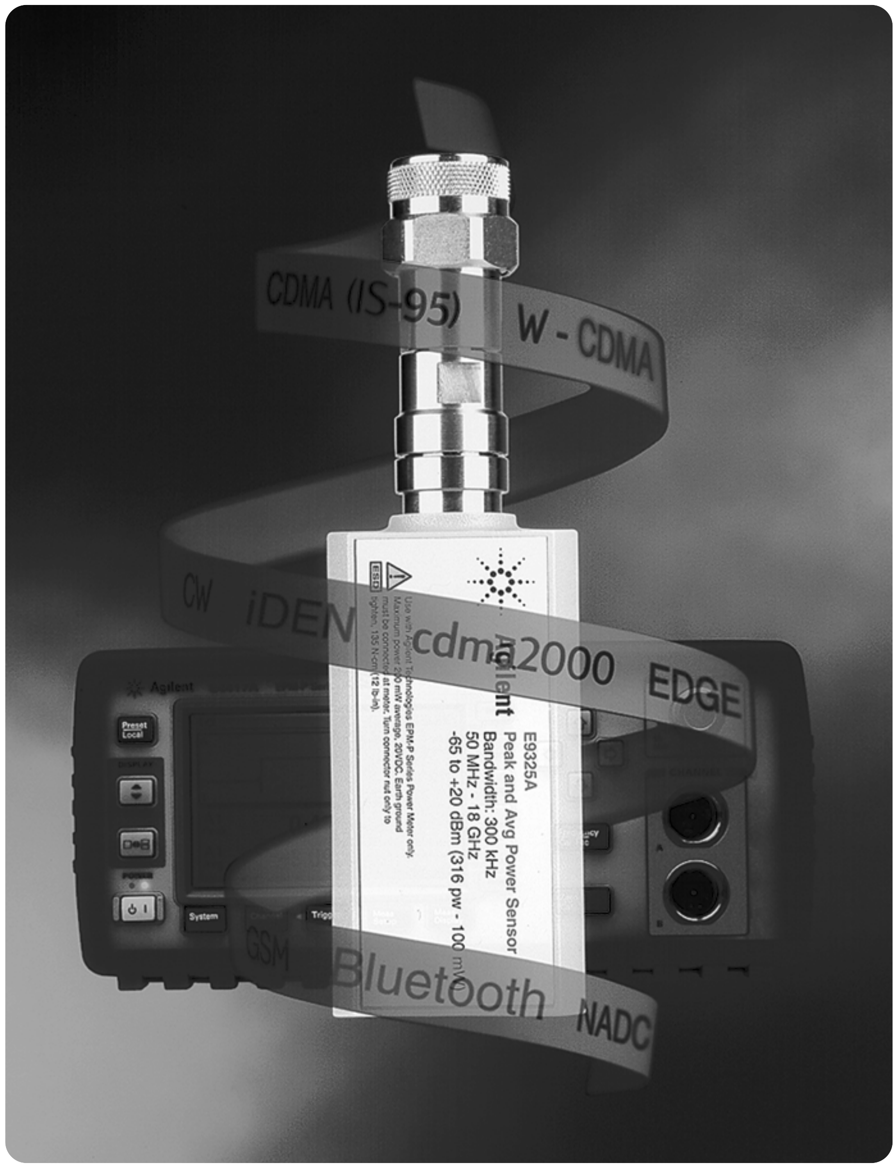
Agilent
EPM-P Series
Single- and Dual-Channel
Power Meters

Demo Guide



Agilent Technologies

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Introduction

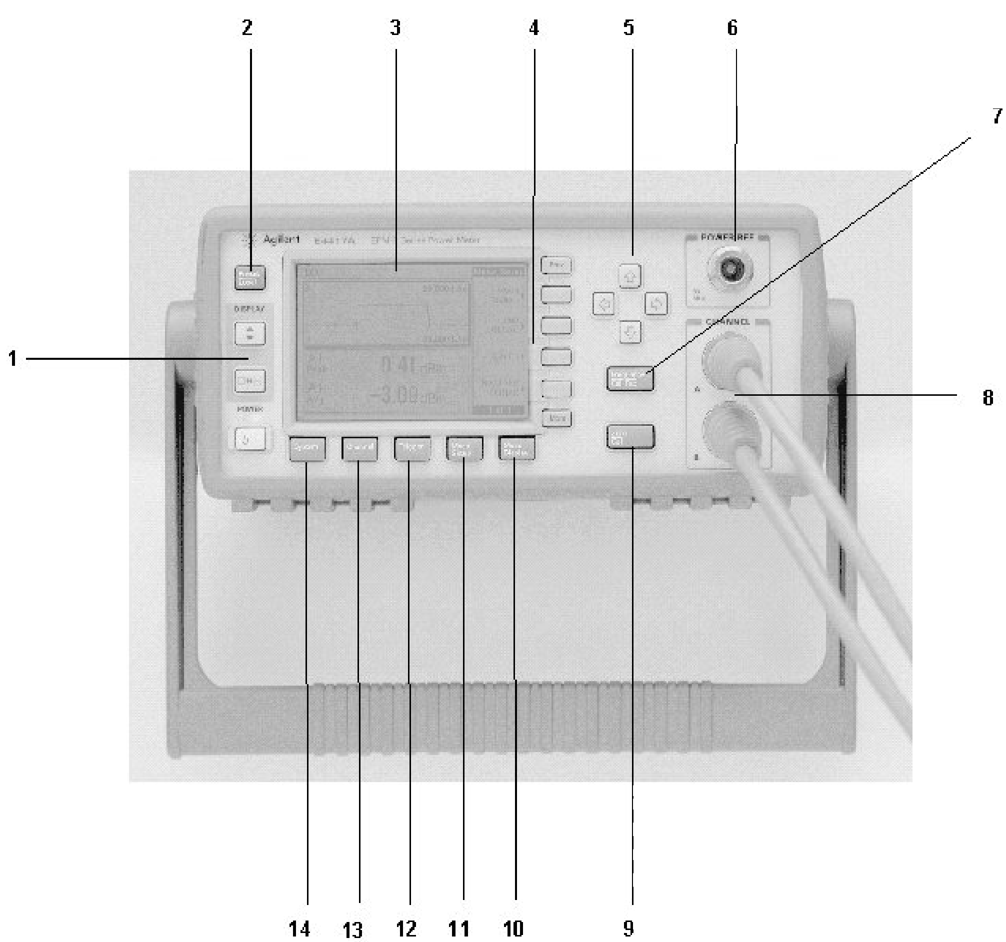
This demo guide will help you gain familiarity with the basic and advanced features and functionality of the EPM-P series power meters and the E9320 peak and average power sensors.

All demonstration exercises in this guide require an Agilent EPM-P single channel power meter, E4416A[1], an Agilent E-Series power sensor, E9323A or E9327A (5 MHz bandwidth), an Agilent ESG-D Series RF signal generator, E4433B[2], as the signal source and a BNC cable.

The EPM-P Series power meters operate with all 8480 Series and E-Series power sensors. E9320 sensors must be used with the E9288 (A/B/C) cables (refer to appendix A for power meter and sensor compatibility).

