ML248xA / ML249xA

Wideband Peak Power Meter

Operation Manual

ML2487A and ML2488A software release 2.00
ML2495A and ML2496A software release 2.00
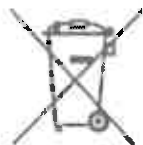
/Inritsu

Crossed-out Wheeled Bin Symbol

Equipment marked with the Crossed-out Wheeled Bin Symbol complies with the European Parliament and Council Directive 2002/96/EC (the "WEEE Directive") in European Union.

For Products placed on the EU market after August 13, 2005, please contact your local Anritsu representative at the end of the product's useful life to arrange disposal in accordance with your initial contract and the local law.

Warranty

The Anritsu product(s) listed on the title page is (are) warranted against defects in materials and workmanship for one year from the date of shipment. Anritsu's obligation covers repairing or replacing products that prove to be defective during the warranty period. Buyers shall prepay transportation charges for equipment returned to Anritsu for warranty repairs. Obligation is limited to the original purchaser. Anritsu is not liable for consequential damages.

Limitation of Warranty

The foregoing warranty does not apply to Anritsu connectors that have failed due to normal wear. Also, the warranty does not apply to defects resulting from improper or inadequate maintenance by the buyer, unauthorized modification or misuse, or operation outside of the environmental specifications of the product. No other warranty is expressed or implied, and the remedies provided herein are the buyer's sole and exclusive remedies.

Notice about Documentation

Anritsu has prepared this manual for use by Anritsu personnel and customers as a guide for the proper installation and operation of Anritsu equipment and computer programs.

The drawings, specifications, and information contained herein are the property of Anritsu. Any unauthorized use or disclosure of these drawings, specifications, and information is prohibited; they shall not be reproduced, copied, or used in whole or in part as the basis for manufacture or sale of the equipment or software programs without the prior written consent of Anritsu Limited.

Trademark Acknowledgements

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Safety Symbols

To prevent the risk of any personnel injury or loss related to equipment malfunction, Anritsu uses the following symbols to indicate safety-related information. For your own safety, please read this information carefully BEFORE operating the equipment.

Symbols Used in This Manual

Danger   Indicates a very dangerous procedure that could result in serious injury or death if not performed properly.

Warning   Indicates a hazardous procedure that could result in serious injury or death if not performed properly.

Caution   Indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and In Manuals

Some or all of the following five symbols may be used on Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE operating the equipment.

This symbol indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This symbol indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

This symbol indicates warning or caution. The contents are indicated symbolically in or near the triangle.

This symbol indicates a note. The contents are described in the box.

These symbols indicate that the marked part should be recycled.

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For Safety

Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If operation is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.

Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

When supplying AC power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

or

WARNING ⚠

The operator cannot repair this equipment. DO NOT attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Declaration of Conformity (ML248xA)

Manufacturer's Name: Anritsu Limited European Measurement Division

Manufacturer's Address: Rutherford Close
Stevenage, Hertfordshire
United Kingdom

declares that the product specified below:

Product Name   :   Peak Power Meter

Model Number   :   ML2487A / ML2488A

conforms to the requirements of:

EMC Directive 89/336/EEC as amended by the Council Directive 92/31/EEC & 93/68/EEC
Low Voltage Directive 73/23/EEC as amended by Council directive 93/68/EEC

Electromagnetic Interference:

EN61326:1997 + Amd 1:1998 Class A

EN61000-3-2:2000

EN61000-3-3:1995

Electrical Safety Requirement:

Product Safety: EN61010-1:2001

Anritsu Limited   26th Nov. 2003

Date   Nick Orchiston, Quality Assurance Manager

European Contact:- For Anritsu product EMC & LVD information contact Anritsu Limited, EMD, Wiltron House, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438 740202)

Declaration of Conformity (ML249xA)

Manufacturer's Name: Anritsu Limited European Measurement Division

Manufacturer's Address: Rutherford Close
Stevenage, Hertfordshire
United Kingdom

declares that the product specified below:

    Product Name   :   Power Meter

    Model Number   :   ML2495/6A

conforms to the requirements of:

    EMC Directive 89/336/EEC as amended by the Council Directive 92/31/EEC & 93/68/EEC
    Low Voltage Directive 73/23/EEC as amended by Council directive 93/68/EEC

Electromagnetic Interference:

    EN61326:1998 + A1 + A2 + A3

      EN61000-3-2:2000

      EN61000-3-3:1995

Electrical Safety Requirement:

Product Safety: EN61010-1:2001

Anritsu Limited   <u>19th Sept. 2005</u>

                Date   Nick Orchiston, Quality Assurance Manager

European Contact:- For Anritsu product EMC & LVD information contact Anritsu Limited, EMD, Wiltron House, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438 740202)

Table of Contents

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Chapter 1. About this Manual

This chapter provides:

- Scope of information covered in this manual and contact address for your comments.

- A summary of, and links to, each of the chapters in the manual.

- A list of associated documentation and resources.

- An explanation of the notation conventions used in this document.

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Purpose and Scope of this Manual

This manual provides set-up and operational information for the ML2487A / ML2488A and ML2495A / ML2496A Peak Power Meters. Explanations in this manual apply equally to all units mentioned above unless otherwise stated.

The structure of this manual is designed to reflect the sequence of steps that the user will go through after receiving the unit; from unpacking and initial inspection, through setup, and to testing.

Your Comments on this Manual

Every effort has been made to ensure that this manual is thorough, easy to use, and free from errors. However, to ensure continued improvement, we would welcome your comments on this, or any other Anritsu document.

Please contact us at the address below if you have any comments, good or bad, find any errors or omissions, or have any suggestions on how our documentation could be improved further.

powermeter.support@eu.anritsu.com

Your comments will be logged and reviewed, and whenever possible, will be reflected in a subsequent release of the document.

Software Versions

This manual provides details of the operation and functionality of the following software versions:

ML2487A: 2.00   ML2495A: 2.00

ML2488A: 2.00   ML2496A: 2.00

Some of the features documented in this manual may not be available to users of software versions prior to 2.00. To check the version of the software you are using, power up the unit and press System > Service > Identity. Details of how to upgrade the software can be found in chapter 5 of this manual in the section titled, *Upgrading the System Software.*

Notification of Software Release

The ML248xA / ML249xA software is periodically updated as new features are added to meet market demands. To receive automatic notification of software releases, send a blank e-mail with the subject heading of "ML248xA / ML249xA Software Notification Request" to powermeter.support@eu.anritsu.com. You will receive an e-mail informing you that the new software is available for download from the site identified.

Using this Manual

Users are advised to read through this manual in its entirety before operating the power meter. The manual should be kept with the unit for reference purposes thereafter.

A brief summary of each of the chapters is given below. If you are viewing the electronic version of this manual you can click on the chapter headings below to jump to the chapter in question.

Associated Documentation and Resources

In addition to this manual, the following documents and resources are available on the CD shipped with the power meter.

Documents	File type
ML248xA / ML249xA Wideband Peak Power Meter Remote Programming Manual (English edition)	PDF
ML248xA Datasheet	PDF
ML249xA Datasheet	PDF
ML2400A Datasheet	PDF
Power Meter Uncertainty Calculator (for ML24x0A)	XLS
High Speed Measurements on Modulated Signals (Application Note for ML248xA)	PDF
Measuring Pulsed Power and Frequency (Application Note for ML248xA)	PDF
WLAN Output Power Measurement (Application Note for ML248xA)	PDF
Accurate Power Measurements on Modern Communication Systems (Application Note for ML24x0A)	PDF
How to Upgrade the Software	PDF
Power Added Efficiency application note	PDF
Measuring pulsed signals with the ML249xA	PDF
Measuring OFDM signals	PDF
Utilities	File type
Screen Capture executable and instructions	EXE
Power suite	EXE
Data logger	EXE

The pdf files listed above can be viewed using Adobe Reader™ a freeware program that can be downloaded from http://www.adobe.com/.

Notation Conventions Used in this Manual

The following conventions have been adopted in this manual.

Channel	Hard keys on the unit are enclosed in a box with a grey background.
Set Up	Soft keys that display on the screen are enclosed in a box with a white background. Pressing a soft key provides access to menu options, toggles selections and allows data entry.
[Exit]	The text that appears on or beneath the keys on the numeric keypad is enclosed in square brackets.
[Channel Set Up]	The titles of input dialogs that appear on the screen are enclosed in square brackets.
"Meas display"	Items or text that display within the main body of the screen are enclosed in quotation marks.
ML248xA	Used throughout this manual to refer to both the ML2487A and the ML2488A power meters.
ML249xA	Used throughout this manual to refer to both the ML2495A and the ML2496A power meters.
>	A chevron (>) is occasionally used to indicate that the user should select the items or keys in sequential order.

Note: Notes are separated from the main body of the text in this manner.

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Chapter 2. Product Overview

This chapter provides:

- Details of ML248xA / ML249xA features.

- A list of power meter options.

- Associated sensors and sensor accessories.

- An overview of associated Anritsu products.

About the ML248xA / ML249xA Peak Power Meter
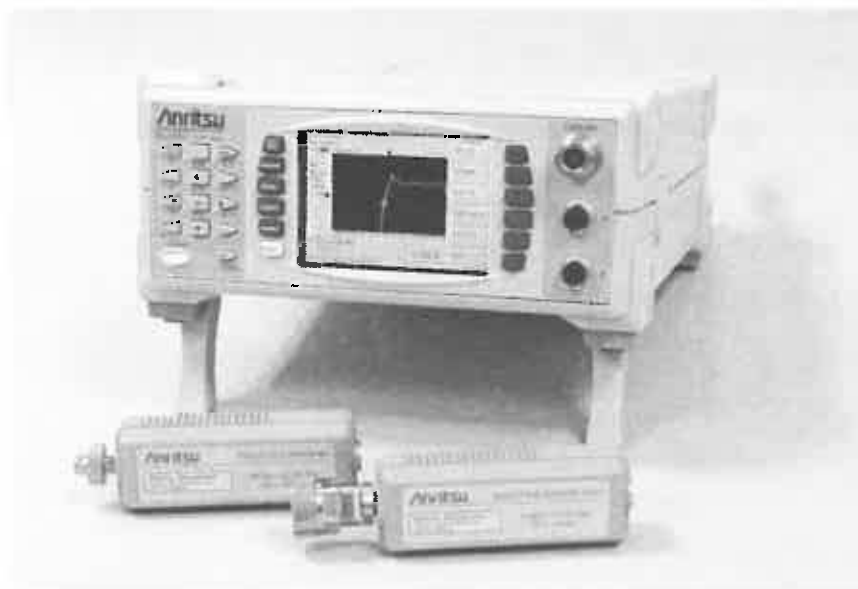
The ML248xA / ML249xA is a wideband peak power meter for the 3G and radar pulse measurement market. It is the ideal product for performing accurate measurements on pulsed and modulated systems.

Model Types

Four models of the peak power meter are available:

ML2487A: Single input peak power meter (20 MHz bandwidth)

ML2488A: Dual input peak power meter (20 MHz bandwidth)

ML2495A: Single input peak power meter (65 MHz bandwidth)

ML2496A: Dual input peak power meter (65 MHz bandwidth)

Features

Ease of operability

Both the ML248xA and ML249xA incorporate a host of features to make setup and operation as simple as possible. There are predefined and configurable presets, 20 settings stores, multiple independently or repeated gates, 4 independent markers for denoting points of interest on the profile, and user configurable templates.

Dual channel display

Both the ML248xA and ML249xA support dual display channels. Each display channel is a measurement set up and can use any selection or combination of the sensor inputs. The instrument can be configured to view one display channel or two and can be switched between display channels quickly and simply via the CH1/CH2 hard key on the front panel.

Large colour display with graphical MMI

The quarter VGA high-resolution colour display is ideal for profiling and other complex sequences.

Video output

The ML249xA has a video connector on the rear panel as standard and can be connected to a standard VGA monitor. The power meter can be located remotely in a test rack and the video screen located close to where the adjustments are taking place.

Enhanced Measurement Bandwidth

On the ML248xA, the 20 MHz bandwidth is ideal for accurate WLAN, WCDMA and Radar measurements, and removes the need for post-measurement accuracy calculations. On the ML249xA, the mainframe has 65 MHz bandwidth that is wide enough for accurate rise time measurements on radar signals, or for measuring the peak signal of the latest 4G OFDM signals. The ML249xA settable resolution on time based measurements from 50ns to 3.2µs is 1ns

Two sampling modes

For time durations up to 3.2 µs, the ML249xA has a continuous sample rate. This can be set either automatically or the sample rate can be adjusted directly by the user. For time durations of 50 ns to 3.2 µs the power meter uses random repetitive sampling to build up the trace to 1 ns settable display resolution. Changeover between these two modes is performed automatically.

High speed sampling

Sampling of up to 64 MS/s (ML248xA) / 62.5 MS/s (ML249xA) is ideal for WCDMA, Radar, EDGE, and WLAN measurements.

Compatibility

The power meter is compatible with all MA2400A/B sensors used on the existing Anritsu power meter range.

Remote interface

The ML248xA and ML249xA support both the GPIB and RS232 interfaces.

Secure mode

The power meter has a secure mode for operations in security sensitive areas. Once activated, the secure mode erases all information stored in the non volatile RAM on power up.

Options and Accessories

Option	Details
ML2400A-01	Rack Mount, single unit
ML2400A-03	Rack Mount, side by side
ML2400A-05	Front Bail Handle
ML2480A-06	Rear Mount input A
ML2480A-07	Rear Mount Input A and Reference
ML2480A-08	Rear Mount inputs A, B and Reference
ML2480A-09	Rear Mount Inputs A and B
ML2490A-06	Rear Mount input A
ML2490A-07	Rear Mount Input A and Reference
ML2490A-08	Rear Mount inputs A, B and Reference
ML2490A-09	Rear Mount Inputs A and B
ML2400A-12	Front Panel Cover
ML2480A-15	1GHz calibrator for MA2411A sensor (ML248xA only)
ML2400A-20	Spare 1.5 m Sensor Cable
ML2400A-21	0.3 m Sensor Cable
ML2480A-33	Extra Operating manual
ML2480A-34	Extra Remote Programming Manual
ML2480A-35	Extra Operating manual Japanese
ML2480A-36	Extra Programming Manual Japanese
ML2480A-98	Additional calibration information formatted in accordance with the standards Z540 and ISO Guidelines 25.
ML2480A-99	A complete set of production test results. These are of particular use to customers wishing to observe calibration trends over the calibration interval of the instrument.
760-209	Hard Side Transit Case
D41310	Soft Carry Case with Shoulder Strap
MA2418A	50 MHz Reference Oscillator & Power Supply
ML2400A/28	Boot Load Cable
ML2480A-37	Electronic Manuals Only
2300-269	Electronic Manuals CD ROM
15000-00042	ML248xA Data Sheet
ML2419A	Range Calibrator
MA2497A	HP8480 series sensor adapter

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Associated Sensors

The following sensors, sensor options, and sensor accessories are available for use with the ML248xA / ML249xA.

Power Sensors (-70 to + 20 dBm)
Fast diode sensors

Model No.	Range
MA2468D	10 MHz – 6 GHz
MA2469D	10 MHz – 18 GHz
	(–60 to +20 dBm, nominal bw 1.4 MHz)

Standard sensors

MA2472D	10 MHz – 18 GHz
MA2473D	10 MHz – 32 GHz
MA2474D	10 MHz – 40 GHz
MA2475D	10 MHz – 50 GHz

Thermal Sensors (-30 to + 20 dBm)

Model No.	Range
MA2421D	100 kHz – 18 GHz
MA2422D	10 MHz – 18 GHz
MA2423D	10 MHz – 32 GHz
MA2424D	10 MHz – 40 GHz
MA2425D	10 MHz – 50 GHz

High Accuracy Sensors (–64 to +20 dBm)

Model No.	Range
MA2442D	10 MHz – 18 GHz
MA2444D	10 MHz – 40 GHz
MA2445D	10 MHz – 50 GHz

Universal Power Sensor

Model No.	Range
MA2481D	10 MHz – 6 GHz
MA2480/01	Add Fast CW
MA2482D	10 MHz – 18 GHz

Wideband Sensor (-60 to +20 dBm)

Model No.	Range
MA2491A	50 MHz – 18 GHz
MA2490A	50 MHz – 8 GHz

Pulse Sensor

Model No.	Range
MA2411B	500 MHz – 40 GHz

Sensor Options

Model No.	Range
MA2400A-10	Extra Cal Factor Freq., 0.01 – 40 GHz

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Note: Sensors MA2411B, MA2490A, and MA2491A can only be used with cable options ML2400A-20 and ML2400A-21. Sensor MA2411B requires the use of option 15 1GHz calibrator (ML248xA only). Sensor versions A-C are also fully compatible with both the ML248xA and ML249xA.

Sensor Accessories

ML2400A-20	1.5 m Sensor Cable
ML2400A-21	0.3 m Sensor Cable
ML2400A-22	3 m Sensor Cable
ML2400A-23	5 m Sensor Cable
ML2400A-24	10 m Sensor Cable
ML2400A-25	30 m Sensor Cable
ML2400A-26	50 m Sensor Cable
ML2400A-27	100 m Sensor Cable
ML2400A-29	Bulkhead Adapter
1N75C	5 Watt Limiter, 0.01 – 3 GHz, Nm-f, 75 Ω
1N50C	5 Watt Limiter, 0.01 – 18 GHz, Nm-f, 50 Ω
1K50A	5 Watt Limiter, 0.01 – 20 GHz, Km-f, 50 Ω
1K50B	3 Watt Limiter, 0.01 – 26 GHz, Km-f, 50 Ω
42N75-20	5 Watt Attenuator
42N50-20	5 Watt Attenuator, Nm-f, DC-18 GHz, 20 dB, 5 W, 50 Ω
42N50-30	50 Watt Attenuator, Nm-f, DC-18 GHz, 30 dB, 5 W, 50 Ω
42KC-20	5 Watt Attenuator, Km-f, DC-40 GHz, 20 dB, 5 W, 50 Ω
MA2497A	HP8480 series sensor adapter

Associated Products

Power Meter (Universal) ML243xA series

The ML2400A series Power Meters combine the advantages of thermal meter accuracy, diode meter speed, and peak power meter display graphics. The result is a single instrument that achieves 90 dB dynamic range with a single sensor. The ML2400A-series includes graphics display capability as a standard feature. The rugged housing and optional, high-capacity NiMH battery bring convenience and accuracy to field service applications.

MS268xA Series Spectrum Analyser

The MS268x is a high-performance Portable Spectrum Analyser Family with wide dynamic range, wide Resolution Band width and high sweep speeds required for evaluation of next-generation (IMT-2000) broadband mobile communications systems and devices.

Chapter 3. Assembly and Connections

This chapter provides:

- Details of how to inspect the power meter upon delivery.
- A list of shipped items.
- Details of how to store and repack the power meter.
- Rack mounting details and illustrations.
- Power and environmental requirements.
- Details of rear panel connections.

Initial Inspection

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the list of shipped items and the instrument has been checked for mechanical and electrical operation.

If the power meter is damaged mechanically, notify your local sales representative or Anritsu Customer Service Center. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Anritsu. Retain the shipping materials for the carrier's inspection.

Shipped Items

Your ML248xA / ML249xA power meter is shipped with the following items. Check that all listed items are present, and contact Anritsu if they cannot be found.

Item	Part number	Quantity supplied
Peak power meter	ML2487A, ML2488A, ML2495A, ML2496A	1
Line power cable	Country dependent: Australia: 800-239 UK: 800-428 US / Japan: 800-427 EU: 800-429	1
Power sensor cable	D41346-2	ML2487A / ML2495A: 1 ML2488A / ML2496A: 2
Operation Manual	13000-00162	1
Remote Programming Manual	13000-00163	1
Utility CD	2300-269	1

Storage and Repackaging

Follow the instructions in this section if, for any reason, it is necessary to repackage, store, or ship your power meter.

Preparation for Storage

Prepare the power meter for storage by cleaning the unit and packing it with moisture-absorbing desiccant crystals.

Environmental Requirements

Store the unit in a temperature controlled environment that is maintained between -40 and +70 degrees C, with a maximum humidity of 90% at 40 degrees C, non-condensing.

Preparation for Shipment

1. To provide maximum protection against damage in transit, the power meter should be repackaged in the original shipping container. If this container is no longer available obtain a corrugated cardboard carton with a 125 kg (275 pound) test strength. This carton should have inside dimensions of no less than six inches larger than the instrument dimensions to allow for cushioning.

2. Wrap the instrument to protect the finish.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument. Provide at least three inches of dunnage on all sides.

4. Seal the carton using either shipping tape or an industrial stapler.

5. If the instrument is being returned to Anritsu for service, mark the address of the appropriate Anritsu service center (refer to the address at the back of this manual), the Return Materials Authorization (RMA) number, and your return address on the carton in a prominent location.

Rack Mounting

The ML248xA / ML249xA can be ordered with rack mounting hardware that allows the instrument to be mounted into a standard 19-inch equipment rack. There are two rack mount option kits available.

The ML2400A-01 Rack Mount option allows the installation of a single ML248xA / ML249xA in either the left or right side rack position.

The ML2400A-03 Rack Mount option allows side-by-side mounting of two ML248xA / ML249xA Test Sets.

Single Unit Rack Mounting (Option 01)

This section describes the assembly procedure for fitting a single ML248xA / ML249xA into an instrument rack. The universal top and bottom covers have removable feet to allow the rack mount kit to be fitted. The procedure involves fitting the support bracket, front plate, base panel, and a rear support bracket to the ML248xA / ML249xA. The ML248xA / ML249xA can then be loaded and secured in the rack position.

Kit Parts List

Anritsu No.	Description	Quantity	Max Torque Setting
50077	Front face plate	1	
900-848	M4, kep nut.	2	14 lbf.in [158 cNm]
790-319	Speed nut	4	
900-345	#4, sst, washer, flat	8	
900-821	Decorative screw	4	
905-68	M3x8, pos, sst, patchlock, screw, metric, pan head.	8	4 lbf.in [45 cNm]
788-575	Snap rivet, plastic	6	
C37276	Rack mount, side, bracket	1	
C41449	Rear support, bracket, rack mount	1	
D41473	Rack mount, support bracket	1	
49361	Bracket support, base panel	1	
ML248xA / ML249xA	Fitted with universal top and bottom covers with removable feet.	1	
50210	Foot removal tool	1	

Tools Required

1 Small Phillips screwdriver

1 Large Phillips screwdriver

1 Small Phillips torque screwdriver 0 cNm to 50 cNm

1 Torque socket driver 10 cNm to 120 cNm

1 Foot removal tool (supplied)

1 Assembly drawing "ML248xA/01 Rack Mounted left or right option"

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Assembly Procedure

1. Confirm the correct tools are available, the parts listed above are present and the assembly drawing is at hand.

2. Remove all feet from the ML248xA / ML249xA using the tool supplied. See diagram and notes on the following pages.

3. Lay the large support bracket D41473 next to the ML248xA / ML249xA as per the assembly drawing. If the instrument needs to be mounted on the left side of the rack, lay the bracket on the right side. i.e. a mirror image of the assembly drawing.

4. Locate the support bracket on to the four case pillars. Secure with 4 screws 905-68 and 4 washers 900-345. See max. torque setting above. Leave the two rear screws loose to allow alignment, location, and securing of the 6 base plate snap rivets 788-575.

5. Locate the front rack mounting bracket C37276 at the front of the instrument on the other side to the large support bracket with two screws 905-68 and two washers 900-345. See max. torque setting above.

6. Locate the rear rack bracket C41449 at the back of the instrument on the other side to the large support bracket with two screws 905-68 and two washers 900-345. See max. torque setting above.

7. Fit the front face plate 50077 with 2 kep nuts 900-848. See max. torque setting above.

8. Position the base panel 49361 as shown in the drawing, and secure with 6 snap rivets 788-575.

9. Fit the four speed nuts 790-319 to the rack in the correct place to allow mounting of the instrument in the rack.

10. Slide the instrument into the rack and secure with 4 decorative screws 900-821.
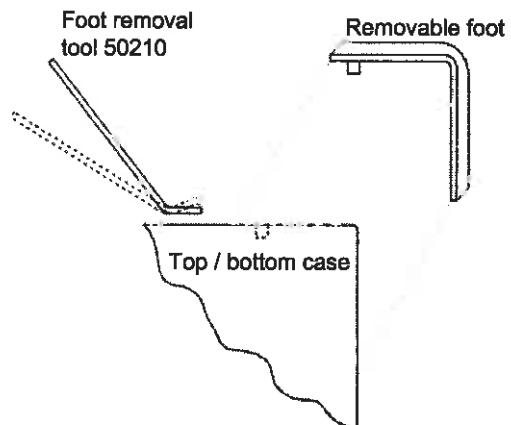
Foot removal
tool 50210   Removable foot

Top / bottom case

Foot removal

1. To remove feet. Locate the removal tool into the recess of each foot located on the top and bottom faces of the covers.

2. Once the removal tool has been located in the foot recess, apply gentle pressure downward. This will release the foot.

3. To replace the feet, simply locate the peg into the recess and press down. The foot will now snap on.

905-68
SCREW M3x8
8 POSITIONS

900-345
WASHER PLAIN M3

C41449
REAR RACKMOUNT SUPPORT BRACKET

C37276
SIDE RACKMOUNT BRACKET

50077
FRONT FACE PLATE

788-575
SNAP RIVET
6 POSITIONS
PRESS DOWN CENTER PIN
USING A FLAT EDGE

D41373
SUPPORT BRACKET

900-848
KEP NUT
2 POSITIONS

FIT COMPLETED ASSEMBLY TO RACK
USING DECORATIVE SCREW 900-821 x4
AND SPEED NUT 790-319 x4
IN 4 CORNER POSITIONS AS SHOWN

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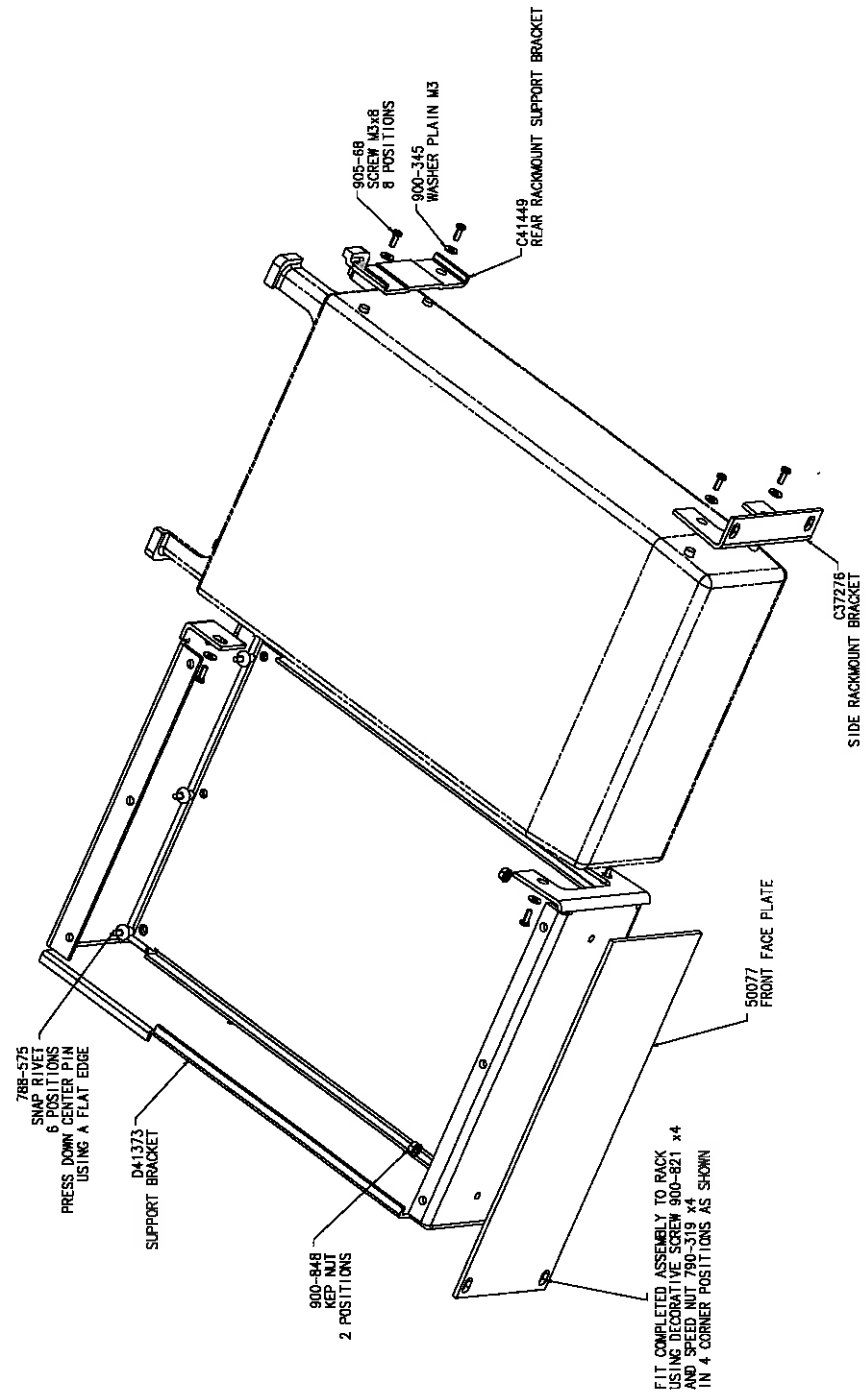
Side-by-Side Rack Mounting (Option 03)

This section describes the assembly procedure for fitting two ML248xA / ML249xA units into an instrument rack. The universal top and bottom covers have removable feet to allow the rack mount kit to be fitted. The procedure involves fitting support brackets and two rear support brackets, one to each unit.

Kit Parts List

Anritsu No	Description	Quantity	Max.Torque Setting
790-319	Speed nut	4	
900-345	#4, sst, washer, flat	16	
900-821	Decorative screw	4	
905-68	M3 x 8, pos, sst, patchlock, screw, metric, pan head.	16	4lbf.in [45cNm]
905-69	M3 x 6, pos, sst, patchlock, screw, metric, flat head.	4	
900-807	Washer, M4 split	4	
900-806	M4 X 12 mm, screw, pan hd.	2	
905-103	M 3.5 x 8 mm, screw, pan hd.	2	
905-63	M4 x 10mm, screw, flt hd.	4	
49415	Rack mount, side bracket	1	
49413	Rack mount, centre rear bracket	1	
49439	Spacer plate	2	
C37275	Rack mount, centre, FRT, bracket	1	
C37276	Rack mount, side, bracket	1	
C37277	Rack mount, centre, bracket	1	
C37279	Rack mount, centre, bracket	1	
C41449	Rear support, bracket, rackmount	2	
50210	Foot removal tool	1	
ML248xA / ML249xA	Fitted with universal top and bottom covers with removable feet	2	

Tools Required

- 1 Small Phillips screw driver

- 1 Large Phillips screw driver

- 1 Small Phillips torque screwdriver 10 cNm to 120 cNm

- 1 Foot removal tool 50210 (supplied)

- 1 Assembly drawing "ML2480/03 SIDE BY SIDE OPTION"

Assembly Procedure

1. Confirm the correct tools are available, the parts listed above are present and the assembly drawing is at hand.

2. Remove all feet using the tool supplied. See diagram on the following page.

3. On the two sides of the ML248xA / ML249xA to be joined together, fit the two rear brackets 49413, C37279, and two front brackets C37275, C37277 using 8 screws 905-68 and 8 washers 900-345. See max. torque setting above.

4. Slide the two units together and secure using 4 counter sink screws 905-69.

5. Locate the two front rack brackets C37276 and 49415 at the front of each unit, one on each side with four screws 905-68 and four washers 900-345. See max. torque setting above.

6. Locate the two rear rack brackets C41449 at the back of each unit, one on each side with four screws 905-68 and four washers 900-345. See max. torque setting above.

7. Fit the four speed nuts 790-319 to the rack in the correct place to allow mounting of the two units in the rack.

8. Slide the two units into the rack and secure with 4 decorative screws 900-821.

Foot removal
tool 50210

Removable foot

Top / bottom case

Foot Removal:
1. To remove feet. Locate the removal tool into the recess of each foot located on the top and bottom faces of the covers.
2. Once the removal tool has been located in the foot recess, apply gentle pressure downward. This will release the foot.
3. To replace the feet, simply locate the peg into the recess and press down. The foot will now snap on.

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C41449
RACKMOUNT BRACKET
REAR SUPPORT
x2
USE THESE BRACKETS WHEN
FITTING A ML2430A TO
ANOTHER ML2430A POWER METER

900-806 x2
SCREW
900-807 x2
SPLIT WASHER
USE THESE FIXINGS WHEN FITTING A
ML2430A POWER METER OR A MF2412A
COUNTER

C37279
RACKMOUNT BRACKET
CENTER INNER REAR

905-103 x2
SCREW
900-807 x2
SPLIT WASHER
USE THESE FIXINGS WHEN ATTACHING TO AN
AGILENT 3440IA OR OTHER PRODUCT USING
IDENTICAL CASING

49413
RACKMOUNT BRACKET
CENTER REAR

49439
SPACER PLATE x2
USE ON A HP34440IA ONLY WHEN
FITTING TO A ML2430A OR ML2412A,
USE ALSO WITH BRACKET 49415 INSTEAD OF
BRACKET C37276

49415
RACKMOUNT SIDE BRACKET

C37275
RACKMOUNT BRACKET
CENTER FRONT

C37277
RACKMOUNT BRACKET
CENTER INNER FRONT

905-63
SCREW x4
USE IN CONJUNCTION WITH
49439 SPACER PLATE

FIT COMPLETED ASSEMBLY TO RACK
USING DECORATIVE SCREW 900-621 x4
AND SPEED NUT 790-319 IN 4
CORNER POSITIONS AS SHOWN

Power Requirements

The ML248xA / ML249xA Power Meter is operated from an AC power line. The Power Meter is intended as an Installation (Overvoltage) Category II, Insulation Category I device.

At power-on, the power meter will perform a brief power-on self test (POST). If a POST error occurs, information and available options will be displayed on the screen. If the POST is successful, the instrument will load the last used configuration.

Note: If "Secure" mode has been enabled, certain stored values will be cleared when the instrument is switched on.

AC Line Power

The ML248xA / ML249xA Power Meter can operate on AC input power of 85-264V, 47-440 Hz, 80 VA maximum. The Power Meter automatically configures itself for the voltage applied. The AC line input is protected by an internal fuse.

Fuses

The AC input lines are protected by an internally mounted fuse. This fuse should only be changed by qualified service personnel. Replace only with a fuse of the same type and rating (AC fuse, 2A, 250V, slow-blow).

Grounding

The ML248xA / ML249xA Power Meter must be properly grounded. Failure to ground the instrument could be hazardous to operating personnel. The meter is supplied with a three-conductor power cord. The instrument is properly grounded during AC line operation when the plug is connected to a properly installed three-prong receptacle.

Environmental Requirements

The ML248xA / ML249xA Power Meter is designed to operate within the temperature range of 0 to 50 degrees C (32 to 122 degrees F) with a maximum humidity of 90% at 40 degrees C (104 degrees F), non-condensing. Full accuracy is dependent upon the sensor specification. Refer to the sensor manual for details.

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Rear Panel Connections
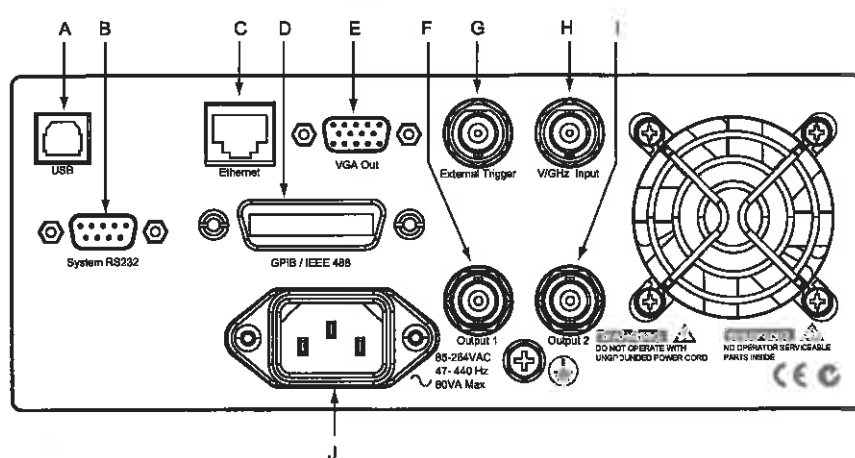
A   **USB connector (ML249xA only)**

Not currently implemented.

B   **RS232 serial connector**

Serial control and data output commands are entered using the same format as the GPIB interface.

C   **Ethernet (ML249xA only)**

Not currently implemented.

D   **GPIB / IEEE488 connector**

Standard General Purpose Interface Bus connector used to connect through GPIB to other test equipment and a host computer. The ML248xA / ML249xA is compatible with IEEE- 488.2 requirements.

E   **VGA Out (ML249xA only)**

For video output to 1/4 VGA external display.

F   **Output 1**

Multi-purpose BNC connector is user configurable for Analog Output 1 (volts/units),or Limits Pass/fail (TTL). Supports pass/fail testing for channel 1. Also configurable to output a real-time measurement signal from sensor input A, suitable for levelling purposes.

G   **Input 1 (Digital)**

Multi purpose BNC connector used as a TTL Trigger Input.

H   **Input 2 (Analog)**

Multi purpose BNC connector used for Volts per GHz connection. Supports 0 to + 20V nominal input voltage with software selectable scaling. V/GHz is used for automatic CAL FACTOR correction by applying an external voltage, scaled to

frequency. The correct calibration factor for this frequency is automatically interpolated and applied when in V/GHz calibration factor mode. Different scaling may be applied to sensor A or B allowing for measurement of frequency translation devices. Available simultaneously with channel A and/or B data, the data rate is as set on the channel. Also used for PAE measurements using a current probe.

I **Output 2**

Multi-purpose BNC connector is user configurable for Analog Output 2 (volts/units),or Limits Pass/fail (TTL). Supports pass/fail testing for channel 2. Also configurable to output a real-time measurement signal from sensor input B, suitable for levelling purposes. Also supports trigger out.

J **AC main power input**

85-264 VAC, 47- 440 Hz, 80 VA maximum. Connecting the AC power puts the instrument into standby mode.

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Chapter 4. Front Panel Layout and Operation

This chapter provides:

- Details of the power-on procedure.
- Illustrations and explanations of the front panel.
- An explanation of the data entry procedure.

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Before attempting to use the ML248xA / ML249xA it is first necessary to understand the layout and basic operation of the front panel. This chapter presents several detailed illustrations of the front panel and explains the operation of each of the component sections in turn.

It is recommended that you read through this chapter whilst identifying each of the component sections and performing the procedures detailed on your power meter. First, follow the procedure below to power on the ML248xA / ML249xA.

Power-On Procedure

1. Ensure that all the required power meter connections have been made as specified in the previous chapter.

2. Press the [On/Standby] button on the numerical keypad.

3. At power-on, the power meter performs a brief power-on self test (POST). After the POST, the instrument loads the most recently used configuration and display settings.

4. If a POST error occurs, information and available options are displayed on the screen. Press the [Clr] hard key to display the main command menu.

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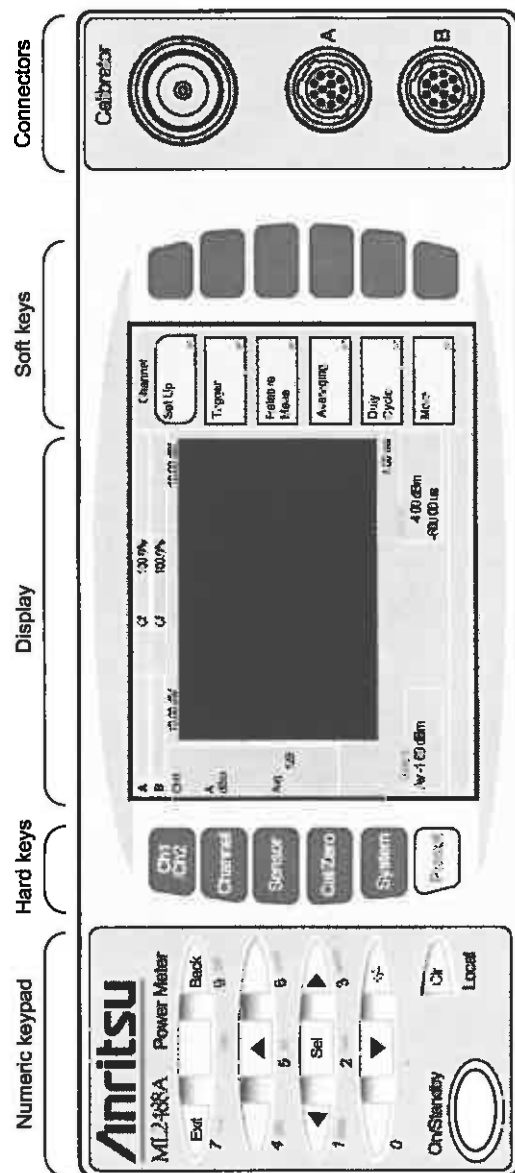
The Front Panel

Note: The illustration above shows the front panel of the ML2488A. With the exception of the model number itself, the front panel of the ML2496A is also identical. The ML2487A and ML2495A models have only one sensor connector.

The Numeric Keypad
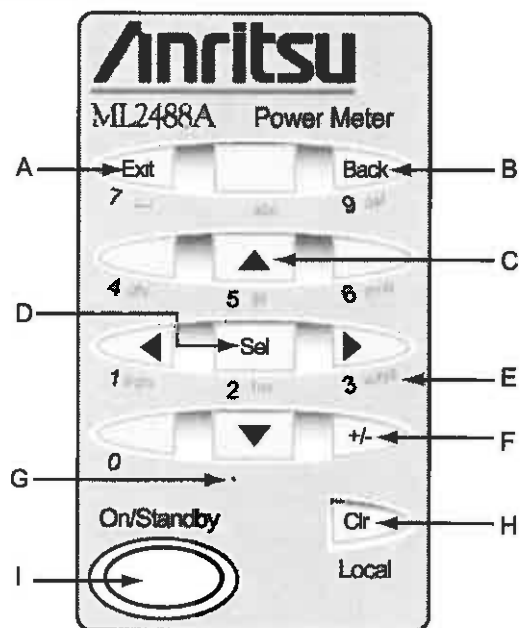
A   **[Exit]**

The [Exit] key is used to close a pop-up dialog and revert to the previous page of commands. Pressing this key when a field in a dialog has been selected for user input will result in entry of the number "7" or the entry of a space if the field is non-numeric.

B   **[Back]**

The [Back] key is used to revert to the previous page of commands. Pressing this key when a field in a dialog has been selected for user input will result in entry of the number "9" or the entry of the letter "d' if the field is non-numeric.

C   **Arrows**

The arrow keys to the top and bottom of the center [Sel] key are used to move vertically between the entry fields in a dialog. The right and left arrows can be used to jump between columns in tables that display within a dialog. The arrow keys can also be used to reposition the active marker.

D   **[Sel]**

The [Sel] key is used to enable an entry field for input by the user. When the [Sel] key is pressed, the field is highlighted in white and a number of underscores are used to indicate the maximum length of permissible entry. Pressing this key when a field in a dialog has been selected for user input will result in entry of the number "2" or the entry of the letter "t, u, v' if the field is non-numeric.

E   **wxyz**

A number and a series of letters appear beneath most of the keys on the numeric keypad. These can be used when an entry field has been selected for user input using the [Sel] key. Refer to the example of text input later in this chapter.

F   **[+/-]**

Used to enter a "+" or "-" symbol in a numerical entry field.

G   **Decimal point**

Used to enter a decimal point in certain fields for numeric entry.

H   **[Clr] / Local**

The [Clr] key is used In a user entry field to delete the letter or number that was last entered. It is also used to revert the unit from remote to local operation.

I   **[On/Standby]**

Used to turn the power meter on and off once the main AC power has been supplied.

The Hard Keys

The hard keys are used to display the associated soft key commands. When a hard key is pressed the commands within that group display next to the soft keys at the right of the screen. The menu items are grouped in to a logical hierarchical structure, a full mapping of which is provided in appendix A at the rear of this manual. When a hard key is pressed, the name of that key displays at the top of the soft key menu. An overview of each of the hard keys is provided below.

Ch1 /Ch2   Used to change the currently active channel. The menu displayed in the menu area is updated to reflect the state of the new active measurement channel.

Channel   Controls channel related functions such as display channel set up, triggering, gating, averaging, and markers.

Sensor   Controls sensor related function such as cal factor settings and offsets.

Cal/Zero   Enables measurement errors to be minimized prior to measurement, and sensors to be zeroed and/or calibrated.

System   Controls system level commands such as the rear panel configuration, security, and software upgrading.

Preset   Allows the user to select and configure predefined configuration and default settings.

The Screen

The screen on the ML248xA / ML249xA can be sub-divided into several sections, each of which is illustrated and explained below.
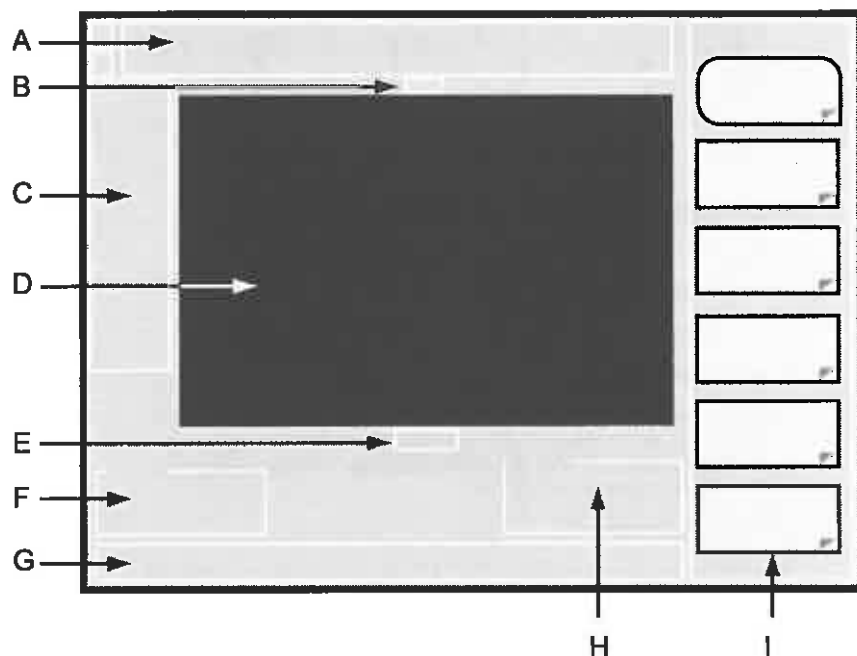
A	Sensor related information.
B	Profile display icon.
C	Channel related information.
D	Area for profile and readout displays.
E	Sample rate display.
F	Gating and statistics related information.
G	Status bar for error message and status reports.
H	Marker and cursor related information.
I	Soft key commands.

