# Keysight N1913/1914A EPM Series Power Meters

KEYSIGHT TECHNOLOGIES

Service Guide

# Notices

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**CAUTION**

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

**WARNING**

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

## Certification

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

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# Equipment Operation

## Warnings and Cautions

This guide uses warnings and cautions to denote hazards.

**WARNING** A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or loss of life. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

**CAUTION** A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

## Personal Safety Considerations

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.

# Safety Considerations

Read the information below before using this instrument.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards for design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

**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.

## Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

| | | | |
|---|---|---|---|
| | Direct current (DC) | | Alternating current (AC) |
| | Off (mains supply) | | On (mains supply) |
| | Caution, risk of electric shock | | Caution, risk of danger (refer to this manual for specific Warning or Caution information) |
| | Earth (ground) terminal | | Frame or chassis (ground) terminal |
| | Protective earth (ground) terminal | | Equipment protected throughout by double insulation or reinforced insulation |
| | Both direct and alternating current | | Out position of a bi-stable push control |
| | Caution, hot surface | | In position of a bi-stable push control |
| | Equipotentiality | 3 | Three-phase alternating current |
| | This symbol indicates the operating switch for 'Stand-by' mode. Note, this instrument is NOT isolated from the mains when the switch is pressed. To isolate the instrument, the mains coupler (mains input cord) should be removed from the power supply. | | This symbol indicates that a device, or part of a device, may be susceptible to electrostatic discharges (ESD) which can result in damage to the product. Observe ESD precautions given on the product, or its user documentation, when handling equipment bearing this mark. |

# Regulatory Information

The N1913/1914A complies with the following safety and Electromagnetic Compatibility (EMC) compliances:

## General

This product complies with the essential requirements of the following applicable European (EC) Directives, and carries the CE marking accordingly to Low Voltage Directive (2006/95/EC) and EMC Directive (2004/108/EC and 89/336/EEC).

## Safety compliance

- IEC 61010-1:2010/EN 61010-1:2010 (3rd Edition)
- Canada: CAN/CSA-C22.2 No. 61010-1-12
- USA: ANSI/UL 61010-1 (3rd Edition)

## EMC compliance

The EMC test conforms to the IEC61326-1:2005/EN61326-1:2006 and CISPR11:2003/EN55011:2007 (Group 1, Class A) standards. In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

- IEC 61326-1:2005/EN 61326-1:2006
- CISPR11:2003/EN 55011:2007, Group 1 Class A
- Canada: ICES/NMB-001:Issue 4, June 2006
- Australia/New Zealand: AS/NZS CISPR 11:2004

## Low voltage directive

- This product conforms to the requirements of European Council Directive “2006/95/EC”.

# Regulatory Markings

| | | | |
|---|---|---|---|
| CE ICES/NMB-001 ISM GRP 1-A | The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.<br>ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.<br>Cet appareil ISM est conforme a la norme NMB-001 du Canada.<br>ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product. | C US | The CSA mark is a registered trademark of the Canadian Standards Association. |
| | This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home. | | The RCM mark is a registered trademark of the Australian Communications and Media Authority. |
| 40 | This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product. | | This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste. |

# Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

## Product category

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

# Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/epm
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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# 1 Specifications and Characteristics

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This chapter describes the specifications and characteristics of your EPM Series Power Meters.

# Introduction

This chapter details the EPM Series Power Meters specifications and supplemental characteristics.

## Specification definitions

There are two types of product specifications:

- Warranted specifications
- Characteristic specifications

### Warranted specifications

Warranted specifications are covered by the product warranty and apply after a 30 minutes 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.

### Characteristic specifications

Supplemental characteristics which are shown in italics are intended to provide information useful in applying the power meter by giving typical, but non-warranted performance parameters. These characteristics are shown in *italics* or denoted as *"typical", "nominal"*, or *"approximate"*.

Characteristic information is representative of the product. In many cases, it may also be supplemental to a warranted specification. Characteristic specifications are not verified on all power meters. The types of characteristic specifications can be placed in two groups:

- The first group of characteristic types describes 'attributes' common to all products of a given model or option.

  Examples of characteristics that describe 'attributes' are product weight, and 50 Ω input N-type connector. In these examples, product weight is an *approximate* value and a 50 Ω input is *nominal*. These two terms are most widely used when describing a product's 'attributes'.
- The second group of characteristic types describes 'statistically' the aggregate performance of the population of products.

These characteristics describe the expected behavior of the population of products. They do not guarantee the performance of any individual product. No measurement uncertainty value is accounted for in the specification. These specifications are referred to as *typical*.

### Conditions

The power meter and power sensor meet its specifications when:

- Stored for a minimum of two hours at a stable temperature within the operating temperature range, and turned on for at least 30 minutes.
- The power meter and power sensor are within their recommended calibration periods.
- Used in accordance to the information provided in the *Keysight N1913/1914A EPM Series Power Meters User's Guide*.

## Recommended Calibration Interval

Keysight Technologies recommends a two-year calibration cycle for the N1913/1914A EPM Series Power Meters.

# Power Meter Specifications

## Frequency Range

9 kHz to 110 GHz, power sensor dependent

## Power Range

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

## Power Sensors Compatibility

- Keysight 8480 Series power sensors
- Keysight E9300 E-Series average power sensors
- Keysight E4410 E-Series average power sensors
- Keysight N8480 Series power sensors
- Keysight U2000 Series average USB power sensors

## Single Sensor Dynamic Range

- 90 dB maximum (Keysight E-Series power sensors)
- 50 dB maximum (Keysight 8480 Series power sensors)
- 55 dB maximum (Keysight N8480 Series power sensors)
- 80 dB maximum (Keysight U2000 Series USB power sensors)

## Display Units

Absolute: Watts (W) 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 or three digits in linear mode

# 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.

## Accuracy

### Instrumentation

Absolute accuracy[1]: ±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 accuracy[1]: ±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 and Table 1-2). For Keysight E-Series power sensors, this specification applies when zeroing is performed with the sensor input disconnected from the POWER REF.

[1] Refer to the power sensor linearity specification in your power sensor manual to assess overall system accuracy.

**Table 1-1** Zero set specifications

| Power sensor | Zero set[a] |
|---|---|
| 8481A[b] | ±50 nW |
| 8481B[b] | ±50 mW |
| 8481D[b] | ±20 pW |
| 8481H[b] | ±5 mW |
| 8482A[b] | ±50 nW |
| 8482B[b] | ±50 mW |
| 8482H[b] | ±5 mW |
| 8483A[b] | ±50 nW |
| 8485A[b] | ±50 nW |
| 8485D[b] | ±20 pW |
| R8486A[b] | ±50 nW |
| R8486D[b] | ±30 pW |
| Q8486A[b] | ±50 nW |
| Q8486D[b] | ±30 pW |
| V8486A[b] | ±200 nW |
| W8486A[b] | ±200 nW |
| 8487A[b] | ±50 nW |
| 8487D[b] | ±20 pW |
| E4412A | ±50 pW |
| E4413A | ±50 pW |
| E9300A | ±500 pW |
| E9301A | ±500 pW |
| E9304A | ±500 pW |

**Table 1-1** Zero set specifications (continued)

| Power sensor | Zero set[a] |
|---|---|
| E9300B | ±500 nW |
| E9301B | ±500 nW |
| E9300H | ±5 nW |
| E9301H | ±5 nW |
| N8481A (exclude Option CFT) | ±25 nW |
| N8482A (exclude Option CFT)[b] | ±25 nW |
| N8485A (exclude Option CFT)[b] | ±25 nW |
| N8486A R (exclude Option CFT)[b] | ±25 nW |
| N8486A Q (exclude Option CFT)[b] | ±25 nW |
| N8487A (exclude Option CFT)[b] | ±25 nW |
| N8488A (exclude Option CFT)[b] | ±25 nW |
| N8481B (exclude Option CFT)[b] | ±25 µW |
| N8482B (exclude Option CFT)[b] | ±25 µW |
| N8481H (exclude Option CFT)[b] | ±2.5 µW |
| N8482H (exclude Option CFT)[b] | ±2.5 µW |
| N8481A with Option CFT[b] | ±63 nW |
| N8482A with Option CFT[b] | ±63 nW |
| N8485A with Option CFT[b] | ±63 nW |
| N8486A R with Option CFT[b] | ±63 nW |
| N8486A Q with Option CFT[b] | ±63 nW |
| N8487A with Option CFT[b] | ±63 nW |
| N8481B with Option CFT[b] | ±63 µW |
| N8482B with Option CFT[b] | ±63 µW |

**Table 1-1** Zero set specifications (continued)

| Power sensor | Zero set[a] |
|---|---|
| N8481H with Option CFT[b] | ±6.3 µW |
| N8482H with Option CFT[b] | ±6.3 µW |

[a] The zero set specifications are tested with Keysight 11730A power sensor cable, 1.5 m (7.5 ft).

[b] The zero set specifications are tested at 50 MHz.

**Table 1-2** Zero set (internal and external) for U2000 Series

| Power sensor | Range | Zero set (internal) | Zero set (external) |
|---|---|---|---|
| U2000/1/2A | –60 dBm to –35 dBm | ±1.5 nW | ±600 pW |
| | –38 dBm to –15 dBm | ±2 nW | ±1.5 nW |
| | –20 dBm to –9 dBm | ±12 nW | ±10 nW |
| | –11 dBm to –5 dBm | ±2 µW | ±500 nW |
| | –7 dBm to 15 dBm | ±4 µW | ±1 µW |
| | 10 dBm to 20 dBm | ±6 µW | ±5 µW |
| U2004A | –60 dBm to –35 dBm | ±2.8 nW | ±600 pW |
| | –38 dBm to –15 dBm | ±3 nW | ±1.5 nW |
| | –20 dBm to –9 dBm | ±12 nW | ±10 nW |
| | –11 dBm to –5 dBm | ±2 µW | ±500 nW |
| | –7 dBm to 15 dBm | ±4 µW | ±1 µW |
| | 10 dBm to 20 dBm | ±6 µW | ±5 µW |
| U2000/1/2H | –50 dBm to –25 dBm | ±15 nW | ±8 nW |
| | –28 dBm to –5 dBm | ±20 nW | ±20 nW |
| | –10 dBm to 1 dBm | ±120 nW | ±100 nW |
| | –1 dBm to 5 dBm | ±20 µW | ±20 µW |
| | 3 dBm to 25 dBm | ±40 µW | ±30 µW |
| | 20 dBm to 30 dBm | ±60 µW | ±60 µW |

**Table 1-2** Zero set (internal and external) for U2000 Series (continued)

| Power sensor | Range | Zero set (internal) | Zero set (external) |
|---|---|---|---|
| U2000/1B | –30 dBm to –5 dBm | ±1.8 µW | ±800 nW |
| | –8 dBm to 15 dBm | ±2 µW | ±2 µW |
| | 10 dBm to 21 dBm | ±12 µW | ±10 µW |
| | 19 dBm to 25 dBm | ±2 mW | ±1 mW |
| | 23 dBm to 44 dBm | ±4 mW | ±2 mW |

**NOTE**

The zero set specifications are only applicable to Keysight U2000 Series USB power sensors with serial prefixes as shown below:

- U2000A serial prefix MY480/SG480 and above
- U2001A serial prefix MY481/SG481 and above
- U2002A serial prefix MY482/SG482 and above
- U2004A serial prefix MY484/SG484 and above

For power sensors with earlier prefixes, refer to the *Keysight U2000 Series USB Power Sensors Operating and Service Guide*.

# Power Meter Supplemental Characteristics

## Zero Drift of Sensors

This parameter is also called long term stability and is the change in the power meter indication over a long time (within one hour) at a constant temperature after a 24-hour warm-up of the power meter.

Power sensor dependent (refer to Table 1-4).

## Measurement Noise

Power sensor dependent (refer to Table 1-3 and Table 1-4).

Averaging effects on measurement noise. Averaging over 1 to 1024 readings is available for reducing noise. Table 1-4 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 a Keysight 8481D power sensor in normal mode with the number of averages set to 4, the measurement noise is equal to:

(<45 pW × 2.75) = <124 pW

**Table 1-3** 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 1-4** Power sensor specifications

| Power sensor | Zero drift[a] | Measurement[b] noise |
|---|---|---|
| Keysight 8481A[d] | <±10 nW | <110 nW |
| Keysight 8481B[d] | <±10 mW | <110 mW |
| Keysight 8481D[d] | <±4 pW | <45 pW |

**Table 1-4** Power sensor specifications (continued)

| Power sensor | Zero drift[a] | Measurement[b] noise |
|---|---|---|
| Keysight 8481H[d] | <±1 mW | <10 mW |
| Keysight 8482A[d] | <±10 nW | <110 nW |
| Keysight 8482B[d] | <±10 mW | <110 mW |
| Keysight 8482H[d] | <±1 mW | <10 mW |
| Keysight 8483A[d] | <±10 nW | <110 nW |
| Keysight 8485A[d] | <±10 nW | <110 nW |
| Keysight 8485D[d] | <±4 pW | <45 pW |
| Keysight R8486A[d] | <±10 nW | <110 nW |
| Keysight R8486D[d] | <±6 pW | <65 pW |
| Keysight Q8486A[d] | <±10 nW | <110 nW |
| Keysight Q8486D[d] | <±6 pW | <65 pW |
| Keysight V8486A[d] | <±40 nW | <450 nW |
| Keysight W8486A[d] | <±40 nW | <450 nW |
| Keysight 8487A[d] | <±10 nW | <110 nW |
| Keysight 8487D[d] | <±4 pW | <45 pW |
| Keysight E4412A | <±15 pW | <70 pW |
| Keysight E4413A | <±15 pW | <70 pW |
| Keysight E9300A[c] | <±150 nW | <700 nW |
| Keysight E9301A[c] | <±150 nW | <700 nW |
| Keysight E9304A[c] | <±150 nW | <700 nW |
| Keysight E9300B[c] | <±150 nW | <700 nW |
| Keysight E9301B[c] | <±150 nW | <700 nW |
| Keysight E9300H[c] | <±1.5 nW | <7 nW |

**Table 1-4** Power sensor specifications (continued)

| Power sensor | Zero drift[a] | Measurement[b] noise |
|---|---|---|
| Keysight E9301H[c] | <±1.5 nW | <7 nW |
| Keysight N8481A (exclude Option CFT)[d] | <±3 nW | <80 nW |
| Keysight N8482A (exclude Option CFT)[d] | <±3 nW | <80 nW |
| Keysight N8485A (exclude Option CFT)[d] | <±3 nW | <80 nW |
| Keysight N8486A R (exclude Option CFT)[d] | <±3 nW | <80 nW |
| Keysight N8486A Q (exclude Option CFT) [d] | <±3 nW | <80 nW |
| Keysight N8487A (exclude Option CFT)[d] | <±3 nW | <80 nW |
| Keysight N8488A (exclude Option CFT)[d] | <±3 nW | <80 nW |
| Keysight N8481B (exclude Option CFT)[d] | <±3 µW | <80 µW |
| Keysight N8482B (exclude Option CFT)[d] | <±3 µW | <80 µW |
| Keysight N8481H (exclude Option CFT)[d] | <±0.3 µW | <8 µW |
| Keysight N8482H (exclude Option CFT)[d] | <±0.3 µW | <8 µW |
| Keysight N8481A with Option CFT[d] | <±7 nW | <114 nW |
| Keysight N8482A with Option CFT[d] | <±7 nW | <114 nW |
| Keysight N8485A with Option CFT[d] | <±7 nW | <114 nW |
| Keysight N8486A R with Option CFT[d] | <±7 nW | <114 nW |
| Keysight N8486A Q with Option CFT[d] | <±7 nW | <114 nW |
| Keysight N8487A with Option CFT[d] | <±7 nW | <114 nW |
| Keysight N8481B with Option CFT[d] | <±7 µW | <114 µW |
| Keysight N8482B with Option CFT[d] | <±7 µW | <114 µW |
| Keysight N8481H with Option CFT[d] | <±0.7 µW | <11.4 µW |
| Keysight N8482H with Option CFT[d] | <±0.7 µW | <11.4 µW |

[a] Within one hour after zero set, at a constant temperature after a 24-hour warm-up of the power meter.