For more information on the Agilent EPM-P series power meters and E-series power sensors, including links to the product support pages, see our web page at: www.agilent.com/find/powermeters

Figure 1. Front panel overview



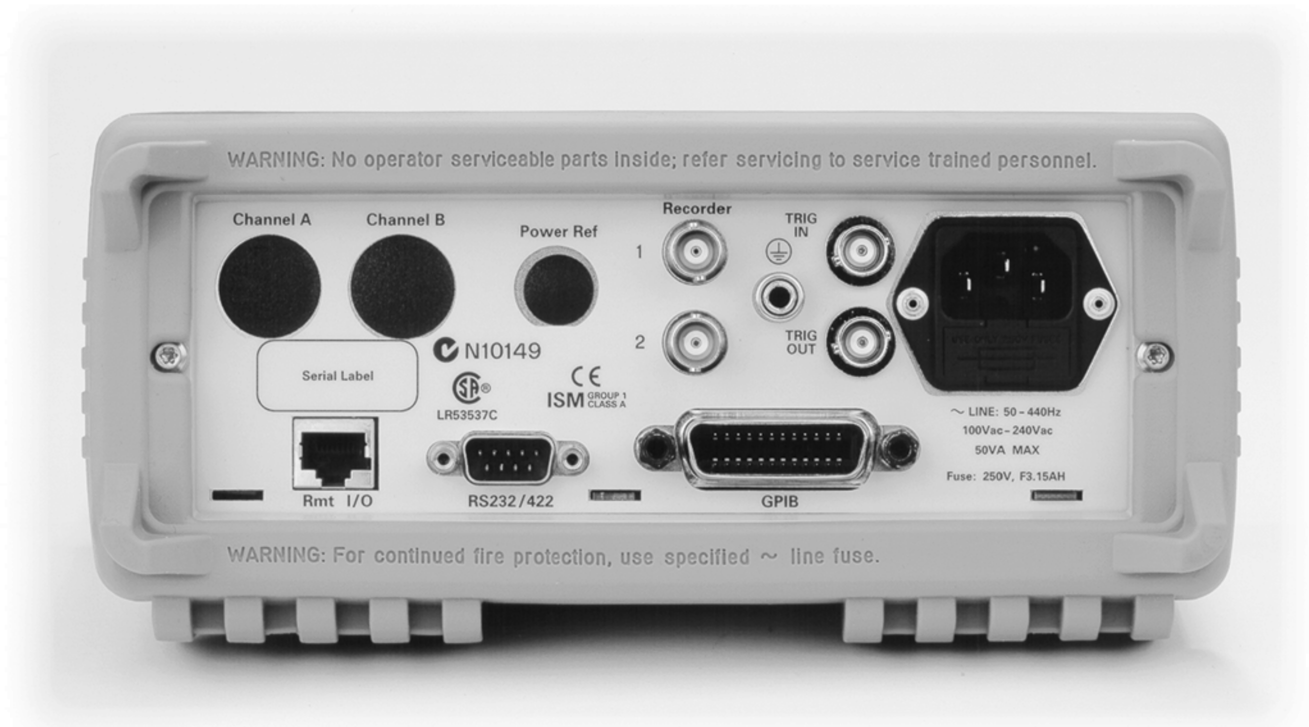
[1]Firmware revision A1.04.03 (or greater)
[2]Firmware revision B1.03.00 (or greater)

Table 1.

Front panel item descriptions

Item	Description
1	**Display Keys** **Up/Down:** Allows the user to select a window. **Split Screen:** Toggles between windowed, expanded or full-screen.
2	**Preset/Local:** Returns the power meter to local control. If already in local, displays the pre-defined setup options.
3	**Large LCD Display:** High resolution display with the back lighting provides a wide viewing angle for all the displayed data. The two horizontal windows on the power meters' easy-to-read display can show a large 1- to 4-line numeric display, an analog display or a trace display.
4	**Softkeys:** Provide the user menu selection.
5	**Arrowkeys:** Allow positioning of the cursor for editing purposes and for character selection.
6	**Power Ref:** 1.00 mW, 50 MHz source used for power sensor calibration (traceable to National Institute of Standards and Technology, NIST).
7	**Frequency/Cal Factor** **Frequency:** Direct entry of the test signal frequency. **Cal Factor:** For sensor frequency response correction (settable from 1% to 200% with 0.1% resolution).
8	**Sensor Connector(s):** Sensor input operates with Agilent 8480 series and E-series sensors. Figure 1 shows the E4417A dual-channel power meter (the E4416A is the single channel version).
9	**Zero/Cal** **Zero:** Fully automatic digital zero corrects for residual offsets. **Cal:** Fully automatic sensor calibration.
10	**MEAS DISPLAY menu:** Accesses the menus associated with configuring the measurement display. The format of display (for example, single numeric, dual numeric, trace, analog), the resolution of the display, parameters for the trace setup and the units to be displayed.
11	**MEAS SETUP menu:** Accesses the menus associated with the configuration of the selected measurement (for example, the relative offset, limits).
12	**TRIGGER menu:** Accesses the menus associated with Triggering (for example, trigger acquisition, trigger source, trigger holdoff). NOTE: Unless an E9320A sensor is connected, all the menu keys are disabled.
13	**CHANNEL menu:** Accesses the channel configuration tables and data (for example, sensor mode, input offset, averaging, gate control, trace control, etc) and the time-gating feature, which allows up to four time gates to be setup.
14	**SYSTEM menu:** Accesses the menus associated with the general configuration (for example, the GPIB address, sensor cal tables). Stores up to 10 instrument configurations (Save/Recal menu).

Figure 2. Rear Panel Overview



Rear Panel Features

- dc Recorder Output, 0 to 1 Volt. The Agilent E4417A has two dc Recorder Outputs as shown.
- Option 002 provides parallel rear panel sensor inputs with the power reference oscillator on the front panel.
- Option 003 provides parallel rear panel sensor inputs and moves the power reference oscillator to the rear panel.
- GPIB connector for remote control of all functions.
- RS232/422 connector for remote control.
- Line power - universal input voltage range with NO range selection switches.
- Ground connector - for those applications where you need a hard-wired connection between the power meter's ground and a common ground.
- Power meter conforms to CE and CSA standards.
- Remote input/output - TTL logic level is output when a measurement exceeds a predetermined limit. TTL inputs are provided to initiate zero and calibration cycles.
- Trig In - accepts a TTL signal for initiating measurements.
- Trig Out - outputs a TTL signal for synchronizing with external equipment.

Getting Started

All demonstrations outlined use the single channel power meter, E4416A, and require an Agilent E9323A or an E9327A power sensor (5 MHz bandwidth).

Key names surrounded by [ ] indicate labeled hard keys located on the front panel, while key names surrounded by { } indicate the menu keys (soft keys) located along the right edge of the display.

Section 1.
Zero and Calibration

Objective:

- Zero and calibrate the power meter/sensor in order to make power measurements.

For a correct power measurement to be recorded the power meter must be zeroed and calibrated at the start of each measurement session. ‘Zeroing’ will remove any residual dc offset on the power meter/sensor combination. Calibration will establish a 0.0 dBm reference that is traceable to the National Institute of Standards and Technology (NIST).

The residual noise of the POWER REF, 50 MHz oscillator, is negligible when the POWER REF is off, therefore the zero and calibration process can be completed in one step.

One step zero and calibration, connect the sensor and cable (E9288 A/B/C) to the channel A port. Connect the sensor to the **POWER REF.** Press the [Zero/Cal], and select **{Zero+Cal}**, this will automatically zero and calibrate the power meter. Note the on-screen “Zeroing Please Wait” and the “Calibrating Please Wait” messages. To check the 0.0 dBm calibration reference toggle **{Power Ref}** to **‘ON’** (ensure that the frequency is 50 MHz, i.e. matching the POWER REF).

Also available is a two step ZERO and CAL.

