ML248xA / ML249xA

Wideband Peak Power Meter

Remote Programming Manual

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

Anritsu

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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.

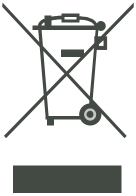

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Table of Contents

Chapter 1. About this Manual

Purpose and Scope of this Manual

This manual provides detailed information of the GPIB mnemonics for the ML2487A / ML2488A and ML2495A / ML2496A Peak Power Meters. Explanations in this manual apply equally to all units mentioned above unless otherwise stated.

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 GPIB commands supported by the following software versions:

ML2487A:	2.00	ML2495A:	2.00
ML2488A:	2.00	ML2496A:	2.00

Some of the commands documented in this manual may not be available to users of software versions prior to 1.21. 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 the Operation Manual in the section titled, *Upgrading the System*.

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

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

Chapter 1: About this Manual

Details of the manual itself, how it is structured, and how to use it.

Chapter 2: General Information

An explanation of the GPIB command format and mnemonics, the registers, and remote operation over RS232.

Chapter 3: IEEE 488.2 Mandatory Commands

Details of all the commands listed as mandatory in the IEEE specification.

Chapter 4: GPIB Remote Trigger Commands

Details of all the remote trigger related commands.

Chapter 5: Channel Commands

Details of the GPIB commands that have functionally equivalent soft key commands accessible from the Channel hard key on the front panel. The commands in this chapter are sub-divided into sections based on the soft key commands within the Channel group. The commands within each of these sections are listed in alphabetical order and a “Quick Reference Table” is provided at the front of the chapter.

Chapter 6: Sensor Commands

Details of the GPIB commands that have functionally equivalent soft key commands accessible from the Sensor hard key on the front panel. The commands in this chapter are sub-divided into sections based on the soft key commands within the Sensor group. The commands within each of these sections are listed in alphabetical order and a “Quick Reference Table” is provided at the front of the chapter.

Chapter 7: Calibration and Zero Commands

Details of the GPIB commands that have functionally equivalent soft key commands accessible from the Cal/Zero hard key on the front panel. The commands in this chapter are sub-divided into sections based on the soft key commands within the Cal/Zero group. The commands within each of these sections are listed in alphabetical order and a “Quick Reference Table” is provided at the front of the chapter.

Chapter 8: System Commands

Details of the GPIB commands that have functionally equivalent soft key commands accessible from the System hard key on the front panel. The commands in this chapter are sub-divided into sections based on the soft key commands within the System group. The commands within each of these sections are listed in alphabetical order and a “Quick Reference Table” is provided at the front of the chapter.

Chapter 9: Preset Commands

Details of the GPIB commands that have functionally equivalent soft key commands accessible from the Preset hard key on the front panel. The commands in this chapter are sub-divided into sections based on the soft key commands within the Preset group. The commands within each of these sections are listed in alphabetical order and a “Quick Reference Table” is provided at the front of the chapter.

Chapter 10: Data Acquisition Commands

Details of the GPIB commands associated with data acquisition that do not have a directly equivalent hard or soft key combination accessible from the front panel.

Chapter 11: Instrument Status Commands

Details of the GPIB commands associated with the instruments current status or error condition. These commands do not have a directly equivalent hard or soft key combination accessible from the front panel.

Chapter 12: Range Calibrator Commands

Details of the GPIB commands associated with use of the ML2419A range calibrator. These commands cannot be accessed at the ML248xA / ML249xA unless the range calibrator is connected.

Chapter 13: Programming Examples

GPIB programming examples for each of the major measurement types.

Appendix A: ML243xA Reference Table

A table listing the ML243xA GPIB commands that can also be used and the equivalent commands for the ML248xA / ML249xA. The table also lists any functionality or settings that may exist when using the ML243xA commands.

Appendix B: Binary Output Decoding Examples

Examples in both Visual Basic and C of how to convert between binary and floating point data formats.

Appendix C: GPIB PC Card Set-up

The GPIB driver configuration recommended for reliable GPIB communication with the ML248xA / ML249xA.

Appendix D: Terminology Glossary

A glossary of acronyms and other terms that may be used in this manual or other GPIB related documentation.

Associated Documentation and Resources

In addition to this manual, the following documents and resources are available on the CD shipped with the ML248xA / ML249xA power meter.

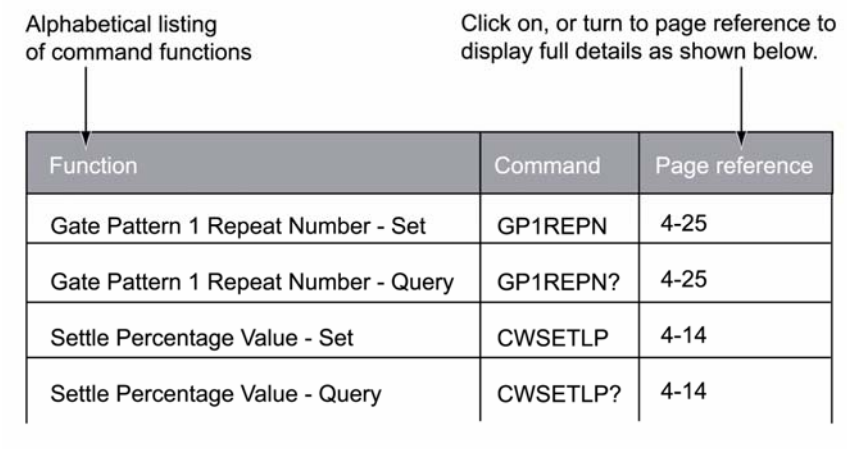
Documents	File type
ML248xA / ML249xA Wideband Peak Power Meter Operation Manual	PDF
ML248xA Datasheet	PDF
ML249xA Datasheet	PDF
ML2400A Datasheet	PDF
Power Meter Uncertainty Calculator (for ML24x0A)	XLS
High Speed Measurements on Modulated Signals (Application Note for ML248xA)	PDF
Measuring Pulsed 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
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/.

The Quick Reference Tables

The first page in each of the main chapters of this manual provides a quick reference table such as that shown below to the GPIB commands detailed within.

The quick reference table allows the user to locate and access the required command quickly and easily. The “Function” column in each table is listed in alphabetical order based on a keyword from the description of the command. The command itself is listed in the center column of the table and if further details are required, the user can turn to the associated page, or, when viewing this manual electronically, just click on the listed page number.



Alphabetical listing of command functions

Click on, or turn to page reference to display full details as shown below.

Function	Command	Page reference
Gate Pattern 1 Repeat Number - Set	GP1REPN	4-25
Gate Pattern 1 Repeat Number - Query	GP1REPN?	4-25
Settle Percentage Value - Set	CWSETLP	4-14
Settle Percentage Value - Query	CWSETLP?	4-14

Chapter Structure

In each chapter, the full details of each command are listed in alphabetical order, and in addition, each of the longer chapters are further divided into sub-sections based on the soft key menu structure. GPIB commands that have functionally equivalent commands on the ML243xA series power meter are indicated in the manual with the words “ML243xA command supported”. Refer to the table in appendix A of this manual for a full listing of these commands and also details on how the settings available may differ.

Setup ←——— Section title based on soft key menu.

ML243xA command supported ←——— Indicates that ML243xA equivalent command can also be used. Refer to Appendix A for a full listing of these commands.

CWSETLP (Set Settle Percentage Value)

CWSETLP? (Query Settle Percentage Value)

Set Command: CWSETLP<ws><c><,><settle_pct>

Details: <c> 1 | 2
<settle_pct> : 0.01 - 10 %

Remarks: The settling percentage determines how long the system waits for the signal to settle. This allows some control over the trade-off between speed, and the extent to which a measurement has settled to its final value.

Query Command: CWSETLP?<ws><c>

Return String: CWSETLP <c>,<settle_pct>

Remarks: Returns the settle percentage setting.

Chapter 2. General Information

Overview

The ML248xA / ML249xA Power Meter can be operated remotely through a General-Purpose Interface Bus (GPIB) connection to a host computer. The ML248xA / ML249xA conforms to the IEEE 488.1 and IEEE 488.2 Standards and implements the following IEEE 488 GPIB Interface Functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, and DT1.

Controller GPIB Card Setup

To communicate with the ML248xA / ML249xA over the GPIB bus you will require a GPIB card, cable, and the associated control software. To communicate effectively with the power meter, there is a recommended 'Standard Configuration Setup' for the PC card. The setup detailed in Appendix C of this manual is for National Instruments GPIB ISA and PCI Cards for both Windows and DOS Operating Systems.

Command Format

The ML248xA / ML249xA GPIB interface is designed to accept commands from a Controller in the format outlined below. When sending commands to the instrument, one or more parameters must be sent in this manner.

1. An ASCII space must be present between the command mnemonic and the first parameter.
2. All subsequent parameters after the first, must be separated by a comma (,)
3. Multiple commands may be sent on the same line, but each must be separated by a semicolon (;)

The GPIB command syntax used throughout this manual is outlined below.

MNEMONIC<ws><param1><,><param2>[<,><param3>]

Item	Meaning
MNEMONIC	Message Header mnemonic command. Usually written in upper case characters. Examples of mnemonics are: CWO, CWAVG, CHCFG.
< >	The parameters or characters string within the angled brackets '< >' must be present. Throughout this document the angled brackets '< >' are only employed as a convention to help users interpret the commands unambiguously. They MUST NOT be included in the command string when issuing commands over GPIB. e.g. If the command syntax is listed as: CWO<ws><channel> The actual string to send to channel 1 would be: CWO 1

ws	White space character (normally a space character, ASCII number 0x20)
[ ]	The parameter or character string within the square brackets is optional. Throughout this document the square brackets '[ ]' are employed as a convention to help users interpret the commands unambiguously. They MUST NOT be included in the command string when issuing commands over GPIB. E.g. CWAVG<ws><c><,> [<mode>]<,>[<avg_num>] Can be sent in the following ways: CWAVG 1, , CWAVG 1,RPT, CWAVG 1,RPT,128
,	Parameter separator. All GPIB commands having more than one parameter must use the comma (,) separator between each parameter.
;	Message unit separator. A GPIB command message can be made up of a number of command units separated by the semicolon (;) as seen in the following example. CHCFG 1,A; CHCFG 2,B; CHUNIT 1,W; CHUNIT 2, DBW.
|	The vertical bar symbol is used within the command parameter list to indicate that there is more than one choice for the specified parameter.

Controller Termination

All commands sent over the GPIB interface to the power meter must be terminated with either (or both) of the following:

End Of String (EOS):	The '\n' or 0x0A character.
End Of message Indicator (EOI):	A hardware line on the GPIB interface bus.

Device Termination

All strings returned in response to GPIB commands are terminated with both the following:

End of String (EOS):	ASCII new-line character ('\n' or 0x0A).
End Of Message Indicator:	A hardware line on the GPIB interface bus.

Suffix Conventions

The ML248xA / ML249xA complies with the IEEE Standard Codes and Formats convention for suffix units and multipliers (e.g. MS for milliseconds.). Suffix units are always allowed but are not required. All commands issued to the instrument that require a parameter to be set as a floating-point numeric value can use either the Exponential notation (E-0x convention) or a suffix multiplier. The table below shows the supported suffix units and multipliers. Suffix units are optional and can be omitted.

Suffix Multipliers		Suffix Units	
Definition	Mnemonic	Definition	Mnemonic
1E18	EX	Watts	W
1E15	PE	Decibels	DB
1E12	T	dB ref to 1 mW	DBM
1E9	G	dB ref to 1 W	DBW
1E6	MA	Volts	V
1E3	K	dB ref to 1 mV	DBMV
1E-3	M	dB ref to 1 µV	DBUV
1E-6	U	Hertz	HZ
1E-9	N	Kilohertz	KHZ
1E-12	P	Mega Hertz	MHZ
1E-15	F	Giga Hertz	GHZ
1E-18	A	Seconds	SEC
		Seconds	S
		Percent	%
		Percent	PCT

Data I/O Formats

All data sent by the power meter over the GPIB bus is formatted in conformance to the IEEE 488.2 specification ‘Response Data’ formatting. The ML248xA / ML249xA uses primarily ‘Arbitrary ASCII Response Data’ for most commands that return data in ‘ASCII’ format. Commands returning data in ‘Binary’ format use the ‘NRx Numeric Response Data’.

Configuration Commands

These commands are designed to change the instrument settings in order to configure the instrument in a given measurement mode, or to modify interface settings.

Query Commands

Most configuration commands have an equivalent query command. When sending a query command the instrument will return the current instrument setting. Query commands are usually issued following a configuration command to ensure the setting changes have taken effect.

Data Acquisition Commands

The main purpose of these commands is to obtain measurement readings. A number of data acquisition commands are available to obtain data in differing formats.

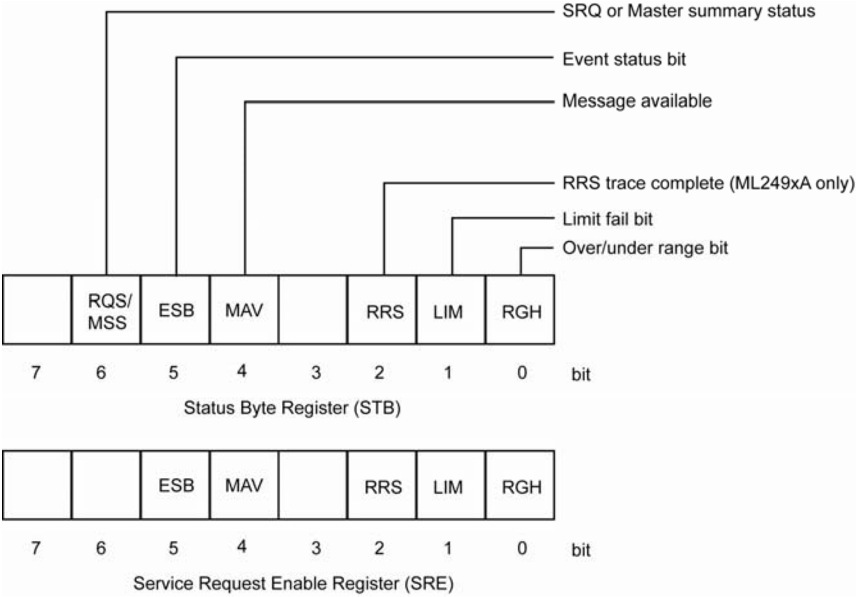
GPIB 488.2 Status Registers

The diagrams that follow show the GPIB Status and Event register sets. The meaning of each bit within a register is described below.

Status Byte Register (STB) and Service Request Enable Register (SRE)

The Status Byte Register (STB) (Read Only), reports instrument status conditions (see diagram below). The IEEE 488.2 GPIB standard defines the RQS, ESB and MAV bits as compulsory bits for device status reporting. The remaining free bits can be used to report instrument specific status conditions.

The Service Request Enable Register (SRE) (Read/Write), allows the programmer to enable selected bits to take advantage of the Service Request facility. The Service Request (SRQ) is a hardware line used by the instrument to request attention from the controller. For example, if setting the RGH bit in the SRE register, whenever the sensor goes over or under the operating range the RGH bit in the Status Byte register is set and the SRQ line is asserted.



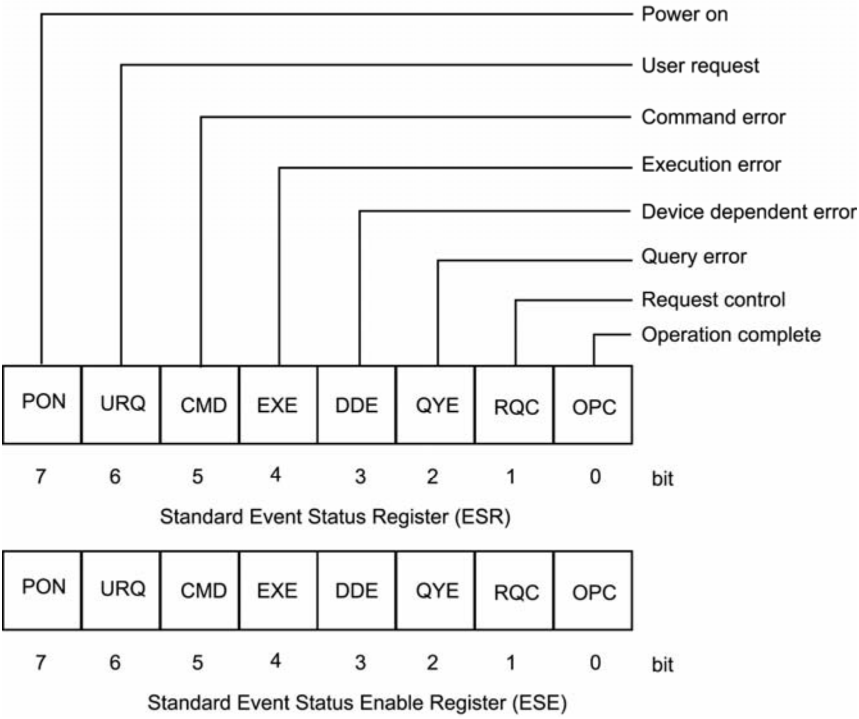
Bit	Definition
RQS/MSS	This bit serves a dual function depending on the command used to read the STB register. When the STB register is read via a Serial Poll operation this bit is RQS (Request Service). When the STB register is read via the *STB? Command this bit is MSS (Master Summary Status). This bit has no function in the SRE Register. (See below for further information on separate bit definitions)

RQS	**Request Service** This bit is set when any of the other bits in the Status Byte are set (except bit 6) **AND** the corresponding bit in the SRE Register is enabled. When the RQS bit is set, an SRQ is indicated from the device to the controller over the GPIB interface. The SRQ is cleared when the controller executes a serial poll, following this the status byte is returned to the controller and the bit within the STB register that caused the SRQ is cleared.
MSS	**Master Summary Status** This bit is set/reset by performing the inclusive OR of the bit-wise combination (excluding bit 6) between the Status Byte register and the Service Request Enable register. Note that the *STB? Command does not alter the Status byte, nor will it clear an SRQ.
ESB	**Event status bit** If any of the Standard Event Status Register (ESR) bits are set by the instrument and the corresponding Standard Event Status Enable Register (ESE) bit has been enabled by the programmer, the ESB bit in the Status Register will be set. A SRQ can be generated by enabling the same bit within the SRE register.
MAV	**Message available** This bit is always set as long as there is data available to be read out of the output buffer and cleared when the output buffer is empty. A SRQ can be generated by enabling the same bit within the SRE register.
RRS	**RRS (ML249xA only)** This bit is set when a random repetitive sampling (RRS) method is being used to acquire the data and the trace has been fully acquired. When the RRS bit is set, an SRQ is indicated from the device to the controller when the trace is complete.
LIM	**Limit Fail Bit** If a channel pass/fail limit settings are exceeded, this bit will be set. A SRQ can be generated by enabling the same bit within the SRE register.
RGH	**Over/under Range bit** If a sensor goes over or under the operating range, this bit is set. A SRQ can be generated by enabling the same bit within the SRE register.

Note: The Status Byte register is read via a Serial Poll or with the *STB? Command. It cannot be written to directly by the user. When the Status Byte is read, all the bits except the MAV bit are cleared. The Service Request Enable Register is written to with the *SRE command and read with the *SRE? Command. It is cleared by *CLS

Standard Event Registers

The standard event registers include the Standard Event Status Register (ESR) and the Standard Event Status Enable Register (ESE).



Bit	Definition
PON	**Power On bit** This bit is set on power up of the device only and cleared if the instrument is reset or receives a *CLS command. This bit only indicates that a power on has occurred.
URQ	**User Request** Not used for the ML248xA / ML249xA.
CMD	**Command error** Received an unrecognised command.
EXE	**Execution error** Could not execute a command. For example, a parameter is out of the permissible range or graph data is being requested whilst in readout mode.

DDE	**Device Dependent Error** The specific error can be found by using the SYERLST command.
QYE	**Query Error** This bit is set if attempting to read data from the instrument when there is no data available in the instrument output buffer or attempting to write data to the instrument when the instrument is busy writing data to the output buffer or there is an output buffer overflow and data has been lost.
RQC	**Request Control** Used by GPIB controllers only.
OPC	**Operation Complete** When a program message that includes the *OPC command has been completed and the GPIB interface is idle with any responses read out of the output buffer this bit is set. For example, if the last command in a configuration sequence is *OPC, the OPC bit in the event status register will be set when that configuration sequence has been completed.

Note: The Standard Event Status Register is read with the *ESR? Command. Reading the ESR will clear it. The Standard Events Status Enable Register is written to with the *ESE command and read with the *ESE? Command. Both registers can be cleared with the *CLS command.

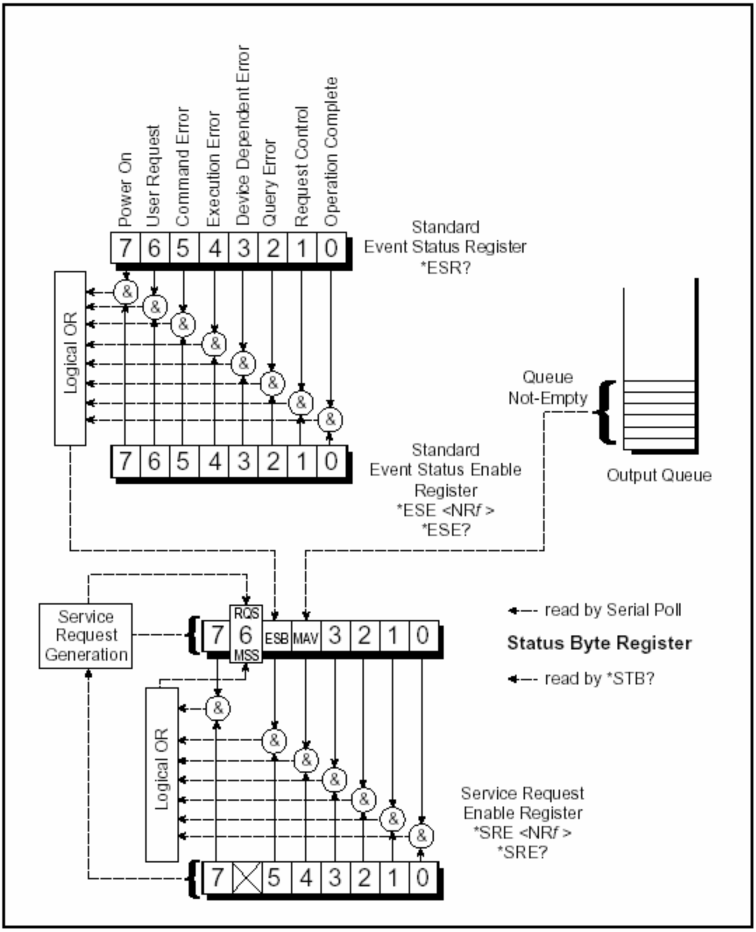
Using the Event Status Bit (ESB) in the Status Byte Register

The state of the ESB bit in the Status Byte is dependent on the ESR register state and the ESE register settings. An SRQ will be generated due to the ESB bit in the Status Byte on the condition that the following conditions apply:

- An event causes any bit within the ESR register to be set.
- The corresponding bit in the ESE register is enabled (using the *ESE command).
- The ESB bit in the SRE register is enabled (using the *SRE command).

When a) and b) apply, the ESB bit in the Status Byte will be set. An SRQ will be generated providing c) also applies. The following example illustrates how an SRQ is generated due to an unrecognised command.

1. Set the CMD bit in the ESE register, and set the ESB bit in the SRE register. Send: *ESE 32;*SRE 32
2. Send an unrecognised command to the ML248xA / ML249xA. The following sequence of arbitrary ASCII characters constituting an unrecognised command: ZKYJQ. An SRQ will be indicated at this point.
3. To clear the SRQ conduct a serial poll using a valid GPIB call, this should return the decimal value 96, bit 6 for the SRQ and bit 5 for the ESB. The SRQ will be cleared following a Status Byte read.
4. Send: *ESR? to read the Event Status Register (ESR). This will put 32 (CMD bit set), or 160 if the PON bit is also set in the output buffer to be read.



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Using the Message Available Bit (MAV) in the Status Byte Register

The MAV bit is set whenever the instrument writes data into the output buffer. Following a request for data, the controller can monitor the MAV bit by reading the Status Register (using the *STB? Command). When the MAV bit is set, the controller knows that the requested data is ready for reading.

Instead of using the *STB? Command, an alternative way to monitor the MAV bit is to configure the instrument to generate a SRQ when the MAV bit is set as in the example below:

1. In Readout display mode with the output buffer empty and the MAV bit clear, configure the ML248xA / ML249xA to generate an SRQ on data becoming available by setting bit 4 (MAV bit) in the Status Register Enable byte (SRE): *SRE 16
2. Send the command below to request a reading from measurement channel 1: CWO 1.
3. A SRQ will be generated when the reading is placed in the output buffer. Conduct a Serial Poll using a valid GPIB call, which should return the decimal value 80, corresponding to bit 6 for the SRQ and bit 4 for the MAV bit.
4. Acquire the reading using a valid GPIB call. If there is no more data pending in the output buffer the MAV bit will be cleared.

These methods should be used to avoid holding up the GPIB bus by issuing a request for data followed by a read operation which the power meter may not be able to satisfy immediately.

Note: The MAV bit should only be used as an indication of a new message pending in the output buffer. Once started reading data, the status of the MAV bit cannot be guaranteed stable until the entire message is acquired including the message terminator.

If attempting to read large amounts of data, for example using the PMPO command in repeated smaller size chunks by carrying out multiple read operations (e.g. using a program loop), the state of the MAV bit should not be relied upon as an indication that the complete data block has been transferred. This is because the MAV bit may be cleared at any time during the transfer if the Controller requests data faster than the power meter can supply. Under these circumstances part of the data may be left unread in the power meter output buffer. The recommended practice when reading large amounts of data is to employ a data buffer whose size is sufficiently large to acquire the whole data in a single data transfer.

GPIB Buffering

The ML248xA / ML249xA default setting is GPIB Buffering Enabled. In this mode, multiple requests for data are queued sequentially in the output buffer. Message items shall be read from the output queue starting from the earliest data request first.

If GPIB Buffering is disabled using the SYBUFS OFF command, messages will not be queued. Any new data request will over-write the previous data. In this mode, if multiple requests for data are made without retrieving the response following each request, all previous messages will be lost. (Note that this does not include the serial poll request, which is handled independently.)

GPIB on RS232

Serial Remote Operation

The ML248xA / ML249xA RS232 connector on the rear panel supports all GPIB commands including IEEE 488.2 low-level control and handshaking.

Hardware handshake CTS and RTS lines are used to control the flow of data in and out of the power meter and must be available in the cable as hardware handshaking is always enabled. The DTR and DSR lines are connected together within the power meter.

The ML248xA / ML249xA communications serial connector pins are as detailed in the table below.

PIN	SIGNAL
1	NOT USED
2	RX Data
3	TX Data
4	DTR handshake signal
5	Signal ground
6	DSR handshake signal
7	RTS handshake signal
8	CTS handshake signal
9	NOT USED

The serial interface baud rate can be set using the System > Config > Remote > Set RS232 Baud Rate menu selection or the equivalent GPIB command. Available baud rates are: 1200, 2400, 4800, 9600 (default), 19200, 38400 and 57600. Other parameters are predefined as: 8 bits, no parity and 1 stop bit and cannot be changed.

Commands are entered as with the GPIB interface, conforming to the command format. All GPIB commands are supported. There are some additional RS232-specific commands that are prefixed with an exclamation mark (!). All GPIB type commands and command strings should be terminated with a new line character (0A in hexadecimal format).

The special serial mode commands do not require a termination character. Requested data is returned in the same format as with GPIB, but with a preceding ‘R’ and a terminating new line character. In serial mode, the meter cannot be addressed to talk, but measurement data can still be obtained by using the GPIB trigger commands TR1 and TR2. All GPIB type commands and command strings should be terminated with a new line character (0A hex). The special serial mode commands do NOT require a termination character. SRQs are available, and are output as SRQ message ‘S’ followed by a terminating new line character. When the SRQ message has been received, an “!SPL” command (equivalent to the GPIB serial poll) can be issued. The power meter will respond with the serial poll data message, which is a single character, preceded by ‘P’ and terminated by a new-line character.

A device clear message !DCL can be sent to clear the power meter input and output message queues, and terminate any GPIB or serial actions pending.

Note: It is recommended that there is only one serial command in each command string. Terminate each command with a new-line character.

Summary of RS232 commands

The following table lists the GPIB/RS232 Modem Commands and the special serial interface only commands.

Mnemonic	Parameter	Meaning	Comments
!DCL	none	Device clear	RS232 type command only. Clears all buffered GPIB/RS232 messages waiting to be processed. Clears all buffered GPIB/RS232 data waiting to be output. Stops any pending actions.
!SPL	none	Serial poll	RS232 type command only. Allows a GPIB type serial poll to be requested in response to an SRQ from the power meter. This will return the instrument status register and clear the SRQ bit within that register. The *CLS command should be used to clear the rest of the register.
P	None	Response to serial poll	Status Byte
R	None	Return of requested data	

Note: The RS232-type commands (!SPL and !DCL) do NOT require terminating. All other commands or strings of commands require a new line character to terminate.

Command Mnemonics

The GPIB command set is organised into functionally related groups, based on the soft-key hierarchy accessible from the front panel hard keys.

To ease identification of commands, each GPIB mnemonic is initiated by a unique two-letter ID string, which provides an indication of the functional group the mnemonic belongs to. The table below defines the two letter ID strings and their related functional groups.

Device-Specific Commands – ML248xA / ML249xA Command Set

ID Code	Description
BN	BNC Rear Panel Connector
CH	Channel
TR	Triggering
PM	Pulsed / Modulated Measurement Mode
GP	Gating Patterns
MK	Markers
LM	Limits
CW	CW measurement mode
PP	Post-Processing
PA	Power Added Efficiency
TT	Statistical Data Processing
SN	Sensor
NV	Non-volatile Stores
SY	System settings
RC	Range Calibrator

Chapter 3. IEEE 488.2 Mandatory Commands

Function	Command	Page reference
GPIB Status Bytes - Clear	*CLS	3-2
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*CLS (Clear GPIB Status Bytes)

Set Command: *CLS

Remarks: Clears all the GPIB status data structures, including the Event Status Register and Status Register, except for the MAV bit. *CLS does not clear the Output Queue.

*ESE (Set Standard Event Status Enable Register)

*ESE? (Query Standard Event Status Enable Register)

Set Command: *ESE<ws><mask>

Details: <mask> 8-bit binary mask in decimal format

Note: <mask> is the sum of the binary weights of each of the bits to be enabled. Refer to chapter 2 for a description of the Standard Event Status and Standard Event Status Enable registers.

Remarks: Each bit in this register reports IEEE 488.2 specific events.

The following are the conditions that will cause a bit within the Standard Event Status Register to be set to TRUE.

Bit 7 The Power On (PON) bit is set when there has been a transition from a power OFF state to a power ON state.

Bit 5 Command Error (CMD). This bit is set when a GPIB command with incorrect syntax is issued to the power meter.

Bit 4 Execution Error (EXE). This bit is set when incorrect data is sent to the power meter (e.g. SYADDR 57 would result in an Execution Error as the allowable address value range is 1 to 30).

Bit 3 Device Dependent Error (DDE). This bit is set true whenever a measurement related error occurs. Device Dependent Errors can be as follows:

a) ZERO fail: Zero attempted for a sensor and failed.

b) CAL 0 dBm fail: 0 dBm value too far out of range to be corrected.

c) Display channel number goes out of displayable range (Displayable range is +299.999 to –299.999 dBm).

d) Illegal log calculation for a channel - When a channel input configuration combines the readings from two sensors, the operation of the data is carried out in linear units. If the result of the combination produces a negative linear value and the units must be converted to dB for display, an illegal logarithmic operation occurs and the DDE flag will be set.

e) Request for data from a channel with no sensor connected.

Bit 2 Query Error (QYE). This bit is set in the following cases:

1. When attempting to read data without having first sent a complete query command
2. When sending a GPIB command before the instrument has finished data output to the GPIB
3. When a Deadlock situation occurs, where both instrument's input and output queues are full, the instrument is waiting to send further data to the output queue and the controller is waiting to send further commands to the instrument.

Bit 0 Operation Complete: Set when the *OPC command completes and can be used to tell the controller that the unit has completed those commands just sent. See *OPC and *OPC? for more detail. All other bits are not used. The bits just described above are 488.2 common bits

Notes: The bits in the Standard Event Status Enable Register are the same as those in the Standard Event Status Register. The two registers are bit-wise AND'ed to determine which standard event(s) will generate a SRQ.

Query Command: *ESE?

Return String: <mask>

Details: <mask> is a decimal representation of the 8-bit mask as defined above.

Remarks: ESE? Does not clear the Standard Event Status Enable register. Use *ESE 0 or *CLS for this purpose.

*ESR? (Standard Event Status Register Query)

Query Command:	*ESR?
Return String:	<mask>
Details:	<mask> is a decimal representation of the binary value of the Standard Event Status Register.
Remarks:	Returns the current state of the Standard Event Register (ESR)
Example:	A return value of 5 (0000 0101 in binary) indicates that bits 0 (Operation Complete) and bit 2 (Query Error) are set.

*IDN? (Identification Query)

Query Command:	*IDN? (alternatively SYOI can be used)	
Return String:	<company name>,<model>,<serial>,<firmware version>	
Details:	<company name>	ASCII string (7 characters)
	<model>	ML248xA / ML249xA
	<serial>	Instrument unique serial number
	<firmware version>	Current firmware version loaded into the instrument
Remarks:	This command identifies the instrument returning the message string with details described above.	

*OPC (Set Operation Complete Indication)

*OPC? (Query Operation Complete Indication)

Set Command: *OPC

Remarks: Sets the OPC Event bit in the Standard Event Status Register when all pending operations are completed.

Example: SNRGH A, 1; SNRGH B, 3; *OPC

Query Command: *OPC?

Remarks: An ASCII ‘1’ will be placed in the output buffer when the range hold commands have been completed.

