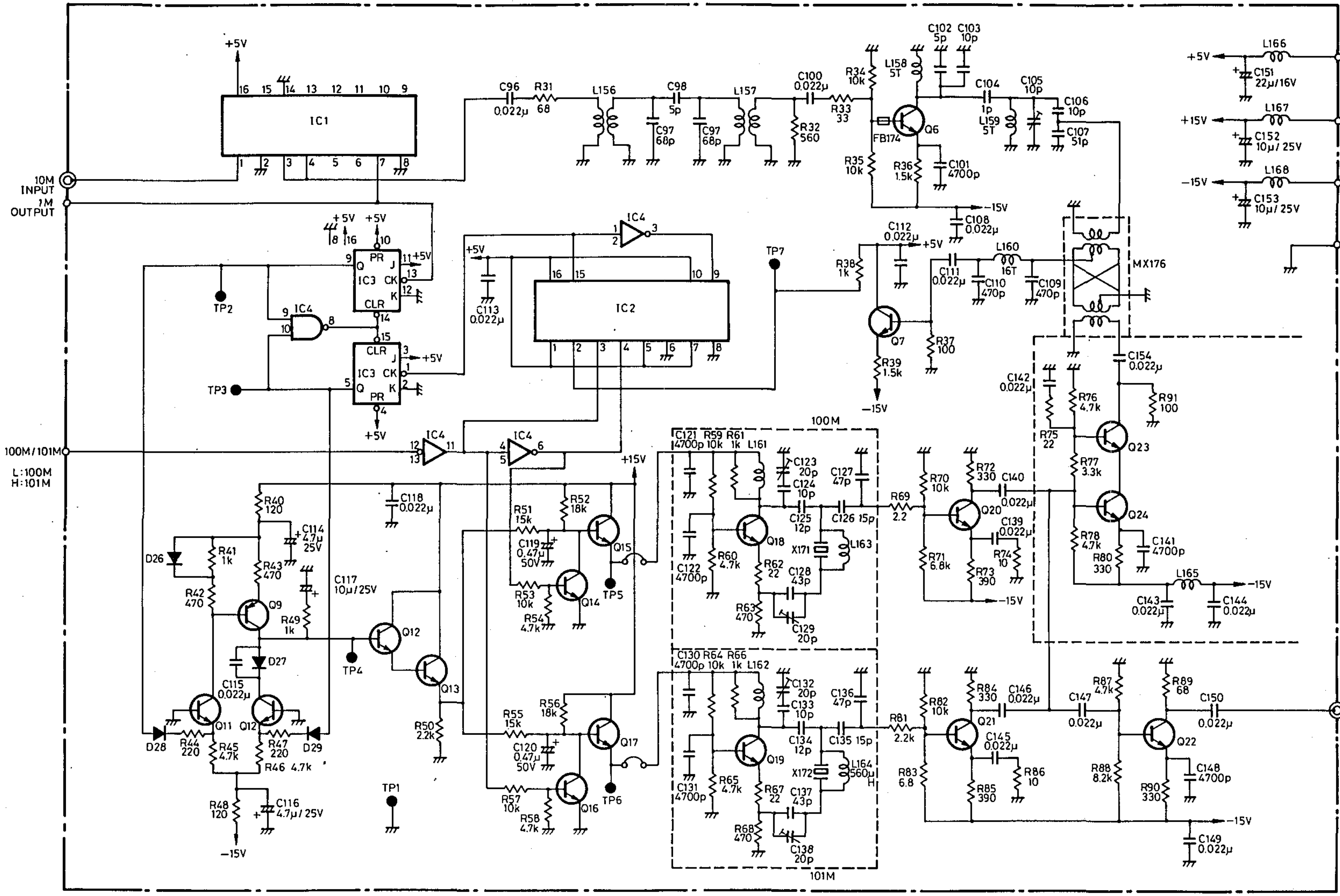
MEP-405

BLF-011247



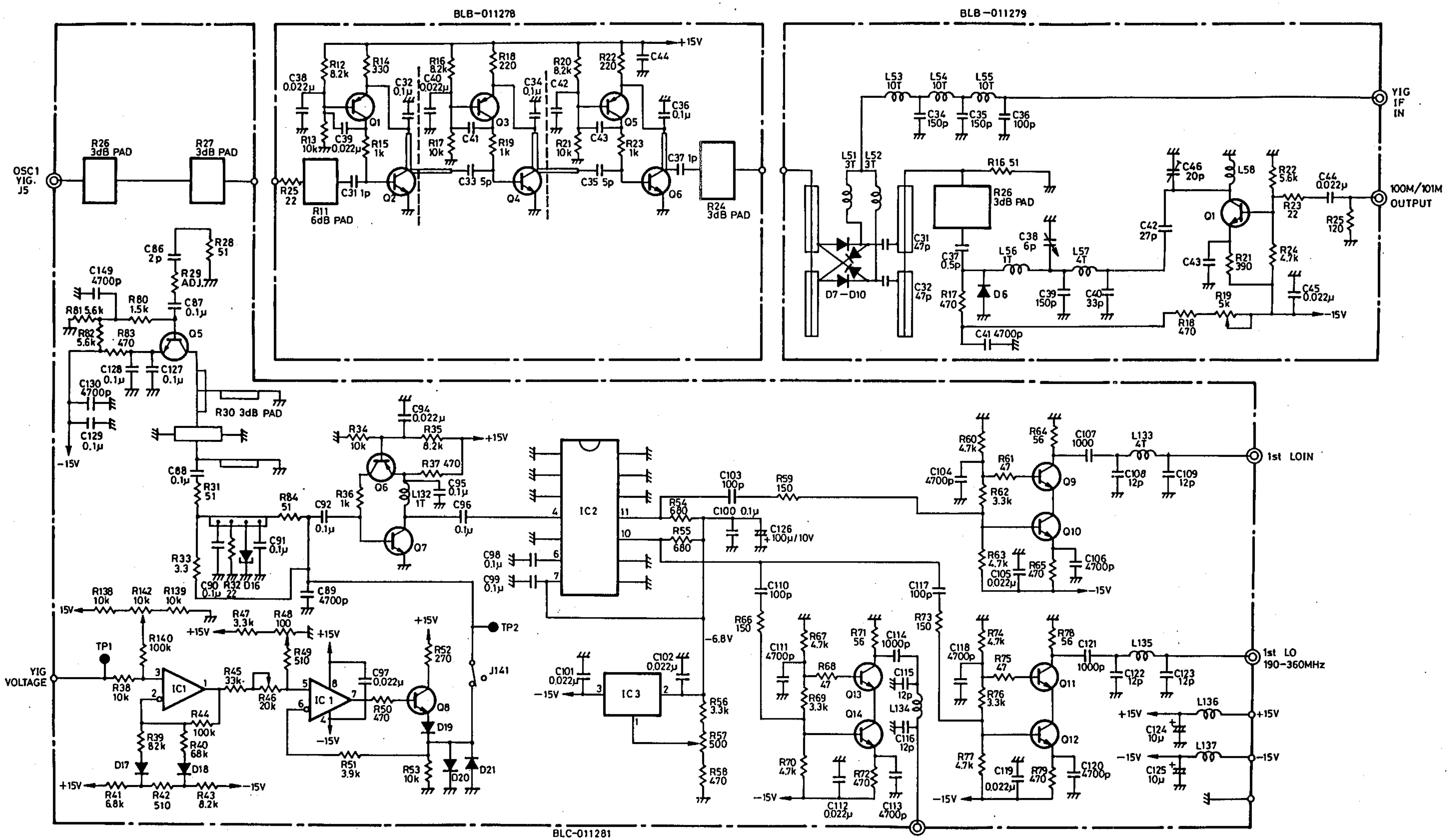
47 TR4171
MEP−405
RF (REF.ATT)
BGJ−011248