Section 2.
Preset

The EPM-P series power meter with the E9320 power sensors measures the complex modulation formats of today’s TDMA and CDMA standards, as well as emerging wideband-CDMA (W-CDMA) standards for 3G wireless communications.

The power meter contains a variety of pre-defined setups for wireless standards. It is configured for the following measurements as illustrated in Figure 3:

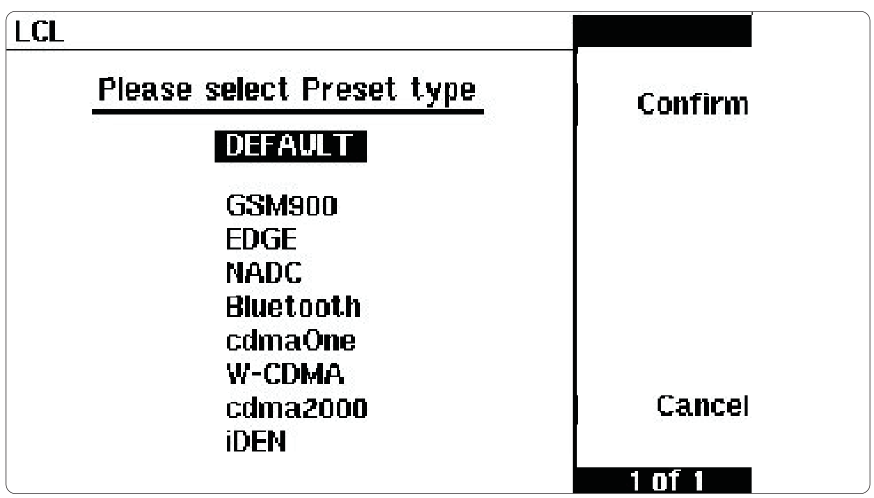


Figure 3 EPM-P preset screen

To access the above setup:

Note: The pre-defined setups are only available when using a sensor from the E9320 family.

Instructions	Keystrokes
1. Access pre-defined setups	**[Preset/Local]**, use the arrow keys to highlight the preset you wish to view, **{Confirm}**

(Refer to Appendix B for pre-defined setup measurements).

Section 3.
Basic Measurements
Section 3.1 GSM900

Objectives

- Show the ability of the power meter to measure average power in an active GSM900 timeslot (i.e. the *useful* part of the burst) and demonstrate the trigger holdoff feature.

Making a measurement using the GSM900 pre-defined setup:

Instructions	Keystrokes
1. Zero and Cal	(Refer to Section 1)
2. Recall the GSM900 preset	**[Preset/Local]**, use the arrow keys to highlight GSM900, **{Confirm}**

The power meter is configured to show the power trace of the GSM900 signal in the upper window, and the average power in the useful part of a single GSM900 burst, in the lower window, as illustrated in figure 4.

The E4433B Signal Generator is used as the signal source in this demonstration. It is configured as follows:

Instructions	Keystrokes
1. Connect the sensor to the RF Output, 50 Ω, port	
2. Frequency	**[Frequency]**, use the numerical keypad to enter the frequency of the signal **[900], {MHz}**
3. Amplitude	**[Amplitude]**, use the numerical keypad to enter the amplitude of the signal **[0]**, **{dBm}**
4. Selecting a GSM signal	**[Mode]**, **{Real Time I/Q Baseband}**, **{TDMA}**, **{GSM}**, toggle **{GSM ON}**, toggle **{Data Format Framed}**, toggle **{Frame Repeat Cont}**
5. Activating an GSM signal	Toggle **[RF On/Off]** to **'ON'**, toggle **[Mod On/Off]** to **'ON'**

When considering a GSM900 signal with multiple active timeslots, stable triggering can be a problem. The EPM-P power meter offers a **Trigger Holdoff** facility to overcome this problem. After a trigger event occurs, the trigger mechanism is disabled for the configured time period (the trigger holdoff period). This allows stable triggering to be achieved even when a signal has multiple edges, for example a TDMA signal with non-constant amplitude modulation. Trigger holdoff values up to 400 ms can be configured.

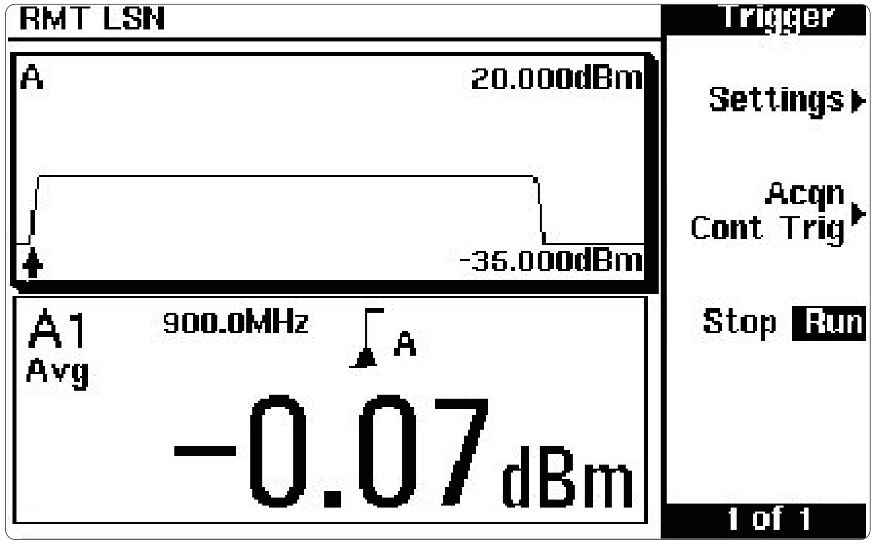


Figure 4 The display shows the GSM900 data

To activate multiple GSM900 timeslots the E4433B is configured as follows:

Instructions	Keystrokes
1. Configure timeslot 3 to 'ON'	**{Configure Timeslots}**, **{Timeslot #}**, use the numeric keypad to enter **[3]**, **{Enter}**, toggle **{Timeslot Off/On}** to **'ON'**, **{Timeslot type}**, **{Normal}**

The trace display of the power meter is not set to show all the active timeslots (0 and 3). To view the active timeslots the trace setup length must be changed:

Instructions	Keystrokes
1. Change the trace setup	Use the display arrow keys to highlight the upper window, **[Channel]**, **{Trace Setup}**, use the arrow keys to highlight 'length', **{Change}**, use the arrow keys to enter **'3'**, **{ms}**, **{Done}**, **{Done]**

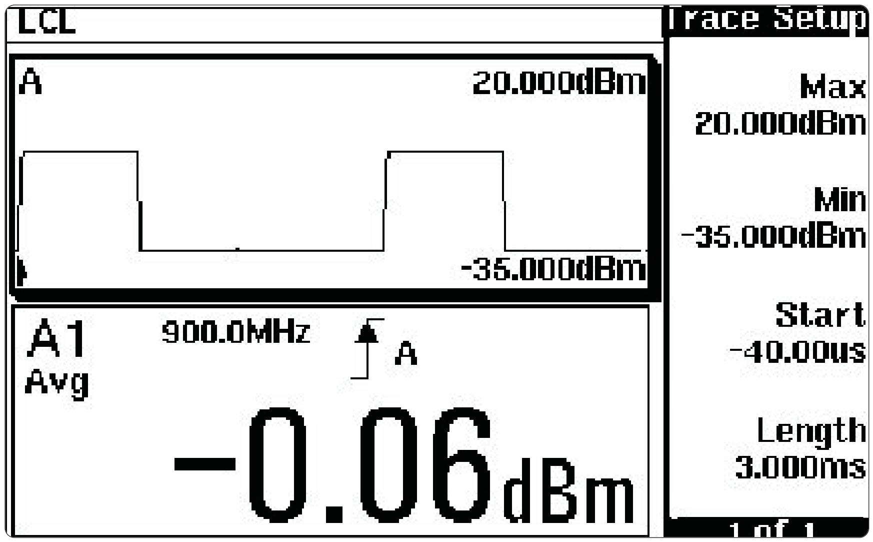


Figure 5 The display will show time slots 0 and 3 on (active)