Example: SNRGH A, 1; SNRGH B, 2; *OPC?

Note: These commands generate indications when all pending operations are completed. An operation is complete when all input messages processed and all responses have been read out of the GPIB output buffer.

*RST (Instrument Reset)

Set Command: *RST

Remarks: Resets the ML248xA / ML249xA to its default configuration. This command has the same effect as pressing the [Preset] > Reset key sequence on the front panel.

Note: The following settings will NOT be affected:

- Offset Tables
- GPIB settings
- GPIB Status Registers
- GPIB Input/Output queues

*SRE (Service Request Enable Register)

*SRE? (Query Service Request Enable Register)

Set Command: *SRE<ws><mask>

Details: <mask> Decimal representation of the 8 bit binary mask

Remarks: <mask> is the sum of the binary weights of each of the bits to be enabled. Refer to the chapter 2 in this manual for a description of the bits in the Status Byte and Service Request Enable registers. Note that bit 6 should never be set.

Example:

1. To enable bit 4 (Message Available): *SRE 16
2. To enable bit 1 (Limit Fail): *SRE 2
3. To enable both bits: *SRE 18

Note: The bits in the Service Request Enable Register (SRE) are the same as those in the Status Byte Register (STB), except for bit 6, which is not used in the SRE. With the exception of bit 6 the two registers are bit-wise AND'ed to determine which condition(s) will generate a SRQ.

Query Command: *SRE?

Return String: <mask>

Details: <mask> Decimal representation of the 8-bit mask as defined above.

Remarks: *SRE? Does not clear the Instrument Status Enable register. Use *SRE 0 or *CLS for this purpose. Bit 6 will never be set.

*STB? (Status Byte Register Query)

Query Command: *STB?

Return String: <mask>

Details: Decimal representation of the binary value of the Instrument Status Register.

Remarks: Returns the current state of the Status Byte Register (STB) with the RQS bit replaced by the MSS bit (bit 6). MSS is the GPIB Master Summary Status; when set it indicates that the device has at least one reason for requesting service.

Note: Although the MSS message is sent in bit position 6 of the device's response to the *STB? query, it is not sent in response to a serial poll and should not be considered part of the IEEE 488.1/ IEEE 488.2 Status Register. MSS = the Status Byte (STB) OR`ed with the Service Request Enable register (SRE).

Unlike the *ESR? command *STB? does not clear the Instrument Status Register following the query.

Example: A return value of 67 (binary 0100 0011) indicates that bits 0 (Over/Under Range Bit), 1 (Limit Fail Bit), and bit 6 (Master Summary Status) are set.

*TRG (Trigger Command)

Set Command: *TRG

Remarks: This command has the equivalent effect as the GPIB Group Execute Trigger (GET) command. The action performed on receiving a *TRG depends upon the currently enabled GTn settings and will result in either a TR1-type or TR2-type measurement acquisition.

Following a triggered data acquisition, the instrument will return a single measurement if in Single Channel Display or two measurement readings if in Dual Channel Display. Note that the type of measurement returned depends on the Channel Configuration (refer to the TR1, TR2 command explanations for a full definition).

*TST? (Self-test Query Command)

Query Command: *TST?

Return String: Depending on the outcome of the self-test the return string will be:

SUCCESS	If self-test was successful
FAILURE	If any test within the self-test cycle failed

Remarks: Invokes an instrument Self-test cycle and places the return string in the output buffer. Use the command SYTEST for more detail on the results of Self-test.

Note: This command will re-start the measurement sweep in Power Added and Statistical post-processing modes. Ensure that any relevant data is acquired using the appropriate command before sending *TST?

*WAI (Wait to Continue)

Set Command: *WAI

Remarks: This command prevents the instrument from executing any new commands or queries until the command being currently executed has been terminated.

Note: This command is supported as a mandatory 488.2 command. However, since the ML248xA / ML249xA series does not support overlapped commands, issuing this command will effectively result in no action being taken.

Chapter 4. GPIB Remote Trigger Commands

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GT0 (Enable Ignore the Group Execute Trigger (GET) Command)

Set Command:	GT0
Remarks:	When this command is issued the ML248xA / ML249xA will ignore the Group Execute Trigger (GET) or the *TRG commands.

GT1 (Enable 'GET' Command to TR1 Type (Immediate) Trigger)

Set Command:	GT1
Remarks:	When the power meter receives a GET or *TRG command, the system will perform a TR1-type trigger command.

GT2 (Enable 'GET' Command to TR2 Type (Settling Delay) Trigger)

Set Command:	GT2
Remarks:	When the power meter receives a GET or *TRG command, the system will perform a TR2-type trigger command.

TR0 (Trigger Hold Mode)

Set Command:	TR0
Remarks:	This command places the instrument into trigger hold mode. In this mode the instrument will not respond to any trigger event until it receives a TR1, TR2,GET (group executive trigger), or a *TRG command. On sending the TR0 command the instrument will clear the internal averaging buffers and restart the averaging count, according to the averaging number setting, ready for the following command.
Note:	Use the TR3 command to revert back to the instrument trigger mode prior to sending the TR0 command.

TR1 (Trigger Immediate)

Set Command: TR1<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: The measurement reading(s) returned depend on the selected channel(s) for the TR1 command and on the current measurement mode configuration for the selected channel(s) as outlined below:

IMPORTANT NOTE: On successful execution of this command, by default, the instrument will place one or two measurement readings in the GPIB output buffer. These readings must be fetched from the instrument first, before attempting to request additional measurement data.

Channel 1 | 2

CW Mode:	<ch_meas>
Pulsed/Modulated Mode:	
Active Gating Pattern (default)	<gp_meas_average>
Capture Time (if no gates enabled)	<ct_meas_average>
Post Processing Mode:	
Statistical Analysis	TR1 not supported in this mode
Power Added Efficiency	TR1 not supported in this mode

Channel 1&2:

IMPORTANT NOTE: If <c> is 1&2, the instrument must be in Linked Trigger mode (see TRLINKS command), and both channels must be configured in the same measurement mode. An execution error will be raised if failing to meet these conditions.

CW Mode:	<ch1_meas>,<ch2_meas>
Pulsed/Modulated Mode:	
Active Gating Pattern	<ch1_gp_avg>,<ch2_gp_avg>
Whole Capture Time	<ch1_ct_avg>,<ch2_ct_avg>
Post Processing Mode**:**	
Statistical Analysis	TR1 not supported in this mode
Power Added Efficiency	TR1 not supported in this mode

Measurement Mode Combinations:

Combinations of the above measurements will be returned when channels are configured in different measurement modes. For example for channel 1 configured in 'CW mode' and channel 2 in 'Pulsed/Modulated Mode - Active Gating Pattern':

Return String:	<ch1_meas>,< ch2_gp_avg >

Remarks:

On successful execution of this command, by default, the instrument will place one or two measurement readings in the GPIB output buffer as outlined below. These readings must be fetched from the instrument first, before attempting to request additional measurement data.

This command will set up the trigger conditions for a data acquisition cycle on the selected channel. The trigger conditions are defined by the Hardware Trigger Settings (e.g. whether internal or external triggering or rising of falling edge etc.).

The relationship between the TR1 command and the Hardware Trigger can be defined as follows: When sent, the TR1 command will act as a 'Trigger Qualifier' for the next Hardware Trigger event for the selected channel, effectively placing the instrument into a 'Wait for Trigger State'. When the Trigger event occurs, the instrument will carry out a data acquisition cycle and then place itself into a 'Trigger Hold State' until the next TR-type command is sent. The TR1 command effectively causes a single shot Hardware Trigger event.

While in 'Trigger Hold State', the user is guaranteed valid measurements for the same trigger event. At this point the user can retrieve measurement data, in addition to the default measurements, by sending the appropriate GPIB Data Acquisition commands (e.g. CWO, PMPO,GPMO etc. depending on the instrument's measurement mode configuration).

The instrument will process the acquired data according to the Measurement Mode, the Averaging Mode and the Averaging Number settings as follows:

Pulsed / Modulated Measurement Mode:

Following the hardware trigger, the acquired sample will be added to the internal averaging buffer. The reading returned to the user will be the average of all the past samples contained in the averaging buffer including the latest sample just acquired, according to the current averaging settings.

CW Measurement Mode:

The CW averaging settings will affect the behaviour of the TR1 command as follows:

a) Moving Average and Automatic Averaging – Following the hardware trigger, the acquired sample will be added to the internal averaging buffer. The reading returned to the user will be the average of all the past samples contained in the averaging buffer including the latest sample just acquired, according to the current averaging settings.

b) Repeat Average – The returned reading will be the average of ‘n’ samples where ‘n’ is the user-selected Averaging Number.

c) Averaging Off,– When averaging is turned OFF, the instrument will return the next sample as a measurement reading.

Notes:

Use the TR0 command before sending any other TR-type command if wishing to clear the Internal Averaging Buffers and place the instrument into Trigger Hold Mode. This will effectively prevent the instrument from acquiring any further samples until a TR1 command is issued.

The instrument will only return the default average readings, without mnemonic header or channel parameter.

In Pulsed/Modulated mode the gating pattern average reading is returned as default. If no gating patterns are enabled, then the average over capture time is returned.

Additional measurements can be obtained over and above the default measurements by issuing the appropriate GPIB data acquisition commands (e.g. CWO, PMPO, GPMO etc.).

TR2 (Trigger with Settling Delay)

Set Command: TR2<ws><c>

Details: <c> 1 | 2 | 1&2

Remarks: * Channel 1&2 only allowed in linked trigger mode.

IMPORTANT NOTE: On successful execution of this command, by default, the instrument will place one or two measurement readings in the GPIB output buffer as outlined below. These readings must be fetched from the instrument first, before attempting to request additional measurement data.

Return String: The measurement reading(s) returned depend on the selected channel(s) for the TR2 command and on the current measurement mode configuration for the selected channel(s) as follows:

If <c> is 1 | 2:

CW Mode	<ch_meas>
Pulsed/Modulated:	
Active Gating Pattern (default)	<gp_meas_average>
Capture Time (if no gates enabled)	<ct_meas_average>
Post Processing:	
Statistical Analysis	TR2 not supported in this mode
Power Added Efficiency	TR2 not supported in this mode

If <c> is 1&2:

IMPORTANT NOTE: If <c> is 1&2, the instrument must be in Linked Trigger mode (see TRLINKS command), and both channels must be configured in the same measurement mode. An execution error will be raised if failing to meet these conditions.

CW Mode:	<ch1_meas>,<ch2_meas>
Pulsed/Modulated:	
Active Gating Pattern	<ch1_gp_avg>,<ch2_gp_avg>
Whole Capture Time	<ch1_ct_avg>,<ch2_ct_avg>
Post Processing:	
Statistical Analysis	TR2 not supported in this mode
Power Added Efficiency	TR2 not supported in this mode

The instrument will only return the default average readings, without mnemonic header or channel parameter.

In Pulsed/Modulated mode the gating pattern average reading is returned as default. If no gating patterns are enabled, then the average over capture time is returned.

Additional measurements can be obtained whilst still in trigger hold state by issuing the appropriate GPIB data acquisition commands (e.g. CWO, PMPO, GPMO etc.).

Use the TR0 command before sending any other TR-type command if wishing to clear the Internal Averaging Buffers and place the instrument into Trigger Hold Mode. This will effectively prevent the instrument from acquiring any further samples until a TR2 command is issued.

Remarks: This command sets up the trigger conditions for a data acquisition cycle on the selected channel. The trigger conditions are defined by the Hardware Trigger Settings (e.g. whether internal or external triggering etc.).

The relationship between the TR2 command and the Hardware Trigger can be defined as follows: When sent, the TR2 command will act as a ‘Trigger Qualifier’ for the next Hardware Trigger event for the selected channel, effectively placing the instrument into a ‘Wait for Trigger State’.

When a trigger event occurs, the instrument will then perform as many data acquisition cycles as required, depending on the Averaging parameter settings, before placing itself into a ‘Trigger Hold State’ until the next TR-type command is sent.

For a TR2 command this means the following:

When Averaging is ON:

Acquiring multiple samples (under the defined trigger conditions) into the internal averaging buffers up to the user-selected Averaging Number. Only then an averaged measurement reading will be returned to the user.

When Averaging in OFF:

Returning the next sample as a measurement reading.

Note that each time the TR2 command is issued, the Internal Averaging buffers will be cleared and a new acquisition cycle re-started.

While in Trigger Hold State, the user is guaranteed valid measurements for the same trigger event. Additional measurement data (over and above the returned default measurements) shall be retrieved by sending the appropriate GPIB Data Acquisition commands (e.g. CWO, PMPO,GPMO etc. depending on the instrument’s measurement mode configuration).

Note that data will not be guaranteed valid on a non-selected channel (i.e. sending the command ‘TR2 2’ guarantees valid data for channel 2 only.

The instrument will process the acquired data according to the

Measurement Mode, the Averaging Mode and the Averaging Number settings as follows:

Pulsed /Modulated Measurement Mode:

Averaging ON:

The returned reading will be the average of ‘n’ samples where ‘n’ is the user-selected Sweep Averaging Number.

Averaging OFF:

Returns the next sample as a measurement reading.

CW Measurement Mode:

The averaging settings for CW will affect the behaviour of the TR2 command as follows:

a) **Repeat Average** – The returned measurement reading will be the average of ‘n’ samples where ‘n’ is the user-selected Averaging Number.

b) **Moving Average** and **Automatic Averaging** – For a TR2 command, these averaging settings will be treated in the same way as Repeat Averaging.

c) **Averaging Off,**– When averaging is turned OFF, the instrument will return the next sample as a measurement reading.

TR3 (Trigger Free Run)

Set Command: TR3

Remarks: Sets the power meter back into free run mode on both channels.

Chapter 5. Channel Commands

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Setup

CHACTIV (Set Active Channel)

CHACTIV? (Query Active Channel)

Set Command: CHACTIV<ws><c>

Details: <c> 1 | 2

Remarks: Sets the instrument active channel. When operated from the front panel, channel-based settings will only affect the active channel.

Note: This setting does not have any effect on GPIB commands general operation. The user shall be able to change configuration settings and / or obtain measurement data from a channel other than the active channel. Data is only available from the non-active channel when the instrument is operating in dual channel mode. This reflects front panel operation where only the displayed channel(s) have data available.

Query Command: CHACTIV?

Return String: CHACTIV <c>

Remarks: Returns the channel currently selected as the active channel.

CHCFG (Set Channel Input Configuration)

CHCFG? (Query Channel Input Configuration)

Set Command: CHCFG<ws><c><,><config>

Details:

<c>	1 | 2
<config>	A | B | A – B | B – A | A / B | B / A | V

A	Sensor A
B	Sensor B
A – B	Sensor A minus Sensor B
B – A	Sensor B minus Sensor A
A / B	Sensor A divided by Sensor B
B / A	Sensor B divided by Sensor A
V	External Volts

Remarks: Selects the channel input configuration. For single input channel instruments the choice is restricted to Sensor A or External Volts (V).

Note: Input Configuration V is only permitted in CW measurement mode (an execution error will be returned when selecting V in all other measurement modes).

Query Command: CHCFG?<ws><c>

Return String: CHCFG <c>,<config>

Remarks: Returns the selected channel input configuration.

CHDISPN (Set Number of displayed channels)

CHDISPN? (Query Number of displayed channels)

Set Command:	CHDISPN<ws><num_channels>
Details:	<num_channels> 1 → 2
Remarks:	Sets the instrument to show one or both measurement channels on the display panel.

Query Command:	CHDISPN?
Return String:	CHDISPN <num_channels>
Remarks:	Returns the setting for the number of displayed channels selected.

CHMODE (Set Channel Measurement Mode)

CHMODE? (Query Channel Measurement Mode)

Set Command:	CHMODE<ws><c><,><mode>		
Details:	<c>	1 | 2	
	<mode>	CW | PMOD	
		CW	Continuous Wave measurements
		PMOD	Pulsed / Modulated measurements
Remarks:	This command sets the channel measurement mode. CW mode supports conventional power meter measurements using a readout display. In PMOD mode the instrument can be set up to measure pulsed signals or modulated signals (e.g. CDMA , TDMA etc.). In PMOD measurement mode, the measured power can either be viewed as a graphical profile or as readout display.		

Query Command:	CHMODE?<ws><c>
Return String:	CHMODE <c>,<mode>
Remarks:	Returns the selected channel measurement mode setting.

CHRES (Set Channel Decimal Point Resolution)

CHRES? (Query Channel Decimal Point Resolution)

Set Command:	CHRES<ws><c><,><dec_places>	
Details:	<c>	1 | 2
	<dec_places>	1 → 3
Remarks:	Set the number of decimal places displayed for the specified channel.	
Query Command:	CHRES?<ws><c>	
Return String:	CHRES <c>,<dec_places>	
Remarks:	Returns the setting for the selected number of decimal places.	

CHUNIT (Set Channel Units)

CHUNIT? (Query Channel Units)

Set Command: CHUNIT<ws><c><,><units>

Details:

<c>	1 | 2
<units>	DBM | DBMV | DBUV | DBW | W | V

For sensor input configurations A, B, A – B, B – A the following units can be selected:

DBM	dBm
DBMV	dBmV
DBUV	dBμV
DBW	Dbw
W	Watts
V	Volts

Note: **Non-selectable units:**

The channel units displayed on the front panel may differ from the selected <units> depending on the Channel Input Configuration settings (see CHCFG command) as follows:

Ratio Measurements:

For sensor input configurations A / B, B / A and Relative Measurements (see CWREL command) all logarithmic units will be displayed in ‘dB

When linear units of W (Watts) or V (Volts) are selected and the sensor input configuration is set to A/B, B/A, the units will be displayed as % (percentage).

When selecting input configuration EXTV (external volts), units of Volts (V) will be automatically displayed.

Relative Measurements:

In CW Measurement mode only, when enabling Relative Measurement the following units will show the letter ‘r’ appended to the suffix unit:

dBr dB relative to a stored value (applies to all logarithmic units)

%r percentage relative to a stored value (applies to linear units of Watts and Volts only).

In EXTV (External Volt) input configuration only:

Vr External voltage source relative to a stored voltage.

Remarks: Sets the measurement units for the selected channel.

Query Command: CHUNIT?<ws><c>

Return String: CHUNIT <c>,<units>

Remarks: Returns the units currently set up for the selected channel.

ML243xA command supported

CWSETLP (Set Settle Percentage Value)

CWSETLP? (Query Settle Percentage Value)

Set Command: CWSETLP<ws><c><,><settle_pct>

Details: <c> 1 | 2

<settle_pct> 0.01→ 10.00 %

Remarks: The settling percentage determines how long the system waits for the signal to settle. This allows some control over the trade-off between speed, and the extent to which a measurement has settled to its final value.

Query Command: CWSETLP?<ws><c>

Return String: CWSETLP <c>,<settle_pct>

Remarks: Returns the settle percentage configuration setting.

PMDTYP (Set Pulsed/Modulated Measurement Display Type)

PMDTYP? (Query Pulsed/Modulated Measurement Display Type)

Set Command:	PMDTYP<ws><c><,><meas_type>	
Details:	<c>	1 | 2
	<meas_type>	PRF | RDO
	PRF	Profile
	RDO	Readout
Remarks:	Selects the measurement display type for Pulsed/Modulated Measurement mode.	

Query Command:	PMDTYP?<ws><c>
Return String:	PMDTYP <c>,<meas_type>
Remarks:	Returns the Pulsed/Modulated display type setting.

PMMEAS (Set Pulsed/Modulated Measurement Type)

PMMEAS? (Query Pulsed/Modulated Measurement Type)

Set Command: PMMEAS<ws><c><,><meas_type_num>

Details:

<c>	1 | 2
<meas_type_num>	1 → 5

Where <meas_type_num> is:

1:	Average Power
2:	Average Power, Peak Power
3:	Average Power, Peak Power, Crest Factor
4:	Average Power, Min Power & Time , Max Power & Time
5:	Average Power, Held Min Power & Time, Held Max Power & Time

Remarks: Selects the channel pulsed/modulated measurement type. The measurement type selected is applied to the overall channel capture time if all gating patterns are disabled. If any gating patterns are enabled, the measurements will be applied to the gating patterns instead.

Query Command: PMMEAS?<ws><c>

Return String: PMMEAS <c>,<meas_type_num>

Remarks: Returns Gating pattern measurement type currently selected.

Trigger

PMRRS? (Query RRS Trace State) (ML249xA only)

Query Command: PMRRS?<ws><c>

Details: <c> 1 | 2

Remarks: Returns the status of the measurement trace when the instrument is operating in RRS mode.

Return String: PMRRS<c>,<state>

Details: <state> FALSE | FULL | PARTIAL

FALSE:	Channel not in RRS mode.
FULL:	RRS trace complete.
PARTIAL:	RRS trace only partially available.

TRARMD (Set Trigger Arming Mode)

TRARMD? (Query Trigger Arming Mode)

Set Command: TRARMD<ws><c><,><meas_mode><,><arm_mode>

Details:

<c>	1 | 2
<meas_mode>	CW | PMOD
<arm_mode>	AUTO | SINGLE | FRAME
AUTO	Automatically arms the trigger after a trigger event has occurred.
SINGLE	Arms the trigger for a new trigger event following a user key press.
FRAME	Pulsed/Modulated only - Frame-based trigger arming mode.

Listed below are restrictions on the selection of Trigger Arming Modes:

Measurement Mode:	CW (see CHMODE command)
Trigger Source:	INTA | INTB | EXTTL (see TRSRC command)
Selectable Arming Modes:	AUTO | SINGLE
Measurement Mode:	PMOD (see CHMODE command)
Trigger Source:	INTA | INTB | EXTTL (see TRSRC command)

	Selectable Arming Modes:	AUTO | SINGLE | FRAME
	Trigger Source:	CONT
	Selectable Arming Modes:	Arming disallowed

Remarks: Sets the trigger Arming Mode. Frame Arming can be used for burst signals having phase or amplitude based modulation schemes where large amplitude variations may cause unwanted re-triggering within the burst. With frame arming the user specifies a 'Frame Level' and a 'Frame Duration'. This ensures that triggering will be re-armed only when the signal has fallen (and stayed) below the 'Frame Level' for the 'Frame Duration'. (see TRFLEV,TRFTIM commands).

Query Command: TRARMD?<ws><c><,><meas_mode>

Return String: TRARMD <c>,<meas_mode>,<arm_mode>

Remarks: Returns the trigger arming configuration setting for the selected channel and measurement mode.

TRAUTOS (Set Auto-Triggering State)

TRAUTOS? (Query Auto-Triggering State)

Set Command: TRAUTOS<ws><c><,><state>

Details:	<c>	1 | 2
	<state>	ON | OFF

Remarks: Turns auto-triggering ON or OFF only for the Pulsed/Modulated measurement mode on the selected channel.

Query Command: TRAUTOS?<ws><c>

Return String: TRAUTOS <c>, <state>

Remarks: Returns the auto-triggering state for the Pulsed/Modulated measurement mode on the selected channel.

TRBW (Set Trigger Bandwidth)

TRBW? (Query Trigger Bandwidth)

Set Command:	TRBW<ws><c><,><bandwidth>	
Details:	<c>	1 | 2
	<bandwidth>	20MHZ | 2MHZ | 200KHZ | 20KHZ
	20MHZ	Select 20 MHz trigger filter bandwidth.
	2MHZ	Select 2 MHz trigger filter bandwidth.
	200KHZ	Select 200 kHz trigger filter bandwidth.
	20KHZ	Select 20 kHz trigger filter bandwidth.
Remarks:	Select the trigger bandwidth to be used for internally triggered Pulsed/Modulated measurements.	
Query Command:	TRBW?<ws><c>	
Return String:	TRBW<ws><c><,><bandwidth>	
Remarks:	Returns the currently selected trigger bandwidth.	

TRCAPT (Set Capture Time)

TRCAPT? (Query Capture Time)

Set Command: TRCAPT<ws><c><,><meas_mode><,><time>[<units>]

Details:

<c>	1 | 2
<meas_mode>	CW | PMOD
<time>	Valid range for <time> is dependent on Power Meter model, <meas_mode> setting and Trigger Source setting (see below).
[<units>]	optional suffix units

Pulsed/Modulated Mode - ML248xA model:

<time>	3.125 us → 7.000 s (200 measurement display points)
	6.250 us → 7.000 s (400 measurement display points)

Pulsed/Modulated Mode - ML249xA model:

Trigger source – Continuous (RRS mode not Allowed):

<time>	3.200 us → 7.000 s (200 measurement display points)
	6.400 us → 7.000 s (400 measurement display points)

Trigger source - Internal or External (RRS mode allowed):

<time>	50.000 ns → 7.000 s (200 & 400 measurement display points)

CW Mode – All models:

<time>	50.000 us → 7.000 s

Remarks: Sets the time duration for data collection following a trigger event. Note that the capture time valid range will be different depending on the power meter model, <meas_mode> setting and trigger source setting (see TRSRC and CHMODE commands)

Notes: <time> can be entered in floating point format or using suffix_units with the optional <units> parameter. If <units> is omitted, second(s) will be taken as default.

Query Command: TRCAPT?<ws><c><,><meas_mode>

Return String: TRCAPT <c>,<meas_mode>,<time>

Remarks: Returns the trigger capture time for the selected channel.

TRDLYT (Set Trigger Delay Time)

TRDLYT? (Query Trigger Delay Time)

Set Command: TRDLYT<ws><c><,><meas_mode><,><time>[<units>]

Details:

<c>	1 | 2
<meas_mode>	CW | PMOD
<time>	(See Below)
[<units>]	optional suffix units

Note: Conditions apply to <time> depending on trigger source and Measurement mode:

Meas Mode: Pulsed / Modulated – Trigger Source: All

<time> Pre-trig delay → Post-trig delay

Where:

Pre-trig delay = (-1) x (0.95 x Capture Time[†])

Post-trig delay = (2^{24} –1) / (Sample Rate[††])

[†] See TRCAPT for information on Capture Time.

[††] See TRSAMPL for information on Sample Rate

'Pre-trig delay' is defined as a negative trigger delay. The maximum selectable pre-trigger delay allowed is 0.95 the selected Capture Time for that channel.

The maximum selectable 'Post-trig delay' is dependent on the Sample Rate. The selectable sample rates will also change between the ML248xA and ML249xA instrument models.

Meas Mode: CW - Trigger Source: Continuous

<time> 0.00 s (default)

Meas Mode: CW - Trigger Source: Internal | External

<time> 0.00 → 999.00 ms

Remarks: Sets the trigger delay time. Note that <time> can be entered in floating point format or using suffix_units with the optional <units> parameter. If <units> is omitted, second(s) will be taken as default.

Query Command: TRDLYT?<ws><c><,><meas_mode>

Return String: TRDLYT<c>,<meas_mode>,<time>

Remarks: Returns the trigger delay time setting.

TRFLEV (Set Trigger Frame Arming Level)

TRFLEV? (Query Trigger Frame Arming Level)

Set Command: TRFLEV<ws><c><,><frm_level>

Details:

<c>	1 | 2
<frm_level>	-230.00 dBm → +220.00 dBm

Remarks: Sets the Frame Arming amplitude for Pulsed/Modulated measurements. This parameter will be used with Frame Arming enabled (see TRARMD command). When the incoming signal falls below the specified <frm_level> for 'Frame Duration' (see TRFTIM), the hardware trigger is re-armed.

Note: This command applies only to Pulsed/Modulated Measurements.

Query Command: TRFLEV?<ws><c><,><frm_level>

Return String: TRFLEV <c>,<frm_level>

Remarks: Returns the Frame Arming level setting for the selected channel.

TRFTIM (Set Trigger Frame Arming Time Duration)

TRFTIM? (Query Trigger Frame Arming Time Duration)

Set Command: TRFTIM<ws><c><,><frm_duration>

Details:

<c>	1 | 2
<frm_duration>	0.00 → $(2^{24} -1)$ x Sample Period

Where Sample Period is the reciprocal of Sample Rate (1 / Sample Rate) selected (see TRSAMPL). The range of Sample Periods is different depending on the instrument type as follows:

16.0 ns → 32.768 us (ML24x9A)

15.625 ns → 32.0 us (ML24x8A)

Remarks: Selects the time duration for Frame Arming. This setting is applied when Frame Arming is enabled (see TRARMD command). When the signal has fallen below ‘Frame Level’, the instrument will wait for the specified <frm_duration> before re-arming the hardware trigger. This command applies only to Pulsed/Modulated measurements.

Notes: The maximum time selectable for <frm_duration> is dependent on the selected Sample Rate (see TRSAMPL command). For example, with the ML24x9A, if the Sample Rate is set to 62.5Ms/s (i.e. 16.0ns sample period), the maximum selectable <frm_duration> will be 268.4 ms.

Query Command: TRFTIM?<ws><c>

Return String: TRFTIM <c>,<frm_duration>

Remarks: Returns the Frame Arming time duration setting for the selected channel.

TRHOFS (Set Trigger Hold-off State) (ML248xA only)

TRHOFS? (Query Trigger Hold-off State) (ML248xA only)

Set Command: TRHOFS<ws><c><,><state>

Details:

<c>	1 | 2
<state>	OFF | ON

Remarks: Turns trigger hold off ON or OFF.

Note: This command applies only to Pulsed/Modulated Measurements

Query Command: TRHOFS?<ws><c>

Return String: TRHOFS <c>,<state>

Remarks: Returns the hold-off state for the selected channel.

TRHOFT (Set Trigger Hold-off Time) (ML248xA only)

TRHOFT? (Query Trigger Hold-off Time) (ML248xA only)

Set Command: TRHOFT<ws><c><,><holdoff_time>

Details:

<c>	1 | 2
<holdoff_time>	0.00 → 7.00 seconds

Note: This command applies only to Pulsed/Modulated Measurements.

Remarks: Selects the time delay between a trigger event occurring and the trigger being re-armed, when arming mode is set to AUTO (see TRARMD command). Trigger Holdoff is useful when wishing to prevent unwanted trigger events from occurring as a result of noisy signals etc

Query Command: TRHOFT?<ws><c>

Return String: TRHOFT <c>,<holdoff_time>

Remarks: Returns the hold off time currently selected.

TRINEDG (Set Internal Trigger Edge)

TRINEDG? (Query Internal Trigger Edge)

Set Command:	TRINEDG<ws><c><,><meas_mode><,><edge>	
Details:	<c>	1 | 2
	<meas_mode>	CW | PMOD
	<edge>	RISE | FALL
Remarks:	Selects the signal edge for internal triggering. This setting applies only when the trigger source is set to Internal A or Internal B (see TRSRC command).	
Query Command:	TRINEDG?<ws><c><,><meas_mode>	
Return String:	TRINEDG <c>,<meas_mode>,<edge>	
Remarks:	Returns the status of the internal trigger edge setting.	

TRINLEV (Set Internal Trigger Level)

TRINLEV? (Query Internal Trigger Level)

Set Command:	TRINLEV<ws><c><,><meas_mode><,><pw_lev>	
Details:	<c>	1 | 2
	<meas_mode>	CW | PMOD
	<pw_lev>	-230.0 dBm → +220.0 dBm
Remarks:	If the Trigger source is set to INTA or INTB (internal A or B) the system triggers on a rising or falling power level edge. Use this command to set the level to which the signal must rise above or fall below before the power meter initiates a trigger event.	
Query Command:	TRINLEV?<ws><c><,><meas_mode>	
Return String:	TRINLEV<c>,<meas_mode>,<pw_lev>	
Remarks:	Returns the trigger power level setting.	

TRLINKS (Set Trigger Linking State)

TRLINKS? (Query Trigger Linking State)

Set Command: TRLINKS<ws><state>

Details: <state> OFF | ON

Remarks: This option allows both measurement channels to share the same measurement triggering set up.

When <state> is set to ON:

- the trigger settings from the ‘ACTIVE’ channel are also copied to the ‘inactive’ channel.
- Any changes to the trigger settings on either channel from then on will take effect on both channels.

When <state> is set to OFF:

- The trigger settings at this stage will be exactly identical on both channels.
- From then on any changes to the trigger setting will affect only the selected channel.

Note: Both channels must be set to the same measurement mode. If failing to meet this condition the instrument will produce an execution error.

Query Command: TRLINKS?

Return String: TRLINKS <state>

Remarks: Returns the status of the trigger link setting.

TRSAMPL (Set Sample Rate)

TRSAMPL? (Query Sample Rate)

Set Command: TRSAMPL<ws><c><,><sample_rate>

Details:

<c>	1 | 2
<sample_rate>	AUTO | 31K25 | 62K5 | 125K | 250K | 500K |1M | 2M | 4M | 8M | 16M | 32M | 64M | 31M25 | 62M5
AUTO	Instrument determines sample rate
31K25	31.25 ksamples/sec
62K5	62.5 ksamples/sec
125K	125 ksamples/sec
250K	250 ksamples/sec
500K	500 ksamples/sec
1M	1 Msamples/sec
2M	2 Msamples/sec
4M	4 Msamples/sec
8M	8 Msamples/sec
16M	16 Msamples/sec
32M	32 Msamples/sec (ML248xA only)
64M	64 Msamples/sec (ML248xA only)
31M25	31.25 Msamples/sec (ML249xA only)
62M5	64 Msamples/sec (ML249xA only)

Remarks: Sets the sample rate for Pulsed/Modulated measurements on the selected channel.

Note: Use the appropriate top sample rates depending on the power meter model (i.e. 32M, 64M for ML248xA and 31M25, 62M5 for the ML249xA). This command applies only to Pulse/Modulated Measurements.

Query Command: TRSAMPL?<ws><c>

Return String: TRSAMPL <c>,< sample_rate >

Remarks: Returns the sample rate setting for the selected channel.

TRSRC (Set Trigger Source)

TRSRC? (Query Trigger Source)

Set Command: TRSRC<ws><c><,><meas_mode><,><source>

Details:

<c>	1 | 2
<meas_mode>	CW | PMOD
<source>	CONT | INTA | INTB | EXTTL

CONT	Continuous.
INTA | INTB	Internally monitoring the RF level at the specified sensor.
EXTTL	External BNC TTL trigger input.