0253503-047-A



48 TR4171
MEP-406
1st LO (100M/101M OSC)
BLC-011282

025303-048-A



0253503-049-A

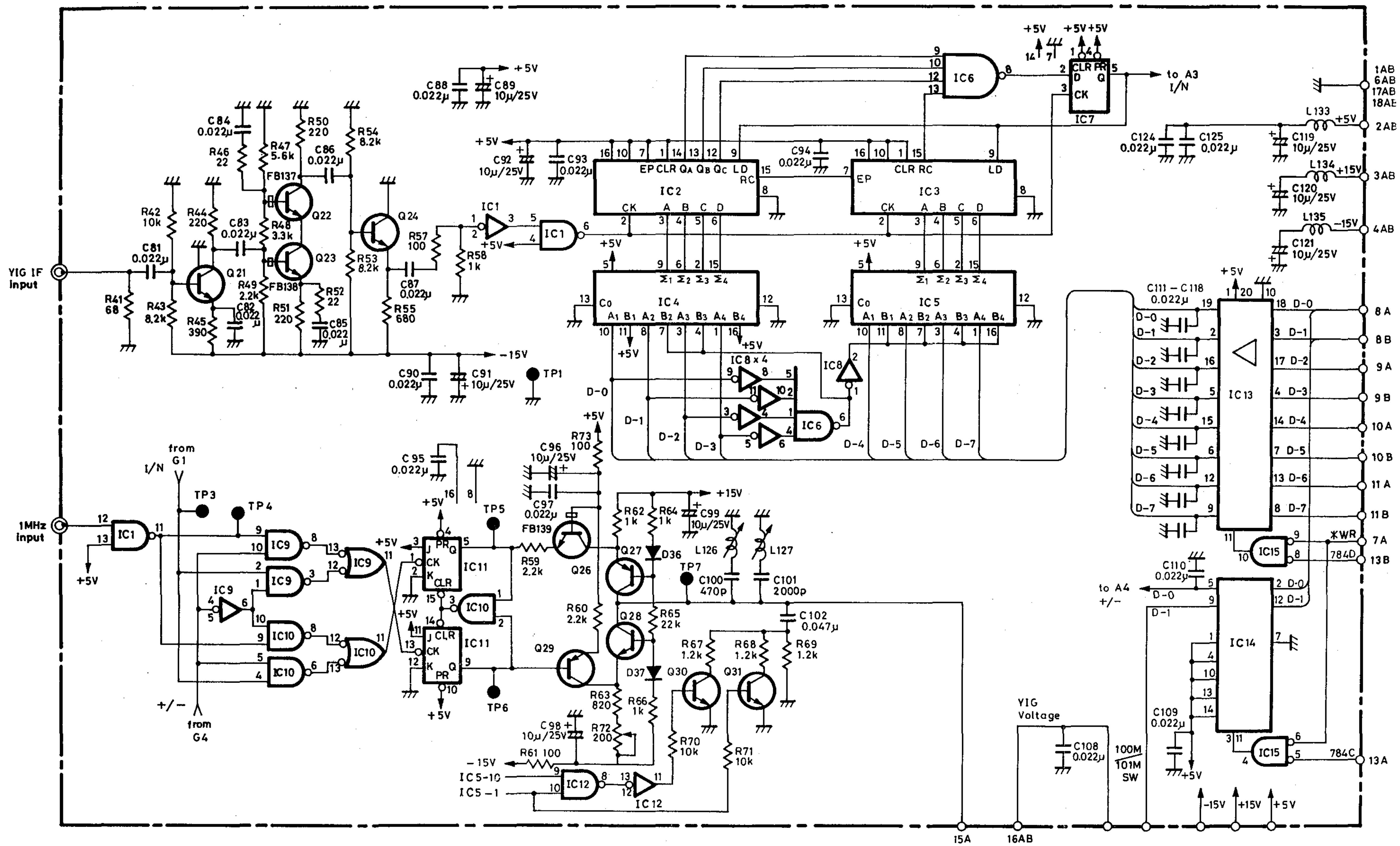
49

TR4171

MEP-406

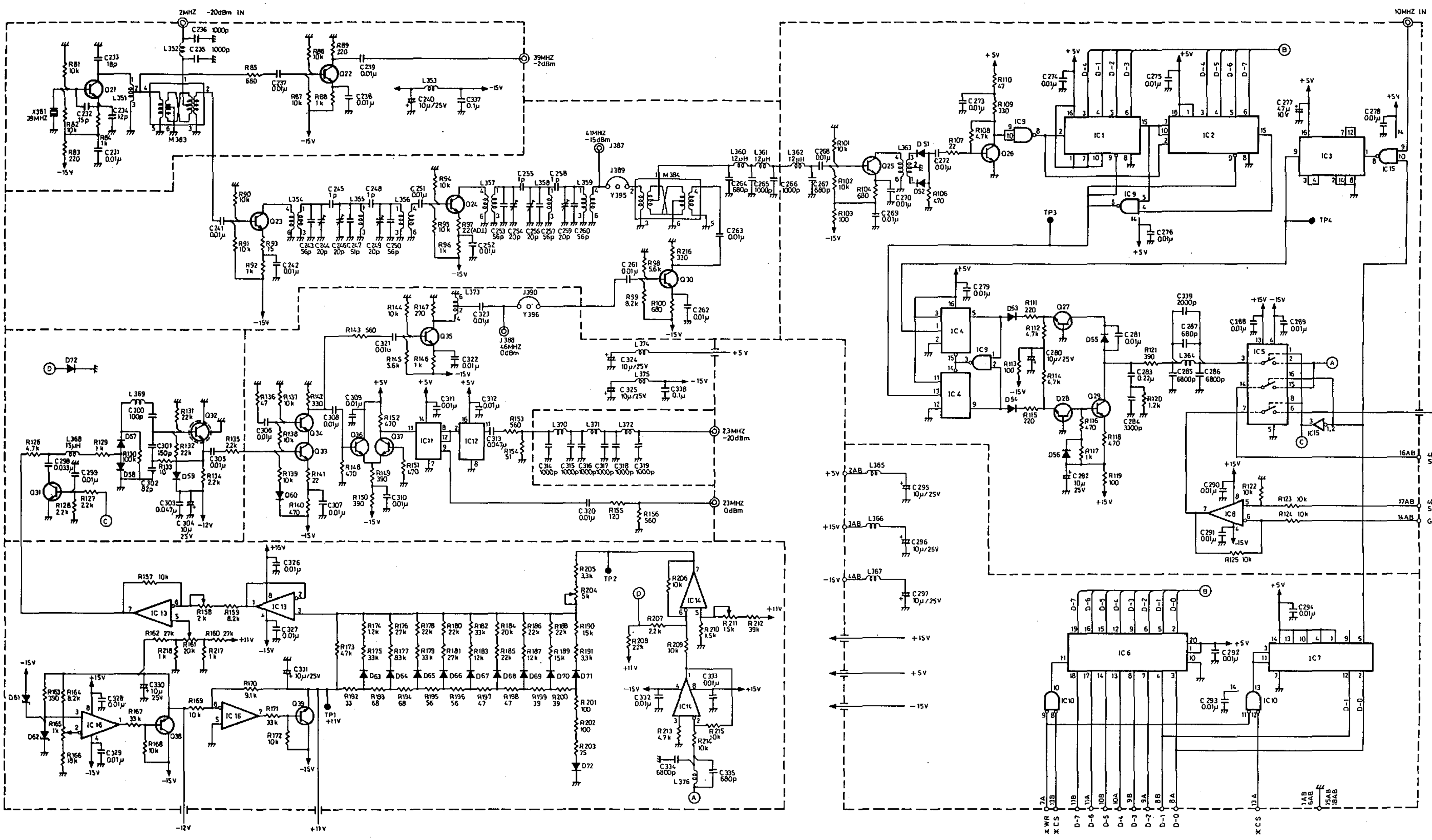
1st LO (ISO AMP./YIG. DIVIDER / YIG. IF)