[b] The number of averages at 16 (for normal mode) and 32 (for x2 mode), at a constant temperature, measured over a one minute interval and two standard deviations. For Keysight E-Series power sensors, the measurement noise is measured within the low range. Refer to the relevant power sensor manual for further information.

[c] Specification applies to the low power path, up to 75% relative humidity.

[d] The zero drift and measurement noise specifications are tested at 50 MHz.

**Table 1-5** U2000 Series power sensors specification

| Power sensor | Range | Zero drift[a] | Measurement[b] noise |
|---|---|---|---|
| U2000/1/2A | –60 dBm to –35 dBm | 200 pW | 1 nW |
| | –38 dBm to –15 dBm | 400 pW | 1.5 nW |
| | –20 dBm to –9 dBm | 1.5 nW | 15 nW |
| | –11 dBm to –5 dBm | 50 nW | 650 nW |
| | –7 dBm to 15 dBm | 500 nW | 1 µW |
| | 10 dBm to 20 dBm | 2 µW | 10 µW |
| U2004A | –60 dBm to –35 dBm | 200 pW | 1 nW |
| | –38 dBm to –15 dBm | 400 pW | 1.5 nW |
| | –20 dBm to –9 dBm | 1.5 nW | 15 nW |
| | –11 dBm to –5 dBm | 50 nW | 650 nW |
| | –7 dBm to 15 dBm | 500 nW | 1 µW |
| | 10 dBm to 20 dBm | 2 µW | 10 µW |
| U2000/1/2H | –50 dBm to –25 dBm | 2 nW | 10 nW |
| | –28 dBm to –5 dBm | 4 nW | 15 nW |
| | –10 dBm to 1 dBm | 15 nW | 150 nW |
| | –1 dBm to 5 dBm | 500 nW | 6.5 µW |
| | 3 dBm to 25 dBm | 5 µW | 10 µW |
| | 20 dBm to 30 dBm | 20 µW | 100 µW |

**Table 1-5** U2000 Series power sensors specification (continued)

| Power sensor | Range | Zero drift[a] | Measurement[b] noise |
|---|---|---|---|
| U2000/1B | –30 dBm to –5 dBm | 200 nW | 1 µW |
| | –8 dBm to 15 dBm | 400 nW | 1.5 µW |
| | 10 dBm to 21 dBm | 1.5 µW | 15 µW |
| | 19 dBm to 25 dBm | 50 nW | 650 µW |
| | 23 dBm to 44 dBm | 500 µW | 1 mW |

[a] Within one hour after zero set, at a constant temperature after a 24-hour warm-up of the power meter.

[b] The number of averages at 16 (for normal mode) and 32 (for x2 mode), at a constant temperature, measured over a one minute interval and two standard deviations. For Keysight E-Series power sensors, the measurement noise is measured within the low range. Refer to the relevant power sensor manual for further information.

**NOTE**

The zero drift and measurement noise specifications are only applicable to Keysight U2000 Series USB power sensors with serial prefixes as shown below:

- U2000A serial prefix MY480/SG480 and above
- U2001A serial prefix MY481/SG481 and above
- U2002A serial prefix MY482/SG482 and above
- U2004A serial prefix MY484/SG484 and above

For power sensors with earlier prefixes, refer to the *Keysight U2000 Series Operating and Service Guide*.

# Settling Time

## For Keysight 8480 Series power sensors

0 to 99% settled readings over the GPIB.

Manual filter, 10 dB decreasing power step (refer to Table 1-6).

Auto filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes (refer to Figure 1-1).

**Table 1-6** 8480 Series 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* |
| Settling 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* |

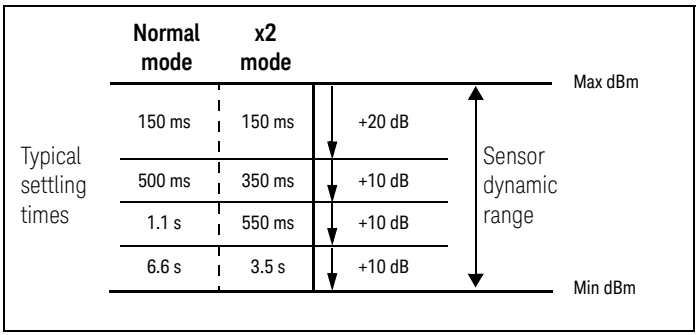


**Figure 1-1** 8480 Series settling time with auto-filter

## For Keysight E-Series power sensors

For E441X Series and E9300 Series power sensors in normal and x2 speed modes, manual filter, 10 dB decreasing power step (refer to Table 1-7).

Auto-filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes (refer to Figure 1-2 for E441X Series sensors and Figure 1-3 for E9300 Series sensors).

**Table 1-7** E441x and E9300 Series settling time[a]

| Number of averages | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Settling time (s) (Normal mode) | *0.08* | *0.13* | *0.24* | *0.45* | *1.1* | *1.9* | *3.5* | *6.7* | *14* | *27* | *57* |
| Settling time (s) (x2 mode) | *0.07* | *0.09* | *0.15* | *0.24* | *0.45* | *1.1* | *1.9* | *3.5* | *6.7* | *14* | *27* |

[a] E-Series power sensors in Fast mode (using free run trigger), within the range –50 dBm to +17 dBm, the settling time is:

N1913A: 10 ms
N1914A: 20 ms

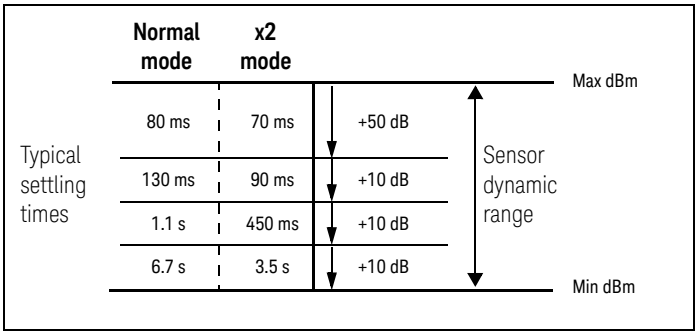


**Figure 1-2** E441x Series settling time with auto-filter

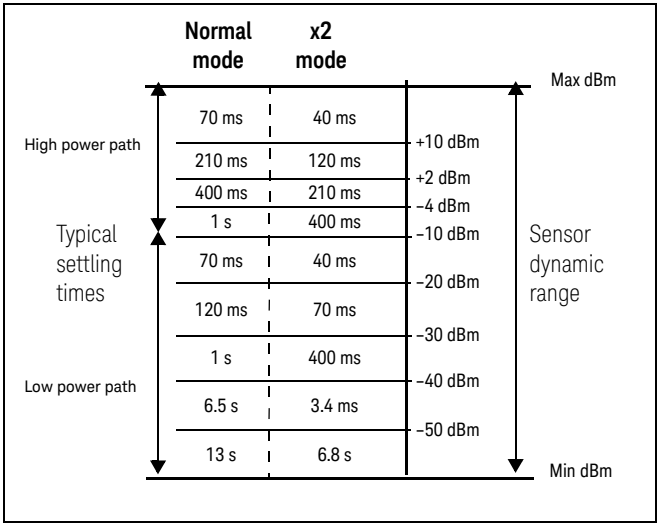


**Figure 1-3** E9300 Series settling time with auto-filter

### For Keysight N8480 Series power sensors

Typical Settling time: 0 to 99% settled readings over the GPIB.

Auto filter, default resolution, 10 dB decreasing power step, normal and x2 speed modes (refer to Figure 1-4). Manual filter, 10 dB decreasing power step (refer to Table 1-8).

**Table 1-8** N8480 Series 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* |
| Settling 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* |

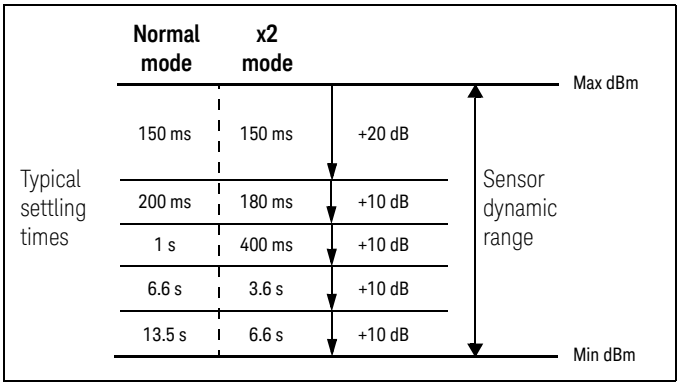


**Figure 1-4** N8480 Series settling time with auto-filter

### For Keysight U2000 Series power sensors

In FAST mode (using Free Run trigger), for a 10 dB decreasing power step, the settling time is *25 ms*[1].

**Table 1-9** U2000 Series settling time

| Number of averages | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Settling time[a] (s) (Normal mode) | *0.045* | *0.09* | *0.17* | *0.34* | *0.66* | *1.3* | *2.6* | *5.2* | *10.4* | *20.9* | *41.9* |
| Settling time[a] (s) (x2 mode) | *0.042* | *0.05* | *0.09* | *0.17* | *0.34* | *0.66* | *1.3* | *2.6* | *5.2* | *10.4* | *20.9* |

[a] Manual filter, 10 dB decreasing power step (not across the switching point)

[1] When a power step crosses the auto-range switch point of the sensor, add 25 ms.

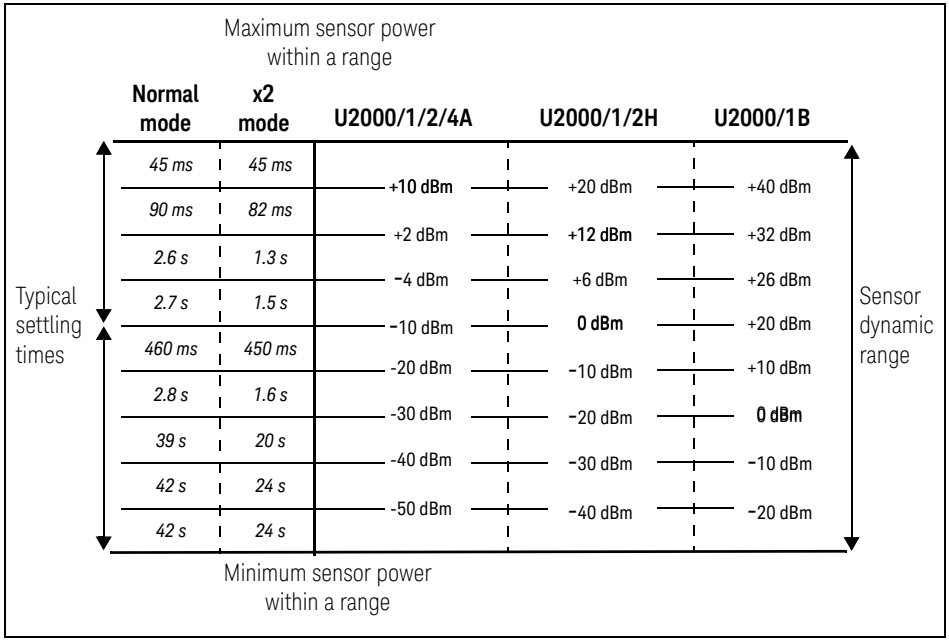


**Figure 1-5** U2000 Series settling time with auto-filter

# Measurement Characteristics

## Measurement speed

Over the GPIB, 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[1]: 400 readings/second, for Keysight E-Series power sensors only

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

[1] For N1914A, if both channels are used in the fast mode, the measurement speed will be reduced to 200 readings/second for each channel.

# Rear Panel Inputs and Output Connections

| | |
|---|---|
| **Recorder output(s)** | Analog 0 to 1 V, 1 kΩ output impedance, BNC connectors |
| **GPIB**<br>**USB 2.0**<br>**10/100Base-T LAN** | Interfaces allow communication with an external controller |
| **Trigger input (optional)** | Input has TTL compatible logic levels and uses a BNC connector |
| **Trigger out (optional)** | Output provides TTL compatible logic levels and uses a BNC connector |
| **Ground** | Binding post, accepts 4 mm plug or bare wire connection |
| **USB host (optional)** | To connect U2000 Series power sensors |
| **VGA out (optional)** | Standard 15-pin VGA connector, allows connection of external VGA monitor |

## Line power

| | |
|---|---|
| **Input voltage range** | 100 – 240 Vac<br>100 – 120 Vac<br>Automatic voltage selection<br>Fluctuations not exceeding ±10% |
| **Input frequency range** | 50 – 60 Hz (100 to 240 Vac)<br>400 Hz (100 to 120 Vac) |
| **Power requirement** | 70 VA (maximum) |

# 1 mW Power Reference

**NOTE** The *1 mW Power Reference* is provided for calibration of the E-Series, 8480 Series, and N8480 Series power sensors.

| | |
|---|---|
| **Power output** | 1.00 mW (0.0 dBm)<br>Factory set to ±0.4% traceable to the National Physical Laboratories (NPL), UK |
| **Accuracy** | ±1.2% (0 – 55 °C)<br>±0.4% (25 ±10 °C) |
| **Frequency** | 50 MHz nominal |
| **SWR** | 1.08 (0 - 55 °C)<br>1.05 (typical) |
| **Connector type** | Type N (f), 50 Ω |

## Battery storage conditions

Storage temperature limits: –20°C to 60°C, ≤ 80% RH

**NOTE** Refer to “Battery Information (Optional)” on page 90 of *Keysight N1913/1914A EPM Series Power Meters User’s Guide* for more details on the battery pack.

# Physical Characteristics

## 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

| | |
|---|---|
| **N1913/1914A weight (net)** | *≤ 3.60 kg (approximately)* |
| **N1913/1914A weight (shipping)** | *≤ 8.20 kg (approximately)* |

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# 2 Performance Tests

Introduction 48
Complete Equipment List 49
1 mW Power Reference Level Test 51
Output Standing Wave Ratio (SWR) Test 53
Zero Set (Average Path) 58
Absolute Accuracy Test (Average Path) 59
Linearity (Average Path) 63

This chapter contains procedures that allows you to test the power meter's electrical performance to its specifications.

# Introduction

The performance tests described in this chapter test the power meter's electrical performance against the specifications detailed in Chapter 1. They are used for incoming inspection, during calibration cycle (also called periodic maintenance), or after repairs have been made.

**NOTE**

- **This document does not provide a complete breakdown for these tests; it only gives a brief overview of each, in line with Keysight's recommendation that the Keysight N7800 Series calibration software should be used at all times.**
- **Performance testing is limited to the measurement and verification of warranted specifications.**
- **Some tests cannot be performed manually, and so the N7800 Series calibration software is essential.**
- **Measurement uncertainty will not be addressed in this document (this is handled by the N7800 Series software).**

The following performance tests are described in this chapter:


- "1 mW Power Reference Level Test" on page 51
- "Output Standing Wave Ratio (SWR) Test" on page 53
- "Zero Set (Average Path)" on page 58
- "Absolute Accuracy Test (Average Path)" on page 59
- "Linearity (Average Path)" on page 63

# Complete Equipment List

| Instrument | Critical specifications | Recommended Keysight model number | Alternative Keysight model number |
|---|---|---|---|
| Meters | | | |
| Power Meter | Dual channel<br>Absolute accuracy: 0.5%<br><br>Power reference accuracy: 0.9% – (a best capability measurement is required for the power reference output – the power level must be accurately measured, and the uncertainty of this measurement must also be known) | E4419B | E4419A |
| Power Sensor | Frequency: 50 MHz<br>Amplitude range: –70 dBm to –20 dBm<br>SWR: 1.15 at 50 MHz | 8481D | |
| Power Sensor | Frequency: 50 MHz<br>Amplitude range: –30 dBm to +20 dBm<br>SWR: 1.1 at 50 MHz | N8482A | 8482A |
| Power Sensor | Frequency: 50 MHz<br>Amplitude range: –70 dBm to +20 dBm<br>SWR: 1.06 maximum | E4412A | |
| Attenuator | | | |
| 20 dB Fixed Attenuator | N-type (m,f) | 8491B (Option 020) | |

| Instrument | Critical specifications | Recommended Keysight model number | Alternative Keysight model number |
|---|---|---|---|
| Miscellaneous | | | |
| Power Splitter | Frequency: DC to 18 GHz insertion<br>Loss: 7 dB<br>Equivalent output SWR: 1.20 DC to 8 GHz | 11667A (Option 001) | |
| Coaxial Termination | DC to 18 GHz | 909A | |
| BNC Cable | Cable Assy-Coaxial RG/223 cable 50-Ohm straight BNC male to straight BNC 24-in LG | 8120-1839 | |
| Calibration Test Cable required for N1913A and N1914A | | 11730A | |
| Sensor Cable | | 85032B | |
| N-Type Calibration Kit | | 85032B | |
| Assorted accessories (cables and adapters) required | | | |

# 1 mW Power Reference Level Test

## Description

The 1 mW power reference is used for the calibration of 8480 Series, N8480 Series and E-Series power sensors, and is traceable to national standards. This test uses an N8482A power sensor to transfer the power measured on an accurately calibrated E4419B or E4417A power meter to the DUT reference.

