ISA-30/80/132/265
Spectrum Analyzer
WiMAX(802.16e) Manual
Ver 1.0

Read this manual before using the equipment.
Keep this manual with the equipment

TABLE OF CONTENTS

SECTION 1
GENERAL

1.1 Introduction

This option provides a total solution to testing WiMAX equipment(Mobile or subscriber station) which performs power, spectrum and modulation quality measurements in accordance with IEEE 802.16e-2005 standards.

This measurement personality includes following measurements.

- Spectrum with FFT
- Power versus Time
- Spectral Flatness
- Modulation Quality (Constellation, EVM vs Symbol, EVM vs Subcarriers)
- Modulation quality related numerical result
  - EVM RMS, Peak in % and dB scale
  - EVM for pilot % and dB scale
  - EVM for Unmodulated Carrier % and dB scale
  - Frequency Error in Hz
- Power Statistics CCDF

1.2 ISA RF Digitizer Hardware Specification

ISA series signal analyzer basically includes wide band digitizer. It is optimized for analyzing various wireless communication systems which has complicated and wide band characteristics.

1. Frequency range
   - Range : 3Hz to 3 GHz/13.2GHz/26.5GHzz
   - Bandwidth : 30MHz
   - Resolution : 1Hz

2. Dynamic range & Accuracy
   : Typically 80 dB intermodulation free dynamic range Adjacent Channel Leakage Ratio (ACLR)
   - Residual EVM
   : < 1% (nominal)

3. A/D Converter
   - Resolution
   : 14 bits
   - ADC Clock
   : Fixed 85.6 MHz
   - Sample Rate Control
   : IF: 21.4 MHz , IQ : Variable 541.666 ks/s to 42.8 Ms/s
   - Amplitude Flatness
   : Flatness: Typically 0.5 dB to 30 MHz
   - Phase Flatness
   : 0.05 radians pk-pk to 30 MHz

4. Storage

- Data Output

: Sampled digital I/Q data are stored on internal memory of digitizer. (Its resolution is 32bits) It transferred to CPU unit by way of PCI bus.

- Sample Memory

: 128Mbytes (32Msamples)

1.3 Installing WiMAX Measurement Personality

To license your WiMAX Measurement Personality uses the following procedure

When you add a new option, or update an existing option, you will get the updated version of all your current options since they are reloaded simultaneously. This process may also require you to update the signal analyzer program so that it is compatible with the new option.
If your analyzer came with the WiMAX measurement licensed, you can skip the licensing.
You must keep a copy of your license key number in a secure location. If you lose your license key number, call your nearest service or sales office for assistance.
In case of user buy digitizer with this option, it must be sent to manufacturer. All hardware, software installations will be completed by manufacturer and send it back to user.

1. Connect keyboard and mouse to the PS2 ports or the USB ports.

2. Turn on the signal analyzer. And wait until the analyzer complete the power up sequence.

3. Press System, *Option Info.*, *Option Activate*.

4. Select “WiMAX” field in the license active dialog window.

※ NOTE
All purchased options must be selected.

5. Enter the letters/digits of your 32 characters license code using the mouse or the keyboard. The license key number is a hexadecimal number.

6. Press *Activate*.

7. Licensing completed successfully then “Activation Success” dialog window was displayed.

If “Invalid License!” was displayed, you enter the correct license code again.

8. Press *OK* or press any keypad, then you exit from the license menu.

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SECTION 2
Measurement Guide

This section provides a guide for making measurement of mobile WiMAX(802.16e) signal. By referring the steps which specified in this section, user can easily have an experiment with mobile WiMAX device.

2.1 Measurement Preparation

Before connecting a signal to the instrument, make sure the instrument can safely accept the signal level provided. The maximum RF input level is +30dBm and it can be attenuated from 0dB to 55dB by its input RF attenuator. It also provide 20dB preamp for weak signal measurement.

By connecting 10MHz reference input, user can synchronize analyzer with signal source(DUT. In reference with the figure below, user can set the Signal Analyzer for testing mobile WiMAX device(SS or MS).

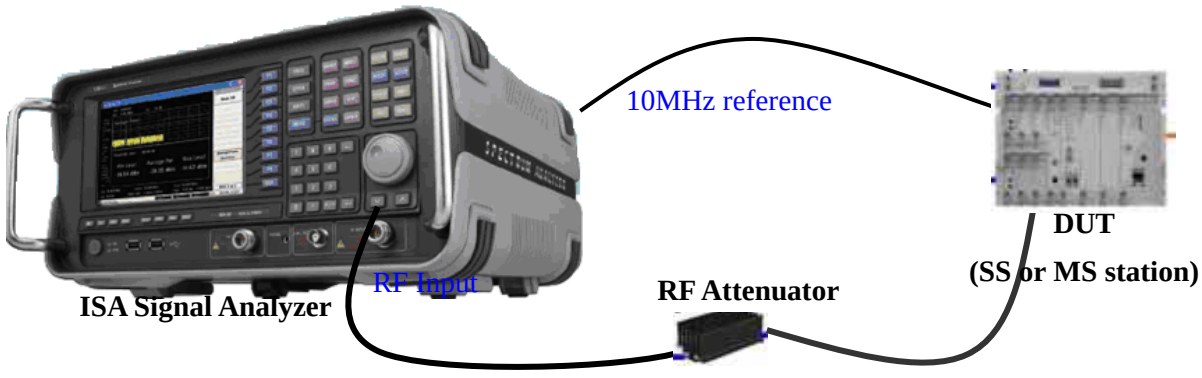


Fig. 2-1 WiMAX measurement setup

2.2 General steps to make measurement

All measurements performed in 'WiMAX' options can be performed with following steps.

1. Select the WiMAX measurement option
   - Press MODE : All of the installed and licensed options(Phase Noise, EMI Receiver, WiMAX etc) will be available and shown.
   - Press NEXT: WiMAX option can be seen by pressing more menu
   - Press *802.16e OFDMA* : User goes to WiMAX option specific measurement menu by select this menu.

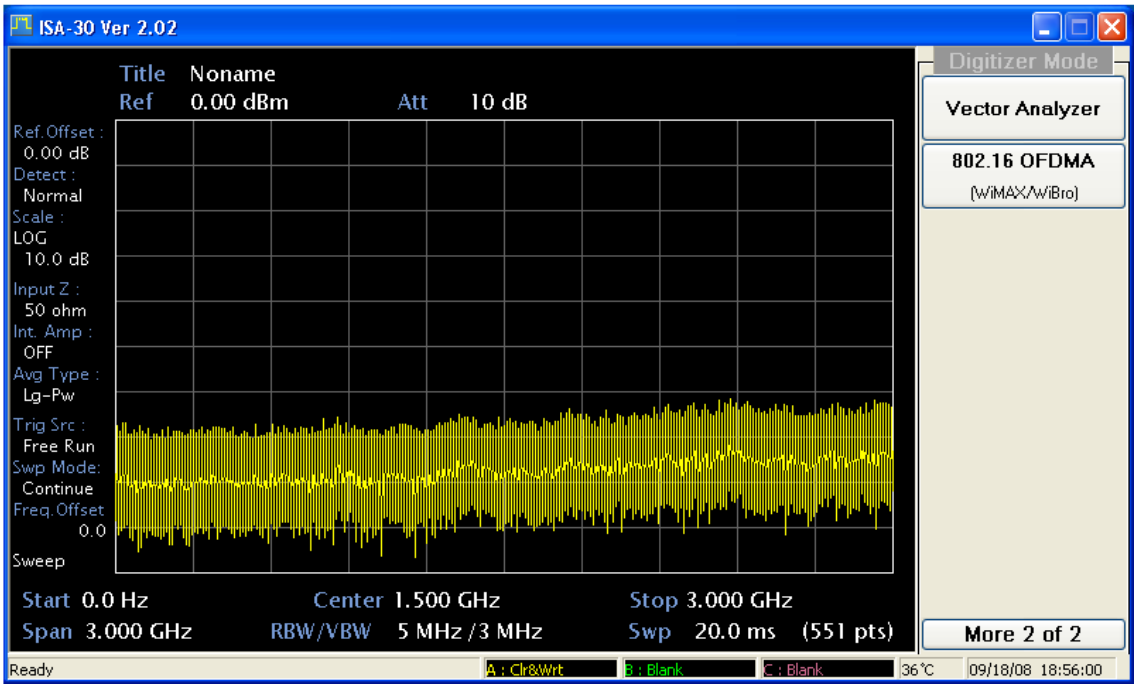


Fig. 2-2 Select WiMAX Measurement option

2. Select measurement to be performed.

: In WiMAX option provide various measurements for WiMAX signal physical layer analysis. So user can select measurement among following measurement menu .

- *FFT Analysis*
- *Power vs Time*
- *Spectral Flatness*
- *Constellation*
- *EVM*
- *CCDF*

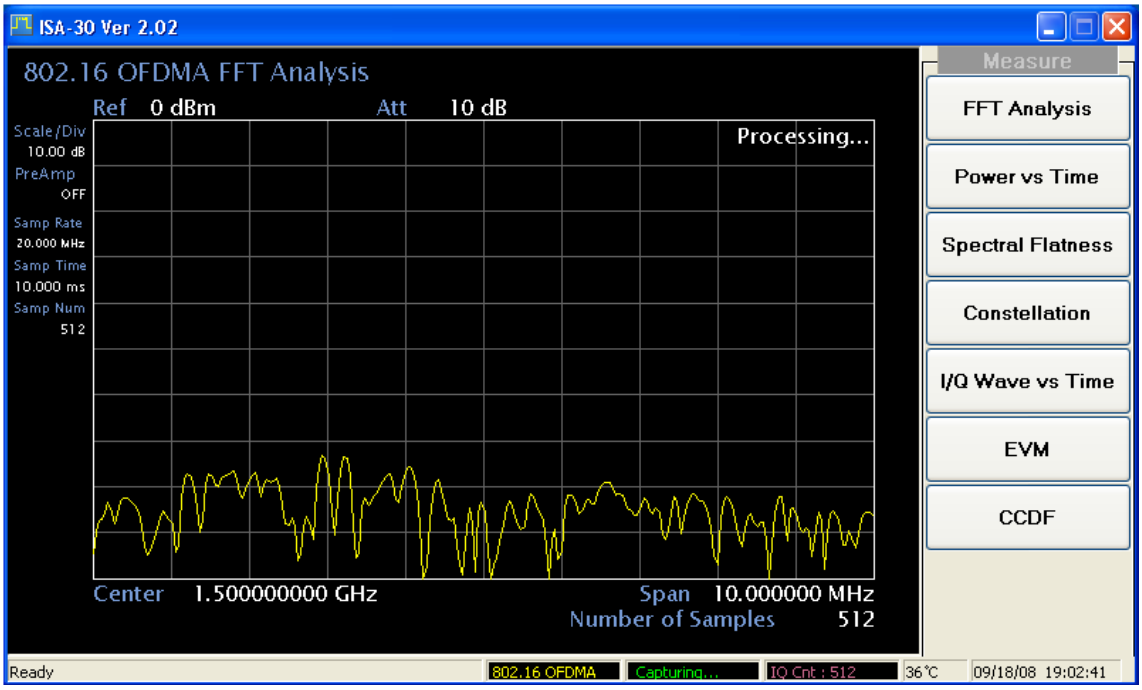


Fig. 2-3 Select WiMAX Specific Measurement

3. Configure OFDMA parameters.

: User can configure various WiMax frequency and timing parameters by pressing by pressing SETUP. After set above parameters link(Down link or Up link) must be configured by pressing F1 key. with And in case of zone and burst parameters can be configured by press NEXT and select *Edit Zone Info….* This configuration is important for evaluating modulation quality measurement exactly. After finishing configuration user can return to measurement menu by pressing MEAS.