BLB-011278 / BLB-011279 / BLC-011281



0253503−050−A

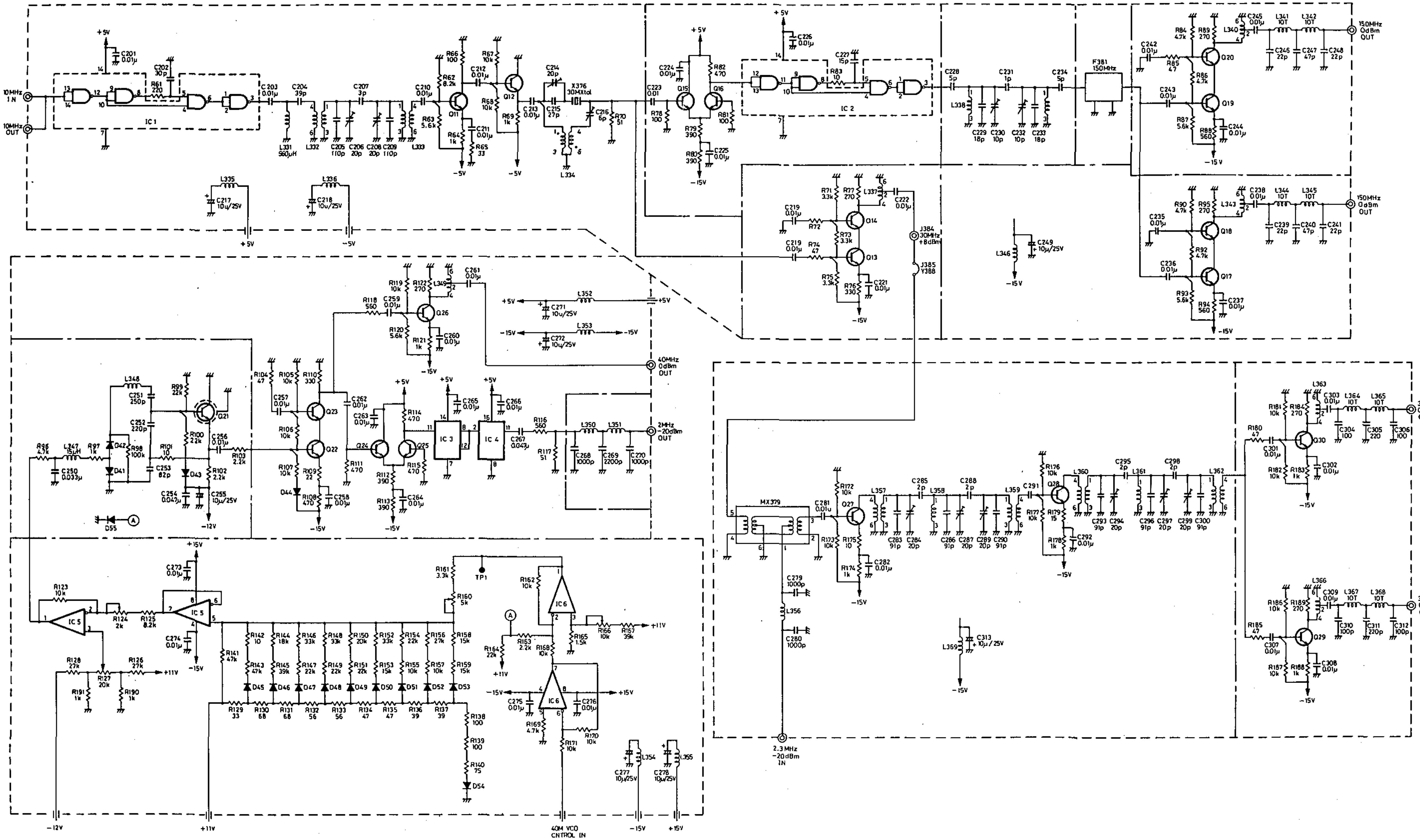
TR4171
50
1st LO PLL
MEP−406
BGN−011735



c253503-051-A

51

TR4171
MEP−407
2nd/3rd LO (46M PLL)
BGN−011223



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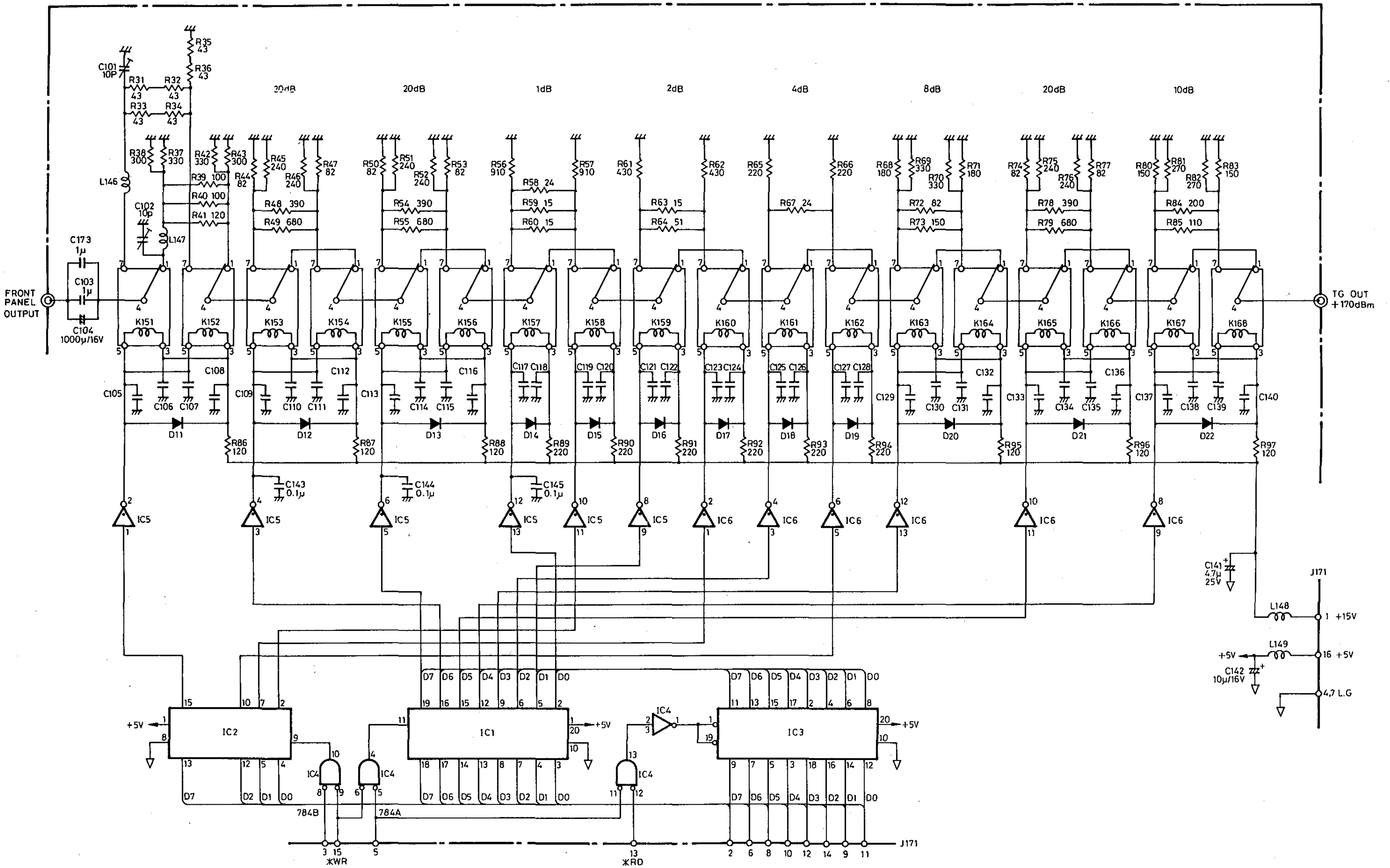
52