Remarks: Selects the source that the instrument will monitor to initiate a trigger event. The <meas_mode> parameter allows selection of which trigger settings to modify independently of the active channel setup.

Query Command: TRSRC?<ws><c><,><meas_mode>

Return String: TRSRC<c>,<meas_mode>,<source>

Remarks: Returns the status of the trigger source setting.

TRWFPOS (Set Trigger Waveform Position)

Set Command: TRWFPOS<ws><c><,><position>

Details:

<c>	1 | 2
<position>	TOP | MIDDLE | BOTTOM | UP | DOWN
TOP	Position waveform at the top of the graticule.
MIDDLE	Position waveform in the middle of the graticule.
BOTTOM	Position waveform at the bottom of the graticule.
UP	Move the waveform up by one pixel.
DOWN	Move the waveform down by one pixel.

Remarks: Sets the position of the trigger waveform within the graticule.

TRWFS (Set Trigger Waveform State)

TRWFS? (Query Trigger Waveform State)

Set Command:	TRWFS<ws><c><,><state>	
Details:	<c>	1 | 2
	<state>	ON | OFF
Remarks:	Turns the trigger waveform display on or off.	
Query Command:	TRWFS?<ws><c>	
Return String:	TRWFS<ws><c><,><state>	
Remarks:	Returns the state of the trigger waveform display.	

TRXEDG (Set External Trigger Edge)

TRXEDG? (Query External Trigger Edge)

Set Command:	TRXEDG<ws><edge>	
Details:	<edge>	RISE | FALL
Remarks:	Sets the signal edge on which the internal trigger event will occur. This setting applies only when the trigger source is set to external TTL (see TRSRC command).	
Query Command:	TRXEDG?	
Return String:	TRXEDG<edge>	
Remarks:	Returns the status of the external trigger edge setting.	

Gating

GP1REPN (Set Gate Pattern 1 Repeat Number)

GP1REPN? (Query Gate Pattern 1 Repeat Number)

Set Command:	GP1REPN<ws><c><,><repeat_number>	
Details:	<c>	1 | 2
	< repeat_number>	2 → 8
Remarks:	Set the number of times gate pattern 1 is to be repeated.	
Query Command:	GP1REPN?<ws><c>	
Return String:	GP1REPN <c>,< repeat_number >	
Remarks:	Returns gate pattern 1 repeat count.	

GP1REPS (Set Gate Pattern 1 Repeat State)

GP1REPS? (Query Gate Pattern 1 Repeat State)

Set Command:	GP1REPS<ws><c><,><state>	
Details:	<c>	1 | 2
	<state>	ON | OFF
Remarks:	Set/Reset the gate pattern 1 repeat feature.	
Query Command:	GP1REPS?<ws><c>	
Return String:	GP1REPS <c>,<state>	
Remarks:	Returns the state of gate pattern 1 repeat feature.	

GP1REPT (Set Gate Pattern 1 Repeat Offset)

GP1REPT? (Query Gate Pattern 1 Repeat Offset)

Set Command:	GP1REPT<ws><c><,><time>
Details:	<c> 1 | 2
	<time> 0.00 → 7.00 s
Remarks:	Set gate pattern 1 time offset between successive gates. Time offset will be the same for all repeated gate patterns.
Query Command:	GP1REPT?<ws><c>
Return String:	GP1REPT <c>,<time>
Remarks:	Returns the time offset for gate pattern 1 repeat.

GPACTN (Set Active Gating Pattern Number)

GPACTN? (Query Active Gating Pattern Number)

Set Command:	GPACTN<ws><c><,><gp>
Details:	<c> 1 | 2
	<gp> 1 → 4
Remarks:	Selects the gating pattern number to be designated as 'Active'. Measurements for the active gating pattern are displayed on the front panel.
Query Command:	GPACTN?<ws><c>
Return String:	GPACTN <c>,<gp>
Remarks:	Returns the active gating pattern number.

GPAMO (Output Active Gating Pattern Measurement)

Query Command: GPAMO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: **Channels 1 | 2:**

GPAMO <c>,<meas_type>,<agp_data>

Channels 1&2:

GPAMO <c> ,<ch1_meas_type>,<ch1_agp_data>,
<ch2_meas_type>, <ch2_agp_data>

Details: <meas_type>: The measurement type number: 1 → 5 (see below)

<agp_data>: The measurements for the active gating pattern.

When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above. Listed below are the measurements provided by <meas_type> number:

1	Average Power
2	Average Power, Peak Power
3	Average Power, Peak Power, Crest Factor
4	Average Power, Min Power & Time , Max Power & Time
5	Average Power, Held Min Power & Time, Held Max Power & Time

The format of <agp_data> will be different depending upon the selected measurement type number. A two-letter prefix always precedes the measurements readings to help decoding the data string:

No.	Data Format
1	<gp_num>,<PA>,<avg_pow>
2	<gp_num>,<PA>,<avg_pow>,<PK>,<pk_pow>
3	<gp_num>,<PA>,<avg_pow>,<PK>,<pk_pow>,<CF>,<cres_fact>
4	<gp_num>,<PA>,<avg_pow>,<PN>,<min_pow>,<TN>,<min_time>, <PX>,<max_pow>,<TX>,<max_time>
5	<gp_num>,<PA>,<avg_pow>,<PHN>,<hmin_pow>, <THN>,<hmin_time>,<PHX>,<hmax_pow>,<THX>,<hmax_time>

Where:

<gp_num> The active gating pattern number to which the measurements apply

The two-letter prefixes have the following meanings:

PA	Average Power
PK	Peak Power

CF	Crest Factor
PN	Min Power
TN	Time of Min Power in units of seconds (s)
PX	Max Power
TX	Time of Max Power in units of seconds (s)
PHN	Held Min Power
PHX	Held Max Power
THN	Time of Held Min Power in units of seconds (s)
THX	Time of Held Max Power in units of seconds (s)

Remarks: When in Pulsed / Modulated mode, this command returns the active gating pattern readings. Power readings will be returned in the units currently selected for the measurement channel (see CHUNIT command). The time readings relate to the time at which the minimum or maximum power reading occurred relative to the start time of the gate and it is always returned in units of seconds. The measurement reading type <meas_type> is selected using the PMMEAS command. An execution error is raised if there are no enabled gating patterns.

Note that gating pattern numbers 5 → 8 will only return a reading if the Gate1 Repeat Pattern State is enabled (see GP1REPS command) and Gate1 Repeat Count has been set to 5 → 8 (see GP1REPN). An execution error is returned if either condition is not met.

If all gating patterns are disabled, then the PMRDO command can be used if wishing to obtain measurement readings over the whole Capture Time.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

GPARST (Gating Patterns Min/Max Tracking Reset)

Set Command:	GPRST<ws><c>	
Details:	<c>	1 | 2
Remarks:	This command resets the min/max values when the measurement for Held Max/Min power is selected (see PMMEAS).	
Note:	This command should be used for both Enabled Gating Patterns and overall Capture Time measurements.	

GPFENS (Set Fence Number State)

GPFENS? (Query Fence Number State)

Set Command:	GPFENS<ws><c><,><gp><,><state>	
Details:	<c>	1 | 2
	<gp>	1 → 4
	<state>	OFF | ON
Remarks:	Enables the fence for the selected gating pattern.	
Query Command:	GPFENS?<ws><c><,><gp>	
Return String:	GPFENS <c>,<gp>,<state>	
Remarks:	Returns the fence state for the selected gating pattern.	

GPFENSP (Set Fence Stop Time)

GPFENSP? (Query Fence Stop Time)

Set Command:	GPFENSP<ws><c><,><gp><,><time>	
Details:	<c>	1 | 2
	<gp>	1 → 4
	<time>	0.00 → 7.00 s
Remarks:	Sets the fence stop time for the gating pattern.	

Query Command: GPFENSP?<ws><c><,><gp>

Return String: GPFENSP <c>,<gp>,<time>

Remarks: Returns the fence stop time for the specified gating pattern.

GPFENST (Set Fence Start Time)

GPFENST? (Query Fence Start Time)

Set Command:	GPFENST<ws><c><,><gp><,><time>	
Details:	<c>	1 | 2
	<gp>	1 → 4
	<time	0.00 → 7.00 s
Remarks:	Sets the fence start time for the gating pattern.	

Query Command: GPFENST?<ws><c><,><gp>

Return String: GPFENST <c>,<gp>,<time>

Remarks: Returns the fence start time for the specified gating pattern.

GPGATS (Set Gate Number State)

GPGATS? (Query Gate Number State)

Set Command: GPGATS<ws><c><,><gp><,><state>

Details:

<c>	1 | 2
<gp>	1 → 4
<state>	OFF | ON

Remarks: Enables/Disables the gating pattern for the selected channel. Enabling a gating pattern will initiate processing of the measurements falling within the gate. .

Note: Reading(s) can only be obtained for enabled gating patterns. The type of readings returned depend upon the Pulsed/Modulated Measurement type selected (see PMMEAS command).

Query Command: GPGATS?<ws><c><,><gp>

Return String: GPGATS <c>,<gp>,<state>

Remarks: Returns the state of the selected gating pattern.

GPHIDES (Set Hide Gating Patterns State)

GPHIDES? (Query Hide Gating Patterns State)

Set Command: GPHIDES<ws><c><,><state>

Details:

<c>	1 | 2
<state>	OFF | ON

Remarks: Hides (ON) or shows (OFF) the enabled gating patterns line segments on the instrument display panel.

The gating patterns are still applied enabled and their measurements still available. This command only removes them from view.

Query Command: GPHIDES?<ws><c>

Return String: GPHIDES <c>,<state>

Remarks: Returns the state of the gating pattern hide parameter.

GPMO (Output All Enabled Gating Patterns Measurements)

Query Command: GPMO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: **For channels 1 | 2** :

GPMO <c>,<gp_count>,<meas_type>, <gp_1_data>, … <gp_n_data>

For channels 1&2 :

GPMO <c>,<ch1_gp_count>,<ch1_meas_type>, <ch1_gp_1_data>, … <ch1_gp_n_data>,<ch2_gp_count>,<ch2_meas_type>, <ch2_gp_1_data>, <ch2_gp_n_data>

Details:

<gp_count>	The total number of enabled gating patterns available.
<meas_type>	The measurement type number: 1 → 5 (see below).
<gp_n_data>	The measurements for each enabled gating pattern.

Note: When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Note that the <gp_ count > range is 1 → 4 if Gate1 Repeat Pattern state is disabled (see GP1REPS command). If enabled, <gp_ count > range is 1 → 8, depending on the selection for Gate1Repeat Count (see GP1REPN).

Listed below are the measurements provided by <meas_type> number:

Number	:Measurement Type:
1	Average Power
2	Average Power, Peak Power
3	Average Power, Peak Power, Crest Factor
4	Average Power, Min Power & Time , Max Power & Time
5	Average Power, Held Min Power & Time, Held Max Power & Time

The format of <gp_n_data> will be different depending upon the selected measurement type number. A two-letter prefix always precedes the measurements readings to help decoding the data string:

No.	Data Format:
1	<gp_num>,<PA>,<avg_pow>
2	<gp_num>,<PA>,<avg_pow>,<PK>,< pk_pow>
3	<gp_num>,<PA>,<avg_pow>,<PK>,<pk_pow>,<CF>,<cres_fact>
4	<gp_num>,<PA>,<avg_pow>,<PN>,<min_pow>,<TN>,<min_time>, <PX>,<max_pow>,<TX>,<max_time>
5	<gp_num>,<PA>,<avg_pow>,<PHN>,<hmin_pow>,<THN>,<hmin_ti

me>,<PHX>,<hmax_pow>,<THX>,<hmax_time>

Where:

<gp_num> The gating pattern number to which the measurements apply.

The two-letter prefixes have the following meanings:

PA	Average Power
PK	Peak Power
CF	Crest Factor
PN	Min Power
TN	Time of Min Power in units of seconds (s)
PX	Max Power
TX	Time of Max Power in units of seconds (s)
PHN	Held Min Power
PHX	Held Max Power
THN	Time of Held Min Power in units of seconds (s)
THX	Time of Held Max Power in units of seconds (s)

When in Pulsed / Modulated mode, this command returns the selected measurement readings for all enabled gating patterns. Power readings will be returned in the units currently selected for the measurement channel (see CHUNIT command). The time readings relate to the time at which the minimum or maximum power reading occurred relative to the start time of the gate and it is always returned in units of seconds. The measurement readings type <meas_type> is selected using the PMMEAS command. An execution error is raised if there are no enabled gating patterns.

Note that gating pattern numbers 5 → 8 will only return a reading if the Gate1 Repeat Pattern State is enabled (see GP1REPS command) and Gate1 Repeat Count has been set to 5 → 8 (see GP1REPN). An execution error is returned if either condition is not met.

If all gating patterns are disabled, the PMRDO command can be used if wishing to obtain measurement readings over the whole Capture Time.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

GPNMO (Output Gating Pattern Number Measurement)

Query Command: GPNMO<ws><c><,><gp_num>

Details:

<c>	1 | 2 | 1&2
<gp_num>	1 → 8

Return String:

For channels 1 | 2:

GPNMO <c>,<meas_type>, <gp_n_data>

For channels 1&2:

GPNMO <c>,<ch1_meas_type>,<ch1_gp_n_data>,
<ch2_meas_type>, <ch2_gp_n_data>

Details: When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Listed below are the measurements provided by <meas_type> number:

Number	Measurement Type:
1	Average Power
2	Average Power, Peak Power
3	Average Power, Peak Power, Crest Factor
4	Average Power, Min Power & Time , Max Power & Time
5	Average Power, Held Min Power & Time, Held Max Power & Time

The format of <gp_n_data> will be different depending upon the selected measurement type number. A two-letter prefix always precedes the measurement readings to help decode the data string:

No.	Data Format
1	<gp_num>,<PA>,<avg_pow>
2	<gp_num>,<PA>,<Avg_pow>,<PK>,<Pk_pow>
3	<gp_num>,<PA>,<Avg_pow>,<PK>,<Pk_pow>,<CF>,<Cres_Fact>
4	<gp_num>,<PA>,<Avg_pow>,<PN>,<min_pow>,<TN>,<min_time>, <PX>,<max_pow>,<TX>,<max_time>
5	<gp_num>,<PA>,<Avg_pow>,<PHN>,<hmin_pow>,<THN>,<hmin_time>,<PHX>,<hmax_pow>,<THX>,<hmax_time>

Where:

<gp_num> The gating pattern number to which the measurements apply

The range of <gp_num > will be 1 → 4 if Gate1 Repeat Pattern is disabled (see GP1REPS command).

If enabled, the range will extend to 1 → 8, depending on the selection for

Gate1 Repeat Count (see GP1REPN).

The two-letter prefixes have the following meanings:

PA	Average Power
PK	Peak Power
CF	Crest Factor
PN	Min Power
TN	Time of Min Power in units of seconds (s)
PX	Max Power
TX	Time of Max Power in units of seconds (s)
PHN	Held Min Power
PHX	Held Max Power
THN	Time of Held Min Power in units of seconds (s)
THX	Time of Held Max Power in units of seconds (s)

When in Pulsed / Modulated mode this command returns the specified gating pattern readings. Power readings will be returned in the units currently selected for the measurement channel. The timing readings relate to the time at which the minimum or maximum power reading occurred with respect to the trigger point and it is always returned in units of seconds. An execution error is returned if there are no enabled gating patterns. The measurement type is selected using the PMMEAS command.

Gating pattern numbers 5 → 8 will only return a reading if Gate1 Repeat Pattern is enabled (see GP1REPS command) and Gate1 Repeat Count has been set to 5 → 8 (see GP1REPN). An execution error is returned if either condition is not met.

If all gating patterns are disabled, using the PMRDO command will return measurement readings over the whole Capture Time.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

GPOFF (Switch OFF Gating Patterns)

Set Command: GPOFF<ws><c>

Details: <c> 1 | 2

Remarks: Turns OFF all enabled gating patterns including the active gating pattern. This action will end internal processing of measurements associated to gating patterns. The gating patterns definitions however remain unchanged.

Note: By definition each Gating Patten can be thought of as a single entity, which includes a Gate and a Fence pair. A Fence is always associated with its corresponding Gate and cannot be used on its own. The ‘Gate Enable’ setting (see GPGATS command) has overall control over the Fence as well. Therefore, using the GPOFF command will turn the ‘Gate Enable’ setting OFF and also override its associated ‘Fence Enable’ state. When sending a GPOFF command the following settings will remain unchanged, but will not be active:

Gate Start Time

Gate Stop Time

Fence State

Fence Start Time

Fence Stop Time

Gating Pattern 1 Repeat State

Gating Pattern 1 Repeat Number

Gating Pattern 1 Repeat Offset

After having issued the GPOFF command, if the user should wish to re-enable Gating Pattern 1, by turning the ‘Gate Enable’ setting ON, the associated Gate, Fence and Gating Pattern 1 Repeat settings listed above will also take effect.

GPTIMSP (Set Gate Stop Time)

GPTIMSP? (Query Gate Stop Time)

Set Command:	GPTIMSP<ws><c><,><gp><,><time>	
Details:	<c>	1 | 2
	<gp>	1 → 4
	<time>	0.00 → 7.00 s
Remarks:	Sets the gate stop time for the selected gating pattern.	
Query Command:	GPTIMSP?<ws><c><,><gp>	
Return String:	GPTIMSP <c>,<gp>,<time>	
Remarks:	Returns the gate stop time for the specified gating pattern.	

GPTIMST (Set Gate Start Time)

GPTIMST? (Query Gate Start Time)

Set Command:	GPTIMST<ws><c><,><gp><,><time>	
Details:	<c>	1 | 2
	<gp>	1 → 4
	<time>	0.00 → 7.00 s
Remarks:	Sets the gate start time for the selected gating pattern.	
Query Command:	GPTIMST?<ws><c><,><gp>	
Return String:	GPTIMST <c>,<gp>,<time>	
Remarks:	Returns the gate start time for the specified gating pattern.	

Relative Measurement

ML243xA command supported

CWREL (Relative Mode Control)

CWREL? (Query Relative Mode Control)

Set Command: CWREL<ws><c><,><mode>

Details:

	<c>	1 | 2
	<mode>	0 Turn OFF
		1 Turn ON and reference
		2 Turn ON, use old references if not first time.

Remarks: This command sets the relative mode for CW measurements. Immediately after turning 'Relative mode' ON, the instrument will take a reading of the measured power and use it as a reference value thereafter for all subsequent measurements. The measurements returned over GPIB from then on will be relative to the reference power.

For linear units of Watts (W), in relative mode, the returned readings will be as percentage relative to the reference value (%r). All logarithmic units will be returned in dB relative to the reference value (dBr).

Note: When selecting <mode> to be 1, the instrument will always take a new reference reading (this is the equivalent of toggling the 'Relative' button ON from the front panel, then pressing the 'Reset' button). When selecting <mode> to be 2, the instrument will use the old reference value, unless there is no reference value stored (e.g. When switching ON a new unit for the first time or following a software upgrade).

Query Command: CWREL?<ws><c>

Return String: CWREL <c>,<mode>

Remarks: Returns the state of Relative Mode.

Averaging

CWAVG (Set CW Averaging Mode)

CWAVG? (Query CW Averaging Mode)

Set Command: CWAVG<ws><c><,> [<mode>]<,>[<avg_num>]

Details:

<c>	1 | 2
<mode>	OFF | MOV | RPT | AUTO
<avg_num>	1 → 512 (Applies only to MOV and RPT averaging)
OFF	Averaging OFF
MOV	MOVING Average
RPT	REPEAT Averaging
AUTO	AUTOMATIC Averaging

Remarks: Moving averaging uses a sliding-window type of averaging. The width of the sliding window is defined by <avg_num>. In this mode the returned measurement update is at every sample.

Repeat averaging only returns a reading when the number of samples specified by <avg_num> has been taken. The process will re-start each time with a fresh set of samples.

AUTOMATIC averaging is similar to MOVING averaging. The averaging number is selected internally to provide optimum speed versus settling of samples over the GPIB interface.

In AUTOMATIC averaging the user-defined <avg_num> is not used, but the user may send the CWAVG command to select AUTOMATIC averaging mode and also include <avg_num>. This will in effect also update the <avg_num> setting.

Examples:

CWAVG 1, AUTO, 64	This command will set the system to AUTO averaging and the <avg_num> averaging number to 64.
CWAVG 1, AUTO,	Change Channel 1 to Auto Averaging (note the comma following AUTO even though the <avg_num> parameter is not being sent).
CWAVG 2, MOV, 32	Change Channel 2 to Moving average and the User Average number to 32.

CWAVG 1, RPT,	Change Channel 1 to Repeat average and keep the User Average number as 32.
CWAVG 1, , 128	Change Channel 1 User Average number to 128, but keep the previously set averaging mode (note comma to indicate the <mode> parameter is not being sent).

Query Command: CWAVG?<ws><c>

Return String: CWAVG <c>,<mode>,<avg_num>

Remarks: Returns the averaging mode for the selected channel. Note that when channel averaging <mode> is OFF or AUTO the <avg_num> field will default to 1. For all other settings the selected averaging number will be returned.

PMAVGN (Set Profile Sweep Averaging Number)

PMAVGN? (Query Profile Sweep Averaging Number)

Set Command: PMAVGN<ws><c><,><value>

Details:

<c>	1 | 2
<value>	1 → 512

Remarks: Sets the sweep averaging number for the Pulsed/Modulated measurement mode.

The instrument will calculate a point-by-point average on N trace sweeps (where N is the Sweep Averaging Number), before updating the displayed profile. When the Sweep Averaging Number is reached, a moving type of average will be applied from then on.

Query Command: PMAVGN?<ws><c>

Return String: PMAVGN <c>,<value>

Remarks: Returns the setting for the sweep averaging number.

PMAVGS (Set Pulsed/Modulated Profile Averaging State)

PMAVGS? (Query Pulsed/Modulated Profile Averaging State)

Set Command: PMAVGS<ws><c><,><state>

Details: <c> 1 | 2

<state> OFF | ON

Remarks: Sets the Pulsed/Modulated Sweep Averaging state.

Query Command: PMAVGS?<ws><c>

Return String: PMAVGS <c>,<state>

Remarks: Returns the state of Pulsed/Modulated Sweep Averaging setting.

PMAVRST (Reset Pulsed/Modulated Profile Averaging)

Set Command: PMAVRST<ws><c>

Details: <c> 1 | 2

Remarks: If Pulsed/Modulated Sweep Averaging is set to ON (see PMAVGS command), this command will restart the profile sweep averaging.

PMPDRST (Reset Pulsed/Modulated Profile)

Set Command: PMPDRST<ws><c>

Details: <c> 1 | 2

Remarks: Resets the profile data points when the Pulsed/Modulated min/max tracking mode is set to ‘Infinite’ (see PMPTRK command) and the Data Representation Type is set to MIN, MAX or MIN&MAX (see PMPDREP command). The command will be ignored if the Data Representation Type is set to NORM.

Duty Cycle

CWDUTY (Set Duty Cycle Value)

CWDUTY? (Query Duty Cycle Value)

Set Command: CWDUTY<ws><c><,><duty_pct>

Details:

<c>	1 | 2
<duty_pct>	0.10 → 100.00 %

Remarks: This command applies the duty cycle value to the selected channel. Duty cycle can be used when measuring pulsed signals in CW measurement mode and wishing to extract the pulse power from an average power reading (for example a reading from a MA2421A thermal sensor). Note that the duty-cycle corrected pulse power reading is only an approximation and assumes constant peak power.

Use the power meter in Pulsed/Modulated mode with an MA2491A sensor to obtain accurate peak power measurements.

Query Command: CWDUTY?<ws><c>

Return String: CWDUTY <c>,<duty_pct>

Remarks: Returns the duty cycle value for the selected channel.

CWDUTYS (Set Duty Cycle State)

CWDUTYS? (Query Duty Cycle State)

Set Command: CWDUTYS<ws><c><,><state>

Details:

<c>	1 | 2
<state>	OFF | ON

Remarks: Turns the duty cycle for the selected channel on or off.

Query Command: CWDUTYS?<ws><c>

Return String: CWDUTYS <c>,<state>

Remarks: Returns the duty cycle state for the selected channel.

Markers

MKACTN (Set Active Marker)

MKACTN? (Query Active Markers)

Set Command:	MKACTN<ws><c><,><marker_num>	
Details:	<c>	1 | 2
	<marker_num>	1 → 4
Note:	A marker must be made active before it is moved.	
Remarks:	Sets the selected marker to be the active marker. When made active, the marker can subsequently move along the time axis.	

Query Command:	MKACTN?<ws><c>
Return String:	MKACTN <c>,<marker_num>
Remarks:	Returns the active marker number.

MKACTO (Output Active Marker Readings)

Query Command: MKACTO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: **For channels 1 | 2**:

MKACTO <c>,<mk_num>,<mk_n_data>

For channels 1&2:

MKACTO<c>,<ch1_mk_num>,<ch1_mk_n_data>,<ch2_mk_num>,<ch2_mk_n_data>

Details:

<mk_num>	The active marker number
<mk_n_data>	The measurements for the active marker

The format of <mk_n_data> is as follows:

<mk_pow>,< mk_p_unit_type >,<mk_time>

<mk_pow>	The marker power reading (1→ 4)
<mk_p_unit_type>	The unit type for the power reading (Depending on the current measurement units for the selected channel)
<mk_time>	The time reference for the power reading.

Remarks: Returns the active marker reading. If no markers are enabled, an execution error is returned. When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKAOFF (Switch All Markers Off)

Set Command: MKAOFF<ws><c>

Details: <c> 1 | 2

Remarks: All markers are switched off. Following this command, markers will no longer be visible on the front panel and readings will not be available over GPIB.

MKAPOS (Set Active Marker Position)

MKAPOS? (Query Active Marker Position)

Set Command: MKAPOS<ws><c><,><time>[<units>]

Details:

<c>	1 | 2
<time>	See notes below
[<units>]	NS | US | MS | S

Remarks: Sets the active marker to the specified position on the measurement profile time axis. The marker will return the current reading at that position (using any of the Markers Data Acquisition commands). Note that markers can ONLY be moved within the profile capture time currently set. The instrument will ignore this command if sending a <time> that exceeds the capture time. An execution error will be returned if the selected marker is disabled. This command can be issued to control any enabled marker regardless of the current active marker.

Note: The marker search is carried out on a 200 or 400 point measurement data set depending on the Display Resolution setting (see SYDRES command). The marker x-axis resolution is therefore a function of Capture Time and Display Resolution. If the marker is moved over GPIB by a finer increment than the current display resolution, the instrument shall return the measurement reading from the nearest data point.

Query Command: MKAPOS? <ws><c>

Return String: MKAPOS<c>,<active_mkr_num>,<time>

<active_mkr_num> The marker number currently assigned as active.

Remarks: Returns the active marker number and position along the trace.

MKDELTS (Set Delta Marker Enable State)

MKDELTS? (Query Delta Marker Enable State)

Set Command: MKDELTS<ws><c><,><state>

Details:

<c>	1 | 2
<state>	OFF | ON

Remarks: Enables the delta marker. There must be an enabled active marker for the delta marker to operate. If no markers are enabled, on executing this command the instrument will also enable the last used active marker. Following the above action the default /user-selected delta marker readings will be available.

Query Command: MKDELTS?<ws><c>

Return String: MKDELTS<c>,<state>

Remarks: Returns the enable state of the delta marker.

MKDLINK (Set Delta Markers Link State)

MKDLINK? (Query Delta Markers Link State)

Set Command:	MKDLINK<ws><c><,><state>	
Details:	<c>	1 | 2
	<state>	OFF | ON
Remarks:	Links the delta marker to the active marker, so that they can be moved together as a pair.	

Query Command:	MKDLINK?<ws><c>
Return String:	MKDLINK <c>,<state>
Remarks:	Returns the delta marker link state.

MKDMEAS (Set Delta Marker Measurement Type)

MKDMEAS? (Query Delta Marker Measurement Type)

Set Command:	MKDMEAS<ws><c><,><meas_type>	
Details:	<c>	1 | 2
	<meas_type>	PDIFF | PAVG
	PDIFF	Power Difference
	PAVG	Average Power
Remarks:	Selects the delta marker measurement type to be displayed on the front panel or returned over GPIB.	

Query Command:	MKDMEAS?<ws><c>
Return String:	MKDMEAS<c>,<meas_type>
Remarks:	Returns the delta marker measurement type currently selected.

MKDO (Output Delta Marker Readings)

Query Command:	MKDO<ws><c>
Details:	<c> 1 | 2 | 1&2
Return String:	**For channels 1 | 2**: MKDO <c>,<dmkr_data> **For channels 1&2**: MKDO <c>,<ch1_dmkr_data>,<ch2_dmkr_data>
Details:	The format of < dmkr_data > is as follows: < meas_type >,<dmk_meas_data>,<units>,<dmk_time>

<meas_type>	PDIFF | PAVG
<dmk_meas_data>	Measurement data value
<units>	Current measurement units
<dmk_time>	Marker time position

Remarks: Returns the delta marker readings. If the marker is disabled an error is flagged. When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Note: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKDPOS (Set Delta Marker Position)

MKDPOS? (Query Delta Marker Position)

Set Command: MKDPOS<ws><c><,><time>[<units>]

Details:

<c>	1 | 2
<time>	See notes below
[<units>]	NS | US | MS | S

Remarks: Sets the delta marker to the specified position on the measurement profile time axis. The marker will return the current reading at that position (using any of the Markers Data Acquisition commands). Note that markers can ONLY be moved within the profile capture time currently set. The instrument will ignore this command if sending a <time> that exceeds the capture time. An execution error will be returned if the selected marker is disabled. This command can be issued to control any enabled marker regardless of the current active marker.

Note: The marker search is carried out on a 200 or 400 point measurement data set depending on the Display Resolution setting (see SYDRES command). The marker x-axis resolution is therefore a function of Capture Time and Display Resolution. If the marker is moved over GPIB by a finer increment then the current display resolution, the instrument shall return the measurement reading from the nearest data point.

Query Command: MKDPOS? <ws><c>

Return String: MKDPOS <c>,<time>

Remarks: Returns the delta marker position on the time axis.

MKENO (Output All Enabled Markers Readings)

Query Command: MKENO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: **For channels 1 | 2**:

MKENO <c>,<mk_count>,<mk_1_data>, … <mk_n_data>

For channels 1&2:

MKENO <c>,<ch1_mk_count>,<ch1_mk_1_data>, …
<ch1_mk_n_data> <ch2_mk_count>,<ch2_mk_1_data>, …
<ch2_mk_n_data>

Details:

<mk_count>	The number of enabled markers
<mk_n_data>	The measurements for each enabled marker

The format of <mk_n_data> is as follows:

<mk_num>,<mk_pow>,< mk_p_unit_type >,<mk_time>

<mk_num>	The marker number
<mk_pow>	The marker power reading
<mk_p_unit_type>	The unit type for the power reading (Depending on the current measurement units for the selected channel)
<mk_time>	The time reference for the power reading

Remarks: Returns readings for all enabled markers. If no markers are enabled an execution error is returned.

When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKNO (Output Marker Number Reading)

Query Command: MKNO<ws><c><,><mk_num>

Details:

<c>	1 | 2 | 1&2
<mk_num>	1 → 4

Return String:

For channels 1 | 2:

MKNO <c>,<mk_num>,<mk_n_data>

For channels 1&2:

MKNO<c>,<ch1_mk_num>,<ch1_mk_n_data>,<ch2_mk_num>,<ch2_mk_n_data>

Details:

<mk_num>	The marker number selected.
<mk_n_data>	The measurements for the selected marker.

The format of <mk_n_data> is as follows:

<mk_pow>,< mk_p_unit_type >,<mk_time>

<mk_pow>	The marker power reading
<mk_p_unit_type>	The unit type for the power reading (Depending on the current measurement units for the selected channel)
<mk_time>	The time reference for the power reading.

Remarks: Returns the measurement reading for the selected marker. If the marker is disabled an execution error is returned. When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKPFTO (Output Pulse Fall Time)

Query Command:	MKPFTO <ws><c>
Details:	<c> 1 | 2 | 1&2
Return String:	MKPFTO <c>,<pf_time>
Details:	<pf_time> 0.00 → 7.00 s
Remarks:	Advanced marker functions command. Returns the selected pulse shape fall time. This function relies on the user positioning the active marker within the pulse shape. If attempting to obtain a reading over GPIB, as a minimum, the user should obtain the position of the pulse on the time axis. The active marker can be used to return a measurement reading to ensure the correct position of the pulse is found. The time reference obtained can be subsequently entered for the <mkf_time> parameter to return the Pulse Fall Time.
Notes:	The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKPOS (Set Marker Position)

MKPOS? (Query Marker Position)

Set Command: MKPOS<ws><c><,><marker_num><,><time>[<units>]

Details:

<c>	1 | 2
<marker_num>	1 → 4
<time>	See notes below
[<units>]	NS | US | MS | S

Remarks: Sets the selected marker to the specified position on the measurement profile time axis. The marker will return the current reading at that position (using any of the Markers Data Acquisition commands). Note that markers can ONLY be moved within the profile capture time currently set. The instrument will ignore this command if sending a <time> that exceeds the capture time. An execution error will be returned if the selected marker is disabled. This command can be issued to control any enabled marker regardless of the current active marker.

Note: The range for <time> depends upon the selected Capture Time.

The marker search is carried out on a 200 or 400 point measurement data set depending on the Display Resolution setting (see SYDRES command). The marker x-axis resolution is therefore a function of Capture Time and Display Resolution. If the marker is moved over GPIB by a finer increment then the current display resolution, the instrument shall return the measurement reading from the nearest data point.

Query Command: MKPOS?<ws><c><,><marker_num>

Return String: MKPOS <c>,<marker_num>,<time>

Remarks: Returns the selected marker time.