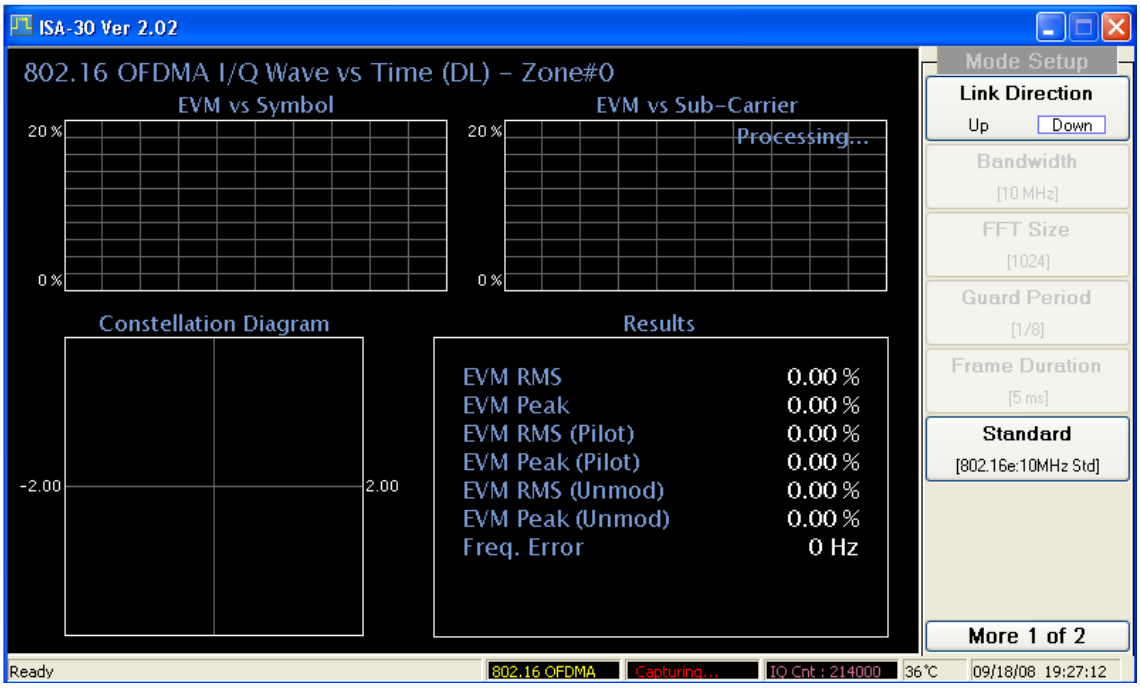


Fig. 2-4 Set up WiMAX frequency & timing parameters

Fig. 2-5 Set up WiMAX Zone, Burst parameters

2.3 802.16e Signal Measurement Guide

This chapter gives guidance for measuring physical layer performance of WiMAX (802.16e) signal. Especially it describes typical procedure for each measurement of WiMAX signal. So user easily can get a measurement result by referring this manual. The target system(BS or MS) of this measurement option must follow the IEEE 802.16e OFDMA standard which released on 2005.

2.3.1 OFDMA Basic Theory

Orthogonal Frequency Division Multiplexing Acess(OFDMA) is a multiple Access technique which subdivides the bandwidth into multiple frequency sub-carriers. The Fig. 2-2 gives simple description for multi-carrier modulation method of OFDMA system. In an OFDMA system, the input data stream is divided into several parallel sub-streams with reduced data rate(it increases symbol duration). And each sub-stream is modulated and transmitted on a separate orthogonal sub-carrier. The increased symbol duration improves the robustness of OFDMA to delay spread.

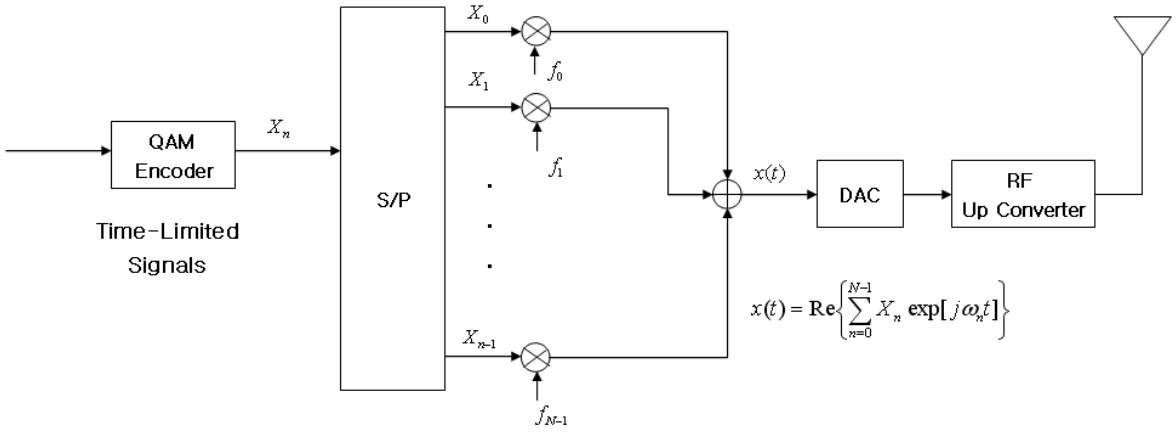


Fig. 2-6 Descriptions for modulation of OFDMA

Furthermore, the introduction of the cyclic prefix (CP) can completely eliminate Inter-Symbol Interference (ISI) as long as the CP duration is longer than the channel delay spread. The CP is typically a repetition of the last samples of data portion of the block that is appended to the beginning of the data payload as shown in Fig. 2-7.

The CP prevents inter-block interference and makes the channel appear circular and permits low-complexity frequency domain equalization. A perceived drawback of CP is that it introduces overhead, which effectively reduces bandwidth efficiency. While the CP does reduce bandwidth efficiency somewhat, the impact of the CP is similar to the “roll-off factor” in raised-cosine filtered single-carrier systems.

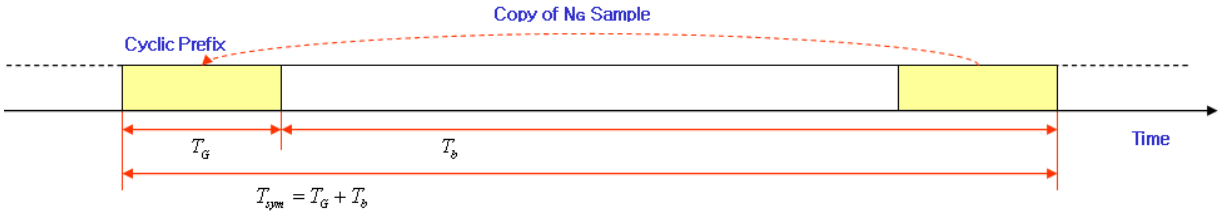


Fig. 2-7 CP(Cyclic Prefix) concept

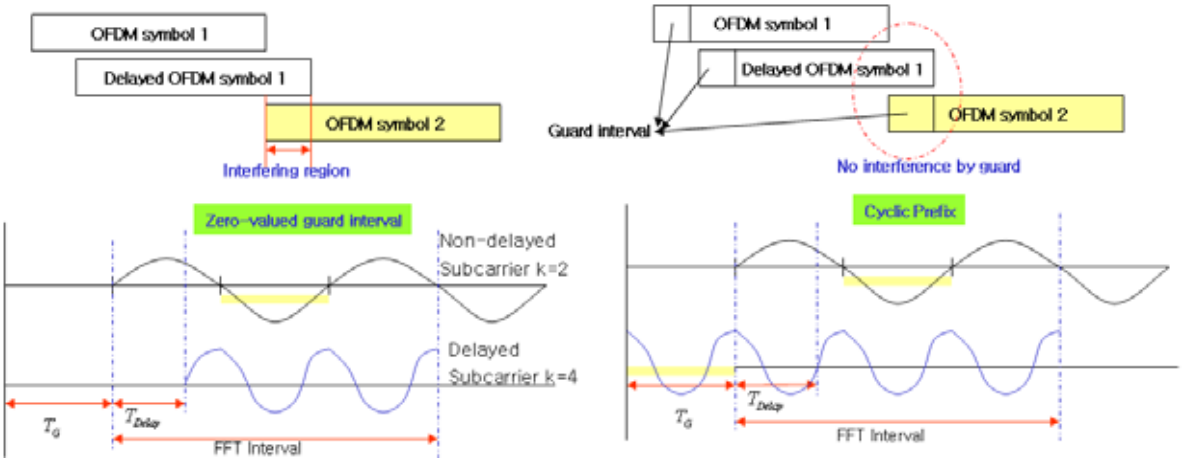


Fig. 2-8 Illustration for eliminating ISI by CP

The OFDMA symbol composed with three types of sub-carriers as shown in Fig. 2-9. Data sub-carriers for data transmission, pilot sub-carriers for estimation and synchronization purposes and null sub-carriers for no transmission, it allocated on guard bands and DC carriers

Active (data and pilot) sub-carriers are grouped into subsets of sub-carriers called sub-channels. The WiMAX OFDMA PHY [3] supports sub-channelization in both DL and UL.

