Operation and Maintenance Manual

ML2419A RANGE CALIBRATOR

Anritsu Company
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USA

Part Number: 10585-00007
Revision: B
Published: March 2014

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

declares that the product specified below:

Product Name: Power Meter Range Calibrator

Model Number: ML2419A

conforms to the requirement of:

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

Electromagnetic Interference:

Emissions: CISPR 11:1990/EN55011:1991 Group 1 Class A

Immunity: EN50082 -1:1992 Generic Immunity Standard
IEC801-2 Electrostatic Discharge - 4kV CD, 8kV AD
IEC801-3 RF Radiated Field Immunity - 3V/m
IEC801-4 Electrical Fast Transients - 0.5kV SL, 1kV PL

Electrical Safety Requirement:

Product Safety: IEC 1010-1:1990 + A1/EN61010-1:1993

Jeri Blasi
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Morgan Hill, CA

12-FEB-98
Date

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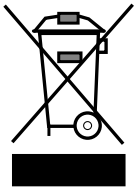

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印刷线路板 (PCA)	×	○	×	×	○	○
机壳、支架 (Chassis)	×	○	×	×	○	○
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Symbols Used in Manuals

Danger

This indicates a risk from a very dangerous condition or procedure that could result in serious injury or death and possible loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Warning

WARNING ⚠

This indicates a risk from a hazardous condition or procedure that could result in light-to-severe injury or loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Caution

This indicates a risk from a hazardous procedure that could result in loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Safety Symbols Used on Equipment and in Manuals

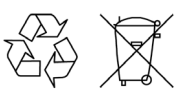
The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

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

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

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

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



These indicate that the marked part should be recycled.

For Safety

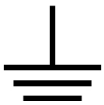
Warning

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

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

Warning

or



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

Warning

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

Caution

Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.

Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

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Chapter 1 — General Information

1-1 Scope of Manual

This manual provides installation, operation, and maintenance information for the Anritsu model ML2419A Range Calibrator.

Figure 1-1. ML2419A Range Calibrator

1-2 Introduction

This chapter provides information to familiarize the user with the basic ML2419A Range Calibrator. Included is information about the equipment identification number, options, and accessories.

1-3 Identification

The ML2419A identification number is affixed to the rear panel (see Figure 3-2, “ML2419A Rear Panel” on page 3-2). Please use the complete identification number when ordering parts or corresponding with the Anritsu Customer Service department.

1-4 Options and Accessories

The ML2419A Range Calibrator is available with the following options:

- **760-209:** Hard Side Transit Case
- **D41310:** Soft Sided Carry Case with shoulder strap
- **2400-82:** Rack Mount, single unit
- **2400-83:** Rack Mount, side-by-side

Note	Options 2400-82 and 2400-83 are mutually exclusive. 1.5 meter sensor cables are supplied with the Anritsu ML24xxx Series Power Meter.

1-5 Verification and Test

The ML2419A Range Calibrator provides a traceable series of voltages to facilitate accuracy measurements for the ML2430A and ML248xx / ML249xA Series Power Meter signal channels. The voltages are produced by means of a precision voltage reference and a series of switchable attenuators, operated by a microcontroller. All voltages produced are accurate, stable, and low-noise such that errors inherent in the Range Calibrator itself do not contribute significantly to the error measurements of the signal channel.

Instrument Control

The Range Calibrator is controlled remotely using the ML24xxx Series Power Meter menu system via the sensor cables. On connection of a sensor cable, the meter automatically senses the presence of the Range Calibrator. From this point, the Range Calibrator is controlled using the ML24xxx keypad and displayed menus.

Test Conditions

The Range Calibrator is intended for use as a calibration instrument, and as such must be operated under controlled conditions of temperature and humidity in order to meet its specified precision and stability.

All tests must be performed at 25 °C ± 10 °C (77 °F ± 18 °F) and a relative humidity of less than 75 % at 40 °C (104 °F), non-condensing.

Prior to making any precision measurements, allow the Range Calibrator and the Power Meter to warm up for a period of 15 minutes from power on. If the power supply is interrupted for any reason, allow a similar settling period.

1-6 Related Documentation

The procedures in this manual may require reference to the following Power Meter Operation and Remote Programming manuals and other information provided on the product disc:

- *ML2430A Series Operation and Remote Programming Manual:* 10585-00001
- *ML248xx / ML249xA Operation Manual:* 13000-00238
- *ML248xx / ML249xA Remote Programming Manual:* 13000-00239
- *Anritsu Power Meters and Sensors Application and Documentation Disc:* 2300-283

The above product disc contains all of the required documentation and spreadsheets specified in this manual. Updated information can be downloaded from each product page on the Anritsu web site:
http://www.anritsu.com

Chapter 2 — Installation

2-1 Introduction

This section provides information for the initial inspection and preparation for use of the ML2419A Range Calibrator. Shipping and storage information is also included.

2-2 Initial Inspection

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

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

2-3 Power Requirements

The ML2419A Range Calibrator is operated from AC line power and is intended as an Installation (Overvoltage) Category II, Insulation Category I device. A front-panel LED indicates when power is applied.

AC Line Power

The ML2419A Range Calibrator can operate on AC input power of 90 to 132 V or 180 to 264V, 47 Hz to 63 Hz, 6 VA max.

Fuses

The ML2419A Range Calibrator AC input line is protected by an internally mounted fuse. This fuse should only be changed by qualified service personnel. Replace only with a fuse of the same type and rating: 0.5 A, 250 V, antisurge (T).

Grounding

The ML2419A Range Calibrator must be properly grounded. Failure to ground the instrument could be hazardous to operating personnel. The instrument is supplied with a three-conductor power cord. The instrument is properly grounded during AC line operation when the plug is connected to a properly installed three-prong receptacle. A grounding terminal is also provided on the rear panel.

2-4 Environmental

The ML2419A Range Calibrator is designed to operate within the temperature range of 0 °C to 50 °C (32 °F to 122 °F) with a maximum relative humidity of 95 % at 40 °C (104 °F), non-condensing.

Full accuracy is specified at 25 °C ± 10 °C (77 °F ± 18 °F), at a maximum relative humidity of 75 % at 40 °C (104 °F), non-condensing.

2-5 Rack Mounting

The ML2419A Range Calibrator can be ordered with rack mounting hardware that allows the unit to be mounted into a standard 19 inch equipment rack. There are two rack mount option kits available:

- The 2400-82 Rack Mount option allows the installation of a single ML2419A in either the left or right-side rack position.
- The 2400-83 Rack Mount option allows mounting of two ML2419A Range Calibrators (or one Range Calibrator and one ML24xxx Series Power Meter) side-by-side.

The instrument itself must be ordered from the factory as a rack mount unit. As such, it will be fitted with rack mount top and bottom cases that have extra mounting holes so that the rack mount kits can be installed. Instructions for installing the rack mount kits are supplied with the rack mounting kits.

2-6 Storage and Shipment

The following paragraphs describe preparing the range calibrator for storage and shipment.

Preparation for Storage

Preparing the range calibrator for storage consists of cleaning the unit and packing it with moisture-absorbing desiccant crystals.

Environmental Requirements

Store the unit in a temperature controlled environment that is maintained between –40 and +70 °C (–40 to +156 °F), with a maximum humidity of 95 % at 40 °C (104 °F), non-condensing.

Preparation for Shipment

To provide maximum protection against damage in transit, the range calibrator should be repackaged in the original shipping container. If this container is no longer available and the range calibrator is being returned to Anritsu for repair, follow the packaging instructions below:

- Use a Suitable Container: Obtain a corrugated cardboard carton with a 275 pound test strength. This carton should have inside dimensions of no less than six inches larger than the instrument dimensions to allow for cushioning.
- Protect the Instrument: Wrap the instrument to protect the finish.
- Cushion the Instrument: Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument. Provide at least three inches of dunnage on all sides.
- Seal the Container: Seal the carton using either shipping tape or an industrial stapler.
- Address the Container: If the instrument is being returned to Anritsu for service, mark the address of the appropriate Anritsu service center (refer to http://www.anritsu.com/contact.asp), the Return Materials Authorization (RMA) number, and your return address on the carton in a prominent location.

Chapter 3 — Connections

3-1 Introduction

This section provides descriptions of the ML2419A Range Calibrator front and rear panels and connectors.

3-2 Front Panel

The front panel is illustrated in Figure 3-1. There are three connectors and an ON/OFF indicator LED on the front panel.

Figure 3-1. ML2419A Front Panel

AC Power LED: This LED lights whenever AC power is applied to the ML2419A Range Calibrator and the power switch is in the on position.

50 MHz 0 dBm Connector: This precision output provides a nominal 50 MHz, 0.0 dBm reference signal to approximate the sensor calibration. For a traceable calibration, use the 50 MHz source on the ML24xxx Series Power Meter. The 0.0 dBm level is available at this N-type connector whenever the Range Calibrator is powered on.

Sensor A Connector: This connector is a 12 pin, circular precision connector to be used in conjunction with 1.5 meter power sensor cables.

Sensor B Connector: This connector is a 12 pin, circular precision connector to be used in conjunction with 1.5 meter power sensor cables.

3-3 Rear Panel

The Rear Panel has four connectors, the AC input voltage selector, and an ID number label.

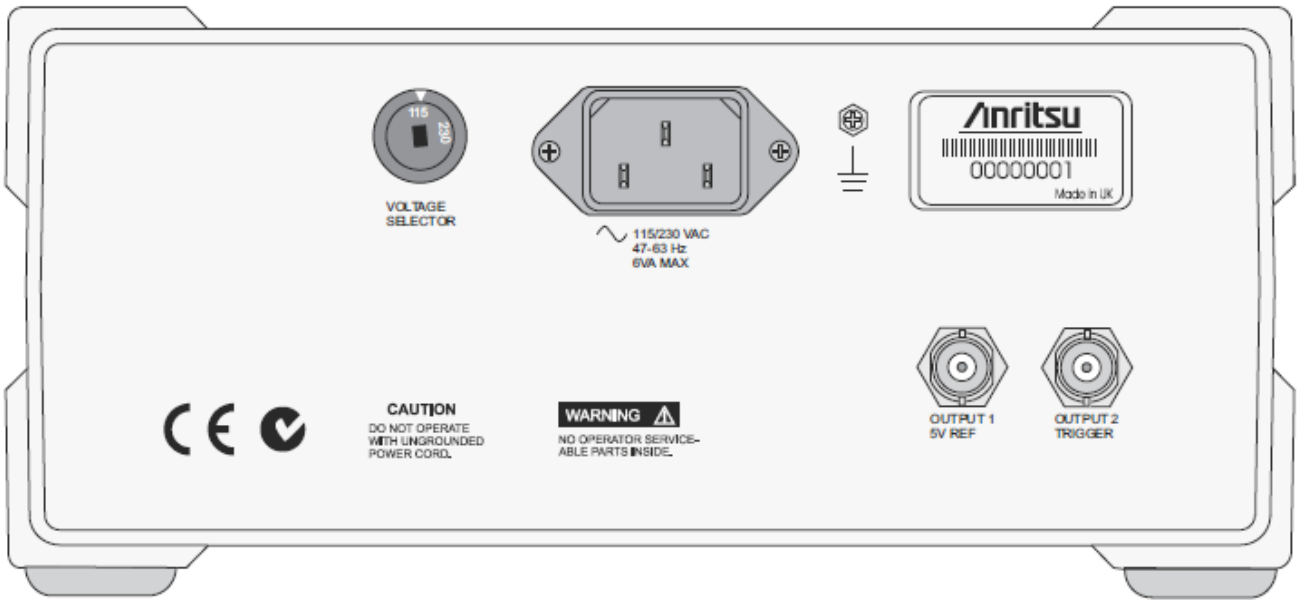


Figure 3-2. ML2419A Rear Panel

AC Line Power Connector: The ML2419A Range Calibrator can operate on AC input power of 90 to 132 V or 180 to 264V, 47 Hz to 63 Hz, 50 VA max. The Range Calibrator must be properly configured using the voltage selector for the voltage being applied. No on/off switch is provided, as the unit is powered continuously during use. A front-panel LED indicates when power is applied.