The trace display is stable due to the trigger holdoff being set to 4.275ms (default setting for GSM900). However by reducing the trigger holdoff such that it occurs before the rising edge of timeslot 3, the trace display will become unstable. For this example, to ensure that the trace display is stable, the trigger holdoff must be set to greater than 2 ms. this can be verified as follows:

Instructions	Keystrokes
1. Changing the trigger holdoff to illustrate an unstable display	**[Trigger]**, **{Settings}**, **{More}**, **{Holdoff}**, use the arrow keys to enter **'1.5'**, **{ms}**
2. Changing the trigger holdoff to a stable display	**[Trigger]**, **{Settings}**, **{More}**, **{Holdoff}**, use the arrow keys to enter **'2'**, **{ms}**

Section 3.2 EDGE

Objectives

- Show the ability of the power meter to measure average and peak-to-average ratio power measurements for an EDGE signal, and also illustrate the filtering feature of the power meter.

Making a measurement using the EDGE pre-defined setup:

Instructions	Keystrokes
1. Zero and Cal	(Refer to Section 1)
2. Recall the EDGE preset	**[Preset/Local]**, use the arrow keys to highlight EDGE, **{Confirm}**

The power meter is configured to show the power trace of the EDGE signal in the upper window, and the average power and peak-to-average ratio in an EDGE pulse in the lower window, as shown in figure 6.

The E4433B Signal Generator is used as the signal source in this demonstration. It is configured as follows:

Instructions	Keystrokes
1. Connect the sensor to the RF Output, 50 Ω, port	
2. Frequency	**[Frequency]**, use the numerical keypad to enter the frequency of the signal **[900]**, **{MHz}**
3. Amplitude	**[Amplitude]**, use the numerical keypad to enter the amplitude of the signal **[0]**, **{dBm}**
4. Selecting an EDGE signal	**[Mode]**, **{Real Time I/Q Baseband}**, **{TDMA}**, **{EDGE}**, toggle **{EDGE ON}**, toggle **{Data Format Framed}**, toggle **{Frame Repeat Cont}**
5. Activating an EDGE signal	Toggle **[RF On/Off]** to **'ON'**, toggle **[Mod On/Off]** to **'ON'**

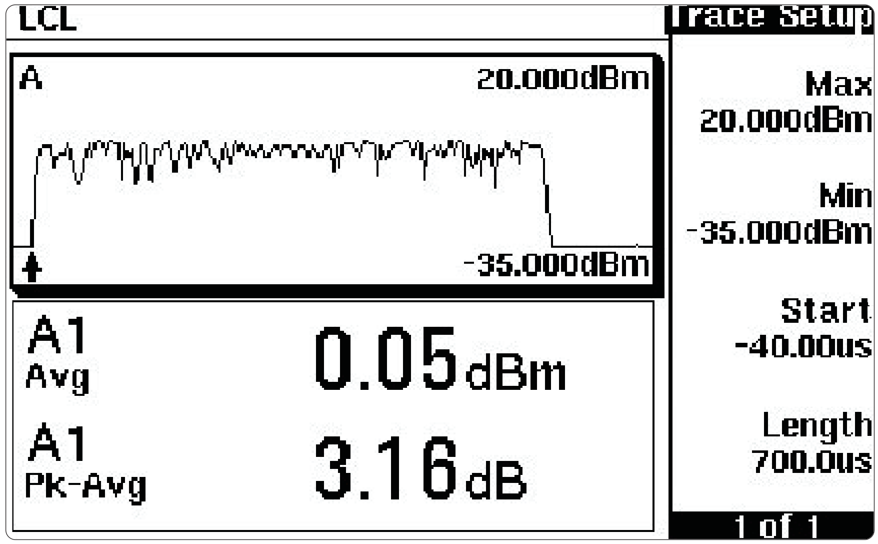


Figure 6 The display will show the EDGE data.

It can be noted that the average and peak-to-average ratio readings on the lower window display fluctuate due to the EDGE modulation format. Changing the filtering (averaging) on the power meter can reduce the reading variations:

Instructions	Keystrokes
1. Changing the filtering (averaging)	**[Channel]**, use the arrow keys to highlight **'Filter: AUTO'**, toggle **{Change}** to **'MAN 1'**, use the arrow keys to highlight **'1'**, **{Change}**, use the arrow keys to change the **'Filter Length'** to **'32'**, **{Enter}**, **{Done}**

Section 3.3 *Bluetooth™*

Objectives

- Show the ability of the power meter to measure average and peak power for a *Bluetooth™* signal, and the gate and trace control features.

Making a measurement using the Bluetooth™ *pre-defined setup:*

Instructions	Keystrokes
1. Zero and Cal	(Refer to Section 1)
2. Recall the *Bluetooth™* preset	**[Preset/Local]**, use the arrow keys to highlight *Bluetooth™*, **{Confirm}**

The power meter is configured to show the power trace of the *Bluetooth™* signal in the upper window, and the average and peak power in a single *Bluetooth™* DH1 data burst, in the lower window, as shown in figure 7.

The E4433B Signal Generator is used as the signal source in this demonstration. It is configured as follows:

Instructions	Keystrokes
1. Connect the sensor to RF Output, 50 Ω, port	
2. Frequency	**[Frequency]**, use the numerical keypad to enter the frequency of the signal **[2.4]**, **{GHz}**
3. Amplitude	**[Amplitude]**, use the numerical keypad to enter the amplitude of the signal **[-10]**, **{dBm}**
4. Selecting a *Bluetooth™* signal	**[Mode]**, **{Arb Waveform Generator}**, **{*Bluetooth™*}**, toggle **{*Bluetooth™* ON}**
5. Activating a *Bluetooth™* signal	Toggle **[RF On/Off]** to **'ON'**, toggle **[Mod On/Off]** to **'ON'**

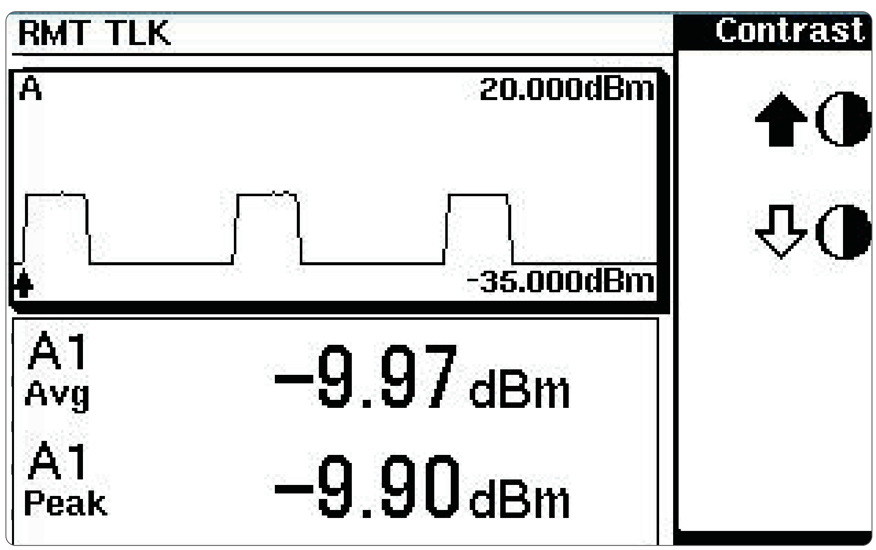


Figure 7 The display shows the *Bluetooth™* data

The gate setup and control function of the EPM-P series power meter allows closer analysis of the signal under test. The gate control screen shows the pulse trace, delta time, delta average, delta peak and delta peak-to-average power ratio for the gate selected.