TR4171
MEP−407
2nd / 3rd LO
BLN−011224



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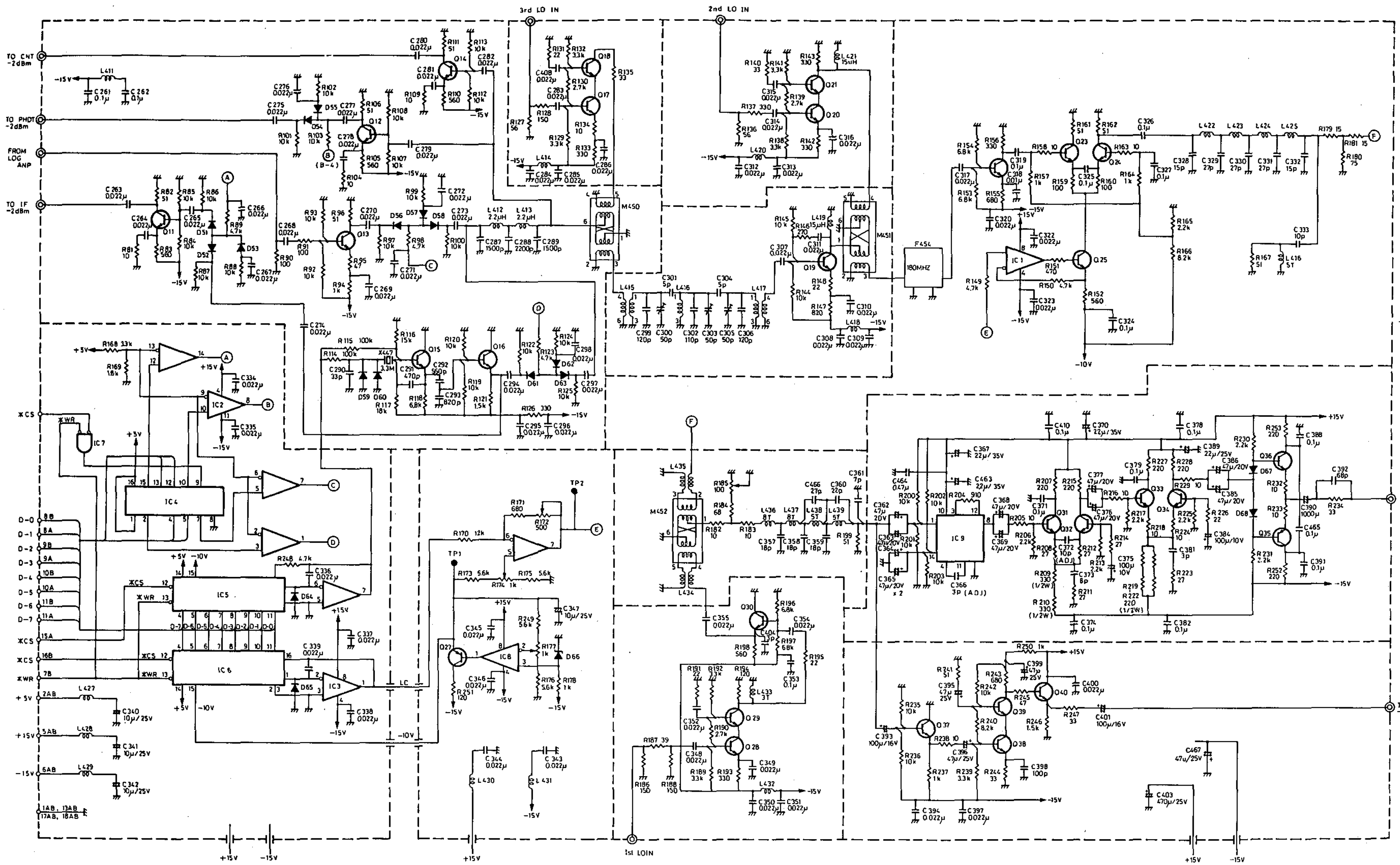
TR4171
MEP−408
T.G ATT
BLJ−011222