Output 1 5V Reference: This function is reserved for future use.

Output 2 Trigger: This function is reserved for future use.

Chassis Ground: This grounding terminal can be used to connect the chassis ground of the Range Calibrator to other equipment as necessary.

The instrument itself is properly grounded when the AC line plug is connected to a properly installed three-prong receptacle.

ID Number Label: The ML2419A identification number is affixed to the rear panel. Please use the complete identification number when ordering parts or corresponding with the Anritsu Customer Service department.

Chapter 4 — Operation with an ML2430A Series Power Meter

4-1 Performing a Verification

The performance of the Anritsu ML2430A Series Power Meter's individual signal channel inputs are verified using the following procedure. References in this procedure to sensor input B apply to model ML2438A (dual-channel) power meter only. Before starting this procedure, refer to Section 1-5 "Verification and Test" for information on the appropriate Test Conditions.

1. Connect the Range Calibrator to the Power Meter using 1.5 meter sensor cables. The inputs to be verified must be connected to the corresponding connectors on the Range Calibrator; that is, connect Power Meter connector A to Range Calibrator connector A, and connector B to connector B (ML2438A only).
2. On connection of the sensor cables, the meter automatically detects that a Range Calibrator is present and displays the performance verification menus.

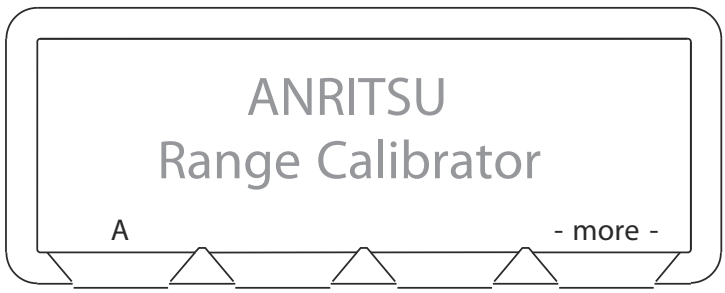


Figure 4-1. ML2419A Range Calibrator Top Menu (single-channel power meter)

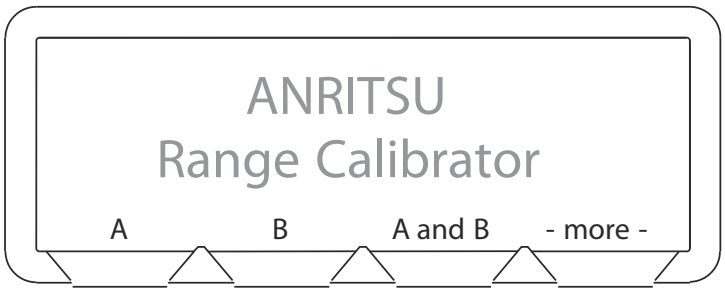


Figure 4-2. ML2419A Range Calibrator Top Menu (dual-channel power meter)

3. The performance verification tests will begin when the soft key for the sensor input to be verified is selected. For single-channel power meters (ML2437A), press the A soft key. For dual-channel models (ML2438A), press A, B, or A and B. If the "A and B" soft key is selected, all measurements are first taken on sensor input A, then repeated for sensor input B. Performance verification tests for each sensor input are performed in the following sequence:
   - The signal channel input is zeroed.
   - The Power Meter signal channels are checked at the upper and lower levels of each measurement range. A null is performed at each range setting prior to every measurement.

4. When all measurements have been performed on the selected inputs, the results are presented on the screen and the following soft keys are displayed:

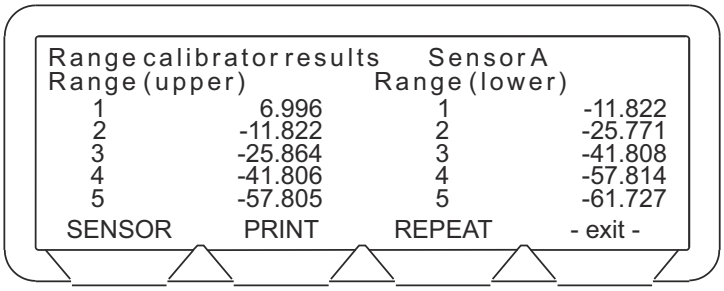


Figure 4-3. ML2419A Range Calibrator Verification Results Menu Example

SENSOR: Toggles the display to show the data for each sensor channel verified. If only one channel has been verified, the **SENSOR** soft key shown in Figure 4-3 will not be displayed.

PRINT: The verification data can be printed using the **PRINT** selection. The data is output through the ML2430A Series Power Meter rear panel printer port. The printer type will be the same as that selected when operating the meter in stand-alone mode. Refer to the ML2430A Series Power Meter Operation Manual for information on print commands and supported printers.

See Figure 4-4 for an example of a printed Range Calibrator Report.

Note	The results of the Range Calibrator tests are available from the power meter via the GPIB, once the Range Calibrator is disconnected from the power meter. Refer to the description of the RCD command in the ML2430A Series Power Meter Operation Manual.

REPEAT: The last selected performance verification sequence is repeated.

-exit-: Returns the user to the top-level menu (Figure 4-1 or Figure 4-2).

5. To exit the Range Calibrator mode, disconnect the sensor cables. The Power Meter will reset to the default mode.

ANRITSU Power Meter ML2438A s/n: 97310026
Range Calibrator Report

Firmware: 1.02

Date:

Time:

Operator:

Range Calibrator s/n:

Range	Input A	Input B
	Zeroed	Zeroed
Zero	-84.790dB	-86.864dB
Range 1 upper	6.990dB	6.990dB
Range 1 lower	-11.834dB	-11.834dB
Range 2 upper	-11.834dB	-11.834dB
Range 2 lower	-25.774dB	-25.774dB
Range 3 upper	-25.860dB	-25.860dB
Range 3 lower	-41.803dB	-41.803dB
Range 4 upper	-41.803dB	-41.803dB
Range 4 lower	-57.812dB	-57.812dB
Range 5 upper	-57.812dB	-57.812dB
Range 5 lower	-61.732dB	-61.732dB

Figure 4-4. Example Range Calibrator Report

4-2 RF Calibrator

The Range Calibrator RF Calibrator output can be used to approximate the 0.0 dBm at 50 MHz reference calibration of a sensor. Calibration is accomplished using the ML2430A Series Power Meter **Cal/Zero** menu. Sensors should be zeroed before being calibrated (refer to the ML2430A Series Power Meter Operation Manual, part number 10585-00001). Zeroing a power sensor compensates for noise and thermal EMF of the device under test, and is recommended prior to taking important power readings in the bottom 20 dB of a power sensor's dynamic range.

When the sensor is first attached, the message **SENSOR x ZERO not done** (where x = A or B as appropriate) is displayed. Perform the sensor zeroing procedure described in the ML2430A Series Power Meter Operation Manual.

After zeroing the power sensor, perform the following procedure to calibrate the sensor:

1. Connect the sensor to the ML2419A Range Calibrator 50 MHz, 0.0 dBm reference output connector labeled **CALIBRATOR**.
2. Press the **Cal/Zero** front panel key and the **Cal 0 dBm** soft key, then select the appropriate sensor. Note that if only one sensor is connected, the **A and B** selection is not displayed and the calibration process begins immediately.
3. On successful completion of the calibration operation, the buzzer sounds.

The sensors can also be calibrated using the **GPIB CAL** command (refer to the programming section of the ML2430A Series Power Meter Operation Manual).

4-3 Interpreting the Results

The tabular data presented consist of the values read by the meter for each range, with one measurement taken at each end of each range. For each of these measurements, there is an expected value. These measured values must meet the specification limits defined in Appendix A, "ML2419A Range Calibrator Specifications".

dB Error Figure

The Range Calibrator measures the "Zero" level, and the "Upper" and "Lower" limits of each of the five ranges (both channels on a dual-channel meter). To calculate the dB Error Figure for each level, subtract the expected level from the measured level.

Pass/Fail Criteria

The meter should be accepted as PASSED if it meets the following conditions applied to the error figures calculated by the above method.

Note	Note that the provided Excel™ spreadsheet form can also be used to determine pass/fail status. Refer to Appendix B, "Range Calibrator Verification Spreadsheet Information".

Table 4-1. Pass / Fail Criteria

Range	Specifications (dB)
Range 1 Absolute Error	–0.028 ≤ R1U ≤ 0.028
Range 1 Linearity	–0.028 ≤ R1U – R1L ≤ 0.028
Ranges 1 – 2 Change	–0.028 ≤ R1L – R2U ≤ 0.028
Range 2 Linearity	–0.028 ≤ R2U – R2L ≤ 0.028
Ranges 2 – 3 Change	–0.028 ≤ R2L – R3U ≤ 0.028
Range 3 Absolute Error	–0.028 ≤ R3U ≤ 0.028
Range 3 Linearity	–0.028 ≤ R3U – R3L ≤ 0.028
Ranges 3 – 4 Change	–0.028 ≤ R3L – R4U ≤ 0.028
Range 4 Linearity	–0.028 ≤ R4U – R4L ≤ 0.028
Range 4 – 5 Change	–0.075 ≤ R4L – R5U ≤ 0.075
Range 5 Linearity	–0.023 ≤ R5U – R5L ≤ 0.023

Absolute Error

The calculated absolute error should be as shown in table above. For example, the calculated absolute errors for Range 1 Upper (R1U) should be between –0.028 dB and +0.028 dB.

Linearity

The linearity values should be as shown in table above. For example, the Range 1 Lower (R1L) should differ from Range 1 Upper (R1U) by no less than 0.028 dB.

Range Change Error

The range change error, defined as the difference between the errors for the two dB levels at the overlap between any two ranges, should be as shown in the table above. For example, the maximum range change error between Range 1 Lower and Range 2 Upper (R1L – R2U) should be between –0.028 dB and +0.028 dB.

4-4 Diagnostic Mode

The Diagnostics mode allows the user to investigate meter problems by holding on any of the fixed level outputs to examine the results of a particular measurement. From the top-level menu press -more-and DIAGS. When the Diagnostics option is selected, the SENSOR, LEVEL, and ZERO soft keys become available.