MKPOTO (Output Pulse Off Time)

Query Command:	MKPOTO <ws><c>
Details:	<c> 1 | 2 | 1&2
Return String:	MKPOTO<c>,<po_time>
Details:	<po_time> 0.00 → 7.00 s
Remarks:	Advanced marker functions command. Returns the selected pulse shape width. This function relies on the user positioning the active marker within the pulse shape.
Notes:	If attempting to obtain a reading over GPIB, as a minimum, the user should obtain the position of the pulse on the time axis. The active marker can be used to return a measurement reading to ensure the correct position of the pulse is found. The time reference obtained can be subsequently entered for the <mkf_time> parameter to return the Pulse Off Time.
Notes:	The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKPRIO (Output Pulse Repetition Interval)

Query Command:	MKPRIO<ws><c>
Details:	<c> 1 | 2
Return String:	MKPRIO<c>,<mkf_time>
Details:	<mkf_time> 0.00 to 7.00 s
Remarks:	Advanced marker functions command. Returns the Pulse Repetition Interval (PRI) of the selected pulse shape. This function relies on the user positioning the active marker within the pulse shape. If attempting to obtain a reading over GPIB, as a minimum, the user should obtain the position of the pulse on the time axis. The active marker can be used to return a measurement reading to ensure the correct position of the pulse is found. The time reference obtained can be subsequently entered for the <mkf_time> parameter to return the Pulse Repetition Interval.
Notes:	The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKPRTO (Output Pulse Rise Time)

Query Command:	MKPRTO <ws><c>
Details:	<c> 1 | 2 | 1&2
Return String:	MKPRTO <c>,<pr_time>
Details:	<pr_time> 0.00 → 7.00 s
Remarks:	Advanced marker function command. Returns the selected pulse shape rise time. This function relies on the user positioning the active marker inside the pulse shape. If attempting to obtain a reading over GPIB, as a minimum, the user should obtain the position of the pulse on the time axis. The active marker can be used to return a measurement reading to ensure the correct position of the pulse is found. The time reference obtained can be subsequently entered for the <pr_time> parameter to return the Pulse Rise Time.
Notes:	The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKPSLT (Set Advanced Marker Search Lower Target)

MKPSLT? (Query Advanced Marker Search Lower Target)

Set Command:	MKPSLT<ws><c><,><value>
Details:	<c> 1 | 2
	<value> 1.00 % to 99.00 %
Remarks	Sets the advanced marker search lower target value.
Query Command:	MKPSLT?<ws><c>
Return String:	MKPSLT <c>,<value>
Remarks:	Returns the lower target's current value.

MKPSSV (Set Advanced Marker Search Start Value Source)

MKPSSV? (Query Advanced Marker Search Start Value Source)

Set Command:	MKPSSV<ws><c><,><source>	
Details:	<c>	1 | 2
	<source>	MARKER | GATE
	MARKER	The active marker power value is used to start the search from.
	GATE	The active gate's average power value is used to start the search from.
Remarks	Sets the source of the power value that the advanced marker search is started from.	
Query Command:	MKPSSV?<ws><c>	
Return String:	MKPSSV <c>,<source>	
Remarks:	Returns the current source of the advanced marker search start value.	

MKPSUT (Set Advanced Marker Search Upper Target)

MKPSUT? (Query Advanced Marker Search Upper Target)

Set Command:	MKPSUT<ws><c><,><value>	
Details:	<c>	1 | 2
	<value>	1.00 % to 99.00 %
Remarks	Sets the advanced marker search upper target value.	
Query Command:	MKPSUT?<ws><c>	
Return String:	MKPSUT <c>,<value>	
Remarks:	Returns the upper target's current value.	

MKPWTO (Output Pulse Width)

Query Command: MKPWTO <ws><c>

Details: <c> 1 | 2 | 1&2

Return String: MKPWTO<c>,<pw_time>

Details: <pw_time> 0.00 → 7.00 s

Remarks: Advanced marker functions command. Returns the selected pulse shape width. This function relies on the user positioning the active marker within the pulse shape. If attempting to obtain a reading over GPIB, as a minimum, the user should obtain the position of the pulse on the time axis. The active marker can be used to return a measurement reading to ensure the correct position of the pulse is found. The time reference obtained can be subsequently entered for the <pw_time> parameter to return the Pulse Width.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

MKSTATE (Set Markers State)

MKSTATE? (Query Markers State)

Set Command: MKSTATE<ws><c><,><marker_num><,><state>

Details:

<c>	1 | 2
<marker_num>	1 → 4
<state>	OFF | ON

Remarks: Enables the selected marker. If set to ON, this command will display the selected marker on the instrument front panel and make a reading available depending on the marker position.

Query Command: MKSTATE?<ws><c><,><marker_num>

Return String: MKSTATE<c>,<marker_num>,<state>

Remarks: Returns the state of the selected marker.

MKTMAX (Position Active Marker to Maximum)

Set Command: MKTMAX<ws><c>

Details: <c> 1 | 2

Remarks: Places the active marker at the maximum point on the trace. If no markers are enabled the default active marker will be enabled before is moved. The reading can be obtained with the MKACTO command.

MKTMIN (Move Active Marker to Minimum)

Set Command: MKTMIN<ws><c>

Details: <c> 1 | 2

Remarks: Places the active marker at the minimum point on the trace. If no markers are enabled the default active marker will be enabled before is moved. The reading can be obtained with the MKACTO command.

Limit Checking

ML243xA command supported

LMFBEEP (Set Fail Beep Control)

LMFBEEP? (Query Fail Beep Control)

Set Command:	LMFBEEP<ws><c><,><state>
Details:	<c> 1 | 2 <state> OFF | ON
Remarks:	When ON, causes an audio beep every time the limits for the selected channel fail. If LMFBEEP is ON, and LMFHOLD is ON, whenever the limits specified for the channel have been exceeded, a beep sounds once every second until LMFHOLD is turned OFF, or the CLEAR key (CLR) is pressed. The FAIL indication is not affected by the CLEAR key, and can only be cleared by turning LMFHOLD off. If a limit fail happens again, the alarm will sound again.
Query Command:	LMFBEEP?<ws><c>
Return String:	LMFBEEP <c>,<state>
Remarks:	Returns the state of the fail beep control setting.

LMFCLR (Clear Limit Failure Indicator)

Set Command:	LMFCLR<ws><c>
Details:	<c> 1 | 2
Remarks:	When Fail Hold is enabled, this command will clear any limit failure indicators.

ML243xA command supported

LMFHOLD (Set Fail Indicator Hold)

LMFHOLD? (Query Fail Indicator Hold)

Set Command: LMFHOLD<ws><c><,><state>

Details: <c> 1 | 2

<state> OFF | ON

Remarks: If a failure is detected on either Upper or Lower limits, and this setting is turned ON, the failure indicators will continue to issue a limit failure until this command is issued again to turn the Fail Indicator Hold OFF. All BNC outputs, beeps and displays continue to be in the 'fail' state until after the OFF is received.

Query Command: LMFHOLD?<ws><c>

Return String: LMFHOLD <c>,<state>

Remarks: Returns the state of the fail indicator hold setting.

LMLINE (Set Limit Line Test Type)

LMLINE? (Query Limit Line Test Type)

Set Command: LMLINE<ws><c><,><limit_line>

Details: <c> 1 | 2

<limit_line> BOTH | UPPER | LOWER

Remarks: This command allows selection of the limit lines to be applied to the measurements for limit checking.

Query Command: LMLINE?<ws><c>

Return String: LMLINE <c>,<limit_line>

Remarks: Returns the selected limit lines for limit checking of the measurements.

ML243xA command supported

LMSLO (Set Lower Limit Line Value for Simple Limits Checking)

LMSLO? (Query Lower Limit Line Value for Simple Limits Checking)

Set Command: LMSLO<ws><c><,><limit_val>

Details: <c> 1 | 2

<limit_val> –999.99 →+999.99 E+06

Remarks: Set the lower limit value for simple limit checking. The value of <limit_val> is regarded as 'unit-less' number; hence <limit_val> magnitude will be checked against the current measurements regardless of the instrument's currently selected units. The user must ensure that <limit_val> is consistent with the selected measurement units.

Note: The instrument will not carry out a unit conversion if different measurement units are selected.

Query Command: LMSLO?<ws><c>

Return String: LMSLO <c>,<limit_val>

Remarks: Return the current value for the lower limit line.

LMSTATE (Set Limit Checking State)

LMSTATE? (Query Limit Checking State)

Set Command: LMSTATE<ws><c><,><state>

Details: <c> 1 | 2

<state> OFF | ON

Remarks: Enables limit checking on the selected channel.

Query Command: LMSTATE?<ws><c>

Return String: LMSTATE <c>,<state>

Remarks: Returns the selected channel limit checking status.

ML243xA command supported

LMSUP (Set Upper Limit Line Value for Simple Limits Checking)

LMSUP? (Query Upper Limit Line Value for Simple Limits Checking)

Set Command: LMSUP<ws><c><,><limit_val>

Details: <c> 1 | 2

<limit_val> –999.99 →+999.99 E+06

Remarks: Sets the upper limit power value for simple limit checking. Note that <limit_val> is regarded as a 'unitless' number; this means that the magnitude of <limit_val> will be used to check the limits against the current measurements, regardless of the units selected for the current channel. The user must ensure that the magnitude of <limit_val> is consistent with the intended measurement units for which the measurements are to be limit checked.

Note: The instrument will not carry out a unit conversion if different measurement units are selected.

Query Command: LMSUP?<ws><,><c>

Return String: LMSUP <c>,<limit_val>

Remarks: Return the current value for the upper limit line.

LMTYP (Set Limit Checking Type)

LMTYP? (Query Limit Checking Type)

Set Command: LMTYP<ws><c><,><type>

Details: <c> 1 | 2

<type> COMPLEX | SIMPLE

Remarks: Selects the type of limits to be applied to be applied to the Pulsed/Modulated profile. Note that for CW measurement only simple limit checking is available.

Query Command: LMTYP?<ws><c>

Return String: LMTYP <c><,><type>

Remarks: Returns the selected limit checking type.

LMXASTQ (Query All Complex Limits Stores State)

Query Command: LMXASTQ

Return String: LMXASTQ <store_category>,<store_1>,<state><store_category><store_n>,<state>

Details:

<store_category>	USER | PDEF		
<store_n>	USER:	30	
	PDEF:	20	
<flag>	FREE | USED		

Where:

USER:	user defined stores
PDEF:	pre-defined stores
FREE:	The store does not hold a limits specification
USED:	The store holds a valid limits specification

Remarks: Returns the status of all complex limits stores.

LMXNAME (Set Complex Limits Store Name)

LMXNAME? (Query Complex Limits Store Name)

Set Command: LMXNAME<ws><store_num><,><name_str>

Details:

<store_num>	1→ 30
<name_str>	ASCII string (16 characters max)

Remarks: Replaces the existing name string with a new name for the complex limit specification at the target <store_num>.

Query Command: LMXNAME?<ws><store_num>

Return String: LMXNAME <store_num>,<name_str>

Remarks: Returns the name string for the specified store number. If the target store does not hold a valid specification, the return string will be: LMXNAME <store_num>, 0.

LMXPOF (Set Complex Limits Power Offset)

LMXPOF? (Query Complex Limits Power Offset)

Set Command:	LMXPOF<ws><c><,><offset>
Details:	<c> 1 | 2
	<offset> - 999.99 → +999.99 E+06
Remarks:	Sets the complex limits specification power offset. If the value exceeds the <offset> range an execution error is returned.
Note:	The value of <offset> is 'unit-less'. The user must ensure that the value of <offset> agrees with the intended measurement units. The magnitude of <offset> will be accepted (providing it is within the specified <offset> range), regardless of the permitted range for the measurement units currently selected on channel <c>.
Query Command:	LMXPOF?<ws><c>
Return String:	LMXPOF <c>,<offset>
Remarks:	Returns the limit specification amplitude offset.

LMXREPN (Set Complex Limits Repeat Count)

LMXREPN? (Query Complex Limits Repeat Count)

Set Command:	LMXREPN<ws><c><,><count>
Details:	<c> 1 | 2
	<count> 2 → 8
Remarks:	Sets the number of times the limit specification is to be replicated.
Query Command:	LMXREPN?<ws><c>
Return String:	LMXREPN <c>,<count>
Remarks:	Returns the number of times the limit specification is replicated.

LMXREPS (Set Complex Limits Repeat State)

LMXREPS? (Query Complex Limits Repeat State)

Set Command: LMXREPS<ws><c><,><state>

Details:

<c>	1 | 2
<state>	OFF | ON

Remarks: Enables the complex limits repeat feature. When enabled the complex limit specification currently applied will be repeated according to the selection for repeat count(LMXREPN), and power/time replication offsets (LMXROFP,LMXROFT).

Query Command: LMXREPS?<ws><c>

Return String: LMXREPS <c>,<state>

Remarks: Returns the complex limits repeat state.

LMXROFP (Set Complex Limits Power Replication Offset)

LMXROFP? (Query Complex Limits Power Replication Offset)

Set Command: LMXROFP<ws><c><,><offset>

Details:

<c>	1 | 2
<offset>	– 999.99 → +999.99 E+06

Remarks: Sets the limits replication amplitude offset. If the value exceeds the <offset> range an execution error is returned. This command is used in conjunction with the LMXREPN command to define the power offset to be applied to the repeated limit mask.

The value of <offset> is unit-less and will be accepted (providing it is within <offset> range), regardless of the permitted range for the channel units currently selected.

Note: The user must ensure that the value of <offset> agrees with the intended measurement units.

Query Command: LMXROFP?<ws><c>

Return String: LMXROFP <c>,<offset><suffix_mult><suffix_units>

Remarks: Returns the complex limits replication amplitude offset.

LMXROFT (Set Time Replication Offset)

LMXROFT? (Query Time Replication Offset)

Set Command:	LMXROFT<ws><c><,><offset>	
Details:	<c>	1 | 2
	<offset>	-7.00 → +7.00 s

Remarks: Sets the complex limit specification time replication offset. This command is used in conjunction with the LMXREPN command to define the time offset applied to the repeated limit mask.

Notes: The replicated mask will be offset with respect to the original specification reference point (i.e. segment 1 start time).

Query Command: LMXROFT?<ws><c>

Return String: LMXROFT <c>,<offset><suffix_mult><suffix_units>

Remarks: Returns the limit specification time offset.

LMXSAVE (Save Specification to Complex Limits Store)

Set Command: LMXSAVE

Remarks: This command saves the complex limits specification being currently edited to the target non-volatile store number. Issue this command to complete the command sequence LMXSID, LMXSEG, LMXSAVE required for defining a complex limits specification having one or more segments.

Failing to issue this command will result in loss of data if a subsequent LMXSID is sent, or the instrument is turned OFF.

An execution error will be returned if this command is issued without first sending the LMXSID command, or if this command is sent twice or more when saving a specification.

LMXSEG (Define Complex Limits Segment)

Set Command: LMXSEG<ws><seg_limits>

Details: <seg_limits> <start_time><,> <stop_time><,><up_lim_start><,><up_lim_stop><,><low_lim_start><,><low_lim_stop>

Note:	<start_time>	Segment start time
	<stop_time>	Segment stop time
	<up_lim_start>	Upper limit power start
	<up_lim_stop>	Upper limit power stop
	<low_lim_start>	Lower limit power start
	<low_lim_stop>	Lower limit power stop

The absolute maximum range for each of the above input parameters are defined below. Note that all time-related parameters are defined with respect to the trigger point (t = 0)

Time parameters -7.00 → +7.00 s

Power parameters -999.99 → +999.99 E+06

IMPORTANT: All parameters specified for <seg_limits> must be entered in the order in which they are listed. Amplitude related parameters are ‘unit-less’. The user must ensure that the magnitude of these values agree with the intended measurement units.

Remarks: Defines a single limit segment to be saved to the target complex limits store. Repeat this command two or more times to define up to a maximum of 24 segments. Contiguous segments must not overlap in time, but gaps between segments are allowed. It is possible to define only UPPER or only LOWER limits for any segment within a specification by only sending the start/stop limit of interest and leaving the other fields empty (the separating commas must be included, see examples below).

While sending multiple segments, If any one segment causes an execution error the user must re-send all data from the start again. (GPIB will discard any valid segments previously sent and will NOT accept any subsequent segments). It is recommended to query the GPIB status registers for any execution errors following each LMXSEG command.

When an execution error is raised, the user MUST issue a new LMXSID command to clear the editor and restart receiving segments again. Ensure that the error within the segment is rectified before re-sending the command sequence.

IMPORTANT:

Examples:

To define the UPPER limit only (assume sloping limit and dBm units):

```
LMXSEG  20US, 28US, -30,-45, , ,
```

To define the LOWER limit only (assume flat limit and dBm units):

```
LMXSEG 20US,28US, , , -30,-30
```

Notes: Only send this command following the LMXSID command. Failing to do so will result in an execution error. Also use the LMXSAVE command at the end of the segment definition. Failing to do so will result in loss of data if a subsequent LMXSID is sent, or the instrument is turned OFF.

LMXSID (Set Complex Limits Specification ID Header)

Set Command: LMXSID<ws><store_num><,><name_str>

Details:

<store_num>	1 → 30
<name_str>	ASCII string (16 characters max)

Remarks: Defines the target store number and name string for the complex limits specification. Note that this command must be followed by one or more LMXSEG commands and always terminated by the LMXSAVE command to save the specification to the target non-volatile store.

Failing to use the LMXSAVE command will result in loss of data if the user subsequently sends a new LMXSID command or the instrument is turned OFF.

Notes: Sending LMXSID followed immediately by LMXSAVE is accepted as a valid operation and will effectively erase an existing store. Attempting to use such store number to a trace (using the LMXSPEC command) will result in no limit checking being applied as there are no segments defined.

LMXSPEC (Set Complex Limits Specification Number to Apply)

LMXSPEC? (Query Applied Complex Limit Specification)

Set Command: LMXSPEC<ws><c><,><spec_category><,><spec_number>

Details:

<c>	1 | 2
<spec_category>	USER | PDEF
<spec_number>	see below

Note: The range of <spec_number> depends on the specification category selected as follows:

USER:	1 → 30
PDEF	1 → 20

Remarks: When the limit checking state is ON and the selected limit type is COMPLEX, the selected complex limits specification stored at <spec_number> store will be applied to the P/M profile on channel <c>.

Query Command: LMXSPEC? <ws><c>

Return String: LMXSPEC <c>,<spec_category>,<spec_number>

Remarks: Returns the complex limits specification number being applied to the selected channel.

LMXSPEF (Define Full Complex Limits Specification)

Set Command: LMXSPEF<ws><store_num><,><name_str><,><num_seg><,><seg_data>

Details:

<store_num>	1 → 30
<name_str>	ASCII string (16 characters max)
<num_seg>	Total number of segments to be sent (1 → 24)
<seg_data>	Must be sent in the sequence; <seg_1><,><seg_2><,><seg_3><,> … <seg_N>

Where: <seg_N> is the total number of segments as defined in the <num_seg> parameter or the maximum number of segments (24 max.). Each segment <seg_N> must be defined as follows:

<start_time>	Segment start time
<stop_time>	Segment stop time
<up_lim_start>	Upper limit power start
<up_lim_stop>	Upper limit power stop
<low_lim_start>	Lower limit power start
<low_lim_stop>	Lower limit power stop

The absolute maximum range for the above input parameters is as follows:

Time parameters	0 → 7s (15.625 ns resolution)
Power parameters	-999.99 → +999.99 E+06

NOTE: All time-related parameters are defined with respect to the trigger point (t= 0)

Remarks: This command sends a complete complex limits specification to be saved at the target store number. The specification must not contain more than 24 segments. Contiguous segments must not overlap in time, but gaps between segments are allowed. If any of the specified parameters in any segment does not comply with these rules, GPIB will reject the whole data and raise an execution error.

It is possible to define only UPPER or only LOWER limits for any segment within a specification by only sending the start/stop limit of interest and leaving the other fields empty (the separating commas must be included, see examples below).

Notes: DO NOT use LMXSAVE with this command.

Amplitude related parameters are unit-less. The user must ensure that the magnitude of these values agree with the intended measurement units.

All parameters specified for <seg_N> must be entered in the order in which they are listed.

Example: Defining a specification in dBm units, UPPER LIMIT only, having 2 segments at store 5 (assumed FREE).

Segment 1: Start_t = 20µs, Stop_t = 28µs, Up_lim_pow_start = –30,

Up_lim_pow_stop = -30

Segment 2: Start_t = 28µs, Stop_t = 38µs, Up_lim_pow_start = -1,

Up_lim_pow_stop = -1

```
LMXSPEF 5, GSM2SLOT_DBM, 2, 20US, 28US, -30, -30, , ,28US,
38US, -1, -1, , ,
```

LMXSPO (Output Complex Limits Specification)

Query Command:	LMXSPO<ws><store_category><,><store_num>		
Details:	<store_category>	USER | PDEF	
	<store_num>	USER:	1 → 30
		PDEF:	1 → 20

Return String: LMXSPO <store_category>,<store_num>,<name_str>,<num_seg>, <seg_data>

Details:	<name_str>	ASCII string (16 characters max)
	<num_seg>	Total number of segments to be sent (1 → 24)
	<seg_data>	(See below)

The format for <seg_data> is as follows:

<seg_1>,<seg_2>,…<seg_N>

Where: <seg_N> is the number of segments defined in the specification (1 → 24). Each segment <seg_N> is returned in the following format:

<start_time>,<stop_time>,<up_lim_start>,<up_lim_stop>,<low_lim_st art>,<low_lim_stop>

<start_time>	Segment start time
<stop_time>	Segment stop time
<up_lim_start>	Upper limit power start
<up_lim_stop>	Upper limit power stop
<low_lim_start>	Lower limit power start
<low_lim_stop>	Lower limit power stop

Remarks: Returns the complex limit specification held at the target <store_num> store in ASCII format. If the store does not hold a valid specification, the return string is LMXSPO 0

Notes: If any segment within the specification was originally defined as having only an UPPER or a LOWER limit, the instrument will substitute the absolute maximum / minimum magnitude ratings for the missing limits (i.e. – 999.99 for LOWER and +999.99 E+06 for UPPER limit, see example below).

Example:

Returning a specification defined in the USER stores, dBm units, UPPER LIMIT only, having 2 segments at store 5.

Segment 1: Start_t = 20µs, Stop_t = 28µs, Up_lim_pow_start = –30, Up_lim_pow_stop = -30

Segment 2: Start_t = 28µs, Stop_t = 38µs, Up_lim_pow_start = -1,

Up_lim_pow_stop = -1

LMXSPO USER, 5, GSM2SLT_DBM, 2, 20US, 28US, -30, -30, 999.99E+06, 999.99E+06, 28US, 38US, -1, -1, – 999.99, – 999.99

LMXSTQ (Query Complex Limits Memory Store)

Query Command:	LMXSTQ<ws><store_num>	
Details:	<store_number>	1 → 30
Return String:	LMXSTQ <store_number>,<store_ status>	
Details:	<status_status> FREE | USED	
	FREE	The store is empty.
	USED	The store holds a valid limits specification.
Remarks:	This command allows querying the status of a selected user complex limits store. Use this command to avoid over-writing a store that may already hold a valid specification.	

LMXTOF (Set Complex Limits Time Offset)

LMXTOF? (Query Complex Limits Time Offset)

Set Command:	LMXTOF<ws><c><,><offset>	
Details:	<c>	1 | 2
	<offset>	– 7.00 s → +7.00 s

Remarks:: Sets the complex limit specification time offset. This command allows for minor adjustments of the limit mask along the profile x-axis. Note that the specification reference point is taken to be segment 1 start time with respect to the trigger point (t = 0). Sending a time <offset> will move the whole mask by the defined amount from segment 1 reference point.

Query command: LMXTOF?<ws><c>

Return String: LMXTOF <c>,<offset>

Remarks: Returns the selected time offset for the complex limit specification being applied.

Scaling

PMPAUTO (Autoscale Pulsed/Modulated Profile)

Set Command: PMPAUTO<ws><c>

Details:

<c>	1 | 2

Remarks: Single-shot autoscale function to scale the displayed Pulsed/Modulated measurement profile to fill the measurement window.

PMPREF (Set Pulsed/Modulated Profile Reference Level)

PMPREF? (Query Pulsed/Modulated Profile Reference Level)

Set Command: PMPREF<ws><c><,><unit_type><,><ref_level>[<suffix_mult>][<suffix_unit>]

Details:

<c>	1 | 2
<unit_type>	DB | W | % or PCT
<ref_level>	see below for allowed ranges
[<suffix_mult>]	Applies only to W units (N to G)
[<suffix_unit>]	see CHUNIT for supported units

The <ref_level> parameter depends upon the units selected:

LOG units	-998.99 to +999.99
Watts	100 GW to 100 NW
% or PCT	10,000 to 0.0001

Units Resolution:

LOG units	0.01 DB
Watts	variable *****
PCT	variable *****

***** Numeric entries for this field are limited to a maximum of 5 digits including 2 decimal point digits. The resolution, as a result, will vary according to the magnitude of the selected reference level. (e.g. if selecting a 4-digit integer value, the resolution will be to one decimal point digit).

Note: If <suffix_mult> is not specified, the default units of Watts will be assumed.

Remarks: Sets the graph reference level for Pulsed/Modulated measurements.

Query Command: PMPREF?<ws><c><,><unit_type>

Return String: PMPREF <c>,<unit_type>,<ref_level>

Remarks: Returns the graph reference level for Pulsed/Modulated measurements.

PMPSCAL (Set Pulsed/Modulated Profile Scale)

PMPSCAL? (Query Pulsed/Modulated Profile Scale)

Set Command: PMPSCAL<ws><c><,><unit_type><,><scale_value>[<suffix_mult>][<suffix_unit>]

Details:

<c>	1 | 2
<unit_type>	DB | W | % or PCT
<scale_value>	See below for allowed resolution
[<suffix_mult>]	Applies only to W units (N to G)
[<suffix_unit>]	See CHUNIT for allowed units

The <scale_value> parameter varies depending upon the units selected:

LOG units	0.1 DB/div to 50 DB/div
Watts	10 GW/div to 10 NW/div
% or PCT	1000 units/div to 0.001 units/div

Note: If <suffix_mult> is not specified, the default units of Watts will be assumed.

Remarks: Sets the graticule scale for Pulsed/Modulated measurements.

Query Command: PMPSCAL?<ws><c><,><unit_type>

Return String: PMPSCAL<c>,<unit_type>,<scale_value>

Remarks: Returns Sets the graticule scale for Pulsed/Modulated measurements.

Min/Max

ML243xA command supported

CWMMRST (Reset Min and Max Tracking)

Set Command:	CWMMRST<ws><c>
Details:	<c> 1 | 2
Remarks:	This command resets the min/max values for the CW measurement mode if Min/Max tracking state is enabled (see CWMMTKS).

ML243xA command supported

CWMMTKS (Set Min and Max Values Tracking State)

CWMMTKS? (Query Min and Max Values Tracking State)

Set Command:	CWMMTKS<ws><c><,><state>
Details:	<c> 1 | 2
	<state> OFF | ON
Remarks:	Turns the min/max tracking for the specified channel ON or OFF.

Query Command:	CWMMTKS?<ws><c>
Return String:	CWMMTKS<c>,<state>
Remarks:	Returns the min/max tracking state.

Profile Display

PMPDREP (Set Pulsed/Modulated Profile Data Representation Type)

PMPDREP? (Query Pulsed/Modulated Profile Data Representation Type)

Set Command: PMPDREP<ws><c><,><type>

Details:

<c> 1 | 2

<type>	NORM | MIN&MAX | MIN | MAX
NORM	This is the default setting. The average for each data point is drawn on the displayed profile.
MIN&MAX	Displays the minimum (MIN) and maximum (MAX) measured values for each data point on the displayed profile. A vertical line linking the MIN and MAX values is drawn for each data point.
MIN:	Displays only the MIN measurement values for each point on the displayed profile.
MAX:	Displays only the MAX measurement values for each point on the displayed profile.

Remarks: Defines the measurement profile data representation for Pulsed/Modulated profile mode. The displayed minimum and maximum value for each data point is extracted from a ‘sample window’ with the number of samples dependent upon the system acquisition speed and the selected profile capture time.

Notes: When selecting MIN, MAX or MIN&MAX, the selected data representation will take effect from the time this command is received or following a Pulsed/Modulated profile reset command (see PMPDRST command).

Query Command: PMPDREP? <ws><c>

Return String: PMPDREP <c>,<type>

Remarks: Returns the Pulsed/Modulated data hold representation type.

PMPTRK (Set Pulsed/Modulated Profile Min/Max Tracking Mode)

PMPTRK? (Query Pulsed/Modulated Profile Min/Max Tracking Mode)

Set Command:	PMPTRK<ws><c><,><mode>	
Details:	<c>	1 | 2
	<mode>	SINGLE | INFINITE
	SINGLE:	Resets min and max values after each sweep.
	INFINITE:	Never resets the MIN and MAX values. Following every new measurement sweep, each profile data point is only updated if the new measurement is greater than the displayed MAX value or smaller than the MIN value.
Remarks:	Sets the P/M profile min/max tracking mode. The tracking is applied to the whole trace regardless of gating patterns setups (i.e. tracking cannot be 'localised' within gates only).	

Query Command:	PMPTRK?<ws><c>
Return String:	PMPTRK <c>,<mode>
Remarks:	Returns the P/M profile min/max tracking mode selected.

Meas Hold

CHOLD (Set Display Channel Measurement Hold)

CHOLD? (Query Display Channel Measurement Hold)

Set Command:	CHOLD<ws><c><,><state>	
Details:	<c>	1 | 2
	<state>	ON | OFF
Remarks:	This command holds the displayed readings for the selected channel on the instrument front panel.	

Query Command:	CHOLD?<ws><c>
Return String:	CHOLD <c>,<state>
Remarks:	Returns the state of the display channel hold setting.

Peaking Indicator

CHPIRST (Reset Channel Readout Peaking Indicator)

Set Command:	CHPIRST<ws><c>
Details:	<c> 1 | 2
Remarks:	When this command is issued, the Peaking Indicator is reset to a half its full-scale deflection.

CHPKS (Set Channel Readout Peak Indicator State)

CHPKS? (Query Channel Readout Peak Indicator State)

Set Command:	CHPKS<ws><c><,><state>
Details:	<c> 1 | 2 <state> OFF | ON
Remarks:	This command controls the display of the Peaking Indicator on the instrument front panel. This setting will only take effect when the instrument is in Readout display mode. In Pulsed/Modulated Readout mode, only the measurement Average is used. When set to ON, the instrument will display a bar graph with a 10 dB full-scale deflection.

Query Command:	CHPKS?<ws><c>
Return String:	CHPKS <c>,<state>
Remarks:	Returns the state of the channel Peaking Indicator.

Post Processing

PPACQRT (Restart Post Processing Acquisition)

Set Command:	PPACQRT<ws><c>	
Details:	<c>	1 | 2
Remarks:	Restarts post-processing acquisition cycle. An execution error is returned if post-processing is disabled on the selected channel or Power Added Efficiency (PAE) is selected.	

PPACQS (Set Post Processing Acquisition State)

PPACQS? (Query Post Processing Acquisition State)

Set Command:	PPACQS<ws><c><,><state>	
Details:	<c>	1 | 2
	<state>	OFF | ON
Remarks:	When this command sets <state> to ON the first time, the selected post-processing module measurements acquisition will start. Use the PPACQRT command to restart a new acquisition cycle.	
Query Command:	PPACQS?<ws><,><c>	
Return String:	PPACQS<c>,<state>	
Remarks:	Return the state of post processing acquisition.	

PPFUNC (Set Post-processing Function Module)

PPFUNC? (Query Post-processing Function Module)

Set Command:	PPFUNC<ws><c><,><module>	
Details:	<c>	1 | 2
	<module>	STATS | PAE
	STATS	Statistical Analysis Module
	PAE	Power Added Efficiency

Remarks: Allows selection of a function module for post-processing on the target channel. The PAE module requires two input signals to calculate a PAE reading and hence is only available on ML2488A dual channel units. An execution error is returned if using this command to select PAE with single channel units. PAE measurements can be made in both CW and Pulsed/Modulated measurement modes. When using Pulsed/Modulated mode, the user can additionally select the measurement source for the PAE calculations (see PAESRC command).

Query Command: PPFUNC?<ws><c>

Return String: PPFUNC <c>,<module>

Remarks: Return the selected post processing function module

Statistical Processing

TTFRO (Output Statistical Post-processing Function Readings)

Query Command: TTFRO<ws><c>

Return String: **Channels 1 | 2**

TTFRO <c>,<num_elements>,<ch_pct_1>, … <ch_pct_N>

Channels 1&2

TTFRO <c>,<num_elements>,<ch1_pct_1>, …
<ch1_pct_N>,<ch2_pct_1>, … <ch2_pct N>

<num_elements>	The total number of data point readings
<ch_pct_N>	Percentage reading

Remarks: Return a 400 point per channel data set for the selected statistical function. When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above. When selecting <c> to be 1&2, the <num_elements> value will be the total number of readings for both channels.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

TTFUNC (Set Statistical Post-processing Function Type)

TTFUNC? (Query Statistical Post-processing Function Type)

Set Command: TTFUNC<ws><c><,><function>

Details:

<c>	1 | 2
<function>	PDF | CDF | CCDF

Where:-

PDF	Probability Density Function
CDF	Cumulative Distribution Function
CCDF	Complementary Cumulative Distribution Function

Remarks: Selects the statistical function type.

Query Command: TTFUNC?<ws><c>

Return String: TTFUNC <c>,<function>

Remarks: Returns the statistical function type selected.

TTMKPOS (Set Statistical Post-processing Marker Position)

TTMKPOS? (Query Statistical Post-processing Marker Position)

Set Command: TTMKPOS<ws><c><,><position>

Details:

<c>	1 | 2
<position>	-999.99 → +999.99 dB(m)

Remarks: Moves the cursor to a selected power along the x-axis. The marker will be moved to the nearest sample class resolution matching the input position entered by the user. An execution error is returned if attempting to move the marker beyond the selected power range.

Query Command: TTMKPOS?<ws><c>

Return String: TTMKPOS <c>,<position>

Remarks: Returns the current cursor position along the x-axis in dB(m).

