MX887060A
IEEE 802.15.4
TX Measurement
Operation Manual

Fourth Edition

- **For safety and warning information, please read this manual before attempting to use the equipment.**
- **Additional safety and warning information is provided in the MT8870A Universal Wireless Test Set Operation Manual. Please also refer to this document before using the equipment.**
- **Keep this manual with the equipment.**

ANRITSU CORPORATION

Document No.: M-W3744AE-4.0

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These indicate that the marked part should be recycled.

MX887060A
IEEE 802.15.4 Measurement
Operation Manual

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1. Product Model

Software: MX887060A IEEE 802.15.4 TX Measurement

2. Applied Directive and Standards

When the MX887060A IEEE 802.15.4 TX Measurement is installed in the MT8870A, the applied directive and standards of this software conform to that of the MT8870A main frame.

PS: About main frame
Please contact Anritsu for the latest information on the main frame types that MX887060A can be used with.

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RCM marking

1. Product Model

Software: MX887060A IEEE 802.15.4 TX Measurement

2. Applied Directive and Standards

When the MX887060A IEEE 802.15.4 TX Measurement is installed in the MT8870A, the applied directive and standards of this software conform to that of the MT8870A main frame.

PS: About main frame

Please contact Anritsu for the latest information on the main frame types that MX887060A can be used with.

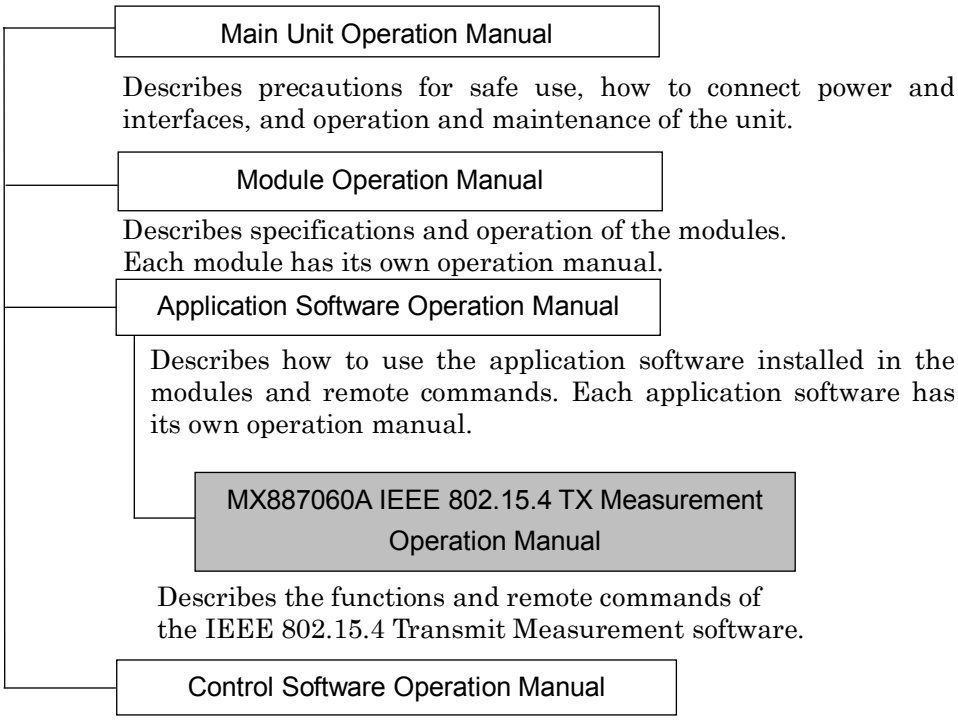
About This Manual

This manual mainly describes the use, panels, and specifications of the MX887060A IEEE 802.15.4 TX Measurement.

Products related to the MT8870A Universal Wireless Test Set include:

- MT8870A Universal Wireless Test Set (main unit)
- Modules installed in the MT8870A
- Application software installed in the modules
- Control software installed in a PC controller

These products are referred to as the "Universal Wireless Test Set Series". The operation manuals of the Universal Wireless Test Set Series consist of separate documents for the main unit, module(s), application software, and control software, as shown below. ▭ represents this manual.



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IV.

Chapter 1 Outline

This chapter outlines the MX887060A IEEE802.15.4 Tx Measurement. Refer to Appendix A “Specifications” for the software function and specifications.

1.1 Outline

The MX887060A IEEE802.15.4 TX Measurement (hereafter MX887060A) measures the Radio characteristics of the device under test (DUT) corresponding to standard IEEE802.15.4 Low-Rate Wireless Personal Area Networks (LR-WPANs) specified by IEEE (The Institute of Electrical and Electronics Engineers, Inc).

The RF signal output from the MU887000A is input to the RF connector of the DUT and the signal output from the DUT is input to the MU887000A.

Any file pattern can be specified at the MX887060A to send to DUT as the signal waveform. The MX887060A is sent as a modulation signal pattern read from memory, irrespective of the DUT signal information (non-signalling).

The MX887060A software does not support signalling transmission methods in which the DUT signal information is detected and the output signal modulation is changed.

1.2 Features

The MX887060A software features:

High-speed measurement

High-speed measurement is supported by the latest processor and measurement algorithm.

1.3 Composition

The composition of the MX887060A is shown in the Table 1.3-1. The electronic files are stored in one or more storage media (DVD, etc.).

Table 1.3-1 Composition

Model/Code	Name	Remarks
MX887060A	IEEE 802.15.4 TX Measurement	—
W3744AE	MX887060A IEEE 802.15.4 TX Measurement Operation Manual	English

1.4 License Registration

Before the MX887060A software can be used, the software license must be registered in the MU887000A.

Refer to Chapter 8 “Utility Tool” in *the MU887000A TRX Test Module Operation Manual* for the license registration procedure.

1.5 Abbreviations

The abbreviations used in this manual are listed in Table 1.5-1.

Table 1.5-1 Abbreviations

Abbreviations	Name
ACK	Acknowledge
AVG	Average
DUT	Device Under Test
EVM	Error Vector Magnitude
IEEE	The Institute of Electrical and Electronics Engineers, Inc
LR-WPANs	Low-Rate Wireless Personal Area Networks
O-QPSK	Offset Quadrature Phase Shift Keying
PER	Packet Error Rate
PHR	PHY Header
PHY	Physical layer
PPDUs	PHY Protocol Data Units
PSD	Power Spectral Density
RC	Raised Cosine
SCPI	Standard Commands for Programmable Instruments
SFD	Start-of-Frame Delimiter
SHR	Synchronization Header

Chapter 2 Fundamental Measurement

This chapter describes the fundamental functions and commands of the MX887060A. For details of the commands, refer to Chapter 3 “SCPI Command Reference” and Chapter 4 “Native Command Reference”.

2.1 Common Operations

This section explains operation of MX887060A software.
Both Native and SCPI commands are described in the introduction to commands.

2.1.1 Selecting application

Switch the MU887000A application software to LRWPAN by using the following command.

```
SYSSEL
:INSTrument[:SELect]
```

Switch the target measurement standard using the following command.
Set the parameter to WP4 when the measuring object is IEEE 802.15.4.

```
STDSEL, CONF:LRWP:STAN
:CONFigure:LRWPan:STANdard
```

2.1.2 Setting ports

Set the MU887000A ports to be used. The following command sets both the port for outputting the signal and the port for receiving the signal of the device under test (DUT).
Set Port1 to Port4 at the parameter

```
PORT
:ROUTe:PORT:CONNect:DIRection
```

When setting the sequence table in sequence measurement, the sequence commands set only the output port to Port 1 to Port 4.
The above-mentioned command sets the receiving port.

2.1.3 Frequency and level

Frequency

Set the MU887000A receiving frequency and MU887000A transmitting frequency using the following commands.

- Measuring Frequency (Transmitting frequency of DUT)
  `CONF:LRWP:FREQ`
  `:CONFigure:LRWPan:FREQuency`
- Transmitting Frequency (Receiving frequency of DUT)
  `SOUR:GPRF:GEN:RFS:FREQ`
  `:SOURce:GPRF:GENerator:RFSettings:FREQuency`

Level

Set the level of the signal received by and sent from the MU887000A using the following commands.

- Input Level
  `CONF:LRWP:POW`
  `:CONFigure:LRWPan:POWer`
- Output Level
  `SOUR:GPRF:GEN:RFS:LEV`
  `:SOURce:GPRF:GENerator:RFSettings:LEVel`

Refer to Chapter 5 “SCPI Command Reference” in the *MU887000A TRX Test Module Operation Manual* for detail descriptions of the commands setting the transmitting frequency and output level.

Cable loss correction

The loss of coaxial cables can be corrected for the output, input, and measured levels.
Refer to Chapter 3 “Fundamental Operation” in the *MU887000A TRX Test Module Operation Manual* for an explanation of the commands and loss correction data.

2.1.4 Setting transmission signal

To transmit the waveform pattern from MU887000A, load the waveform file into the waveform memory, and then follow the procedure below:

1. Select the waveform file in the waveform memory.
2. Select the waveform pattern in the waveform file selected in step 1.
3. Set the Modulation On/Off and Output On/Off.

Use the following commands to set these settings.
Refer to Chapter 5 "SCPI Command Reference" in the *MU887000A TRX Test Module Operation Manual* for detail descriptions of the commands.

- To load the waveform file into the waveform memory
  `SOUR:GPRF:GEN:ARB:FILE:LOAD`
  `:SOURce:GPRF:GENerator:ARB:FILE:LOAD`
- To query the file name in the waveform memory
  `SOUR:GPRF:GEN:ARB:WAV:NAME`
  `:SOURce:GPRF:GENerator:ARB:WAVeform:NAME`
- To optimize the waveform memory capacity
  `SOUR:GPRF:GEN:ARB:WAV:DEFR`
  `:SOURce:GPRF:GENerator:ARB:WAVeform:DEFRag`
- To delete the waveform file in the waveform memory
  `SOUR:GPRF:GEN:ARB:WAV:DEL`
  `:SOURce:GPRF:GENerator:ARB:WAVeform:DELete`
- To query the waveform memory free space
  `SOUR:GPRF:GEN:ARB:WAV:FREE`
  `:SOURce:GPRF:GENerator:ARB:WAVeform:FREE`

- Waveform Pattern Select
  `SOUR:GPRF:GEN:ARB:WAV:PATT:SEL`
  `:SOURce:GPRF:GENerator:ARB:WAVeform:PATTern:SELect`
- Modulation On/Off
  `SOUR:GPRF:GEN:BBM`
  `:SOURce:GPRF:GENerator:BBMode`
- Output On/Off
  `SOUR:GPRF:GEN:STAT`
  `:SOURce:GPRF:GENerator:STATe`

2.1.5 Waveform patterns

To send an IEEE 802.15.4 waveform pattern, specify a file of MV887060A IEEE 802.15.4 waveform files as the waveform file.

Refer to Chapter 3, “Waveform File Details” in the *Waveform File for IEEE 802.15.4 Application Operation Manual* for an explanation of the MV887060A IEEE 802.15.4 Waveform files.

2.1.6 Setting IEEE 802.15.4 signal

Set the following items to measure the IEEE 802.15.4 signal.

PHY

Sets the Physical Layer type. Selects O-QPSK PHY.

Band

The target signal sets the band to use. IEEE 802.15.4 defines the characteristics of the signal to use by their PHY and Band.

Table 2.1.6-1 Setting Items

PHY	Band	Data Rate	Chip Rate	Filter
O-QPSK	2450	250 kb/s	2000 kchip/s	half-sine
	915	250 kb/s	1000 kchip/s	half-sine
	868	100 kb/s	400 kchip/s	half-sine
	780	250 kb/s	1000 kchip/s	raised cosine (roll-off = 0.8)

The above parameters are to specify signal characteristics. By specifying measurement frequency, the measurement can be performed in the frequency different from the predetermined one.

The below values can be checked by commands after setting PHY and Band.

Modulation

Check the modulation method information of the signals defined by PHY and Band settings.

Data Rate

Check the Data Rate information of the signals defined by PHY and Band settings.

Chip Rate

Check the Chip Rate information of the signals defined by PHY and Band settings.

Filter

Check the Filter information of the signals defined by PHY and Band settings.

The following commands are used to set the IEEE 802.15.4 signal.

- PHY
  `CONF:LRWP:WP4:PHY`
  `:CONFigure:LRWPan:WP4:PHY`
- Band
  `CONF:LRWP:WP4:PHY:BAND`
  `:CONFigure:LRWPan:WP4:PHY:BAND`
- Modulation (Query only)
  `CONF:LRWP:WP4:PHY:INFO:MOD?`
  `:CONFigure:LRWPan:WP4:PHY:INFO:MODulation?`
- Data Rate (Query only)
  `CONF:LRWP:WP4:PHY:INFO:BRAT?`
  `:CONFigure:LRWPan:WP4:PHY:INFO:BRATe?`
- Chip Rate (Query only)
  `CONF:LRWP:WP4:PHY:INFO:CRAT?`
  `:CONFigure:LRWPan:WP4:PHY:INFO:CRATe?`
- Filter (Query only)
  `CONF:LRWP:WP4:PHY:INFO:FILT?`
  `:CONFigure:LRWPan:WP4:PHY:INFO:FILTer?`

Note:

Perform the settings in the following order.
Standard, PHY, Band

2.1.7 Common settings on Measurement items

Signal Format

Specifies the signal format.

Burst: Used for measuring IEEE 802.15.4 signals.

Continuous: Used for measuring IEEE 802.15.4 continuous signals and CW power (unmodulated continuous wave). However, when measuring CW, the results other than Transmit Power will be invalid. Used for Chapter 5 “Performance Test”.

Trigger Source

Selects a method to detect the position to start loading waveform after the measurement starts.

LEVEL: Detects the rise in the DUT signal level and starts loading waveform. Sets the signal detection level by Trigger Level.

SG MARKER1: Detects the Marker position set for the waveform selected as transmission signal, and starts loading waveform.

FREERUN: Starts loading waveforms right after measurement starts. Available only when Signal Format is continuous.

Note:

Select FREERUN when Signal Format is Continuous. When LEVEL or SG MARKER1 are selected, loading waveform does not start after the measurement starts, and a timeout error occurs.

Trigger Level

Sets the signal detection level in dB.
The total of the input level described in 2.1.3 “Frequency and level” and this setting value will be detection level.

Example: When the input level value is –10 dBm and the Trigger Level value is –20dB:
Signal Detection Level = –10 + (–20) = –30 dBm

When Signal Format is Burst, a trigger signal is detected based on the set value of this parameter regardless of Trigger Source type. The signals below the detection level are not the target for detection.
Also, after one trigger signal is detected, the following signals detected during the interval of Measurement Offset value + Measurement Interval value cannot be triggers.

When Signal Format is Burst, transmit burst signals with Off intervals of 1 data symbol or more between them. The length of 1 data symbol depends on PHY and Band settings. Refer to Table 2.1.7-1.

Table 2.1.7-1 Setting Items

PHY	Band	data symbol*	Chip	Symbol*
O-QPSK	2450	1	32	16
	915		16	8
	868		16	8
	780		16	8

*: For definitions of "Data symbol" and "Symbol" in this software, refer to Section 2.1.7.1 "Symbol".

Capture Time

Sets an interval to capture waveforms after measurement starts.
The timing to start loading waveforms depends on the Trigger Source setting.
Capturing waveforms is aborted when the signal analysis set by Storage Count is completed while loading waveforms is still in progress.

Storage Count

Sets the signal number (Packet number) to measure.
When failed to detect signals in the number set by Storage Count within the time set by Capture Time, only the detected signals are measured. In this case, the measurement status is 14. (Refer to Section 2.1.8 "Measurement start and end".)

Sync Mode

Sets how to specify reference position for deciding analysis position.

Off: Does not synchronize signals. The time when a signal rise is detected will be the reference position.

SFD: Starts searching for the SFD pattern after detecting the signal rise. Find the preamble position from the SFD, and make its head the reference position.

Note:

When Signal Format is Continuous, the setting of this parameter is invalid. The MX887060A operates in a state where Sync Mode is Off.

Measurement Offset

Sets the position to start analyzing.
The measurement starts after the interval from the reference position to this parameter value is over.

Measurement Interval

Decides the analysis interval.
The interval from the measurement start position to this parameter value is the analysis target.

Set the Measurement Interval value (symbol) + Measurement Offset value (symbol) to 4096 or under.

The unit of Measurement Offset and Measurement Interval is “Chip” or “Symbol”. However, this “symbol” is different from the “symbol” used in IEEE802.15.4 standards.
Refer to Section 2.1.7.1 “Symbol” for details.

The following commands are used for the Common settings among measurement items.

- Signal Format
  CONF:LRWP:SIGN:FORM
  :CONFigure:LRWPan:SIGNal:FORMat
- Trigger Source
  CONF:LRWP:TRIG
  :CONFigure:LRWPan:TRIGger
- Trigger Level
  CONF:LRWP:TLEV
  :CONFigure:LRWPan:TLEVel
- Sync Mode
  CONF:LRWP:SYNC:MODE
  :CONFigure:LRWPan:SYNC:MODE
- Measurement Offset
  CONF:LRWP:MEAS:OFFS
  CONF:LRWP:MEAS:OFFS:CHIP
  :CONFigure:LRWPan:MEAS:OFFSet
  :CONFigure:LRWPan:MEAS:OFFSet:CHIP
- Measurement Interval
  CONF:LRWP:MEAS:INT
  CONF:LRWP:MEAS:INT:CHIP
  :CONFigure:LRWPan:MEAS:INTerval
  :CONFigure:LRWPan:MEAS:INTerval:CHIP
- Storage Count
  CONF:LRWP:STOR:COUN
  :CONFigure:LRWPan:STORage:COUNt
- Capture Time
  CONF:LRWP:CAPT:TIME
  :CONFigure:LRWPan:CAPTure:TIME

2.1.7.1 Symbol

This software defines “symbol” as a unit to represent a piece of information (I,Q) for outputting as RF signals, and it corresponds to 2 chips in IEEE 802.15.4 standards.

The “symbol” described in IEEE 802.15.4 standards is defined as “data symbol” in the software and this operation manual.

2.1.8 The other settings

EVM Calculation Reference

Sets reference for ideal power of signal when calculating EVM.

Actual: Calculates by ideal amplitude of the actual signal.

Offset: Calculates by ideal amplitude equivalent to that of Offset EVM calculation.

This parameter is effective for the EVM result, but not for the Offset EVM result.

2.1.9 Starting/stopping measurement

Starting measurement

To start measurement, send the following command.
The status indication lamp 3 of MU887000A is on during the execution of measurement or analysis. For the explanation of the status lamp, refer to Appendix D “Status Indication of lamps” in *the MU887000A TRX Test Module Operation Manual*.

```
INIT:LRWP
:INITiate:LRWPan
```

Stopping measurement

To stop measurement, send the following command.

```
ABOR:LRWP
:ABORt:LRWPan
```

Checking measurement status

To query the measurement status and errors, send the following command.

```
STAT:LRWP:MEAS?
:STATus:LRWPan:MEASurement?
```

Table 2.1.9-1 Query Responses

Response	Meaning
0	Measurement completed normally
2	Level exceeded The MU887000A receive level is higher than the set input level.
5	Synchronization word not detected Failed to detect SFD when Sync Mode was SFD, because the correct IEEE 802.15.4 signal was not output.
9	Measurement in progress or not executed
12	Tx measurement timeout No trigger occurred before measurement timed out
14	Transmission measurement timeout. The signals that are set by Storage Count are not detected within the time for loading waveforms.

The measurement status and errors can be queried using the status registers. Refer to Chapter 3 “Fundamental Operation” in the *MU887000A TRX Test Module Operation Manual* for an explanation of the status registers.