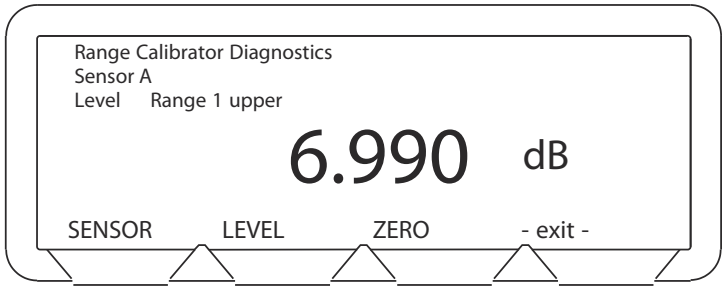


Figure 4-5. ML2419A Diagnostics Menu

SENSOR: Toggles the display to show the measurements for each channel. If only one channel is connected, the SENSOR soft key shown in Figure 4-5 will not be displayed.

LEVEL: Selects the level to be verified.

ZERO: The selected sensor input is zeroed.

When a **SENSOR** and **LEVEL** are selected, the range calibrator outputs the required signal to the appropriate sensor input on the meter, and the meter continuously measures it. The reading obtained for a particular range should be the same as when the full set of tests were run (within the specifications listed in Appendix A, "ML2419A Range Calibrator Specifications"). To obtain an accurate measurement, it is important to **ZERO** at each selection of **SENSOR** and **LEVEL**.

-exit-: Returns the user to the top-level menu (Figure 4-1 or Figure 4-2).

Chapter 5 — Operation with an ML248xx or ML249xA Series Power Meter

5-1 Performing a Verification

The performance of the ML248xx / ML249xA Series Power Meter's individual signal channel inputs are verified using the following procedure. References in this procedure to sensor input B apply to ML248xx and ML2496A (dual-channel) power meters only. Before starting this procedure, refer to Section 1-5 "Verification and Test" for information on the appropriate Test Conditions.

1. Connect the Range Calibrator to the Power Meter using 1.5 m sensor cables. The inputs to be verified must be connected to the corresponding connectors on the Range Calibrator; that is, connect Power Meter connector A to Range Calibrator connector A, and connector B to connector B (ML248xx and ML2496A only).
2. On connection of the sensor cables, the power meter automatically detects the Range Calibrator and displays the following screen.

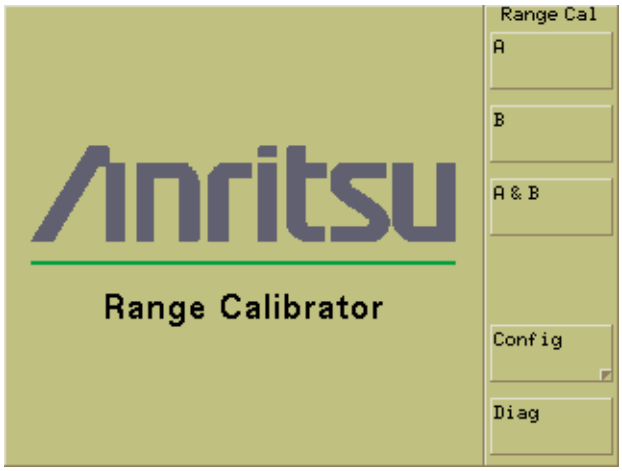


Figure 5-1. ML2419A Range Calibrator Top Menu

3. Press the soft key of the sensor input to be verified. For single-channel power meters (ML2487x and ML2495A), press the **A** soft key. For dual-channel models (ML248xx and ML2496A), press **A**, **B**, or **A & B**. If the **A & B** soft key is selected, all measurements are first taken on sensor input A, then repeated for sensor input B. Performance verification tests for each sensor input are performed in the following sequence:
   a. The signal channel input is zeroed.
   b. The Power Meter signal channel are checked at the upper and lower levels of each measurement range. A null is performed at each range setting prior to every measurement.

4. When all measurements have been performed on the selected inputs, the results are presented on the screen as shown below.

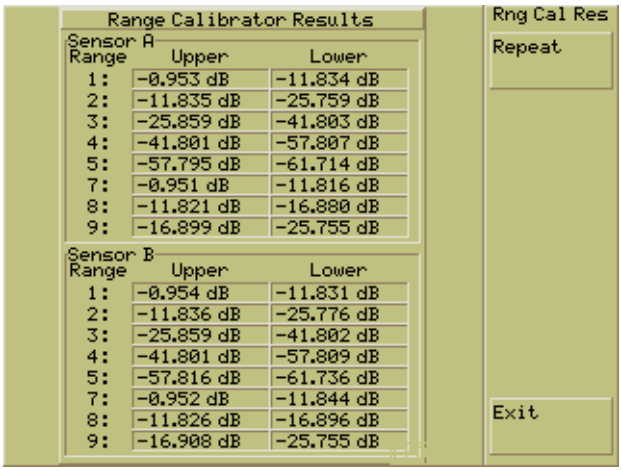


Figure 5-2. ML2419A Range Calibrator Verification Results Menu Example

The figure above shows the results for inputs A and B acquired by pressing the **A & B** soft key. Once results for both inputs have been acquired, the information is retained until the power is turned off.

5-2 Interpreting the Results

The tabular data consists of the values read by the meter for each range, with one measurement taken at each end of each range. For each of these measurements, the expected value must meet the specification limits as defined in Appendix A, "ML2419A Range Calibrator Specifications".

dB Error Figure

The Range Calibrator measures the "Zero" level, and the "Upper" and "Lower" limits of each of the five ranges (both channels on a dual-channel meter). To calculate the dB Error Figure for each level, subtract the expected level from the measured level.

Pass/Fail Criteria

The meter should be accepted as PASSED if it meets the error and linearity statistics in the following table.

Note	Note that the provided Excel™ spreadsheet form can also be used to determine pass/fail status. Refer to Appendix B, "Range Calibrator Verification Spreadsheet Information".

Table 5-1. Pass / Fail Criteria

Range	Specifications (dB)
Range 1 Absolute Error	–0.020 ≤ R1U ≤ 0.020
Range 1 Linearity	–0.040 ≤ R1U – R1L ≤ 0.040
Ranges 1 – 2 Change	–0.030 ≤ R1L – R2U ≤ 0.030
Range 2 Linearity	–0.040 ≤ R2U – R2L ≤ 0.040
Ranges 2 – 3 Change	–0.030 ≤ R2L – R3U ≤ 0.030
Range 3 Absolute Error	–0.020 ≤ R3U ≤ 0.020
Range 3 Linearity	–0.040 ≤ R3U – R3L ≤ 0.040
Ranges 3 – 4 Change	–0.030 ≤ R3L – R4U ≤ 0.030
Range 4 Linearity	–0.040 ≤ R4U – R4L ≤ 0.040
Range 4 – 5 Change	–0.030 ≤ R4L – R5U ≤ 0.030
Range 5 Linearity	–0.040 ≤ R5U – R5L ≤ 0.040
Range 7 Absolute Error	–0.030 ≤ R7U ≤ 0.030
Range 8 Absolute Error	–0.030 ≤ R8U ≤ 0.030
Range 8 Linearity	–0.085 ≤ R8U – R8L ≤ 0.085
Range 9 Absolute Error	–0.050 ≤ R9U ≤ 0.050
Range 9 Linearity	–0.18 ≤ R9U – R9L ≤ 0.18

Absolute Error

The calculated absolute error should be as shown in table above. For example, the calculated absolute errors for Range 1 Upper (R1U) should be between –0.020 dB and +0.020 dB.

Linearity

The linearity values should be as shown in table above. For example, the Range 1 Lower (R1L) should differ from Range 1 Upper (R1U) by no less than 0.040 dB.

Range Change Error

The range change error, defined as the difference between the errors for the two dB levels at the overlap between any two ranges, should be as shown in the table above. For example, the maximum range change error between Range 1 Lower and Range 2 Upper (R1L – R2U) should be between –0.030 dB and +0.030 dB.

5-3 Using the Diagnostics Menu

The Diagnostics mode allows the user to investigate meter problems by holding on any of the fixed level outputs to examine the results of a particular measurement.

1. Connect the Range Calibrator to the Power Meter using 1.5 m sensor cables. The inputs to be verified must be connected to the corresponding connectors on the Range Calibrator; that is, connect Power Meter connector A to Range Calibrator connector A, and connector B to connector B (ML248xx and ML2496A only).
2. Press the **Diag** soft key to display the **Rng Cal Diag** group of commands and the **Range Calibrator Diagnostics** dialog.

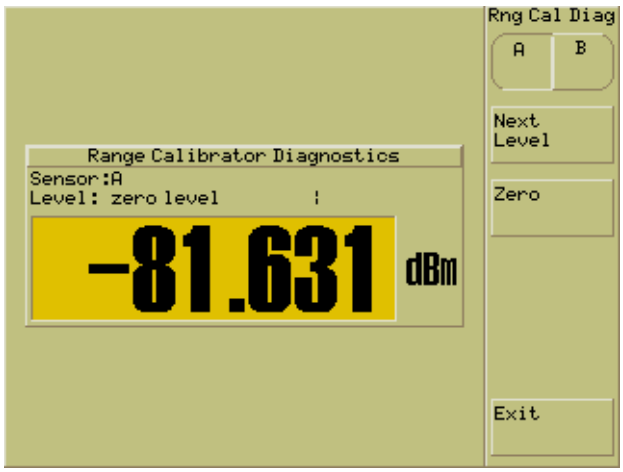


Figure 5-3. ML2419A Range Calibrator Diagnostics Menu

3. Press the **Next Level** soft key to display the required level. The range calibrator outputs the required signal to the appropriate sensor input on the meter, and the meter continuously measures it. The reading obtained for a particular range should be the same as when the full set of tests was run.
4. Press the **Zero** soft key to zero the residual range for the required level.
5. Press the **Exit** soft key to close the dialog and return to the main **Range Cal** menu.

5-4 Using the Range Calibrator Config Menu

The range calibrator config menu houses four commands normally found under the **System** hard key of the ML248xx / ML249xA Series Power Meter. These commands have been included so that the user can access them without the need to disconnect from the range calibrator. The soft keys in the **Rng Cal Conf** menu are summarized below. Refer to chapter 5 of this manual for a more detailed explanation.

Identity: Press to display instrument type, serial number, and firmware version details.

Set GPIB Address: Press to display or change the instrument's GPIB address.

Set RS232 Baud Rate: Press to display or change the baud rate.

Screen Dump Mode: Press to retain the display of the soft keys in screen dumps captured remotely using the supplied *ScreenCapture.exe* program.

Chapter 6 — Maintenance

6-1 Introduction

This chapter describes the functional test and calibration of the ML2419A Range Calibrator used for performance verification of the ML24xxx Series Power Meter. Also included is a list of recommended test equipment.

Note	Procedures in this section should be performed by qualified technical personnel only. These procedures require access to internal test points and adjustment pots, and care should be taken to avoid contact with potentially hazardous voltages. No conductors carrying AC voltages are readily accessible provided the unit is operated correctly with all insulators intact. As there are conductors carrying AC voltages on the underside of the motherboard, the unit must always be powered with the rear panel and motherboard firmly in place on the base.