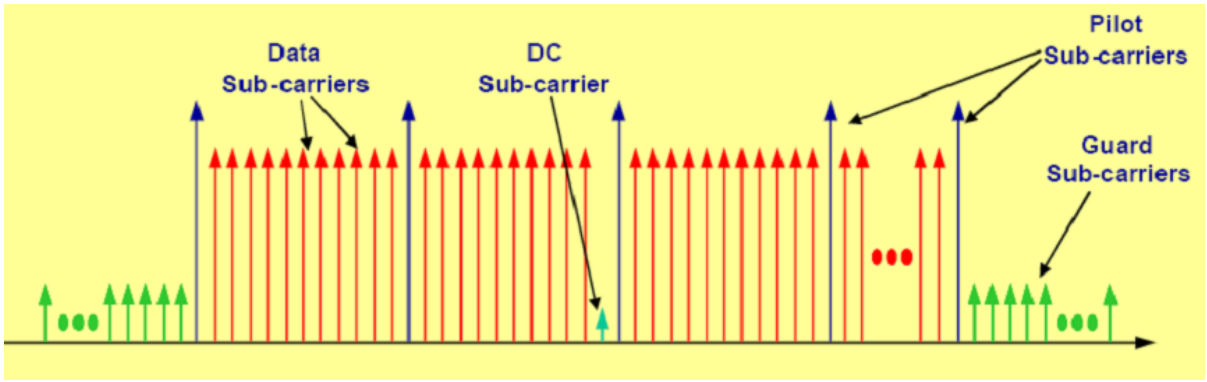


Fig. 2-9 Descriptions for OFDMA subcarriers

2.3.2 WiMAX and 802.16e standard

The IEEE 802.16 group produced 802.16a, to include NLOS applications in the 2GHz–11GHz band, using an orthogonal frequency division multiplexing (OFDM)-based physical layer. Additions to the MAC layer, such as support for orthogonal frequency division multiple access (OFDMA), were also included. Further revisions resulted in a new standard in 2004, called IEEE 802.16-2004, which replaced all prior versions and formed the basis for the first WiMAX solution. These early WiMAX solutions based on IEEE 802.16-2004 targeted fixed applications, and we will refer to these as fixed WiMAX.
In 2005, the IEEE group completed and approved IFEEE 802.16e-2005, an amendment to the IEEE 802.16-2004 standard that added mobility support. The IEEE 802.16e-2005 forms the basis for the WiMAX solution for nomadic and mobile applications and is often referred to as mobile WiMAX . The basic characteristics of the various IEEE 802.16 standards are summarized in Table 2-1.

	802.16-2004	802.16e-2005
Frequency band	2GHz ~ 11GHz	2GHz–11GHz for fixed; 2GHz–6GHz for mobile applications
Application	Fixed NLOS	Fixed and mobile NLOS
MAC architecture	Point to multipoint mesh	Point to multipoint mesh
Transmission Scheme	Single carrier, 256 OFDM or 2,048 OFDM	Single carrier, 256 OFDM or scalable OFDM with 128, 512, 1,024, or 2,048 subcarriers
Modulation	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM
Gross rata rate	1Mbps ~ 75Mbps	1Mbps ~ 75Mbps
Multiplexing	Burst TDM/TDMA/OFDMA	Burst TDM/TDMA/OFDMA
Duplexing	TDD and FDD	TDD and FDD
Channel Bandwidth	1.75MHz, 3.5MHz, 7MHz, 14MHz, 1.25MHz, 5MHz, 10MHz, 15MHz, 8.75MHz	1.75MHz, 3.5MHz, 7MHz, 14MHz, 1.25MHz, 5MHz, 10MHz, 15MHz, 8.75MHz

Table. 2-1 IEEE-802.16 basic parameters

2.3.2.1 Definition of Mobile WiMAX basic parameters

Mobile WiMAX, which is based on the IEEE 802.16e-2005 standard, uses a scalable OFDMA-based physical layer. In the case of mobile WiMAX, the FFT sizes can vary from 128 bits to 2,048 bits. The terms which described here follows IEEE 802.16e-2005 standard.

1) Primitive parameters definitions
- BW : This is the nominal channel bandwidth.
- Nused : Number of used subcarriers (which includes the DC subcarrier).
- n : Sampling factor. This parameter, in conjunction with BW and Nused determines the subcarrier spacing, and the useful symbol time. This value is set to 8/7 as follows: for channel bandwidths that are a multiple of 1.75 MHz then n = 8/7 else for channel bandwidths that are a multiple of any of 1.25, 1.5, 2 or 2.75 MHz then n = 28/25 else for channel bandwidths not otherwise specified then n = 8/7.
- G : This is the ratio of CP time to “useful” time. The following values shall be supported: 1/32, 1/16,1/8, and 1/4.

2) Definition of slot
The definition of an OFDMA slot depends on the OFDMA symbol structure, which varies for uplink and downlink, for FUSC and PUSC, and for the distributed subcarrier permutations and the adjacent subcarrier permutation.
- For downlink FUSC and downlink optional FUSC using the distributed subcarrier permutation, one slot is one sub-channel by one OFDMA symbol.
- For downlink PUSC using the distributed subcarrier permutation , one slot is one sub-channel by two OFDMA symbols.
- For uplink PUSC using either of the distributed subcarrier permutations, and for downlink TUSC1 and, one slot is one sub-channel by three OFDMA symbols.
- For the adjacent subcarrier permutation, one slot is one sub-channel by two, three, or six OFDMA symbols.

2.3.2.2 Mobile WiMAX(802.16e) physical parameters

In Mobile WiMAX, the FFT size is scalable from 128 to 2,048. Here, when the available bandwidth increases, the FFT size is also increased such that the subcarrier spacing is always 10.94kHz. This keeps the OFDM symbol duration, which is the basic resource unit, fixed and therefore makes scaling have minimal impact on higher layers. A scalable design also keeps the costs low. The subcarrier spacing of 10.94kHz was chosen as a good balance between satisfying the delay spread and Doppler spread requirements for operating in mixed fixed and mobile environments. This subcarrier spacing can support delay-spread values up to 20us and vehicular mobility up to 125 km/h when operating in 3.5GHz. A subcarrier spacing of 10.94kHz implies that 128, 512, 1,024, and 2,048 FFT are used when the channel bandwidth is
1.25MHz, 5MHz, 10MHz, and 20MHz, respectively. It should, however, be noted that mobile WiMAX may also include additional bandwidth profiles. (See the inclined column on Table. 2-2) For example, a profile compatible with WiBro will use an 8.75MHz channel bandwidth and 1,024 FFT. This obviously will require a different subcarrier spacing and hence will not have the same scalability properties.

Parameters	Values						
System BW(MHz)	1.25	5	10	20	3.5	7	*8.75*
Sampling Factor	28/25				8/7		
Sampling frequency(Fs,MHz)	1.4	5.6	11.2	22.4	4	8	*10*
Sampling time (1/Fs,nsec)	714.3	178.6	89.3	44.6	250	125	*100*
FFT Size(NFFT)	128	512	1024	2048	512	1024	*1024*
Subcarrier frequency spacing (Δ f,kHz)	10.9375				7.8125		*9.765625*
Useful symbol time (Tb=1/Δ f,us)	91.4				128		*102.4*
Guard time (Tg=Tb/8)	11.4				16		*12.8*
OFDMA symbol time(Ts=Tb+Tg,us)	102.8				144		*115.2*

Table. 2-2 IEEE-802.16e Time, Frequency parameters

2.3.2.3 Mobile WiMAX(802.16e) frame structure (in TDD operation mode)

The 802.16e standard supports TDD(Time Division Duplex) and Full and Half-Duplex FDD(Frequency Division Duplex) operation. With ongoing releases, FDD profiles will be considered by the WiMAX Forum to address specific market opportunities where local spectrum regulatory requirements either prohibit TDD or are more suitable for FDD deployments.

Even TDD operation requires system-wide synchronization, TDD is the preferred duplexing mode for the following reasons.

- TDD enables adjustment of the downlink/uplink ratio to efficiently support asymmetric downlink/uplink traffic, while with FDD, downlink and uplink always have fixed and generally, equal DL and UL bandwidths.
- TDD assures channel reciprocity for better support of link adaptation, MIMO and other closed loop advanced antenna technologies.
- Unlike FDD, which requires a pair of channels, TDD only requires a single channel for both downlink and uplink providing greater flexibility for adaptation to varied global spectrum allocations.
- Transceiver designs for TDD implementations are less complex and therefore less expensive.

Fig. 2-10 illustrates the OFDM frame structure in TDD(Time Division Duplex) mode implementation. Each frame is divided into DL and UL sub-frames separated by Transmit/Receive and Receive/Transmit Transition Gaps (TTG and RTG, respectively) to prevent DL and UL transmission collisions. In a frame, the following control information is used to ensure optimal system operation:

- Preamble: The preamble, used for synchronization, is the first OFDM symbol of the frame.
- Frame Control Header (FCH): The FCH follows the preamble. It provides the frame configuration information such as MAP message length and coding scheme and usable sub-channels.
- DL-MAP and UL-MAP: The DL-MAP and UL-MAP provide sub-channel allocation and other control information for the DL and UL sub-frames respectively.
- UL Ranging: The UL ranging sub-channel is allocated for mobile stations (MS) to perform closed-loop time, frequency, and power adjustment as well as bandwidth requests.