C253503-054-A

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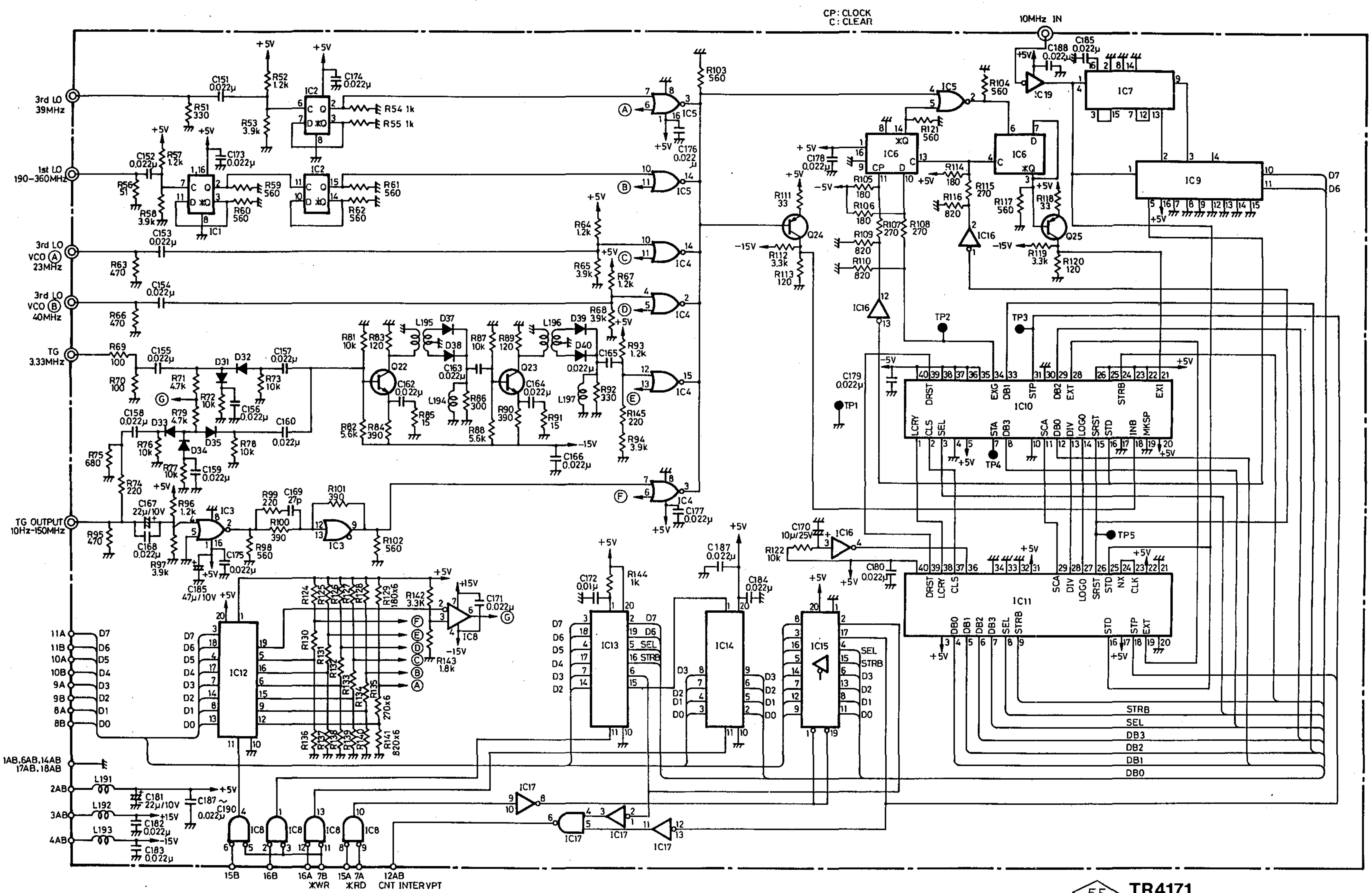
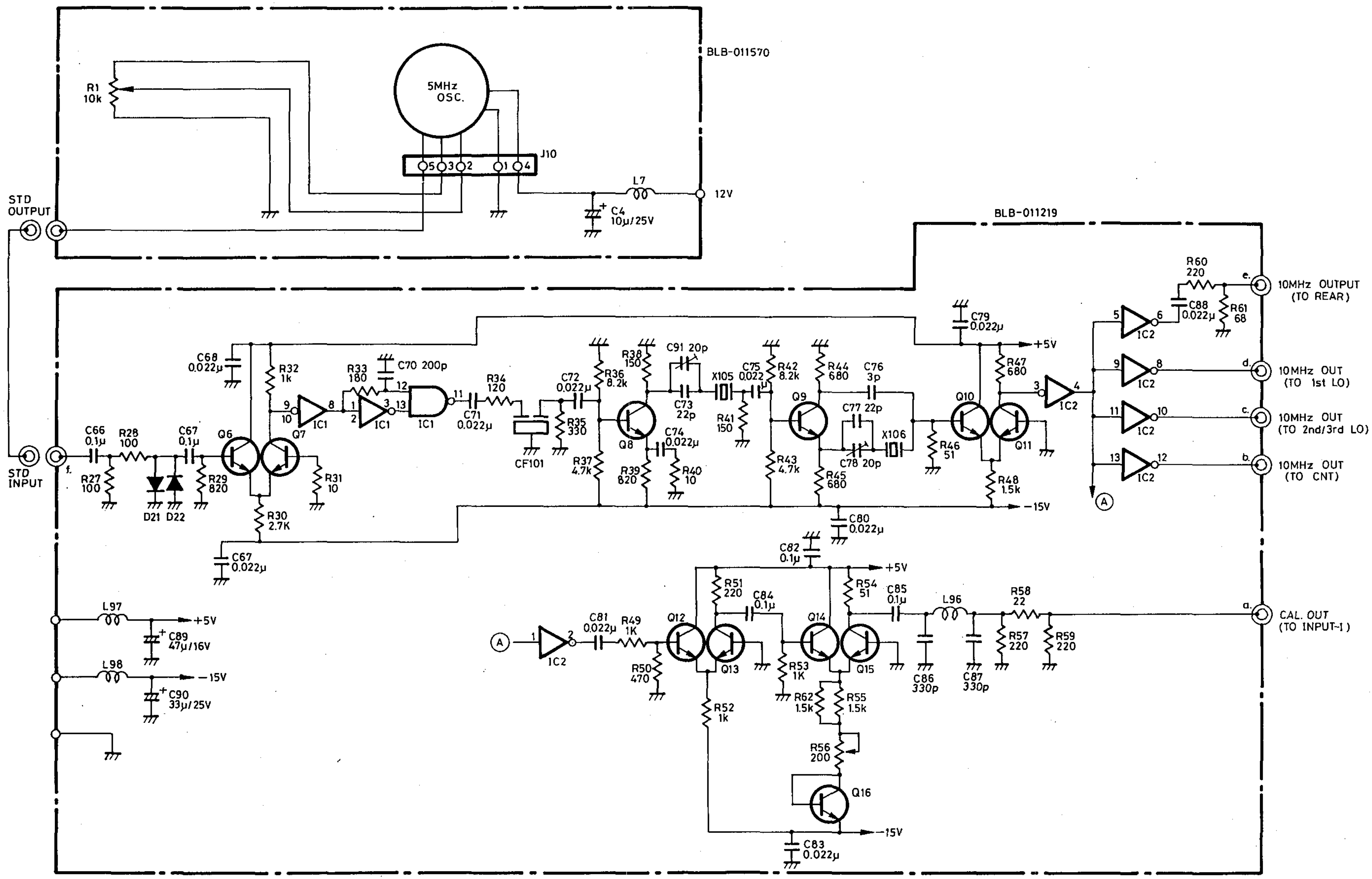
TR4171
MEP-409
T.G
BGN-011220