Note: The figure above represents the screen when the measurement display setting is set to "Profile". When viewed in "Readout" mode, sections B, E, F, and H are not displayed. Refer to "Selecting the Measurement Display Style" in chapter 5 of this manual.

Sensor Information

Sensor related information displays at the top of the screen (section A in the figure on the previous page). On the ML2487A / ML2495A there is one line of sensor information, and on the ML2488A / ML2496A, a second line is added beneath for sensor input B.
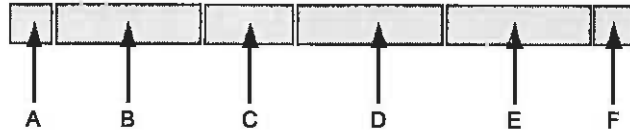
A   **Sensor input letter**

Displays the letter (either A or B) of the associated sensor input.

B   **Sensor model**

Displays the model number of the sensor connected to the input.

C   **Measurement option**

Information is displayed in this section If a Universal sensor with option 1 is connected to the input. If the user has selected the Fast CW measurement option, 'F-CW' displays, otherwise 'T-RMS' displays for the True RMS measurement option.

D   **Cal factor information**

Displays the source and value of the calibration factor being applied to the sensor. The following abbreviations are used to indicated the source of the cal. Factor:

'Cf'   Frequency - the calibration factor is derived from the cal factor table using the input signal frequency.

'Cm'   Manual - the user has set the calibration factor value.

'Cv'   V/GHz - the calibration factor is derived from the cal factor table using the frequency value that is proportional to the voltage on the rear panel input.

E   **Offset Information**

The type of the offset and its value are displayed. The following abbreviations are used to indicate the type of offset:

'Of'   Fixed - the user has set the offset value.

'Ot'   Table - the offset value is derived from the selected offset table.

F   **Held range information**

Information is displayed if the current sensor input is being held to a single operating range.

Channel Information

Channel related information displays at the left of the screen (section C in the main screen overview figure).
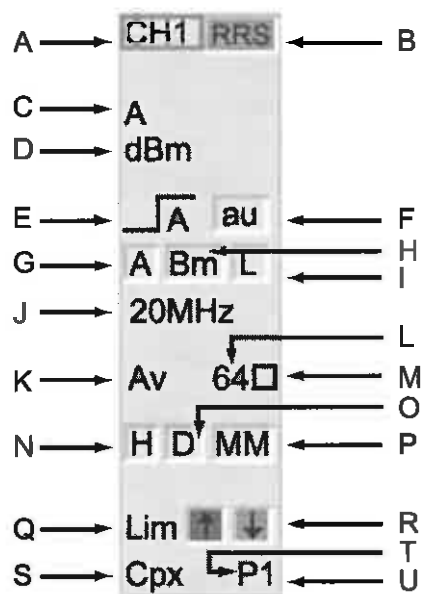
A   **Channel ID (Ch1/ Ch2)**

Used to identify the channel being displayed on the screen.

B   **RRS mode flag (Channel > Trigger > Set Cap Time > Enter value <3.19 μs) (ML249xA only)**

"RRS" (red):   RRS measurement incomplete.

"RRS" (green):   RRS measurement complete.

Blank space: Non-RRS measurement.

C   **Input configuration (Channel > Set Up > "Input Config")**

Displays the input (or input combination) being used to derive the measurement(s)

D   **Measurement units (Channel > Set Up > "Units")**

Displays the units that the measurement is being displayed in.

E   **Trigger status (Channel > Trigger > Trigger Source)**

The first section of the trigger status icon conveys the settings at the "Source" and "Type" items in the [Trigger Set Up] dialog.

⎽⊓⊓⎽   External trigger, rising edge

⎺⊔⊔⎽   External trigger, falling edge

⎽⏉A   Internal trigger, input A, rising edge

A̅⎽   Internal trigger, input A, falling edge

⎽⏉B   Internal trigger, input B, rising edge

B̅⎽   Internal trigger, input B, falling edge

▭▭▭▭   Continuous

F   **Auto Trigger indicator (Channel > Trigger > Trigger Level > Auto Trigger)**

"au":   Auto triggering on.

Blank space: Auto triggering off.

G   **Arming type flag (Channel > Trigger > More > Arming)**

"A":   Automatic

"S":   Single

"F":   Frame

H   **Trigger bandwidth flag (Channel > Trigger > Trigger Bandwidth) (ML249xA only)**

"Ba":   Automatic selection of bandwidth

"Bm":   User selected bandwidth

I   **Linked triggers flag (Channel > Trigger > More > Link)**

"L":   Triggers are linked.

Blank space: Triggers are not linked.

J   **Trigger bandwidth value (Channel > Trigger > Trigger Bandwidth)**

K   **Averaging mode ([CW mode] > Channel > Averaging)**

Blank line: Averaging is off (CW & pulsed / modulated)

"Av":   Auto averaging (CW)

            Averaging on (pulsed / modulated)

"Am":   Moving averaging (CW)

"Ar":   Repeat averaging (CW)

L   **Number of averages (Channel > Averaging > Set Avg Number)**

M   **Averaging active indicator (Channel > Averaging > Averaging)**

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N   Measurement hold flag (Channel > More > Meas Hold)

    "H":   Measurement held

    "Blank space":   Measurement not held

O   Data hold flag ([Pulsed / modulated mode] > Channel > More > Profile
    Display > Data Hold > Infinite)

    "D":   Data hold on.

    "Blank space":   Data hold off.

P   Min/Max hold flag ([Pulsed / modulated mode] > Channel > Set Up >
    "Measurement" > Min & Max Hold)

    "MM":   Min/Max hold on.

    "Blank space":   Min/Max hold off.

Q   Limit checking flag (Channel > More > Limit Checking > Limit Checking)

    "Lim":   Limit checking on.

    "Blank space":   Limit checking off.

R   Upper / Lower limit check status (Channel > More > Limit Checking > Set
    Up > "Application")

    Green background: Check passed.

    Red background: Check failed.

    Blank space: Check off.

S   Limit checking type (Channel > More > Limit Checking > Set Up > "Mode")

    "Simple": Simple limit check being performed.

    "Cpx":   Complex limit check being performed.

T   Complex limit type and number (Channel > More > Limit Checking > Set Up
    > "Specification")

    "P":   Predefined specification in use.

    "U":   User defined specification in use.

U   Complex limit specification number (Channel > More > Limit Checking >
    Set Up > "Specification")

Status Bar

The status bar is used to display status information and error messages. If the instrument is in remote operation, one of the following is displayed at the right end of the status information line.

REM: Indicated that the instrument is in remote operation.

LLOC: Indicates that the instrument is in remote operation with local lockout enabled.

Note: Both the REM and the LLOC indicators are displayed if the instrument is in remote operation with local lockout enabled.

The Soft Keys

A ——→ Channel

- Set Up
- Trigger
- Relative Meas
- Averaging
- Duty Cycle
- More

B

C
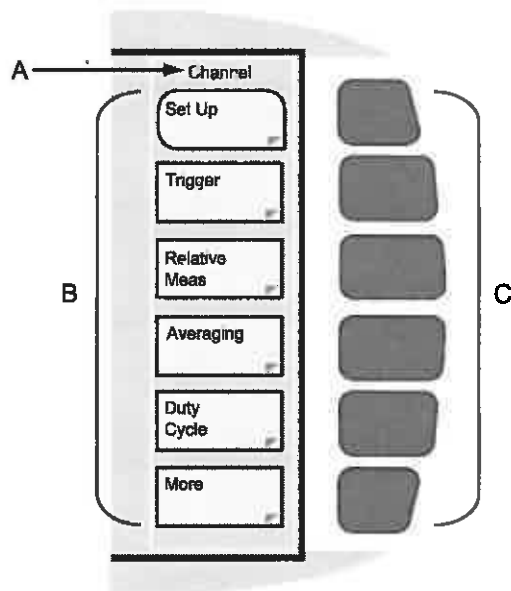
A   The title of each menu grouping is shown at the top of the menu area.

B   Each menu set contains a maximum of six commands at any one time, although some may contain only one or two. In the case of the example above, additional commands that could not be displayed on a single page are accessed by pressing the More command. The shape of the soft key indicates the type of screen that will display when this key is pressed. Illustrations and descriptions of each type of soft key are provided on the following page.

C   The labelled soft keys themselves cannot be pressed, and instead the corresponding key to the right is pressed to select the command.

Displays an additional page of soft keys. The fold in the lower right corner indicates to the user that there is more on the following page.

Displays an additional page of soft keys and an input dialog for the key that was pressed. When entry in the dialog box is complete, the user must then press [Exit].

Displays a numeric entry field allowing the user to enter a value for the associated parameter. The text displayed on buttons of this type is always followed by three dots (…).

Runs a function with no further user interaction.

Allows the user to toggle between two choices. The side of the button that appears depressed is the side that is currently active.

Toggles a parameter between on and off. The green light in the lower right corner indicates that the current state of the parameter is on, active, or true.

Used to select one of several possible alternatives. The strip on the right side of the button is lit green to indicate the option that is currently selected.

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Dialog Boxes
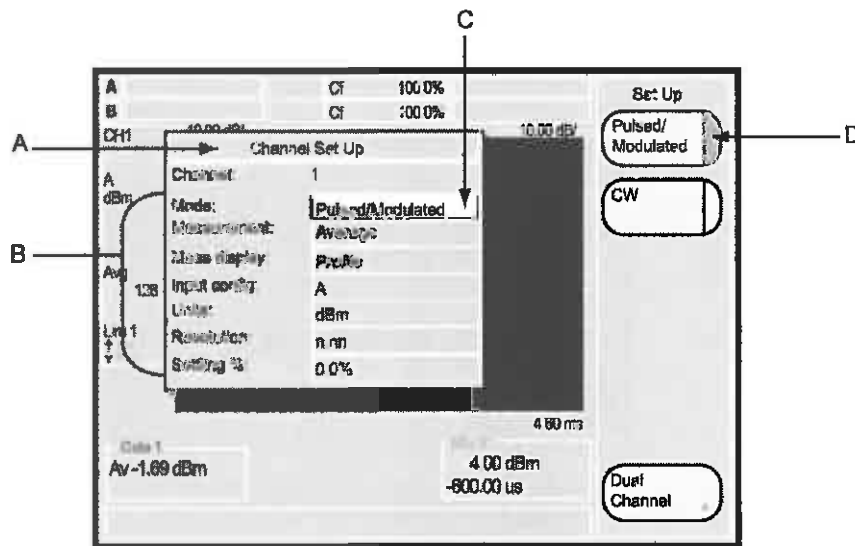
A   Dialog title bar.

B   Setting items. The user can move between settings using the up and down arrows on the numerical keypad. Items that are not available for selection are grayed out, and these are skipped over when the user moves up and down the list.

C   The item that is currently selected in an input dialog is highlighted in white. There are two basic types of entry field in dialogs such as the one shown in the figure above. The first type is one in which, once the item is selected, the required setting is selected from the soft keys that display to the right. In the example above, all the fields apart from "Settling %" are of this type. The second type of entry field is for numeric or alphabetic entry, and an example of this can be seen at the "Settling %" item in the dialog above. Entry into a field of this type is made by at the numerical keypad by pressing [Sel], entering the required value, and then pressing a soft key to enter the value or select the units of measurement.

D   The soft keys that display in the menu area change to display the commands for the entry field in the dialog that is currently selected. In the case of the example above, the "Mode" entry field is selected and the green stripe on the Pulsed/Modulated soft key indicates that this is the setting that is currently selected.

Note: Dialogs are closed by pressing either the [Exit] key on the keypad, or by selecting any of the hard keys except ⬛⬛⬛ when the dialog in question is a channel related one.

The Connectors
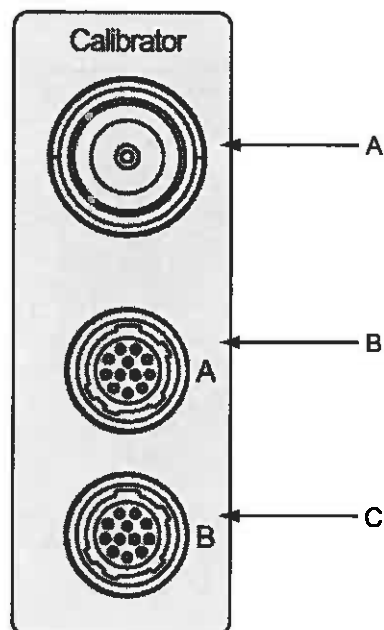
A **Calibrator Reference**
This connector is a precision female N- Type, 50 Ohm connector that provides a precision, traceable 0.0 dBm, 50 MHz or 1 GHz reference signal for absolute calibration of the sensors. (The 1 GHz signal is standard on the ML249xA, and available as an option for the ML248xA.) The calibration signal can be turned on or off through the Cal/Zero menu. As an option, the calibrator reference can be positioned on the rear panel, either in combination with sensor A connector (option 7), or with both the A and B connectors (option 8).

B **Sensor A connector**
This connector is a 12- pin circular precision connector to be used in conjunction with power sensor cables. An optional rear panel Channel A connector is offered as an alternative. If the rear panel connector option is installed, the front panel connector is not installed.

C **Sensor B connector**
This connector is a 12- pin circular precision connector to be used in conjunction with power sensor cables. An optional rear panel Channel B connector is offered as an alternative. If the rear panel connector option is installed, the front panel connector is not installed.

Data Entry Procedure

Numeric Entry Example

The steps below serve as an example of how to enter a numeric value. Follow the steps carefully until you become familiar with the procedure.

1. Press the ▓Change▓ hard key followed by the Set Up soft key.

2. A user entry dialog opens with the "Mode" entry field already highlighted and set to "Pulsed/Modulated". The soft keys to the right of the dialog indicate that this is a selection type entry field, and that the setting can be changed by pressing the soft keys available. In this case, there are two choices Pulsed/Modulated and CW , and as these are pressed, the entry in the "Mode" field changes accordingly. For the purposes of this explanation, select Pulsed/Modulated. As described earlier in this section, a green strip on the right of the soft button indicates the parameter that is currently selected.

3. Press the down arrow on the numeric keypad to move the cursor down to "Settling %".

4. Press the center [Sel] key on the numeric keypad. The current setting in the "Settling %" entry field is now replaced with a number of underscores. The number of underscores indicates the number of digits that can be entered in this field.
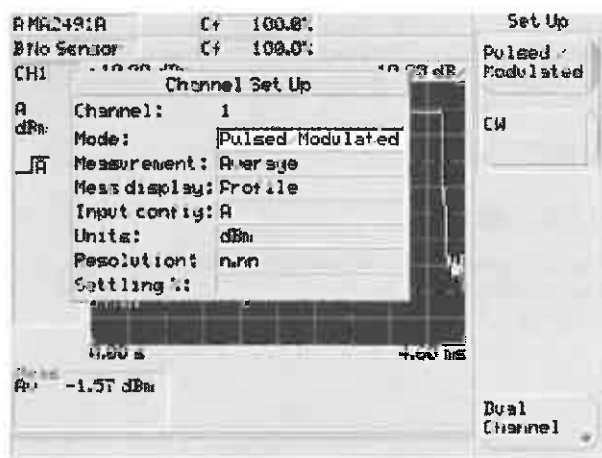
5. Enter a value from the numeric keypad. If a digit is entered by mistake, use the [Clr] to delete the digit last entered.

6. When entry is complete, press the Enter soft key to enter the value. The arrow keys on the numeric keypad can now be used to move the cursor to the next field if further entry is required.

7. If there is nothing further to enter, press the [Exit} key to save the settings and revert to the previous page in the command hierarchy.

Text Entry

1. On selection of the text entry field using the [Sel] key, the current contents of the field are cleared and replaced by a number of underscores, '_', indicating the number of characters that may be entered.

2. Text can now be entered from the numeric keypad. Beneath each of the buttons on the keypad there are three, or in some cases four, letters. The first press of a key enters the first of the letters associated with it. Subsequent immediate presses replace that letter with the second, third, or forth letter.

3. In some places, such as the dialog to enter the screen title, there is a Next soft key that displays after pressing the [Sel] key. The Next key is used to input consecutive letters that are both entered from the same key on the keypad. For example, to enter the word "EDGE", the user would press the "def" key twice to enter the "e", press the Next soft key, and then press the "def" key again to enter the following "d".

4. If a mistake is made, use the [Clr] key to delete the last entered character. If the field is empty when [Clr] is pressed, text entry will be terminated. Pressing the Enter soft key when the field is empty also terminates text entry and in both cases, the previous value of the field is restored.

5. Press the Enter soft key when data entry is complete.

Power-Off Procedure

Press the [On/Standby] button to turn off the ML248xA / ML249xA at any point during operation. Changes made to any of the settings prior to the point when the power was cut are saved automatically.

Chapter 5. Common Procedures

This chapter provides:

- A quick reference table for locating the required procedure.

- Details of procedures commonly performed on the ML248xA / ML249xA.

"How Do I ..." Quick Reference Table

The table below provides a quick reference to the procedures detailed in this chapter.

1. Find the procedure required from the alphabetical listing in the "Procedure" column.

2. Refer to the "Key combination" column for a summary of setting information.

3. Turn to the listed page for detailed procedural steps or, if you are viewing the electronic version of this manual, click on the page number to jump to the associated page.

Procedure	Key combination	Page
Averaging - enable in CW mode	**Channel** → Averaging	5-46
Averaging - enable in pulse/modulated mode	**Channel** → Averaging → Averaging	5-45
Averaging - restart in pulsed/modulated mode	**Channel** → Averaging → Restart averaging	5-46
Averaging - set up	**Channel** → Averaging → Set Avg Number → Enter value.	5-44
BNC connector - zero	**Cal/Zero** → Ext v Zero	5-86
Calibration factor table- select	**Sensor** → Cal Factor → Select "Table"	5-77
Channel - change	**Ch1/Ch2**	5-10
Channels - display both simultaneously	**Channel** → Set Up → Dual Channel	5-23
Data hold method - resetting in pulsed/modulated mode	**Channel** → More → Profile Display → Data Hold → Reset	5-69
Data hold method - set in pulsed/modulated mode	**Channel** → More → Profile Display → Data Hold	5-69
Delta marker - link to the active marker.	**Channel** → Markers → Delta Marker → Link to Act Mkr	5-51
Delta marker - display	**Channel** → Markers → Delta Marker → Delta Marker	5-50
Delta marker - position.	**Channel** → Markers → Delta Marker → Position Delta Mkr → Enter value.	5-50

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Procedure	Key combination	Page
Delta marker calculation - select	**Channel** → Markers → Delta Marker → Display Pwr Diff or Display Average	5-51
Display - adjust brightness	**System** → Config → Display → Backlight	5-91
Duty cycle – setting in CW mode	**Channel** → Duty Cycle → Set Duty Cycle	5-59
Firmware and serial number - view	**System** → Service → Identity	5-98
Gate – select active	**Channel** → Gating → Set Active Gate → Enter value.	5-42
Gates - repeat gate 1	**Channel** → Gating → Repeat Gate 1	5-43
Gates – set repeat number	**Channel** → Gating → Repeat Gate 1 → Set Repeat Count → Enter value.	5-43
Gates – set repeat offset	**Channel** → Gating → Repeat Gate 1 → Set Repeat Offset → Enter value.	5-43
Gates and fences - set up and enable	**Channel** → Gating → Set Up → Select gate/fence → Enter value.	5-39
Gates and fences - view	**Channel** → Gating → Display Gates	5-41
GPIB address - set	**System** → Config → Remote → Set GPIB Address	5-92
GPIB buffering - enable	**System** → Config → Remote → GPIB O/p Buffering	5-93
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Procedure	Key combination	Page
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Procedure	Key combination	Page
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Procedure	Key combination	Page
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Procedure	Key combination	Page
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Sensor – enter calibration adjustment	**Sensor** → Cal Factor → Select "Cal adjust" → Enter value.	5-77
Sensor – enter calibration factor	**Sensor** → Cal Factor → Select "Cal factor" → Enter value.	5-77
Sensor – enter calibration frequency	**Sensor** → Cal Factor → Select "Frequency" → Enter value.	5-77
Sensor – select calibration source	**Sensor** → Cal Factor → Select "Source" → Select from soft keys.	5-77
Sensor – zero	**Cal/Zero** → Zero → Zero Sensor A/B	5-85
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Sensor input(s) – set up the sensors	**Sensor** → Set Up	5-76
Sensor offset – set	**Sensor** → Offset	5-79
Sensor offset tables - creating	**Sensor** → Edit Tables → Edit Offset Tbl → Edit Entries	5-83

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Procedure	Key combination	Page
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Trigger - capture time	**Channel** → Trigger → Set Cap Time → Enter value	5-27
Trigger - delay	**Channel** → Trigger → Set Trig Delay → Enter value	5-29
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Trigger - level	**Channel** → Trigger → Trigger Level → Set Trig Level → Enter value	5-31
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Procedure	Key combination	Page
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Units of measurement – increment and decrement steps	**System** → **Config** → **Set Inc / Dec Steps**	5-97
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Channel

Understanding and Setting Up the Channels

The ML248xA / ML249xA has either single or dual sensor inputs, two channels, two modes, and two measurement display options, and before explaining how these are set up, it is first important to ensure that the meanings and uses are fully understood.

Sensor Inputs

The sensor inputs are the physical connector(s) on the front panel to which the sensors are attached. The ML2488A and ML2496A have two sensor inputs, labelled A and B, and the ML2487A and ML2495A have one.

Channels

Both the ML248xA and the ML249xA have two display channels; 1 and 2, each of which may be configured to measure a signal from either a CW or pulsed/modulated source, and each of which may display the results in either a profile (graphical) or readout form. The channels can also be configured for any of the available sensor inputs. To allow each channel to be set up as required, the power meter employs the concept of the "active channel". The active channel can be changed at any time by pressing the [   ] hard key.
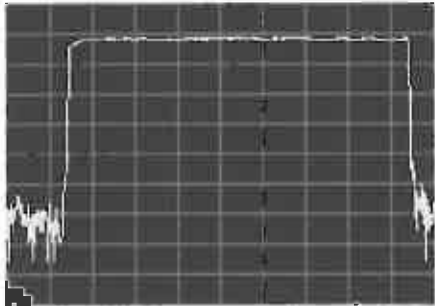
Modes

There are two modes available; "Pulsed/Modulated" and Continuous Wave ("CW"), and both of the channels can be set up for either mode.

Mode	Definition
Pulsed/Modulated	Select this mode to measure pulsed or modulated signals. This selects the high-speed data acquisition system to measure the signal. The measurement is made on data captured over a specified time period. This time period can either be set by the user in the gate settings, for example for TDMA or Radar measurements, or can be left at the default setting for applications such as CDMA.
CW	Measurements are made continuously and displayed at a rate determined by the averaging parameters and signal level.

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Measurement Displays

There are two measurement displays available; "Readout" and "Profile". The difference between the displays is explained below.

Display	Definition
	Profile: The measurement of the active channel is displayed as a graphical trace to which markers and gating patterns can be added.
5.12 **AV.** **dBm**	**Readout:** The measurement of the active channel is displayed as a digital readout. In this mode, a waveform of the signal under test is not shown, but the numeric information is identical to that in Profile mode.

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Channel Configuration Overview

The figure below summarizes the information above. It shows that both channels can be configured independently to almost any combination of settings. The information in parentheses shows settings that are not available on the ML2487A or ML2495A, or those that are unavailable due to specific setting combinations. Each of the settings shown in the figure is explained in detail in the following pages.

```
 ┌── Mode ──┐      ┌── Measurement⁽¹⁾ ──┐   ┌─ Meas display ─┐
 │          │      │                    │   │                │
 │  CW      │      │  Avg               │   │  Profile ⁽¹⁾    │
 │  Pulsed/ │      │  Avg & Peak        │   │  Readout       │
 │  Modulated│     │  Avg, Peak & Crest │   │                │
 │          │      │  Avg, Min & Max    │   │                │
 └──────────┘      └────────────────────┘   └────────────────┘

┌─ Input config ─┐                              ┌── Units ──┐
│                │                              │           │
│  A             │                              │  dBm      │
│  B ⁽²⁾          │           Channel 1          │  dBµV     │
│  Ext Voltage   │             (2)              │  dBmV     │
│  A/B ⁽²⁾        │                              │  dBW      │
│  B/A ⁽²⁾        │                              │  W        │
│  A-B ⁽²⁾        │                              │  dB ⁽³⁾    │
│  B-A ⁽²⁾        │                              │  % ⁽³⁾     │
└────────────────┘                              └───────────┘

        ┌── Resolution ──┐   ┌── Settling% ──┐
        │                │   │               │
        │  n.n           │   │  User input⁽⁴⁾ │
        │  n.nn          │   │               │
        │  n.nnn         │   │               │
        └────────────────┘   └───────────────┘
```
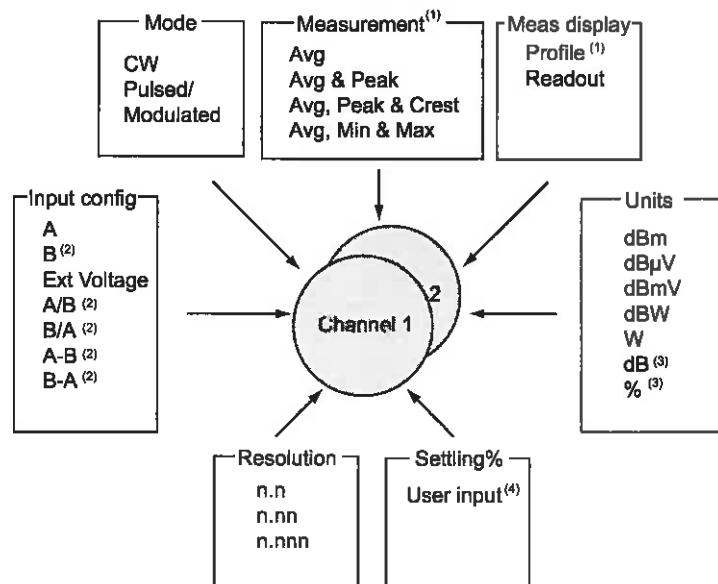
(1) : Pulsed/Modulated mode only
(2) : ML2488A / ML2496A only
(3) : A/B or B/A input config only
(4) : CW mode only

Selecting the Measurement Mode

1. Press the ▨▨▨▨▨ hard key to display the Channel group of commands.

2. Press the ⌷Set Up⌷ soft key to display the [Channel Set Up] dialog for the channel that is currently active. The dialog will open with the "Mode" item already selected.

```
A MA2491A          Cf   100.0%              Set Up
B No Sensor        Cf   100.0%          ┌──────────┐
CH1    - 10.00 dBm         10.00 dB     │ Pulsed / │
                    Channel Set Up      │ Modulated│
A         Channel:      1               └──────────┘
dBm       Mode:      │Pulsed/Modulated│  ┌──────────┐
          Measurement: Average          │ CW       │
_A        Meas display: Profile         └──────────┘
          Input config: A
          Units:        dBm
          Resolution:   n.nn
          Settling %:
          0.00 s              4.00 ms
Meas
Av   -1.57 dBm                          ┌──────────┐
                                        │ Dual     │
                                        │ Channel  │
                                        └──────────┘
```
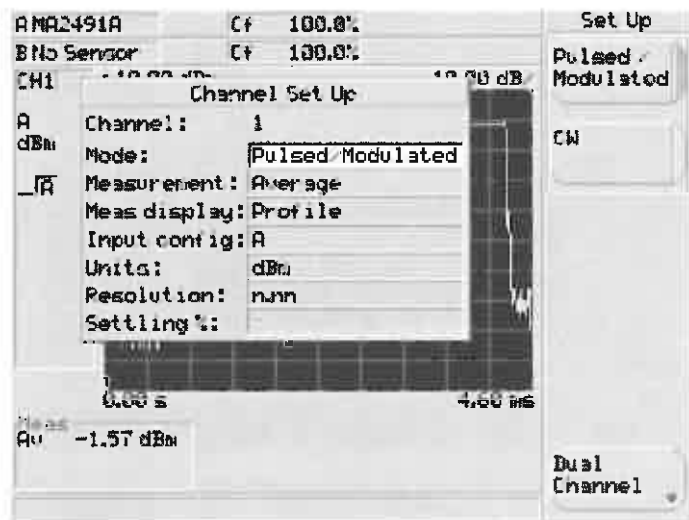
3. Use the soft keys to select the required mode. There are two options available; "Pulsed/Modulated" or "CW".

4. Use the down arrow on the numerical keypad to select another item in the dialog, or press the [Exit] hard key if no further settings are required.

Selecting the Measurement Type

1. Press the [ ] hard key to display the [Channel] group of commands.

2. Press the [Set Up] soft key to display the [Channel Set Up] dialog.
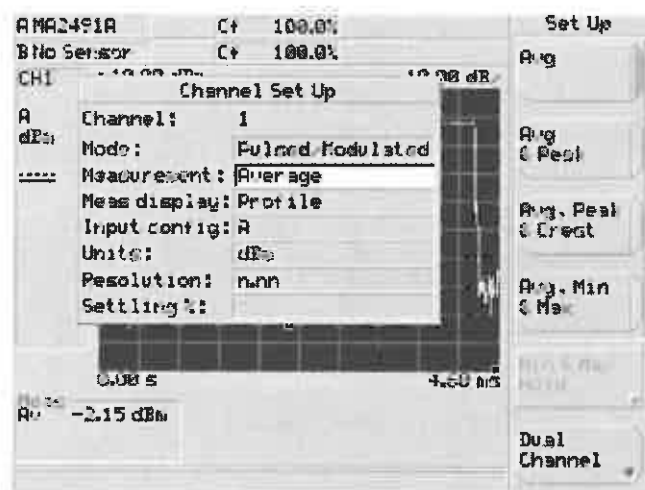
3. Make sure that the "Channel" item in the dialog is displaying the channel for which the settings are required. If the channel is incorrect, press the [ ] hard key to change the active channel.

4. Press the down arrow on the numeric keypad to select the "Measurement" item and then select the required measurement mode using the soft keys. Refer to the table below.

Item	Meaning
Avg	The ML248xA / ML249xA extracts the average power from each enabled gating pattern or from the data captured during the trigger capture time.
Avg & Peak	The ML248xA / ML249xA extracts the average power, along with the peak power value, from each enabled gating pattern or from the data captured during the trigger capture time.
Avg, Peak & Crest	The ML248xA / ML249xA extracts the average power, along with the peak power value and the crest factor, from each enabled gating pattern or from the data captured during the trigger capture time.
Avg, Min & Max	The ML248xA / ML249xA extracts the average power, along with the minimum and maximum power values, from each enabled gating pattern or from the data captured during the trigger capture time. When averaging is applied, the maximum values are derived from the averaged trace data.

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Note: The "Measurement" item is not available in CW mode.

Note: It is important to note the difference between Max and Peak in the settings above. Max represents the highest averaged value acquired over each section of the signal. This Max value can differ to Peak value considerably in that Peak represents the highest value taken from the raw samples. For WCDMA, WLAN, and EDGE measurements, the user is advised to select the Avg, Peak & Crest setting to measure and display the peak value taken from the sampled data itself. For RADAR measurements, the user is advised to select the Avg, Min & Max setting to reduce the effects of peak impulse noise.

Selecting the Measurement Display Style

1. Press the [_____] hard key to display the Channel group of commands.

2. Press the [Set Up] soft key to display the [Channel Set Up] dialog for the channel that is currently active.
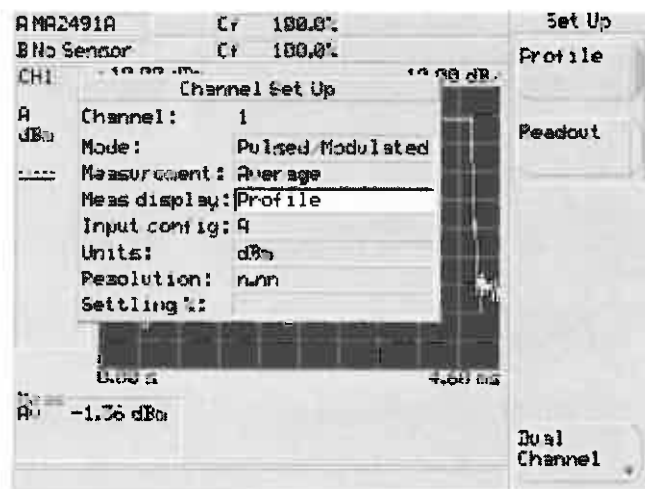
3. Press the down arrow on the numeric keypad to select the "Meas Display" item.

4. Use the soft keys to select the required mode. There are two options available; "Profile" or "Readout", the difference between which is explained earlier in this chapter.

5. Use the down arrow on the numerical keypad to select another item in the dialog, or press the [Exit] hard key if no further settings are required.

Note: The "Meas display" item is not available in CW mode.

Selecting the Sensor Input (ML2488A and ML2496A only)

1. Press the [   ] hard key to display the Channel group of commands.

2. Press the Set Up soft key to display the [Channel Set Up] dialog for the channel that is currently active.
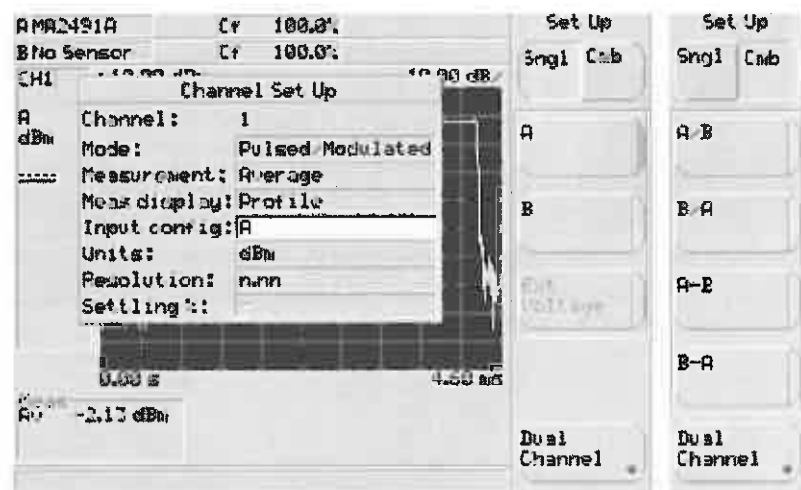
3. Press the down arrow on the numeric keypad to select the "Input config" item.

    The uppermost soft key within the [Set Up] menu for input configuration shows that there are two subgroups within this menu; "Sngl" (Single) or "Cmb" (Combined). Single mode is selected by default, and in this mode there is a simple choice between sensor input A, B, or Ext Voltage.

Note:	The "Ext Voltage" item is not available in Pulsed/Modulated mode.

    The "Cmb" (combined) grouping contains further options and in this case a calculation is made between the power values for inputs A and B. Further details of all the input configurations are presented in the table below.

Note:	For the ML2487A and ML2495A the user can select between sensor input A and Ext Voltage for a CW channel.

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Single	A	Input is taken from sensor A.
	B	Input is taken from sensor B.
	Ext Voltage	Take input from the rear panel BNC, "Input 2, Analog".
Combined	A/B	Sensor measurement A is divided by sensor measurement B and displayed on the current channel.
	B/A	Sensor measurement B is divided by sensor measurement A and displayed on the current channel.
	A-B	Sensor measurement B is subtracted from sensor measurement A and displayed on the current channel.
	B-A	Sensor measurement A is subtracted from sensor measurement B and displayed on the current channel.

4. Select the required input configuration from either the Sngl or Cmb menus.

5. Use the down arrow on the numerical keypad to select another item in the dialog, or press the [Exit] hard key if no further settings are required.

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Setting the Units of Measurement

1. Press the ▮Channel▮ hard key to display the Channel group of commands.

2. Press the ▭Set Up▭ soft key to display the [Channel Set Up] dialog for the channel that is currently active.
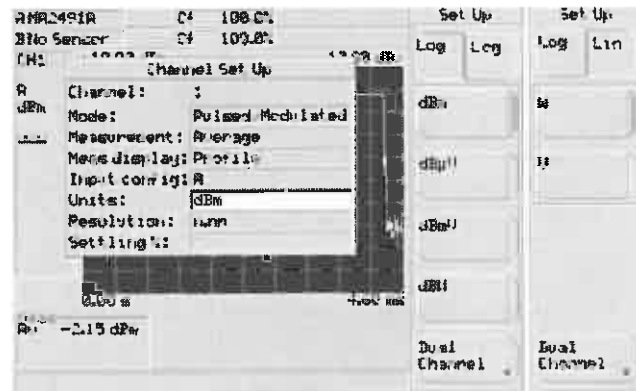
3. Press the down arrow on the numeric keypad to select the "Units" item.

4. Use the soft keys to select the required unit.

Note: The default setting for the ML248xA / ML249xA is to display units in dBm, but this can be changed to any of the other options available.

Note: The figure above shows the units available when the "Input config" item is set to "A", "B", "A-B", or "B-A". When "Input config" is set to "A/B" or "B/A", the units available for selection are "dB" or "%".

Selecting the Resolution

1. Press the ▢▢▢▢ hard key to display the Channel group of commands.

2. Press the ⌐Set Up¬ soft key to display the [Channel Set Up] dialog for the channel that is currently active.
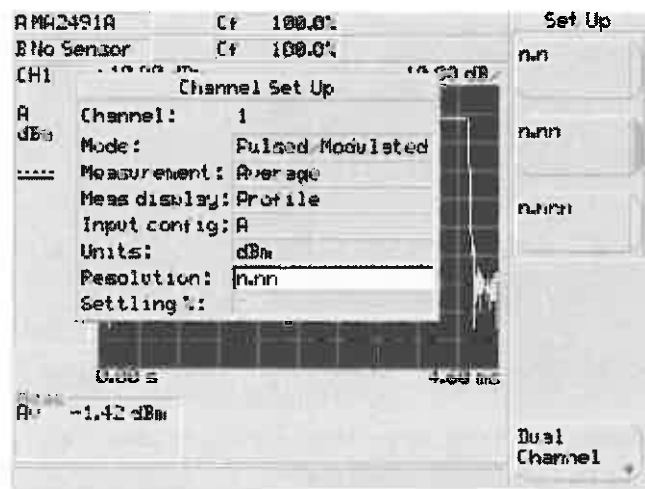
3. Press the down arrow on the numerical keypad to select "Resolution".

4. Use the soft keys to select the required resolution. The default setting for the ML248xA / ML249xA is to display the resolution to two decimal places (n.nn).

5. Use the arrows on the numerical keypad to select another item in the dialog, or press the [Exit] hard key if no further settings are required.

Entering the Settling Percentage

The settling value allows some control over the tradeoff between speed and the extent to which a measurement has settled to its final value. A 1% settling time value relates to approximately 0.04 dB.

1. Press the [Channel] hard key to display the Channel group of commands.

2. Press the [Set Up] soft key to display the [Channel Set Up] dialog for the channel that is currently active.
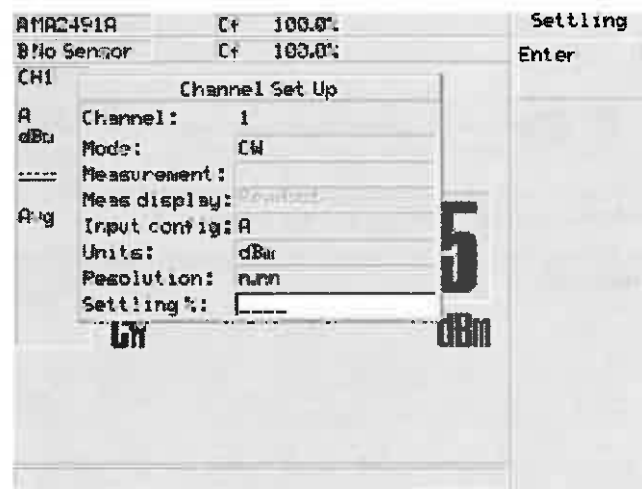
3. Press the down arrow on the numerical keypad to select "Settling %".

4. Press the [Sel] key and enter the required setting value from the numeric keypad.

5. Press the [Enter] soft key when complete.

6. Use the arrows on the numerical keypad to select another item in the dialog, or press the [Exit] hard key if no further settings are required.

Note: The "Settling %" item is only available in CW mode.

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Selecting Dual Display Channel Mode

As explained earlier in this chapter, the ML248xA / ML249xA allows the user to measure power on two channels. There are a number of possible scenarios when this may be of use, such as to display the same measurement in different units, or to measure power at different points on the same test system.

Setting Up the Second Channel

1. Press the [Channel] hard key to display the Channel group of commands.

2. Press the Set Up soft key to display the [Channel Set Up] dialog for the channel that is currently active. The active channel is identified at the "Channel" item at the top of the dialog.

3. Press the [Channel] to close the current dialog and display an identical dialog for the second channel. This button can be used at any time to jump between channels.

4. Make the required mode, measurement display, and input configuration settings for the second channel as explained earlier in this chapter.

5. Press the [Exit] key to close the [Channel Set Up] dialog and revert to the previous page of commands.

Displaying Both Channels Simultaneously

1. Press the [Channel] hard key to display the Channel group of commands.

2. Press the Set Up soft key to display the [Channel Set Up] dialog for the channel that is currently active. The active channel is identified at the "Channel" item at the top of the dialog.

3. Press the Dual Channel soft key to display both channels on screen simultaneously. The green LED on the Dual Channel button shows that this dual channel mode is enabled.
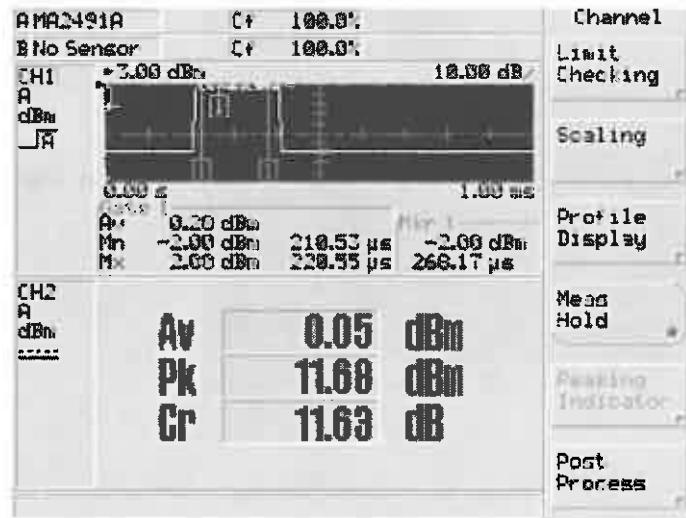
4. Press the [Exit] key to close the [Channel Set Up] dialog and revert to the previous page of commands.

5. As shown in the figure below, both channels are now displayed simultaneously, channel 1 at the top and channel 2 at the bottom of the screen. Pressing the [Ch1/Ch2] hard key at any time jumps from one channel to the other, and the currently active channel is identified by the green border around the channel number.

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Understanding Triggering

The following pages explain each of the settings in the [Trigger Set Up] dialog. The figure below provides an overview of the meaning of each setting. The black area in the figure represents the screen on the ML248xA / ML249xA.

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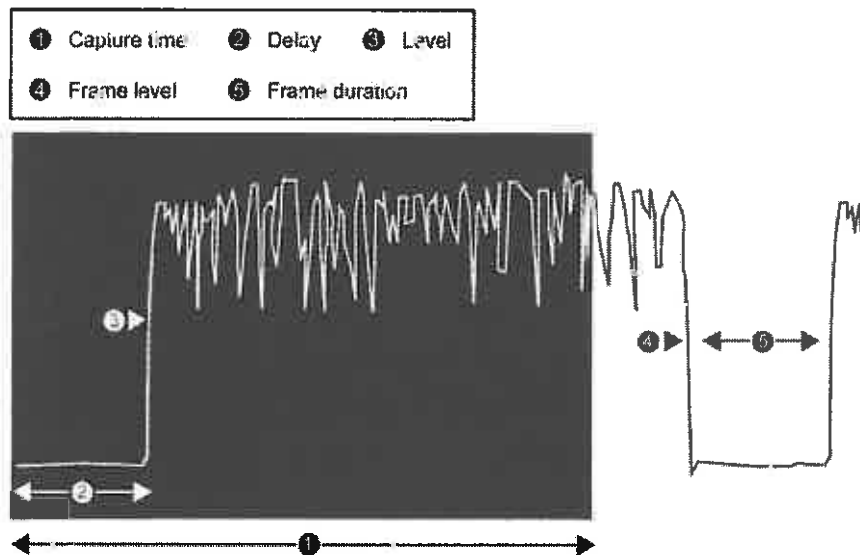
Selecting the Triggering Mechanism

1. Press the ▪▪▪▪▪▪ hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press the Trigger Source soft key to display the screen shown below.
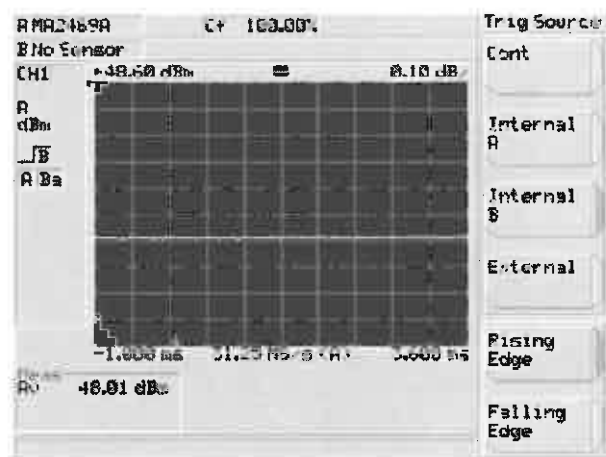
3. Use the soft keys to select the triggering source. There are four possible settings available as detailed below.

