Service Guide

Agilent Technologies
E4418B/E4419B Power Meters

Agilent Technologies

Agilent Technologies Part no. E4418-90059
November 2001

Printed in the UK.

Legal Information

Notice

Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Agilent Technologies instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Agilent Technologies will at its option, either repair or replace products which prove to be defective. For warranty service or repair, this product must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent Technologies and Agilent Technologies shall pay shipping charges, duties, and taxes for products returned to Agilent Technologies from another country. Agilent Technologies warrants that its software and firmware designated by Agilent Technologies for use with an instrument will execute its programming instructions when properly installed on that instrument. Agilent Technologies does not warrant that the operation of the instrument, or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. AGILENT TECHNOLOGIES SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Exclusive Remedies

THE REMEDIES PROVIDED HEREIN ARE BUYER’S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Equipment Operation

Warnings and Cautions

This guide uses warnings and cautions to denote hazards.

WARNING **A warning calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in injury or the loss of life. Do not proceed beyond a warning until the indicated conditions are fully understood and met.**

Caution A caution calls attention to a procedure, practice or the like which, if not correctly performed or adhered to, could result in damage to or the destruction of part or all of the equipment. Do not proceed beyond a caution until the indicated conditions are fully understood and met.

Personal Safety Considerations

WARNING **This is a Safety Class I product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition (in which all means of protection are intact) only.

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

For continued protection against fire hazard, replace the line fuse(s) only with fuses of the same type and rating (for example, normal blow, time delay, etc.). The use of other fuses or material is prohibited.

General Safety Considerations

WARNING **Before this instrument is switched on, make sure it has been properly grounded through the protective conductor of the ac power cable to a**

socket outlet provided with protective earth contact.
Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

Caution Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

Markings

The CE mark shows that the product complies with all the relevant European legal Directives (if accompanied by a year, it signifies when the design was proven.

ICES/NMB-001

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

ISM Group 1 Class A

This is the symbol of an Industrial Scientific and Medical Group 1 Class A product.

The CSA mark is a registered trademark of the Canadian Standards Association.

External Protective Earth Terminal.

While this is a Class I product, provided with a protective earthing conductor in a power cord, an external protective earthing terminal has also been provided. This terminal is for use where the earthing cannot be assured. At least an 18AWG earthing conductor should be used in such an instance, to ground the instrument to an assured earth terminal.

IEC 1010-1 Compliance

This instrument has been designed and tested in accordance with IEC Publication 1010-1 +A1:1992 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

Statement of Compliance

This product has been designed and tested for compliance with IEC 60529 (1989) Degrees of Protection Provided by Enclosures (IP Code). Level IPx4 is attained if, and only if, the carry case (Agilent part number 34141A) is fitted.

User Environment

This product is designed for use in a sheltered environment (avoiding extreme weather conditions) in accordance with Pollution Degree 3 defined in IEC 60664-1, with the carry case (Agilent part number 34141A) fitted over the instrument.

The product is suitable for indoor use only, when this carry case is not fitted.

Installation Instructions

To avoid unnecessary over-temperature conditions, while this carry case is fitted do not apply an ac mains supply voltage, only operate your power meter from the battery pack.

List of Related Publications

The Agilent E4418B and Agilent E4419B *User's Guides* are also available in the following languages:

- English Language User's Guide - Standard
- German Language User's Guide - Option ABD
- Spanish Language User's Guide - Option ABE
- French Language User's Guide - Option ABF
- Italian Language User's Guide - Option ABZ
- Japanese Language User's Guide - Option ABJ

Agilent E4418B/E4419B Service Guide is available by ordering Option 915.

Agilent E4418B/E4419B CLIPs (Component Location and Information Pack) is available by ordering E4418-90031.

Sales and Service Offices

For more information about Agilent Technologies test and measurement products, applications, services, and for a current sales office listing, visit our web site:http://www.agilent.com

You can also contact one of the following centers and ask for a test and measurement sales representative.

Asia Pacific:

Agilent Technologies
19/F, Cityplaza One, 1111 King’s Road,
Taikoo Shing, Hong Kong, SAR
(tel) (852) 2599 7889
(fax) (852) 2506 9233

Japan:

Agilent Technologies Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi
Yokyo, 192-8510
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Australia/New Zealand:

Agilent Technologies Australia Pty Ltd
347 Burwood Highway
Forest Hill, Victoria 3131
(tel) 1-800 629 485 (Australia)
(fax) (61 3) 9272 0749
(tel) 0 800 738 378 (New Zealand)
(fax) (64 4) 802 6881

Canada:

Agilent Technologies Canada Inc.
5150 Spectrum Way,
Mississauga, Ontario
L4W 5G1
(tel) 1 877 894 4414

Europe:

Agilent Technologies
Test & Measurement
European Marketing Organisation
P.O. Box 999
1180 AZ Amstelveen
The Netherlands
(tel) (31 20) 547 9999

Latin America:

Agilent Technologies
Latin American Region Headquarters
5200 Blue Lagoon Drive, Suite #950
Miami, Florida 33126
U.S.A.
(tel) (305) 267 4245
(fax) (305) 267 4286

United States:

Agilent Technologies
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
(tel) 1 800 452 488

In any correspondence or telephone conversations, refer to the power sensor by its model number and full serial number. With this information, the Agilent Technologies representative can quickly determine whether your unit is still within its warranty period.

Returning Your Power Meter for Service

Use the information in this section if you need to return your power meter to Agilent Technologies.

Package the Power Meter for Shipment

Use the following steps to package the power meter for shipment to Agilent Technologies for service:

1. Fill in a blue service tag (available at the end of this guide) and attach it to the power meter. Please be as specific as possible about the nature of the problem. Send a copy of any or all of the following information:
   - Any error messages that appeared on the power meter display.
   - Any information on the performance of the power meter.

Caution Power meter damage can result from using packaging materials other than those specified. Never use styrene pellets in any shape as packaging materials. They do not adequately cushion the power meter or prevent it from shifting in the carton. Styrene pellets cause power meter damage by generating static electricity and by lodging in the rear panel.

2. Use the original packaging materials or a strong shipping container that is made of double-walled, corrugated cardboard with 159 kg (350 lb) bursting strength. The carton must be both large enough and strong enough to accommodate the power meter and allow at least 3 to 4 inches on all sides of the power meter for packing material.
3. Surround the power meter with at least 3 to 4 inches of packing material, or enough to prevent the power meter from moving in the carton. If packing foam is not available, the best alternative is SD-240 Air Cap ™ from Sealed Air Corporation (Commerce, CA 90001). Air Cap looks like a plastic sheet covered with 1-1/4 inch air filled bubbles. Use the pink Air Cap to reduce static electricity. Wrap the power meter several times in the material to both protect the power meter and prevent it from moving in the carton.
4. Seal the shipping container securely with strong nylon adhesive tape.
5. Mark the shipping container “FRAGILE, HANDLE WITH CARE” to ensure careful handling.
6. Retain copies of all shipping papers.

About this Guide

Chapter 1: Specifications

This chapter lists the power meter’s specifications and describes how to interpret these specifications.

Chapter 2: Performance Tests

This chapter contains procedures which allow you to test the power meter’s electrical performance to it’s specifications.

Chapter 3: Adjustments

This chapter contains checks and adjustments that ensure proper performance of the power meter.

Chapter 4: Theory of Operation

This chapter describes how each of the power meter’s individual assemblies operate.

Chapter 5: Replaceable Parts

This chapter details the power meter’s replaceable parts. It also explains how to assemble and disassemble the power meter.

Chapter 6: Troubleshooting

This chapter contains troubleshooting flow charts designed to isolate faults in the Rmt I/O, GP-IB and RS232/422 interface ports.

Table of Contents

List of Figures

List of Tables

1

Specifications

Introduction

This chapter details the power meter's specifications and supplemental characteristics.

Specifications describe the warranted performance and apply after a 30 minute warm-up. These specifications are valid over the power meter's operating and environmental range unless otherwise stated and after performing a zero and calibration.

Supplemental characteristics, which are shown in italics, are intended to provide information useful in applying the power meter by giving typical, but nonwarranted performance parameters. These characteristics are shown in italics or denoted as “typical”, “nominal” or “approximate”.

For information on measurement uncertainty calculations, refer to Agilent Application Note 64-1A, “Fundamentals of RF and Microwave Power Measurements”, Literature Number 5965-6630.

Power Meter Specifications

Meter

Frequency Range

100 kHz to 110 GHz, power sensor dependent

Power Range

-70 dBm to +44 dBm (100 pW to 25 W), power sensor dependent

Power Sensors

Compatible with all Agilent 8480 series power sensors and Agilent E-series power sensors.

Single Sensor Dynamic Range

90 dB maximum (Agilent E-series power sensors)
50 dB maximum (Agilent 8480 series power sensors)

Display Units

Absolute: Watts or dBm
Relative: Percent or dB

Display Resolution

Selectable resolution of:

1.0, 0.1, 0.01 and 0.001 dB in logarithmic mode, or
1, 2, 3 and 4 significant digits in linear mode

Default Resolution

0.01 dB in logarithmic mode
3 digits in linear mode

Accuracy

Instrumentation

Absolute: ±0.02 dB (Logarithmic) or ±0.5% (Linear). (Refer to the power sensor linearity specification in your power sensor manual to assess overall system accuracy.)
Relative: ±0.04 dB (Logarithmic) or ±1.0% (Linear). (Refer to the power sensor linearity specification in your power sensor manual to assess overall system accuracy.)

Zero Set (digital settability of zero): Power sensor dependent (refer to Table 1-1). For Agilent E-series power sensors, this specification applies when zeroing is performed with the sensor input disconnected from the POWER REF.

Table 1-1: Zero Set Specifications

Power Sensor	Zero Set
Agilent 8481A	±50 nW
Agilent 8481B	±50 µW
Agilent 8481D	±20 pW
Agilent 8481H	±5 µW
Agilent 8482A	±50 nW
Agilent 8482B	±50 µW
Agilent 8482H	±5 µW
Agilent 8483A	±50 nW
Agilent 8485A	±50 nW
Agilent 8485D	±20 pW
Agilent R8486A	±50 nW
Agilent R8486D	±30 pW
Agilent Q8486A	±50 nW
Agilent Q8486D	±30 pW
Agilent V8486A	±200 nW
Agilent W8486A	±200 nW
Agilent 8487A	±50 nW
Agilent 8487D	±20 pW
Agilent E4412A	±50 pW
Agilent E4413A	±50 pW

Power Reference

Power Output

1.00 mW (0.0 dBm). Factory set to ±0.7% traceable to the US National Institute of Standards and Technology.

Accuracy

±1.2% worst case (±0.9% rss) for one year.

Power Meter Supplemental Characteristics

Power Reference

Frequency

50 MHz nominal

SWR

1.05 maximum

Connector

Type N (f), 50 Ω

Measurement Speed

Over the GP-IB, three measurement speed modes are available as shown, along with the typical maximum measurement speed for each mode:

- ***Normal:*** *20 readings/second*
- ***x2:*** *40 readings/second*
- ***Fast:*** *200 readings/second, for Agilent E-series power sensors only*

Maximum measurement speed is obtained using binary output in free run trigger mode.

Zero Drift of Sensors

Power sensor dependent (refer to Table 1-3).

Measurement Noise

Power sensor dependent (refer to Table 1-2 and Table 1-3).

Averaging effects on measurement noise. Averaging over 1 to 1024 readings is available for reducing noise. Table 1-3 provides the measurement noise for a particular power sensor with the number of averages set to 16 for normal mode and 32 for x2 mode. Use the “Noise Multiplier” for the appropriate mode (normal or x2) and number of averages to determine the total measurement noise value.

For example, for an Agilent 8481D power sensor in normal mode with the number of averages set to 4, the measurement noise is equal to:

(<45 pW x 2.75) = <124 pW

Table 1-2: Noise Multiplier

Number of Averages	1	2	4	8	16	32	64	128	256	512	1024
Noise Multiplier (Normal Mode)	*5.5*	*3.89*	*2.75*	*1.94*	*1.0*	*0.85*	*0.61*	*0.49*	*0.34*	*0.24*	*0.17*
Noise Multiplier (x2 mode)	*6.5*	*4.6*	*3.25*	*2.3*	*1.63*	*1.0*	*0.72*	*0.57*	*0.41*	*0.29*	*0.2*

Table 1-3: Power Sensor Specifications±

Power Sensor	*Zero Drift*[1]	*Measurement Noise*[2]
Agilent 8481A	<±10 nW	<110 nW
Agilent 8481B	<±10 µW	<110 µW
Agilent 8481D	<±4 pW	<45 pW
Agilent 8481H	<±1 µW	<10 µW
Agilent 8482A	<±10 nW	<110 nW
Agilent 8482B	<±10 µW	<110 µW
Agilent 8482H	<±1 µW	<10 µW
Agilent 8483A	<±10 nW	<110 nW
Agilent 8485A	<±10 nW	<110 nW
Agilent 8485D	<±4 pW	<45 pW
Agilent R8486A	<±10 nW	<110 nW
Agilent R8486D	<±6 pW	<65 pW
Agilent Q8486A	<±10 nW	<110 nW
Agilent Q8486D	<±6 pW	<65 pW
Agilent W8486A	<±40 nW	<450 nW
Agilent 8487A	<±10 nW	<110 nW
Agilent 8487D	<±4 pW	<45 pW
Agilent E4412A	<± 15 pW	<70 pW
Agilent E4413A	<± 15 pW	<70 pW

1. Within 1 hour after zero set, at a constant temperature, after a 24 hour warm-up of the power meter.
2. The number of averages at 16 (for normal mode) and 32 (for x2 mode), at a constant temperature, measured over a 1 minute interval and 2 standard deviations. For Agilent E-series power sensors the measurement noise is measured within the low range. Refer to the relevant power sensor manual for further information.

Settling Time

0 to 99% settled readings over the GP-IB.

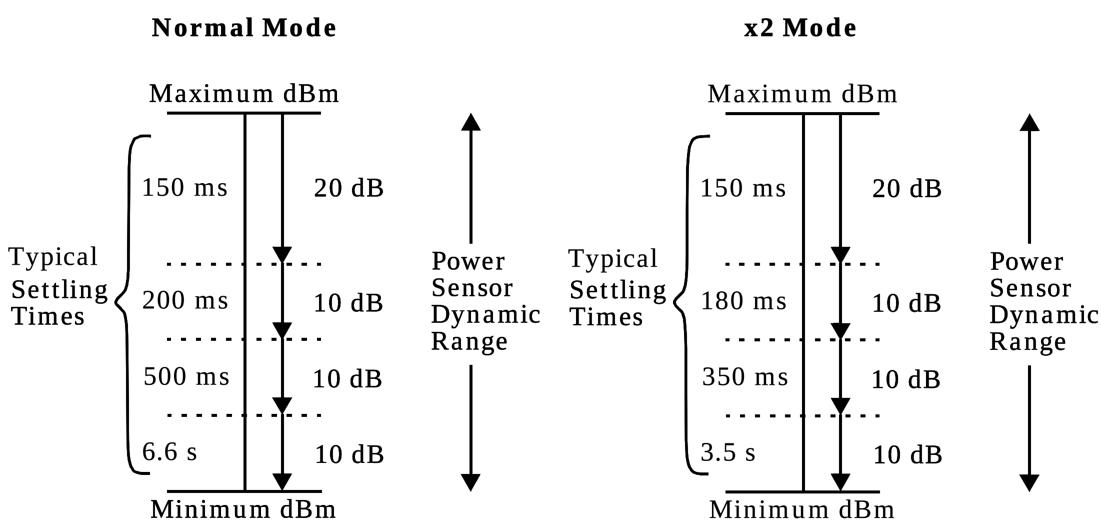
For Agilent 8480 series power sensors

Manual filter, 10 dB decreasing power step:

Table 1-4: Settling Time

Number of Averages	1	2	4	8	16	32	64	128	256	512	1024
Settling Time (s) (Normal Mode)	*0.15*	*0.2*	*0.3*	*0.5*	*1.1*	*1.9*	*3.4*	*6.6*	*13*	*27*	*57*
Response Time (s) (x2 mode)	*0.15*	*0.18*	*0.22*	*0.35*	*0.55*	*1.1*	*1.9*	*3.5*	*6.9*	*14.5*	*33*

Auto filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes:



For Agilent E-series power sensors

In FAST mode, within the range -50 dBm to +17 dBm, for a 10 dB decreasing power step, the settling time is 10 ms[1] for the Agilent E4418B and 20 ms[1] for the Agilent E4419B

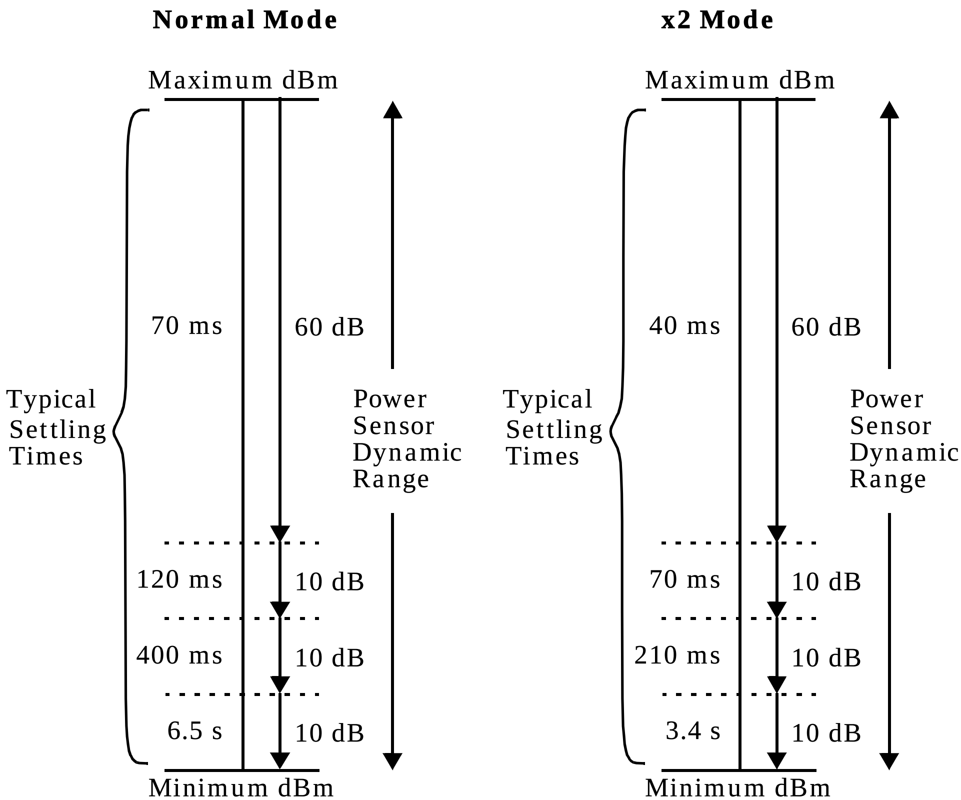
[1]When a decreasing power step crosses the power sensor's auto-range switch point, add 25 ms. Refer to the relevant power sensor manual for further information.

