

Keysight 53150A/151A/152A Microwave Frequency Counter

This guide describes how to use the Keysight 53150A, 53151A, and 53152A Microwave Frequency Counters. The information in this guide applies to instruments having the number prefix listed below, unless accompanied by a “Manual Updating Changes” package indicating otherwise.

**SERIAL PREFIX NUMBER: 3735A, US3925, and US4050 (53150A)
3736A, US3926, and US4051 (53151A)
3737A, US3927, and US4052 (53152A)**

Assembly Level
Service Guide

Notices

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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.

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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.

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.

	Caution, risk of danger (refer to this manual for specific Warning or Caution information)		Caution, risk of electric shock
	Earth (ground) terminal		Frame or chassis (ground) terminal
	Alternating current (AC)		Direct current (DC)

Detailed Warranty Information

Keysight does not warrant that the operation of Keysight products will be uninterrupted or error free. If Keysight is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product.

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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

INSTRUCTIONS FOR ADJUSTMENTS WHILE COVERS ARE REMOVED AND FOR SERVICING ARE FOR USE BY SERVICE-TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM SUCH ADJUSTMENTS OR SERVICING UNLESS QUALIFIED TO DO SO.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE GROUNDING CONDUCTOR (INSIDE OR OUTSIDE THE PRODUCT'S CIRCUITRY) OR DISCONNECTING THE PROTECTIVE EARTH TERMINAL WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY. (GROUNDING ONE CONDUCTOR OF A TWO CONDUCTOR OUTLET IS NOT SUFFICIENT PROTECTION.)

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction), make sure the common terminal is connected to the earthed pole terminal (neutral) of the power source.

Instructions for adjustments while covers are removed and for servicing are for use by trained personnel only. To avoid dangerous electric shock, do not perform such adjustments or servicing unless qualified to do so.

For continued protection against fire, replace the line fuse(s) with fuses of the same current rating and type (for example, normal blow, time delay). Do not use repaired fuses or short-circuited fuseholders.

Safety Earth Ground

An uninterruptible safety earth ground must be maintained from the mains power source to the product's ground circuitry.

WARNING

WHEN MEASURING POWER LINE SIGNALS, BE EXTREMELY CAREFUL AND ALWAYS USE A STEP-DOWN ISOLATION TRANSFORMER WHICH OUTPUT IS COMPATIBLE WITH THE INPUT MEASUREMENT CAPABILITIES OF THIS PRODUCT. THIS PRODUCT'S FRONT AND REAR PANELS ARE TYPICALLY AT EARTH GROUND. THUS, NEVER TRY TO MEASURE AC POWER LINE SIGNALS WITHOUT AN ISOLATION TRANSFORMER.

Acoustic Noise Emissions

LpA<47 dB at operator position, at normal operation, tested per EN 27779. All data are the results from type test.

Geräuschemission

LpA<47 dB am Arbeits platz, normaler Betrieb, geprüft nach EN 27779. Die Angaben beruhen auf Ergebnissen von Typenprüfungen.

Electrostatic Discharge Immunity Testing

When the product is tested with 8kV AD, 4kV CD and 4kV ID according to IEC801-2, a system error may occur that may affect measurement data made during these disturbances. After these occurrences, the system self-recovers without user intervention.

Waste Electrical and Electronic Equipment (WEEE) Directive

This instrument complies with the WEEE Directive 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.

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Keysight 53150A/151A/152A Microwave Frequency Counter Assembly Level Service Guide

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This guide provides assembly-level service information for the Keysight 53150A, 53151A, and 53152A Counters.

How to Use This Guide

Repair Strategy

This service guide is designed to isolate failures to the assembly level only.

The Keysight 53150A/151A/152A Counter can be returned to Keysight for all service work, including troubleshooting, and verifying specifications. Contact your nearest Keysight Sales and Service Office for more details.

NOTE

ISD (Instrument Service Division) Emergency Response or Express Calibration Service is available for Keysight customers in the USA. If downtime is critical, you can receive your repaired Counter via overnight shipment. Call **1-800-403-0801**, and ask for *Emergency Response* or *Express Calibration Service*. When your Counter is repaired, it is returned via overnight shipment at no extra charge.

If you decide to service the Counter yourself, use the troubleshooting procedures in [Chapter 2 \(Service\)](#) and the disassembly and reassembly procedures in [Chapter 3 \(Replacing Assemblies - Disassembly and Reassembly\)](#). Then, use the calibration instructions in [Chapter 2](#) to calibrate the Counter for peak-performance operation, and finally, perform all of the performance tests in [Chapter 1](#) to verify that the Counter is operating to the specifications.

NOTE

If the motherboard, the sampler, or the front-panel assembly are defective, the instrument must be returned to an Keysight Service Center for repair and recalibration.

Instrument Identification

The instrument is identified by the serial number on the rear panel. Keysight uses a two-part serial number with the first part (prefix) identifying a series of instruments and the second part (suffix) identifying a particular instrument within a series. Keysight-assigned alpha characters before the prefix identify the country in which the instrument was manufactured.

Instruments Covered by this Guide

This guide applies directly to Keysight 53150A, 53151A, and 53152A Counters that have the same serial number prefix(es) shown on the title page. If the serial number prefix of your Counter differs from that listed on the title page of this guide, there may be differences between this guide and your instrument.

Instruments having a higher serial prefix are covered (when required) by one or more manual-change sheets included with this guide. If a required change sheet is missing, contact your nearest Keysight Sales Office listed at the back of this guide.

Assembly-Level Service Guide Organization

This Assembly-Level Service Guide consists of a table of contents, a preface, six chapters, and an index. The page headers identify the chapters and sections of this manual. The chapter contents are summarized as follows:

Chapter 1, “Performance Tests - Verifying Specifications” provides procedures that verify the Counter operates properly and meets the Keysight 53150A/151A/152A specifications given in **Chapter 6**, “Specifications” in this guide.

Chapter 2, “Service” is divided into seven main sections that provide instructions for returning the Counter to Keysight for service, calibrating the Counter, and troubleshooting the assemblies in the Counter.

Chapter 3, “Replacing Assemblies - Disassembly and Reassembly” provides procedures for replacing defective assemblies and/or modules in the Counter.

In This Guide

Chapter 4, “Replaceable Parts” lists the replaceable parts contained in the Counter, and explains how to order replacement parts for your Counter.

Chapter 5, “Backdating” contains information required to adapt this manual for older instruments (to be provided when required).

Chapter 6, “Specifications” lists all the specifications and operating characteristics for the Keysight 53150A/151A/152A Counter.

How to Order Guides

The part number for this guide is listed on the *Certification and Warranty* page (page 4) and on the back cover of this guide.

Description of the Microwave Frequency Counter

The Keysight 53150A, 53151A, and 53152A Microwave Frequency Counters are capable of measuring frequencies from 10 Hz to 125 MHz on Channel 1 and from 50 MHz to 20 GHz (53150A), 26.5 GHz (53151A), and 46 GHz (53152A) on Channel 2. These frequency counters are also capable of measuring power on Channel 2 (in the same frequency ranges). All three Counters have a maximum frequency resolution of 1 Hz.

The Keysight 53150A/151A/152A provides GPIB and RS-232 serial interfaces and are suitable for bench-top and ATE operation.

The basic measurement functions of the Keysight 53150A/151A/152A include Frequency, Relative Frequency, Frequency Offset, and Power (including Power Offset and Relative Power). All of these features are accessible from the front panel and over the GPIB and RS-232 interfaces.

The Keysight 53150A/151A/152A includes the following additional measurement functions and features that are designed specifically for manufacturing and service applications:

- 1, 2, 5, and 10 MHz external reference capability
- Optional high-stability oven oscillator for high-accuracy needs and lengthened calibration cycles
- Frequency and power offset capabilities for relative measurements
- SCPI programming capability
- Battery and dc input option for operation in locations where AC power is unavailable
- Optional soft carrying case for safe transportation and mobile use

Programmable control is performed via an GPIB or an RS-232 serial interface. The GPIB and RS-232C ports are standard for the Keysight 53150A, 53151A, and 53152A.

Options

The options available for the Keysight 53150A/151A/152A are listed following this paragraph. Specifications for the options are listed in [Chapter 6, “Specifications”](#). Options ordered with the Counter are installed at the factory and are ready for operation on delivery.