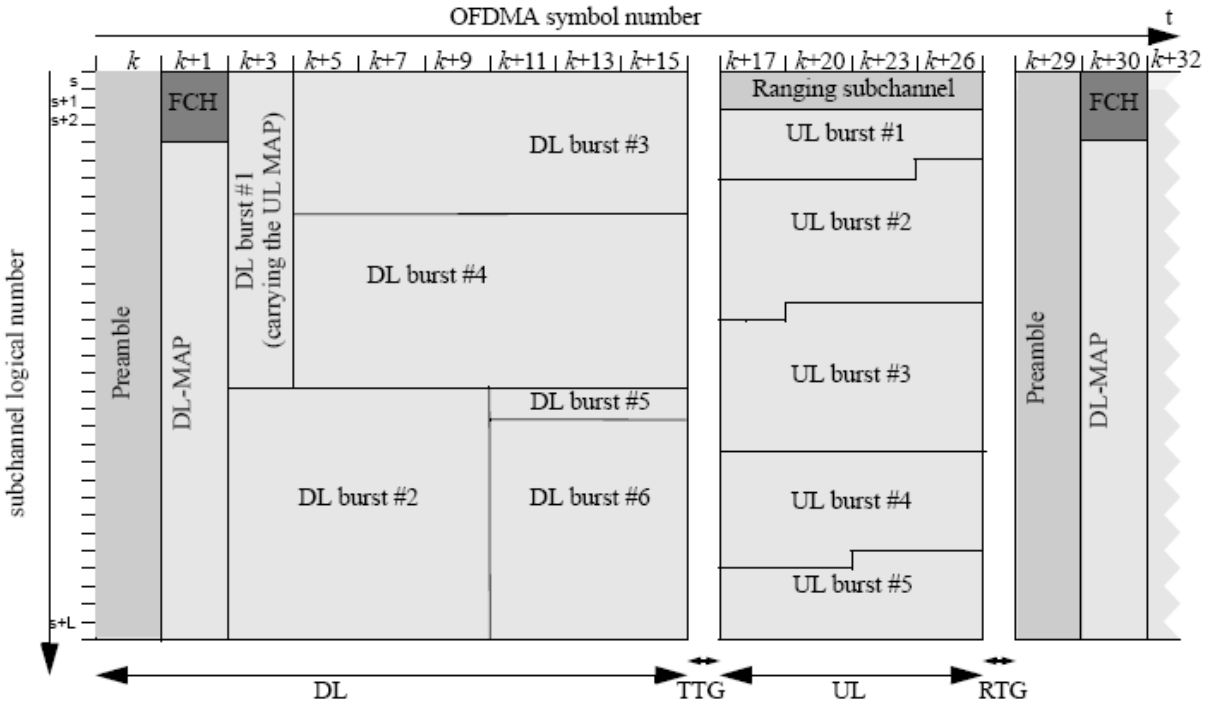


Fig. 2-10 Example of an OFDMA frame in TDD mode

2.3.3 WiMAX Transmitter Test : Spectrum & Power

2.3.3.1 Spectrum Measuremt s

: This measurement shows the spectrum analysis result based on FFT method. This mode of spectrum shows a free run mode of operation.

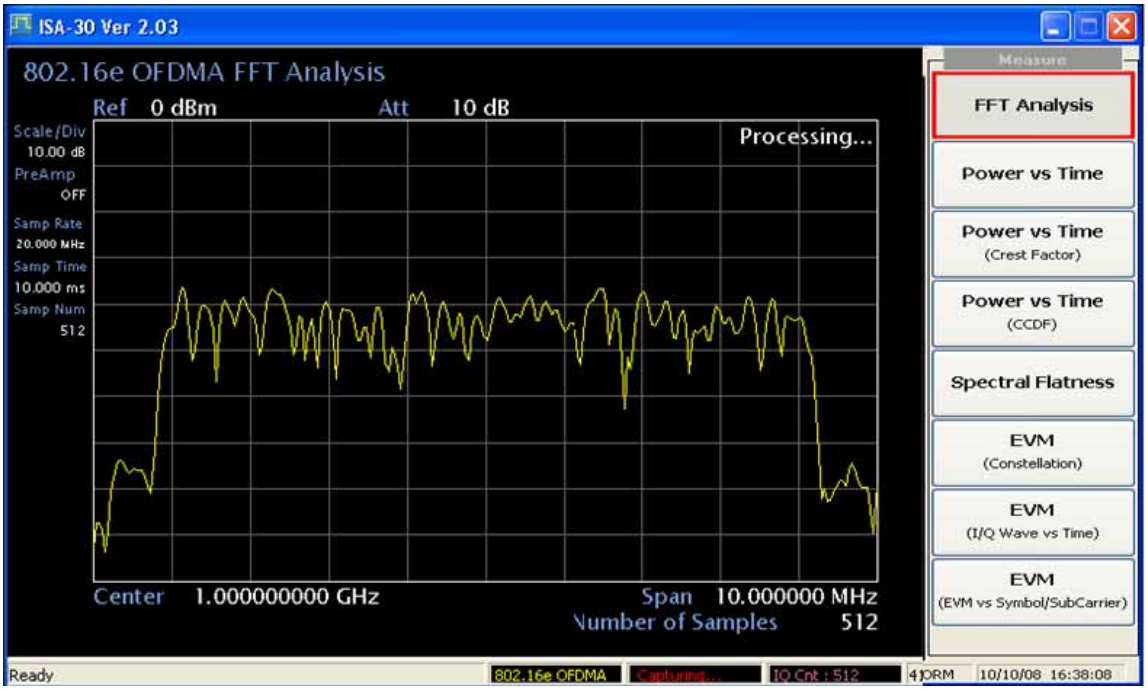
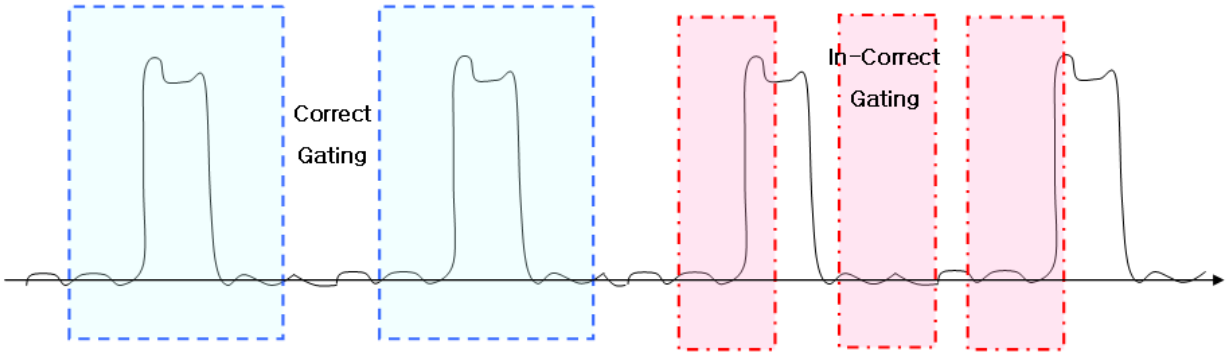


Fig. 2-11 FFT Measurement (802.16e DL signal)

2.3.3.2 Power vs time

: This measurement shows OFDMA burst characteristics in time domain. Its measurement can be gated on and off by S/W trigger method, based on its burst information which set by user. So the 'Power vs time' measurement can be seen in either 'free run' mode or Gated mode.



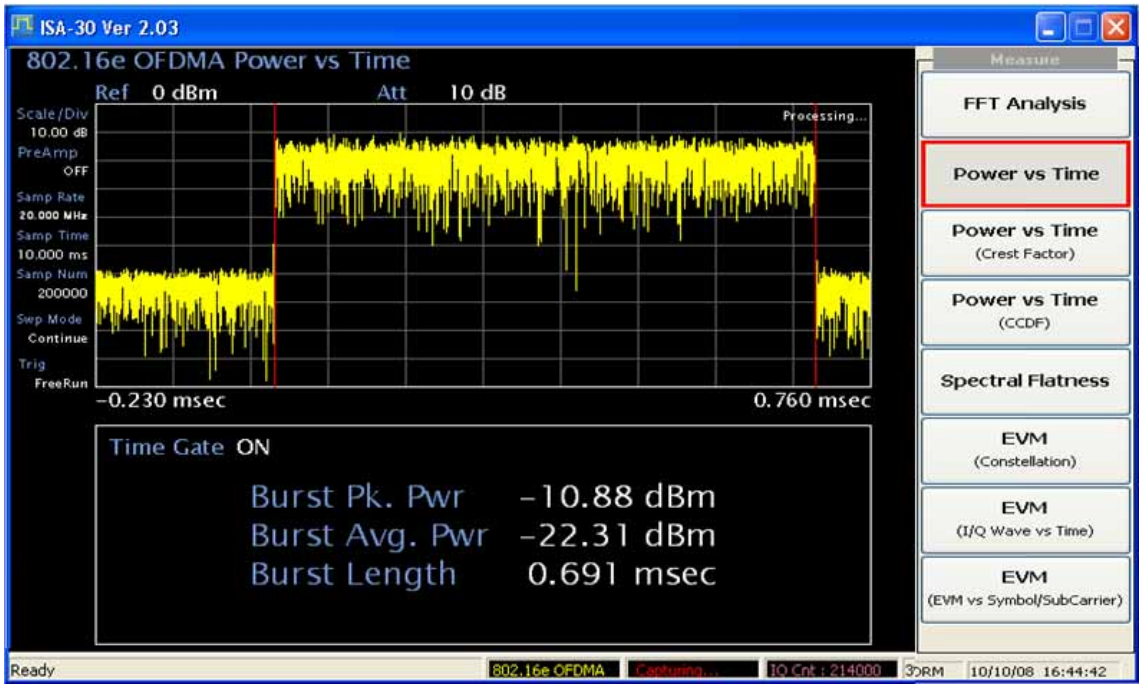


Fig. 2-12 Power vs Time in Gated mode (802.16e DL signal)