Setting	Trigger action
Cont	The instrument restarts the acquisition process immediately after displaying the results. This setting is most suitable when there is no particular amplitude pattern in the measurement, such as is the case with CDMA.
Internal A	The trigger signal is obtained by monitoring the RF signal level measured by the sensor. Triggering occurs when the level crosses a specific point.
Internal B	The trigger signal is obtained from sensor B (ML2488A and ML2496A only).
External	Data acquisition is triggered by a TTL transition on the external input. The program can be set up to respond to either a rising or a falling edge.

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Selecting the Type of Triggering

1. Press the [   ] hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press the
    Trigger Source soft key to display the screen shown below.
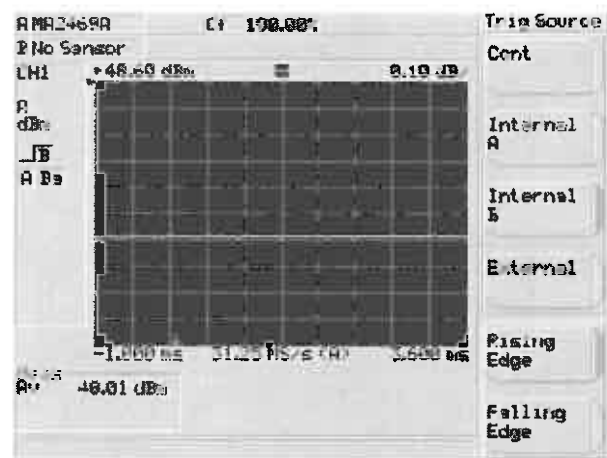
Note: The triggering type cannot be specified if the trigger source is set to "Continuous".

3. Use the soft keys to set triggering to occur on either the rising or falling edge of the
    signal.

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Entering the Triggering Capture Time

The capture time represents the amount of data displayed on the screen at any one time. If a positive value is entered at the "Delay" item, the capture time will commence once the specified delay has been reached.

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press the Set Cap Time.. soft key to display the screen shown below.
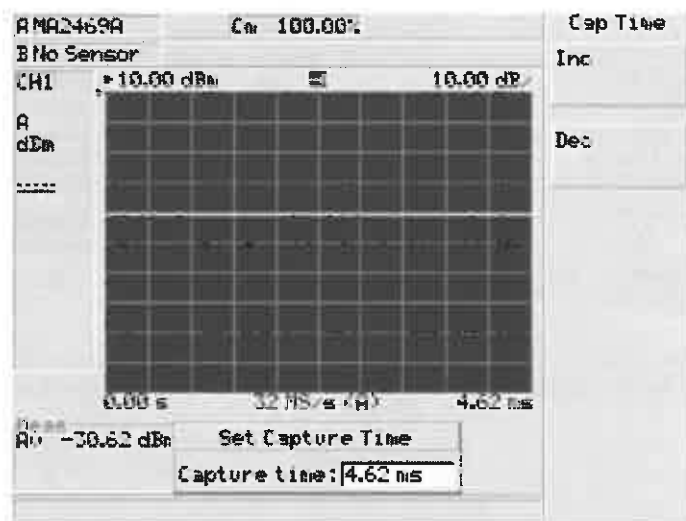
3. Specify the capture time using either of the methods below.

   • Use the Inc and Dec soft keys to increment or decrement the displayed value by the amount specified from System > Config > Set Inc/Dec Steps .

   • Press the [Sel] key on the numeric keypad and enter a value as described in the previous chapter. Press the required units from the soft key when the required time has been set.

Note: The capture time setting determines the effective sampling rate. Details of this are given in the table below.

Capture time	ML248xA Sampling rate	ML249xA Sampling rate
50 ns to 3.19 μs (#1)	N/A	RRS (#1)
3.2 μS to 4.09 ms	64 MS/s	62.5 MS/s
4.1 ms to 8.19 ms	32 MS/s	31.25 MS/s
8.2 ms to 16.38 ms	16 MS/s	16 MS/s

(#1) Available for ML249xA only.

Random Repetitive Sampling (RRS) (ML249xA only)

As shown in the table on the previous page, if the capture time is set to a value less than 3.2 μs, a random repetitive sampling (RRS) method is used to acquire the data. RRS is selected automatically as necessary by the power meter and no user setting is required. When active, an RRS flag displays in the top right corner of the channel display area.

```
CH1  RRS

A
dBm

_|A  au

A  Bm  L

20MHz
```
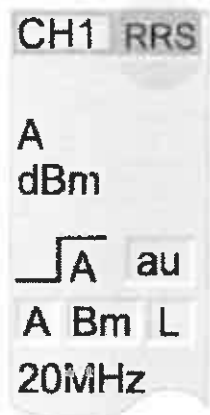
When RRS is active, an effective sampling rate of 1 Gsample per second is achieved by progressively filling up data slots until the entire trace has been acquired. The particular slot to which the data for any of the sweeps is written is determined by the time between the trigger and the first measurement point, and then the time from this point to the current measurement point. When an RRS measurement is being made but is not yet complete, the measurement and marker values display as a series of dashed lines. When all of the 16 data slots have been filled and the trace is complete, the readout values are then displayed, and the RRS indicator in the channel area of the screen changes from red to green.

It should be noted that as RRS relies upon multiple successive measurements of a repetitive signal, it is not available for continuously triggered measurements.

The message, "Out of range for continuous trigger" displays if an attempt is made to set the trigger capture time to less than 3.2 μs when the trigger source is set to continuous.

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Entering the Triggering Delay

A trigger delay allows the user to impose a time lag (positive or negative) between the trigger event and the data displayed on screen. Specifying a positive delay has the affect of zooming in on a section of the pulse occurring some time after the trigger event. Specifying a negative delay allows the user to display data occurring immediately before the trigger event.

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the [Trigger] soft key to display the [Trigger] menu and then press the [Set Trig Delay..] soft key to display the screen shown below.
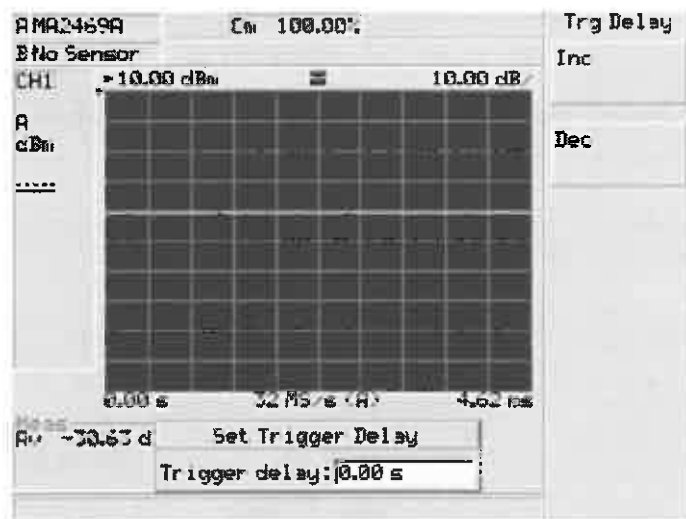
3. Specify the trigger delay using either of the methods below. A positive value represents a delay after the trigger point, and a negative value represents the time before the trigger allowing the user to display the pre-trigger information.

    *   Use the [Inc] and [Dec] soft keys to increment or decrement the displayed value by the amount specified from [System] > [Config] > [Set Inc/Dec Steps].

    *   Press the [Sel] key on the numeric keypad and enter a value as described in the previous chapter. Press the required units from the soft key when the required time has been set.

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Enabling Auto Triggering

Both the ML248xA and the ML249xA units can be configured to trigger automatically as detailed below. When auto triggering is enabled for the ML248xA the user must manually set a trigger level for each of the three ranges. For the ML249xA, the trigger level is specified automatically and no additional setting is required on the part of the operator.

1.　Press the [Channel] hard key to display the [Channel] group of commands.

2.　Press the Trigger soft key to display the [Trigger] menu and then press the Trigger Level > Auto Trigger soft keys.

3.　When auto triggering is enabled, the LED on the soft key is lit green and the trigger status icon shown below displays in the channel information section of the screen.

　au

Note: Auto triggering cannot be enabled if the trigger source is set to "Continuous" or "External".

Entering the Triggering Level

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press the
    Trigger Level > Set Trig Level.. soft keys to display the [Set Trigger Level] dialog
    shown below.
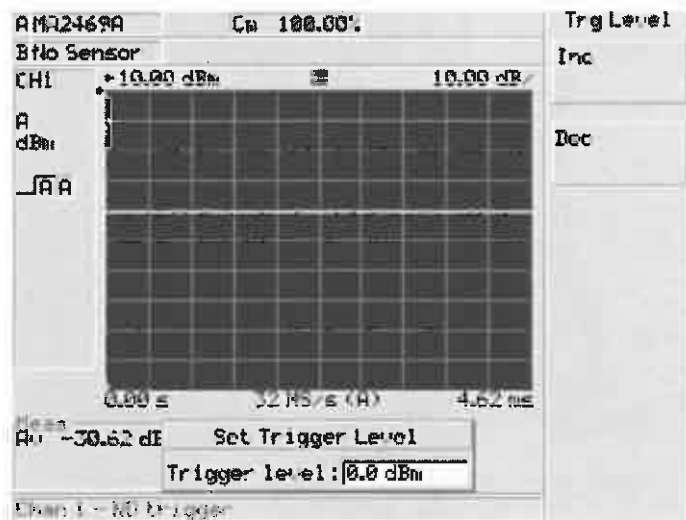
Note: The trigger level cannot be set if the "Source" item is set to "Continuous" or
"External".

3. Specify the trigger level using either of the methods below.

    *   Use the Inc and Dec soft keys to increment or decrement the displayed value
        by the amount specified from System > Config > Set Inc/Dec Steps .

    *   Press the [Sel] key on the numeric keypad and enter a value as described in the
        previous chapter. Press the required units from the soft key when the required
        time has been set.

Note: For the ML248xA, the specified trigger level is only applicable for the operational
level of the amplifier range in use.

Setting the Trigger Bandwidth (ML249xA only)

1.   Press the [   ] hard key to display the [Channel] group of commands.

2.   Press the Trigger soft key to display the [Trigger] menu and then press the
      Trigger Bandwidth soft keys to display the [Trigger BW] group of commands shown
      below.
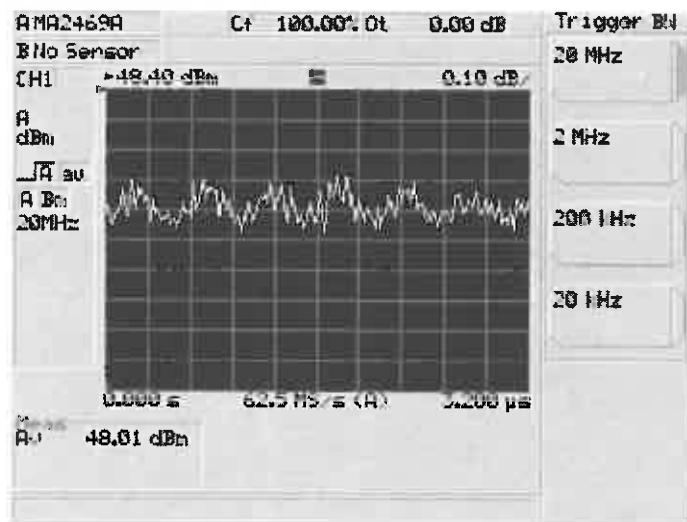
3.   Use the soft keys to select the trigger bandwidth to be used when making pulsed /
      modulated measurements.

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Selecting the Trigger Arming Method

1. Press the ▮▮▮▮▮ hard key to display the [Channel] group of commands.

2. Press the [Trigger] soft key to display the [Trigger] menu and then press [More] followed by [Arming] to display the screen shown below.
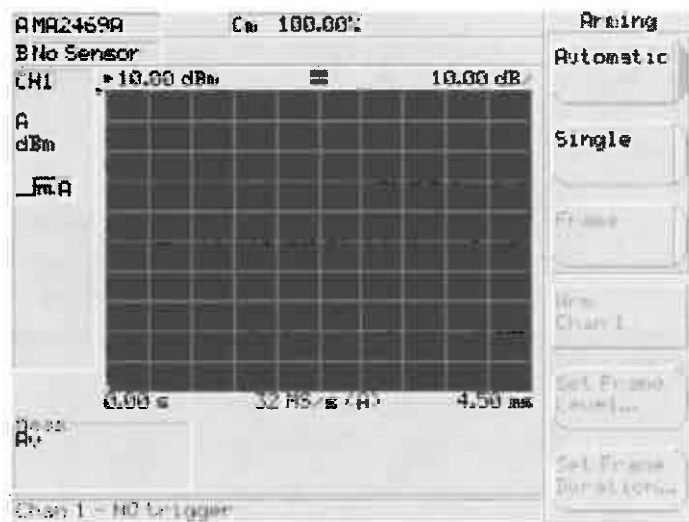
Note: Arming settings cannot be made if the Trigger source item is set to "Continuous".

3. Use the soft keys to set the arming item to single, automatic, or frame. Refer to the table below.

Setting Item	Meaning
Automatic	The trigger is re-armed automatically after the trigger event has occurred.
Single (Not available for ML249xA when RRS is active)	The trigger is armed in response to a key press or remote control command. This allows a measurement to be captured and examined at leisure while internal or external trigger events continue to occur. If arming is set to "Single", the [Arm Chan X] command is enabled in the [Trigger] menu.
Frame	The trigger is armed on the condition that the signal level stays below the threshold specified using the [Set Frame Level..] command for the period of time specified using [Set Frame Duration].
	It should be noted that although frame arming is available on the ML249xA when RRS is active, manual sampling is unavailable at this setting.

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Entering a Frame Arming Level and Duration

As explained on the previous page, a frame arming level and duration can be specified to find the off period of a pulsed waveform. The trigger is re-armed only on the condition that the signal stays below the specified level for the specified duration. Once the trigger has been re-armed the power meter will then always trigger on the first rising edge of the sequence of pulses after the off-period.

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press More followed by Arming.

3. Press the Frame soft key to enable use of the Set Frame Level and Set Frame Duration.. soft keys

4. Press Set Frame Level and set the frame level using either of the methods below.

    •   Use the Inc and Dec soft keys to increment or decrement the displayed value by the amount specified from **System** > Config > Set Inc/Dec Steps .

    •   Press the [Sel] key on the numeric keypad and enter a value as described in the previous chapter.

5. Press Set Frame Duration.. and set the frame duration in the same manner.

Setting the Sampling Rate

This function allows the user to set the sampling rate for the active channel.

Note: The sampling rate is only applicable to pulsed/modulated measurements.

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press More followed by Set Sample Rate to display the [Set Sample Rate] dialog shown below.
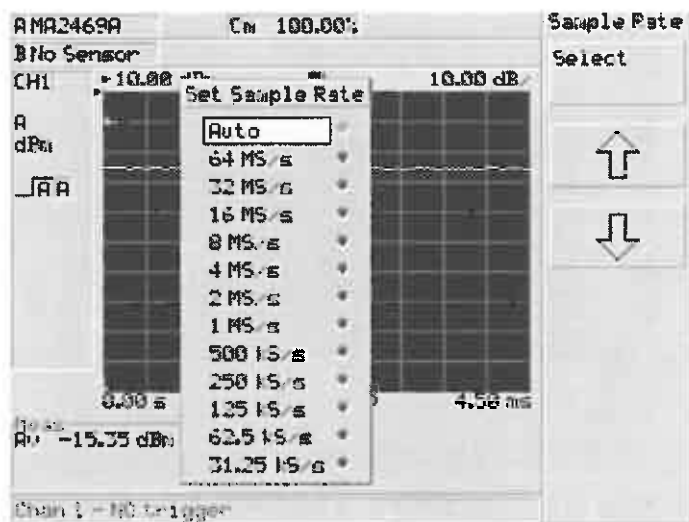
3. Use the up and down soft keys or the keys on the numeric keypad to select the required rate. The rate is enabled by pressing the Select soft key or the [Sel] key on the numeric keypad. The currently active rate is indicated by the green LED.

   The current sampling rate displays beneath the profile graticule of a pulsed/modulated measurement. If "Auto" is selected as the sampling rate, (A) is displayed after the rate that the instrument has selected.

Note: The power meter can only hold a finite number of samples at any one time and the following 'rule' is followed:

Number of measurement points <= number of samples <= Max number of samples

When "Auto" is selected, the ML248xA / ML249xA calculates the fastest sample rate that will satisfy the above rule when used with the current capture time. If a user selected sampling rate is being used, the current capture time may result in the ML248xA / ML249xA trying to capture too many or too few samples. In this case the capture time will be adjusted so that the rule is satisfied. Changing the number of measurement points from 200 to 400 may also result in the capture time being changed.

The sample rates shown in the figure above are those for the ML248xA. The sample rates for the ML249xA are slightly different as they are locked at 1 GHz.

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Selecting the Trigger Indicator (ML249xA only)

When the ML249xA is operating in pulsed modulated mode with an internal or external trigger source, the user can display the trigger point as either a small arrow at the bottom of the trace, or as an additional stepped waveform

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press More followed by Trigger Indication to display the [Trigger Ind] group of commands shown below.
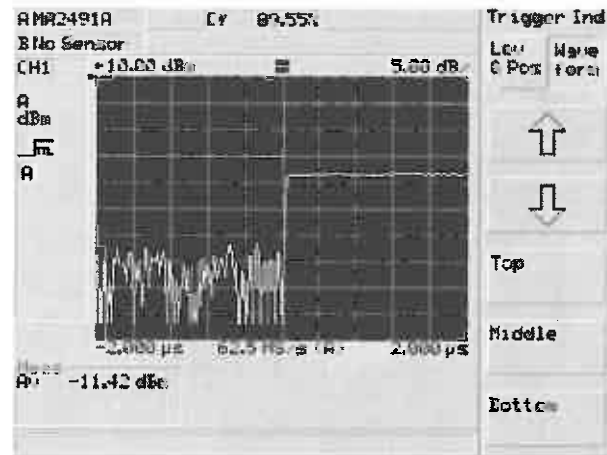
3. Press the Lev & Pos / Wave form soft key to switch between the arrow and waveform trigger point displays. When waveform mode is selected, the step occurs at the trigger point and the direction matches the currently selected trigger edge. The waveform does not indicate the trigger level in any way and can be positioned at any point on the vertical axis using the up and down soft keys or jumped directly to the top, middle, or bottom of the graticule.

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Linking the Channel Trigger Settings

The trigger settings for channel 1 and channel 2 can be linked in the manner described below. The channels can only be linked when the "Mode" setting in the [Channel Set Up] dialog is the same for both channels.

1. Press the Channel hard key to display the [Channel] group of commands.

2. Press the Trigger soft key to display the [Trigger] menu and then press More followed by Link soft key. When the key is pressed, the trigger settings for the active channel are copied to the inactive channel, and further changes are automatically copied over thereafter.

Gates and Fences

Up to four different gating patterns may be applied simultaneously to any measurement. Before going on to describe how the gates and fences are set up, it is first necessary to make sure that the terms themselves are understood.

Term	Definition
Gate:	A gate is a specification for extracting an averaged power reading measurement between two defined points on a pulsed waveform. These points are defined with respect to the point in time at which the measurement trigger occurred.
Fence:	A fence is set up within the boundaries of a gate. All data sampled between the fence start and stop positions is excluded from the average power calculations for the associated gate. This is useful for purposes such as excluding a training sequence from an EDGE measurement.
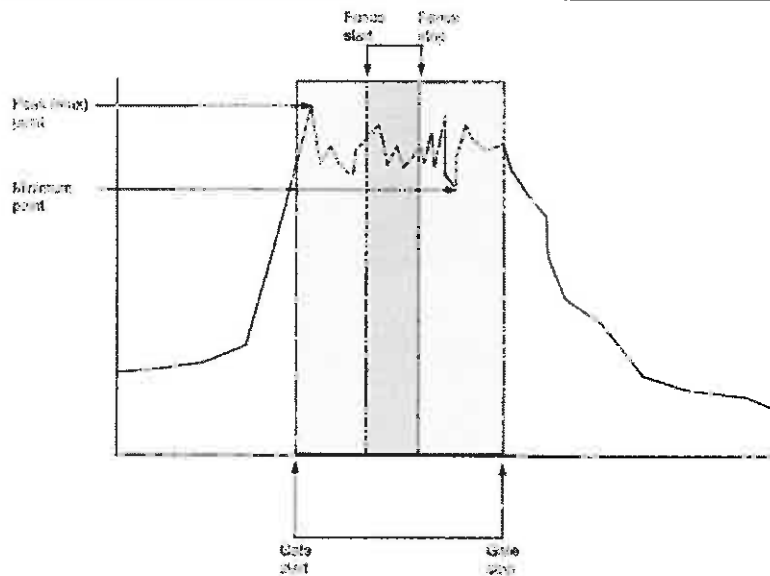
Certain restrictions and conditions apply when setting up gating and fence settings, these are listed below.

- A maximum of four gating patterns can be applied to any single measurement, or eight in a repeated gating pattern.

- The fence start and stop positions cannot be set outside of the area defined by the gate start and stop positions.

- The Gate Start and Stop points are included in the measurement.

- The Fence Start and Stop points are excluded from the measurement and have priority over the Gate Start and Stop points if they coincide.

- Gating patterns are independent and may overlap without interfering with each other.

Setting Up and Enabling Gates and Fences

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the [Gating] soft key followed by the [Set Up] soft key to display the [Gating Set Up] dialog. The dialog opens with the "Gate 1" setting already selected for user entry.

```
A MA2469A            Ch  100.00%              Set Up

B No Sensor                                   Enabled
CH        -10.00 dB.          -              10.00 dB
                    Gating Set Up
A                                                    .
dB              Channel :1
                                             Set as
             Start       Stop      Active     Active
  Gate 1:  * 0.00 s      577.00 µs    *
  Fence 1: * 225.00 µs   321.00 µs             Inc
  Gate 2:  * 0.00 s      577.00 µs    *
  Fence 2: * 225.00 µs   321.00 µs
  Gate 3:  * 0.00 s      577.00 µs    *        Dec
  Fence 3: * 225.00 µs   321.00 µs
  Gate 4:  * 0.00 s      577.00 µs    *
  Fence 4: * 225.00 µs   321.00 µs
     0.00 s        32 RS/s (A)     4.50 ns
                                             All Gates
Av  -15.35 dBm                               Off

Chan 1 - No Trigger
```

3. Enter the required time using either of the methods detailed below.

    *   Use the [Inc] and [Dec] soft keys to increment or decrement the displayed value by the amount specified from [System] > [Config] > [Set Inc/Dec Steps] .

    *   Press the [Sel] button on the numeric keypad and enter a value. Select the required units from the soft key menu to set this value.

4. Press the right arrow on the numeric keypad to select the gate 1 stop item. Select the required units from the soft key menu to set this value.

5. Press the [Enabled] soft key to enable use of this gate setting. A green LED to the right of the "Gate 1" item is lit to show that this setting is currently enabled.

6. Repeat steps 3 to 5 above to make the required settings for fence 1.

7. Repeat steps 3 to 6 above to make and enable the second, third, and forth fence/gate settings.

8. Set the active gate by selecting the required gate and pressing the [Set as Active] soft key. The green LED at the right of the dialog indicates the gate currently selected.

    The active gate can also be set from the [Set Active Gate] soft key, refer to the section in this chapter titled "Setting the Active Gate".

9. Press the [Exit] key when complete to close the [Gating Set Up] dialog and revert to the previous page of commands.

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Note: The difference between an active gate and an enabled gate should be made clear.

Enabled   An enabled gate is a gate that has been enabled for viewing but one for which measurement data is not made available unless operating the ML248xA / ML249xA remotely over a GPIB connection. All four of the gates can be enabled simultaneously.

Active: The active gate is the gate that is currently selected and being used as the boundary for the acquisition of data.

Viewing Gating Patterns

1. Press the [Channel] hard key to display the Channel group of commands.

2. Press the Gating soft key.

3. Press the Display Gates soft key to display the gates on the profile as shown in the figure below. The gate start and stop points appear on the profile as solid vertical green lines, and the fence points can be seen as dotted green lines.

    The number of the gate displays at the base of the start and stop lines. If more than one gate has been enabled in the [Gating Set Up] dialog the concept of active and inactive gates is introduced.
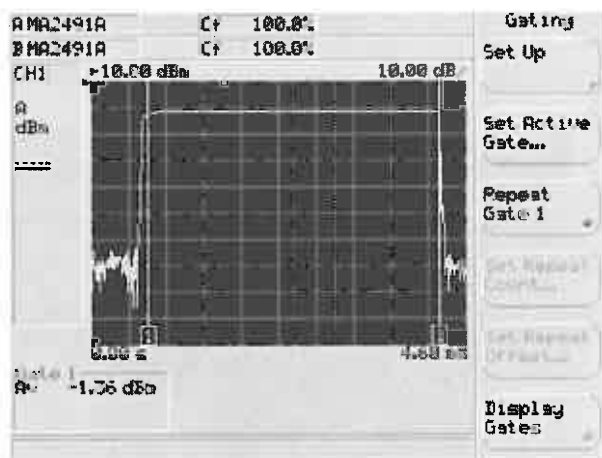
> **Note:** Gating patterns can only be viewed when the channel in question is viewed in profile mode. Refer to *Selecting the Measurement Display* earlier in this chapter for details of how to change the display mode.

Setting the Active Gate

Up to four gates can be enabled and viewed simultaneously on the profile display. In this situation, the gate that is currently active is shown on the display by a green box around the number at the base on the start and stop positions. This is shown in the figure below.

Follow the procedure below to specify the active gate.

1. Press the [   ] hard key to display the Channel group of commands.

2. Press the Gating soft key.

3. Press Set Active Gate... and enter the required gating number in the [Set Active Gate] dialog. The number is entered in the usual manner by pressing [Sel] on the numeric keypad to clear the current entry. Press the Enter soft key when complete, followed by the [Exit] key to close the dialog.

    The display will now have been updated to display the specified number as the active gate.
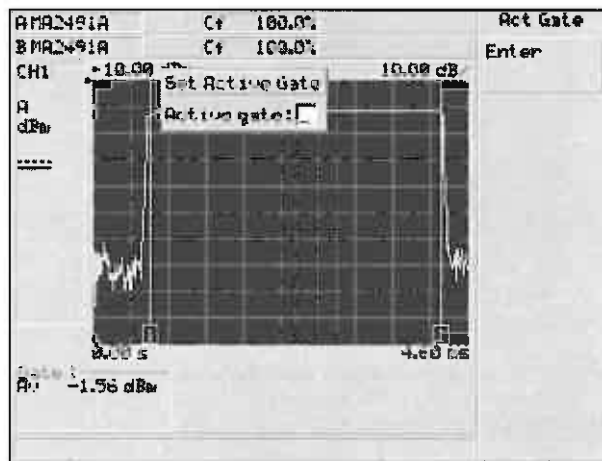
Note: The active gate can also be set in the [Gating Set Up] dialog as described in the earlier section. Both access points are updated automatically regardless of where the settings are made.

Setting Up Repeat Gates

To facilitate the measurement of sequences on a regular basis, the user can select to repeat gate 1.

Follow the procedure below to make the gate repetition settings.

1. Press the [Channel] hard key to display the Channel group of commands.

2. Press the [Gating] soft key.

3. Press [Repeat Gate 1] to display the repeated gate on screen.
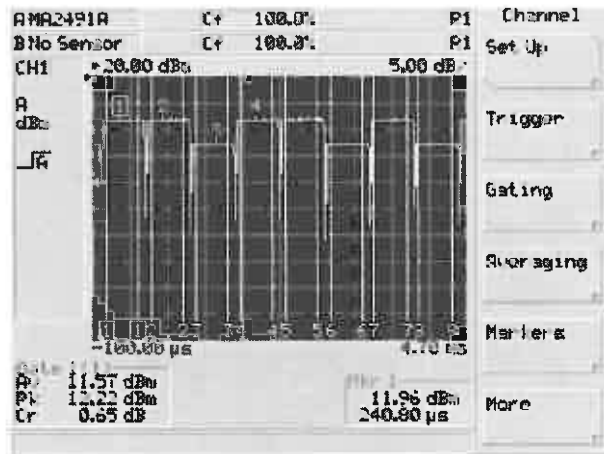
4. Press [Set Repeat Count...] and specify the number of repetitions required by entering a number from the keyboard in the usual manner.

5. Press [Set Repeat Offset...] and specify the offset between consecutive gates.

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Averaging

The averaging settings allow the user to specify a given number of measurements over which the average result is then calculated. The commands found within the [Averaging] menu differ depending on whether the channel mode is set to Pulsed/Modulated or CW. Explanations in this section apply to both modes unless otherwise stated.

Setting Up Averaging

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Averaging soft key to display the [Averaging] menu.

3. Press the Set Avg Number soft key to display the [Set Averaging Number] dialog.
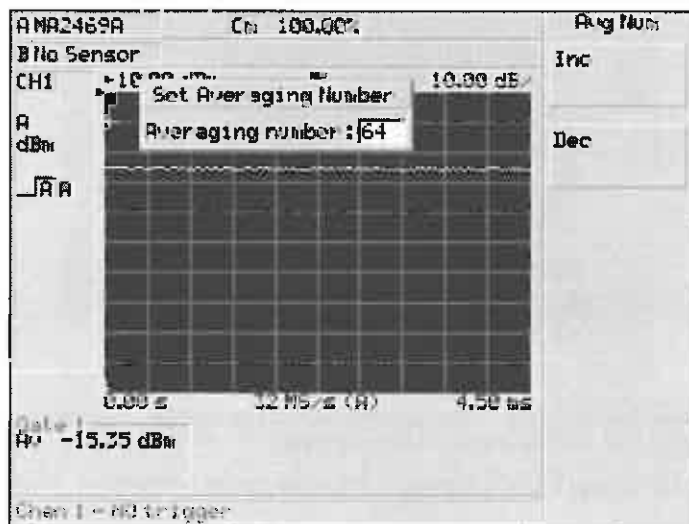
4. Enter the required averaging number using either of the methods detailed below.

    *   Use the Inc and Dec soft keys to increment or decrement the displayed value by a factor of two.

    *   Press the [Sel] key on the keypad and enter the number of measurements over which the average will be calculated.

Note: The maximum averaging value that can be specified is 512, and settings in excess of this are automatically reset to this maximum.

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Enabling Averaging in Pulsed/Modulated Mode

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the Averaging soft key to display the [Averaging] menu.

3. Press the Averaging soft key to toggle averaging between on and off. When averaging is enabled, the LED on the soft key is lit green.

It is important to note that in pulsed / modulated mode, the higher the number that averaging is set to, the smaller the contribution of the new reading into the averaged value. If for example, averaging is set to 64, each point on the trace is averaged as follows:
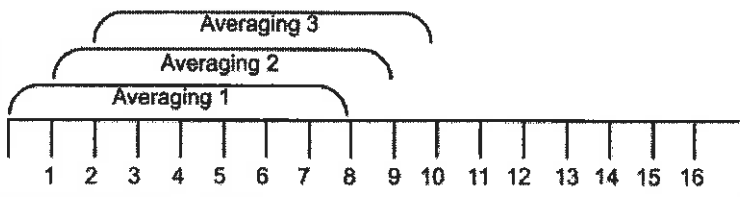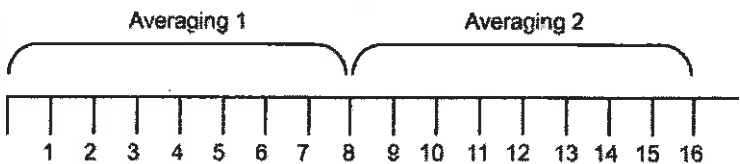
(Current value x 63/64) + (Newly acquired value x 1/64)

From the above it can be seen that at this setting, only 1/64th of the new reading is reflected in the trace as opposed to 1/8th if, for example, averaging was set to a value of 8.

Note: If averaging is set, the letters "AV" display at the left side of the monitor. A flashing square icon to the right of this indicates that averaging is being performed, and the currently specified averaging value displays to the left of this icon. Refer to the explanation of the screen in chapter 4 of this manual.

Enabling Averaging in CW Mode

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the [Averaging] soft key to display the [Averaging] menu.

3. There are four averaging settings available as detailed below.

Setting	Meaning
Off:	Averaging in not performed.
Auto:	Averaging is performed automatically depending on the power level.
Moving:	Averaging is continuously performed over the number of measurements specified. When the specified number is reached the average is calculated and as the next measurement is finished the average is recalculated from the new start and stop positions. Refer to the figure below that shows moving averaging performed over 8 measurements.
Repeat:	Averaging is performed over the number of measurements specified. The averaging value is not recalculated until the next entire batch of measurements is complete. Refer to the figure below that shows repeat averaging performed over 8 measurements.

4. Use the soft keys to select the averaging setting required.

Restarting Averaging in Pulsed/Modulated Mode

1. Press the [Channel] hard key to display the [Channel] group of commands.

2. Press the [Averaging] soft key to display the [Averaging] menu.

3. Press the [Restart Averaging] soft key.

Markers

The ML248xA / ML249xA can display up to four markers and one delta marker on a profile display at any time. Each of the markers is assigned a number, and the marker that is set up as the active marker is shown on screen by a number in a blue box. The delta marker is shown by a triangular symbol and is used as the reference for differential calculations with the active marker. The calculation between the delta and active markers can be set to show the difference in power level behind the two points, or to show the average power between the two markers.

Note: Markers are not available when the measurement display for the channel in question is set to Readout.

Marker	Meaning
1	The non-active markers are shown by a blue number.
2	The active marker is enclosed in a blue box. Any of the four regular markers can be set up as the active marker.
△	The delta maker is shown by a blue triangle. The delta marker is used as the reference for calculations with the active marker.

Setting Markers

1. Press the [Channel] hard key followed by the Markers soft key to display the Markers group of commands.

2. Press the Set Up Markers soft key to display the [Marker Set Up] dialog. The dialog shows a numeric position for each of the markers.
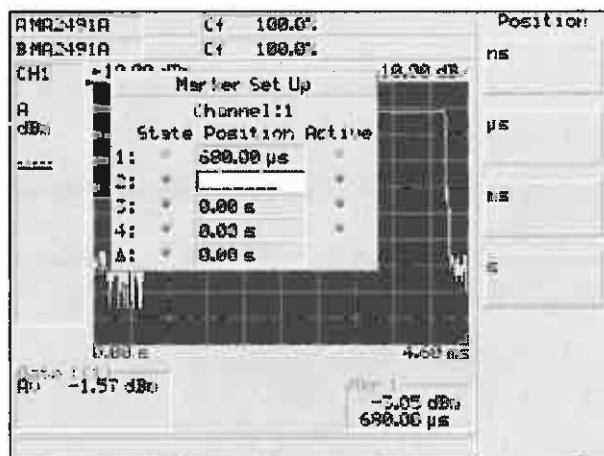
3. Use the arrows on the keypad to select the marker, and then enter the required position using either of the methods detailed below.

    •   Use the [Inc] and [Dec] soft keys to increment or decrement the displayed value.

    •   Press the [Sel] key on the keypad and enter the number in the usual manner.

4. Once the position has been set the user can chose to display the marker by pressing [Display Marker]. The LED to the left of the input value is lit green when the marker is set to be displayed.

5. Use the down arrow on the numeric keypad to move to the remaining markers, and repeat steps 3 and 4 above.
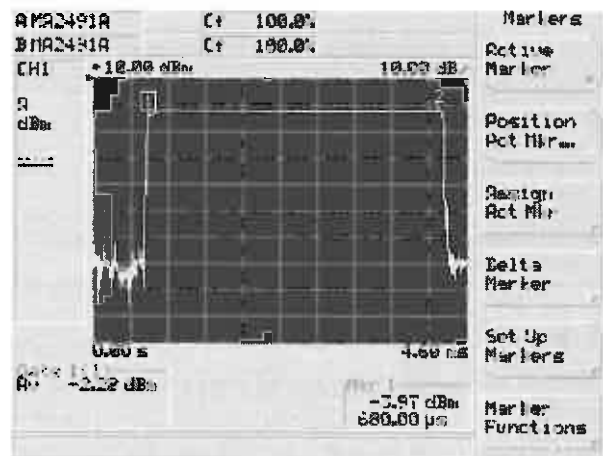
6. Press [Exit] to close the [Marker Set Up] dialog when all settings are complete.

Turning all Markers Off

1. Press the [Channel] hard key followed by the [Markers] soft key to display the [Markers] group of commands.

2. Press the [Set Up Markers] soft key to display the [Marker Set Up] dialog.

3. Press the [All Mkrs Off] soft key to clear all markers from the display.

Setting and Viewing the Active Marker

1. Press the [Channel] hard key followed by the [Markers] soft key to display the Markers group of commands.

2. Press the [Assign Act Mkr] soft key and select the marker to serve as the active marker.

Note: The active marker can also be set by pressing the [Set Up Markers] soft key to display the [Marker Set Up] dialog, selecting the required marker, and pressing the [Set as Active] soft key. The changes made to the active marker using either of these methods are reflected at both locations.

Positioning the Active Marker

There are two ways in which the position of the active marker can be changed.

Method 1

1. Press the [Channel] hard key followed by the [Markers] soft key to display the [Markers] group of commands.

2. Press the [Position Act Mkr...] soft key in the [Markers] group of commands and set the required marker position using the [Inc] and [Dec] soft keys, or the numeric keypad in the normal manner. If the [Position Act Mkr...] soft key is not available, press the [Active Marker] soft key to enable it.

Method 2

Use the right and left arrow keys on the numerical keypad to move the active marker on the active channel to the required position.

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Positioning the Delta Marker

Two methods are available to position the delta marker.
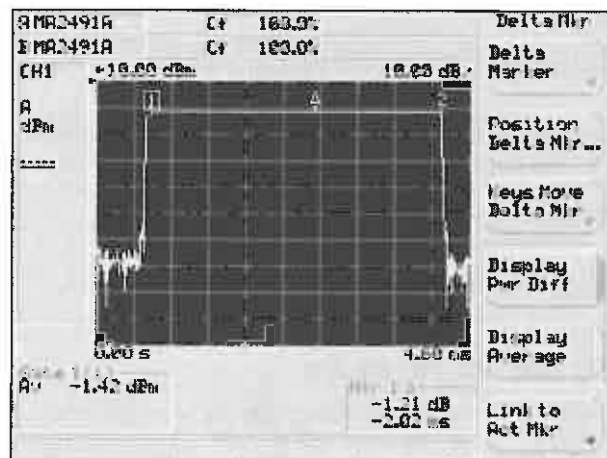
Method 1

1. Press the [Channel] hard key followed by the [Markers] soft key to display the [Markers] group of commands.

2. Press the [Delta Marker] soft key to display the [Delta Mkr] group of commands.

3. Press the [Delta Marker] soft key to enable the display of the delta marker. When the delta marker is visible the green LED on the [Delta Marker] soft key is lit.

4. Press the [Position Delta Mkr...] soft key to display the [Position Delta Marker] dialog.

5. Enter a value using the [Inc] and [Dec] soft keys, or from the keypad in the normal manner.

Method 2

1. Press the [Channel] hard key followed by the [Markers] soft key to display the [Markers] group of commands.

2. Press the [Delta Marker] soft key to display the [Delta Mkr] group of commands.

3. Press the [Delta Marker] soft key to enable the display of the delta marker. When the delta marker is visible the green LED on the [Delta Marker] soft key is lit.

4. Check that a green LED is visible on the [Keys Move Delta Mkr] soft key and then use the right and left arrow on the keypad to position the delta marker as required.

Note: The active marker is displayed automatically when the delta marker is enabled.

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Setting the Delta Marker Calculation

The delta marker can be used to show either of the following calculations:

- The difference in power level between the delta marker and the active marker.

- The average power between the delta marker and the active marker.

In both cases, the calculated value is shown on the screen at the active marker measurement readout. Follow the procedure below to select the required calculation.

1. Press the ▨▨▨▨ hard key followed by the Markers soft key to display the [Markers] group of commands.

2. Press the Delta Marker soft key and select either Display Pwr Diff or Display Average .

Linking the Delta Marker to the Active Marker

Follow the procedure below to link the delta marker to the movement of the active marker such that the time difference between the two remains constant.

1. Press the ▨▨▨▨ hard key followed by the Markers soft key to display the [Markers] group of commands.

2. Press the Delta Marker soft key followed by Link to Act Mkr . When the delta and active markers are linked in this manner, the LED on the soft key is lit green.

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Moving the Active Marker to the Maximum Point

1. Press the [Channel] hard key followed by the Markers soft key to display the [Markers] group of commands.

2. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

3. Press the Active to Max soft key.
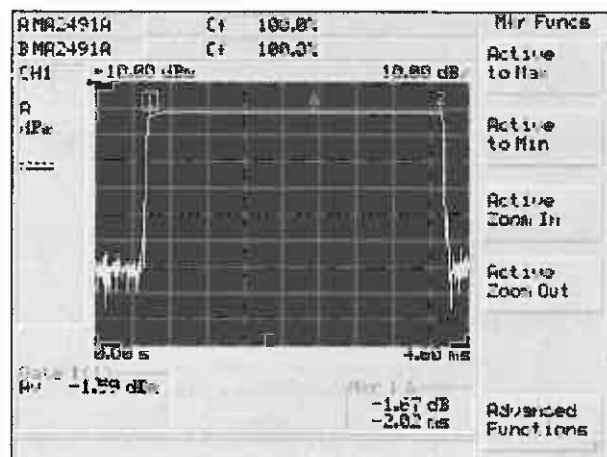
Moving the Active Marker to the Minimum Point

1. Press the [Channel] hard key followed by the Markers soft key to display the [Markers] group of commands.

2. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

3. Press the Active to Min soft key.

Zooming In or Out on the Active Marker

1. Press the [Channel] hard key followed by the Markers soft key to display the [Markers] group of commands.

2. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

3. Press the Active Zoom In or Active Zoom Out soft keys to zoom in or out around the active maker.

Note: The number of measurement points displayed is reduced each time the Active Zoom In soft key is pressed.

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Measuring the Pulse Rise Time

The rise time of the pulse that the active marker is currently position on can be calculated automatically as described below. The delta marker is set by default to the 90% linear power point on the rising edge, and the active marker is set to the 10% linear power point. These positions can be adjusted as required using the Search Set Up soft key. Refer to the *Setting the Search Target Levels* later in this chapter.

1. Ensure that the active marker is positioned on top of the pulse for which measurement is required. If it is not, use the right and left arrow keys on the numeric keypad to position the active marker as required.

2. Press the Channel hard key followed by the Markers soft key to display the [Markers] group of commands.

3. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

4. Press the Advanced Functions soft key to display the [Adv Funcs] group of commands.

5. Press the Pulse Rise Time soft key.
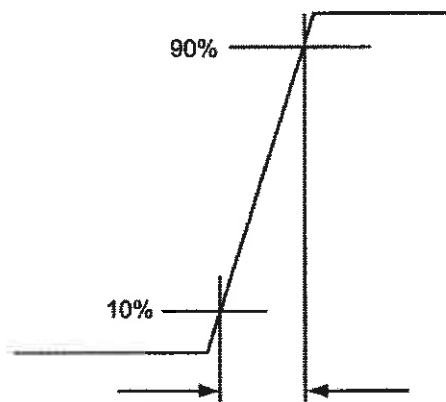
Note: Measurement is limited by a sampling resolution of 16 ns / point and a display resolution of 200 / 400 points. For the highest resolution, the power meter must be set to a capture time of 3.2 μs and 200 points, i.e. 200 x 16 ns = 3.2 μs, or 400 x 16 ns = 6.4 μs.

Measuring the Pulse Fall Time

The fall time of the pulse that the active marker is currently positioned on can be calculated automatically as described below. The delta marker is set by default to the 10% linear power point on the falling edge, and the active marker is set to the 90% linear power point. These positions can be adjusted as required using the Search Set Up soft key. Refer to the *Setting the Search Target Levels* later in this chapter.

1. Ensure that the active marker is positioned on top of the pulse for which measurement is required. If it is not, use the right and left arrow keys on the numeric keypad to position the active marker as required.

2. Press the ▢▢▢▢ hard key followed by the Markers soft key to display the [Markers] group of commands.

3. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

4. Press the Advanced Functions soft key to display the [Adv Funcs] group of commands.

5. Press the Pulse Fall Time soft key.
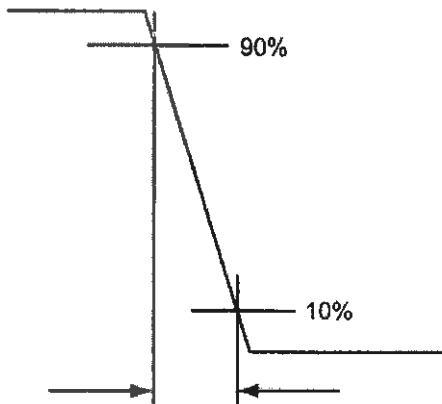
Note: Measurement is limited by a sampling resolution of 16 ns / point and a display resolution of 200 / 400 points. For the highest resolution, the power meter must be set to a capture time of 3.2 µs and 200 points, i.e. 200 x 16 ns = 3.2 µs, or 400 x 16 ns = 6.4 µs.

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Measuring the Pulse Width

The width of the pulse that the active marker is currently positioned on can be calculated automatically as described below. The delta marker is set to the 50% linear power point on the falling edge, and the active marker is set to the 50% linear power point on the rising edge.

1. Ensure that the active marker is positioned on top of the pulse for which measurement is required. If it is not, use the right and left arrow keys on the numeric keypad to position the active marker as required.