When the buzzer is On and the MX887060A detects the Level exceeded, the audible signals are emitted.
Refer to Chapter 3 “Fundamental Operation” in the *MU887000A TRX Test Module Operation Manual* for the buzzer setting.

The allocations of the MX887060A status registers are described in the following tables.

Native command mode:

Table 2.1.9-2 Bit Definitions of End Event Status Register (Signal Generator)

Bit	Description
7 to 1	Not used and always set to 0
0	Changed to 1 at end of reading waveform file

Table 2.1.9-3 Bit Definitions of End Event Status Register (Measurement)

Bit	Description
7 to 2	Not used and always set to 0
1	Changed to 1 after trigger prepared
0	Changed to 1 when measurement preparation completed

Table 2.1.9-4 Bit Definitions of Error Event Status Register (Signal Generator)

Bit	Description
7 to 1	Not used and always set to 0
0	Changed to 1 at error in read waveform file

Table 2.1.9-5 Bit Definitions of Error Event Status Register (Measurement)

Bit	Description
7 to 3	Not used and always set to 0
2	Changed to 1 at measurement timeout
1	Not used and always set to 0
0	Changed to 1 when measurement result over level

SCPI command mode:

Table 2.1.9-6 Bit Definitions of Signal Generator Status Register

Bit	Description
15 to 1	Not used and always set to 0
0	Changed to 1 while reading file

Table 2.1.9-7 Bit Definitions of Measurement Status Register

Bit	Description
15 to 2	Not used and always set to 0
1	Changed to 1 while preparing trigger
0	Changed to 1 during measurement

Table 2.1.9-8 Bit Definitions of Signal Generator Questionable Register

Bit	Description
15 to 1	Not used and always set to 0
0	Changed to 1 at error in read file

Table 2.1.9-9 Bit Definitions of Measurement Questionable Register

Bit	Description
15 to 3	Not used and always set to 0
2	Changed to 1 at measurement timeout
1	Not used and always set to 0
0	Changed to 1 when measurement result over level over

2.2 Modulation Analysis

Modulation Analysis measures the following items of DUT.

When PHY = O-QPSK

Transmit center frequency tolerance
Transmit power
Offset EVM
EVM
Origin Offset
Time Offset

Refer to section 2.2.1 to 2.2.5 for details of the items.

Modulation Analysis settings are:

Frequency of input signals

Set the frequency of the RF signal input to the MU887000A by referring to the Measuring Frequency command in section 2.1.3 “Frequency and level”.

Input level

Set the level of the RF signal input to the MU887000A by referring to the Input Level command in section 2.1.3 “Frequency and level”.

Port

Set the input port for the MU887000A by referring to the command in section 2.1.2 “Setting ports”.

Signal Setting

Perform the settings in section 2.1.6 “Setting IEEE 802.15.4 signal.”

Common settings on Measurement items

Perform the settings in section 2.1.7 “Common settings on Measurement items.”

Measurement On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:MOD
:CONFigure:LRWPan:SELect:MODulation
```

The commands for querying the Modulation Analysis measurement results are:

```
FETC:LRWP:MOD[n]?
:FETCh:LRWPan:MODulation[n]?
```

Refer to Chapter 3 for the details of the responses.

2.2.1 Transmit center frequency tolerance

Transmit center frequency tolerance measures frequency errors of the DUT signals.

For the reference frequency for error measurement, set the measurement frequency described in Section 2.1.3 “Frequency and level”.

When the storage count value is 2 or bigger, the maximum frequency error is a value with the maximum absolute value in each burst signal measurement results.

2.2.2 Transmit power

Transmit power measures the transmit power of the DUT signals.

2.2.3 Offset EVM

Offset EVM (Offset Error Vector Magnitude) is the magnitude ratio of the error vector to the reference vector. The error vector is the difference between the vector of the measured signal and the reference vector.

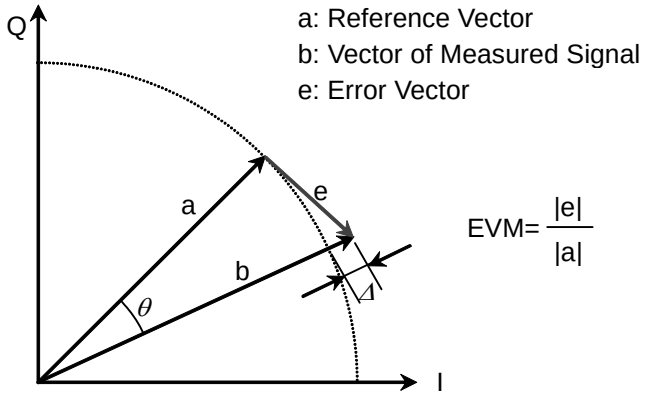

Figure 2.2.3-1 Definition of EVM

In Offset-QPSK, Phase Q is behind Phase I by 1 chip. Offset EVM is calculated by using the corrected IQ value with Phase Q shifted by 1 chip (IQ value of 1 symbol).

Refer to Section 2.1.7.1 “Symbol” for details of symbol.

Measure Offset EVM every 1 symbol, the root mean square value of all symbols in the specified analysis interval is Offset EVM (rms) and the maximum value among all symbols is Offset EVM (peak).

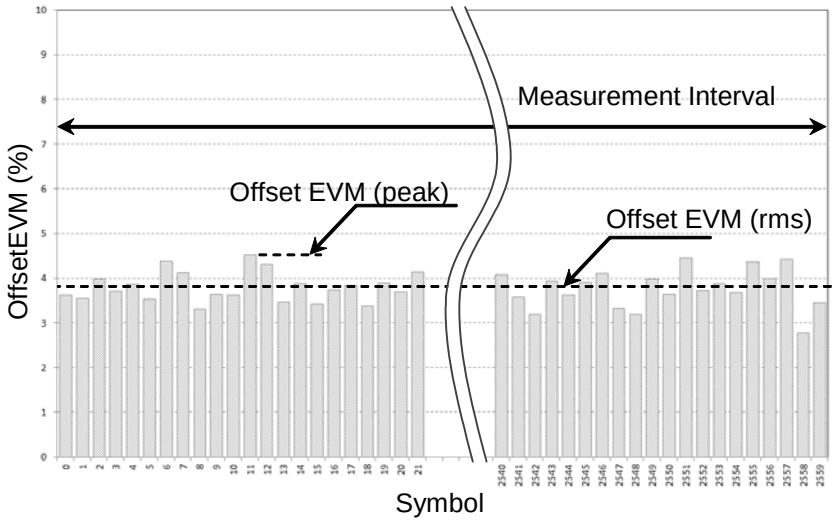

Figure 2.2.3-2 Difference between Offset EVM (rms) and Offset EVM (peak)

2.2.4 EVM

EVM (Error Vector Magnitude) is the magnitude ratio of the error vector to the reference vector. The error vector is the difference between the vector of the measured signal and the reference vector.

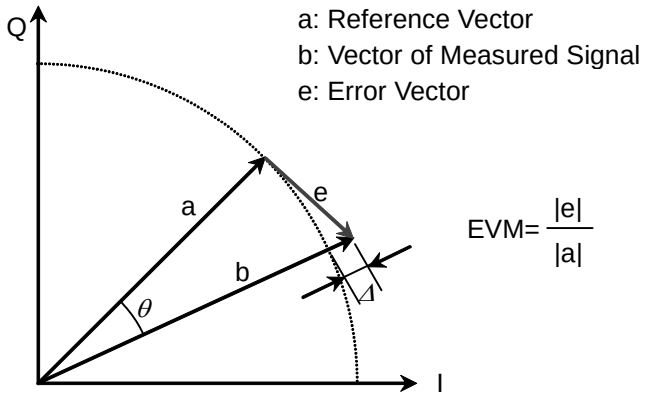

Figure 2.2.4-1 Definition of EVM

In Offset-QPSK, Phase Q is behind Phase I by 1 chip. EVM is calculated by using the 1 chip IQ value without Phase Q shifted by 1 chip.

Measure EVM every 1 chip, the root mean square value of all chip in the specified analysis interval is EVM (rms) and the maximum value among all symbols is EVM (peak).

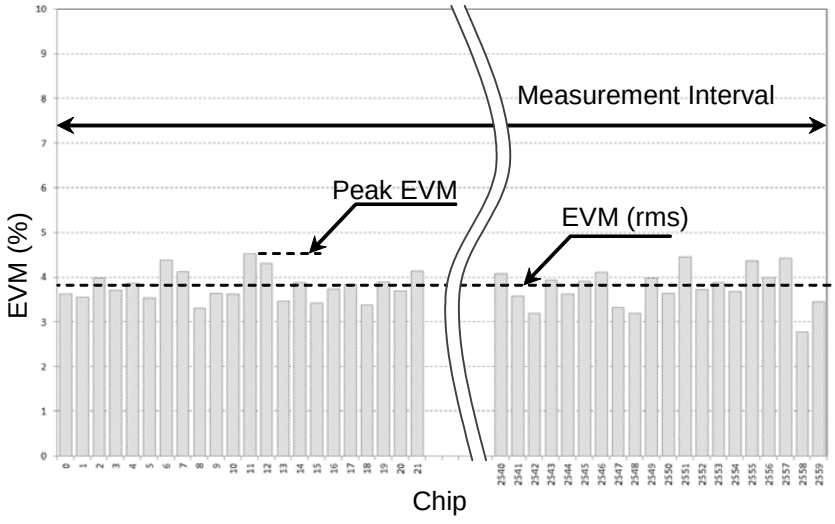

Figure 2.2.4-2 Difference between EVM (rms) and EVM (peak)

2.2.5 Origin Offset

The Origin Offset is the offset of the IQ vector origin calculated as:

$$offset = 20\log_{10}\left(\frac{|offset\_vector|}{|Referrence\_vector|}\right) \text{ (dB)}$$

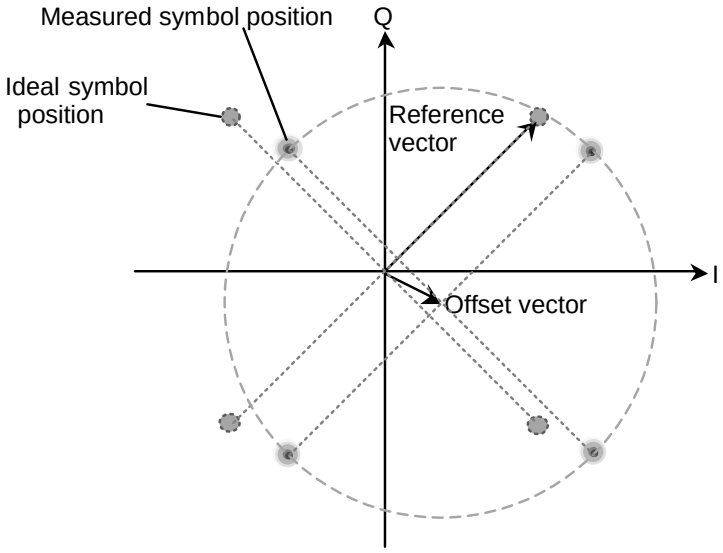

Figure 2.2.5-1 Definition of Origin Offset

2.2.6 Time Offset

Time Offset measures the time difference from the trigger detection time to the signal preamble head.

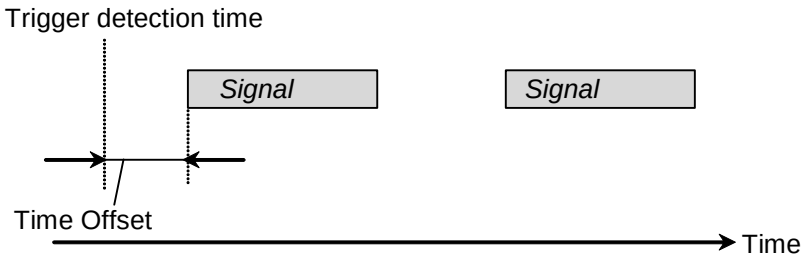

Figure 2.2.6-1 Definition of the timing error

The trigger is detected by the method set by Trigger Source.
The results of this measurement are valid when Trigger Source is SG Marker or Level.

Time Offset measures only the first signal after waveform loading starts. For that reason, it is not a target of storage.

2.3 Symbol Rate Error

In this measurement, Symbol Rate Error is measured from the Burst Interval value and the SFD cycle of the input signals.
To execute this measurement, known cycle signals should be input regularly.

The settings are:

Frequency of input signals

Set the frequency of the RF signal input to the MU887000A by referring to the Measuring Frequency commands in section 2.1.3 “Frequency and level” .

Input level

Set the level of the RF signal input to the MU887000A by referring to the Input Level command in section 2.1.3 “Frequency and level”.

Port

Set the input port for the MU887000A by referring to the command in section 2.1.2 “Setting ports”.

Signal Setting

Perform the settings in section 2.1.6 “Setting IEEE 802.15.4 signal.”

Common settings on Measurement items

Perform the settings in section 2.1.7 “Common settings on Measurement items.”

Measurement On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:SRER
:CONFigure:LRWPan:SELect:SRERror
```

Burst Interval

Set the Burst Interval using the following commands.
Calculates Symbol Rate Error from the Burst Interval value and the SFD cycle included in signals.

```
CONF:LRWP:BURS:INT
:CONFigure:LRWPan:BURSt:INTerval
```

The commands for querying the Symbol Rate Error measurement results are:

```
FETC:LRWP:MOD[n]?
:FETCh:LRWPan:MODulation[n]?
```

Refer to Chapter 3 for the details of the responses.

Note:

When Signal Format is Continuous, Symbol Rate Error cannot be measured. An invalid value is returned as result.

2.4 PSD Mask (Transmit power spectral density mask)

In PSD Mask measurement, pass/fail is judged and peak level is measured under the conditions selected by PSD Mask Type.

As PSD Mask Type, the mask defined by 10.3.2 “Transmit power spectral density (PSD) mask” in IEEE 802.15.4-2011 can be selected for the Band2450, 915, 780 signals.

The table below shows the values for PSD Mask judgment.

Table 2.4-1 Limit of PSD Mask Type 15_4_2450 (quotes from IEEE 802.15.4-2011 Table76)

Frequency	Relative limit	Absolute limit
$\lvert f - f_c \rvert > 3.5\,\mathrm{MHz}$	–20 dB	–30 dBm

RBW: 100 kHz
Detection range of Relative Limit reference level: $f_c \pm 600kHz$

Table 2.4-2 Limit of PSD Mask Type 15_4_915, or 15_4_780 (quotes from IEEE 802.15.4-2011 Table75)

Frequency	Relative limit	Absolute limit
$\lvert f - f_c \rvert > 1.2\,\mathrm{MHz}$	–20 dB	–20 dBm

RBW: 100 kHz
Detection range of Relative Limit reference level: $f_c \pm 1MHz$

The PSD Mask settings are:

Frequency of input signals

Set the frequency of the RF signal input to the MU887000A by referring to the Measuring Frequency commands in section 2.1.3 “Frequency and level”.

Input level

Set the level of the RF signal input to the MU887000A by referring to the Input Level command in section 2.1.3 “Frequency and level”.

Port

Set the input port for the MU887000A by referring to the command in section 2.1.2 “Setting ports”.

Measurement On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:PSDM
:CONFigure:LRWPan:SELect:PSDMask
```

PSD Mask Type

Select a judgment line type for PSD Mask measurement.
Please note that this parameter is reset to the default specified for each band when the band setting is changed.

Table 2.4-3 PHY, Band and default

PHY	Band	Selectable value	Default
O-QPSK	2450	15_4_2450	15_4_2450
	915	15_4_915	15_4_915
	868	NONE*	NONE*
	780	15_4_780	15_4_780

*: Returns a non-measured value for NONE.

PSD Mask Limit Offset abs

Add offset to the absolute limit value of the mask judgment line selected by PSD Mask Type. Use the following commands.

```
CONF:LRWP:PSDM:LIM:OFFS:ABS
:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS
```

PSD Mask Limit Offset rel

Add offset to the relative limit value of the mask judgment line selected by PSD Mask Type. Use the following commands.

```
CONF:LRWP:PSDM:LIM:OFFS:REL
:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative
```

The results of the spectrum emission mask measurement are as follows:

Numeric result

- Evaluation Result (total)
  The pass/fail threshold is decided by PSD Mask Type and Offset value. It is judged pass if the spectrum is just on the threshold or below, and judged fail if it exceeds.
- Reference level
  Reference level for relative limit. The highest level among the spectra in the detection range of each PSD Mask is the reference level.
- Evaluation Result (offset1)
  Same as Evaluation Result (total)
- Peak frequency (Offset1)
  The frequency of the point that has the least difference from the pass/fail threshold among the spectra in the judgement range. Peak frequency is returned as offset value from the center frequency.
- Peak level (Offset1)
  The level of the point [dBm] with the least difference from the pass/fail threshold among spectra in the judgement range.
- Margin (Offset1)
  The margin is the level difference [dB] between the point with the least difference from the pass/fail threshold and the pass/fail threshold among the spectra in the judgement range.

Graph result

- Spectrum
  Outputs waveforms. The frequency intervals are equal.
- Spectrum 2
  Outputs waveforms. This value is used for pass/fail judgment.
  The frequency intervals are partly unequal.
- Limit Line
  This value is used for pass/fail judgment regarding each frequency point of Spectrum 2. Compare the Absolute Limit value and the Relative Limit value, and take whichever is more severe.

The commands for querying the PSD Mask measurement results are:

- Numeric result (Pass/Fail Judgement, Reference level, Peak level etc.)
  `FETC:LRWP:PSDM?`
  `:FETCh:LRWPan:PSDMask?`

- Spectrum
  FETC:LRWP:PSDM:GRAP?
  :FETCh:LRWPan:PSDMask:GRAPh?
- The number of data of the Spectrum
  FETC:LRWP:PSDM:GRAP:NUMB?
  :FETCh:LRWPan:PSDMask:GRAPh:NUMBer?
- Spectrum 2
  FETC:LRWP:PSDM:GRAP2?
  :FETCh:LRWPan:PSDMask:GRAPh2?
- The frequency of each point of the Spectrum 2.
  FETC:LRWP:PSDM:GRAP2:FREQuency?
  :FETCh:LRWPan:PSDMask:GRAPh2:FREQ?
- The judgment value according to each point of the Spectrum 2.
  FETC:LRWP:PSDM:GRAP2:LIM?
  :FETCh:LRWPan:PSDMask:GRAPh2:LIMit?
- The number of data of the Spectrum 2
  FETC:LRWP:PSDM:GRAP2:NUMB?
  :FETCh:LRWPan:PSDMask:GRAPh2:NUMBer?

2.5 Constellation

This section explains outputting constellation graph data.
Phase I and Phase Q values are output alternatively with Phase Q shifted by 1 chip.

The setting required for outputting the constellation graph data is as below.

The settings for Modulation Analysis measurement

Calculate the constellation graph data in the process of Modulation Analysis measurement. The same settings as Modulation Analysis are required.

Refer to Section 2.2 “Modulation Analysis”.

Graph result On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:CONS
:CONFigure:LRWPan:SELect:CONStellation
```

Use the following commands to query the Constellation graph data:

- Constellation graph data
  ```
  FETC:LRWP:CONS:GRAP?
  :FETCh:LRWPan:CONStellation:GRAPh?
  ```
- Constellation graph data number
  ```
  FETC:LRWP:CONS:GRAP:NUMB?
  :FETCh:LRWPan:CONStellation:GRAPh:NUMBer?
  ```

2.6 Data Table

This section explains outputting demodulated data of measurement signals.
Phase I and Phase Q data are output alternatively in either 0 or 1 for each chip datum.