## Equipment

- Required test equipment:
  - 1 unit of E4419B or E4417A dual channel power meter
  - 1 unit of N8482A power sensor
  - 11730A power sensor cable
- Either of these E4419B or E4417A power meters can be used. This specific power meter model must be used.

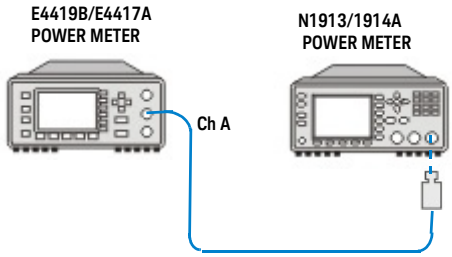


**Figure 2-1** 1 mW power reference level test setup connection diagram

**NOTE** For rear panel options, the connections will differ from the illustration shown here. Refer to the connector identification markings on the rear panel for further details.

## Test method

1. Enter the recorded measurement uncertainty of the E4419B or E4417A 1 mW power reference.
2. Using the E4419B or E4417A power meter and the N8482A sensor, measure the 1 mW power reference of the E4419B or E4417A.
3. Using the E4419B or E4417A power meter and the N8482A sensor, measure the 1 mW power reference of the DUT.
4. Using all of these values, the N7800 Series software will calculate the power reference level of the DUT.

**NOTE**

- The 1 mW reference of the E4419B or E4417A power meter must be precisely calibrated at a standards accredited lab, and the uncertainty of this measurement known.
- Anyone who has a basic understanding of metrology should be able to perform this test manually; it is simply the transfer of known power level with a known calibration uncertainty to the DUT.
- An adjustment is available for this test if it fails (see Chapter 3, "Adjustments").

# Output Standing Wave Ratio (SWR) Test

## Description

Connector mismatch is the largest single contributor to measurement uncertainty, so this specification must be warranted to provide assurance of instrument accuracy. The 1 mW power reference level test must be carried out prior to this test, as the VSWR specification is only valid at 1 mW. This test measures VSWR by equating relative powers (measured by the test system power meter and its sensors) when the power reference is exercised under different load conditions.

## Equipment

- Required test equipment:
  - 1 unit of 8753ES/ET network analyzer
  - 1 unit of 85032B Type N calibration kit
  - 1 unit of E4419B or E4417A dual channel power meter
  - 2 units of 8481D power sensor
  - 2 units of 11667A #001 power splitter
  - 1 unit of 20 dB pad, male to female (e. g. 8491A)
  - 1 unit of 30 dB pad (e. g. 11708A reference attenuator)
  - 2 units of 11730A power sensor cable
- An alternative network analyzer can be used, as long as it can measure S11 in the 45 MHz to 55 MHz range
- These specific models of power sensors and power splitters must be used
- Any type of pad can be used (as long as there are no additional mating connections, or differing pad values)
- 1 unit of 11667A, 1 unit of 8481D, and the 30 dB pad combine to create the ‘Calibration System’
- 1 unit of 11667A, 1 unit of 8481D, and the 20 dB pad combine to create the ‘Measurement System’

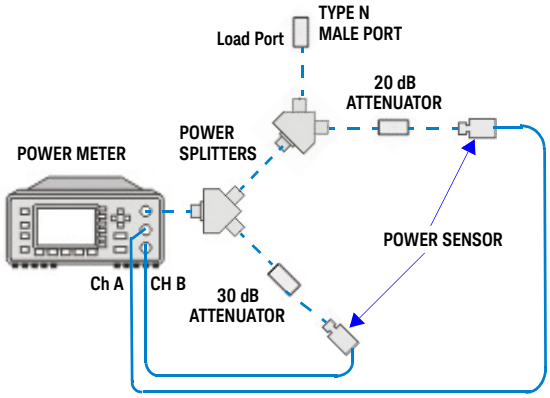


**Figure 2-2** System calibration connection diagram

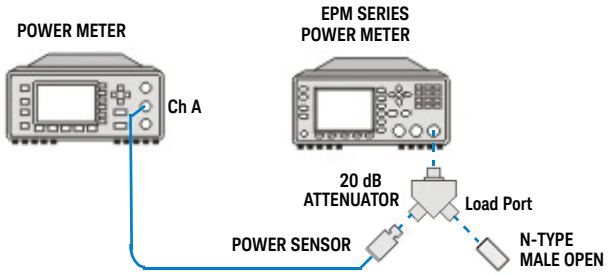


**Figure 2-3** Output SWR test setup-open connection diagram

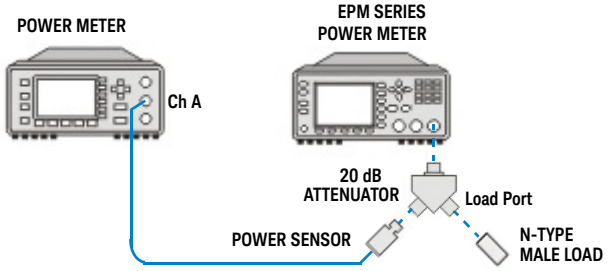


**Figure 2-4** Output SWR test setup-load connection diagram

**NOTE** For rear panel options, the connections will differ from the illustration shown here. Refer to the connector identification markings on the rear panel for further details.

## Test method

1 Obtain the S11 parameter of the calibration system.

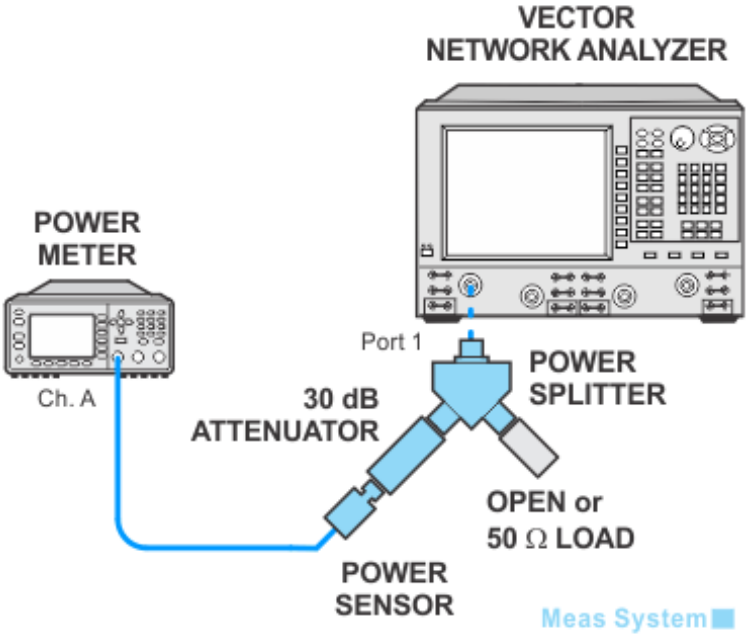


**Figure 2-5** S11 Calibration

**2** Connect the measurement system to the calibration system and obtain its S21 (load) and S21 (open) parameters.

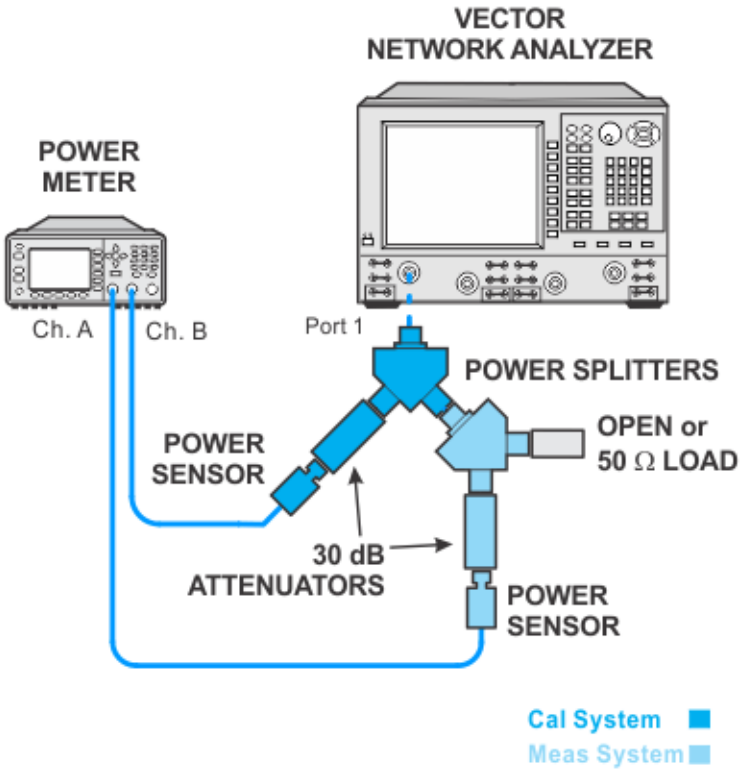


**Figure 2-6** S21 Calibration

**3** Using only the measurement system, terminated with the OPEN connector from the 85032B calibration kit, measure the 1 mW power reference level of the DUT.

**4** Remove the OPEN connector from the measurement system, terminate it with the 50 R load from the 85032B calibration kit, and repeat the 1 mW power reference level measurement.

5 Using all of these values, the N7832A software will calculate the VSWR of the power reference output.

**NOTE**

- This test cannot be performed manually, due to the complexity of the equipment calibration procedure, and the complexity of the measurement algorithm.
- No adjustment is available for this test if it fails (see Chapter 5, "Troubleshooting Guide").

# Zero Set (Average Path)

## Description

Zero set is defined as the amount of residual offset error that is present following a zero operation. This offset error is caused by contamination from several sources, including circuit noise. This test measures the effectiveness of zero set by performing 15 back-to-back zero operations of the average path (with no sensor attached), after which the standard deviation of the results is calculated and returned as the measured value.

## Equipment

No test equipment required

## Test method

1. Execute the internal zero set measurement procedure for channel A.
2. Read back the result of the measurement from the DUT.
3. If the DUT model number is N1914A, then repeat this procedure for channel B.
4. The test will take a few minutes to complete.
5. The measurement result should be less than 0.0000175. The smaller the measurement result, the smaller the amount of residual offset error.

**NOTE**

This test can be performed manually via the commands:

```
SERV:BIST:CW[1|2]:ZSET
SERV:BIST:CW[1|2]:ZSET:NUM?
```

(Refer to the *N1913/1914A EPM Series Power Meters Programming Guide* for further details on the use of these commands)

# Absolute Accuracy Test (Average Path)

## Description

The absolute accuracy test checks the ability of the power meter to accurately measure the power sensor voltage and display the appropriate power level.

## Equipment

- Required test equipment:
  - 1 unit of 3458A digital multimeter
  - 1 unit of 33250A function generator
  - 1 unit of 11683A (Option H01) range calibrator
  - 1 unit of 11730A power sensor cable
  - 2 units of 10503A BNC cable
  - 1 unit of BNC T-joint connector (BNC female, male, female)
  - 1 unit of BNC (female) to dual banana connector

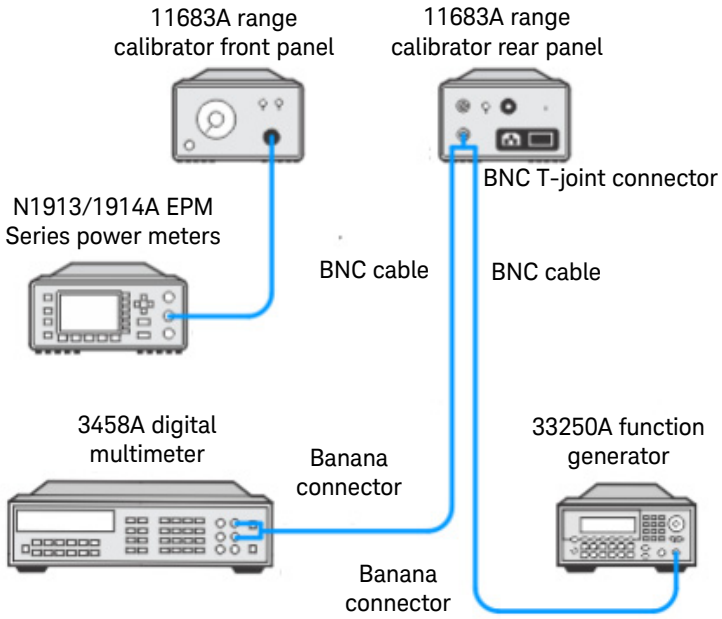


**Figure 2-7** Absolute accuracy test setup

**NOTE** The procedure details the key presses required on the Keysight N1913A EPM Series power meters. For the Keysight N1914A EPM Series power meters, the equivalent key presses should be performed on both channels.

## Test Method

1. Connect the equipment as shown in Figure 2-7.
2. Unplug the power cord from the range calibrator. Eliminate ground loops to enable the 11683A (Option H01) range calibrator to operate properly.

Disconnect the power cord to stop the operation of the range calibrator as the range calibrator will continue to operate with no power applied.

**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 Keysight N1913/1914A EPM Series power meters. This settling would appear on the Keysight N1913/1914A EPM Series power meters display as downward drift. When the drift has reached minimum, (typically less than 60 seconds), the range calibrator is settled.**

**3** Turn on the voltmeter and allow it to warm up for 4 hours.

**4** Turn on the DC source and allow it to warm up. Set the output voltage to 0 V.

**5** Turn on the DUT and allow it to warm up for 30 minutes.

**6** Ensure the range calibrator is not plugged in or powered on.

**7** Connect the range calibrator to the DUT using the power meter interconnect cable.

**8** Connect the DC source to the range calibrator external voltage input and the voltmeter using cables and a BNC T-joint connector at the range calibrator.

**9** Configure the DUT as shown below.

| Parameter | Value |
|---|---|
| Filter/Averaging | On |
| Filter Mode/Measurement Average | Manual |
| Filter Length/Average Number | 16 |
| Resolution | 4 digits |

**NOTE** **All other settings use the default setup settings. The *RST command sets the default setup.**

**10** Configure the voltmeter using the default setup settings.

**11** Perform a power meter zero on the DUT. The voltage of the range calibrator is assumed to be 0 V.

**12** Set the DC voltage to 89.6056 mV as measured by the voltmeter.

**13** Perform a power meter calibration on the DUT.

**14** Measure and record the absolute accuracy of the N1913/1914A in a table as shown below.

| Effective power | DC Voltage | Voltmeter range | Power meter filter / voltmeter NRDNS | CH A % error | CH B % error | Specification |
|---|---|---|---|---|---|---|
| -12 dBm | 0.00565 V | 0.1 V | 256 | | | ±0.5% |
| -5 dBm | 0.02834 V | 0.1 V | 64 | | | ±0.5% |
| 5 dBm | 0.28400 V | 1 V | 64 | | | ±0.5% |
| 8 dBm | 0.56700 V | 1 V | 16 | | | ±0.5% |
| 10 dBm | 0.90100 V | 1 V | 16 | | | ±0.5% |
| 12 dBm | 1.43500 V | 10 V | 16 | | | ±0.5% |
| 14 dBm | 2.29000 V | 10 V | 16 | | | ±0.5% |
| 16 dBm | 3.66700 V | 10 V | 16 | | | ±0.5% |
| 17 dBm | 4.65200 V | 10 V | 16 | | | ±0.5% |
| 18 dBm | 5.91500 V | 10 V | 16 | | | ±0.5% |
| 19 dBm | 7.53000 V | 10 V | 16 | | | ±0.5% |
| 20 dBm | 9.62300 V | 10 V | 16 | | | ±0.5% |

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# Linearity (Average Path)

## Description

Linearity over the full input voltage range of the measurement path is warranted to provide assurance of instrument accuracy. This test measures linearity by using a calibration DAC and a calibration ADC (built into the DUT) to stimulate and compare performance of the average path against the measurement ADC, returning the worst case percentage error.