2. Press the [Channel] hard key followed by the Markers soft key to display the [Markers] group of commands.

3. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

4. Press the Advanced Functions soft key to display the [Adv Funcs] group of commands.

5. Press the Pulse Width soft key.
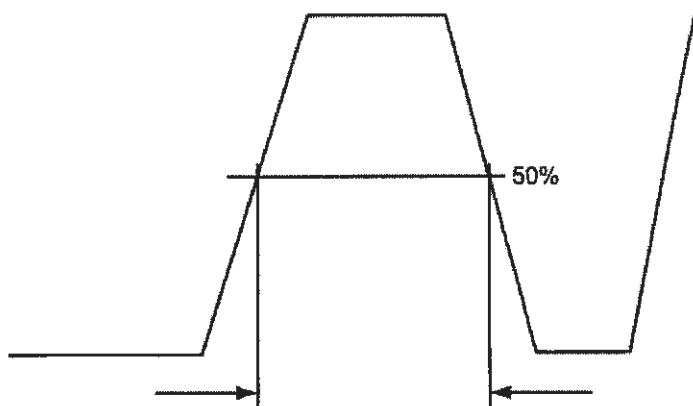
Measuring the Off Time

The off time of the pulse that the active marker is currently positioned on can be calculated automatically as described below. The active marker is set to the 50% point on the falling edge, and the delta marker is set to the 50% point on the rising edge of the next pulse.

1. Ensure that the active marker is positioned on top of the pulse immediately prior to the off time to be measured. If it is not, use the right and left arrow keys on the numeric keypad to position the active marker as required.

2. Press the [   ] hard key followed by the Markers soft key to display the [Markers] group of commands.

3. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

4. Press the Advanced Functions soft key to display the [Adv Funcs] group of commands.

5. Press the Off Time soft key.

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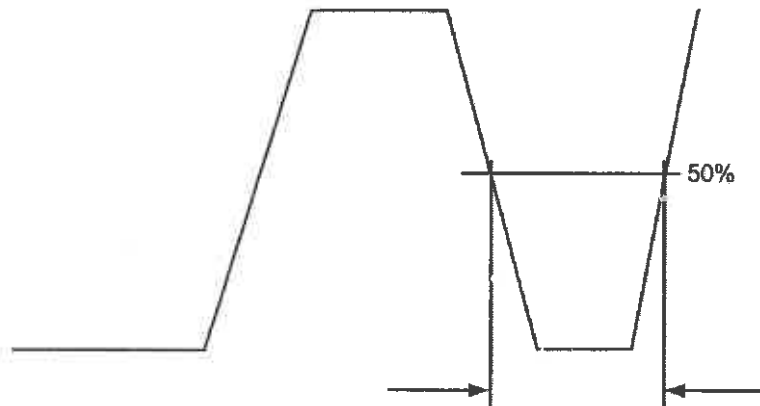
Measuring the Pulse Repetition Interval

The repetition interval of the pulse that the active marker is currently positioned on can be calculated automatically as described below. The active marker is set to the 50% point on the rising edge, and the delta marker is set to the 50% point on the rising edge of the next pulse.

1. Ensure that the active marker is positioned on top of the pulse to be included in the measurement. If it is not, use the right and left arrow keys on the numeric keypad to position the active marker as required.

2. Press the [Channel] hard key followed by the Markers soft key to display the [Markers] group of commands.

3. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

4. Press the Advanced Functions soft key to display the [Adv Funcs] group of commands.

5. Press the PRI soft key.

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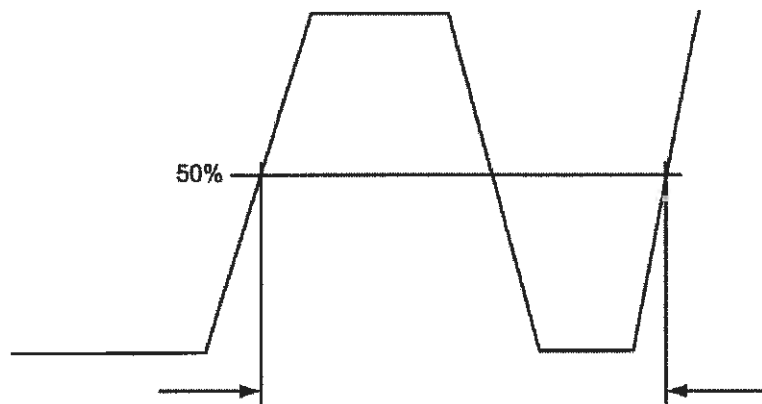
Setting the Search Target Levels

This function is used to set the upper and lower target levels for the pulse rise and fall time searches. It is also used to select the search start source.

1. Press the [＿＿＿＿] hard key followed by the Markers soft key to display the [Markers] group of commands.

2. Press the Marker Functions soft key to display the [Mkr Funcs] group of commands.

3. Press the Advanced Functions soft key to display the [Adv Funcs] group of commands.

4. Press the Search Set Up soft key to display the [Marker Search Set Up] dialog shown below.
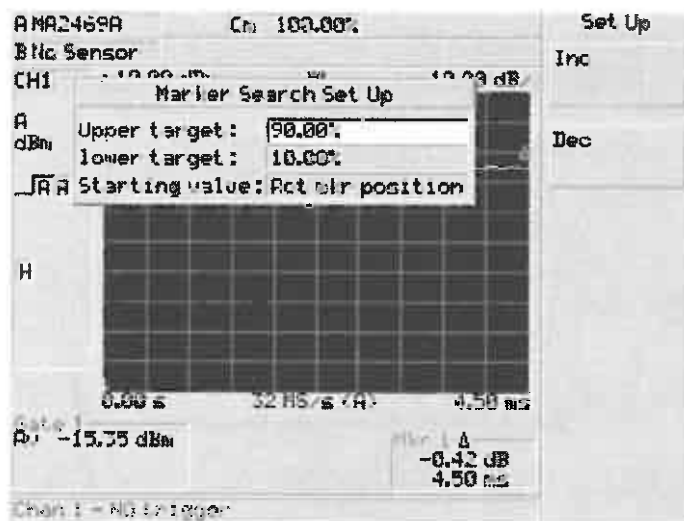
5. Use the up or down arrow keys to select the upper and lower target fields and enter a value using the Inc and Dec soft keys, or from the keypad in the normal manner.

6. Move down the "Starting value" field and set the source to be either the active marker position or active gate average.

Setting the Duty Cycle in CW Mode

This menu is used to set up and apply duty cycle correction to the currently active channel in CW mode.

1. Ensure that the currently active channel is set to CW mode.

2. Press the [Channel] hard key followed by the [Duty Cycle] soft key.

3. Press the [Set Duty Cycle] soft key to display the [Set Duty Cycle] dialog. Press [Sel] and enter the required duty cycle correction value from the keypad in the normal manner.

4. Press [Exit] and then press the [Duty Cycle] soft key to enable the setting. When the duty cycle setting is enabled, the LED on the soft key is lit green.

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Limits

Upper and lower limits can be used during measurement to check that the results of measurement fall within an acceptable range. Limits can be set up by using one of those already defined within the instruments firmware, or by creating either a simple or complex limit specification.

Creating and Viewing Simple Limits

A simple limit is one with only one segment and is thus shown on the profile as a straight line. The user can choose to set only an upper limit, only a lower limit, or both an upper and a lower limit. Simple limits can be used in both CW and Pulsed / Modulated modes.

1. Press the [░░░░░] hard key followed by the More soft key.

2. Press the Limit Checking soft key to display the [Lim Check] group of commands.

3. Press the Set Up soft key to display the [Limit Checking Set Up] dialog.
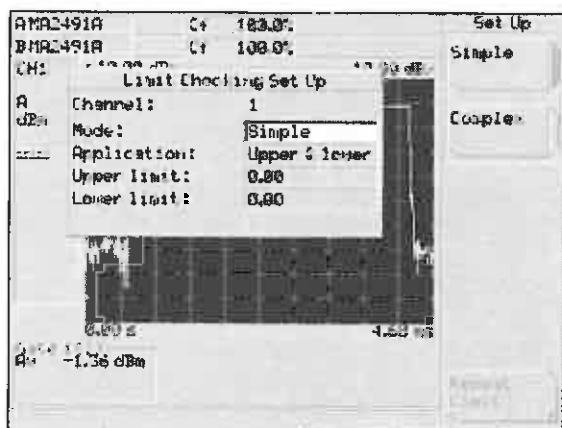
4. Make sure that the "Channel" item in the dialog is displaying the channel for which the limit settings are required. If the channel is incorrect, press the [░░░░░] hard key to change the active channel.

5. The "Mode" item is selected automatically when the dialog is opened. Select the Simple soft key.

6. Press the down arrow on the numeric keypad to select the "Application" item in the dialog and then use the soft keys to select either upper and lower limits, upper only, or lower only.

7. Press the down arrow on the numeric keypad to select the upper and / or lower limit setting item(s) in the dialog and enter the required value(s) using the Inc and Dec soft keys, or from the keypad in the normal manner. Press [Exit] when all settings are complete.

8. Press the Limit Checking soft key in the [Lim Check] menu to enable and display the limits on the screen. When limit checking is enabled, the green LED on the soft key is lit and the word "Limit" displays at the left side of the screen.

Creating and Saving Complex Limits

A complex limit is one with multiple segments that allow the user to change the limit at, for example, different points in time along a GSM burst. Each segment within the complex limit is defined by specifying a point in time relative to the trigger point and an associated power level. Complex limits cannot be used in CW mode.

Note: Once created and saved in the manner described below, the user can recall any of the limit specifications and use the time and amplitude offset items to shift the limit lines to a different time or amplitudinal position on the trace. Refer to *Recalling User or Predefined Complex Limits*.

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1. Press the [Channel] hard key followed by the [More] soft key.

2. Press the [Limit Checking] soft key to display the [Lim Check] group of commands.

3. Press the [Edit Limit Spec] soft key to display the [Edit Limit Specification] dialog.

4. Press the [Edit Segments] soft key to display the [Edit Seg] group of commands and then press the [Add Segment] soft key. When the [Add Segment] soft key is pressed the first field in the limit specification table is highlighted for user entry.

5. Enter a start time from the keypad in the usual manner and then press the right arrow on the keypad to enter an upper and / or lower limit value as required.

Note: The upper and lower values specified in the [Edit Limit Specification] dialog are unitless and reference the units specified in the [Channel Set Up] dialog. Refer to *Setting the Units of Measurement* earlier in this chapter.

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6. Press the down arrow on the keypad and enter the settings for the Stop point on the first segment. Repeat this process until all the required segments have been specified.

7. Press the [Back] key and then press the [Edit Title] soft key. Enter a title from the keypad and press [Enter].

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8. Press the ⌜Save Spec⌝ soft key followed by the ⌜Save as⌝ soft key. Use the hard or soft key arrows to select a vacant slot within the [User Limits] dialog, and then press ⌜Select⌝ .

9. Press [Exit] to close the specifications table and then press the ⌜Set Up⌝ soft key to open the [Limit Checking Set Up] dialog.

10. Select the limit settings by setting the "Mode" item to 'Complex". Use the down arrow to select the "Specification id" item, press the ⌜User Limit Spec⌝ soft key and select the specification saved in step 8 above.

11. Press [Exit] to close the dialog and then press the ⌜Limit Checking⌝ soft key to display the limits on the screen. When limit checking is enabled, the green LED on the soft key is lit and the word "Limit" displays at the left side of the screen.

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Recalling User or Predefined Complex Limits

Once created and saved in the manner described above, the user can quickly and easily recall any of the limit specifications. In addition to the user defined specifications, a number of predefined limit specifications are also available.

1. Press the [Channel] hard key followed by the More soft key.

2. Press the Limit Checking soft key to display the [Lim Check] group of commands.

3. Press the Set Up soft key to display the [Limit Checking Set Up] dialog.

4. The "Mode" item is selected automatically when the dialog is opened. Select the Complex soft key.

5. Press the down arrow on the numeric keypad to select the "Application" item in the dialog and then use the soft keys to select to create either upper and lower limits, upper only, or lower only.

6. Press the down arrow on the numeric keypad to select the "Specification id" item in the dialog and then use the soft keys to select either User Limit Spec or Predefined Limit Spec. The difference between these two spec options is explained below.

Setting Item	Meaning
User Limit Spec	Selecting User Limit Spec opens a [User Limits] dialog from which the user can select any of up to 30 settings created and saved in the manner described on the previous page. Once loaded, the limit settings can be edited and resaved as required.
Predefined Limit Spec	Selecting Predefined Limit Spec opens a [Predefined Limits] dialog from which the user can select any of a number of predefined limit settings. Once loaded, the limit settings can be edited and saved under a different name to a vacant slot in the [User Limits] dialog.

8. Use the soft key arrows, or the arrows on the keypad, to select the required User or Predefined limit from the dialog and press the Select soft key. The slot number of the selected item displays within the "Specification id" field followed by either "(User)" or "(Predefined)". The required limit specification can also be selected by highlighting the "Specification id" field, pressing [Sel] on the keypad and entering the slot number of the specification to be used. After entering the slot number, select either the User or Predefined soft key to complete entry at this field.

9. Press the down arrow on the numeric keypad to select the "Amplitude offset" and "Time offset" items in the dialog. Enter a value as required using the Inc and Dec soft keys, or at the numeric keypad in the normal manner. The offset items are used to shift the limit lines to a different time or amplitudinal position on the trace without forcing the user to recalculate and respecify each of the segment points in turn.

10. Press the [Exit] key to close the dialog and then press the Limit Checking soft key in the [Lim Check] menu to enable and display the limits on the screen. When limit checking is enabled, the green LED on the soft key is lit and the word "Limit" displays at the left side of the screen.

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Editing Complex Limits

User generated limit settings can be opened, edited as required, and then resaved or saved under a different name.

Predefined limits can be opened and edited and saved under a new name to a vacant slot in the [User Limits] dialog. Predefined limits cannot be overwritten.

1. Press the [   ] hard key followed by the More soft key.

2. Press the Limit Checking soft key to display the [Lim Check] group of commands.

3. Press the Edit Limit Spec soft key to display the [Edit Limit Specification] dialog.

4. Press the Select Spec soft key and select either User Limit Spec or Predefined Limit Spec.

5. Use the soft key arrows, or the arrows on the keypad to select the required User or Predefined limit from the dialog and press the Select soft key. The values for the limit specification now display within the table.

Note: The value of −999.00 is used in the specification above to ensure that a lower limit failure is not needlessly generated at certain points on the trace.

6. Press the Edit Segments soft key and then edit the values from the keypad as required.

7. When editing is complete, press [Back] and then press the Save Spec soft key.

8. Use the Save or Save As options to save the changes made.

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Repeating Limits

Complex limits can be repeated up to 8 times.

1. Press the [Channel] hard key followed by the [More] soft key.

2. Press the [Limit Checking] soft key to display the [Lim Check] group of commands.

3. Press the [Set Up] soft key to display the [Limit Checking Set Up] dialog.

4. Select the complex limit specification to be repeated by making the required settings in the [Limit Checking Set Up] dialog as detailed on the previous pages.

5. Press the [Repeat Limit] soft key to display the [Repeat Limit] dialog. Enter the number of repeats required (2 to 8) and a time and / or amplitude offset to be used between each repeat.

6. Press the [Repeat Limit] soft key to enable the repetition when the limits lines are displayed on screen. When limit repeating is enabled, the green LED on the soft key is lit

7. Press [Exit] to close each dialog in turn and press the [Limit Checking] soft key to display the limits and repetitions on screen.

Holding the Limit Fail Indicator

Fail Hold can be used to prevent the "Fail" flag in the channel information area reverting to "Pass" if subsequent measurements fall back within the limit specifications.

1. Press the [Channel] hard key followed by the More soft key.

2. Press the Limit Checking soft key to display the [Lim Check] group of commands.
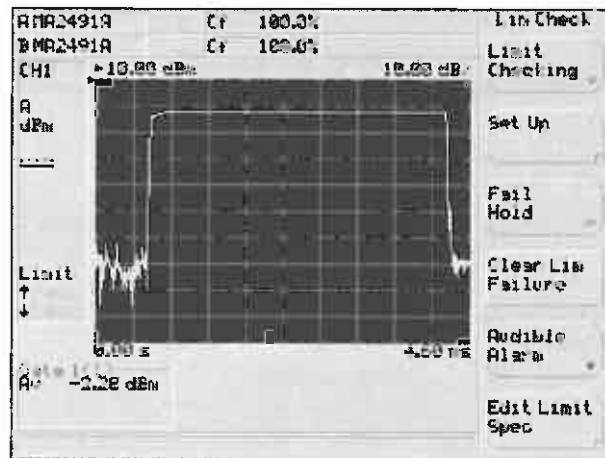
3. Press the Fail Hold soft key. When this function is enabled, the green LED on the soft key is lit. If the results of measurement fall outside any of the specified limits the word "Fail" displays in the limit area at the left side of the screen.

4. In the event of a limit failure, the user can press the Clear Lim Failure soft key to set the pass/fail flag back to "Pass".

Sounding an Alarm on Limit Failure

If simple or complex limits have been enabled as described on the previous pages, the use can chose to sound an alarm if the results go outside any of the specified limits.

1. Press the [Channel] hard key followed by the More soft key.

2. Press the Limit Checking soft key to display the [Lim Check] group of commands.

3. Press the Audible Alarm soft key. When this function is enabled, the green LED on the soft key is lit. If the results of measurement fall outside any of the specified limit(s) an alarm is sounded to alert the user to the limit failure.

Adjusting and Resetting the Trace Measurement Scale

1. Press the [Channel] hard key followed by the More soft key.

2. Press the Scaling soft key to display the [Scaling] group of commands.

3. The reference level and scale can be set by selecting either Set Ref or Set Scale
    and using the Inc and Dec soft keys, or by pressing [Sel] and then entering a number
    at the keypad.

4. The Autoscale command within the [Scaling] menu can be used at any time to
    automatically set the reference level and scale such that the whole of the trace can
    be displayed.

Note: The commands relating to scaling are only available when the measurement
display setting for the active channel is set to profile.
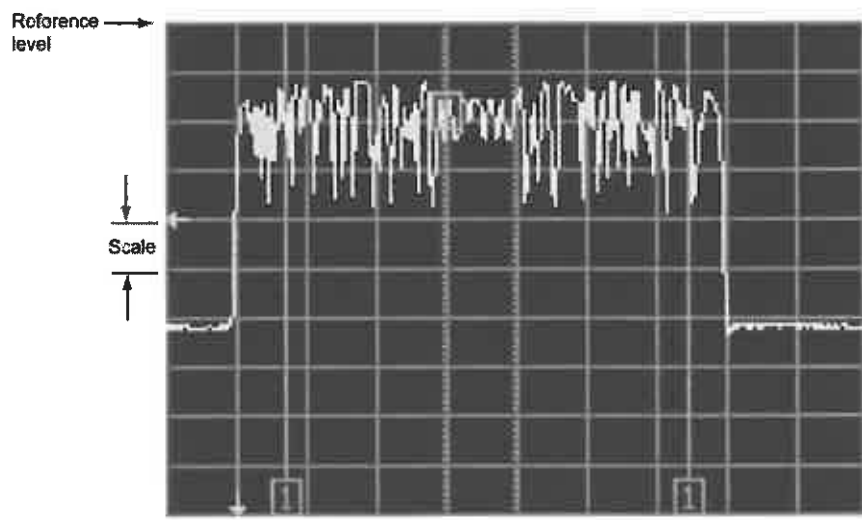
Setting the Profile Display Style

The digital signal processor uses a number of algorithms to determine how the measurements made are processed and thereafter displayed on the screen as one of the points on the profile display. By default each point on the profile represents the average of multiple measurements although this can be changed by the user to show the minimum, the maximum, or both.

1. Press the [Channel] hard key followed by the [More] soft key.

2. Press the [Profile Display] soft key to display the [Prof Disp] group of commands.

3. Press the soft keys to select either average, Avg, Min & Max, Min, or Max. The profile is updated automatically when the user switches between display options. The icon at the top of the screen is used to illustrate the mode that is currently active. The figure below illustrates the affect of changing the profile display mode on a simple pulse.
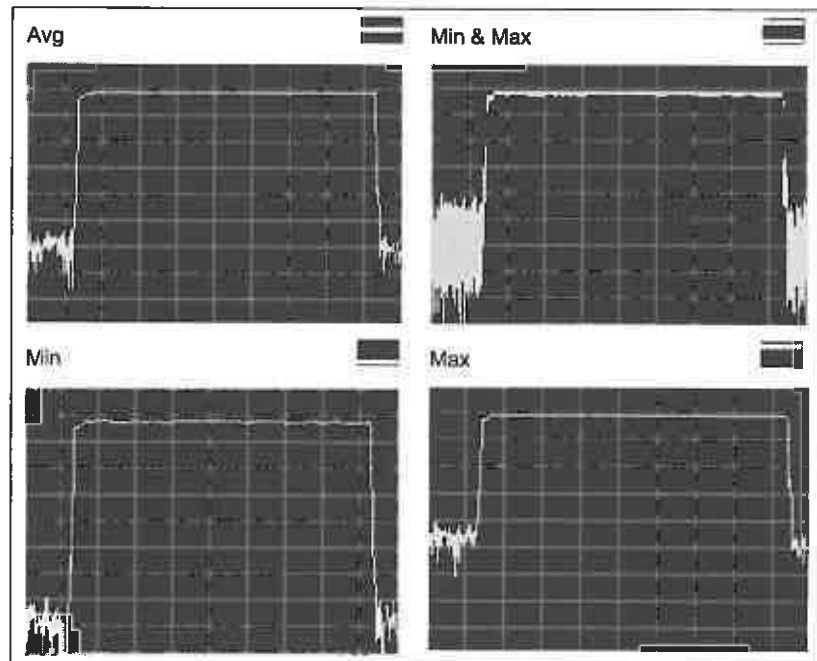
Note: The average, min, and max display settings are represented on the profile as a single line. The min & max setting is displayed as a series of vertical lines showing the maximum and minimum values at each measurement point.

Setting the Profile Display Data Hold Method

1. Press the [Channel] hard key followed by the More soft key.

2. Press the Profile Display soft key to display the [Prof Disp] group of commands.

3. Press the Data Hold soft key to display the [Data Hold] group of commands.

Note: The Data Hold soft key in not available if profile display setting detailed on the previous page is set to Avg.

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4. Use the soft keys to select either single or infinite data holding. Refer to the table below.

Item	Meaning
Single	The profile trace display uses the minimum and maximum measurement point values from each sweep.
Infinite	The minimum and maximum measurement point values are tracked over time. The values are stored from the time that the function is turned on until the time that it is turned off or the values are reset by pressing the Reset soft key. When "Infinite" is selected, a "D" appears in channel information section on the screen. Refer to the "Channel Information" explanation in chapter 4 of this manual.

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Holding Measurement Data in the Currently Active Channel

1. Press the [░░░░░] hard key followed by the More soft key.

2. Press the Meas Hold soft key to hold the measurement data in the currently active channel. The measurement data is not updated whilst being held in this manner. The LED on the soft key is lit green when measurement hold functionality has been enabled.

Note: When measurement data is being held as described above, an "H" appears in the channel information section of the screen. Refer to the "Channel Information" explanation in chapter 4 of this manual.

Setting the Peaking Indicator

The Peaking Indicator soft key is only available when the measurement display for the active channel is set to "Readout". It can be used in CW or pulsed / modulated mode, but in pulsed / modulated mode, only the average measurement is used.

1. Press the [░░░░░] hard key followed by the More soft key.

2. Press the Peaking Indicator soft key to display the [Peak Ind] group of commands.

3. Press the Peaking Indicator soft key to enable the peaking indicator bar on the readout display. The green LED on the soft key is lit when this function is enabled.
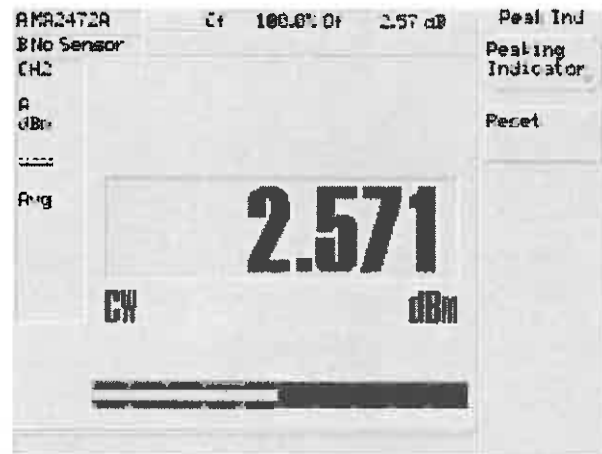
4. Press the Reset soft key as required to set the indicator bar to the center of the 10 dB range with 5 dB at either side of the centralized point.

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Post Processing

The post processing related soft keys allow statistical analysis or PAE of the measurement data for the currently active channel.

1. Press the [Channel] hard key followed by the More soft key.

2. Press the Post Process soft key to display the [Post Proc] group of commands.

3. Press the Post Process soft key to turn post processing functionality on. When post processing is enabled, the LED on the soft key is lit green and statistical or PAE information displays in the section of the screen that is normally reserved for gating related information. (Refer to the screen explanation is chapter 4 of this manual.)

4. Press the Set Up soft key to display the [Post Processing Set Up] dialog shown below.
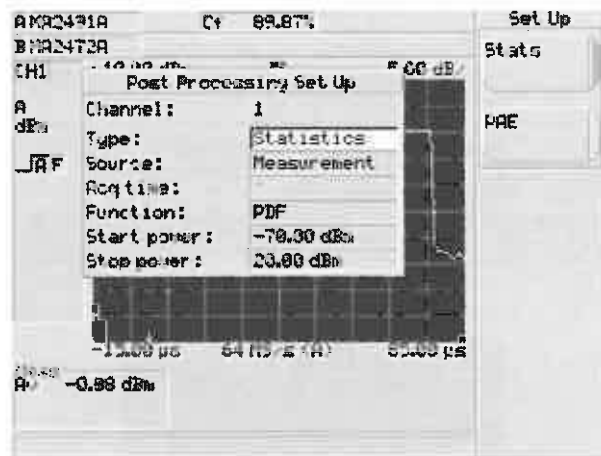
5. The [Post Processing Set Up] dialog opens with the "Type" item pre-selected. There are two options available at this item, the meanings of which are detailed in the table below. Select the required setting.
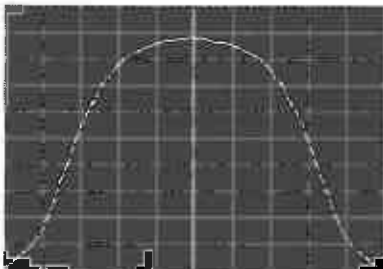
Setting	Meaning
Stats	Used to display statistical analysis of the measurement data.
PAE	Used for measuring the power added efficiency of amplifiers.

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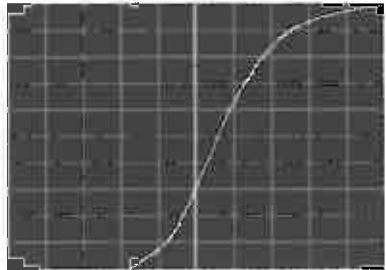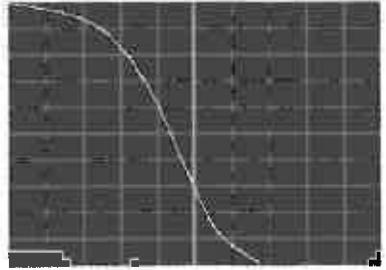
Statistical Post Processing

1. Select the "Type" item in the [Post Processing Set Up] dialog and press the [Stats] soft key.

2. Press the down arrow on the numeric keypad to select the "Source" item. There are three options available at this item, the meanings of which are detailed in the table below. Select the required setting.

Setting	Meaning
Meas	This sets the source for post processing to be the average of the data acquired over the capture time of the measurement.
Active Gate	This sets the source for post processing to be the average of the data within the active measurement gate. A measurement gate must be activated to enable this key.
Active Marker	This sets the source for post processing to be the data at the active marker position. The active marker must be displayed to enable this key.

3. Press the down arrow on the numeric keypad to select the "Function" Item. Again, there are three options available at this item, the meanings of which are detailed in the table below. Select the required setting.

Setting	Meaning
PDF	Applies a Probability Density Function to the data, displaying a plot of percentage of samples against possible measurement values.
CDF	Applies a Cumulative Density Function to the data, displaying a plot of the percentage of samples in which measurements lie *at or below* a given value.

CCDF	Applies a Complementary Cumulative Density Function to the data, displaying a plot of the percentage of samples in which measurements lie *at or above* a given value.

4. Press the down arrow on the numeric keypad to select the "Start Power" and "Stop Power" items. Use the Inc and Dec soft keys or the numeric keypad to enter a start and stop power value over which the selected data will be plotted.

PAE Post Processing

The PAE setting is available on the ML2488A and ML2496A only. It allows the user to display the power added efficiency of an amplifier connected to the sensors on the A and B inputs on the front of the power meter. Once set up and enabled, PAE is calculated and displayed automatically using the formula detailed below.

$$\left(\frac{\text{Linear output power} - \text{Linear input power}}{\text{Bias voltage} \times \text{Bias current}} \right) \times 100\%$$

1. Select the "Type" item in the [Post Processing Set Up] dialog and press the $\boxed{\text{PAE}}$ soft key.

2. Press the down arrow on the numeric keypad to select the "Source" item. There are three options available at this item, the meanings of which are detailed in the table below. Select the required setting.

Setting	Meaning
Meas	This sets the source for post processing to be the average of the data acquired over the capture time of the measurement.
Active Gate	This sets the source for post processing to be the average of the data within the active measurement gate. A measurement gate must be activated to enable this key.
Active Marker	This sets the source for post processing to be the data at the active marker position. The active marker must be displayed to enable this key.

3. Press the down arrow on the numeric keypad to select the "Input config" item. Select either $\boxed{\text{A-B}}$ or $\boxed{\text{B-A}}$ depending on the connector configuration in use.

4. Press the down arrow on the numeric keypad to select the "Bias voltage" item. Specify the voltage being applied to the amplifier by pressing the $\boxed{\text{Inc}}$ and $\boxed{\text{Dec}}$ soft keys, or by pressing [Sel] and then entering a number at the keypad.

5. Press the down arrow on the numeric keypad to select the "Current source" item. There are two options available at this item, the meanings of which are detailed in the table below. Select the required setting.

Setting	Meaning
Fixed	Select this setting if the current of the amplifier is fixed. When the $\boxed{\text{Fixed}}$ soft key is pressed, the final item in the [Post Processing Set Up] dialog box changes to "Bias current". Select this item and enter the current in the normal manner.
Probe	Select this setting when using a current probe on the V/GHz input on the rear of the ML2488A to measure the voltage of the amplifier. When the $\boxed{\text{Probe}}$ soft key is pressed, the final item in the [Post Processing Set Up] dialog box changes to "Conv factor". Select this item and enter the conversion factor that will be used to convert the acquired voltage to a current.

6. Press the [Exit] hard key to close the dialog and display the PAE percentage reading. The PAE display can be turned on and off by pressing the $\boxed{\text{Post Process}}$ soft key.

Note: When PAE is enabled, the input configuration of the ML2488A / ML2496A is automatically set to "A-B". This configuration is maintained even when PAE is subsequently disabled and as a result, trace and redout data will be unavailable if only one sensor is attached at this time. The input configuration can be reset as required by selecting the following sequence of commands, [Channel] > [Set Up] > "Input config".

Setting the Cursor Position

With the post processing set-up complete as described above and the selected plot being displayed, the user can now position the cursor as described below.

1. Press the [Channel] hard key followed by the [More] soft key.

2. Press the [Post Process] soft key to display the [Post Proc] group of commands.

3. Press the [Cursor] soft key to display the [Cursor] group of commands.

4. Press the [Set Cursor Position] soft key and enter the required position using the [Inc] and [Dec] soft keys or the numeric keypad.

Zooming In or Out on the Cursor Position

1. Press the [Channel] hard key followed by the [More] soft key.

2. Press the [Post Process] soft key to display the [Post Proc] group of commands.

3. Press the [Cursor] soft key to display the [Cursor] group of commands.

4. Press the [Zoom In] or the [Zoom Out] soft key to redraw the trace centered on the cursor position.

Sensor

Setting Up the Sensor in Use

1. Press the [Sensor] hard key and then the [Set Up] soft key to display the [Sensor Set Up] dialog.
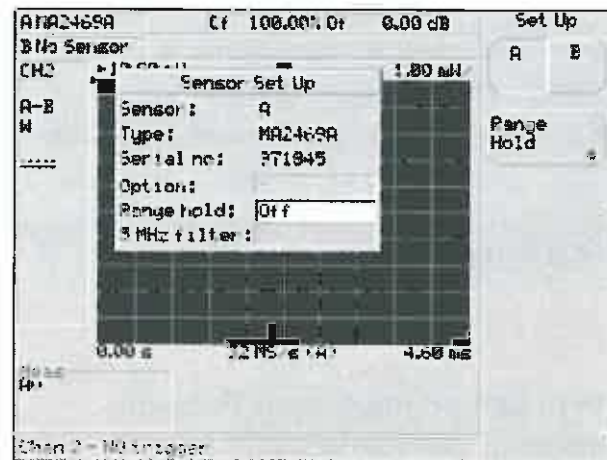
2. The first three items within the [Sensor Set Up] dialog provide details of the current sensor configuration. The "Sensor" item gives the name of the sensor input that is currently selected. The "Type" item gives the type of sensor attached to the currently selected input. The "Serial no" item gives the serial number of the attached sensor.

3. Check that the "Sensor" item is displaying the correct input, and if not, press the [A/B] soft key to change the input as required.

4. Use the down arrow on the numeric keypad to select the "Range Hold" item. This field is used to hold the sensor attached to the input to a specified range. Enter the range by pressing [Sel] and entering a value in the normal manner.

5. Press the [Range Hold] soft key to enable range holding for the selected sensor. When enabled, the most recent range value is used and displayed in the "Range Hold" entry field.

6. Press the down arrow on the numeric keypad to select the "5 MHz filter" item. This field is available only when a wideband sensor (MA2490A, MA2491A) is attached to the specified input. Press the soft key to turn the filter on or off as required.

7. Press the [Exit] key on the keypad to close the [Sensor Set Up] dialog and revert to the previous page of commands.

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Setting the Calibration Factor Applied to the Sensor

1. Press the [Sensor] hard key and then the [Cal Factor] soft key to display the [Cal Factor] dialog.
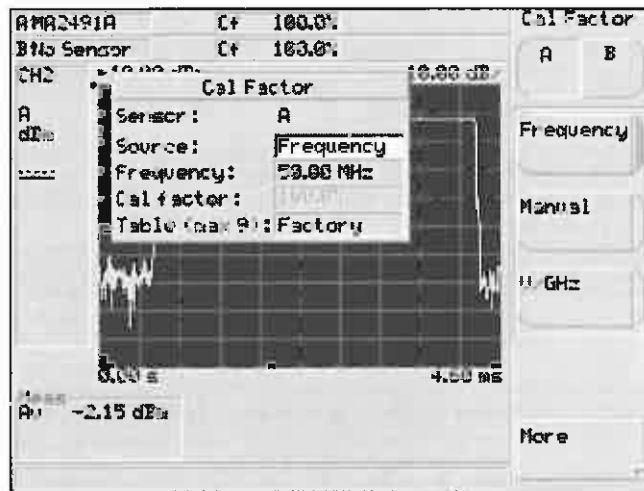
2. Check that the sensor input displayed at the "Sensor" item in the dialog is correct. The sensor input can be changed by pressing the [A/B] soft key.

3. Use the soft keys to select the source of the calibration factor to be used for the selected sensor. Refer to the table below.

Setting	Meaning
Frequency	Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the user's input frequency.
Manual	A user-entered value is used for the correction data.
V/GHz	Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on a frequency derived from the voltage present on the rear panel input connector. This key is unavailable if either measurement channel is using the external voltage as its input configuration.

4. Press the down arrow on the numeric keypad to select the "Frequency" entry field. This item is used to select the input signal frequency to be used when the calibration factor source mode is set to either "Frequency" or "Manual". If the "Source" item is set to "V/GHz" jump to step 7 in this procedure.

5. Enter a frequency value using the [Inc] and [Dec] soft keys, or at the numeric keypad in the normal manner.

6. Press the down arrow on the numeric keypad to select the "Cal Factor" entry field. This sets the calibration factor to be applied when the source mode is set to "Manual". Enter a percentage or dB calibration factor value using the Inc and Dec soft keys, or at the numeric keypad in the normal manner. If the "Source" item is not set to "Manual" jump to step 7 in this procedure.

7. Press the down arrow on the numeric keypad to select the last item in the [Cal Factor] dialog. This item differs depending on the setting at the "Source item".

    "Source" = "Frequency" or "V/GHz"

    If "Source" is set to "Frequency" or "V/GHz", the "Table (max *x*)" item displays. This item is used to select the calibration factor table to be used with the sensor attached to the selected input. Press [Sel] on the keypad to display the [Table Id] group of commands as detailed below.

Item	Meaning
Enter	The user can select any table that they have previously created and saved. Enter the number of the required table at the keypad and press Enter when complete.
Factory	Press the Factory soft key instead of entering a table number from the keypad. The calibration table supplied from the factory is used.
Factory +	Enter the number of the required table at the keypad and then press Factory + to use the factory supplied calibration factor table in combination with the currently selected table.

Note: The maximum number of tables available displays in parenthesis after the word "Table". If the user specifies a completely blank table that has never been used, a message displays requesting that the table be either cleared or preset to the factory data. Refer to *Editing Cal Factor Tables* later in this chapter for details of how to edit and create user cal factor tables as mentioned above.

"Source" = "Manual"

If "Source" is set to "Manual", the "Cal adjust" item displays as the last item in the [Cal Factor] dialog. Enter a percentage or dB adjustment value at the keyboard in the normal manner.

Setting the Power Offset Applied to the Sensors

A power offset can be applied to the sensor in the manner described below.

1. Press the ⬛Sensor⬛ hard key and then the [Offset] soft key to display the [Offset] dialog.

2. Check that the correct sensor (A or B) is selected.

3. The dialog opens with the "Type" field pre-selected for user entry. Select the offset type required from the soft keys as detailed below.

Item	Meaning
Off	No offset is applied to the sensor. This is the default setting.
Fixed	A fixed value specified by the user is applied to the sensor. Press the down arrow on the keypad to select the "Offset" item in the dialog and then enter the offset using the [Inc] and [Dec] soft keys, or at the numeric keypad in the normal manner.
Table	The offset value applied is derived from the table that the user has selected. When "Table" is selected the "Table" item is enabled in the dialog, enabling the user to enter a table number from the keypad or press [Select Table] and make a selection from the dialog. Refer to *Editing the Sensor Offset Tables* later in this chapter.

Note: A positive offset adds a value to the power readings and can be used to compensate for attenuators, couplers, limiters, and other lossy devices. A negative value subtracts a value from the power reading and can be used to compensate for amplification in the measurement path.

Editing Cal Factor Tables

This section explains how to edit or create cal factor tables as mentioned in the section titled, *Setting the Calibration Factor Applied to the Sensor* earlier in this chapter.

1. Press the [Sensor] hard key followed by the Edit Tables and Edit CF Table soft keys to display the [Edit Cal Factor Table] dialog.
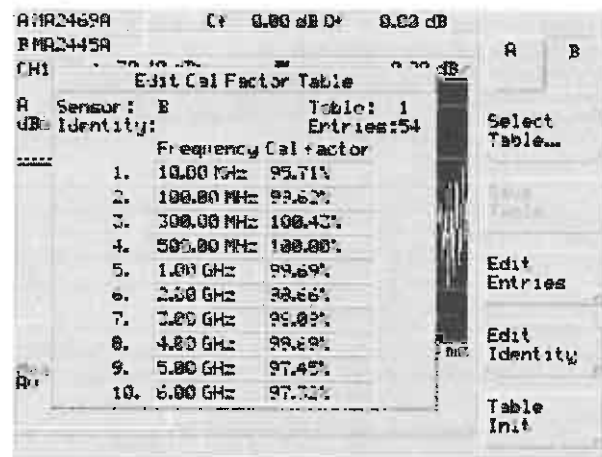
2. The table number is indicated in the top right hand corner of the dialog. If the table is not correct, press the Select Table.. soft key and enter the required table number from the keypad in the normal manner.

3. Press the Edit Entries soft key to highlight the upper left cell in the table. Use the arrow keys on the keypad to select the cell to be changed, press [Sel] and enter a new value in the normal manner. The soft keys that display when the [Edit Cal Factor Table] is open allow the user to navigate between cells and page the list up and down.

Note: To clear a table completely, press Table Init followed by Clear Table . All data in the table is cleared except for the first line. The Preset Table command that also displays on this page can be used to set the table in question to the factory default setting.

---

4. When editing is complete, press [Back] and then press the Save Table soft key to save the changes made.

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Creating New Cal Factor Tables

1. Press the [Sensor] hard key followed by the Edit Tables and Edit CF Table soft keys to display the [Edit Cal Factor Table] dialog.

2. Press the Select Table.. soft key and enter a number from the keypad of one of the available blank tables. If no blank tables are available, the user can select a table that is no longer required and clear all entries in that table by pressing the Table Init soft key followed by Clear Table .

Note: As the tables are stored within the sensor itself rather than the ML248xA / ML249xA, the number of tables available to the user varies depending on the sensor model. When the Select Table.. soft key is pressed, the maximum number of tables available displays in parenthesis in the [Select Table] dialog. This information can also be seen in the [Cal Factor] dialog when the "Source" item is set to "Frequency" or "V/GHz".

---

3. Press the Edit Entries soft key followed by Add Entry to highlight the uppermost cell in the "Frequency" column of the table. Enter a value from the keypad in the normal manner and then use the arrows on the keypad to select the adjacent "Cal Factor" cell.
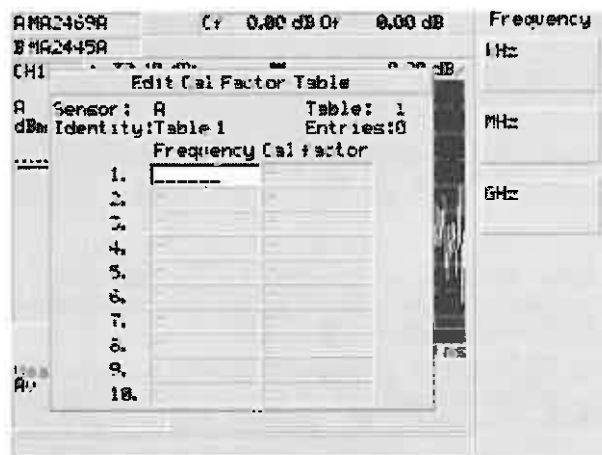
4. When a cal factor value has been entered, press the Add Entry soft key again to move to the next row and repeat this process until all the required entries have been made.

Note: The maximum number of entries that can be made in each table is again determined by the frequency range of the sensor in use. Sensors of up to 40 GHz can have up to 90 entries in each table, 50 GHz sensors can have up to 110 entries, and 65 GHz sensors can have up to 130 entries.

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5. Press the [Back] key on the keypad to display the previous page of soft keys, and press Save Table to save the entries in the new table.

6. The table can also be given a name by pressing the Edit Identity soft key and entering a name from the keypad in the normal manner. When specified, the table name displays in the [Edit Cal Factor Table] dialog to the right of the word "Identity".

Editing the Sensor Offset Tables

This function is used to edit the offset tables stored in the instrument.

1. Press the [Sensor] hard key followed by the [Edit Tables] and [Edit Offset Tbl] soft keys to display the [Edit Offset Table] dialog shown below.

2. The table number and the number of entries in it are indicated on the top line of the dialog. If the table is not correct, press the [Select Table..] soft key and select the required table from the list in the normal manner.

3. Press the [Edit Entries] soft key to highlight the upper left cell in the table. Use the arrow keys on the keypad to select the cell to be changed, press [Sel] and enter a new value in the normal manner. The soft keys that display when the [Edit Offset Table] is open allow the user to navigate between cells and page the list up and down.

Note: To clear a table completely, press [Clear Table]. All data in the table is cleared.

4. When editing is complete, press [Back] on the numeric keypad and then press the [Save Table] soft key to save the changes made.

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Creating New Sensor Offset Tables

New offset tables can be created by following the procedure below.

1. Press the Sensor hard key followed by the Edit Tables and Edit Offset Tbl soft keys to display the [Edit Offset Table] dialog.

2. Press the Select Table.. soft key and enter a number from the keypad of one of the available blank tables. If no blank tables are available, the user can select a table that is no longer required and clear all entries in that table by pressing the Clear Table soft key.

3. Press the Edit Entries soft key followed by Add Entry to highlight the uppermost cell in the "Frequency" column of the table. Enter a value from the keypad in the normal manner and then use the arrows on the keypad to select the adjacent "Offset" cell.
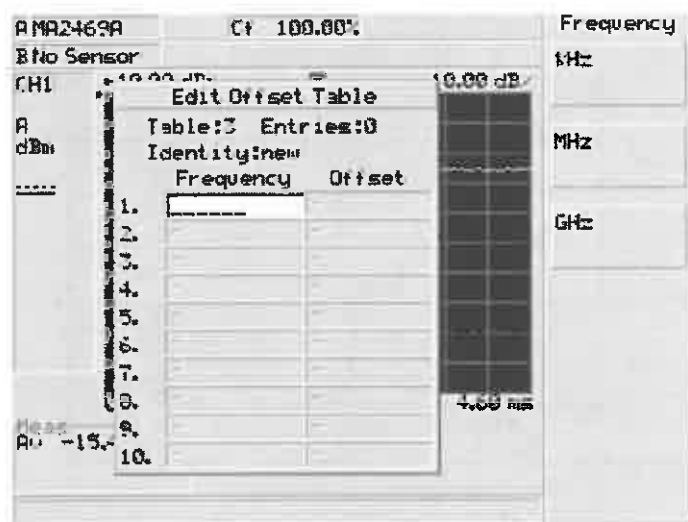
4. When an offset value has been entered, press the Add Entry soft key again to move to the next row and repeat this process until all the required entries have been made.

Note: Up to 200 entries can be made in each table.

