The Power Measurement that uses FFT function

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Outline:

This is a sample software that measures the RF signal by using calculation capability of internal FFT function.
As a result, about 4 times the speed measurement can be expected compared with standard SPA. (SPA: Spectrum Analyzer)

Measurement items:

The measurement items refer the high performance small electric power data communications system of <u>TELEC</u>. (Telecom Engineering Center)
(Note: No Spurious and EVM measurement)

Measurement method:

Set carrier frequency and band width of the power measurement.
Other measurements are measured with SPAN(CB) 1MHz

*The measurement signal makes 11b_cck_5.5Mbps an example.
*When the pulse width is 1ms or less in other standards, we might need to change the software.
*The measuring range can correspond from Special Small Systems to WLAN.
*This sample software contains the EXE file and the source files.

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1. Panel image and Main key
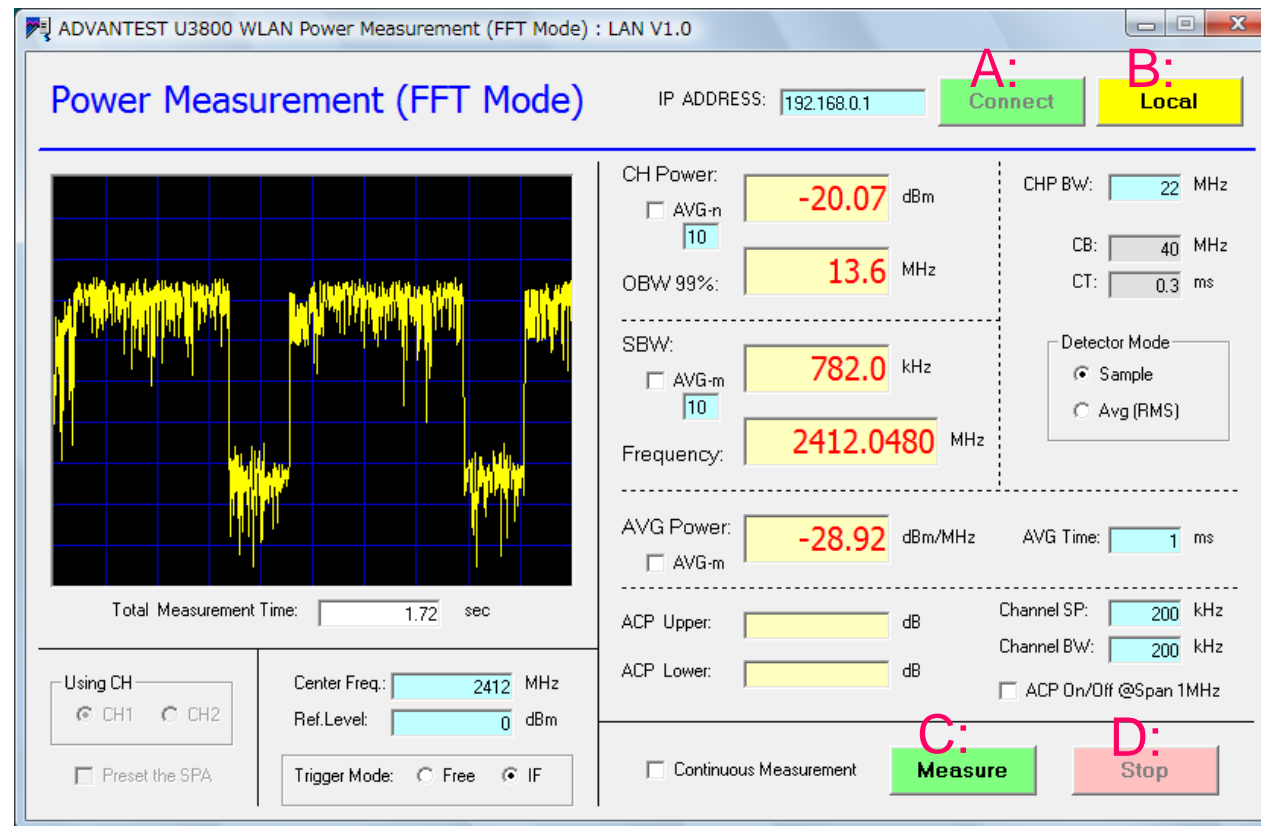
A: | Connect | is pushed, it connects to SPA. Other keys are the prohibitions until the connection is completed.