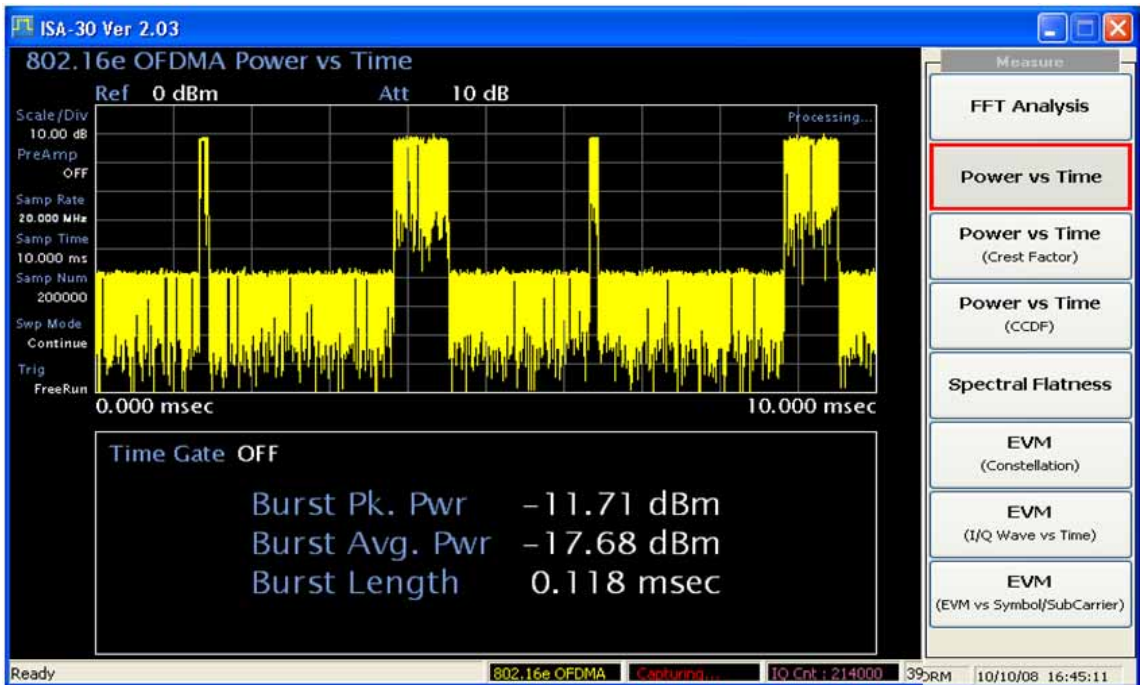


Fig. 2-13 Power vs Time in Free run mode (802.16e UL signal)

2.3.3.3 CCDF

The CCDF(Complementary Cumulative Distribution Function) of the transmit output power is another important measurement of WiMAX transmitter quality. Because OFDM signals tend to exhibit high peak-to-average ratios, due to the AM of the subcarriers, CCDF measurements can help analyze WiMAX transmitter or power amplifier performance.

CCDF shows the distribution of peak-to-average power ratio (PAPR) versus the probability of a particular peak level occurring. Time gating is essential when making CCDF measurements on the OFDMA signal. The CCDF can be seen simultaneously with power vs time measurement. It can be time gated and its time gate position and length can be varied by user.

As can be seen on Fig. 2-14, the CCDF measurement area can be set for its start time and interval as specified 't1' and 't2'. Specifically Fig. 2-14 shows the CCDF measurement for 802.16e (Down link) preamble area(1symbol length) and Fig. 2-15 shows the CCDF measurement for data burst area(2 symbol length). The different measurement result is derived from its different modulation method. (Preamble is modulated with BPSK and data burst modulated with QPSK or QAM modulation method.)

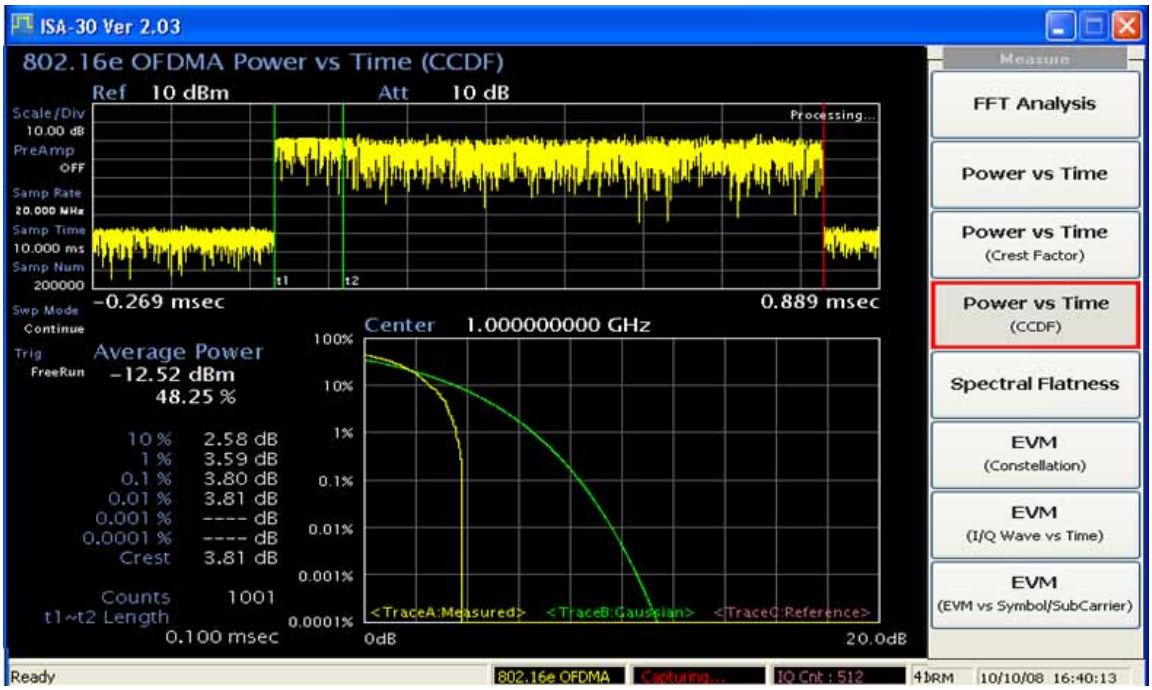


Fig. 2-14 CCDF Measurement (802.16e DL signal, Preamble)

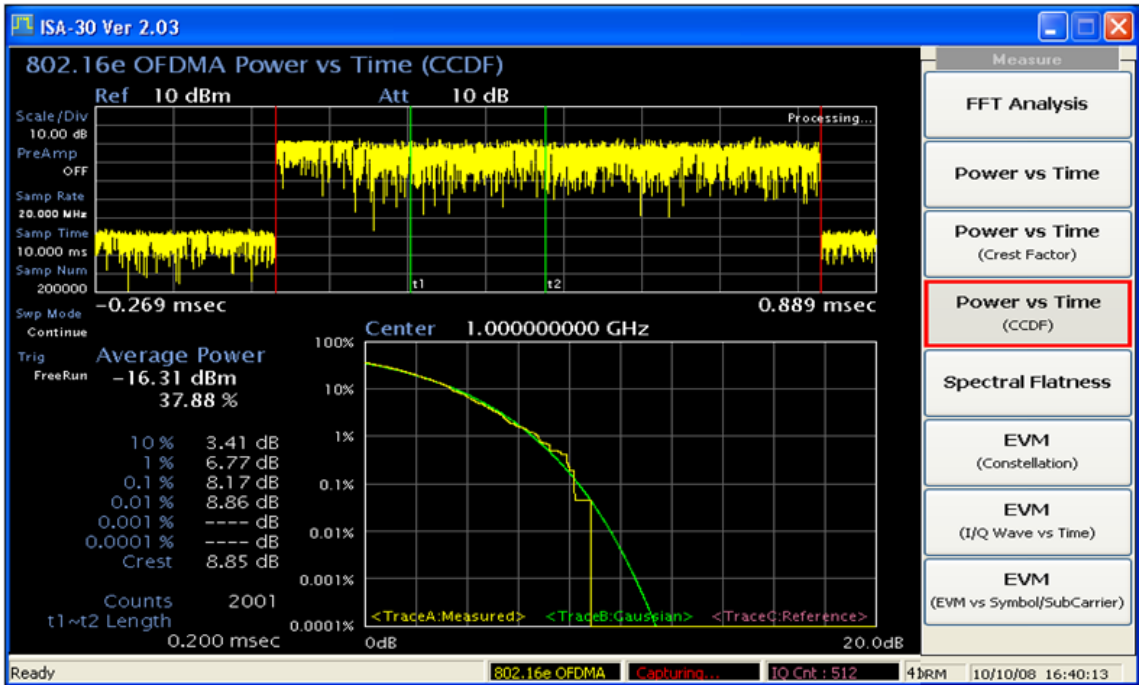


Fig. 2-15 CCDF Measurement (802.16e DL signal, Data burst)

2.3.3.4 Power vs time with Crest Factor

The crest factor or peak-to-average ratio (PAR) or peak-to-average power ratio (PAPR) is a measurement of a waveform, calculated from the peak amplitude of the waveform divided by the RMS (time-averaged) value of the waveform. It is therefore a dimensionless quantity(dB scale).

For burst signal crest factor can be divided burst crest factor and normal crest factor. Burst crest factor can be measured on 'Gate On' mode, in contrast normal crest factor can be measured on 'Gate Off' mode of operation. As similar with previous measurement the time gate position and length can be varied by user. (It is specified by 't1' and 't2' as can be seen below figure.)

Fig. 2-16 shows the crest factor measurement result for preamble and Fig. 2-16 shows data burst area. As it has a different modulation scheme its crest factor is different with its area of burst.