6-2 Recommended Test Equipment

The following test equipment is required to perform the procedures in this chapter.

- A DVM with a DC voltage measurement accuracy of ± 60 ppm ± 1 digit (example: Agilent 34401A)
- General purpose oscilloscope and BNC lead
- Test lead set for DVM
- Frequency Counter (example: Anritsu MF2412B)
- Power Meter (example: Agilent 732A)
- Thermistor Mount Sensor (example: Agilent 478A)

Note	Ensure all test equipment is within its calibration period.

6-3 Test Conditions

The Range Calibrator is intended for use as a calibration instrument and must be operated under controlled conditions of temperature and humidity in order to meet its specified precision and stability. All tests should be performed at a temperature of 25 °C ± 10 °C (77 °F ± 9 °F) and relative humidity of less than 75 % at 40 °C (104 °F), non-condensing. Prior to making any precision measurements, allow the Range Calibrator to warm up for a period of 30 minutes from power on. If the power supply is interrupted for any reason, allow a similar settling period.

6-4 Test Setup

Caution	Procedures in this and the following sections should be performed by qualified technical personnel only. This procedure requires access to internal test points and adjustment pots, and care should be taken to avoid contact with potentially hazardous voltages.

With AC power disconnected, open the unit by loosening the six captive screws on the underside (Figure 6-1, "ML2419A Bottom View" on page 6-3) and separating the top half of the case from the base. Ensure that the front and rear panels remain firmly in place during this operation.

Apply power to the unit using the AC inlet on the rear panel and verify that the front panel LED is illuminated. Prior to making any precision measurements, allow the Range Calibrator to warm up for a period of 30 minutes from power on. If the power supply is interrupted for any reason, allow a similar settling period.

Record all measurements on a copy of the Test Result Sheet provided at the end of this chapter.

6-5 Power Supply Tests

Use a digital voltmeter and the Range Calibrator test lead set, as specified in Section 6-2 "Recommended Test Equipment" on page 6-1 to perform the following tests. See Figure 6-2, "ML2419A Main PCB" on page 6-4 for test point, potentiometer, and jumper locations.

+12 V Supply Test

1. Attach the DVM test leads to **TP30** and **TP31** and "zero" the DVM
2. Using the test lead set, connect the DVM –ve input to **TP21** (0V) and the +ve input to **TP24**.
3. Verify that the +12 V supply is within specification.

   SPECIFICATION: +12.15 V ± 0.5 V

–12 V Supply Test

1. Connect the DVM +ve input to **TP25**.
2. Verify that the –12 V supply is within specification.

   SPECIFICATION: –12.17 V ± 0.50 V

+5 V Supply Test

1. Connect the DVM –ve input to **TP22** and the +ve input to **TP23**.
2. Verify that the +5 V supply is within specification.

   SPECIFICATION: +5.0 V ± 0.2 V

50 MHz Supply

1. Connect the DVM –ve input to **TP26** and the +ve input to **TP32**.
2. Verify that the 50 MHz supply voltage is within specification.

   SPECIFICATION: +24V ± 5 V

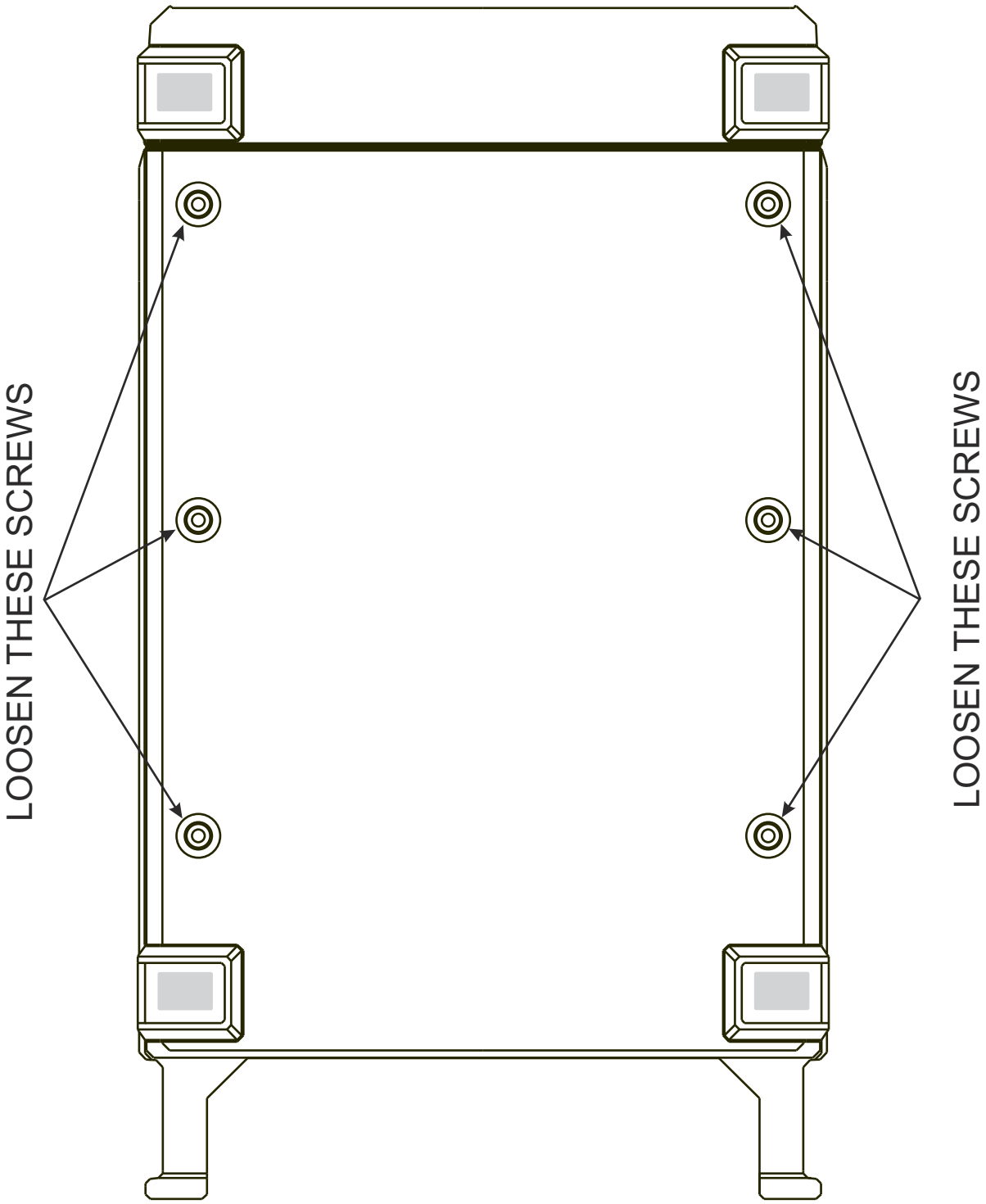


Figure 6-1. ML2419A Bottom View

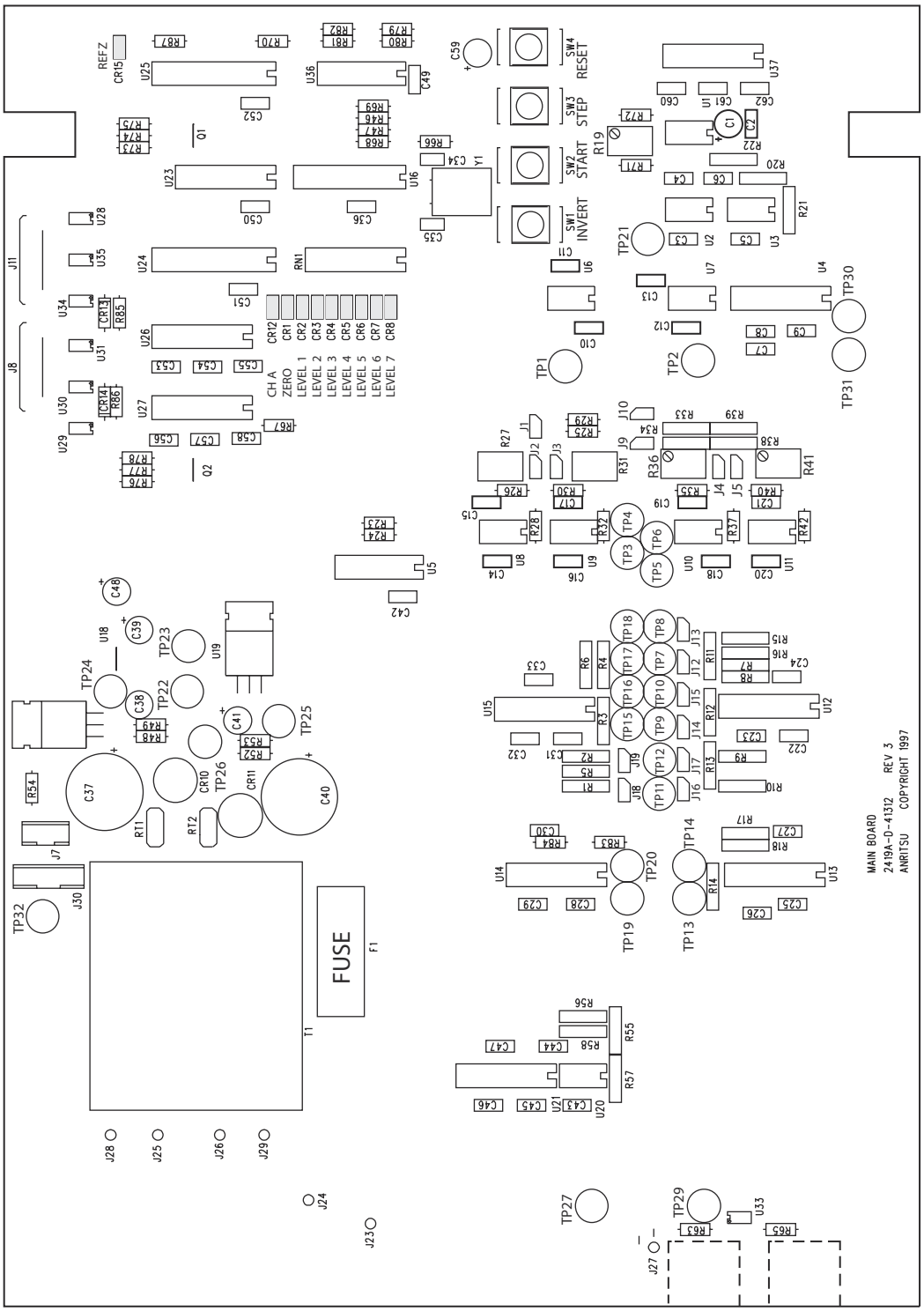


Figure 6-2. ML2419A Main PCB

6-6 Reference Levels

The following tests verify the high and low reference levels. Use a DVM and the test leads as specified in Section 6-2 “Recommended Test Equipment” on page 6-1 to perform these tests. Refer to Figure 6-2, “ML2419A Main PCB” on page 6-4 for test point, potentiometer, and jumper locations.