Hardware

- High Stability Oven Timebase, Option 001
- Battery/DC Power Input, Option 002
- Rack Mount Kit, Option 1CM (not installed)
- Soft Carrying Case, Option 007 (not installed)

NOTE

Hardware options can be retrofitted at an Keysight Service Center. However, the cost to retrofit options is considerably higher than the cost of the same options when purchased with the instrument.

Support

- 3-year Return to Keysight for Repair, Option W30
- 3-year Return to Keysight for Calibration, Option W32
- 3-year Return to Keysight for Standards Compliant Calibration, Option W34
- 5-year Return to Keysight for Repair, Option W50
- 5-year Return to Keysight for Calibration, Option W52
- 5-year Return to Keysight for Standards Compliant Calibration, Option W54

Accessories Supplied and Available

Accessories Supplied

- Power cord, 2.3 meters (part number dependent upon destination country)
- Fuse (Keysight P/N 2110-0007)

Accessories Available

- Accessories for use with Option 002 (Battery/DC Power Input):
 - Automotive Power Adapter (Keysight P/N 53150-60214)
 - Battery (Keysight P/N 53150-80010)
 - Battery Charger (Keysight P/N 53150-60217) 115V (includes Automotive Power Adapter)
 - Battery Charger (Keysight P/N 53150-60218) 230V (includes Automotive Power Adapter)
 - GPIB Cables (Keysight P/N 10833A/B/C/D)
- RS-232 Cable (Keysight P/N 53150-60215)
- Soft Carrying Case (Keysight P/N 53150-80016) – same as Option 007
- Rack Mount Kit (Keysight P/N 53150-67001) – same as Option 1CM

Manuals Supplied

Keysight 53150A/151A/152A Operating Guide
(Keysight P/N 53150-90013)

Keysight 53150A/151A/152A Programming Guide
(Keysight P/N 53150-90014)

Keysight 53150A/151A/152A Assembly-Level Service Guide
(Keysight P/N 53150-90015)

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Introduction

This chapter provides procedures to test the electrical performance of the Keysight 53150A/151A/152A. These procedures are based on the Counter specifications in [Chapter 6, “Specifications”](#).

Two types of testing are provided:

- Operational Verification
- Complete Performance Tests

This chapter is organized as follows:

- [Introduction](#) pg. 26
- [Equipment Required](#) pg. 28
- [Operational Verification](#) pg. 29
- [Complete Performance Tests](#) pg. 35
- [Performance Test Record](#) pg. 54

Operational Verification

Operational Verification is an abbreviated series of tests that you can perform (instead of performing the Complete Performance Tests) to provide a high degree of confidence that the instrument is operating properly. Operational Verification is useful for incoming inspection, routine maintenance, and after instrument repair.

Complete Performance Tests

The Complete Performance Tests verify the specifications listed in [Chapter 6](#), “[Specifications](#)”. All tests can be performed without opening the instrument.

Recommended Calibration Cycle

The Counter requires periodic verification of operation. Depending on the type of use, environmental conditions, aging, and measurement accuracy required, the Counter should be checked using the operational verification procedure at least once every year after the unit is first placed in operation. A full Calibration and Performance Test should be performed each time the Counter changes environment or if an assembly or module has been replaced.

Test Record

The results of the Operational Verification and the Complete Performance Tests should be recorded on a copy of the Performance Test Record, located at the end of the Complete Performance Test section in this chapter.

Equipment Required

Table 1-1 lists the test equipment and accessories needed to perform the tests.

Table 1-1 Recommended Test Equipment and Accessories

Instrument Type	Required Characteristics	Model Recommended ^[a]	Quantity Required	Use ^[b]
Synthesized Signal Generator	10 Hz to 20 MHz +7 dBm to -40 dBm	Keysight 3325A/B	2	OV, P, T
Microwave Synthesized Signal Generator	10 MHz to 50 GHz Accuracy $>1 \times 10^{-10}$ +7 dBm to -50 dBm	Keysight 83650B	1	P, T
Microwave Amplifier	45 MHz to 50 GHz	Keysight 83051A	1	P, T
Power Meter	50 MHz to 50 GHz +13 dBm to -50 dBm	Keysight 437B	1	P, T
Power Sensor	50 MHz to 50 GHz +13 dBm to -50 dBm	Keysight 8487A/D	1	P, T
Power Sensor Cable	2.4 mm to 2.4 mm, 5 ft.	Keysight 11730A	1	P, T
50 Ω Feedthrough Terminator	50 Ω (m to f) BNC	Keysight 10100C	1	OV, P, T
20 dB Attenuator	DC to 50 GHz 2.4 mm (m) to 2.4 mm (f)	Keysight 8490D (Opt. 020)	1	P, T
Power Splitter	DC to 50 GHz 2.4 mm (f3x)	Keysight 11667C/D	1	P, T
Cables	BNC (m) to BNC (m)	Keysight 10503 series	2	OV, P, C, T
	2.4 mm (m) to 2.4 mm (m)	–	2	
Adapters	BNC (m) to SMA (f)	Keysight 1250-2015	1	P, T
	3.5 mm (f) to 2.92 mm (m)	–	1	
	2.92 mm (m) to 2.4 mm (m)	Keysight 11904A	1	
	2.92 mm (m) to 2.4 mm (f)	Keysight 11904D	1	
	2.4 mm (m) to 2.4 mm (m)	Keysight 11900A	1	
2.4 mm (f) to 2.4 mm (f)	Keysight 11900B	1		

[a] Equivalent equipment can be substituted for all instruments and accessories.

[b] OV = Operational Verification P = Performance Tests C = Calibration T = Troubleshooting

Operational Verification

Operational Verification is an abbreviated series of tests that you can perform (instead of performing the Complete Performance Tests) to provide a high degree of confidence that the instrument is operating properly. Operational Verification is useful for incoming inspection, routine maintenance, and after instrument repair.

If you are not familiar with operating the Counter, you should review Chapter 1, “Getting Started,” in the *Keysight 53150A/151A/152A Operating Guide*. However, the procedures in this chapter are written so that little experience is necessary. These procedures should be followed in the order in which they appear.

Power-On Self Tests

NOTE

This test is appropriate for the Keysight 53150A, 53151A, and 53152A Counters.

- 1 Inspect the Counter for damage.
- 2 Make sure no cables are connected to the Counter’s inputs.
- 3 Connect the power cord to the Counter and the power source.

NOTE

Since the Counter’s power supply automatically senses the line voltage, there is no AC input-voltage setting.

- 4 Turn on the **Main ~ Power** switch on the Counter’s rear panel.

NOTE

It is normal for the fan in the Counter to run when the Counter is in Standby mode. Power is supplied to the timebase whenever the **Main ~ Power** switch is on to maintain long-term measurement reliability, and the fan helps to maintain the timebase’s temperature stability.

- 5 Press and release the **Power** button on the front panel.

1 Performance Tests - Verifying Specifications

- 6 Verify that the front-panel display shows the following:
 - All segments of the front-panel display are temporarily activated.
 - **TESTING** is displayed.
 - **SELF TEST OK** is displayed.
 - The model number of the Counter is displayed (a four-digit hex number is also displayed).
 - **GPIB ADDR nn** (nn = a two digit number from 0 to 30) is displayed.
 - **CH2 NO SIGNAL** is displayed.
- 7 If an error message is displayed, refer to the troubleshooting section in [Chapter 2, "Service"](#).
- 8 Mark Pass or Fail in the Performance Test Record on page 54, Test 1.

NOTE

To ensure that the test results are valid, the Counter and the test equipment should be powered on for at least 30 minutes prior to beginning the tests. This allows the internal temperatures of the equipment and the timebase to stabilize.

10 MHz Test

- 1 Connect a BNC-to-BNC cable from the **Reference 10MHz** connector on the Counter's rear panel to the **CHANNEL 1** input connector on the front panel.
- 2 Press and release the **Chan Select** key (CH1 is displayed).
- 3 Verify that the display reads **10,000,000 Hz**.
- 4 Mark Pass or Fail in the Performance Test Record on page 54, Test 2.

Run Self Test

NOTE

This test is appropriate for the Keysight 53150A, 53151A, and 53152A Counters.

- 1 Disconnect all signal cables from the input and **Reference 10MHz** connectors.
- 2 Press and release the **Shift** key, and then press and release the **Menu (Reset/Local)** key.
- 3 Press the up- and/or down-arrow key(s) as many times as necessary until **DO SELF TEST** is displayed.
- 4 Press and release the **Enter** key.
- 5 If no errors are detected, **SELF TEST OK** is briefly displayed when the self test is completed. If any error messages are displayed, refer to the troubleshooting section in [Chapter 2, "Service"](#).
- 6 Mark Pass or Fail in the Performance Test Record on page 54, Test 3.