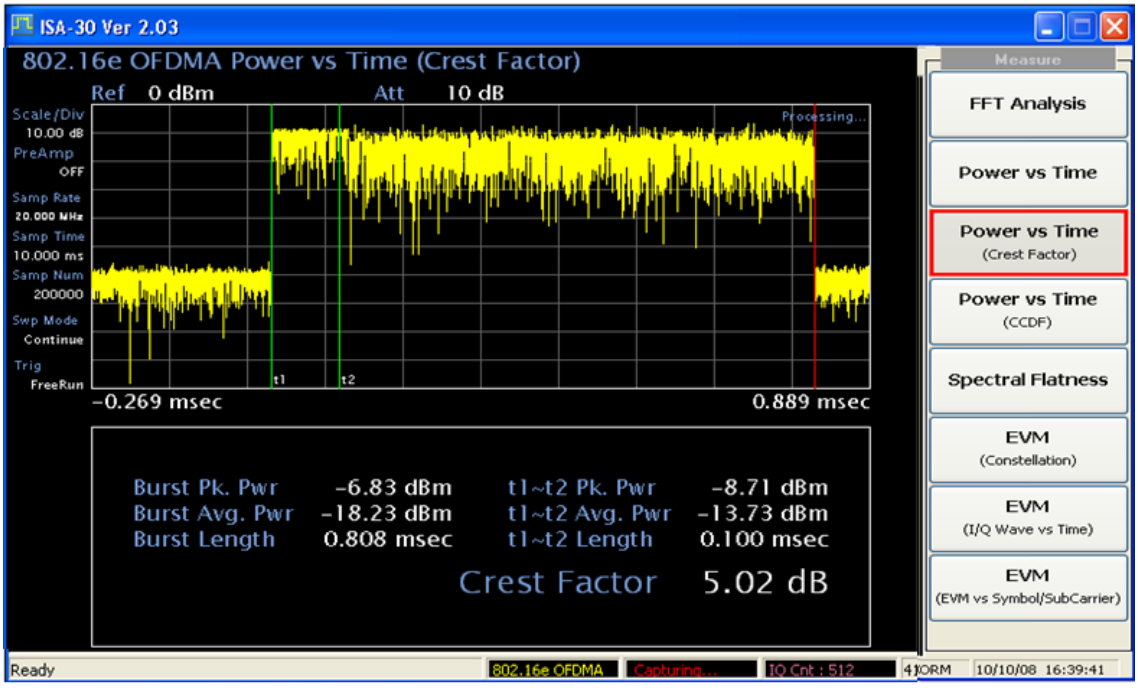


Fig. 2-16 Crest Factor Measurement (802.16e DL signal, Preamble)

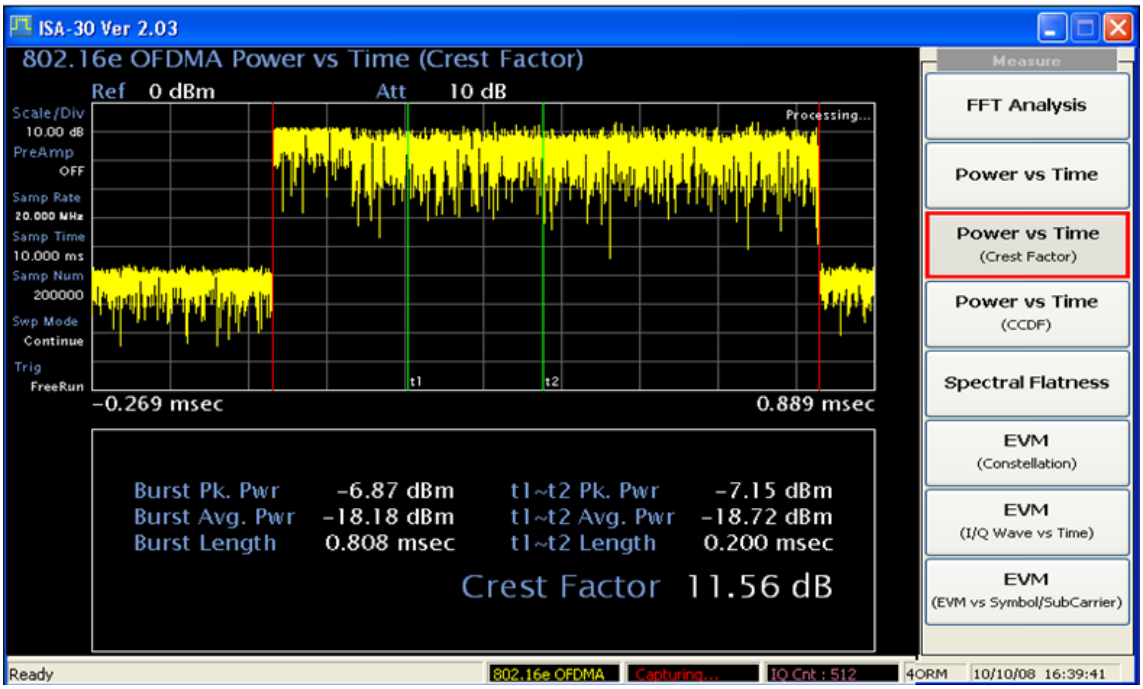


Fig. 2-17 Crest Factor Measurement (802.16e DL signal, Data burst)

2.3.3.5 Spectral Flatness

Spectral flatness is a measure of the consistency in power level of the subcarriers which composing WiMAX OFDMA signal. As specified on WiMAX specification(IEEE -802.16e), adjacent subcarriers are required to be within 0.1 dB in amplitude level. Some deviation is assumed in the overall levels of the carrier, with a window defined by the standard. The close-in or inner one-half subcarriers in a WiMAX burst signal should be within ±2 dB from the average power level of the burst signal, while the outer one-half of the subcarriers should be within +2 and –4 dB of the average power level of the burst signal. IEE 802.16e standard specify for this regulation of spectral flatness as you can see on below table.

Spectral Lines	Spectral Flatness
Spectral lines from –*Nused*/4 to –1 and +1 to *Nused*/4	±2 dB from the measured energy averaged over all *Nused* active tones
Spectral lines from –*Nused*/2 to –*Nused*/4 and +*Nused*/4 to *Nused*/2	+2/–4 dB from the measured energy averaged over all *Nused* active tones

Table. 2-3 Spectral flatness specification in IEEE-802.16e

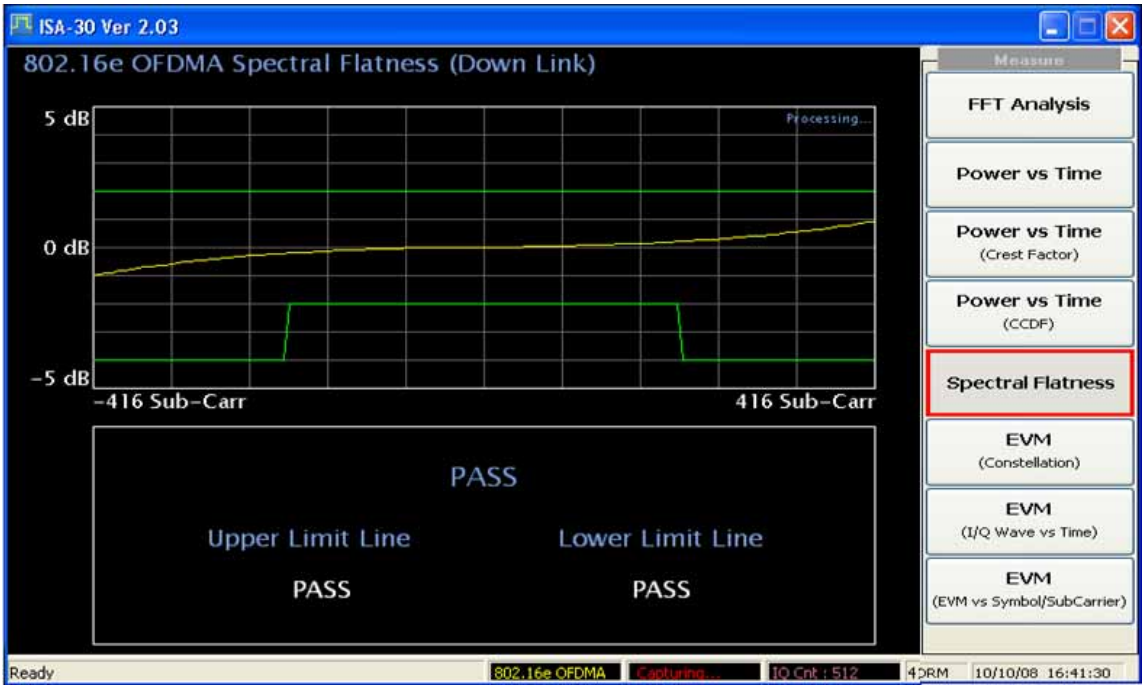


Fig. 2-18 Spectral Flatness Measurement (802.16e DL signal)

2.3.4 WiMAX Transmitter Test : Modulation Quality

2.3.4.1 Configuration for Modulation Quality Measurement

To get an appropriate measurement result for modulation quality, user must set the exact value for various frequency, timing and frame parameters for input WiMAX signal. There are two methods given in this WiMAX option, for setting these parameters. First user only needs to select standard with its bandwidth parameters(5MHz std, 7MHz Std, 8.75MHz Std, 10MHz Std). These parameters can be referenced on Table 2-2 and it is specified on IEEE 802.16e standard. Below describes these parameters.

- Bandwidth : 1.25MHz, 3.5MHz, 4.375Mhz, 5Mhz, 7MHz, 8.75MHz(Default), 10MHz, 20MHz
- FFT Size : 128, 512, 1024(Default), 2048
- Guard period : 1/4, 1/8(Default), 1/16, 1/32
- Frame duration : 2.5ms, 4ms, 5ms(Default), 8ms, 10ms, 12.5ms

Below figure shows 802.16e 10MHz standard signal example for configuring Link Direction and frequency and timing parameters in EVM measurement mode. User can goes to this menu by pressing, Mode -> NEXT -> *802.16e OFDMA* -> SETUP

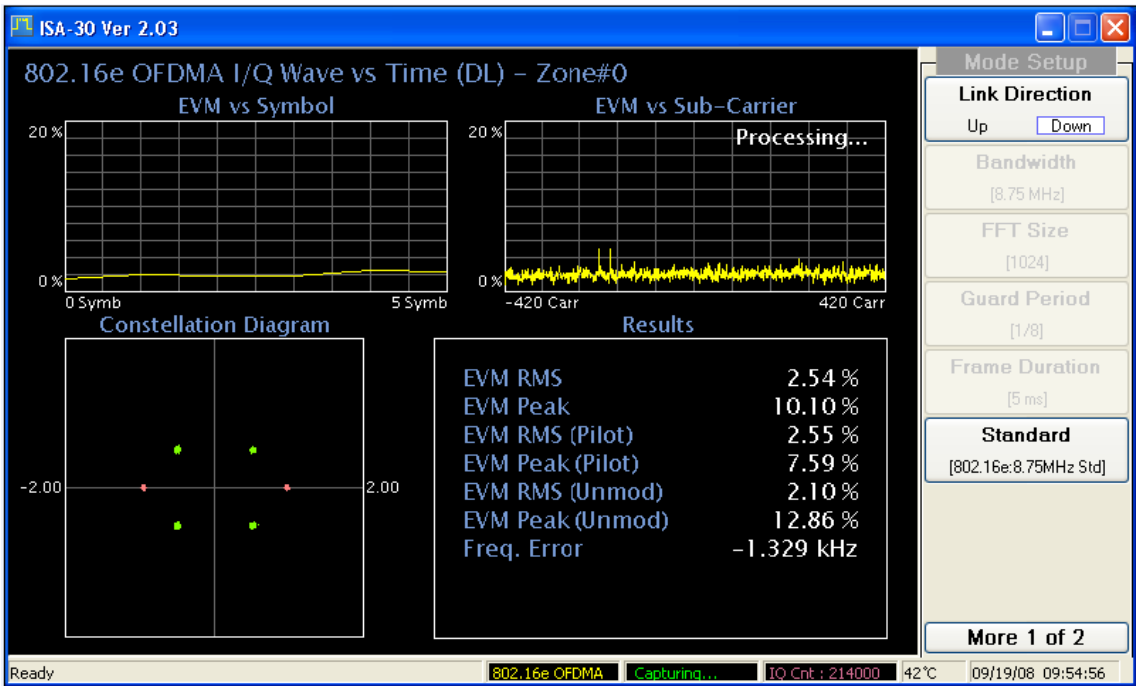


Fig. 2-19 Set frequency and timing parameters (802.16e DL signal)

In addition for setting frequency and timing parameters, zone and burst parameters can be configured by select *More 1 of 2* on above figure. In case of zone parameters, it composed with below parameters.