5. Press the [Back] key on the keypad to display the previous page of soft keys, and press Save Table to save the entries in the new table.

6. The table can also be given a name by pressing the Edit Identity soft key and entering a name from the keypad in the normal manner. When specified, the table name displays at the table item in the [Offset] dialog after pressing Sensor followed by Offset .

Note: A positive offset adds a value to the power readings and a negative value subtracts a value from the power reading.

Holding Sensors on the Current Range

1. Press the ▊▊▊▊ hard key and then the Range Hold soft key.

    If the sensors are auto-ranging when the soft key is pressed, the sensors are held on their current range. If the power meter is an ML2488A and one sensor is currently held on a range, pressing Range Hold will cause the other sensor to be held to its current range as well. If range hold is already enabled for both sensors, pressing Range Hold will set them back to auto-ranging. The LED on the soft key is lit green when a sensor range is being held.

    Typical range hold values for the MA2472B power sensor and the MA2491A wideband sensor are shown in the table below.

Mode	Range		MA2472B	MA2491A
CW	1	top	+20dBm	+20dBm
		bottom	-13	-7
	2	top	-12	-6
		bottom	-27	-20
	3	top	-25	-19
		bottom	-43	-36
	4	top	-42	-35
		bottom	-58	-53
	5	top	-57	-52
		bottom	-72	-67
	6	top	Reserved for "True RMS" sensors.	
		bottom		
Pulsed/ Modulated	7	top	20	20
		bottom	0	5
	8	top	1	6
		bottom	-13	-8
	9	top	-12	-7
		bottom	-34	-28

Notes:

*   The figures in the MA2472B column apply to all standard diode and thermal sensors.
*   The figures in the MA2491A column apply also to the MA2411A.
*   The figures in the table above were obtained with a 1GHz CW input signal.
*   All values are approximate and are provided for guidance only. They will vary between individual sensors, with frequency and with modulation conditions.
*   Ranges 7 to 9 have large overlaps in range hold to extend the range of signals with deep modulation that can be accommodated in a single range.

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Cal/Zero

Zeroing the Sensor

Zeroing the power sensor is vital to remove any residual DC offset on the sensor/meter combination, and to minimize noise.

1.   Connect the sensor to the device under test, making sure that RF is not being supplied.

2.   Press the Cal/Zero hard key.

3.   Press the Zero soft key followed by Zero Sensor A or Zero Sensor B
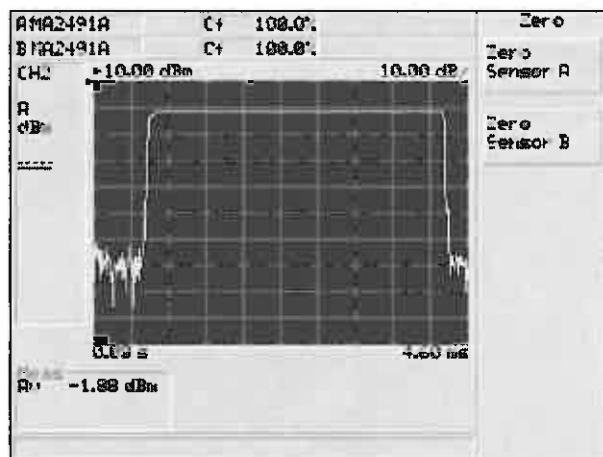
4.   A dialog displays to indicate that the sensor is being zeroed and the message "Sensor x zero....." displays in the status bar at the bottom of the screen.

Zeroing and Calibrating the Sensor

1.   Connect the sensor to the "CALIBRATOR" connector on the front of the ML248xA / ML249xA.

2.   Press the Cal/Zero hard key.

3.   Press the Zero & Cal soft key followed by Zero & Cal Sensor A or Zero & Cal Sensor B

4.   A dialog displays to indicate that the sensor is being zeroed and calibrated and a message displays in the status bar at the bottom of the screen.

Note: Sensor selection is not required on the ML2487A.

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Performing a Zero dBm Calibration

1. Connect the sensor to the "Calibrator" connector on the front of the ML248xA / ML249xA.

2. Press the `Cal/Zero` hard key.

3. Press the `Cal 0 dBm` soft key to display the [Calibrate] menu.

4. Press the `Calibrate Sensor A` or the `Calibrate Sensor B` soft key.

Zeroing the Rear Panel BNC Connector

1. Press the `Cal/Zero` hard key.

2. Press the `Ext v Zero` soft key to calibrate the units to read zero volts on this BNC.

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System

Saving Instrument Settings

The current settings can be saved to any of the instrument's twenty setting stores available.

1. Press the System hard key followed by the Save/Recall soft key.

2. Press Save Settings to display the [Save Settings] dialog. The dialog displays a list of the twenty setting stores, a name if one has been specified, and an indication of whether the store is currently in use.

3. Use the soft key arrows or arrows on the keypad to select any of the available stores and then press either Save or Save as to save the settings as detailed below.

Item	Meaning
Save	The current settings are saved to the selected store. If the store was previously un-used, no name is displayed for the store. If the store was already in use, the previously stored settings are automatically overwritten.
Save as...	Allows the user to set a title of up to 15 characters to the selected store before the settings are saved to it. A [Save As] dialog displays and the user can then set a name from the keyboard in the usual manner. As detailed in this chapter 4 of this manual, the Next soft key can be used to input consecutive letters that are both entered from the same key on the keypad.

Press Enter to close the dialog and revert to the previous page of commands. |

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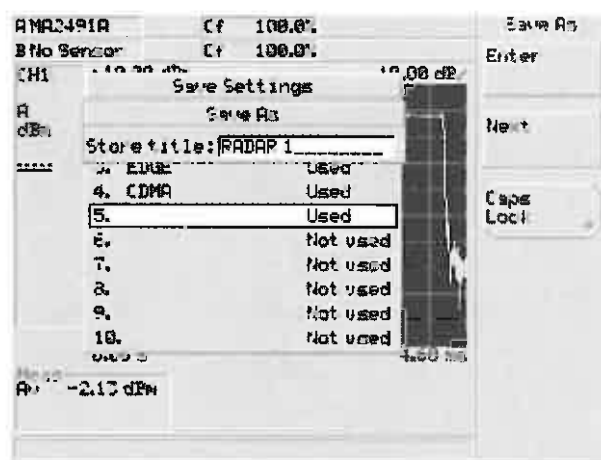
Recalling Instrument Settings

Any of the instrument settings that were saved in the manner described on the previous page can be recalled for use at any time.

1. Press the ▨▨▨▨▨ hard key followed by the Save/Recall soft key.

2. Press Recall Settings to display the [Recall Settings] dialog. The dialog displays a list of the twenty setting stores, a name if one has been specified, and an indication of whether the store is currently in use. Press Page Down soft key as required to display stores 11 to 20.

3. Use the soft key arrows or arrows on the keypad to select any of the available stores and then press Recall to revert the unit to the saved configuration.
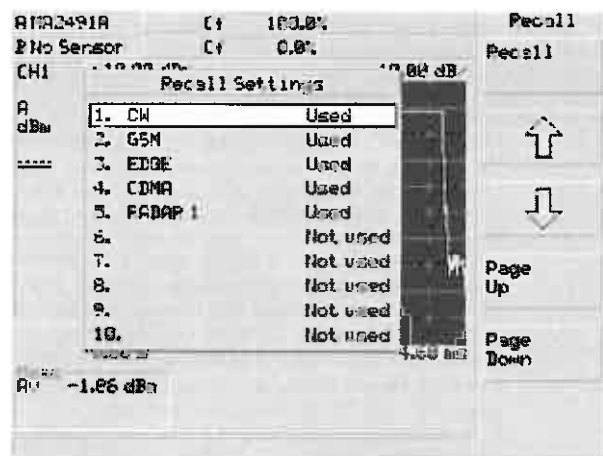
Note: On the ML249xA settings can also be recalled from the Preset menu.

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Displaying and Changing the Screen Title

1. Press the System hard key followed by the Config soft key.

2. Press the Display soft key.

3. Press the Set Screen Title soft key to display the [Set Screen Title] dialog where the title can be entered from the keypad. Press the [Sel] key on the keypad and then enter the required name as detailed in the "Text Entry" section in chapter 4 of this manual.
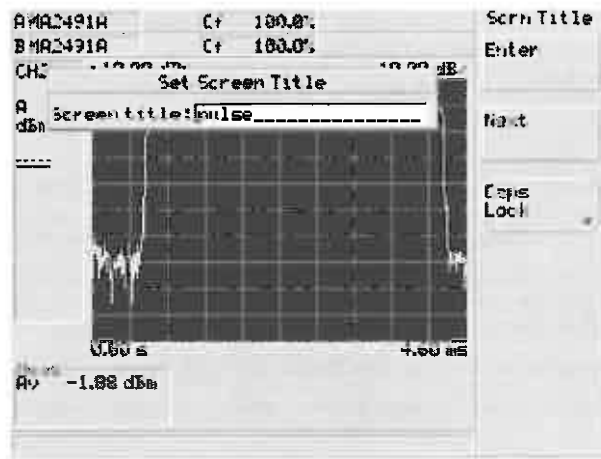
Note: The Next key is used to input consecutive letters that are both entered from the same key on the keypad. For example, to enter the word "EDGE", the user would press the "def" key twice to enter the "e", press the Next soft key, and then press the "def" key again to enter the following "d".

4. Press the [Enter] soft key when entry is complete and then press [Exit] on the keypad to close the dialog.

5. If screen titles have been enabled for viewing, the specified title now displays in the tool bar at the bottom of the display.

If the title does not appear, press the Screen Title soft key to turn the display of the screen title on. The LED on the soft key is lit green when the titles are set to on.

Capturing the Screen Image

The screen on the ML248xA / ML249xA can be captured as a bitmap image using the "ScreenCapture.exe" program on the CD supplied with the power meter. Follow the procedure below.

1. Use a GPIB cable and card to connect the ML248xA / ML249xA to the PC in the normal manner for remote operation.

2. Copy the "ScreenCapture.exe" program from the CD to a suitable location on the PC. It can be copied to any location on the PC, but users should be aware that the screen images are also generated at the same location.

3. Press the System hard key followed by the Config soft key.

4. Press the Display soft key followed by the Screen Dump Mode soft key. The LED on the soft key is lit when screen dump mode is enabled.
    Pressing the Screen Dump Mode soft key allows the user to retain the display of the soft keys even when the unit is being operated remotely. Screen dump mode also hides the remote indicator that would otherwise appear in the status window.

5. Ensure that the GPIB address of the power meter is set to 13. The procedure for this can be found on the following page. If the power meter is not configured at this address the program will exit and an explanatory message will appear on screen.

6. Display the screen to be captured on the ML248xA / ML249xA.

7. Double click the "ScreenCapture.exe" icon on the PC to open the program as shown below.
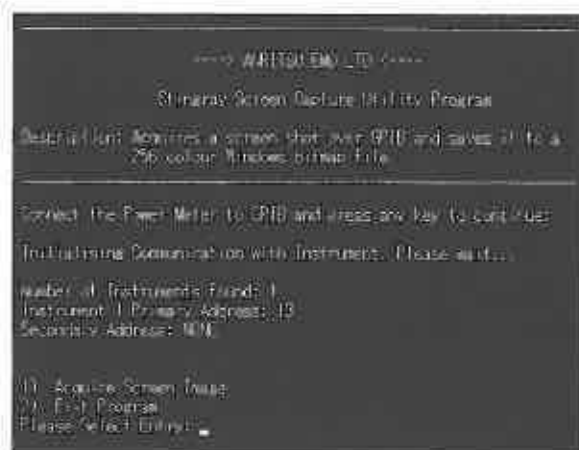
8. Press any key to continue, and then press [1] followed by [Enter].

9. Enter a name for the bitmap image followed by the extension ".bmp". For successful generation, the file name must not exceed 8 characters in length.

10. The image is generated at the same location as the "ScreenCapture.exe" file.

Changing the Brightness of the Display Backlight

1.   Press the System hard key followed by the Config soft key.

2.   Press the Display soft key.

3.   Press the Backlight soft key.
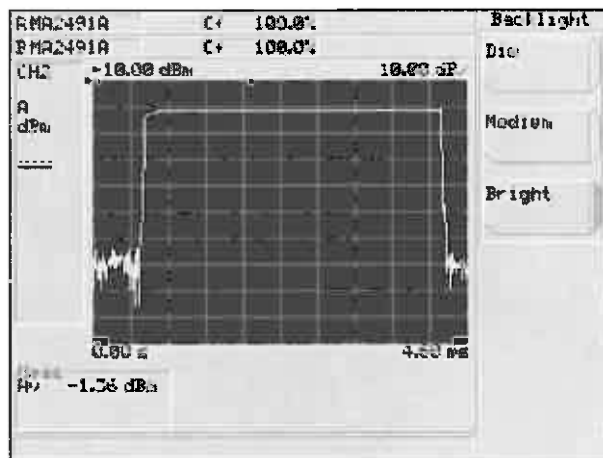
4.   Use the soft keys to select the level of lighting required.

Setting the GPIB Address for the Instrument

1. Press the ▨▨▨▨ hard key followed by the Config soft key.

2. Press the Remote soft key.

3. Press the Set GPIB Address soft key display the [Set GPIB Address] dialog.
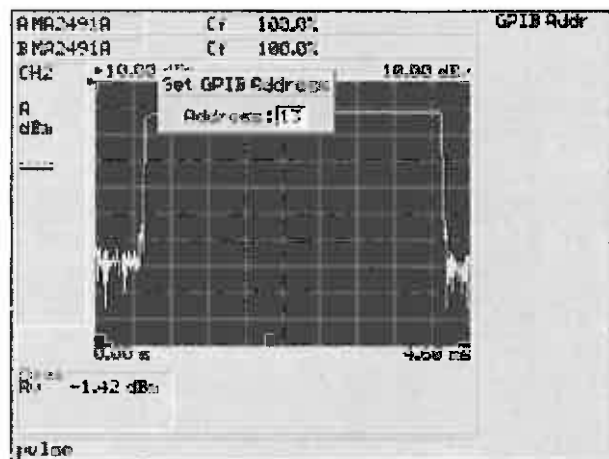
4. Enter the GPIB address at the numeric keypad in the usual manner.

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Enabling Buffering of the GPIB Output

1. Press the System hard key followed by the Config soft key.

2. Press the Remote soft key.

3. Press the GPIB O/p Buffering soft key to enable buffering of the GPIB output. The LED on the soft key is lit green when buffering is enabled.

Setting the RS232 Serial Port Baud Rate

1. Press the System hard key followed by the Config soft key.

2. Press the Remote soft key.

3. Press the Set RS232 Baud Rate soft key to display the [Baud Rate] dialog.

4. Use the up and down arrows on the soft keys or on the numeric keypad to select the required baud rate.

5. When the required rate has been selected, press the Set Baud Rate soft key to enable the selected rate. The LED to the right of the setting is lit green to indicate that the setting is enabled.

```
Baud Rate

  1200    *
  2400    *
  4800    *
 [9600]   *
 19200    *
 38400    *
 57600    *
```
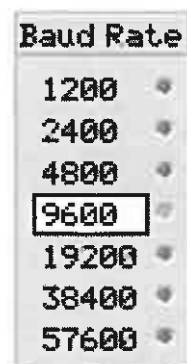
Configuring the Rear Panel Outputs

1. Press the [System] hard key followed by the |Config| soft key.

2. Press the |Rear Panel Config| soft key to display the [Rear Panel Configuration] dialog. The dialog is split into two halves; the upper half for port 1 and the lower for port 2. When the settings for one side are complete, press the |O/P 1/2| soft key to switch between outputs.

```
A MA2491A         C+   100.0%.        Rear Panel
B MA2491A         C+   100.0%.
                                      O/P 1 O/P 2
            Rear Panel Configuration
O/P 1
Mode:      [Off_____]       Off


                                      Analog
                                      Output

O/P 2                                 Pass·Fail
Mode:      Off

                                      Signal
                                      Channel

                                      Levelling

pulse
```
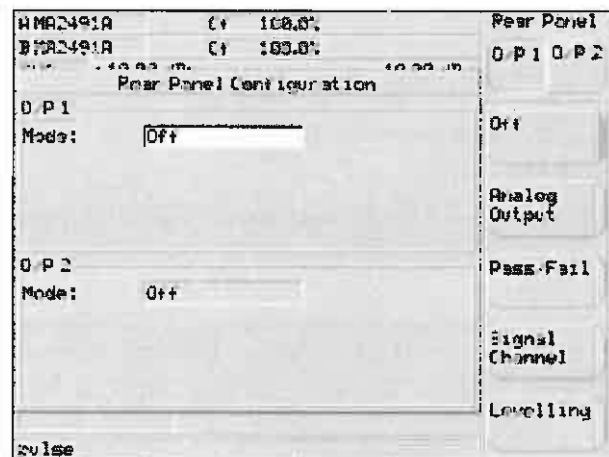
3. Use the soft keys to change the "Mode" setting as required. There are five options available as detailed in the table below.

Setting	Meaning
Off	Sets the output of the port to ground.
Analog Output	Sets the port to provide a voltage proportional to the measurement in the selected measurement channel. (CW mode)
Pass/Fail	Sets the port to provide a logic level output dependent upon the result of the limit checking of the selected measurement channel.
Signal Channel (ML248xA only)	Sets the port to provide a real time output from the CW signal channel associated with the port. BNC port 1 is associated with sensor input A and BNC port 2 is associated with sensor input B.
Levelling	Used to set the port to provide an output from either range 1 or range 2 of the signal channel associated with the port. The port association is the same as for the 'Signal Channel' mode.
Trigger Out (ML249xA only)	Used to set Output 2 for trigger out. Rise time is 2 μs.

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The items that display for each port differ depending on the "Mode" setting selected. The settings available are summarized in the table below.

Off	Analog Output	Pass Fail	Signal Channel	Levelling
—	Channel	Channel	Sensor	Sensor
—	Start / Stop voltage	Pass Level	—	Range
—	Start / Stop power.	—	—	—

If "Mode" is set to "Analog Output":

```
O/P 1
Mode:      Analog output
Channel:   1
                Voltage        Power
Start:     0.00 U         -10.00 dBm
Stop:      5.00 U          0.00 dBm
```

i.   Use the down arrow on the numeric keypad to select the "channel" item and then use the soft keys to select measurement channel 1 or 2.

ii. Use the down arrow on the numeric keypad to select the "Start" / "Voltage" entry field. Enter the start and stop voltages used to derive the output voltage proportional to the measurement. The voltages are entered using the Inc and Dec soft keys, or at the numeric keypad in the normal manner.

iii. Use the right arrow on the numeric keypad to select the "Start" / "Power" entry field. Enter the start and stop powers used to derive the output voltage proportional to the measurement. The powers are entered using the Inc and Dec soft keys, or at the numeric keypad in the normal manner.

If "Mode" is set to "Pass/Fail":
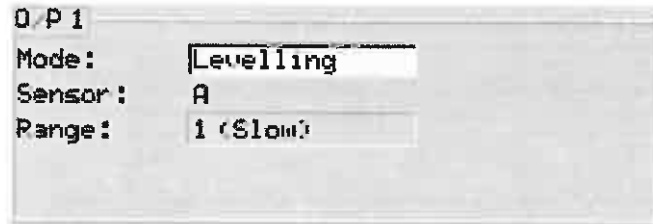
```
O/P 1
Mode:       Pass/fail
Channel:    1
Pass level: High
```

i.   Use the down arrow on the numeric keypad to select the "channel" item and then use the soft keys to select measurement channel 1 or 2.

ii. Use the down arrow on the numeric keypad to select the "Pass level" entry field. Use the soft keys to set the output signal pass level to high or to low.

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If "Mode" is set to "Leveling":

```
O/P 1
Mode:      Levelling
Sensor:    A
Range:     1 (Slow)
```

i.   Use the down arrow on the numeric keypad to select the "Range" item and then use the soft keys to select the input range of the sensor input associated with the BNC port.

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Turning the Key Click On or Off

1. Press the [System] hard key followed by the [Config] soft key.

2. Press the [Key Click] soft key. The LED on the soft key is lit green when the key click is turned on.

Setting Increment and Decrement Steps

The amount by which a numeric entry changes when the user presses the [Inc] and [Dec] soft keys is specified for each unit of measurement as detailed below.

1. Press the [System] hard key followed by the [Config] soft key.

2. Press the [Set Inc / Dec Steps] soft key to display the [Set Inc / Dec Steps] dialog shown below.
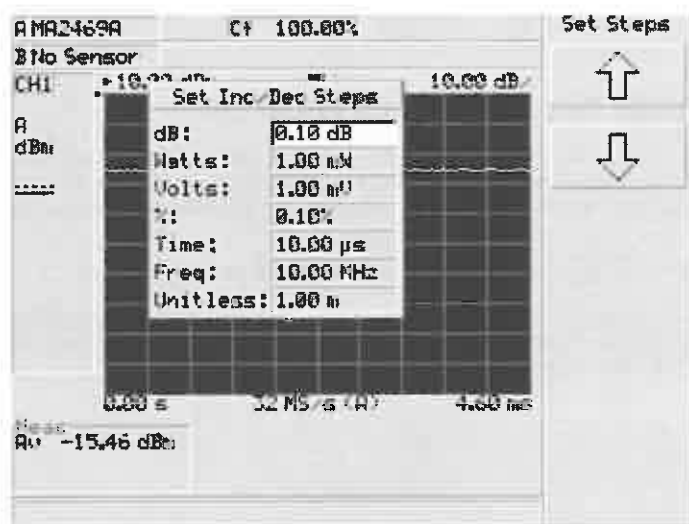
3. Use the soft arrow keys, or the arrow keys on the numeric keypad, to navigate between units of measurement in the dialog.

4. Press the [Sel] key and enter the required step interval from the keyboard in the usual manner.

5. Repeat this process until all items in the dialog have been corrected as required.

Viewing the Instrument Identity Dialog

1. Press the [System] hard key followed by the [Service] soft key.

2. Press the [Identity] soft key to display the [Identity] dialog with details of the instruments firmware version, serial number, and instrument type.

```
              Identity
Firmware version: 2.08
DSP sub-version:  120
FPGA sub-version: 59
Serial number:    6K00001304
Instrument type:  ML2496A
```
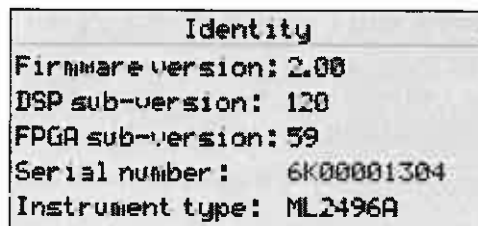
Turning the Security Feature On or Off

The security feature can be enabled to delete stores of data that may contain sensitive information that could otherwise be accessed when the unit is booted up. All information stores are cleared, together with cal factor settings, and any settings stored with the Save command.

1. Press the [System] hard key followed by the [Service] soft key.

2. Press the [Secure] soft key to toggle security between on and off. The LED on the soft key is lit green when security is enabled, and any sensitive information is deleted when the instrument is turned on.

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Diagnostics

The Diag soft key in the [Service] group of commands is for use as a diagnostics tool by Anritsu employees only. A password is required to access the associated commands.

Upgrading the System Software

Software upgrades will be posted on the Anritsu website at the address given in the procedure below. To receive e-mail notification each time the software is updated, send a blank mail to powermeter.support@eu.anritsu.com with the subject heading of "ML248xA / ML249xA firmware upgrade notification".

1. Download the latest software from the Anritsu website. To do this, go to http://www.eu.anritsu.com, click the "Downloads" link in the toolbar, select "ML2480A" from the drop down list, and click [Show Downloads].

2. Click the software download link, save the zipped data to a local drive on the PC and unzip it as required.

3. Connect the PC com port to the serial port on the ML248xA / ML249xA using the bootload cable.

4. Power-up the ML248xA / ML249xA and press [Clr] when the self-test screen displays to commence normal operation.

5. Press the System hard key followed by the Service soft key.

6. Press Upgrade to display the [Upgrade Instrument] dialog.

7. Press Continue after checking that the serial cable is connected.

8. Open the zipped folder downloaded in step 2 and click once on the appropriate boot file to select it ("boot1" for com port 1, "boot2" for com port 2).

9. The new software is downloaded and a message displays in the dialog when download is complete.

Note: The upgrade procedure will time-out at the PC if the appropriate boot file is not selected within 10 seconds of pressing Continue.

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Preset

Resetting the System

There are two settings available to the user to return the instrument to the system set up or factory defaults. It is recommended that a preset be carried out prior to each new measurement type and whenever the meter is reconfigured for a new measurement.

1. Press the [____] hard key to display the [Preset] dialog shown below.

```
                    Preset
    ┌──────────────────────────────┐
    │ 1. Preset                     │
    │ 2. Factory                    │
    │ 3. GSM 900                    │
    │ 4. GSM 1800                   │
    │ 5. EDGE                       │
    │ 6. GPRS                       │
    │ 7. WCDMA                      │
    │ 8. CDMA2000                   │
    │ 9. WLAN 802.11a               │
    │ 10. WLAN 802.11b              │
    └──────────────────────────────┘
```
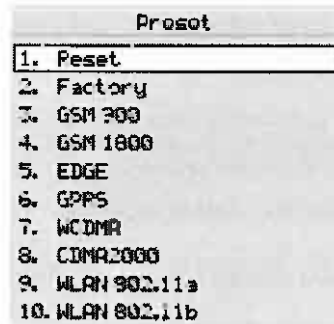
Use the arrows on the soft key menu or numeric keypad to select "Reset" or "Factory" and press the Select soft key. The difference between "Reset" or "Factory" is explained below.

Reset: Resets the instrument to the system set up. The offset tables and the GPIB interface are not affected. Resetting commences without further warning when the Select soft key is pressed with "Reset" selected.

Factory: Resets the instrument to the factory defaults. The offset tables and external interfaces are also reset. When the Select soft key is pressed with "Factory" selected, a [Factory Preset] dialog displays to warn the user that the offset tables and external interfaces will also be reset. The user can then select to continue or to return to the previous page.

2. Use the soft keys to select the preset type required and press the Select soft key.

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Using the Preset Configurations

Preset configurations can be used to automatically configure the instrument for each of the major measurement types. For the ML248xA there are 11 presets and for the ML249xA an additional five are available (numbers 14 to 18 in the figure below).

1. Press the [......] hard key to display the [Preset] dialog shown below.

```
                    Preset
    ┌──────────────────────────────┐
    │ 1.  Reset                     │
    └──────────────────────────────┘
      2.  Factory
      3.  GSM 900
      4.  GSM 1800
      5.  EDGE
      6.  GPPS
      7.  WCDMA
      8.  CDMA2000
      9.  WLAN 802.11a
     10.  WLAN 802.11b
     11.  WLAN 802.11g
     12.  Bluetooth
     13.  IS95
     14.  OFDM Continuous
     15.  Radar 200ns
     16.  Radar 5us
     17.  DME
     18.  Demo Box Int Trigger
```

Note: The figure above is a composite image showing all of the presets available. On the unit itself the dialog displays only the first ten options and the user presses the Page Down soft key to display options 11 to 18.

2. Use the arrows on the soft key menu or numeric keypad to select the required configuration and press the Select soft key.

Note: Refer to Appendix C *Default Values* for details of each of the preset settings.

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Chapter 6. Remote Operation

The ML248xA and ML249xA are equipped for remote operation by means of the GPIB (General Purpose Interface Bus) standard. As an alternative, the user can select to use an RS232 connection.

Overview of GPIB

The GPIB provides a remote means to control the power meter as an alternative to using the interface on the unit itself. All commands on the ML248xA have an equivalent GPIB command and these can either by used simply to control the unit remotely, or in a complete GPIB program which can be used to set up multiple units to the required state, execute the required tests, and feed back the results to the PC acting as the controller. The GPIB measurement signal path is illustrated in the figure on the following page.

Refer to the "ML248xA / ML249xA Peak Power Meter Remote Programming Manual" for full details of all supported GPIB commands.

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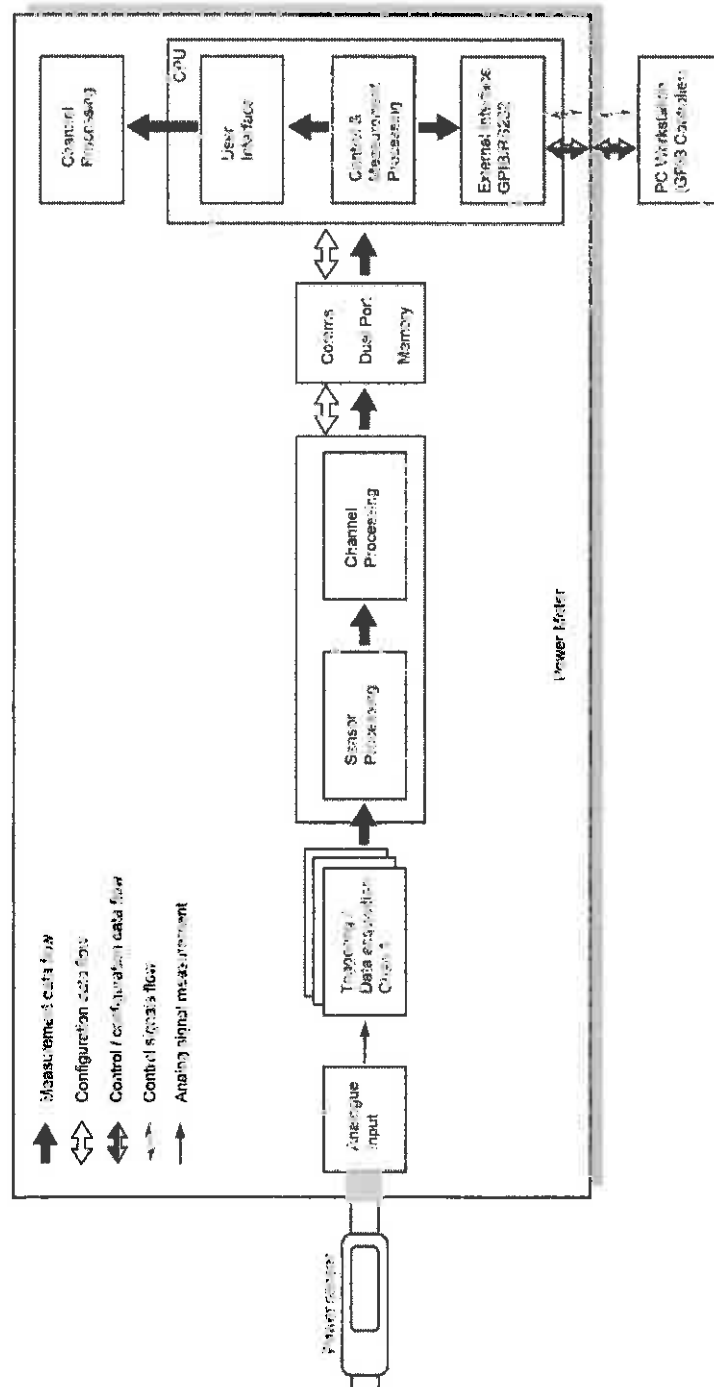
Chapter 7. CW Setup and Measurement

Setting Up the Power Meter for CW Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform continuous wave measurement.

Note: Either of the channels can be set up for CW measurement in the manner described below, but it should be noted that channel 2 is already preset for CW measurement.

1. Perform calibration

    Connect the sensor in use to the input on the front panel.

    Connect the RF port of the sensor to the "Calibrator" input on the front panel.

    Press the [Cal/Zero] hard key followed by the [Zero & Cal] soft key.

    Press the [Zero & Cal Sensor] soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

    Press the [Sensor] hard key followed by the [Cal Factor] soft key to display the [Cal Factor] dialog.

    Use the soft keys to select [Frequency] at the "Source" item, and then enter the required frequency at the keypad after selecting the "Frequency" item. Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the input frequency.

2. Set up the channel

    Press the [Channel] hard key followed by the [Setup] soft key to display the [Channel Set Up] dialog. The settings required in this dialog are detailed below.

Item	Required setting
Mode:	CW
Input Config:	Set to the input in use.
Units:	Select the required units. The default setting is dBm and this is suitable for CW measurement.
Resolution:	The default setting of n.nn is suitable.
Settling%:	Enter a settling percentage as required. A 1% settling time value relates to approximately 0.04 dB.

3.   Set up averaging

Press the Channel hard key followed by the Averaging soft key. The averaging setting should be set to Auto by default and this setting is suitable for CW measurement. Averaging can also be set to either Moving or Repeat and the difference between these settings is explained in the section on common procedures.

4.   Connect the RF port on the sensor to the DUT and monitor the measurement results on the screen.

Chapter 8. GSM Setup and Measurement

Setting Up the Power Meter for GSM Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform GSM measurement.

Note: The "GSM 900" or "GSM 1800" options in the [Preset] dialog can also be used to automatically configure the unit for GSM measurement. Press the ▨▨▨▨ hard key and then use the arrow keys to select option 3 or 4.

---

1. Perform calibration

   Connect the sensor in use to the input on the front panel.

   Connect the RF port of the sensor to the "Calibrator" input on the front panel.

   Press the Cal/Zero hard key followed by the Zero & Cal soft key.

   Press the Zero & Cal Sensor soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

   Press the Sensor hard key followed by the Cal Factor soft key to display the [Cal Factor] dialog.

   Use the soft keys to select Frequency at the "Source" item, and then enter the required frequency at the keypad after selecting the "Frequency" item. Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the input frequency.

2. Select the type of measurement to be made on the data.

   Press the Channel hard key followed by the Set Up soft key. Set the "Mode" item to "Pulsed / Modulated". Use the down arrow on the keypad to select the "Measurement" item and then use the soft keys to select the measurements to be made. Refer to the explanation in chapter 5 of this manual in the section titled "Selecting the Type of Measurement to be Made".

3. Set up triggering

   Press the Channel hard key followed by the Trigger soft key. Use the soft keys to make the settings detailed below.

Item	Required setting
Trigger Source:	Internal A
Type:	Rising
Set Trig Level:	Use the numeric keypad to enter a value below the power level to be measured.
Arming:	Automatic.

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Item	Required setting
Set Cap Time:	A GSM pulse is 577 µs long, so the capture time should be sufficient to accommodate that, e.g., 1 ms.
Set Trig Delay:	Enter a value as required to delay the capture time with respect to the trigger event.

4. Set up the gating patterns.

    Press the Channel hard key followed by the Gating soft key.

    Press the Set Up soft key to display the [Gating Set Up] dialog. The gating settings are set up for GSM measurement by default so the user needs only to use the arrows on the numeric keypad to select the settings required and then enable each one with the Enabled soft key. If the default settings are not suitable they can be changed by selecting the gate in the dialog and entering a new value from the numeric keypad in the usual manner.

    Press [Exit] when complete and then display the gates on screen by pressing the Display Gates soft key.

5. Set the display scaling.

    Press the Channel hard key followed by the More soft key.

    Press the Scaling soft key to display the [Scaling] menu.

    Use the Set Ref and the Set Scale soft keys to set the level and scale as required.

6. Enter the limits as described in the "Common Procedures" section of this manual.

    Press the Channel hard key followed by the More soft key.

    Press the Limit Checking soft key to display the [Lim Check] group of commands.

    Press the Set Up soft key to display the [Limit Checking Set Up] dialog.

    Enter the limits as required.

7. Set up the markers as described in the "Common Procedures" section of this manual.

    Press the Channel hard key followed by the Markers soft key.

    Use the commands in the [Markers] menu to set up and display the markers as required.

8. Connect the RF port on the sensor to the DUT and monitor the measurement results on the screen.

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Chapter 9. CDMA Setup and Measurement

Setting Up the Power Meter for CDMA Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform CDMA measurement.

Note: The "WCDMA" option in the [Preset] dialog can also be used to automatically configure the unit for CDMA measurement. Press the [ ] hard key and then use the arrow keys to select option 7.

---

1. Perform calibration

   Connect the sensor in use to the input on the front panel.

   Connect the RF port of the sensor to the "Calibrator" input on the front panel.

   Press the [Cal/Zero] hard key followed by the [Zero & Cal] soft key.

   Press the [Zero & Cal Sensor] soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

   Press the [Sensor] hard key followed by the [Cal Factor] soft key to display the [Cal Factor] dialog.

   Use the soft keys to select [Frequency] at the "Source" item, and then enter the required frequency after selecting the "Frequency" item. Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the input frequency.

2. Set up the channel

   Press the [Channel] hard key followed by the [Setup] soft key to display the [Channel Set Up] dialog. The settings required in this dialog are detailed below.

Item	Required setting
Mode:	Pulsed/Modulated
Measurement:	Select the type of measurement to be made on the data. Refer to the explanation in chapter 5 of this manual in the section titled "Selecting the Type of Measurement to be Made".
Meas display:	Readout

3. Set the triggering source.

   Press the [Channel] hard key followed by the [Trigger] soft key to display the [Trigger] group of commands.

   Press the [Trigger Source] soft key and select [Cont].

4. Set the time over which the measurement is taken.

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5. Connect the RF port on the sensor to the DUT and monitor the measurement results on the screen as shown in the figure below.
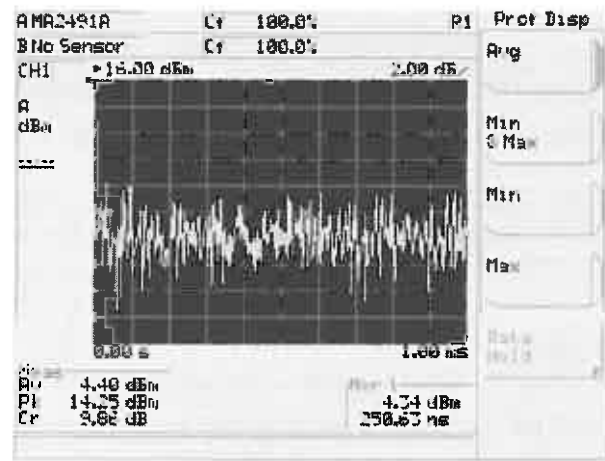
Chapter 10. EDGE Setup and Measurement

Setting Up the Power Meter for EDGE Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform EDGE measurement.

Note: The "EDGE" option in the [Preset] dialog can also be used to automatically configure the unit for EDGE measurement. Press the [Preset] hard key and then use the arrow keys to select option 5.

1. Perform calibration

   Connect the sensor in use to the input on the front panel.

   Connect the RF port of the sensor to the "Calibrator" input on the front panel.

   Press the Cal/Zero hard key followed by the Zero & Cal soft key.

   Press the Zero & Cal Sensor soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

   Press the Sensor hard key followed by the Cal Factor soft key to display the [Cal Factor] dialog.

   Use the soft keys to select Frequency at the "Source" item, and then enter the required frequency after selecting the "Frequency" item. Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the input frequency.

2. Select the type of measurement to be made on the data.

   Press the Channel hard key followed by the Set Up soft key. Use the down arrow on the keypad to select the "Measurement" item and then use the soft keys to select the measurements to be made. Refer to the explanation in chapter 5 of this manual in the section titled "Selecting the Type of Measurement to be Made".

3. Set up triggering

   Press the Channel hard key followed by the Trigger soft key. Use the soft keys within the trigger menu to make the settings detailed below.

Item	Required setting
Trigger Source:	Internal A
Type:	Rising
Set Trig Level:	Use the numeric keypad to enter a value below the power level to be measured.
Arming:	Automatic.

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Item	Required setting
Set Cap Time	An EDGE pulse is 577 µs long, so the capture time should be sufficient to accommodate that, e.g., 1 ms.
Set Trig Delay:	Enter a value as required to delay the capture time with respect to the trigger event.
Hold off:	Set to a value to match the length of the burst or slightly longer.

4. Set up the gating and fence patterns.

    Press the Channel hard key followed by the Gating soft key.

    Press the Set Up soft key to display the [Gating Set Up] dialog. The gating settings are set up for GSM measurement by default and these can also be used for EDGE. The user needs only to use the arrows on the numeric keypad to select the settings required and then enable each one with the Enabled soft key. If the default settings are not suitable they can be changed by selecting the gate in the dialog and entering a new value from the numeric keypad in the usual manner. For EDGE measurements the user may wish to set a fence in the middle of the gate to exclude the measurements results from the mid-burst training sequence.

    Press [Exit] when complete and then display the gates on screen by pressing the Display Gates soft key.

5. Set the display scaling.

    Press the Channel hard key followed by the More soft key.

    Press the Scaling soft key to display the [Scaling] menu.

    Use the Set Ref and the Set Scale soft keys to set the level and scale as required.

6. Enter the limits as described in the "Common Procedures" section of this manual.

    Press the Channel hard key followed by the More soft key.

    Press the Limit Checking soft key to display the [Lim Check] group of commands.

    Press the Set Up soft key to display the [Limit Checking Set Up] dialog.

    Enter the limits as required.

7. Set up the markers as described in the "Common Procedures" section of this manual.

    Press the Channel hard key followed by the Markers soft key.

    Use the commands in the [Markers] menu to set up and display the markers as required.

8. Connect the RF port on the sensor to the DUT and monitor the measurement results on the screen.

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Chapter 11.   WLAN Setup and Measurement

Setting Up the Power Meter for WLAN Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform WLAN measurement.

Note: The "WLAN" options in the [Preset] dialog can also be used to automatically configure the unit for WLAN measurement.   Press the [Preset] hard key and then use the arrow keys to select option 9, 10, or 11.

802.11b, a, and g

1. Perform calibration

    Connect the sensor in use to the input on the front panel.

    Connect the RF port of the sensor to the "Calibrator" input on the front panel.

    Press the [Cal/Zero] hard key followed by the Zero & Cal soft key.

    Press the Zero & Cal Sensor soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

    Press the [Sensor] hard key followed by the Cal Factor soft key to display the [Cal Factor] dialog.

    Use the soft keys to select Frequency at the "Source" item, select the "Frequency" item and then enter a frequency at the keypad of 2.4 GHz for 802.11b and g, or 5 → 6 GHz for 802.11a.

2. Set up triggering

    Press the [Channel] hard key followed by the Trigger soft key. Use the soft keys within the trigger menu to make the settings detailed below.

Item	Required setting
Trigger Source:	Internal A
Set Cap Time	Enter a value suitable to display the full pulse with both rising and falling edges. The capture time would typically be about 20% longer that the packet length.
Set Trig Delay:	Enter a value as required to delay the capture time with respect to the trigger event. A negative value must be entered to display pre-trigger information as shown in the figure at the end of this chapter.
Type:	Rising
Set Trig Level:	Enter a value below the power level to be measured. A typical value would be in the region of –5 dBm.

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Item	Required setting
Arming:	Frame.
Hold off:	Off

3. Set up the gating and fence patterns.

    Press the [Channel] hard key followed by the [Gating] soft key.

    Press the [Set Up] soft key to display the [Gating Set Up] dialog. As shown in the
    figure at the bottom of this section, the user will typically require two gates. The first
    gate would be used to measure the training sequences at the start of the gate, e.g., 2
    µs to 18 µs. The second gate would be used to measure the payload itself e.g., 30
    µs to 150 µs. Make the settings required and then enable each one with the [Enabled]
    soft key.

    Press [Exit] when complete and then display the gates on screen by pressing the
    [Display Gates] soft key.

4. Set the channel measurement mode to [Avg, Peak & Crest].

    Press the [Channel] hard key to display the [Channel] group of commands.

    Press the [Set Up] soft key to display the [Channel Set Up] dialog.

    Select the "Measurement" item and select [Avg, Peak & Crest] from the soft keys.

Note: The upper limit of the operational range of the sensors used to make the power
measurement is +20 dBm. This upper limit is the peak signal that the power sensor can
correct. For signals with a high peak to average ratio, an attenuator is needed to keep the
peak signal within the operational range of the sensor. For example, a +20 dBm average
power WLAN signal with a peak of +10 dB will have peaks at +30 dBm. A 10 dB
attenuator should therefore be used in front of the sensor. Apply offset correction by
pressing the [Sensor] hard key followed by the [Offset] soft key.
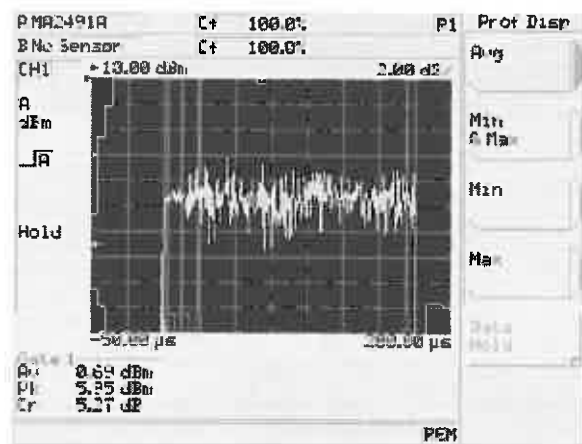
Chapter 12. Radar Setup and Measurement

Setting Up the Power Meter for Radar Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform Radar measurement on single pulses.

Note: There are two Radar options in the [Preset] dialog which can also be used to automatically configure the unit for single pulse radar measurement. Press the [Preset] hard key and then use the arrow keys to select either option 15 Radar 200ns or option 16 Radar 5μs. These will set the display time up to either 200ns (RRS mode) or 5μs for capturing a radar pulse. Trigger is set to Internal A.

1. Perform calibration

    Connect the sensor in use to the input on the front panel.

    Connect the RF port of the sensor to the "Calibrator" input on the front panel.

    Press the Cal/Zero hard key followed by the Zero & Cal soft key.

    Press the Zero & Cal Sensor soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

    Press the Sensor hard key followed by the Cal Factor soft key to display the [Cal Factor] dialog.

    Use the soft keys to select Frequency at the "Source" item, and then enter the required frequency after selecting the "Frequency" item. Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the input frequency.

2. Select the type of measurement to be made on the data.

    Press the Channel hard key followed by the Set Up soft key. Use the down arrow on the keypad to select the "Measurement" item and then use the soft keys to select the measurements to be made. Refer to the explanation in chapter 5 of this manual in the section titled "Selecting the Measurement Type".

3. Set up triggering

    Press the Channel hard key followed by the Trigger soft key. Use the soft keys within the trigger menu to make the settings detailed below.