External Timebase Test

This test verifies the 10 MHz external timebase specifications of the Counter by verifying that setting **REF OSC** to **EXT** allows the Counter to be synchronized to the external reference signal.

Equipment Required

Keysight 3325A/B Synthesizer (2)
Keysight 10100C 50 Ω Feedthrough Terminator
Keysight 10503 Series Coaxial Cables (BNC m to m) (2)

NOTE

- To ensure that the test results are valid, the Counter and the test equipment should be powered on for at least 30 minutes prior to beginning the tests. This allows the internal temperatures of the equipment to stabilize.
 - These tests are appropriate for the Keysight 53150A, 53151A, and 53152A Counters.
-

10 MHz External Timebase Input Test

- 1 Connect an Keysight 10503 series coaxial cable between the output of the first Keysight 3325A/B Synthesizer and the **Reference 10MHz** connector on the Counter's rear panel (see [Figure 1-2](#)).
- 2 Connect the Keysight 10100C 50 Ω Feedthrough Terminator to the Counter's **CHANNEL 1** input connector.
- 3 Connect an Keysight 10503 series coaxial cable between the output of the second Synthesizer and the Keysight 10100C 50 Ω Feedthrough Terminator on the Counter's **CHANNEL 1** input connector.

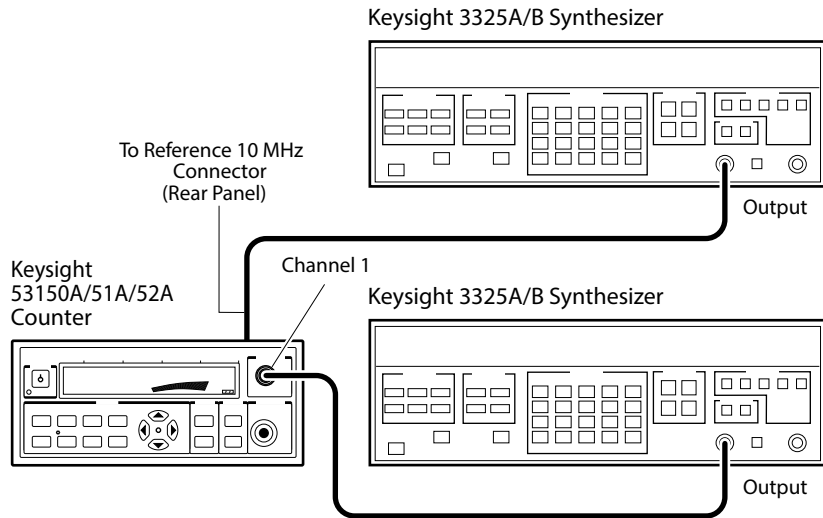


Figure 1-1 External Timebase Test Setup

- 4 Cycle the **POWER** button to preset the Counter.
- 5 Press the **Shift** key on the Counter's front panel.
- 6 Press the **Menu** key on the Counter's front panel.
- 7 If necessary, use the up- and down-arrow keys to cycle the display until it reads **REF OSC > INT**.
- 8 Press the right-arrow key once. **INT** begins to flash off and on.
- 9 Press the up- or down-arrow key once. **INT** changes to **EXT**.
- 10 Press the **Enter** key.
- 11 Press the **Chan Select** key once to select the **CHANNEL 1** input connector.

1 Performance Tests - Verifying Specifications

- 12** Set the first Synthesizer (the one connected to the Counter's rear-panel **Reference 10MHz** connector) to output a 10 MHz, 1V rms, sine-wave signal.
- 13** Set the second Synthesizer (the one connected to the **CHANNEL 1** input) to output a 2 MHz, 100 mV rms, sine-wave signal.
- 14** Press and release the Counter's **Reset/Local** key.
- 15** Verify that the Counter displays a reading of approximately 2 MHz and that the **Ext Ref** annunciator is activated.
- 16** Mark Pass or Fail for Test **4** in the Performance Test Record on page 54.

This completes the Operational Verification.

NOTE

- If you intend to perform the Complete Performance Tests next, do not disconnect the cable from the Counter's **Reference 10 MHz** connector. This connection is used in the Complete Performance Tests.
 - Do not turn off the Counter if you intend to perform the Complete Performance tests. Turning the Counter off and back on resets the reference oscillator (REF OSC) selection to internal (INT) and the channel selection to **CHANNEL 2**.
-

Complete Performance Tests

The Complete Performance Tests verify the specifications of the Keysight 53150A/151A/152A Counter listed in [Chapter 6, “Specifications”](#). All of these tests can be performed without opening the instrument. [Table 1-2](#) lists a summary of the performance tests.

Record the results of the performance tests in the appropriate place on the Performance Test Record, which starts on page 54.

NOTE

To ensure that the test results are valid, the Counter and the test equipment should be powered on for at least 30 minutes prior to beginning the tests. This allows the internal temperatures of the equipment and the timebase to stabilize.

Table 1-2 Complete Performance Tests

Page Number	Test Description
Page 36	Test 1: External Timebase Input Test
Page 36	Test 2: Channel 1 Frequency Sensitivity
Page 45	Test 3: Channel 2 Frequency Sensitivity
Page 49	Test 4: Channel 2 Power Measurement

NOTE

Other Counter measurement functions (e.g., Averaging) are mathematically derived by the microprocessor from the parameters verified by these performance tests. If the Counter passes the performance tests, the other measurement functions are also functioning to specifications.

Test 1: External Timebase Input Test

This test verifies the 10 MHz external timebase specifications of the Counter by verifying that setting **REF OSC** to **EXT** allows the Counter to be synchronized to the external reference signal.

Equipment Required

Keysight 3325A/B Synthesizer (2)
Keysight 10100C 50 Ω Feedthrough Terminator
Keysight 10503 Series Coaxial Cables (BNC m to m) (2)

NOTE

- To ensure that the test results are valid, the Counter and the test equipment should be powered on for at least 30 minutes prior to beginning the tests. This allows the internal temperatures of the equipment to stabilize.
 - These tests are appropriate for the Keysight 53150A, 53151A, and 53152A Counters.
-

1 MHz External Timebase Input Test

- 1 Connect an Keysight 10503 series coaxial cable between the output of the first Keysight 3325A/B Synthesizer and the **Reference 10MHz** connector on the Counter's rear panel (see [Figure 1-2](#)).
- 2 Connect the Keysight 10100C 50 Ω Feedthrough Terminator to the Counter's **CHANNEL 1** input connector.
- 3 Connect an Keysight 10503 series coaxial cable between the output of the second Synthesizer and the Keysight 10100C 50 Ω Feedthrough Terminator on the Counter's **CHANNEL 1** input connector.

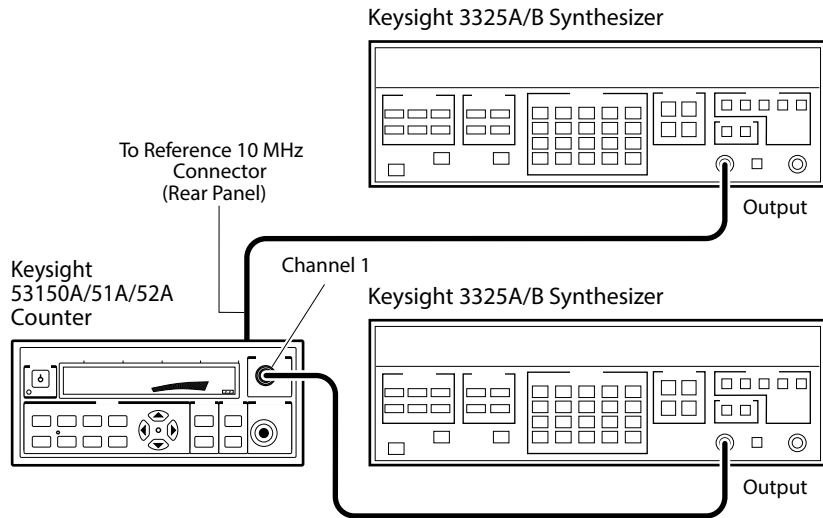


Figure 1-2 External Timebase Test Setup

- 4 Cycle the **POWER** button to preset the Counter.
- 5 Press the **Shift** key on the Counter's front panel.
- 6 Press the **Menu** key on the Counter's front panel.
- 7 If necessary, use the up- and down-arrow keys to cycle the display until it reads **REF OSC > INT**.
- 8 Press the right-arrow key once. **INT** begins to flash off and on.
- 9 Press the up- or down-arrow key once. **INT** changes to **EXT**.
- 10 Press the **Enter** key.
- 11 Press the **Chan Select** key once to select the **CHANNEL 1** input connector.

