



# SPECTRUM ANALYZERS

## 3250 Series



# WiMAX (802.16e) Measurement User Manual

Document part no. 47090/004

---



# **SPECTRUM ANALYZERS 3250 SERIES**

## **WiMAX (802.16e) Measurement User Manual**

© Aeroflex International Ltd. 2009

*No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, or recorded by any information storage or retrieval system, without permission in writing by Aeroflex International Ltd. (hereafter referred to throughout the document as 'Aeroflex').*

Manual part no. 47090/004 (PDF version)  
Based on Issue 1 of the printed manual

29 July 2009

---

## About this manual

This manual explains how to use the WiMAX measurement option for the 3250 Series Spectrum Analyzers.

### Intended audience

People carrying out work relating to the design and manufacture of RF and microwave sub-systems and modules, or the installation and maintenance of those systems.

Familiarity with the terms used in RF and microwave measurements is assumed.

### Document conventions

The following conventions apply throughout this manual:

**CAPS** Capitals are used to identify names of controls and panel markings.

[CAPS] Capitals in square brackets indicate hard key titles.

[*Italics*] Italics in square brackets indicate soft key titles.

### Associated publications

- **3250 Series Operating Manual**  
(PDF version 46892/974, printed version 46882/974)

---

# Contents

General.....	6
Specifications .....	7
Frequency .....	7
Dynamic range and accuracy .....	7
A/D converter .....	7
Storage .....	7
Installing the WiMAX measurement option .....	8
Measurement guide.....	9
Preparation for measurement .....	9
General steps in making a measurement .....	9
802.16e signal measurement guide.....	13
OFDMA basic theory .....	13
WiMAX and 802.16e standard .....	14
Definition of mobile WiMAX basic parameters.....	15
Mobile WiMAX (802.16e) physical parameters.....	16
Mobile WiMAX (802.16e) frame structure (in TDD operation mode) .....	16
WiMAX transmitter test (spectrum & power) .....	18
Spectrum measurement.....	18
Power vs time.....	18
CCDF.....	19
Power vs time with crest factor.....	20
Spectral flatness .....	22
WiMAX transmitter test (modulation quality).....	23
Configuration for modulation quality measurement .....	23
EVM measurement .....	25
Constellation measurement .....	26
Frequency error measurement.....	26
Menu descriptions .....	28
WiMAX measurement mode .....	28
Mode setup.....	28
Frequency menu.....	29
Span menu (FFT analysis only) .....	29
Amplitude menu .....	29
Measure menu.....	30
Measure control menu (except FFT analysis).....	30
Marker menu (FFT analysis only) .....	31
Peak menu (FFT analysis only) .....	31
Display menu .....	31
Sweep menu .....	32
BW menu .....	32
Trace menu (FFT analysis only) .....	32
Preset menu.....	32
Detailed description of commands .....	33
General .....	33
SA command.....	33
Amplitude.....	34
RL .....	34
AT.....	35
SD .....	36
Average (FFT Analysis Only).....	37
AVG.....	37
AVGC .....	38
Bandwidth (FFT analysis only).....	39
RB .....	39

---

RBA .....	40
Display .....	41
GRAT .....	41
WH.....	42
File .....	43
FREAD .....	43
FSAVE.....	44
FLOAD .....	45
FDEL .....	46
FCOPY .....	47
FRENAME .....	48
FMOVE .....	49
Frequency.....	50
CF .....	50
SR .....	51
REF .....	51
Marker (FFT analysis only) .....	52
MS[1~9].....	52
MM[1~9] .....	53
MF[1~9].....	54
MA[1~9].....	55
MAO.....	56
Measurement .....	57
MEA .....	57
PVTOUT.....	58
PVMOUT .....	59
CCDFOUT.....	60
FLATOUT .....	61
EVMCOUT.....	62
EVMWOUT .....	63
EVMOUT .....	64
Measurement control.....	65
MEAT .....	65
Mode .....	66
MODE.....	66
WIMAXSTD .....	67
Peak search (FFT analysis only) .....	68
MPK[1~9].....	68
MPKN[1~9] .....	68
Preset.....	69
PRST.....	69
Printer.....	70
HCOPY .....	70
Span (FFT analysis only) .....	71
SP.....	71
Sweep.....	72
CO.....	72
SI.....	73
System.....	74
BEEP.....	74
ECHO .....	74
Trace (FFT analysis only) .....	75
TRF .....	75
GPIB common commands .....	76
*CLS .....	76
*ESE .....	77
*ESR? .....	78
*IDN? .....	79
*OPC.....	80

---

---

*OPC?.....	81
*RST.....	82
*SRE.....	83
*STB?.....	84
GPIB common commands — others.....	85
ESE2.....	85
ESR2?.....	86
ERR.....	87
Remote commands .....	88
< Catalog order > .....	88
< SA command order >.....	90
< SCPI command order >.....	92
Error codes.....	94

---

# General

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

You can make the following measurements:

- FFT Analysis
- Spectrum with FFT
- Power versus Time
- Spectral Flatness
- Modulation Quality (Constellation, EVM vs Symbol, EVM vs Subcarriers)
- Modulation quality-related numerical results
  - 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

---

## Specifications

The instrument includes a wide-band RF digitizer, which is optimized for complex signal analysis applications in communications system test.

### Frequency

<b>Frequency range</b>	3 Hz to 3 GHz / 8 GHz / 13.2 GHz / 26.5 GHz
Bandwidth	30 MHz
Resolution	1 Hz

### Dynamic range and accuracy

<b>Intermodulation free dynamic range Adjacent Channel Leakage Ratio (ACLR)</b>	Typically 80 dB
<b>Residual EVM</b>	<1% (nominal)

### A/D converter

<b>Resolution</b>	14 bits
<b>ADC clock</b>	Fixed 85.6 MHz
<b>Sample rate control</b>	IF: 21.4 MHz; IQ: variable 541.666ks/s to 42.8 Ms/s
<b>Amplitude flatness</b>	Typically 0.5 dB to 30 MHz
<b>Phase flatness</b>	0.05 radians pk-pk to 30 MHz

### Storage

<b>Data output</b>	Sampled digital I/Q data is stored in the digitizer's internal memory. Its resolution is 32 bits. It is transferred to the CPU over the PCI bus.
<b>Sample memory</b>	128 Mb (32 Msample)

---

## Installing the WiMAX measurement option

To license your WiMAX measurement option, use the following procedure.

*Note: when you add a new option, or update an existing option, you receive the updated version of all your current options because 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.*

*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.*

*If you bought the digitizer with this option, it must be sent to manufacturer. All hardware and software installations will be completed by manufacturer and the instrument returned to you.*

- 1 Connect keyboard and mouse to the PS2 ports or the USB ports.
- 2 Turn on the instrument. Wait until the instrument completes its power-up sequence.
- 3 Press [System], [Option Info.], [Option Activate].
- 4 Select the WiMAX field in the license active dialog window.

*Note: all purchased options must be selected.*

- 5 Enter the letters/digits of your 32-character license code using the mouse or the keyboard. The license key number is a hexadecimal number.
- 6 Press [Activate].
- 7 If licensing completes successfully then the *Activation Success* dialog window displays. If *Invalid License!* is displayed, enter the correct license code again.
- 8 Press *OK* or press any keypad, then exit from the license menu.

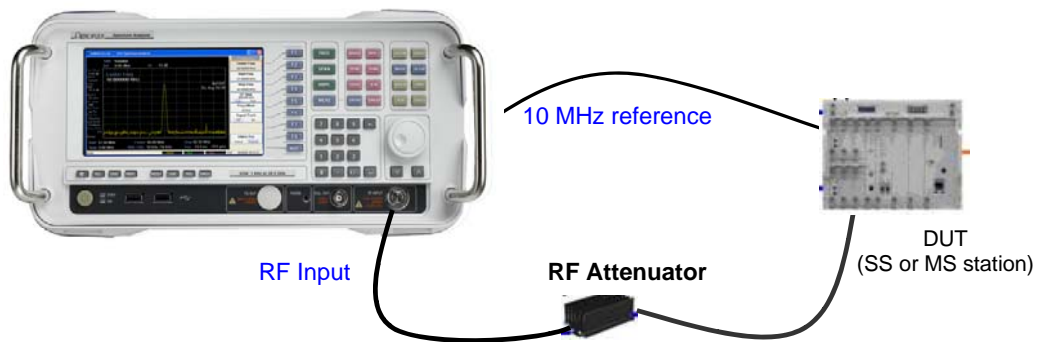
---

# Measurement guide

This section provides a guide to making measurements of mobile WiMAX (802.16e) signals. Using the procedures specified in this section, you can get WiMAX signal analysis results.

## Preparation for measurement

Before connecting a signal to the instrument, make sure the instrument can safely accept the signal level provided. The maximum RF input level is +30 dBm. If the RF input attenuator level is set to 10 dB, the input level can be increased to +40 dBm. Connect a 10 MHz reference input to synchronize the analyzer with a signal source. Fig. 1 shows the instrument set up for testing a device.



*Fig. 1 WiMAX measurement setup*

## General steps in making a measurement

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

### 1 Select the WiMAX measurement option

Press [MODE]. All of the installed and licensed options (Phase Noise, EMI Receiver, WiMAX etc.) become available and are shown.

Press [NEXT] until the WiMAX option is visible

Press [802.16 OFDMA] to go to the WiMAX measurement menu.

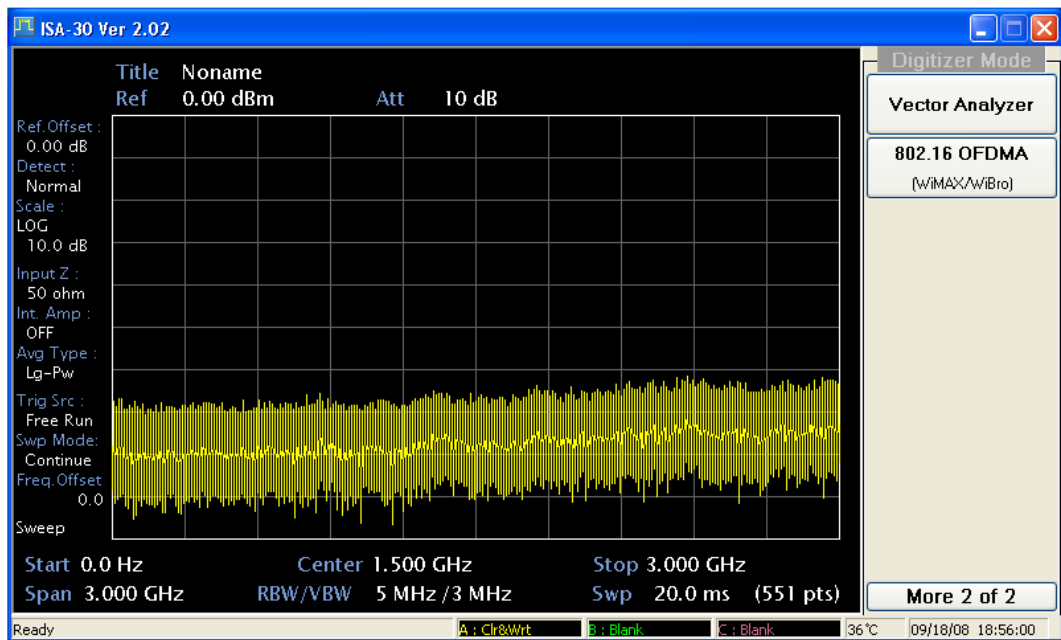


Fig. 2 Select WiMAX measurement option

## 2 Select the measurement to be performed

The WiMAX option provides various measurements for analyzing the WiMAX signal's physical layer. Select the measurement from the following menu:

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

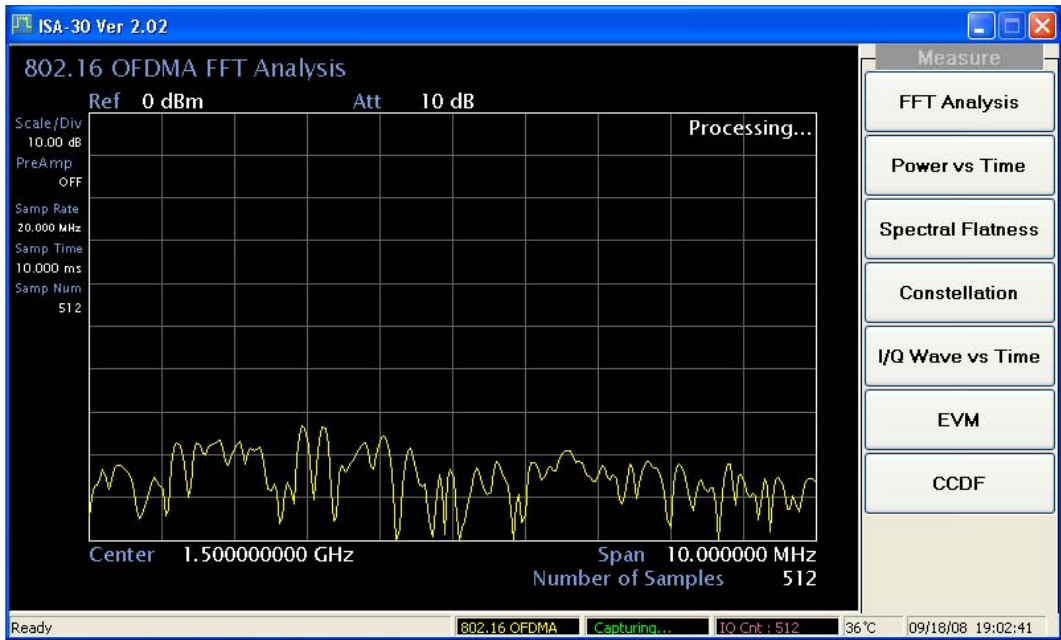


Fig. 3 Select WiMAX Specific Measurement

### 3 Configure OFDMA parameters

This configuration is important for evaluating modulation quality measurements exactly. Configure WiMAX frequency and timing parameters by pressing [Setup]. Configure the link direction (Downlink or Uplink) by pressing the [F1] key. Configure zone and burst parameters by pressing [NEXT] and selecting [Edit Zone Info...]. After finishing configuration, return to the measurement menu by pressing [MEASURE].