TTMKRO (Output Marker reading)

Query Command: TTMKRO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String:

Channels 1 | 2

TTMKRO <c>,<tmk_pct>,<tmk_pow>

Channels 1&2

TTMKRO <c>,<ch1_tmk_pct>,<ch1_tmk_pow>,<ch2_tmk_pct>, <ch2_tmk_pow>

<tmk_pct>	Percentage reading at cursor position
<tmk_pow>	Power reading at cursor position

Remarks: Returns the Statistics cursor readings. The cursor percentage reading at a specific power range (or power bucket) is the number of readings falling in that bucket divided by the total power range being measured (not only the graph displayed power range). The cursor power is the reading from one of 400 data points on the Statistic displayed profile. The power resolution for each data point is calculated from the start/stop power range (see TTPST, TTPSP commands), divided by 400 data points.

When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the returned string format. If the marker is disabled, an execution error is returned (see TTMKS command).

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

TTMKS (Set Statistical Post-processing Marker State)

TTMKS? (Query Statistical Post-processing Marker Position)

Set Command:	TTMKS<ws><c><,><state>	
Details:	<c>	1 | 2
	<state>	OFF | ON
Remarks:	Sets the cursor state for statistical post-processing functions.	
Query Command:	TTMKS?<ws><c>	
Return String:	TTMKS <c>,<state>	
Remarks:	Returns the statistical post-processing functions cursor state.	

TTPSP (Set Statistical Post-processing Display Stop Power)

TTPSP? (Query Statistical Post-processing Display Stop Power)

Set Command:	TTPSP<ws><c><,><power>	
Details:	<c>	1 | 2
	<power>	-999.99 → +999.99 dB(m)
Remarks:	Sets the stop power for the display of statistical data.	
Query Command:	TTPSP?<ws><c>	
Return String:	TTPSP <c>,<power>	
Remarks:	Returns the stop power for the display of statistical data.	

TTPST (Set Statistical Post-processing Display Start Power)

TTPST? (Query Statistical Post-processing Display Start Power)

Set Command: TTPST<ws><c><,><power>

Details: <c> 1 | 2

<power> -999.99 → +999.99 dB(m)

Remarks: Sets the start power for the display of statistical data.

Query Command: TTPST?<ws><c>

Return String: TTPST <c>,<power>

Remarks: Returns the start power for the display of statistical data.

TTSRC (Set Statistical Post-processing Source Selection)

TTSRC? (Query Statistical Post-processing Source Selection)

Set Command: TTSRC<ws><c><,><source>

Details: <c> 1 | 2

<source> CHANNEL | GATE | MARKER

Remarks: Selects the measurement source for statistical post-processing data. Note that when selecting GATE or MARKER, the currently ‘Active’ gate or marker will be used as the measurement source. An execution error is returned if there are no enabled gates or markers.

Query Command: TTSRC?<ws><c>

Return String: TTSRC <c>,<source>

Remarks: Returns the source selected for statistical post-processing.

TTZIN (Statistical Post-processing Function Zoom In)

Query Command: TTZIN<ws><c>

Remarks: When sending this command the instrument performs a zoom-in centred on the cursor position.

TTZOUT (Statistical Post-processing Function Zoom Out)

Query Command: TTZOUT<ws><c>

Remarks: When sending this command the instrument performs a zoom-out centred on the cursor position.

PAE Processing

PAEBI (Set PAE Bias Current Value)

PAEBI? (Query PAE Bias Current Value)

Set Command: PAEBI<ws><c><,><current>

Details:

	<c>	1 | 2
	<current>	1.00 uA → 1.00 kA

Remarks: Selects the Bias Current value for PAE post-processing measurements. When changing the Bias Current value using this command, the appropriate instrument setting will be modified. The new value however, will only be applied if the configuration for Bias Current Source is FIXED (see PAEBIS command).

Query Command: PAEBI?<ws><c>

Return String: PAEBI <c>,<current>

Remarks: Returns the value of the PAE Bias Current.

PAEBICF (Set PAE Bias Current Conversion Factor)

PAEBICF? (Query PAE Bias Current Conversion Factor)

Set Command: PAEBICF<ws><c><,><factor>

Details:

	<c>	1 | 2
	<factor>	1.00 mV/A → 100.00 V/A

Remarks: Selects the Bias Current conversion factor value for PAE post-processing measurements. This conversion factor will be applied only when the Bias Current Source selected is PROBE (see PAEBIS command).

Query Command: PAEBICF?<ws><c>

Return String: PAEBICF <c>,<factor>

Remarks: Returns the value of the PAE Bias Current Conversion Factor.

PAEBIS (Set PAE Bias Current Source)

PAEBIS? (Query PAE Bias Current Source)

Set Command:	PAEBIS<ws><c><,><source>	
Details:	<c>	1 | 2
	<source>	FIXED | PROBE
Remarks:	Configures the source from which the PAE Post-processing module will extract the Bias Current. If the source is FIXED the bias current is supplied directly using the command PAEBI. If the source is PROBE, the bias current is calculated from a voltage supplied at the rear panel V/GHZ input and a conversion factor supplied with the command PAEBICF.	
Query Command:	PAEBIS?<ws><c>	
Return String:	PAEBIS <c>,<source>	
Remarks:	Returns the Bias Current source selected for PAE post-processing.	

PAEBV (Set PAE Bias Voltage Value)

PAEBV? (Query PAE Bias Voltage Value)

Set Command:	PAEBV<ws><c><,><volts>	
Details:	<c>	1 | 2
	<volts>	1.00 uV → 1.00 MV
Remarks:	Selects the Bias Voltage value for PAE post-processing measurements.	
Query Command:	PAEBV?<ws><c>	
Return String:	PAEBV <c>,<volts>	
Remarks:	Returns the value of the PAE Bias Voltage.	

PAECFG(Set PAE Input Configuration)

PAECFG? (Query PAE Input Configuration)

Set Command: PAECFG<ws><c><,><config>

Details: <c> 1 | 2

<config> A-B | B-A

A-B Input A minus Input B

B-A Input B minus Input A

Remarks: Selects the Input Configuration for the PAE post-processing module. The default value for the input configuration is A-B.

Query Command: PAECFG?<ws><c>

Return String: PAECFG <c>,< config >

Remarks: Returns the PAE Input Configuration for the queried channel.

PAEO (Output PAE Reading)

Set Command: PAEO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: Return String for channels 1 | 2:

PAEO <c>,<pae>

Return String for channels 1&2:

PAEO 1&2,<pae_ch1>,<pae_ch2>

<pae> Power Added Efficiency reading

Remarks: Returns the PAE reading or readings as a percentage (%) of the difference between the output and input power, divided by the bias power for the requested channel(s).

PAESRC (Set PAE Source Selection)

PAESRC? (Query PAE Source Selection)

Set Command: PAESRC<ws><c><,><source>

Details:

<c>	1 | 2
<source>	CHANNEL | GATE | MARKER

Remarks: Selects the measurement source for Power Added Efficiency (PAE) post-processing data. Note that when selecting GATE or MARKER, the currently ‘Active’ gate or marker will be used as the measurement source. An execution error will be returned if there are no enabled gates or markers. Similarly, an execution error is returned if selecting GATE or MARKERS with a channel configured in CW mode.

Query Command: PAESRC?<ws><c>

Return String: PAESRC <c>,<source>

Remarks: Returns the source selected for statistical post-processing.

Chapter 6. Sensor Commands

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Set Up

SNFILTS (Set Sensor Filter State)

SNFILTS? (Query Sensor Filter State)

Set Command: SNFILTS<ws><s><,><state>

Details:

<s>	A | B
<state>	OFF | ON

Note: Sets the sensor filter state. This setting will take effect only when a wideband sensor type MA2490A or MA2491A is connected to the sensor input. The instrument will ignore this setting if any other sensor type is connected.

Query Command: SNFILTS?<ws><s>

Return String: SNFILTS <s>,<state>

Remarks: Returns the selected sensor filter state.

ML243xA command supported

SNTYPE (Query Sensor Information)

Query Command: SNTYPE<ws><s>

Details:

<s>	A | B

Return String: <sensor_id>,<sensor serial>

Where:

<sensor_id>	Sensor model identification code
<sensor serial>	Sensor serial number

Remarks: This command returns an identification string for the sensor connected to the selected input.

Example: SNTYPE A

Example Return String: MA2491A,008887

Notes: If no sensor is connected, the return string will be “NONE”

ML243xA command supported

SNUNIVM (Set Universal Sensor Operation Mode)

SNUNIVM? (Query Universal Sensor Operating Mode)

Query Command: SNUNIVM<ws><s><,><mode

Details:

	<s>	A | B
	<mode>	TRMS | FCW
	TRMS	True RMS mode
	FCW	Fast CW mode

Remarks: Selects between using a universal power sensor in normal operating mode (TRMS) or Option 1 mode (FCW). FCW is only selectable with universal power sensors with Option 1 fitted. An execution error is returned if attempting to select FCW when Option 1 is not fitted.

Query command: SNUNIVM?<ws><s>

Return String: SNUNIVM <s>,<mode>

Remarks: Returns the universal power sensor current mode.

Cal Factor

ML243xA command supported

SNCFADJ (Set Sensor Calibration Factor Adjust)

SNCFADJ? (Query Sensor Calibration Factor Adjust)

Set Command:	SNCFADJ<ws><s><,><units><,><val>	
Details:	<s>	A or B
	<units>	% | PCT | DB
	<val>	0.07 → 150.00 % | +31.55 → -1.76dB

Remarks: When the Cal Factor Source is set to MANUAL (see SNCFSRC command), the instrument will use the cal factor adjust value set with this command when performing a 0dBm calibration.

If the sensor calibration factor source is set to V/GHz or Frequency, the sensor internal EEPROM correction value at 50 MHz is used.

Note that the Cal Factor <val> can be entered in either percent (%) or dB depending on the selected <units>.

Query Command: SNCFADJ?<ws><s>

Return String: SNCFADJ <s>,<units>,<val>

Remarks: Returns the calibration factor used for a 0dBm cal.

ML243xA command supported

SNCFCAL (Set Calibration Factor Manual)

SNCFCAL? (Query Calibration Factor Manual)

Set Command: SNCFCAL<ws><s><,><units><,><val>

Details:

<s>	A or B
<units>	% | PCT | DB
<val>	0.07 → 150.00 % | +31.55 → -1.76dB

Remarks: Sets the manual Cal Factor value. This value will be used when the Cal Factor source is set to Manual.

Query Command: SNCFCAL?<ws><s>

Return String: SNCFCAL <s>,<units>,<val>

Remarks: Returns the Manual Cal Factor value.

ML243xA command supported

SNCFRQ (Set Calibration Factor Frequency Value)

SNCFRQ? (Query Calibration Factor Frequency Value)

Set Command: SNCFRQ<ws><s><,><value>[units]

Details:

<s>	A | B
<value>	100.00 kHz → 400.00 GHz

Remarks: Sets the frequency used to look up the correction data from the sensor's internal table.

Examples: Both of the following examples set the frequency for cal source frequency to 25 GHz for sensor A.

```
SNCFRQ A,25E9
SNCFRQ A,25GHZ
```

Query Command: SNCFRQ?<ws><s>

Return String: SNCFRQ<s>,<calf_freq>

Remarks: Returns the Cal Factor frequency currently selected for the specified sensor.

ML243xA command supported

SNCFSRC (Set Sensor Cal Factor Source)

SNCFSRC? (Query Sensor Cal Factor Source)

Set Command: SNCFSRC<ws><s><,><source>

Details:

<s>	A | B
<source>	FREQ, MAN, VGHZ
FREQ (Frequency)	Uses the internal EEPROM calibration factor value in the sensor, from the frequency set by the SNCFRQ command. Selected frequencies falling between Cal Factor data points are interpolated linearly to 0.01 dB resolution.
MAN (Manual)	Uses the manual Cal Factor set using the command SNCFCAL.
VGHZ (V/GHz)	Obtains the frequency from the V/GHz input and looks up the calibration factor table from the selected sensor internal EEPROM.

Remarks: Sets the source of the calibration factor.

Query Command: SNCFSRC?<ws><s>

Return String: SNCFSRC<ws><s><,><source>

Remarks: Returns the cal factor source.

ML243xA command supported

SNCFU (Set Sensor Cal Factor Display Units)

SNCFU? (Query Sensor Cal Factor Display Units)

Set Command: SNCFU<ws><units>

Details:

<s>	A | B
<units>	% (PCT) | dB

Remarks: This command changes the cal factor units displayed on the front panel. Note that this setting will also change the <units> for any Cal factor data requested over GPIB.

Query Command: SNCFU? <s>

Return String: SNCFU <s>,<units>

Remarks: Returns the sensor cal factor display units.

ML243xA command supported

SNCFVAL (Query Current Cal Factor Value)

Query Command:	SCFVAL<ws><s>
Details:	<s> A | B
Return String:	SCFVAL<s>,<cf_val>
Details:	<cf_val> 0.07 → 150.00 % | +31.55 → -1.76dB

Remarks:

Returns the cal factor value currently being used for the specified sensor. This will be a fixed value only when in MANUAL cal factor mode, otherwise the value will depend on the frequency entered when cal source is FREQUENCY and the scaled frequency when the cal source is V/GHz.

SNCFVAL will not return the updated Cal Factor Value if the system is in TR0 Trigger Hold mode. That is, if you change the Cal Factor Frequency and want to read back what the unit has set the Cal Factor to when the system is in TR0 mode, the system will return the last Cal Factor value before you went into TR0 mode.

There may be a delay of approximately 0.25 seconds after changing the Cal Factor Frequency to read back the Cal Factor Value, even when not in TR0. This is as SNCFVAL is not updated instantly after changing the Cal Factor Frequency.

This restriction only applies to the SNCFVAL GPIB command and does not effect any measurement taken. If you are in TR0 mode, change the Cal Factor Frequency and then take a measurement; the Cal factor will be calculated correctly.

ML243xA command supported

SNZSPF (Set V/GHz Calibration Factor Stop Frequency)

SNZSPF? (Query V/GHz Calibration Factor Stop Frequency)

Set Command: SNZSPF<ws><s><,><freq>[units]

Details: <s> A | B

<freq> 100.00 kHz → 400.00 GHz

Remarks: Sets the stop frequency of the V/GHz calibration factor settings.

Query Command: SNZSPF?<ws><s>

Return String: SNZSPF <s>,<freq>

Remarks: Returns V/GHz calibration factor stop frequency.

ML243xA command supported

SNZSPV (Set V/GHz Calibration Factor Stop Voltage)

SNZSPV? (Query V/GHz Calibration Factor Stop Voltage)

Set Command: SNZSPV<ws><s><,><volt>[units]

Details: <s> A | B

<volt> 0.00 → 20.00 V

Remarks: Sets the stop voltage of the V/GHz calibration factor settings.

Query Command: SNZSPV?<ws><s>

Return String: SNZSPV <s>,<volt>

Remarks: Returns V/GHz calibration factor stop voltage.

ML243xA command supported

SNZSTF (Set V/GHz Calibration Factor Start Frequency)

SNZSTF? (Query V/GHz Calibration Factor Start Frequency)

Set Command: SNZSTF<ws><s><,><freq>[units]

Details:

	<s>	A or B
	<freq>	100.00 kHz → 400.00 GHz

Remarks: Sets the start frequency of the V/GHz calibration factor settings.

Query Command: SNZSTF?<ws><s>

Return String: SNZSTF <s>,<freq>

Remarks: Returns V/GHz calibration factor start frequency.

ML243xA command supported

SNZSTV (Set V/GHz Calibration Factor Start Voltage)

SNZSTV? (Query V/GHz Calibration Factor Start Voltage)

Set Command: SNZSTV<ws><s><,><volt>[units]

Details:

	<s>	A | B
	<volt>	0.00 → 20.00 V

Remarks: Sets the start voltage of the V/GHz calibration factor settings.

Query Command: SNZSTV?<ws><s>

Return String: SNZSTV <s>,<volt>

Remarks: Returns V/GHz calibration factor start voltage.

Offset

ML243xA command supported

SNOFIX (Set Fixed Offset Value)

SNOFIX? (Query Fixed Offset Value)

Set Command:	SNOFIX<ws><s><,><fix_offset>[units]	
Details:	<s>	A | B
	<fix_offset>	-200.00 → +200.00
	<units>	dB
Remarks:	This command defines a fixed offset to be applied to the selected sensor. When the selected sensor offset type is ‘FIXED’ (see SNOFTYP command), <fixed_offset> will be added to the sensor measurement readings.	
Query Command:	SNOFIX?<ws><s>	
Return String:	SNOFIX <s>,<fix_offset>	
Remarks:	Returns the fixed offset value added to the sensor readings.	

ML243xA command supported

SNOFTYP (Set Sensor Offset Type)

SNOFTYP? (Query Sensor Offset Type)

Set Command: SNOFTYP<ws><s><,><type>

Details:

<s>	A | B
<offset_type>	OFF | FIXED | TABLE

OFF:	No offset to be used
FIXED:	Use the fixed value (SNOFIX) specified
TABLE:	Use the Offset table (SNOTSEL) specified.

Remarks: This command is used to select the type of offset to apply to the sensor.

Query Command: SNOFTYP?<ws><s>

Return String: SNOFTYP <s><,><offset_type>

Remarks: Returns the correct setting for the offset type.

ML243xA command supported

SNOFVO (Output Sensor Offset Value)

Query Command: SNOFVO<ws><s>

Details: <s> A | B

Return String: SNOFVO <s>, <offset_val>

Remarks: Returns the offset value being applied to the specified sensor if the offset feature is enabled (see SNOFTYP). When an offset table is selected (see SNOFTYP,SNOTSEL commands), the offset will be extracted from the table entry whose frequency matches the cal factor frequency entry (see SNCFRQ command). If there is no frequency match, than the offset applied is a linearly interpolated value calculated from the adjacent frequency values in the offset table.

SNOTAO (Output Sensor Offset Table in ASCII)

Query Command: SNOTAO<ws><table_num>

Details: SNOTAO SNOTAO <table_num>,<id_string>,<num_entry_pairs>,<freq_1>,<offset_1>, <freq_N>,<offset_N>

<table_num>	1 → 5
<id_string>	Table Identification string (9 characters maximum)
<num_entry_pairs>	200 entries maximum
<freq_N>	Frequency as a floating point value
<offset_N>	Offset (dB only) as a floating-point value.

Remarks: Returns the selected offset <table_num> data in ASCII format. If <table_num> exceeds the maximum number of tables, or the selected table is not initialised, the Execution Error (EXE) bit in the Event Status Register (ESR) will be set.

SNOTAW (Sensor Offset Table ASCII Write)

Query Command: SNOTAW

Details: <ws><table_num><,><id_string><,><num_entry_pairs><,><ascii_data>

<table_num>	1 → 5
<id_string>	Table Identification string (9 characters maximum)
<num_entry_pairs>	200 entries maximum
<ascii_data>	<freq_1>[<suffix_mult><suffix_unit>], <offset_1> … <freq_N>[<suffix_mult><suffix_unit>], <offset_N>

Where: N is the number of entries. The range for <freq_N> and <offset_N> is as follows:

<freq_N>	100.00 kHz → 400.00 GHz
<offset_N>	-200.00 dB → +200.00 dB

Remarks: Loads user-defined frequency/offset data pairs in ASCII format into the selected instrument's offset table store. Note that this command will overwrite any offset table data previously saved at <table_num>. To avoid inadvertently erasing an existing offset table, use the command SNOTVLD to check if the store is in use.

If <table_num> exceeds the maximum number of tables, or any of the frequency/offset pairs exceeds the specified range, the whole data string will be rejected and the Execution Error (EXE) bit in the Event Status Register (ESR) will be set.

SNOTADD (Add Offset Table Entry)

Query Command: SNOTADD<ws><table_num><,><freq>[<suffix_mult><suffix_unit>]<,><offset>

Details:

<table_num>	1 → 5
<freq>	100.00 kHz → 400.00 GHz
<offset>	-200.00 dB → +200.00 dB

Remarks: This command adds a frequency/offset data pair to the selected offset table store number. Offset table data pairs are added until the maximum number of data entries is reached (200 maximum). Each valid entry is added to the appropriate index in the table in ascending frequency order (starting from the lowest index to the highest).

The Execution Error (EXE) bit in the Event Status Register (ESR) will be set on the following conditions:

- The <table_num> exceeds the maximum number of tables
- The frequency or offset value exceeds the specified range
- The table is full

ML243xA command supported

SNOTBO (Output Offset Table in Binary Format)

Query Command: SNTOBO<ws><table_num>

Details: <table_num> 1 → 5

Return String: SNOTBO #<length><num_bytes>,<bin_data_block>

Details:

<length> The number of characters in the <num_bytes> field

<num_bytes> The number of bytes in <bin_data_block>, following the comma (,).

<bin_data_block> <id_string><num_entries> <offset_tbl_entries>

<id_string> 10 bytes (9 for the identity, plus a NULL terminator byte)

<num_entries> 2 bytes representing the number of table entry pairs

<offset_tbl_entries> <element1> … <elementN>

Where:

<elementN> 8-byte frequency / power-offset values

Remarks: Returns the selected offset table frequency/power-offset data in binary format. Use this command as a convenient way to obtain and store offset tables in compact format for later reloading using the command SNOTBW. If wishing to decode the binary data string, the example below shows how raw data bytes are assembled into offset table elements. See also commands SNOTAO, SNOTAW for manipulating offset tables in ASCII format.

Example:

Sending the command: SNOTBO 1

Will return the string:

SNOTBO#41600,<id1>…<id10><cnt1><cnt2><data1>…<dataN>

Where:

4 The number of characters to read next to determine how many bytes (after the comma separator) are available in the output buffer

1600 The size in bytes of the offset table.

<id1>…<id10> A 10-byte identity string. If no string is defined, the value of each byte is ‘0’

<cnt1><cnt2> Two bytes whose combined value is a 16-bit integer containing the number of

	frequency/entry pairs that follow in the data fields.
<dataN>	is a single data byte, where N = 1600 in this example

Note that each <elementN> is made up of 8 data bytes, therefore 1600 bytes make up 200 consecutive elements (with no comma separator). The leftmost four bytes of <elemenN> represent the frequency value and the rightmost four bytes represent the offset value in dB for that frequency.

For example, the elements:

<data_element1>…<data_elementN>

Would consist of individual data bytes as follows:

<F1 F1 F1 F1 B1 B1 B1 B1>…<FN FN FN FN BN BN BN BN>

Where: ‘FN’ represents the frequency value as a 4-byte single precision floating point number, and ‘BN’ represents the offset value in dB as a 4-byte single precision floating point number.

ML243xA command supported

SNOTBW (Write Offset Table)

Set Command: SNOTBW<ws>< table_num ><,>< num_bytes ><,><binary_data>

Details:

<table_num>	1 → 5
<num_bytes>	number of bytes in the <binary_data> string
<bin_data_block>	<id_string><num_entries> <offset_tbl_entries>
<id_string>	10 bytes (9 for the identity, plus a NULL terminator byte)
<num_entries>	2 bytes representing the number of table entry pairs
<offset_tbl_entries>	<element1> … <elementN>

Where:

<elementN>	8-byte frequency / power-offset values

Remarks: This command writes data to the offset table specified by <table_num>. The <num_bytes> field defines the total number of bytes in <bin_data_block>. The contents of <bin_data_block> are binary data obtained using the SNOTBO command. Use this command as a convenient way to download existing offset table from an instrument to quickly program offset tables into other instruments. Refer to the SNOTAW command using ASCII-formatted data, if wishing to easily define and write new offset tables to the instrument.

Note: Note that sending this command will overwrite any offset table data previously saved to <table_num>. To avoid inadvertently erasing an existing offset table use the SNOTVLD command first, to check if the store is already in use.

If <table_num> exceeds the maximum number of tables the Execution Error (EXE) bit in the Event Status Register (ESR) will be set.

When programming instruments with newly defined offset tables, the recommended practice is to use the ASCII-based SNOTAW command. Using this command instead involves additional complexity in generating the correct floating-point data that the instrument will understand.

ML243xA command supported

SNOTCLR (Clear Offset Table)

Set Command:	SNOTCLR<ws><table_num>	
Details:	<table_num>	1 → 5
Remarks:	Sets all the values in the specified table to 0 dB and 0.00 Hz	

SNOTID (Set Offset Table Identity Name)

SNOTID? (Query Offset Table Identity Name)

Set Command:	SNOTID<ws><table_num><,><id_string>	
Details:	<table_num>	1 → 5
	<id_string>	9 characters maximum or until a message terminator is read as the end of the identity string
Remarks:	This command sets or updates the offset table store identity string.	
Query Command:	SNOTID?<ws><table_num>	
Return String:	SNOTID <table_num>,<id_string>	
Remarks:	Returns the selected offset table ID string.	

ML243xA command supported

SNOTSEL (Select Offset Table to Apply to Sensor)

SNOTSEL? (Query Offset Table Applied to Sensor)

Set Command: SNOTSEL<ws><s><,><table_num>

Details:

<s>	A | B
<table_num>	1 → 5

Remarks: This command applies the offset table specified by <table_num>. Use this command when the offset type is set to TABLE (see SNOFTYP command). The offset tables are a set of frequency vs. dB offset value pairs. The offset value that the instrument selects from the table depends on the Cal Factor Source setting (see SNCFSRC command).

If the source is FREQUENCY, the entered frequency is used to calculate the offset from the table. If the frequency correction source is V/GHz, the frequency value calculated from the supplied ramp input is used to calculate the offset from the table. If the frequency does not match any frequency in the table, interpolation is used to calculate the correct offset.

Note: If the frequency is greater than the maximum frequency in the table, the offset value from the maximum table frequency is used. If the frequency is less than the minimum frequency in the table, the offset from the minimum table frequency is used. The frequency comparisons start from the beginning of the table; if the entry is 0 Hz, this is counted as the end of the table.

Query Command: SNOTSEL?<ws><s>

Return String: SNOTSEL <s>,<table_num>

Remarks: Returns the offset table number being used.

SNOTVLD (Query Valid Offset Table)

Query Command: SNOTVLD<ws><table_num>

Return String: <table_num> 1 → 5

Return String: FALSE | TRUE

Where:

FALSE	Offset table queried is invalid or empty
TRUE	Offset table queried is valid

Remarks: Queries the instrument on whether the selected offset table <table_num> is a valid initialised table.

Edit CF Table

ML243xA command supported

SNCFUSE (Query Cal factor Table Number In Use)

Query Command: SNCFUSE<ws><s>

Details: <s> A | B

Return String: SNCFUSE <s>,<table_num>

Details: <table_num> 0 = factory default table.

1 → 10 = user table being used.

11 → 20 = factory table + user table being used.

Remarks: Returns a number indicating the cal factor table, or combination of tables being used by the selected sensor.

ML243xA command supported

SNCTABN (Set Cal Factor Table Number)

Set Command: SNCTABN<ws><s><,><table_number>

Details: <s> A | B

<table_number> Table number or combination to use

0 Factory default table

1 →10 User table being used

11→20 Factory table + User table being used.

Remarks: Selects the cal factor table or combination of tables to be used and automatically updates the sensor. This command only executes when cal factor source is set to Frequency or V/GHz. An execution error is returned if set to Manual or if the selected table store is empty.

ML243xA command supported

SNCTADD (Set Cal Factor Table Entry)

Set Command: SNCTADD<ws><s><,><table number><,><frequency value>[units]<,><cal factor><,><cal factor units>

Details:

<s>	A | B
<table number>	1 → number of tables supported by the sensor type
<frequency value>	100.00 kHz → 400.00 GHz
<cal factor>	0.07 → 150% or
	+31.55 → –1.76 dB
<cal factor units>	% | PCT | DB

Remarks: This command adds a cal factor/frequency data pair to the selected cal factor table. The edited cal factor table will not be used by the instrument until it is saved to the sensor memory using the SNCSAV command (this is because the instrument will only edit a copy of the selected cal factor table). Note that if the sensor is removed from the input connector or power is lost before the cal factor table being edited is saved to the sensor memory, all changes will be lost.

Note: The user must ensure that the maximum number of cal factor data pairs entered into a table is not exceeded. Sensors with a maximum frequency of up to 40 GHz will hold 90 pairs, while sensors with a maximum frequency of 50 GHz will hold 110 pairs.

SNCTAO (Output Sensor Cal Factor Table in ASCII

Query Command: SNCTAO<ws><s><,><table_number>

Details:

<s>	A | B	
<table_number>	0 | F	Factory default table
	1 → N	User tables

Where: N is the number of tables supported by the sensor type (sensor dependent).

Return String: SNCTAO <s>,<table number>,<id_string>,<num_entry_pairs>,<ascii_data>

<id_string>	Identification string (7 characters maximum)
<num_entry_pairs>	90-pair entries maximum for sensors up to 40 GHz. 110-pair entries maximum for sensors up to 50 GHz
<ascii_data>	<freq_val_1>,<cal_factor_1> … <freq_val_N>,<cal_factor_N>

Where: <freq_val_N>,<cal_factor_N> is the number of frequency/cal factor entries in the table.

<freq_val_N>	Frequency as a floating point value
<cal_factor_N>	Cal Factor (in dB only) as a floating point value.

Remarks: Returns the specified Cal Factor <table_number> for the specified sensor in ASCII format. If <table_number> exceeds the maximum number of tables held in the sensor, or the selected table is not initialised, the Execution Error (EXE) bit in the Event Status Register (ESR) will be set.

SNCTAW (Cal Factor Table Direct ASCII Write to Sensor)

Set Command: SNCTAW<ws><s><,><table_number><,><id_string><,><num_entry_pairs><,><ascii_data>

Details:

<s>	A | B
<table number>	1 to N, where N is the number of tables supported by the sensor
<id_string>	Identification name string (7 characters maximum)
<num_entry_pairs>	90-pair maximum entries for sensor up to 40 GHz. 110-pair maximum entries for sensors up to 50 GHz

<ascii_data><freq_val>[<suffix_mult><suffix_unit>],<cal_factor>[<suffix_mult> <suffix_unit>]

Where:

<freq_val>	100.00 kHz → 122.00 GHz
<cal_factor>	-1.76 → +31.55 dB

Remarks: Loads the frequency / Cal factor pairs defined in <ascii_data> to the target <table_number>. This command will automatically save data to the sensor. The Execution Error (EXE) bit in the Event Status Register (ESR) will be set if the <num_entry_pairs> exceeds the maximum number of tables allowed.

ML243xA command supported

SNCTBIN (Cal Factor Table Binary Load)

Set Command: SNCTBIN<ws><s><,><table number><,><length><,><binary data>

Details:

<s>	A | B
<table number>	1 → N, where: N is the number of tables supported by the sensor type
<length>	Length of message in bytes
<binary data>	data in binary format as retrieved using the SNCTBO command

Remarks: Loads a Cal factor table in binary format to the target <table_number> in the specified sensor. The <length> field defines the total number of bytes in <binary_data>. The contents of <binary_data> are binary data bytes obtained using the SNCTBO command. This command will automatically save data to the target sensor. Processing will take approximately 5 seconds.

Use this command as a convenient way to download existing Cal factor tables from an instrument to quickly program Cal factor tables into other sensors. Refer to the SNCTAW command using ASCII-formatted data instead, if wishing to easily define and write new Cal factor tables to one or more sensors.

Note that sending this command will overwrite any Cal factor data previously saved to <table_num>. To avoid inadvertently erasing an existing table use the SNCTVAL command first, to check if the store is already in use.

If <table_num> exceeds the maximum number of tables the Execution Error (EXE) bit in the Event Status Register (ESR) will be set.

When programming instruments with newly defined Cal factor tables, the recommended practice is to use the ASCII-based SNCTAW command. Using this command instead involves additional data manipulation to convert data to a format suitable for the instrument.

ML243xA command supported

SNCTBO (Output Cal Factor Table in Binary Format)

Set Command:	SNCTBO<ws><s><,><table number>		
Details:	<s>	A | B	
	<table_number>	0 | F	for Factory default table
		1 → N	for User tables
		where: N is the number of tables supported by the sensor type.	

Remarks:

This command outputs in binary format the cal factor table stored at <table_number>. Each frequency/cal factor pair is held in a 6-byte block. The frequency is encoded as a 4-byte LONG INTEGER value with a 32768e-06 conversion factor. The cal factor is encoded as a 2-byte INTEGER value with a 1024 conversion factor. To convert frequency/cal factor pairs into Real numbers carry out the following steps:

1. Read the first 4 bytes into a 32-bit LONG Integer variable (long int in C)
2. Cast the LONG variable to a 32-bit FLOATing point variable (float in C)
3. Divide the FLOAT variable by 32768e-06 to find the frequency as a floating point number
4. Read the last 2 bytes into the least significant bytes of a LONG Integer variable
5. Cast the LONG variable to a FLOAT
6. Divide the FLOAT variable by 1024 to obtain the Cal Factor as a floating point number

Use this command as a convenient way to quickly store Cal factor tables for later loading into one or more sensors or simply as a data backup. Refer to the command SNCTBIN for writing Cal factor tables to a sensor. For reading or writing ASCII-formatted Cal factor tables refer to the SNCTAO and SNCTAW commands.

Return String: SNCTBO<ws><bin_data_len><,><bin_data_block>

Details:	<bin_data_len>	Total length in bytes of <bin_data_block> (following the comma separator)
	<bin_data_block>	<id_string><num_entries> <cal_factor_entries>
	<id_string>	8 bytes (7 for the identity, plus a NULL terminator byte)
	<num_entries>	2 bytes representing the number of table pair entries
	<cal_factor_entries>	The frequency/cal factor pair data in binary format.

ML243xA command supported

SNCTCLR (Clear Cal Factor Table)

Set Command:	SNCTCLR<ws><s><,><table number>	
Details:	<s>	A | B
	<table number>	1 → N, where N is the number of tables supported by the sensor.
Remarks:	Clears the cal factor table to one entry for 50 MHz at 100% and the identity name string from the table. The cleared table is automatically saved to the sensor.	