The screen of the power meter is currently showing three active pulses of a *Bluetooth™* DH1 data burst (Figure 7). The *Bluetooth™* pre-defined setup has Gate 1 configured, this measures the average and peak power across the first burst. The graphical gate setup and control feature of the EPM-P series power meter provide an easy method of configuring and controlling further gates. In addition to the numerical entry, markers can be used to set the gate parameters. This method is particularly useful when the start of the pulse and length are unknown.

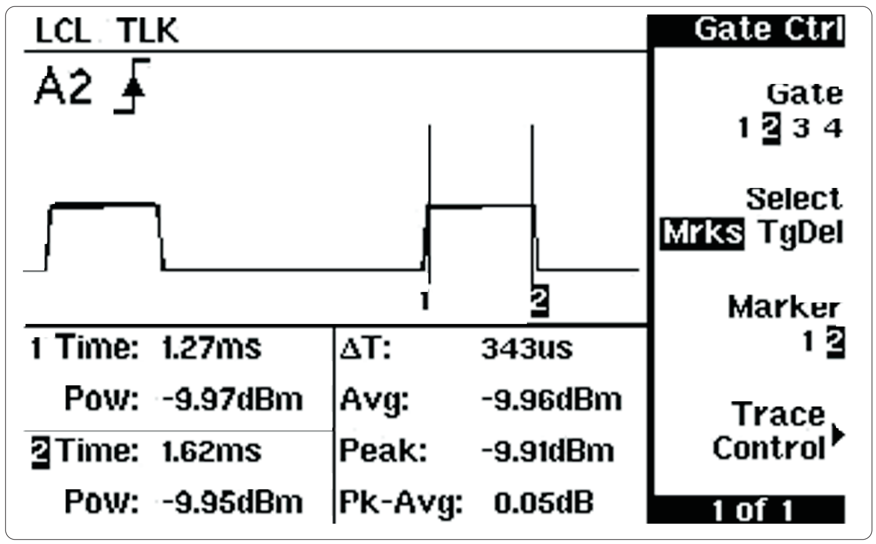


Figure 8 The display will show the following *Bluetooth™* data

Gate 2 can be setup to measure the average and peak power in the second pulse as follows:

Instructions	Keystrokes
1. View the gate control screen	**[Channel]**, **{Gates}**, *NOTE: only Gate 1 is currently setup,* **{Gate Control}**
2. Zoom the screen to show the first and second pulse only	**{Trace Control}**, use the arrow keys to select 'Horizontal Length', {⇓} to decrease the length to ~2ms
3. Setup gate 2 to measure the power across the second pulse	**{Gate Control}**, toggle **{Gate}** to highlight '2', use the arrow keys to move marker to the rising edge of the second pulse (~1.3ms), toggle **{Marker}** to highlight '2', use the arrow keys to move marker 2 to the falling edge of the second pulse (~1.6ms)

Section 3.4 W-CDMA

Objectives

- Show the ability of the power meter to measure average, peak and peak-to-average ratio power for a W-CDMA signal. Illustrate the relationship between the gate length and peak-to-average ratio for a W-CDMA signal.

Making a measurement using the W-CDMA pre-defined setup:

Instructions	Keystrokes
1. Zero and Cal	(Refer to Section 1)
2. Recall the W-CDMA preset	**[Preset/Local]**, use the arrow keys to highlight W-CDMA, **{Confirm}**

The power meter is configured to show the average power of a W-CDMA signal in the upper window, and the peak and peak-to-average ratio power in a W-CDMA signal, in the lower window, as shown in figure 9.

The E4433B Signal Generator is used as the signal source in this demonstration. It is configured as follows:

Instructions	Keystrokes
1. Connect the sensor to RF Output, 50 Ω, port	
2. Frequency	**[Frequency]**, use the numerical keypad to enter the frequency of the signal **[1.9]**, **{GHz}**
3. Amplitude	**[Amplitude]**, use the numerical keypad to enter the amplitude of the signal **[-10]**, **{dBm}**
4. Selecting a W-CDMA signal	**[Mode]**, **{Arb Waveform Generator}**, **{CDMA Formats}**, **{W-CDMA (3GPP 3.2 03-00)}**, toggle **{W-CDMA ON}**
5. Activating a W-CDMA signal	Toggle **[RF On/Off]** to **'ON'**, toggle **[Mod On/Off]** to **'ON'**

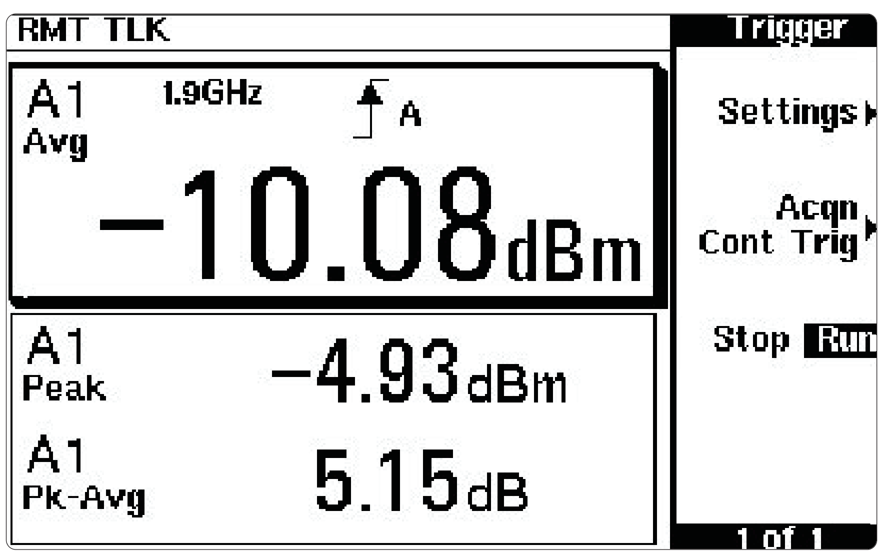


Figure 9 The display will shows the W-CDMA data

The CCDF (Complementary Cumulative Distribution Function) can be viewed on the E4433B to allow graphical verification of the peak-to-average reading on the power meter.

Note from the displayed CCDF, the peak-to-average ratio for a probability of between 0.01% and 0.001% is approximately 5.2 dB. If you reduce the length of Gate 1, the probability of capturing the maximum peak of a W-CDMA signal (a noise-like signal) is reduced. Hence the peak-to-average ratio is less than the expected maximum.

Instructions	Keystrokes
1. View the CCDF	**[Mode]**, **{Arb Waveform Generator}**, **{CDMA Formats}**, **{W-CDMA (3GPP 3.1 12-99)}**, **{Waveform Statistics}**, **{Plot CCDF}**

Note a reduction in the peak-to-average ratio reading on the power meter.

Instructions	Keystrokes
1. Changing the length of Gate 1	**[Channel]**, **{Gates}**, use the arrow keys to highlight **'Gate 1 Length'**, **{Change}**, use the arrow keys to enter **'1'**, **{ms}**, **{Done}**, **{Done}**

Section 4.
Advanced Measurements

The EPM-P power meter offers extensive triggering facilities for making time-gated measurements. This allows useful average, peak and peak-to-average ratio measurements of complex modulation formats to be taken.