- Zone number (Active zone)
- Zone Type
- Zone Length
- Zone offset
- Permutation base

Below figure give a simple example for zone configurations. . User can goes to this menu by pressing, Mode -> NEXT -> *802.16e OFDMA* -> SETUP -> NEXT -> *Edit Zone Info*.

Fig. 2-20 Set parameters for zone (802.16e DL signal)

In case of burst zone parameters, it composed with below parameters.

- Burst number(Active burst)
- Burst symbol number
- Burst sub-channel number
- Burst symbol offset
- Burst Modulation type : QPSK, 16QAM, 64QAM

Below figure give a simple example for burst configurations. Burst can be added by select *Add Burst* and can be deleted by select *Delete Burst*. User can goes to this menu by pressing, Mode -> NEXT -> *802.16e OFDMA* -> SETUP -> NEXT -> *Edit Zone Info* -> NEXT.

Fig. 2-21 Set parameters for Burst (802.16e DL signal)

2.3.4.2 EVM Measurement

The modulation accuracy is the relative difference between received signal constellation point and its ideal constellation point. As noted above, the measurement is carried out on both modulated and un-modulated carriers to ensure that the MS does not degrade the link for itself or other users. The equalizer is set to operate on pilots, and remove amplitude, phase, and timing errors, thereby matching the expected capability of a BS receiver.

To measure EVM, user goes to [Mode] -> [NEXT] -> *802.16e OFDMA* -> [MEASURE] -> *EVM* .

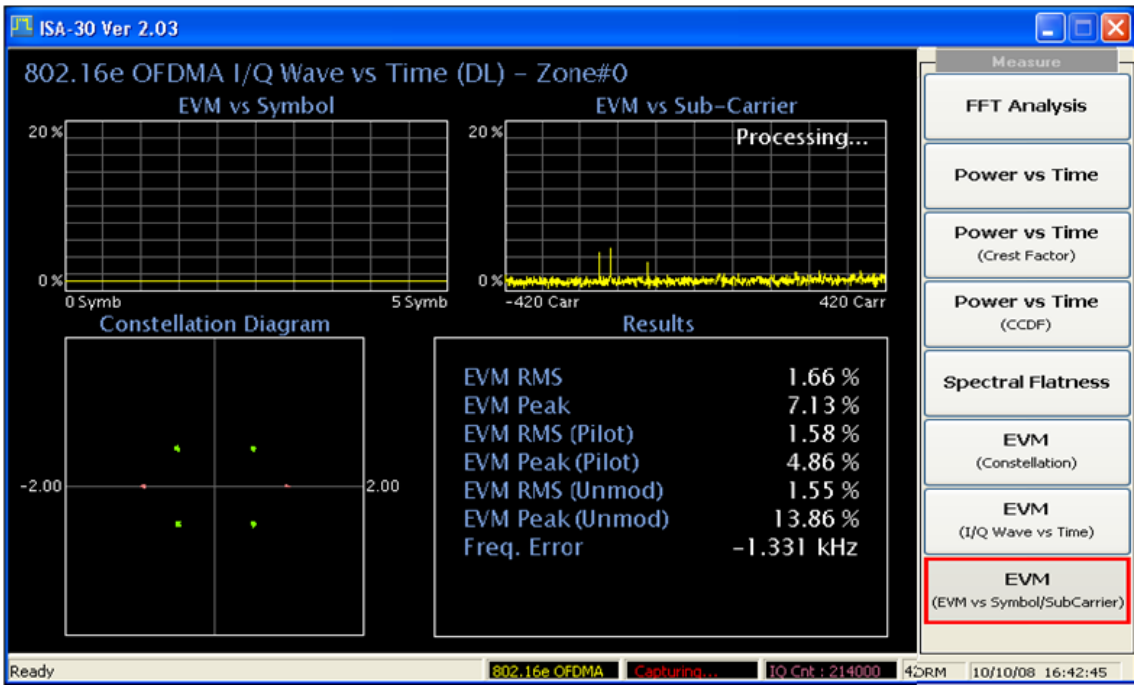


Fig. 2-22 Measuring EVM for WiMAX signal (802.16e DL signal)

2.3.4.3 Constellation Measurement

There are three modulation types available for modulating the data onto the subcarriers: QPSK, 16QAM, and 64QAM. In the UL, the transmit power is automatically adjusted when the modulation coding sequence (MCS) changes to maintain the required nominal carrier-to-noise ratio at the BS receiver. 64QAM is not mandatory for the UL. Binary phase shift keying (BPSK) modulation is used during the preamble, on the pilots, and when modulating subcarriers in the ranging channel.

In IEEE-802.16e standard defines the allowed relative constellation error(RCE) as you can see on Table. 2-4.

In this constellation measurement, it separate modulation burst by its different color. Fig. 2-21 shows two type of modulation, one is BPSK (preamble) and the other is QPSK(data burst).

To measure Constellation, user goes to Mode -> NEXT -> *802.16e OFDMA* -> MEASURE -> *Constellation* .

Burst Type	Relative constellation for SS(dB)	Relative constellation for BS(dB)
QPSK-1/2	-15	-15
QPSK-3/4	-18	-18
16-QAM-1/2	-20.5	-20.5
16-QAM -3/4	-24	-24
64-QAM-1/2	-26	-26
64-QAM-2/3	-28	-28
64-QAM-3/4	-30	-30

Table. 2-4 Allowed relative constellation error versus data rate

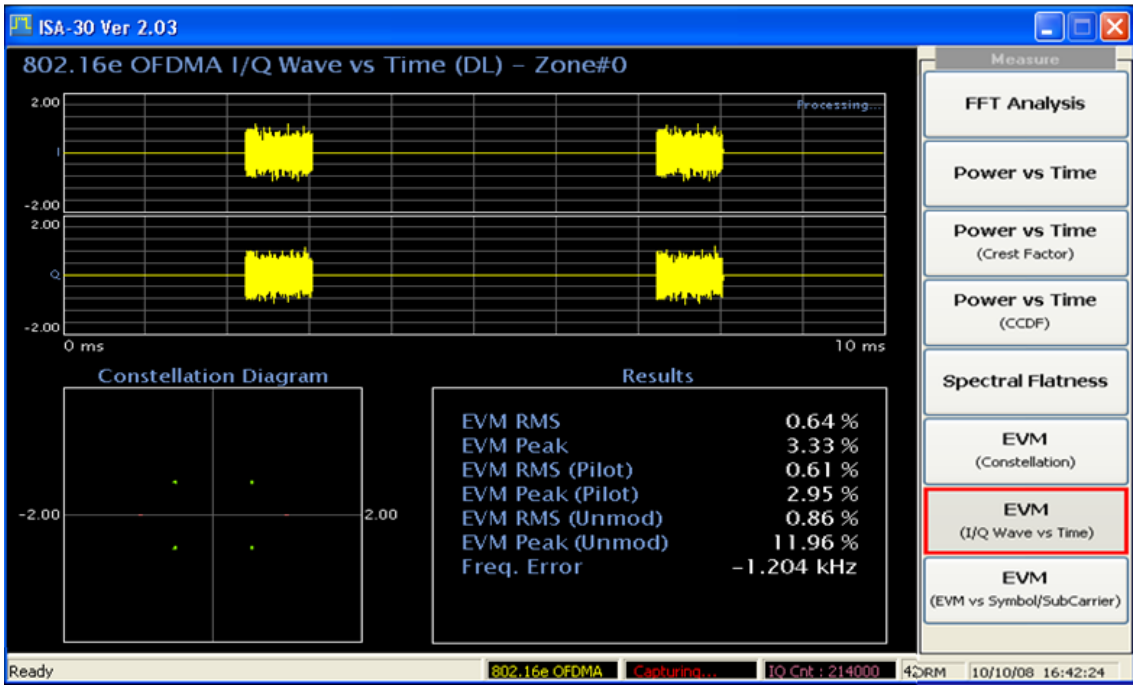


Fig. 2-23 Measuring Constellation for WiMAX signal (802.16e DL signal)

2.3.4.4 Frequency error measurement

At the SS, both the transmitted center frequency and the sampling frequency shall be derived from the same reference oscillator. Thereby, the SS uplink transmission shall be locked to the BS, so that its center frequency shall deviate no more than 2% of the subcarrier spacing, compared to the BS center frequency.

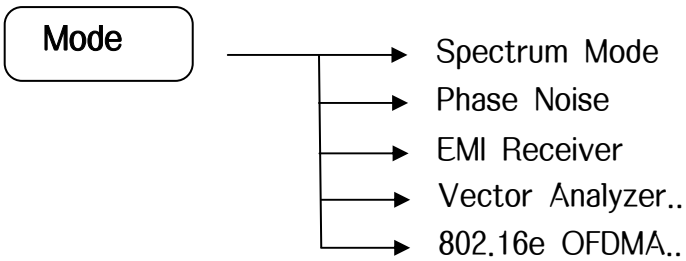
In case of 8.75Mhz BW WiMAX signal(Wibro), the subcarrier space is 9.765625kHz. This means that the allowed transmitter frequency error must be less than 195.3125Hz. This measurement can be seen on EVM and Constellation measurement with modulation quality parameters.

SECTION 3
Menu Descriptions

Read this manual and keep in mind contents before using the WIMAX measurement option.