ML243xA command supported

SNCTID (Update Cal Factor Table Identity Name)

SNCTID? (Query Cal Factor Table Identity Name)

Set Command:	SNCTID<ws><s><,><table number><,><id_string>	
Details:	<s>	A | B
	<table number>	1 → N, where: N is the number of tables supported by the sensor
	<id_string>	Seven characters or until a message terminator is read as the identity.
Remarks:	Updates the seven-character identity string. This only affects the copy of the cal factor table stored in the memory of the power meter. To take effect and not be lost, the table must be saved to the sensor using the SNCTSAV command.	
Query Command:	SNCTID?<ws><s><,><table number>	
Return String:	SNCTID <s>,<table number>,<id_string>	
Remarks:	Returns the selected Cal Factor table ID string for the selected sensor.	

ML243xA command supported

SNCTNQ (Query Number of Cal Factor Tables in the Sensor)

Set Command: SNCTNQ <s>

Details: <s> A | B

Remarks: Returns the number of cal factor tables available in the selected sensor.

ML243xA command supported

SNCTPRE (Preset Cal Factor Table)

Set Command: SNCTPRE<ws><s><,><table number>

Details:

<s>	A | B
<table number>	1 → N, where: N is the number of tables supported by the sensor type.

Remarks: Presets the cal factor table to the factory settings. The preset table is automatically saved to the sensor.

Notes: Universal power sensors with Option 1 fitted hold 2 sets of User Cal Factor tables: one set for True RMS and one for Fast CW sensor modes. When sending this command, the instrument will only preset the user table associated to the currently selected sensor mode (see SNUNIVM command).

ML243xA command supported

SNCTSAV (Cal Factor Table Save)

Set Command: SNCTSAV

Remarks: This command saves the cal factor table currently being edited to the appropriate sensor. Processing may take a few seconds.

Note: It is the user responsibility to issue a SNCTSAV command when finished editing a cal factor table. The changes just made will NOT be automatically saved if selecting a new table for editing.

ML243xA command supported

SNCTVAL (Query Valid Cal Factor Table)

Set Command:	SNCTVAL<ws><s><,><table number>	
Details:	<s>	A | B
	<table number>	1 → N, where: N is the number of tables supported by the sensor type
Return string:	SNCTVAL <s>,<table number>,<flag>	
Details:	<flag>	FALSE | TRUE
	Where:	
	FALSE	Table queried non-valid
	TRUE	Table queried valid
Remarks:	Queries the instrument on whether the table number passed is a valid initialised table for the selected sensor.	

Range Hold

ML243xA command supported

SNRGH (Set Sensor Range Hold)

SNRGH? (Query Sensor Range Hold)

Set Command: SNRGH<ws><s>[,<range>]

Details:

<s>	A | B
<range>	AUTO | 1 → 9

Different <range> numbers are allocated depending on the Measurement Mode as follows:

Pulsed/Modulated

AUTO | 7 → 9

CW

AUTO | 1 → 5 (1 → 6 Universal Power Sensor Only in True RMS mode)

AUTO Selects the suitable <range> depending on the incoming signal level and measurement mode (see above)

Remarks: This function can be used to affect the range hold setting as follows:

1. To toggle between holding the current operating range and AUTO issue the command with the <s> parameter only e.g. SNRGH<ws><s>
2. To select or change the range hold value, use SNRGH<ws><s><,><range>

Query Command: SNRGH?<ws><s>

Return String: SNRGH <s>,<range>

Remarks: Returns the current sensor range being held. Note that <range> number will depend on the selected measurement mode (see above).

Chapter 7. Calibration and Zero Commands

Function	Command	Page reference
BNC Input Connector - Zero	BNVZERO	7-2
Calibrate Sensor to 0 dBm Reference Source	SNCAL	7-2
Reference Calibrator Frequency - Set or Query	SNCALF	7-3
RF Reference Calibrator State - Set or Query	SNRFCAL	7-3
Sensor - Zero	SNZERO	7-4

ML243xA command supported

BNVZERO (Zero the BNC Input Connector)

Set Command: BNVZERO

Remarks: Zeros the multipurpose BNC connector used for Volts per GHz connection (Analogue Input 2). This will calibrate the units to read zero volts on this BNC.

Notes: During this operation the BNC connector must be connected to 0V DC for the zeroing sequence to be successful. Carry out one of following actions to ensure the BNC input is connected to 0V DC:

a) Disconnect any appliance from the BNC input connector.

b) Connect the BNC input connector to a 0V DC source

ML243xA command supported

SNCAL (Calibrate Sensor to 0 dBm Reference Source)

Set Command: SNCAL <ws><s>

Details: <s> A | B

Remarks: Performs a 0dBm calibration at the selected calibrator frequency when a sensor is attached to the reference 0dBm source on the ML248xA / ML249xA (or another 0dBm reference source). Use the command SNCALF to select the RF frequency source. If the calibration fails, the Execution Error (EXE) bit in the Event Status Register is set.

SNCALF (Set Reference Calibrator Frequency)

SNCALF? (Query Reference Calibrator Frequency)

Set Command: SNCALF<ws>< cal_frq >

Details: <cal_frq> 50MHZ | 1GHZ

Remarks: Selects the RF source frequency for the reference calibrator.

Notes: The 1 GHz calibrator is optional. If selecting 1GHZ when the calibrator is not fitted, an execution error is returned.

Query Command: SNCALF?

Return String: SNCALF <cal_frq>

Remarks: Returns the calibrator selected RF source frequency.

ML243xA command supported

SNRFCAL (Set RF Reference Calibrator State)

SNRFCAL? (Query RF Reference Calibrator State)

Set Command: SNRFCAL<ws><state>

Details: <state> ON | OFF

Remarks: Turns ON or OFF the selected RF reference calibrator.

Query Command: SNRFCAL?

Return String: SNRFCAL <state>

Remarks: Returns the selected RF reference calibrator state.

ML243xA command supported

SNZERO (Zero the Selected Sensor)

Set Command: SNZERO <s>

Details: <s> A | B

Remarks: This command will execute a zero sequence on the selected power sensor. Zeroing a power sensor compensates for noise and thermal EMF of the device under test. This is recommended prior to taking important power readings in the bottom 20 dB of a power sensor's dynamic range.

Chapter 8. System Commands

Function	Command	Page reference
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BNC 1 Output Mode - Set or Query	BNC1M	8-6
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BNC Analogue Output Display Power Start Value - Set or Query	BNDST	8-9
BNC Analogue Output Display Power Stop Value- Set or Query	BNDSP	8-8
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Save/Recall

*RCL (Recall Stored Setups)

Set Command: *RCL<ws><store>

Details: <store> 1 → 20

Remarks: The ML248xA / ML249xA can store up to 20 instrument configurations for convenient recall. The configuration parameters stored are Sensor Setup, Channel Setup, and Trigger Setup.

This command sets the ML248xA / ML249xA to a configuration previously stored in memory locations 1 through to 20.

Trying to recall a setup from an empty memory store will set the Execution (EXE) bit in the Event Status Register (ESR).

*SAV (Save Configuration)

Set Command: *SAV <ws><store>

Details: <store> 1 → 20

Remarks: Saves the configuration of the power meter into the memory location specified by the settings store number. Sensor Setup, Channel Setup, and Trigger Setup are saved along with all other instrument parameters.

ML243xA command supported

NVLOAD (Load Saved Setup store over the GPIB)

Set Command: NVLOAD<ws><store number><,><data length><,><binary data>

Details:

<store number>	1 → 20
<data length>	Number of bytes of binary data
<binary data>	Data previously read from the meter using the NVOUT command.

Remarks: This command writes to the instrument a binary-formatted saved setup store that had been previously read using the NVOUT command. Note that the contents of <binary_data> cannot be edited because of the encoding scheme employed. Use this command as a convenient way to quickly configure one or more instruments to the same settings. This command will overwrite any data held at <store_number>. Before writing, ensure that the target store does not contain important configuration settings.

ML243xA command supported

NVNAME (Set Saved Setups Name)

NVNAME? (Query Saved Setup Name)

Set Command: NVNAME<ws><store_number><,><store_name>

Details:

<store_number>	1 → 20
<text>	Name string (16 characters max.)

Remarks: This command allows the saved setups to have a user-defined text string associated to them rather than just the 'USED' and 'NOT USED' text. An execution error is returned if attempting to send this command to an unused store.

Query Command: NVNAME?<ws><store_number>

Return String: NVNAME <store number>,<store name>

Details: <store_name> USED | NOT USED | 'user_defined_string'

USED	Returned when a setup is saved (using the *SAV command)
NOT USED	Returned when querying a free store.
'user defined string'	A user-defined name string previously set using this command.

Querying All Stores:

Sending the query command in the following formats will return the status of all stores:

NVNAME?

Or alternatively NVNAME? 0

The return string will be in the following format:

NVNAME 1,<store _1 _name>,2,<store _2 name>,
… ,20,<store_20_name>

ML243xA command supported

NVOUT (Output the saved setup over the GPIB)

Query Command:	NVOUT<ws><store_number>	
Details:	<store_number>	0 (current setup) | 1 → 20 (saved stores)
Return String:	NVOUT<ws><#><num_digits><data_length >,<binary data>	
Details:	<digits_length>	The number of digits for the following <data_length> field
	<data_length>	The number of bytes of binary data in <binary_data>
	<binary data>	Saved setup in binary format

Remarks: Requests that the saved stored setup is output over the GPIB. This is a BINARY output that allows the stored setup to be programmed into other ML248xA / ML249xA series power meters and stores via the NVLOAD command. If a request for a store number that has not had a setup stored into it is made, an execution error event will be set in the Event Status Register (ESR).

Config

BNC1M (Set BNC 1 Output Mode Select)

BNC1M? (Query BNC 1 Output Mode)

Set Command: BNC1M<ws><mode>

Details: <mode> OFF | AOUT | PSFL | LVLA1 | LVLA2 |

OFF	Output tied to ground
AOUT	Analogue scaled output
PSFL	Pass/Fail Logic level output
LVLA1	Slow Signal channel range 1 amplifier output for sensor A
LVLA2	Slow Signal channel range 2 amplifier output for sensor A

Remarks: Selects the output mode for the rear panel BNC1 connector.

Note: Mode AOUT applies to CW or Pulsed/Modulated Readout measurement modes only.

Query Command: BNC1M?

Return String: BNC1M <mode>

Remarks: Returns the BNC1 output mode setting.

BNC2M (Set BNC 2 Output Mode Select)

BNC2M? (Query BNC 2 Output Mode)

Set Command: BNC2M<ws><mode>

Details:

<mode>	OFF | AOUT | PSFL | LVLB1 | LVLB2 | TRIG |
OFF	Output set 0V DC
AOUT	Analogue scaled output
PSFL	Pass/Fail Logic level output
LVLB1	Slow Signal channel range 1 amplifier output for sensor B
LVLB2	Slow Signal channel range 2 amplifier output for sensor B
TRIG	Measurement channel trigger signal

Remarks: Selects the output mode for the rear panel BNC2 connector.

Note: Mode AOUT applies to CW or Pulsed/Modulated Readout measurement modes only. Mode TRIG applies the internal and external triggers in CW and Pulsed/Modulated measurement modes.

Query Command: BNC2M?

Return String: BNC2M <mode>

Remarks: Returns the BNC output setting.

ML243xA command supported

BNDSP (Set BNC Analogue Output Display Power Stop Value)

BNDSP? (Query BNC Analogue Output Display Stop Value)

Set Command: BNCDSP<ws><bnc><,><units><,><power>

Details:

<bnc>	1 | 2
<units>	DB | DBM | DBUV | DBMV | DBW | W
DB	dB
DBM	dBm
DBUV	dBμV
DBMV	dBmV
DBW	Dbw
W	Watts
<power>	-270.00 → +260.00 dB | dBm
	-163.00 → +367.00 dBμV
	-223.00 → +307.00 dBmV
	-283.00 → +247.00 dBW
	0.00 → 999.99 MW (clipped)

Note: The instrument keeps separate <power> settings for each supported <units>. The user can program the <power> for each of the <units> independent of the units currently applied to the active measurement channel. When changing the channel display units (using the command CHUNIT), the instrument will apply the correct <power> setting from the appropriate <unit> store.

Remarks: This command defines the Stop Power associated to the rear panel analogue output voltage (see BNVOST command) . When the selected <bnc> is configured in 'Analogue Scaled Output' mode (see BNC1M,BNC2M commands), the instrument uses the Power Range (defined by Start/Stop Power with BNDSP,BNDST) to derive a voltage at the <bnc> output proportional to the power measurement.

Query Command: BNDSP?<ws><bnc><,><units>

Return String: BNDSP <bnc>,<units>,<power>

Remarks: Returns the BNC analogue output display stop power for the selected units.

ML243xA command supported

BNDST (Set BNC Analogue Output Display Power Start Value)

BNDST? Query BNC Analogue Output Display Power Start Value)

Set Command: BNDST<ws><bnc><,><units><,><power>

Details:

<bnc>	1 | 2
<units>	DB | DBM | DBUV | DBMV | DBW | W
DB	dB
DBM	dBm
DBUV	dBμV
DBMV	dBmV
DBW	Dbw
W	Watts
<power>	-270 → +260dB | dBm
	-163.00 → +367.00 dBμV
	-223.00 → +307.00 dBmV
	-283.00 → +247.00 dBW
	0.00 → 999.99 MW (clipped)

Note: The instrument keeps separate <power> settings for each supported <units>. The user can program the <power> for each of the <units> independent of the units currently applied to the active measurement channel. When changing the channel display units (using the command CHUNIT), the instrument will apply the correct <power> setting from the appropriate <unit> store.

Remarks: This command defines the Start Power associated to the rear panel analogue output voltage (see BNVOST and BNVOSP commands). When the selected <bnc> is configured in 'Analogue Scaled Output' mode (see BNC1M, BNC2M commands), the instrument uses the Power Range (defined by Start/Stop Power with BNDSP,BNDST) to derive a voltage at the <bnc> output proportional to the power measurement.

Query Command: BNDST?<ws><bnc><,><units>

Return String: BNDST <bnc>,<units>,<power>

Remarks: Returns the BNC analogue output display start power for the selected units.

ML243xA command supported

BNOCH (Set BNC Output Channel Configuration)

BNOCH? (Query BNC Output Channel Configuration)

Set Command:	BNOCH<ws><bnc><,><channel>	
Details:	<bnc>	1 | 2
	<channel>	1 | 2
Remarks:	This command applies only to 'Analogue Scaled Output' and 'Pass/Fail' BNC output modes (see BNC1M, BNC2M commands). The source <signal> channel can be routed to the selected <bnc> output connector.	
Query Command:	BNOCH?<ws><bnc>>	
Return String:	BNOCH <bnc>,<channel>	
Remarks:	Returns the BNC output channel configuration setting.	

ML243xA command supported

BNPLEV (Set BNC Pass Voltage Level)

BNPLEV? (Select BNC Pass Voltage Level)

Set Command:	BNPLEV<ws><port><,><volt_level>	
Details:	<bnc>	1 | 2
	<volt_level>	HIGH (TTL high is PASS)
		LOW (TTL low is PASS)
Remarks:	This command allows selection of which TTL voltage level (+5V or –5V) will be set at the BNC output to signify a PASS in a PASS/FAIL measurement setup (see BNC1M, BNC2M commands).	
Query Command:	BNPLEV?<ws><port>	
Return String:	BNPLEV <port>,<volt_level>	
Remarks:	Returns the <volt_level> setting for the <bnc> Output Pass Level.	

ML243xA command supported

BNVOSP (Set BNC Analogue Output Stop Voltage Scale)

BNVOSP? (Query BNC Analogue Output Stop Voltage Scale)

Set Command:	BNVOSP<ws><bnc><,><volts>
Details:	<bnc> 1 | 2
	<volts> –5.00 → +5.00 Volts
Remarks:	This command sets the analogue voltage stop value for the ‘Analogue Scaled Output’ BNC Output Mode (see BNC1M, BNC2M). An execution error is returned if attempting to set the start value to a voltage greater than the stop value or vice versa.
Query Command:	BNVOSP?<ws><bnc>
Return String:	BNVOSP <bnc>,<volts>
Remarks:	Returns the stop voltage setting for the ‘Analogue Scaled Output’ BNC Output Mode (see BNC1M, BNC2M).

ML243xA command supported

BNVOST (Set BNC Analogue Output Start Voltage Scale)

BNVOST? (Query BNC Analogue Output Start Voltage Scale)

Set Command:	BNVOST<ws><bnc><,><volts>
Details:	<bnc> 1 | 2
	<volts> –5.00 → +5.00 Volts
Remarks:	This command sets the analogue voltage start value for the ‘Analogue Scaled Output’ BNC Output Mode (see BNC1M, BNC2M). An execution error is returned if attempting to set the start value to a voltage greater than the stop value or vice versa.
Query Command:	BNVOST?<ws><bnc>
Return String:	BNVOST <bnc>,<volts>
Remarks:	Returns the voltage scale start value for the BNC Output Mode ‘Analogue’ setting.

ML243xA command supported

SYADDR (Set GPIB Address)

SYADDR? (Query GPIB Address)

Set Command: SYADDR <ws><val>

Details: <val> 1 → 30 (Decimal value)

Remarks: Selects the GPIB address. NOTE: Once the address has been changed, the ML248xA / ML249xA will no longer respond to the GPIB default address 13.

ML243xA command supported

SYBAUD (Set RS232 Baud Rate)

SYBAUD? (Query RS232 Baud Rate)

Set Command: SYBAUD<ws><baud_rate>

Details: <baud_rate> 12 | 24 | 48 | 96 | 192 | 384 | 576 hundred bits per second.

Remarks: Sets the RS232 Baud rate for the rear panel serial port.

Query Command: SYBAUD?

Return String: SYBAUD <baud_rate>

Remarks: Returns the RS232 Baud rate setting.

ML243xA command supported

SYBEEPS (Set Audible Beep on Entry Error State)

SYBEEPS? (Query Audible Beep on Entry Error State)

Set Command:	SYBEEPS<ws><state>
Details:	<state> OFF | ON
Remarks:	Turns the user entry error warning beep ON or OFF.

Query Command:	SYBEEPS?
Return String:	SYBEEPS <state>
Remarks:	Returns the state of the error beep.

ML243xA command supported

SYBUFS (Set GPIB Response Buffering State)

SYBUFS? (Query GPIB Response Buffering State)

Set Command:	SYBUFS <state>
Details:	<state> OFF | ON
Remarks:	When this command is set to ON, if a request for data is made to the instrument, the response data will be placed in a GPIB output buffer for the controller to access and retrieve. If another data request is made and the previous data has not been retrieved from the output buffer; the new data will be queued after the previous data. If buffering is set to OFF, whenever a request for data is made to the instrument (except by serial poll), the output buffer is cleared and the only data in the output queue will be the response to the last data request made. The output buffer is cleared once a valid GPIB data request command has been recognised.

Query Command:	SYBUFS?
Return String:	SYBUFS <state>
Remarks:	Returns the state of GPIB buffering setting.

SYDLIT (Set Display Backlight Adjust)

SYDLIT? (Query Display Backlight Adjust)

Set Command: SYDLIT<ws><setting>

Details:

<setting>	DIM | MEDIUM | BRIGHT
DIM	DIM setting
MEDIUM	MEDIUM setting
BRIGHT	BRIGHT setting

Remarks: Sets the display backlight brightness adjust.

Query Command: SYDLIT?

Return String: SYDLIT <setting>

Remarks: Returns the current setting for the display backlight adjust.

SYDRES (Set Display Measurement Points)

SYDRES? (Query Display Measurement Points)

Set Command: SYDRES<ws><num_points>

Details: <num_points> P200 | P400

P200 Plots 200 measurement points (one measurement for each pixel on the display panel)

P400 Plots 400 measurement points (two measurements for each pixel on the display panel)

Note: This setting affects the number of profile measurement readings returned over GPIB (when sending the appropriate Pulsed/Modulated Profile commands i.e. PMPO etc.). See also TRCAPT command:

<u>ML248xA models:</u>

P200 200 readings/channel

P400 400 readings/channel

<u>ML249xA models – Capture Time > 200 ns :</u>

P200 200 readings/channel

<u>ML249xA models – Capture Time < 200 ns :</u>

P200 ‘N’ readings/channel

where N = capture time / 1ns + 1

<u>ML249xA models – Capture Time > 400 ns :</u>

P400 400 readings/channel

<u>ML249xA models – Capture Time < 400 ns :</u>

P400 ‘N’ readings/channel

where N = capture time / 1ns + 1

Example1: With the ML249xA, <num_points> = P400, capture time = 300ns

N = 301 readings/channel

Example2: With the ML249xA, <num_points> = P200, capture time = 50ns

N = 51 readings/channel

Remarks: This command changes the number of measurement points plotted on the front panel display when in Pulsed/Modulated Profile display mode.

Query Command: SYDRES?

Return String: SYDRES < num_points >

Remarks: Returns the current setting for the number of displayed measurement points.

SYIMAGE (Output Displayed Screen Image)

Set Command: SYIMAGE

Return String: SYIMAGE <#><length><number_of_bytes><data_byte_1> … <data_byte_n>

Details:

<length>	A single digit number in ASCII decimal defining the length of <number_of_bytes> digits which follows (digit 5 in this case for full screen image)
<number_of_bytes>	A 5-digit string, the numeric value of which indicates the number of data bytes contained in the data that follows (76800 bytes for 320 x 240 pixels display size).
<data_byte_n>	A single 8-bit data byte

Remarks: Captures the screen image being displayed on the LCD panel. The screen image data is output as a definite length arbitrary block data of size 76.8 Kbytes.

The range for each <data_byte_n> is between 0 and 255. The numeric value of <data_byte_n> represents the index into a 256 look-up table entry. Each entry within the look-up table defines the RGB (red-green-blue) values that make up the colour seen on the LCD panel. The look-up table is defined separately and can be downloaded using the SYLUT command.

Notes: To preserve the menu keys when going to remote, the instrument must be placed into ‘Screen Dump Mode’. This mode can only be enabled from the front panel pressing the keys: System > Config > Display > Screen Dump Mode.

SYLUT (Output Graphics Look-up Table Entries)

Set Command: SYLUT

Return String: SYLUT <#><length><number_of_bytes><data_byte_1> … <data_byte_n>

Details:

<length>	A single digit number in ASCII decimal defining the length of <number_of_bytes> digits that follows (digit number 3 in this case for the look-up table size).
<number_of_bytes>	A 3-digit string whose numeric value indicates the number of data bytes contained in the data that follows (768 bytes for 256 * RGB table, where RGB = 3 bytes).
<data_byte_n>	A single 8-bit data byte.

Remarks: Outputs the graphics colour look-up table entries. The look-up table data is formatted as a definite length arbitrary block data. Each 3-byte data block represents the Red, Green and Blue values for one look-up table entry.

SYSTEP (Set Increment/Decrement Step)

SYSTEP? (Query Increment/Decrement Step)

Set Command: SYSTEP<ws><unit_type><,><value>[<suffix_mult>][<suffix_unit>]

Details:

<unit_type>	DB | W | V | A | % or PCT | TIME | FREQ | ULESS
<value>	see below for allowed ranges
<suffix_mult>	
<suffix_unit>	
DB	log values' step
W	Watts values' step
V	Voltage values' step
A	Amp values' step
% or PCT	percentage values' step
TIME	time values' step
FREQ	frequency values' step
ULESS	unit-less values' step

The range of the <value> parameter depends upon the <unit_type> selected:

dB	0.01 dB to 10.00 dB
Watts	1.00 µW to 10.00 GW
Volts	1.00 µV to 1.00 MV
Amps	1.00 µA to 1.00 A
%	0.01% to 1000.00%
Time	1.00 µs to 1.00 s
Frequency	1.00 kHz to 10.00 GHz
Unitless	1.00 µ to 1.00 M

NOTE: If <suffix_mult> is not specified, the default units are assumed, e.g. Watts (W).

Remarks: Sets the value of the selected increment/decrement step.

Query Command: SYSTEP?<ws>< unit_type >

Return String: SYSTEP < unit_type >,< value >

Remarks: Returns the current value of the selected increment/decrement step

ML243xA command supported

SYTACTS (Set Tactile Feedback Sound State)

SYTACTS? (Query Tactile Feedback Sound State)

Set Command:	SYTACTS<ws><state>
Details:	<state> OFF | ON
Remarks:	When SYTACTS is set to ON, tactile feedback is enabled. Pressing a key on the instrument front panel will produce an audible key click.

Query Command:	SYTACTS?
Return String:	SYTACTS <state>
Remarks:	Returns the state of the audible key click setting.

ML243xA command supported

SYTEXT (Write User Text ID string)

SYTEXT? (Query User Text ID string)

Set Command:	SYTEXT<ws><text_string>
Details:	<text_string> Text string of up to 20 characters
Remarks:	Defines a text string to be displayed on the instrument front panel (normally used for identification purposes when operating the instrument remotely). Use the SYTEXTS command to turn display the string on the front panel.

Query Command:	SYTEXT?
Return String:	SYTEXT <text_string>
Remarks:	Returns the remote text ID string currently held in the instrument.

ML243xA command supported

SYTEXTS (Set User Defined Display Text State)

SYTEXTS? (Query User Defined Display Text State)

Set Command:	SYTEXTS <state>
Details:	<state> ON | OFF
Remarks:	This command turns ON or OFF the display of a user-defined text string entered using the SYTEXT command.

Query Command:	SYTEXTS?
Return String:	SYTEXTS <state>
Remarks:	Returns the state of the user-defined text display setting.

Service

ML243xA command supported

NVSECS (Set Secure System State)

NVSECS? (Query Secure System State)

Set Command: NVSECS<ws><state>

Details: <state> OFF | ON

Remarks: When set to ON, the instrument will erase its non-volatile memory and default to the factory settings at power on.

When turning the unit ON with secure state disabled, the ML248xA / ML249xA will return to the configuration settings it was left in when last powered OFF. Enabling secure state can be useful when wishing to delete any sensitive information from the instrument.

Query Command: NVSECS?

Return String: NVSECS <state>

Remarks: Returns the secure state of the instrument.

ML243xA command supported

SYOI (Output Device Identification)

Query Command: SYOI

Return String: <Company name>,<model>,<serial>,<firmware version>

Details:

<company name>	ASCII string (7 characters)
<model>	ML248xA / ML249xA
<serial>	Instrument unique serial number
<firmware version>	Current firmware version loaded into the instrument.

Remarks: Returns the instrument identification string. This command performs the equivalent action of the *IDN? command.

Chapter 9. Preset Commands

Function	Command	Page reference
Factory Reset	NVFRST	9-3
Pre-defined Application Setup Number - Set or Query	NVAPN	9-2

NVAPN (Preset Instrument to Pre-defined Application Setup Number)

NVAPN? (Query Instrument Pre-defined Application Setup Number)

Set Command: NVAPN<ws><store_num>

Details: <store_num> 1 → 20

Remarks: Presets the instrument to pre-defined applications setups. See below for a list of factory presets.

1. Reset
2. Factory Reset
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. not used
15. not used
16. not used
17. not used
18. not used
19. not used
20. not used

NOTE: See *RST or NVFRST commands for more information if selecting ‘Reset’ or ‘Factory Preset’

Query Command: NVAPN?

Return String: NVAPN <store_num>

Remarks: Returns the store number for the pre-defined application currently applied to the selected channel.

ML243xA command supported

NVFRST (Factory Reset)

Set Command: NVFRST

Remarks: Resets the ML2430A Series to the factory default configuration. Unlike the *RST command, the offset tables are cleared and all external interfaces are reset. Note that any settings in the *ESE and *SRE registers prior to this command will be reset. The equivalent front panel key sequence is PRESET | Factory

WARNING: It may be necessary to reinitialise the connection to the instrument after sending this command.

Chapter 10. Data Acquisition Commands

Function	Command	Page reference
Channel Readings – Output specified number	CWON	10-3
CW Channel Readings - Output	CWO	10-2
Pulsed / Modulated Graph Max Data - Output in ASCII Format	PMXPO	10-18
Pulsed / Modulated Profile - Output max binary log	PMXPBLO	10-15
Pulsed / Modulated Profile - Output min binary log	PMNPBLO	10-4
Pulsed / Modulated Profile Data - Output in ASCII Format	PMPO	10-12
Pulsed / Modulated Profile Data - Output in Binary Format	PMPBO	10-8
Pulsed/Modulated Profile Max Data - Output in Binary Format	PMXPBO	10-17
Pulsed/Modulated Profile Min Data - Output in ASCII format	PMNPO	10-8
Pulsed/Modulated Profile Min Data - Output in Binary Format	PMNPBO	10-6
Readout Measurements - Output over Capture Time	PMRDO	10-13

ML243xA command supported

CWO (Output CW Channel Readings)

Query Command: CWO<ws><c>

Return String: <c> 1 | 2 | 1&2

Details: **Channel 1 | 2**

CWO <c>,<reading>

Channels 1&2

CWO<c>,<ch1_reading>,<ch2_reading>

An execution error is returned in the following instances:

a) Channel 1 | 2 requests: If channel turned OFF or not set to CW.

b) Channels 1&2 requests: If either channel turned OFF or either channel not set to CW.

Remarks: When in CW mode, this command returns a measurement reading for the selected channel. Multiple requests for readings by sending this command repeatedly will be queued in the instrument output buffer, if GPIB buffering is enabled (see SYBUFS command). The MAV bit in the status byte indicates whether there are any readings available in the buffer.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

ML243xA command supported

CWON (Output Specified Number of Channel Readings)

Query Command: CWON<ws><c><,><num_readings>

Details:

	<c>	1 | 2 | 1&2
	<num_reading>	1 → 1500

Return String:

Channels 1 | 2

<reading_1>, …<reading_n>

Channels 1&2

ch1_reading_1>,<ch2_reading_1>, …
<ch1_reading_n>,<ch2_reading_n>

Details:

<reading_n>	Measurements for the selected channels up to <num_readings>

Remarks: This command returns the requested number of readings for the specified channel. The number of readings are all first collected and buffered internally, before being returned over the GPIB as a whole.

Example:

If measuring a fairly steady power on each channel at approximately the following levels.

Channel 1:	–10 dBm approx.
Channel 2:	–25 dBm approx.

Sending the command CWON 1&2, 8 will return 16 readings in the following order:

–10.234, –25.449, –10.234, –25.732,–10.235, –25.694, –10.238, –25.043, –10.250, –25.230, –10.270, –25.883, –10.500, –25.049, –10.291, –25.175

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

PMNPBLO (Output Pulsed / Modulated Profile Min Binary Long Format)

Query Command: PMNPBLO<ws><c>

Details:

<c> 1 | 2 | 1&2
Return String for channels 1 | 2:
PMNPBLO <c>,<#><length><num_bytes><data_byte_1>...
<data_byte_n>

Return String for channels 1&2:
PMNPBLO<c>,<#><length><num_bytes><ch1_data_byte_1>...
<ch1_data_byte_n><ch2_data_byte_1> ...<ch2_data_byte_n>

<length>	number of ASCII characters making up the num_bytes value
<num_bytes>	Number of bytes of data contained in rest of the string
<data_byte_n>	Four (4) bytes will make up a single measurement reading

Remarks: This command restricts the range of valid measurement units to logarithmic units only (i.e. dB(m), dBmV, dBuV and dBW). If using this command to request data from a channel whose configuration for measurement units is different from the above, an execution error will be returned.

Outputs the Pulsed/Modulated profile minimum data in binary format. Each measurement reading returned with this command is encoded as a 4-byte LONG INTEGER. Each reading is also multiplied by fixed value of 1024 (10-bit left shift) to minimise rounding errors when converting to single-precision floating point.

This command will return for each channel, either 800 bytes in <num_bytes> (e.g. 200 points * 4 bytes/reading) or 1600 bytes (e.g. 400 points * 4 bytes/reading) depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available). In LONG INTEGER format <num_bytes> will be set to 204 (i.e. 51 * 4bytes/reading).

When selecting <c> to be 1&2, <num_bytes> value will be the total number of bytes for both channels. Data for channel 1 will be output first, immediately followed by channel 2 data.

The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a

‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

Example:

If the following 4-byte Hex value string is assigned to a long integer variable, its value is:

FF FF D1 64 = –11932

To convert the integer value to a floating point reading (based on 1024/dB scaling), divide by 1024 to get the dB value (–11.652 dB).

Note that the exact units (whether dBm or dBmV etc.) for the reading depend upon the power meter configuration for Units on requesting data.

PMNPBO (Output Pulsed/Modulated Profile Min Data in Binary Format)

Query Command: PMNPBO<ws><c>

<c> 1 | 2 | 1&2

Return String: **Channels 1 | 2**

PMNPBO
<c>,<#><length><num_bytes><data_byte_1> ...<data_byte_n>

Channels 1&2

PMNPBO<c>,<#><length><num_bytes><ch1_data_byte_1>
...<ch1_data_byte_n>

Details:

<length>	Number of ASCII characters making up the <num_of_bytes> value
<num_of_bytes>	Number of bytes of data contained in rest of the string
<data_byte_n>	Four (4) of these values make up a floating point reading.

Remarks: Outputs the Pulsed/Modulated profile minimum data in binary format to the GPIB (as a definite length arbitrary block response data).

Note: If <c> is 1&2, the <num_of_bytes> value will double to show the total bytes output. The data for channel 1is output first, immediately followed by the data for channel 2.

Each of the measurement readings is encoded in a 4-byte single precision floating-point value.

This command will return 800 bytes in <num_bytes> (200 points * 4 bytes/reading) or 1600 bytes (400 points * 4 bytes/reading) per channel depending on the number of points resolution setting.

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available). In floating point format <num_bytes> will be 204 (i.e. 51 * 4bytes/reading).

The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g.

sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

PMNPO (Output Pulsed/Modulated Profile Min Data in ASCII format)

Query Command: PMNPO<ws><c>

Details: <c> 1 | 2 | 1&2

Remarks: This command returns the next complete set of pulsed/modulated MINIMUM graph data points in ASCII format. The data returned will be either 200 or 400 readings per channel depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available).