1 Performance Tests - Verifying Specifications

- 12** Set the first Synthesizer (the one connected to the Counter's rear-panel **Reference 10MHz** connector) to output a 1 MHz, 1V rms, sine-wave signal.
- 13** Set the second Synthesizer (the one connected to the **CHANNEL 1** input) to output a 2 MHz, 100 mV rms, sine-wave signal.
- 14** Press and release the Counter's **Reset/Local** key.
- 15** Verify that the Counter displays a reading of approximately 2 MHz and that the **Ext Ref** annunciator is activated.
- 16** Mark Pass or Fail for Test **1a** in the Performance Test Record on page 54.

2 MHz External Timebase Input Test

- 1** Change the frequency of the first Synthesizer (connected to the Counter's rear-panel **Reference 10 MHz** connector) to 2 MHz.
- 2** Press and release the Counter's **Reset/Local** key.
- 3** Verify that the Counter displays a reading of approximately 2 MHz and that the **Ext Ref** annunciator is activated.
- 4** Mark Pass or Fail for Test **1b** in the Performance Test Record on page 54.

5 MHz External Timebase Input Test

- 1** Change the frequency of the first Synthesizer (connected to the Counter's rear-panel **Reference 10 MHz** connector) to 5 MHz.
- 2** Press and release the Counter's **Reset/Local** key.
- 3** Verify that the Counter displays a reading of approximately 2 MHz and that the **Ext Ref** annunciator is activated.
- 4** Mark Pass or Fail for Test **1c** in the Performance Test Record on page 54.

10 MHz External Timebase Input Test

- 1 Change the frequency of the first Synthesizer (connected to the Counter's rear-panel **Reference 10 MHz** connector) to 10 MHz.
- 2 Press and release the Counter's **Reset/Local** key.
- 3 Verify that the Counter displays a reading of approximately 2 MHz and that the **Ext Ref** annunciator is activated.
- 4 Mark Pass or Fail for Test **1d** in the Performance Test Record on page 54.

Test 2: Channel 1 Frequency Sensitivity

This set of tests verifies the frequency-sensitivity specifications of Channel 1 of the Keysight 53150A/151A/152A Counters.

Equipment Required

Keysight 3325A/B Synthesizer
Keysight 83650B Synthesizer
Keysight 437B Power Meter
Keysight 8487A/D Power Sensor
Keysight 11730A Power Sensor Cable
Keysight 11667C Power Splitter
Keysight 8490D (Opt. 020) 20 dB Attenuator
Keysight 1250-2015 BNC (m) to SMA (f) Adapter
Keysight 11904A 2.92 mm (m) to 2.4 mm (m) Adapter
Keysight 10503 Series Coaxial Cable (BNC m to m)
2 mm (m) to 2 mm (f) Cable (2)

Test 2a: 10 Hz to 20 MHz Frequency Sensitivity

NOTE

This test is appropriate for the Keysight 53150A, 53151A, and 53152A Counters.

- 1 Connect an Keysight 10503 Series Coaxial Cable between the RF output connector on the Keysight 3325A/B Synthesizer and Counter's **CHANNEL 1** connector.

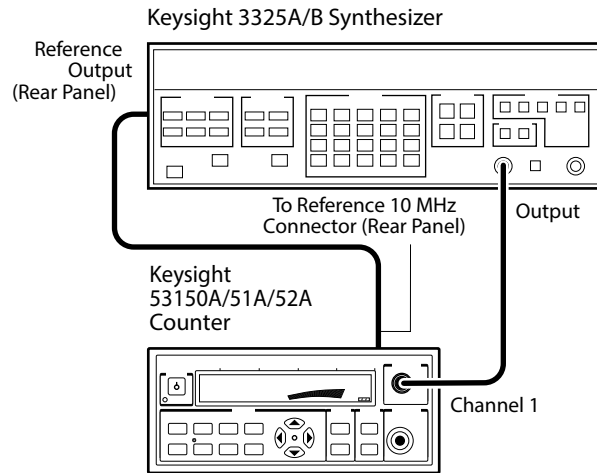


Figure 1-3 10 Hz to 20 MHz Frequency Sensitivity Test Setup

- 2 Verify that the Counter is still set to use an external reference signal (refer to steps 5 through 10 on page 37).
- 3 Set the output of the Synthesizer to the first frequency specified for Test 2a in the Performance Test Record on page 54 (10 Hz).
- 4 Set the power output of the Synthesizer to the first power value specified for Test 2a in the Performance Test Record on page 54 (-14.9 dBm) (40 mV).
- 5 Record the frequency value read on the Counter (± 1 count) for Test 2a in the Performance Test Record on page 54.
- 6 Repeat steps 3, 4, and 5 for each of the remaining frequencies specified for Test 2a. Don't forget to change the power level when performing the 1 KHz test (-19.2 dBm) (25 mV).
- 7 If all of the frequency values you recorded for Test 2a are correct, mark Pass in the Performance Test Record for Test 2a. If any of the frequency readings you recorded are incorrect, mark Fail in the Performance Test Record.

NOTE

- Do not disconnect the cable from the **Counter's Reference 10 MHz** connector. This connection is used in the following test.
- Do not turn off the Counter. Turning the Counter off and back on resets the reference oscillator (REF OSC) selection to internal (INT) and the channel selection to **CHANNEL 2**.

Test 2b: 50 MHz to 125 MHz Frequency Sensitivity

- 1 Connect an Keysight 10100C 50 Ω Feedthrough Terminator to the **CHANNEL 1** input connector on the Counter's front panel (refer to [Figure 1-4](#) for steps 1 through 9).

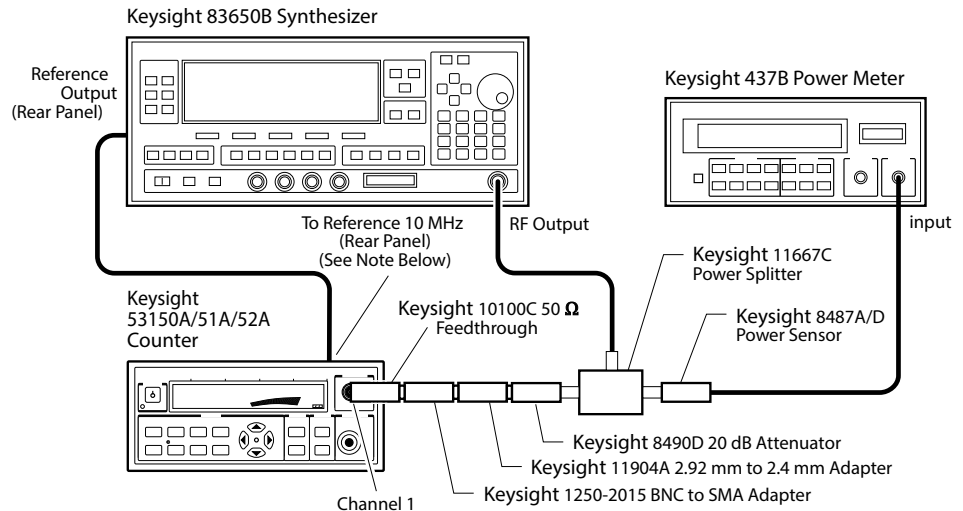


Figure 1-4 50 MHz to 125 MHz Frequency Sensitivity Test Setup

NOTE

If the 10 MHz reference output of the 53650B Synthesizer is not sufficient to drive the 53150A/51A/52A, reverse the test setup so that you drive the 83650B from the Counter.