Item	Required setting
Source:	Internal A (can also use external)
Capture time:	The capture time should be sufficient to accommodate the pulse being measured, e.g., 200ns or 5μs
Delay:	A negative delay value represents the time before the trigger allowing the user to display the pre-trigger information.
Type:	Rising

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Item	Required setting
Level:	Use the numeric keypad to enter a value below the power level to be measured or use the auto trigger setting (default)
Arming:	Automatic (default setting)

4. Set up the gating patterns.

    Press the [Channel] hard key followed by the [Gating] soft key.

    Press the [Set Up] soft key to display the [Gating Set Up] dialog. Use the arrows on the numeric keypad to select the gating settings required and then enable each one with the [Enabled] soft key. If the default settings are not suitable they can be changed by selecting the gate in the dialog and entering a new value from the numeric keypad in the usual manner.

    Press [Exit] when complete and then display the gates on screen by pressing the [Display Gates] soft key.

5. Set the display scaling.

    Press the [Channel] hard key followed by the [More] soft key.

    Press the [Scaling] soft key to display the [Scaling] menu.

    Use the [Set Ref] and the [Set Scale] soft keys to set the level and scale as required.

6. Enter the limits as described in the "Common Procedures" section of this manual.

    Press the [Channel] hard key followed by the [More] soft key.

    Press the [Limit Checking] soft key to display the [Lim Check] group of commands.

    Press the [Set Up] soft key to display the [Limit Checking Set Up] dialog.

    Enter the limits as required.

7. Set up the markers as described in the "Common Procedures" section of this manual.

    Press the [Channel] hard key followed by the [Markers] soft key.

    Use the commands in the [Markers] menu to set up and display the markers as required.

    For radar measurement, the user may wish to set up the delta and active markers as shown in the figure below to display the power difference across the burst.

8. Use the advanced marker functions as required. Refer to the explanation in the "Common Procedures" section of this manual.

9. Connect the RF port on the sensor to the DUT and monitor the measurement results on the screen.

10. For multi-pulse measurement use the frame arming facility. Refer to *Entering a Frame Arming Level and Duration* in chapter 5.

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Chapter 13.   OFDM Setup and Measurement

Setting up the Power Meter for Continuous OFDM Measurements

Follow the procedure below to set up the ML248xA / ML249xA to perform measurements on continuous OFDM signals. For framed signals use the procedure outlined for the WLAN signals and use frame arming for triggering.

This set up uses a dithered sample rate.

Note: The "OFDM Continuous" option in the [Preset] dialog can also be used to automatically configure the unit for OFDM measurement. Press the ⬛⬛⬛ hard key and then use the arrow keys to select option 14.

---

1. Perform calibration.

    Connect the sensor in use to the input on the front panel.

    Connect the RF port of the sensor to the "Calibrator" input on the front panel.

    Press the ⬛⬛⬛ hard key followed by the Zero & Cal soft key.

    Press the Zero & Cal Sensor soft key for the input in use. The sensor is now calibrated and a message displays on the screen when calibration is complete. Remove the sensor from the "Calibrator" input when complete.

    Press the ⬛⬛⬛ hard key followed by the Cal Factor soft key to display the [Cal Factor] dialog.

    Use the soft keys to select Frequency at the "Source" item, and then enter the required frequency after selecting the "Frequency" item. Correction data is read from the EEPROM in the sensor and applied automatically to the measurement based on the input frequency.

2. Set up the channel.

    Press the ⬛⬛⬛ hard key followed by the Setup soft key to display the [Channel Set Up] dialog. The settings required in this dialog are detailed below.

Item	Required setting
Mode:	Pulsed/Modulated
Measurement:	Select the type of measurement to be made on the data. Refer to the explanation in chapter 5 of this manual in the section titled "Selecting the Type of Measurement to be Made".
Meas display:	Readout

---

3.   Set the triggering source.

Press the Channel hard key followed by the Trigger soft key to display the [Trigger] group of commands.

Press the Trigger Source soft key and select Cont.

4.   Set the time over which the measurement is taken. The preset uses 1ms.

5.   Set the sample rate.

Press the Channel hard key followed by the Trigger soft key. Then press More followed by Set Sample Rate.

Select 2MS/s. This sample rate is derived from digitally dithering the 64 or 62.5 MS/s sample rate with a pseudo random sequence.

Connect the RF port on the sensor to the DUT and monitor the measurement results on the screen.

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Chapter 14. Examples of Dual Display Channel Operation

This chapter provides details of two scenarios in which the user may wish to view both measurement channels simultaneously.

Displaying a Measurement in Different Units

The user may wish to display the measurement from one sensor using different units of measurement on each channel. The example below details how to set up the channels to display in Watts on channel 1, and in dBm on channel 2.

1. Press the Channel hard key followed by the Set Up soft key to display the [Channel Set Up] dialog.

2. Use the soft keys to set the "Mode" to "CW".

3. Press the down arrow on the keypad to select "Input Config" and check that the channel is configured for the correct input.

4. Press the down arrow on the keypad to select "Units" and use the soft keys to select "W".

5. Press the Ch1/Ch2 hard key.

6. Use the soft keys to set the "Mode" to "CW".

7. Press the down arrow on the keypad to select "Input Config" and check that the channel is configured for the correct input.

8. Press the down arrow on the keypad to select "Units" and use the soft keys to select "dBm".

9. Press the Dual Channel soft key and then press the [Exit] key on the keypad.

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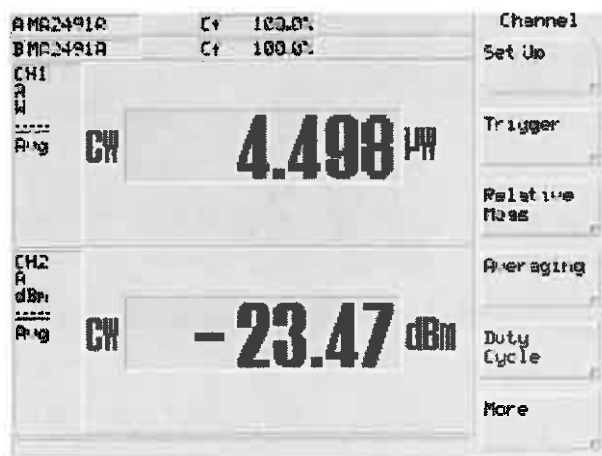
Displaying a Pulsed/Modulated Measurement in Different Modes

1. Press the ⬚Channel⬚ hard key followed by the ⎡Set Up⎤ soft key to display the [Channel Set Up] dialog.

2. Use the soft keys to set the "Mode" to "Pulsed/Modulated".

3. Press the down arrow on the keypad to select "Meas display" and use the soft keys to select "Profile".

4. Press the down arrow on the keypad to select "Input Config" and check that the channel is configured for the correct input.

5. Press the down arrow on the keypad to select "Units" and use the soft keys to select "dBm".

6. Press the ⬚Ch1/Ch2⬚ hard key.

7. Use the soft keys to set the "Mode" to "Pulsed/Modulated".

8. Press the down arrow on the keypad to select "Meas display" and use the soft keys to select "Readout".

9. Press the down arrow on the keypad to select "Input Config" and check that the channel is configured for the correct input.

10. Press the down arrow on the keypad to select "Units" and use the soft keys to select "dBm".

11. Press the ⎡Dual Channel⎤ soft key and then press the [Exit] key on the keypad.

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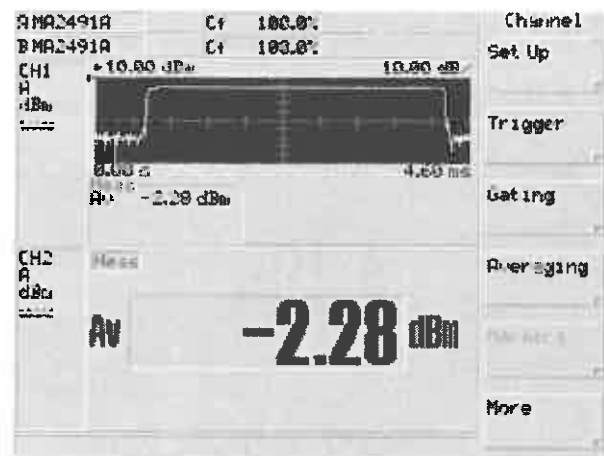
Chapter 15.   Dual Sensor Operation
(ML2488A / ML2496A Only)

Displaying Measurements from Two Sensors Simultaneously

As stated earlier in this manual, the ML2488A can display the results for both sensor inputs simultaneously. The user may wish to simply display both measurements as is, but more likely, may want to set one channel to calculate the gain between the two measurements. This scenario is shown in the figure below.
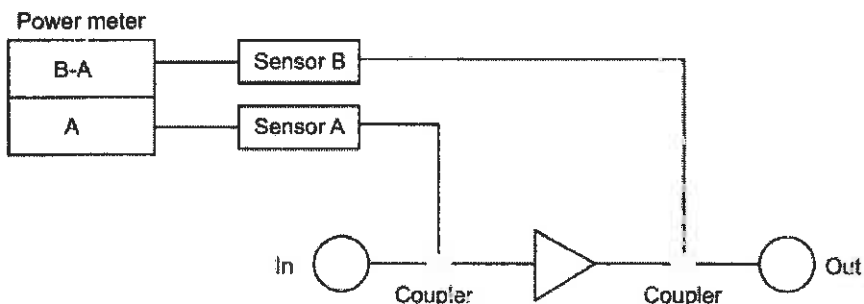
Power meter

1. Press the [Channel] hard key followed by the Set Up soft key to display the [Channel Set Up] dialog.

2. Use the soft keys to set the "Mode" to "Pulsed/Modulated" or "CW" as required.

3. Press the down arrow on the keypad to select "Meas display" and use the soft keys to select "Readout".

4. Press the down arrow on the keypad to select "Input Config" and then press the Sngl/Cmb soft key.

5. For the purposes of our example above, we will select B-A to calculate the gain in dBm.

6. Press the down arrow on the keypad to select "Units" and use the soft keys to select "dBm".

7. Press the [Ch1/Ch2] hard key.

8. Use the soft keys to set the "Mode" to "Pulsed/Modulated".

9. Press the down arrow on the keypad to select "Meas display" and use the soft keys to select "Readout".

10. Press the down arrow on the keypad to select "Input Config", and use the soft keys to select "A".

11. Press the down arrow on the keypad to select "Units" and use the soft keys to select "dBm".

12. Press the Dual Channel soft key and then press the [Exit] key on the keypad.

13. In addition to the measurement results, the current setup for each display channel is shown in the pane on the left of the screen.

Chapter 16. ML2419A Range Calibrator

This chapter provides:

- Information on the inspection and requirements of the ML2419A range calibrator.

- Details of the front and rear panel connectors.

- Details of operation and expected range output levels.

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Overview of the ML2419A Range Calibrator

The ML2419A Range Calibrator provides a traceable series of voltages to facilitate accuracy measurements for the ML248xA / ML249xA power meter signal channels. The voltages are produced by means of a precision voltage reference and a series of switchable attenuators, operated by a microcontroller. All voltages produced are accurate, stable and low-noise such that errors inherent in the Range Calibrator itself do not contribute significantly to the error measurements of the signal channel. The sensor cables connect the ML2419A to the power meter, and on connection the normal soft key menu is replaced by a new series of menus for control of the ML2419A.

Initial Inspection

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If the instrument is damaged mechanically, notify your local sales representative or Anritsu Customer Service Center. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as Anritsu. Retain the shipping materials for the carrier's inspection.

Power Requirements

The ML2419A Range Calibrator is operated from AC line power, and is intended as an Installation (Overvoltage) Category II, Insulation Category I device. Voltage input is selectable between 230V/50Hz and 115V/60Hz. No on/off switch is provided, as the unit is powered continuously during use. A front-panel LED indicates when power is applied.

AC Line Power

The ML2419A Range Calibrator can operate on AC input power of 90-132/180-264V, 47-63 Hz, 6 VA maximum. The Range Calibrator must be properly configured for the voltage applied.

Fuses

The ML2419A Range Calibrator AC input line is protected by an internally mounted fuse. This fuse should only be changed by qualified service personnel. Replace only with a fuse of the same type and rating (0.1A, 250V, antisurge (T)).

Grounding

The ML2419A Range Calibrator must be properly grounded. Failure to ground the instrument could be hazardous to operating personnel. The unit is supplied with a three-conductor power cord. The instrument is properly grounded during AC line operation when the plug is connected to a properly installed three-prong receptacle. A grounding terminal is also provided on the rear panel.

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Environmental Requirements

The ML2419A Range Calibrator is designed to operate within the temperature range of 0 to 50° C with a maximum relative humidity of 95% at 40° C, non-condensing. Full accuracy is specified at 25° C ± 10° C, at a maximum relative humidity of 75% at 40° C, non-condensing. Prior to making any precision measurements, allow the Range Calibrator and the Power Meter to warm up for a period of 15 minutes from power on. If the power supply is interrupted for any reason, allow a similar settling period.

Rack Mounting

The rack mount procedure for the ML2419A is identical to the procedure for the power meter itself. Refer to chapter 3 of this manual for full details.

Storage and Shipment

Storage and shipping related information is exactly the same as that for the power meter itself. Refer to chapter 3 of this manual for full details.

Front Panel Connections

The front panel is illustrated in the figure below.
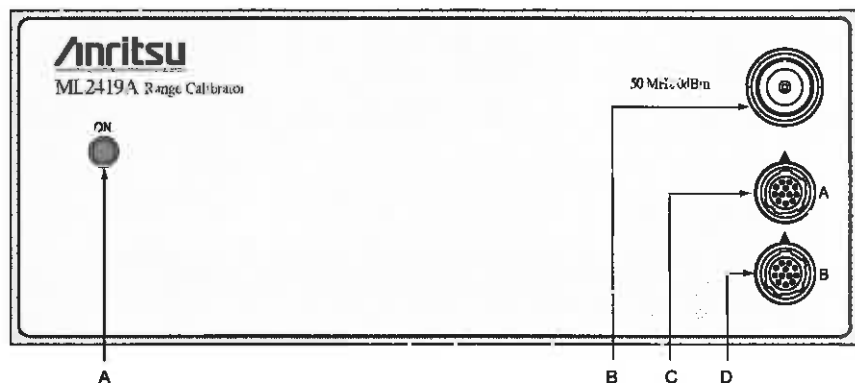
A   **AC Power LED**

         This LED is lit whenever AC power is applied to the ML2419A Range Calibrator. No on/off switch is provided, as the unit is powered continuously during use.

B   **50 MHz 0dBm Connector**

         This precision output provides a traceable 50 MHz, 0.0 dBm reference power meter. The 0.0 dBm level is available at this N-type connector whenever the range calibrator is powered on.

C   **Sensor A Connector**

A 12-pin circular precision connector to be used in conjunction with 1.5m power sensor cables.

D   **Sensor B Connector**

A 12-pin circular precision connector to be used in conjunction with 1.5m power sensor cables.

Rear Panel Connectors

The Rear Panel is illustrated in the figure below.
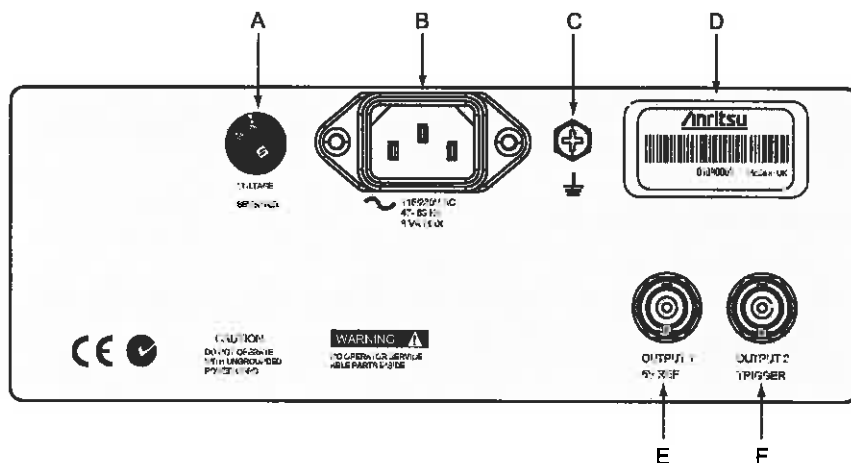
A   **AC Voltage Selector**

The range calibrator must be properly configured for the input voltage applied. Using a small flat-bladed screwdriver, rotate the selector to either 115 or 230 as appropriate for the application.

B   **AC Line Power Connector**

The ML2419A can operate on AC input power of 90-132/180-264V, 47-63 Hz, 6 VA maximum. The ML2419A must be properly configured for the voltage applied. No on/off switch is provided, as the unit is powered continuously during use. A front-panel LED indicates when power is applied.

C   **Chassis Ground**

This grounding terminal can be used to connect the chassis ground of the ML2419A to other like equipment as necessary. The instrument itself is properly grounded when the AC line plug is connected to a properly installed three-prong receptacle.

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D   **ID Number Label**

The ML2419A identification number is affixed to the rear panel. Please use the complete identification number when ordering parts or corresponding with the Anritsu Customer Service department.

E   **Output 1 5V Reference**

Reserved for future use.

F   **Output 2 Trigger**

Reserved for future use.

Performing Verification

The performance of the ML248xA / ML249xA signal channel inputs is verified using the following procedure. References in this procedure to sensor input B apply to ML2488A and ML2496A (dual-channel) power meters only.

1.   Connect the Range Calibrator to the Power Meter using 1.5 m sensor cables. The input(s) to be verified must be connected to the corresponding connector(s) on the Range Calibrator; that is, connect Power Meter connector A to Range Calibrator connector A, and connector B to connector B (ML2488A and ML2496A only).

2.   On connection of the sensor cable(s), the power meter automatically detects the Range Calibrator and displays the following screen.
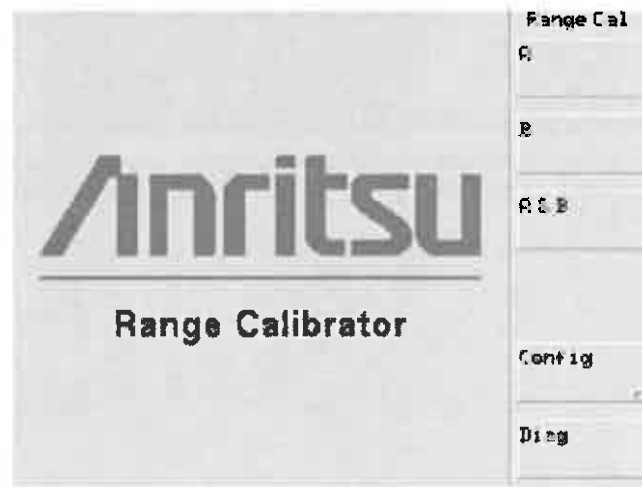
3. Press the soft key of the sensor input to be verified. For single-channel power
    meters (ML2487A and ML2495A), press the A soft key. For dual-channel models
    (ML2488A and ML2496A), press A, B, or A & B. If the A & B soft key is selected,
    all measurements are first taken on sensor input A, then repeated for sensor input B.
    Performance verification tests for each sensor input are performed in the following
    sequence:

    i.   The signal channel input is zeroed.

    ii. The Power Meter signal channel(s) are checked at the upper and lower levels of
         each measurement range. A null is performed at each range setting prior to
         every measurement.

4. When all measurements have been performed on the selected input(s), the results
    are presented on the screen as shown below.
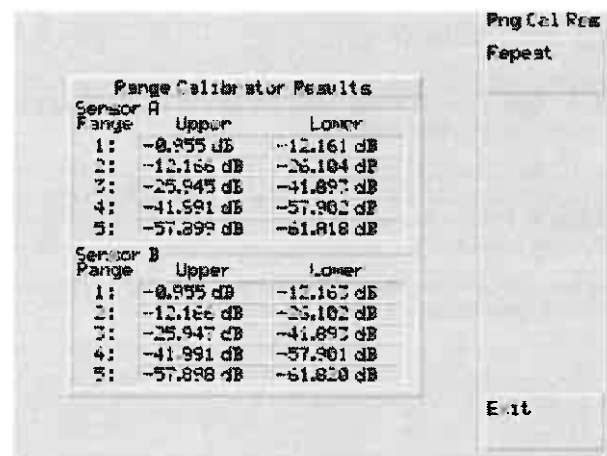
The figure above shows the results for inputs A and B acquired by pressing the A & B
soft key. Once results for both inputs have been acquired, the information is retained until
the power is turned off.

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Interpreting the Results

The tabular data consists of the values read by the meter for each range, with one measurement taken at each end of each range. For each of these measurements, there is an expected value that must meet the specification limits as shown in the table below.

Range	Expected output levels
Range 1 Upper Level	-0.9540 dB
Range 1 Lower Level	−11.8342 dB
Range 2 Upper Level	−11.8342 dB
Range 2 Lower Level	−25.7741 dB
Range 3 Upper Level	−25.8606 dB
Range 3 Lower Level	−41.8031 dB
Range 4 Upper Level	−41.8031 dB
Range 4 Lower Level	−57.8139 dB
Range 5 Upper Level	−57.8139 dB
Range 5 Lower Level	−61.7260 dB

The Range Calibrator measures the "Zero" level, and the "Upper" and "Lower" limits of each of the five ranges (both channels on a dual-channel meter). To calculate the dB Error Figure for each level, subtract the expected level from the measured level.

Pass/Fail Criteria

The meter should be accepted as PASSED if it meets the following conditions applied to the error figures calculated by the above method.

Range 1 and Range 3 Absolute Error and Linearity:

- The calculated absolute errors for Range 1 Upper and Range 3 Upper should each be ≥ -0.020 dB and ≤ 0.020 dB.

- The calculated absolute error for Range 1 Lower should differ from the Range 1 Upper error by ≤ 0.04 dB.

- The calculated absolute error for Range 3 Lower should differ from the Range 3 Upper error by ≤ 0.04 dB.

Ranges 2, 4 and 5 Linearity:

- For Ranges 2 and 4 the absolute error (calculated as above) for the range Lower Level should differ from the Upper Level error by ≤ 0.04 dBm.

- For Range 5, the absolute error (calculated as above) for the range Lower Level should differ from the Upper Level by ≤ 0.04 dB.

Range Change Error

The Range Change Error is defined as the difference between the errors for the two dB levels at the overlap between any two ranges.

The maximum Range Change Error between ranges is specified below:

Range 1 Lower - Range 2 Upper: $\geq$ - 0.020 dB and $\leq$ 0.020 dB

Range 2 Lower - Range 3 Upper: No range change error check

Range 3 Lower - Range 4 Upper: $\geq$ - 0.020 dB and $\leq$ 0.020 dB

Range 4 Lower - Range 5 Upper: $\geq$ - 0.020 dB and $\leq$ 0.020 dB

Using the Diagnostics Menu

The Diagnostics mode allows the user to investigate meter problems by holding on any of the fixed level outputs to examine the results of a particular measurement.

1. Connect the Range Calibrator to the Power Meter using 1.5 m sensor cables. The input(s) to be verified must be connected to the corresponding connector(s) on the Range Calibrator; that is, connect Power Meter connector A to Range Calibrator connector A, and connector B to connector B (ML2488A and ML2496A only).

2. Press the Diag soft key to display the [Rng Cal Diag] group of commands and the [Range Calibrator Diagnostics] dialog.
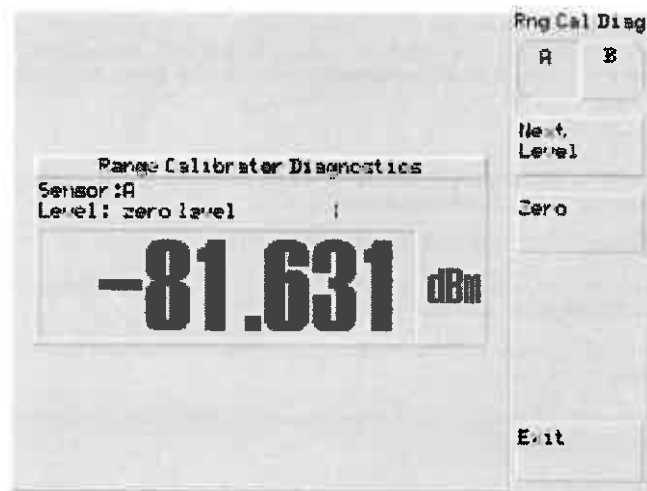
3. Press the Next Level soft key to display the required level. The range calibrator outputs the required signal to the appropriate sensor input on the meter, and the meter continuously measures it. The reading obtained for a particular range should be the same as when the full set of tests was run.

4. Press the Zero soft key to zero the residual range for the required level.

5. Press the Exit soft key to close the dialog and return to the main [Range Cal] menu.

Using the Range Calibrator Config Menu

The range calibrator config menu houses four commands normally found under the
System hard key of the ML248xA / ML249xA. These commands have been included so
that the user can access them without the need to disconnect from the range calibrator.
The soft keys in the [Rng Cal Conf] menu are summarized below. Refer to chapter 5 of
this manual for a more detailed explanation.

Identity   Press to display instrument type, serial number, and
                            firmware version details.

Set GPIB Address   Press to display or change the instrument's GPIB address.

Set RS232 Baud Rate   Press to display or change the baud rate.

Screen Dump Mode   Press to retain the display of the soft keys in screen dumps
                            captured remotely using the supplied [ScreenCapture.exe]
                            program.

Chapter 17.   Secure Mode

This chapter provides:

- Details of how information is stored on the power meter and how it can be removed for security purposes.

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Types of Memory

The ML248xA and ML249xA power meters have three different types of memory device in the power meter.

Flash Memory (2 Mbyte)

This contains the firmware for the main processor, the firmware for the DSP, the code for the FPGA, the Instrument type, the options fitted and the serial number. It does not contain any user information or any variables generated during the execution of the code. The user cannot access this memory or write to it directly.

Volatile Static RAM (1Mbyte + internal DSP memory)

This contains the DSP execution code variables. This is initialised on power up and wiped clean when powered down. The user cannot write to this memory directly, and it is completely cleared during power down. This memory is not accessible by the user.

Non-volatile Static RAM (1Mbyte)

This is a battery backed static RAM used to store the current instrument set up, saved instrument set ups, and the main processor code execution variables. All of the user set parameters such as the frequency used for the cal factor, the trigger time, and which sensor is connected are stored in these set ups. The user cannot write to this memory directly, but it can be completely cleared using the secure mode procedure. The user can store and retrieve instrument set ups in this memory.

Secure Mode

Information such as the cal factor frequency needs to be removed from the power meter if the power meter is moved out of a secure facility. This can be accomplished very easily by using the secure mode to completely wipe the non-volatile static RAM of all information.

The user sets the secure mode on the power meter. When the power meter is next turned on the non-volatile static RAM is completely purged of all information. The power meter then sets the factory defaults for the current settings.

Clearing the Non-Volatile Static RAM

Press the System hard key followed by the Service soft key. Press the Secure soft key within the [Service] menu to light the green LED. Switch the power off and then on again. The power meter will now power up with the non-volatile memory completely purged. The code execution variables are also purged at power on as well.

The secure state can also be set over the GPIB using the following command NVSECS ON.

Anritsu Power Sensors EEPROM

Anritsu manufactures several different families of sensors. All families have an EEPROM type of memory device in the power sensor.

All A,B,C sensors (except MA2490/1 series, MA2411 series)

These sensors all contain a 64Kbit, 8K x 8 EEPROM.

All D sensors MA2490/1 and MA2411 series sensors

These sensors all contain a 128Kbit,16K x 8 EEPROM.

EEPROM Contents

The EEPROM is used to store the following information

- Linearity data
- Temperature Correction Coefficients
- Sensor ID
- Factory cal factor data
- User cal factor table data

Only the user cal factor table data can be erased without the functionality of the sensor being affected. This can be done by pressing Sensor > Edit Tables > Edit CF Table > Table Init > Clear Table

Appendix A. The Command Hierarchies

The commands within the ML248xA / ML249xA are shown in the command hierarchies in this appendix. The hierarchies are split into manageable sections and not only show all the commands within the grouping, but also all the items within any dialogs that may display. The hierarchies are covered in a logical order, working through the hard keys and all commands within from top to bottom as they display on the screen.

The figure below explains how the hierarchical maps on the following pages are structured.

Hard key. The hard keys are dealt with sequentially as they appear on the front panel.

First level soft key commands. Refer to chapter 4 of this manual for details of the meanings of the shapes of the soft keys.

Second level commands may be seen on some command trees. On others, one of the first level commands may open a dialog directly.

Dialog displayed by pressing soft key shown directly above.

Symbol indicating that user entry for this item is made at the numeric keypad.

Corresponding item name.

The commands that display after selecting each of the items in the dialog are listed vertically beneath the item name.

Channel – Set Up (Pulsed/Modulated)

Channel

Set Up	Trigger	Gating	Averaging	Markers	More

Channel Set Up

- Channel
- Mode
- Measurement
- Meas display
- Input Config
- Units
- Resolution
- Setting %

Continued below

Mode	Measurement	Meas display	Input Config	
			Sngl	**Cmb**
Pulsed/ Modulated	Avg	Profile	A	A/B
CW	Avg & Peak	Readout	B	B/A
Dual Channel	Avg, Peak & Crest	Dual Channel	Ext Voltage	A-B
	Avg, Min & Max		Dual Channel	B-A
	Min & Max Hold (*1)			Dual Channel
	Dual Channel			

(*1)
[Min & Max Hold] is only available when
the "Measurement" item is set to
[Avg, Min & Max]. Pressing [Min & Max Hold]
displays the following commands.

- Hold Min & Max
- Reset Min & Max

Continued from above

Units		Resolution
Log	**Lin**	
dBm	W	n n
dBµV	V	n.nn
dBmV	Dual Channel	n.nnn
dBW		Dual Channel
Dual Channel		

Channel – Set Up (CW)

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Channel – Trigger – Trigger Source

Channel – Trigger – Set Capture Time

```
                    ┌─────────────┐
                    │   Channel   │
                    └──────┬──────┘
        ┌──────────┬───────┴───┬──────────┬──────────┬──────────┐
    ┌───────┐  ┌───────┐  ┌───────┐  ┌───────┐  ┌───────┐  ┌───────┐
    │ Set Up│  │Trigger│  │Gating │  │Averaging│ │Markers│  │ More  │
    └───────┘  └───┬───┘  └───────┘  └───────┘  └───────┘  └───────┘
        ┌──────────┼──────────┬──────────┬──────────┬──────────┐
   ┌────────┐  ┌───────┐  ┌───────┐  ┌───────┐  ┌────────┐  ┌───────┐
   │ Trigger│  │Set Cap│  │Set Trig│ │Trigger│  │Trigger │  │ More  │
   │ Source │  │ Time  │  │ Delay │  │ Level │  │Bandwidth│ └───────┘
   └────────┘  └───┬───┘  └───────┘  └───────┘  └────────┘
                   │
         ┌─────────────────────┐
         │  Set Capture Time   │
         ├─────────────────────┤
         │ Capture time   [   ]│
         └─────────┬───────────┘
                   │
         ┌─────────────────┐
         │  Capture time   │
         ├─────────────────┤
         │ Inc             │
         │                 │
         ├─────────────────┤
         │ Dec             │
         │                 │
         └─────────────────┘
```

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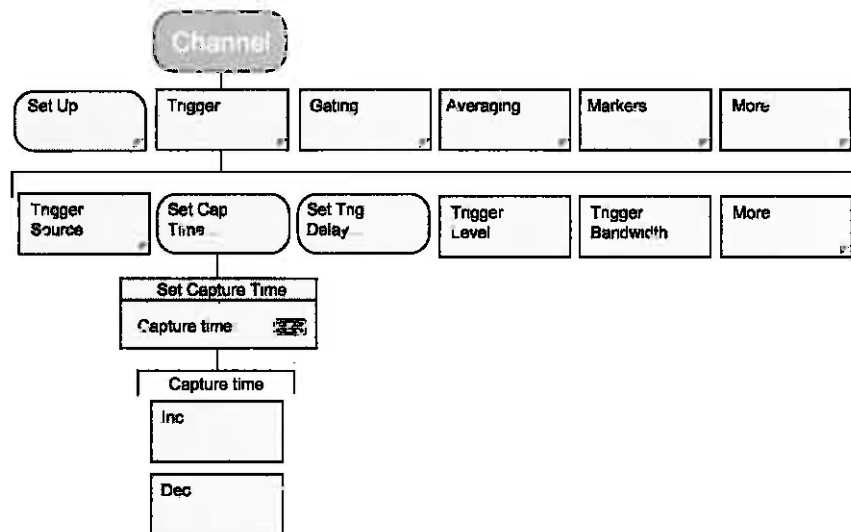
Channel – Trigger – Set Trigger Delay

```
                    ┌─────────┐
                    │ Channel │
                    └────┬────┘
       ┌────────┬────────┼─────────┬─────────┬─────────┐
   ┌───┴──┐ ┌───┴────┐ ┌─┴────┐ ┌──┴─────┐ ┌─┴─────┐ ┌─┴──┐
   │Set Up│ │Trigger │ │Gating│ │Averaging│ │Markers│ │More│
   └──────┘ └───┬────┘ └──────┘ └────────┘ └───────┘ └────┘
      ┌─────────┼────────┬──────────┬───────────┬────────┐
  ┌───┴───┐ ┌───┴────┐ ┌─┴────┐ ┌───┴───┐ ┌─────┴────┐ ┌─┴──┐
  │Trigger│ │Set Cap │ │Set Trig│ │Trigger│ │Trigger  │ │More│
  │Source │ │Time    │ │Delay │ │Level  │ │Bandwidth │ └────┘
  └───────┘ └────────┘ └───┬──┘ └───────┘ └──────────┘
                    ┌───────┴────────┐
                    │Set Trigger Delay│
                    ├────────────────┤
                    │Trigger Delay  ▣│
                    └───────┬────────┘
                    ┌───────┴────────┐
                    │ Trigger Delay  │
                    ├────────────────┤
                    │ Inc            │
                    │                │
                    ├────────────────┤
                    │ Dec            │
                    │                │
                    └────────────────┘
```

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Channel – Trigger – Trigger Level

```
                    ┌──────────┐
                    │ Channel  │
                    └────┬─────┘
   ┌──────────┬─────────┼─────────┬──────────┬──────────┐
┌────────┐┌────────┐┌────────┐┌────────┐┌────────┐┌────────┐
│ Set Up ││Trigger ││ Gating ││Averaging││Markers ││ More   │
└────────┘└───┬────┘└────────┘└────────┘└────────┘└────────┘
   ┌──────────┼──────────┬──────────┬──────────┬──────────┐
┌────────┐┌────────┐┌────────┐┌────────┐┌──────────┐┌────────┐
│Trigger ││Set Cap ││Set Trig││Trigger ││ Trigger  ││ More   │
│Source  ││ Time   ││ Delay  ││ Level  ││Bandwidth ││        │
└────────┘└────────┘└────────┘└───┬────┘└──────────┘└────────┘
              ┌───────────────────┴────┐
        ┌──────────┐            ┌──────────┐
        │ Auto     │            │ Set Trig │
        │ Trigger  │            │ Level    │
        └──────────┘            └────┬─────┘
                          ┌──────────────────────┐
                          │  Set Trigger Level    │
                          ├──────────────────────┤
                          │ Trigger level   [   ] │
                          └──────────┬───────────┘
                              ┌──────────────┐
                              │ Trigger Level │
                              ├──────────────┤
                              │ Inc          │
                              │              │
                              ├──────────────┤
                              │ Dec          │
                              │              │
                              └──────────────┘
```

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Channel – Trigger – Trigger Bandwidth (ML249xA only)

```
                    ┌──────────┐
                    │ Channel  │
                    └──────────┘
   ┌────────┬──────────┬────────┬────────────┬──────────┬──────┐
 ┌────────┐┌────────┐┌────────┐┌────────┐┌────────┐┌────────┐
 │ Set Up ││Trigger ││ Gating ││Averaging││Markers ││ More  │
 └────────┘└────────┘└────────┘└────────┘└────────┘└────────┘

 ┌────────┬─────────┬────────┬──────────┬──────────┬──────┐
┌────────┐┌────────┐┌────────┐┌────────┐┌────────┐┌────────┐
│Trigger ││Set Cap ││Set Trig││Trigger ││Trigger  ││ More  │
│Source  ││Time    ││Delay   ││Level   ││Bandwidth││       │
└────────┘└────────┘└────────┘└────────┘└────────┘└────────┘

              ┌────────┬─────────┬──────────┐
            ┌────────┐┌────────┐┌────────┐┌────────┐
            │20 MHz  ││ 2 MHz  ││200 kHz ││20 kHz  │
            └────────┘└────────┘└────────┘└────────┘
```

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Channel – Trigger – More – Arming

```
                    ┌──────────┐
                    │ Channel  │
                    └────┬─────┘
   ┌─────────┬──────────┼──────────┬──────────┬──────────┐
┌──────┐ ┌───────┐ ┌───────┐ ┌──────────┐ ┌────────┐ ┌──────┐
│Set Up│ │Trigger│ │Gating │ │Averaging │ │Markers │ │ More │
└──────┘ └───────┘ └───────┘ └──────────┘ └────────┘ └──────┘

   ┌──────────┬──────────┬──────────┬──────────┬──────────┐
┌────────┐ ┌───────┐ ┌───────┐ ┌────────┐ ┌─────────┐ ┌──────┐
│Trigger │ │Set Cap│ │Set Trg│ │Trigger │ │Trigger  │ │ More │
│Source  │ │Time   │ │Delay  │ │Level   │ │Bandwidth│ │      │
└────────┘ └───────┘ └───────┘ └────────┘ └─────────┘ └──────┘

              ┌──────────┬──────────┬──────────┐
          ┌───────┐ ┌────────┐ ┌────────┐ ┌──────┐
          │Arming │ │Set     │ │Trigger │ │ Link │
          │       │ │Sample  │ │Indication│ │      │
          │       │ │Rate    │ │        │ │      │
          └───────┘ └────────┘ └────────┘ └──────┘

   ┌─────────┬──────────┬──────────┬──────────┬──────────┐
┌─────────┐ ┌──────┐ ┌──────┐ ┌───────┐ ┌─────────┐ ┌─────────┐
│Automatic│ │Single│ │Frame │ │Arm    │ │Set Frame│ │Set Frame│
│         │ │      │ │      │ │Chan 1 │ │Level    │ │Duration │
└─────────┘ └──────┘ └──────┘ └───────┘ └─────────┘ └─────────┘
```

Set Frame Level		Set Frame Duration	
Frame level	🔲	Frame Duration	🔲

Frame Level
Inc
Dec

Frame Duration
Inc
Dec

Channel – Trigger – More – Set Sample Rate

Note: The figure above shows the sample rates for the ML248xA. For the ML249xA the first two sample rates are replaced with 62.5 MS/s and 31.25 MS/s.

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Channel – Trigger – More – Trigger Indication
(ML249xA only)

```
                        ┌─────────┐
                        │ Channel │
                        └────┬────┘
   ┌────────┬──────────┬─────┴────┬───────────┬─────────┬──────────┐
┌──────┐ ┌───────┐ ┌────────┐ ┌──────────┐ ┌────────┐ ┌──────┐
│Set Up│ │Trigger│ │Gating  │ │Averaging │ │Markers │ │More  │
└──────┘ └───┬───┘ └────────┘ └──────────┘ └────────┘ └──────┘
   ┌─────────┴───┬──────────┬──────────┬───────────┬─────────┐
┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐ ┌──────┐
│Trigger │ │Set Cap │ │Set Trig│ │Trigger │ │Trigger   │ │More  │
│Source  │ │Time    │ │Delay   │ │Level   │ │Bandwidth │ └──┬───┘
└────────┘ └────────┘ └────────┘ └────────┘ └──────────┘    │
              ┌────────────┬──────────────┬──────────────────┤
         ┌────────┐ ┌───────────┐ ┌──────────┐ ┌──────┐
         │Arming  │ │Set Sample │ │Trigger   │ │Link  │
         └────────┘ │Rate       │ │Indication│ └──────┘
                    └───────────┘ └────┬─────┘
   ┌───────────┬─────────┬─────────┬───┴──────┬─────────┐
┌────────┐ ┌───────┐ ┌───────┐ ┌────────┐ ┌────────┐ ┌────────┐
│Lev Wave│ │  ⬆    │ │  ⬇    │ │Top     │ │Middle  │ │Bottom  │
│& Pos   │ └───────┘ └───────┘ └────────┘ └────────┘ └────────┘
│    Form│
└────────┘
```

www.valuetronics.com
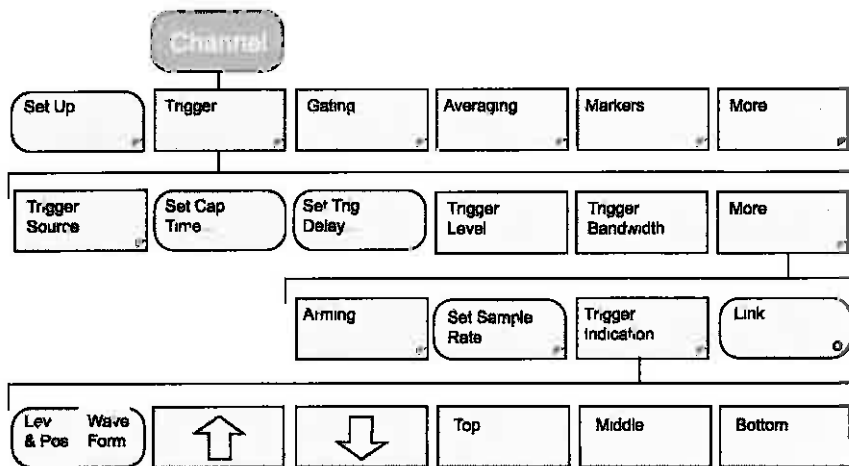
Channel – Gating – Set Up (Pulsed/Modulated)

```
                         ┌──────────┐
                         │ Channel  │
                         └────┬─────┘
    ┌──────┐  ┌──────┐  ┌──────┐  ┌───────────┐  ┌────────┐  ┌──────┐
    │Set Up│  │Trigger│  │Gating│  │ Averaging │  │Markers │  │ More │
    └──────┘  └──────┘  └──┬───┘  └───────────┘  └────────┘  └──────┘
    ┌──────┐  ┌──────────┐  ┌────────┐  ┌───────────┐  ┌───────────┐  ┌─────────┐
    │Set Up│  │Set Active│  │ Repeat │  │Set Repeat │  │Set Repeat │  │ Display │
    │      │  │  Gate    │  │ Gate 1 │  │  Count    │  │  Offset   │  │  Gates  │
    └──┬───┘  └──────────┘  └────────┘  └───────────┘  └───────────┘  └─────────┘
```

```
┌─────────────────────┐
│  Gating Set Up      │
├─────────────────────┤
│  Channel            │
│  Gate 1             │
│  Fence 1            │
│  Gate 2             │
│  Fence 2            │
│  Gate 3             │
│  Fence 3            │
│  Gate 4             │
│  Fence 4            │
└──────────┬──────────┘
```

```
┌─────────────────────┐
│  Gate and Fence 1 to 4
└──────────┬──────────┘

┌─────────────────────┐
│  Enabled            │
│                   ○ │
└─────────────────────┘

┌─────────────────────┐
│  Set as Active      │
└─────────────────────┘

┌─────────────────────┐
│  Inc                │
└─────────────────────┘

┌─────────────────────┐
│  Dec                │
└─────────────────────┘

┌─────────────────────┐
│  All Gates Off      │
└─────────────────────┘
```

www.valuetronics.com
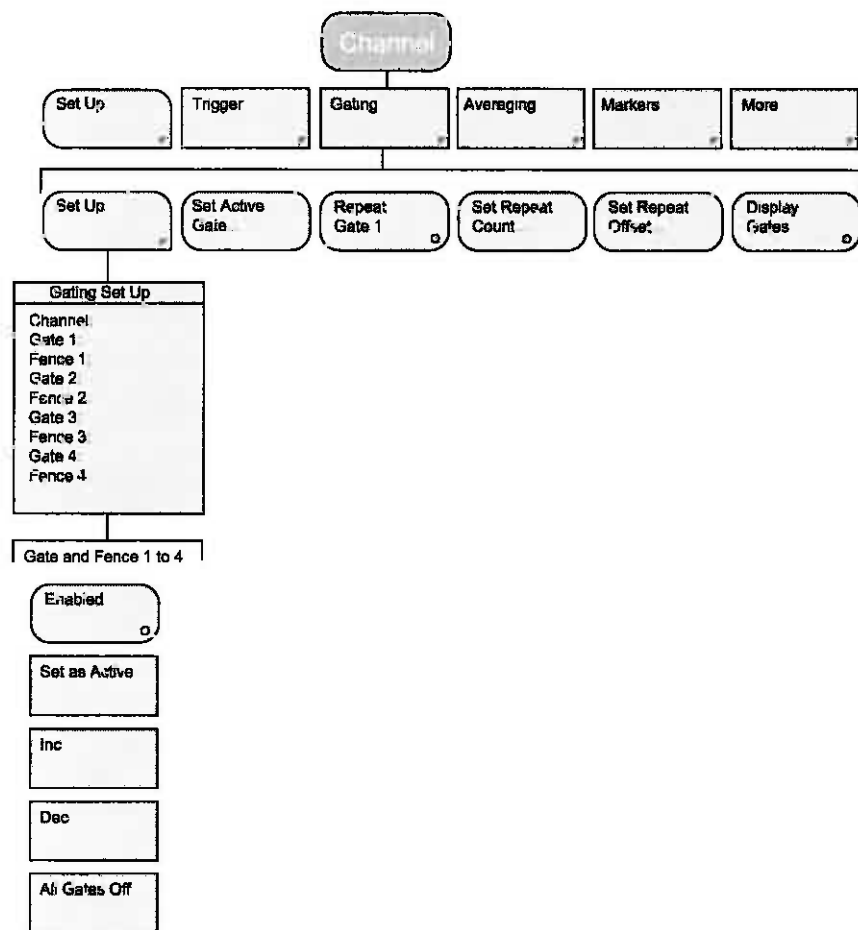
Channel – Gating (Cont) (Pulsed/Modulated)

```
                              ┌──────────┐
                              │ Channel  │
                              └────┬─────┘
    ┌────────┬────────┬───────────┼────────┬─────────┬────────┐
 ┌──────┐ ┌───────┐ ┌───────┐ ┌──────────┐ ┌────────┐ ┌──────┐
 │Set Up│ │Trigger│ │Gating │ │Averaging │ │Markers │ │ More │
 └──────┘ └───────┘ └───┬───┘ └──────────┘ └────────┘ └──────┘
    ┌────────┬───────────┼──────────┬────────────┬──────────┐
 ┌──────┐ ┌────────┐ ┌───────┐ ┌────────┐ ┌────────────┐ ┌────────┐
 │Set Up│ │Set Active│ │Repeat │ │Set Repeat│ │Set Repeat│ │Display │
 │      │ │Gate    │ │Gate 1 │ │Count   │ │Offset    │ │Gates   │
 └──────┘ └───┬────┘ └───────┘ └───┬────┘ └────┬───────┘ └────────┘
```