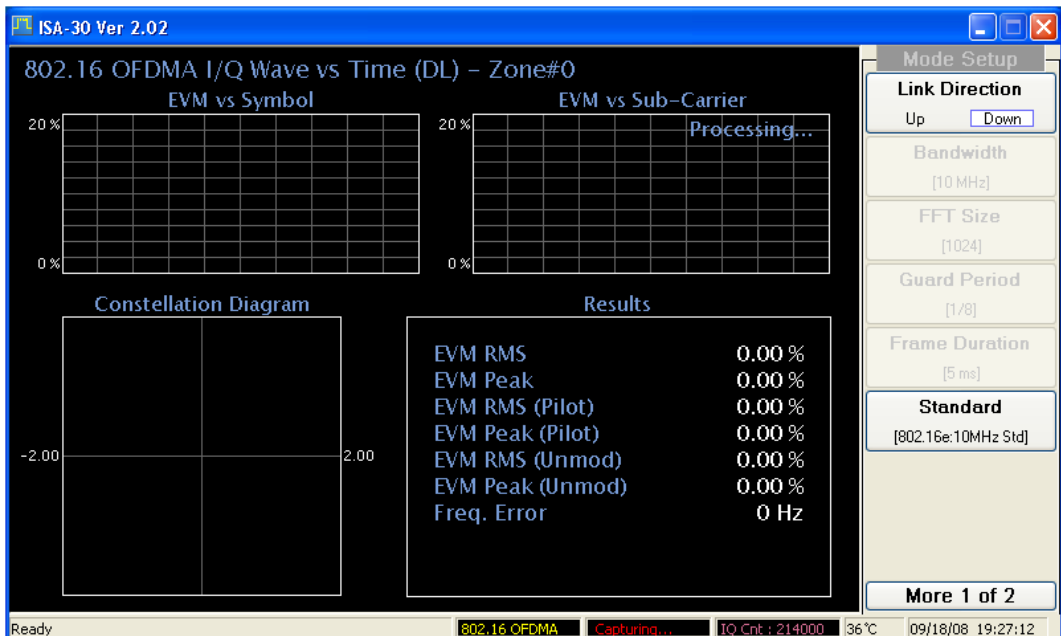


Fig. 4 Set up WiMAX frequency & timing parameters

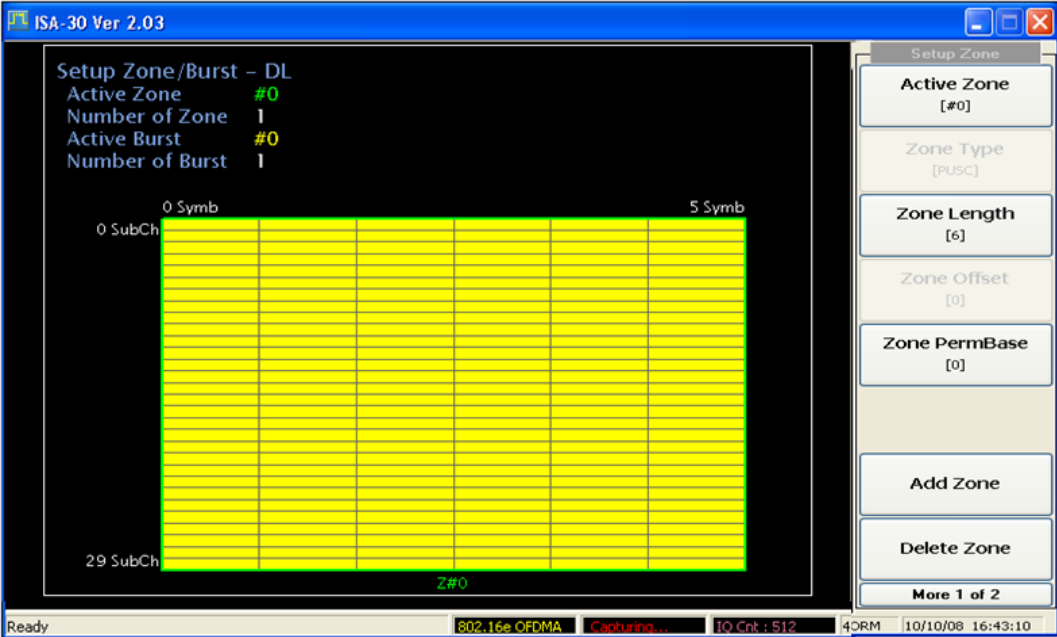


Fig. 5 Set up WiMAX Zone and Burst parameters

## 802.16e signal measurement guide

This chapter gives guidance for measuring the physical layer performance of a WiMAX (802.16e) signal. It describes a typical procedure for each measurement of a WiMAX signal. The target system (BS or MS) of this measurement option must follow the IEEE 802.16e OFDMA standard, released in 2005.

### OFDMA basic theory

Orthogonal Frequency Division Multiplexing Access (OFDMA) is an access technique that subdivides the bandwidth into multiple frequency subcarriers. Fig. 6 gives a simple description for the multi-carrier modulation method of an OFDMA system. In an OFDMA system, the input data stream is divided into several parallel sub-streams with reduced data rate (increasing symbol duration). Each sub-stream is modulated and transmitted on a separate orthogonal subcarrier. The increased symbol duration improves the robustness of OFDMA to delay spread.

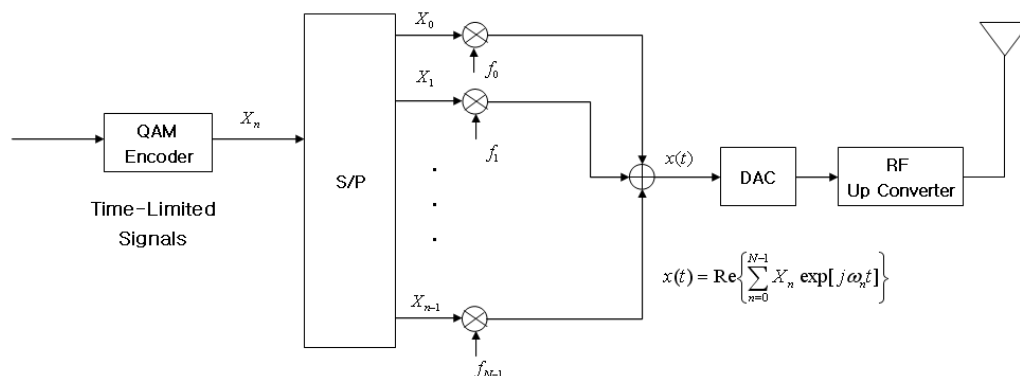


Fig. 6 Description of OFDMA modulation

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 the data portion of the block, which are appended to the beginning of the data payload as shown in Fig. 7.

The CP prevents inter-block interference, 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.

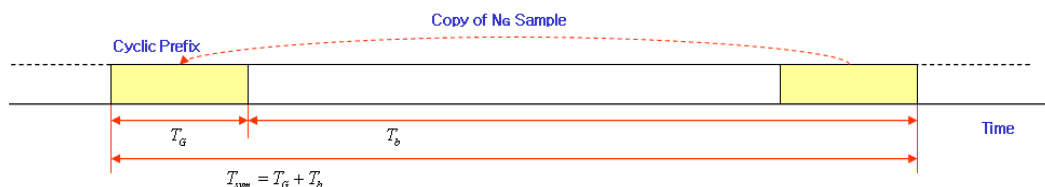


Fig. 7 CP (Cyclic Prefix) concept

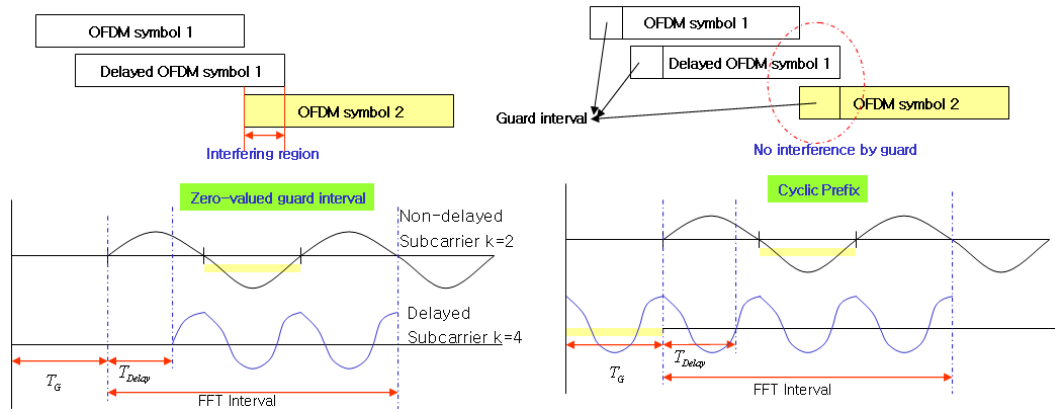


Fig. 8 Eliminating ISI by CP

The OFDMA symbol is composed of three types of subcarrier, as shown in Fig. 9: data subcarriers for data transmission, pilot subcarriers for estimation and synchronization purposes, and null subcarriers for no transmission, together with guard bands and DC carriers

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

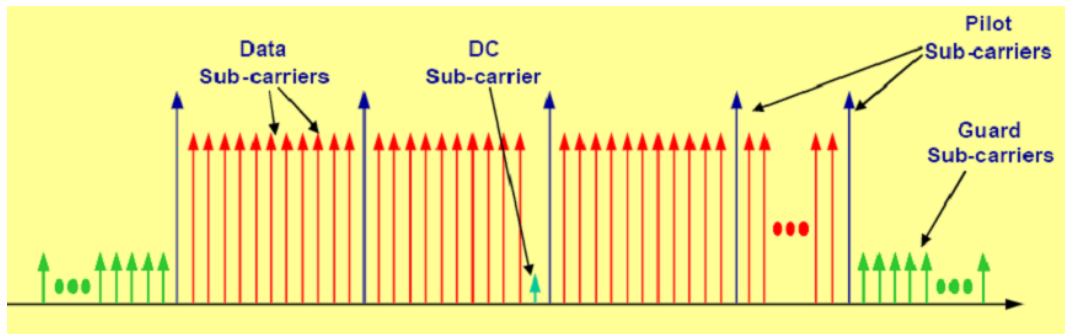


Fig. 9 OFDMA subcarriers

## WiMAX and 802.16e standard

The IEEE 802.16 group produced 802.16a, to include NLOS applications in the 2 GHz–11 GHz 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 refer to these as ‘fixed WiMAX’.

In 2005, the IEEE group completed and approved IEEE 802.16e-2005, an amendment to the IEEE 802.16-2004 standard that added mobility support. 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 1.

Table 1 IEEE-802.16 basic parameters

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

## 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 described here follow the IEEE 802.16e-2005 standard.

### 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,  $n = 8/7$ . For channel bandwidths that are a multiple of any of 1.25, 1.5, 2 or 2.75 MHz,  $n = 28/25$ . For channel bandwidths not otherwise specified  $n = 8/7$ .

**G:** this is the ratio of CP time to ‘useful’ time. The following values are supported: 1/32, 1/16, 1/8, and 1/4.

### 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, 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.

## 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 10.94 kHz. This keeps the OFDM symbol duration, which is the basic resource unit, fixed and therefore scaling has minimal impact on higher layers. A scalable design also keeps the costs low. The subcarrier spacing of 10.94 kHz 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 20  $\mu$ s and vehicular mobility up to 125 km/h when operating in 3.5 GHz. A subcarrier spacing of 10.94 kHz implies that 128, 512, 1,024, and 2,048 FFT are used when the channel bandwidth is 1.25 MHz, 5 MHz, 10 MHz, and 20 MHz, respectively. It should, however, be noted that mobile WiMAX may also include additional bandwidth profiles (see the column in italics in Table 2). For example, a profile compatible with WiBro will use an 8.75 MHz channel bandwidth and 1,024 FFT. This obviously requires a different subcarrier spacing and hence does not have the same scalability properties.

**Table 2 IEEE-802.16e time, frequency parameters**

Parameters	Values						
<b>System BW (MHz)</b>	1.25	5	10	20	3.5	7	<i>8.75</i>
<b>Sampling factor</b>	28/25				8/7		
<b>Sampling frequency (Fs,MHz)</b>	1.4	5.6	11.2	22.4	4	8	<i>10</i>
<b>Sampling time (1/Fs,nsec)</b>	714.3	178.6	89.3	44.6	250	125	<i>100</i>
<b>FFT size (NFFT)</b>	128	512	1024	2048	512	1024	<i>1024</i>
<b>Subcarrier frequency spacing (<math>\Delta f</math>,kHz)</b>	10.9375				7.8125		<i>9.765625</i>
<b>Useful symbol time (<math>T_b=1/\Delta f</math>,us)</b>	91.4				128		<i>102.4</i>
<b>Guard time (<math>T_g=T_b/8</math>)</b>	11.4				16		<i>12.8</i>
<b>OFDMA symbol time (<math>T_s=T_b+T_g</math>,us)</b>	102.8				144		<i>115.2</i>

## 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 adoption, 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 adapting to varied global spectrum allocations.

Transceiver designs for TDD implementations are less complex and therefore less expensive.

Fig. 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.

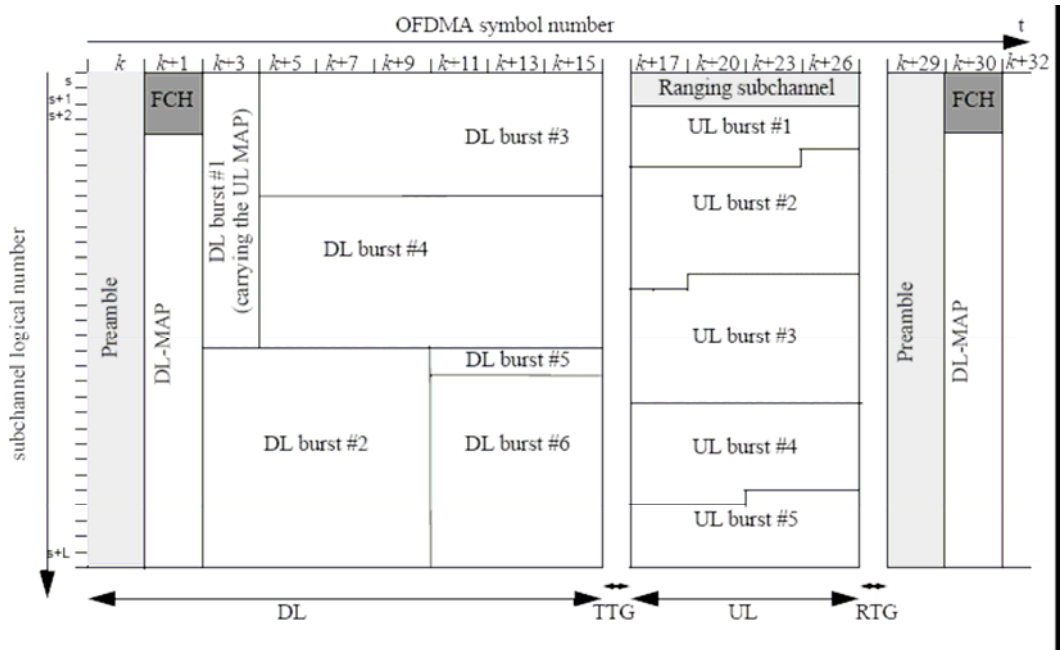


Fig. 10 Example of an OFDMA frame in TDD mode

## WiMAX transmitter test (spectrum & power)

### Spectrum measurement

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

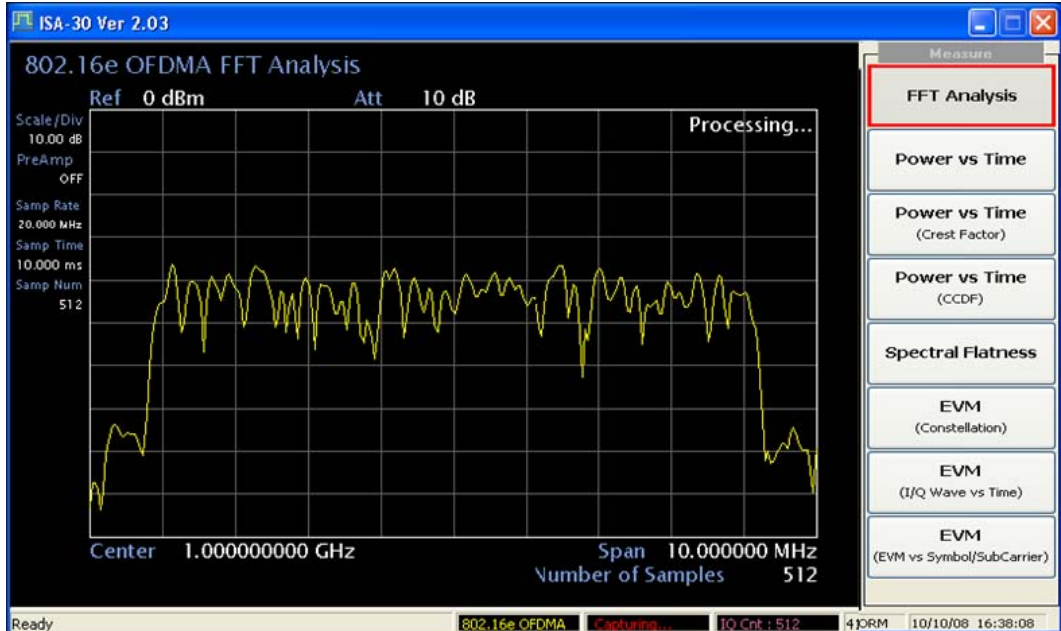
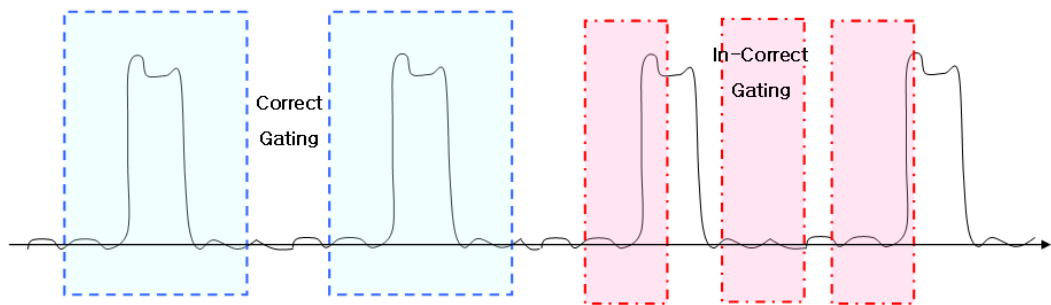