TR4171
MEP—410
BGN—011221

0253503-055-A



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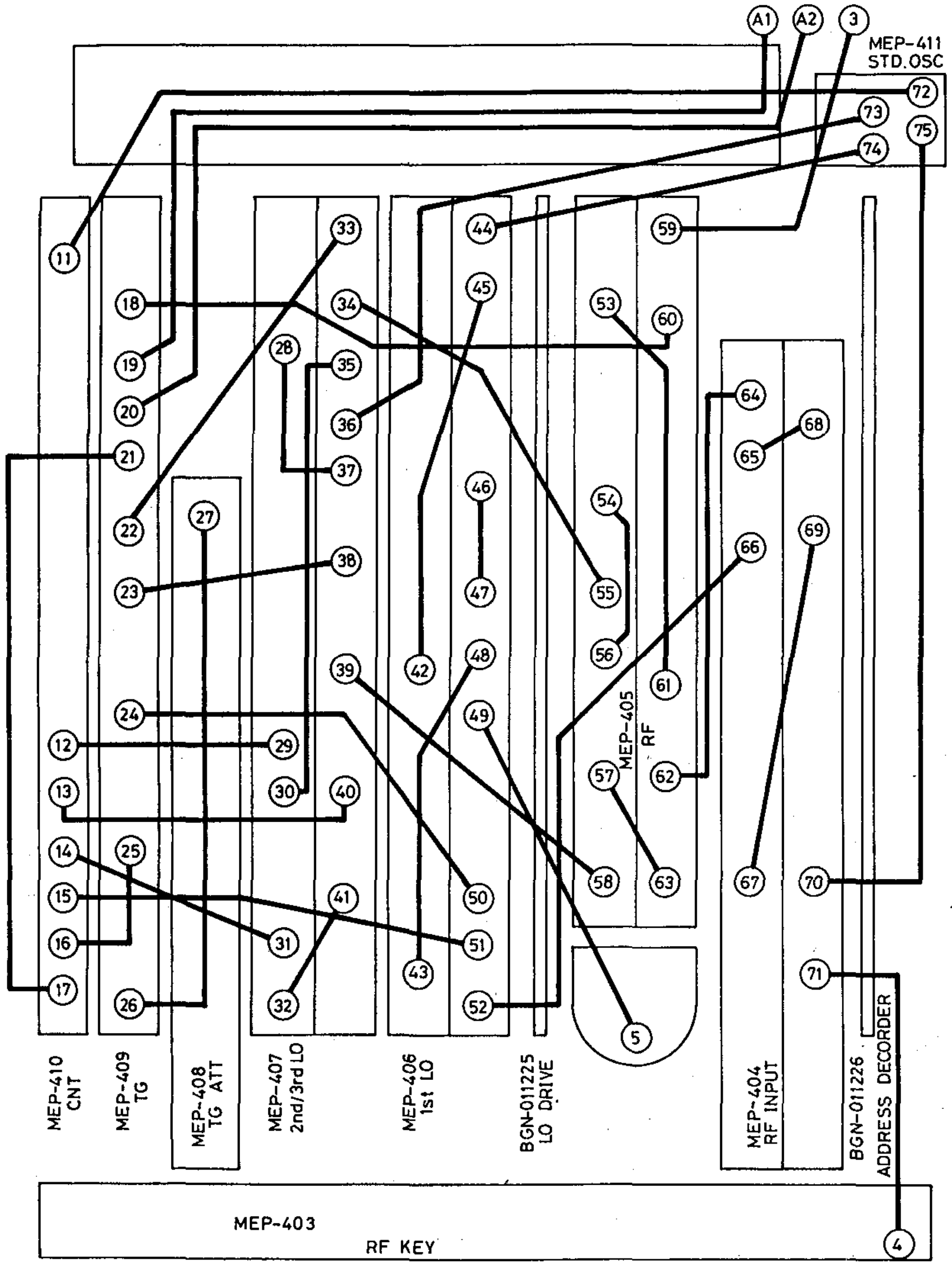
TR4171
MEP-411
STD. OSC.
BLB-011219 / BLB-01157

0253503-056-A



INTERCONNECTION TABLE

	TERMINAL	UNIT		TERMINAL	UNIT	CABLE	Freg.	LEVEL	
11	10MHz IN	MEP-410	72	CNT	MEP-411	DCB-FF0971X13A-1	10MHz	TTL	1
12	23MHz IN	MEP-410	29	23MHz OUT	MEP-407	DCB-FF0971X14A-1	23MHz	0dBm	2
13	40MHz IN	MEP-410	40	40MHz OUT	MEP-407	DCB-FF0971X06A-1	40MHz	0dBm	3
14	39MHz IN	MEP-410	31	39MHz OUT	MEP-407	DCB-FF0971X05A-1	39MHz	0dBm	4
15	1st LO IN	MEP-410	51	CNT	MEP-406	DCB-FF0971X09A-1	179−300MHz	0dBm	5
16	TG IN	MEP-410	25	TG OUT(CNT)	MEP-409	DCB-FF0971X01A-1	10Hz−120MHz	−10dBm	6
17	3.3MHz IN	MEP-410	21	CNT	MEP-409	DCB-FF0971X10A-1	3.3MHz	−2dBm	7
18	IF	MEP-409	60	3.3MHz IN	MEP-405	DCB-FF0971X09A-1	3.3MHz	−2dBm	8
19	LOG	MEP-409	2	(A1)	(REAR)	DCB-FF0985X05-1	3.3MHz	0dBm	9
20	PHASE	MEP-409	2	(A2)	(REAR)	DCB-FF0985X05-1	3.3MHz	−2dBm	10
22	3rd LO IN	MEP-409	33	3rd LO OUT (TG)	MEP-407	DCB-FF0971X07A-1	32.3MHz	0dBm	11
23	2nd LO IN	MEP-409	38	2nd LO OUT (TG)	MEP-407	DCB-FF0971X04A-1	150MHz	0dBm	12
24	1st LO IN	MEP-409	50	TG	MEP-406	DCB-FF0971X08A-1	179 −300MHz	0dBm	13
26	TG OUT	MEP-409	27	IN	MEP-408	DCB-FF0971X09A-1	10Hz−120MHz	+17dBm	14
28	10MHz IN	MEP-407	37	10MHz OUT	MEP-407	DCB-FF0971X01A-1	10MHz	TTL	15
30	2.3MHz OUT	MEP-407	35	2.3MHz IN	MEP-407	DCB-FF0971X09A-1	2.3MHz	−20dBm	16
32	2MHz IN	MEP-407	41	2MHz OUT	MEP-407	DCB-FF0971X02A-1	2.0MHz	−20dBm	17
34	*3rd LO OUT(RF)*	*MEP-407*	55	*3rd LO IN*	*MEP-405*	*DCB-FF0971X09A-1*	*32.3MHz*	*0dBm*	18
36	10MHz IN	MEP-407	73	2nd/3rd LO	MEP-411	DCB-FF0971X13A-1	10MHz	TTL	19
39	2nd LO OUT(RF)	MEP-407	58	2nd LO IN	MEP-405	DCB-FF0971X08A-1	150MHz	0dBm	20
42	1MHz IN	MEP-406	45	1MHz OUT	MEP-406	DCB-FF0971X08A-1	1MHz	TTL	21
43	YIG IF IN	MEP-406	48	YIG IF OUT	MEP-406	DCB-FF0971X05A-1	6−44MHz	−30dBm	22
44	10MHz IN	MEP-406	74	1st LO	MEP-411	DCB-FF0971X09A-1	10MHz	TTL	23
46	100M/101M OUT	MEP-406	47	100M/101M IN	MEP-406	DCB-FF0971X01A-1	100M/101M	+6dBm	24
49	YIG IN	MEP-406	5	(OUT)	YIG OSC	DCB-FF0934X17-1	2148−3600MHz	+14dBm	25
52	INPUT	MEP-406	66	1st LO IN	MEP-404	DCB-FF0971X10A-1	179 −300MHz	0dBm	26
53	3rd IF OUT	MEP-405	61	REF IN	MEP-405	DCB-FF0971X08A-1	3.3MHz	+0.5dB	27
54	2nd IF IN	MEP-405	56	2nd IF OUT	MEP-405	DCB-FF0971X02A-1	29MHz	−3dB	28
57	1st IF IN	MEP-405	63	1st IF OUT	MEP-405	DCB-FF0971X01A-1	179MHz	+2dB	29
59	REF OUT	MEP-405	3	(OUT)	(REAR)	DCB-FF1223X10-1	3.3MHz	0dB	30
62	1st IF IN (INPUT)	MEP-405	64	1st IF OUT	MEP-404	DCB-FF0971X08A-1	179MHz	−12dB	31
65	50/75 IN	MEP-404	68	50/75 OUT	MEP-404	DCB-FF0971X06A-1	10Hz−120MHz	−1dB	32
67	ARS OUT	MEP-404	69	ARS IN	MEP-404	DCB-FF0971X07A-1	10Hz−120MHz	−12dB	33
70	CAL IN	MEP-404	75	CAL OUT	MEP-411	DCB-FF0971X13A-1	10MHz	−6dBm	34
71	CAL OUT	MEP-404	4	(CAL OUT)	(FRONT)	DCB-FF1223X05-1	10MHz	−10dBm	35