Set Active gate	Set Repeat Count	Set Repeat Offset
Active gate	Repeat Count	Repeat Offset
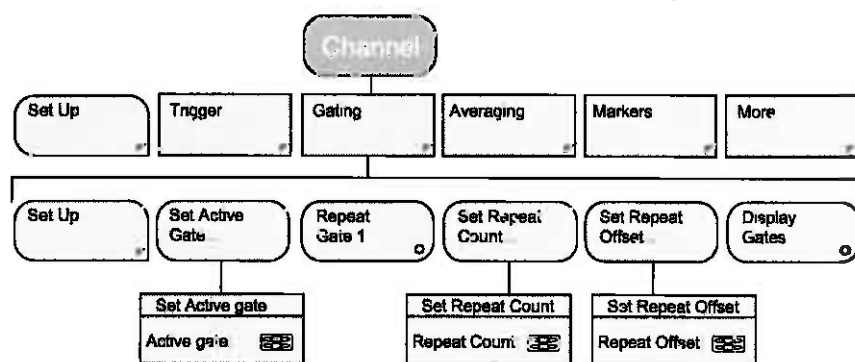
Channel – Relative Meas (CW)

www.valuetronics.com
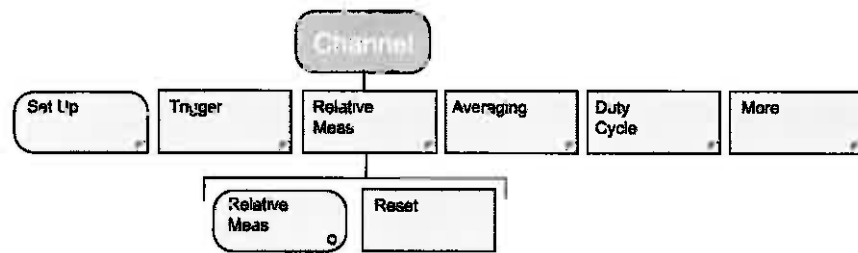
Channel – Averaging – Set Avg Number (Pulsed/Modulated)

```
                          ┌──────────┐
                          │ Channel  │
                          └──────────┘
                               │
  ┌────────┬────────┬────────┬────────┬────────┬────────┐
┌──────┐ ┌───────┐ ┌───────┐ ┌──────────┐ ┌────────┐ ┌──────┐
│Set Up│ │Trigger│ │Gating │ │Averaging │ │Markers │ │ More │
└──────┘ └───────┘ └───────┘ └──────────┘ └────────┘ └──────┘
                                    │
                        ┌───────────┼───────────┐
                   ┌──────────┐ ┌────────┐ ┌──────────┐
                   │Averaging │ │Set Avg │ │Restart   │
                   │          │ │Number  │ │Averaging │
                   └──────────┘ └────────┘ └──────────┘
                                    │
                        ┌──────────────────────┐
                        │Set Averaging Number   │
                        │                       │
                        │Averaging number  �  │
                        └──────────────────────┘
```
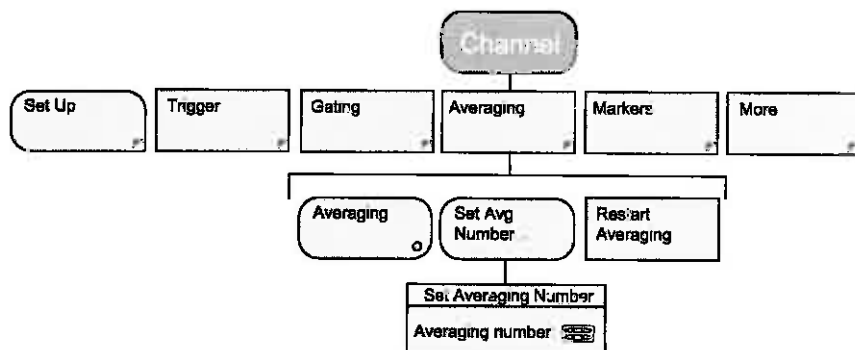
Channel – Averaging – Set Avg Number (CW)

```
                              ┌───────────┐
                              │  Channel  │
                              └─────┬─────┘
    ┌────────┬─────────┬───────────┼──────────┬──────────┐
 ┌──────┐ ┌───────┐ ┌────────┐ ┌─────────┐ ┌──────┐ ┌──────┐
 │Set Up│ │Trigger│ │Relative│ │Averaging│ │Duty  │ │More  │
 │      │ │       │ │Meas    │ │         │ │Cycle │ │      │
 └──────┘ └───────┘ └────────┘ └────┬────┘ └──────┘ └──────┘
    ┌────────┬─────────┬────────┬────┴─────┐
 ┌──────┐ ┌──────┐ ┌────────┐ ┌───────┐ ┌────────┐
 │Off   │ │Auto  │ │Moving  │ │Repeat │ │Set Avg │
 │      │ │      │ │        │ │       │ │Number  │
 └──────┘ └──────┘ └────────┘ └───────┘ └───┬────┘
                                    ┌────────┴─────────┐
                                    │Set Averaging Number│
                                    ├──────────────────┤
                                    │Averaging number  ▦│
                                    └──────────────────┘
```

www.valuetronics.com
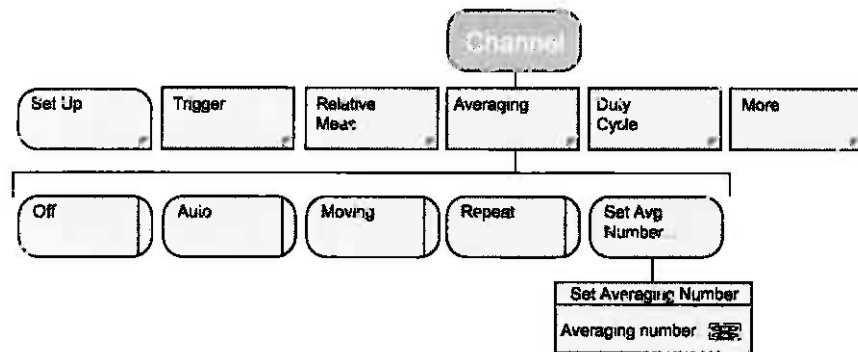
Channel – Markers – Position Act Mkr (Profile)

```
                                              ┌──────────┐
                                              │ Channel  │
                                              └────┬─────┘
                                                   │
 ┌────────┐  ┌────────┐  ┌────────┐  ┌──────────┐  ┌────────┐  ┌────────┐
 │ Set Up │  │ Trigger│  │ Gating │  │ Averaging│  │ Markers│  │ More   │
 └────────┘  └────────┘  └────────┘  └──────────┘  └───┬────┘  └────────┘
                                                        │
 ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐  ┌──────────┐
 │ Active │  │Position│  │ Assign │  │ Delta  │  │ Set Up │  │ Marker   │
 │ Marker │  │ Act Mkr│  │ Act Mkr│  │ Marker │  │ Markers│  │ Functions│
 └────────┘  └───┬────┘  └────────┘  └────────┘  └────────┘  └──────────┘
                 │
      ┌──────────────────────┐
      │ Position Active Marker│
      ├──────────────────────┤
      │ Active mkr position   │
      └──────────────────────┘
```

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Channel – Markers – Assign Act Mkr (Profile)

```
                                    ┌──────────┐
                                    │ Channel  │
                                    └────┬─────┘
  ┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐ ┌─────────┐ ┌────────┐
  │ Set Up │ │ Trigger│ │ Gating │ │Averaging │ │ Markers │ │ More   │
  └────────┘ └────────┘ └────────┘ └──────────┘ └────┬────┘ └────────┘

  ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐
  │ Active │ │Position│ │ Assign │ │ Delta  │ │ Set Up │ │ Marker   │
  │ Marker │ │Act Mkr │ │ Act Mkr│ │ Marker │ │ Markers│ │ Functions│
  └────────┘ └────────┘ └───┬────┘ └────────┘ └────────┘ └──────────┘

  ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐
  │Marker 1│ │Marker 2│ │Marker 3│ │Marker 4│
  └────────┘ └────────┘ └────────┘ └────────┘
```

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Channel – Markers – Delta Marker – Position Delta Mkr (Profile)

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Channel – Markers – Set Up (Profile)

```
                                    ┌──────────┐
                                    │ Channel  │
                                    └────┬─────┘
   ┌────────┬─────────┬─────────┬───────┼───────┬────────┐
┌──────┐ ┌──────┐ ┌──────┐ ┌─────────┐ ┌───────┐ ┌──────┐
│Set Up│ │Trigger│ │Gating│ │Averaging│ │Markers│ │More  │
└──────┘ └──────┘ └──────┘ └─────────┘ └───────┘ └──────┘
```

```
   ┌────────┬─────────┬─────────┬─────────┬─────────┬──────────┐
┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌─────────┐
│Active  │ │Position│ │Assign  │ │Delta   │ │Set Up  │ │Marker   │
│Marker  │ │Act Mkr │ │Act Mkr │ │Marker  │ │Markers │ │Functions│
└────────┘ └────────┘ └────────┘ └────────┘ └────────┘ └─────────┘
```

```
                        ┌───────────────┐
                        │ Marker Set Up │
                        ├───────────────┤
                        │ Channel       │
                        │ 1             │
                        │ 2             │
                        │ 3             │
                        │ 4             │
                        │ 5             │
                        └───────────────┘
                                │
                        ┌──────────────┐
                        │  1, 2, 3, 4  │
                        ┌───────────────┐
                        │ Display      │
                        │ Marker       │
                        └───────────────┘

                        ┌───────────────┐
                        │ Set as        │
                        │ Active        │
                        └───────────────┘

                        ┌───────────────┐
                        │ Inc           │
                        └───────────────┘

                        ┌───────────────┐
                        │ Dec           │
                        └───────────────┘

                        ┌───────────────┐
                        │ All Mkrs      │
                        │ Off           │
                        └───────────────┘
```

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Channel – Markers – Marker Functions – Advanced Functions (Profile)

```
                                          ┌──────────┐
                                          │ Channel  │
                                          └──────────┘
                                                │
  ┌────────┐ ┌────────┐ ┌────────┐ ┌───────────┐ ┌────────┐ ┌────────┐
  │ Set Up │ │Trigger │ │ Gating │ │ Averaging │ │Markers │ │ More   │
  └────────┘ └────────┘ └────────┘ └───────────┘ └────────┘ └────────┘
                                                      │
  ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐
  │ Active │ │Position│ │ Assign │ │ Delta  │ │ Set Up │ │ Marker │
  │ Marker │ │Act Mkr │ │Act Mkr │ │ Marker │ │Markers │ │Functions│
  └────────┘ └────────┘ └────────┘ └────────┘ └────────┘ └────────┘
                                                              │
             ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐
             │ Active │ │ Active │ │ Active │ │ Active │ │ Advanced │
             │ to Max │ │ to Min │ │Zoom In │ │Zoom Out│ │Functions │
             └────────┘ └────────┘ └────────┘ └────────┘ └──────────┘
                                                              │
  ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐
  │ Pulse  │ │ Pulse  │ │ Pulse  │ │ Off    │ │ PRI    │ │ Search   │
  │Rise Time│ │Fall Time│ │ Width  │ │ Time   │ │        │ │ Set Up   │
  └────────┘ └────────┘ └────────┘ └────────┘ └────────┘ └──────────┘
                                                              │
                                          ┌──────────────────────────┐
                                          │ Marker Search Set Up      │
                                          │                           │
                                          │ Upper target      ▓▓▓     │
                                          │ Lower target      ▓▓▓     │
                                          │ Starting value            │
                                          └──────────────────────────┘
                                                        │
              ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
              │ Upper targer │  │ Lower targer │  │Starting value│
              │  ┌────────┐  │  │  ┌────────┐  │  │  ┌────────┐  │
              │  │  Inc   │  │  │  │  Inc   │  │  │  │Act Mkr │  │
              │  └────────┘  │  │  └────────┘  │  │  │  Pos   │  │
              │  ┌────────┐  │  │  ┌────────┐  │  │  └────────┘  │
              │  │  Dec   │  │  │  │  Dec   │  │  │  ┌────────┐  │
              │  └────────┘  │  │  └────────┘  │  │  │Act Gate│  │
              │              │  │              │  │  │  Avg   │  │
              └──────────────┘  └──────────────┘  └──────────────┘
```

Channel – Duty Cycle (CW)

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Channel – More – Limit Checking – Set Up (Pulsed/Modulated)

Channel

| Set Up | Trigger | Gating | Averaging | Markers | More |

| Limit Checking | Scaling | Profile Display | Meas Hold | Peaking Indicator | Post Process |

| Limit Checking | Set Up | Fail Hold | Clear Lim Failure | Audible Alarm | Edit Limit Spec |

Limit Checking Set Up

Channel
Mode
Application
Specification id
Amplitude offset
Time offset

Mode	Application	Specification id	Amplitude offet	Time offet
Simple	Upper & Lower	User Limit Spec	Inc	Inc
Complex	Upper Only	Predefined Limit Spec	Dec	Dec
Repeat Limit	Lower Only	Repeat Limit	Repeat Limit	Repeat Limit
	Repeat Limit			

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Channel – More – Limit Checking – Edit Limit Spec – Select Spec

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Channel – More – Limit Checking – Edit Limit Spec – Save Spec

Channel

Set Up	Trigger	Gating	Averaging	Markers	More

Limit Checking	Scaling	Profile Display	Meas Hold	Peaking Indicator	Post Process

Limit Checking	Set Up	Fail Hold	Clear Lim Failure	Audible Alarm	Edit Limit Spec

Select Spec	Save Spec	Edit Segments	Edit Title	Page Up	Page Down

Save	Save as

User Limits

1 to 30

1 to 30

Select

⇧

⇩

Page Up

Page Down

www.valuetronics.com
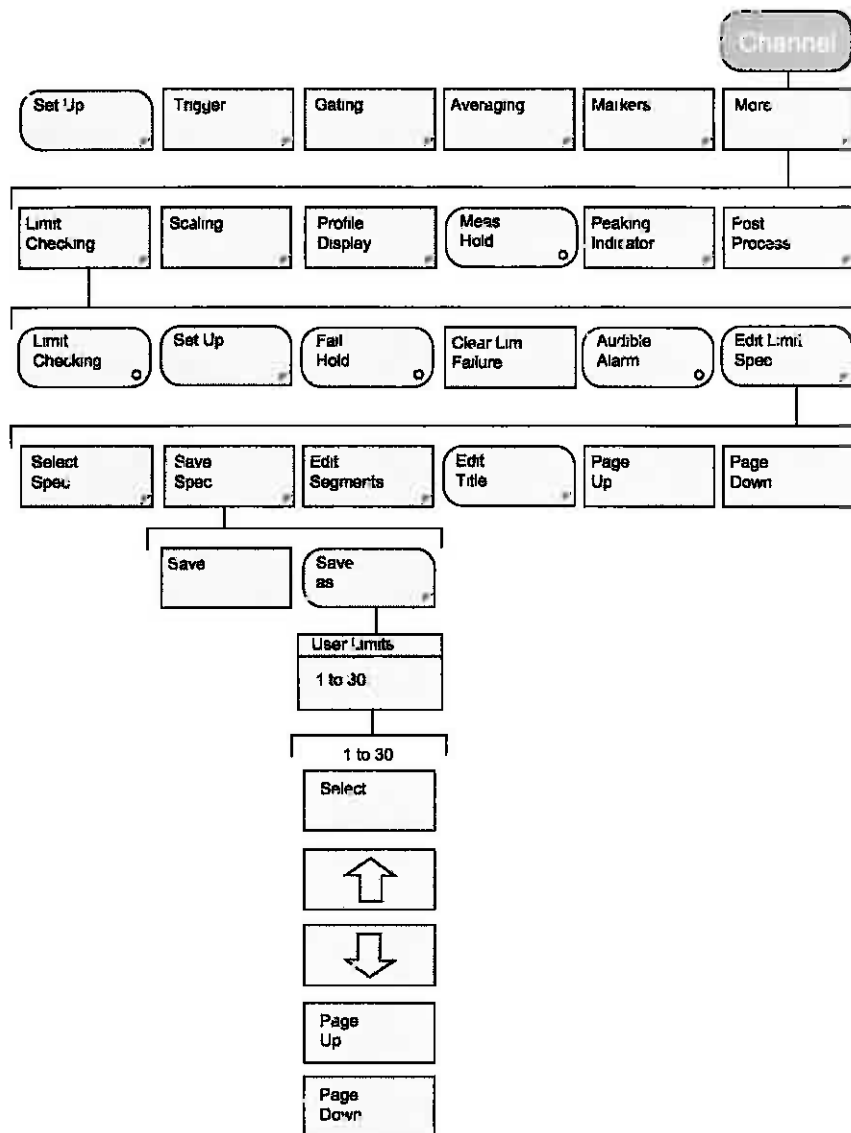
Channel – More – Limit Checking – Edit Limit Spec – Edit Segments

Channel

| Set Up | Trigger | Gating | Averaging | Markers | More |

| Limit Checking | Scaling | Profile Display | Meas Hold | Peaking Indicator | Post Process |

| Limit Checking | Set Up | Fail Hold | Clear Lim Failure | Audible Alarm | Edit Limit Spec |

| Select Spec | Save Spec | Edit Segments | Edit Title | Page Up | Page Down |

| Previous Segment | Next Segment | Page Up | Page Down | Add Segment | Delete Segment |

Limit Limit Specification
Start (Upper) (Lower)
Stop (Upper) (Lower)

| ns |

| µs |

| ms |

| s |

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Channel – More – Limit Checking – Edit Limit Spec – Edit Title

Channel - More –Scaling (Profile)

```
                                                          ┌─────────┐
                                                          │ Channel │
                                                          └────┬────┘
                                                               │
 ┌────────┐  ┌────────┐  ┌────────┐  ┌───────────┐  ┌────────┐  ┌──────┐
 │ Set Up │  │ Trigger│  │ Gating │  │ Averaging │  │ Markers│  │ More │
 └────────┘  └────────┘  └────────┘  └───────────┘  └────────┘  └──┬───┘
                                                                    │
 ┌──────────┐  ┌────────┐  ┌─────────┐  ┌──────┐  ┌──────────┐  ┌─────────┐
 │ Limit    │  │ Scaling│  │ Profile │  │ Meas │  │ Peaking  │  │ Post    │
 │ Checking │  │        │  │ Display │  │ Hold │  │ Indicator│  │ Process │
 └──────────┘  └───┬────┘  └─────────┘  └──────┘  └──────────┘  └─────────┘
                   │
        ┌──────────┼──────────────┐
   ┌────────┐  ┌────────┐  ┌───────────┐
   │ Set    │  │ Set    │  │ Autoscale │
   │ Ref    │  │ Scale  │  │           │
   └───┬────┘  └───┬────┘  └───────────┘
       │           │
 ┌──────────────┐ ┌──────────┐
 │Set Reference │ │Set Scale │
 │    Level     │ │          │
 ├──────────────┤ ├──────────┤
 │Ref Level  ▓▓ │ │Scale  ▓▓ │
 └───┬──────────┘ └───┬──────┘
     │                │
 ┌────────┐       ┌────────┐
 │ Inc    │       │ Inc    │
 └────────┘       └────────┘

 ┌────────┐       ┌────────┐
 │ Dec    │       │ Dec    │
 └────────┘       └────────┘
```

www.valuetronics.com
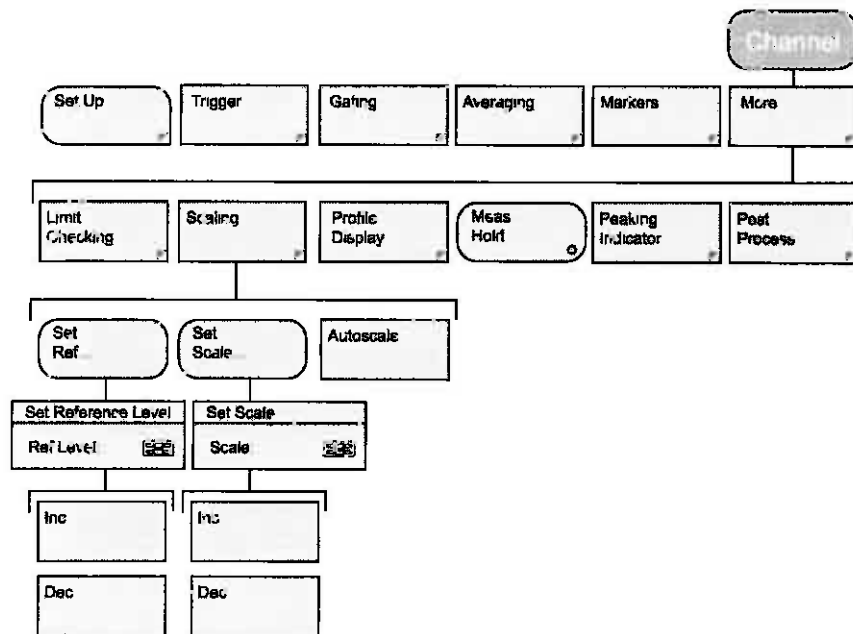
Channel – More – Profile Display (Profile)

Channel

Set Up	Trigger	Gating	Averaging	Markers	More

Limit Checking	Scaling	Profile Display	Meas Ho'd	Peaking Indicator	Post Process

Avg	Min & Max	Min	Max	Data Hold

Single	Infinite	Reset

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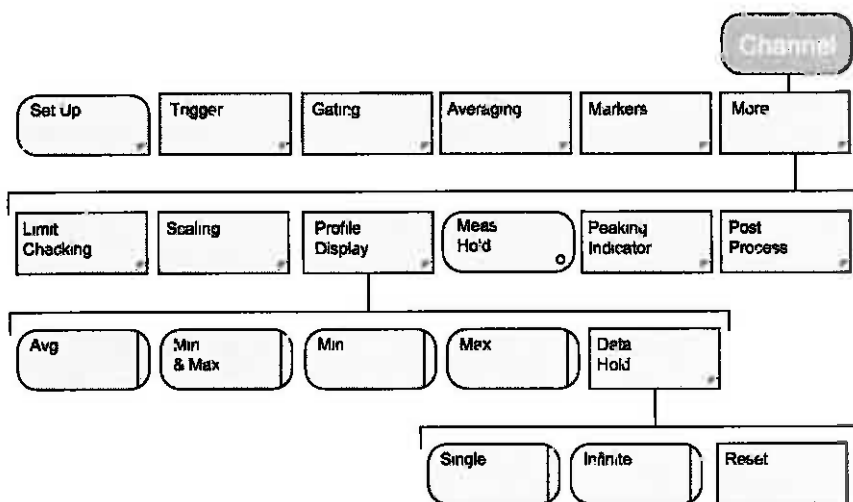
Channel – More – Peaking Indicator (Pulsed/Modulated)

```
                                                              ┌──────────┐
                                                              │ Channel  │
                                                              └────┬─────┘
┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐ ┌────────┐ ┌───────┴──┐
│ Set Up │ │ Trigger│ │ Gating │ │ Averaging│ │ Markers│ │  More    │
└────────┘ └────────┘ └────────┘ └──────────┘ └────────┘ └────┬─────┘
                                                               │
┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌──────────┐ ┌────┴────┐
│ Limit  │ │Scaling │ │Profile │ │ Meas   │ │ Peaking  │ │  Post   │
│Checking│ │        │ │Display │ │ Hold   │ │indicator │ │ Process │
└────────┘ └────────┘ └────────┘ └────────┘ └────┬─────┘ └─────────┘
                                                  │
                                        ┌─────────┴──┐ ┌────────┐
                                        │ Peaking    │ │ Reset  │
                                        │ Indicator  │ │        │
                                        └────────────┘ └────────┘
```
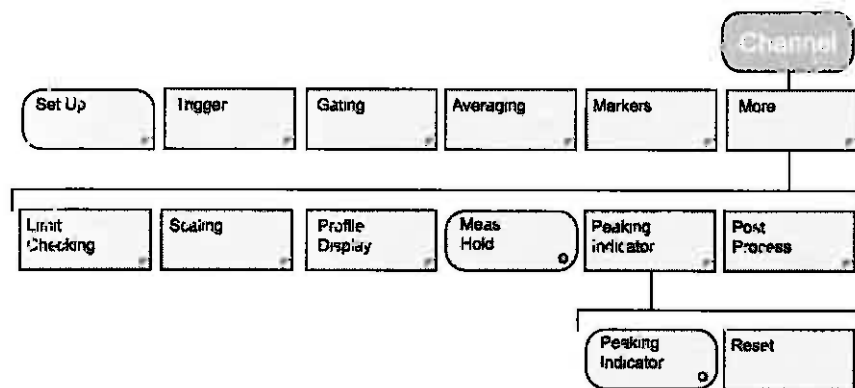
Channel – More – Peaking Indicator (CW)

```
                                                          ┌──────────┐
                                                          │ Channel  │
                                                          └────┬─────┘
                                                               │
┌────────┐  ┌────────┐  ┌──────────┐  ┌──────────┐  ┌────────┐  ┌────────┐
│ Set Up │  │Trigger │  │ Relative │  │Averaging │  │  Duty  │  │  More  │
│        │  │        │  │  Meas    │  │          │  │ Cycle  │  │        │
└────────┘  └────────┘  └──────────┘  └──────────┘  └────────┘  └────┬───┘
                                                                     │
        ┌──────────┬──────────┬──────────┬──────────────┬──────────┐
   ┌────┴─────┐  ┌─┴──────┐  ┌─┴──────┐  ┌─┴────────┐  ┌─┴──────┐
   │  Limit   │  │Min/Max │  │  Meas  │  │ Peaking  │  │  Post  │
   │ Checking │  │        │  │  Hold  │  │Indicator │  │Process │
   └──────────┘  └────────┘  └────────┘  └────┬─────┘  └────────┘
                                              │
                              ┌───────────────┴──────┐
                         ┌────┴─────┐  ┌──────────┐
                         │ Peaking  │  │  Reset   │
                         │Indicator │  │          │
                         └──────────┘  └──────────┘
```

Channel – More – Post Process – Set Up

www.valuetronics.com

Channel – More – Post Process – Cursor

```
                                                              ┌──────────┐
                                                              │ Channel  │
                                                              └────┬─────┘
                                                                   │
  ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌───────────┐  ┌─────────┐  ┌─────────┐
  │ Set Up  │  │ Trigger │  │ Gating  │  │ Averaging │  │ Markers │  │ More    │
  └─────────┘  └─────────┘  └─────────┘  └───────────┘  └─────────┘  └────┬────┘
                                                                          │
  ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌───────────┐  ┌─────────┐
  │ Limit   │  │ Scaling │  │ Profile │  │ Meas    │  │ Peaking   │  │ Post    │
  │ Checking│  │         │  │ Display │  │ Hold    │  │ Indicator │  │ Process │
  └─────────┘  └─────────┘  └─────────┘  └─────────┘  └───────────┘  └────┬────┘
                                                                          │
                        ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐
                        │ Post    │  │ Set Up  │  │ Cursor  │  │ Restart │
                        │ Process │  │         │  │         │  │         │
                        └─────────┘  └─────────┘  └────┬────┘  └─────────┘
                                                       │
                        ┌─────────┐  ┌────────────┐  ┌─────────┐  ┌─────────┐
                        │ Cursor  │  │ Set Cursor │  │ Zoom    │  │ Zoom    │
                        │         │  │ Position   │  │ In      │  │ Out     │
                        └─────────┘  └────────────┘  └─────────┘  └─────────┘
```

Sensor – Setup

www.valuetronics.com

Sensor – Cal Factor

```
                          ┌──────────┐
                          │  Sensor  │
                          └────┬─────┘
     ┌────────────┬───────────┼──────────────┬─────────────┐
┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐  ┌─────────┐
│ Set Up  │  │  Cal    │  │ Offset  │  │  Edit   │  │  Range  │
│         │  │ Factor  │  │         │  │ Tables  │  │  Hold   │
└─────────┘  └────┬────┘  └─────────┘  └─────────┘  └─────────┘
                  │
        ┌─────────────────────┐
        │      Cal Factor      │
        ├─────────────────────┤
        │ Sensor               │
        │ Source               │
        │ Frequency        ▦   │
        │ Cal factor       ▦   │
        │ Cal adjust (*1)  ▦   │
        └──────────┬──────────┘
     ┌──────────┬────────────┬────────────┐
   Source    Frequency    Cal factor    Cal adjust
 ┌───────┐  ┌───────┐   ┌───────┐   ┌───────┐
 │ A   B │  │ A   B │   │ A   B │   │ A   B │
 └───────┘  └───────┘   └───────┘   └───────┘
 ┌───────┐  ┌───────┐   ┌───────┐   ┌───────┐
 │Frequency│ │ Inc  │   │ Inc  │   │ Inc  │
 └───────┘  └───────┘   └───────┘   └───────┘
 ┌───────┐  ┌───────┐   ┌───────┐   ┌───────┐
 │Manual │  │ Dec  │   │ Dec  │   │ Dec  │
 └───────┘  └───────┘   └───────┘   └───────┘
 ┌───────┐  ┌───────┐   ┌───────┐   ┌───────┐
 │ V/GHz │  │More(*2)│  │More(*2)│  │More(*2)│
 └───────┘  └───────┘   └───────┘   └───────┘
 ┌───────┐
 │More(*2)│
 └───────┘
```

Table (max x)

┌───────────┐
│ Enter   │
└───────────┘

┌───────────┐
│ Factory │
└───────────┘

┌───────────┐
│ Factory + │
└───────────┘

(*1)
If the "Source" item in the [Cal Factor] dialog is set to "Frequency" or "V/GHz", "Table (max x)" displays in the dialog instead of "Cal adjust". The commands shown to the left are available when the [Sel] key is pressed after selecting "Table (max x)".

(*2)

┌───────────┐
│   %   │
└───────────┘

┌───────────┐
│   dB   │
└───────────┘

┌───────────┐
│ V/GHz   │
│ Set Up   │
└─────┬─────┘

┌──────────────────────┐
│   V/GHz Set Up   │
├──────────────────────┤
│ Frequency Start ▦   │
│ Frequency Stop   ▦   │
│ Voltage Start   ▦   │
│ Voltage Stop   ▦   │
└──────────────────────┘

Sensor – Offset

```
                              ┌──────────┐
                              │  Sensor  │
                              └────┬─────┘
                                   │
   ┌──────────┬──────────┬────────┴────────┬──────────┬──────────┐
┌──────┐  ┌──────┐  ┌──────┐        ┌──────┐   ┌──────┐
│Set Up│  │ Cal  │  │Offset│        │ Edit │   │Range │
│      │  │Factor│  │      │        │Tables│   │Hold  │
└──────┘  └──────┘  └──┬───┘        └──────┘   └──────┘
                       │
                ┌──────┴──────┐
                │   Offset    │
                ├─────────────┤
                │ Sensor      │
                │ Type        │
                │ Offset or Table │
                └──────┬──────┘
                       │
        ┌──────────────┼──────────────┐
      Type           Table          Offset
   ┌──────────┐   ┌──────────┐   ┌──────────┐
   │ A     B  │   │ A     3  │   │ A     B  │
   └──────────┘   └──────────┘   └──────────┘

   ┌──────────┐   ┌──────────┐   ┌──────────┐
   │ Off      │   │ Select   │   │ Inc      │
   │          │   │ Table    │   │          │
   └──────────┘   └──────────┘   └──────────┘

   ┌──────────┐                  ┌──────────┐
   │ Fixed    │                  │ Dec      │
   │          │                  │          │
   └──────────┘                  └──────────┘

   ┌──────────┐
   │ Table    │
   │          │
   └──────────┘
```

Sensor – Edit Tables

Sensor – Edit Tables – Edit Identity

```
                    ┌──────────┐
                    │  Sensor  │
                    └────┬─────┘
    ┌──────────┬──────────┬──────────┬──────────┐
 ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐
 │ Set Up │ │  Cal   │ │ Offset │ │  Edit  │ │ Range  │
 │        │ │ Factor │ │        │ │ Tables │ │  Hold  │
 └────────┘ └────────┘ └────────┘ └───┬────┘ └────────┘
                              ┌────────┴────────┐
                          ┌────────┐        ┌────────┐
                          │  Edit  │        │  Edit  │
                          │CF Table│        │Offset Tbl│
                          └───┬────┘        └────────┘
                    ┌─────────┴─────────┐
                    │ Edit Cal Factor Table │
                    ├───────────────────┤
                    │ Frequency      ▦ │
                    │ Cal Factor     ▦ │
                    └─────────┬─────────┘
    ┌──────┬──────┬──────┬──────┬──────┬──────┐
 ┌───────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐
 │ A   B │ │Select│ │ Save │ │ Edit │ │ Edit │ │Table │
 │       │ │Table │ │Table │ │Entries│ │Identity│ │ Init │
 └───────┘ └──────┘ └──────┘ └──────┘ └──┬───┘ └──┬───┘
                                  ┌───────┴────┐    │
                                  │Table Identity│   │
                                  ├────────────┤    │
                                  │Identity  ▦ │    │
                                  └────────────┘    │
                                          ┌──────────┴──────────┐
                                      ┌───────┐          ┌───────┐
                                      │ Clear │          │ Preset│
                                      │ Table │          │ Table │
                                      └───┬───┘          └───┬───┘
                                  ┌───────┴──────────┐       │
                                  │Clear Cal Factor Table?│  │
                                  └───────┬──────────┘       │
                                  ┌───────┴───────┐          │
                              ┌───────┐      ┌───────┐        │
                              │  Yes  │      │  No   │        │
                              └───────┘      └───────┘        │
                                          ┌──────────────────┴──┐
                                          │Preset Cal Factor Table?│
                                          └──────────┬───────────┘
                                          ┌──────────┴──────────┐
                                      ┌───────┐          ┌───────┐
                                      │  Yes  │          │  No   │
                                      └───────┘          └───────┘
```

Sensor – Edit Tables – Edit Offset Table

```
                    ┌──────────┐
                    │  Sensor  │
                    └──────────┘

  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐
  │ Set Up │  │  Cal   │  │ Offset │  │  Edit  │  │ Range  │
  │        │  │ Factor │  │        │  │ Tables │  │ Hold  o│
  └────────┘  └────────┘  └────────┘  └────────┘  └────────┘

                          ┌────────┐  ┌────────┐
                          │  Edit  │  │  Edit  │
                          │CF Table│  │Offset Tbl│
                          └────────┘  └────────┘

                          ┌────────────────────┐
                          │  Edit Offset Table  │
                          │  Frequency          │
                          │  Offset             │
                          └────────────────────┘

  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐
  │ Select │  │  Save  │  │  Edit  │  │  Edit  │  │ Clear  │
  │ Table  │  │ Table  │  │ Entries│  │Identity│  │ Table  │
  └────────┘  └────────┘  └────────┘  └────────┘  └────────┘

  ┌────────────┐                    ┌────────────────┐
  │Offset Table│                    │ Table Identity │
  │  1 to 5    │                    │  Identity      │
  └────────────┘                    └────────────────┘

  ┌────────────┐                      ┌──────────────────────┐
  │  Select    │                      │ Clear Cal Factor Table? │
  └────────────┘                      └──────────────────────┘

  ┌────────────┐                    ┌────────┐  ┌────────┐
  │    ⬆       │                    │  Yes   │  │  No    │
  └────────────┘                    └────────┘  └────────┘

  ┌────────────┐
  │    ⬇       │
  └────────────┘

  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐  ┌────────┐
  │Previous│  │  Next  │  │  Page  │  │  Page  │  │  Add   │  │ Delete │
  │ Entry  │  │ Entry  │  │  Up    │  │ Down   │  │ Entry  │  │ Entry  │
  └────────┘  └────────┘  └────────┘  └────────┘  └────────┘  └────────┘

                          ┌────────────────────┐
                          │  Edit Offset Table  │
                          │  Frequency          │
                          │  Offset             │
                          └────────────────────┘
```

Cal/Zero

```
                    ┌──────────┐
                    │ Cal/Zero │
                    └──────────┘
                         │
   ┌─────────┬───────────┼───────────┬───────────┐
┌──────┐  ┌──────┐  ┌──────┐   ┌──────────┐  ┌──────┐
│ Zero │  │ Zero │  │ Cal  │   │Calibrator│  │ Ext  │
│      │  │ & Cal│  │ 0 dBm│   │          │  │ Zero │
└──────┘  └──────┘  └──────┘   └──────────┘  └──────┘
   │         │          │           │
┌─────────────────────┐ │          │
│ ML2488A / ML2496A only│ │        ┌──────────────┐
│ ┌──────┐  ┌──────┐  │ │         │ Calibrator   │
│ │ Zero │  │ Zero │  │ │         │ RF           │
│ │Sensor A│ │Sensor B│ │         └──────────────┘
│ └──────┘  └──────┘  │ │         ┌──────────────┐
└─────────────────────┘ │         │ 50 MHz  (*1) │
              ┌──────────────────────┐  └──────────────┘
              │ ML2488A / ML2496A only│  ┌──────────────┐
              │ ┌──────┐  ┌──────┐  │   │ 1 GHz   (*1) │
              │ │Zero &Cal│ │Zero &Cal│ │  └──────────────┘
              │ │Sensor A│ │Sensor B│ │
              │ └──────┘  └──────┘  │
              └──────────────────────┘
         ┌──────────────────────┐
         │ ML2488A / ML2496A only│
         │ ┌──────┐  ┌──────┐  │
         │ │Calibrate│ │Calibrate│ │
         │ │Sensor A│ │Sensor B│ │
         │ └──────┘  └──────┘  │
         └──────────────────────┘
```

(*1) These commands are only
displayed when a 1 GHz
calibrator option is fitted.

System – Save / Recall

```
              ┌──────────┐
              │  System  │
              └────┬─────┘
     ┌─────────────┼──────────────┐
┌─────────┐  ┌─────────┐    ┌─────────┐
│ Save/   │  │ Config  │    │ Service │
│ Recall  │  │         │    │         │
└────┬────┘  └─────────┘    └─────────┘
     │
 ┌───┴─────────────────┐
┌─────────┐      ┌─────────┐
│ Save    │      │ Recall  │
│ Settings│      │ Settings│
└────┬────┘      └─────────┘
     │
┌──────────────┐
│ Save Settings│
│   1 to 20    │
└──────┬───────┘
       │
   ┌───┴──────
   │ 1 to 20
┌─────────┐
│ Save    │
└─────────┘

┌─────────┐
│ Save as │
└─────────┘

┌─────────┐
│    ⬆    │
└─────────┘

┌─────────┐
│    ⬇    │
└─────────┘

┌─────────┐
│ Page    │
│ Up      │
└─────────┘

┌─────────┐
│ Page    │
│ Down    │
└─────────┘
```

System – Recall Settings

```
                    ┌──────────────┐
                    │   System     │
                    └──────────────┘
                            │
        ┌───────────────────┼───────────────────┐
   ┌─────────┐        ┌─────────┐         ┌─────────┐
   │ Save/   │        │ Config  │         │ Service │
   │ Recall  │        │         │         │         │
   └─────────┘        └─────────┘         └─────────┘
        │
   ┌────┴──────────────────┐
┌─────────┐         ┌─────────┐
│ Save    │         │ Recall  │
│ Settings│         │ Settings│
└─────────┘         └─────────┘
                         │
                  ┌──────────────┐
                  │Recall Settings│
                  ├──────────────┤
                  │  1 to 20     │
                  └──────────────┘
                         │
                  ┌──────────────┐
                  │   1 to 20    │
                  └──────────────┘
                  ┌──────────────┐
                  │  Recall      │
                  └──────────────┘
                  ┌──────────────┐
                  │      ⇧       │
                  └──────────────┘
                  ┌──────────────┐
                  │      ⇩       │
                  └──────────────┘
                  ┌──────────────┐
                  │  Page        │
                  │  Up          │
                  └──────────────┘
                  ┌──────────────┐
                  │  Page        │
                  │  Down        │
                  └──────────────┘
```

System – Config – Display – Set Screen Title

System – Config – Display – Backlight

www.valuetronics.com
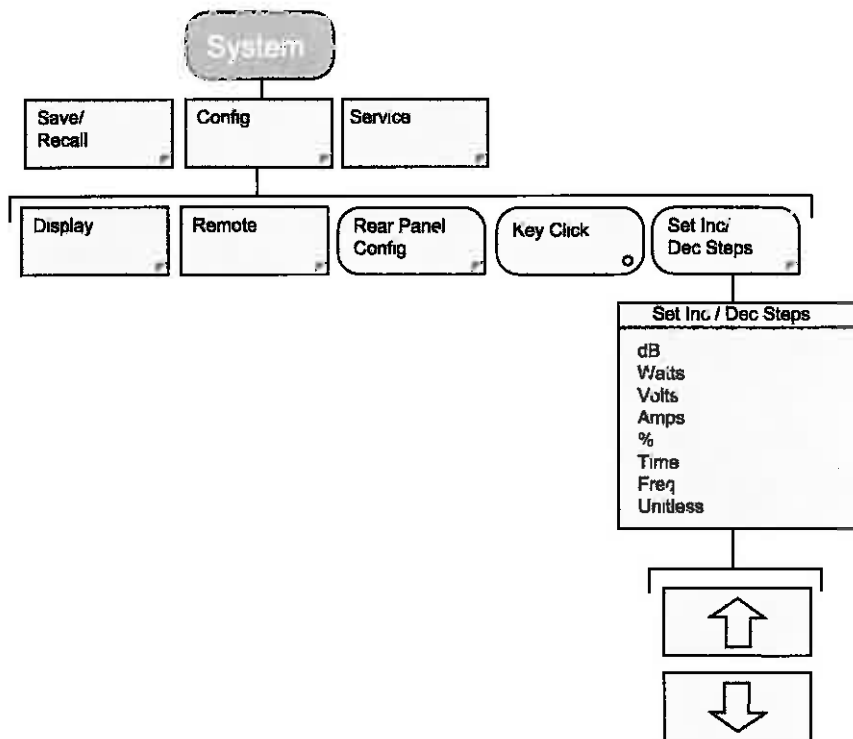
System – Config – Remote – Set RS232 Baud Rate

System – Config – Rear Panel Config

```
                         System

     Save/           Config          Service
     Recall


   Display        Remote        Rear Panel      Key Click      Set Inc/
                                Config                         Dec Steps


                          Rear Panel Configuration

                          Mode
                          Channel
                          Pass level
                          Range


         Mode           Channel        Pass level        Range

      O/P1  O/P2      O/P1  O/P2      O/P1  O/P2       O/P1  C/P2

       Off            Channel         High            Range 1
                      1

       Analog         Channel         Low             Range 2
       Output         2

       Pass/Fail

       Signal
       Channel

       Levelling
```

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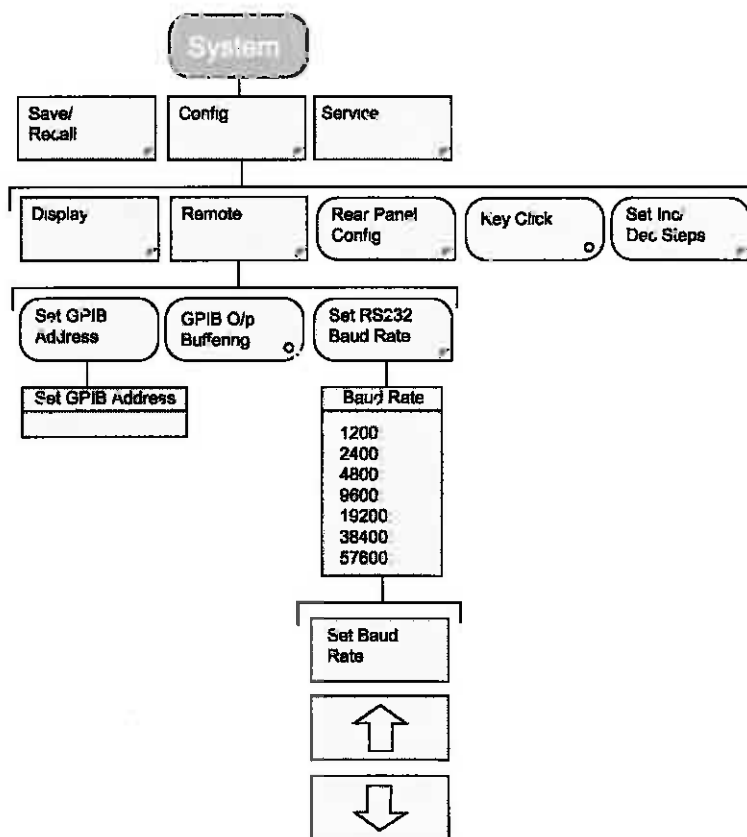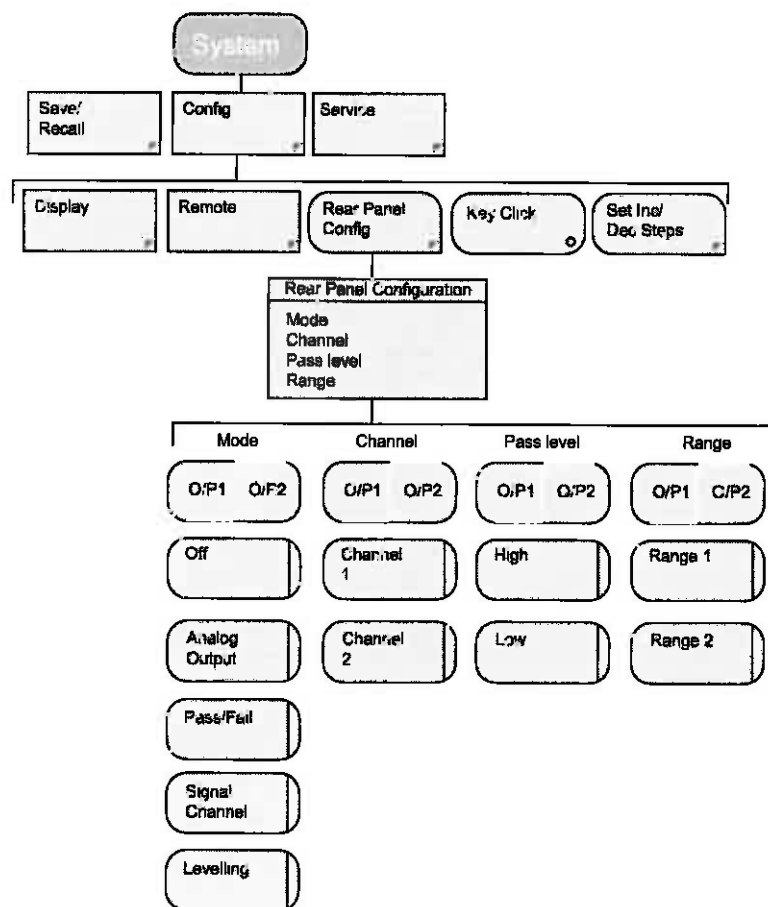
System – Config – Set Inc/Dec Steps