Fig. 11 FFT measurement (802.16e DL signal)

### Power vs time

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



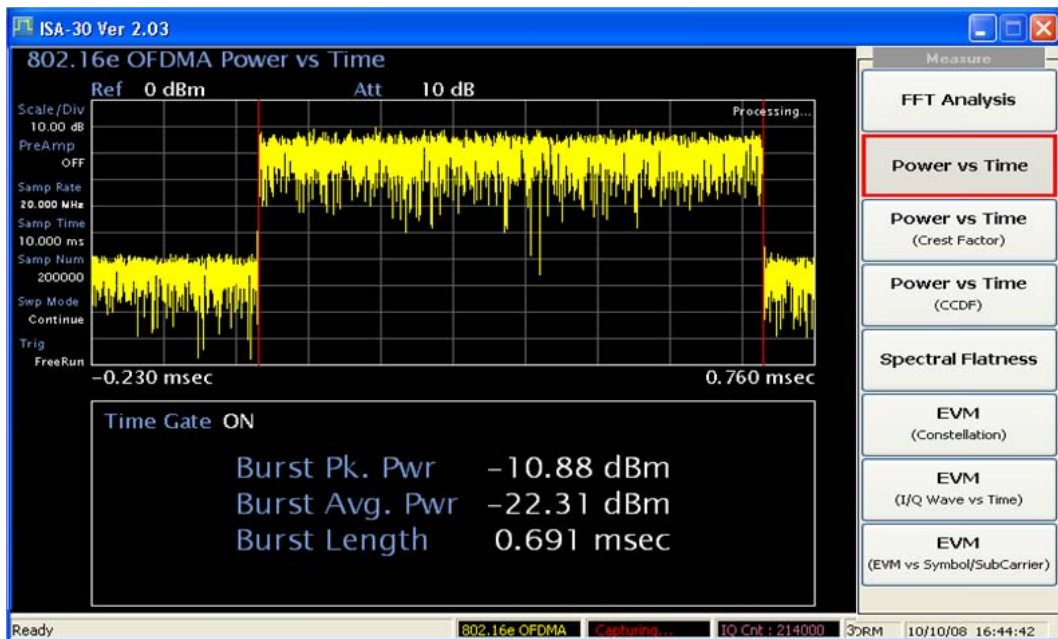


Fig. 12 Power vs Time in gated mode (802.16e DL signal)

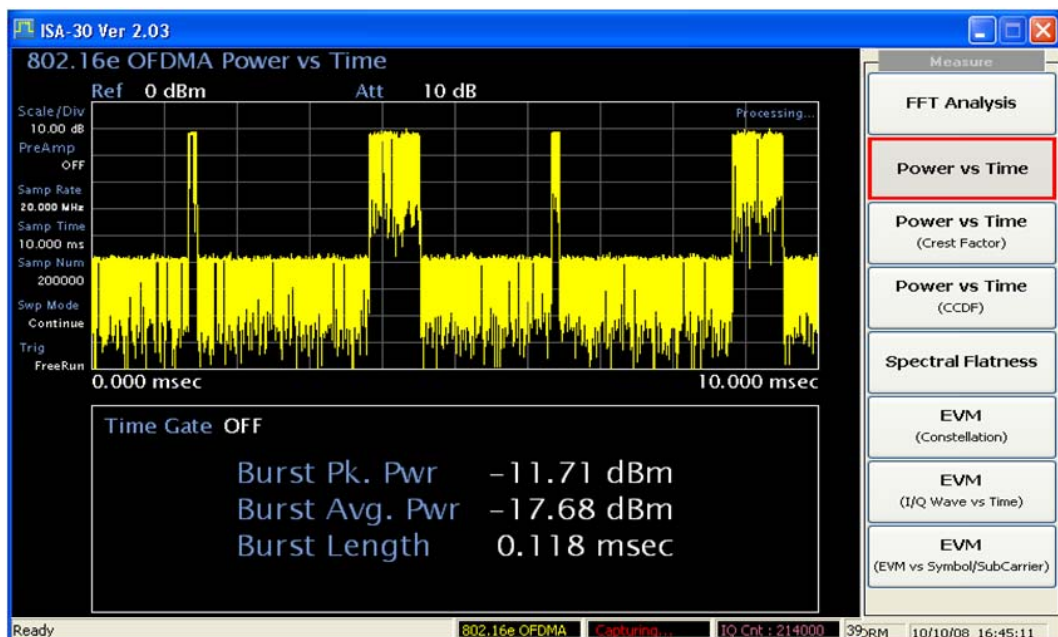


Fig. 13 Power vs Time in Free run mode (802.16e UL signal)

## 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 the power vs time measurement. It can be time-gated, and you can vary its time-gate position and length.

As can be seen in Fig. 14, the CCDF measurement area can be set for its start time and interval as specified 't1' and 't2'. Specifically, Fig. 14 shows the CCDF measurement for the 802.16e (Downlink) preamble area (one symbol length) and Fig. 15 shows the CCDF measurement for the data burst area (two 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).

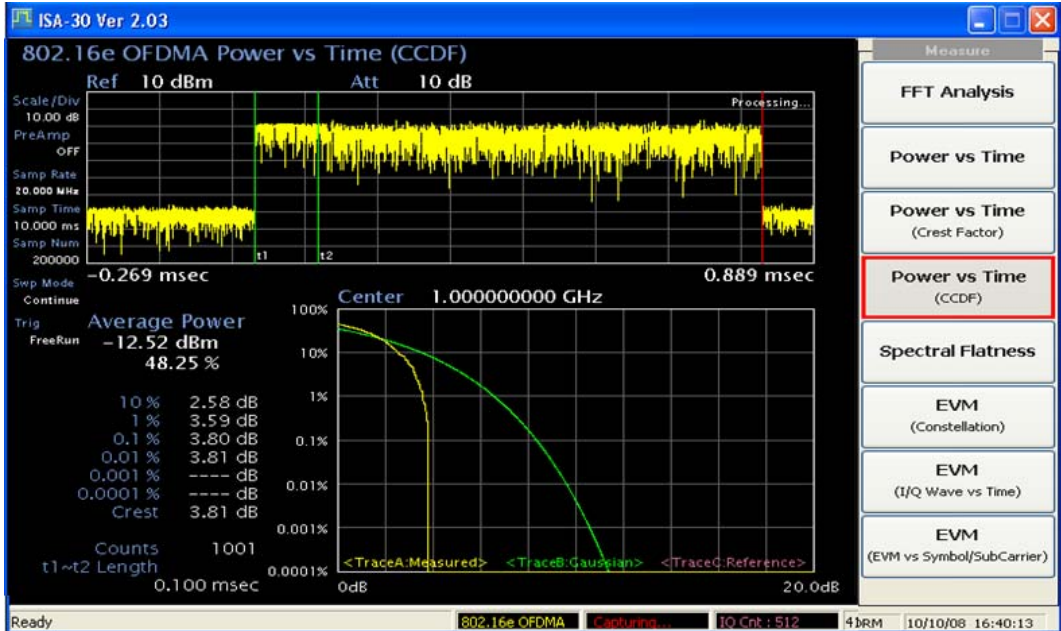


Fig. 14 CCDF measurement (802.16e DL signal, Preamble)

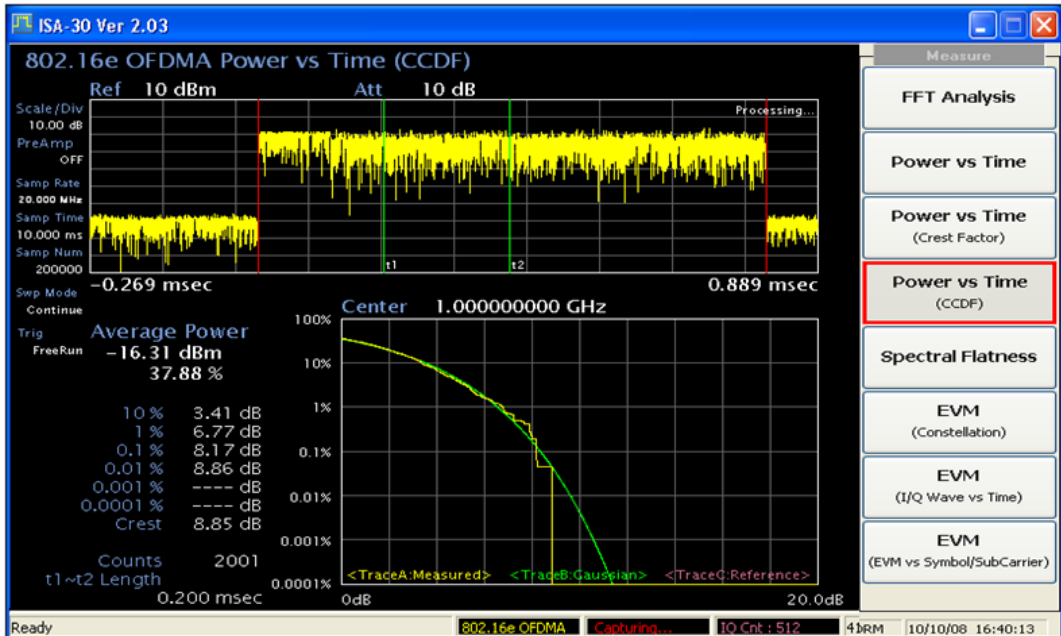


Fig. 15 CCDF measurement (802.16e DL signal, Data burst)

### 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).

## MEASUREMENT GUIDE

For a burst signal, the crest factor can be divided into burst crest factor and normal crest factor. Burst crest factor can be measured in 'Gate On' mode, while normal crest factor can be measured in the 'Gate Off' mode of operation. Similarly to the previous measurement, you can vary the time gate position and length: it is specified by 't1' and 't2' as shown in Fig. 16 and Fig. 17.

Fig. 16 shows the crest factor measurement result for preamble and Fig. 17 shows the data burst area; as it has a different modulation scheme its crest factor is different to its area of burst.

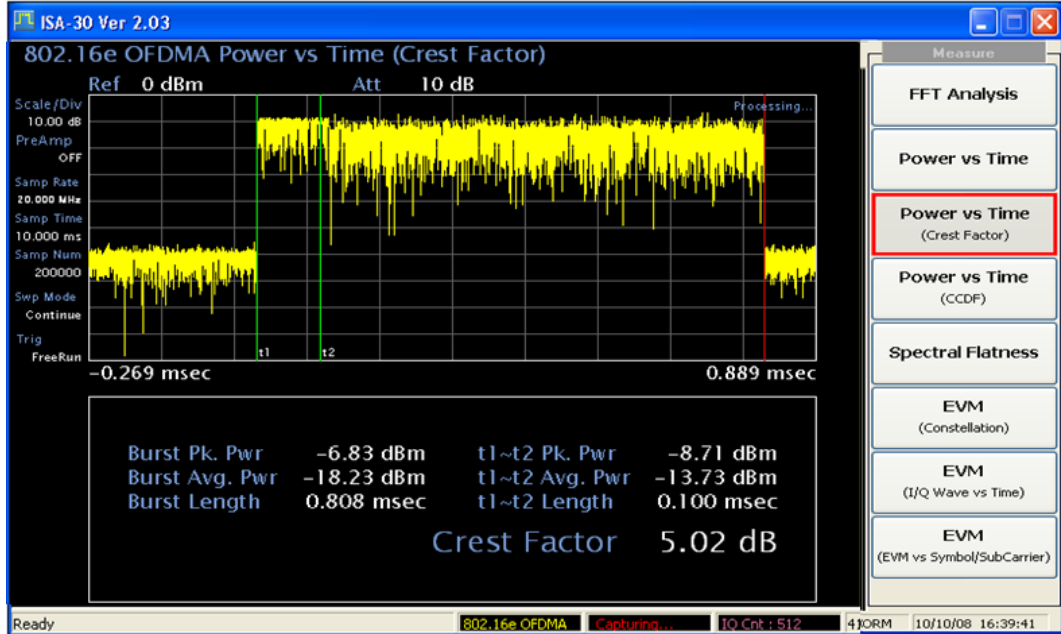


Fig. 16 Crest factor measurement (802.16e DL signal, Preamble)

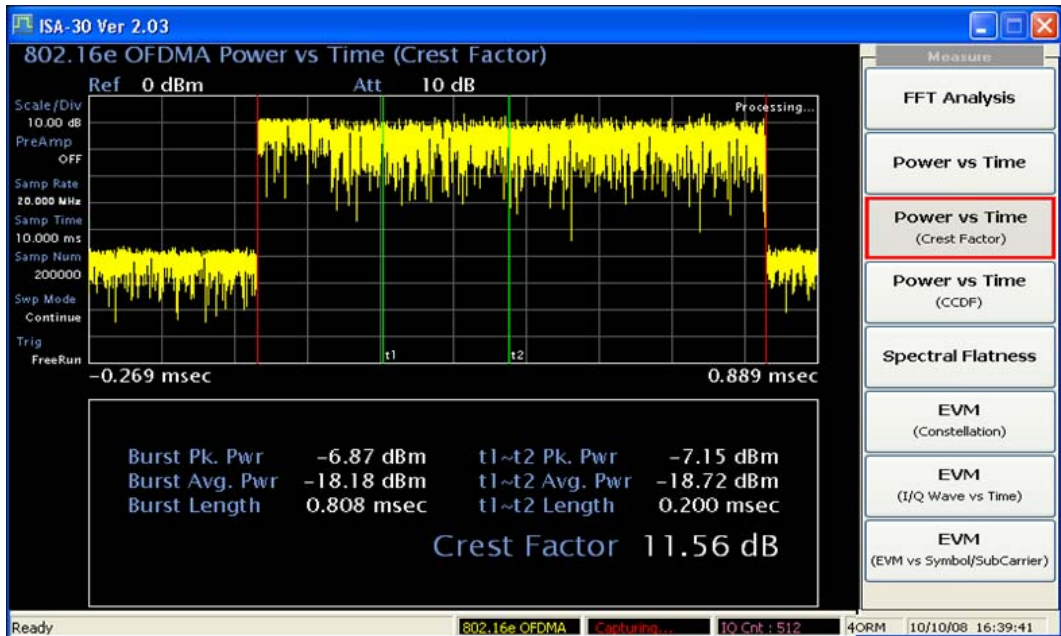


Fig. 17 Crest factor measurement (802.16e DL signal, Data burst)

## Spectral flatness

Spectral flatness is a measure of the consistency in power level of the subcarriers that compose a WiMAX OFDMA signal. As specified in the 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  $\pm 2$  dB of 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 specifies this regulation of spectral flatness as shown in Table 3.