- 2** Connect the Keysight 1250-2015 BNC (m) to SMA (f) Adapter to the Keysight 10100C Feedthrough Terminator on the Counter's **CHANNEL 1** connector.
- 3** Connect the Keysight 11904A 2.92 mm (m) to 2.4 mm (m) Adapter to the Keysight 1250-2015 Adapter.
- 4** Connect the Keysight 8490D 20 dB Attenuator to the Keysight 11904A Adapter.
- 5** Connect one of the output connectors on the Keysight 11667C Power Splitter to the Keysight 8490D Attenuator
- 6** Connect the Keysight 11900B 2.4 mm (f) to 2.4 mm (f) Adapter to the RF output of the Synthesizer.
- 7** Connect a 2.4 mm (m) to 2.4 mm (m) cable between the Adapter on the Synthesizer's RF output connector and the input connector on the Keysight 11667C Power Splitter.
- 8** Connect the Keysight 8487A/D Power Sensor to the remaining output connector on the Keysight 11667C Power Splitter.
- 9** Connect the Keysight 11730A Power Sensor Cable between the Power Sensor and the sensor connector on the Keysight 437B Power Meter.
- 10** Verify that the Counter is still set to use an external reference signal (refer to steps 5 through 10 on page 37).
- 11** Set the output of the Keysight 83650B Synthesizer to the first frequency specified for Test **2b** in the Performance Test Record on page 54 (50 MHz).
- 12** Set the power output of the Synthesizer (read on the Power Meter) to a power value 20 dBm above the value specified for Test **2b** in the Performance Test Record on page 54 (+.8 dBm). (The added 20 dBm compensates for the 20 dB Attenuator.)

1 Performance Tests - Verifying Specifications

- 13** Record the frequency value read on the Counter (± 1 count) for Test **2b** in the Performance Test Record on page 54.
- 14** Set the output of the Synthesizer to 125 MHz, and repeat steps 11 through 13.
- 15** If both of the frequency values you recorded for Test **2b** are correct, mark Pass in the Performance Test Record for Test **2b**. If either of the frequency readings you recorded are incorrect, mark Fail in the Performance Test Record.
- 16** Disconnect the Keysight 10100C Feedthrough Terminator, the Keysight 1250-2015 Adapter, and the Keysight 11904A Adapter from the Counter's **CHANNEL 1** connector.

NOTE

- Do not disconnect the rest of the test setup, as these connections are also used in the Channel 2 Frequency Sensitivity test.
 - Do not turn off the Counter. Turning the Counter off and back on resets the reference oscillator (REF OSC) selection to internal (INT).
-

Test 3: Channel 2 Frequency Sensitivity

This set of tests verifies the frequency-sensitivity specifications of Channel 2 of the Keysight 53150A/151A/152A Counters.

Equipment Required

Keysight 83650B Synthesizer
Keysight 437B Power Meter
Keysight 8487A/D Power Sensor
Keysight 11667C Power Splitter
Keysight 11730A Power Sensor Cable
Keysight 8490D (Opt. 020) 20 dB Attenuator
Keysight 11904D 2.92 mm (m) to 2.4 mm (f) Adapter
Keysight 10503 series Coaxial Cable (BNC m to m)
2.4 mm (m) to 2.4 mm (m) Cable (2)

Test 3a: 50 MHz to 20 GHz Frequency Sensitivity

NOTE

This test is appropriate for the Keysight 53150A, 53151A, and 53152A Counters.

- 1 Connect the Keysight 11904D 2.92 mm (m) to 2.4 mm (f) Adapter to the Counter's **CHANNEL 2** input connector (refer to [Figure 1-5](#) for steps 1 through 4).
- 2 Connect the Keysight 8490D Attenuator to the Keysight 11904D Adapter, as shown in [Figure 1-5](#) (the other end of the Attenuator should remain connected to the Keysight 11667C Power Splitter).
- 3 Verify that the cable (with Adapter) is still connected between the RF output of the Keysight 83650B Synthesizer and the Power Splitter input connector.
- 4 Verify that the Power Sensor is still connected to the Power Splitter and that the Power Sensor Cable is still connected between the Power Sensor and the sensor connector on the Power Meter.

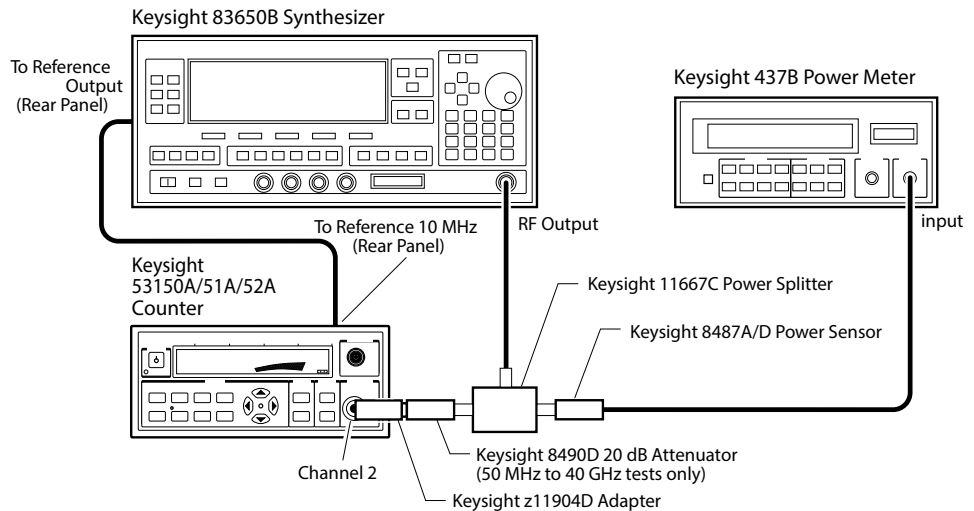


Figure 1-5 50 MHz to 20 GHz Frequency Sensitivity Test Setup

- 5 Verify that the Counter is still set to use an external reference signal (refer to steps 5 through 10 on page 37).
- 6 Set the output of the Keysight 83650B Synthesizer to the first frequency specified for Test 3a in the Performance Test Record on page 55 (50 MHz).
- 7 Set the power output of the Synthesizer (read on the Power Meter) to a power value 20 dBm above the value specified for Test 3a in the Performance Test Record on page 55 (0 dBm). (The added 20 dBm compensates for the 20 dB Attenuator.)
- 8 Record the frequency value read on the Counter (± 1 count) for Test 3a in the Performance Test Record on page 55.
- 9 Repeat steps 6, through 8 for each of the remaining frequencies specified for Test 3a. Don't forget to change the power level when performing the 400 MHz and 19 GHz tests (53150A, 53151A, and 53152A) and the 16 GHz and 19 GHz tests (53152A only).

- 10 If all of the frequency values you recorded for Test 3a are correct, mark Pass in the Performance Test Record. If any of the frequency readings you recorded are incorrect, mark Fail in the Performance Test Record.

Test 3b: 22 GHz to 26.5 GHz Frequency Sensitivity

NOTE

This test is appropriate for the Keysight 53151A and 53152A Counters.

- 1 Use the same test setup as described for Test 3a on page 45.
- 2 Set the output of the Keysight 83650B Synthesizer to the first frequency specified for Test 3b in the Performance Test Record on page 55 (22 GHz).
- 3 Set the power output of the Synthesizer (read on the Power Meter) to a power value 20 dBm above the value specified for Test 3b in the Performance Test Record on page 55 (-5 dBm for the Keysight 53151A; -7 dBm for the Keysight 53152A). (The added 20 dBm compensates for the 20 dB Attenuator.)
- 4 Record the frequency value read on the Counter (± 1 count) for Test 3b in the Performance Test Record on page 55.
- 5 Repeat steps 2 through 4 for each of the remaining frequencies specified for Test 3b.
- 6 If all of the frequency values you recorded for Test 3b are correct, mark Pass in the Performance Test Record for Test 3b. If any of the frequency readings you recorded are incorrect, mark Fail in the Performance Test Record.

Test 3c: 30 GHz to 46 GHz Frequency Sensitivity

NOTE

This test is appropriate for the 53152A Counter only.

- 1 Use the same test setup as described for Test 3a on page 45.
- 2 Set the output of the Keysight 83650B Synthesizer to the first frequency specified for Test 3c in the Performance Test Record on page 55 (30 GHz).
- 3 Set the power output of the Synthesizer (read on the Power Meter) to a power value 20 dBm above the value specified for Test 3c in the Performance Test Record on page 55 (-3 dBm). (The added 20 dBm compensates for the 20 dB Attenuator.)
- 4 Record the frequency value read on the Counter (± 1 count) for Test 3c in the Performance Test Record on page 55.
- 5 Repeat steps 2, through 4 for each of the remaining frequencies specified for Test 3c. Don't forget to change the power level for the 42, 44, and 46 GHz tests.
- 6 If all of the frequency values you recorded for Test 3c are correct, mark Pass in the Performance Test Record for Test 3c. If any of the frequency readings you recorded are incorrect, mark Fail in the Performance Test Record.