B: | Local | is pushed, the connection with SPA is released. SPA becomes the local mode.

C: | Measure | is pushed, the measurement begins. The continuous measurement is also possible by check.

D: | Stop | is pushed, the measurement is ended. LAN is a waiting state like the opening.

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Startup and Measurement:

a. Execution of the Software. (Select the U3800 PowerMeasFunc from the START)
b. IP Address is confirmed or it changes. (Default:192.168.0.1)
c. When the Connect button is pushed, it is connected with SPA. (Set Using CH, Preset)
d. BW of CH Power is confirmed or is set. (CB and CT are the automatic settings)
e. Select the Trigger Mode. Averaging On/Off is possible while measuring it.
f. Additionally, when a necessary condition is set, and the Measure button is pushed, the measurement is begun.
g. The end of program pushes the Local, and closes the Window. (use the x mark)

Measurement details of each items:

CH Power: DGT and FFT mode, set C-Freq. CB uses the value about twice CHP-BW. After other conditions are set and Cap B and Cap T are displayed, and measuring. CH Power is calculated on specified CHP-BW from the measured waveform.

OBW 99%: OBW is calculated from the waveform of FFT mode.

SBW 90%: SBW is calculated from the waveform of FFT at CB 1MHz and CT 5ms.

Frequency: After SBW is calculated, the center frequency is calculated.

Ave Power: Set the Power-Time of FFT mode and the Average Power is calculated.
(BW 1MHz) (In this example, CT is 5ms and AVG Power time is 1ms.)

ACP: Low/Up If ACP measurement ON, set DGT-FFT mode and the ACP is calculated.
(Span 1MHz) (Input the C-SP and C-BW.)

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3. Averaging Function

Each measurement items have average function.

1. Channel Power and…
2. OBW 99%
   >AVG-n is checked, it becomes AVG ON.
     The AVG number puts the numerical value in the input column.
     It is sweep method. (sweep: 2 to 30 times)

3. SBW and Frequency
   >AVG-m is checked, it becomes AVG ON.
     The AVG number puts the numerical value in the input column.
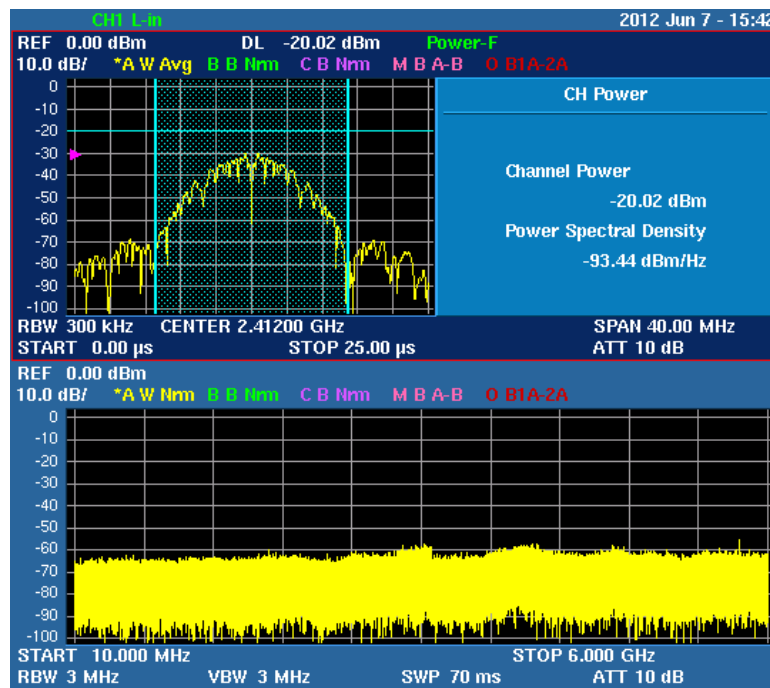   It is sweep method.