**Table 3 Spectral flatness specification in IEEE-802.16e**

Spectral lines	Spectral flatness
Spectral lines from $-N_{used}/4$ to $-1$ and $+1$ to $N_{used}/4$	$\pm 2$ dB from the measured energy averaged over all $N_{used}$ active tones
Spectral lines from $-N_{used}/2$ to $-N_{used}/4$ and $+N_{used}/4$ to $N_{used}/2$	+2/-4 dB from the measured energy averaged over all $N_{used}$ active tones

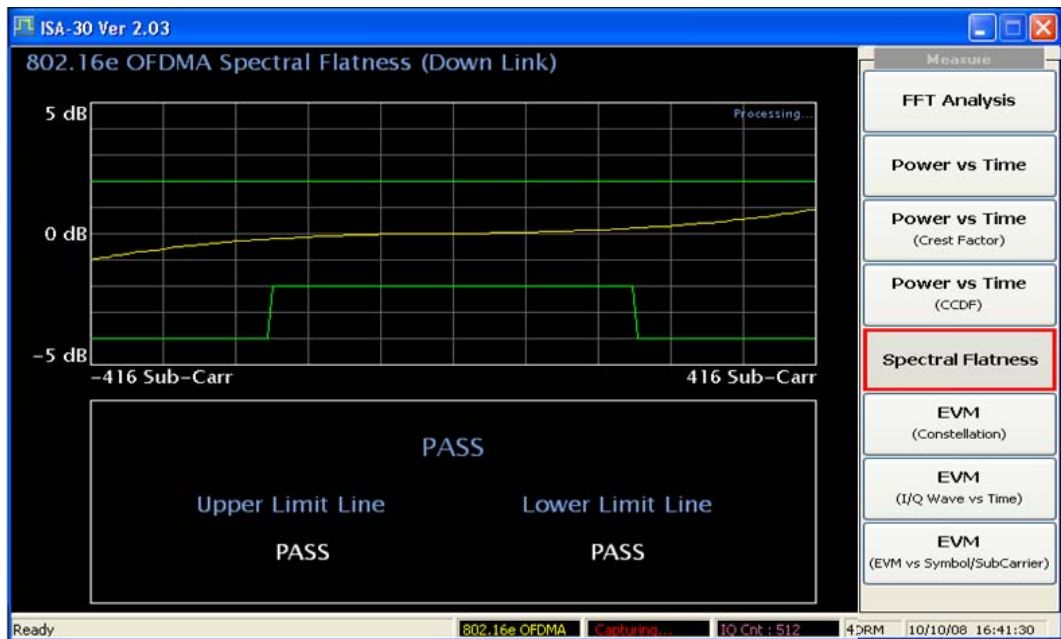


Fig. 18 Spectral flatness measurement (802.16e DL signal)

## WiMAX transmitter test (modulation quality)

### Configuration for modulation quality measurement

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

Bandwidth: 1.25 MHz, 3.5 MHz, 4.375 MHz, 5 MHz, 7 MHz, 8.75 MHz (default), 10 MHz, 20 MHz

FFT size: 128, 512, 1024 (default), 2048

Guard period: 1/4, 1/8 (default), 1/16, 1/32

Frame duration: 2.5 ms, 4 ms, 5 ms (default), 8 ms, 10 ms, 12.5 ms

Fig. 19 shows an 802.16e 10MHz standard signal example for configuring link direction and frequency and timing parameters in EVM measurement mode.

Go to this menu by pressing [Mode]. [NEXT], [802.16 OFDMA], [Setup].

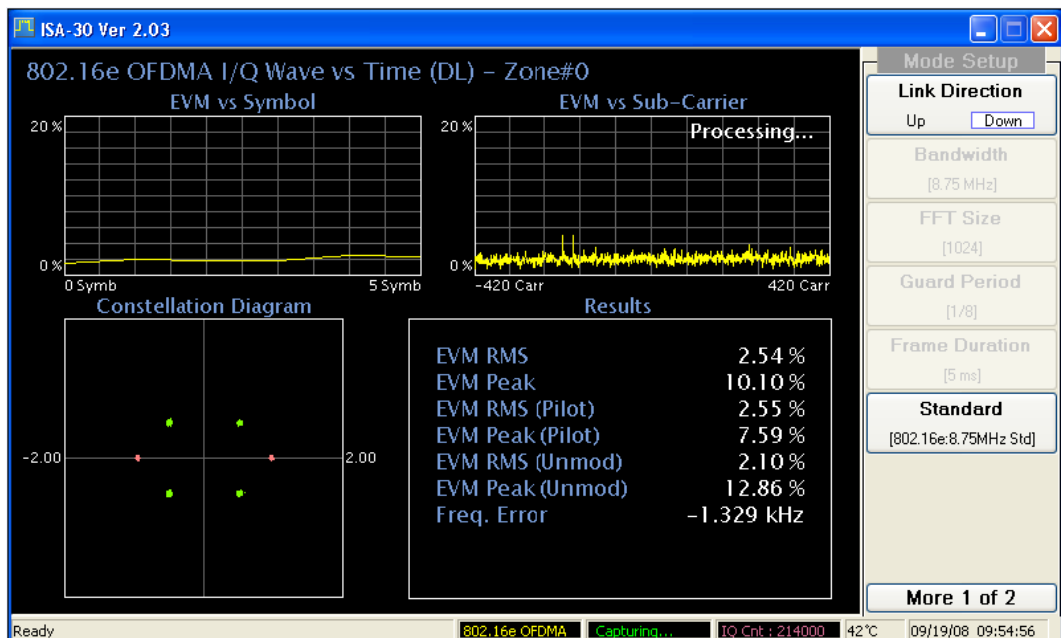


Fig. 19 Set frequency and timing parameters (802.16e DL signal)

In addition to setting frequency and timing parameters, zone and burst parameters can be configured by selecting *[More 1 of 2]* in Fig. 19. The zone parameters are as below:

- Zone number (active zone)
- Zone type
- Zone length
- Zone offset
- Permutation base

Fig. 20 gives a simple example for zone configurations.

Go to this menu by pressing [Mode]. [NEXT], *[802.16 OFDMA]*, [Setup], [NEXT], *[Edit Zone Info]*.



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

Burst zone parameters are as below:

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

Fig. 21 gives a simple example for burst configurations. Burst can be added by selecting [Add Burst] and can be deleted by select [Delete Burst]. Go to this menu by pressing [Mode]. [NEXT], [802.16 OFDMA], [Setup], [NEXT], [Edit Zone Info], [NEXT].



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

### EVM measurement

Modulation accuracy is the relative difference between a received signal constellation point and its ideal constellation point. As noted above, the measurement is carried out on both modulated and unmodulated 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, go to [Mode]. [NEXT], [802.16 OFDMA], [MEASURE], [EVM].

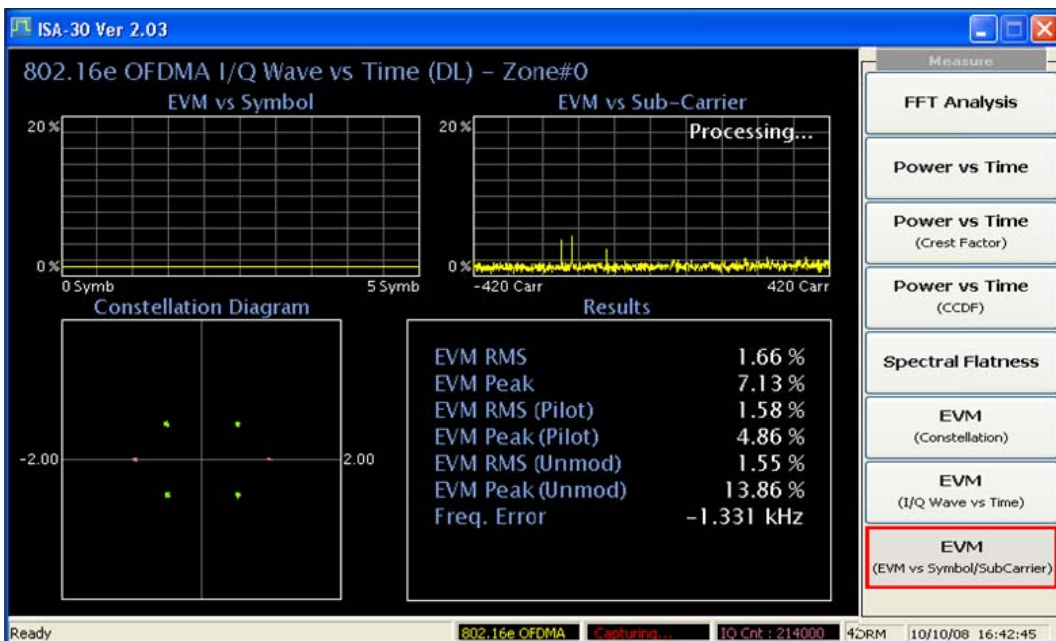


Fig. 22 Measuring EVM for WiMAX signal (802.16e DL signal)

### 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.

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

This constellation measurement separates modulation burst by color. Fig. 23 shows two type of modulation, one is BPSK (preamble) and the other is QPSK (data burst).

To measure constellation, go to [Mode]. [NEXT], [802.16 OFDMA], [MEASURE], [Constellation].

**Table 4 Allowed relative constellation error versus data rate**

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

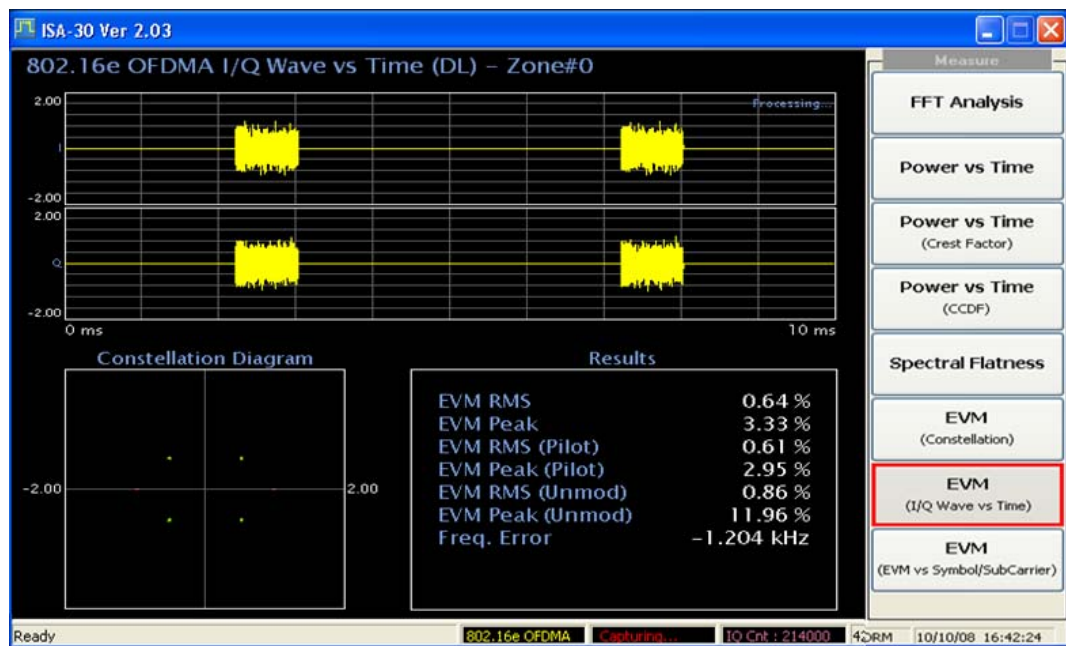


Fig. 23 Measuring constellation for WiMAX signal (802.16e DL signal)

### Frequency error measurement

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

## MEASUREMENT GUIDE

---

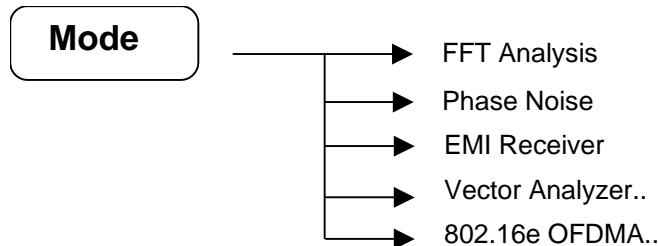
In the case of an 8.75 MHz BW WiMAX signal (WiBro), the subcarrier spacing is 9.765625 kHz. This means that the allowed transmitter frequency error must be less than 195.3125 Hz. This measurement can be seen on EVM and constellation measurements with modulation quality parameters.

---

# Menu descriptions

## WiMAX measurement mode

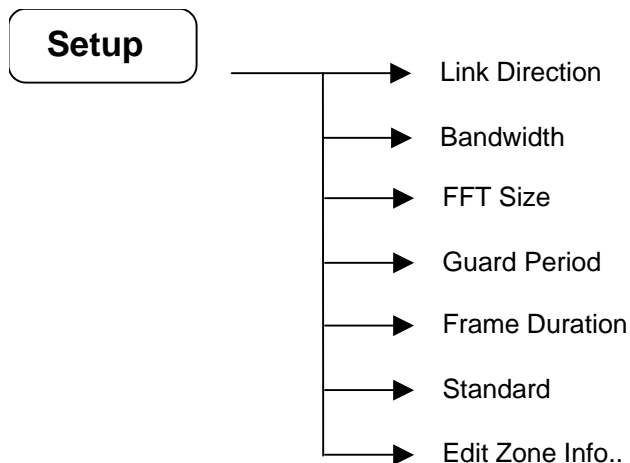
To use WiMAX measurement options, first set the system to WiMAX mode:



Select [MODE], then press [802.16e OFDMA] mode at the right side of the screen.

## Mode setup

Press [Setup] in WIMAX mode:



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 1.25 MHz to 20 MHz (default: 8.75 MHz)
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 2 ms to 20 ms (default: 5 ms)
Standard	Select BW-based standard, which has unique time-frequency parameters. Standard list is 5MHz Std, 7MHz Std, 8.75MHz Std, 10MHz Std (which is the most reliable standard)

## MENU DESCRIPTIONS

---

### Edit Zone Info

Set the zone and burst parameters that specify the input WiMAX signal.

Zone configuration parameters:

Active Zone: Current activated zone

Zone Type: PUSC

Zone offset

Zone Permutation Base

Burst configuration parameters

Active burst: Current activated burst

Burst symbols

Burst subchannel

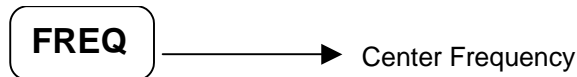
Burst symbol offset

Burst subchannel offset

Burst modulation type: QPSK, 16QAM, 32QAM

## Frequency menu

Press [FREQ] in WiMAX mode:

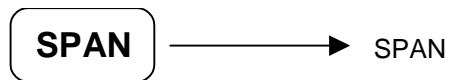


You can access frequency functions from this menu.

Center Frequency      Set to center frequency: 1 kHz to 3 / 8 / 13.2 / 26.5 GHz

## Span menu (FFT analysis only)

Press [SPAN] in WiMAX mode:

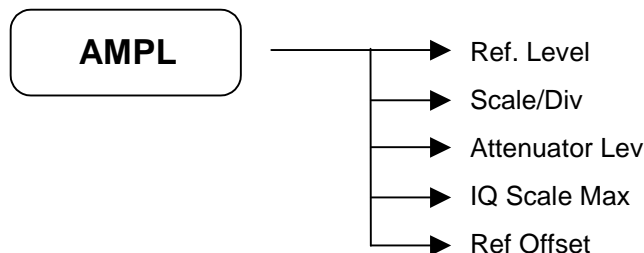


SPAN

Set to span frequency: 100 kHz to 30 MHz.

## Amplitude menu

Press [AMPL] in WiMAX mode:

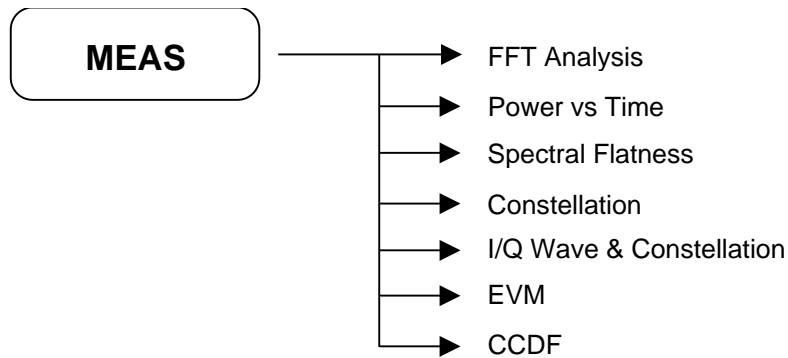


Amplitude menu keys are used for setting functions that affect the way data on the vertical axis is displayed or corrected.