Note	Section 6-6 and Section 6-9 require measurement of µV offset voltages while the top cover is removed. To avoid interference during these measurements, turn off all nonessential equipment within close proximity (2 m) of the test. Prior to making the following measurements, press the **RESET** button on the Range Calibrator PCB and ensure that the **REFZ** LED is not lit. If the **REFZ** LED is lit, refer to Section 6-7 for information on controlling the LED.

Before performing the reference level tests listed below, “zero” or “null” the DVM with the DVM test leads attached to **TP30** and **TP31**.

High Level Offsets

1. Attach the DVM –ve lead to **TP21** and the +ve lead to **TP3**.
2. Move the jumper from **J1** to **J2.**
3. Verify the offset voltage measured at **TP3** is within specifications, even when the Invert button is pressed. Record the results.
4. Move the jumper from **J2** to **J3** and the DVM +ve lead to **TP4.**
5. Verify the offset voltage measured at **TP4** is within specifications, even when the Invert button is pressed. Record the results.

   SPECIFICATION: 0, ±20 µV

Positive High Level

1. Remove the jumper from **J3** and return it to **J1**.
2. Attach the DVM +ve lead to **TP1**.
3. Adjust **R19** to set the measurement as close as possible to +2.5000V, changing to –2.5000V when the Invert button is pressed.

   SPECIFICATION: ±2.5000, ± 0.1 mV.

Balancing VH+ and VH–

The voltage at **TP2** should be the inverse of the voltage at **TP1**. Measure the voltages at **TP1** and **TP2** alternately while adjusting **R19** if necessary to balance the two voltages as close as possible within their specification. Obtain the best balance possible, including the effect of pressing the Invert button. Record the final **TP1** and **TP2** voltages.

SPECIFICATION: ±2.5000, ± 0.1 mV.

Positive Low Level

1. Move the Jumper from **J1** to **J4,** and place the DVM +ve lead on **TP5** and the –ve lead on **TP21**.

Note	Zero the DVM at **TP30** and **TP31** before making the following measurements.

2. Adjust **R36** such that the offset voltage measured is balanced about zero when the Invert button is alternately pressed and released. Obtain the best possible balance within the specification. Record the results.

   SPECIFICATION: 0, ±11 µV.

3. Move the jumper to **J5**, and the DVM +ve lead to **TP6**.
4. Repeat the above operation, this time adjusting **R41** to obtain the best possible balance about zero at **TP6**. Record the results.

   SPECIFICATION: 0 ± 11 µV.

Low Level Differential Voltage

1. Move the jumper from **J5** back to the park position at **J1**.
2. Move the DVM +ve lead to **TP5** and the DVM –ve lead to **TP6**.
3. Measure and record the voltages, both with and without the Invert button pressed.

   SPECIFICATION: ±279.33 mV ± 0.06 mV

6-7 Microcontroller Operation

On power-up, the Range Calibrator defaults to normal operation, whereby the unit is controlled remotely by the ML24xxx Series Power Meter. To gain control of the Range Calibrator locally, hold down the **START** button and press the PCB **RESET** button momentarily. Refer to Figure 6-2, “ML2419A Main PCB” on page 6-4 for switch and LED locations.

To place the Range Calibrator in each of its states sequentially, press the PCB **STEP** button repeatedly and note that indication of present state is given by the bank of LEDs on the PCB.

The sequence will step from Channel A, Level ZERO through LEVEL 7 to LEVEL 1, followed by Channel B, Level ZERO through LEVEL 7 to LEVEL 1. Once all of the states have been stepped through the cycle will repeat so that it is possible to return to any given state by repeatedly pressing the **STEP** button.

To operate the Reference Zero function, hold both the **START** and **STEP** buttons down together and press the PCB **RESET** button momentarily. Now repeated operation of the **STEP** button will result in a single cycle through the Channel A and Channel B levels, but with the **REFZ LED** illuminated indicating that a reference voltage of 0.0 V has been selected. Once all of the states have been stepped through, the cycle will repeat with the **REFZ LED** extinguished, indicating that the normal reference of 5.0 V has been selected.

To return to normal operation, press the PCB **RESET** button. In this mode, the **STEP** button will have no effect since the instrument is waiting for instructions from the ML24XX Power Meter. Control can be switched between local and remote operation as required without the need to cycle power, avoiding warm-up time delays.

6-8 Attenuator Function

Prior to verification of the attenuation factors, check the basic function of the attenuator control as follows:

Note	Zero the DVM at **TP30** and **TP31** before making any of the following measurements.

1. Attach the DVM –ve lead to **TP20** and the +ve lead to **TP19**.
2. Cycle through each attenuator step with the **STEP** button and verify the following readings on the DVM. Use the **INVERT** button at each step to verify the negative polarity. Record the result.

LEVEL	EXPECTED VALUE
7	± 208 µV, ± 5 µV
6	± 512 µV, ± 5 µV
5	± 2.646 mV, ± 5 µV
4	± 20.434 mV, ± 5 µV
3	± 65.552 mV, ± 10 µV
2	± 802.78 mV, ± 100 µV
1	± 5.0000V, ± 500 µV
ZERO	± 0.000 mV,± 5 µV

6-9 Reference Zero Function

To check the Reference Zero function:

1. Hold both the START and STEP buttons down together and press the RESET button momentarily.
2. Verify that the voltage measured with the leads at TP19 and TP20 for each of the Channel A and Channel B level states is always at zero while the REFZ LED is on.

   SPECIFICATION: 0.00mV ±50 µV

Note	Press the **RESET** button when this test is completed and ensure that the **REFZ LED** is off before proceeding to the next test.

6-10 Low Level Attenuators

Note	Zero the DVM at **TP30** and **TP31** before making any of the following measurements.

To check the low level attenuators:

1. Remove the jumpers from **JP9** and **JP10**.
2. Place the DVM +ve lead on **TP5** and the –ve lead on **TP6**.
3. Measure and record the voltage level.

Note	Measure and record all voltage levels to four decimal places.

4. Place the leads on **TP7** and **TP8** and record the voltage level.
5. Divide the first voltage by the second to compare with the expected attenuation factor.

   EXPECTED VALUE: 13.6701 ± 0.0027
6. Insert the jumpers on **JP12** and **JP13**.
7. Measure and record the new voltage at **TP7** and **TP8**.
8. Attach the DVM leads to **TP9** and **TP10** and record the voltage level.
9. Divide the first voltage by the second to compare with the expected attenuation factor.

   EXPECTED VALUE: 7.7224 ± 0.0016
10. Insert the jumpers on **JP14** and **JP15**.
11. Measure and record the new voltage at **TP9** and **TP10**.
12. Attach the DVM leads on **TP11** and **TP12** and record the voltage level.
13. Divide the first voltage by the second to compare with the expected attenuation factor.

    EXPECTED VALUE: 5.1651 ± 0.0010
14. Insert the jumpers on **JP16** and **JP17**.
15. Measure and record the new voltage at **TP11** and **TP12**.
16. Attach the DVM –ve test lead to **TP14** and the +ve test lead to **TP13** and record the voltage level.
17. Divide the first voltage by the second to compare with the expected attenuation factor.

    EXPECTED VALUE: 2.4661 ± 0.0005

6-11 High Level Attenuators

Note	Zero the DVM at **TP30** and **TP31** before making any of the following measurements.

To check the high level attenuators:

1. Attach the DVM +ve lead on **TP3** and the –ve lead on **TP4** and record the voltage level.

Note	Measure and record all voltage levels to four decimal places.

2. Attach the leads on **TP15** and **TP16** and record the voltage level.
3. Divide the first voltage by the second to compare with the expected attenuation factor.

   EXPECTED VALUE: 6.2281 ± 0.0013
4. Remove the jumpers from **J16** and **J17** and insert them on **J18** and **J19.**
5. Measure and record the new voltage at **TP15** and **TP16**.
6. Attach the leads on **TP17** and **TP18** and record the voltage level.
7. Divide the first voltage by the second to compare with the expected value.

   EXPECTED VALUE: 12.2471 ± 0.0025

Note	Remove the jumpers from J18 and J19 and return them to J9 and J10 once these measurements are complete. Failure to do this will lead to incorrect operation of the Low Level attenuator chain. (Correct operation may be verified by repeating the operations described in Section 6-6 “Reference Levels” on page 6-5.

6-12 Rear Panel Functions

The following paragraphs describe the rear panel functions.

5 V Reference Output

Refer to Section 6-7 “Microcontroller Operation” for information on the Range Calibrator using the on-board push-button switches.

1. Attach the DVM +ve lead on **TP29** and the DVM –ve lead on **TP27**.
2. Verify that the voltage measured at **TP29** is +5 V when any level is selected other than level **ZERO**. Record the result.

   EXPECTED VALUE: +5.000 V, ± 1 mV
3. Confirm that when level **ZERO** is selected, the voltage at **TP29** is 0 V. Record the result.

   EXPECTED VALUE: 0 V, ± 1 mV

Trigger Output

Refer to Section 6-7 "Microcontroller Operation" for information on the Range Calibrator using the on-board push-button switches.

1. Using a general-purpose oscilloscope and BNC lead, verify that every time the level is changed by pressing the **STEP** button, a 300 µs duration positive going TTL pulse is generated at the **TRIGGER** BNC output.
2. Set the oscilloscope vertical scale to 2 V/Div, horizontal scale to 100 µs/Div, and trigger on the rising edge. The trace should appear as below:

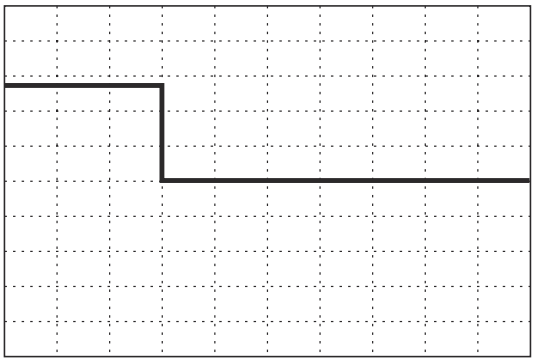


Figure 6-3. ML2419A Trigger BNC Output Trace

6-13 ML2419A 50 MHz, 0 dBm Reference Calibration Procedure

Scope

This document details how to calibrate and adjust the ML2419A 50 MHz, 0 dBm Reference.

Equipment Required

- Anritsu MF2412B Frequency Counter
- RF Cable with BNC male connection at one end and an N-type male connection at other end
- Agilent 432A Analog Power Meter
- Agilent 34420A Nano Volt / Micro Ohm Meter or equivalent
- Agilent 8478B Power Sensor

Frequency Calibration for the 50 MHz, 0 dBm Reference

Procedure

1. Power on the ML2419A and MF2412B. Allow both units to warm up for 30 minutes before taking any measurements.
2. On the MF2412B, press the Preset Key.