When selecting <c> to be 1&2, <num_elements> will be the total number of readings for both channels. The measurement data for channel 1 will be output first, immediately followed by channel 2 measurements.

Note: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

Return String: **Channels 1 | 2**

PMNPO <c>,<num_elements>,<element_1>, … <element_n>

<c> 1 | 2 | 1&2

Channels 1&2

PMNPO <c>,<num_elements>,<ch1_element_1>, …<ch1_element_n>

Details:

<num_elements>	The total number of data points
<element_n>	Readings

PMPBLO (Output Pulsed / Modulated Profile in Binary Long Format

Query Command: PMPBLO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String:

Channels 1 | 2

PMPBLO
<c>,<#><length><num_bytes><data_byte_1>...<data_byte_n>

Channels 1&2

PMPBLO<c>,<#><length><num_bytes><ch1_data_byte_1>
...<ch1_data_byte_n> <ch2_data_byte_1>
...<ch2_data_byte_n>

<length> number of ASCII characters making up the num_bytes value

<num_bytes> Number of bytes of data contained in rest of the string

<data_byte_n> Four (4) bytes will make up a single measurement reading

Remarks:

This command restricts the range of valid measurement units to logarithmic units only (i.e. dB(m), dBmV, dBuV and dBW). If using this command to request data from a channel whose configuration for measurement units is different from the above, an execution error will be returned.

Outputs the Pulsed/Modulated profile average data in binary format. Each measurement reading returned with this command is encoded as a 4-byte LONG INTEGER. Each reading is also multiplied by fixed value of 1024 (10-bit left shift) to minimise rounding errors when converting to single-precision floating point.

This command will return for each channel, either 800 bytes in <num_bytes> (e.g. 200 points * 4 bytes/reading) or 1600 bytes (e.g. 400 points * 4 bytes/reading) depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument’s graph measurement buffers will be resized to ‘N’ data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available). In LONG INTEGER format <num_bytes> will be 204 (i.e. 51 * 4bytes/reading).

When selecting <c> to be 1&2, <num_bytes> value will be the total number of bytes for both channels. Data for channel 1 will be output first, immediately followed by channel 2 data.

The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

Example:

If the following 4-byte Hex value string is assigned to a long integer variable, its value is:

FF FF D1 64 = –11932

To convert the integer value to a floating point reading (based on 1024/dB scaling), divide by 1024 to get the dB value (–11.652 dB).

Note that the exact units (whether dBm or dBmV etc.) for the reading depend upon the power meter configuration for Units on requesting data.

PMPBO (Output Pulsed / Modulated Profile Data in Binary Format)

Query Command: PMPBO<ws><c>

Details: <c> 1 | 2 | 1&2

Remarks: Outputs the Pulsed/Modulated profile average graph data in binary format to the GPIB (as a definite length arbitrary block response data). Each of the measurement readings is encoded in a 4-byte single precision floating-point value.

This command will return 800 bytes in <num_bytes> (200 points * 4 bytes/reading) or 1600 bytes (400 points * 4 bytes/reading) per channel depending on the number of points resolution setting. When selecting <c> to be 1&2, <num_bytes> value will be the total number of bytes for both channels. Data for channel 1 will be output first, immediately followed by channel 2 data.

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available). In floating point format <num_bytes> will be 204 (i.e. 51 * 4bytes/reading).

Return String: **Channels 1|2**

PMPBO <c>,<#><length><num_bytes><data_byte_1>... <data_byte_n>

Channels 1&2

PMPBO <c>,<#><length><num_bytes><ch1_data_byte_1>... <ch1_data_byte_n>

Details:

<length>	number of ASCII characters making up the num_bytes value.
<num_bytes>	number of bytes of data contained in rest of the string.
<data_byte_n>	four of these values make up the long integer.

Note: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

PMPO (Output Pulsed / Modulated Profile Data in ASCII Format)

Query Command: PMPO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: **Channels 1|2**

PMPO <c>,<num_elements>,<element_1>, … <element_n>

<c> 1 | 2 | 1&2

Channels 1&2

PMPO <c>,<num_elements>,<ch1_element_1>, … <ch1_element_n>,

<num_elements> The total number of measurement data points

<element_n> Measurement readings

Remarks: This command returns the next complete set of pulsed/modulated AVERAGE graph data points in ASCII format. The data returned will be either 200 or 400 readings per channel depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available).

When selecting <c> to be 1&2, <num_elements> will be the total number of readings for both channels. The measurement data for channel 1 will be output first, immediately followed by channel 2 measurements.

Note: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

PMRDO (Output Readout Measurements over Capture Time)

Query Command: PMRDO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String:

Channels 1 | 2

PMRDO <c>,<meas_type>, <ct_data>

Channels 1&2

PMRDO <c>,<ch1_meas_type>,<ch1_ct_data>,

<ch2_meas_type>,<ch2_ct_data>

<meas_type>	The measurement type number 1 → 5
<ct_data>	The measurements over the capture time

When selecting channels 1&2, channel 1 readings will be output first, followed immediately by channel 2 as shown in the return string format above.

Number	:Measurement Type:
1	Average Power
2	Average Power, Peak Power
3	Average Power, Peak Power, Crest Factor
4	Average Power, Min Power & Time , Max Power & Time
5	Average Power, Held Min Power & Time, Held Max Power & Time

The format of <ct_data> will be different depending upon the selected measurement type number. A two-letter prefix always precedes the measurements readings to help decoding the data string:

No.	Data Format
1	<PA>,<avg_pow>
2	<PA>,<Avg_pow>,<PK>,< Pk_pow>
3	<PA>,<Avg_pow>,<PK>,< Pk_pow>,<CF>,<Cres_Fact>
4	<PA>,<Avg_pow,<PN>,<min_pow>,<TN>,<min_time>,<PX>, <max_pow>,<TX>,<max_time>
5	<PA>,<Avg_pow>,<PHN>,<hmin_pow>,<THN>,<hmin_time>, <PHX>,<hmax_pow>,<THX>,<hmax_time>

The 2-letter prefixes have the following meanings:

PA	Average Power
PK	Peak Power
CF	Crest Factor

PN	Min Power
TN	Time of Min Power in units of seconds (s)
PX	Max Power
TX	Time of Max Power in units of seconds (s)
PHN	Held Min Power
PHX	Held Max Power
THN	Time of Held Min Power in units of seconds (s)
THX	Time of Held Max Power in units of seconds (s)

Remarks: When in Pulsed/Modulated mode, this command returns measurement readings over the whole capture time. Power readings will be returned in the units currently selected for the measurement channel (see CHUNIT). The time readings relate to the time at which the minimum or maximum power reading occurred with respect to the trigger point and it is always returned in units of seconds. The measurement readings type <meas_type> is selected using the PMMEAS command.

Note that these measurements are only available if there are NO ENABLED GATES, (see GPMO, GPAMO, GPNMO commands for gating patterns measurements acquisition). An execution error is returned if the selected channel mode is not Pulsed/Modulated or there are one or more enabled gating patterns.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If TR-type commands are not used, a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument set-up have rippled through to the measurement system.

PMXPBLO (Output Pulsed / Modulated Profile Max Binary Long Format)

Query Command: PMXPBLO<ws><c>

Details: <c> 1 | 2 | 1&2

Return String: **Channel 1 | 2**

PMXPBLO <c>,<#><length><num_bytes><data_byte_1>... <data_byte_n>

Channel 1&2

PMXPBLO <c>,<#><length><num_bytes><ch1_data_byte_1>... <ch1_data_byte_n><ch2_data_byte_1> ...<ch2_data_byte_n>

<length>	number of ASCII characters making up the num_bytes value
<num_bytes>	Number of bytes of data contained in rest of the string
<data_byte_n>	Four (4) bytes will make up a single measurement reading

Remarks: This command restricts the range of valid measurement units to logarithmic units only (i.e. dB(m), dBmV, dBuV and dBW). If using this command to request data from a channel whose configuration for measurement units is different from the above, an execution error will be returned.

Outputs the Pulsed/Modulated profile maximum data in binary format. Each measurement reading returned with this command is encoded as a 4-byte LONG INTEGER. Each reading is also multiplied by fixed value of 1024 (10-bit left shift) to minimise rounding errors when converting to single-precision floating point.

This command will return for each channel, either 800 bytes in <num_bytes> (e.g. 200 points * 4 bytes/reading) or 1600 bytes (e.g. 400 points * 4 bytes/reading) depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument’s graph measurement buffers will be resized to ‘N’ data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available). In LONG INTEGER format <num_bytes> will be 204 (i.e. 51 * 4bytes/reading).

When selecting <c> to be 1&2, <num_bytes> value will be the total number of bytes for both channels. Data for channel 1 will be output first, immediately followed by channel 2 data.

The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a ‘Wait Delay’ should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

Example:

If the following 4-byte Hex value string is assigned to a long integer variable, its value is:

FF FF D1 64 = –11932

To convert the integer value to a floating point reading (based on 1024/dB scaling), divide by 1024 to get the dB value (–11.652 dB).

Note that the exact units (whether dBm or dBmV etc.) for the reading depend upon the power meter configuration for Units on requesting data.

PMXPBO (Output Pulsed/Modulated Profile Max Data in Binary Format)

Query Command: PMXPBO<ws><c>

Details: <c> 1 | 2 | 1&2

Remarks: Outputs the Pulsed/Modulated profile maximum graph data in binary format to the GPIB (as a definite length arbitrary block response data). Each measurement reading is encoded in a 4-byte single-precision floating point format.

This command will either return 800 bytes in <num_bytes> (e.g. 200 points * 4 bytes/reading) or 1600 bytes (e.g. 400 points * 4 bytes/reading) per channel depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available). In floating point format <num_bytes> will be 204 (i.e. 51 * 4bytes/reading).

When selecting <c> to be 1&2, <num_bytes> value will be the total number of bytes for both channels. Data for channel 1 will be output first, immediately followed by channel 2 data.

Return String:

Channel 1 | 2

PMXPBO<c>,<#><length><num_bytes><data_byte_1> ...<data_byte_n>

Channel 1&2

PMXPBO <c>,<#><length><num_bytes><ch1_data_byte_1>...
<ch1_data_byte_n>

Details:

<length>	Number of ASCII characters making up the 'number_of_bytes' value.
<num_of_bytes>	Number of bytes of data contained in rest of the string.
<data_byte_n>	Four (4) of these values make up a floating point reading.

Note: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

PMXPO (Output Pulsed / Modulated Graph Max Data in ASCII Format)

Query Command: PMXPO<ws><c>

Details: <c> 1 | 2 | 1&2

Remarks: This command returns the next complete set of pulsed/modulated MAXIMUM graph data points in ASCII format. The data returned will be either 200 or 400 readings per channel depending on the number of points resolution setting (see SYDRES command).

Note: On the ML249xA in RRS Mode, if the trigger capture time is below 200 ns with 200 points display (or below 400 ns with 400 points display), the instrument's graph measurement buffers will be resized to 'N' data points at 1ns resolution (where N = capture time / 1ns + 1). For example, with a capture time of 50ns, the number of readings taken per measurement sweep will be 50 + 1 (including the measurement at time stamp 0 ns). Therefore, when requesting data over GPIB using this command <num_elements> will be set to 51 (i.e. there will be 51 measurement readings available).

When selecting <c> to be 1&2, <num_elements> will be the total number of readings for both channels. The measurement data for channel 1 will be output first, immediately followed by channel 2 measurements.

Notes: The recommended practice for requesting measurement data over GPIB is to use TR-type commands to ensure that up-to-date readings are obtained, in particular after sending configuration commands that affect the measured power (e.g. sending the SNOFIX command to add an offset to the measurements). If not using TR-type commands, then a 'Wait Delay' should be introduced between the configuration commands and the data acquisition command to ensure that any changes to the instrument setup have rippled through to the measurement system.

Return String: **Return String for channels 1 | 2:**

PMXPO <c>,<num_elements>,<element_1>, … <element_n>

Return String for channels 1&2:

PMXPO <c>,<num_elements>,<ch1_element_1>, … <ch1_element_n>, <ch2_element_1>, <ch2_element_n>

Details:

<c>	1 | 2 | 1&2
<num_elements>	The total number of measurement data points
<element_n>	Measurement readings

Chapter 11. Instrument Status Commands

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DDE Error List - Query	SYERLST	11-3
Fast Mode	SYFAST	11-5
Initial Startup Self-test Command	SYSTART	11-6
Return results of POST or *TST	SYTEST	11-15
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Status Message	SYSTATE	11-7

ML243xA command supported

SYCONT (Continue)

Set Command:	SYCONT
Remarks:	This command will allow the system to continue the start-up sequence if there are self-test failures other than DSP errors.

ML243xA command supported

SYDISP (Set Display Update)

SYDISP? (Query Display Update)

Set Command:	SYDISP<ws><state>
Details:	<state> OFF | ON
Remarks:	This command controls the measurement display update on the instrument front panel to increase GPIB throughput. When the display update is turned OFF, there will be no measurement updates on the front panel and the instrument will indicate that the display update is turned OFF.
Note:	Turning the instrument's power OFF or carrying out an instrument Preset will return this setting to its default ON value.
Query command:	SYDISP?
Return string:	SYDISP <state>
Remarks:	Returns the status of the display update setting.

ML243xA command supported

SYERLST (DDE Error List Query)

Set Command: SYERLST

Remarks: On detecting a DDE (Device Dependent Error) event, this command returns the error list giving the state of the DDE causes.

Reading the error list by issuing the SYERLST command will automatically clear the list just read from the instrument queue. In addition the error list queue will be updated by any further occurrence of the listed events.

The SYERLST response is returned in the following format:

ABCDEFGHIJKLMN!OOOOOO!PPPPPP!

A	Sensor A SNZERO state: 0 - ZERO done, 1 - Not done, 2 - SNZERO failed.
B	Sensor B SNZERO state: 0 - ZERO done, 1 - Not done, 2 - SNZERO failed.
C	Sensor A SNCAL state: 0 - Done, 1 - Failed.
D	Sensor B SNCAL state, 0 - Done, 1 - Failed.
E	Sensor A range hold: 0 - OK, 1 - Over range, 2 – Under range.
F	Sensor B range hold: 0 - OK, 1 – Over range, 2 – Under range.
G	Display channel 1 reading out of range: 0 - OK, 1 - Over range, 2 – Under range.
H	Display channel 2 reading out of range: 0 - OK, 1 - Over range, 2 – Under range.
I	Display channel 1 illegal log operation: 0 - OK, 1 - Error.
J	Display channel 2 illegal log operation: 0 - OK, 1 - Error.
K	Sensor A fitted and used state: 0 - Fitted, 1 - Not fitted or used
L	Sensor B fitted and used state: 0 - Fitted, 1 - Not fitted and used
M	Display channel 1 limits state: 0 - Passed, 1 - High limit failed, 2 – Low limit failed
N	Display channel 2 limits state: 0 - Passed, 1 - High limit failed, 2 – Low limit failed.
OOOOOO	Last cause of a GPIB command error.
PPPPPP	Last cause of a GPIB execution error.

The GPIB command error and GPIB execution error are always enclosed within exclamation marks (!). If no errors have been produced since the last SYERLST was read, the SYERLST will end with '!!!'.

Note: When read for the first time after start-up, a sensor may be reported as not fitted even though it is. This is because the error condition of a sensor used in a channel configuration was recorded before the sensor initialisation was completed. If a sensor is not used in a channel configuration, it will be reported as Zeroed, although it may not have been. If the sensor is then used in a channel configuration, its zero status will be correctly reported.

ML243xA command supported

SYFAST (Fast Mode)

SYFAST? (Fast Mode)

Set Command: SYFAST<ws><state>

Details: <state> OFF | ON

Remarks: This command increase GPIB data transfer for a limited set of data output commands (see list below for Fast Mode compliant commands). Note that the instrument still operates in 488.2 compliant mode

The command sequence to set up the instrument into Fast Mode is as follows:

Pulsed / Modulated Measurement Mode :

CHUNIT <c> , DBM

PMAVGS <c> , OFF

SYDISP OFF

SYFAST ON

CW Measurement Mode :

CHUNIT <c> , DBM

CWAVG <c> , OFF

CWSETLP <c>, 10

SYDISP OFF

SYFAST ON

Where: <c> 1 | 2

Note that the SYFAST command must be the last command in the command sequence before requesting measurement readings.

Below is a list of the Fast Mode Compliant commands that will give the highest possible data throughput.

1. CWO
2. GPAMO

Notes: In Fast Mode the following restrictions apply:

- Only ‘Average’ readings available
- Measurements updates on screen will stop and a message will appear indicating the instrument is in fast mode.

- Measurement requests for both channels as one message (channel 1&2) are not handled.
- Measurements will be output in dBm units only.
- Readings are formatted in floating point, three decimal point digits only (i.e. +/- nnn.fff).
- RS232 support disabled.
- Sensor over / under range reporting disabled.

Query Command: SYFAST?

Return String: SYFAST <state>

SYSTART (Initial Startup Self-test Command)

Set Command: SYSTART

Remarks: This is useful for ATE control. After the system has been given time to start up, this command can be used to find out what state the system is in. If the self-test has failed, 'SYCONT' can be used to get the system running. This is an initial startup self test status command and will return one of the following:

0	Passed self-test and running.
1	Startup self test ongoing.
-1	Start up self-test FAILED.

In this stage of the startup process, all commands except SYTEST, SYSTART, SYCONT and GPIB 488.2 event and status commands will produce a GPIB execution error. SYTEST will return the self-test result string.

ML243xA command supported

SYSTATE (Status Message)

Set Command: SYSTATE

Remarks: Replies with the power meter’s current status code. In this format, the number of identical letters specify the number of digits, with preceding zeroes for padding if necessary.

The format is:

ABCDEFGHIJKLMNOPQRRRRSSSSTUVWXXYYZΑΒΧΔΔΔΕΕΕΦΓΗΙϑΚΛ
ΜΝΟΠΘΡ

Where:

A =	Channel 1 Measurement Mode
B =	Channel 2 Measurement Mode
C =	Channel Linking State
D =	Channel 1 input configuration
E =	Channel 2 input configuration
F =	Channel 1 units
G =	Channel 2 units
H =	Channel 1 Trigger Source
I =	Channel 2 Trigger Source
J =	Internal Trigger Edge
K =	External Trigger Edge
L =	Channel 1 relative status
M =	Channel 2 relative status
N =	Channel 1 limit checking type
O =	Channel 2 limit checking type
P =	Channel 1 limit lines checking
Q =	Channel 2 limit lines checking
RRRR =	Channel 1 Gating Patterns state
SSSS =	Channel 2 Gating Patterns state
T =	Channel 1 Gating Patterns Repeat state
U =	Channel 2 Gating Patterns Repeat state
V =	Channel 1 Gating Pattern Measurements
W =	Channel 1 Gating Pattern Measurements
XX =	Sensor A range hold

YY =	Sensor B range hold
Z =	Sensor A Input Offset Mode
Α =	Sensor B Input Offset Mode
Β =	Channel 1 averaging mode:
Χ =	Channel 2 averaging mode
ΔΔΔ =	Channel 1 averaging number
ΕΕΕ =	Channel 2 averaging number
Φ =	Channel 1 low level averaging
Γ =	Channel 2 low level averaging
Η =	Channel 1 Post-processing function
Ι =	Channel 2 Post-processing function
ϑ =	Sensor A zeroed status
Κ =	Sensor B Zeroed status
Λ =	BNC1 Output Configuration
Μ =	BNC2 Output Configuration
Ν =	GPIB trigger mode
Ο =	GPIB group trigger mode
Π =	Calibrator state
Θ =	Calibrator Frequency
Ρ =	GPIB FAST status

See below for a breakdown of status codes.

A = Channel 1 Measurement Mode:

0 = CW

1 = P/M Profile

2 = P/M Readout

B = Channel 2 Measurement Mode:

0 = CW

1 = P/M Profile

2 = P/M Readout

C = Channel Linking State:

0 = OFF

1 = ON

D = Channel 1 input configuration:

1 = A

2 = B

3 = A–B

4 = B–A

5 = A/B

6 = B/A

7 = EXT Volts

E = Channel 2 input configuration:

1 = A

2 = B

3 = A–B

4 = B–A

5 = A/B

6 = B/A

7 = EXT Volts

F = Channel 1 units:

0 = dBm

1 = Watts

2 = Volts

3 = dBuV

4 = dBmV

5 = dBW

G = Channel 2 units:

0 = dBm

1 = Watts

2 = Volts

3 = dBuV

4 = dBmV

5 = dBW

H = Channel 1 Trigger Source:

0 = Internal A

1 = Internal B

2 = External TTL

4 = Continuous

5 = Internal A AUTOMATIC Trigger

6 = Internal B AUTOMATIC Trigger

I = Channel 2 Trigger Source:

0 = Internal A

1 = Internal B

2 = External TTL

4 = Continuous

5 = Internal A AUTOMATIC Trigger

6 = Internal B AUTOMATIC Trigger

J = Internal Trigger Edge

0 = Channel 1 RISING, Channel 2 RISING

1 = Channel 1 FALLING, Channel 2 RISING

2 = Channel 1 RISING, Channel 2 FALLING

3 = Channel 1 FALLING, Channel 2 FALLING

K = External Trigger Edge

0 = RISE

1 = FALL

L = Channel 1 relative status:

0 = Rel OFF

1 = Rel ON

M = Channel 2 relative status:

0 = Rel OFF

1 = Rel ON

N = Channel 1 limits

0 = OFF

1 = SIMPLE

2 = COMPLEX

O = Channel 2 limits

0 = OFF

1 = SIMPLE

2 = COMPLEX

P = Channel 1 limit lines checking:

0 = UPPER

1 = LOWER

2 = BOTH

Q = Channel 2 limit lines checking:

0 = UPPER

1 = LOWER

2 = BOTH

RRRR = Channel 1 Gating Patterns state:

0000 = All Gates OFF

1000 = Gate 1 ON

1100 = Gate 1 ON, Gate 2 ON

1110 = Gate 1 ON, Gate 2 ON, Gate 3 ON

1111 = All Gates ON

SSSS = Channel 2 Gating Patterns state:

0000 = All Gates OFF

1000 = Gate 1 ON

1100 = Gate 1 ON, Gate 2 ON

1110 = Gate 1 ON, Gate 2 ON, Gate 3 ON

1111 = All Gates ON

T = Channel 1 Gating Pattern 1 Repeat state:

0 = OFF

1 = ON

U = Channel 2 Gating Pattern 1 Repeat state:

0 = OFF

1 = ON

V = Channel 1 Gating Pattern Measurements:

0 = Average

1 = Average, Peak

2 = Average,Peak,Crest

3 = Average,Max power, Min power, Max-Min time

4 = Averag, Held Max power, Held Min power, Held Max-Min time

W = Channel 2 Gating Pattern Measurements:

0 = Average

1 = Average, Peak

2 = Average,Peak,Crest

3 = Average,Max power, Min power, Max-Min time

4 = Averag, Held Max power, Held Min power, Held Max-Min time

XX = Sensor A range:

01 to 06	CW Manual Hold
11 to 16	CW Auto-range
07 to 09	P/M Manual Hold
17 to 19	P/M Auto-range

YY = Sensor B range hold:

01 to 06	CW Manual Hold
11 to 16	CW Auto-range
07 to 09	P/M Manual Hold
17 to 19	P/M Auto-range

Z = Sensor A Input Offset Mode:

0 = OFF

1 = Fixed

2 = Table

A = Sensor B Input Offset Mode:

0 = OFF

1 = Fixed

2 = Table

B = Channel 1 Averaging mode:

0 = OFF

1 = AUTO

2 = Moving

3 = Repeat

4 = Exponential (P/M only)

X̣= Channel 2 Averaging mode:

0 = OFF

1 = AUTO

2 = Moving

3 = Repeat

4 = Exponential (P/M only)

ΔΔΔ = Channel 1 averaging number

This number is between 1 and 512.

EEE = Channel 2 averaging number

This number is between 1 and 512.

Φ = Reserved for future use.

0 = Not Applicable

Γ = Reserved for future use.

0 = Not Applicable

H = Channel 1 Post-processing function

0 = OFF

2 = Statistics

3 = PAE

I = Channel 2 Post-processing function

0 = OFF

2 = Statistics

3 = PAE

ϑ = Sensor A Zero status:

0 = Not zeroed

1 = Zeroed

K = Sensor B Zeroed status:

0 = Not zeroed

1 = Zeroed

Λ = BNC1 Output Configuration:

0 = OFF

1 = Analog Out

2 = Pass /Fail

4 = Levelling A1

5 = Levelling A2

M = BNC2 Output Configuration:

0 = OFF

1 = Analog Out

2 = Pass /Fail

4 = Levelling B1

5 = Levelling B2

8 = Trigger Out

Ν = GPIB trigger mode:

0 = TR0 hold ON

1 = Free run

Ο = GPIB group trigger mode:

0 = GTO

1 = GT1

2 = GT2

Π = Calibrator state:

0 = OFF

1 = ON

Θ̣= Calibrator Frequency

0 = 50 MHz

1 = 1 GHz

Ρ = GPIB FAST mode status:

0 = OFF

1 = ON

SYTEST (Return results of POST or *TST)

Set Command: SYTEST

Remarks: Returns a message string holding the self test status results following a power-on self-test (POST) or after issuing the command *TST. The returned string is in the following format:

FLASH<ws>0xnnnn,CALDAT<ws>0xnnnn,PERSON<ws>0xnnnn,RAM <ws>0xnnnn, NONVOL<ws>0xnnnn,LCD<ws>0xnnnn,KBD<ws> 0xnnnn, DSP<ws>0xnnnn,SPARTAN<ws>0xnnnn

Where: <ws> = white space.

The possible values returned are listed below:

FLASH (Flash Memory) checksum test:

0x0000 = Passed

0xffff = Failed

CALDAT (Cal Data) checksum test:

0x0000 = Passed

0xffff = Failed

PERSON (Personality data):

0x0000 = Passed

0xffff = Failed

RAM read/write test:

0x0000 = Passed

0xffff = Failed

NONVOL (Non-volatile) RAM test:

0x0000 = Passed

0x0001 = Software version fail

0x0002 = Current store fail

0x0004 = Saved store fail

0x0008 = secure mode fail

0xffff = read failure

LCD memory test:

0x0000 = Passed

0xffff = Failed

KBD (Keyboard) stuck key test:

0x0000 = Passed

0xffff = Failed

DSP test:

0x0000 = Passed

else FATAL error

SPARTAN test:

0x0000 =	Passed
0x0001 =	Device startup failure – INIT line failed to switch high
0x0002 =	Device startup failure – DONE line failed to switch low
0x0003 =	Device loading failure – DONE line failed to switch high
0xffff=	General Device failure – Failed initialisation sequence

Chapter 12. Range Calibrator Commands

Function	Command	Page reference
Range Calibrator – Zero Sensor Input	RCZERO	12-6
Range Calibrator Data - Output	RCD	12-2
Range Calibrator Diagnostics Test - Data Output	RCDIAGO	12-3
Range Calibrator Diagnostics Test – Set or Query	RCDIAGT	12-4
Range Calibrator Test - Abort	RCABORT	12-2
Range Calibrator Test - Start	RCTEST	12-5

RCABORT (Abort Range Calibrator Test)

Set Command:	RCABORT
Remarks:	This command ends the Range Calibrator test if a test is currently running. If a test is not running, this command is ignored. Partial test results will not be available when aborting a test sequence prematurely. An execution error is returned if the Range Calibrator is not connected to the power meter.

RCD (Range Calibrator Data Output)

Set Command:	RCD<ws><s>	
Details:	<s>	A | B
Return String:	RCD <s>,<valid_flag>,<test_results>	
Details:	<valid_flag>	TRUE | FALSE
	<test_results>	see below for data format
	TRUE	Indicates that a full test sequence has been executed on the specified sensor and the results are valid.
	FALSE	The test results are invalid. The Range Calibrator has been disconnected and a new test sequence has not been executed on the specified sensor.
	<test_results>	<zero_level>,<range1_upper>, <range1_lower>, …<range_N_upper>, <range_N_lower>
	where:	N = 5

<zero_level>	The lowest measurable level for range 5
<range_N_upper>	The upper level for the measurement range
<range_N_lower>	The lower level for the measurement range

Notes: A value of '0' is returned in <test_results>, if the <valid_flag> is FALSE (i.e. test results are invalid).

Remarks: This command returns the ML2419x Range Calibrator test results for the specified sensor that become available once a full test sequence has finished executing (see RCTEST command). If a test sequence on the selected sensor has not been requested, the <valid_flag> will be FALSE to indicate that there is no valid data available for that sensor.

The test results of a test sequence are stored in memory and can be retrieved over GPIB until a new Range Calibrator test sequence is initiated or the ML2419x is disconnected from the power meter. An execution error is returned if sending this command while a test sequence is currently ongoing or if the Range Calibrator is not connected to the power meter.

RCDIAGO (Range Calibrator Diagnostics Test Data Output)

Set Command: RCDIAGO

Return String: RCDIAGO <s>,<reading>

Details:

<s>	A | B
<reading>	Averaged reading for the selected measurement range test

Remarks: This commands returns the ML2419x Range Calibrator Diagnostics readings for the selected range test (see RCDIAGT command), which will become available as soon as the instrument has obtained at least one test result from the Range Calibrator.

Note: Note that each test result is averaged to all previous results, therefore the <reading> returned over GPIB will be the latest averaged reading since the start of the selected diagnostics test sequence. An execution error is returned if this command is sent when the Range Calibrator is not connected to the power meter or the instrument is not in diagnostics mode.

RCDIAGT (Set Range Calibrator Diagnostics Test)

RCDIAGT? (Query Range Calibrator Diagnostics Test)

Set Command: RCDIAGT<ws><s><,><test>

Details:

<s>	A | B
<test>	0 → 10 (see below)

0	ZERO LEVEL
1	RANGE 1 HIGH
2	RANGE 1 LOW
3	RANGE 2 HIGH
4	RANGE 2 LOW
5	RANGE 3 HIGH
6	RANGE 3 LOW
7	RANGE 4 HIGH
8	RANGE 4 LOW
9	RANGE 5 HIGH
10	RANGE 5 LOW

Remarks: This command switches to Range Calibrator Diagnostics Mode and initiates the selected test on the target sensor input. The selected test will run continuously at a rate determined by the range selected and a factory pre-defined averaging at that range. The selected test will stop when a new range is selected or the user exits Diagnostics Mode by sending the RCTEST command. Use the RCDIAGO command to obtain the latest test result reading. An execution error is returned if the Range Calibrator is not connected to the power meter.

Note: The instrument rejects this command and raises an execution error if the Range Calibrator is currently running a full test sequence (see RCTEST command). In this case the user should wait until the test sequence has finished executing or send the RCABORT command to exit the test sequence, before attempting to send the RCDIAGT command again.

Query Command: RCDIAGT?

Return String: RCDIAGT <s>,<test>

Remarks: This command returns the Range Calibrator Diagnostics test currently selected for the specified sensor. An execution error is returned if sending the query command when the instrument is not in diagnostics mode.

RCTEST (Start Range Calibrator Test)

Set Command: RCTEST <ws><s>

Details: <s> A | B | A&B

Remarks: This commands initiates a Range Calibrator full test on the selected sensor input(s) (see below). At the end of the test sequence the test results can be obtained using the RCD command. An execution error is returned if the Range Calibrator is not connected to the power meter. A full test involves the sequence below for each sensor input. The sensor input is zeroed before each step is carried out.

Test ZERO LEVEL

Test RANGE 1 HIGH

Test RANGE 1 LOW

Test RANGE 2 HIGH

Test RANGE 2 LOW

Test RANGE 3 HIGH

Test RANGE 3 LOW

Test RANGE 4 HIGH

Test RANGE 4 LOW

Test RANGE 5 HIGH

Test RANGE 5 LOW

Note: The instrument accepts no other commands when this test is running. For automatic notification on the Test sequence being completed, send the *OPC command with this command (e.g. RCTEST; *OPC) and set up the OPC bit in the Event Status Register to raise a SRQ on test sequence completion.

RCZERO (Diagnostics Zero Range Calibrator Sensor Input)

Set Command: RCZERO

Remarks: When in Diagnostics Mode, this command performs a Zero on the selected sensor input. A Zero is always recommended prior to requesting a reading, when first entering Diagnostics Mode, or when switching to a new measurement range.

An execution error is returned if this command is sent when the instrument is not configured in Diagnostics Mode or if the Range Calibrator is not connected to the power meter.

Note: While a Zero is being carried out, no other commands will be accepted. For automatic notification on the Zero sequence being completed, send the *OPC command with this command (e.g. RCZERO; *OPC) and set up the OPC bit in the Event Status Register to raise a SRQ.

Chapter 13. Programming Examples

This chapter provides programming examples for the following functions.

- CW measurement
- Edge measurement
- GSM measurement
- GPRS measurement
- Multiple radar pulse measurement
- WLAN measurement
- WCDMA measurement
- Dual channel set up.
- Cal and Zero operations.