Ref. Level	This allows you to set the value in dBc/Hz of a specified position on the graticule display.
Scale/Div	This allows you to set the value of scale in dB for each division of Y-axis.
Attenuator Lev	This allows you to set the internal attenuator level in dB.
IQ Scale Max	This allows you to set the value of I/Q scale of Y-axis.
Ref Offset	Sets the offset value for the displayed signal.

**Measure menu**

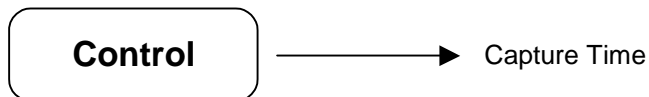
Press [MEAS] in WiMAX mode:



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

**Measure control menu (except FFT analysis)**

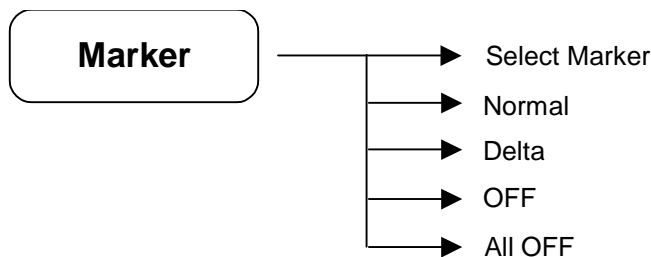
Press [CONTROL] in WiMAX mode:



Capture Time	Specifies the time to be captured for I/Q analysis. The maximum capture time differs according to the sampling rate.
--------------	--

### Marker menu (FFT analysis only)

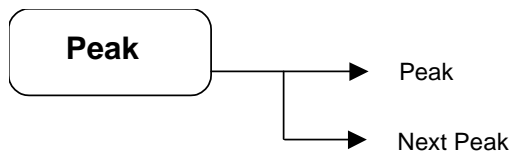
Press [MARKER] in WiMAX mode:



- Select Marker      Allows you to select one of the four possible markers. Having selected one of the markers, use the other soft keys 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 markers is fixed while the second of the pair can be moved using the scroll knob or the numeric keys. The frequency difference and the amplitude difference between these two points is displayed.
- 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 are removed from it.

### Peak menu (FFT analysis only)

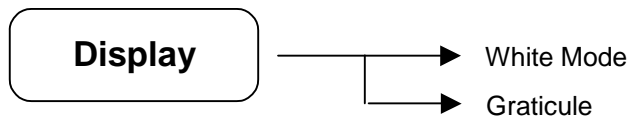
Press [PEAK] in WiMAX mode:



- Peak                 Sets active marker to max level of FFT trace.
- Next Peak          Sets active marker to next max level of FFT trace.

### Display menu

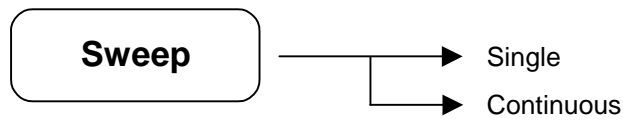
Press [Display] in WiMAX mode:



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

### Sweep menu

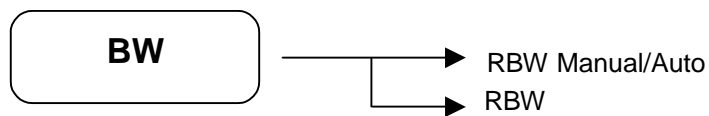
Press [Sweep] in WiMAX mode:



- |            |   |
|------------|---|
| Single     | The analyzer performs one single measurement and then stops. You have to press [Restart] 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.                      |

### BW menu

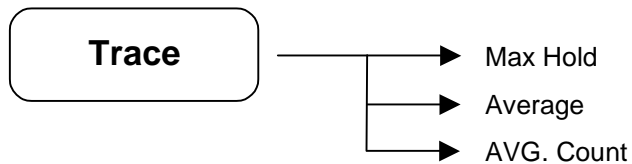
Press [BW] in WiMAX mode:



- |                 |  |
|-----------------|--|
| RBW Manual/Auto | Sets RBW mode to manual or auto. In Auto mode, RBW is set automatically to Span/100. |
| RBW             | Set to RBW value (1 kHz to 300 kHz).   |

### Trace menu (FFT analysis only)

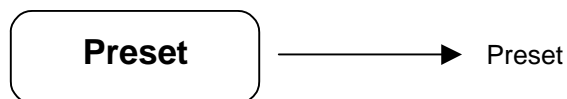
Press [TRACE] in WiMAX mode:



- |            |  |
|------------|--|
| Max Hold   | Trace level is maximum level.                        |
| Average    | Trace level is averaged. The trace is then smoothed. |
| Avg. Count | Set to the average count (2 to 1000).                |

### Preset menu

Press [Preset] in WiMAX mode:



The sub menus of [Preset] have the same function as in the basic spectrum analysis mode. Please refer to the Spectrum Analyzer Operating Manual (part number 46892/974) for other soft key functions.

---

# Detailed description of commands

## General

This section gives detailed descriptions of the device messages for the spectrum analyzer in functional order. The following example shows the command format.

*Note that ' ' = 'blank' throughout this document.*

### SA command

### SCPI command

	Command Name
Function	The explanation of the command.
Remote Command	SA Command sw SA Command f SA Command? SCPI Command sw SCPI Command f SCPI Command?
Response Message	sw or f  (Depending on command)
Value of f	Range of sw or f  (Depending on command)
Suffix code	Unit of f  (Depending on command)
Initial setting	Initial value for SA System
Example	SA Command sw; SA Command f; SA Command?; SCPI Command sw; SCPI Command f; SCPI Command?;

## Amplitude

### RL

#### **:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel**

	Reference Level
Function	Sets the reference level value.
Remote Command	RL f RL? :DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel f :DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel?
Response Message	Reference Level (dBm)
Value of f	-170 dBm to 30 dBm (Step : 0.01 dBm)
Suffix code	None : dBm DBM : dBm
Initial setting	0 dBm
Example	RL 10; RL 30DBM; RL ?; DISP:WIND:TRAC:Y:RLEV 10; DISP:WIND:TRAC:Y:RLEV 30DBM; DISP:WIND:TRAC:Y:RLEV?;

## AT

### **[[:SENSE]:POWer[:RF]:ATTenuation**

	Attenuation
Function	Sets the amount of attenuation for the input attenuator.
Remote Command	AT f AT? [:SENSe]:POWer[:RF]:ATTenuation f [:SENSe]:POWer[:RF]:ATTenuation?
Response Message	amount of attenuation (dB)
Value of f	0 dB to 55 dB (Step : 5 dB)
Suffix code	None : dB DB : dB
Initial setting	10 dB
Example	AT 10; AT 10DB; AT?; POW:ATT 10; POW:ATT 10DB; POW:ATT?;

**SD**

**:DISPlay:LPLot:WINDow:TRACe:Y[:SCALe]:PDIVision**

	Scale/Divide
Function	Sets the scale/divide value.
Remote Command	SD f SD? :DISPlay:LPLot:WINDow:TRACe:Y[:SCALe]:PDIVision f :DISPlay:LPLot:WINDow:TRACe:Y[:SCALe]:PDIVision?
Response Message	Scale/Divide (dB/div)
Value of f	0.01 dB to 20 dB (step : 0.01 dB)
Suffix code	None : dB/div DB : dB/div
Initial setting	10 dB/div
Example	SD 5; SD 10DB; SD?; DISP:LPL:WIND:TRAC:Y:PDIV 5; DISP:LPL:WIND:TRAC:Y:PDIV 10DB; DISP:LPL:WIND:TRAC:Y:PDIV?;

## Average (FFT Analysis Only)

### AVG

#### [[:SENSe]:AVERage[:STATe]

	Average
Function	Turns the trace average to on or off. Depends on the condition of the average count and the average mode.
Remote Command	AVG n AVG sw AVG? [:SENSe]:AVERage[:STATe] n [:SENSe]:AVERage[:STATe] sw [:SENSe]:AVERage[:STATe]?
Response Message	1 : ON 0 : OFF
Value of n	1 : ON 0 : OFF
Value of sw	ON : ON OFF : OFF
Initial setting	0
Example	AVG 1; AVG ON; AVG?; AVER 1; AVER ON; AVER?;

## AVGC

### **[[:SENSE]:AVERAGE:COUNT**

	Average Count
Function	Sets the averaging count.
Remote Command	AVGC n AVGC? [:SENSE]:AVERAGE:COUNT n [:SENSE]:AVERAGE:COUNT?
Response Message	Average count
Value of n	2 to 1000
Initial setting	100
Example	AVGC 30; AVGC?; AVERAGE:COUNT 30; AVERAGE:COUNT?;

## Bandwidth (FFT analysis only)

### RB

#### **[[:SENSe]:BANDwidth|BWIDth[:RESolution]**

	Resolution Bandwidth
Function	Sets the NBW value.
Remote Command	RB f RB? [:SENSe]:BANDwidth BWIDth[:RESolution] f [:SENSe]:BANDwidth BWIDth[:RESolution]?
Response Message	Resolution Bandwidth (Hz)
Value of f	1 kHz to 300 kHz / 1 MHz / 2 MHz (Step : 10 Hz)
Suffix code f	None : Hz (10 <sup>0</sup> ) HZ : Hz (10 <sup>0</sup> ) KHZ : kHz (10 <sup>3</sup> ) MHZ : MHz (10 <sup>6</sup> ) GHZ : GHz (10 <sup>9</sup> )
Initial setting	Span/100
Example	RB 1000; RB 3KHZ; RB? BAND 1000; BAND 3KHZ; BAND?;

## RBA

### **[[:SENSe]:BANDwidth|BWIDth[:RESolution]:AUTO**

	Resolution Bandwidth Auto
Function	Sets the NBW mode to the auto mode or the manual mode.
Remote Command	RBA n RBA sw RBA? [:SENSe]:BANDwidth BWIDth[:RESolution]:AUTO n [:SENSe]:BANDwidth BWIDth[:RESolution]:AUTO sw [:SENSe]:BANDwidth BWIDth[:RESolution]:AUTO?
Response Message	1 : ON 0 : OFF
Value of n	1 : ON 0 : OFF
Value of sw	ON : ON OFF : OFF
Initial setting	1
Example	RBA 1; RBA ON; RBA? BAND:AUTO 1; BAND:AUTO ON; BAND:AUTO?;

## Display

### GRAT

#### **:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]**

	Graticule
Function	Sets the display graticule to Type1 or Type2 or OFF.
Remote Command	GRAT sw GRAT? :DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe] sw :DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]?
Response Message	TYPE1 : Type1 TYPE2 : Type2 OFF : OFF
Value of sw	TYPE1 : Type1 TYPE2 : Type2 OFF : OFF
Initial setting	TYPE1
Example	GRAT TYPE1; GRAT? DISP:WIND:TRAC:Y:GRAT:GRID TYPE1; DISP:WIND:TRAC:Y:GRAT:GRID?;

## WH

### :DISPlay:WINDow:WHITe

	White Mode
Function	Turns the white mode ON or OFF.
Remote Command	WH n WH sw WH? :DISPlay:WINDow:WHITe n :DISPlay:WINDow:WHITe sw :DISPlay:WINDow:WHITe?
Response Message	1 : ON 0 : OFF
Value of n	1 : ON 0 : OFF
Value of sw	ON : ON OFF : OFF
Initial setting	0
Example	WH 1; WH ON; WH? DISP:WIND:WHIT 1; DISP:WIND:WHIT ON; DISP:WIND:WHIT?;

## File

### FREAD

#### :MMEMory:CATalog

Function	File Read
Remote Command	Reads files in the selected folder. FREAD? 'file_folder' :MMEMory:CATalog? 'file_folder'
Value of file_folder	File Folder
Response Message	File Name,,File Size.
Example	FREAD? 'C:'; FREAD? 'D:\Temp'; MMEM:CAT? 'C:'; MMEM:CAT? 'D:\Temp';

## FSAVE

### :MMEMory:STORe

	File Save
Function	Saves the file, type defined by the extension.
Remote Command	FSAVE 'file_name' :MMEMory:STORe 'file_name'
Value of file_name	File Path + File Name
Supported Extension	csv : I/Q data bmp : Bitmap jpg : jpeg png : png zon : Zone/Burst
Example	FSAVE 'C:\demo.zon'; MMEM:STRO 'C:\demo.zon';

## FLOAD

### :MMEMory:LOAD

	File Load
Function	Loads the selected file.
Remote Command	FLOAD 'file_name' :MMEMory:LOAD 'file_name'
Value of file_name	File Path + File Name
Supported Extension	zon : Zone/Burst
Example	FLOAD 'C:\demo.zon'; MMEM:LOAD 'C:\demo.zon';

## FDEL

### :MMEMory:DElete

	File Delete
Function	Deletes the selected file.
Remote Command	FDEL 'file_name' :MMEMory:DElete 'file_name'
Value of file_name	File Path + File Name
Example	FDEL 'C:\demo.bmp'; MMEM:DEL 'C:\demo.bmp';

## FCOPY

### :MMEMory:COPY

	File Copy
Function	Copies the selected file.
Remote Command	FCOPY 'src_file_name', 'dest_file_name' :MMEMory:COPY 'src_file_name', 'dest_file_name'
Value of src_file_name, dest_file_name	File Path + File Name
Example	FCOPY 'C:\demo.bmp', 'D:\demo.bmp'; MMEM:COPY 'C:\demo.bmp', 'D:\demo.bmp';

## FRENAME

### :MMEMory:MOVE

	File Rename
Function	Renames the selected file.
Remote Command	FRENAME 'src_file_name','dest_file_name' :MMEMory:MOVE 'src_file_name','dest_file_name'
Value of src_file_name, dest_file_name	File Path + File Name
Example	FRENAME 'C:\demo.bmp','C:\demo1_1.bmp'; MMEM:MOVE 'C:\demo1.bmp','C:\demo1_1.bmp';

## FMOVE

### MMEMory:DATA

	File Move
Function	Sends or receives binary data of the selected file. The maximum size of the sent file is 2 Mbyte, and the maximum size of the received file is 30 Mbyte.
Remote Command	FMOVE 'file_name',definite_length_block FMOVE? 'file_name' MMEMory:DATA 'file_name',definite_length_block MMEMory:DATA? 'file_name'
Value of file_name	File Path + File Name
Value of definite_length_block	# + number of file size + file size + file data
Example	FMOVE 'C:\Sended_Sample.txt',#14abcd; cf) #+1+4+abcd FMOVE? 'C:\Received_Sample.txt'; MMEM:DATA 'C:\ Sended_Sample.txt',#14abcd; MMEM:DATA? 'C:\ Received_Sample.txt';

## Frequency

### CF

#### **[[:SENSe]:FREQuency:CENTer**

	Center Frequency
Function	Sets the center frequency.
Remote Command	CF f CF? [:SENSe]:FREQuency:CENTer f [:SENSe]:FREQuency:CENTer?
Response Message	Center Frequency (Hz) (Range : 1 kHz to 3 / 8 / 13.2 / 26.5 GHz)
Value of f	1 kHz to 3 / 8 / 13.2 / 26.5 GHz
Suffix code	None : Hz (10 <sup>0</sup> ) HZ : Hz (10 <sup>0</sup> ) KHZ : kHz (10 <sup>3</sup> ) MHZ : MHz (10 <sup>6</sup> ) GHZ : GHz (10 <sup>9</sup> )
Initial setting	1.5 / 4 / 6.6 / 12.25 GHz
Example	CF 123456; CF 50MHZ; CF?; FREQ:CEN7T 123456; FREQ:CENT 50MHZ; FREQ:CENT?;

## SR

### **[[:SENSE]:FREQUENCY:SAMPLING:RATE**

	Sampling Frequency
Function	Sets to Sampling Rate.
Remote Command	SR f SR? [:SENSE]:FREQUENCY:SAMPLING:RATE f [:SENSE]:FREQUENCY:SAMPLING:RATE?
Response Message	Sampling Rate (Hz) (50 kHz to 52 MHz)
Suffix code	None : Hz (10 <sup>0</sup> ) HZ : Hz (10 <sup>0</sup> ) KHZ : kHz (10 <sup>3</sup> ) MHZ : MHz (10 <sup>6</sup> )
Initial setting	According to Span and RBW
Example	USF 123456; USF 50MHZ; USF?; FREQ:SAMP:RATE 123456; FREQ:SAMP:RATE 50MHZ; FREQ:SAMP:RATE?;

## REF

### **:INPut:REFerence**

	Reference
Function	Sets to 10 MHz Reference.
Remote Command	REF sw REF? :INPut:REFerence sw :INPut:REFerence?
Response Message	INT : Internal EXT : External
Value of sw	INTernal: Internal EXTernal: External
Initial setting	INT
Example	REF INT; REF? INP:REF INT; INP:REF?