Figure 6-4. MF2412B Preset Key

3. On the MF2412B, press the Input key (also the number 0 key).

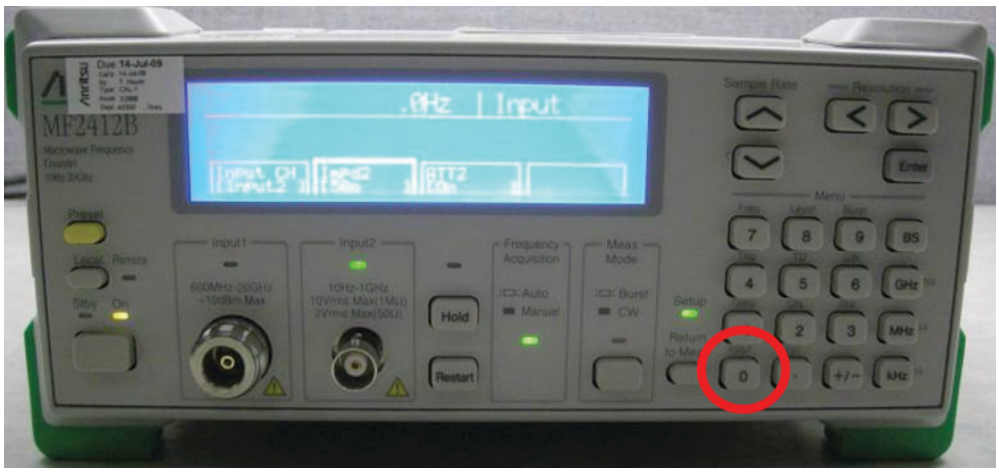


Figure 6-5. MF2412B Input Key

4. On the MF2412B, press the Left Arrow key to highlight Input CH area.

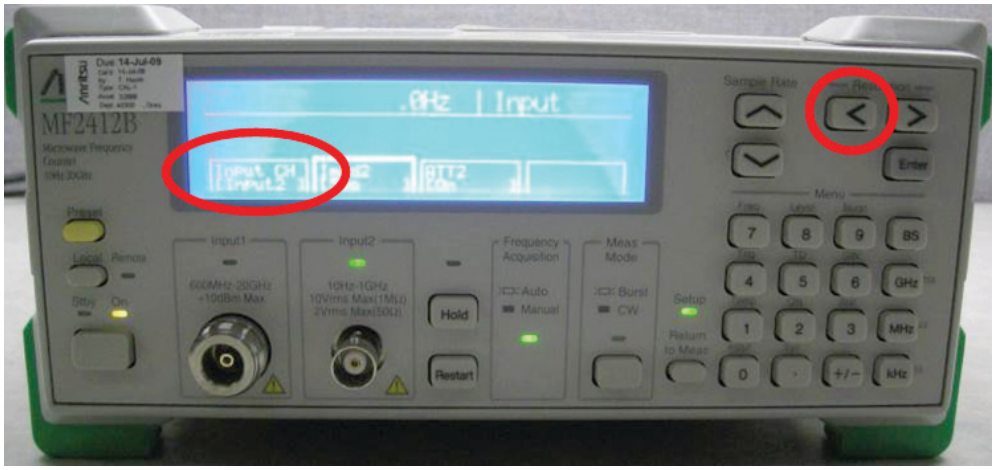


Figure 6-6. MF2412B Input CH

5. On the MF2412B, press the enter key until “Input 2” is selected.

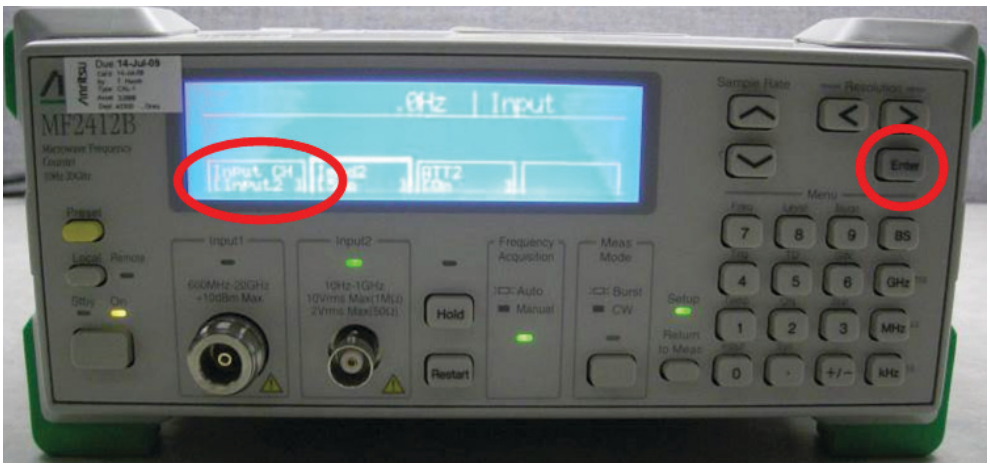


Figure 6-7. MF2412B Input 2

6. On the MF2412B, press the right arrow key to highlight the Impd2 area.

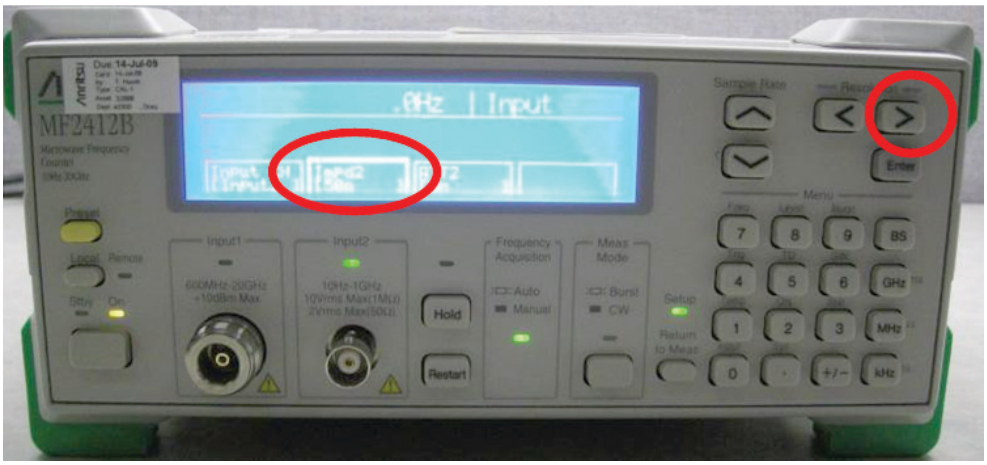


Figure 6-8. MF2412B Impd2

7. On the MF2412B, press the enter key until 50 Ω is selected.

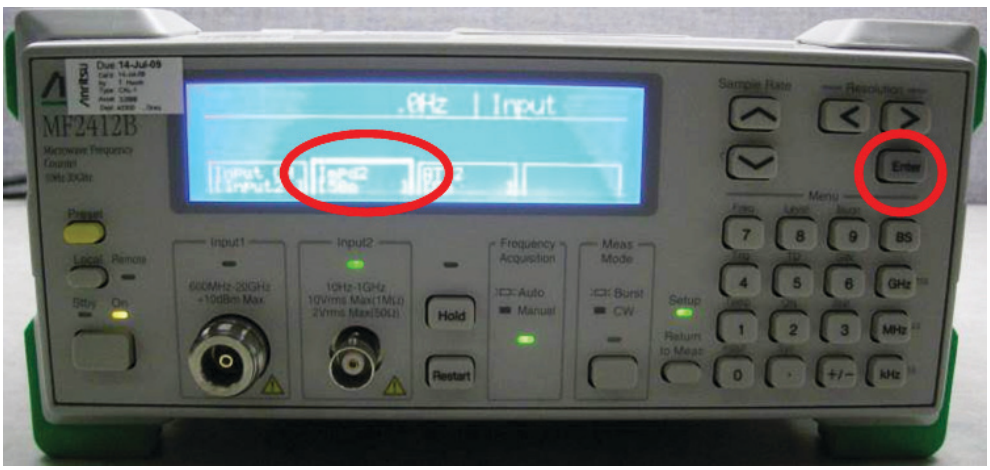


Figure 6-9. MF2412B 50 Ω

8. On the MF2412B, press the “Return to Meas” key

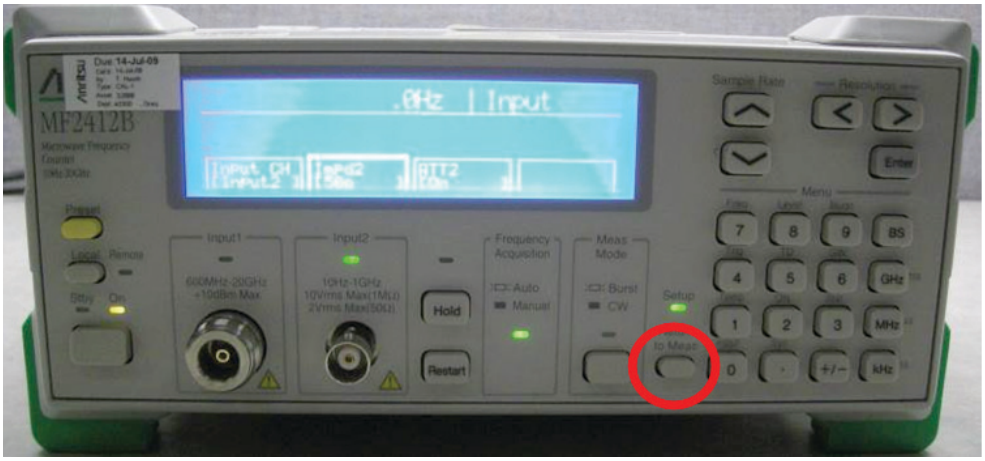


Figure 6-10. MF2412B Return to Measure

9. Connect an RF cable from Input 2 of the MF2412B to the 50 MHz 0 dBm output connector on the ML2419A.
10. Adjust the inductor core through the access hole in the module cover, using a non-metallic tool, so that the frequency counter reads 50 MHz, +/- 10 kHz.