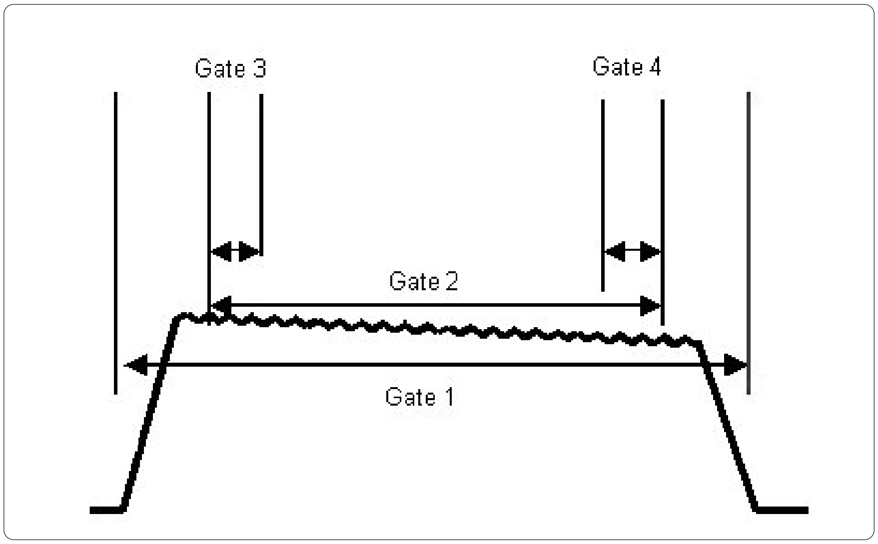


Figure 10 Powerful data configuration routines permit measurements during 4 gate times, each with 2 data “feeds” for display. Computed paramaters such as peak-to-average ratio can also be displayed.

Section 4.1 Time-gating

Objective

- Show the versatility of the time-gating features of the EPM-P power meters, by setting up four independent time gates on a TDMA signal to measure various power parameters, as shown in Figure 10.

In this example time-gating is used to measure the average power of the useful period (5% to 95% of the burst duration), peak power, peak-to-average ratio and pulse droop in a GSM900 signal:

Instructions	Keystrokes
1. Set up GSM900 format for the EPM-P power meter and E4433B	(Refer to Section 3.1)

Figure 10 illustrates a GSM900 pulse, where Gate 2 provides the burst average power over the useful GSM time period and Gate 1 indicates the peak-to-average power over the whole timeslot. A pulse droop measurement can be obtained from Gate 4/Gate 3. To achieve this, the gates are setup as follows:

Instructions	Keystrokes
1. Setting up gates	**[Channel]**, **{Gates}**
	Gate 1 Use the arrow keys to select **‘Gate 1 Start Time’**, **{Change}**, use the arrow keys to enter **‘0’**, **{us}**, use the arrow keys to select **‘Gate 1 Length’**, **{Change}**, use the arrow keys to enter **‘600’**, **{us}**
	Gate 2 Use the arrow keys to select **‘Gate 2 Start Time’**, **{Change}**, use the arrow keys to enter **‘20’**, **{us}**, use the arrow keys to select **‘Gate 2 Length’**, **{Change}**, use the arrow keys to enter **‘520’**, **{us}**
	Gate 3 Use the arrow keys to select **‘Gate 3 Start Time’**, **{Change}**, use the arrow keys to enter **‘20’**, **{us}**, use the arrow keys to select **‘Gate 3 Length’**, **{Change}**, use the arrow keys to enter **‘40’**, **{us}**
	Gate 4 Use the arrow keys to select **‘Gate 4 Start Time’**, **{Change}**, use the arrow keys to enter **‘500’**, **{us}**, use the arrow keys to select **‘Gate 4 Length’**, **{Change}**, use the arrow keys to enter **‘40’**, **{us}**, **{Done}**, **{Done}**

The four gates that have been configured will now be setup to display and measure the burst average power, peak-to-average ratio and the pulse droop. The upper window is to be configured to display the burst average power (Gate 2) and the lower window configured to display the peak-to-average ratio (Gate 1) and the pulse drop (Gates 4/Gate 3):

Instructions	Keystrokes
1. Set up measurement display	**Upper Window** Use the **DISPLAY up/down** key to highlight the upper window, [**Meas Display**], {**Disp Type**}, {**Single Numeric**},
	Lower Window Use the **DISPLAY up/down** key to highlight the lower window, [**Meas Display**], {**Disp Type**}, {**Dual Numeric**}
2. Configuring measurement setup	**Upper Window** Use the **DISPLAY up/down** key to highlight the upper window, [**Meas Setup**], {**Meas Select**}, use the arrow keys to highlight the number under **'Gate'**, toggle **{Change}** until **'2'** is shown, {**Done**}
	Lower Window, Upper Line Use the **DISPLAY up/down** key to highlight the lower window upper line, [**Meas Setup**], {**Meas Select**}, use the arrow keys to highlight the characters under **'Meas'**, toggle {**Change**} to **'Pk-Avg'**, {**Done**}
	Lower Window, Lower Line Use the **DISPLAY up/down** keys to highlight the lower window lower line, [**Meas Setup**], {**Meas Select**}, toggle {**Function**} to {**Function COMB**}, toggle {**Combination**} to {**Combination Feed 1/Feed 2**}, use the arrow keys to highlight the number under **'Feed 1' 'Gate'**, toggle {**Change**} until **'4'** is shown, use the arrow keys to highlight the number under **'Feed 2' 'Gate'**, toggle {**Change**} to **'3'**, {**Done**}

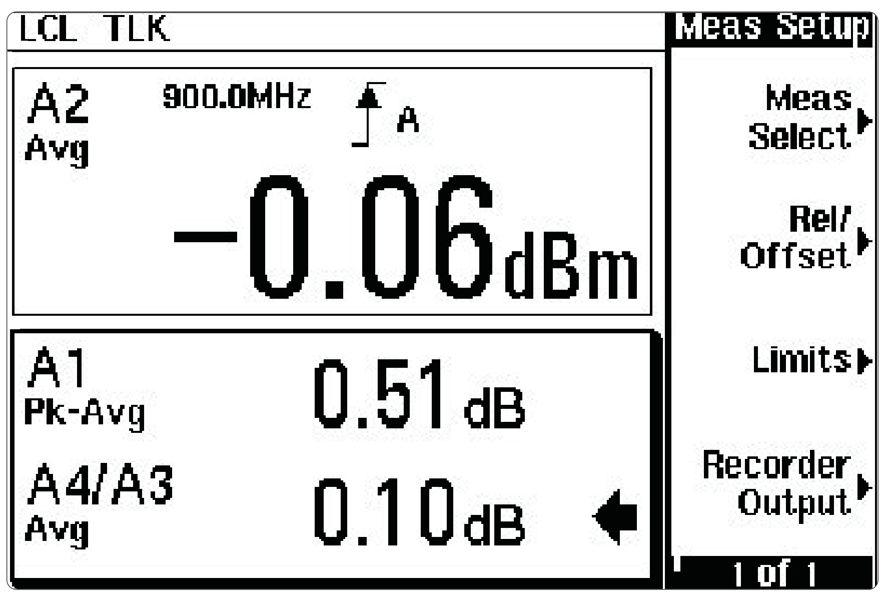


Figure 11 The display will now show the GSM900 data

Section 4.2 Sensitivity

Objective

- Show the sensitivity of the power meter for measuring the average power of a CW signal and GSM900. For the GSM900 signal an external trigger is used.