## Marker (FFT analysis only)

### MS[1~9]

#### :CALCulate:MARKer[1~9]:STATe

	Marker State
Function	Sets the selected marker state.
Remote Command	MS[1~9] n MS[1~9] sw MS[1~9]? :CALCulate:CCDF:MARKer[1~9]:STATe n :CALCulate:CCDF:MARKer[1~9]:STATe sw :CALCulate:CCDF:MARKer[1~9]:STATe?
Response Message	1 : ON 0 : OFF
Value of n	1 : ON 0 : OFF
Value of sw	ON : ON OFF : OFF
Initial setting	0
Example	MS 1; MS5 1; MS5?; CALC:CCDF:MARK:STAT 1; CALC:CCDF:MARK5:STAT ON; CALC:CCDF:MARK5:STAT?

## MM[1~9]

### :CALCulate:MARKer[1~9]:MODE

	Marker Mode
Function	Sets the selected marker to Normal, Delta Mode.
Remote Command	MM[1~9] sw MM[1~9]?
:	CALCulate:MARKer[1~9]:MODE sw :CALCulate:MARKer[1~9]:MODE?
Response Message	POS : Normal DELT : Delta OFF : OFF
Value of sw	POSition : Normal DELTa : Delta OFF : OFF
Initial setting	OFF
Example	MM POS; MM5?; CALC:CCDF:MARK:MODE POS; CALC:CCDF:MARK5:MODE?

## MF[1~9]

### :CALCulate:MARKer[1~9]:X

	Marker Frequency
Function	Sets the marker frequency of the selected marker. If the marker mode is the delta mode, sets the difference value of the marker frequency and the delta marker frequency.
Remote Command	MF[1~9] f MF[1~9]? :CALCulate:MARKer[1~9]:X f :CALCulate:MARKer[1~9]:X?
Response Message	Marker Frequency (Hz)
Value of f	Start Frequency to Stop Frequency
Suffix code	None : Hz (10 <sup>0</sup> ) HZ : Hz (10 <sup>0</sup> ) KHZ : kHz (10 <sup>3</sup> ) MHZ : MHz (10 <sup>6</sup> ) GHZ : GHz (10 <sup>9</sup> )
Initial setting	Center Frequency
Example	MF 123456; MF5.1GHZ; MF5?; CALC:MARK:X 123456; CALC:MARK5:X 1GHZ; CALC:MARK5:X?

**MA[1~9]**

**:CALCulate:MARKer[1~9]:Y**

Function	Marker Amplitude Returns the amplitude data.
Remote Command	MA[1~9]? :CALCulate:MARKer[1~9]:Y?
Response Message	Marker Amplitude
Example	MA?; MA5? CALC:MARK:Y? CALC:MARK5:Y?

## MAO

### **:CALCulate:LPLot:MARKer:AOff**

	Marker All OFF
Function	Turns off all markers.
Remote Command	MAO :CALCulate:LPLot:MARKer:AOff
Example	MAO; CALC:LPL:MARK:AOff;

## Measurement

### MEA

#### :MEASure:STARt

	Measure Start
Function	Starts the measurement.
Remote Command	MEA sw MEA? :MEASure:STARt sw :MEASure:STARt?
Response Message	FFT : FFT Analysis PVT : Power vs Time PVTC : Power vs Time (Crest Factor) CCDF : Power vs Time (CCDF) SPEC : Spectral Flatness EVMC : EVM (Constellation) EVMW : EVM (I/Q Wave vs Time) EVM : EVM (EVM vs Symbol/Subcarrier)
Value of sw	FFT : FFT Analysis PVT : Power vs Time PVTC : Power vs Time (Crest Factor) CCDF : Power vs Time (CCDF) SPEC : Spectral Flatness EVMC : EVM (Constellation) EVMW : EVM (I/Q Wave vs Time) EVM : EVM (EVM vs Symbol/Subcarrier)
Example	MEA FFT; MEA?; MEAS:STAR FFT; MEAS:STAR?;

## PVTOUT

### :FETCh|MEASure|READ:PVTime

	Power vs Time Output
Function	Return to results of Power vs Time.
Remote Command	PVTOUT? :FETCh MEASure READ:PVTime?
Response Message	Burst Peak Power (dBm), Burst Average Power (dBm), Burst Length (s)
Example	PVTOUT?; MEAS:PVT?;

## PVTCOUT

### :FETCh|MEASure|READ:PVTime:CRESt

	Power vs Time (Crest Factor) Output
Function	Return to results of Power vs Time (Crest Factor).
Remote Command	PVTCOUT?
	:FETCh MEASure READ:PVTime:CRESt?
Response Message	Burst Peak Power (dBm), Burst Average Power (dBm), Burst Length (s), t1~t2 Peak Power (dBm), t1~t2 Average Power (dBm), t1~t2 Length (s), Crest Factor (dB)
Example	PVTCOUT?; MEAS:PVT:CRESt?

## CCDFOUT

### :FETCh|MEASure|READ:PVTime:CCDF

	Power vs Time (CCDF) Output
Function	Return to results of Power vs Time (CCDF).
Remote Command	CCDFOUT? :FETCh MEASure READ:PVTime:CCDF?
Response Message	Average Power (dBm), Average Power Percent (%), 10% Level Difference (dB), 1% Level Difference (dB), 0.1% Level Difference (dB), 0.01% Level Difference (dB), 0.001% Level Difference (dB), 0.0001% Level Difference (dB), Crest Level Difference (dB), Counts, t1~t2 Length (s)
Example	CCDFOUT?; MEAS:PVT:CCDF?;

## FLATOUT

### :FETCh|MEASure|READ:FLATness

	Spectral Flatness Output
Function	Return to results of Spectral Flatness.
Remote Command	FLATOUT? :FETCh MEASure READ:FLATness?
Response Message	All State, Upper State, Lower State
Example	FLATOUT?; MEAS:FLAT?;

## EVMCOUT

### :FETCh|MEASure|READ:EVM:CONStellation

	EVM (Constellation) Output
Function	Return to results of EVM (Constellation).
Remote Command	EVMCOUT? :FETCh MEASure READ:EVM:CONStellation?
Response Message	EVM RMS (dB/%), EVM Data (dB/%), EVM RMS Pilot (dB/%), EVM Peak Pilot (dB/%), EVM RMS Unmod (dB/%), EVM Peak Unmod (dB/%), Frequency Error (Hz)
Example	EVMCOUT?; MEAS:EVM:CONST?;

## EVMWOUT

### :FETCh|MEASure|READ:EVM:WVTime

	EVM (I/Q Wave vs Time) Output
Function	Return to results of EVM (I/Q Wave vs Time).
Remote Command	EVMCOUT? :FETCh MEASure READ:EVM:WVTime?
Response Message	EVM RMS (dB/%), EVM Data (dB/%), EVM RMS Pilot (dB/%), EVM Peak Pilot (dB/%), EVM RMS Unmod (dB/%), EVM Peak Unmod (dB/%), Frequency Error (Hz)
Example	EVMWOUT?; MEAS:EVM:WVT?;

## EVMOUT

### :FETCh|MEASure|READ:EVM

Function	EVM (EVM vs Symbol/SubCarrier) Output Return to results of EVM (EVM vs Symbol/SubCarrier).
Remote Command	EVMOUT? :FETCh MEASure READ:EVM?
Response Message	EVM RMS (dB/%), EVM Data (dB/%), EVM RMS Pilot (dB/%), EVM Peak Pilot (dB/%), EVM RMS Unmod (dB/%), EVM Peak Unmod (dB/%), Frequency Error (Hz)
Example	EVMOUT?; MEAS:EVM?;

## Measurement control

### MEAT

#### :MEASure:TIME

	Capturing Time
Function	Sets to Capturing Time.
Remote Command	MEAT f MEAT? :MEASure:TIME f :MEASure:TIME?
Response Message	Capturing Time (s)
Value of f	1 ms to max (max changes according to sampling rate)
Suffix	None : s ( $10^0$ ) kSEC : ks ( $10^3$ ) SEC : s ( $10^0$ ) MSEC : ms ( $10^{-3}$ )
Initial setting	5 ms
Example	MEAT 0.001; MEAT 1MSEC; MEAT?; MEA:TIME 0.001; MEA:TIME 1MSEC; MEA:TIME?;

## Mode

### MODE

#### :INSTrument[:SElect]

	Mode
Function	Sets Current Mode.
Remote Command	MODE sw MODE? :INSTrument[:SElect] sw :INSTrument[:SElect]?
Response Message	SA : Spectrum Mode VECTOR : Vector Analyzer Mode WIMAX : WiMAX mode
Value of sw	SA : Spectrum Mode VECTOR : Vector Analyzer Mode WimAX : WiMAX Mode
Initial setting	SA
Example	MODE SA; MODE?; INST SA; INST?;

## Mode setup

### WIMAXSTD

	WiMAX Standard
Function	Sets to WiMAX Standard.
Remote Command	WIMAXSTD sw
	WIMAXSTD?
Response Message	802.16e10MHZ : 802.16e 10 MHz 802.16e8.75MHZ : 802.16e 8.75 MHz 802.16e7MHZ : 802.16e 7 MHz 802.16e5MHZ : 802.16e 5 MHz
Value of sw	802.16e10MHZ : 802.16e 10 MHz 802.16e8.75MHZ : 802.16e 8.75 MHz 802.16e7MHZ : 802.16e 7 MHz 802.16e5MHZ : 802.16e 5 MHz
Initial setting	802.16e8.75MHZ
Example	WIMAXSTD 802.16e8.75MHZ; WIMAXSTD?;

## Peak search (FFT analysis only)

### MPK[1~9]

#### :CALCulate:MARKer[1~9]:MAXimum

	Peak Search
Function	Places the selected marker on the highest point of the marker trace.
Remote Command	MPK[1~9] :CALCulate:MARKer[1~9]:MAXimum
Example	MPK; MPK5; CALC:MARK:MAX; CALC:MARK5:MAX;

### MPKN[1~9]

#### :CALCulate:MARKer[1~9]:MAXimum:NEXT

	Next Peak Search
Function	Places the selected marker on the next highest point of the marker trace.
Remote Command	MPKN[1~9] :CALCulate:MARKer[1~9]:MAXimum:NEXT
Example	x           MPKN; MPKN5; CALC:MARK:MAX:NEXT; CALC:MARK5:MAX:NEXT;

## Preset

### PRST

#### :SYSTem:PRESet

Function	Preset
Remote Command	Executes preset. All instrument parameters are set to default values. PRST :SYSTem:PRESet
Example	PRST; SYST:PRES;

## Printer

### HCOPY

#### :HCOPY[:IMMEDIATE]

Function	Hard Copy Prints entire screen image.
Remote Command	HCOPY :HCOPY[:IMMEDIATE]
Example	HCOPY; HCOP;

## Span (FFT analysis only)

### SP

#### **[[:SENSe]:FREQuency:SPAN**

	Span
Function	Sets the span.
Remote Command	SP f SP? [:SENSe]:FREQuency:SPAN f [:SENSe]:FREQuency:SPAN?
Response Message	Span (Hz)
Value of f	100 kHz to 30 MHz
Suffix code	None : Hz (10 <sup>0</sup> ) HZ : Hz (10 <sup>0</sup> ) KHZ : kHz (10 <sup>3</sup> ) MHZ : MHz (10 <sup>6</sup> )
Initial setting	30 MHz
Example	SP 123456; SP 30MHZ; SP ?; FREQ:SPAN 123456; FREQ:SPAN 30MHZ; FREQ:SPAN?;

## Sweep

### CO

#### **:INITiate:CCDF:CONTinuous**

	Continuous Sweep
Function	Sets the continuous sweep mode. Repeats active sweep.
Remote Command	CO :INITiate:CONTinuous
Example	CO; INIT:CONT;

## SI

### **:INITiate[:IMMediate]**

Function	Single Sweep Sets the single sweep mode. After activating sweep, stops sweep repeating.
Remote Command	SI :INITiate[:IMMediate]
Example	SI; INIT;

## System

### BEEP

	Beep
Function	Turns Beep to ON or OFF when pressing key pad..
Remote Command	BEEP n BEEP sw BEEP?
Response Message	1 : ON 0 : OFF
Value of n	1 : ON 0 : OFF
Value of sw	ON : ON OFF : OFF
Initial setting	0
Example	BEEP 1; BEEP ON; BEEP?;

### ECHO

	Echo
Function	Turns Echo to ON or OFF when controlled by hyper terminal.
Remote Command	ECHO n ECHO sw ECHO?
Response Message	1 : ON 0 : OFF
Value of n	1 : ON 0 : OFF
Value of sw	ON : ON OFF : OFF
Initial setting	1
Example	ECHO 1; ECHO ON; ECHO?;

## Trace (FFT analysis only)

### TRF

#### :TRACe:MODE

Function	Trace Status
Remote Command	Sets the trace status. TRF sw TRF? :TRACe:MODE sw :TRACe:MODE?
Response Message	WRIT : Clear & Wirte MAXH : Max Hold
Value of sw	WRITE : Clear & Wirte MAXHold : Max Hold
Initial setting	WRIT
Example	TRF WRIT; TRF? TRAC:MODE WRIT; TRAC:MODE?;

## GPIB common commands

### **\*CLS**

	Clear Status Command
Function	Clears the status byte register.
Remote Command	*CLS
Example	*CLS;

**\*ESE**

	Standard Event Status Enable
Function	Sets the standard event status enable register.
Remote Command	*ESE n *ESE?
Response Message	Register Value
Value of n	0 to 255 : Represents the sum of the bit-weighted values.
Example	*ESE 20: *ESE?;

**\*ESR?**

Function	Standard Event Status Register Query
Remote Command	Returns the current value in the standard event status register.
Response Message	*ESR?
Example	Register Value
	*ESR?;

## DETAILED DESCRIPTION OF COMMANDS

---

### **\*IDN?**

Function	Identification Query
Remote Command	Returns the model name, etc of the equipment
Response Message	*IDN?
Example	Company, Model, Serial, Version
	*IDN?;

**\*OPC**

	Operation Complete Command
Function	Sets the standard event register bit 0 to 1 when the requested action is complete.
Remote Command	*OPC
Example	*OPC;

**\*OPC?**

	Operation Complete Query
Function	Sets the output queue to 1 to generate a MAV summary message when all pending select device operations have completed.
Remote Command	*OPC?
Response Message	1
Example	*OPC?;

**\*RST**

	Rest Command
Function	Resets the device.
Remote Command	*RST
Example	*RST;

**\*SRE**

	Service Request Enable Command
Function	Sets the bits in the service request enable register.
Remote Command	*SRE n *SRE?
Response Message	Register Value
Value of n	0 to 255 : Represents the sum of the bit-weighted values.
Example	*SRE 32; *SRE?;

## DETAILED DESCRIPTION OF COMMANDS

---

### \*STB?

Returns Status Byte Command

Function

Returns the current values of the status bytes including the MSS bit.

Remote Command

\*STB?