For Agilent E-series power sensors in normal and x2 speed modes, manual filter, 10 dB decreasing power step:

Table 1-5: Settling Time

Number of Averages	1	2	4	8	16	32	64	128	256	512	1024
Settling Time (s) (Normal Mode)	*0.07*	*0.12*	*0.21*	*0.4*	*1*	*1.8*	*3.3*	*6.5*	*13*	*27*	*57*
Response Time (s) (x2 mode)	*0.04*	*0.07*	*0.12*	*0.21*	*0.4*	*1*	*1.8*	*3.4*	*6.8*	*14.2*	*32*

Auto filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes:



Power Sensor Specifications

Definitions

Zero Set

In any power measurement, the power meter must initially be set to zero with no power applied to the power sensor. Zero setting is accomplished within the power meter by digitally correcting for residual offsets.

Zero Drift

This parameter is also called long term stability and is the change in the power meter indication over a long time (usually one hour) for a constant input power at a constant temperature, after a defined warm-up interval.

Measurement Noise

This parameter is also known as short term stability and is specified as the change in the power meter indication over a short time interval (usually one minute) for a constant input power at a constant temperature.

Battery Option 001 Operational Characteristics

The following information describes characteristic performance based at a temperature of 25 °C unless otherwise noted. Characteristics describe product performance that is useful in the application of the product, but is not covered by the product warranty.

Typical Operating Time

Up to 2 hours with LED backlight on; up to 3 hours with LED backlight off.

Charge Time

< 2 hours to charge fully from an empty state: 50 minutes charging enables 1 hour of operation with LED backlight ON; 35 minutes charging enables 1 hour of operation with the LED backlight OFF. Power meter is operational whilst charging.

Service Life

To 70% of initial capacity at 25 °C: approximately 450 charge/discharge cycles.

Chemistry

Nickel Metal Hydride.

Weight

1 kg.

General Characteristics

Rear Panel Connectors

Recorder Output(s)

Analog 0-1 Volt, 1 kΩ output impedance, BNC connector

GP-IB

Allows communication with an external GP-IB controller.

RS-232/422

Allows communication with an external RS-232 or RS422 controller. Male Plug 9 position D-subminiature connector.

Remote Input/Output

A TTL logic level is output when the measurement exceeds a predetermined limit. TTL inputs are provided to initiate zero and calibration cycles. RJ-45 series shielded modular jack assembly.

TTL output: high = 4.8 V max; low = 0.2 V max
TTL input: high = 3.5 V min, 5 V max; low = 1 V max, -0.3 V min

Ground

Binding post, accepts 4 mm plug or bare-wire connection

Line Power

- ***Input Voltage Range:*** *85 to 264 Vac, automatic selection*
- ***Input Frequency Range:*** *50 to 440 Hz*
- ***Power Requirement:*** *approximately 50 VA (14 Watts)*

Environmental Characteristics

General Conditions

Complies with the requirements of the EMC Directive 89/336/EEC. This includes Generic Immunity Standard EN 50082-1: 1992 and Radiated Interference Standard EN 55011:1991/CISPR11:1990, Group 1 - Class A.

Operating Environment

Temperature

0°C to 55°C

Maximum Humidity

95% at 40°C (non-condensing)

Minimum Humidity

15% at 40°C (non-condensing)

Maximum Altitude

3,000 meters (9,840 feet)

Storage Conditions

Storage Temperature

-20°C to +70°C

Non-Operating Maximum Humidity

90% at 65°C (non-condensing)

Non-Operating Maximum Altitude

15,240 meters (50,000 feet)

General

Dimensions

The following dimensions exclude front and rear panel protrusions: 212.6 mm W x 88.5 mm H x 348.3 mm D (8.5 in x 3.5 in x 13.7 in)

Weight

Net

Agilent E4418B, 4.0 kg (8.8 lb) - 5.0 kg (11.0 lb) with option 001

Agilent E4419B, 4.1 kg (9.0 lb) - 5.1 kg (11.2 lb) with option 001

Shipping

Agilent E4418B, 7.9 kg (17.4 lb) - 8.9 kg (19.6 lb) with option 001

Agilent E4419B, 8.0 kg (17.6 ib) - 9.0 kg (19.8 lb) with option 001

Safety

Conforms to the following Product Specifications:

- EN61010-1: 1993/IEC 1010-1:1990+A1/CSA C22.2 No. 1010-1:1993
- EN60825-1: 1994/IEC 825-1: 1993 Class 1
- Low Voltage Directive 72/23/EEC

Remote Programming

Interface

GP-IB interface operates to IEEE 488.2. RS-232 and RS-422 interfaces are supplied as standard.

Command Language

SCPI standard interface commands.

Agilent E4418B is HP 437B code compatible.

HP E4419B is HP 438A code compatible

Agilent E4418B/E4419B GP-IB Compatibilty

SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DC1, DT1, C0

Non-Volatile Memory

Battery

Lithium Polycarbon Monoflouride, approximate lifetime 5 years at 25ºC.

2

Performance Tests

Introduction

The procedures in this chapter test the power meter's electrical performance using the specifications in Chapter 1 as the performance standards. All tests can be performed without access to the interior of the power meter. A simpler operational test is included in "Self Test" of the *User's Guide*.

Note

For valid performance tests, the following conditions must be met:

a. The power meter and test equipment must have a 30 minute warm-up for all specifications.

b. The line voltage for the power meter must be 85 to 264 Vac and the line frequency must be 50 to 440 Hz.

c. The ambient temperature must be 0^0 to 55^0C.

Equipment Required

Table 2-1 lists all the equipment required for the adjustments and performance tests. If substitutions must be made, the equipment used must meet the critical specifications.

Table 2-1: Required Equipment

Equipment Required	Model Number	Critical Specification	Usage[1]
Digital Multimeter	Agilent 3458A	Range 0 to 20 V Resolution 0.01 V	P and A
Range Calibrator	Agilent 11683A	Calibration Uncertainty ±0.25%	P and A
Frequency Counter	Agilent 5314A	Range 10 Hz to 50 MHz Resolution 1 Hz	P and A
Power Meter	Agilent 432A	Range 1 mW Transfer Accuracy 0.2%	P and A
Thermistor Mount	Agilent 478A Option H75 Agilent 478A Option H76	SWR<1.05 at 50 MHz Accuracy ±0.5% at 50 MHz	P and A
Power Sensor	Agilent E-series power sensor		P
30 dB Attenuator	Agilent 11708A *or* Agilent 8491A Option 030		P
Power Sensor Cable	Agilent 11730A		P and A

1. P = Performance Tests, A = Adjustments

Performance Test Record

Results of the performance tests may be tabulated in Table 2-6, “Performance Test Record,” on page 2-19. The Performance Test Record lists all of the performance test specifications and the acceptable limits for each specification. If performance test results are recorded during an incoming inspection of the power meter, they can be used for comparison during periodic maintenance. The test results may also prove useful in verifying proper adjustments after repairs are made.

Performance Tests

The performance tests given in this chapter are suitable for incoming inspection or preventive maintenance. During any performance test, all shields and connecting hardware must be in place.

The tests are designed to verify published power meter specifications. Perform the tests in the order given and record the data in Table 2-6 on page 2-19 and/or in the data spaces provided at the end of each procedure.

Calibration Cycle

This power meter requires periodic verification of performance to ensure that it is operating within specified tolerances. The performance tests described in this chapter should be performed once each year. Under conditions of heavy usage or severe operating environments, the tests should be more frequent. Adjustments that may be required are described in Chapter 3.

Test Procedures

It is assumed that the person performing the following tests understands how to operate the specified test equipment. Equipment settings, other than those for the power meter, are stated in general terms. It is assumed that the person will select the proper cables, adapters, and probes required for test setups illustrated in this chapter.

Zero Test

Specification

Electrical Characteristics	Performance Limits
Accuracy: Zero set (Digital settability of zero)	±0.0764 µW[1]

1. This performance limit is determined by the zero set specification of the power sensor used in the measurement plus the measurement noise. The range calibrator has a zero set specification of ±0.05 µW. The calibrator measurement noise specification is 110 nW at 16 averages. At 512 averages a noise multiplier of 0.24 is required, giving a measurement noise specification of 0.0264 µW (0.24x512).

Description

After the power meter is initially calibrated and zeroed, the change in the digital readout is monitored. This test also takes drift and noise into account, since drift, noise and zero readings cannot be separated.

Equipment

Range Calibrator .... Agilent 11683A
Power Sensor Cable .... Agilent 11730A

Test Setup

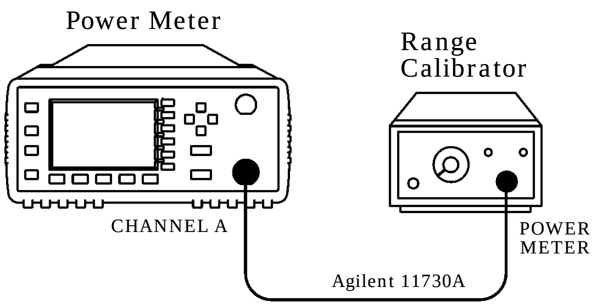


Figure 2-1: Zero Test Setup

Procedure

The following procedure should be performed for the Zero Test.

Note The procedure details the key presses required on the Agilent E4418B. For the Agilent E4419B the equivalent key presses should be performed on both channels.

---

1. Connect the equipment as shown in Figure 2-1.
2. Switch the power meter on.
3. Press (Preset Local) then `Confirm`.
4. Press (dBm/W), `W` for a reading in watts.
5. Set the range calibrator as follows:

   RANGE .... 3 μW
   POLARITY .... NORMAL
   FUNCTION .... STANDBY
   LINE .... ON

Note When switching the range calibrator to STANDBY, allow enough time for the range calibrator to settle to its zero value before attempting to zero the power meter. This settling would appear on the power meter display as downward drift. When the drift has reached minimum, (typically less than 60 seconds), the range calibrator is settled.

---

6. On the power meter press (System Inputs), `Input Settings`, (More), `Filter`, `Filter On`, `Mode Man`, `Length`, and set the filter length to 512 in the pop up window then press `Enter`.
7. On the power meter press (Zero Cal), `Cal`. When the wait symbol disappears press `Zero`. Wait approximately 10 seconds for the wait symbol to disappear.
8. Wait 30 seconds then verify that the power meter's reading is within ±0.05 μW. Record the reading.

Table 2-2: Zero Test Results

Min	Channel A Actual Result	Channel B Actual Result (Agilent E4419B Only)	Max
-76.40 nW	______________	______________	+76.40 nW

Instrument Accuracy Test

Specification

Electrical Characteristics	Performance Limits
Accuracy	±0.5% or ±0.02 dB [1]

1. This performance limit does not include the corresponding sensor power linearity specification.

Description

The power meter accuracy is verified for various power inputs. The range calibrator is switched to provide these reference inputs.

Equipment

Range Calibrator .... Agilent 11683A
Power Sensor Cable .... Agilent 11730A

Test Setup

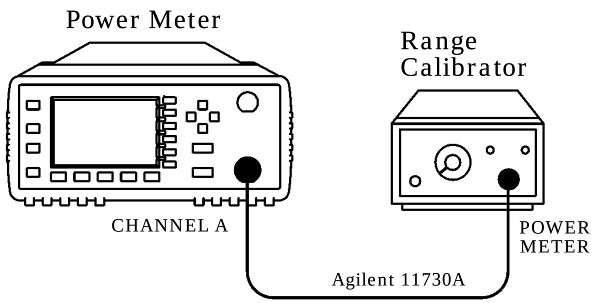


Figure 2-2: Instrument Accuracy Test Setup

Procedure

The following procedure should be performed for the Instrument Accuracy Test.

Note The procedure details the key presses required on the Agilent E4418B. For the Agilent E4419B the equivalent key presses should be performed on both channels.

1. Connect the equipment as shown in Figure 2-2.
2. Switch the power meter on.
3. Press [Preset Local] then `Confirm`.
4. Press [dBm/W], `W` for a reading in watts.
5. Set the range calibrator as follows:

   RANGE .... 3 μW

   POLARITY .... NORMAL

   FUNCTION.................................... STANDBY

   LINE .... ON

Note When switching the range calibrator to STANDBY, allow enough time for the range calibrator to settle to its zero value before attempting to zero the power meter. This settling would appear on the power meter display as downward drift. When the drift has reached minimum, (typically less than 60 seconds), the range calibrator is settled.

6. On the power meter press [System Inputs], `Input Settings`, [More], `Filter`, `Filter On`, `Mode Man`, `Length`, and set the filter length to 512 in the pop up window then press `Enter`.
7. On the power meter press [Zero Cal], `Zero`. Wait approximately 10 seconds for the wait symbol to disappear. Verify that the display reads 0 ±0.05 μW.
8. Set the range calibrator's FUNCTION switch to CALIBRATE.
9. Set the range calibrator's RANGE switch to 1 mW.
10. Press `Cal` to calibrate the power meter.
11. Set the range calibrator's RANGE switch to the positions shown in Table 2-3 on page 2-10. For each setting, verify that the power meter's reading is within the limits shown.

Table 2-3: Instrument Accuracy Results

Range Calibrator Setting	Min[1]	Channel A Actual Results	Channel B Actual Results (Agilent E4419 B only)	Max[1]
3 μW	3.100 μW	______________	______________	3.230 μW
10 μW	9.900 μW	______________	______________	10.10 μW
30 μW	31.40 μW	______________	______________	31.80 μW
100 μW	99.50 μW	______________	______________	100.5 μW
300 μW	314.00 μW	______________	______________	318.00 μW
1 mW	0.995 mW	______________	______________	1.005 mW
3 mW	3.141 mW	______________	______________	3.171 mW
10 mW	9.984 mW	______________	______________	10.08 mW
30 mW	31.63 mW	______________	______________	31.94 mW
100 mW	100.9 mW	______________	______________	101.8 mW

1. These performance limits are determined by the zero set specification of the power sensor used in the measurement plus the measurement noise.

Note The nominal outputs for the 3 μW, 30 μW, 300 μW, 3 mW, 10 mW, 30 mW and, 100 mW settings are 3.16 μW, 31.6 μW, 316 μW, 3.156 mW, 10.03 mW, 31.78 mW, and 101.3 mW respectively.

Note It is not necessary to check instrument accuracy in dBm. The power meter uses the same internal circuitry to measure power and mathematically converts watts to dBm.

Power Reference Level Test

Electrical Characteristics	Performance Limits	Conditions
Power Reference	1 mW	Internal 50 MHz oscillator factory set to ±0.7% traceable to National Institute of Standards and Technology (NIST).
Power Reference Accuracy	±1.9%	Worst case (power meter accuracy plus verification system error).
	±0.9%	RSS for one year.

Description

The power reference oscillator output is factory adjusted to 1 mW ±0.7%. This accuracy is achieved using a measurement system accurate to 0.5% (traceable to the National Institute of Standards and Technology) and allows for a transfer error of ±0.2% when making the adjustment.

If an equivalent measurement system is employed for verification, the power reference oscillator output can be verified to 1 mW ±1.9%. The 1.9% maximum error is made up of ±0.7% factory adjustment accuracy, ±0.5% worst case oscillator drift for one year, ±0.5% verification system error and ±0.2% transfer error.

If the Power Reference Oscillator Level Adjustment is carried out before this verification test is performed, the result obtained here will be more accurate.

The power reference oscillator can be set to ±0.7% using the same equipment and following the adjustment procedure. To ensure maximum accuracy in verifying the power reference oscillator output, the following procedure provides step by step instructions for using specified Agilent Technologies test instruments of known capability. If equivalent test instruments are used, signal acquisition criteria may vary and reference should be made to the manufacturer's guidelines for operating the instruments.