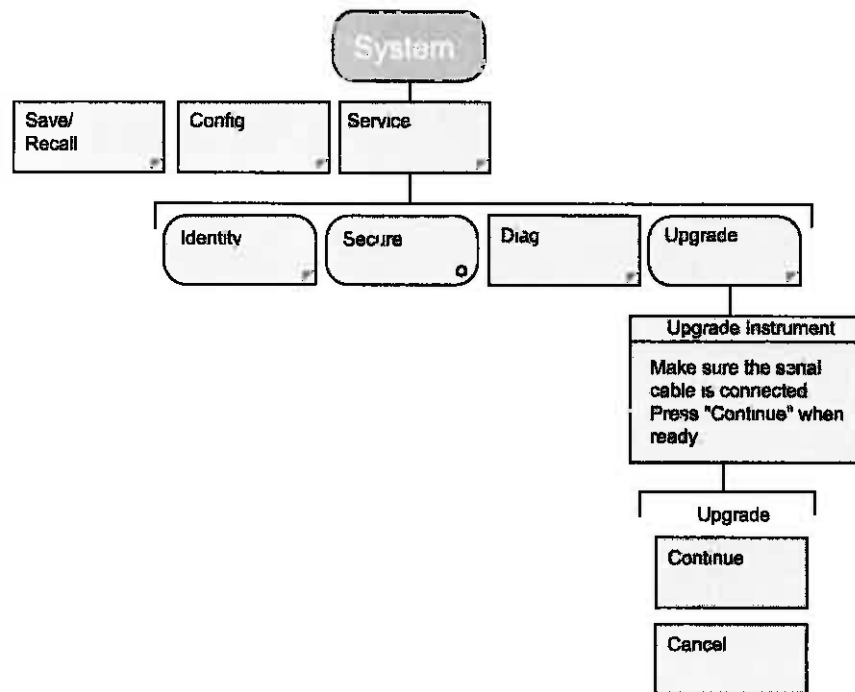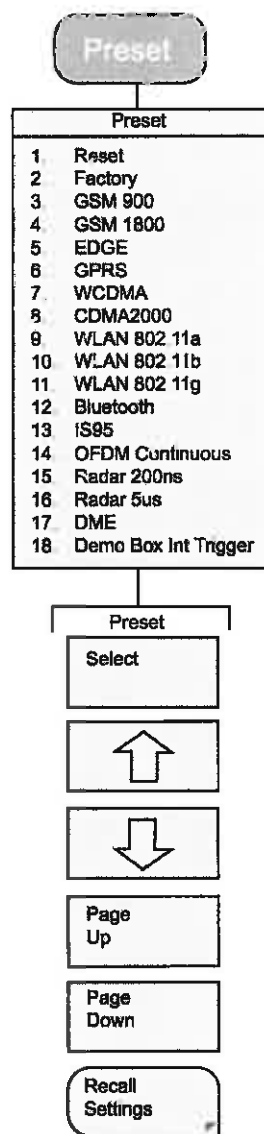## System – Service – Identity

www.valuetronics.com
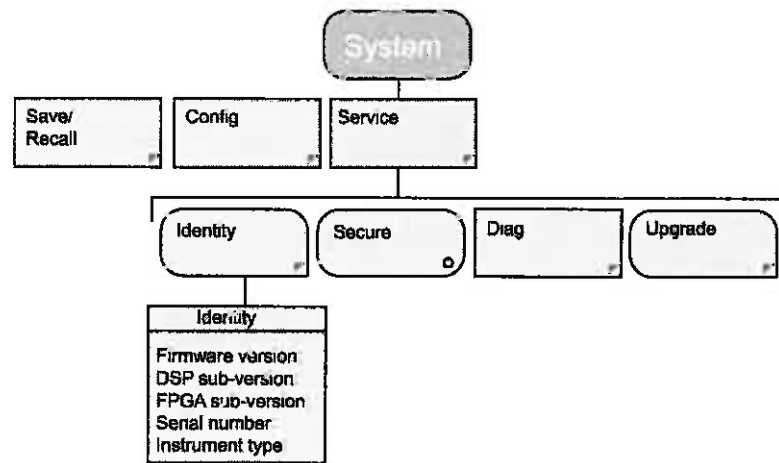
System – Service – Diag
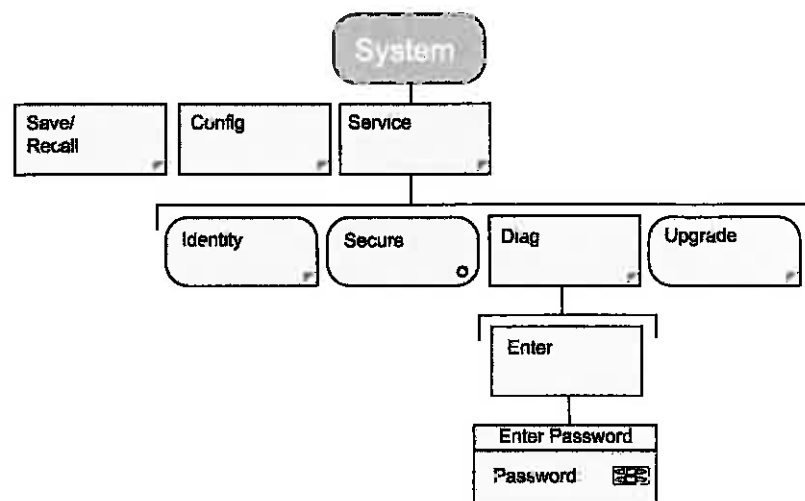
Note: The diagnostics group of commands is password protected and available for use by authorized service personnel only.

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System – Service – Upgrade

```
                         ┌──────────────┐
                         │   System     │
                         └──────┬───────┘
   ┌──────────┐  ┌──────────┐   │  ┌──────────┐
   │ Save/    │  │ Config   │   └──│ Service  │
   │ Recall   │  │          │      │          │
   └──────────┘  └──────────┘      └────┬─────┘
                                        │
   ┌──────────┐  ┌──────────┐  ┌──────────┐  ┌──────────┐
   │ Identity │  │ Secure   │  │ Diag     │  │ Upgrade  │
   └──────────┘  └──────────┘  └──────────┘  └────┬─────┘
                                                  │
                                    ┌─────────────────────────┐
                                    │   Upgrade Instrument     │
                                    ├─────────────────────────┤
                                    │ Make sure the serial     │
                                    │ cable is connected       │
                                    │ Press "Continue" when    │
                                    │ ready                    │
                                    └────────────┬────────────┘
                                                 │
                                             Upgrade
                                    ┌─────────────────────────┐
                                    │ Continue                │
                                    │                         │
                                    └─────────────────────────┘
                                    ┌─────────────────────────┐
                                    │ Cancel                  │
                                    │                         │
                                    └─────────────────────────┘
```

Preset

Preset

Preset

1	Reset
2	Factory
3	GSM 900
4	GSM 1800
5	EDGE
6	GPRS
7	WCDMA
8	CDMA2000
9	WLAN 802 11a
10	WLAN 802 11b
11	WLAN 802 11g
12	Bluetooth
13	IS95
14	OFDM Continuous
15	Radar 200ns
16	Radar 5us
17	DME
18	Demo Box Int Trigger

Preset

Select

⬆

⬇

Page
Up

Page
Down

Recall
Settings

Note: Presets 14 to 18 in the figure above are not available on the ML248xA.

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Appendix B. Specification

Specifications	
Frequency Range	100 kHz to 65 GHz, sensor dependant
Power Sensors	Meter compatible with all MA2400A/B/C/D Sensors
Display Measurement Range	-70 to +200dBm dependant upon sensor range, external coupler or attenuator
Display Resolution	Selectable from 0.1 to 0.001 dB in Readout Mode 0.01dB in profile mode Time Axis 1ns settable resolution Pulse/Modulated Mode <200ns capture time (200 points) 15us CW Mode
Display Units	Linear: nW to GW, %, Volts Log: dBm,dBW,dB, dBμV,dBmV
Measurements	Power:-Average, Peak, Crest, Maximum, Minimum Statistics:- PDF, CDF and CCDF PAE:- Power Added Efficiency
Measurement Modes	Pulse/Modulated for wideband measurements CW for CW measurements Peaking Meter ±5dB range Readout/CW mode only
Measurement Display	Profile (Graph) for Pulse/Modulated Mode Readout (Numerical) for Pulse/Modulated and CW Display Average, Max, Min, Max and Min Measurement Hold, Max, Min Hold
Power Measurement Dynamic Range	
Overall Dynamic Range	Standard Diode Sensors: -70 dBm to +20 dBm CW mode -34dBm to +20dBm Pulse Modulated Mode Wideband Sensors: -60 dBm to +20 dBm CW mode

Power Meter Amplifier Range	-30 dBm to +20 dBm Pulse Modulated Mode
	Pulse modulated mode dynamic range covered by 3 overlapping amplifier ranges, R7,R8 & R9 CW mode dynamic range covered by 5 overlapping amplifier ranges, R1,R2,R3, R4 & R5 Universal Sensor MA2481/82D ranges 1 to 6
Pulse Modulated Amplifier Dynamic Range Performance	
Range 7 Dynamic Range Maximum normal nominal operational value to Bottom nominal limit	-2dBm to +20dBm MA2491A -6dBm to +20dBm MA2472D
Range 8 Dynamic Range Maximum normal nominal operational value to Bottom limit	-20dBm to +10dBm MA2491A -24dBm to +6dBm MA2472D
Range 9 Dynamic Range Maximum normal nominal operational value to Bottom limit	-30dBm to -4dBm MA2491A -34dBm to -9dBm MA2472D
Range Control	Automatic or manual. When in manual clear indication given to user (display and GPIB) of fault conditions (under or over-range)

Power Measurement Accuracy	As defined by uncertainty calculations with relevant sensor and source match conditions		
Instrumentation Accuracy CW Mode	<0.5% ±0.02 dB absolute accuracy ±0.04 dB relative accuracy		
Zero set CW mode (each range)	Equivalent Noise Power 256 Moving Average	MA2472D	MA2491A
	Range 1	0.5µW	2µW
	Range 2	50nW	100nW
	Range 3	0.5nW	2nW
	Range 4	0.2nW	1nW
	Range 5	50pW	0.5nW
Instrumentation Accuracy Pulse/Modulated Mode	<0.8% Nominal range 7,8		

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Zero Set	Equivalent Noise Power	MA2472D		MA2491A
Pulse/Modulated Mode (each range)	Range 7	5μW		15μW
	Range 8	1μW		5μW
	Range 9	0.5μW		2μW
Bandwidth				
Nominal Bandwidth Pulse/Modulated mode Mainframe 3dB point				
Repetitive Sampling	>65 MHz range 7 >38 MHz range 8 >16 MHz range 9			
One shot	20 MHz			
Nominal Bandwidth CW mode Mainframe 3dB point	17 kHz range 1,2,3,4 36 Hz range 5			
Nominal Bandwidth with MA2411A Sensor MA2411A Sensor nominal Bandwidth 50MHz	Combined B/W >39 MHz range 7 >29 MHz range 8 >12 MHz range 9			
Rise Time with MA2411A sensor 10% to 90% at +10dBm System Rise Time	Typical 8ns Maximum 12ns			
Rise Time Measurement Dynamic Range	The ML249XA will be able to functionally measure 10% to 90% rise times over the following dynamic range with the MA2491A. Peak power −20dBm to +20dBm			
Overshoot Pulsed Modulated Mode	<= 3% in linear power at +10dBm			

Sampling	
Sampling Modes	Random Repetitive Sample Mode (display set to 200 points) 50ns-3.2μs Trigger Capture (Display) time
	Continuous Sampling Mode (display set to 200 points) 3.2μs-7s Trigger Capture (Display) time
	Automatic selection, with current mode indicated on display.
	Conflicts between setting selected and other instrument setting are indicated through user warnings (displayed and GPIB)
Sampling Rate	62.5 MS/s pulse/modulated mode 75 kS/s in CW mode Manual Setting (Pulse Modulated mode only) 62.5 MS/s to 30.5 kS/s
Sample Rate Clock Accuracy	± 100ppm

Time Display Trigger Capture Time	
Trigger / Display Capture Range	50 ns to 7s
Settable Time Measurement Resolution Trigger capture time 50ns to 3.2μs	1ns
Trigger Time Resolution Uncertainty Trigger Capture time 50ns to 3.2μs	± 2ns or display resolution, whichever is the larger
Trigger Time Resolution Uncertainty Trigger Capture time 3.2μs to 7s	±16ns or display resolution whichever is the larger
Trigger Capture Time settable Resolution	Display points = 200 1ns or 0.5% of trigger capture time, which ever is the larger. Display Points = 400 1ns or 0.25% of trigger capture time (400points), which ever is the larger.

Triggering	
Trigger Sources	**Signal Triggers** Continuous (not in Random Repetitive Sampling mode) Internal, External TTL Rising or falling Edge Remote Bus Triggers (TR1,TR2,TR3) GPIB or external Bus
Arming Sources	**Repetitive Sampling Modes** Automatic Frame for QAM and multi-pulse **Continuous Sampling Mode** Single Automatic Frame for QAM and multi-pulse
Frame Arming Time Range	0 to 64 x trigger capture time range or 120μs whichever is the greater.
Trigger Modes	**Manual** Single power value set to cover entire measurement dynamic range of sensor **Auto** Automatically sets trigger level for signal over measurement dynamic range
Internal Trigger Dynamic Range	-18 dBm to +14 dBm with MA2491A in Pulse/Modulated mode -30 dBm to +10 dBm with MA2472D in Pulse/Modulated mode -28 dBm to +10 dBm with MA2472D in CW mode
Internal Trigger Settable Resolution	0.1dB
Nominal Internal Trigger Bandwidth	Variable-auto set 20MHz, 2MHz, 200KHz, 20KHz
External Trigger Maximum Trigger Rate	10 MHz minimum
Trigger / Display Capture Range	50 ns to 7s

Trigger Capture settable Resolution	Display points = 200 1ns or 0.5% of trigger capture time, which ever is the larger. Display Points = 400 1ns or 0.25% of trigger capture time (400points), which ever is the larger.
Trigger Delay Range	Pulse Modulated Mode Pretrigger (-ve): 95% of the Trigger Capture range Post Trigger: Set by 256K buffer and sample rate CW mode Post Trigger Only: 0-999ms depending on Trigger Capture period setting
Trigger Delay Settable Resolution	Display points = 200 1ns or 0.5% of trigger capture time, which ever is the larger. Display Points = 400 1ns or 0.25% of trigger capture time (400points), which ever is the larger
Trigger Delay Uncertainty	+/-2ns for pre and post trigger Trigger capture time set to 50ns.
Trigger point waveform displayed on screen	Trigger point depicted by trigger edge waveform. Edge represents trigger point of signal. Display position of trigger edge waveform adjustable.
Power Reference **ML2480A-15 specification** **Standard in ML2495A**	
Output Power	1.00 mW Traceable to National standards
50MHz Frequency Accuracy	<1%
50MHz VSWR	1.12
50MHz Output Power Accuracy	±1.2% per year, 0.9% RSS Traceable to National Standards
1GHz Frequency Accuracy	<2%
1GHz VSWR	1.2
1GHz Output Power Accuracy	±1.2% per year, 0.9% RSS Traceable to National Standards
Connector	Type N female

Sensor/Channel Control	
Limit Lines	Simple pass fail for CW Complex limits for pulsed and TDMA systems Limits can be stored in the instrument
Markers	4 Markers and 1 Delta Marker Marker to Max/Min Pulse Rise Time Pulse Fall Time Pulse Width Off Period Pulse Repetition Interval
Gates	4 Independently set Gates or 8 repeated Gates 1 Fence per Measurement Gate Gate Measurement supports Average, Peak, Crest, Max and Min

System Configuration	
Display	LCD, Colour ¼ VGA
Save /Recall	20 settings stores Preset accessible on Front Panel Offset tables
Secure Mode	Wipes non-volatile memory on power up when active

Interfaces	
GPIB Speed CW Mode	>400 Readings/second TR3 mode
GPIB speed Pulse Modulated Mode Continuous Sampling	>350 Readings/second 1μs pulse, readout mode, Display turned off TR3 Mode
GPIB speed Pulse Modulated Mode Profile data	200 points per sweep:-Binary Float Output 5μs Trigger Capture Time >10 profile transfers/sec

GPIB speed Pulse Modulated Mode Repetitive sampling	>20 Readings/sec 50ns pulse, readout mode, Display turned off TR3 Mode
GPIB Compatibility	Back Compatible with ML2480A products. All equivalent functionality supported, and uses identical GPIB commands. Additional functionality added.
RS232	1200,2400,4800,9600,19200,38400,57600 Baud rates supported
External Video Display	CRT VGA Compatible timing output, display size is ¼ of VGA screen size
BNC I/O Rear Panel	
V/GHz	Can be configured for Cal factor correction from synthesiser Ext Voltage Voltmeter Connection current probe for PAE applications
External Trigger	External TTL trigger Input. Maximum Trigger frequency 10MHz
Output 1	Can be configured for Analog Output Pass/Fail TTL o/p Limits Levelling:- Sensor Input A
Output 2	Can be configured for Analog Output Pass/Fail TTL o/p Limits Levelling:- Sensor Input B Trigger Output
General Specifications	
General	MIL-T28800F, Class 3
Operating Temperature Range	0 to 50°C, Mainframe only. See sensor specification for performance of sensors.
Storage Temperature Range	-40 to 70°C
Power Requirements	AC 90V to 250V 47 to 440Hz

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EMC and Safety	Complies with requirements for CE marking EN 61326 EN61010-1
Non Volatile RAM Battery Type	Lithium
Non Volatile RAM Battery Life	5 years
Warranty	1 year standard 3 year optional
MTBF	10,000 hours
Dimensions	Width 213mm (8.39 inches) Height 88mm (3.46 inches) Depth 390mm (9.84 inches)
Weight	3kg

13000-00162
September 2005

Appendix C. Default Values and Presets

The table below details the ranges and default settings for each item on the ML248xA / ML249xA that can be set by the user. The columns to the right of 'Default' indicate the settings for each of the preset configurations. Cells left blank in these columns indicate that the setting for the item in question is the same as the default setting.

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / 1999	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 200ns	Radar 5us	DME	Trigger Using 8µs PW
Acquisition Time	1 s to 360000 s	60 s														
Active Channel	Ch1	Ch2	Ch1														
Active Marker Assignment	1 to 4	1														
Amplitude Offset	-999.99 to +999.99exp 06	0														
Amplitude Replication Offset	-999.99 to +999.99exp 06	0														
Analogue O/P Assignment	Channel 1	Channel 2	O/P1: Ch1 O/P2: Ch2														
Analogue O/P Start Voltage	-5 V to +5 V	-5 V														

DESCRIPTION	RANGE	DEFAULT	GSM 800	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / 1XEV	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 300Hz	Radar	DME	Demo Box Int. Trigger
Analogue O/P Stop Voltage	-5 V to +5 V	+5 V														
Audible Alarm on Fail State	Off | On	Off														
Audible Alarm State	Off | On	Off														
Audible Key Click State	Off | On	Off														
Audio Beep on User Entry Error State	Off | On	Off														
Auto Sensor ID	Automatic | Off	Automatic														
Averaging Mode	Off | Auto | Moving | Repeat	Auto														
Averaging Number	1 to 512	64														
BNC Output 1 Configuration	Off | Analogue Out | Pass / Fail | Signal Channel A | Levelling	Off														

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 <1895	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 300ns	Radar 5us	CME	Demo Bus Ext Trigger
	A1 | Levelling A2 | Levelling A1F | Levelling A2F															
BNC Output 2 Configuration	Off | Analogue Out | Pass / Fail | Signal Channel B | Levelling B1 | Levelling B2 | Levelling B1F | Levelling B2F	Off														
Cal Factor Data Source	Factory | Table | Both	Factory														
Cal Factor Frequency	100kHz to 400GHz	50 MHz	900 MHz	1800 MHz	900 MHz	900 MHz	2.2 GHz	5 GHz	2.4 GHz	2.4 GHz	2.4 GHz	50 MHz	50 MHz	50 MHz	1 GHz	1 GHz
Cal Factor Source	Frequency | Manual	Frequency														

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1000	EDGE	GPRS	WCDMA / CDMA2000 / NADC	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Calibration	Radar 200ns	Radar 5us	CW	Trigger Delay Full Screen
Cal Factor Table Name	Set | V/GHz | 7 characters max.	0														
Cal Factor Table Number	1 to 10	1														
Cal Factor Units	dB | %	dB														
Capture Time	Pulsed / Mod: 3.125 µs to 7s (200 meas point) 6.25 µs to 7 s (400 meas point) CW: 50 us to 7s	4.6 ms	1.0 ms	1.0 ms	1.0 ms	3.0 ms	1.0 ms	250.0 µs	4.4 ms	250.0 µs	150.0 µs	1.0 ms	200 ns	5.0 µs	50 µs	80 µs
Channel	CW | Pulsed/Mo	Ch1: Pulse													Ch1: Pulse	

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / IS95	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar Store	Radar Sup	CW	Demo Max Int Trigger
Mode	d	d/Mod Ch2: CW													d/Mod Ch2: Pulse d/Mod	
Channels Linked	Off | On	Off														
Cursor State	Off | On	Off														
Data Acq Speed for Levelling O/P	High | Low	High														
Delta Marker Link State	Off | On	Off														
Delta Marker On/Off	Off | On	Off														
Delta Marker Position	TBD	0														
Delta Marker readout Type	Power Difference | Average	Power Difference														
Display	Average | Max/Min & Average	Average														
Display Start Power	-999.89 dB(m) to	-70 dB(m)														

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DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / 1xEV	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	CDM Continuous	Radar 300ns	Radar 3μs	DME	Demo Box Int Trigger
Display Stop Power	+999.99 dB (m)	+20 dB(m)														
Display Update State	Off | On	On														
Duty Cycle Correction State	Off | On	Off														
Duty Cycle Value	0.1% to 100%	100%														
External Trig Edge	Rising | Falling	Rising														
Fall Hold State	Off | On	Off														
Fall Hold State	Off | On	Off														
Fence Enabled (1 to 4)	Off | On	Off			1: On 2 to 4: Off											
Fence Start Time	0 to 7s	225 μs			240.6 μs											

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / 1EV88	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 200us	Radar 3us	DME	Delta Bus Int Trigger
Fence Stop Time	0 to 7s	321 μs			336.4 μs											
Fixed Offset	-200.00 dB to +200.00 dB	0 dB														
Frame Arming Duration	0 to (63 x Capture Time)	4.6 ms				600 μs		50 μs	50 μs	50 μs						
Frame Arming Level	-230 dBm to +220 dBm	0 dBm				-5.0 dBm		-5.0 dBm	-5.0 dBm	-5.0 dBm						
Function	PDF | CDF | CCDF	PDF														
Active Gate	1|2|3|4	1	1	1	1	1		2	1	2	1				1	1
Gate Enabled (1 to 4)	Off | On	Off	1: On 2 to 4: Off	1: On 2 to 4: Off	1: On 2 to 4: Off	1: On 2 to 4: Off		1 & 2: On 3 & 4: Off	1: On 2 to 4: Off	1 & 2: On 3 & 4: Off	1: On 2 to 4: Off				1: On 2 to 4: Off	1: On 2 to 4: Off
Gate Start Time	0 to 7s	0	57.7 μs	57.7 μs	57.7 μs	57.7 μs		1: 2.00 μs 2: 30.00 μs	50.0 μs	1: 2.00 μs 2: 30.00 μs	12.0 μs				0	5.0 μs
Gate Stop	0 to 7s	577 μs	519.3	519.3	519.3	519.3		1: 18.00	4.2	1: 18.00	108.0				5 μs	45 μs

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / IS95	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 200kHz	Radar 5kHz	DME	IR Data Comm / Trigger
Time		s	μs	μs	μs	μs		2: 160.00 μs	ms	2: 160.0 0 μs	μs					
GPIB Address	0 to 30	13														
GPIB Fast Mode State	Off | On	Off														
GPIB Output Buffering State	Off | On	On														
GPIB Screen Dump State	Off | On	Off														
Hide Gating Patterns State	Off | On	Off														
Input Configuration	A | B | A-B | B-A | A/B | B/A | External Volts	A														
Input Offset Mode	Off | Fixed | Table	Off														
Input Offset Table Name	7 characters max	0														

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DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / IS95	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Chirpmania	Radar 200us	Radar 8us	OTP	Digital Bus Int Trigger
Input Offset Table Number	1 to 5	1														
Internal Trig Edge	Rising | Falling	Rising														
Internal Trigger Level	-230 dBm to +220 dBm	0 dBm	-5.0 dBm	-5.0 dBm	-5.0 dBm	-5.0 dBm		-5.0 dBm	-5.0 dBm	-5.0 dBm	-5.0 dBm		Auto	Auto	-10 dBm	Auto
LCD Backlight State	Dim | Medium | Bright	Bright														
Levelling Range	1 | 2	1														
Limit Checking State	Off | On	Off														
Limit Checking State	Off | On	Off														
Limit Checking Type	Simple | Complex	Simple														
Lower Limit Value	-999.99 to +999.99exp	-999.9														

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DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	CPHS	WCDMA / CDMA 2000 / IS95	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	Or DM Continuous	Radar 200ns	Radar 2us	ISM	Demo Bus Int Trigger
Manually Set Cal Factor (for sensor cal)	0.07% to 150% or +31.55 dB to −1.76 dB	100% (0 dB)														
Marker Position	Depends on display time range	0														
Marker State	Off | On	Off														
Marker Table State	Off | On	Off														
Marker(1 to 4) On/Off	Off | On	Off														1: On
Max Meas Readout Resolution	1 to 3 decimal places	2														
Max/Min Tracking State	Off | On	Off														
Measurement Points Display	200 | 400	200													400	
Measurement	Av Power |	Av.	Av &	Av &			Av. &	Av. &	Av. &	Av. &	Av &	Av. &			Av. &	

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / 1999	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Communications	Radar 300ns	Radar Pulse	DME	Demo Box Int Trigger
Av & Pk Power | ; Av. & Pk Power & Crest Factor | ; Av Power & Max Power (and time) & Min Power (and time) | ; Av. Power & Held Max Power (and time) Held Min Power (and time)		Power	Pk Power	Pk Power			Pk Power & Crest Factor	Pk Power & Crest Factor	Pk Power & Crest Factor	Pk Power & Crest Factor	Pk Power	Pk Power & Crest Factor			Pk Power & Crest Factor	
No. of Displayed Channels	1 – 2	1													2	
Pass / Fail Assignment	Channel 1 | Channel 2	O/P1: Ch1 O/P2: Ch 2														
Pass / Fail Level Assignment	High | Low	O/P1: High O/P2:														

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	CDMA	WCDMA / CDMA 2000 / 1x99	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OP DM Continuous	Radar 200Hz	Radar 1kHz	DME	Dump Data list Trigger
		High														
Pattern 1 Repeat Count	2 to 8	2														
Pattern 1 Repeat Enabled	Off | On	Off														
Pattern 1 Repeat Offset	0 to 7s	577 μs														
Peak Indicator State	Off | On	Off														
Post-processing Function	Statistics | PAE	Statistics														
Post-processing Function State	Off | On	Off														
Power Reference Frequency	50 MHz | 1 GHz	50 MHz														
Power Reference State	Off | On	Off														
Profile Data Representati	Min | Max | Min&Max	Normal														

DESCRIPTION	on Type	RANGE (Normal)	DEFAULT	GSM 900	GSM 1900	EDGE	GPRS	WCDMA-CDMA 2000 / 1999	WLAN 802.11b	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 300ns	Radar 3us	DME	String Box Int T100W
Profile Display Hold State		Off | On	Off														
Profile Min/Max Tracking Mode		Single | Infinite	Single														
Profile Reference Level (dBm)		-898.99 dBm to 999.99 dBm	10.0 dBm	20.0 dBm	20.0 dBm		20.0 dBm		20.0 dBm	20.0 dBm	20.0 dBm	20.0 dBm		20.0 dBm	20.0 dBm	20.0 dBm	16.0 dBm
Profile Scale (dB)		0.10 dB to 50 dB	10.0 dBm	5.0 dB	5.0dB		5.0dB		5.0dB	5.0dB	5.0dB	5.0dB		5.0dB	5.0d B	2.0dB	2.0dB
Range		CW: 1 | 2 | 3 | 4 | 5 | (6)[1] | Auto Pulsed/Mod: 7 | 8 | 9 | Auto	Auto														

[1] Range 6 only becomes available for the Universal Sensor operating in true RMS mode.

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 3000 - 1888	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 300M	Radar 5/s	DME	Demo Box Int Trigger
Readout Peak Indicator State	Off | On	On														
Relative Measurement State	Off | On	Off														
Relative Measurement Value	-999.99 dB to +999.99 dB	0 dB														
Repeat Count	2 to 8	2				4										
Repeat State	Off | On	Off				On										
RS232 Baud Rate	1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600	9600														
Sampling rate	32.25 kS/s to 64 MS/s		1 MS/s	1 MS/s		1 MS/s	32 MS/s	64 MS/s	4 MS/s	64 MS/s	4 MS/s	2 MS/s	62.5 MS/s	62.5 MS/s	62.5M S/s	62.5MS/ s
Screen Title State	Off | On	Off														
Secure State	Off | On	Off														
Select	Profile |	Profile					Read					Readou			CH1:	

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 / 1988	WLAN 802.11b	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 300kHz	Radar 5us	CME	Demo Box Int. Trigger
Display Type	Readout						out					↑			Profile CH2: Read out	
Settle Percentage	0 to 10%	0.01%														
Sweep Averaging State	Off | On	Off														
Sweep Averaging Target Number	1 to 512	16														
Time Offset	-7 to +7 s	0 s														
Time Replication Offset	0 to 7 s	0 s				577 µs										
Trig Hold-off State	Off | On	Off														
Trig Hold-off Time	0 to 7 s	4.6 ms														
Trigger Arming Mode	Automatic | Single | Frame	Automatic				Frame	Frame	Frame	Frame	Frame						
Trigger Delay	Pulsed	0	-200.0	-200.0		-100.0		-50.0	-50.0	-50.0	-15.0		-50.0	-500	-5 µs	-10 µs

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1800	EDGE	GPRS	WCDMA / CDMA 2000 1xEV	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	CW OR Continuous	Radar 250Hz	Radar 5kHz	DME	Trigger 300µs 604 8m
	/Mod: [-1x (0.95 x Capture time)] to 999 ms CW: 0 to 999 ms		µs	µs		µs		µs	µs	µs	µs		ns	ns		
Trigger Source	Continuous | Internal A | Internal B | External	Continuous	Internal A	Internal A		Internal A		Internal A	Internal A	Internal A	Internal A		Internal A	Internal A	Internal A	Internal A
Units	dBm | dB | dBr | dBmV | dBµV | dBW | % | %r | W | V | Vr	dBm														
Universal Sensor Mode	Fast CW | True RMS	Stored in sensor														
Upper Limit Value	-999.99 to +999.99exp 06	+999.99exp 06														

DESCRIPTION	RANGE	DEFAULT	GSM 900	GSM 1900	EDGE	GPRS	WCDMA / CDMA 2000 - 1899	WLAN 802.11a	WLAN 802.11b	WLAN 802.11g	Bluetooth	OFDM Continuous	Radar 300ns	Radar 5us	DME	Debug Bus Int Trigger
Upper/Lower Limit Test State	Both | Upper | Lower	Both														
Upper/Lower Limit Test State	Both | Upper | Lower	Both														

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Appendix D. ML2400A Reference Table

Note: The information in this chapter may be of benefit to users already familiar with existing Anritsu power meters.

In addition to the obvious differences between the ML248xA / ML249xA and the power meters in the ML2400A series, there are also many similarities in the basic grouping of commands and operation concepts. Users familiar with the ML2400A series power meters should quickly be able to adapt to the improvements made on the ML248xA / ML249xA. To make this process easier, this chapter provides a table summarizing some of the key differences in terms of the location of the commands. This information will not be of benefit to users who are new to Anritsu power meters.

The table below is split into three columns, the left column detailing the procedure or command in question, and the center and right side columns giving the required hard and soft key combinations for both the ML248xA / ML249xA and ML2400A.

Command / Procedure	ML2400A series	ML248xA / ML249xA
Averaging	Sensor / Averaging	Channel / Averaging
Triggering	Trigger	Channel / Trigger
Markers (cursor)	System / Control	Channel / Markers
Preset	System / Setup / More / Preset	Preset
Measurement display	System / Setup / Mode	Channel / Setup / "Meas display"
Change channel	Channel / Set Up / Channel	Ch1/Ch2
Capture time, delay, and data hold	System / Profile	Channel / Trigger
Scaling	System / Control / More / Scale	Channel / More / Scaling
Data hold	System / Profile / Data hold	Channel / More / Profile Display

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Appendix E. Terminology Glossary

The table below provides an alphabetical glossary of:

- Acronyms commonly used in this and other related documentation.

- Abbreviations that may be seen on the ML248xA / ML249xA display.

Term	Meaning
Acq	Acquisition
Act	Active
Adv	Advanced
Ampl	Amplitude
Avg	Averaging
Cal	Calibration
CDF	Cumulative Density Function
CDMA	Code-Division Multiple Access
Chan	Channel
Cmb	Combination
Config	Configuration
Cont	Continuous
Corr	Correction
CW	Continuous Wave
Diff	Difference
EDGE	Enhanced Data GSM Environment
EEPROM	Electrically Erasable Programmable Read-Only Memory.
EPROM	Erasable Programmable Read-Only Memory.
Ext	External
Freq	Frequency
Func	Function
GPIB	General Purpose interface Bus
GSM	Global System for Mobile Communications
Id	Identity
IEEE	Institute of Electrical and Electronics Engineers

Term	Meaning
Ind	Indicator
Lim	Limit
Lvl	Level
Max	Maximum
Meas	Measurement
Min	Minimum
Mkr	Marker
Num	Number
PDF	Probability Density Function
Pk	Peak
Pos	Position
POST	Power On Self-Test
Pwr	Power
Ref	Reference
Rel	Relative
Res	Resolution
RRS	Random repetitive sampling
RS232C	Recommended standard-232C
Sngl	Single
Spec	Specification
TTL	Transistor-Transistor Logic
USB	Universal Serial Bus,
Vltg	Voltage
WCDMA	Wideband CDMA
WLAN	Wireless Local-Area Network

Appendix F. Technical Support

Whilst every effort has been made to ensure the quality and reliability of this product, there may be times when operation difficulties are experienced and technical support is required.

Technical support can be obtained in either of the following methods.

- Copy and fill out the form on the following page and fax it to Anritsu at the number shown.

- Send an e-mail to our technical support team at powermeter.support@eu.anritsu.com providing the information indicated on the form.

The firmware version, serial number, and sub-versions can be checked by:

1. Pressing the System hard key followed by the Service soft key.

2. Pressing the Identity soft key to display the [Identity] dialog.

Every effort will be made to ensure that you are contacted within one working day.

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For the attention of "Power Meter Technical Support".

Please fill in this form In as much detail as possible and then FAX it to this number:	**+44 (0)1438 740202**
Product model:	**ML2487A / ML2488A / ML2495A / ML2496A**
Power meter serial number:	
Sensor model:	
Sensor serial number:	
Firmware version:	
DSP and FPGA sub version	

Description of the problem:

List of error messages:

Description of steps required to reproduce the problem:

Efforts already made to correct the problem:

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Appendix G. Uncertainty Information

Power measurement uncertainty has many component parts that affect uncertainty when measuring power with Anritsu power sensors.

- Instrument Accuracy – the accuracy of the meter used to read the power sensor.

- Sensor Linearity and Temperature Linearity – Sensor linearity and temperature linearity describe the relative power level response over the dynamic range of the sensor.

- Temperature linearity should be considered when operating the sensor at other than room temperature.

- Noise, Zero Set and Drift – These are factors within the test system that impact measurement accuracy at the bottom of a power sensor dynamic range.

- Mismatch Uncertainty – Mismatch uncertainty is typically the largest component of measurement uncertainty. The error is caused by differing impedances between the power sensor and the device to which the power sensor is connected. Mismatch uncertainty can be calculated as follows:

$$\% \text{ Mismatch Uncertainty} = 100 \{ \mid 1 + \Gamma_1\Gamma_2 \mid^2 - 1 \}$$

$$\text{dB Mismatch Uncertainty} = 20\log \mid 1 + \Gamma_1\Gamma_2 \mid$$

where

Γ_1 and Γ_2 are the two differing impedances that are connected together.

- Sensor Calibration Factor Uncertainty - Sensor Calibration Factor Uncertainty is defined as the accuracy of the sensor calibration at a standard calibration condition.

- Anritsu follows the industry standard condition of calibration at reference power = 0 dBm (1 mW) and ambient temperature = 25_C.

- Reference Power Uncertainty – Reference power uncertainty specifies the maximum possible output drift of the power meter 50 MHz, 0.0 dBm power reference between calibration intervals.

Uncertainty Examples

There are several ways in which uncertainties can be calculated. The classic way is to take each parameter from the data sheet and RSS (squareRoot of the Sum of the Squares) the values together. It is valid to RSS the values together because the measurands are not physically correlated.

Although this method is commonly used, most measurands have a probability associated with them and rather than implying an absolute value that can never be exceeded, an alternative method of expressing uncertainties using probability distributions has been used by standards labs worldwide. Further details on this methodology can be found in documents such as the UKAS M3003 Guide to expression of Uncertainty. In this methodology each measurand is assigned a probability distribution. The limit for each measurand is then divided by the correction factor for this distribution and an RSS calculation is then performed for all uncertainties to give a probability that the uncertainty lies within the calculated limits. This figure is then expanded, assuming a normal distribution to give the uncertainty at a factor of k=2 which is a probability of 95.8% that the uncertainty will lie within the calculated limits.

The table below shows the difference between the two methods. In this table the mismatch uncertainty has assumed to be rectangular. This is only because this has been calculated using the published limits for the vswr of the sensor. If an actual measurement

had been used of the VSWR then the mismatch should be treated as a U-shaped distribution and the value divided by √2 for the purposes of the calculation.

This example has been for a MA2472D sensor, CW mode, 16 GHz, 12.0dBm, source VSWR 1.5:1

Measurand	Probability Distribution	Dividing Factor	MA2472D RRS	MA2472D Probability
Instrumentation Accuracy	Rectangular	√3	0.50%	0.29%
Sensor Linearity	Rectangular	√3	1.80%	1.04%
Noise	Normal @2δ	2	0.00%	0.00%
Zero Set and drift	Rectangular	√3	0.00%	0.00%
Mismatch Uncertainty	Rectangular	√3	3.67%	2.12%
Sensor Cal factor Uncertainty	Normal @2δ	2	0.83%	0.42%
Reference Power Uncertainty	Rectangular	√3	1.2%	0.69%
Reference to Sensor Mismatch Uncertainty	Rectangular	√3	0.23%	0.13%
Temperature linearity	Rectangular	√3	1.00%	0.58%
RSS Total			4.31%	
RSS k=1				2.58%
RSS expanded k=2	95.8% probability			5.16%

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Appendix H. Frequently Asked Questions

Can I use my existing sensors with my new power meter?

Yes, all of the sensors used with the ML2400A series power meter can be used with the ML248xA / ML249xA. The MA2499A sensor adapter is not supported and as a result none of the sensors designed for the ML4803A power meter can be used.

Can I use sensors made by other manufacturers?

Yes, the MA2497A sensor adapter can be used for Agilent sensors on both the ML248xA and the ML249xA.

Why are some of my settings greyed out?

There are two main reasons why the settings in a dialog or the soft key commands may be unavailable. These include:

* Settings or commands that are not applicable to the current configuration. In this case, changing the associated settings may enable the greyed out areas.

* Settings or commands that are not applicable until the main setting in the group has been enabled.

Are the channels and the sensor inputs the same thing?

No, the two terms should not be confused. The sensor inputs are the physical connector(s) on the front panel to which the sensors are attached. The ML2488A and ML2496A have two sensor inputs, labelled A and B, and the ML2487A and ML2495A have one. The channels, of which all power meter models have two, can be configured for either of the available inputs, can be set up to measure a signal from either a CW or pulsed/modulated source, and can display the measurement results in either a profile (graphical) or readout form.

How often do I need to calibrate the sensor?

Anritsu recommend that the sensor be calibrated at the beginning of each measurement session. To do this, connect the sensor to the "Calibrator" port on the front of the unit and use the commands that display after pressing the Cal/Zero hard key. Refer to the explanations in chapter 5 of this manual for details.

Is the ML248xA / ML249xA a replacement for the earlier ML2400A series power meter?

No, the ML248xA / ML249xA is designed to expand the Anritsu Power Meter range by adding a Peak Power Meter to the product line-up. The ML2400A series power meters will continue to be manufactured and supported.

Can I capture screen images?

Screen images can be captured as bitmaps using the "ScreenCapture.exe" program on the CD. Refer to the explanation in chapter 5 of this manual.

Appendix I.   Connector Care and Handling

Follow the precautions listed below when handling or connecting cables. Complying with these precautions will guarantee longer component life and less equipment down time due to connector or device failure.

Beware of destructive pin depth mating connectors

Destructive pin depth of mating connectors is the major cause of failure in the field. When an RF component is mated with a connector having a destructive pin depth, damage will usually occur to the RF component connector. A destructive pin depth is one that is too long in respect to the reference plane of the connector (see figure below).
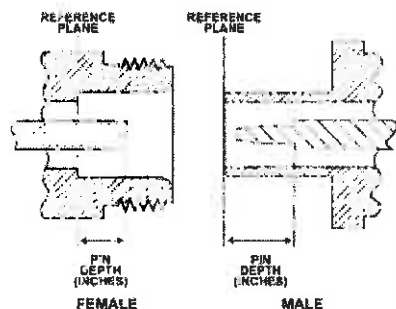
N connector pin depth definition

The center pin of a precision RF component connector has a precision tolerance. The mating connectors of various RF components may not be precision types. Consequently, the center pins of these devices may not have the proper pin depth. The pin depth of DUT connectors should be measured to assure compatibility before attempting to mate them with Power Sensor connectors. An Anritsu Pin Depth Gauge or equivalent can be used for this purpose.

Pin depth gauge

If the measured connector is out of tolerance in the "+" region, the center pin is too long (see Allowable DUT connector pin depth table below). Mating under this condition will likely damage the precision RF component connector. If the test device connector measures out of tolerance in the "-" region, the center pin is too short. This should not cause damage, but it will result in a poor connection and a consequent degradation in performance.

DUT Connector Type	Anritsu Gauging Set Model	Pin Depth (inches)	Pin Depth Gauge Reading
N - Male	01-163	207 -0.000	207 +0.000
N - Female		+0.030	-0.030
WSMA - Male	01-162	-0.000	Same as pin depth
WSMA - Female			
3.5 mm - Male		-0.010	
3.5 mm - Female			

Allowable DUT connector pin depth

Avoid over torquing connectors

Over torquing connectors is destructive; it may damage the connector center pin. Finger-tight is usually sufficient for Type N connectors. *Always* use a connector torque wrench (8 inch-pounds) when tightening WSMA, K or V type connectors. *Never use pliers to tighten connectors.*

Avoid mechanical shock

Precision connectors are designed to withstand years of normal bench handling. However, do not drop or otherwise treat them roughly. Mechanical shock will significantly reduce their service life.

Do not disturb Teflon tuning washers on connector center pins

The center conductor on many RF component connectors contains a small Teflon washer that is located near the point of mating. This washer compensates for minor impedance discontinuities at the interface. *Do not disturb this washer*. The location of the washer is critical to the performance of the RF component.

Cleaning connectors

The precise geometry that makes possible the RF component's high performance can easily be disturbed by dirt and other contamination adhering to the connector interfaces. When not in use, keep the connectors **covered.**

To clean the connector interfaces, use a clean cotton swab that has been dampened with denatured alcohol.

> NOTE: Most cotton swabs are too large to fit in the smaller connector types. In these cases, it is necessary to peel off most of the cotton and then twist the remaining cotton tight. Be sure that the remaining cotton does not get stuck in the connector. Cotton swabs of the appropriate size can be purchased through a medical laboratory-type supply center.

The following are some important tips on cleaning connectors:

- Use only denatured alcohol as a cleaning solvent

- Do not use excessive amounts of alcohol as prolonged drying of the connector may be required

- Never put lateral pressure on the center pin of the connector

- If installed, do not disturb the Teflon washer on the center conductor pin

- Verify that no cotton or other foreign material remains in the connector after cleaning it

- If available, use compressed air to remove foreign particles and to dry the connector

- After cleaning, verify that the center pin has not been bent or damaged.

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