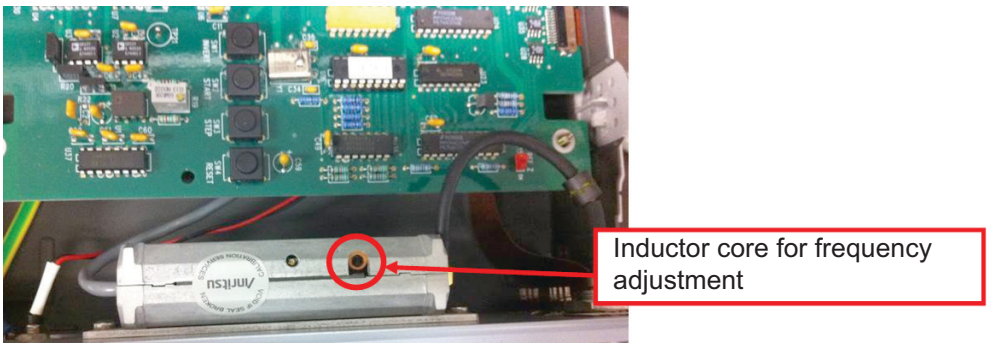
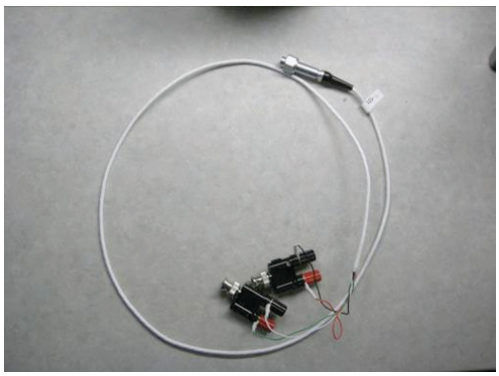


Figure 6-11. ML2419A Inductor Core

Output Power Level Calibration for the 50 MHz, 0 dBm Reference

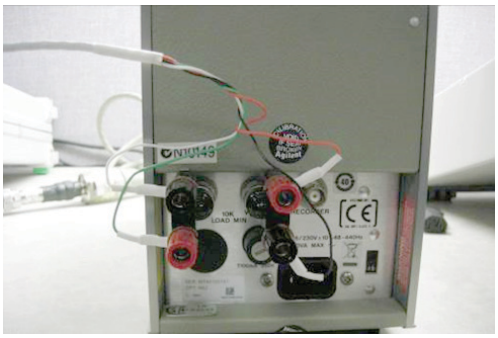
Procedure

1. Connect the Agilent 34420A to the Agilent 432A using the 4-wire cable provided with the Agilent 34420A.



4-wire cable provided with the Agilent 34420A, along with two BNC to binding-posts adapters needed to connect the four wires to the rear of the 432A power meter.

Connection shown to the Agilent 34420A.



Connection shown to the rear of the 432A power meter.

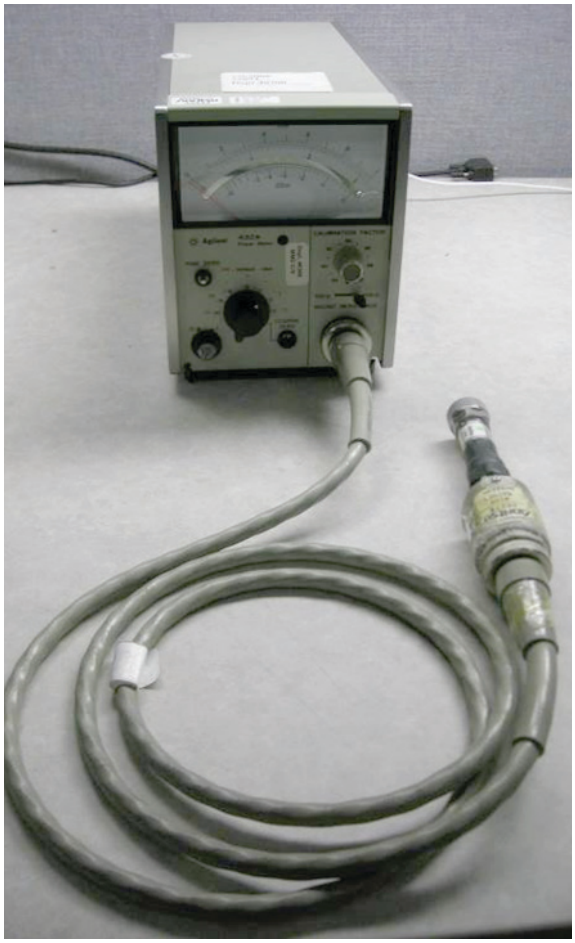
Green = V_{rf}

White = GND of V_{rf}

Red = V_{comp}

Black = GND of V_{comp}

2. Connect the Agilent Power Sensor 8478B to the Agilent Power Meter 432A.



432A Power meter shown connected to the 8478B power sensor.

Figure 6-12. 432A Power Meter and 8487B Power Sensor

3. Power on the 432A power meter and the 34420A voltmeter. Allow the units to warm up for 30 minutes before taking any measurements.

4. On the front panel of the 432A power meter, set the mount resistance to 200 Ω.

Figure 6-13. 432A Mount Resistance

5. On the front panel of the 432A power meter, set the calibration factor to 100.

Figure 6-14. Set 432A Calibrator

6. After the 432A and 34420A have warmed up for 15 minutes, perform a zero of the 432A power meter according to the instructions listed in the 432A user manual.
7. On the front panel of the 432A power meter, set the Range to 0 dBm.

Figure 6-15. Set 432A Range

8. Unplug the ML2419A so there is no output from the 50 MHz, 0 dBm Reference.
9. Connect the 8478B power sensor to the ML2419A 50 MHz, 0 dBm Reference.
10. Select DCV 1-2 on the Agilent 34420A. Record the number shown in the display of the 34420A as V0. (This will be a number near 20 micro-volts.)

    V_0 = _____ V

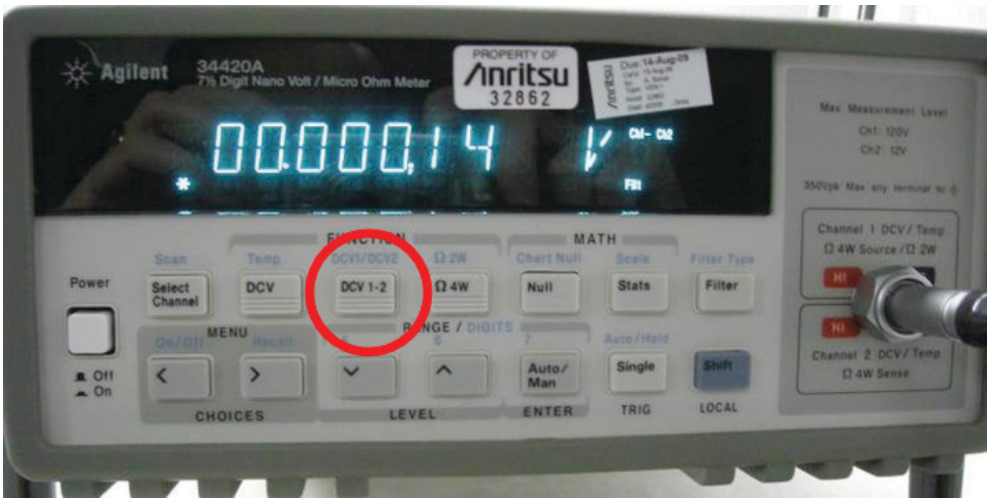


Figure 6-16. 34420A DCV 1-2 Key

11. Plug in the ML2419A so the 50 MHz, 0 dBm Reference is active.

12. Record the new number on the Agilent 34420A as V1. (This will be a number near 80 milli-volts.)

V_1 = _____ V

13. 10.While the Reference is still ON, press the DCV key on the 34420A and record this number as V_{comp}. (This will be a number near 5 volts.)

V_{comp} = _____ V

Figure 6-17. 34420A DCV Key

14. Use the below equation to determine P_{meas} (the 50 MHz, 0 dBm Reference output power in Watts). Start by finding the Mismatch (M), then using this number along with V_0, V_1, V_{comp}, R, and EE to solve for P_{meas}.

$$P_{meas} = \left[\frac{2 \cdot V_{comp} \cdot (V_1 - V_0) + V_0^2 - V_1^2}{4 \cdot R \cdot EE \cdot M} \right]$$

$M = 1 - \Gamma_d^2$, This is the worst case value for M and should be used in the P_{meas} equation above.

Γ_d = _____, This is the reflection coefficient of the 8478B sensor which can be found in 8478B calibration data.

EE = _____, This is the effective efficiency of the 8478B sensor which can be found in 8478B calibration data.

R = _____200____, This is the mount resistance of the 432A power meter.

V_{comp} = _____, This number is from step 13 above.

V_1 = _____, This number is from step 12 above.

V_0 = _____, This number is from step 10 above.

P_{meas}= _____, This number is calculated from the P_{meas} equation above.

15. If P_{meas} is between 0.000998 and 0.001002 W then calibration is complete. If outside of these limits, adjust the power level through the access hole in the module cover, using a non-metallic tool, and re-calculate P_{meas} until it's within the 1.0000 +/- 0.002 mW limit.

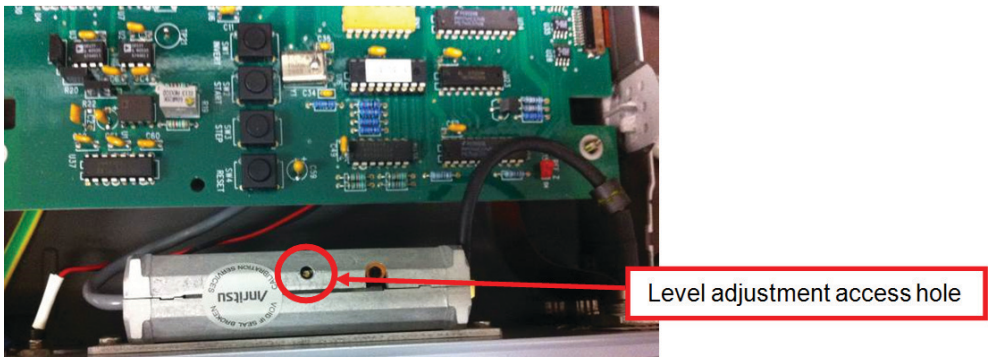


Figure 6-18. Level Adjustment Access

6-14 Post test

Upon Completion of the tests:

- Remove the AC power.
- Remove all test leads and cables.
- Secure the range Calibrator top cover by tightening the six captive screws (Figure 6-1 on page 6-3). Take care to not overtighten the screws.

Test Result Sheet		
Parameter	**Measured Value**	**Limits**
+12V Supply		+12.15V, ±0.50V
–12V Supply		–12.17V, ±0.50V
+5V Supply		+5.0V, ±0.2V
50 MHz Supply		+24V, ±5V
High Level offsets	Normal Inverted TP3 _____ / _____ TP4 _____ / _____	 0V, ±20 µV 0V, ±20 µV
Balance VH+/VH–	Normal Inverted TP1 _____ / _____ TP2 _____ / _____	 2.5000V, ±0.1 mV 2.5000V, ±0.1 mV
Positive Low Level VL+	TP5 _____ / _____ TP6 _____ / _____	0V, ±11 µV 0V, ±11 µV
Low Level Differential Voltage	Normal Inverted _____ / _____	 ±279.33 mV, ±0.06 mV
Attenuator Function LEVEL 7 LEVEL 6 LEVEL 5 LEVEL 4 LEVEL 3 LEVEL 2 LEVEL 1 ZERO	Normal Inverted _____ / _____ _____ / _____ _____ / _____ _____ / _____ _____ / _____ _____ / _____ _____ / _____ _____ / _____	 ±208 µV, ±5 µV ±512 µV, ±5 µV ±2.646 mV, ±5 µV ±20.434 mV, ±5 µV ±65.552 mV, ±10 µV ±0.80278V, ±100 µV ±5.0000V, ±500 µV ±0.000 mV, ±5 µV
Reference Zero Function	PASS ❒ FAIL ❒	0V, ±50 µV
Low Level Attenuators	_____ _____ _____	13.6701, ±0.0027 7.7224, ±0.0016 5.1651, ±0.0010 2.4661, ±0.0005
High Level Attenuators	_____	6.2281, ±0.0013 12.2471, ±0.0025
5V Reference Output	_____	+5.000V, ±1 mV 0, ±1 mV
Trigger Output		300 µs ±50 µs
50 MHz, 0 dBm Level		0.00dBm, ±0.03 dBm

UUT Serial number: _____

Tested By:_____ Date: _____

Appendix A — ML2419A Range Calibrator Specifications

Specifications

This section provides range, mechanical, power supply, and environmental specifications.