Wider bandwidths allow you to profile fast-changing signals, but at the expense of dynamic range. The EPM-P power meters and E9320 sensors allow you to select the best video bandwidth for your application while still maintaining the widest possible dynamic range. Three video bandwidth settings (High, Medium and Low) plus an off mode are provided (refer to Appendix F).

The E9320 power sensors combine stable, low-level power measurements, to meet a wider range of test needs. These sensors have two independent measurement paths, providing the exceptional value of two sensors in one package:

Normal path for high-speed, continuously sampled measurement of modulated signals and time-gated measurements. This is the default path for E9320 sensors.

Average only path for stable, low level average power measurements.

CW Power Measurement.
To measure the dynamic range for CW power measurements the power meter is setup as follows:

Instructions	Keystrokes
1. Zero and Cal	(Refer to Section 1)
2. Recall the DEFAULT preset	**[Preset/Local]**, use the arrow keys to highlight DEFAULT, **{Confirm}**

To illustrate the sensitivity of the sensor for CW measurements the E4433B is set as follows:

Instructions	Keystrokes
1. Preset the signal generator	[Preset]
2. Connect the sensor to RF Output, 50 Ω, port	
3. Frequency	**[Frequency]**, use the numerical keypad to enter the frequency of the signal **[50]**, **{MHz}**
4. Amplitude	**[Amplitude]**, use the numerical keypad to enter the amplitude of the signal **[15]**, **{dBm}**
5. Set up incremental step for the amplitude	**[Amplitude]**, **[Incr Set]**, use the numerical keypad to enter **[5]**, **{dB}**
6. Activating a CW signal	Toggle **[RF On/Off]** to **'ON'**, toggle **[Mod On/Off]** to **'ON'**
7. Decreasing the amplitude from 15 dBm to -40 dBm in 5 dB steps	**[Amplitude]**, use the down arrow key to decrease the amplitude in steps of 5 dB's until it is -40 dBm

At the bottom of the Normal path dynamic range (-40 dBm for the E9323A and E9327A) it is observed that the reading on the power meter fluctuates from the expected value. However if the sensor is changed to the Average Only path, the power meter will display a stable, accurate power reading to -60 dBm.

Change the power meter to the Average Only path is as follows:

Instructions	Keystrokes
1. Change the sensor mode to the Average Only path	**[Channel]**, use the arrow keys to highlight **'Sensor Mode: Normal'**, **{Change}**, use the arrow keys to select **'AVG only'**, **{Enter}**, **{Done}**

GSM900 Dynamic Range Power Measurement.
Measure the useful dynamic range for a GSM900 signal:

Instructions	Keystrokes
1. Set up GSM900 format for the EPM-P power meter and E4433B	(Refer to Section 3.1)
2. Trace setup	**[Channel]**, **{Trace Setup}**, use the arrow keys to highlight 'Min:', **{Change}**, use the arrow keys to enter **'-40'**, **{dBm}**, **{Done}**, **{Done}**
3. Setup external trigger	**[Trigger]**, **{Settings}**, **{Source}**, **{Ext}**
4. Connect a BNC cable to the 'TRIG IN' port on the rear panel of the power meter	

To illustrate the sensitivity of the sensor for GSM900 power measurements using an external trigger, the E4433B is set as follows:

It can be noted that the power meter will give a stable reading for this setup as low as –35 dBm.

Instructions	Keystrokes
1. Connect the BNC cable to the 'Event 1' port on the rear panel of the E4433B	
2. Set up incremental step for the amplitude	**[Amplitude]**, **[Incr Set]**, use the numerical keypad to enter **[5]**, **{dB}**
3. Decreasing the amplitude from 0 dBm to -35 dBm in 5 dB steps	**[Amplitude]**, use the down arrow key to decrease the amplitude in steps of 5 dB's until it is -35 dBm

Appendixes

Appendix A

Power Meter and Sensor Compatibility

	EPM-P Power Meters	EPM Power Meters	11730 Sensor cables	E9288 Sensor cables
8480 Power Sensors	Yes	Yes	Yes	Yes
E4412A/13A Sensors	Yes	Yes	Yes	Yes
E9300 Power Sensors	Yes	Yes	Yes	Yes
E9320 Power Sensors	Yes	No	No	Yes

Appendix B

Pre-defined Setup Measurements

DEFAULT Default displays the average power as a single numeric value in the upper window and an analog display in the lower window. The frequency is set to 50 MHz, thus matching the Power Ref.

GSM900 GSM (Global System for Mobile communication) is the industry standard for digital cellular systems. Measurement started by detecting the GSM RF burst using the internal RF level trigger. Time-gating is used to measure the average power in the RF burst.

EDGE EDGE (Enhanced Data for Global Evolution) is an enhancement of the GSM standard and may evolve to be part of the 3-G systems. As EDGE does not have constant amplitude GSMK modulation like GSM, the peak-to-average ratio is of interest. Detecting the EDGE RF burst using the internal RF level trigger starts measurement. Time-gating is used to measure the average power in the timeslot and the peak-to-average ratio in the RF burst.

NADC NADC (North American Digital Cellular) is a digital radio format currently being used through many parts of North America, South America and Canada. It uses TDMA as its transport mechanism. Detecting the RF burst using the internal RF level trigger starts measurement. Time-gating is used to measure the average power in each active time slot.

Bluetooth™ *Bluetooth™* is a specialized communications method for short-range connection between smart phones, computers and personal communications devices. Measurement is to be started by detecting the *Bluetooth™* RF burst using the internal RF trigger. Time-gating is used to measure the peak and average power in a single DH1 data burst, which lasts for 366us. The DH1 burst does not occupy a full *Bluetooth™* timeslot, which lasts for 625us.

cdmaOne CDMAone is a digital cellular communications format that uses CDMA as its transport mechanism. CDMA is an air interface that assigns a code to each data packet sent over the air. It has a bandwidth less than 1.5 MHz. Detecting a CDMA signal using the internal RF trigger starts measurement. Time-gating is used to measure the average power, peak power and peak-to-average ratio of CDMAone signal is measured, this will give an indication of how CDMA channel loading affects peak and power distribution.

Appendix B

Pre-defined Setup Measurements continued

W-CDMA	W-CDMA (Wideband Code Division Multiple Access) is a third generation cellular standard largely based upon GSM, but which used a code division multiple access air interfaces. This technology will be especially well suited to data transmission for services such as WAP based Internet use. It has a bandwidth less than or equal to 5 MHz. Detecting a 3 GPP signal using the internal RF trigger triggers the measurement. The average, peak, and peak-to-average ratio of a W-CDMA signal will be measured.
cdma2000	Is similar to W-CDMA, with the difference being that cdma2000 has a modulation bandwidth of less than or equal to 4 MHz. It is setup to measure the average, peak and peak-to-average ratio of a cdma2000 signal.
iDEN	iDEN (integrated Digital Enhanced Network) is a technology that offers advanced capabilities by bringing together dispatch radio, cellular telephony and short message service. Detecting the iDEN training burst using the internal RF level trigger starts measurement. Time-gating is used to measure the average and peak-to-average power in the data pulse (15 ms). A 90 ms frame is also captured to measure the average power in the entire frame.

Appendix C

Error Messages

If an error occurs while using the EPM-P power meter an error message will appear in the upper right hand corner of the display. To access the error press **[System]**, **{Error List}**. This will show the error that has occurred. If there is more than one error, they can be viewed by pressing **{Next}**. Once all the errors have been viewed press **{Clear Errors}** to clear the memory. To return to the setup display press **{Done}**.