The required settings for outputting the data table are as below.

Settings for Modulation Analysis

The data in the data table is calculated in the process of Modulation Analysis measurement. The same settings as Modulation Analysis are required.

Refer to Section 2.2 " Modulation Analysis."

Data Table On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:DATA
:CONFigure:LRWPan:SELect:DATA
```

Use the following commands to query the Data Table graph data:

- Data Table graph data
  ```
  FETC:LRWP:DATA?
  :FETCh:LRWPan:DATA?
  ```
- Data Table graph data number
  ```
  FETC:LRWP:DATA:NUMB?
  :FETCh:LRWPan:DATA:NUMBer?
  ```

2.7 Power vs Time

In Power vs Time, outputs the time change of DUT signal level.

The range to output is as below.

When PHY = O-QPSK

Output start position: Signal detection time – 100 symbol
Output end position: End position of analysis interval (Measurement Interval) + 100 symbol

Note:

Different from the "symbol" described in IEEE802.15.4, the definition of the above "symbol" is a value equivalent to 200 chips. Refer to Section 2.1.7.1 "Symbol" for details.

Only the last storage result is output as the result of this measurement.

Power vs Time settings are as below:

Frequency of input signals

Set the frequency of the RF signal input to the MU887000A by referring to the Measuring Frequency command in Section 2.1.3 "Frequency and level".

Input Level

Set the level of the RF signal input to the MU887000A by referring to the Input Level command in section 2.1.3 "Frequency and level".

Port

Set the input port for the MU887000A by referring to the command in section 2.1.2 "Setting ports".

Signal Setting

Perform the settings in section 2.1.6 "Setting IEEE 802.15.4 signal."

Common settings on Measurement items

Perform the settings in section 2.1.7 "Common settings on Measurement items."

Measurement On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:PVT
:CONFigure:LRWPan:SELect:PVTime
```

Use the following commands to query the Power vs Time graph data:

- Power vs Time graph data
  `FETC:LRWP:PVT:GRAP?`
  `:FETCh:LRWPan:PVTime:GRAPh?`
- Power vs Time graph data number
  `FETC:LRWP:PVT:GRAP:NUMB?`
  `:FETCh:LRWPan:PVTime:GRAPh:NUMBer?`

The sampling data smoothed by smoothing length is returned. (The data interval is equivalent to smoothing length.)

The detailed conditions are as the table below.

Table 2.7-1 Power vs Time measurement conditions

PHY	Band	Graph data
O-QPSK	2450	Smoothing length 1 [symbol] Data interval 1 [symbol]
	915, 780	
	868	

2.8 Power Monitor

This section explains the calculation of the following values for each burst signal.
Make sure the analysis interval is set within the burst signal On section.

- Difference between burst signal trigger detection time and analysis start position
- Ratio of the burst signal On section within the analysis interval

Frequency of input signals

Set the frequency of the RF signal input to the MU887000A by referring to the Measuring Frequency command in Section 2.1.3 “Frequency and level”.

Input level

Set the level of the RF signal input to the MU887000A by referring to the Input Level command in Section 2.1.3 “Frequency and level”.

Port

Set the input port for the MU887000A by referring to the command in section 2.1.2 “Setting ports”.

Signal Setting

Perform the settings in Section 2.1.6 “Setting IEEE 802.15.4 signal.”

Common settings on Measurement items

Perform the settings in Section 2.1.7 “Common settings on Measurement items.”

Measurement On/Off

Set the measurement On/Off using the following commands.

```
CONF:LRWP:SEL:PMON
:CONFigure:LRWPan:SELect:PMONitor
```

Use the following commands to query the Power Monitor results:
The number of responses is the same as the set value for Storage Count.

- Difference between burst signal trigger detection time and analysis start position

  ```
  FETC:LRWP:PMON1?
  :FETCh:LRWPan:PMONitor1?
  ```

- Ratio of the burst signal On section within the analysis interval

  ```
  FETC:LRWP:PMON2?
  :FETCh:LRWPan:PMONitor2?
  ```

2.9 Detected Signal

The detected signal number is queried when the signals set by Storage Count are not detected within the time set by Capture Time.

The following values are returned to the query of signal detection result.

- Set number for Storage Count
- Detected signal number

Use the following commands to query.

```
FETC:LRWP:DSIG?
:FETCh:LRWPan:DSIGnals?
```

2.10 Packet Error Rate

Signals are output from the MU887000A to measure Packet Error Rate at DUT.

Note:

DUT needs a function to measure Packet Error Rate based on FCS information.

Use the following waveform pattern for Packet Error Rate measurement.

File Name: MV887060A_ZB2450_0001
MV887060A_ZB915_0001
MV887060A_ZB868_0001
MV887060A_ZB780_0001

Group Number: 1

For details of the functions and commands to control the transmit signal, refer to Chapter 5 “SCPI Command Reference” in the *MU887000A TRX Test Module Operation Manual*.

For details of the waveform pattern, refer to the *Waveform Files for IEEE 802.15.4 Application Operation Manual*.

2.11 Sample Program

This section describes a sample program using free Tera Term software. For the Tera Term communication settings of, refer to 2.3.1 “Ethernet” in the *MU887000A TRX Test Module Operation Manual*.

2.11.1 Example of Transmit measurement

An example of Measurement Sample Program using the SCPI command mode is described here.

The sample program on the following pages can be executed as a Tera Term macro. Refer to the Tera Term Help file for how to execute the macro.

Processing Flow

1. Set the application software type to the MX887060A.
2. Set the following measurement conditions:

Test Port	Port 2
Input Level	–10 dBm
Measuring Frequency	2450 MHz
Standard	WP4 (IEEE 802.15.4)
PHY	O-QPSK
Band	2450
Signal Format	Burst
Trigger Source	Level
Trigger Level	–20 dB
Capture Time	2 s
Storage Count	1
Sync Mode	SFD
Measurement Offset	0
Measurement Interval	500
PSD Mask Type	15_4_2450
Modulation Analysis On/Off	ON
PSD Mask On/Off	ON
Symbol Rate Error On/Off	OFF
Constellation On/Off	ON
Data Table On/Off	OFF
Power vs Time On/Off	OFF
Power Monitor On/Off	OFF

3. Start measurement.
4. Read the measurement status
5. After measurement is completed, query the following measurement results:
   Transmit center frequency tolerance, Transmit Power,
   Offset EVM (rms), Origin Offset, PSD Mask judgement results
6. Query the following waveform data:
   Constellation (I), Constellation (Q)

```
; Sample program for Modulation Analysis and PSD Mask
; Anritsu Corporation September,2014
; Macro for Tera Term Version 4.69
;
; set local echo to on
setecho 1
flushrecv
; time out 3 second
timeout=3

; Set language to "SCPI".
sendln ':SYSTem:LANGuage SCPI'
call check_error_code

; Set application type to "LRWPAN".
sendln ':INSTrument:SELect LRWPAN'
call check_error_code

; Set standard to "WP4 (IEEE 802.15.4)".
sendln ':CONFigure:LRWPan:STANdard WP4'
call check_error_code

; Set test port to "PORT2".
sendln ':ROUTe:PORT:CONNect:DIRection PORT2,PORT2'
call check_error_code

; Set Input Range to "-10 dBm".
sendln ':CONFigure:LRWPan:POWer -10'
call check_error_code

; Set center frequency to "2450 MHz".
sendln ':CONFigure:LRWPan:FREQuency 2450MHZ'
call check_error_code

; Set PHY to "OQPSK".
sendln ':CONFigure:LRWPan:WP4:PHY OQPSk'
call check_error_code

; Set Band to "2450".
sendln ':CONFigure:LRWPan:WP4:PHY:BAND 2450'
call check_error_code

; Set Signal Format to "Burst".
sendln ':CONFigure:LRWPan:SIGNal:FORMat BURSt'
```

```
call check_error_code

; Set Trigger Source to "Level".
sendln ':CONFigure:LRWPan:TRIGger LEVEL'
call check_error_code

; Set Trigger Level to "-20 dB".
sendln ':CONFigure:LRWPan:TLEVel -20'
call check_error_code

; Set Capture Time to "2 s".
sendln ':CONFigure:LRWPan:CAPTure:TIME 2'
call check_error_code

; Set Storage Count to "1".
sendln ':CONFigure:LRWPan:STORage:COUNt 1'
call check_error_code

; Set Sync Mode to "SFD".
sendln ':CONFigure:LRWPan:SYNC:MODE SFD'
call check_error_code

; Set Measurement Offset to "0".
sendln ':CONFigure:LRWPan:MEAS:OFFSet 0'
call check_error_code

; Set Measurement Interval to "500".
sendln ':CONFigure:LRWPan:MEAS:INTerval 500'
call check_error_code

; Set PSD Mask Type to "15_4_2450".
sendln ' :CONFigure:LRWPan:PSDMask:TYPE 15_4_2450'
call check_error_code

; Set Measurement of Modulation Analysis to "ON".
sendln ':CONFigure:LRWPan:SELect:MODulation ON'
call check_error_code

; Set Measurement of PSD Mask to "ON".
sendln ':CONFigure:LRWPan:SELect:PSDMask ON'
call check_error_code

; Set Measurement of Symbol Rate Error to "OFF".
sendln ':CONFigure:LRWPan:SELect:SRERror OFF'
```

```
call check_error_code

; Set Measurement of Constellation to "ON".
sendln ':CONFigure:LRWPan:SELect:CONStellation ON'
call check_error_code

; Set Measurement of Data Table to "OFF".
sendln ':CONFigure:LRWPan:SELect:DATA OFF'
call check_error_code

; Set Measurement of Power vs Time to "OFF".
sendln ':CONFigure:LRWPan:SELect:PVTime OFF'
call check_error_code

; Set Measurement of Power Monitor to "OFF".
sendln ':CONFigure:LRWPan:SELect:PMONitor OFF'
call check_error_code

; Start measurement
sendln ':INITiate:LRWPan'
call check_error_code

; waiting measurement up to 10 second
for i 1 10

  sendln ':STATus:LRWPan:MEASurement?'
  pause 1; wait 1 second
  recvln
  recvln
  str2int inputstrNum inputstr
  if inputstrNum=0 then
         ;call check_response  ; debug
         if result=0 goto _timeout
         if result=1 then
                break
         endif
         call check_error_code
  endif
next

; Query  Transmit center frequency tolerance,Transmit Power,EVM(rms) ,Origin
Offset
sendln ':FETCh:LRWPan:MODulation?'
call check_error_code
```

```
; Query PSD Mask
sendln ':FETCh:LRWPan:PSDMask?'
call check_error_code

; Query Constellation Graph
sendln ':FETCh:LRWPan:CONStellation:GRAPh?'
call check_error_code

messagebox  'Macro end successfully' 'Finish'

End

;       ------------ subroutines -----------

:check_error_code
  ; query error
  sendln ':SYSTem:ERRor?'
  waitln 'No error'

  ; in case of timeout
  if result=0 goto _timeout
  ; in case of error occurring
  if result=2 then
         e_message='Error code = '
         strconcat e_message inputstr
         messagebox  e_message 'Command Error occurred'
         end
  endif

  ; in case of no error

return

:check_response

  ;for debug
  messagebox inputstr 'debug1'
  int2str result_str result
  messagebox result_str 'debug2'

  return

:_timeout
```

```
messagebox  'No response from MT8870A.' 'Time out!'
call check_error_code
End
```

2.11.2 Example of transmit the waveform for Packet Error Rate

An example of Measurement Sample Program using the SCPI command mode is described here.

The sample program on the following pages can be executed as a Tera Term macro. Refer to the Tera Term Help file for how to execute the macro.

Purpose of Process

To transmit the waveform “MV887060A_ZB2450_0001” 100 times.

Processing Flow

1. Set VSG operation mode to NORMAL and set the signal output conditions as below.

Test Port	Port 1, Port 2 (Output Port: Port 2)
VSG operation mode	NORMAL
Operation mode after sequence ends	1 (NORMAL)
RF signal output	ON
Baseband mode	CW output
RF output level	–120 dBm
Waveform to load in waveform memory	MV887060A_ZB2450_0001 ZERO_16000KHZ_16000P
Sequence start segment number and end segment number	Sequence Table 1, 1 to 2
Sequence repeat method	Sequence Table 1, SINGLE
Start segment number of the 2nd sequence or later in repetition	Sequence Table 1, 1
End conditions for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, TRIGGER Sequence Table 1, 2, SNUMBER
Trigger source for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, WFGEND Sequence Table 1, 2, WFGEND
Delay time for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, 0 ms Sequence Table 1, 2, 0 ms
Repetition control for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, NSEGMENT Sequence Table 1, 2, LOOP
Baseband mode for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, ARB (Modulation Output) Sequence Table 1, 2, ARB (Modulation Output)
Waveform change trigger for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, OFF Sequence Table 1, 2, OFF

Output level for the specified 1 segment of SG sequencer data	Sequence Table 1, 2, –120 dBm
Output port for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, Port 2 Sequence Table 1, 2, Port 2
Waveform file name and group number in waveform list table	Sequence Table 1, Waveform list index 1,ZERO_16000KHZ_16000P, 1 Sequence Table 1, Waveform list index 2,ZERO_16000KHZ_16000P, 1 Sequence Table 1, Waveform list index 3,ZERO_16000KHZ_16000P, 1
Remove waveform file from waveform list table	Sequence Table 1, Waveform list index 4
Change conditions for waveform list table	Sequence Table 1, Waveform list index 1, REPEAT Sequence Table 1, Waveform list index 2, REPEAT Sequence Table 1, Waveform list index 3, NONE
Repetition count of waveform pattern	Sequence Table 1, Waveform list index 1, 1 time Sequence Table 1, Waveform list index 2, 1 time Sequence Table 1, Waveform list index 3, 1 time
Trigger output for SG sequencer when switching waveform patterns in waveform list table	Sequence Table 1, Waveform list index 1, OFF Sequence Table 1, Waveform list index 2, ON Sequence Table 1, Waveform list index 3, OFF
Number of sequence tables and execution order	1, Sequence Table 1

2. Set VSG operation mode to SEQUENCE, and set the signal output conditions as below.

Test Port	Port 1, Port 2
VSG operation mode	SEQUENCE
Waveform file name and group number in waveform list table	Sequence Table 1, Waveform list index 2, MV887060A_ZB2450_0001,1
Repetition count of waveform patterns	Sequence Table 1, Waveform list index 2, 100 times
Frequency for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, 2450 MHz Sequence Table 1, 2, 2450 MHz
Output level for the specified 1 segment of SG sequencer data	Sequence Table 1, 1, –10 dBm

3. Starts signal output.

```
; Sample program for Packet Error Rate
; Anritsu Corporation September,2014
; Macro for Tera Term Version 4.69
;
; set local echo to on
setecho 1
flushrecv
; time out 3 second
timeout=3

; Set language to "SCPI".
sendln 'SYST:LANG SCPI'
call check_error_code

; Set test port to "PORT1, PORT2".
sendln ':ROUT:PORT:CONN:DIR PORT1,PORT2'
call check_error_code

; Set VSG Mode  to "NORMAL".
sendln ':SOURce:GPRF:GENerator:MODE NORMAL'
call check_error_code

; Set Sequence Reinitialization to "1".
sendln ':SOURce:GPRF:GENerator:SEQuence:REINitialization 1'

; Set RF Output   to "ON".
sendln ':SOURce:GPRF:GENerator:STATe ON'
call check_error_code

; Set Modulation  to "CW".
sendln ':SOURce:GPRF:GENerator:BBMode CW'
call check_error_code

; Set Level to "-120dBm".
sendln ':SOURce:GPRF:GENerator:RFSettings:LEVel -120'
call check_error_code

; Deleting All Waveform Files in ARB Memory.
sendln ':SOURce:GPRF:GENerator:ARB:WAVeform:DELete:ALL'
call check_error_code

; Waveform File Loading "MV887060A_ZB2450_0001".
sendln ':SOURce:GPRF:GENerator:ARB:FILE:LOAD "MV887060A_ZB2450_0001"'
call check_error_code
```

```
sendln '*WAI'

; Waveform File Loading "ZERO_16000KHZ_16000P".
sendln ':SOURce:GPRF:GENerator:ARB:FILE:LOAD "ZERO_16000KHZ_16000P"'
call check_error_code
sendln '*WAI'
; Set Sequence Start and Stop Segment to "1","1","2".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:GENeral:SSTop 1,1,2'
call check_error_code

; Set Sequence Repetition Mode to "1","SINGLE".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:GENeral:REPetition 1,SINGLE'
call check_error_code

; Set Sequence Start Index for continuous mode to "1","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:GENeral:GOTO 1,1'
call check_error_code

; Set End Condition of Segment in Sequence to "1","1","TRIGGER".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:ENDCondition 1,1,TRIGGER'
call check_error_code

; Set End Condition of Segment in Sequence to "1","2","SNUMBER".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:ENDCondition 1,2,SNUMBER'
call check_error_code

; Set Trigger Source of Segment in Sequence to "1","1","WFGEND".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:TRIGger:SOURce 1,1,WFGEND'
call check_error_code

; Set Trigger Source of Segment in Sequence to "1","2","WFGEND".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:TRIGger:SOURce 1,2,WFGEND'
call check_error_code

; Set Trigger Delay of Segment in Sequence to "1","1","0 ms".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:TRIGger:DELay 1,1,0.000'
call check_error_code

; Set Trigger Source of Segment in Sequence to "1","2","0 ms".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:TRIGger:DELay 1,2,0.000'
call check_error_code

; Set Loop Control of Segment in Sequence to "1","1","NSEGMENT".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:NSLControl 1,1,NSEGMENT'
```

```
call check_error_code

; Set Loop Control of Segment in Sequence to "1","2","LOOP".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:NSLControl 1,2,LOOP'
call check_error_code

; Set Base Band Mode of Segment in Sequence to "1","1","ARB".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:BBMode 1,1,ARB'
call check_error_code

; Set Base Band Mode of Segment in Sequence to "1","2","ARB".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:BBMode 1,2,ARB'
call check_error_code

; Set Waveform Change Trigger of Segment in Sequence to "1","1","OFF".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:WCTRigger 1,1,OFF'
call check_error_code

; Set Waveform Change Trigger of Segment in Sequence to "1","2","OFF".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:WCTRigger 1,2,OFF'
call check_error_code

; Set Level of Segment in Sequence to "1","2","-120 dBm".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:LEVel 1,2,-120DBM'
call check_error_code

; Set Output Port of Segment in Sequence to "1","1","PORT2".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:OUTPut:STATe 1,1,PORT2'
call check_error_code

; Set Output Port of Segment in Sequence to "1","2","PORT2".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:OUTPut:STATe 1,2,PORT2'
call check_error_code

; Set Sequence Waveform Pattern Configuration to
"1","1","ZERO_16000KHZ_16000P","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:PATTern:SELect
1,1,"ZERO_16000KHZ_16000P",1'
call check_error_code

;Set Sequence Waveform Pattern Configuration to "1","2","ZERO_16000KHZ_16000P",
"1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:PATTern:SELect
1,2,"ZERO_16000KHZ_16000P",1'
```

```
call check_error_code

; Set Sequence Waveform Pattern Configuration to
"1","3","ZERO_16000KHZ_16000P","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:PATTern:SELect
1,3,"ZERO_16000KHZ_16000P",1'
call check_error_code

; Set Sequence Waveform Pattern Delete "1","4".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:PATTern:DELete 1,4'
call check_error_code

; Set Pattern End Condition of Sequence Waveform to "1",”1”,”REPEAT”.
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:ENDCondition 1,1,REPEAT'
call check_error_code

; Set Pattern End Condition of Sequence Waveform to "1","2","REPEAT".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:ENDCondition 1,2,REPEAT'
call check_error_code

; Set Pattern End Condition of Sequence Waveform to "1","3","NONE".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:ENDCondition 1,3,NONE'
call check_error_code

; Set Repetition Count of Sequence Waveform Pattern to "1","1","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:IREPetition 1,1,1'
call check_error_code

; Set Repetition Count of Sequence Waveform Pattern to "1","2","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:IREPetition 1,2,1'
call check_error_code

; Set Repetition Count of Sequence Waveform Pattern to "1","3","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:IREPetition 1,3,1'
call check_error_code

; Set Group End Trigger of Sequence Waveform Pattern to "1","1","0".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:GETRigger 1,1,0'
call check_error_code

; Set Group End Trigger of Sequence Waveform Pattern to "1","2","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:GETRigger 1,2,1'
call check_error_code
```

```
; Set Group End Trigger of Sequence Waveform Pattern to "1","3","0".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:GETRigger 1,3,0'
call check_error_code

; Set Sequence Table Combination Selection to "1","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:COMBination:PATTern 1,1'
call check_error_code

; Set VSG Mode to "SEQUENCE".
sendln ':SOURce:GPRF:GENerator:MODE SEQUENCE'
call check_error_code

; Set Sequence Waveform Pattern Configuration to "1","2","
MV887060A_ZB2450_0001","1".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:PATTern:SELect 1,2,
"MV887060A_ZB2450_0001",1'
call check_error_code

; Set Repetition Count of Sequence Waveform Pattern to "1","2","100".
sendln ':SOURce:GPRF:GENerator:SEQuence:WAVeform:IREPetition 1,2,100'
call check_error_code

; Set Frequency of Segment in Sequence to "1",”1”,”2450 MHz”.
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:FREQuency 1,1,2450MHZ'
call check_error_code

; Set Frequency of Segment in Sequence to "1","2","2450 MHz".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:FREQuency 1,2,2450MHZ'
call check_error_code

; Set Level of Segment in Sequence to "1","1","-10 dBm".
sendln ':SOURce:GPRF:GENerator:SEQuence:RX:LEVel 1,1,-10DBM'
call check_error_code

; Sequence Execution.
sendln ':SOURce:GPRF:GENerator:SEQuence:EXECute'
call check_error_code
messagebox  'Macro end successfully' 'Finish'

End

;       ------------ subroutines -----------

:check_error_code
```

```
  ; query error
  sendln ':SYSTem:ERRor?'
  waitln 'No error'

  ; in case of timeout
  if result=0 goto _timeout
  ; in case of error occurring
  if result=2 then
         e_message='Error code = '
         strconcat e_message inputstr
         messagebox  e_message 'Command Error occurred'
         end
  endif

  ; in case of no error

return

:check_response
  ;for debug
  messagebox inputstr 'debug1'
  int2str result_str result
  messagebox result_str 'debug2'

  return

:_timeout
  messagebox  'No response from MT8870A.' 'Time out!'
  call check_error_code
  End
```