4. AVG Power(dBm/1MHz)
   >AVG-m is checked, it becomes AVG ON. It is sweep method.
     The AVG number uses the same numerical value as SBW.

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4-1. Operation of Measurement

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Example Signal: 11b_cck_5.5Mbps
Meas-1: Channel Power (Total Power) BW 22MHz
Meas-2: OBW 99%

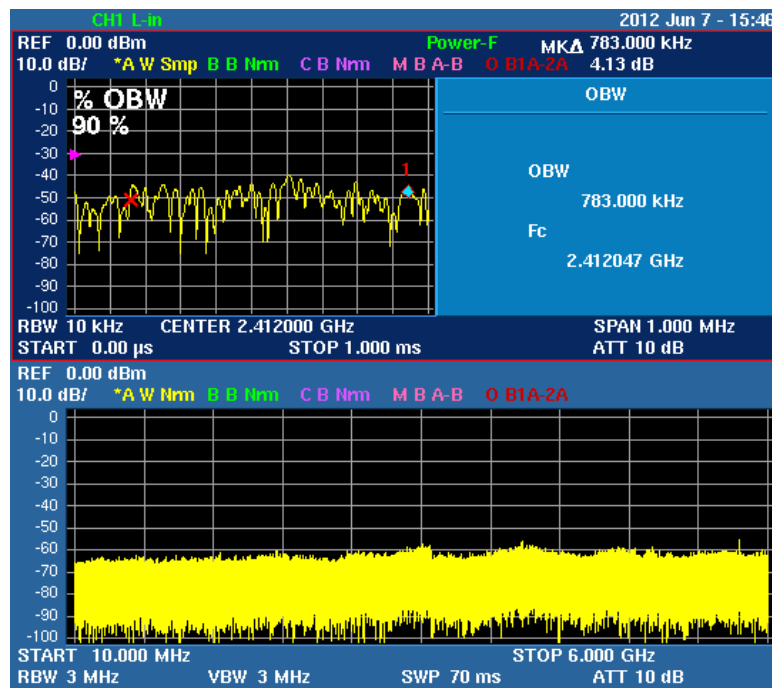Conditions   DGT CB:40MHz, CT:0.3ms, Data(25us):FFT

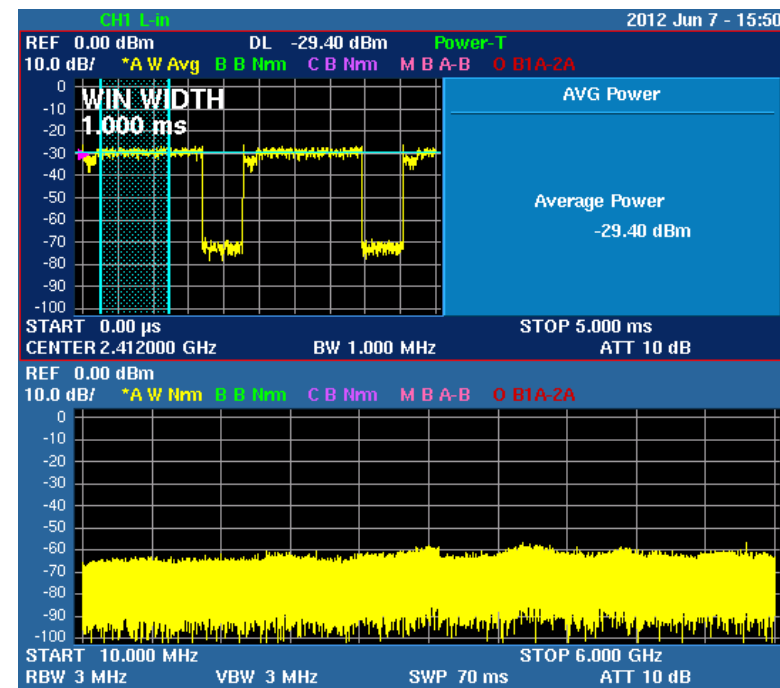Meas-1: CH Power   Meas-2: OBW (99%)