3.1 WiMAX Measurement Mode

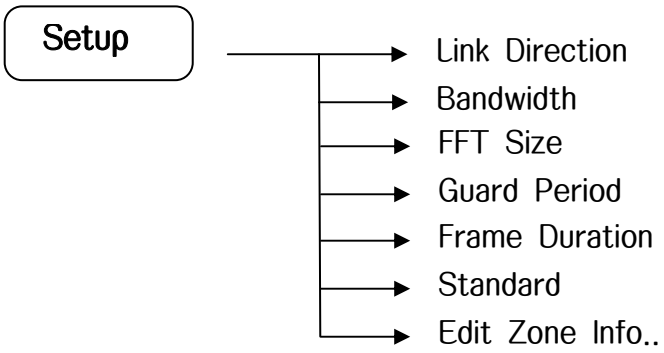
For using WiMAX measurement options, firstly user must transform system to WiMAX mode.



Select Mode key of front panel of signal analyzer, and then press *802.16e OFDMA* Mode of soft function key of the right side of screen.

3.2 Mode-Setup

Press Setup key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.

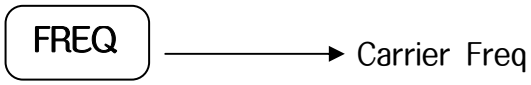


- Link Direction : Determine the link direction for WiMAX signal source to be analyzed. (Default : Down Link)
- Bandwidth : Select bandwidth parameter for WiMAX signal source to be analyzed. This value varies from 1.25Mhz to 20MHz. (Default :8.75MHz)
- FFT Size : Select FFT parameter for WiMAX signal source to be analyzed. This value varies from 128 to 2048. (Default :1024)
- Guard Period : Select Guard period parameter for WiMAX signal source to be analyzed. This value can be 1/4, 1/8, 1/16, 1/32. (Default : 1/8)
- Frame Duration : Select Guard frame duration parameter for WiMAX signal source to be analyzed. This value varies from 2ms to 20ms. (Default :5ms)
- Standard : Select BW based standard which has unique time frequency parameters. Standard list is 5Mhz Std, 7MHz Std, 8.75MHz Std, 10Mhz Std which most reliable standard.
- Edit Zone Info : Set the zone and burst parameters which specific input WiMAX signal.
  1. Zone configuration parameters.
     - Active Zone : Current activated zone.
     - Zone Type : PUSC
     - Zone offset
     - Zone Permutation Base

2. Burst configuration parameters
   - Active burst : Current activated burst
   - Burst symbols
   - Burst subchannel
   - Burst symbol offset
   - Burst subchannel offset
   - Burst modulation type : QPSK, 16QAM, 32QAM

3.3 Frequency Channel Menu

Press FREQ key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.

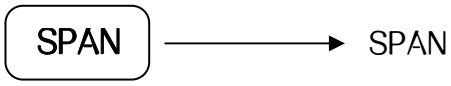


Via this menu you can access frequency functions.

- Carrier Freq : Allows user to specify the frequency of input WIMAX signal.

3.4 Span Menu

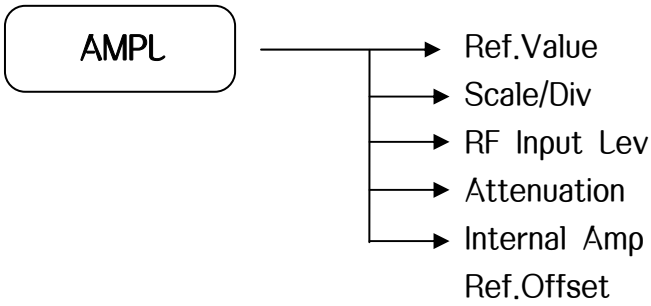
Press SPAN key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.



- SPAN : Specify the measurement span for WIMAX input signal to be measured. (Only in spectrum analysis.)

3.5 Amplitude Menu

Press AMPL key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.

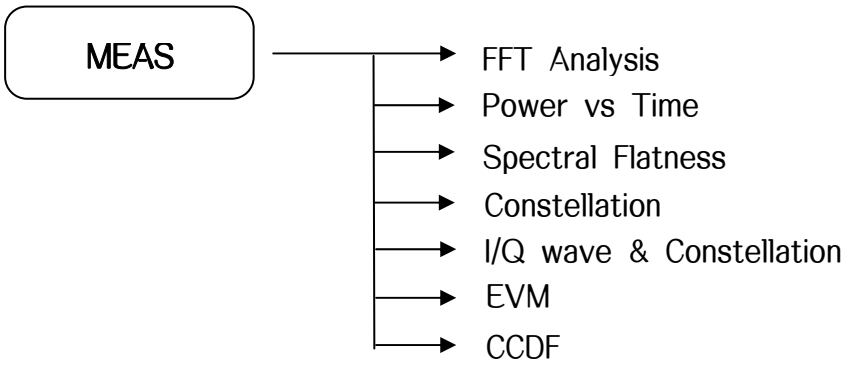


Amplitude menu keys are used for setting functions that affect the way data on the vertical axis is displayed or corrected.

- Ref.Value : This allows user to set the value in dBc/Hz of a specified position on the graticule display.
- Scale/Div : This allows user to set the value of scale in dB for each division of Y-axis.
- Attenuation : Set variable attenuator which variable from 0dB to 55dB and step size is 5dB. (Default : 10dB)
- Internal Amp : On or off the internal preamplifier.
- Ref.Offset : Set the offset value for the signal displayed.

3.6 Measure Menu

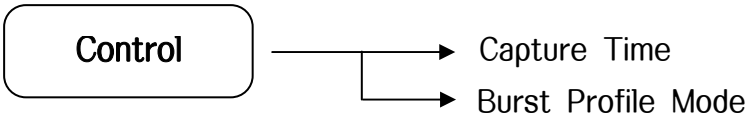
Press MEAS key of front panel in WIMAX Mode status and then appear menu following above-mentioned. This menu include the following functions.



- FFT Analysis : Analyze WiMAX signal in spectrum mode.
- Power vs Time : Measure the Power vs Time of WIMAX signal.
- Spectral Flatness : Measure the Spectral Flatness of WIMAX signal for it's sub-carrier. The Pass/Fail result for carrier flatness will be measured and displayed. (Refer IEEE 802.16e Std)
- Constellation : Measure the constellation diagram for WIMAX input signal. The modulation related numerical result will be shown on left side of window.
- I/Q wave & Constellation : Show the constellation result simultaneously with its I/Q wave versus time.
- EVM : Measure the Error Vector Magnitude for WIMAX input signal. 'EVM vs Symbols' and 'EVM vs Sub-carriers' will be shown.
- CCDF : Measure the CCDF (Complementary Cumulative Distribution Function) of WIMAX signal.

3.7 Measure Control Menu

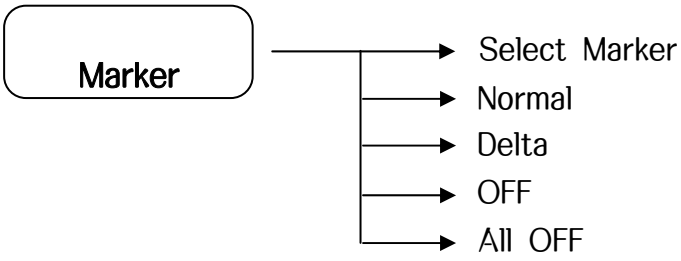
Press Control key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.



- Capture Time : Specify the time to be captured for WIMAX signal analysis. The maximum capture time is 28.037ms and the minimum is 0.001ms.

3.8 Marker Menu

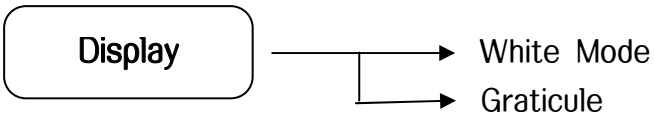
Press Marker key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.



- Select Marker : Allows you to select one of the four possible markers. Having selected one of the markers, use the other softkeys on this menu to specify the type of marker or measurement.
- Normal : Sets the specified marker to be a normal marker.
- Delta : A delta marker is actually a pair of markers. By pressing Delta, you set a pair of markers at your current frequency offset. One of this pair of marker is fixed while the second of the pair can be moved using your RPG knob or the numeric keys. The frequency difference and the amplitude difference between these two points is displayed.
- Marker Trace : Allows you to select which of the two traces your currently selected marker is applied to.
- OFF : Switches the specified marker off.
- All OFF : Switches all markers off. All markers are removed from the graticule display, and if the marker table is also being displayed, all entries will be removed from it.

3.9 Display Menu

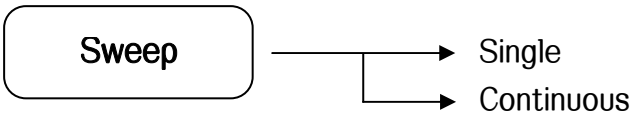
Press Display key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.



- White Mode : Change the screen background to white color.
- Graticule : Allows you to display or hide the graticule lines on the display.

3.10 Sweep Menu

Press Sweep key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.

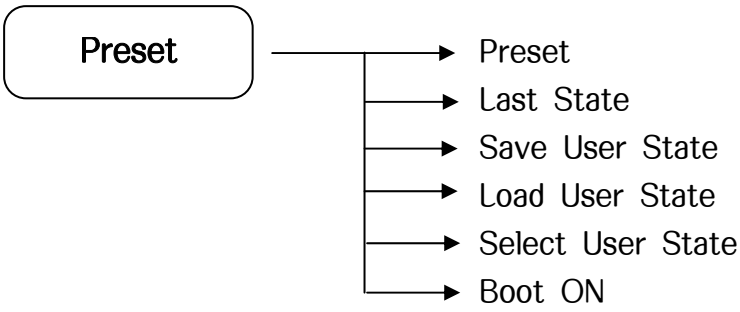


- Single : The analyzer performs one single measurement and then stops. You have to press the Restart button every time you want to make another measurement.

- Continuous : The analyzer continuously measures the signal it is receiving and repeatedly updates the plots and the measurements.

3.11 Preset Menu

Press Preset key of front panel in WIMAX Mode status and then appear menu following above-mentioned. Each menu include the following functions.



The sub menus of Preset have the same function of basic spectrum analysis mode. (Please refer 'ISA Spectrum Analyzer Operation Manaul' for other softkey fucntion.)

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