Signal Channel Ranges

The power meter Signal Channel incorporates five voltage measurement ranges spanning "power" levels from +7 dB to −70 dB relative to 1.0 V. These ranges are divided as follows:

RANGE 1	+7 to −12 dB
RANGE 2	−11 to −28 dB
RANGE 3	−25 to −44 dB
RANGE 4	−41 to −58 dB
RANGE 5	−56 to −70 dB

The top two ranges (Range 1 and Range 2) operate using DC voltage levels, while Range 3, Range 4, and Range 5 operate with voltages chopped at 250 Hz to reduce offset and drift errors. The power meter expects an additional gain of 309.5 from the external voltage source (sensor or Range Calibrator) when operating in the chopped mode. During operation in the three lower ranges, the Chop reference is provided by the meter.

The voltages provided by the Range Calibrator are such that each range will be tested close to the maximum and minimum power levels for that range (with the exception of Range 5, which is tested at maximum and at 30 % of maximum only). Where possible, a single voltage is used to measure the dB level at the overlap between two adjacent ranges.

Output Levels

(dB relative to 1.0000 V)

	ML2430A Series Power Meter	ML248xx / ML249xB Series Power Meter
Range 1 Upper Level	+6.990 dB	−0.954 dB
Range 1 Lower Level	−11.834 dB	−11.834 dB
Range 2 Upper Level	−11.834 dB	−11.834 dB
Range 2 Lower Level	−25.774 dB	−25.774 dB
Range 3 Upper Level	−25.861 dB	−25.861 dB
Range 3 Lower Level	−41.803 dB	−41.803 dB
Range 4 Upper Level	−41.803 dB	−41.803 dB
Range 4 Lower Level	−57.814 dB	−57.814 dB
Range 5 Upper Level	−57.814 dB	−57.814 dB
Range 5 Lower Level	−61.726 dB	−61.726 dB
Range 7 Upper Level	–	−0.954
Range 7 Lower Level	–	−11.834
Range 8 Upper Level	–	−11.834
Range 8 Lower Level	–	−16.897
Range 9 Upper Level	–	−16.897
Range 9 Lower Level	–	−25.774

Range 1 Upper Level Accuracy

Set point Accuracy	± 0.002 dB
Temperature Stability	± 10.612 PPM per °C (± 9.217 x 10^{-4} dB over ± 10 °C)
Long-Term Drift	± 5.003 PPM per month (± 5.214 x 10^{-4} dB over 12 months)

All Other Levels

(worst case accuracy)

Set point Accuracy	± 0.003 dB
Temperature Stability	± 14.617 PPM per °C = ± 0.001 dB over 10 °C
Long-Term Drift	± 9.928 PPM per month = ± 0.001 dB over 12 months

Noise

(1 kHz bandwidth)

Range 1 Upper Level	1.02 x 10^{-5} Vrms
Range 1 Lower Level	1.75 x 10^{-7} Vrms
Range 2 Upper Level	1.75 x 10^{-7} Vrms
Range 2 Lower Level	1.03 x 10^{-7} Vrms
Range 3 Upper Level	1.64 x 10^{-6} Vrms
Range 3 Lower Level	1.17 x 10^{-7} Vrms
Range 4 Upper Level	1.17 x 10^{-7} Vrms
Range 4 Lower Level	1.03 x 10^{-7} Vrms
Range 5 Upper Level	1.03 x 10^{-7} Vrms
Range 5 Lower Level	1.03 x 10^{-7} Vrms

50 MHz, 0.0 dBm Reference[1]	These specifications are valid when the output is terminated with a matched 50 ohm load.
Reference Power	0 dBm / 1.000 mW
Power Accuracy	+/- 1.2 % per year
Frequency	50 MHz (nominal)
Frequency Accuracy	< 1 %
RF Output Connector	Front Panel, 50 ohm precision N-Type (female)
Mechanical	All equipment markings meet the requirements of EN 61010-1:1993.
Dimensions	Width: 213 mm (8.39 in) Height: 88 mm (3.46 in) Depth: 250 mm (9.84 in)
Weight	2.2 Kg (4.84 lb)
Power Supply Requirements	
AC Line Power (selectable)	230 V / 50 Hz 115 V / 60 Hz 6 VA maximum
Fuse Rating	0.1 A, 250 V, antisurge (T)
Environmental	Full accuracy specified at 25 °C (77 °F) ± 10 °C, maximum relative humidity of 75 % at 40 °C (104 °F), non-condensing
Operating Temperature Range	0 °C to 50 °C (32 °F to 122 °F)
Storage Temperature Range	–40 to +70 °C (–40 °F to +156 °F)
Maximum Relative Humidity	95 % at 40 °C (104 °F), non-condensing

General Options and Accessories

760–209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap

1.This precision output provides a nominal 50 MHz, 0.0 dBm reference signal to approximate a sensor calibration. For a traceable calibration, use the 50 MHz source on the ML24xxx series power meter.

Appendix B — Range Calibrator Verification Spreadsheet Information

B-1 Introduction

The Range Calibrator Verification Spreadsheet is a form that can be used to enter range data during a power meter calibration. There are two versions of this form, one for the ML243xA power meters and one for the ML248xx/ML249xA power meters. This form can be obtained from the Anritsu public website: http://www.anritsu.com, under the Library tab of the power meter model being calibrated. The advantage of using these forms is it will provide pass/fail indications automatically when entering the range data.

B-2 Using the Spreadsheet Form

The following procedure can be used to enter data into the spreadsheet from the Range Calibrator Report (see Figure 4-4, "Example Range Calibrator Report" on page 4-3). The Range Calibrator Report can be printed using the **PRINT** selection (see "PRINT" on page 4-2) on the ML2430A Series Power Meter.

1. Open the appropriate Excel spreadsheet file for your series of power meter:

   ML2430A Series Power Meter: *49424.xls*

   ML248xx / ML249xA: *63153.xls*

2. Click on the cell assigned to Channel A (CHA) Range 1 Upper and type the measured dB value from the Range Calibrator Report printout for that level. Press **Enter** and continue to type the data for Channel A until all the measured values have been entered.
3. If the Power Meter is dual-channel (ML2438A, ML2488x, or ML2496A), click on the cell assigned to Channel B (CHB) Range 1 Upper and type the measured dB value for that level. Press **Enter** and continue to type the data for Channel B from the report printout.
4. If the power meter is single-channel (ML2437A, ML2487x, or ML2495A), leave the CHB Measured Level column empty. If old data is in this column, drag over the old values and press **Delete** to clear the column. When the CHB Measured Level column is empty, the CHB Error and CHB Results columns will show N/A.
5. Check that all values have been entered correctly. The measurements are automatically assessed with respect to the specification limits for absolute accuracy, linearity, and range-change error. The RESULTS columns indicate PASS or FAIL accordingly.

To properly maintain calibration records, complete the rest of the form, print, and file the report.

Pre Calibration Range Calibrator ML2419A Verification Spreadsheet For ML2487/8X and ML249XA

Enter measurements (dB) HERE and HERE

	V	V	Expected	Error (dB)	Error (dB)
Measured Level (dB)	CHA	CHB	Level(dB)	CHA	CHB
Range 1 Upper			-0.9540	N/A	N/A
Range 1 Lower			-11.8342	N/A	N/A
Range 2 Upper			-11.8342	N/A	N/A
Range 2 Lower			-25.7741	N/A	N/A
Range 3 Upper			-25.8606	N/A	N/A
Range 3 Lower			-41.8031	N/A	N/A
Range 4 Upper			-41.8031	N/A	N/A
Range 4 Lower			-57.8139	N/A	N/A
Range 5 Upper			-57.8139	N/A	N/A
Range 5 Lower			-61.7260	N/A	N/A
Range 7 Upper			-0.9540	N/A	N/A
Range 7 Lower			-11.8342	N/A	N/A
Range 8 Upper			-11.8342	N/A	N/A
Range 8 Lower			-16.8965	N/A	N/A
Range 9 Upper			-16.8965	N/A	N/A
Range 9 Lower			-25.7741	N/A	N/A

Anritsu Power Meter s/n:	
Firmware:	
Range Calibrator s/n:	
Operator:	
Date:	

RF Calibrator Output 0 dBm Specification 0dBm ± 0.03 dB

Level	Error	Pass/Fail
	0	PASS

	MEASURED (dB)		SPECIFICATIONS (dB)	RESULTS	
	CHA	CHB	CHA & CHB	CHA	CHB
Range 1 Absolute Error	N/A	N/A	-0.020<=R1U<=0.020	N/A	N/A
Range 1 Linearity	N/A	N/A	-0.040<=R1U-R1L<=0.040	N/A	N/A
Ranges 1-2 Change	N/A	N/A	-0.030<=R1L-R2U<=0.030	N/A	N/A
Range 2 Linearity	N/A	N/A	-0.040<=2RU-R2L<=0.040	N/A	N/A
Ranges 2-3 Change	N/A	N/A	-0.030<=R2L-R3U<=0.030	N/A	N/A
Range 3 Absolute Error	N/A	N/A	-0.020<=R3U<=0.020	N/A	N/A
Range 3 Linearity	N/A	N/A	-0.040<=R3U-R3L<=0.040	N/A	N/A
Ranges 3-4 Change	N/A	N/A	-0.030<=R3L-R4U<=0.030	N/A	N/A
Range 4 Linearity	N/A	N/A	-0.040<=R4U-R4L<=0.040	N/A	N/A
Range 4-5 Change	N/A	N/A	-0.030<=R4L-R5U<=0.030	N/A	N/A
Range 5 Linearity	N/A	N/A	-0.040<=R5U-R5L<=0.040	N/A	N/A
Range 7 Absolute Error	N/A	N/A	-0.030<=R7U<=0.030	N/A	N/A
Range 8 Absolute Error	N/A	N/A	-0.030<=R8U<=0.030	N/A	N/A
Range 8 Linearity	N/A	N/A	-0.085<=R8U-R8L<=0.085	N/A	N/A
Range 9 Absolute Error	N/A	N/A	-0.050<=R9U<=0.050	N/A	N/A
Range 9 Linearity	N/A	N/A	-0.18<=R9U-R9L<=0.18	N/A	N/A

NOTE: For single-channel meter, leave the CHB Measured Level column empty - Results will then show N/A in the CHB columns.

Figure B-1. Example of 63153.xls Spreadsheet

Anritsu

10585-00007

B

Anritsu utilizes recycled paper and environmentally conscious inks and toner.

Anritsu Company
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA
http://www.Anritsu.com