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Meas-3: SBW 90%, Frequency
Meas-4: AVG Power (1MHz RBW, 1ms)

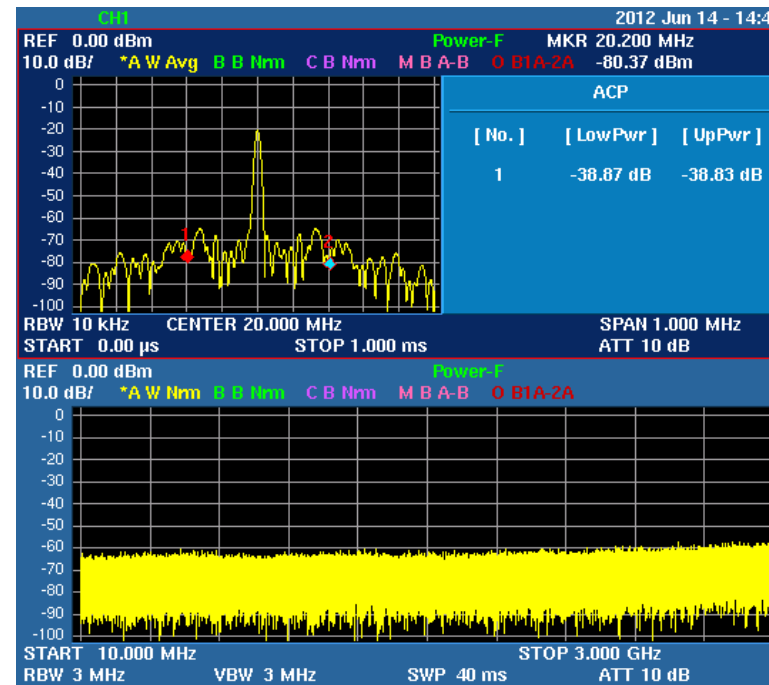Conditions   DGT CB:1MHz, CT:5ms, Data(1ms):FFT

Meas-3: SBW (OBW90%)
Frequency

Meas-4: AVG Power

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Meas-5: ACP (Option)

Conditions: DGT CB:1MHz, CT:5ms, Data(1ms):FFT

Meas-5: ACP

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5. Power Measurement Formula

Formula of Channel Power

(Details: See U3800 series
 User's Guide)

Note: Advantest uses
PBW=RBW*1.06

$$P_{CH} = 10\log\left[\sum_{n=X1}^{X2}\left(10^{\frac{P(n)}{10}}\right) \times \frac{1}{PBW} \times \frac{SPAN}{(X2 - X1)}\right]$$

|	
P_{CH}:	Channel power to be obtained
$P(n)$:	Displayed data at each trace point (dBm)
SPAN:	Channel Width setting value
PBW:	Noise power bandwidth
X1:	Trace point at the window's left edge
X2:	Trace point at the window's right edge

Formula of Average Power

(Details: See U3800 series
 User's Guide)

$$P_{AVG} = 10\log\left[\sum_{n=X1}^{X2}\left(10^{\frac{P(n)}{10}}\right) \times \frac{1}{1001}\right]$$

P_{AVG}:	Average power to be obtained
$P(n)$:	Displayed data at each trace point (dBm)
X1:	1
X2:	1001