NOTE

- Do not disconnect the Power Sensor or the Power Sensor Cable from the power meter or the Power Splitter. These connections are reused in the following tests.
 - Do not turn off the Counter. Turning the Counter off and back on resets the reference oscillator (REF OSC) selection to internal (INT).
-

Test 4: Channel 2 Power Measurement

This set of tests verifies the power-measurement specifications of Channel 2 of the Keysight 53150A/151A/152A Counters.

Equipment Required

Keysight 83650B Synthesizer
Keysight 83051A Microwave Amplifier
Keysight 437B Power Meter
Keysight 8487A/D Power Sensor
Keysight 11730A Power Sensor Cable
Keysight 11667C Power Splitter
Keysight 11904D 2.92 mm (m) to 2.4 mm (f) Adapter
Keysight 11900A 2.4 mm (m) to 2.4 mm (m) Adapter
Keysight 11900B 2.4 mm (f) to 2.4 mm (f) Adapter
2.4 mm (m) to 2.4 mm (m) Cable (2)

Test 4a: 50 MHz to 20 GHz Power Measurement (-20 dBm)

NOTE

This test is appropriate for the Keysight 53150A, 53151A, and 53152A Counters.

- 1 Verify that the cable (with Adapter) is still connected to the RF output of the Keysight 83650B Synthesizer.
- 2 Connect the other end of the 2.4 mm cable to the input connector on the Keysight 83051A Microwave Amplifier.
- 3 Connect a 2.4 mm cable from the output of the Microwave Amplifier to the input connector on the Keysight 11667C Power Splitter.
- 4 Verify that the Power Sensor is still connected to the Power Splitter and that the Power Sensor Cable is still connected between the Power Sensor and the sensor connector on the Power Meter.

1 Performance Tests - Verifying Specifications

- 5 Connect the Keysight 11900A 2.4 mm (m) to 2.4 mm (m) Adapter to the Counter's **CHANNEL 2** input connector.
- 6 Connect the unused output of the Microwave Splitter to the Adapter on the Counter's **CHANNEL 2** input connector.

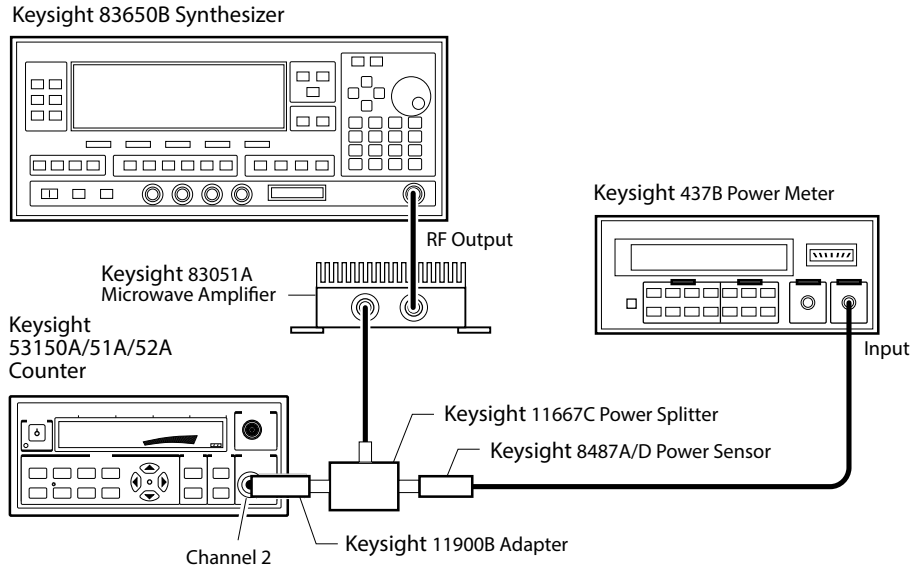


Figure 1-6 50 MHz to 20 GHz (-20 dBm) Power Measurement Test Setup

- 7 Verify that the Counter is still set to **CHANNEL 2** (if necessary, use the **Chan Select** key on the Counter's front panel to select **CHANNEL 2**).
- 8 Adjust the power output of the Synthesizer so that the power output of the Microwave Amplifier is -20 dBm.
- 9 Set the Synthesizer to the first frequency value listed for Test 4a in the Performance Test Record on page 56 (50 MHz).
- 10 Record the actual power reading in the Performance Test Record.

- 11 Repeat steps 8 through 10 for each of the remaining frequency values listed for Test 4a.
- 12 Mark Pass or Fail for Test 4a in the Performance Test Record.

Test 4b: Channel 2 22 GHz to 26.5 GHz Power Measurement (-20 dBm)

NOTE

This test is appropriate for the Keysight 53151A and 53152A Counters.

- 1 Use the same test setup as described for Test 4a on page 49.
- 2 With the power output of the Microwave Amplifier still at -20 dBm (adjust the power output of the Keysight 83650B Synthesizer, if necessary), set the Synthesizer to the first frequency value listed for Test 4b in the Performance Test Record on page 56 (22 GHz).
- 3 Record the actual power reading in the Performance Test Record.
- 4 Repeat steps 2 and 3 for each of the remaining frequency values listed for Test 4b.
- 5 Mark Pass or Fail for Test 4b in the Performance Test Record.

Test 4c: Channel 2 26.5 GHz to 46 GHz Power Measurement (-20 dBm)

NOTE

This test is appropriate for the Keysight 53152A Counter only.

- 1 Use the same test setup as described for Test 4a on page 49.
- 2 With the power output of the Microwave Amplifier still at -20 dBm (adjust the power output of the Synthesizer, if necessary), set the Synthesizer to the first frequency value listed for Test 4c in the Performance Test Record on page 56 (30 GHz).
- 3 Record the actual power reading in the Performance Test Record.
- 4 Repeat steps 2 and 3 for each of the remaining frequency values listed for Test 4c.
- 5 Mark Pass or Fail for Test 4c in the Performance Test Record.

Test 4d: Channel 2 50 MHz to 20 GHz Power Measurement (0 dBm)

NOTE

This test is appropriate for the Keysight 53150A, 53151A, and 53152A Counters.

- 1 Use the same test setup as described for Test 4a on page 49.
- 2 Adjust the power output of the Synthesizer so that the power output of the Microwave Amplifier is 0 dBm.
- 3 Set the Synthesizer to the first frequency value listed for Test 4d in the Performance Test Record on page 57 (50 MHz).
- 4 Record the actual power reading in the Performance Test Record.
- 5 Repeat steps 2 through 4 for each of the remaining frequency values listed for Test 4d.
- 6 Mark Pass or Fail for Test 4d in the Performance Test Record.

Test 4e: Channel 2 22 GHz to 26.5 GHz Power Measurement (0 dBm)

NOTE

This test is appropriate for the Keysight 53151A and 53152A Counters.

- 1 Use the same test setup as described for Test 4a on page 49.
- 2 With the power output of the Microwave Amplifier still at 0 dBm (adjust the power output of the Synthesizer, if necessary), set the Synthesizer to the first frequency value listed for Test 4e in the Performance Test Record on page 57 (22 GHz).
- 3 Record the actual power reading in the Performance Test Record.
- 4 Repeat steps 2 and 3 for the remaining frequency values listed for Test 4e.
- 5 Mark Pass or Fail for Test 4e in the Performance Test Record.

Test 4f: Channel 2 30 GHz to 46 GHz Power Measurement (0 dBm)

NOTE

This test is appropriate for the Keysight 53152A Counter only.

- 1 Use the same test setup as described for Test 4a on page 49.
- 2 With the power output of the Microwave Amplifier still at 0 dBm (adjust the power output of the Synthesizer, if necessary), set the Synthesizer to the first frequency value listed for Test 4f in the Performance Test Record on page 57 (30 GHz).
- 3 Record the actual power reading in the Performance Test Record.
- 4 Repeat steps 2 and 3 for each of the remaining frequency values listed for Test 4f.
- 5 Mark Pass or Fail for Test 4f in the Performance Test Record.