Chapter 3 SCPI Command Reference

This chapter describes the details of SCPI commands.
To switch to the SCPI command mode, send the command SYST:LANG SCPI.

3.1 List of Commands

The following table shows the rules for describing messages.

[ ]	Messages or parameters in square brackets can be omitted.
|	Choose one of several choices. A | B | C | D indicates a choice of A, B, C, and D.
{}	Choose one of the groups in braces. A | B({C | D}) indicates a choice of A, B(C), or A, B(D).

3.1.1 Common commands

Operation Status Register

Function	Command	Query	Response
Measurement Operation Status Register Query	-----	:STATus:LRWPan:MEASurement?	<response>

Common

Function	Command	Query	Response
Standard	:CONFigure:LRWPan:STANdard <mode>	:CONFigure:LRWPan:STANdard?	<mode>
Set Connect Port Direction	:ROUTe:PORT:CONNect:DIRection <in>,<out>	:ROUTe:PORT:CONNect:DIRection?	<in>,<out>

Measurements

Function	Command	Query	Response
Measurement Stop	:ABORt:LRWPan	-----	-----
Measurement Start	:INITiate:LRWPan	-----	-----

Common Parameters

Function	Command	Query	Response
PHY (802.15.4)	:CONFigure:LRWPan:WP4:PHY <mode>	:CONFigure:LRWPan:WP4:PHY?	<mode>
Band (802.15.4)	:CONFigure:LRWPan:WP4:PHY:BAND <mode>	:CONFigure:LRWPan:WP4:PHY:BAND?	<mode>
Modulation Scheme	-----	:CONFigure:LRWPan:WP4:PHY:INFO:MODulation?	<mode>
Chip Rate	-----	:CONFigure:LRWPan:WP4:PHY:INFO:CRATe?	<mode>
Bit Rate	-----	:CONFigure:LRWPan:WP4:PHY:INFO:BRATe?	<mode>
Filter	-----	:CONFigure:LRWPan:WP4:PHY:INFO:FILTer?	<mode>

System

Function	Command	Query	Response
Application Select	:INSTrument[:SELect] <app>	:INSTrument[:SELect]?	<app>
Language Selection of Remote Command	:SYSTem:LANGuage <mode>	:SYSTem:LANGuage?	<mode>

3.1.2 Fundamental measurement commands

Common Parameters

Function	Command	Query	Response
Center Frequency	:CONFigure:LRWPan:FREQuency <freq>	:CONFigure:LRWPan:FREQuency?	<freq>
Input Level	:CONFigure:LRWPan:POWer <level>	:CONFigure:LRWPan:POWer?	<level>
Input Level (W)	:CONFigure:LRWPan:POWer:WATT <level>	:CONFigure:LRWPan:POWer:WATT ?	<level>
Trigger Source	:CONFigure:LRWPan:TRIGger <mode>	:CONFigure:LRWPan:TRIGger?	<mode>
Trigger Level	:CONFigure:LRWPan:TLEVel <trglevel>	:CONFigure:LRWPan:TLEVel?	<trglevel>

Fundamental Measurement Parameters

Function	Command	Query	Response
Signal Format	:CONFigure:LRWPan:SIGNal:FORMat <mode>	:CONFigure:LRWPan:SIGNal:FORMat?	<mode>
Sync Mode	:CONFigure:LRWPan:SYNC:MODE <mode>	:CONFigure:LRWPan:SYNC:MODE?	<mode>
Measurement Interval	:CONFigure:LRWPan:MEAS:INTerval <range>	:CONFigure:LRWPan:MEAS:INTerval?	<range>
Measurement Interval (chip)	:CONFigure:LRWPan:MEAS:INTerval:CHIP <range>	:CONFigure:LRWPan:MEAS:INTerval:CHIP?	<range>
Measurement Offset	:CONFigure:LRWPan:MEAS:OFFSet <range>	:CONFigure:LRWPan:MEAS:OFFSet?	<range>
Measurement Offset (chip)	:CONFigure:LRWPan:MEAS:OFFSet:CHIP <range>	:CONFigure:LRWPan:MEAS:OFFSet:CHIP?	<range>
Burst Interval	:CONFigure:LRWPan:BURSt:INTerval <range>	:CONFigure:LRWPan:BURSt:INTerval?	<range>
Burst Interval (time)	:CONFigure:LRWPan:BURSt:INTerval:TIME <range>	:CONFigure:LRWPan:BURSt:INTerval:TIME?	<range>
Capture time	:CONFigure:LRWPan:CAPTure:TIME <range>	:CONFigure:LRWPan:CAPTure:TIME?	<range>
Storage Count	:CONFigure:LRWPan:STORage:COUNt <range>	:CONFigure:LRWPan:STORage:COUNt?	<range>
PSD Mask Type	:CONFigure:LRWPan:PSDMask:TYPE <type>	:CONFigure:LRWPan:PSDMask:TYPE?	<type>

Fundamental Measurement Parameters (Cont'd)

Function	Command	Query	Response
PSD Mask Limit Offset abs	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS <level>	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS?	<level>
PSD Mask Limit Offset rel	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative <level>	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative?	<level>
EVM Calculation Reference	:CONFigure:LRWPan:CALCulation:EVM:REFerence <mode>	:CONFigure:LRWPan:CALCulation:EVM:REFerence?	<mode>
Modulation Analysis On/Off	:CONFigure:LRWPan:SELect:MODulation <mode>	:CONFigure:LRWPan:SELect:MODulation?	<mode>
PSD Mask On/Off	:CONFigure:LRWPan:SELect:PSDMask <mode>	:CONFigure:LRWPan:SELect:PSDMask?	<mode>
Constellation On/Off	:CONFigure:LRWPan:SELect:CONStellation <mode>	:CONFigure:LRWPan:SELect:CONStellation?	<mode>
Symbol Rate Error On/Off	:CONFigure:LRWPan:SELect:SRERror <mode>	:CONFigure:LRWPan:SELect:SRERror?	<mode>
Data Table On/Off	:CONFigure:LRWPan:SELect:DATA <mode>	:CONFigure:LRWPan:SELect:DATA?	<mode>
Power vs Time On/Off	:CONFigure:LRWPan:SELect:PVTime <mode>	:CONFigure:LRWPan:SELect:PVTime?	<mode>
Power vs Monitor On/Off	:CONFigure:LRWPan:SELect:PMONitor <mode>	:CONFigure:LRWPan:SELect:PMONitor?	<mode>
All Measurement On/Off	:CONFigure:LRWPan:SELect:ALL <mode>	:CONFigure:LRWPan:SELect:ALL?	<mode>

Results

Function	Command	Query	Response
Modulation Analysis Result	-----	:FETCh:LRWPan:MODulation[n]?	Refer to Table 3.2.2-2.
PSD Mask Result (Numeric)	-----	:FETCh:LRWPan:PSDMask?	<res1>,<res2>,...<resN>
PSD Mask Result (graph - level)	-----	:FETCh:LRWPan:PSDMask:GRAPh[n]?	<res1>,<res2>,...<resN>
PSD Mask Result (graph data number)	-----	:FETCh:LRWPan:PSDMask:GRAPh[n]:NUMBer?	<res>
PSD Mask Result (graph - frequency)	-----	:FETCh:LRWPan:PSDMask:GRAPh2:FREQuency?	<freq1>,<freq2>,...<freqN>
PSD Mask Result (graph - limit line)	-----	:FETCh:LRWPan:PSDMask:GRAPh2:LIMit?	<level1>,<level2>,...<levelN>
Constellation (graph)	-----	:FETCh:LRWPan:CONStellation:GRAPh?	<res1>,<res2>,...<resN>
Constellation (graph data number)	-----	:FETCh:LRWPan:CONStellation:GRAPh:NUMBer?	<res>
Data Table	-----	:FETCh:LRWPan:DATA?	<res1>,<res2>,...<resN>
Data Table (data number)	-----	:FETCh:LRWPan:DATA:NUMBer?	<res>
Power vs Time (graph)	-----	:FETCh:LRWPan:PVTime:GRAPh?	<res1>,<res2>,...<resN>
Power vs Time (graph data number)	-----	:FETCh:LRWPan:PVTime:GRAPh:NUMBer?	<res>
Power Monitor	-----	:FETCh:LRWPan:PMONitor[n]?	<res1>,<res2>,...<resN>
Detected Signals	-----	:FETCh:LRWPan:DSIGnals?	<res1>,<res2>

3.2 Details of Commands

This section describes commands in alphabetic order.

■ Terms in this command list

EX ..... Command name (header)

Example ..... Command function name

Function ..... Command function

Command..... Programming command syntax

Query ..... Query syntax

Response .....Response syntax

Parameter ..... Parameter definition

Details ..... Command restrictions and others

Example of Use..... Command usage example

Related Commands .....Introduction of related commands

■ Suffix Code list

Suffix Code	Unit	Suffix Code	Unit
%	%	MS	ms
DB	dB	MW	mW
DBM	dBm	MZ	MHz
FW	fW	NS	ns
GHZ	GHz	NW	nW
GZ	GHz	PW	pW
HZ	Hz	S	s
KHZ	kHz	US	µs
KZ	kHz	UW	µW
KW	kW	W	W
MHZ	MHz		

3.2.1 Common commands

:ABORt:LRWPan

Measurement Stop

Function

Stops current measurement

Command

```
:ABORt:LRWPan
```

Example of Use

To stop measurement:
:ABOR:LRWP

:CONFigure:LRWPan:STANdard

Standard

Function

Sets or queries measurement standard

Command

```
:CONFigure:LRWPan:STANdard <mode>
```

Query

```
:CONFigure:LRWPan:STANdard?
```

Response

<mode>

Parameter

<mode>	Standard
WP4	IEEE 802.15.4
Default	WP4

Details

IEEE 802.15.4 is a standard for the ZigBee physical layer.

Example of Use

To set the measurement standard to IEEE 802.15.4:
:CONF:LRWP:STAN WP4
:CONF:LRWP:STAN?
> WP4

Related Commands

The commands below are used to set the signal type.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:CONFigure:LRWPan:WP4:PHY

PHY (802.15.4)

Function

Sets or queries the Modulation scheme

Command

```
:CONFigure:LRWPan:WP4:PHY <mode>
```

Query

```
:CONFigure:LRWPan:WP4:PHY?
```

Response

<mode>

Parameter

<mode>	Modulation scheme
OQPSk	O-QPSK
Default	OQPSk

Details

This command is available when Standard is set to IEEE 802.15.4.

Example of Use

To set the Modulation scheme to O-QPSK:
:CONF:LRWP:WP4:PHY OQPS
:CONF:LRWP:WP4:PHY?
> OQPS

Related Commands

The commands below are used to set the signal type.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:CONFigure:LRWPan:WP4:PHY:BAND

Band (802.15.4)

Function

Sets or queries frequency band.

Command

```
:CONFigure:LRWPan:WP4:PHY:BAND <mode>
```

Query

```
:CONFigure:LRWPan:WP4:PHY:BAND?
```

Response

<mode>

Parameter

<mode>	Frequency Band
780	780 MHz band
868	868 MHz band
915	915 MHz band
2450	2450 MHz band
Default	2450

Details

This command is available when Standard is set to IEEE 802.15.4.

Example of Use

To set the frequency band to 2450 MHz band:
:CONF:LRWP:WP4:PHY:BAND 2450
:CONF:LRWP:WP4:PHY:BAND?
> 2450

Related Commands

The commands below are used to set the signal type.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:CONFigure:LRWPan:WP4:PHY:INFO:BRATe?

Bit Rate

Function

Queries Bit Rate specified by Band and PHY

Query

```
:CONFigure:LRWPan:WP4:PHY:INFO:BRATe?
```

Response

<mode>

Parameter

<mode>	Bit Rate
100	100
250	250

Details

This command is available when Standard is set to IEEE 802.15.4.

Example of Use

To query Bit Rate:
:CONF:LRWP:WP4:PHY:INFO:BRAT?
> 250

Related Commands

This command queries the physical layer information of the signals set by the commands below.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:CONFigure:LRWPan:WP4:PHY:INFO:CRATe?

Chip Rate

Function

Queries Chip Rate specified by Band and PHY

Query

```
:CONFigure:LRWPan:WP4:PHY:INFO:CRATe?
```

Response

<mode>

Parameter

<mode>	Chip Rate
400	400 kchip/s
1000	1000 kchip/s
2000	2000 kchip/s

Details

This command is available when Standard is set to IEEE 802.15.4.

Example of Use

To query Chip Rate:
:CONF:LRWP:WP4:PHY:INFO:CRAT?
> 2000

Related Commands

This command queries the physical layer information of the signals set by the commands below.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:CONFigure:LRWPan:WP4:PHY:INFO:FILTer?

Filter

Function

Queries Filter specified by Band and PHY

Query

```
:CONFigure:LRWPan:WP4:PHY:INFO:FILTer?
```

Response

<mode>

Parameter

<mode>	Transmit Filter Type
HSIN	Half-sine Filter
RC	Raised-cosine Filter

Details

This command is available when Standard is set to IEEE 802.15.4.

Example of Use

To query Filter:
:CONF:LRWP:WP4:PHY:INFO:FILT?
> RC

Related Commands

This command queries the physical layer information of the signals set by the commands below.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:CONFigure:LRWPan:WP4:PHY:INFO:MODulation?

Modulation Scheme

Function

Queries Modulation Scheme specified by Band and PHY

Query

```
:CONFigure:LRWPan:WP4:PHY:INFO:MODulation?
```

Response

<mode>

Parameter

<mode>		Modulation scheme
	OQPS	O-QPSK

Details

This command is available when Standard is set to IEEE 802.15.4.

Example of Use

To query Modulation Scheme
:CONF:LRWP:WP4:PHY:INFO:MOD?
> OQPS

Related Commands

This command queries the physical layer information of the signals set by the commands below.
:CONFigure:LRWPan:STANdard
:CONFigure:LRWPan:WP4:PHY <mode>
:CONFigure:LRWPan:WP4:PHY:BAND <mode>

:INITiate:LRWPan

Measurement Start

Function

Executes measurement

Command

`:INITiate:LRWPan`

Details

When this command is sent, the measurement is executed only once.
If sending this command during the measurement, the measurement is interrupted for a moment and is resumed.
The timing of measurement completion needs synchronous processing by *WAI.

Example of Use

To start measurement:
:INIT:LRWP
*WAI
:FETC:LRWP:MOD1?
> 1.67,2.28,0.00068163,0.00093061,-10.77,-10.77,0.0836579084396362,0.0836996957659721,...

Related Commands

:STATus:LRWPan:MEASurement?

:INSTrument[:SELect]

Application Select

Function

Sets or queries type of application software executing on MU887000A

Command

```
:INSTrument[:SELect] <app>
```

Query

```
:INSTrument[:SELect]?
```

Response

<app>

Parameter

<app>		Type of application software
	CELLULAR	Cellular Application MX887010A, MX887011A, MX887012A, MX887013A, MX887014A, MX887015A, MX887016A, or MX887017A
	SRW	Short Range Wireless Application MX887030A, MX8877031A, MX8867040A, or MX887050A
	LRWPAN	IEEE 802.15.4 Application MX887060A

Details

Set the parameter to LRWPAN and send the command before using the MX887060A.

Example of Use

To set the application software to IEEE 802.15.4 Application:
:INST LRWPAN
:INST?
> LRWPAN

Remarks

Select LRWPAN by INSTrument[:SELect] and set WP4 by :CONFigure:LRWPan:STANdard.

:ROUTe:PORT:CONNect:DIRection

Set Connect Port Direction

Function

Sets or queries connector settings for inputting and outputting RF signals

Command

```
:ROUTe:PORT:CONNect:DIRection <in>,<out>
```

Query

```
:ROUTe:PORT:CONNect:DIRection?
```

Response

<in>,<out>

Parameter

<in>	Test Port No.
PORT1	Test Port1
PORT2	Test Port2
PORT3	Test Port3
PORT4	Test Port4
Default	PORT1
<out>	Test Port No.
PORT1	Test Port1
PORT2	Test Port2
PORT3	Test Port3
PORT4	Test Port4
Default	PORT1

Details

MU887000A:
Both Test Port1 and Test Port2 can be set to input and output simultaneously.
Test Port3 and Test Port4 can be set to either input or output at one time.
MU887001A:
Test Port1 to 4 can be set to input and output simultaneously.