Equipment

Test power meter.................................. Agilent 432A

Thermistor Mount .... Agilent 478A Option H75 or H76

Digital Voltmeter (DVM)....................... Agilent 3458A

Test Setup

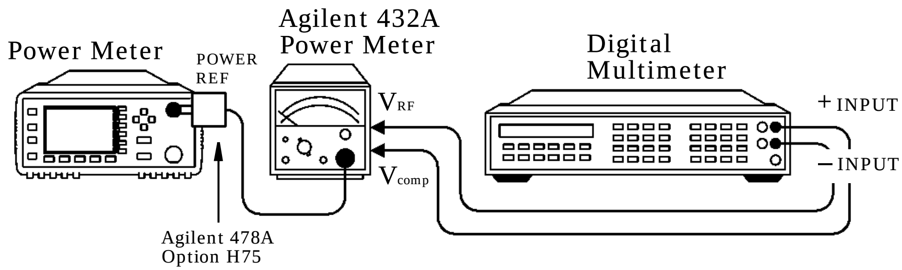


Figure 2-3: Power Reference Level Test Setup

Procedure

The following equation allows the Power Reference Oscillator power to be calculated by measuring the voltages V_0, V_1, V_{comp}, and the resistance R.

$$P_{meas} = \frac{2V_{comp}(V_1 - V_0) + V_0^2 - V_1^2}{4R(CalibrationFactor)}$$

The definitions of the terms in this equation are:

- V_0 is the voltage measured between V_{comp} and V_{RF} with no power applied and after the Agilent 432A has been zeroed.
- V_1 is the voltage measured between V_{comp} and V_{RF} with power applied. This power is approximately 1 mW.
- V_{comp} is the voltage between the Agilent 432A V_{comp} connector and chassis ground with power applied.
- R is the resistance of the mount resistor in the Agilent 432A power meter.
- Calibration Factor is the value of the thermistor mount at 50 MHz.

The following procedure should be performed to allow you to calculate P_{meas}.

Note The procedure details the key presses required on the Agilent E4418B. For the Agilent E4419B the equivalent key presses should be performed on both channels.

1. Set the DVM to measure resistance. Connect the DVM between the V_{RF} connector on the rear panel of the Agilent 432A and pin 1 on the thermistor mount end of the sensor cable. Verify that no power is applied to the Agilent 432A.
2. Round off the DVM reading to two decimal places and record this value as the internal bridge resistance (R) of the Agilent 432A (approximately 200 Ω).
   - R ___________Ω
3. Connect the equipment as shown in Figure 2-3, ensuring that the DVM input leads are isolated from chassis ground.

Note Ensure that the Agilent 432A and the power meter under test have been powered on for at least 30 minutes before performing the following steps.

4. Press [Preset Local], then `Confirm` on the power meter.
5. Set the Agilent 432A RANGE switch to Coarse Zero. Adjust the front panel Course Zero control to obtain a zero meter indication.
6. Fine zero the Agilent 432A on the most sensitive range, then set the RANGE switch to 1 mW.
7. Set the DVM to measure microvolts. Connect the positive and negative input leads, respectively, to the V_{comp} and V_{RF} connectors on the rear panel of the test power meter.
8. Observe the reading on the DVM. If less than 400 µV, proceed to the next step. If 400 µV or greater, press and hold the test power meter Fine Zero switch and adjust the Coarse Zero control so that the DVM indicates 200 µV or less. Release the Fine Zero switch and proceed to the next step.
9. Round the DVM reading to two decimal places. Record this reading as V_0.
   - V_0 ___________

10. Turn the power reference on by pressing
    - Zero Cal, `Power Ref Off On` on the Agilent E4418B.
    - Zero Cal, `Cal`, More, `Power Ref Off On` on the Agilent E4419B.
11. Round the DVM reading to two decimal places. Record this reading as V_1.
    - V_1 ____________
12. Disconnect the DVM negative input lead from the V_{RF} connector on the Agilent 432A. Reconnect it to the Agilent 432A chassis ground.
13. Observe the DVM reading. Record the reading as V_{comp}.
    - V_{comp} ___________
14. Calculate the Power Reference Oscillator power using the following equation:

$$P_{meas} = \frac{2V_{comp}(V_1 - V_0) + V_0^2 - V_1^2}{4R(Calibration Factor)}$$

15. Verify that P_{meas} is within the limits shown in Table 2-4. Record the reading.

Table 2-4: Power Reference Level Result

Min	Channel A Actual Result	Channel B Actual Result (Agilent E4419B Only)	Max
0.981 mW	________________	________________	1.019 mW

Agilent E-Series Power Sensor Interface Test

The Agilent E-series power sensors have their sensor calibration tables stored in EEPROM which enables the frequency and calibration factor data to be downloaded automatically by the power meter. The frequency and calibration factor data have checksums which are compared with the data downloaded by the power meter. For the Agilent E4419B dual channel power meter, this test should be performed on both channels.

Procedure

1. When there is no power sensor connected to the Channel A input the message “`No Sensor`” (“`No Sensor ChA`” on the Agilent E4419B) appears on the measurement window.
2. Connect the Agilent E-series power sensor to the power meter’s Channel A input. The message “`Reading Sensor ChA`” appears. When all the data is downloaded this message disappears and a reading is displayed on the measurement window. If the download fails, a warning message and error flag are displayed on the front panel. Also, SCPI error message “-310, System Error” is generated.
3. For the Agilent E4419B repeat these steps for Channel B.

Agilent E-Series Power Sensor Functional Test

Description

This test verifies that the meter/sensor combination can make RF measurements.

The Agilent E-series power sensors operate over a 90 dB dynamic range (-70 to +20 dBm). However, since there is an amplifier in these power sensors, the voltages presented to the power sensor connector are always within the range of voltages available from the Agilent 11683A range calibrator.

Equipment

Power Sensor Cable.............................. Agilent 11730A
Reference Attenuator............................ Agilent 11708A
Agilent E-series power sensor

Procedure

To complete the Functional Test the following procedure should be performed.

Note The procedure details the key presses required on the Agilent E4418B. For the Agilent E4419B the equivalent key presses should be performed on both channels.

1. Connect the equipment as shown in Figure 2-4.

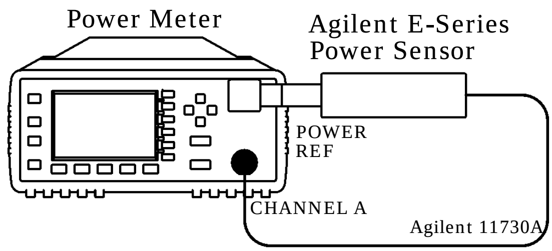


Figure 2-4: Sensor Functional Test Setup

2. Press Preset/Local then `Confirm`.
3. On the power meter press Zero/Cal, `Zero`. Wait approximately 10 seconds for the wait symbol to disappear. Verify that the display reads 0 ±50 pW.
4. Press `Cal` to calibrate the power meter.
5. Turn the power reference on by pressing
   - Zero/Cal, `Power Ref Off On` on the Agilent E4418B.
   - Zero/Cal, `Cal`, More, `Power Ref Off On` on the Agilent E4419B.

6. Connect the 30 dB attenuator as shown in Figure 2-5.

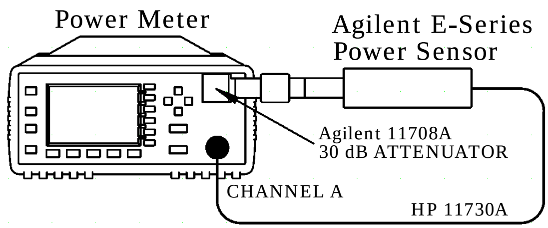


Figure 2-5: Sensor Functional Test Setup with Attenuator

7. Press [System Inputs], `Input Settings`, and select `Range` to "LOWER". This switches to the power sensor's low range.
8. Verify that the display reads -30 dBm ±1 dB. Record the reading.
9. Press `Range` and set to "UPPER". This switches to the power sensor's upper range.
10. Verify that the display reads -30 dBm ±1 dB. Record the reading.
11. Press `Range` and set to "LOWER".
12. Disconnect the 30 dB attenuator and reconnect as shown in Figure 2-4.
13. Verify that an overload error is displayed on the status line at the top of the power meter's display.
14. Press `Range` and set to "UPPER".
15. Verify that the display reads 0 dBm ±1 dB. Record the reading.

Table 2-5: Functional Test Result

Test	Channel A Overload Error	Channel B Overload Error (Agilent E4419B Only)
Low Range, 30 dB pad		
Upper Range, 30 dB pad		
Low Range, no pad		
High Range, no pad		

Performance Test Record

Model Agilent E4418B/E4419B Power Meter

Tested by ____

Serial Number ____________________________________

Date ______________

Table 2-6: Performance Test Record

Test	Min Result	Channel A Actual Result	Channel B Actual Result	Max Result
Zero Test	–76.40 nW			+76.40 nW
Instrument Accuracy				
3 µW	3.100 µW	________	________	3.230 µW
10 µW	9.900 µW	________	________	10.10 µW
30 µW	31.40 µW	________	________	31.80 µW
100 µW	99.50 µW	________	________	100.5 µW
300 µW	0.314 mW	________	________	0.318 mW
1 mW	0.995 mW	________	________	1.005 mW
3 mW	3.141 mW	________	________	3.171 mW
10 mW	9.984 mW	________	________	10.08 mW
30 mW	31.63 mW	________	________	31.94 mW
100 mW	100.9 mW	________	________	101.8 mW
Power Reference				
P_{meas}	0.981 mW	________	________	1.019 mW
Interface Test	Pass/Fail	________	________	Pass/Fail
Functional Test				
Low Range, 30 dBm pad	Pass/Fail	________	________	Pass/Fail
Low Range, 30 dBm pad	Pass/Fail	________	________	Pass/Fail
Low Range, no pad	Pass/Fail	________	________	Pass/Fail
Upper Range, no pad	Pass/Fail	________	________	Pass/Fail

3

Adjustments

Introduction

This chapter describes adjustments and checks which ensure proper performance of the power meter. Adjustments are not normally required on any fixed periodic basis, and normally are performed only after a performance test has indicated that some parameters are out of specification. Performance tests should be completed after any repairs that may have altered the characteristics of the power meter. The test results will make it possible to determine if adjustments are required. Allow 30 minutes for the power meter to warm up, and then remove the cover, for access to the test and adjustment points.

To determine which performance tests and adjustments to perform after a repair, see “Post-Repair Adjustments”, on page 3-3.

Safety Considerations

This warning must be followed for your protection and to avoid damage to the equipment being used.

WARNING **Adjustments described in this chapter are performed with power applied to the instrument and with protective covers removed. Maintenance should be performed only by trained personnel who are aware of the hazards involved. When the maintenance procedure can be performed without power, the power should be removed.**

Equipment Required

The adjustment procedures include a list of recommended test equipment. The test equipment is also identified on the test setup diagrams.

Post-Repair Adjustments

Table 3-1 lists the adjustments related to repairs or replacement of any of the assemblies.

Table 3-1: Post Repair Adjustments, Tests, and Checks

Assembly Replaced	Related Adjustments, Performance Tests or Self Tests
A1 Power Supply	Self Test.
A2 Processor Assembly	Frequency and Level Adjustments, Power Reference Level Test, Display Brightness and Contrast Adjustment.
A3 Front Panel Assembly	Instrument Accuracy Test, Display Brightness and Contrast Adjustment.
A4 Comms Assembly	All automated Tests and Serial Interface Self Test.
A5 Daughter Assembly	Instrument Accuracy Test.
A6 Measurement Assembly	Zero Test, Instrument Accuracy Test.
W1 or W2 Power Sensor Cable	Instrument Accuracy Test, Zero Test.
BT1 Lithium Battery	Battery Self Test.
Power Reference Cable Kits	Power Reference Level Test.

Power Reference Oscillator Frequency Adjustment

Note Adjustment of the power reference oscillator frequency may also affect the output level of the oscillator. Therefore, after the frequency is adjusted to 50.0 ±0.5 MHz, the output level should be checked as described in “Power Reference Oscillator Level Adjustment”, on page 3-6.
The power reference oscillator frequency is a nominal specification.

Description

Variable inductor A2L9 is adjusted to set the power reference oscillator output frequency to 50.0 ±0.5 MHz. This frequency is a supplemental characteristic.

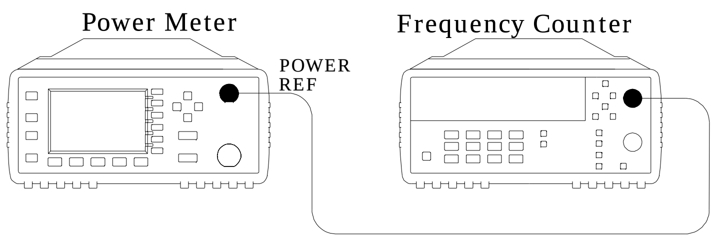


Figure 3-1: Adjustment Setup

Equipment

Frequency Counter................................ Agilent 5314A

Procedure

1. Ensure that the power meter has been powered on for at least 30 minutes before making any measurements.
2. Connect the equipment as shown in Figure 3-1. Set up the counter to measure frequency.

3. Turn the power reference on by pressing
   - [Zero Cal], `Power Ref Off On` on the Agilent E4418B.
   - [Zero Cal], `Cal`, [More], `Power Ref Off On` on the Agilent E4419B.
4. Observe the reading on the frequency counter. If it is 50.0 ±0.5 MHz, no adjustment of the power reference oscillator frequency is necessary. If it is not within these limits, adjust the power reference oscillator frequency as described in step 5 and step 6.
5. Remove the power meter cover.
6. Adjust A2L9 to obtain a 50.0 ±0.5 MHz indication on the frequency counter. Refer to Figure 3-2 for the position of A2L9.

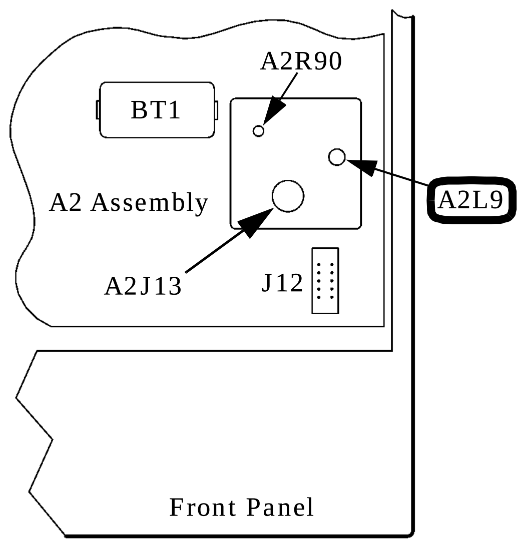


Figure 3-2: A2L9 Adjustment Location

Power Reference Oscillator Level Adjustment

Description

The power reference oscillator is factory adjusted to 1.0 mW ±0.7%. This is done using a special measurement system accurate to 0.5% traceable to the National Institute of Standards and Technology (NIST) and allowing for a 0.2% transfer error. To ensure maximum accuracy in re-adjusting the power reference oscillator, the following procedure provides step-by-step instructions for using specified Agilent Technologies instruments of known capability. If equivalent instruments are used, signal acquisition criteria may vary and reference should be made to the manufacturer's guidelines for operating the equipment.

Note The power meter may be returned to the nearest Agilent Technologies office to have the power reference oscillator checked and/or adjusted.

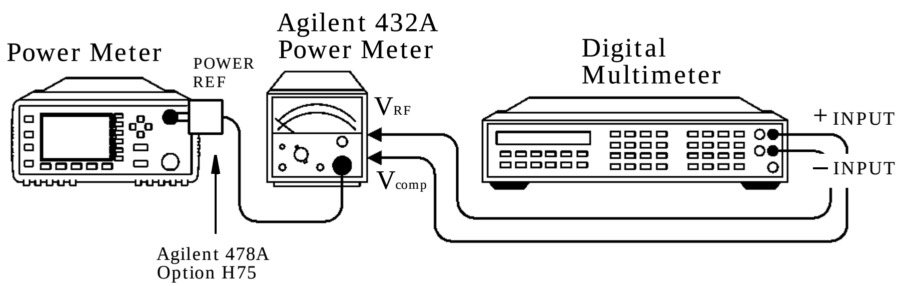


Figure 3-3: Adjustment Setup

For this adjustment the following mathematical assumptions are made:

Equation 1:

$$P_{meas} = \frac{2V_{comp}(V_1 - V_0) + V_0^2 - V_1^2}{4R(CalibrationFactor)}$$

can be manipulated to give equation 2:

$$V_1 = V_{comp} + V_0 - \sqrt{V_{comp}^2 - (10)^{-3}(4R)(CalibrationFactor)}$$

by using the following assumptions:

$$V_0^2 - V_1^2 = -(V_1 - V_0)^2$$

The error in doing this is:

$$-(V_1^2 + V_0^2 - 2V_1V_0) - (V_0^2 - V_1^2) = -2V_0^2 + 2V_1V_0 = 2V_0(V_1 - V_0)$$

So if $2V_0(V_1 - V_0) \ll 2V_{comp}(V_1 - V_0)$, that is, $V_0 \ll V_{comp}$ then the error can be ignored. In practice $V_{comp} \sim 4Volts$ and $V_0 < 400\mu V$. The error is less than 0.01%.

By substituting equation 3 into equation 1 and manipulating the result you get:

$$0 = (V_1 - V_0)^2 - 2V_{comp}(V_1 - V_0) + 4(10^{-3})R(CalibrationFactor)$$

This quadratic can be solved to give equation 2.

The definitions of the terms in equation 2 are:

- V_0 is the voltage measured between V_{comp} and V_{RF} with no power applied and after the Agilent 432A has been zeroed.
- V_1 is the voltage measured between V_{comp} and V_{RF} with power applied. This power is approximately 1 mW.
- V_{comp} is the voltage between the Agilent 432A V_{comp} connector and chassis ground with power applied.
- R is the resistance of the mount resistor in the Agilent 432A power meter.
- Calibration Factor is the value of the thermistor mount at 50 MHz.