## Equipment

No test equipment required

## Test method

1. Execute the internal linearity measurement procedure for channel A.
2. Read back the result of the measurement from the DUT.
3. If the DUT model number is N1914A, then repeat this procedure for channel B.
4. The test will take a few minutes to complete.
5. The measurement result should be less than 0.5 and greater than –0.5. The optimum measurement result for this test is 0.

**NOTE**

This test can be performed manually via the commands:

```
SERV:BIST:CW[1|2]:LIN
SERV:BIST:CW[1|2]:LIN:PERR?
```

(Refer to the *N1913/1914A EPM Series Power Meters Programming Guide* for further details on the use of these commands)

# 3 Adjustments

Introduction 66
Power Reference Level Adjustment 67

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

# Introduction

The adjustment attempts to correct the power reference level if the performance test has failed. Power reference level is controlled by the coarse and fine settings of a digital potentiometer. Adjustment of the coarse and fine settings can only be carried out via remote commands. Adjustment can be carried out without having to remove the outer covers from the DUT.

# Power Reference Level Adjustment

## Equipment

As per the test equipment list for the power reference level performance test.

## Test method

1. Set: Coarse = 834, Fine = 550
2. Measure power ref. level as per the performance test:
   - **a** If the result is > 1 mW, then increment COARSE by 1
   - **b** If the result is < 1 mW, then decrement COARSE by 1
3. Repeat step 2 until the result crosses the 1 mW boundary (in either direction)
4. Measure power ref. level as per the performance test:
   - **a** If the result is > 1 mW, then decrement FINE by 1
   - **a** If the result is < 1 mW, then increment FINE by 1
5. Repeat step 4 until the result crosses the 1 mW boundary (in either direction)
6. The adjustment is completed

**NOTE**

- This adjustment can be performed manually via the commands:

  ```
  SERV:CAL:ADJ:COUR <value>
  SERV:CAL:ADJ:COUR?
  SERV:CAL:ADJ:FINE <value>
  SERV:CAL:ADJ:FINE?
  ```

  (Refer to the *Keysight N1913/1914A EPM Series Power Meters Programming Guide* for further details on the use of these commands.)
- COARSE and FINE values are valid in the range of 0 to 1023
- If adjustment is not possible, then a fault may be present in the DUT (see Chapter 5, "Troubleshooting Guide").

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# 4 Theory of Operation

PPMC Assembly 70
Main Board Assembly 71
Calibrator Assembly 72
Front Panel Assembly 73
PSU Assembly 74

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

# PPMC Assembly

## Purpose

- Provides the main processor and memory for the power meter
- Provides external interfaces for LAN and USB
- Stores the power meter firmware in flash EEPROM
- Stores the power meter serial number and option data

## Inputs

- Power supplies [from PSU, via main board]
- Control and data lines [from main board and front panel]
- LAN/USB communications [from external equipment]
- GPIB communications [from external equipment, via main board]

## Outputs

- Control address and datalines [to main board and front panel]

# Main Board Assembly

## Purpose

- Provides the average measurement path(s)
- Provides external trigger input/output and recorder output(s)
- Provides the driver and the LVDS serialiser for the LCD display
- Provides signal routing between the PPMC and front panel

## Inputs

- Power supplies [from PSU]
- Sensed power level(s) [from sensor flex(s)]
- Trigger input [from external equipment]
- Control, address, and data lines [from PPMC]

## Outputs

- Processed average path measurement [to PPMC]
- Trigger output and recorder output(s) [to external equipment]
- LVDS LCD display control lines [to front panel]
- Control and data lines [to PPMC]

# Calibrator Assembly

## Purpose

- Provides a 1 mW (0 dBm) power reference level at 50 MHz

## Inputs

- Power supplies [from PSU, via main board]
- Control, address, and data lines [from PPMC]

## Outputs

- 1 mW (0 dBm) power reference [to external equipment]
- Control and data lines [to PPMC, via main board]

# Front Panel Assembly

## Purpose

- Provides a keypad as the manual user interface
- Provides an LCD display to assist with manual setups and measurements
- Provides mounting for the sensor and power reference connectors (Option 101)

## Inputs

- Power supplies [from PSU, via main board]
- Front panel control interface [from the PPMC LVDS LCD control lines, via main board]
- Front USB port available for Option 008 (this USB port can only be used for U2000 Series power sensors)

**NOTE** **Front USB port is not to be used with USB flash storage devices.**

## Outputs

- Keypress data [to PPMC, via main board]
- Information on the LCD display
- Control and data lines [to PPMC, via main board]

# PSU Assembly

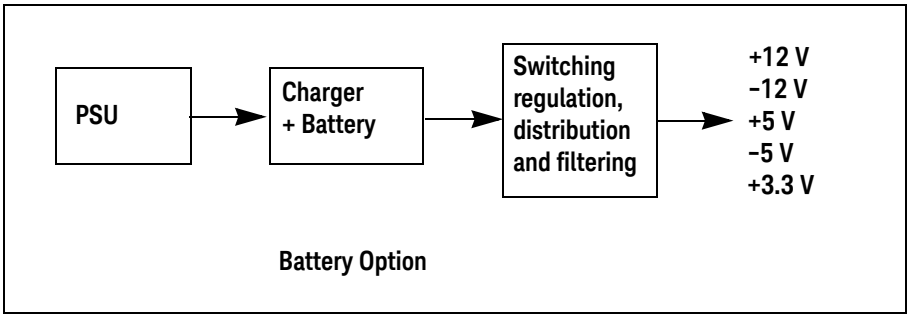
## Purpose

- Provides various DC power supplies

## Inputs

- 100 Vac ~240 Vac, 50 Hz ~60 Hz, 150 VA Max [from an external source]
- Control lines [from front panel, via main board]

## Outputs



# 5 Troubleshooting Guide

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Power-Up Problems 76
Instrument Self-Test 77
Extended Self-Test 78
Performance Test 78
Power Reference Level Adjustment Problems 78
Communication Interface Failures 79
Additional Diagnostic Tests 79

This chapter contains troubleshooting procedures for the EPM Series Power Meters.

# Introduction

This chapter contains general troubleshooting guide to detect failures for the EPM Series Power Meters.

# Power-Up Problems

## Basic external checks

- Check that the mains power source is live
- Check that the mains fuse is operational
- Check the mains cable for any obvious damage
- Check that the line module fuse in the instrument is operational

## Basic internal checks

- Check/reseat the cable between the line module and the PSU
- Check/reseat the cable between the PSU and the main board
- Green LED DS1: If this is off, then the PSU may be faulty
- Green LED DS4: This should come on when the power button is pressed
- Green LEDs DS2/DS3: These will flash on and off during normal operation

## Possible faults

- PSU
- Main board
- Front panel (defective keymat, key flex circuit, or display)
- Loose front panel cable (connection to main board)

# Instrument Self-Test

| Instrument | Purpose | Debug tips | Possible faults |
|---|---|---|---|
| Test point voltages | Checks that all of the supply voltages are present | Replace the PSU to see if this clears the faults | PSU (low probability)<br>Main board (high probability) |
| Calibrator | Verifies that the calibrator is working<br>(Note: This test does not check that the calibrator meets its specifications) | Check/reseat that cable between the calibrator assembly and the main board<br>Attempt to adjust the 1 mW power reference level | Calibrator assembly (high probability)<br>Main board (low probability) |
| Fan | Verifies that the fan is working | Check/reseat the cable between the fan assembly and the main board<br>Check visually if the fan is functioning | Fan assembly (high probability)<br>Main board (low probability) |
| RTC battery | Checks that the lithium manganese battery on the main board is working | Replace the battery to see if this clears the fault | Lithium manganese battery (high probability)<br>Main board (low probability) |
| CW path/ChA CW path | Verifies that the average path of channel A is working<br>(Note: This does not prove that the average path meets its specifications) | Not applicable | Main board |
| ChB CW path | Verifies that the average path of channel B is working<br>(Note: This does not prove that the average path meets its specifications) | Not applicable | Main board |

## Extended Self-Test

| Instrument | Purpose | Debug tips | Possible faults |
|---|---|---|---|
| Keypad | Verifies the operation of every key (apart from the power button) | Not applicable | Front panel (defective keymat or key flex circuit) |
| Bitmap display | Verifies that all pixels in the display can be illuminated in various colors | Not applicable | Front panel (defective display, display interface board, or inverter board) |

## Performance Test

| Type of failures | Debug tips | Possible faults |
|---|---|---|
| 1 mW power reference level failures | Attempt to adjust the 1 mW power reference level | Calibrator assembly (high probability)<br>Main board (low probability) |
| VSWR failures | Not applicable | Calibrator assembly |
| Zero set (average Path) failures | Not applicable | Main board |
| Linearity (average path) failures | Not applicable | Main board |

## Power Reference Level Adjustment Problems

### Possible faults

- Calibrator assembly (high probability)
- Main board (low probability)

## Communication Interface Failures

| Type of communication | Debug tips | Possible faults |
|---|---|---|
| GPIB communication | Check/reseat the ribbon cable connecting the PPMC to the main board | Ribbon cable (low probability)<br>Main board (high probability) |
| LAN/USB communication | Check visually to see whether or not the connector is obstructed/damaged | PPMC assembly |

## Additional Diagnostic Tests

| Type of functionality | Reason | Recommended test method | Possible faults |
|---|---|---|---|
| USB/LAN functionality | The N7800 Series software only tests functionality over GPIB | Check the DUT responds when `*RST` is sent to it via the USB/LAN interfaces | PPMC assembly |
| Sensor functionality | The N7800 Series software does not prove both paths of the sensor flex assembly | Connect an E4412A sensor to the DUT and ensure it can be zeroed/calibrated | Sensor flex assembly |

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# 6 Repair Guide

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Disassembly vs Part Replacement 119
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Front Panel Reassembly Instructions 126
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Main Board vs. Rear Panel Assembly 131
Replacing the PPMC Assembly 132
Replacing the Calibrator Semi-Rigid/Split Ferrite 133

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

# Introduction

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

**1** Replaceable Parts

**2** Tools Required

**3** Disassembly Instructions

**4** Reassembly Instructions

**5** Disassembly vs Part Replacement

**6** Front Panel Disassembly Instructions

**7** Front Panel Reassembly Instructions

**8** Additional Repair Notes

**9** Replacing the PPMC Assembly

**10** Replacing the Calibrator Semi-Rigid/Split Ferrite

You can order replaceable parts from Keysight by contacting your local Keysight Technologies Sales and Service Office.

You can return your power meter for servicing at a qualified service center. Refer to Chapter 7, "Contacting Keysight Technologies".

# Replaceable Parts

## Front panel assembly

### Main assembly

The standard N1913/1914A power meter has the reference calibrator at the front panel. An option is available to move the reference calibrator to the rear panel.

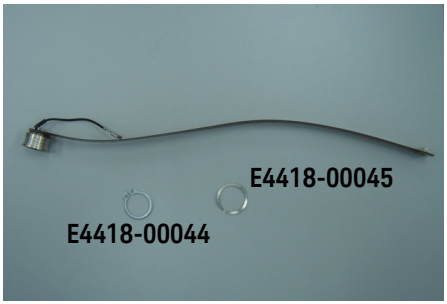
| Keysight part number | Description | Visual |
|---|---|---|
| N1914-60200<br>N1914-60201 | Front panel assembly (front calibrator option)<br><br>Front panel assembly - Front calibrator<br>Front panel assembly - Front calibrator and USB | |
| N1914-60203 | Front panel assembly (rear calibrator option)<br><br>**Note:**<br>– The front panel assembly must be customized to suit the hardware configuration of the unit being repaired<br>– Refurbished front panel assembly are not available<br><br>Front panel assembly - Rear calibrator | |

## Customization details

The standard EPM Series Power Meters has an input sensor connector(s) and a reference calibrator connector on the front panel. Option C03 is available to move the input sensor connector(s) and reference calibrator connector to the rear panel. Below are the customization details on front panel assembly.

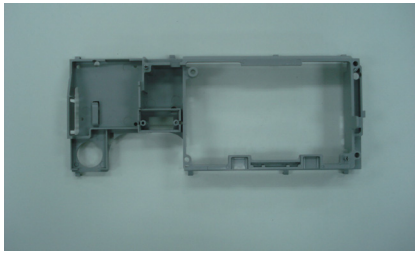
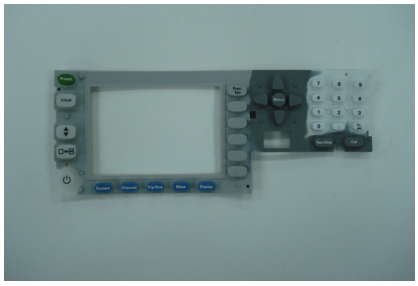
| Connector option | Details | Part number |
|---|---|---|
| N1913A (Front connectors option) | 1 unit of sensor flex assembly | N1913-67300 |
| | 1 unit of calibrator plug | N1912-21003 |
| | 1 unit of PLUG-HOLE TR-HD FOR .688-D-HOLE NYL | 6960-0024 |
| | 1 unit of blank front panel dress label | N1912-00027 |
| | 1 unit of N1913A nameplate | N1913-34300 |
| N1913A (Rear connectors option) | 2 units of PLUG-HOLE TR-HD FOR .688-D-HOLE NYL | 6960-0024 |
| | 1 unit of front panel plug (small) | N1912-21005 |
| | 1 unit of blank front panel dress label | N1914-34302 |
| | 1 unit of N1913A nameplate | N1913-34300 |
| N1914A (Front connectors option) | 2 units of sensor flex assembly | N1913-67300 |
| | 1 unit of calibrator plug | N1912-21003 |
| | 1 unit of blank front panel dress label | N1912-00027 |
| | 1 unit of N1914A nameplate | N1914-34300 |
| N1914A (Rear connectors option) | 2 units of PLUG-HOLE TR-HD FOR .688-D-HOLE NYL | 6960-0024 |
| | 1 unit of front panel plug (small) | N1912-21005 |
| | 1 unit of blank front panel dress label | N1912-00025 |
| | 1 unit of N1914A nameplate | N1914-34300 |

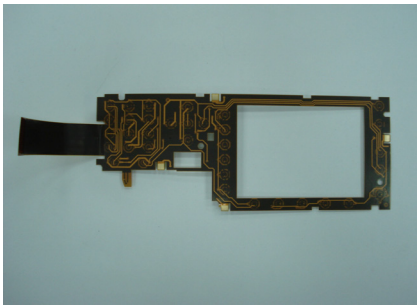
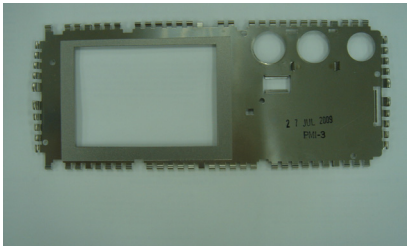
## Customization parts