Example of Use

To set Test Port1 as RF signal input connector and Test Port2 as RF signal output connector:
:ROUT:PORT:CONN:DIR PORT1,PORT2
:ROUT:PORT:CONN:DIR?
> PORT1,PORT2

:SYSTem:LANGuage

Language Selection of Remote Command

Function

Switches language mode of remote control command

Command

```
:SYSTem:LANGuage <mode>
```

Query

```
:SYSTem:LANGuage?
```

Response

<mode>

Parameter

<mode>	Language mode
NAT	Native
SCPI	SCPI
Default	NAT

Example of Use

To switch the remote control command language mode to Native:

:SYST:LANG NAT

:SYST:LANG?

>NAT

:STATus:LRWPan:MEASurement?

Measurement Operation Status Register Query

Function

Queries content of measurement operation status register. The event occurrence can be identified using the retrieved value.

Query

```
:STATus:LRWPan:MEASurement?
```

Response

<response>

Parameter

<response>	Measurement Operation Status Register
0	Measurement completed normally
2	Level over
5	Failed to detect synchronous words
9	Measurement is in progress, or Not measured
12	No time out or trigger occurred (at Burst measurement only)
14	Time out or trigger occurred, but the signals up to the number set by storage count cannot be detected (only at Burst measurement).

Details

The measurement is aborted when the measurement state is 2 or 5.

Example of Use

To query content of measurement operation status register:
:STAT:LRWP:MEAS?
> 0

3.2.2 Fundamental measurement commands

:CONFigure:LRWPan:BURSt:INTerval

Burst Interval

Function

Sets or queries the signal cycle.
Used to measure Symbol Rate Error.

Command

```
:CONFigure:LRWPan:BURSt:INTerval <range>
```

Query

```
:CONFigure:LRWPan:BURSt:INTerval?
```

Response

<range>

Parameter

<range>	Signal cycle
Range	100 to (1 [s] × Symbol Rate [Hz])
Resolution	Symbol Rate [Hz] × 10^{-9}
Default	10000
Unit	symbol

Details

Symbol Rate Error is calculated using the difference of this setting and the actual measurement signal in Symbol Rate Error measurement.
The table below shows the Symbol Rate values according to the setting.

Standard	PHY	Band	Symbol Rate [Hz]
IEEE802.15.4	O-QPSK	780	500 000
		868	200 000
		915	500 000
		2450	1 000 000

Example of Use

To set the Signal cycle to 1000 symbol.
:CONF:LRWP:BURS:INT 10000
:CONF:LRWP:BURS:INT?
> 10000.0000

:CONFigure:LRWPan:BURSt:INTerval:TIME

Burst Interval (time)

Function

Sets or queries the signal cycle.

Command

```
:CONFigure:LRWPan:BURSt:INTerval:TIME <range>
```

Query

```
:CONFigure:LRWPan:BURSt:INTerval:TIME?
```

Response

<range>

Parameter

<range>	Signal cycle
Range	(100 [symbol] / symbol Rate [Hz]) to 0.1
Resolution	0.000000001 s
Suffix code	S, MS, US, NS (uses S when omitted)
Default	0.01
Unit	s

Details

Symbol Rate Error is calculated using the difference of this setting and the actual measured signal in Symbol Rate Error measurement.
The table below shows Symbol Rate values according to the setting.

Standard	PHY	Band	Symbol Rate [Hz]
IEEE802.15.4	O-QPSK	780	500 000
		868	200 000
		915	500 000
		2450	1 000 000

Example of Use

To set Signal cycle to 0.01 s:
:CONF:LRWP:BURS:INT:TIME 0.01
:CONF:LRWP:BURS:INT:TIME?
> 0.010000000

:CONFigure:LRWPan:CALCulation:EVM:REFerence <mode>

EVM Calculation Reference

Function

Sets amplitude of ideal signal as a reference for calculating EVM.

Command

```
:CONFigure:LRWPan:CALCulation:EVM:REFerence <mode>
```

Query

```
:CONFigure:LRWPan:CALCulation:EVM:REFerence?
```

Response

<mode>

Parameter

<mode>		Reference Amplitude
	ACTual	Calculate EVM from the reference amplitude of EVM constellation.
	OFFSet	Calculate EVM from the reference amplitude of Offset EVM constellation.
	Default	ACTual

Details

This function is effective for EVM, but not for Offset EVM when PHY is O-QPSK.

Example of Use

To set the reference amplitude for calculating EVM to ACTual.

CONF:LRWP:CALC:EVM:REF ACT

CONF:LRWP:CALC:EVM:REF?

> ACT

:CONFigure:LRWPan:CAPTure:TIME

Capture time

Function

Sets or queries the time length to capture the analysis target signals.

Command

```
:CONFigure:LRWPan:CAPTure:TIME <range>
```

Query

```
:CONFigure:LRWPan:CAPTure:TIME?
```

Response

<range>

Parameter

<range>	Capture time
Range	0.001 to 2 s
Resolution	0.001 s
Suffix code	S, MS, US, NS (uses S when omitted)
Default	2
Unit	s

Details

The signals that satisfy the following conditions are measurement targets.

The signals captured from the trigger's detection time to this parameter's setting time length up to the number set by storage count.

The capturing ends when the signals up to the number set by storage count are detected and analyzed.

Example of Use

To set the time length for capturing the analysis target signals to 2s.
:CONF:LRWP:CAPT:TIME 2
:CONF:LRWP:CAPT:TIME?
> 2.000

:CONFigure:LRWPan:FREQuency

Center Frequency

Function

Sets or queries the MU887000A receiving frequency

Command

```
:CONFigure:LRWPan:FREQuency <freq>
```

Query

```
:CONFigure:LRWPan:FREQuency?
```

Response

<freq>

Parameter

<freq>		Receiving frequency
	Range	150.000000 to 6000.000000 MHz
	Resolution	1 Hz
	Suffix code	HZ, KHZ, KZ, MHZ, MZ, GHZ, GZ (uses Hz when omitted)
	Default	2450.000000 MHz
	Unit	Hz

Remarks

The Tx frequency is set for the mobile station.

Example of Use

To set the Center Frequency to 2050 MHz:
:CONF:LRWP:FREQ 2050MHZ
:CONF:LRWP:FREQ?
> 2050000000

:CONFigure:LRWPan:MEAS:INTerval

Measurement Interval

Function

Sets or queries the analysis interval in symbol unit

Command

```
:CONFigure:LRWPan:MEAS:INTerval <range>
```

Query

```
:CONFigure:LRWPan:MEAS:INTerval?
```

Response

<range>

Parameter

<range>	Analysis interval
Range	80 to 4096
Resolution	1
Default	500
Unit	symbol

Details

Analysis interval is as below.

Analysis start position: Reference position + Measurement Offset value

Analysis end position: Reference position + Measurement Offset value + Measurement Interval value

To decide reference position, refer to the description of the command below.

:CONFigure:LRWPan:SYNC:MODE

Set Measurement Interval value (symbol) + Measurement Offset value (symbol) under 4096.

Example of Use

To set the Analysis interval to 500 symbols:

:CONF:LRWP:MEAS:INT 500

:CONF:LRWP:MEAS:INT?

>500

Remarks

The “symbol” used as the unit of this command is different from the “symbol” used for IEEE802.15.4 -2011 “10.2.2 Reference modulator diagram” and others. It represents a value equivalent to the “complex chip” that is used in “8.2.3 Error-vector magnitude (EVM) definition”, and it has the relationship below with the “chip” used in “10. O-QPSK PHY”.

1 symbol = 2 chips

Additionally, the “symbol” used in “10.2.2 Reference modulator diagram” and others is called “data symbol” in this document.

:CONFigure:LRWPan:MEAS:INTerval:CHIP

Measurement Interval (chip)

Function

Sets or queries the analysis length in chip unit

Command

```
:CONFigure:LRWPan:MEAS:INTerval:CHIP <range>
```

Query

```
:CONFigure:LRWPan:MEAS:INTerval:CHIP?
```

Response

<range>

Parameter

<range>	Analysis Interval
Range	160 to 8192
Resolution	2
Default	1000
Unit	chip

Details

Analysis interval is as below.

Analysis start position: Reference position + Measurement Offset value

Analysis end position: Reference position + Measurement Offset value + Measurement Interval value

For how to decide reference position, refer to the description of the command below.

:CONFigure:LRWPan:SYNC:MODE

Set Measurement Interval value (chip) + Measurement Offset value (chip) to 8192 or under.

Example of Use

To set the analysis length to 1000 chips

:CONF:LRWP:MEAS:INT:CHIP 1000

:CONF:LRWP:MEAS:INT:CHIP?

>1000

:CONFigure:LRWPan:MEAS:OFFSet

Measurement Offset

Function

Sets or queries offset from the reference position to analysis interval.

Command

```
:CONFigure:LRWPan:MEAS:OFFSet <range>
```

Query

```
:CONFigure:LRWPan:MEAS:OFFSet?
```

Response

<range>

Parameter

<range>		Offset to the analysis interval
	Range	0 to 3996
	Resolution	1
	Default	0
	Unit	symbol

Details

Set Measurement Interval value (symbol) + Measurement Offset value (symbol) to 4096 or under.

For how to decide reference position, refer to the description of the command below.
:CONFigure:LRWPan:SYNC:MODE

Example of Use

To set the offset to the analysis interval to 3996 symbol.
:CONF:LRWP:MEAS:OFFS 3996
:CONF:LRWP:MEAS:OFFS?
>3996

Remarks

The “symbol” used as the unit of this command is different from the “symbol” used for IEEE802.15.4 -2011 “10.2.2 Reference modulator diagram” and others. It represents a value equivalent to the “complex chip” that is used in “8.2.3 Error-vector magnitude (EVM) definition”, and it has the relationship below with the “chip” used in “10. O-QPSK PHY”.

1 symbol = 2 chips

Additionally, the “symbol” used in “10.2.2 Reference modulator diagram" and others is called “data symbol” in this document.

:CONFigure:LRWPan:MEAS:OFFSet:CHIP

Measurement Offset (chip)

Function

Sets or queries the trigger position or the offset from the reference position to the analysis interval in chip unit.

Command

```
:CONFigure:LRWPan:MEAS:OFFSet:CHIP <range>
```

Query

```
:CONFigure:LRWPan:MEAS:OFFSet:CHIP?
```

Response

<range>

Parameter

<range>		Offset to the analysis interval
	Range	0 to 7992
	Resolution	2
	Default	0
	Unit	chip

Details

Set Measurement Interval value (chip) + Measurement Offset value (chip) to 8192 or under.

Example of Use

To set the offset to the analysis interval to 7992 chip.

:CONF:LRWP:MEAS:OFFS:CHIP 7992

:CONF:LRWP:MEAS:OFFS:CHIP?

>7992

:CONFigure:LRWPan:POWer

Input Level

Function

Sets or queries RMS Power of input signal in dBm unit

Command

```
:CONFigure:LRWPan:POWer <level>
```

Query

```
:CONFigure:LRWPan:POWer?
```

Response

<level>

Parameter

<level>		Input level
	Range	
	MU887000A	–65.0 to +35.0 dBm (Port1/2)
		–65.0 to +25.0 dBm (Port3/4)
	MU887001A	–65.0 to +35.0 dBm (Port1/2/3/4)
	Resolution	0.1 dB
	Suffix code	DBM
		(uses dBm when omitted)
	Default	–10 dBm
	Unit	dBm

Example of Use

To set the RMS Power of input signal to –10.0 dBm:

:CONF:LRWP:POW -10

:CONF:LRWP:POW?

> -10.0

:CONFigure:LRWPan:POWer:WATT

Input Level

Function

Sets or queries RMS Power of input signal in W unit

Command

```
:CONFigure:LRWPan:POWer:WATT <level>
```

Query

```
:CONFigure:LRWPan:POWer:WATT?
```

Response

<level>

Parameter

<level>		Input level
	Range	
	MU887000A	0.000001 to 3162.277660 mW (Port1/2)
		0.000001 to 316.227766 mW (Port3/4)
	MU887001A	0.000001 to 3162.277660 mW (Port1/2/3/4)
	Resolution	0.000001 mW
	Suffix code	FW, PW, NW, UW, MW, W, KW
		(uses W when omitted)
	Default	0.1 mW
	Unit	W

Example of Use

To set the RMS Power of input signal to 0.1 mW:

:CONF:LRWP:POW:WATT 0.0001

:CONF:LRWP:POW:WATT?

> 0.000100000

:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS

PSD Mask Limit Offset abs

Function

Sets or queries the offset value to add to the absolute value level of the PSD Mask judgement.

Command

```
:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS <level>
```

Query

```
:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS?
```

Response

<level>

Parameter

<level>		Offset value to add to the absolute value level
	Range	–30 to 30
	Resolution	0.1
	Default	0
	Unit	dB

Details

Example: The values below are defined as Band 2450 limit in IEEE802.15.4 O-QPSK PHY.
Relative Limit: –20 dB
Absolute Limit: –30 dBm

Example: When this parameter is set to –10dB, the measurement is executed by the limit values below.
Relative Limit: –20 dB
Absolute Limit: –40 dBm

Example of Use

To set the offset value to add to the absolute value level of the PSD Mask judgement line to –20 dB.

```
:CONF:LRWP:PSDM:LIM:OFFS:ABS -20
:CONF:LRWP:PSDM:LIM:OFFS:ABS?
> -20.0
```

:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative

PSD Mask Limit Offset rel

Function

Sets or queries the offset value to add to the relative value level of the PSD Mask judgement.

Command

```
:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative <level>
```

Query

```
:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative?
```

Response

<level>

Parameter

<level>		Offset value to add to the relative value level
	Range	–30 to 30
	Resolution	0.1
	Default	0
	Unit	dB

Details

Example: The values below are defined as Band 2450 limit in IEEE802.15.4 O-QPSK PHY.
Relative Limit: –20 dB
Absolute Limit: –30 dBm

Example: When this parameter is set to –10 dB, the measurement is executed by the limit values below.
Relative Limit: –30 dB
Absolute Limit: –30 dBm

Example of Use

To set the offset value to add to the absolute value level of the PSD Mask judgement line to –20 dB.

```
:CONF:LRWP:PSDM:LIM:OFFS:REL -20
:CONF:LRWP:PSDM:LIM:OFFS:REL?
> -20.0
```

:CONFigure:LRWPan:PSDMask:TYPE

PSD Mask Type

Function

Sets and queries the PSD Mask judgement line.

Command

```
:CONFigure:LRWPan:PSDMask:TYPE <type>
```

Query

```
:CONFigure:LRWPan:PSDMask:TYPE?
```

Response

<type>

Parameter

<type>	PSD Mask Type
15_4_2450	For IEEE802.15.4 Band 2450
15_4_780	For IEEE802.15.4 Band 780
15_4_915	For IEEE802.15.4 Band 915
NONE	Mask setting does not exist. Returns non-measured value.
Default	Refer to Details

Details

Usable PSD Mask Type varies among PHY and Bands.
When a band setting is changed, its default PSD Mask Type is selected.

Table 3.2.2-1 PSD Mask Type Defaults at Band Change

PHY	Band	Usable PSD Mask Type	Default
O-QPSK	2450	15_4_2450	15_4_2450
	915	15_4_915	15_4_915
	868	NONE	NONE
	780	15_4_780	15_4_780

Non-measured value is returned for NONE.

Example of Use

To set PSD Mask judgement line to IEEE802.15.4 _Band2450.
:CONF:LRWP:PSDM:TYPE 15_4_2450
:CONF:LRWP:PSDM:TYPE?
>15_4_2450

:CONFigure:LRWPan:SELect:CONStellation

Constellation On/Off

Function

Sets or queries the constellation graph result On/Off

Command

```
:CONFigure:LRWPan:SELect:CONStellation <mode>
```

Query

```
:CONFigure:LRWPan:SELect:CONStellation?
```

Response

<mode>

Parameter

<mode>	Constellation graph result
ON|1	On
OFF|0	Off
Default	OFF

Example of Use

To set the constellation graph result to On:

:CONF:LRWP:SEL:CONS ON

:CONF:LRWP:SEL:CONS?

>1

:CONFigure:LRWPan:SELect:DATA

Data Table On/Off

Function

Sets or queries the demodulation data acquisition On/Off of measurement signal

Command

```
:CONFigure:LRWPan:SELect:DATA <mode>
```

Query

```
:CONFigure:LRWPan:SELect:DATA?
```

Response

<mode>

Parameter

<mode>	Demodulation data acquisition
ON|1	On
OFF|0	Off
Default	OFF

Example of Use

To set the demodulation data acquisition to On:

:CONF:LRWP:SEL:DATA ON

:CONF:LRWP:SEL:DATA?

>1

:CONFigure:LRWPan:SELect:MODulation

Modulation Analysis On/Off

Function

Sets or queries the modulation analysis On/Off

Command

```
:CONFigure:LRWPan:SELect:MODulation <mode>
```

Query

```
:CONFigure:LRWPan:SELect:MODulation?
```

Response

<mode>

Parameter

<mode>	Modulation Analysis On/Off
ON|1	On
OFF|0	Off
Default	ON

Example of Use

To set the modulation analysis to On

:CONF:LRWP:SEL:MOD ON

:CONF:LRWP:SEL:MOD?

>1

:CONFigure:LRWPan:SELect:PMONitor

Power vs Monitor On/Off

Function

Sets or queries Power Monitor measurement result On/Off

Command

```
:CONFigure:LRWPan:SELect:PMONitor <mode>
```

Query

```
:CONFigure:LRWPan:SELect:PMONitor?
```

Response

<mode>

Parameter

<mode>		Power Monitor measurement result On/Off
	ON|1	On
	OFF|0	Off
	Default	OFF

Example of Use

To set Power Monitor measurement result to On:

:CONF:LRWP:SEL:PMON ON

:CONF:LRWP:SEL:PMON?

>1

:CONFigure:LRWPan:SELect:PSDMask

PSD Mask On/Off

Function

Sets or queries PSD Mask measurement On/Off

Command

```
:CONFigure:LRWPan:SELect:PSDMask <mode>
```

Query

```
:CONFigure:LRWPan:SELect:PSDMask?
```

Response

<mode>

Parameter

<mode>		PSD Mask measurement On/Off
	ON|1	On
	OFF|0	Off
	Default	OFF

Example of Use

To set PSD Mask measurement to On

:CONF:LRWP:SEL:PSDM ON

:CONF:LRWP:SEL:PSDM?

>1

:CONFigure:LRWPan:SELect:PVTime

Power vs Time On/Off

Function

Sets or queries Power vs Time graph result On/Off

Command

```
:CONFigure:LRWPan:SELect:PVTime <mode>
```

Query

```
:CONFigure:LRWPan:SELect:PVTime?
```

Response

<mode>

Parameter

<mode>		Power vs Time graph result On/Off
	ON|1	On
	OFF|0	Off
	Default	OFF

Example of Use

To set Power vs Time graph result to On:

:CONF:LRWP:SEL:PVT ON

:CONF:LRWP:SEL:PVT?

>1

:CONFigure:LRWPan:SELect:SRERror

Symbol Rate Error On/Off

Function

Sets or queries Symbol Rate Error measurement On/Off

Command

```
:CONFigure:LRWPan:SELect:SRERror <mode>
```

Query

```
:CONFigure:LRWPan:SELect:SRERror?
```

Response

<mode>

Parameter

<mode>		Symbol Rate Error measurement On/Off
	ON|1	On
	OFF|0	Off
	Default	OFF

Example of Use

To set the symbol rate error measurement to On:

:CONF:LRWP:SEL:SRER ON

:CONF:LRWP:SEL:SRER?

>1

:CONFigure:LRWPan:SELect:ALL <mode>

All Measurement On/Off

Function

Sets all measurement items to On or Off collectively.

Command

```
:CONFigure:LRWPan:SELect:ALL <mode>
```

Parameter

<mode>	Measurement Execution
ON|1	Measures all measurement items.
OFF|0	Measures no measurement items.