Equipment

Test power meter .... Agilent 432A
Thermistor Mount .... Agilent 478A Option H75
Digital Voltmeter (DVM)...................... Agilent 3456A

Procedure

Note The procedure details the key presses required on the Agilent E4418B. For the Agilent E4419B the equivalent key presses should be performed on both channels.

1. Set up the DVM to measure resistance. Connect the DVM between the V_{RF} connector on the rear panel of the Agilent 432A and pin 1 on the thermistor mount end of the sensor cable. Verify that no power is applied to the Agilent 478A
2. Round off the DVM reading to two decimal places and record this value as the internal bridge resistance (R) of the test power meter (approximately 200 Ω).
   - R (Internal Bridge Resistance)_______________Ω
3. Connect the equipment as shown in Figure 3-3. The leads should be isolated from ground. Ensure that the power reference oscillator is off. Ensure that both the power meter under test and the Agilent 432A have been powered on for at least 30 minutes before proceeding to the next step.
4. Set the Agilent 432A range switch to coarse zero and adjust the front panel coarse zero control to obtain a zero meter indication.
5. Fine zero the Agilent 432A on the most sensitive range, then set the range switch to 1 mW.

Note Ensure that the DVM input leads are isolated from chassis ground when performing the next step.

6. Set up the DVM to measure microvolts.
7. Connect the positive and negative input leads, respectively, to the V_{comp} and V_{RF} connectors on the rear panel of the Agilent 432A.

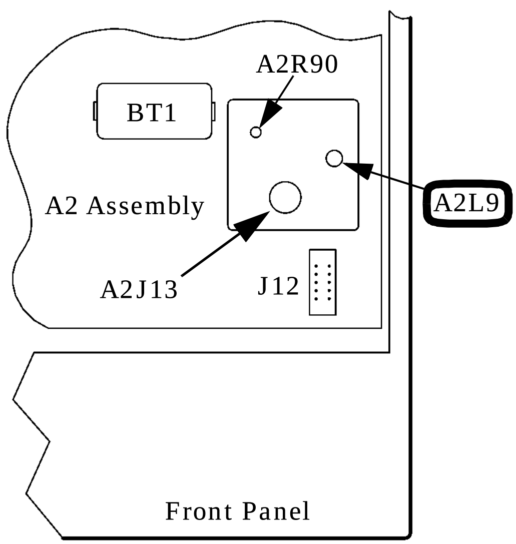
8. Observe the reading on the DVM. If less than 400 µV, proceed with the next step. If 400 µV or greater, press and hold the Agilent 432A fine zero switch and adjust the coarse zero control so that the DVM indicates 200 µV or less. Then release the fine zero switch and proceed to the next step.
9. Round off the DVM reading to the nearest microvolt and record this value as V_0.
   - V_0________________µV
   - Disconnect the DVM negative input lead from the V_{RF} connector on the test power meter and reconnect it to chassis ground.

10. Turn the power reference on by pressing
    - [Zero Cal], `Power Ref Off On` on the Agilent E4418B.
    - [Zero Cal], `Cal`, [More], `Power Ref Off On` on the Agilent E4419B.
11. Record the reading on the DVM to two decimal places. This is V_{comp}.
    - V_{comp} ____________V
12. Reconnect the negative lead to the V_{RF} connector on the rear panel of the Agilent 432A. The DVM is now set up to measure V_1 which represents the power reference oscillator output level.
13. Calculate the required value of V_1 using equation 2.

$$V_1 = V_{comp} + V_0 - \sqrt{V_{comp}^2 - (10)^{-3}(4R)(CalibrationFactor)}$$

14. Remove the power meter's cover and adjust A2R90 until the DVM indicates the calculated value of V_1. Refer to Figure 3-4 for the position of A2R90.

Figure 3-4: A2R90 Adjustment Location



Measurement Uncertainty

When calculating measurement uncertainty the significant multimeter uncertainty parameters are for V_{comp}, V_1-V_0 and R. Other uncertainties which should be included are:

- Maths Assumptions: ±0.01%
- Effective Efficiency Calibration: ±0.05%
- Mismatch Uncertainty with Source and Mount: ±0.1%
- SWR: ≤1.05

These values are typical.

Display Brightness and Contrast Adjustment

Introduction

The following procedure should be performed whenever a front panel assembly or processor assembly are replaced.

The brightness is controlled automaticaly after executing the `Set Brightness` softkey, located under the `Service` softkey menu.

Note The contrast adjustment is subjective and varies according to individual user requirements.

Procedure

1. Access the `Display` softkey menu and use the ⇧◑ softkey to increase the contrast, or the ⇩◑ softkey to decrease the contrast of the display.
2. When the desired display contrast level is obtained, press the `Set Contrast` softkey, located under the `Service` softkey menu.

4

Theory of Operation

Introduction

This chapter describes how each of the power meter's assemblies operate. A block diagram is included at the end of the chapter giving you an overall view of the power meter's operation.

A1 Power Supply/Battery Charger

The A1 power supply/battery charger is a 20 W, 47 to 440 Hz switching power supply producing three dc voltages, (+5 V, +12 V, -12 V) used to power the subassemblies, and a constant current supply to recharge the optional +12 V rechargeable Battery Module (Agilent Part Number E9287A) when operating from an ac power source. The power supply can be driven either by AC power voltages in the range 85 to 264 V or by the A8 Rechargeable Battery Module.

The signal line Power_on, from the A2 processor assembly to the A1 power supply assembly, indcates the status of the front panel POWER switch. This signal line enables and disables the dc voltage outputs of the power supply assembly to the A2 processor asembly when driven by the A8 battery assembly. The charging current for the rechargeable battery module is independent of the state of the Power_on line.

A logic low on the Power_on line indicates that the front panel POWER switch is in standby mode and the three dc voltage outputs from the power supply are disabled. A logic high on this line indicates that the POWER switch is in the On mode and the three dc voltages from the power supply are enabled. Power is distributed to the meter subassemblies via the processor assy (See “A2 Processor Assembly”, on page 4-4).

If fitted, the A8 rechargeable battery module controls the charging current while ac power is connected to the meter.The fan assembly is active under the following conditions:

1. ac power connected and the POWER switch set to On.
   or
2. ac power connected, POWER switch set to Standby and optional +12 V rechargeable battery module fitted.

The ac line fuse is located in the line input module on the power meter’s rear panel (Agilent Part Number 2110-0957). The fuse holder contains a spare fuse as standard on shipment.

A2 Processor Assembly

The processor assembly contains the microcontroller and associated circuits, the power-on/ standby control and switching, the 1 mW reference calibrator, the recorder outputs, TTL input/output, and the front panel drivers. It provides that platform on which the power meter can run, facilitating the system inputs and outputs.

Regulated DC voltages at +12 V, -12 V and +5 V are converted by the A1 power supply assembly when AC power is connected to the rear panel or the optional rechargeable battery is fitted. The DC voltages are connected and distributed to the rest of the system by circuits on the processor assembly. When the ⏻ I key on the front panel is pressed a bistable latch changes state. This, in turn, applies the correct gate voltages to turn on three MOSFET switches, which connects the power supply unit voltages to the distributed power buses. The bistable latch is connected to a permanent power-supply which has the backup of battery power when AC mains is removed from the power meter. The +12 V supply is used to power the fan. This is filtered to decouple it from the rest of the system. When the optional rechargeable battery is fitted and the meter is in standby and connected to the ac power supply, the rechargeable battery will recharge and the fan will be powered on.

The reference oscillator has a 50 MHz oscillator circuit with automatic level control (ALC). The oscillator output is level detected and that level is compared to a temperature stable precision reference voltage. This comparison produces an error signal that gives negative feedback control of the oscillator output power. The frequency and power level of the calibrator are factory set to provide a 50 MHz 1 mW transfer standard. The precision reference voltage and the ALC control signal are both measured in the calibrator self test. The calibrator is switched on or off using a signal from the microcontroller. The front panel LED indicator is switched with a separate microcontroller signal. The recorder outputs are driven from a dual 12 bit DAC which is driven by the microcontroller. The dual DAC outputs are buffered, filtered and scaled to give a 1 V full scale output nominal.

The recorder is a 12 bit DAC driven by the microcontroller. The DAC output is buffered, filtered and scaled to give a 1 V full scale output with a nominal 1 kΩ output impedance.

Circuitry for the keyboard driver includes some damage protection, but it is basically a direct connection from the keypad row and column matrix to the microcontroller’s control lines.

The LCD controller on the A3 front panel assembly is configured as a memory mapped peripheral, and as such requires only to be fed with the appropriate address, data and control lines from the microcontroller circuits. The bias voltage for the LCD is produced by a DC to DC converter that takes the +5 V (DIST) voltage and converts that to a nominal +21 V. The DC to DC converter is adjusted by a combination of the contrast control signal from the microcontroller and the temperature sense voltage that is generated on the A3 front panel assembly. The temperature sense voltage helps to compensate for the normal variation of LCD contrast with temperature. Current to the LCD's LED backlight array is sourced from a constant current circuit that compensates for variation in LED knee voltage. A control input to this circuit from the front panel temperature sense voltage allows for de-rating of the maximum LED current at high operating temperatures. A control input from the microcontroller allows the optimum backlight brightness to be factory set. The temperature sense voltage, LED current and LCD bias voltage are all measured at self test.

An analog multiplexer provides means by which several diagnostic points can be switched to the A6 measurement assembly(s) for analogue to digital conversion. The microcontroller uses this function to perform self test.

A6 measurement assembly(s) to microcontroller communication is conducted on a serial interface bus, the Internal Serial Bus (ISB). The ISB is connected to the bi-directional serial port on the microcontroller via buffers. The system clock and some control signals are connected to the measurement modules. The measurement module interface is completed with the distribution of switched and direct power (+12 V, -12 V and +5 V).

The TTL outputs are connected to the A6 processor assembly via in line resistors located on the A4 interface assembly. A TTL logic level is output from the processor assembly when the user defined windows based limits are exceeded.

The TTL inputs are connected to the processor card via in line resistors located on the interface card and can be used to initiate zero and calibration cycles on the power meter.

The microcontroller circuits that control all the above functions, and provide platform for the system software to run on, comprise the microcontroller itself, memory, and clock and logic circuits. The logic circuits have the function of ensuring the correct sequencing and decoding of the control signals for the various peripherals. The crystal oscillator clock circuit is buffered and distributed to the A4 interface assembly and the A5 daughter assembly. The program memory for the microcontroller is FLASH EEPROM to allow for in-circuit programming. The static RAM is split into volatile and non-volatile blocks, with the power for the non-volatile RAM being connected to the permanent (battery backed) power supply.

Note It is advisable to replace the RAM battery A2BT1 every three years. If the battery fails or drops below 3 V the RAM will lose the following information when power is disconnected from the meter:

Unit Serial Number
Revision letter of Processor Card
Unit Option
User defined setups
User defined sensor calibration tables

A3 Front Panel Assembly

The front panel assembly is made up of a liquid crystal display (LCD), a keypad and, depending on the power meter option, a power reference cable assembly and a sensor cable assembly(s).

There are two inputs to the front panel assembly:

- the flex circuit from connector A2J4 of the processor assembly which controls the keypad.
- the ribbon cable from A2J3 of the processor assembly which controls the LCD display.

The power meter self tests contain display tests. These are accessed by pressing (System Inputs), (More), `Service`, `Self Test`, `Individual`, `Display`.

A4 Comms Assembly

The comms assembly contains the circuitry required for remote control of the power meter. This assembly supports parallel and serial interfaces.

The GP-IB interface is supported by a protocol controller integrated circuit and two physical interface buffers. The system clock is divided by four to provide the GP-IB controller integrated circuit clock signal.

The RS232 and RS422 interface is supported by a single Universal Asynchronous Receiver/Transceiver (UART) integrated circuit and a programmable transceiver. The programmable transceiver can be configured for either RS232 or RS422. The remote interface is designated a DTE (Data Terminal Equipment).

The programmable baud rate generator in the UART is driven from the system clock (16.67 MHz) which allows baud rates in the range 50 to 115.2 K.

The whole assembly is connected to data, address, and control signals from the A2 processor assembly.

The comms assembly also provides a filtered path for the single/dual recorder output signal and the TTL input and output signals. It also provides ESD protection for the RS232.422 , TTL I/O, and Recorder outputs.

A5 Daughter Assembly

The A5 daughter assembly is loaded vertically into the A2 processor assembly. The Agilent E4418B has five connectors on the A5 daughter assembly:

- two 6-way connectors route the signal lines between the rechargeable battery assembly and the A1 power supply/charger assembly, and provide an interface for the signal lines that are monitored by the A2 processor assembly.
- a 48-way connector provides the interface for the A2 processor asembly signals.
- a 36-way slotted post connector provides the interface for the A6 measurement assembly.
- a 2-way connector for production test only.

The Agilent E4419B has an additional 36-way slotted post connector.

A6 Measurement Assembly

There is one measurement assembly in the Agilent E4418B and two in the Agilent E4419B.

The measurement assembly amplifies and converts the chopped AC signal produced by the power sensor (either Agilent 8480 series power sensors or Agilent E-series power sensors) into a 32 bit digital word. This digital word is proportional to the input RF power level applied to the power sensor. The measurement assembly also measures the sensor resistor voltage to detect whether a power sensor is present. If a power sensor is connected it determines the model, and whether it's connected to the front or rear panel. This assembly produces the differential drive signal for the power sensor's chopper. When an Agilent E-series power sensor is present this assembly converts and corrects the power sensor's temperature dependent voltage.

With reference to the block diagram at the end of this chapter, the chopped AC input signal is amplified by the input amplifier. This operational amplifier in combination with a single bipolar transistor in the power sensor, produce a feedback amplifier which has a gain of approximately 500. The "Feedback" line shown sets the gain and also biases the transistor. The differential amplifier removes any common mode noise or interference. It uses a special ground wire ("Sensor Ground"), connected close to the RF bulkhead in the power sensor as it's second input.

The band pass filter represents the filtering action of the input amplifier. When the power meter is working with an Agilent E-series power sensor the equalizer is switched on to reduce the high pass cut off frequency of the input amplifier. This improves the settling time in fast mode operation.

The output of the equalizer is split into two paths. One path is amplified by a gain of 100. Both signals are each converted to digital words by the dual analog to digital converter (ADC). The ADC's sampling rate is set to a frequency 200 times above the chop rate for the Agilent 8480 series power sensors and 100 times above the chop rate for the Agilent E-series power sensors.

The Digital Signal Processor (DSP) converts the chopped signals into digital words proportional to the input level. It compares both levels, calibrates the gain and decides which level is output to the host processor (after additional filtering) via the "Internal Serial Bus".

The DSP chip controls the logic which sets the chopper driver voltage and frequency control. For the:

- Agilent 8480 series power sensors this is 0 V and -10 V at 217 Hz.
- Agilent E-series power sensors this is +7 V and -3 V at 434 Hz.

The DSP also controls logic to allow the AUX ADC to measure a number of voltages, and when requested, send the relevant data to the host processor. The AUX ADC digitizes a voltage which is produced by the Agilent E-series power sensors and is proportional to temperature. This voltage is required for temperature compensation. This AUX ADC also tests the sensor resistor wires to check sensor continuity. Lastly, use is made of this AUX ADC for the power meter’s self test of both the measurement assembly and the A2 processor assembly. The results are reported back to the A2 processor assembly via the “Internal Serial Bus”.

The Agilent E-series power sensors have built in serial EEPROM and range switching which is controlled or accessed via the measurement assembly. The “N-Chop” sensor wire used by the Agilent 8480 series power sensors doubles as a serial clock and the sensor resistor line doubles as a bi-directional serial data line. The “Auto Zero” line is also used as a serial bus enable control.

The wire labelled “Auto Zero” is grounded to the “Sensor Ground” line when an Agilent 8480 series power sensor is used. Autozeroing is accomplished without the need for this signal in the power meter.

All clocks are derived from the 16.67 MHz system clock which is generated on the A2 processor assembly and distributed on the A5 daughter assembly.

A8 Rechargeable Battery Assembly

The A8 Rechargeable Battery Assembly allows the EPM power meter with option 001 fitted to operate when no AC power input is available. The battery pack contains a health monitoring circuit which the A2 processor assembly can interrogate. The A8 battery assembly connects to the A2 processor assembly and the PSU/battery charger circuit via the A5 Daughter Assembly.

There are three connections from the rechargeable battery assembly to the A1 psu/charger assembly, +12V , 0V, and Signal 1. The Signal 1 line is an indicator line which signals when the battery is below a threshold limit. When this line goes low, indicating there is insufficient charge left in the Battery Assembly to continue operating the power meter, it will cause the A1 psu/charger assembly to shut down.

There is one connection, the communications line, from the A8 Battery Module to the A2 processor assembly. This line provides serial communications with the processor assembly on battery pack status information, such as amount of charge remaining. When there is less than 10 minutes run time charge remaining in the battery an error message "Battery Power Low'" is displayed on the power meter front panel display.

The battery assembly can only be recharged when fitted to a power meter with the battery option fitted. The charge current from the charging circuit is controlled by a module contained within the Battery assembly. When the ac power is connected the battery assembly regulates the charging current based on the discharge state of the battery.