Appendix D

Trigger Settings

The settings allow the user to specify the following:

{Source}	Internal **{Int}** or external **{Ext}** (i.e. triggered via the Ext Trig input or a remote command).
{Mode}	Autolevel **{AutoLvl}** or Normal **{Norm}**. *Note:* **{Norm}** *allows you to choose the RF power level transition used as a trigger.*
{Level}	Use the arrow keys to enter the trigger level desired. Once the level has been entered press **{dBm}**. *Note:* **{Level}** *is only available when* **{Norm}** *has been selected.*
{Delay}	The delay time is the time applied between the trigger event and all the gate start times. This allows you to time-shift all the gates by the same amount with one setting change. Use the arrow keys to enter the delay time, select the time units **{s/ms/us}**.
{Slope}	This can be toggled between rising **{+}** and falling **{-}** slope, determining whether the meter will trigger on the rising or falling edge of the signal.
{Holdoff}	Holdoff is the period of time for which the trigger is inactive (i.e. the time before another trigger can be accepted). Use the arrow keys to enter the holdoff time, select the time units **{s/ms/us}.**
{Hysteresis}	Hysteresis is used to help generate a more stable trigger by preventing triggering unless the RF power level achieves the trigger level and the additional hysteresis value. Use the arrow keys to enter the hysteresis, once entered press **{dB}**.
{Output}	A TTL level high is produced at the rear panel TRIG OUT BNC connector when the power meter is triggered when ‘On’ is configured. Can be toggled between **{On}** and **{Off}**.

Appendix E

Measurement setup and display

The EPM-P power meter can measure average, peak and peak-to-average power. The flexible user interface allows you to perform and display up to four simultaneous time-gated measurements. The measurement can be shown as either numeric, analog, or trace. Time-gated measurements, each gate can be set up to measure the average, peak, or peak-to-average ratio, and you can set individual start and duration times for each measurement. This feature is extremely useful for measuring power on TDMA signals that require time-gating of various combinations of peak and average power.

It can be configured to show up to four numeric measurements as illustrated in Figure 12.

The screen size can be changed from windowed, expanded or full-screen for a selected numeric measurement. This is achieved by using the **Display up/down** keys to highlight the numeric measurement to be viewed and toggling between the different screens using the **Display Split Screen** key.

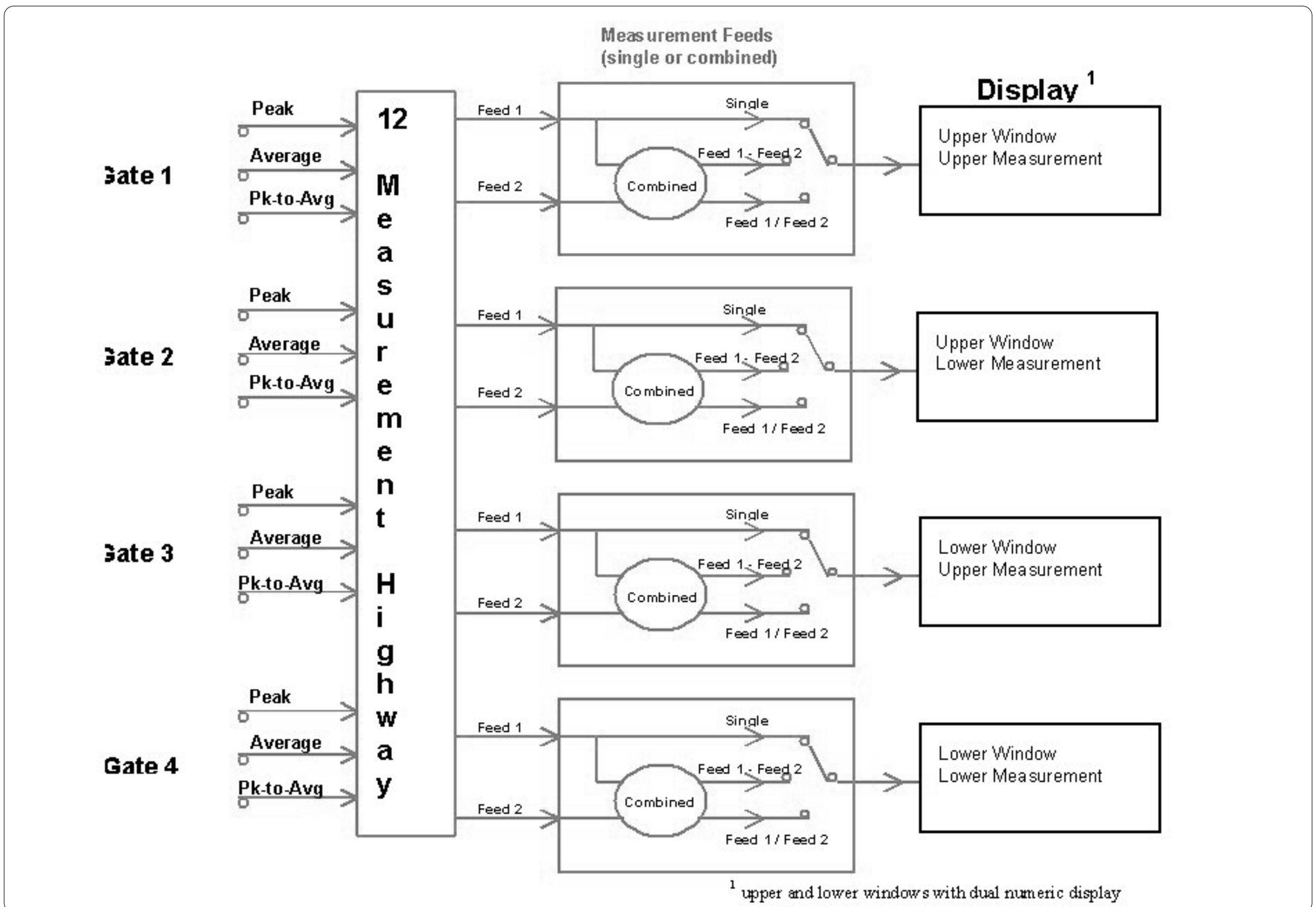


Figure 12

Appendix F

Video Bandwidth versus Peak Power Dynamic Range

The power measurement system, comprising the sensor and meter, has its maximum video bandwidth defined by the E9320 sensor. To optimize the system's dynamic range for **peak power measurements**, the Video bandwidth in the meter can be set to **High**, **Medium** and **Low**, as detailed in the following table. The filter video bandwidths stated in the table are not the 3 dB bandwidths as the video bandwidths are corrected for optimal flatness. A filter **OFF** mode is also provided.

Video Bandwidth versus Peak Power Dynamic Range:

Sensor model	Video Bandwidth / Max. Peak Power Dynamic Range OFF	High	Medium	Low
E9321A/E9325A	300 kHz/-40 dBm to +20 dBm	300 kHz/-42 dBm to +20 dBm	100 kHz/-43 dBm to +20 dBm	30 kHz/-45 dBm to +20 dBm
E9322A/E9326A	1.5 MHz/-36 dBm to +20 dBm	1.5 MHz/-37 dBm to +20 dBm	300 kHz/-38 dBm to +20 dBm	100 kHz/-39 dBm to +20 dBm
E9323A/E9327A	5 MHz/-32 dBm to +20 dBm	5 MHz/-32 dBm to +20 dBm	1.5 MHz/-34 dBm to +20 dBm	300 kHz/-36 dBm to +20 dBm

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