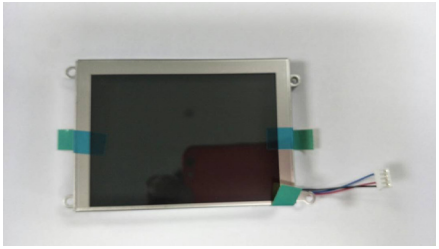
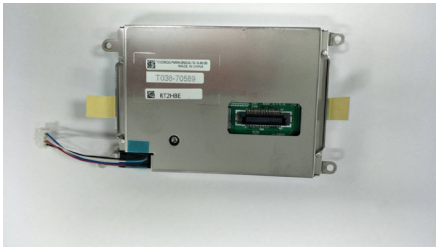
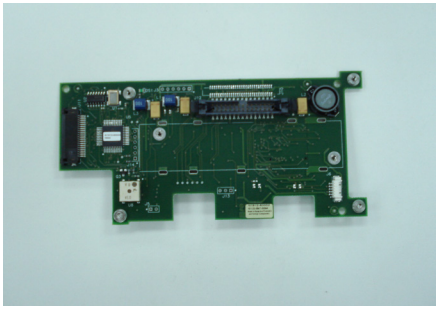
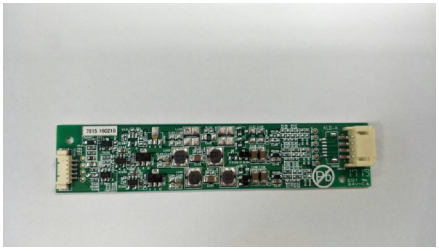
| Keysight part number | Description | Visual |
|---|---|---|
| N1913-67300<br>(Front panel - Long)<br>N1913-67301<br>(Rear panel - short) | Sensor flex assembly<br><br>**Note:**<br>– The same assembly is used for all four sensor positions<br>– The sensor flex assembly is supplied straight, and so it must be folded to match the assembly being replaced (see "Additional Repair Notes" on page 130)<br><br>Power sensor cable assembly - Front<br>Power sensor cable assembly - Rear |  |
| N1912-21003 | Calibrator plug | |
| N1912-21005 | Plug - Front panel small | |

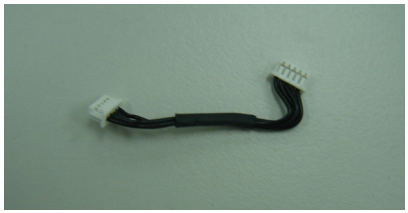
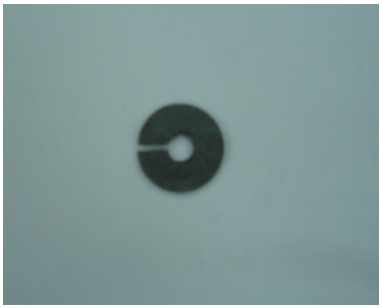
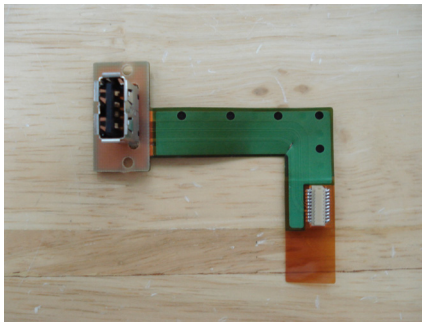
| Keysight part number | Description | Visual |
|---|---|---|
| N1914-34302<br>N1912-00027 | Label dual channel - Rear cal<br>Label - Dual | |
| N1913-34300<br>N1914-34300 | N1913A name plate<br>N1914A name plate | |

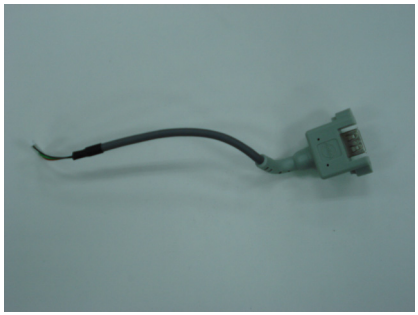
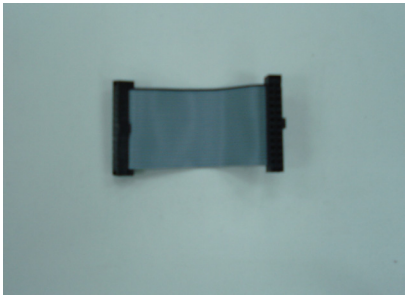
## Replaceable parts

| Keysight part number | Description | Visual |
|---|---|---|
| N1913-40200 | Front panel<br><br>**Note:**<br>This front panel sub-frame is used on all variants of the front panel assembly | |
| N1913-36600 | Display support<br><br>**Note:**<br>This display support molding is used on all variants of the front panel assembly |  |
| N1913-38300 | Keypad<br><br>**Note:**<br>This keypad is used on all variants of the front panel assembly |  |

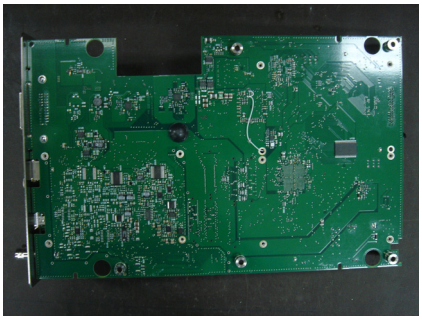
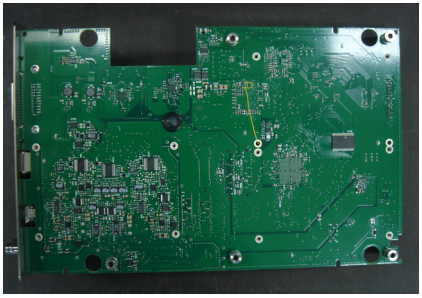
| Keysight part number | Description | Visual |
|---|---|---|
| N1913-66503 | Key flex circuit<br><br>**Note:**<br>This key flex circuit is used on all variants of the front panel assembly |  |
| N1912-20005 | Window EMI shield<br><br>**Note:**<br>This EMI Shielded Window is used on all variants of the Front Panel Assembly | |
| N1913-00600 | EMI screen<br><br>**Note:**<br>This EMI screen is used on all variants of the front panel assembly |  |

| Keysight part number | Description | Visual |
|---|---|---|
| 2090-1101 | Display<br><br>**Note:**<br>This display is used on all variants of the front panel assembly and must be ordered together with the DC to DC converter (0950-5724) | Front view<br>  <br>Rear view<br>  |
| N1912-60002 | Display interface board<br><br>**Note:**<br>This display interface board is used on all variants of the front panel assembly |  |
| 0950-5724 | DC to DC converter<br><br>**Note:**<br>This DC to DC converter is used on all variants of the front panel assembly and must be ordered together with the display (2090-1101) |  |

| Keysight part number | Description | Visual |
|---|---|---|
| N1912-61002 | Cable assembly backlight<br><br>**Note:**<br>This backlight cable is used on all variants of the front panel assembly |  |
| N1912-00038 | EMC split washer |  |
| N1913-68303 | USB assembly - Front<br><br>**Note:**<br>This USB assembly is only available for Option 105, 106, and 167 |  |

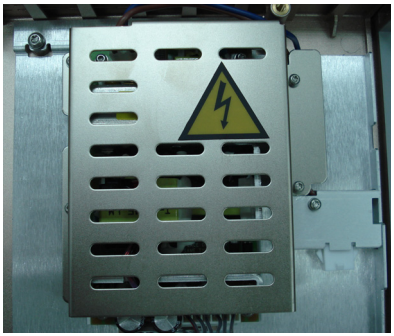
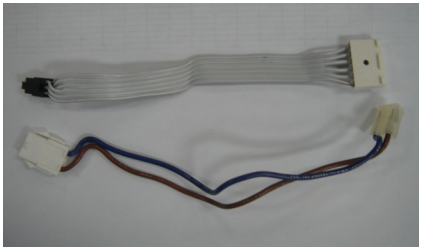
| Keysight part number | Description | Visual |
|---|---|---|
| N1913-68301 (Single)<br>N1913-68302 (Dual) | USB assembly - Single<br>USB assembly - Dual |  |
| 8121-0936 | Flat-Ribbon-Assy- 28-AWG 30-COND 03-IN-LG<br><br>**Note:**<br>This flat ribbon cable is used on all variants of the front panel assembly |  |

## Main board assembly

| Keysight part number | Description | Visual |
|---|---|---|
| N1913-66502 | N1913A mother board [New] |  |
| N1914-66502 | N1914A mother board [New]<br><br>**Note:**<br>– Refurbished main boards are not available<br>– The part number for the Lithium Manganese battery (upper- right of both photographs) is 1420-0394 |  |

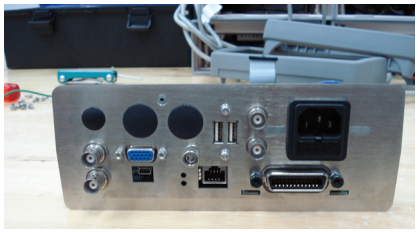
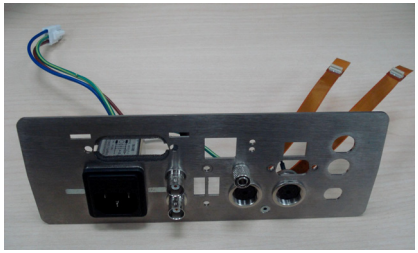
## PPMC (Processor PCI Mezzanine) assembly

| Keysight part number | Description | Visual |
|---|---|---|
| – N1913-66501<br>(Tested single channel processor peripheral component interconnect mezzanine card PCA)<br>– N1914-66501<br>(Tested dual channel processor peripheral component interconnect mezzanine card PCA) | **Note:**<br>– The same assembly is used for both N1913A and N1914A models<br>– N1913-66501 (Tested single channel processor peripheral component interconnect mezzanine card PCA) comes pre-programmed with N1913A firmware<br>– N1914-66501 (Tested dual channel processor peripheral component interconnect mezzanine card PCA) comes pre-programmed with N1914A firmware<br>– Refurbished PPMC Assemblies are not available<br>– The PPMC assembly must be programmed once it has been installed (see"Additional Repair Notes" on page 130)<br>– Ribbon Cable 8121-1076 is supplied separately | <br> |

| Keysight part number | Description | Visual |
|---|---|---|
| | PSU [New] |  |
| N1913-00100 (Non-battery option) | Deck assembly | |
| N1913-00105 (Battery option) | Deck assembly - Battery option | |
| 0950-5015 | Power supply AC-DC Adapter 120-WATT 1-OUTPUT | |
| N1913-34102 | Power supply cover | |
| N1913-37900 | Battery pack | |
| N1913-61301<br>N1913-61604 | Ribbon cable assembly - PSU<br>Cable assembly - PSU |  |

## Rear panel assembly

### Main assembly

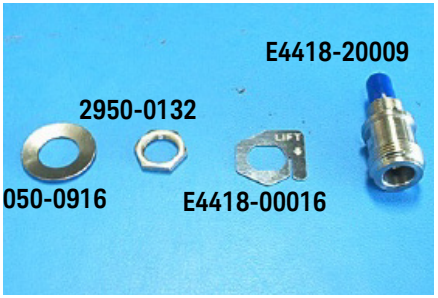
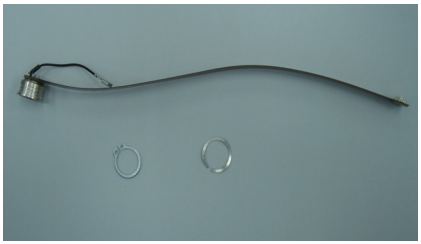
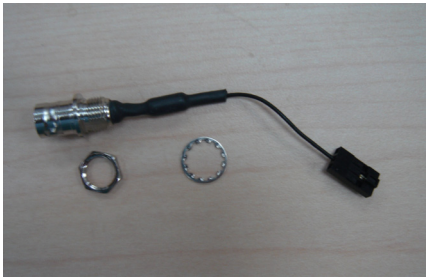
| Keysight part number | Description | Visual |
|---|---|---|
| N1913-00200 | Rear panel assembly [New]<br>Revised rear panel assembly [New]<br><br>**Note:**<br>– The rear panel assembly must be customized to suit the hardware configuration of the unit being repaired<br>– Refurbished rear panel assemblies are not available<br>– The same assemblies are used for both N1913A and N1914A models |  <br>  |

## Customization details

The standard EPM Series Power Meters has an input sensor connector(s) and a reference calibrator connector on the front panel. Option C03 is available to move the input sensor connector(s) and reference calibrator connector to the rear panel. Below are the customization details on the rear panel assembly.

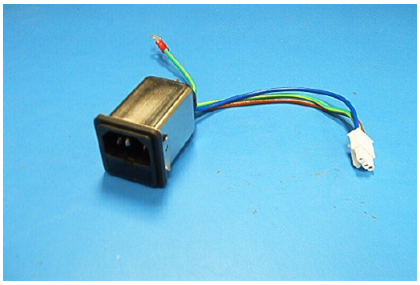
| Connector option | Details | Part number |
|---|---|---|
| N1913A (Front connectors option) | 1 unit of rear panel plug (BNC) | 6960-0081 |
| | 2 units of rear panel plug (Sensor) | 6960-0024 |
| | 1 unit of rear panel plug (Calibrator) | 6960-0178 |
| N1913A (Rear connectors option) | 1 unit of sensor flex assembly | N1913-67300 |
| | 1 unit of N-type connector | E4418-20009 |
| | 1 unit of lock washer | E4418-00016 |
| | 1 unit of Hex nut | 2950-0132 |
| | 1 unit of washer | 3050-0916 |
| | 1 unit of rear panel plug (BNC) | 6960-0081 |
| | 1 unit of rear panel plug (Sensor) | 6960-0024 |
| N1914A (Front connectors option) | 2 units of recorder output cable | E4418-61015 |
| | 2 units of rear panel plug (Sensor) | 6960-0024 |
| | 1 unit of rear panel plug (Calibrator) | 6960-0178 |
| N1914A (Rear connectors option) | 2 units of sensor flex assembly | N1912-61806 |
| | 1 unit of N-type connector | E4418-20009 |
| | 1 unit of lock washer | E4418-00016 |
| | 1 unit of Hex nut | 2950-0132 |

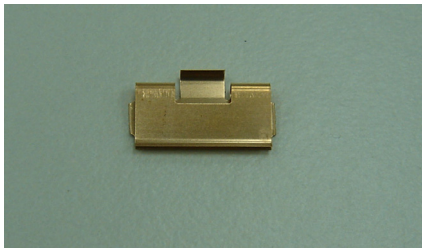
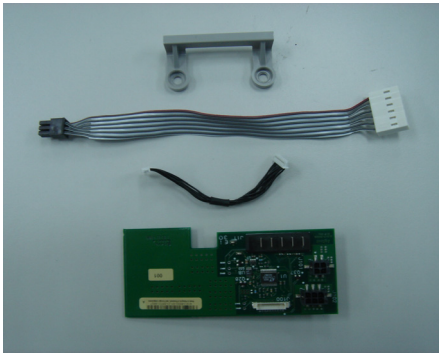
## Customization parts

| Keysight part number | Description | Visual |
|---|---|---|
| E4418-20009<br>E4418-00016<br>2950-0132<br>3050-0916 | N- Type connector<br>Lock washer<br>Hex nut<br>Washer |  |
| N1913-67300<br>N1913-67301 | Sensor flex assembly |  |
| E4418-61015 | Recorder output cable |  |

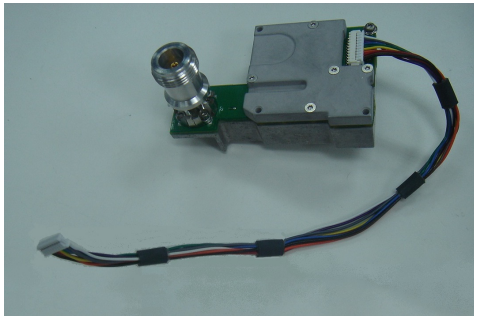
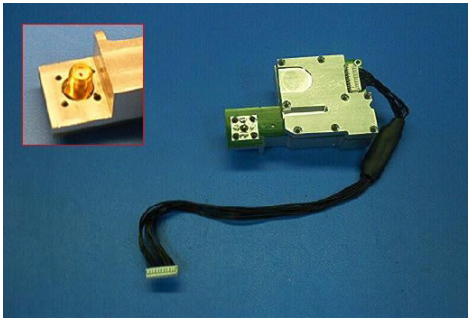
| Keysight part number | Description | Visual |
|---|---|---|
| N1913-67912 | BNC option | |
| 6960-0081<br>6960-0024<br>6960-0178<br>N1913-36200<br>N1913-36201<br>N1913-36202 | BNC plug (rear panel)<br>Sensor plug (front and rear panels)<br>Calibrator plug (rear panel)<br>USB plug (front panel)<br>USB plug (rear panel)<br>VGA plug (rear panel) | |

## Additional spare parts

| Keysight part number | Description | Visual |
|---|---|---|
| N1913-62700 | Line module assembly |  |
| N1913-67910 | VGA option | |

| Keysight part number | Description | Visual |
|---|---|---|
| N1912-00016 | Spring contact - Perpendicular |  |
| N1913-61601<br>N1913-61600<br>N1913-60002 | Wire hardness assembly - 10 to10 Pins<br>Ribbon cable assembly - 6 to 4 Pins<br>PCA - Battery charger |  |

## Calibrator assembly

| Keysight part number | Description | Visual |
|---|---|---|
| N1913-62000 | Calibrator assembly - Front<br>(Front connectors option)<br>For more information on the improved calibrator assembly, refer to "Improved calibrator assembly" on page 102. |  |
| N1911-61002 | Calibrator assembly (Rear connectors option)<br><br>**Note:**<br>Semi-rigid cable N1912-61004 is not included with assembly N1911-61002; if this is required, it is available as a separate item |  |

## Improved calibrator assembly

The N1913/1914A calibrator assembly is improved with a new type-N calibrator connector for a better fit with the front panel assembly as shown in Figure 6-1. The calibrator plug (N1912-21003) will not be needed with the improved calibrator assembly.