The battery should fully charge from empty within 2 hours. At 25 degrees C this will give the meter 2 hrs operational time. The A8 Battery module has a lifetime of approximately 450 charge/discharge cycles after which the battery can still be used, but will only have approximately 70% of its original capacity. The battery capacity may be reduced whilst charging at temperatures above 35 degrees C.

Note:- partially discharging and recharging the battery module will reduce its lifetime. It is advised that periodically the battery assembly should have its charge fully cycled i.e. fully discharged and then fully recharged.

Remove this page and replace with pullout.fm.

5

Replaceable Parts

Introduction

This chapter contains details of some of the higher level components and assemblies which can be ordered from Agilent Technologies. It also details how to assemble and disassemble the power meter for repair.

To order parts contact your local Agilent Technologies Sales and Service Office.

To return your power meter for servicing at a qualified service center refer to “Contacting Agilent Technologies” in chapter 2 of the *User’s Guide*.

Assembly Part Numbers

Reference Designator	Description	Agilent Part Number
A1	Power Supply and Charger Assembly	0950-3445
A2	Processor Assembly	E4418-60028
A301	Front Panel Assembly for: Agilent E4418B and Agilent E4418B Option 002	E4418-61030
A302	Front Panel Assembly for: Agilent E4418B Option 003	E4418-61031
A303	Front Panel Assembly for: Agilent E4419B and Agilent E4419B Option 002	E4419-61001
A304	Front Panel Assembly for: Agilent E4419B Option 003	E4419-61002
A4	Comms Assembly	E4418-60012
A5	Daughter Assembly for: Agilent E4418B	E4418-60015
	Daughter Assembly for: Agilent E4419B	E4419-60003
A6	Measurement Assembly	E4418-60003
A7	Fan Assembly	E4418-61004
BT1	Lithium (RAM) Battery	1420-0338
BT2	Rechargeable Battery Opt 001	E9287A
MP1	Bail Handle	34401-45011
MP2	Front Bumper	34401-86011
MP3	Rear Bumper	34401-86012

Reference Designator	Description	Agilent Part Number
MP4	Outer Cover for: Agilent E4418/9B Agilent E4418/9B Option 001	 E4418-61027 E4418-61016
MP5	Rear Bezel	E4418-20008
Battery Module Cover		E4418-61019
W3	Recorder Output Cable Assy	E4418-61015
Sensor Cable Assembly Kit		E4418-61036
Front Power Reference Cable Kit		E4418-61811
Rear Power Reference Cable Kit		E4418-61813

Front Panel Connector Repair

The front panel assembly is an exchange assembly. However, if front panel sensor cables or power reference cables are faulty they should be replaced by ordering the appropriate kit and following the assembly/disassembly procedure. The instrument accuracy test should then be carried out to verify the functionality of the new part.

Firmware Upgrades

The power meter's firmware can be upgraded using a PC. The current firmware is available on the World Wide Web. A firmware upgrade package (Part Number E4418-61035)can be purchased for users who do not have access to the World Wide Web. The upgrade package contains instructions and a disc pack. The firmware can be upgraded via the GP-IB connector or the serial RS232/422 connector.

To determine the firmware version in your power meter, press:

- System Inputs, More, `Service`, `Version`.

Contact your local Service Center if you require a firmware upgrade. Refer to "Sales and Service Offices", on page -ix for details of your local Service Center.

Downloading Firmware

Instrument Firmware should be downloaded after the processor board is replaced. Firmware can be accessed by Agilent Technologies Service Centers using the World Wide Web.

Assembly and Disassembly Guidelines

The guidelines in this section describe the removal and replacement of the major assemblies in the Agilent E4418B and Agilent E4419B power meters.

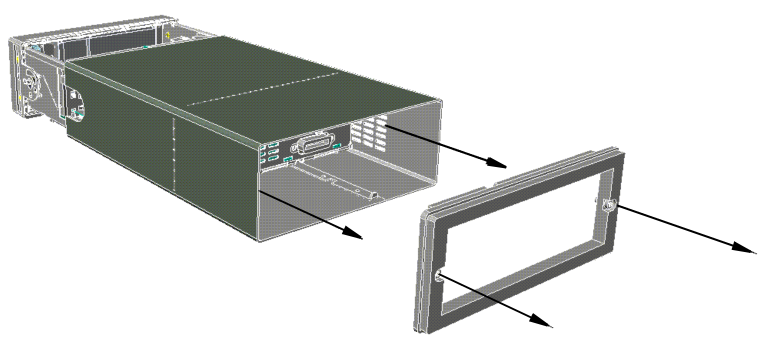
Once an assembly has been replaced, refer to "Post-Repair Adjustments", on page 3-3 to ensure that the correct performance tests and adjustments are carried out.

WARNING **Refer to the safety symbols on the power meter and "Equipment Operation", on page -v before operating this power meter with the cover removed. Failure to comply with the safety precautions can result in severe or fatal injury.**

WARNING **Before carrying out any assembly or disassembly of the power meter ensure that you disconnect the power cord. Even with the power meter switched off there are potentially dangerous voltages present on the power supply assembly.**

Removing the Power Meter Cover

Remove the optional battery if fitted before removing the cover.



When replacing the power meter cover retighten the captive screws in the rear bezel using a 9 lb/in T15 screw driver.

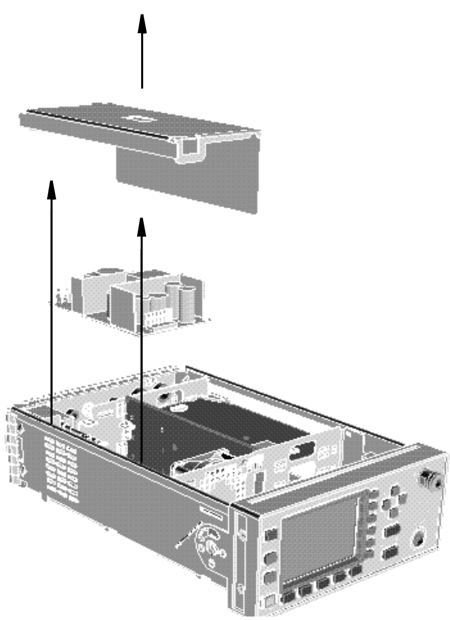
Removing the A1 Power Supply Assembly

1. Remove the power supply cover by lifting it out.
2. Disconnect the line input module from the chassis and power supply assembly.
3. Disconnect the cable assembly from the power supply which connects to the A2 processor assembly.
4. Unscrew the power supply assembly and lift out the power supply. (When replacing these screws use a 9 lb/in T15 screw driver.)

WARNING **When replacing the power supply unit in the power meter ensure that all earth wiring is reconnected. There are two terminals to check:**

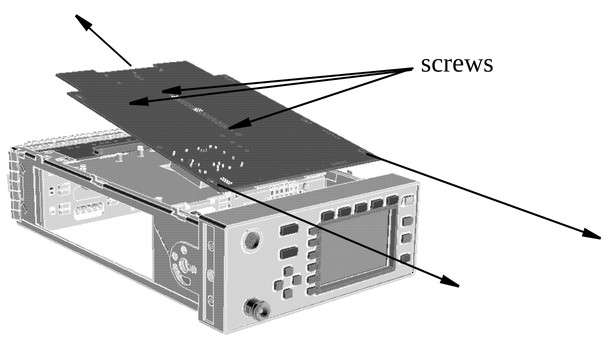
The first is the force fit connector to the power supply unit itself. It is essential that the gap between the terminal and the adjacent large capacitor is maximized. Fit the connector so that its flat side faces towards the large capacitor.
The second, a closed loop terminal bonded to the chassis with an M3.5 machine screw (use a 9 lb/in T15 screw driver).

All the protective earth wiring can be identified by the insulation color green with a yellow stripe.



Removing the A2 Processor Assembly

1. Remove the A5 daughter and A6 measurement assemblies as described on page 5-11.
2. Move the A2 plastic support bracket to its forward position using the two side levers, unclip the flexi-cable retaining bar on the front panel keypad and front panel LCD cable connectors and disconnect the cable.
3. Disconnect the following cables from the A2 processor assembly:
   - power reference semi-rigid
   - fan connector
   - power supply connector
4. Turn the power meter upside down and remove the three screws as shown. (When replacing these screws use a 6 lb/in T10 screw driver.)
5. Push the A2 processor assembly towards the front panel to release it from the 50-pin connector. Lift it upwards to remove.



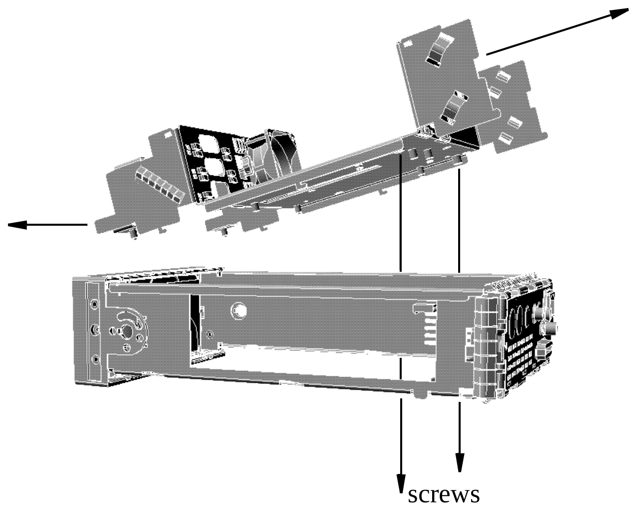
Note	When re-assembling the processor board, ensure the A2 plastic support bracket is returned to its locked position.

Note	After replacing a processor board, the display brightness and contrast must be adjusted. See Chapter 3 “Adjustments”.

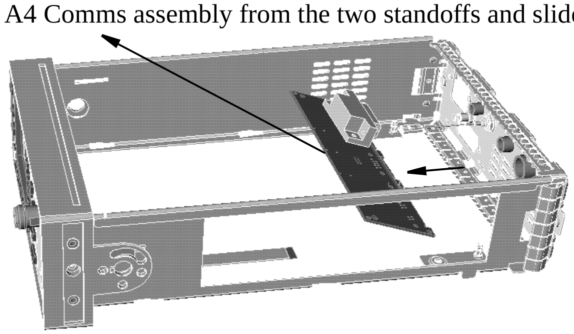
Note	Firmware should be downloaded to the instrument after the processor board is replaced. Refer to “Downloading Firmware”, on page 5-6.

Removing the A4 Comms Assembly

1. Remove the A2 processor, A5 daughter and A6 measurement assemblies as shown on page 5-9 and page 5-11.
2. Disconnect the line power module from the A1 power supply and the chassis.
3. Disconnect the earth wire screw. (When replacing this screw use a 9 lb/in T15 screw driver.)
4. Remove the two screws on the underside of the deck assembly. Remove the assembly by sliding forward and tilting up from the rear (when replacing these screws use a 21 lb/in T15 screw driver).



5. Unscrew the GP-IB and RS232/422 connectors from the rear panel. (When replacing these screws use a 6 lb/in 9/32 in socket.)
6. Disconnect the Recorder cable for channel A from J23 pins 1,2,3. Disconnect the Recorder cable for channel B from J23 pins 4,5,6.
7. Lift the A4 Comms assembly from the two standoffs and slide it out.



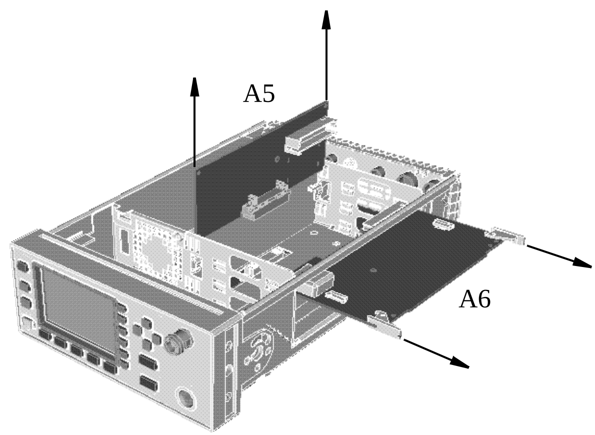
Removing the A5 Daughter or A6 Measurement Assemblies

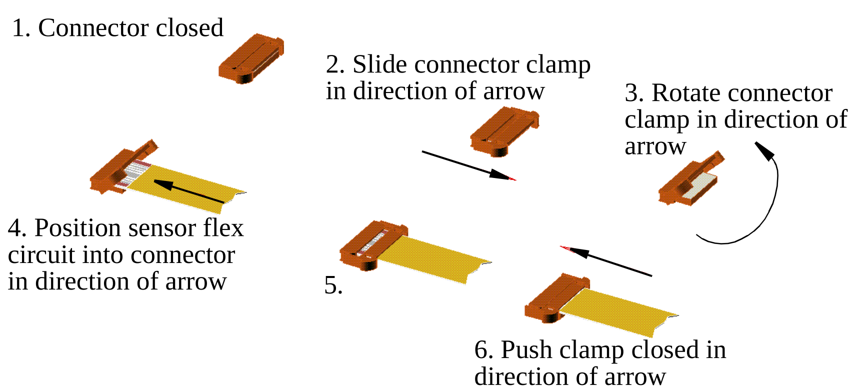
1. Disconnect the flex circuit from measurement assembly.

Note Care should be taken when disconnecting the flex circuit from the measurement assembly.

The flex circuit assembly is released by pushing the connector tab forward and lifting.
To replace the flex circuit, loop it as shown on page 5-16, and connect the flex circuit as shown in the figures below.

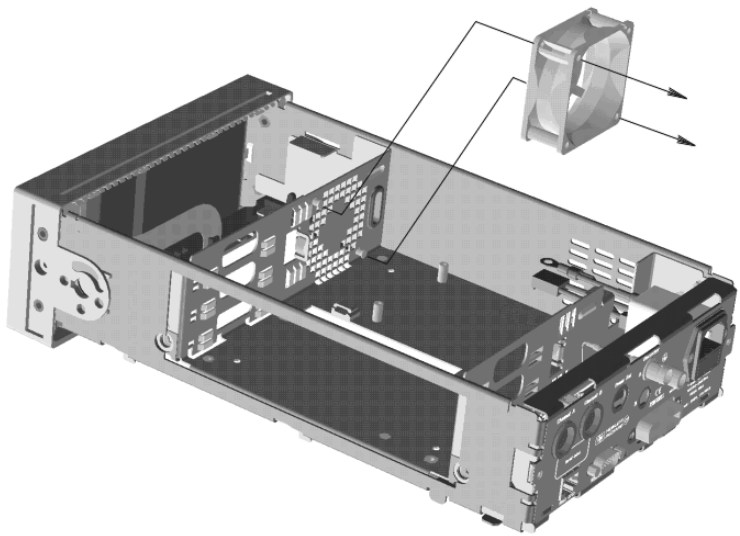
2. Slide out the measurement assembly from the side of the power meter.
3. The daughter assembly is removed vertically.





Removing the A7 Fan Assembly

1. Remove the A1 power supply assembly as shown on page 5-8.
2. Remove the pins which attach the fan to the chassis.
3. Remove the fan cable connector from the A2 processor assembly to release the fan.

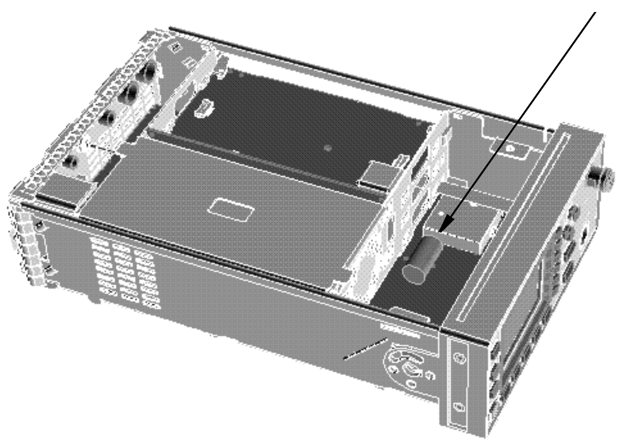


Removing the Power Meter RAM Battery (BT1)

1. Remove the A2 processor assembly as described on page 5-9.
2. Remove the A2J1 link to disconnect the battery from the rest of the circuitry.
3. Verify the battery protection circuitry by:
   - ensuring that there are no electrical short circuits across the battery terminals.
   - ensure that there are no voltages present which could apply a charging voltage.
4. Once the protection circuit has been verified remove the battery. The battery is siliconed to the assembly. It may be necessary to remove it using a scalpel.
5. Store the battery individually in an anti-static (dissipative) bag or suitable non-conductive packaging.
6. After replacing the battery secure it using a tie wrap. This should be secured from the top of the A2 processor assembly. The recommended tie wrap part number is 1400-1154.
7. Replace the A2J1 link.

WARNING **This power meter uses a lithium battery which may explode if mishandled. The battery should not be subjected to short circuit of the battery terminals or to excessive heat.**

Do not recharge this battery or dispose of it by burning. Check local country regulatory requirements on the disposal of lithium batteries.