Performance Test Record (Page 1 of 4)

Keysight 53150A/151A/152A Microwave Frequency Counter				
Serial Number: _____		Repair/Work Order No.: _____		
Test Performed By: _____		Temperature: _____		
Date: _____		Relative Humidity: _____		
Notes: _____				
Pre Calibration Test <input type="checkbox"/>		Post Calibration Test <input type="checkbox"/>		
Test Number	Operational Verification	Specifications	Test Results	
			Pass	Fail
1	Power on Self Tests	N/A	<input type="checkbox"/>	<input type="checkbox"/>
2	10 MHz Test	10,000,000 Hz	<input type="checkbox"/>	<input type="checkbox"/>
3	Run Self Test	N/A	<input type="checkbox"/>	<input type="checkbox"/>
4	10 MHz External Timebase Input Test	2 MHz	<input type="checkbox"/>	<input type="checkbox"/>
Test Number	Complete Performance Tests	Specifications	Test Results	
			Pass	Fail
1a	1 MHz External Timebase Input Test	2 MHz	<input type="checkbox"/>	<input type="checkbox"/>
1b	2 MHz External Timebase Input Test	2 MHz	<input type="checkbox"/>	<input type="checkbox"/>
1c	5 MHz External Timebase Input Test	2 MHz	<input type="checkbox"/>	<input type="checkbox"/>
1d	10 MHz External Timebase Input Test	2 MHz	<input type="checkbox"/>	<input type="checkbox"/>
2a	Channel 1 Frequency Sensitivity	10 Hz @ 40 mV rms (-14.9 dBm) 30 Hz @ 40 mV rms (-14.9 dBm) 1 kHz @ 25 mV rms (-19.2 dBm) 500 kHz @ 25 mV rms (-19.2 dBm) 5 MHz @ 25 mV rms (-19.2 dBm) 10 MHz @ 25 mV rms (-19.2 dBm) 20 MHz @ 25 mV rms (-19.2 dBm)	<input type="checkbox"/>	<input type="checkbox"/>
	10 Hz		_____	_____
	30 Hz		_____	_____
	1 kHz		_____	_____
	500 kHz		_____	_____
	5 MHz		_____	_____
	10 MHz		_____	_____
20 MHz	_____	_____		
2b	Channel 1 Frequency Sensitivity	50 MHz @ 25 mV rms (-19.2 dBm) 125 MHz @ 25 mV rms (-19.2 dBm)	<input type="checkbox"/>	<input type="checkbox"/>
	50 MHz		_____	_____
	125 MHz	_____	_____	_____

Performance Test Record (Page 2 of 4)

Test Number	Complete Performance Tests	Specifications			Test Results	
		53150A	53151A	53152A	Pass	Fail
3a	Channel 2 Frequency Sensitivity	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	50 MHz	-20 dBm	-20 dBm	-20 dBm		
	100 MHz	"	"	"		
	250 MHz	"	"	"		
	300 MHz	-33 dBm	-33 dBm	-33 dBm		
	500 MHz	"	"	"		
	1 GHz	"	"	"		
	2.5 GHz	"	"	"		
	5 GHz	"	"	"		
	10 GHz	"	"	"		
	12.4 GHz	"	"	"		
	16 GHz	"	"	-30 dBm		
	18 GHz	"	"	"		
	19 GHz	-29 dBm	-29 dBm	-27 dBm		
20 GHz	"	"	"			
3b	Channel 2 Frequency Sensitivity	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	22 GHz	N/A	-25 dBm	-27 dBm		
	24 GHz	N/A	"	"		
	26.5 GHz	N/A	"	"		
3c	Channel 2 Frequency Sensitivity	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	30 GHz	N/A	N/A	-23 dBm		
	34 GHz	N/A	N/A	"		
	40 GHz	N/A	N/A	"		
	42 GHz	N/A	N/A	-17 dBm		
	44 GHz	N/A	N/A	"		
	46 GHz	N/A	N/A	"		

Performance Test Record (Page 3 of 4)

Test Number	Complete Performance Tests	Specifications			Test Results	
		53150A	53151A	53152A	Pass	Fail
4a	Power Measurement (-20 dBm):	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	50 MHz	±1.5 dB	±1.5 dB	±1.0 dB	_____	_____
	500 MHz	"	"	"	_____	_____
	1 GHz	"	"	"	_____	_____
	5 GHz	"	"	"	_____	_____
	10 GHz	"	"	"	_____	_____
	12.4 GHz	"	"	±1.5 dB	_____	_____
	15 GHz	"	"	"	_____	_____
	16 GHz	"	"	"	_____	_____
20 GHz	"	"	"	_____	_____	
4b	Power Measurement (-20 dBm):	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	22 GHz	N/A	±2.0 dB	±1.5 dB	_____	_____
	24 GHz	N/A	"	"	_____	_____
	26.5 GHz	N/A	"	"	_____	_____
4c	Power Measurement (-20 dBm):	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	30 GHz	N/A	N/A	±2.0 dB	_____	_____
	34 GHz	N/A	N/A	"	_____	_____
	40 GHz	N/A	N/A	"	_____	_____
	46 GHz	N/A	N/A	"	_____	_____

Performance Test Record (Page 4 of 4)

Test Number	Complete Performance Tests	Specifications			Test Results	
		53150A	53151A	53152A	Pass	Fail
4d	Power Measurement (0 dBm):	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	50 MHz	±1.5 dB	±1.5 dB	±1.0 dB		
	500 MHz	"	"	"		
	1 GHz	"	"	"		
	5 GHz	"	"	"		
	10 GHz	"	"	"		
	12.4 GHz	"	"	±1.5 dB		
	15 GHz	"	"	"		
	16 GHz	"	"	"		
20 GHz	"	"	"			
4e	Power Measurement (0 dBm):	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	22 GHz	N/A	±2.0 dB	±1.5 dB		
	24 GHz	N/A	"	"		
	26.5 GHz	N/A	"	"		
4f	Power Measurement (0 dBm):	53150A	53151A	53152A	<input type="checkbox"/>	<input type="checkbox"/>
	30 GHz	N/A	N/A	±2.0 dB		
	34 GHz	N/A	N/A	"		
	40 GHz	N/A	N/A	"		
	46 GHz	N/A	N/A	"		

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Keysight 53150A/151A/152A Microwave Frequency Counter Assembly Level Service Guide

2 Service

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Introduction

This chapter provides service information for your Keysight 53150A/151A/152A. It is divided into four major sections:

- **Returning the Counter to Keysight Technologies for Service** (page 61). This section provides you with step-by-step instructions on how to return the instrument for service.
- **Calibration Procedure** (page 63). This section provides step-by-step procedures for calibrating the Keysight 53150A/151A/152A.
- **Pre-Troubleshooting Information** (page 65). This section provides you with pertinent information such as safety considerations, recommended test equipment, repair and after-service considerations, and assembly identification and location.
- **Troubleshooting the Counter** (page 70). This section provides you with troubleshooting procedures that isolate the faulty assembly or module. Replacement and recalibration of most modules can only be performed at an authorized Keysight Technologies Service Center.

If the instrument is under warranty, return it to Keysight for service. Refer to “**Returning the Counter to Keysight Technologies for Service**” on page 61. If you decide to troubleshoot the instrument yourself, refer to the section titled “**Troubleshooting the Counter**” on page 70.

Returning the Counter to Keysight Technologies for Service

Providing Repair Information

Before shipping the Counter to an Keysight office for service or repair, call the nearest Keysight Sales Office to make arrangements. Then, tag and package the Keysight 53150A/151A/152A for shipment.

NOTE

ISD (Instrument Service Division) Emergency Response or Express Calibration Service is available for Keysight customers in the USA. If downtime is critical, you can receive your repaired Counter via overnight shipment. Call **1-800-403-0801**, and ask for *Emergency Response* or *Express Calibration Service*. When your Counter is repaired, it is returned via overnight shipment at no extra charge.

- 1 Write the following information on a tag:
 - Owner's name and address
 - Counter model number
 - Complete serial number
 - Description of service required or failure indications
- 2 Attach the tag to the instrument.
- 3 Pack the instrument.

If the original packaging materials are available, use the procedure titled **“Packing the Counter in the Original Packaging Materials”** If the original packaging materials are not available, you can order new packaging materials from an Keysight Sales Office. The new packaging materials are identical to those used by the factory when packaging new instruments. To use commercially available packaging materials, use the procedure titled **“Packing the Counter in Commercially Available Packaging Materials.”** Both procedures are on the following page.

Packing the Counter in the Original Packaging Materials

To prevent shipping damage, it is best to repack the Counter in its original packaging. In any correspondence, refer to the Counter by the model number and the complete serial number.