Response Message

Register Value

Bit	Bit Weight	Bit Name	Condition of status byte register
7	128	----	0 = Not used
6	64	MSS	0 = Service not requested 1 = Service requested
5	32	ESB	0 = Event status not generated 1 = Event status generated
4	16	MAV	0 = No data in output queue 1 = Data in output queue
3	8	ESB2	0 = Event status not generated 1 = Event status generated
2	4	----	0 = Not used
1	2	----	0 = Not used
0	1	----	0 = Not used

Example

\*STB?;

## GPIB common commands — others

### ESE2

	Event Status Enable (End)
Function	Allows the End Event Status Enable Register to select which bit in the corresponding Event Register cause a TRUE ESB summary message bit 3 when set.
Remote Command	ESE2 n ESE2?
Response Message	Register Value
Value of n	0 to 255 : Represents the sum of the bit-weighted values.
Example	ESE2 1; ESE2?;

## DETAILED DESCRIPTION OF COMMANDS

---

### ESR2?

Event Status Register (End) Query

Function

Allows the sum of binary-weighted event bit values of the End Event Status Register to be read out by converting them to decimal. After readout, the End Event status Register is reset to 0.

Remote Command

ESR2?

Response Message

Register Value

Bit	Bit Weight	Event	Description
7	128	Not used	Not used
6	64	Not used	Not used
5	32	Not used	Not used
4	16	Measurement completed	Measurement has completed (Peak search, OBW, X dB, Noise marker, Freq. Counter, Limit Pass/Fail..)
3	8	AUTO TUNE completed	AUTO TUNE has completed.
2	4	Averaging completed	Sweeping according to the specified AVERAGE number has completed.
1	2	Calibration completed	Temp Cal, Pre-Filter Cal, ZNC Cal,. Level Cal.. has completed.
0	1	Sweep completed	A single sweep has completed or is in standby.

Example

ESR2?;

## ERR

### **:SYSTem:ERRor[:NEXT]**

	Error Code
Function	Returns the error code of the current function. The error code is cleared.
Remote Command	ERR?
Response Message	Error code
Example	ERR?;

# Remote commands

## < Catalog order >

Index	Description	SA Command	SCPI Command	Suffix
<b>Amplitude</b>	Ref. Level	RL	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel	<amplitude> ?
<b>Amplitude</b>	Attenuation	AT	[:SENSe]:POWEr[:RF]:ATTenuation	<amplitude> ?
<b>Amplitude</b>	Scale/Div	SD	:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVisIon	<amplitude> ?
<b>Average</b>	Average	AVG	[:SENSe]:AVERAge[:STATe]	OFF ON 0 1 ?
<b>Average</b>	Average Count	AVGC	[:SENSe]:AVERAge:COUNt	<integer> ?
<b>Bandwidth</b>	Resolution Bandwidth	RB	[:SENSe]:BANDwidth BWIDth[:RESolution]	<frequency> ?
<b>Bandwidth</b>	Resolution Bandwidth Auto	RBA	[:SENSe]:BANDwidth BWIDth[:RESolution]:AUTO	OFF ON 0 1 ?
<b>Display</b>	Graticule	GRAT	:DISPlay:WINDow:TRACe:GRATICule:GRID[:STATe]	OFF ON 0 1 ?
<b>Display</b>	White Mode	WH	:DISPlay:WINDow:WHITe	OFF ON 0 1 ?
<b>File</b>	Read	FREAD	:MMEMory:CATalog	? <'directory_name'>
<b>File</b>	Save	FSAVE	:MMEMory:STORe	<'file_name'>
<b>File</b>	Load	FLOAD	:MMEMory:LOAD	<'file_name'>
<b>File</b>	Delete	FDEL	:MMEMory:DELete	<'file_name'>
<b>File</b>	Copy	FCOPY	:MMEMory:COPY	<'file_name1'>,<'file_name2'>
<b>File</b>	Rename	FRENAME	:MMEMory:MOVE	<'file_name1'>,<'file_name2'>
<b>File</b>	Move	FMOVE	:MMEMory:DATA	<'file_name'>,<definite_length_block ?> <'file_name'>
<b>Frequency</b>	Center Frequency	CF	[:SENSe]:FREQuency:CENTer	<frequency> ?
<b>Frequency</b>	Reference	REF	:INPut:REFerence	INTernal EXTernal ?
<b>Marker</b>	Marker State	MS[1~9]	:CALCulate:MARKer[1~9]:STATe	OFF ON 0 1 ?
<b>Marker</b>	Marker Mode	MM[1~9]	:CALCulate:MARKer[1~9]:MODE	POSition DELTA OFF ?
<b>Marker</b>	Marker Freq	MF[1~9]	:CALCulate:MARKer[1~9]:X	<frequency> ?
<b>Marker</b>	Marker Amplitude	MA[1~9]	:CALCulate:MARKer[1~9]:Y	?
<b>Marker</b>	Marker All Off	MAO	:CALCulate:LPLot:MARKer:AOff	none
<b>Measurement</b>	Meas. Start	MEA	:MEASure:STARt	FFT PVT PVTc CCDF SPEC EVMc EVMW EVM ?
<b>Measurement</b>	Power vs Time Output	PVTOUt	:FETCh MEASure READ:PVTTime	?
<b>Measurement</b>	Pwr vs Time (Crest Factor) Output	PVTCOut	:FETCh MEASure READ:PVTTime:CRESt	?
<b>Measurement</b>	Pwr vs Time (CCDF) Output	CCDFOut	:FETCh MEASure READ:PVTTime:CCDF	?
<b>Measurement</b>	Spectral Flatness	FLATOut	:FETCh MEASure READ:FLATness	?
<b>Measurement</b>	EVM (Constellation) OUTPUT	EVMCOUt	:FETCh MEASure READ:EVM:CONStellation	?
<b>Measurement</b>	EVM (I/Q Wave vs Time) OUTPUT	EVMWOut	:FETCh MEASure READ:EVM:WVTime	?
<b>Measurement</b>	EVM (EVM vs Symbol/SubCarrier) OUTPUT	EVMOut	:FETCh MEASure READ:EVM	?
<b>Meas. Control</b>	Capturing Time	MEAT	:MEASure:TIME	<time> ?
<b>Mode</b>	Mode	MODE	:INSTrument[:SELect]	SA BASIC WIMAX ?
<b>Mode Setup</b>	WiMAX Standard	WIMAXSTD		802.16e10MHZ 802.16e8.75MHZ 802.16e7MHZ 802.16e5MHZ ?
<b>Peak Search</b>	Peak Search	MPK[1~9]	:CALCulate:MARKer[1~9]:MAXimum	none
<b>Peak Search</b>	Next Peak Search	MPKN[1~9]	:CALCulate:MARKer[1~9]:MAXimum:NEXt	none
<b>Preset</b>	Preset	PRST	:SYSTem:PRESet	none
<b>Printer</b>	Hard Copy	HCOPY	:HCOPY[:IMMediate]	none

## REMOTE COMMANDS

---

<b>Span</b>	Span	SP	[[:SENSe]:FREQuency:SPAN	<frequency> ?
<b>Sweep</b>	Single	SI	:INITiate:LPLot[:IMMediate]	none
<b>Sweep</b>	Continuous	CO	:INITiate:LPLot:CONTInuous	OFF ON 0 1 ?
<b>System</b>	Beep	BEEP		OFF ON 0 1 ?
<b>System</b>	Echo	ECHO		OFF ON 0 1 ?
<b>Trace</b>	Trace Function	TRF	:TRACe:MODE	WRITE MAXHold ?
<b>Common</b>	*CLS	*CLS	*CLS	none
<b>Common</b>	*ESE	*ESE	*ESE	<integer> ?
<b>Common</b>	*ESR	*ESR	*ESR	?
<b>Common</b>	*IDN	*IDN	*IDN	?
<b>Common</b>	*OPC	*OPC	*OPC	?
<b>Common</b>	*RST	*RST	*RST	none
<b>Common</b>	*SRE	*SRE	*SRE	<integer> ?
<b>Common</b>	*STB	*STB	*STB	?
<b>Others</b>	ESE2	ESE2		<integer> ?
<b>Others</b>	ESR2	ESR2		?
<b>Others</b>	Error Code	ERR	:SYSTem:ERRor[:NEXT]	?

## REMOTE COMMANDS

### < SA command order >

Index	Description	SA Command	SCPI Command	Suffix
Common	*CLS	*CLS	*CLS	none
Common	*ESE	*ESE	*ESE	<integer> ?
Common	*ESR	*ESR	*ESR	?
Common	*IDN	*IDN	*IDN	?
Common	*OPC	*OPC	*OPC	?
Common	*RST	*RST	*RST	none
Common	*SRE	*SRE	*SRE	<integer> ?
Common	*STB	*STB	*STB	?
Amplitude	Attenuation	<b>AT</b>	[:SENSe]:POWer[:RF]:ATTenuation	<amplitude> ?
Average	Average	<b>AVG</b>	[:SENSe]:AVERAge[:STATe]	OFF ON 0 1 ?
Average	Average Count	<b>AVGC</b>	[:SENSe]:AVERAge:COUNt	<integer> ?
System	Beep	<b>BEEP</b>		OFF ON 0 1 ?
Measurement	Pwr vs Time (CCDF) Output	<b>CCDFOUT</b>	:FETCh MEASure READ:PVTime:CCDF	?
Frequency	Center Frequency	<b>CF</b>	[:SENSe]:FREQUency:CENTer	<frequency> ?
Sweep	Continuous	<b>CO</b>	:INITiate:LPLot:CONTinuous	OFF ON 0 1 ?
System	Echo	<b>ECHO</b>		OFF ON 0 1 ?
Others	Error Code	<b>ERR</b>	:SYSTem:ERRor[:NEXT]	?
Others	ESE2	<b>ESE2</b>		<integer> ?
Others	ESR2	<b>ESR2</b>		?
Measurement	EVM (Constellation) OUTPUT	<b>EVMCOUT</b>	:FETCh MEASure READ:EVM:CONSTellation	?
Measurement	EVM (EVM vs Symbol/Sub-Carrier) OUTPUT	<b>EVMOUT</b>	:FETCh MEASure READ:EVM	?
Measurement	EVM (I/Q Wave vs Time) OUTPUT	<b>EVMWOUT</b>	:FETCh MEASure READ:EVM:WVTime	?
File	Copy	<b>FCOPY</b>	:MMEMory:COPIY	<'file_name1'>,<'file_name2'>
File	Delete	<b>FDEL</b>	:MMEMory:DELeTe	<'file_name'>
Measurement	Spectral Flatness	<b>FLATOUT</b>	:FETCh MEASure READ:FLATness	?
File	Load	<b>FLOAD</b>	:MMEMory:LOAD	<'file_name'>
File	Move	<b>FMOVE</b>	:MMEMory:DATA	<'file_name'>,definite_length_block ? <'file_name'>
File	Read	<b>FREAD</b>	:MMEMory:CATalog	? <'directory_name'>
File	Rename	<b>FRENAME</b>	:MMEMory:MOVE	<'file_name1'>,<'file_name2'>
File	Save	<b>FSAVE</b>	:MMEMory:STORe	<'file_name'>
Display	Graticule	<b>GRAT</b>	:DISPlay:WINDow:TRACe:GRATicule:GRID[:STATe]	OFF ON 0 1 ?
Printer	Hard Copy	<b>HCOPY</b>	:HCOPY[:IMMEDIATE]	none
Marker	Marker Amplitude	<b>MA[1~9]</b>	:CALCulate:MARKer[1~9]:Y	?
Marker	Marker All Off	<b>MAO</b>	:CALCulate:LPLot:MARKer:AOFF	none
Measurement	Meas. Start	<b>MEA</b>	:MEASure:START	FFT PVT PVTC CCDF SPEC EVMC EVMW EVM ?
Meas. Control	Capturing Time	<b>MEAT</b>	:MEASure:TIME	<time> ?
Marker	Marker Freq	<b>MF[1~9]</b>	:CALCulate:MARKer[1~9]:X	<frequency> ?
Marker	Marker Mode	<b>MM[1~9]</b>	:CALCulate:MARKer[1~9]:MODE	POSition DELTA OFF ?
Mode	Mode	<b>MODE</b>	:INSTrument[:SELect]	SA BASIC WIMAX ?
Peak Search	Peak Search	<b>MPK[1~9]</b>	:CALCulate:MARKer[1~9]:MAXimum	none
Peak Search	Next Peak Search	<b>MPKN[1~9]</b>	:CALCulate:MARKer[1~9]:MAXimum:NEXT	none
Marker	Marker State	<b>MS[1~9]</b>	:CALCulate:MARKer[1~9]:STATe	OFF ON 0 1 ?
Preset	Preset	<b>PRST</b>	:SYSTem:PRESet	none

## REMOTE COMMANDS

---

Measurement	Pwr vs Time (Crest Factor) Output	<b>PVTCOUT</b>	:FETCh MEASure READ:PVTime:CREST	?
Measurement	Power vs Time Output	<b>PVTOUT</b>	:FETCh MEASure READ:PVTime	?
Bandwidth	Resolution Bandwidth	<b>RB</b>	[:SENSe]:BANDwidth BWIDth[:RESolution]	<frequency> ?
Bandwidth	Resolution Bandwidth Auto	<b>RBA</b>	[:SENSe]:BANDwidth BWIDth[:RESolution]:AUTO	OFF ON 0 1 ?
Frequency	Reference	<b>REF</b>	:INPut:REFerence	INTernal EXTernal ?
Amplitude	Ref. Level	<b>RL</b>	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVel	<amplitude> ?
Amplitude	Scale/Div	<b>SD</b>	:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision	<amplitude> ?
Sweep	Single	<b>SI</b>	:INITiate:LPLot[:IMMEDIATE]	none
Trace	Trace Function	<b>TRF</b>	:TRACe:MODE	WRITe MAXHold ?
Display	White Mode	<b>WH</b>	:DISPlay:WINDow:WHITe	OFF ON 0 1 ?
Mode Setup	WiMAX Standard	<b>WIMAXSTD</b>		802.16e10MHZ  802.16e8.75MHZ  802.16e7MHZ  802.16e5MHZ ?

## REMOTE COMMANDS

### < SCPI command order >

Index	Description	SA Command	SCPI Command	Suffix
Common	*CLS	*CLS	*CLS	none
Common	*ESE	*ESE	*ESE	<integer> ?
Common	*ESR	*ESR	*ESR	?
Common	*IDN	*IDN	*IDN	?
Common	*OPC	*OPC	*OPC	?
Common	*RST	*RST	*RST	none
Common	*SRE	*SRE	*SRE	<integer> ?
Common	*STB	*STB	*STB	?
Marker	Marker All Off	MAO	:CALCulate:LPLot:MARKer:AOff	none
Peak Search	Peak Search	MPK[1~9]	:CALCulate:MARKer[1~9]:MAXimum	none
Peak Search	Next Peak Search	MPKN[1~9]	:CALCulate:MARKer[1~9]:MAXimum:NEXT	none
Marker	Marker Mode	MM[1~9]	:CALCulate:MARKer[1~9]:MODE	POSition DELta OFF ?
Marker	Marker State	MS[1~9]	:CALCulate:MARKer[1~9]:STATe	OFF ON 0 1 ?
Marker	Marker Freq	MF[1~9]	:CALCulate:MARKer[1~9]:X	<frequency> ?
Marker	Marker Amplitude	MA[1~9]	:CALCulate:MARKer[1~9]:Y	?
Display	Graticule	GRAT	:DISPlay:WINDow:TRACe:GRATICule:GRID[:STATe]	OFF ON 0 1 ?
Amplitude	Scale/Div	SD	:DISPlay:WINDow:TRACe:Y[:SCALe]:PDIVision	<amplitude> ?
Amplitude	Ref. Level	RL	:DISPlay:WINDow:TRACe:Y[:SCALe]:RLEVEL	<amplitude> ?
Display	White Mode	WH	:DISPlay:WINDow:WHITe	OFF ON 0 1 ?
Measurement	EVM (EVM vs Symbol/SubCarrier) OUTPUT	EVMOUT	:FETCh MEASure READ:EVM	?
Measurement	EVM (Constellation) OUTPUT	EVMCOUT	:FETCh MEASure READ:EVM:CONSTellation	?
Measurement	EVM (I/Q Wave vs Time) OUTPUT	EVMWOUT	:FETCh MEASure READ:EVM:WVTime	?
Measurement	Spectral Flatness	FLATOUT	:FETCh MEASure READ:FLATness	?
Measurement	Power vs Time Output	PVTOUT	:FETCh MEASure READ:PVTime	?
Measurement	Pwr vs Time (CCDF) Output	CCDFOUT	:FETCh MEASure READ:PVTime:CCDF	?
Measurement	Pwr vs Time (Crest Factor) Output	PVTCOUT	:FETCh MEASure READ:PVTime:CREST	?
Printer	Hard Copy	HCOPY	:HCOPY[:IMMEDIATE]	none
Sweep	Continuous	CO	:INITiate:LPLot:CONTInuous	OFF ON 0 1 ?
Sweep	Single	SI	:INITiate:LPLot[:IMMEDIATE]	none
Frequency	Reference	REF	:INPut:REFerence	INTernal EXTernal ?
Mode	Mode	MODE	:INSTrument[:SELect]	SA BASIC WIMAX ?
Measurement	Meas. Start	MEA	:MEASure:START	FFT PVT FVT POLAR WVT BPSK QPSK OQPSK 8-64PSK 4-256QAM CCDF ?
Meas. Control	Capturing Time	MEAT	:MEASure:TIME	<time> ?
File	Read	FREAD	:MMEMory:CATalog	? <' directory_name'>
File	Copy	FCOPY	:MMEMory:COpy	<' file_name1'>,<' file_name2'>
File	Move	FMOVE	:MMEMory:DATA	<' file_name'>,<definite_length_block?> <' file_name'>
File	Delete	FDEL	:MMEMory:DELete	<' file_name'>
File	Load	FLOAD	:MMEMory:LOAD	<' file_name'>
File	Rename	FRENAME	:MMEMory:MOVE	<' file_name1'>,<' file_name2'>
File	Save	FSAVE	:MMEMory:STORe	<' file_name'>
Others	Error Code	ERR	:SYSTem:ERRor[:NEXT]	?
Preset	Preset	PRST	:SYSTem:PRESet	none