Removing the A3 Front Panel Assembly

1. Disconnect the following cables from the A2 processor assembly:
   - power reference semi-rigid (When replacing use the torques detailed on page 5-17.)
   - front panel keypad
   - front panel LCD

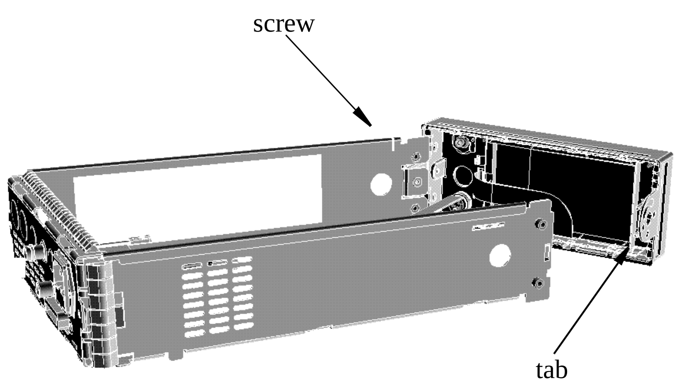
Note Care should be taken when disconnecting the front panel keyboard and LCD. Move the A2 plastic support bracket to its forward position using the two side levers, unclip the flexi-cable retaining bar on the front panel keypad and front panel LCD cable connectors and disconnect the cable.

2. Disconnect the flex circuit from the measurement assembly.

Note Care should be taken when disconnecting the flex circuit from the measurement assembly.

The flex circuit assembly is released by pushing the connector tab forward and lifting.
To replace the flex circuit, loop it as shown on page 5-16, and connect the flex circuit as shown in the figures on page 5-11.

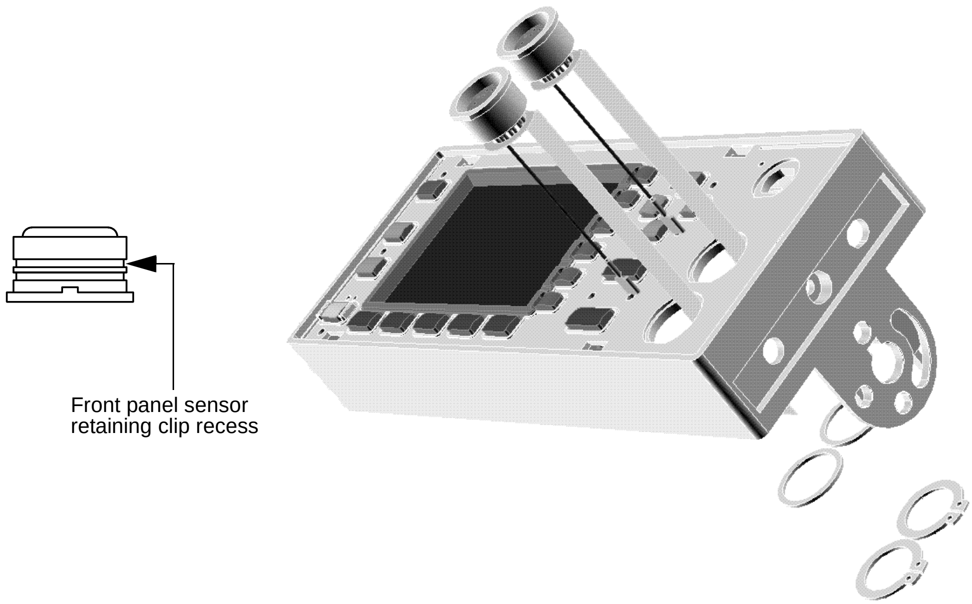
3. Remove the center screw from the right hand side of the front panel.
4. Remove the front panel by pressing in the metal tab on the front panel as shown and push down on the side of the chassis until the standoffs are cleared from the holes.

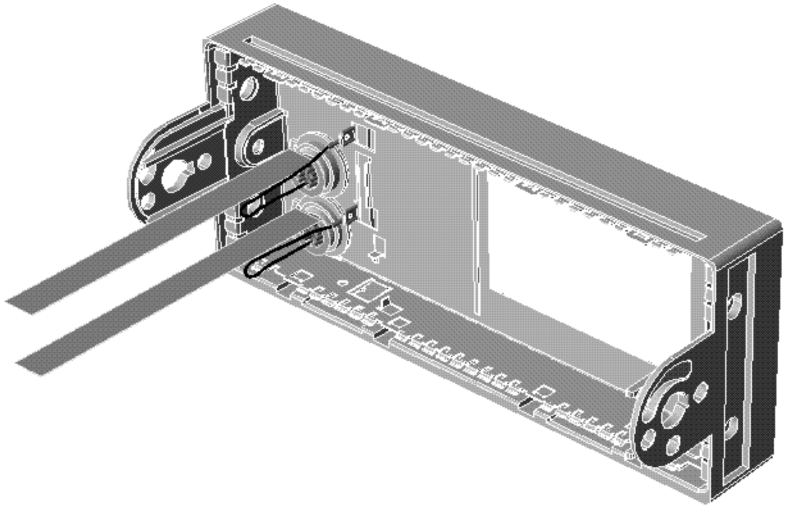


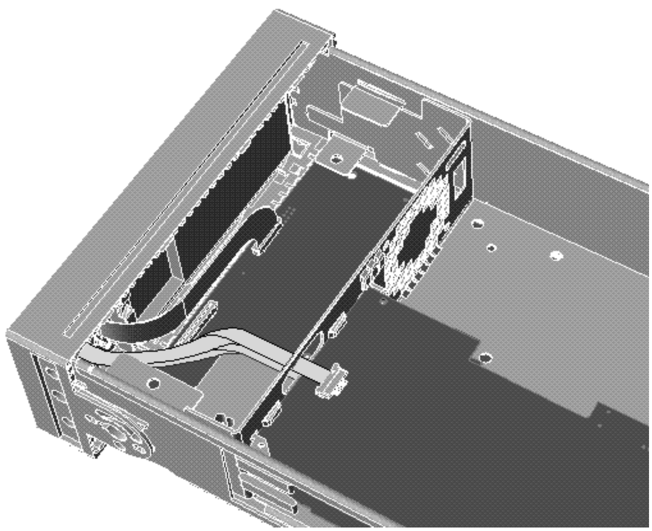
Note After replacing a front panel assembly, the display brightness and contrast must be adjusted. Refer to Chapter 3 “Adjustments”.

Replacing the Front Panel Power Sensor Cable Assemblies

1. Remove the front panel from the power meter. (Refer to “Removing the A3 Front Panel Assembly”, on page 5-14 for details on removing the front panel.)
2. Replace the power sensor cable assembly(s) using the replacement kit.

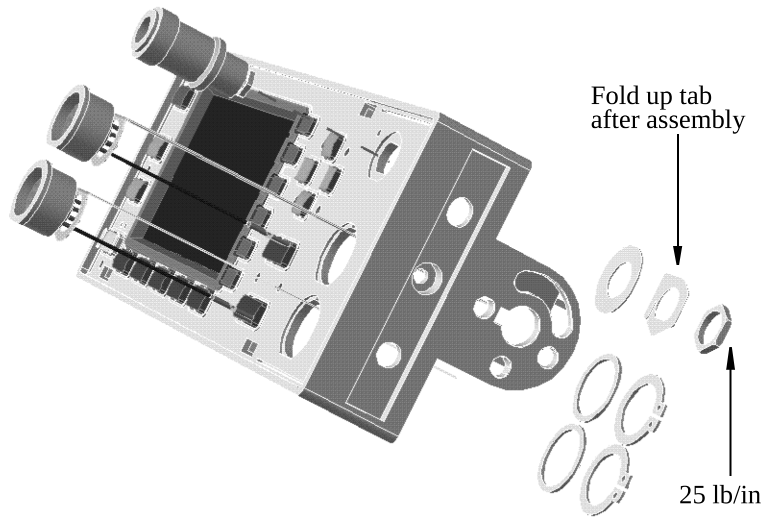


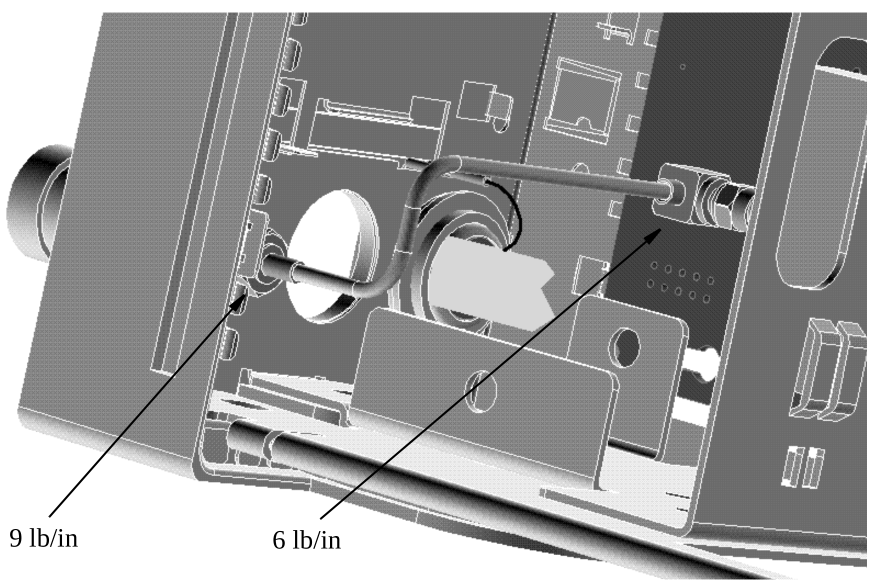




Replacing the Front Panel Power Reference Cable Assembly

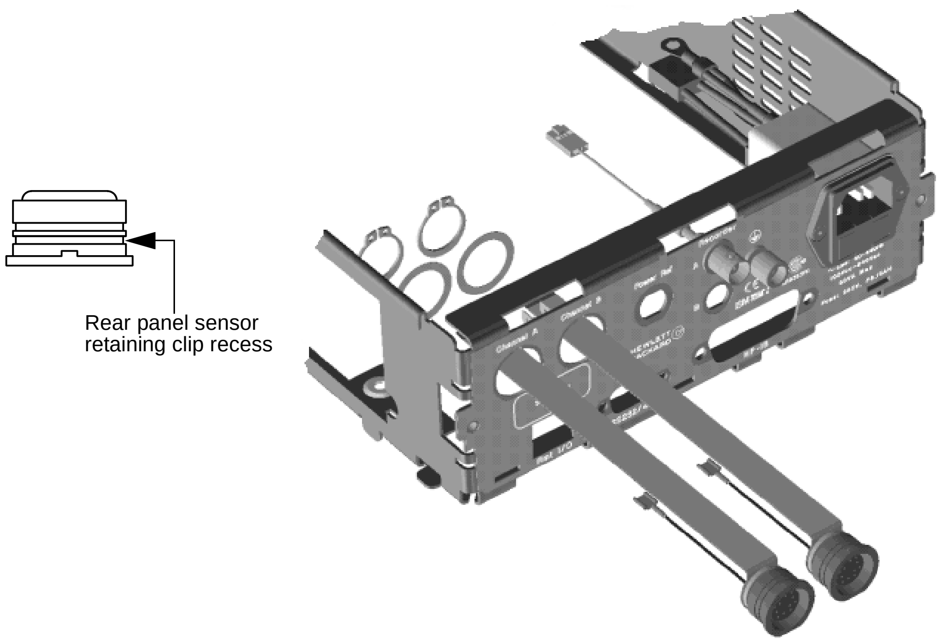
1. Remove the front panel from the power meter. (Refer to "Removing the A3 Front Panel Assembly", on page 5-14 for details on removing the front panel.)
2. Replace the power reference output cable assembly using the replacement kit and the torques indicated on the following diagrams.

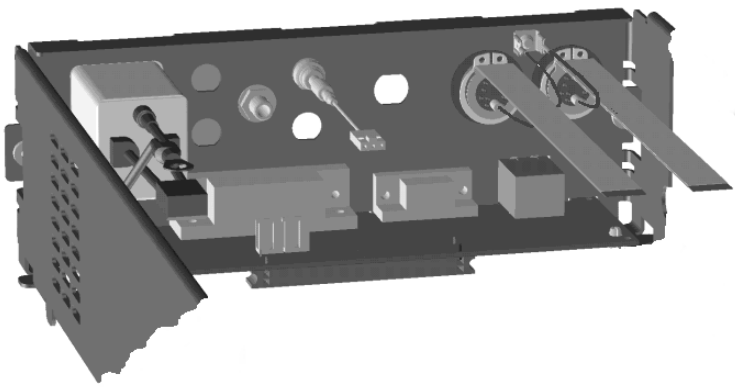


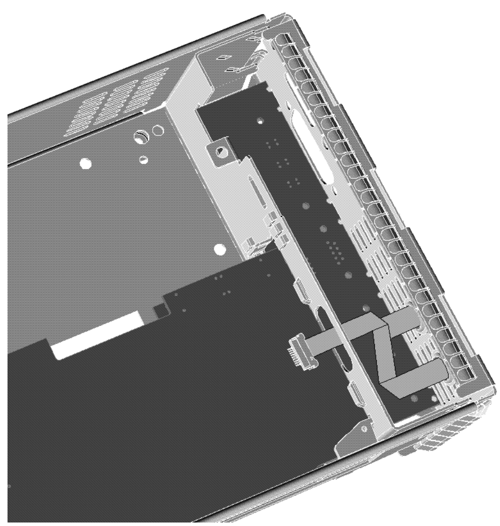


Replacing the Rear Panel Power Sensor Cable Assemblies (Options 002 and 003)

1. Disassemble the power meter to allow access to the rear panel connectors. This is done by following steps 1 through 3 of the A4 comms assembly removal procedure on page 5-10.
2. Replace the power sensor cable assembly(s) using the replacement kits. The inner recess on the power sensor cable is used to locate the circlip when assembling to the rear chassis.

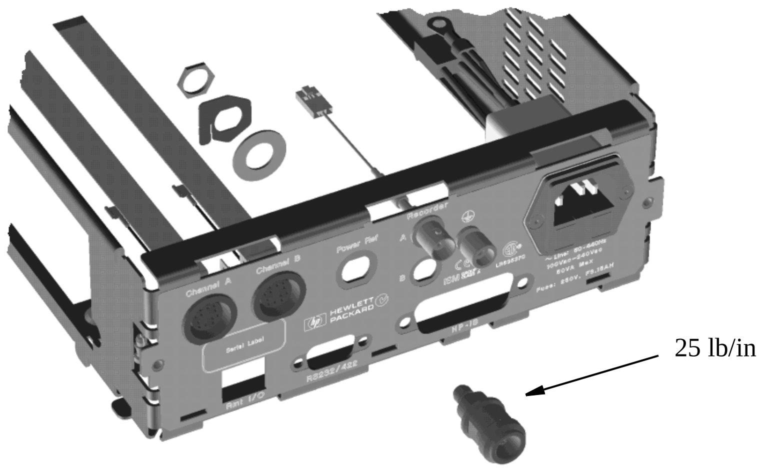


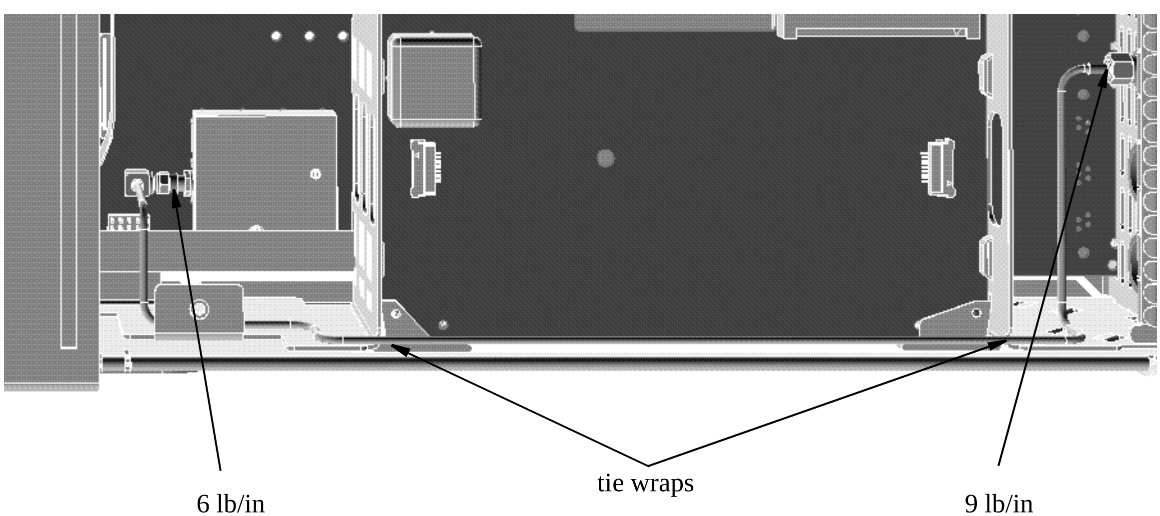




Replacing the Rear Panel Power Reference Cable Assembly (Option 003)

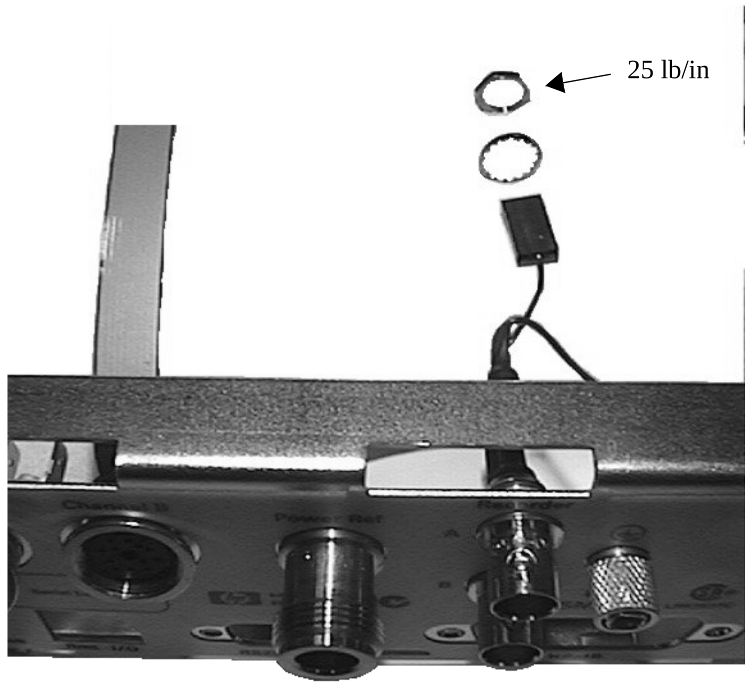
1. Disassemble the power meter down to allow access to the rear panel connectors. (Refer to “Removing the A4 Comms Assembly”, on page 5-10.)
2. Replace the power reference cable assembly using the replacement kit and the torques indicated on the following diagrams.