Example of Use

To set all measurement items to On collectively.

CONF:LRWP:SEL:ALL ON

:CONFigure:LRWPan:SIGNal:FORMat

Signal Format

Function

Sets or queries the measurement signal format

Command

```
:CONFigure:LRWPan:SIGNal:FORMat <mode>
```

Query

```
:CONFigure:LRWPan:SIGNal:FORMat?
```

Response

<mode>

Parameter

<mode>		Signal format
	BURSt	Burst wave of IEEE802.15.4 is the measurement target.
	CONTinuous	IEEE 802.15.4 continuous signals or CW (unmodulated continuous wave) is the measurement target.
	Default	BURSt

Details

When the signal format is Continuous, the measurement target is IEEE 802.15.4 continuous signals or CW.
When the measurement target is CW, only the Transmit power at Modulation analysis is valid.

Example of Use

To set the measurement signal format to the IEEE802.15.4 burst wave
:CONF:LRWP:SIGN:FORM BURS
:CONF:LRWP:SIGN:FORM?
> BURS

:CONFigure:LRWPan:STORage:COUNt

Storage Count

Function

Sets or queries Storage Count.
The measurement ends when the specified storage count is not satisfied in the capture time.

Command

```
:CONFigure:LRWPan:STORage:COUNt <range>
```

Query

```
:CONFigure:LRWPan:STORage:COUNt?
```

Response

<range>

Parameter

<range>	Storage Count
Range	1 to 100
Resolution	1
Default	1
Unit	None

Details

When failed to detect the signals up to the number set by storage count during the capture time, only the detected signals are measurement targets.
When failed to detect the signals up to the number set by storage count, the measurement status obtainable by the following command is 14.

:STATus:LRWPan:MEASurement?

Example of Use

To set the storage count to 100:
:CONF:LRWP:STOR:COUN 100
:CONF:LRWP:STOR:COUN?
>100

:CONFigure:LRWPan:SYNC:MODE

Sync Mode

Function

Sets or queries the synchronous mode of the signal to decide the analysis reference position. When SFD is selected, the analysis position is decided by the signal's SFD pattern.

Command

```
:CONFigure:LRWPan:SYNC:MODE <mode>
```

Query

```
:CONFigure:LRWPan:SYNC:MODE?
```

Response

<mode>

Parameter

<mode>		Sync Word Search
	OFF	Disabled
	SFD	Detect the signal's SFD pattern to decide analysis position.
	Default	OFF

Details

The reference position for specifying the analysis range is decided by the method below.

When the sync mode is set to OFF:

The signal detection time (when the signal rise exceeds the threshold set by Input Level + Trigger Level) is the reference position.

When the sync mode is set to SFD:

Search for SFD pattern from the signal detection time. After detecting the SFD position, count backward the preamble head position to make it reference position.

Example of Use

To set Sync Word Search to SFD:

:CONF:LRWP:SYNC:MODE SFD

:CONF:LRWP:SYNC:MODE?

>SFD

:CONFigure:LRWPan:TLEVel

Trigger Level

Function

Sets or queries Trigger detection level

Command

```
:CONFigure:LRWPan:TLEVel <trglevel>
```

Query

```
:CONFigure:LRWPan:TLEVel?
```

Response

<trglevel>

Parameter

<trglevel>	Trigger detection level
Range	–40 to 0 dB
Resolution	0.1 dB
Default	–20 dB
Unit	dB

Remarks

Judged by average power of 1 symbol interval.

Example of Use

To set the trigger detection level to –20 dB:
:CONF:LRWP:TLEV -20
:CONF:LRWP:TLEV?
> -20.0

:CONFigure:LRWPan:TRIGger

Trigger Source

Function

Sets or queries trigger source

Command

```
:CONFigure:LRWPan:TRIGger <mode>
```

Query

```
:CONFigure:LRWPan:TRIGger?
```

Response

<mode>

Parameter

<mode>	Trigger source
LEVEL	Level trigger
MARKer1	SG Marker1
FREERUN	Free run
Default	LEVEL

Details

When the trigger source is set to Level Trigger, the total of Input Level and Trigger Level is a threshold for signal detection. The measurement starts when the signal above the threshold is detected.
When the trigger source is set to SG Marker1, the measurement starts at the detection of the timing information embedded in the signals output from the MU887000A/ MU887001A.
Whichever is set, only the signals exceeding the Level Trigger threshold are the measurement targets.
Additionally, after the first trigger signal is detected, the following signals within the interval of Measurement Interval + Measurement Offset cannot be triggers.
Free run can be selected only when signal format is CW (unmodulated continuous wave).

Example of Use

To set the trigger source to Level trigger:
:CONF:LRWP:TRIG LEVEL
:CONF:LRWP:TRIG?
>LEVEL

:FETCh:LRWPan:CONStellation:GRAPh?

Constellation (graph)

Function

Queries the Constellation graph display data at last measurement storage

Query

```
:FETCh:LRWPan:CONStellation:GRAPh?
```

Response

```
<res1>,<res2>,...<resN>
```

Response for each symbol with a comma-separated value format and the I- and Q-phase data alternating.

N = (Measurement Interval × 2)

Parameter

<resN> Constellation graph display data

Resolution 0.0001

When Not measured/Signal Abnormal: 9.9999.

Example of Use

To query the constellation graph display data:

:FETC:LRWP:CONS:GRAP?

> 0.7029,0.7033,-0.7066,0.7043,0.7072,-0.7071,-0.7073,0.7037,0.7066,0.7044,...

:FETCh:LRWPan:CONStellation:GRAPh:NUMBer?

Constellation (graph data number)

Function

Queries the number of Constellation graph data point

Query

```
:FETCh:LRWPan:CONStellation:GRAPh:NUMBer?
```

Response

```
<res>
```

Parameter

<res>		The number of graph data point
	Value	Measurement Interval setting value × 2
	When Not measured/Signal Abnormal: 99999.	

Example of Use

To query the number of graph data point:

:FETC:LRWP:CONS:GRAP:NUMB?

> 1000

:FETCh:LRWPan:DATA?

Data Table

Function

Queries the demodulation data (0 or 1, chip information) in the last measurement storage.

Query

```
:FETCh:LRWPan:DATA?
```

Response

```
<res1>,<res2>,...<resN>
```

N = 2 to (Measurement Interval × 2)

Parameter

<resN> Demodulation data (0 or 1)

When Not measured/Signal Abnormal: -.

Details

Query the Demodulation data in Measurement Interval.

Example of Use

To query the demodulation data (0 or 1, chip information)

:FETC:LRWP:DATA?

> 1,1,0,1,1,0,0,1,1,1,...

:FETCh:LRWPan:DATA:NUMBer?

Data Table (data number)

Function

Queries the output data number of the modulation data in the last measurement storage.

Query

```
:FETCh:LRWPan:DATA:NUMBer?
```

Response

```
<res>
```

Parameter

<res> The number of output data

Value Measurement Interval setting value × 2 [chip]

When Not measured/Signal Abnormal: 99999

Example of Use

To query the number of output data:

:FETC:LRWP:DATA:NUMB?

> 1000

:FETCh:LRWPan:DSIGnals?

Detected Signals

Function

Queries the number of bursts of a measuring object and the detected number of bursts.

Query

```
:FETCh:LRWPan:DSIGnals?
```

Response

```
<res1>,<res2>
```

Parameter

<res1> Number of bursts of a measuring object (Storage Count)
Resolution 1
When Not measured/Signal Abnormal: 999
<res2> Detected number of bursts
Resolution 1
When Not measured/Signal Abnormal: 999

Example of Use

To query the number of bursts of a measuring object and the detected number of bursts:
:FETC:LRWP:DSIG?
> 5,5

:FETCh:LRWPan:MODulation[n]?

Modulation Analysis Result

Function

Queries the modulation analysis results.

Query

```
:FETCh:LRWPan:MODulation[n]?
```

Response

Table 3.2.2-2 lists the responses to parameter [n]

Table 3.2.2-2 **Responses to Modulation Analysis result**

n	Response
1 or omitted	When PHY=O-QPSK Resposes are returned with comma separated value format in the following order. <res_1>,<res_2>,...<res_n>,...<res_22> 1. Transmit center frequency tolerance [Hz] (Average value for Storage Count) [Resolution 0.01 Hz] When Not measured/Signal Abnormal: 99999999999.99 2. Transmit center frequency tolerance [Hz] (Maximum value for Storage Count) [Resolution 0.01 Hz] When Not measured/Signal Abnormal: 99999999999.99 3. Transmit center frequency tolerance [ppm] (Average value for Storage Count) [Resolution 0.00000001 ppm] When Not measured/Signal Abnormal: 99999.99999999 4. Transmit center frequency tolerance [ppm] (Maximum value for Storage Count) [Resolution 0.00000001 ppm] When Not measured/Signal Abnormal: 99999.99999999 5. Transmit power [dBm] (Average value for Storage Count) [Resolution 0.01 dB] When Not measured/Signal Abnormal: 999.99 6. Transmit power [dBm](Maximum value for Storage Count) [Resolution 0.01 dB] When Not measured/Signal Abnormal: 999.99 7. Transmit power [mW] (Average value for Storage Count) [Resolution 0.0000000000000001 mW] When Not measured/Signal Abnormal: 999999 8. Transmit power [mW] (Maximum value for Storage Count) [Resolution 0.0000000000000001 mW] When Not measured/Signal Abnormal: 999999 9. Offset EVM (rms) [%] (Average value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 10. Offset EVM (rms) [%] (Maximum value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 11. Offset EVM (peak) [%] (Average value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 12. Offset EVM (peak) [%] (Maximum value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 13. Origin Offset [dB]*1 (Average value for Storage Count) [Resolution 0.01 dB] When Not measured/Signal Abnormal: 999.99 14. Origin Offset [dB]*1 (Maximum value for Storage Count) [Resolution 0.01 dB] When Not measured/Signal Abnormal: 999.99 15. Symbol Rate Error [ppm]*2 (Average value for Storage Count) [Resolution 0.01 ppm] When Not measured/Signal Abnormal: 99999.99

Table 3.2.2-2 Responses to Modulation Analysis result (Cont'd)

n	Response
1 or omitted (Cont'd)	16. Symbol Rate Error [ppm]*2 (Maximum value for Storage Count) [Resolution 0.01 ppm] When Not measured/Signal Abnormal: 99999.99 17. Time Offset(The measurement result of the first Storage) [Resolution 0.01 data symbol] When Not measured/Signal Abnormal: 999.99 18. Time Offset(The measurement result of the first Storage) [Resolution 0.01 μs] When Not measured/Signal Abnormal: 999.99 19. EVM (rms) [%] (Average value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 20. EVM (rms) [%] (Maximum value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 21. EVM (peak) [%] (Average value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99 22. EVM (peak) [%] (Maximum value for Storage Count) [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99
2	Returns 100 data with comma-separated value formats: <res_1>,<res_2>,...<res_n>,...<res_100> <res_n>: Transmit power of the nth storage, [Unit dBm], [Resolution 0.01 dB] When Not measured/Signal Abnormal: 999.99
3	Returns 100 data with comma-separated value formats: <res_1>,<res_2>,...<res_n>,...<res_100> <res_n>: Transmit center frequency tolerance of the nth storage, [Unit Hz], [Resolution 0.01 Hz] When Not measured/Signal Abnormal: 99999999999.99
4	Returns 100 data with comma-separated value formats: <res_1>,<res_2>,...<res_n>,...<res_100> <res_n>: Offset EVM of the nth storage, [Unit %], [Resolution 0.01%] When Not measured/Signal Abnormal: 999.99

*1: Origin Offset is called by the name below.
Local leakage power

*2: Symbol Rate Error is measured in the conditions below.
Symbol Rate Error measurement On
Storage Count ≥ 2
Sync Mode = SFD

Parameter

Refer to Response Table.

Details

If Signal Format is set to Continuous and Measured signal is CW (unmodulated continuous wave), the responses other than the following will be invalid when the parameter [n]=1.

5. Transmit power [dBm] (Average value for Storage Count)
6. Transmit power [dBm] (Maximum value for Storage Count)

Example of Use

To query the modulation analysis results:

:FETC:LRWP:MOD1?

> 1.67,2.28,0.00068163,0.00093061,-10.77,-10.77,0.0836579084396362,0.0836996957659721,...

:FETCh:LRWPan:PMONitor[n]?

Power Monitor

Function

When n is set to 1:
Queries the Offset value from the head of res = storage_n On section to the head of Measurement Interval.
When n is set to 2:
Queries ratio of On section during Measurement Interval.

Query

```
:FETCh:LRWPan:PMONitor[n]?
```

Response

```
<res1>,<res2>,...<resN>
```

N = 1 to 100

Parameter

When n is set to 1 or omitted:

<resN>	Offset value from the head of res = storage_n On section to the head of Measurement Interval.
Resolution	1
Unit	Symbol

When Not measured/Signal Abnormal: 99999

When n is set to 2:

<resN>	Ratio of On section during Measurement Interval
Resolution	0.01
Unit	%

When Not measured/Signal Abnormal: 999.99

Details

When the signal format is CW (unmodulated continuous wave), the response is the same as for Not measured.

Example of Use

To query the Offset value from the head of res = storage_n On section to the head of Measurement Interval:
:FETC:LRWP:PMON1?
> 0,0,0,0,99999,99999,99999,99999,99999,99999,...

:FETCh:LRWPan:PSDMask?

PSD Mask Result (Numeric)

Function

Queries SEM measurement results

Query

```
:FETCh:LRWPan:PSDMask?
```

Response

```
<res1>,<res2>,...<resN>
```

N=1 to 6

Parameter

<res1>		Judgement of SEM
	PASS	Pass
	FAIL	Fail
	-	Not measured
<res2>		Evaluation limits
	Resolution	0.01 dB
	Unit	dBm
	When Not measured or Signal Abnormal: 999.99.	
<res3>		Judgement of Offset 1
	PASS	Pass
	FAIL	Fail
	-	Not measured
<res4>		The frequency at the point that was the most difficult to judge in the Offset 1 interval.
	Resolution	0.001 MHz
	Unit	MHz
	When Not measured or Signal Abnormal: 99999.999	
<res5>		The level at the point that was the most difficult to judge in the Offset 1 interval.
	Resolution	0.01 dB
	Unit	dBm
	When Not measured or Signal Abnormal: 999.99	
<res6>		The level difference from the mask line at the point that was the most difficult to judge in the Offset 1 interval.
	Resolution	0.01 dB
	Unit	dB
	When Not measured or Signal Abnormal: 999.99	

Details

The values below are used as reference for relative limit.
When PSD Mask Type is set to 15_4_2540,
The max power in the Center Frequency ±1 MHz interval.
When PSD Mask Type is set to 15_4_780 or 15_4_915,
The max power in the Center Frequency ±600 kHz interval.

Offset 1
The table below shows the Offset 1 range when the PSD Mask Type is set.
In all cases, the Offset 1 judgement range and the SEM judgement range are equal.

Table 3.2.2-3 Offset 1 range for PSD Mask Type

PHY	Band	PSD Mask Type	Offset 1 Range
O-QPSK	2450	15_4_2450	3.5MHz < |f – fc| ≤ 8 MHz
	915	15_4_915	1.2MHz < |f – fc| ≤ 4 MHz
	868	-	-
	780	15_4_780	1.2 MHz < |f – fc| ≤ 4 MHz

f: Measurement frequency, fc: Center frequency

Example of Use

To query SEM measurement results:
:FETC:LRWP:PSDM?
> PASS,-21.09,PASS,-3.902,-56.79,15.70

:FETCh:LRWPan:PSDMask:GRAPh[n]?

PSD Mask Result (graph - level)

Function

Queries Spectrum data when measuring SEM.

Query

```
:FETCh:LRWPan:PSDMask:GRAPh[n]?
```

Response

```
<res1>,<res2>,...<resN>
```

Refer to Details for response number N.

Parameter

<resN>	Spectrum data
Resolution	0.01
Unit	dBm

When Not measured/Signal Abnormal: 999.99 (one datum)

Details

The response number N is queried by the command :FETCh:LRWPan:PSDMask:GRAPh[n]:NUMBer?.

When n=1, spectrum data with equal frequency intervals is queried.

When n=2, spectrum data used for pass/fail limit is queried.
The frequency intervals are partly unequal.
The frequency of each point queried by the command :FETCh:LRWPan:PSDMask:GRAPh2:FREQuency?

Example of Use

To query Spectrum data:
:FETC:LRWP:PSDM:GRAP?
> -69.84,-69.71,-69.33,-68.79,-68.32,-68.06,-68.00,-68.11,-68.35,-68.72,...

:FETCh:LRWPan:PSDMask:GRAPh[n]:NUMBer?

PSD Mask Result (graph data number)

Function

Queries the number of Spectrum data point.

Query

```
:FETCh:LRWPan:PSDMask:GRAPh[n]:NUMBer?
```

Response

```
<res>
```

Parameter

<res> The number of data point

Resolution 1

When Not measured/Signal Abnormal: 99999.

Details

When n is 1, the response count of : FETCh: LRWPan: PSDMask: GRAPh1? is returned.

When n is 2, the response count of : FETCh: LRWPan: PSDMask: GRAPh2? is returned.

Example of Use

To query the number of Spectrum data point:

:FETC:LRWP:PSDM:GRAP:NUMB?

> 821

:FETCh:LRWPan:PSDMask:GRAPh2:FREQuency?

PSD Mask Result (graph) - Frequency

Function

Queries the frequency of Spectrum data when measuring SEM.

Query

```
:FETCh:LRWPan:PSDMask:GRAPh2:FREQuency?
```

Response

```
<freq1>,<freq2>,...<freqN>
```

Refer to Details for response number N.

Parameter

<freqN>	Frequency (Relative value from setting Center frequency)
Resolution	0.001
Unit	kHz

When Not measured/Signal Abnormal: 999.99 (one datum)

Details

Queries the frequency according to each point of the command :FETCh:LRWPan:PSDMask:GRAPh2?.
The response number N is queried by the command :FETCh:LRWPan:PSDMask:GRAPh2:NUMBer?

Example of Use

To query the frequency of Spectrum data:
:FETC:LRWP:PSDM:GRAP2:FREQ?
> -8000.000,-7980.488,-7960.976,,,,,,,...

:FETCh:LRWPan:PSDMask:GRAPh2:LIMit?

PSD Mask Result (graph - Limit Line)

Function

Queries the limit of Spectrum data when measuring SEM.

Query

```
:FETCh:LRWPan:PSDMask:GRAPh2:LIMit?
```

Response

```
<level1>,<level2>,...<levelN>
```

Refer to Details for response number N.

Parameter

<levelN>	Limit (Level)
Resolution	0.01
Unit	dBm

When Not measured/Signal Abnormal: 999.99 (one datum)

Details

Queries the pass/fail limit according to each point of the command :FETCh:LRWPan:PSDMask:GRAPh2?.

As a limit for each frequency point, set either ABS value or REL value, whichever is more severe.

In the area irrelevant to pass/fail limits, a value at frequency point is 999.99.

The response number N is queried by the command :FETCh:LRWPan:PSDMask:GRAPh2:NUMBer?

Example of Use

To query the limit of Spectrum data:

:FETC:LRWP:PSDM:GRAP2:LIM?

> -30.00, -30.00, -30.00, -30.00, -30.00, -30.00, -30.00, -30.00, -30.00,,...

:FETCh:LRWPan:PVTime:GRAPh?

Power vs Time (graph)

Function

Query Power vs Time value of the last measurement storage.
Returns the Power value by symbol.