## REMOTE COMMANDS

---

Trace	Trace Function	TRF	<b>:TRACe:MODE</b>	WRITe MAXHold ?
Average	Average Count	AVGC	<b>[:SENSe]:AVERAge:COUNT</b>	<integer> ?
Average	Average	AVG	<b>[:SENSe]:AVERAge[:STATe]</b>	OFF ON 0 1 ?
Bandwidth	Resolution Bandwidth	RB	<b>[:SENSe]:BANDwidth BWIDth[:RESolution]</b>	<frequency> ?
Bandwidth	Resolution Bandwidth Auto	RBA	<b>[:SENSe]:BANDwidth BWIDth[:RESolution]:AUTO</b>	OFF ON 0 1 ?
Frequency	Center Frequency	CF	<b>[:SENSe]:FREQuency:CENTer</b>	<frequency> ?
Frequency	Sampling Rate	SR	<b>[:SENSe]:FREQuency:SAMPLing:RATE</b>	<frequency> ?
Span	Span	SP	<b>[:SENSe]:FREQuency:SPAN</b>	<frequency> ?
Amplitude	Attenuation	AT	<b>[:SENSe]:POWer[:RF]:ATTenuation</b>	<amplitude> ?

---

## Error codes

<b>Code</b>	<b>Description</b>
990	Not supported in current mode
991	Not installed (option)
992	System is busy
993	Execution error (EXE)
994	Query error (QYE)
995	Suffix error
996	Input data size over error
997	Undefined command
998	Unnecessary suffix insertion
999	Undefined suffix

---

# AEROFLEX INTERNATIONAL LIMITED SOFTWARE LICENSE AND WARRANTY

This document is an Agreement between the user of this Licensed Software, the Licensee, and Aeroflex International Limited ('Aeroflex'), the Licensor. By installing or commencing to use the Licensed Software you accept the terms of this Agreement. If you do not agree to the terms of this Agreement do not use the Licensed Software.

## 1. DEFINITIONS

The following expressions will have the meanings set out below for the purposes of this Agreement:

Add-In Application Software	Licensed Software that may be loaded separately from time to time into the Designated Equipment to improve or modify its functionality
Computer Application Software	Licensed Software supplied to run on a standard PC or workstation
Designated Equipment	means either: the single piece of equipment or system supplied by Aeroflex upon which the Licensed Software is installed; or a computer that is connected to a single piece of equipment or system supplied by Aeroflex upon which computer the Licensed Software is installed
Downloaded Software	any software downloaded from an Aeroflex web site
Embedded Software	Licensed Software that forms part of the Designated Equipment supplied by Aeroflex and without which the Equipment cannot function
License Fee	means either the fee paid or other consideration given to Aeroflex for the use of the Licensed Software on the Designated Equipment
Licensed Software	all and any programs, listings, flow charts and instructions in whole or in part including Add-in, Computer Application, Downloaded and Embedded Software supplied to work with Designated Equipment
PXI Software	Licensed Software specific to Aeroflex's 3000 Series PXI product range

## 2. LICENSE FEE

The Licensee shall pay the License Fee to Aeroflex in accordance with the terms of the contract between the Licensee and Aeroflex.

## 3. TERM

This Agreement shall be effective from the date of receipt or download (where applicable) of the Licensed Software by the Licensee and shall continue in force until terminated under the provisions of Clause 8.

## 4. LICENCE

- 4.1 The following rights and restrictions in this Article 4 apply to all Licensed Software unless otherwise expressly stated in other Articles of this Agreement.
- 4.2 Unless and until terminated, this License confers upon the Licensee the non-transferable and non-exclusive right to use the Licensed Software on the Designated Equipment.
- 4.3 The Licensee may not use the Licensed Software on other than the Designated Equipment, unless written permission is first obtained from Aeroflex and until the appropriate additional License Fee has been paid to Aeroflex.
- 4.4 The Licensee may not amend or alter the Licensed Software and shall have no right or license other than that stipulated herein.
- 4.5 Except as specifically permitted elsewhere in this Agreement the Licensee may make not more than two copies of the Licensed Software (but not the Authoring and Language Manuals) in machine-readable form for operational security and shall ensure that all such copies include Aeroflex's copyright notice, together with any features which disclose the name of the Licensed Software and the Licensee. Furthermore, the Licensee shall not permit the Licensed Software or any part to be disclosed in any form to any third party and shall maintain the Licensed Software in secure premises to prevent any unauthorized disclosure. The Licensee shall notify Aeroflex immediately if the Licensee has knowledge that any unlicensed party possesses the Licensed Software. The Licensee's obligation to maintain confidentiality shall cease when the Licensed Software and all copies have been destroyed or returned. The copyright in the Licensed Software shall remain with Aeroflex. The Licensee will permit Aeroflex at all reasonable times to audit the use of the Licensed Software.
- 4.6 The Licensee will not disassemble or reverse engineer the Licensed Software, nor sub-license, lease, rent or part with possession or otherwise transfer the whole or any part of the Licensed Software.

**5 ADDITIONAL LICENSE RIGHTS SPECIFIC TO PXI SOFTWARE**

5.1 Definitions for PXI Software

The following expressions will have the meanings set out below for the purposes of the supplementary rights granted in this Article.

PXI Drivers	All 3000 Series PXI module device drivers including embedded firmware that are installed at runtime
PXI Executable Applications	All executable applications supplied with each 3000 Series PXI module including:- PXI Studio Soft Front Panels (manual operation graphical user interfaces) Utilities including: RF Investigator, PXI Version Information and Self Test
PXI Spectrum Analysis Library	The spectrum analysis measurement suite library .dll software supplied with each 3000 Series PXI module
PXI Optional Application Library	Individual measurement suite available from a range of optional .dll application libraries

5.2 PXI Drivers, PXI Executable Applications and PXI Spectrum Analysis Library License Rights

Subject to the License granted in Article 4 hereof notwithstanding the limitations on number of copies in Clause 4.5 hereof, the Licensee is entitled to make and distribute as many copies of the PXI Drivers and PXI Executable Applications as necessary for use with 3000 Series PXI modules acquired by the Licensee from Aeroflex or its authorized distributor or reseller provided that the Licensee may not sell or charge a fee for the PXI Drivers and PXI Executable Applications.

5.3 PXI Optional Application Library License Rights

Subject to the License granted in Article 4 hereof notwithstanding the limitations on number of copies in Clause 4.5 hereof, the Licensee is entitled to distribute as many copies of any PXI Optional Application Library as necessary for use with 3000 Series PXI modules acquired by the Licensee from Aeroflex or its authorized distributor or reseller provided that:

5.3.1 copies of the applicable PXI Optional Application Library are used solely with 3000 Series PXI modules which the customer has purchased with the corresponding option or part number for the applicable PXI Optional Application Library; and

5.3.2 the Licensee may not sell or charge a fee for the PXI Optional Application Library.

**6 WARRANTY**

6.1 Aeroflex certifies that the Licensed Software supplied by Aeroflex will at the time of delivery function substantially in accordance with the applicable Software Product Descriptions, Data Sheets or Product Specifications published by Aeroflex.

6.2 The warranty period (unless an extended warranty for Embedded Software has been purchased) from date of delivery in respect of each type of Licensed Software is:

PXI Drivers	24 months
Embedded Software	12 months
Add-In Application Software	90 days
Computer Application Software	90 days
Downloaded Software	No warranty

6.3 If during the appropriate Warranty Period the Licensed Software does not conform substantially to the Software Product Descriptions, Data Sheets or Product Specifications Aeroflex will provide:

6.3.1 In the case of Embedded Software and at Aeroflex's discretion either a fix for the problem or an effective and efficient work-around.

6.3.2 In the case of Add-In Application Software and Computer Application Software and at Aeroflex's discretion replacement of the software or a fix for the problem or an effective and efficient work-around.

6.4 Aeroflex does not warrant that the operation of any Licensed Software will be uninterrupted or error free.

6.5 The above Warranty does not apply to:

6.5.1 Defects resulting from software not supplied by Aeroflex, from unauthorized modification or misuse or from operation outside of the specification.

6.5.2 Third party produced proprietary software which Aeroflex may deliver with its products, in such case the third party software license agreement including its warranty terms shall apply.

6.6 The remedies offered above are sole and exclusive remedies and to the extent permitted by applicable law are in lieu of any implied conditions, guarantees or warranties whatsoever and whether statutory or otherwise as to the Licensed Software all of which are hereby expressly excluded.

**7. INDEMNITY**

7.1 Aeroflex shall defend, at its expense, any action brought against the Licensee alleging that the Licensed Software infringes any patent, registered design, trademark or copyright, and shall pay all Licensor's costs and damages finally awarded up to an aggregate equivalent to the License Fee provided the Licensee shall not have done or permitted to be done anything which may have been or become any such infringement and shall have exercised reasonable care in protecting the same failing which the Licensee shall indemnify Aeroflex against all claims costs and damages incurred and that Aeroflex is given prompt written notice of such claim and given information, reasonable assistance and sole authority to defend or settle such claim on behalf of the Licensee. In the defense or settlement of any such claim, Aeroflex may obtain for the Licensee the right to continue using the Licensed Software or replace it or modify it so that it becomes non-infringing.

7.2 Aeroflex shall not be liable if the alleged infringement:

- 7.2.1 is based upon the use of the Licensed Software in combination with other software not furnished by Aeroflex, or
- 7.2.2 is based upon the use of the Licensed Software alone or in combination with other software in equipment not functionally identical to the Designated Equipment, or
- 7.2.3 arises as a result of Aeroflex having followed a properly authorized design or instruction of the Licensee, or
- 7.2.4 arises out of the use of the Licensed Software in a country other than the one disclosed to Aeroflex as the intended country of use of the Licensed Software at the commencement of this Agreement.

7.3 Aeroflex shall not be liable to the Licensee for any loss of use or for loss of profits or of contracts arising directly or indirectly out of any such infringement of patent, registered design, trademark or copyright. Notwithstanding anything in this Agreement to the contrary, the total liability of Aeroflex and its employees, in contract, tort, or otherwise (including negligence, warranty, indemnity, and strict liability) howsoever arising out of this License shall be limited to the total amount of the License Fee and total support fees actually paid to Aeroflex by the Licensee.

#### **8. TERMINATION**

8.1 Notwithstanding anything herein to the contrary, this License shall forthwith determine if the Licensee:

- 8.1.1 As an individual has a Receiving Order made against him or is adjudicated bankrupt or compounds with creditors or as a corporate body, compounds with creditors or has a winding-up order made against it or
- 8.1.2 Parts with possession of the Designated Equipment.

8.2 This License may be terminated by notice in writing to the Licensee if the Licensee shall be in breach of any of its obligations hereunder and continue in such breach for a period of 21 days after notice thereof has been served on the Licensee.

8.3 On termination of this Agreement for any reason, Aeroflex may require the Licensee to return to Aeroflex all copies of the Licensed Software in the custody of the Licensee and the Licensee shall, at its own cost and expense, comply with such requirement within 14 days and shall, at the same time, certify to Aeroflex in writing that all copies of the Licensed Software in whatever form have been obliterated from the Designated Equipment.

#### **9. THIRD PARTY LICENCES**

- 9.1 The Licensed Software or part thereof may be the proprietary property of third party licensors. In such an event such third party licensors (as may be referenced on the software media, or any on screen message on start up of the software or on the order acknowledgement) and/or Aeroflex may directly enforce the terms of this Agreement and may terminate the Agreement if the Licensee is in breach of the conditions contained herein.
- 9.2 If any third party software supplied with the Licensed Software is supplied with, or contains or displays the third party's own license terms then the Licensee shall abide by such third party license terms (for the purpose of this Article the term "third party" shall include other companies within the Aeroflex group of companies).

#### **10. EXPORT REGULATIONS**

The Licensee undertakes that where necessary the Licensee will conform with all relevant export regulations imposed by the Governments of the United Kingdom and/or the United State of America.

#### **11. U.S. GOVERNMENT RESTRICTED RIGHTS**

The Licensed Software and documentation are provided with RESTRICTED RIGHTS. Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.227-7013 or subparagraphs (c)(1) and (2) of the Commercial Computer Software-Restricted Rights at 48 CFR 52.227-19, as applicable.

#### **12. NOTICES**

Any notice to be given by the Licensee to Aeroflex shall be addressed to:

Aeroflex International Limited, Longacres House, Six Hills Way, Stevenage, SG1 2AN, UK.

#### **13. LAW AND JURISDICTION**

This Agreement shall be governed by the laws of England and shall be subject to the exclusive jurisdiction of the English courts. This agreement constitutes the whole agreement between the parties and may be changed only by a written agreement signed by both parties.

<b>CHINA Beijing</b>	Tel: [+86] (10) 6539 1166	Fax: [+86] (10) 6539 1778
<b>CHINA Shanghai</b>	Tel: [+86] (21) 5109 5128	Fax: [+86] (21) 5150 6112
<b>FINLAND</b>	Tel: [+358] (9) 2709 5541	Fax: [+358] (9) 804 2441
<b>FRANCE</b>	Tel: [+33] 1 60 79 96 00	Fax: [+33] 1 60 77 69 22
<b>GERMANY</b>	Tel: [+49] 8131 2926-0	Fax: [+49] 8131 2926-130
<b>HONG KONG</b>	Tel: [+852] 2832 7988	Fax: [+852] 2834 5364
<b>INDIA</b>	Tel: [+91] 80 [4] 115 4501	Fax: [+91] 80 [4] 115 4502
<b>JAPAN</b>	Tel: [+81] 3 3500 5591	Fax: [+81] 3 3500 5592
<b>SCANDINAVIA</b>	Tel: [+45] 9614 0045	Fax: [+45] 9614 0047
<b>SPAIN</b>	Tel: [+34] (91) 640 11 34	Fax: [+34] (91) 640 06 40
<b>UK Cambridge</b>	Tel: [+44] (0) 1763 262277	Fax: [+44] (0) 1763 285353
<b>UK Stevenage</b>	Tel: [+44] (0) 1438 742200	Fax: [+44] (0) 1438 727601
	Freephone: 0800 282388	
<b>USA</b>	Tel: [+1] (316) 522 4981	Fax: [+1] (316) 522 1360
	Toll Free: 800 835 2352	

[www.aeroflex.com](http://www.aeroflex.com)

[info-test@aeroflex.com](mailto:info-test@aeroflex.com)

April 2006