CW Measurement Example

Function CWMeas (avg_data as string, trace_data as string, num_meas as string)

```
‘allocate memory for TR mode
Dim trmode as Integer

‘set the meter into CW mode
Call Send (boardid, address, “CHMODE 1,CW”,NLend)

‘set the cal factor to frequency mode
Call Send(boardid, address, “SNCFSRC A,FREQ; SNCFRQ A,1MHZ”,NLend)

‘set the averaging mode to auto
Call Send(boardid, address, “CWAVG 1,AUTO”, NLend)

‘set the TR mode you want
trmode = x          ‘x is replaced by either 1 or 2, depending on the data requested

‘trigger the meter
Call Send(boardid, address, “TR” & trmode, NLend)
Call Receive(boardid, address, buffer, STOPend)
avg_data = buffer   ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

‘collect trace and number data
Call Send(boardid, address, “CWO”, NLend)
Call Receive(boardid, address, buffer, STOPend)
trace_data = buffer ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

Call Send(boardid, address, “CWON”, NLend)
Call Receive(boardid, address, buffer, STOPend)
num_meas = buffer ‘transfers the buffer data to a global string
```

```
buffer = “” ‘clears the buffer


End Function
```

EDGE Measurement Example

Function EdgeMeas (avg_data as string, trace_data as string)

```
'allocate memory for TR mode

Dim trmode as Integer


'set the meter into PMOD mode

Call Send(boardid, address, "CHMODE 1,PMOD",NLend)


'set the measurement type to average and peak

Call Send(boardid, address, "PMMEAS 1,2",NLend)


'set a gate

Call Send(boardid, address, "GPGATS 1,1,ON; GPTIMST 1,1,57U; GPTIMSP 1,1,520U;
GPACTN 1,1", NLend)


'set a fence in the mid burst training region

Call Send(boardid, address, "GPFENS 1,1,ON; GPFENST 1,1,240U; GPFENSP
1,1,320U", NLend)


'set trigger capture time

Call Send(boardid, address, "TRCAPT 1,PMOD,625U", NLend)


'set trigger edge and hold-off

            Call Send(boardid, address, "TRINEDG 1,PMOD,RISE; TRHOFS 1,ON;
TRHOFT 1,650U", NLend)


'set averaging

Call Send(boardid, address, "PMAVGS 1,ON; PMAVGN 1,16", NLend)


'set the TR mode you want

trmode = x          'x is replaced by either 1 or 2, depending on the data requested
```

```
‘trigger the meter
Call Send(boardid, address, “TR” & trmode, NLend)
Call Receive(boardid, address, buffer, STOPend)
avg_data = buffer    ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

‘collect other data such as trace data
Call Send(boardid, address, “PMPBO 1”, NLend)
Call Receive(boardid, address, buffer, STOPend)
trace_data = buffer  ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

End Function
```

GSM Measurement Example

Function GSMMeas (avg_data as string, trace_data as string)

```
‘allocate memory for TR mode

Dim trmode as Integer


‘load GSM set-up

Call Send(boardid, address, “NVAPN 1”,NLend)


‘set the meter into PMOD mode

Call Send(boardid, address, “CHMODE 1,PMOD”,NLend)


‘set a gate

Call Send(boardid, address, “GPGATS 1,1,ON; GPTIMST 1,1,57U; GPTIMSP 1,1,520U;
GPACTN 1,1”, NLend)


‘set a fence in the mid burst training region

Call Send(boardid, address, “GPFENS 1,1,ON; GPFENST 1,1,240U; GPFENSP
1,1,320U”, NLend)


‘set trigger capture time

Call Send(boardid, address, “TRCAPT 1,PMOD,625U”, NLend)


‘set trigger edge and hold-off

Call Send(boardid, address, “TRINEDG 1,PMOD,RISE; TRHOFS 1,ON; TRHOFT 1,650U”,
NLend)


‘set averaging

Call Send(boardid, address, “PMAVGS 1,ON; PMAVGN 1,16”, NLend)


‘set the TR mode you want

trmode = x          ‘x is replaced by either 1 or 2, depending on the data requested
```

```
'trigger the meter
Call Send(boardid, address, "TR" & trmode, NLend)
Call Receive(boardid, address, buffer, STOPend)
avg_data = buffer    'transfers the buffer data to a global string
buffer = "" 'clears the buffer

'collect other data such as trace data
Call Send(boardid, address, "PMPBO 1", NLend)
Call Receive(boardid, address, buffer, STOPend)
trace_data = buffer  'transfers the buffer data to a global string
buffer = "" 'clears the buffer

End Function
```

GPRS Measurement Example

Function GPRSMeas (avg_data as string, trace_data as string)

```
‘allocate memory for TR mode

Dim trmode as Integer


‘set the meter into PMOD mode

Call Send(boardid, address, “CHMODE 1,PMOD”,NLend)


‘set gates on

Call Send(boardid, address, “GPGATS 1,1,ON; GPGATS 1,2,ON; GPGATS 1,3,ON;
GPGATS 1,4,ON”, NLend)


‘set gate times and active gate

Call Send(boardid, address, “GPTIMST 1,1,57U; GPTIMST 1,2,634U; GPTIMST
1,3,1.211M; GPTIMST 1,4,1.788M; GPTIMSP 1,1,520U; GPTIMSP 1,2,1.097M;
GPTIMSP 1,3,1.674M; GPTIMSP 1,4,2.251M; GPACTN 1,1”, NLend)


‘set gate repeat state

Call Send(boardid, address, “GP1REPS 1,ON; GP1REPN 1,4; GP1REPT 1,577U”,
NLend)


‘set trigger edge and hold-off

Call Send(boardid, address, “TRHOFS 1,ON; TRHOFT 1,2.308M”, NLend)


‘set the TR mode you want

trmode = x            ‘x is replaced by either 1 or 2, depending on the data requested


‘trigger the meter

Call Send(boardid, address, “TR” & trmode, NLend)

Call Receive(boardid, address, buffer, STOPend)

avg_data = buffer     ‘transfers the buffer data to a global string

buffer = “” ‘clears the buffer
```

```
‘collect other data such as trace data
Call Send(boardid, address, “GPMO 1”, NLend)
Call Receive(boardid, address, buffer, STOPend)
trace_data = buffer  ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

End Function
```

Multiple Radar Pulse Measurement Example

```
Function MRPMeas (mrk_data as string, gate_data as string)

‘set the meter into PMOD mode

Call Send(boardid, address, “CHMODE 1,PMOD”,NLend)


‘set gates on

Call Send(boardid, address, “GPGATS 1,1,ON; GPGATS 1,2,ON”, NLend)


‘set gate times and active gate

Call Send(boardid, address, “GPTIMST 1,1,0.5U; GPTIMST 1,2,10.5U; GPTIMSP
1,1,1.5U; GPTIMSP 1,2,11.5U; GPACTN 1,1”, NLend)


‘set a marker

Call Send(boardid, address, “MKACTN 1,1; MKTMIN 1”, NLend)


‘set trigger capture time and trigger edge

Call Send(boardid, address, “TRCAPT 1,PMOD,20U; TRINEDG 1,PMOD,RISE”, NLend)


‘set averaging mode

Call Send(boardid, address, “PMAVGS 1,ON; PMAVGN 1,16”, NLend)


‘get the marker values

Call Send(boardid, address, “MKACTO 1”, NLend)

Call Receive(boardid, address, buffer, STOPend)

mrk_data = buffer    ‘transfers the buffer data to a global string

buffer = “” ‘clears the buffer


‘get gate values

Call Send(boardid, address, “GPMO 1”, NLend)

Call Receive(boardid, address, buffer, STOPend)

gate_data = buffer   ‘transfers the buffer data to a global string

buffer = “” ‘clears the buffer

End Function
```

WLAN Measurement Example

```
Function WLANMeas (avg_data as string)


‘set the meter into PMOD mode

Call Send(boardid, address, “CHMODE 1,PMOD”,NLend)


‘set gates on

Call Send(boardid, address, “GPGATS 1,1,ON; GPGATS 1,2,ON”, NLend)


‘set gate times and active gate

Call Send(boardid, address, “GPTIMST 1,1,0; GPTIMST 1,2,200U; GPTIMSP 1,1,16U;
GPTIMSP 1,2,300U; GPACTN 1,1”, NLend)


‘set a marker

Call Send(boardid, address, “MKACTN 1,1; MKTMIN 1”, NLend)


‘set trigger capture time and trigger edge

Call Send(boardid, address, “TRCAPT 1,PMOD,500U; TRINEDG 1,PMOD,RISE”, NLend)


‘set averaging mode

Call Send(boardid, address, “PMAVGS 1,ON; PMAVGN 1,16”, NLend)


‘get gate values

Call Send(boardid, address, “GPMO 1”, NLend)

Call Receive(boardid, address, buffer, STOPend)

gate_data = buffer   ‘transfers the buffer data to a global string

buffer = “” ‘clears the buffer


End Function
```

WCDMA Measurement Example

```
Function WCDMAMeas (gate_data as string)

‘allocate memory for TR mode
Dim trmode as Integer

‘set the meter into PMOD mode
Call Send(boardid, address, “CHMODE 1,PMOD”,NLend)

‘set meter to read average peak and crest power
Call Send(boardid, address, “PMMEAS 1,3”, NLend)

‘set trigger to continuous
Call Send(boardid, address, “TRSRC 1,PMOD,CONT”, NLend)

‘set trigger to encompass all data
Call Send(boardid, address, “TRCAPT 1,PMOD,10M”, NLend)

‘set the TR mode you want
trmode = x             ‘x is replaced by either 1 or 2, depending on the data requested

‘trigger the meter
Call Send(boardid, address, “TR” & trmode, NLend)
Call Receive(boardid, address, buffer, STOPend)
avg_data = buffer    ‘transfers the buffer data to a global string
buffer = “”‘clears the buffer

End Function
```

Dual Channel Set Up Example

Function DCMeas (mrk_data as string, gate_data as string, mrk_rpt as string, mrk_rpf as string)

```
‘set the meter into PMOD mode

Call Send(boardid, address, “CHMODE 1,PMOD; CHMODE 2,PMOD”,NLend)


‘set gates on

Call Send(boardid, address, “GPGATS 1,1,ON; GPGATS 1,2,ON; GPGATS 2,1,ON”,
NLend)


‘set gate times and active gate

Call Send(boardid, address, “GPTIMST 1,1,0.5U; GPTIMST 1,2,10.5U; GPTIMST 2,1,1U;
GPTIMSP 1,1,1.5U; GPTIMSP 1,2,11.5U; GPTIMSP 2,11U; GPACTN 1,1; GPACTN 2,1”,
NLend)


‘set markers

Call Send(boardid, address, “MKACTN 1,1; MKTMIN 1”, NLend)


‘set trigger capture time and edge

Call Send(boardid, address, “TRCAPT 1,PMOD,20U; TRCAPT 1,PMOD,RISE”, NLend)


‘set averaging mode

Call Send(boardid, address, “PMAVGS 1,ON; PMAVGN 1,16”, NLend)


‘collect marker readings

Call Send(boardid, address, “MKACTO 1”, NLend)

Call Receive(boardid, address, buffer, STOPend)

mrk_data = buffer    ‘transfers the buffer data to a global string

buffer = “” ‘clears the buffer


‘collect gate readings

Call Send(boardid, address, “GPMO 1”, NLend)

Call Receive(boardid, address, buffer, STOPend)
```

```
gate_data = buffer   ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

‘collect pulse repetition time readings
Call Send(boardid, address, “MKPRIO 2”, NLend)
Call Receive(boardid, address, buffer, STOPend)
mrk_rpt = buffer     ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

‘collect pulse repetition frequency readings
Call Send(boardid, address, “MKPRFO 2”, NLend)
Call Receive(boardid, address, buffer, STOPend)
mrk_rpf = buffer     ‘transfers the buffer data to a global string
buffer = “” ‘clears the buffer

End Function
```

Cal and Zero Operation Examples

```
Function CalZero
'sets query toggle memory space
Dim query as Boolean

'setting toggle
query = ??

'calibrating and zeroing according to toggle
If query = True then
        Call Send(boardid, address, "SNCAL A; SNZERO A; *OPC?", NLend)
        Do Until buffer = "1"
                buffer = ""
                Call Receive(boardid, address, buffer, STOPend)
                Loop
                txtResult.Text = "Operation complete. Sensor cal-ed and zeroed"
        Else
                Call Send(boardid, address, "*CLS", NLend)
                Call Send(boardid, address, "SNCAL A; SNZERO A; *OPC", NLend)
                Do Until Right$(buffer, 1) = 1 or Right$(buffer, 1) = 3 or Right$(buffer, 1) = 5 or Right$(buffer, 1) = 7 or Right$(buffer, 1) = 9
                buffer = ""
                Call Receive(boardid, address, buffer, STOPend)
                Loop
                txtResult.Text = "Operation complete. Sensor cal-ed and zeroed"
        End If

End Function
```

Appendix A. ML243xA Reference Table

This table below lists the full ML243xA GPIB command set in the first column and any equivalent ML248xA / ML249xA GPIB command in the second column. A hyphen '-' in the second column indicates that the ML243xA command is no longer supported on ML248xA / ML249xA power meters and no equivalent command exists (i.e., a command that performs exactly the same operation). The third column provides suggestions on alternative commands that can be used when no equivalent command exists or details of the differences between the two commands.

ML243xA	ML248xA / ML249xA	Alternative Commands / Notes
ADDR	SYADDR	
AVG	-	Refer to commands: CWAVG, PMAVGS, PMAVGN
AVGLL	-	
AVGM	-	Refer to commands: CWAVG, PMAVGS, PMAVGN
BAUTS	-	
BAUTT	-	
BUFF	SYBUFS	
CAL	SNCAL	
CFADJ	SNCFADJ	
CFCAL	SNCFCAL	
CFFRQ	SNCFRQ	Frequency range changed
CFSRC	SNCFSRC	
CFUADD	SNCTADD	Frequency range changed
CFUCT	SNCTCLR	
CFUID	SNCTID	
CFULD	SNCTBIN	
CFUNITS	SNCFU	
CFUPT	SNCTPRE	
CFURD	SNCTBO	
CFUSAV	SNCTSAV	
CFUSEL	SNCTABN	
CFUTBL	SNCTNQ	
CFUUSE	SNCFUSE	
CFUVLD	SNCTAVL	
CFVAL	SNCFVAL	
CHCFG	CHCFG	
CHRES	CHRES	
CHUNIT	CHUNIT	
CONT	SYCONT	
CUR	-	Refer to the following mode dependent commands. Pulsed Modulated Profile: MKSTATE, MKPOS, MKACTN, MKAPOS Statistics: TTMKS, TTMKPOS
CURLK	-	Refer to commands: MKDELTS, MKDLINK
CVSPF	SNZSPF	Frequency range changed
CVSPV	SNZSPV	Voltage range changed
CVSTF	SNZSTF	Frequency range changed

ML243xA	ML248xA / ML249xA	Alternative Commands / Notes
CVSTV	SNZSTV	Voltage range changed
DBLGHT	-	No battery support
DBLTIM	-	No battery support
DCONT	-	Refer to command: SYDLIT
DCONTD	-	
DCONTU	-	
DISP	SYDISP	
DPEAK	-	Refer to commands: CHPKS, CHPIRST
DTRGD	-	Refer to command: TRDLYT
DUTY	-	Refer to command: CWDUTY
DUTYS	-	Refer to command: CWDUTYS
EMUL	-	
ENTERR	SYBEEPS	
ERRLST	SYERLST	Data format changed
FAST	SYFAST	See command notes
FBEEP	LMFBEEP	
FHOLD	LMFHOLD	
FROFF	-	
FRST	NVFRST	
GMNMX	-	Refer to commands: PMMEAS, PMRDO, GPAMO, GPNMO, GPMO
GPRST	-	Refer to commands: PMPDREP, PMPTRK, PMPDRST
GRAUTO	-	Refer to command: PMPAUTO
GRAVG	-	
GRCP	-	
GRDATA	-	
GRDDT	-	
GRDRQ	-	
GRFS	-	
GRMD	-	Refer to commands: CHMODE, PMDTYP
GRPIX	-	Refer to command; PMPDREP
GRPRD	-	
GRPTP	-	Refer to command: TRDLYT
GRSWP	-	Refer to command: PMAVGN
GRSWR		Refer to command: PMAVRST
GRSWS		Refer to command: PMAVGS
GRTMM	-	Refer to command: PMPTRK
GRYB	-	Refer to commands: PMPSCAL, PMPREF
GRYT	-	Refer to commands: PMPSCAL, PMPREF
GT0	GT0	
GT1	GT1	
GT2	GT2	
GTARM	-	Refer to command: TRARMD
GTDLY	-	Refer to command: TRDLYT
GTGW		Refer to commands: GPGATS, GPTIMST, GPTIMSP, GPFENS, GPFENST, GPFENSP
GTLVL		Refer to command: TRINLEV
GTSRC		Refer to command: TRSRC

ML243xA	ML248xA / ML249xA	Alternative Commands / Notes
GTTYP		Refer to command: TRINEDG
GTXTTL		Refer to command: TRXEDG
HLIM	LMSUP	Limits range has changed
HLIMS		Refer to command: LMSTATE, LMLINE, LMTYP
HOLD	-	Refer to command: CHOLD
IBBLP	-	
KEYCK	SYTACTS	
LINK	-	Refer to command: TRLINKS
LLIM	LMSLO	Limits range has changed
LLIMS		Refer to command: LMSTATE, LMLINE, LMTYP
MMRST	CWMMRST	Applies only to CW mode.
MNGDB	-	Refer to commands: PMNPBO,PMNPBLO
MNGD	-	Refer to command: PMNPO
MNMXS	CWMMTKS	Applies only to CW mode
MODDEL	-	
MODINIT	-	
MODLIM	-	
MODPH	-	
MODPWR	-	
MODRED	-	
MODRNG	-	
MXGDB	-	Refer to commands: PMXPBO,PMXPBLO
MXGD	-	Refer to command: PMXPO
O	CWO	Review command operation
OBACM	-	
OBCH	BNOCH	
OBDSP	BNDSP	Added dBW units
OBDST	BNDST	Added dBW units
OBMD	-	Refer to commands: BN1CM, BNC2M
OBPL	BNPLEV	
OBVSP	BNVOSP	
OBVST	BNVOST	
OBZL	-	
OFFCLR	SNOTCLR	
OFFFIX	SNOFIX	Offset Range has changed
OFFTBL	SNOTSEL	
OFFTBR	-	See SNOTBO, SNOTAO command
OFFTBU	-	See SNOTBW, SNOTAW command
OFFTYP	SNOFTYP	
OFFVAL	SNOFVO	
OGBD	-	Refer to command: PMPBO
OGD	-	Refer to command: PMPO
OGSD	-	
OI	SYOI	
ON	CWON	Returns also readings for both channels (ch 1&2)
OPMD	-	Refer to commands: CHMODE, PMDTYP

ML243xA	ML248xA / ML249xA	Alternative Commands / Notes
PRINT	-	
PRNSEL	-	
RCD	RCD	See also additional Range Calibrator commands
REL	CWREL	Applies only to CW mode
RFCAL	SNRFCAL	
RGH	SNRGH	New ranges + range selection channel mode dependent. Pulsed/Modulated: AUTO | 7 to 9 CW: AUTO | 1 to 6
RSBAUD	SYBAUD	Added 57.6 kbits per second
RSMODE	-	
SECURE	NVSECS	
SENMM	-	
SENMO	SNUNIVM	
SENSTL	CWSETLP	
SENTYP	SNTYPE	
SRCMOD	-	
SRCSPFRQ	-	
SRCSPPWR	-	
SRCSTAT	-	
SRCSTFRQ	-	
SRCSTPWR	-	
START	SYSTART	
STATUS	SYSTATE	Data format has changed
STERR	SYTEST	Data format has changed
SYSLD	NVLOAD	Number of stores extended to 20
SYSLNM	NVNAME	
SYSRD	NVOUT	Number of stores extended to 20
TEXT	SYTEXT	
TEXTS	SYTEXTS	
TR0	TR0	
TR1	TR1	Totally new operation. Review command description.
TR2	TR2	Totally new operation. Review command description.
TR3	TR3	
TRGARM	-	Refer to command: TRARMD
TRGDLY	-	Refer to command: TRDLYT
TRGGW	-	Refer to commands: GPGATS, GPTIMST, GPTIMSP, GPFENS, GPFENST, GPFENSP
TRGLVL	-	Refer to command: TRINLEV
TRGMODE	-	Refer to command: TRLINKS
TRGSRC		Refer to command: TRSRC
TRGTYP		Refer to command: TRINEDG
TRGXTTL		Refer to command: TRXEDG
VZERO	BNVZERO	
ZERO	SNZERO	

Appendix B. Binary Output Decoding Examples

Pulsed/Modulated Profile Binary to Float Conversion using Visual Basic

This example in Visual Basic shows how to convert profile data from binary to floating point format for the GPIB command PMPBO. Replace the string in the Send() function to PMXPBO or PMNPBO to obtain minimum or maximum profile data.

```
' DATA VARIABLES AND FUNCTION DEFINITION SHOULD BE PLACED IN A
' VISUAL BASIC MODULE
' The function GetBinaryGraphData()converts the graph data points
' from binary format to floating point format.

' Graph Data
Public GraphArray(1 To 200) As Single

' conversion types for binary output
Public Type FloatBox
   Datbox As Single
End Type

Public Type longBox
   Datbox(0 To 3) As Byte
End Type

' Function Definition:
' Paramter 1: GPIBBoard is the GPIB board identification (usually
' 0)
' Paramter 2: MT248x_Addr is the power meter GPIB address (default
' 13)
' Paramter 3: Channel is the target Pulsed/Modulated Profile
' channel (1 | 2 | 1&2)
'
Public Function GetBinaryGraphData(GPIBBoard As Integer,
MT248x_Addr As Integer, Channel As Integer) As Boolean

  ' required to convert binary to floating point variable
  Dim longval As longBox
  Dim floatval As FloatBox

  Dim c As Integer
  Dim start As Integer
  Dim size As Integer
  Dim pos As Integer
  Dim byten As Integer
  Dim Point As Integer

  Dim GPIBbuff As String * 4095
  Dim buffer As String

  Dim ByteShift(0 to 3) as integer

  ' Shift the bytes as the byte format output of MT248x is rotated
  ByteShift(0) = 2     ' byte 0 becomes byte 2
  ByteShift(1) = 3     ' byte 1 becomes byte 3
ByteShift(2) = 1     ' byte 2 becomes byte 1
ByteShift(3) = 0     ' byte 3 becomes byte 0

Call Send(GPIBBoard_Addr, MT248x_Addr, "PMPBO " & Channel,NLend)
Call Receive(GPIBBoard_Addr, MT2488x_Addr, GPIBbuff, STOPend)

' check if we have the correct data
If (ibsta And EERR) = EERR Then Exit Function

' move our starting position to the correct place in the GPIB
' returned data string
buffer = Left(GPIBbuff, ibcntl - 1)
pos = InStr(buffer, "#") + 1
size = Mid(buffer, pos + 1, Mid(buffer, pos, 1))
start = pos + Mid(buffer, pos, 1)

' go through the binary data, 4bytes at a time
For pos = 1 To size Step 4

  ' go through each byte in the 4bytes block
  For byten = 0 To 3

    ' convert byte value into integer
    c = Asc(Mid(buffer, start + pos + byten, 1))

    ' place the byte into the correct position in the convertion
    ' array
    longval.Datbox(ByteShift(byten)) = c

  Next byten

  ' cast the longval array into a floating point value
  LSet floatval = longval

  ' increase our graph points position
  Point = Point + 1

  ' Set the graph array position to this value from our floatval
  ' type
  GraphArray(Point) = floatval.Datbox

Next pos

' return success!
GetBinaryGraphData = True

End Function
```

Pulsed/Modulated Profile Binary to Float Conversion using Microsoft Visual C

```
/*
** This function reads Pulsed/Modulated profile measurements in
** binary format and converts to single precision floating
** point reading to 3 decimal digits. To extract floating point
** readings correctly, binary data bytes MUST be re-arranged to
** convert from c165 16-bit little-endian to 32-bit little endian.
** NOTE: This function assumes that the ReadBuffer[] array is
** declared global and contains the binary data to be decoded. The
** data string to be decoded is formatted as follows:
** PMPBO <c>,<#><length><num_bytes><data_byte_1>...<data_byte_n>
** In this specific example the converted data and measurements
** are written to a file using the C stream standard library
** functions
*/
void Convert__Binary_Meas_Data(void)
{
  int x = 0;
  int i = 0;

  // char pointer used for assembly of float value
  char *pCF;
  float fval;
  char tempBuff[100];
  char sNumChars[10];
  int numDig = 0;
  int totalBytes;

  // extract mnemonic header + channel
  while(1)
  {
    if (ReadBuffer[x] == ',')
    {
      tempBuff[x] = '\0';
      fprintf( fp,"%s\n",tempBuff);   // write header to file
      x++;                            // skip comma separator
      break;

    }
    tempBuff[x] = ReadBuffer[x];
    x++;
  }

  //find # separating character
  while(1)
  {
    if (ReadBuffer[x] == '#')
    {
      x++;
      break;
    }
    x++;
  }
  // read <length> field,  how many digits to read next
  sNumChars[0] = ReadBuffer[x++];
  sNumChars[1] = '\0';               // null terminate as a string
  numDig = atoi(sNumChars);          // convert to integer

  // numDig  to  how many bytes to expect in measurement data
    for (i=0; i<numDig; i++)
  {
    sNumChars[i] = ReadBuffer[x++];
  }
  sNumChars[i] = '\0';               // null terminate as a string

  // totalBytes is the number of binary data bytes we must read
    totalBytes = atoi(sNumChars);

  // initialise pointer pCF to variable fval. pCF can now access
   // any byte in fval in any order
  pCF = (char *)&fval;

  // copy each byte from data buffer at the specified offset to
  // obtain a floating point reading
  for ( i=0; i<totalBytes; i+=4)
  {
    // switch least significant word to most significant word,
    // keep little endian format
    *(pCF + 2) = ReadBuffer[x++];
       *(pCF + 3) = ReadBuffer[x++];
    *(pCF + 0) = ReadBuffer[x++];
    *(pCF + 1) = ReadBuffer[x++];

    // write floating point value to file
    fprintf( fp,"%.3f  ",fval);

    fprintf( fp,"%c",'\n');          // move to newline
    pCF = (char *)&fval;             // re-initialise pointer
  }
}
```

Offset Tables Binary to Float Conversion using Microsoft Visual C

This example in C using Microsoft Visual Studio shows how to convert Offset Table data from binary format to floating point 32-bit little-endian format. The binary data is acquired by sending the command GPIB SNOTBO command.

```
/* GLOBAL VARIABLES DECLARATION */
typedef union
{
  char cval[4];
  float fval;
  short ival;
  long lval;
} data_bytes;

char buffer[4096];            // gpib data array
float real_freq[200];         // 200 offset table entries maximum
float real_offset[200];
float real_cal[200];
data_bytes bin_data;

/*
** This function decodes binary formatted offset table data.
** In this example the function expect the binary data to be held
** in the global character array buffer. The binary data acquired
** from the instrument will be in the following format:
**  SNOTBO #<length><num_bytes>,<bin_data_block>
** where:
**  <length>          The number of characters in the <num_bytes>
**                    field
**  <num_bytes>       The number of bytes in <bin_data_block>,
**                    following the comma (,)
**  <bin_data_block>  <id_string><num_entries><offset_tbl_entries>
** where:
**  <id_string>                 10 bytes (9 for the identity, plus a
                           NULL
**                              terminator byte)
**  <num_entries>               2 bytes representing the number of
                           table
**                              entry pairs
**  <offset_tbl_entries>   <element1> … <elementN>
** where:
**  <elementN>                  8-byte frequency/power-offset values
*/
void decode_bin_offset_table(void)
{
  int count;
  long *bin_value;
  char *cptr;
  char ch_val[6];
  int length;

  // Decode header
  cptr = strtok(&buffer[0],"#");      // Find # character
  cptr = strtok(NULL,"#");
  // Get the number of characters for binary length, null
  // terminate and convert to integer
  ch_val[0] = *cptr++;
  ch_val[1] = NULL;

   // count is the number of characters to expect next
  count = atoi(&ch_val[0]);

  // Get binary data length field, and convert to integer
  for (loop = 0; loop < count; loop++)
  {
   ch_val[loop] = *cptr++;
  }
  ch_val[count] = NULL;

   // length value is how many data bytes are in the buffer
  length = atoi(&ch_val[0]);

  *cptr++;              // skip the comma character

  // The binary offset table may contain up to 200 sets
  // frequency-power entry pairs. Each element of a single entry
  // pair (e.g. frequency or power)is represented by a 4-byte
  // single precision floating point number. To extract data
  // correctly we must re-order each byte to form a floating point
  // number in 32-bit little-endian format
  count = 0;
  loop = 0;
  while (count < length)
  {
    // Frequency conversion
    bin_data.cval[2] = *cptr++;
    bin_data.cval[3] = *cptr++;
    bin_data.cval[0] = *cptr++;
    bin_data.cval[1] = *cptr++;
    real_freq[loop] = bin_data.fval;
    // dB conversion
    bin_data.cval[2] = *cptr++;
    bin_data.cval[3] = *cptr++;
    bin_data.cval[0] = *cptr++;
    bin_data.cval[1] = *cptr++;
    real_offset[loop++] = bin_data.fval;
    count += 8;
  }
}
```

Cal Factor Tables Binary to Float Conversion using Microsoft Visual C

This example in C using Microsoft Visual Studio shows how to convert Cal Factor Table data from binary format to floating point 32-bit little-endian format. The binary data is acquired by sending the command GPIB SNCTBO command.

```
/* GLOBAL VARIABLES DECLARATION */
typedef union
{
  char cval[4];
  float fval;
  short ival;
  long lval;
} data_bytes;

char buffer[4096];            // gpib data array
float real_freq[200];         // 200 offset table entries maximum
float real_offset[200];
float real_cal[200];
data_bytes bin_data;

/*
** This function decodes binary formatted cal factor table data.
** In this example the function expect the binary data to be held
** in the global character array buffer. The binary data acquired
** from the instrument will be in the following format:
**  SNCTBO<ws><bin_data_len><,><bin_data_block>
** where:
**  <bin_data_len>     Total length in bytes of <bin_data_block>
**  <bin_data_block>   <id_string><num_entries><cal_factor_entries>
** where:
**  <id_string>            8 bytes (7 for the identity, plus a NULL
**                                           terminator byte)
**  <num_entries>          2 bytes representing the table number of
**                                           entry pairs
**  <cal_factor_entries>   The frequency/cal_factor data pairs
**                                                          in binary
                           format
*/
void Decode_Bin_Cal_Factor_Table(void)
{
  int data_idx = 0, count = 0, val_cnt = 0, loop;
  int length, table_entries;
  char arr_ch[6], ident[10], ch;
  char *cptr;
  float freq, cal;

  // skip header 'SNCTBO ' by 7 chars
  data_idx = 7;

  // read binary data length field and convert to integer
  while(1)
  {
    ch = buffer[data_idx];
    if(ch == ',')
```

```
      break;
    arr_ch[count++] = ch;
    data_idx++;
  }
  arr_ch[data_idx] = '\0';
  length = atoi(arr_ch);

  // skip one byte to set pointer after the comma
  data_idx++;
  cptr = &buffer[data_idx];

  // Read the table identity character string, max 8 chars
  count = 8;
  for (loop = 0; loop < count; loop++)
  {
    ident[loop] = *cptr++;
    length = length - 1;
  }
  ident[count] = '\0';

  // Read number of entries
  bin_data.cval[0] = *cptr++;
  bin_data.cval[1] = *cptr++;
  bin_data.cval[2] = 0;
  bin_data.cval[3] = 0;
  table_entries = bin_data.ival;
  length = length - 2;

  // cal factor table frequency/cal_factor pairs are encoded as:
  // frequency:   32768.0e-6 * LONG INTEGER (4 bytes)
  // cal factor:  1024 * INTEGER (2 bytes)
  count = 0;
  while (count < length)
  {
    // Frequency conversion
    bin_data.cval[0] = *cptr++;
    bin_data.cval[1] = *cptr++;
    bin_data.cval[2] = *cptr++;
    bin_data.cval[3] = *cptr++;
    freq = ((float)(bin_data.lval))/(float)32768e-6;

    // dB conversion
    bin_data.cval[0] = *cptr++;
    bin_data.cval[1] = *cptr++;
    bin_data.cval[2] = 0;
    bin_data.cval[3] = 0;
    cal = ((float)(bin_data.ival))/(float)1024.0;
    count += 6;

    // write results to a file
    fprintf( fp,"%.2f  ",freq);
    fprintf( fp,"%c  ",',');
    fprintf( fp,"%.2f  ",cal);
    fprintf( fp,"%c",'\n');
  }
```

Appendix C. GPIB PC Card Set-up

The following GPIB driver configuration set up is recommended for reliable GPIB communication with the ML248xA / ML249xA. The set up is expressed in the terms used by the National Instruments GPIB ISA and PCI cards and drivers for Windows and DOS.

GPIB Card Settings

The recommended GPIB board settings are as follows:

Terminate read on EOS	NO
Set EOI with EOS on write	YES
Type of compare on EOS	8 bit
Send EOI at end of write	YES
EOS byte	10 (0x0A hexadecimal)
System controller	YES
Assert REN when SC	YES
Enable Auto serial polling	NO
NI card. Cable length for HS488	Disabled

GPIB Device Template

The ML248xA / ML249xA GPIB Default Primary Address is 13. If you decide to use this Primary Address you need to select Device 13 (DEV13) from the ‘Device Template’ list. Once selected you select ‘Configure’ to modify the Device configuration as follows:

Primary Address	13
Secondary address	NONE
Terminate Read on EOS	YES
Set EOI with EOS on Write	YES
Type of Compare on EOS	8-bit
Send EOI at end of Write	YES
EOS Byte	10 (0x0A hexadecimal)
Repeat Addressing	YES

Appendix D. Terminology Glossary

Item	Explanation
Action Commands	A command mnemonic used to carry out a specific action (e.g. zoom in / out).
CIC	The controller (usually a PC) in charge of controlling and co-ordinating communication with devices attached to the GPIB bus.
Command Unit	A complete command formatted with parameters and terminators.
Configuration Commands	Commands issued to instrument that change a specific instrument configuration.
Data Acquisition Commands	Commands used to obtain measurement data from instrument.
GPIB	General Purpose Interface Bus
GPIB Controller	A device in charge of controlling and co-ordinating communication with devices attached to the GPIB bus.
IEEE 488.1	The original GPIB specification.
IEEE 488.2	The second GPIB specification that built on the original by defining a minimum set of device interface, a common set of data codes and formats, a device message protocol, and a status reporting model.
Message	A sequence of commands used together to configure the instrument in a specified manner.
Mnemonic	The GPIB command name, e.g., CHACTIV
Query Command	A command mnemonic used to request information from the instrument. A query command mnemonic is usually the same as the Set Command with a question mark appended.
Set Command	A command mnemonic that changes a specific configuration setting.
Terminator	A specific action used to indicate the termination of a GPIB message string.

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