Query

```
:FETCh:LRWPan:PVTime:GRAPh?
```

Response

```
<res1>,<res2>,...<resN>
```

N: response number

Parameter

<resN>	Power vs Time value
Resolution	0.01 dB
Unit	dBm

When Not measured/Signal Abnormal: 999.99 (one datum)

Details

The power value [dBm] is returned in the range below.

Start position: Latch Address detection symbol – 100 symbol
End position: The last symbol of Measurement Interval + 100 symbol

Example of Use

To query the value of Power vs Time (symbol):
:FETC:LRWP:PVT:GRAP?
> -65.74,-61.62,-63.97,-65.01,-63.49,-63.35,-65.24,-63.11,-65.45,-64.25,...

:FETCh:LRWPan:PVTime:GRAPh:NUMBer?

Power vs Time (graph data number)

Function

Queries the number of Power vs Time measurement data

Query

```
:FETCh:LRWPan:PVTime:GRAPh:NUMBer?
```

Response

```
<res>
```

Parameter

<res>		The number of Power vs Time measurement data
	Range	Start position: Latch Address detection symbol – 100 symbol
		End position: The last symbol of Measurement Interval + 100 symbol
		Maximum value: 2 × (Meas. Offset + Meas. Int) + 100 + 100 = 8392
	When Not measured/Signal Abnormal: 99999	

Example of Use

To query the number of Power vs Time measurement data

:FETC:LRWP:PVT:GRAP:NUMB?

> 1100

Chapter 4 Native Command Reference

Native commands of this application are the same as short forms of SCPI commands. Comparison tables of SCPI commands and Native commands are shown in List of Commands.

For details of commands, refer to Chapter 3 “SCPI Command Reference”.

To switch to the Native command mode, send the command SYST:LANG NAT.

4.1 List of Commands

The following table shows the rules for describing messages.

[ ]	Messages or parameters in square brackets can be omitted.
|	Choose one of several choices. A|B|C|D indicates a choice of A, B, C, and D.
{}	Choose one of the groups in braces. A|B({C|D}) indicates a choice of A, B(C), or A, B(D).

4.1.1 Common commands

Operation Status Register

Function	SCPI Command, Query	Native Command, Query
Measurement Operation Status Register Query	:STATus:LRWPan:MEASurement?	STAT:LRWP:MEAS?

Common

Function	SCPI Command, Query	Native Command, Query
Standard	:CONFigure:LRWPan:STANdard <mode>	STDSEL <mode>
		CONF:LRWP:STAN <mode>
	:CONFigure:LRWPan:STANdard?	STDSEL?
		CONF:LRWP:STAN?
Set Connect Port Direction	:ROUTe:PORT:CONNect:DIRection <in>,<out>	PORT <in>,<out>
	:ROUTe:PORT:CONNect:DIRection?	PORT?

Measurements

Function	SCPI Command, Query	Native Command, Query
Measurement Stop	:ABORt:LRWPan	ABOR:LRWP
Measurement Start	:INITiate:LRWPan	INIT:LRWP

Common Parameters

Function	SCPI Command, Query	Native Command, Query
PHY (802.15.4)	:CONFigure:LRWPan:WP4:PHY <mode>	CONF:LRWP:WP4:PHY <mode>
	:CONFigure:LRWPan:WP4:PHY?	CONF:LRWP:WP4:PHY?
Band (802.15.4)	:CONFigure:LRWPan:WP4:PHY:BAND <mode>	CONF:LRWP:WP4:PHY:BAND <mode>
	:CONFigure:LRWPan:WP4:PHY:BAND?	CONF:LRWP:WP4:PHY:BAND?
Modulation Scheme	:CONFigure:LRWPan:WP4:PHY:INFO:MODulation?	CONF:LRWP:WP4:PHY:INFO:MOD?
Chip Rate	:CONFigure:LRWPan:WP4:PHY:INFO:CRATe?	CONF:LRWP:WP4:PHY:INFO:CRAT?
Bit Rate	:CONFigure:LRWPan:WP4:PHY:INFO:BRATe?	CONF:LRWP:WP4:PHY:INFO:BRAT?
Filter	:CONFigure:LRWPan:WP4:PHY:INFO:FILTer?	CONF:LRWP:WP4:PHY:INFO:FILT?

System

Function	SCPI Command, Query	Native Command, Query
Application Select	:INSTrument[:SELect] <app>	SYSSEL <app>
	:INSTrument[:SELect]?	SYSSEL?
Language Selection of Remote Command	:SYSTem:LANGuage <mode>	SYST:LANG <mode>
	:SYSTem:LANGuage?	SYST:LANG?

4.1.2 Fundamental measurement commands

Common Parameters

Function	SCPI Command, Query	Native Command, Query
Center Frequency	:CONFigure:LRWPan:FREQuency <freq>	CONF:LRWP:FREQ <freq>
	:CONFigure:LRWPan:FREQuency?	CONF:LRWP:FREQ?
Input Level	:CONFigure:LRWPan:POWer <level>	CONF:LRWP:POW <level>
	:CONFigure:LRWPan:POWer?	CONF:LRWP:POW?
Input Level	:CONFigure:LRWPan:POWer:WATT <level>	CONF:LRWP:POW:WATT <level>
	:CONFigure:LRWPan:POWer:WATT?	CONF:LRWP:POW:WATT?
Trigger Source	:CONFigure:LRWPan:TRIGger <mode>	CONF:LRWP:TRIG <mode>
	:CONFigure:LRWPan:TRIGger?	CONF:LRWP:TRIG?
Trigger Level	:CONFigure:LRWPan:TLEVel <trglevel>	CONF:LRWP:TLEV <trglevel>
	:CONFigure:LRWPan:TLEVel?	CONF:LRWP:TLEV?

Fundamental Measurement Parameters

Function	SCPI Command, Query	Native Command, Query
Signal Format	:CONFigure:LRWPan:SIGNal:FORMat <mode>	CONF:LRWP:SIGN:FORM <mode>
	:CONFigure:LRWPan:SIGNal:FORMat?	CONF:LRWP:SIGN:FORM?
Sync Mode	:CONFigure:LRWPan:SYNC:MODE <mode>	CONF:LRWP:SYNC:MODE <mode>
	:CONFigure:LRWPan:SYNC:MODE?	CONF:LRWP:SYNC:MODE?
Measurement Interval	:CONFigure:LRWPan:MEAS:INTerval <range>	CONF:LRWP:MEAS:INT <range>
	:CONFigure:LRWPan:MEAS:INTerval?	CONF:LRWP:MEAS:INT?
Measurement Interval	:CONFigure:LRWPan:MEAS:INTerval:CHIP <range>	CONF:LRWP:MEAS:INT:CHIP <range>
	:CONFigure:LRWPan:MEAS:INTerval:CHIP?	CONF:LRWP:MEAS:INT:CHIP?
Measurement Offset	:CONFigure:LRWPan:MEAS:OFFSet <range>	CONF:LRWP:MEAS:OFFS <range>
	:CONFigure:LRWPan:MEAS:OFFSet?	CONF:LRWP:MEAS:OFFS?
Measurement Offset	:CONFigure:LRWPan:MEAS:OFFSet:CHIP <range>	CONF:LRWP:MEAS:OFFS:CHIP <range>
	:CONFigure:LRWPan:MEAS:OFFSet:CHIP?	CONF:LRWP:MEAS:OFFS:CHIP?
Burst Interval	:CONFigure:LRWPan:BURSt:INTerval <range>	CONF:LRWP:BURS:INT <range>
	:CONFigure:LRWPan:BURSt:INTerval?	CONF:LRWP:BURS:INT?
Burst Interval	:CONFigure:LRWPan:BURSt:INTerval:TIME <range>	CONF:LRWP:BURS:INT:TIME <range>
	:CONFigure:LRWPan:BURSt:INTerval:TIME?	CONF:LRWP:BURS:INT:TIME?
Capture time	:CONFigure:LRWPan:CAPTure:TIME <range>	CONF:LRWP:CAPT:TIME <range>
	:CONFigure:LRWPan:CAPTure:TIME?	CONF:LRWP:CAPT:TIME?
Storage Count	:CONFigure:LRWPan:STORage:COUNt <range>	CONF:LRWP:STOR:COUN <range>
	:CONFigure:LRWPan:STORage:COUNt?	CONF:LRWP:STOR:COUN?
PSD Mask Type	:CONFigure:LRWPan:PSDMask:TYPE <type>	CONF:LRWP:PSDM:TYPE <type>
	:CONFigure:LRWPan:PSDMask:TYPE?	CONF:LRWP:PSDM:TYPE?

Fundamental Measurement Parameters (Cont'd)

Function	SCPI Command, Query	Native Command, Query
PSD Mask Limit Offset abs	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS <level>	CONF:LRWP:PSDM:LIM:OFFS:ABS <level>
	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:ABS?	CONF:LRWP:PSDM:LIM:OFFS:ABS?
PSD Mask Limit Offset rel	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative <level>	CONF:LRWP:PSDM:LIM:OFFS:REL <level>
	:CONFigure:LRWPan:PSDMask:LIMit:OFFSet:RELative?	CONF:LRWP:PSDM:LIM:OFFS:REL?
EVM Calculation Reference	:CONFigure:LRWPan:CALCulation:EVM:REFerence <mode>	CONF:LRWP:CALC:EVM:REF <mode>
	:CONFigure:LRWPan:CALCulation:EVM:REFerence?	CONF:LRWP:CALC:EVM:REF?
Modulation Analysis On/Off	:CONFigure:LRWPan:SELect:MODulation <mode>	CONF:LRWP:SEL:MOD <mode>
	:CONFigure:LRWPan:SELect:MODulation?	CONF:LRWP:SEL:MOD?
PSD Mask On/Off	:CONFigure:LRWPan:SELect:PSDMask <mode>	CONF:LRWP:SEL:PSDM <mode>
	:CONFigure:LRWPan:SELect:PSDMask?	CONF:LRWP:SEL:PSDM?
Constellation On/Off	:CONFigure:LRWPan:SELect:CONStellation <mode>	CONF:LRWP:SEL:CONS <mode>
	:CONFigure:LRWPan:SELect:CONStellation?	CONF:LRWP:SEL:CONS?
Symbol Rate Error On/Off	:CONFigure:LRWPan:SELect:SRERror <mode>	CONF:LRWP:SEL:SRER <mode>
	:CONFigure:LRWPan:SELect:SRERror?	CONF:LRWP:SEL:SRER?
Data Table On/Off	:CONFigure:LRWPan:SELect:DATA <mode>	CONF:LRWP:SEL:DATA <mode>
	:CONFigure:LRWPan:SELect:DATA?	CONF:LRWP:SEL:DATA?
Power vs Time On/Off	:CONFigure:LRWPan:SELect:PVTime <mode>	CONF:LRWP:SEL:PVT <mode>
	:CONFigure:LRWPan:SELect:PVTime?	CONF:LRWP:SEL:PVT?
Power vs Monitor On/Off	:CONFigure:LRWPan:SELect:PMONitor <mode>	CONF:LRWP:SEL:PMON <mode>
	:CONFigure:LRWPan:SELect:PMONitor?	CONF:LRWP:SEL:PMON?
All Measurement On/Off	:CONFigure:LRWPan:SELect:ALL <mode>	CONF:LRWP:SEL:ALL <mode>

Results

Function	SCPI Command, Query	Native Command, Query
Modulation Analysis Result	:FETCh:LRWPan:MODulation[n]?	FETC:LRWP:MOD[n]?
PSD Mask Result (Numeric)	:FETCh:LRWPan:PSDMask?	FETC:LRWP:PSDM?
PSD Mask Result (graph - level)	:FETCh:LRWPan:PSDMask:GRAPh[n]?	FETC:LRWP:PSDM:GRAP[n]?
PSD Mask Result (graph data number)	:FETCh:LRWPan:PSDMask:GRAPh[n]:NUMBer?	FETC:LRWP:PSDM:GRAP[n]:NUMB?
PSD Mask Result (graph - frequency)	:FETCh:LRWPan:PSDMask:GRAPh2:FREQuency?	FETC:LRWP:PSDM:GRAP2:FREQ?
PSD Mask Result (graph - limit line)	:FETCh:LRWPan:PSDMask:GRAPh2:LIMit?	FETC:LRWP:PSDM:GRAP2:LIM?
Constellation (graph)	:FETCh:LRWPan:CONStellation:GRAPh?	FETC:LRWP:CONS:GRAP?
Constellation (graph data number)	:FETCh:LRWPan:CONStellation:GRAPh:NUMBer?	FETC:LRWP:CONS:GRAP:NUMB?
Data Table	:FETCh:LRWPan:DATA?	FETC:LRWP:DATA?
Data Table (data number)	:FETCh:LRWPan:DATA:NUMBer?	FETC:LRWP:DATA:NUMB?
Power vs Time (graph)	:FETCh:LRWPan:PVTime:GRAPh[n]?	FETC:LRWP:PVT:GRAP?
Power vs Time (graph data number)	:FETCh:LRWPan:PVTime:GRAPh:NUMBer[n]?	FETC:LRWP:PVT:GRAP:NUMB?
Power Monitor	:FETCh:LRWPan:PMONitor[n]?	FETC:LRWP:PMON[n]?
Detected Signals	:FETCh:LRWPan:DSIGnals?	FETC:LRWP:DSIG?

Chapter 5 Performance Test

This chapter explains how to setup the measuring instruments required for the MX887060A IEEE 802.15.4 performance tests as well as the test procedures.

5.1 Outline

The performance tests are performed to assure that the MU887000A performance does not deteriorate. Test the performance of the MU887000A at the initial acceptance inspection, at periodic inspections, and after repairs. Test important items periodically to assure the performance. This chapter explains the following test items.

- Output EVM
- Tx Power measurement accuracy (CW)
- Frequency/Modulation measurement — Carrier frequency accuracy
  Residual EVM

We recommend testing the performance periodically once or twice a year. If the test results do not meet the specifications, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

⚠ CAUTION

Warm-up the MU887000A and the required measuring instruments for at least 30 minutes (except when specified otherwise) to stabilize them. To achieve the highest accuracy, the test should be performed at room temperature using a power supply with as little voltage fluctuation as possible in an environment free from noise, vibration, dust and humidity.

5.2 Instruments for Testing Performance

The following table lists the measuring instruments required for testing the MU887000A performance and the specifications for each instrument.

Table 5.2-1 Measuring Instruments for Performance Test

Performance Test Item	Instrument Required Specifications*1	Recommended Instrument (Anritsu Model)
Output EVM	Signal Analyzer ● Frequency Range: 440 to 2500 MHz ● Resolution: 1 Hz ● Measured Power Range: –140 to +20 dBm ● Measurement Accuracy: ±0.05 dB ● External Reference Input: (10 MHz)	Signal Analyzer (MS269xA or MS2830A) Vector Modulation Analysis Software (MX269017A)
Tx Power Measurements ● Measurement Accuracy	Signal Generator ● Frequency Range: 440 to 2500 MHz ● Resolution: 1 Hz ● Output Level Range Unmodulated: –143 to +13 dBm Resolution: 0.01 dB	Vector Signal Generator (MG3700A) Mechanical Attenuator (MG3700A-002) High Frequency 6 GHz (MG3700A-011)
	Signal Analyzer Same as above	Signal Analyzer (MS269xA or MS2830A)
	Power Meter ● Main Frame Accuracy: ±0.02 dB ● Frequency Range: 440 to 2500 MHz ● Resolution: 0.01 dB	Power Meter (ML2437A)
	Power sensor ● Frequency Range: 440 to 2500 MHz ● Measured Power Range: –40 to +20 dBm ● Input Connector: N type	Power Sensor (MA2442D)
Frequency/Modulation Measurements ● Carrier Frequency Accuracy ● Residual EVM	Signal generator supporting output of IEEE 802.15.4 -2011 “O-QPSK PHY” modulation signals Same as above	Same as above
	Power Meter Same as above	Same as above
	Power sensor ● Frequency Range: 440 to 2500 MHz ● Measured Power Range: –30 to +20 dBm ● Input Connector: N type	Power Sensor (MA24002A)
Common	3-dB Attenuator	3-dB Attenuator (AT-103)

*1: The performance covers the test item measurement range.

5.3 Performance Test for Each Measurement

Common test items

The following list shows the common settings for each measurement at the MU887000A.

Application:	LRWPAN
Standard:	WP4
PHY:	O-QPSK

5.3.1 Calibrating signal generator (CW)

This procedure captures the calibration value for measurements using an unmodulated waveform (CW).

(1) Measuring instruments

- Vector signal generator: MG3700A
- Power meter: ML2437A
- Power sensor: MA2442D
- 3-dB Attenuator: AT-103 (2 sets)

(2) Setup

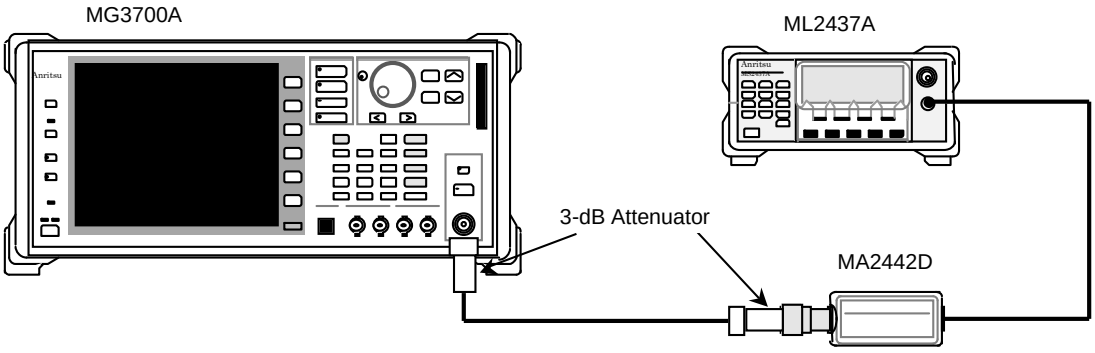

Figure 5.3.1-1 Signal Generator Calibration Setup (CW)

(3) Procedure

1. Setup the instruments as shown in Figure 5.3.1-1.
2. Output a CW 439.99 MHz signals from the Vector signal generator (SG) at a level of +6 dBm
3. Measure the level with the ML2437A power meter and adjust the SG so that the output level is 0 dBm.
4. Change the frequency as shown in Table 5.3.1-1 "Measurement Points and Frequency" and perform the same measurement to obtain the calibration value.
5. Repeat steps 3 and 4 over while changing the output level (value measured with power meter) to –10, –25 dBm, successively to measure and obtain the calibration value.

Table 5.3.1-1 Measurement Point and Frequency

Meas. Point	Frequency (MHz)
1	440
2	760
3	940
4	2400
5	2500

Note:

Add an offset of −10 kHz to the frequency in the above table and set the frequency as SG output frequency, except for the measurement described in section 5.3.5.

5.3.2 Calibrating signal generator (MOD)

This procedure captures the calibration value for measurement using a modulated waveform.