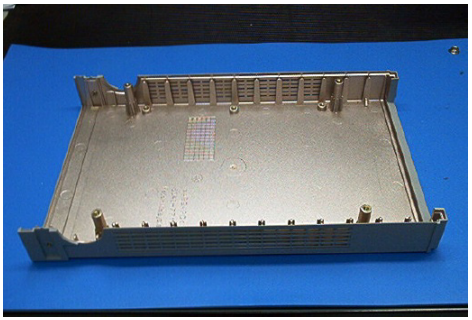
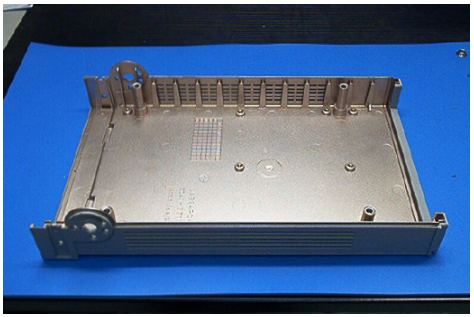
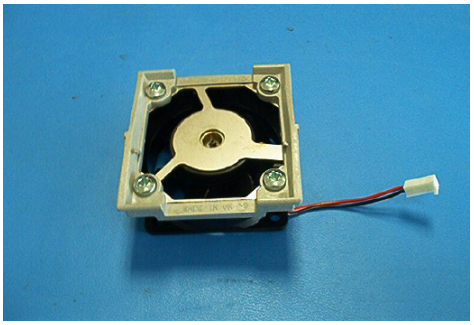
**NOTE** **The N1913/1914A performance will not be affected with the improved calibrator assembly.**

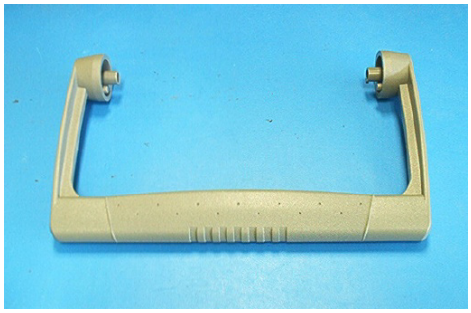
**Calibrator assembly**

**Improved calibrator assembly**

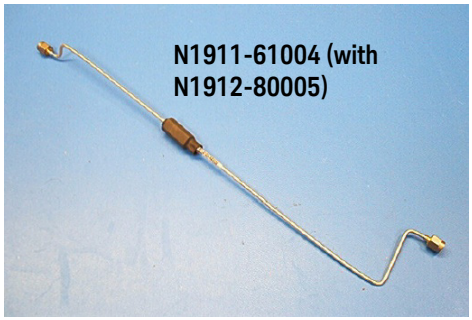
**Figure 6-1** Calibrator assembly and improved calibrator assembly

## Outer housing components

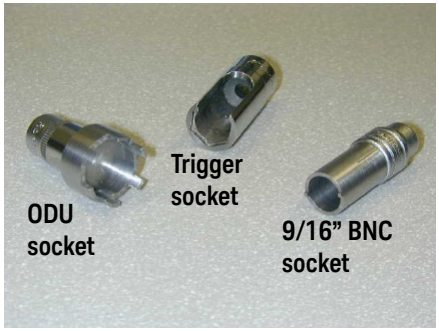
| Keysight part number | Description | Visual |
|---|---|---|
| N1913-30100<br>N1913-30101 | Top clamshell - Non battery option<br>Top clamshell - Battery option |  |
| 5041-7718 | Clamshell (Bottom) |  |
| N1912-61005 | Fan assembly |  |

| Keysight part number | Description | Visual |
|---|---|---|
| 34401-86020 | Bumper kit | |
| 34401-45021 | Handle |  |

## Sundries

| Keysight part number | Description | Visual |
|---|---|---|
| N1911-61004<br>N1912-80005<br>0890-2337 | – Cable assembly S-R-Rear option<br>– Split ferrite<br>– Tubing heat-shrink 9.5 mm EXP ID 4.80 mm RCVD ID 0.56 mm WTHKNS<br><br>**Note:**<br>If the semi-rigid cable is replaced, then the split ferrite must be positioned correctly (see"Additional Repair Notes" on page 130)<br><br>Tubing-HS 9.5 MM EXP ID 4.80 MM RCVD ID 0.56 MM WTHKNS<br>Split ferrite<br>Cable assembly S-R-Rear option |  |
| 2110-1334 | Line module fuse, 2.5 A/250 V (time-lag) | |

# Tools Required

| Keysight part number | Description | Visual |
|---|---|---|
| N1911-61004<br>N1912-80005 | – 3 units of ¼” drive torque wrenches<br>  – 1 unit calibrated to 2.37 Nm (21 lb-in)<br>  – 1 unit calibrated to 1.02 Nm (9 lb-in)<br>  – 1 unit calibrated to 0.68 Nm (6 lb-in) | |
| | – 3 units of torque screwdrivers<br>  – 1 unit calibrated to 2.37 Nm (21 lb-in)<br>  – 1 unit calibrated to 0.56 Nm (5 lb-in)<br>  – 1 unit calibrated to 0.34 Nm (3 lb-in) | |
| | – T6, T8, T10, and T20 Torx screwdriver bits | |
| | – 7/16” break spanner, calibrated to 2.37 Nm (21 lb- in) | |
| | – 5/16” break spanner, calibrated to 1.02 Nm (9 lb- in) | |
| | – 9/32” socket | |
| N1912-61807 | Special tooling kit<br>– Contains:<br>  – ODU socket<br>  – Trigger socket<br>  – 9/16” BNC socket<br>– Sockets must be used in conjunction with a ¼” drive torque wrench, calibrated to 2.37 Nm (21 lb-in)<br>– The 9/16” BNC socket is required to remove the Trig In/Out fasteners for the majority of N1913/1914A power meters<br>– The trigger socket is required to remove the Trig In/Out fasteners for a minority of N1913/1914A power meters |  |

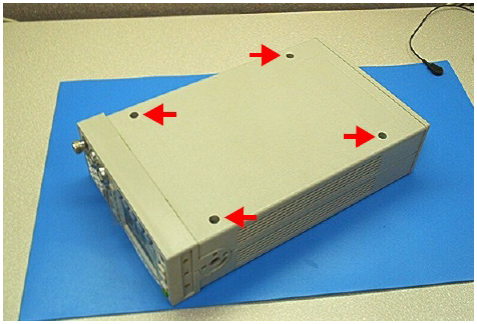
# Required Torque Values for Fasteners

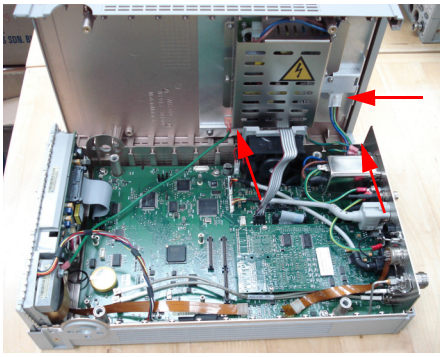
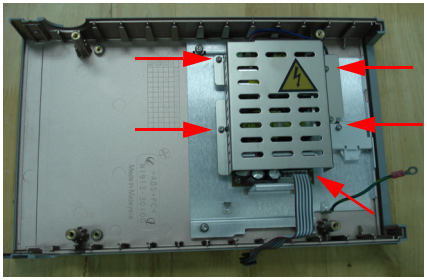
Required tools and torque values for fasteners are listed below:

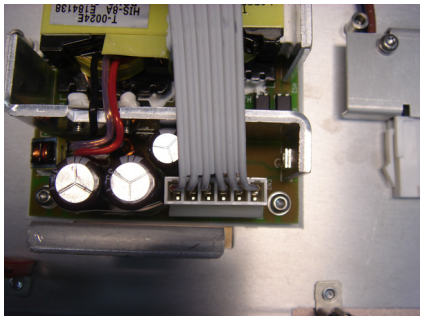
| Item | Description/Default | Range of values |
|---|---|---|
| Fit rear panel GPIB standoffs | 9/32” socket | 2.37 Nm |
| Fit rear panel Trig In/Out connectors | Special tooling kit (N1912-61807) | 2.37 Nm |
| Fit rear panel recorder output connectors | 7/16” spanner | 2.37 Nm |
| Attach main board to clamshell | T20 screwdriver | 2.37 Nm |
| Attach PPMC assemblies to main board | T8 screwdriver | 0.56 Nm |
| Fit calibrator semi-rigid, both ends (Option 003) | 5/16” spanner | 1.02 Nm |
| Attach earth wires (nut) | 9/32” socket | 1.02 Nm |
| Attach earth wires (screw) | T20 screwdriver | 2.37 Nm |
| Attach top clamshell to bottom clamshell | T20 screwdriver | 2.37 Nm |
| Fit sensor connector | Circlip pliers | |
| Fit PSU/PSU safety cover | T10 screwdriver | 2.37 Nm |
| Fit display to display support molding | T6 screwdriver | 0.56 Nm |
| Fit calibrator to display support molding | T6 screwdriver | 0.34 Nm |
| Fit display interface board to inverter board | T6 screwdriver | 0.56 Nm |

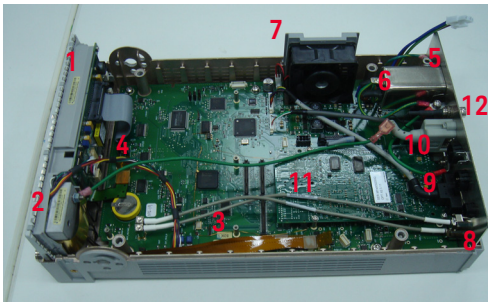
# Disassembly Instructions

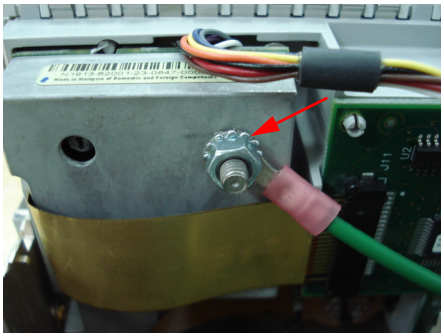
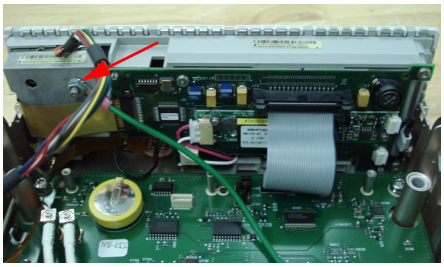
The guidelines in this section describe the disassembly of the major assembling in the Keysight N1913A and N1914A power meters.

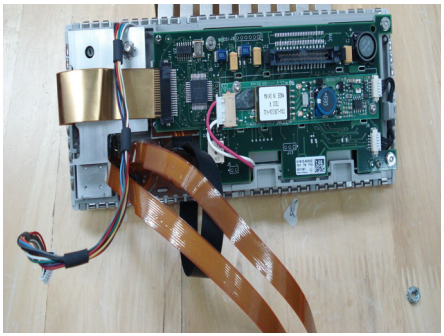
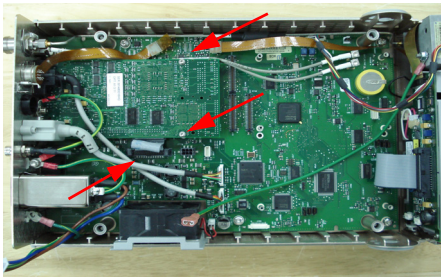
| Instructions | Visual |
|---|---|
| This procedure focuses primarily on model N1913A and N1914A (i. e. dual channel, with front panel sensor and power reference connectors) | **N1913A** **N1914A** |
| – Remove the handle. Rotate it to the vertical position. Pull both sides outwards from the body of the unit.<br>– Remove the front/rear bumpers: Pull one side of the bumper outwards to disengage it. Pull it away from the unit.<br>– Separate the clamshells (Figure 6-2): Use the T20 Torx screwdriver bit to loosen the four captive screws. |  **Figure 6-2** Separate the clamshells |

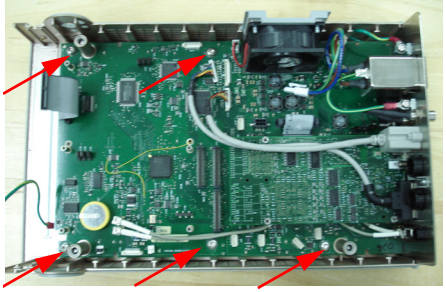
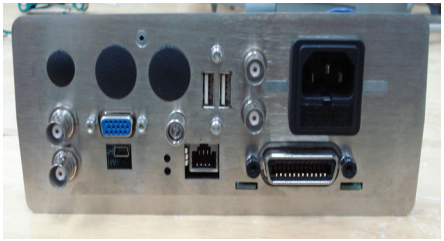
| Instructions | Visual |
|---|---|
| Remove the top clamshell (Figure 6-3). Disconnect the mains power connector from the top clamshell. Disconnect the ribbon cable from the main board. Disconnect both earth spade connectors from the top clamshell. Remove top clamshell. |  **Figure 6-3** Remove the top clamshell |
| – Remove the PSU safety cover (Figure 6-4). Use the T10 Torx screwdriver bit to remove the four screws attaching the PSU safety cover to the top clamshell. Lift and remove the safety cover.<br>– Remove the PSU cable guide (Figure 6-4). Use the T10 Torx screwdriver bit to remove the screw attaching the cable guide to the top clamshell. Lift and remove cable guide. |  **Figure 6-4** Remove the PSU safety cover and cable guide |

| Instructions | Visual |
|---|---|
| Remove the PSU (Figure 6-5). Use the T10 Torx screwdriver bit to remove the six screws attaching the PSU to the top clamshell. Lift and remove the PSU. |  **Figure 6-5** Remove the PSU |