Replacing the Rear Panel Recorder Output(s) Cable Assembly

1. Disassemble the power meter down to allow access to the rear panel connectors. (Refer to “Removing the A4 Comms Assembly”, on page 5-10).
2. Replace the recorder output cable assembly using the replacement kit and the torque indicated on the following diagram.



Note	Recorder output A connects to A4 J23 and recorder output B connects to A4 J24.

6

Troubleshooting

Introduction

This chapter enables qualified service personnel to diagnose suspected faults with the power meter Rmt I/O (Remote Input/Output) signal lines and RS232/422 serial port.

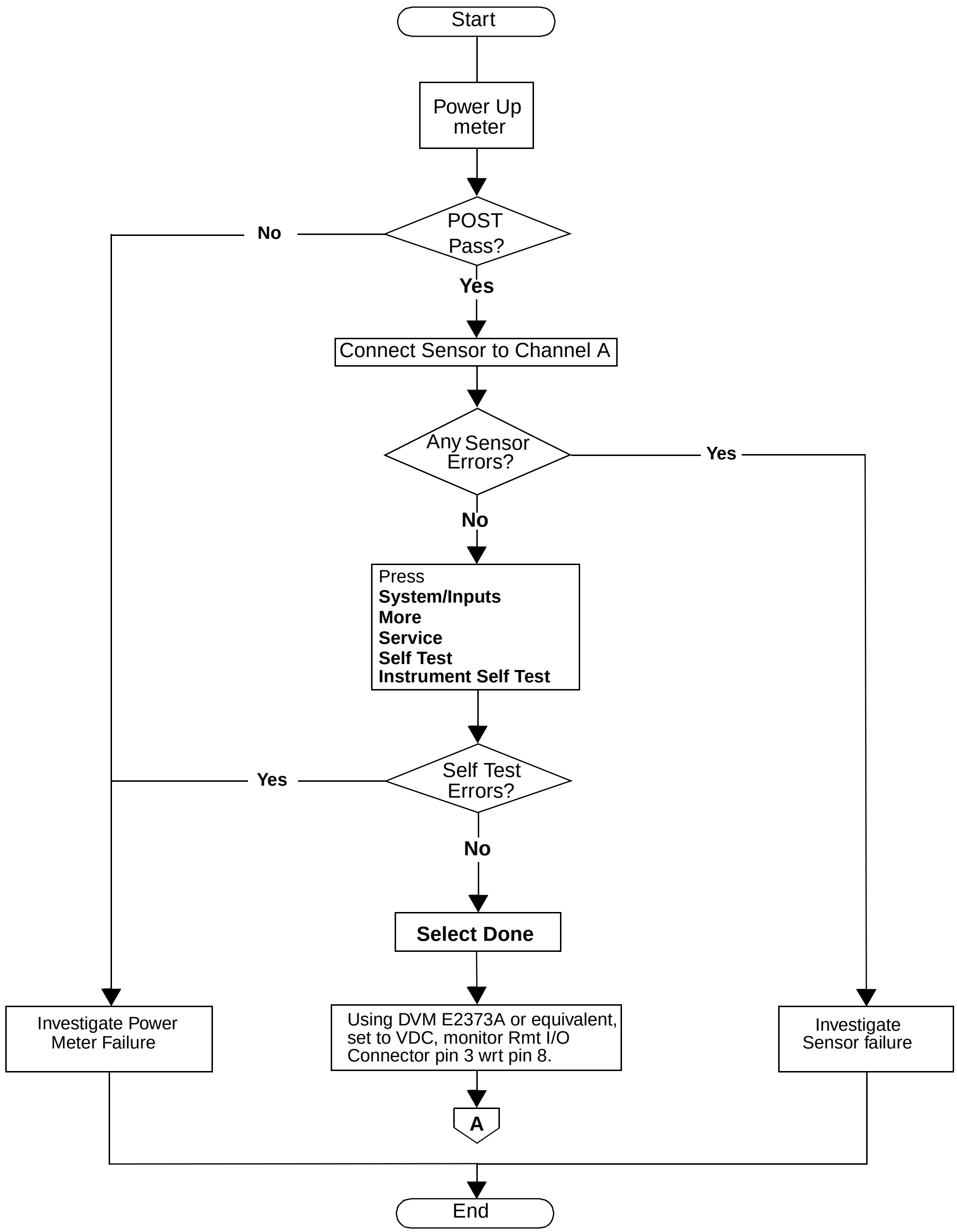
If there is a problem when attempting to use the RS232/422 serial interface or the remote I/O functions, consult the User's Guide and confirm that all the user setups are correct before proceeding with the following fault finding flow charts.

Suggested Diagnostic Equipment

1. Digital multi-meter capable of measuring voltage and resistance, for example, Agilent E4975.
2. Signal source capable of producing 300 ms TTL single shot pulses, for example, Agilent 33120A.
3. +5 V TTL logic level source.
4. RS232 self test connector - 9 way 'D' type female connector with the following pins wired together:
   Pin 2 (Rx) to Pin 3 (Tx)
   Pin 4 (DTR) to Pin 6 (DSR)
   Pin 7 (RTS) to Pin 8 (CTS)
5. RS422 self test connector - 9 way 'D' type female connector with the following pins wired together:
   Pin 1 (CTS-) to Pin 9 (RTS-)
   Pin2 (Rx-) to Pin 4 (Tx-)
   Pin 3 (Tx+) to Pin6 (Rx+)
   Pin7 (RTS+) to Pin 8 (CTS+)
6. 8 way RJ45 plug with flying leads wired to pins 2, 3, 4, 5 and 6 to apply and monitor signals on the remote TTL I/O connector.
7. HP-IB controller and cable - required to apply "*RST" command through the rear panel GP-IB connector.

Note In the following flowcharts a **bold** font indicates the label of a soft/hard key the user must select.

Figure 6-1: Troubleshooting Guide -Upper Window TTL Output



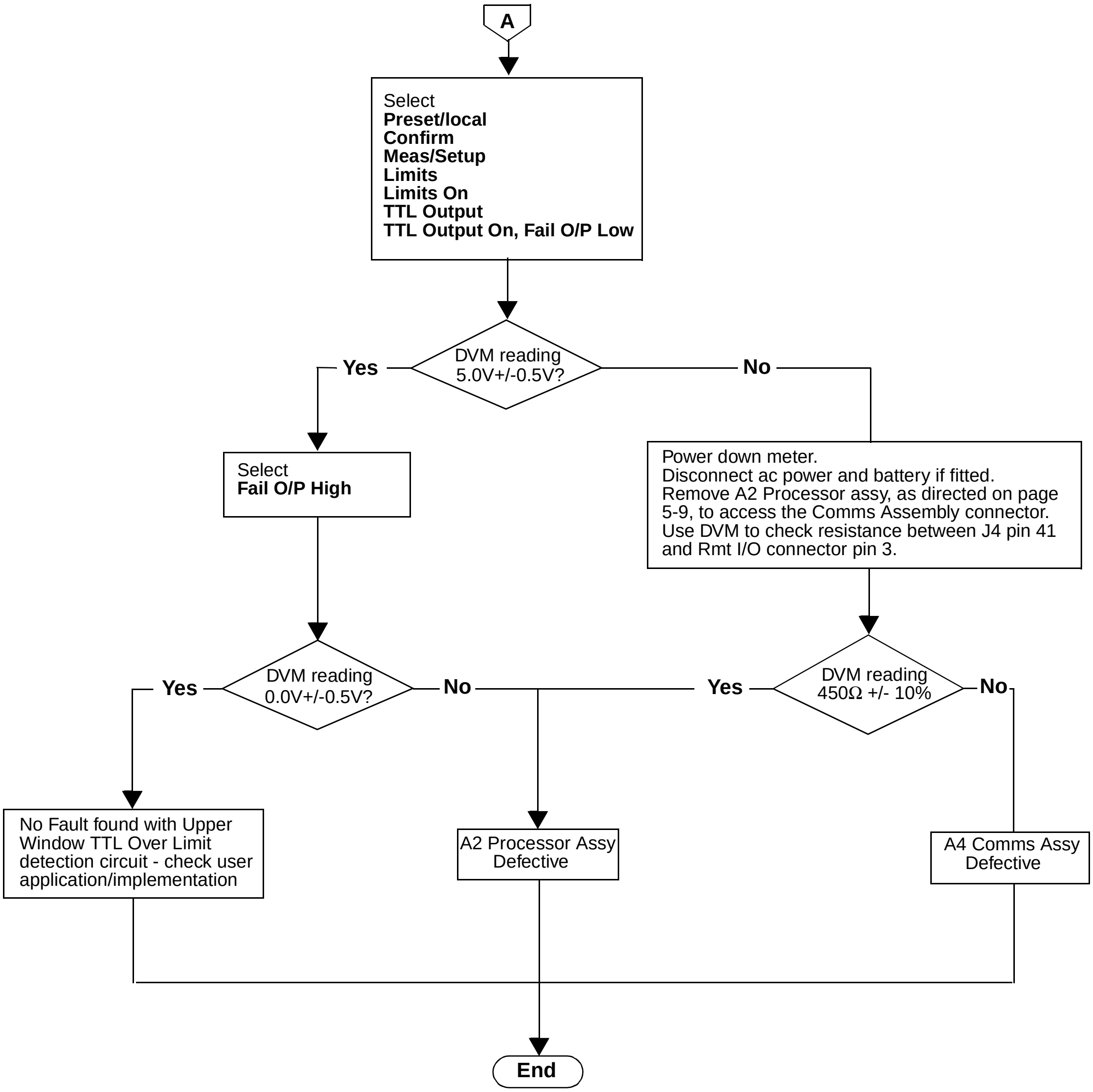
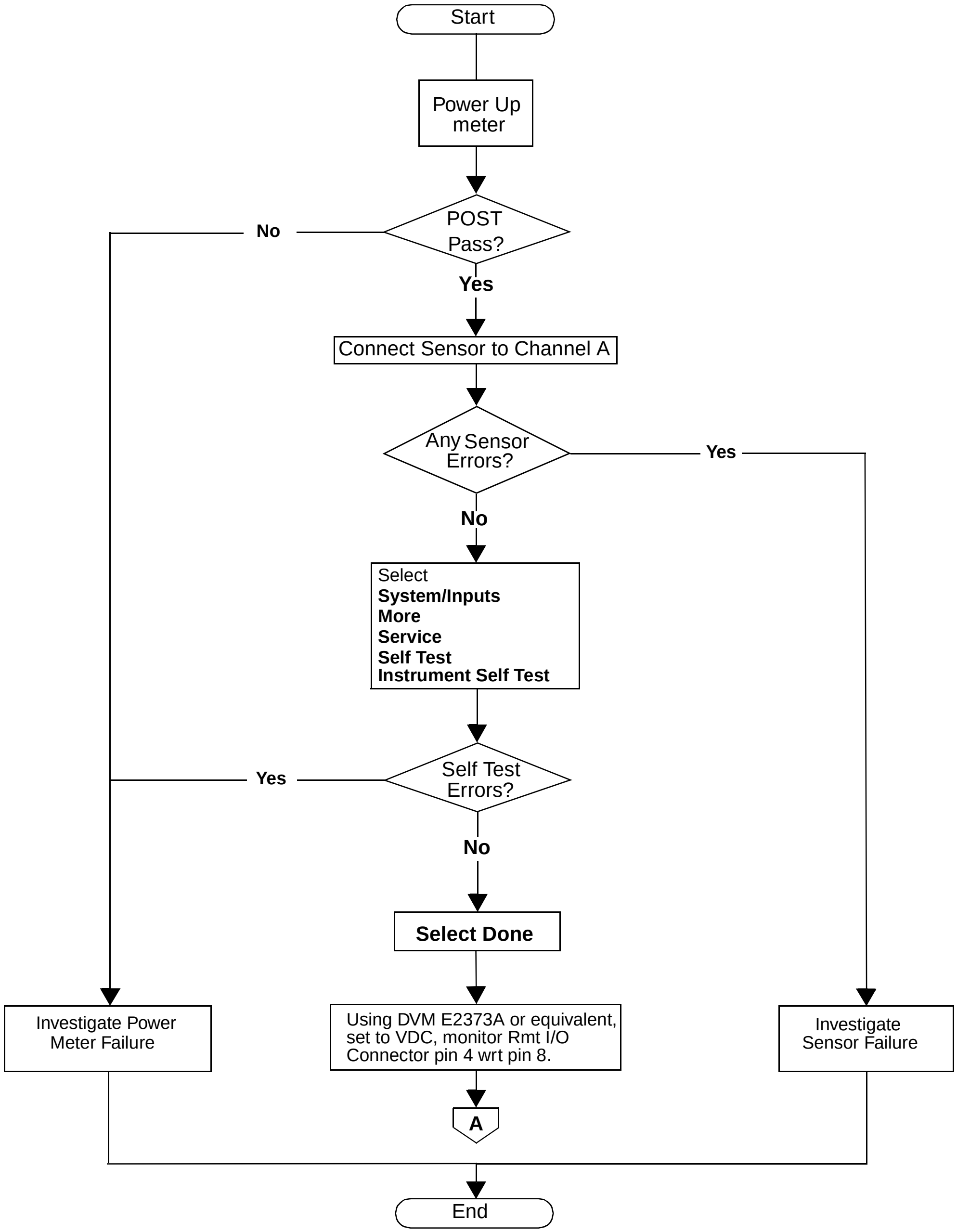

A
Select
Preset/local
Confirm
Meas/Setup
Limits
Limits On
TTL Output
TTL Output On, Fail O/P Low
DVM reading 5.0V+/-0.5V?
Yes
No
Select
Fail O/P High
Power down meter.
Disconnect ac power and battery if fitted.
Remove A2 Processor assy, as directed on page 5-9, to access the Comms Assembly connector.
Use DVM to check resistance between J4 pin 41 and Rmt I/O connector pin 3.
DVM reading 0.0V+/-0.5V?
Yes
No
DVM reading 450Ω +/- 10%
Yes
No
No Fault found with Upper Window TTL Over Limit detection circuit - check user application/implementation
A2 Processor Assy Defective
A4 Comms Assy Defective
End