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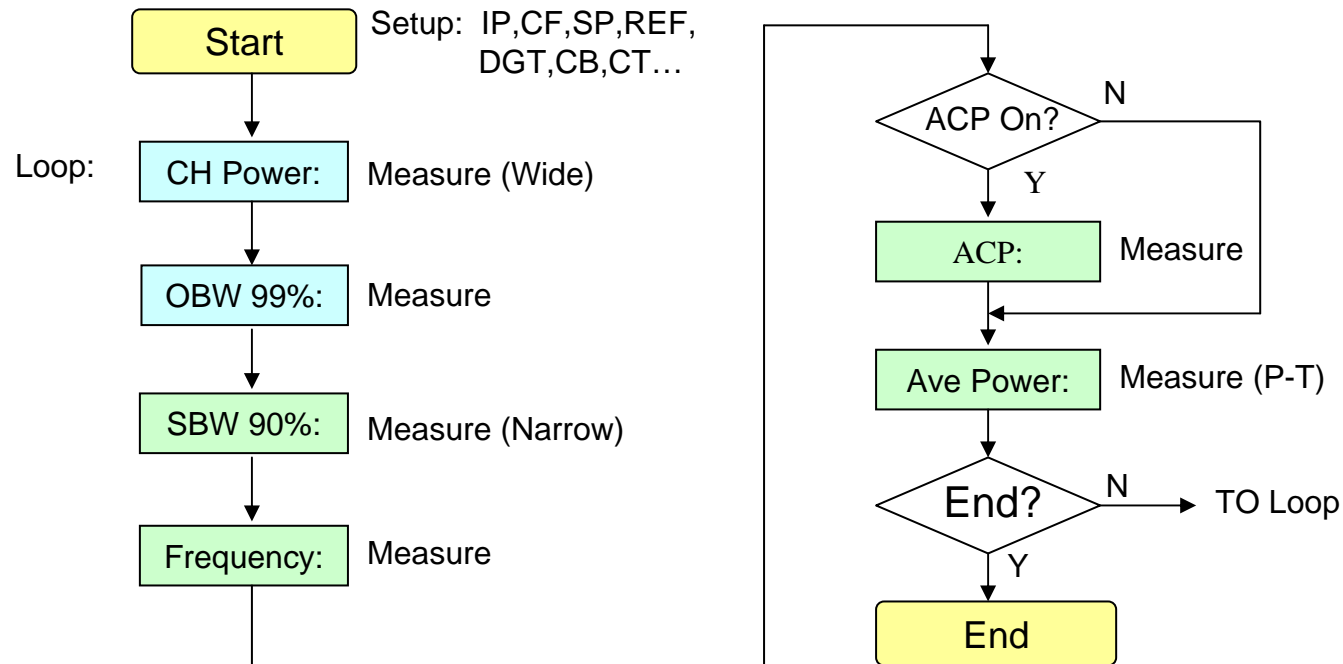
Note1: Trigger: SI sweep command is used. Sweep End is detected while seeing STB.

Note2: GHz, MHz, kHz, and Hz use a fixed unit for the unit of the display.

Note3: The continuous measurement is enabled.

Note4: Width and Span are up to Max 40MHz.

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Example Signal: 11b_cck_5.5Mbps, Other: See table

The pulse width of the WLAN was measured for sample software U3800 PowerMeasDGT.
It is necessary to change AVG time and internal constant value according to each standard.

			(bps)	Pulse (~ms)	Offset	AVG time
					(Internal)	(Menu)
11b	DSSS		1M	8.3ms	250us	1ms
	DSSS		2M	4.2ms	250us	1ms
	CCK		5.5M	1.7ms	250us	1ms
	CCK		11M	1.0ms	250us	0.7ms
11g	DSSS_OFDM		6M	1.5ms	250us	1ms
			9M	1.0ms	250us	0.8ms
			12M	0.87ms	50us	0.7ms
			18M	0.65ms	50us	0.5ms
			24M	0.54ms	50us	0.4ms
			36M	0.42ms	50us	0.3ms
			48M	0.38ms	50us	0.25ms
			54M	0.38ms	50us	0.25ms

Note(Green)

1. It is necessary to use Cap-RBW 3MHz, (Software-->SBWspan=3)
   because the pulse width becomes a range where FFT cannot be narrowly done.
2. Cap-Time uses 1ms, because the pulse width is narrow. (Software-->SBWswp=1)
   (Offset in calculation start point automatically becomes 50us.)
3. The measurement used 3MHzBW. But the standard is 1MHzBW,
   the correction or the reinvestigation is necessary.

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