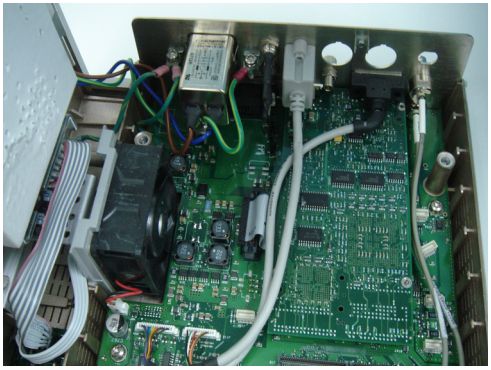
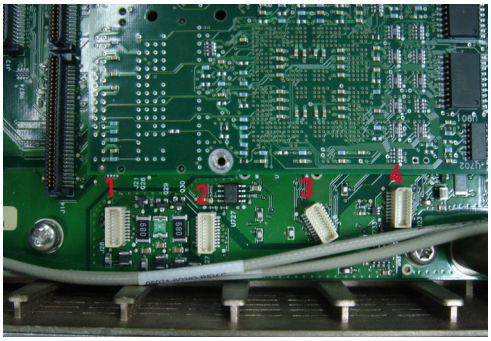
| Instructions | Visual |
|---|---|
| Key to Figure 6-6:<br>**1** Front panel assembly<br>**2** Calibrator assembly<br>**3** Sensor flex connection(s)<br>**4** Calibrator cable connection<br>**5** Rear panel assembly<br>**6** Line module<br>**7** Fan assembly<br>**8** Analog recorder output connection(s)<br>**9** VGA cable<br>**10** USB cable<br>**11** PPMC assembly<br>**12** Trigger BNC<br><br>With reference to Figure 6-6:<br>– Lift and remove the cable clamp.<br>– Disconnect the cable attaching the fan assembly to the main board.<br>– Lift and remove the fan assembly<br>– Disconnect the sensor RF connections from the main board.<br>– Disconnect the sensor flex connection(s) from the main board.<br>– Disconnect the calibrator cable connection from the main board.<br>– Disconnect the analog recorder output connection(s) from the main board. |  <br>**Figure 6-6** Top view with top clamshell removed |

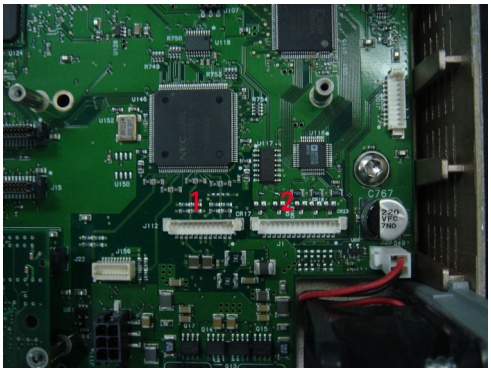
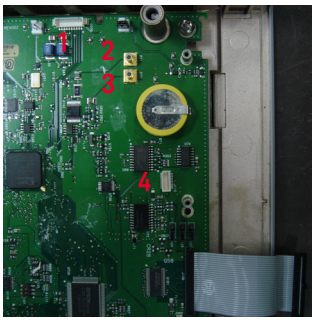
| Instructions | Visual |
|---|---|
| Remove the EMI earth wires (Figure 6-7). Use the 9/32” socket to remove the Hex nut attaching the EMI earth wires to the calibrator assembly. Remove the earth wires and washers, taking note of the assembly order. |  **Figure 6-7** Remove the EMI earth wires |
| Disconnect the front panel cable (Figure 6-8). Depress both sides of the connector holding the ribbon cable to eject it. |  **Figure 6-8** Disconnect the front panel cable |
| Disconnect the semi-rigid cable (Figure 6-9).<br><br>**Note:**<br>This only applies to Option 003 units. Use the 5/16” spanner to disconnect the semi-rigid cable from the N-type connector on the rear panel. | **Figure 6-9** Disconnect the semi-rigid cable |

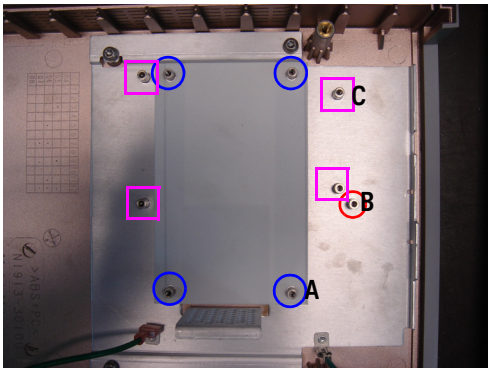
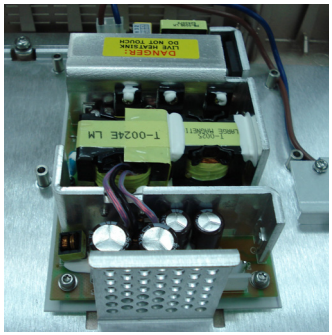
| Instructions | Visual |
|---|---|
| Remove the front panel (Figure 6-10). Carefully lift and remove the front panel assembly. |  **Figure 6-10** Remove the front panel |
| – Disconnect PPMC cables (Figure 6-11). Disconnect the service connector cable from the PPMC assembly. Disconnect the ribbon cable from the main board, whilst leaving it connected to the PPMC assembly.<br>– Remove the PPMC assembly (Figure 6-11). Use the T8 Torx screwdriver bit to remove the screws attaching the DAP and PPMC assemblies to the main board. Carefully remove the PPMC assembly by lifting the end closest to the DAP assembly. Carefully remove each DAP assembly by lifting the end closest to the rear panel. |  **Figure 6-11** Remove PPMC |

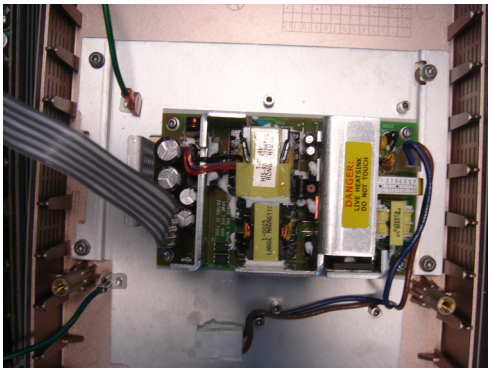
| Instructions | Visual |
|---|---|
| Remove the main board (Figure 6-12). Use the T20 Torx screwdriver bit to remove the five screws attaching the main board to the bottom clamshell. Use the T20 Torx screwdriver bit to remove the screw attaching the earth wires to the line module. Remove the earth wires and washers, taking note of the assembly order. Lift and remove the main board. |  **Figure 6-12** Remove the main board |
| Remove the rear panel Figure 6-13). Use the N1912-61807 special tooling kit to remove the fasteners on the trigger connectors. Use the 9/32" socket to remove the GPIB standoffs. Carefully pull the rear panel away from the main board. |  **Figure 6-13** Remove the rear panel |

# Reassembly Instructions

| Instructions | Visual |
|---|---|
| The reassembly process is simply the reverse of the disassembly process. However, there are various points to be aware of.<br>– USB/LAN connectors must rest on top of the rear panels' EMC spring fingers.<br>– The position of the cable clamp depends on whether Option 101 or 003 is fitted.<br>– The main board connector from the PSU must be pushed firmly to fully engage it.<br>– Take care not to trap any cables when fitting the top clamshell.<br>– Analog recorder output connections (Figure 6-14). Ensure that recorder 1 is plugged into the rear connector. Where applicable, recorder 2 is plugged into the connector nearer to the front. |  <br>**Figure 6-14** Analog recorder output connections |
| Sensor flex connections (Figure 6-15)<br>– A - Front, Channel A (for Option 101)<br>– B - Front, Channel B (for Option 101)<br>– C - Rear, Channel A (for Option 003)<br>– D - Rear, Channel B (for Option 003) |  <br><br>**1** J28 - front Ch 1<br>**2** J127 - front Ch 2<br>**3** J23 - rear Ch 2<br>**4** J18 - rear Ch 1 |

| Instructions | Visual |
|---|---|
| |  <br>**1** J112 - USB (rear)<br>**2** J1 - VGA<br>  <br>**1** J109 - Calibrator<br>**2** P71 - Trig Out<br>**3** P70 - Trig In<br>**4** J115 - USB (front)<br>**Figure 6-15** Sensor flex connections |

| Instructions | Visual |
|---|---|
| PSU screw locations (Figure 6-16)<br>– **A** - Attach PSU to clamshell (4 screws)<br>– **B** - Attach PSU cable guide (1 screw)<br>– **C** - Attach PSU safety cover (4 screws) |  <br>  <br>**Figure 6-16** PSU screw locations |

| Instructions | Visual |
|---|---|
| PSU cable routing (Figure 6-17). Ensure the PSU cables are positioned such that the cable guide does not trap them or pinch them. |  **Figure 6-17** PSU cable routing |

# Disassembly vs Part Replacement

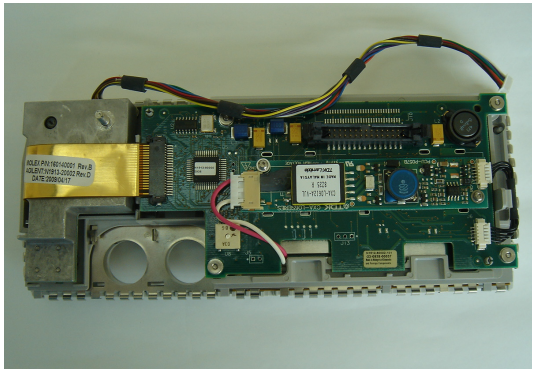
| Disassembly of replacement part | Instructions |
|---|---|
| Main board/Rear panel assembly/Bottom clamshell | Full strip-down required |
| PSU/Top clamshell | – Remove handle, bumpers, and top clamshell (including PSU)<br>– PSU can now be removed from the top clamshell |
| Fan assembly | – Remove handle, bumpers, and top clamshell (including PSU)<br>– Disconnect fan assembly from the main board<br>– Fan assembly can now be removed |
| PPMC assembly<br>(Front connectors option) | – Remove handle, bumpers, and top clamshell (including PSU)<br>– Disconnect the main board ribbon cable from the PPMC<br>– Disconnect the service connector cable from the PPMC<br>– Dismantle rear USB assembly N1913-68301 or N1913-68302 (if applicable)<br>– Remove the four screws securing the PPMC to the main board<br>– PPMC assembly can now be removed |
| PPMC assembly<br>(Rear connectors option) | – Remove handle, bumpers, and top clamshell (including PSU)<br>– Disconnect the sensor flex connection(s) from the main board<br>– Disconnect the main board ribbon cable from the PPMC<br>– Disconnect the service connector cable from the PPMC<br>– Dismantle rear USB assembly N1913-68301 or N1913-68302 (if applicable)<br>– Remove the four screws securing the PPMC to the main board<br>– PPMC assembly can now be removed |

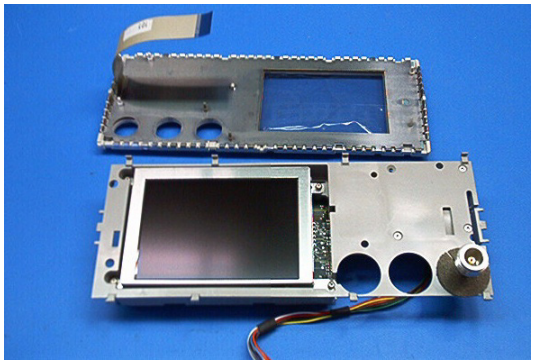
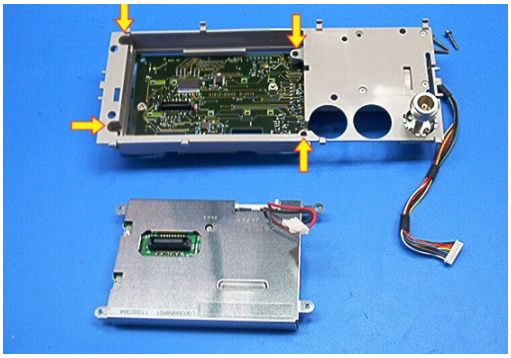
| Disassembly of replacement part | Instructions |
|---|---|
| Front panel assembly (Front connectors option) | – Remove handle, bumpers, and top clamshell (including PSU)<br>– Disconnect the sensor RF connections from the main board<br>– Disconnect the sensor flex connection(s) from the main board<br>– Disconnect the calibrator assembly cable connection from the main board<br>– Disconnect the EMI earth wires from the calibrator assembly<br>– Disconnect main board ribbon cable from the front panel assembly<br>– Front panel assembly can now be removed |
| Front panel assembly<br>(Rear connectors option) | – Remove handle, bumpers, and top clamshell (including PSU)<br>– Disconnect calibrator semi-rigid from the rear panel assembly<br>– Disconnect the calibrator assembly cable connection from the main board<br>– Disconnect the EMI earth wires from the calibrator assembly<br>– Disconnect main board ribbon cable from the front panel<br>– Front panel assembly can now be removed |
| Sensor flex assembly<br>(Front connectors option) | – Remove front panel assembly as previously described<br>– Use the N1912-61807 special tooling kit to remove the sensor flex assembly |
| Sensor flex assembly<br>(Rear connectors option) | – Remove handle and front/rear bumpers<br>– Remove top clamshell (including PSU)<br>– Disconnect the sensor RF connections from the main board<br>– Disconnect the sensor flex connection from the main board<br>– Use the N1912-61807 special tooling kit to remove the sensor flex assembly |

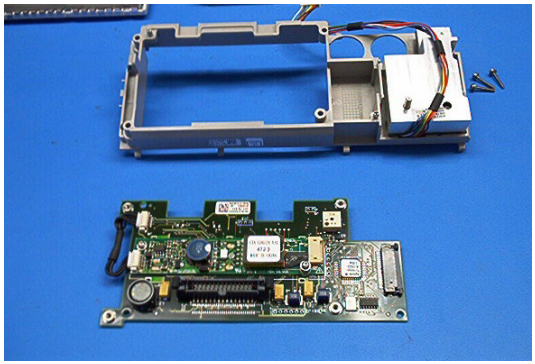
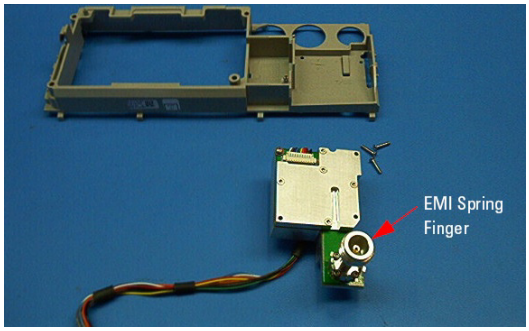
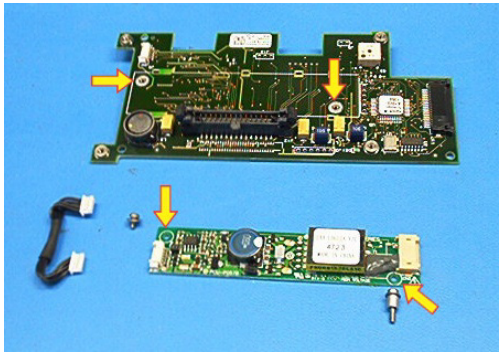
# Front Panel Disassembly Instructions

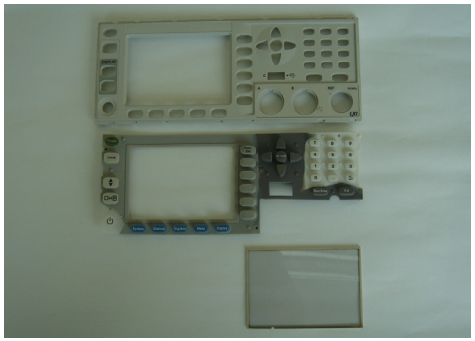
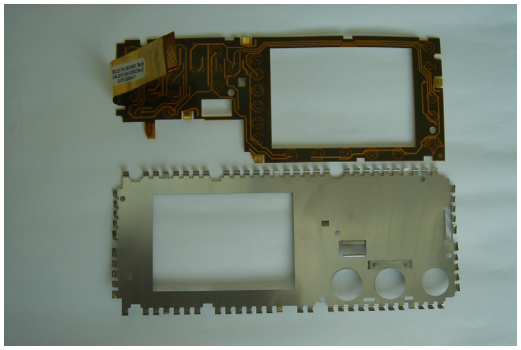
**CAUTION**

- The front panel assembly should only be repaired in a clean and dust-free environment.
- Failure to do so may introduce contamination between the EMI shielded window and the display.
- Also note that it may not be necessary to completely disassemble the front panel in order to repair or replace some of its parts. As such, this procedure should be tailored to suit the specific repair requirements.