0253503-057-A

APPENDIX

A-1. FREQUENCY ADJUSTMENT OF INTERNAL REFERENCE OSCILLATOR

When adjusting the frequency of the internal reference oscillator, measure the signal output from the 10 MHz OUTPUT connector on the rear panel with an external frequency counter which is calibrated to an accuracy of at least 2×10^{-9}, and turn the FREQ. ADJ control until exactly 10 MHz is obtained.
If a frequency standard of an accuracy of at least 2×10^{-9} is available, easy frequency adjustment can be provided with the following method.

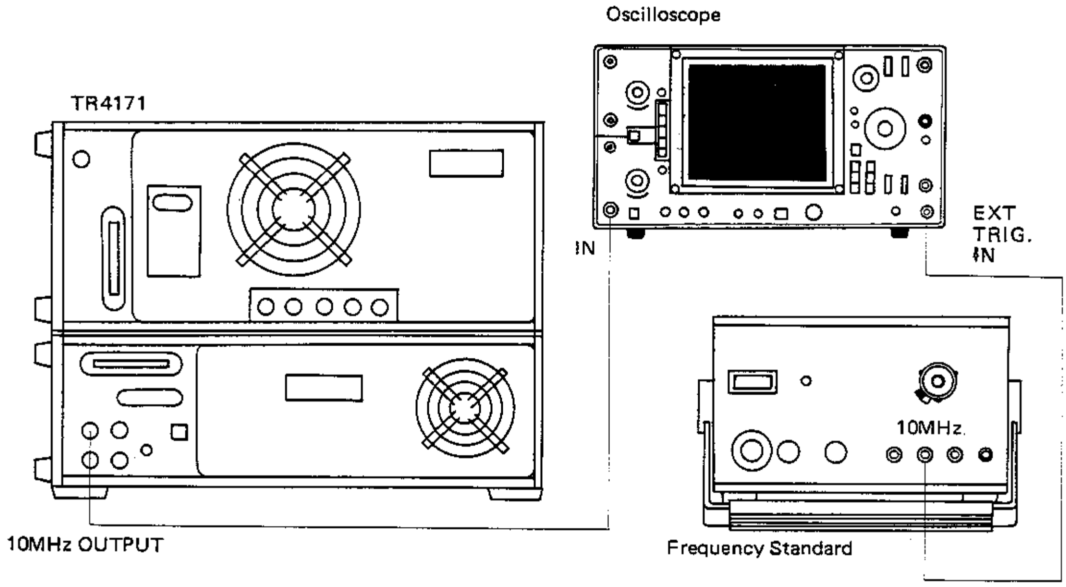


Fig. A-1 Calibration of Internal Reference Oscillator with Frequency Standard

Input a 10 MHz signal from the frequency standard to the External trigger input connector of an oscilloscope, and the signal from the 10 MHz OUTPUT connector of the TR4171 to the input connector of the oscilloscope, as shown in the figure. Then turn the FREQ. ADJ control until the waveform displayed on the screen of the oscilloscope does not move laterally. This completes the calibration of the internal reference oscillator.

A-2. HANDLING OF CLOSE-UP DEVICE

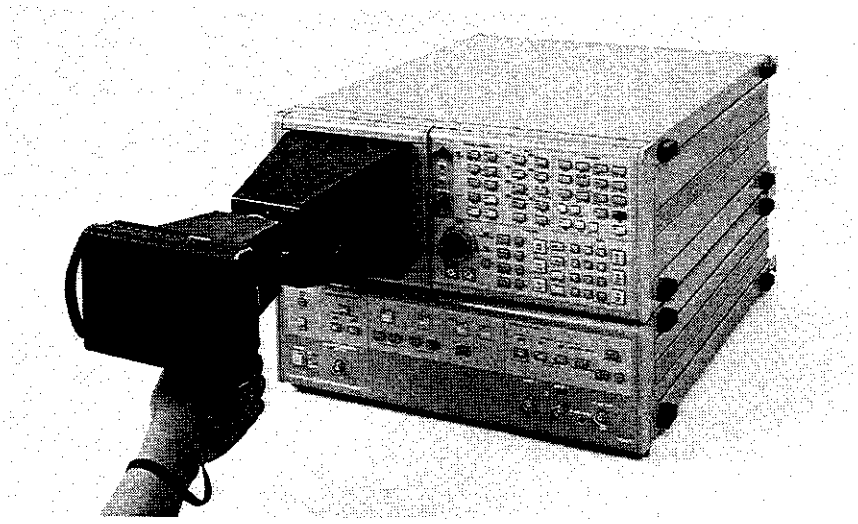


Fig. A-2 How to Use Photographic Device

Assemble the photographic device as shown in Figure A-3.

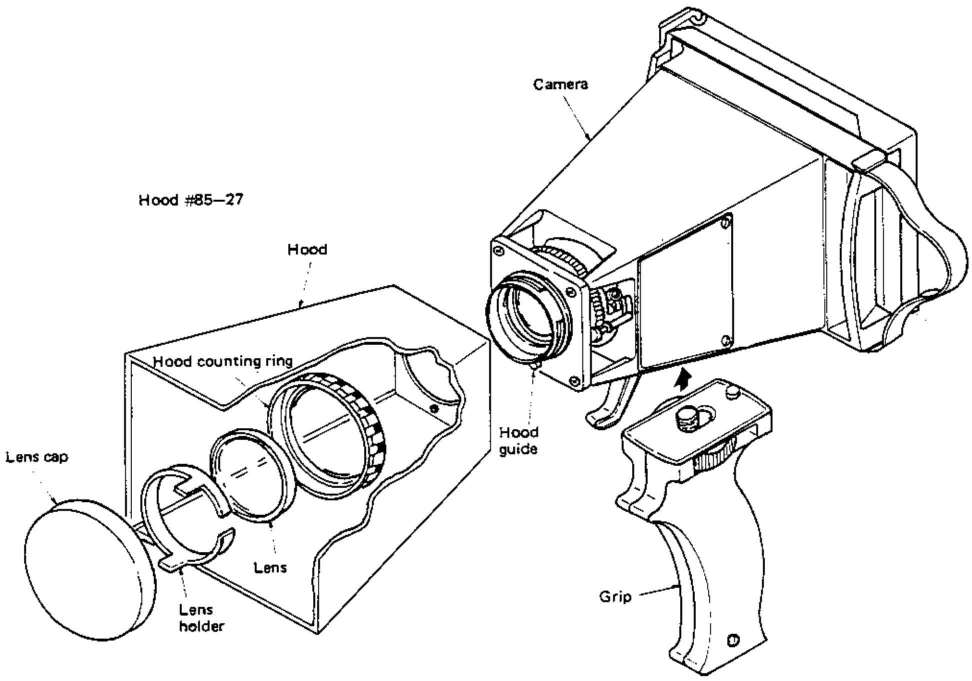


Fig. A-3 Assembling Polaroid Camera M-085D and Hood #85-27

The setting of the camera depends on the setting of the INTENSITY control on the TR4171.