Figure 6-2: Troubleshooting Guide - Lower Window TTL Output



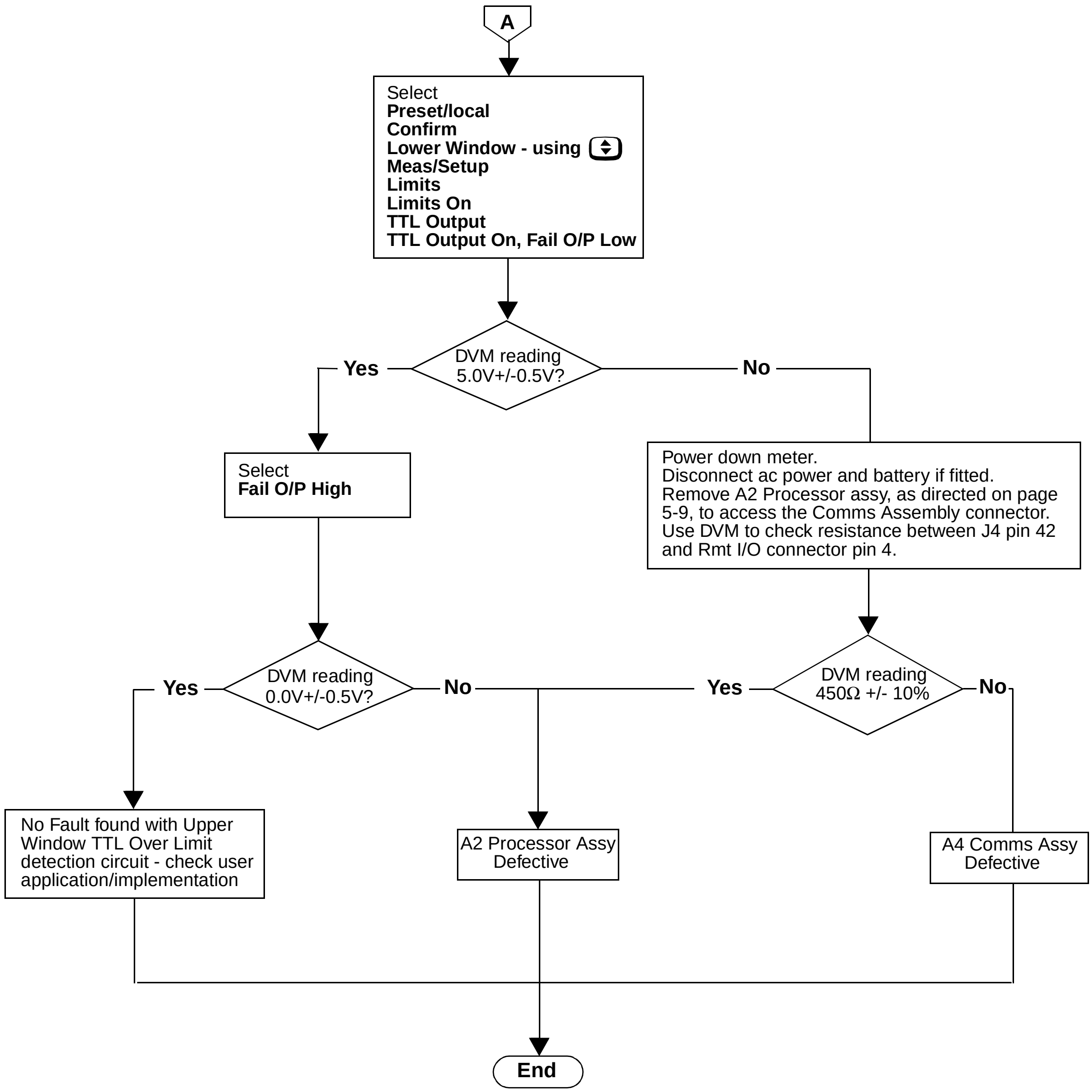
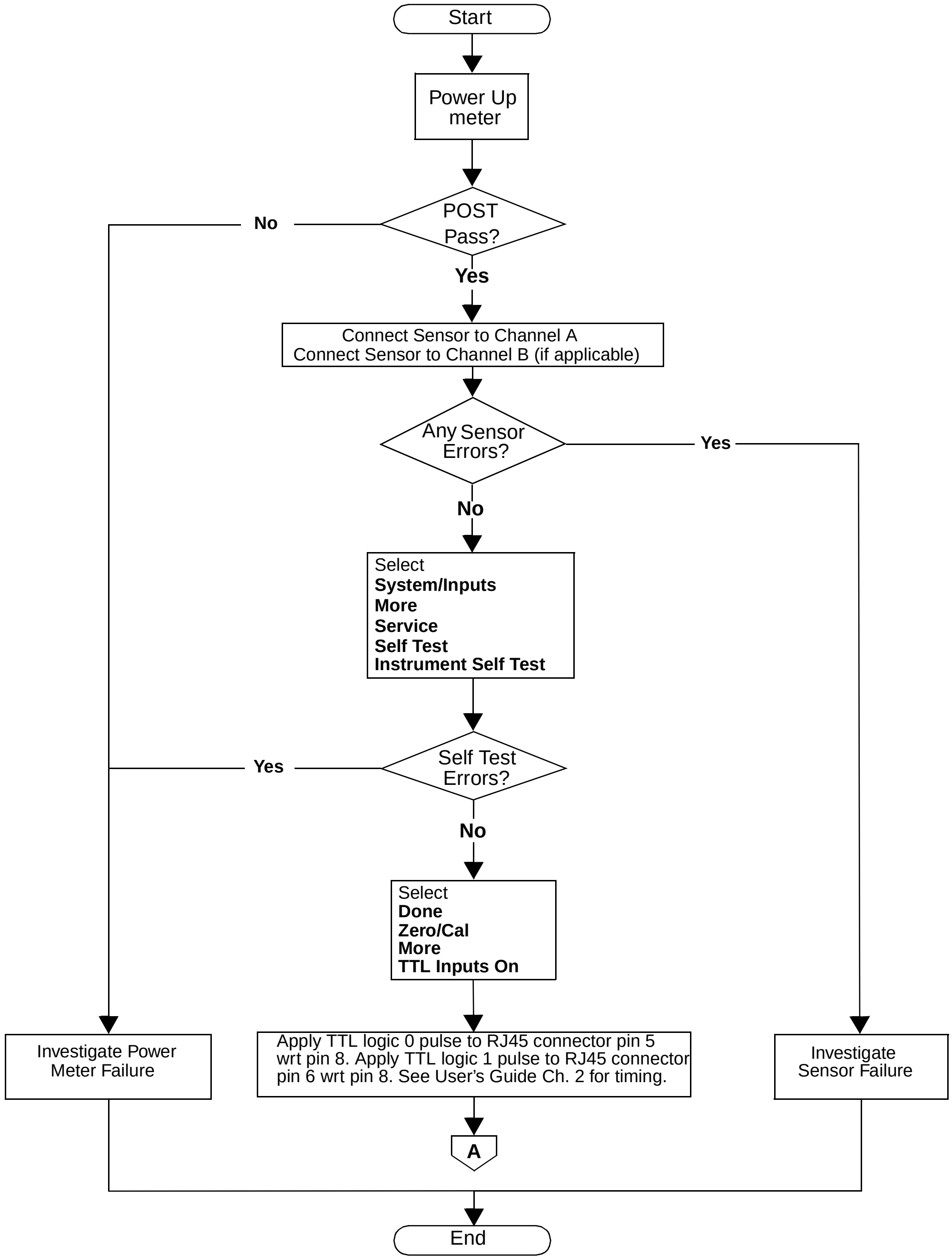
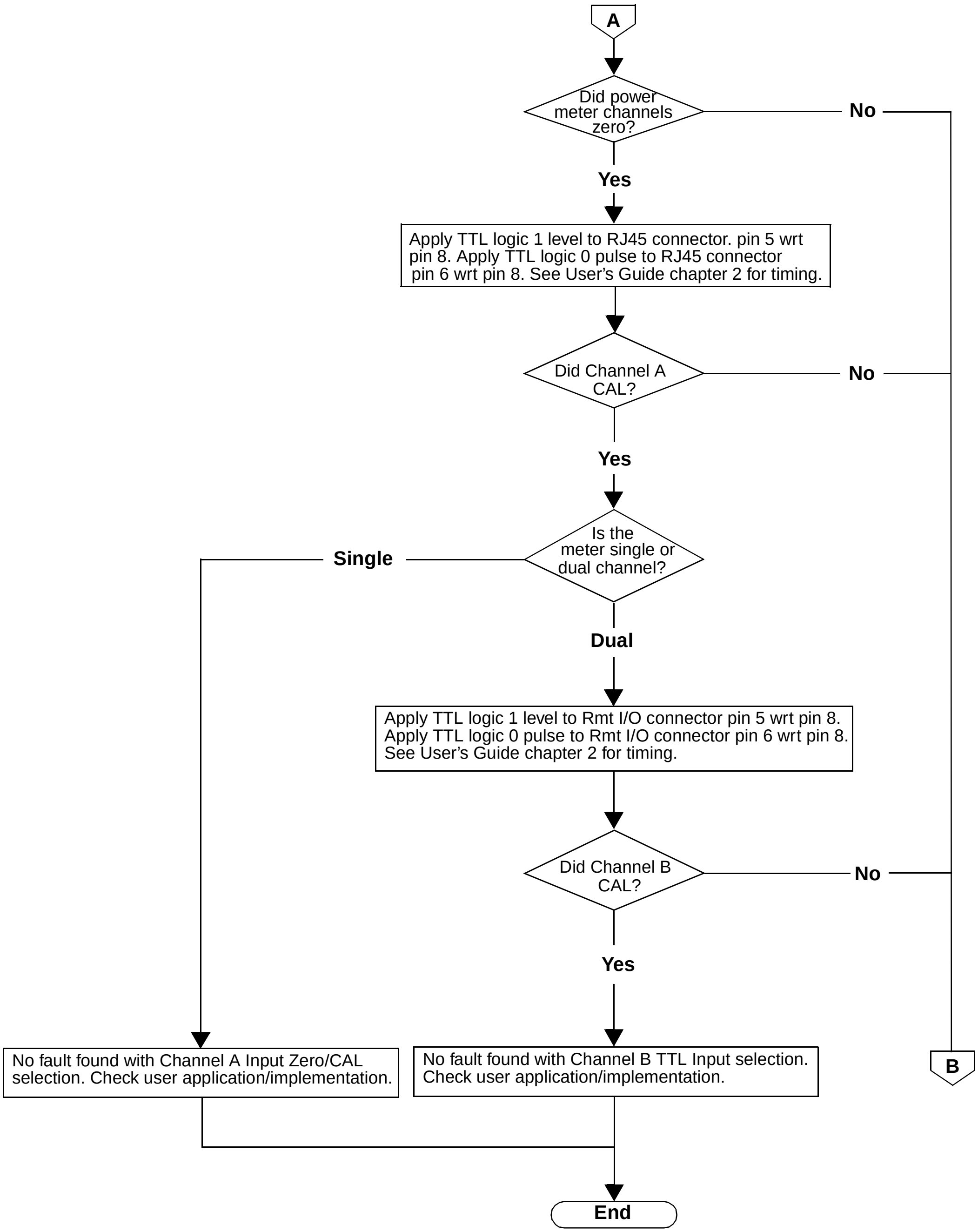

A
Select
Preset/local
Confirm
Lower Window - using
Meas/Setup
Limits
Limits On
TTL Output
TTL Output On, Fail O/P Low
DVM reading 5.0V+/-0.5V?
Yes
No
Select
Fail O/P High
Power down meter.
Disconnect ac power and battery if fitted.
Remove A2 Processor assy, as directed on page 5-9, to access the Comms Assembly connector.
Use DVM to check resistance between J4 pin 42 and Rmt I/O connector pin 4.
DVM reading 0.0V+/-0.5V?
Yes
No
Yes
DVM reading 450Ω +/- 10%
No
No Fault found with Upper Window TTL Over Limit detection circuit - check user application/implementation
A2 Processor Assy Defective
A4 Comms Assy Defective
End

Figure 6-3: Troubleshooting Guide - TTL Inputs




A
Did power meter channels zero?
No
Yes
Apply TTL logic 1 level to RJ45 connector. pin 5 wrt pin 8. Apply TTL logic 0 pulse to RJ45 connector pin 6 wrt pin 8. See User's Guide chapter 2 for timing.
Did Channel A CAL?
No
Yes
Is the meter single or dual channel?
Single
Dual
Apply TTL logic 1 level to Rmt I/O connector pin 5 wrt pin 8. Apply TTL logic 0 pulse to Rmt I/O connector pin 6 wrt pin 8. See User's Guide chapter 2 for timing.
Did Channel B CAL?
No
Yes
No fault found with Channel A Input Zero/CAL selection. Check user application/implementation.
No fault found with Channel B TTL Input selection. Check user application/implementation.
B
End

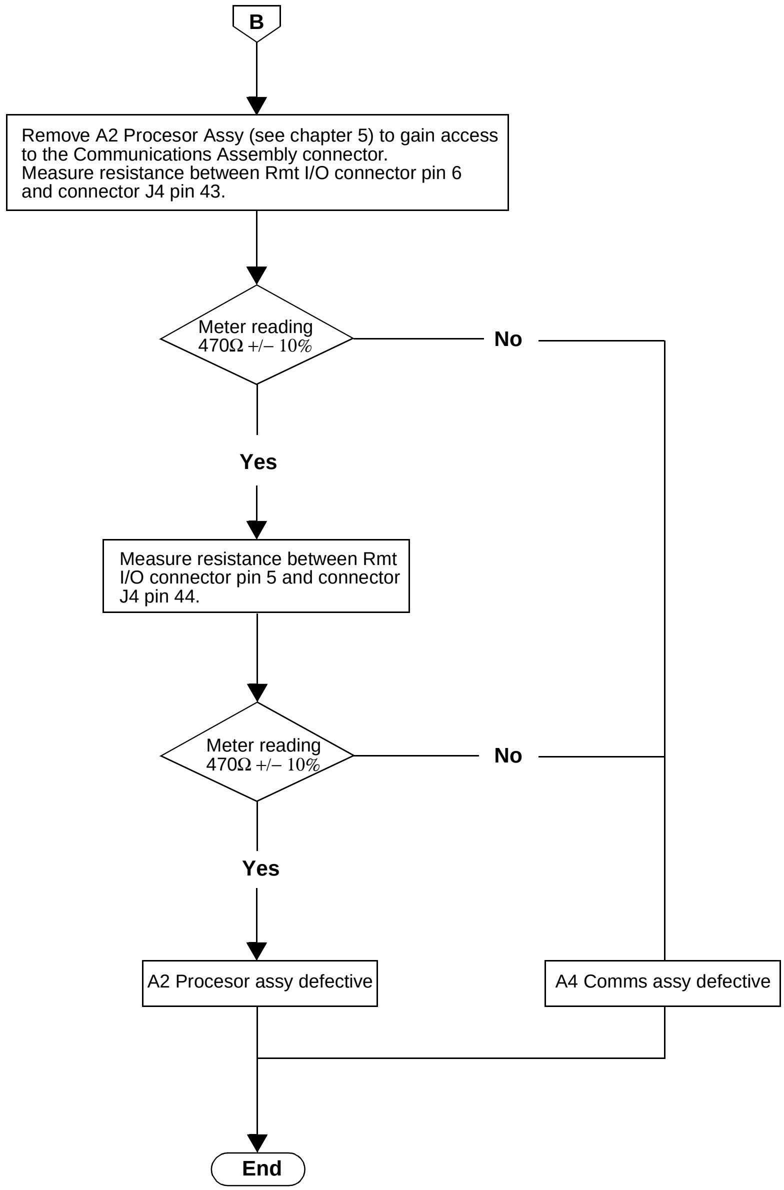
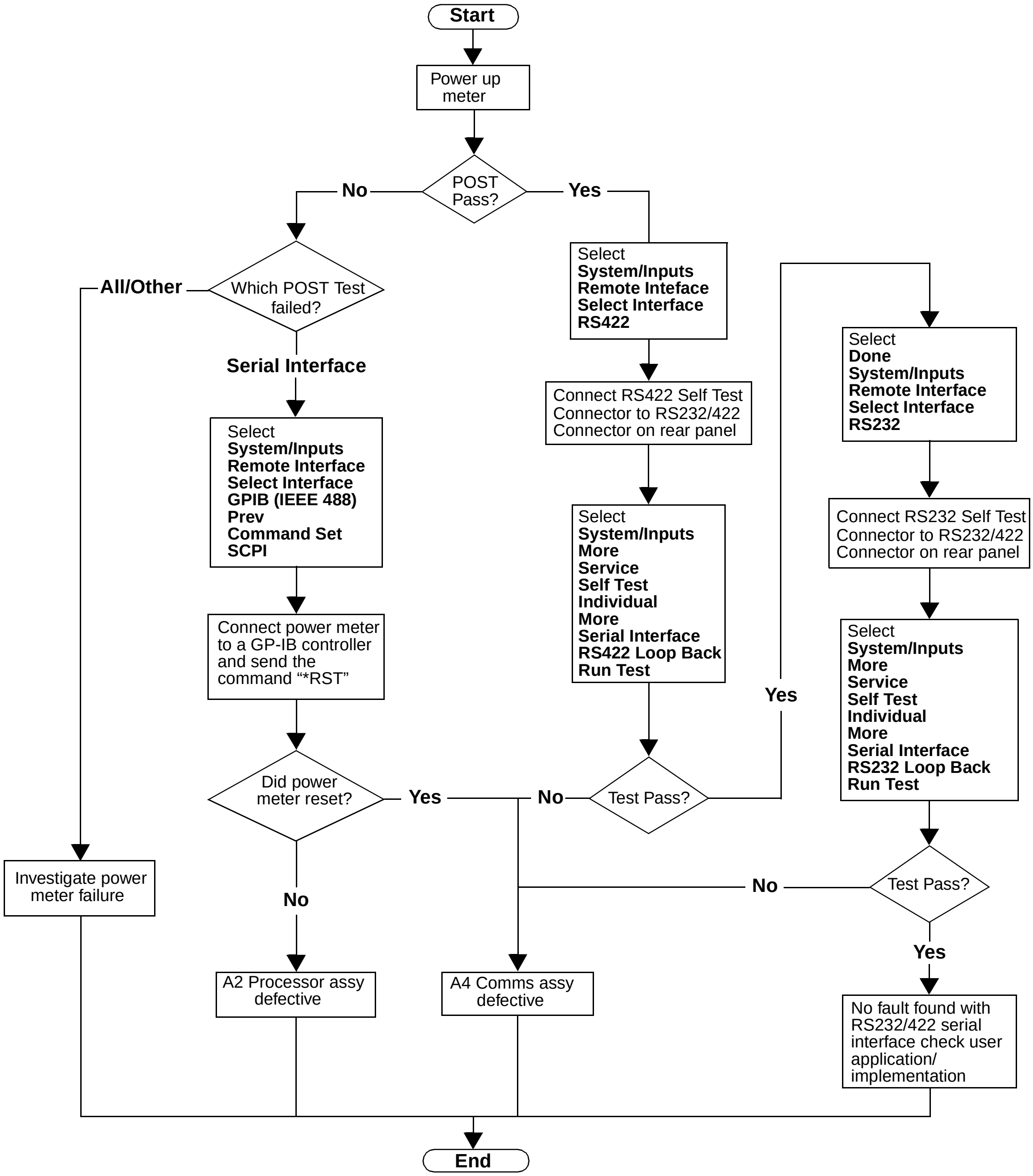

B
Remove A2 Procesor Assy (see chapter 5) to gain access to the Communications Assembly connector.
Measure resistance between Rmt I/O connector pin 6 and connector J4 pin 43.
Meter reading 470Ω +/– 10%
No
Yes
Measure resistance between Rmt I/O connector pin 5 and connector J4 pin 44.
Meter reading 470Ω +/– 10%
No
Yes
A2 Procesor assy defective
A4 Comms assy defective
End

Figure 6-4: Troubleshooting Guide - RS232/422 Interface



Index

S

T

U

V

W

Z