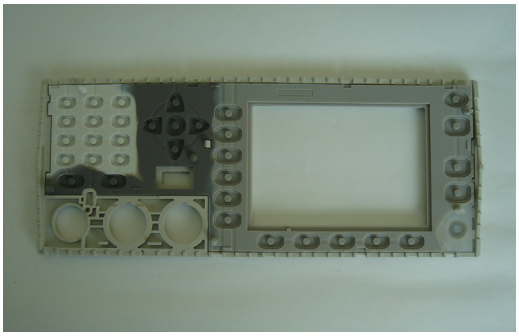
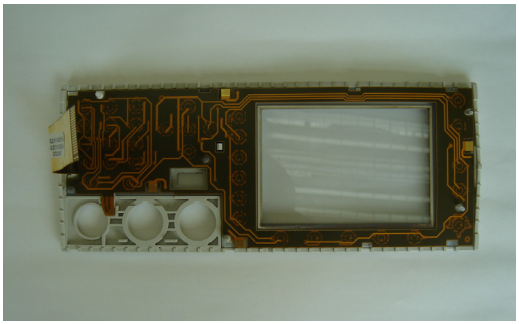
| Instructions | Visual |
|---|---|
| **Step 1**<br>Carefully lift and remove the calibrator plug. [This step is not applicable to units with rear-panel connectors.]<br>This step is only applicable for calibrator assembly with the calibrator plug.<br>For more information on the improved calibrator assembly, refer to "Improved calibrator assembly" on page 102. | |
| **Step 2**<br>Use Circlip pliers to remove N1912-61806 sensor flex assembly.<br>Release the tab holding the flex cable to the display interface board, and then disconnect it.<br><br>**Step 3**<br>Disconnect the white plastic plug from the display interface board. |  |

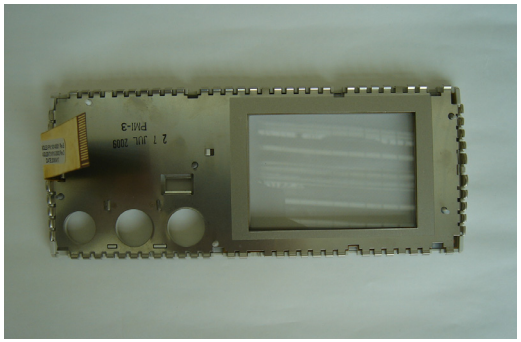
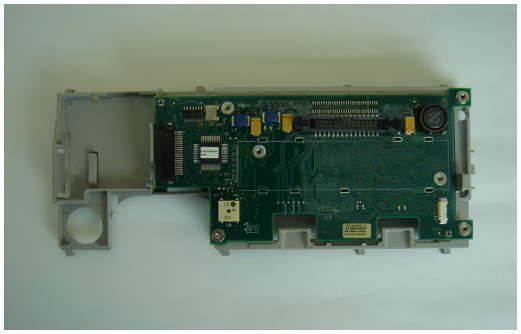
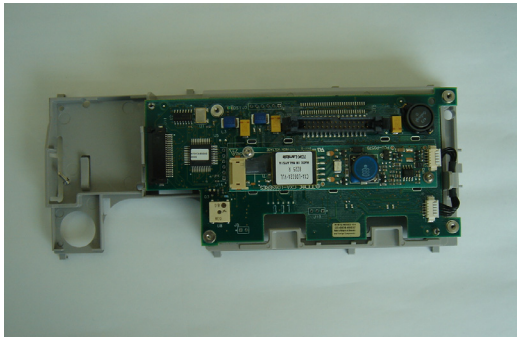
| Instructions | Visual |
|---|---|
| **Step 4**<br>Unlock the main plastic clip that holds the front panel sub-frame and display support molding together (situated beside the key flex circuit), and carefully pull them apart to separate them. |  |
| **Step 5**<br>Remove the four screws that are attached to the display from the display support molding, and then disconnect it from the display interface board. |  |

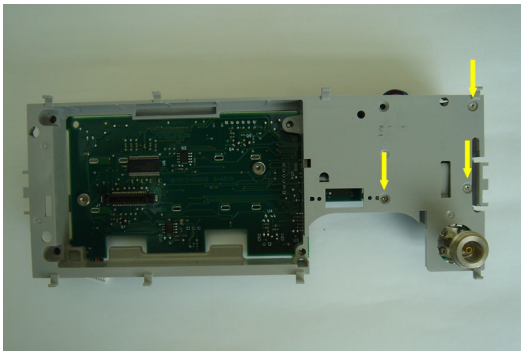
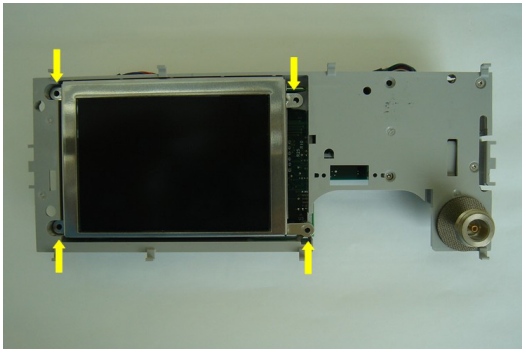
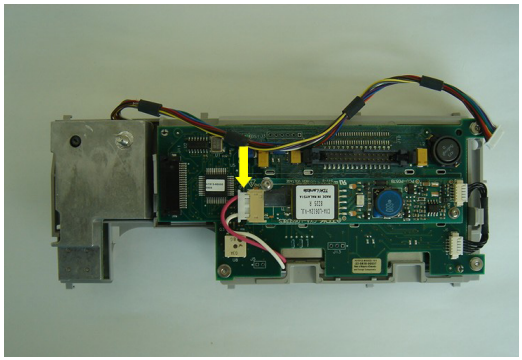
| Instructions | Visual |
|---|---|
| **Step 6**<br>Lift the display interface board off of the plastic mounting lugs on the display support molding to separate them from one another. |  |
| **Step 7**<br>Remove the three screws that are attached to the calibrator assembly from the display support molding, and separate them from one another.<br><br>**Note:**<br>Take care not to damage the EMI spring fingers on the calibrator assembly. |  |
| **Step 8**<br>Disconnect the backlight cable assembly from the display interface board and inverter board.<br><br>**Step 9**<br>Remove the two screws that are attached to the display inter face board from the inverter board, and separate them from one another. |  |

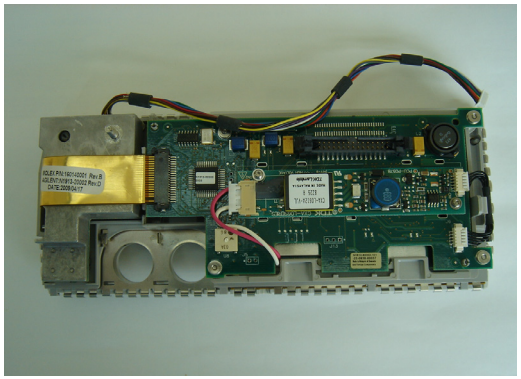
| Instructions | Visual |
|---|---|
| **Step 10**<br>Release the metal tabs holding the EMI Screen to the front panel sub-frame, and separate them from one another.<br><br>**Step 11**<br>Disengage the rubber tabs that are attached to the key flex circuit from the keymat, and carefully lift it out. |  |
| **Step 12**<br>Remove the EMI shielded window and the keymat from the front panel sub-frame. |  |

# Front Panel Reassembly Instructions

| Instructions | Visual |
|---|---|
| **Step 1**<br>Insert the keymat into the front panel sub-frame.<br><br>**Step 2**<br>Insert the EMI shielded window into the keymat, ensuring that it is clean and free from fingerprints. |  |
| **Step 3**<br>Overlay the key flex circuit onto the keymat, ensuring that all of the rubber lugs are engaged to hold it securely. |  |

| Instructions | Visual |
|---|---|
| **Step 4**<br>Overlay the EMI screen onto the key flex circuit, ensuring that all of the metal tabs are engaged to hold it securely. |  |
| **Step 5**<br>Fit the display interface board onto the plastic mounting lugs on the display support molding. |  |
| **Step 6**<br>Attach the inverter board to the display interface board using the two screws removed earlier.<br><br>**Step 7**<br>Connect the inverter board to the display interface board using the backlight cable assembly.<br><br>**Note:**<br>The cable must be tucked under the plastic clip to prevent any fouling. |  |

| Instructions | Visual |
|---|---|
| **Step 8**<br>Attach the calibrator assembly to the display support molding using the three screws removed earlier.<br><br>**Step 9**<br>Carefully spread the EMI fingers outwards, ensuring they extend beyond the edges of the hole in which the calibrator assembly is fitted. |  |
| **Step 10**<br>Fit the split washer to the calibrator assembly.<br><br>**Step 11**<br>Attach the display to the display interface board using the four screws removed earlier. |  |
| **Step 12**<br>Connect the white plastic plug to the display interface board. |  |

| Instructions | Visual |
|---|---|
| **Step 13**<br>Attach the front panel sub-frame to the display support molding, ensuring that all plastic clips are engaged to hold it securely.<br><br>**Step 14**<br>Connect the flex cable to the display interface board, and then tighten the locking tab. |  |
| **Step 15**<br>Re-fit the calibrator plug.<br>This step is only applicable for calibrator assembly with the calibrator plug.<br>For more information on the improved calibrator assembly, refer to “Improved calibrator assembly” on page 102 | |

# Additional Repair Notes

## Replacing the sensor flex assembly

The sensor flex assembly is supplied straight. Do not bend the sensor flex cable.

**NOTE** **Route and connect the sensor flex assembly. Once the sensor flex assembly has been attached to the power meter, do not bend the sensor flex cable.**

# Main Board vs. Rear Panel Assembly

| Instructions | Visual |
|---|---|
| – Due to a difference in the connector positions for main board revision 102 and revision 103, there are two different rear panels.<br>– Revision 102 main boards are not available as spares - all spare main boards will be revision 103 (or newer).<br>– When replacing a revision 102 main board, take note that the rear panel will need to be replaced<br>– Figure 6-18 shows the main board revision markings | <br>**Figure 6-18** Main board revision markings |

# Replacing the PPMC Assembly

- The PPMC Assembly is pre-programmed with the N1914A firmware.
- Always perform a firmware upgrade to the instrument if the PPMC assembly has been replaced.

**NOTE** **Fitting a PPMC assembly that has been pre-programmed with N1913A firmware to an N1914A power meter will generate errors; these errors will disappear once the firmware upgrade procedure has been carried out.**

- Instrument serial number:

  This can be stored min the PPMC assembly via the command:

  ```
  SERV: SNUM <CHARACTER DATA>
  ```

- Instrument option(s):

  This/these can be stored in the PPMC assembly via the command:

  ```
  SERV: OPT “< CHARACTER DATA>”
  ```

- Refer to the *Keysight N1913/1914A EPM Series Power Meters Programming Guide* for further details on the use of these commands.

# Replacing the Calibrator Semi-Rigid/Split Ferrite

| Instructions | Visual |
|---|---|
| – Separate the two halves of the ferrite (Figure 6-19).<br>– Position the ferrite such that it's furthest edge is 120 mm (4 ¾”) from the bend of the semi-rigid.<br>– Hold the ferrite in place by applying a coating of silicone or silicone-rubber compound (e. g. RTV) along that 20 mm (¾”) section of the semi-rigid.<br>– Join both halves of the ferrite, keeping the mating surfaces free of the silicone compound if possible. | <br>**Figure 6-19** Separate the two halves of the ferrite |

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# 7 Contacting Keysight Technologies

Introduction 136
Before Calling Keysight Technologies 137
Check the Basics 138
Instrument Serial Numbers 139
Returning Your Power Meter for Service 140
Useful Web Pages 141

This chapter details what to do if you have a problem with your power meter.

# Introduction

## Contacting Keysight Technologies

This section details what to do if you have a problem with your power meter. If you have a problem with your power meter, first refer to "Before Calling Keysight Technologies" on page 137. This section contains a checklist that helps identify some of the most common problems.

If you wish to contact Keysight Technologies to enquire about the N1913/1914A EPM Series Power Meters, from service problems to ordering information, refer to "Sales and Technical Support" on page 9. If you wish to return the power meter to Keysight Technologies, refer to "Returning Your Power Meter for Service" on page 140.

# Before Calling Keysight Technologies

Before calling Keysight Technologies or returning the power meter for service, please make the checks listed in "Check the Basics" on page 138. If your power meter is covered by a separate maintenance agreement, please be familiar with the terms.

Keysight Technologies offers several maintenance plans to service your power meter after warranty expiration. Call your Keysight Technologies Sales and Service Center for full details.

If the power meter becomes faulty and you wish to return the faulty instrument, follow the description on how to return the faulty instrument in "Returning Your Power Meter for Service" on page 140.

# Check the Basics

Problems can be solved by repeating what was being performed when the problem occurred. A few minutes spent in performing these simple checks may eliminate time spent waiting for instrument repair. Before calling Keysight Technologies or returning the power meter for service, please make the following checks:

- Check that the line socket has power.
- Check that the power meter is plugged into the proper AC power source.
- Check that the power meter is switched on.
- Check that the line fuse is in working condition.
- Check that the other equipment, cables, and connectors are connected properly and operating correctly.
- Check the equipment settings in the procedure that was being used when the problem occurred.
- Check that the test being performed and the expected results are within the specifications and capabilities of the power meter.
- Check the power meter display for error message.
- Check operation by performing the self tests.
- Check with a different power sensor.

# Instrument Serial Numbers

Keysight Technologies makes frequent improvements to its products to enhance their performance, usability, and reliability. Keysight Technologies service personnel have access to complete records of design changes for each instrument. The information is based on the serial number and option designation of each power meter.

Whenever you contact Keysight Technologies about your power meter have a complete serial number available. This ensures you obtain the most complete and accurate service information. The serial number can be obtained by:

- Querying the power meter over a remote interface (via the `*IDN?` command)
- From the front panel (via the Service menu)
- From the serial number label

The serial number label is attached to the rear of each Keysight Technologies instrument. This label has two instrument identification entries. The first provides the instruments serial number and the second provides the identification number for each option built into the instrument.

The serial number is divided into two parts: the prefix (two letters and the first four numbers), and the suffix (the last four numbers). The prefix letters indicate the country of manufacture. This code is based on the ISO international country code standard, and is used to designate the specific country of manufacture for the individual product. The same product number could be manufactured in two different countries. In this case the individual product serial numbers would reflect different country of manufacture codes. The prefix also consists of four numbers. This is a code identifying the date of the last major design change.

The suffix indicates an alpha numeric code which is used to ensure unique identification of each product throughout Keysight Technologies.

# Returning Your Power Meter for Service

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

### Packaging the power meter for shipment to Keysight for service

- Fill in a blue service tag (available at the end of most hardcopy *Keysight Service Guides*) 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.**

- 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.
- Surround the power meter with at least three to four 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 TM 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.
- Seal the shipping container securely with strong nylon adhesive tape.
- Mark the shipping container “FRAGILE, HANDLE WITH CARE” to ensure careful handling.
- Retain copies of all shipping papers.

## Useful Web Pages

- Main Product Page

  www.keysight.com/find/epm

- Product Manuals

  http://www.keysight.com/en/pd-1659613-pn-N1913A/epm-series-single-channel-power-meter?pm=PL&nid=-536902901.899990&cc=MY&lc=eng

- Product Firmware

  http://www.keysight.com/main/software.jspx?ckey=1783747&lc=eng&cc=MY&nid=-536902901.899990&id=1783747

- Performance Test & Calibration Software

  http://cal.software.keysight.com/

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This information is subject to change without notice. Always refer to the Keysight website for the latest revision.

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