(1) Measuring instruments

- Vector signal generator: MG3700A
- Power meter: ML2437A
- Power sensor: MA24002A
- 3-dB Attenuator: AT-103 (2 sets)

(2) Setup

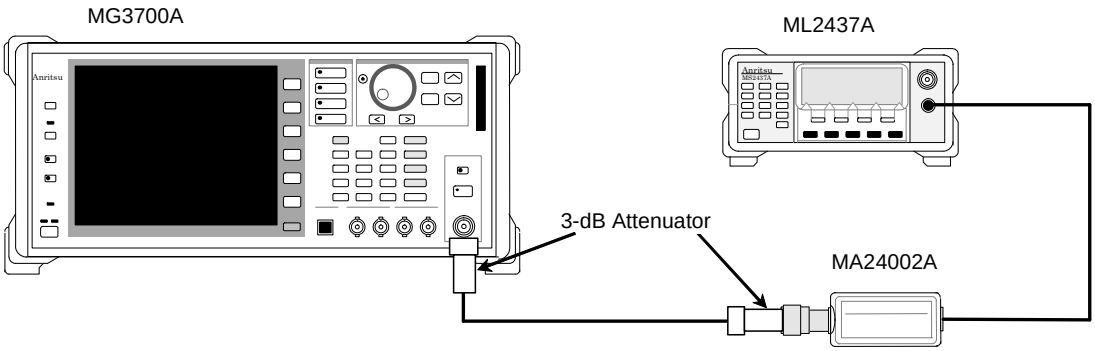

Figure 5.3.2-1 Signal Generator Calibration Setup (MOD)

(3) Procedure

1. Setup the instruments as shown in Figure 5.3.2-1.
2. Output a modulated 439.99 MHz signal from the Vector signal generator (SG) at a level of –4 dBm with Waveform pattern equivalent to MV887060A_ZB2450_0002. .
3. Measure the level with the ML2437A Power Meter and adjust the SG so that the output level is –10 dBm.
4. Change the frequency as shown in Table 5.3.1-1 “Measurement Points and Frequency” and perform the same measurements to obtain the calibration value.

5.3.3 Output EVM

This test measures the output signal EVM.

(1) Test specifications

EVM	Remarks
≤ 3.0%rms	440 to 2500 MHz

(2) Measuring instruments

- Signal Analyzer: MS269XA or MS2830A

(3) Setup

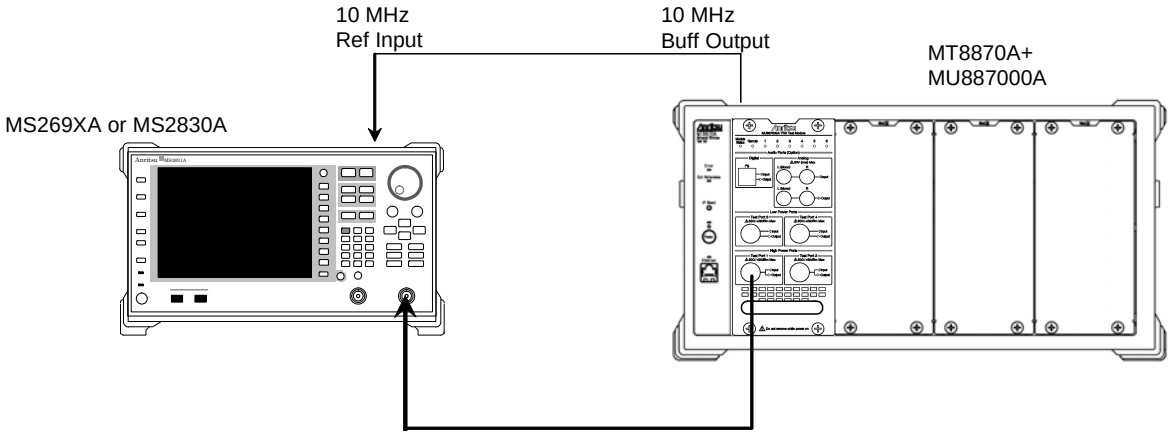

Figure 5.3.3-1 Output EVM Measurement Setup

(4) Procedure

1. Setup the instruments as shown in Figure 5.3.3-1.
2. Select the signal analyzer (SA) measurement software and set the following:

Measurement software:	MX269017A (Package version 6.01.05 or later)
Input level:	Output level of step 4
Level offset:	0 dB
Trigger On/Off:	On
Trigger Source:	Video
Trigger Level:	Input Level –20 dB
Common Setting:	Frame Formatted
Modulation:	Offset-QPSK
Symbol Rate:	1 Msps
Reference Filter (1st):	Half Sine
Frame Format:	1,1

Slot Length: 512
Measurement offset: 0
Measurement Interval: 500
Sync Search: On
Sync Slot: 0
Sync word Length: 32
Sync word: 9C3522ED7B8C9607
Sync word Offset: 128
Capture Interval: 1 Frame

3. Select the MU887000A application software.
4. Set the MU887000A input and output levels.

Test Port1

Output level: –10.9 dBm
Input level: +35 dBm
Frequency: 10 MHz

Test Port3

Output level: –0.9 dBm
Input level: +25 dBm
Frequency: 10 MHz

5. Set the MU887000A output frequency to 440 MHz and output the test pattern.

Package Select: MV887060A_ZB2450_0002
Pattern name: Group No. 1
Connect port: Test Port1 or Test Port3
Output level ON/OFF: ON
Frequency: 440 MHz

6. Measure the EVM at the SA.
7. In the same manner, change the MU887000A output frequency sequentially from 440, 760, 940, 2400, 2500 MHz and measure the Offset EVM at each frequency.
8. Change the Test Port in steps 4 and 5 and repeat steps 4 to 7 over.

5.3.4 Tx Power measurement accuracy (CW)

This test is related to the accuracy of Tx power measurements.

(1) Test specifications

Test Port1/2

Measurement Accuracy	Input Level	Temperature
±0.5 dB	–25 dBm ≤, ≤+35 dBm	10 to 40°C
±0.7 dB	–55 dBm ≤, <–25 dBm	10 to 40°C
±0.9 dB	–65 dBm ≤, <–55 dBm	10 to 40°C

Test Port3/4

Measurement Accuracy	Input Level	Temperature
±0.7 dB	–25 dBm ≤, ≤+25 dBm	10 to 40°C
±0.9 dB	–55 dBm ≤, <–25 dBm	10 to 40°C
±1.1 dB	–65 dBm ≤, <–55 dBm	10 to 40°C

(2) Measuring instruments

- Vector signal generator: MG3700A
- 3-dB Attenuator: AT-103 (2 sets)

(3) Setup

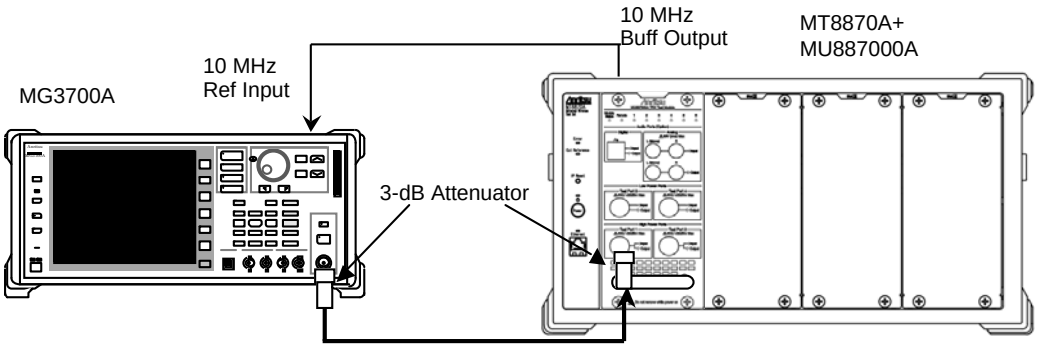

Figure 5.3.4-1 Setup for Measuring Amplitude Measurement Accuracy

(4) Test procedure

1. Setup the instruments as shown in Figure 5.3.4-1.
2. Set the MU887000A as follows:

Connect port:	Test Port1
Output level ON/OFF :	OFF
Input level:	–10 dBm
Center frequency:	440 MHz
Standard:	IEEE 802.15.4
PHY:	O-QPSK
Band:	2450
Signal Format:	Continuous
Trigger Source:	Free Run
Sync Mode:	Off
Measurement Offset:	0
Measurement Interval:	500
Modulation Analysis:	ON
Storage Count:	1

3. Set the Vector signal generator (SG) as follows:

Modulation:	OFF
Output frequency:	439.99 MHz
Output level:	–10 dBm (This output level reflects the calibration value for item 5.3.1.)

4. Change the frequency of the MU887000A and SG according to Table 5.3.1-1 “Measurement Point and Frequency” and measure the Transmit power.
5. Change the SG output level and MU887000A input level each to –55, and –65 dBm and repeat steps 2 to 4 over and measure the Transmit power. (This output level reflects the calibration value for item 5.3.1.)

Note:

Add the differences from –55 dBm and –65 dBm respectively to the calibration value of –25 dBm described in Section 5.3.1 and use these values.

6. Change the Connect Port setting for the connection with the MU887000A to Test Port2/3/4,successively, and repeat steps 2 to 5 over.

5.3.5 Frequency/Modulation measurement

This test is related to the following modulation analyses.

- Carrier frequency accuracy
- Residual EVM

(1) Test specifications

Test Port1/2

Carrier frequency accuracy	±(Set frequency × Reference oscillator accuracy + 20 Hz)
Residual EVM	≤ 1.5% (rms)

Input level: –30 dBm ≤, ≤+35 dBm

Test Port3/4

Carrier frequency accuracy	±(Set frequency × Reference oscillator accuracy + 20 Hz)
Residual EVM	≤ 1.5% (rms)

Input level: –30 dBm ≤, ≤+25 dBm

(2) Measuring instruments

- Vector signal generator: MG3700A
- 3-dB Attenuator: AT-103 (2 sets)

(3) Setup

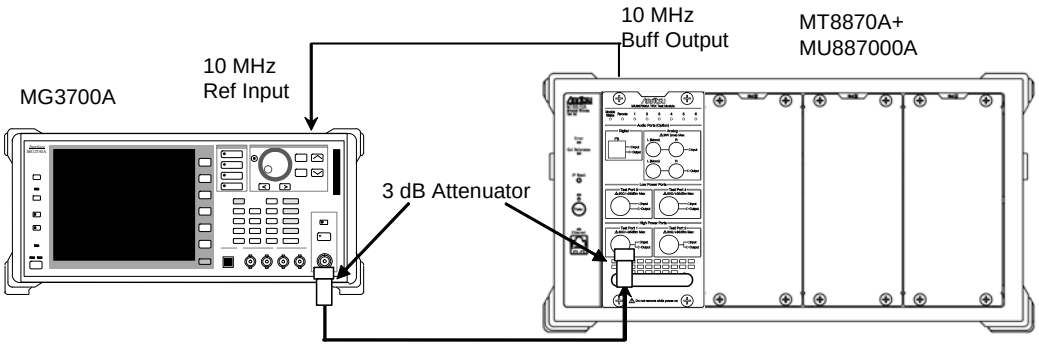

Figure 5.3.5-1 Setup for Measuring Frequency/Modulation

(4) Test procedure

1. Setup the instruments as shown in Figure 5.3.5-1.
2. Set the MU887000A as follows:

Connect port:	Test Port1
Output level ON/OFF:	OFF
Input level:	–10 dBm
Center frequency:	440 MHz
Signal Format:	Burst
Trigger Source:	LEVEL
PHY:	O-QPSK
Band:	2450
Sync Mode:	SFD
Measurement Offset:	0
Measurement Interval:	500
Storage Count:	1
Modulation Analysis:	ON

3. Set the Vector signal generator (SG) as follows:

Modulation:	ON
Waveform pattern:	MV887060A_ZB2450_0002
Output frequency:	440 MHz
Output level:	–10 dBm (This output level reflects the calibration value for item 5.3.2.)

4. Measure the frequency error and Offset EVM.

Center frequency tolerance:	Average value
Offset EVM (rms):	Average value

5. Change the MU887000A and SG frequencies according to Table 5.3.1-1 “Measurement Point and Frequency” and repeat steps 2 to 4 over.
6. Change the SG output level and the MU887000A input level to –30 dBm and measure by repeating steps 2 to 5 over. (This output level reflects the calibration value for item 5.3.2.)
7. Change the Connect Port setting for the connection with the MU887000A to Test Port2/3/4 successively, and repeat steps 2 to 6 over.

5.3.6 About evaluation signals

The evaluation signals (Waveform pattern) described in the performance test items 5.3.2, 5.3.5 are set as follows. When the user is executing performance tests, set the SG actually used based on the following setting contents.

Install the MG3700A-002 Mechanical Attenuator option in the MG3700A. In addition, the MG3700A-011 High Frequency 6 GHz option is required to support Opt-015/016.

Outline of Evaluation Signals

Evaluation signals are the signals in Band2450 and with 16 octets in PDSU. They are generated by the method described in IEEE 802.15.4 -2011 “10. O-QPSK PHY”.

5.3.7 Sample format for performance test result sheets

Use the following test result sheets when testing the MX887060A performance. Duplicate these sheets as necessary for tests.

Test location _____ Report No. _____

_____ Date _____

_____ Person-in-charge _____

Model:

Serial No. _____ Ambient temperature _____ °C

Power source frequency _____ Hz Relative humidity _____ %

Remarks _____

_____

_____

SG Calibration (CW)

SG Calibration Value (CW)

MG3700A Unmodulated Wave

Frequency (MHz)	SG Setting (dBm)		
	0 dBm	–10 dBm	–25 dBm
440			
760			
940			
2400			
2500			

SG Calibration (MOD)

SG Calibration (MOD)

MG3700A Modulation Wave

Frequency (MHz)	SG Setting (dBm)
	–10 dBm
440	
760	
940	
2400	
2500	

Output EVM

Output EVM

Frequency (MHz)	Offset EVM (%) Test Port1 MU887000A Output Level: –10.9 dBm			Offset EVM (%) Test Port3 MU887000A Output Level: –0.9 dBm		
	Measured Value	Spec.	Measurement uncertainty	Measured Value	Spec.	Measurement uncertainty
440		≤ 3.0	0.2		≤ 3.0	0.2
760						
940						
2400						
2500						

Tx Power Measurement Accuracy (CW)

Tx Power Measurement Accuracy Port1/2

MU887000A Input Level: –10 dBm (Item 5.3.1 Calibration Value)

Frequency (MHz)	MX887060A Measured Value (P) (dBm)	Measurement Accuracy (dB)			
		Lo Limit	Measurement Accuracy –10 – (P)	Hi Limit	Measurement uncertainty
440		–0.5		+0.5	±0.15
760					
940					
2400					
2500					

Tx Power Measurement Accuracy Port1/2

MU887000A Input Level: –55 dBm (Item 5.3.1 Calibration Value)

Frequency (MHz)	Item 5.3.1 –55 dBm Calibration Value (C) (dB)	MX887060A Measured Value (P) (dBm)	Measurement Accuracy (dB)			
			Lo Limit	Measurement Accuracy –25 + (C) – (P)	Hi Limit	Measurement uncertainty
440			–0.7		+0.7	±0.13
760						
940						
2400						
2500						

Tx Power Measurement Accuracy Port1/2

MU887000A Input Level: –65 dBm (Item 5.3.1 Calibration Value)

Frequency (MHz)	Item 5.3.1 –65 dBm Calibration Value (C) (dB)	MX887060A Measured Value (P) (dBm)	Measurement Accuracy (dB)			
			Lo Limit	Measurement Accuracy –25 + (C) – (P)	Hi Limit	Measurement uncertainty
440			–0.9		+0.9	±0.13
760						
940						
2400						
2500						

Tx Power Measurement Accuracy (CW) (continued)

Tx Power Measurement Accuracy Port3/4

MU887000A Input Level: –10 dBm (Item 5.3.1 Calibration Value)

Frequency (MHz)	MX887060A Measured Value (P) (dBm)	Measurement Accuracy (dB)			
		Lo Limit	Measurement Accuracy –10 – (P)	Hi Limit	Measurement uncertainty
440		–0.7		+0.7	±0.17
760					
940					
2400					
2500					

Tx Power Measurement Accuracy Port3/4

MU887000A Input Level: –55 dBm (Item 5.3.1 Calibration Value)

Frequency (MHz)	Item 5.3.1 –55 dBm Calibration Value (C) (dB)	MX887060A Measured Value (P) (dBm)	Measurement Accuracy (dB)			
			Lo Limit	Measurement Accuracy –25 + (C) – (P)	Hi Limit	Measurement uncertainty
440			–0.9		+0.9	±0.14
760						
940						
2400						
2500						

Tx Power Measurement Accuracy Port3/4

MU887000A Input Level: –65 dBm (Item 5.3.1 Calibration Value)

Frequency (MHz)	Item 5.3.1 –65 dBm Calibration Value (C) (dB)	MX887060A Measured Value (P) (dBm)	Measurement Accuracy (dB)			
			Lo Limit	Measurement Accuracy –25 + (C) – (P)	Hi Limit	Measurement uncertainty
440			–1.1		+1.1	±0.14
760						
940						
2400						
2500						

Frequency/Modulation Measurement

Residual EVM/Carrier Frequency Accuracy

MU887000A Input Level: –10 dBm

Frequency (MHz)	Residual EVM (%)			Carrier Frequency Accuracy (Hz)		
	Measured Value	Spec.	Measurement uncertainty	Measured Value	Spec.	Measurement uncertainty
440		≤ 1.5	±0.1		±20.0	±3.0
760						
940						
2400						
2500						

MU887000A Input Level: –30 dBm

Frequency (MHz)	Residual EVM (%)			Carrier Frequency Accuracy (Hz)		
	Measured Value	Spec.	Measurement uncertainty	Measured Value	Spec.	Measurement uncertainty
440		≤ 1.5	±0.1		±20.0	±3.0
760						
940						
2400						
2500						

5.4 Servicing

If any unit is found to be broken or does not operate as described in the specifications, contact an Anritsu Service and Sales office. Contact information can be found on the last page of the printed version of this manual, and is available in a separate file on the PDF version.

When requesting repair, supply the following information:

(a) Model name and serial number marked on rear panel

(b) Failure symptoms

(c) Person to contact about nature of failure and repair completion notification

(d) Software version

Appendix A Specifications

This appendix lists the specifications of the MX887060A IEEE 802.15.4 TX Measurement. Refer to section 1.3 “Composition” for details of the product configuration.

These specifications assume use of the system at a constant temperature after warming-up the instruments for 30 minutes. The abbreviation (typ.) indicates the reference data at 20 to 30°C and is not a guaranteed value.

Table A-1 MX887060A Specifications

<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Tx Power Measurement
Input Level Range

Input Frequency Range
Measurement Accuracy</td><td>Port1, Port2: –65.0 to +35.0 dBm
Port3, Port4: –65.0 to +25.0 dBm
440 to 2500 MHz

Port1, Port2: After calibration, 10 to 40°C
<table>
<tr><th>Input Level</th><th>Measurement Accuracy</th></tr>
<tr><td>–25 to +35 dBm</td><td>±0.3 dB (typ.)
±0.5 dB</td></tr>
<tr><td>–55 to –25 dBm</td><td>±0.7 dB</td></tr>
<tr><td>–65 to –55 dBm</td><td>±0.9 dB</td></tr>
</table>
Port3, Port4: After calibration, 10 to 40°C
<table>
<tr><th>Input Level</th><th>Measurement Accuracy</th></tr>
<tr><td>–25 to +25 dBm</td><td>±0.7 dB</td></tr>
<tr><td>–55 to –25 dBm</td><td>±0.9 dB</td></tr>
<tr><td>–65 to –55 dBm</td><td>±1.1 dB</td></tr>
</table></td></tr>
</table>

Table A-1 MX887060A Specifications (Cont'd)

Item	Specification
Modulation Analysis	
Input Level Range	Port1, Port2: –30.0 to +35.0 dBm Port3, Port4: –30.0 to +25.0 dBm
Input Frequency Range	440 to 2500 MHz
Modulation Accuracy	Residual Vector Error: ≤ 1.5% (At analysis length over 1000 chips)
Carrier Frequency Accuracy	±(Set frequency × Reference oscillator accuracy + 20 Hz) (At analysis length over 1000 chips)

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References are page numbers.

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