CAUTION

> If the CRT screen or filter is soiled by dust or other foreign matter, good photos cannot be obtained. Clean the CRT screen and filter as described in Section 2-5.
> If the roller installed on the inner surface of the rear panel of the camera is dirty, the film may not be ejected. Remove and clean the roller as necessary.

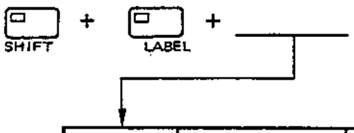
A-3. SHIFT FUNCTIONS

Those of the shift functions which are not indicated on the panel are listed below.

SHIFT + ____

Key	Page	Function
D	4-87	Turns dBμ/m display on
G	4-87	Erases dBμ/m display
?	4-47	Negative peak search
n	4-85	Normal detection
p	4-85	Positive peak detection
s	4-85	Negative peak detection
z	4-85	Sample detection
=	4-86	Reference level offset

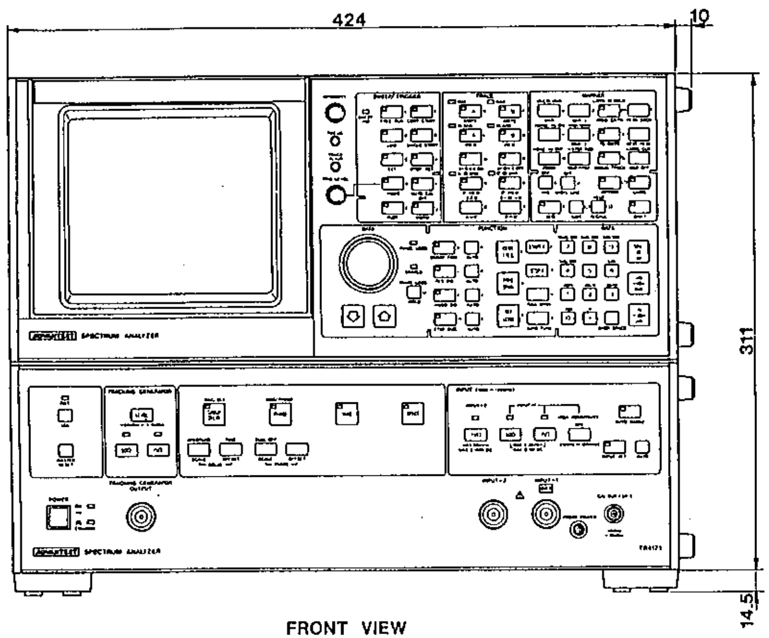
A-4. DOUBLE SHIFT FUNCTIONS



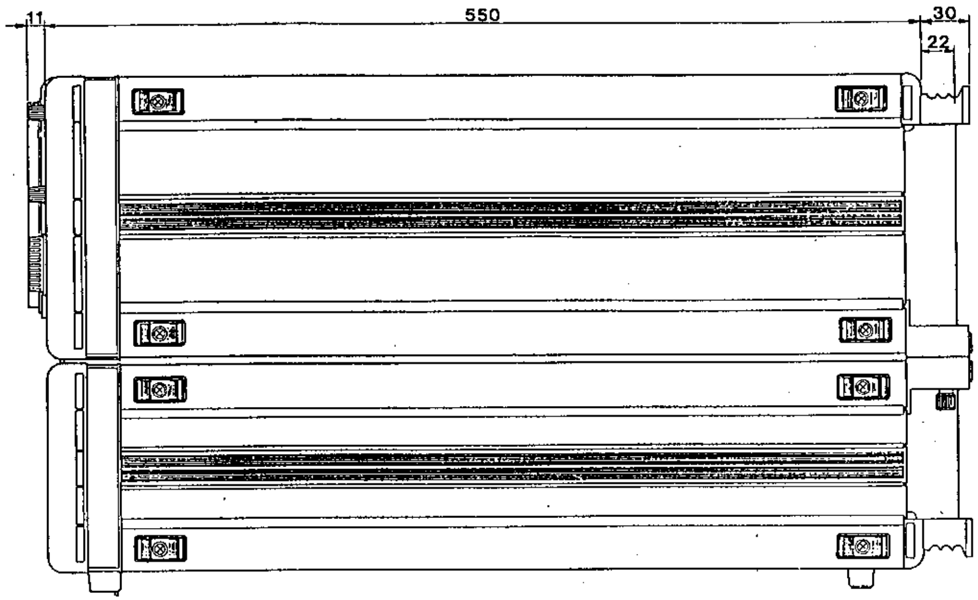
Key	Page	Function
μ	4-90	Writes upper and lower limits
?	4-47	Auto peak search
d	4-68	Resets sweep
<	4-88	Turns logarithmic display on
>	4-88	Erases logarithmic display
␣	4-16	Panel lock release
B	-	Enables UNCAL
C	-	Disables UNCAL
4	-	Repositions center frequency for each sweep
5	-	Releases center frequency repositioning for each sweep

INDEX

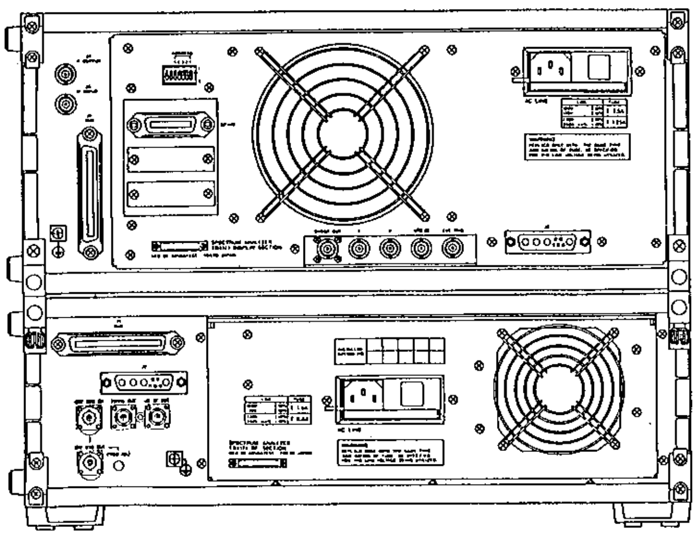
MEMO



FRONT VIEW



SIDE VIEW



REAR VIEW

Unit : mm

TR4171
EXTERNAL VIEW

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   (f) Advantest's incorporation or use of any specifications or designs supplied by Purchaser;

   (g) the occurrence of an event of force majeure, including, without limitation, fire, explosion, geological change, storm, flood, earthquake, tidal wave, lightning or act of war; or

   (h) any negligent act or omission of the Purchaser or any third party other than Advantest.

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