- 1 Disconnect the power cord, probes, cables, or other accessories attached to the instrument.
- 2 Make sure the folded corrugated spacer (which normally contains the manuals) is in the box to ensure proper fitting.
- 3 Make sure one of the polystyrene blocks is in its proper position in the box.
- 4 Place the instrument, front panel end first, on the polystyrene block.
- 5 Place the other polystyrene block on top of the rear end of the instrument to secure it.
- 6 Do not return the manuals with the instrument. Return an accessory only when it is a part of the failure symptoms.
- 7 Seal the shipping container securely.

Packing the Counter in Commercially Available Packaging Materials

If the original factory packaging materials are not available, use the following procedure to pack the Counter in commercially available shipping materials.

- 1 Wrap the instrument in heavy paper or plastic.
- 2 Place the instrument in a strong shipping container. Use a double-walled carton made of at least 350 lb. test material.
- 3 Protect the control panel with cardboard.
- 4 Add a layer of shock-absorbing material that is 3 to 4 inches (70 to 100 mm) thick around all sides of the instrument cushion it and to prevent it from moving within the container
- 5 Seal the shipping container securely.
- 6 Mark the shipping container **FRAGILE**.

Calibration Procedure

There is only one calibration procedure that can be performed outside of an Keysight authorized service facility. The following procedure describes how to calibrate the Counter's timebase.

NOTE

The Counter should be powered on for at least 30 minutes prior to beginning the calibration procedure. This allows the internal temperature of the Counter and its timebase to stabilize.

Equipment Required

10 MHz Reference Standard
Non-metallic adjustment tool for slotted screw head
Keysight 10503 series Coaxial Cable

- 1 Connect an Keysight 10503 series coaxial cable from the output of your 10 MHz frequency standard to the Channel 1 input on the Counter's front panel.
- 2 If there is a label covering the calibration adjustment access hole, remove it (see [Figure 2-1](#)).

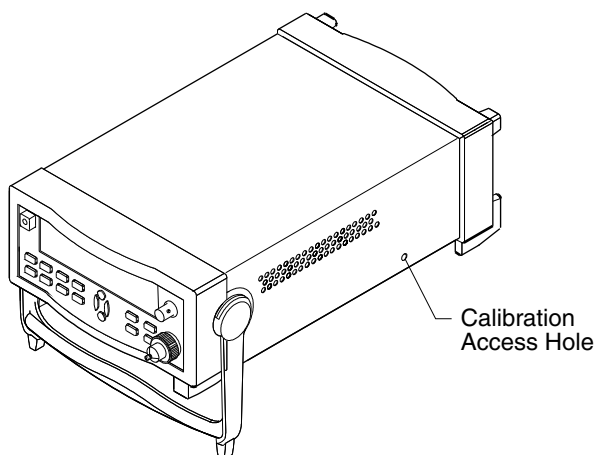


Figure 2-1 Calibrating the Counter

- 3** Insert a non-metallic slotted adjustment tool through the hole in the lower-right side of the Counter's cover and into the slot in the timebase calibration screw.
- 4** Turn the calibration screw clockwise to increase the Counter's reading or counter-clockwise to decrease the reading until the frequency value displayed on the Counter's front panel is exactly **10,000,000 Hz**.

Pre-Troubleshooting Information

This section contains the following pertinent troubleshooting information:

- Safety Considerations
- Recommended Test Equipment
- Repair Considerations
- After Service Considerations
- Assembly Identification and Location

Safety Considerations

Although this instrument has been designed in accordance with international safety standards, this guide contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition. Service instructions, and adjustment procedures requiring removal of the instrument cover, are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing or make any adjustments with the cover removed, unless qualified to do so.

WARNING

BEFORE APPLYING AC POWER, THE INSTRUMENT AND ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTO TRANSFORMERS, AND DEVICES CONNECTED TO THE INSTRUMENT SHOULD BE CONNECTED TO A PROTECTIVE EARTH GROUNDED SOCKET.

ANY INTERRUPTION OF THE PROTECTIVE GROUNDING CONDUCTOR INSIDE OR OUTSIDE THE INSTRUMENT OR DISCONNECTION OF THE PROTECTIVE EARTH TERMINAL WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY. INTENTIONAL INTERRUPTION IS PROHIBITED.

Any maintenance and repair of the opened instrument under voltage should be avoided as much as possible and, if necessary, should be carried out only by a skilled person who is aware of the hazards involved (for example, fire and electric shock).

Recommended Test Equipment

Test equipment recommended for testing and troubleshooting the Keysight 53150A/151A/152A is listed in [Chapter 1](#), “[Performance Tests - Verifying Specifications](#)”. Substitute equipment may be used if it meets or exceeds the required characteristics listed in [Table 2-1](#).

Repair Considerations

Electrostatic Discharge

Electronic components and assemblies in the Keysight 53150A/151A/152A can be permanently degraded or damaged by electrostatic discharge.

Use the following precautions when servicing the instrument:

- 1 ENSURE** that static-sensitive devices or assemblies are serviced at static-safe work stations providing proper grounding for service personnel.
- 2 ENSURE** that static-sensitive devices or assemblies are stored in static shielding bags or containers.
- 3 DO NOT** wear clothing subject to static-charge buildup, such as wool or synthetic materials.
- 4 DO NOT** handle components or assemblies in carpeted areas.
- 5 DO NOT** remove an assembly or component from its static shielding protection until you are ready to install it.
- 6 AVOID** touching component leads (handle by packaging only).

Surface Mount Repair

None of the assemblies in the Counter that use surface-mount components can be repaired outside of authorized Keysight Service Centers. Any attempt to repair these assemblies voids the Keysight factory warranty and makes the assemblies ineligible for return credit.

Disassembly and Reassembly Specifics

Refer to [Chapter 3](#) of this guide, “[Replacing Assemblies - Disassembly and Reassembly](#),” for complete disassembly and reassembly instructions, and [Chapter 4](#), “[Replaceable Parts](#)” for an exploded view of the instrument’s parts.

After Service Considerations

Product Safety Checks

The following safety checks must be performed after any troubleshooting and repair procedures have been completed to ensure the safe operation of the instrument.

WARNING

THE RESISTANCE CHECKS DESCRIBED IN THE FOLLOWING TEXT REQUIRE THAT THE POWER CORD BE CONNECTED TO THE INSTRUMENT AND THAT AC POWER BE DISCONNECTED. BE SURE THAT THE POWER CORD IS NOT CONNECTED TO AN AC POWER SOURCE BEFORE PERFORMING ANY SAFETY CHECKS.

- 1 VISUAL INSPECTION.** Visually inspect the interior of the instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy the cause of any such condition.
- 2 GROUND CONTINUITY TEST.** Plug the power cord into the rear- panel power receptacle. (DO NOT connect the instrument to AC power at this time.) Using a suitable ohmmeter, check resistance from the instrument's metallic connection (such as the rear panel or BNC ground collar) to the ground pin on the power cord plug. The reading must be less than 1Ω . Flex the power cord while making this measurement to determine whether intermittent discontinuities exist.
- 3** Check any indicated front- or rear-panel ground terminals marked, using the above procedure.
- 4 INSULATION RESISTANCE TEST.** Tie the line and neutral pins of the power cord plug together. Measure the resistance from the instrument enclosure (chassis) to the line and neutral pins of the power cord plug. The minimum acceptable resistance is $2\text{ M}\Omega$. Replace any component which results in a failure.

Product Performance Checks

After replacement of any functional assembly, perform the operational verification test in [Chapter 1](#) of this guide, “[Performance Tests - Verifying Specifications.](#)”

Assembly Identification and Location

The assembly number, name, and Keysight part number for each of the Keysight 53150A, 53151A, and 53152A assemblies are listed in [Table 2-1](#). [Figure 2-2](#) illustrates the replaceable assemblies in the Keysight 53150A/151A/152A.

Table 2-1 Keysight 53150A/151A/152A Assembly Identification

Assembly Name	Keysight Part No.
A1 Adapter (53152A only)	53152-80001
A2 Cooling Fan Assembly	53150-80012
A3 Standby Power Switch Assembly	53150-80013
A4 Battery Housing Assembly ^[a]	53150-00002
A5 DC/DC Converter PCB ^[a]	53150-60004
A6 Battery ^[a]	53150-80010
A7 Battery Sled Assembly ^[a]	53150-00004
A8 Battery Cover Assembly	53150-00003
A9 Rear Panel Assembly	—
A10 Power Entry Module Assembly	53150-40007
A11 Power Supply Assembly	0950-3299
A12 Rear Panel Power Switch Assembly	53150-60220

[a] With Option 002 (Battery Option) only.

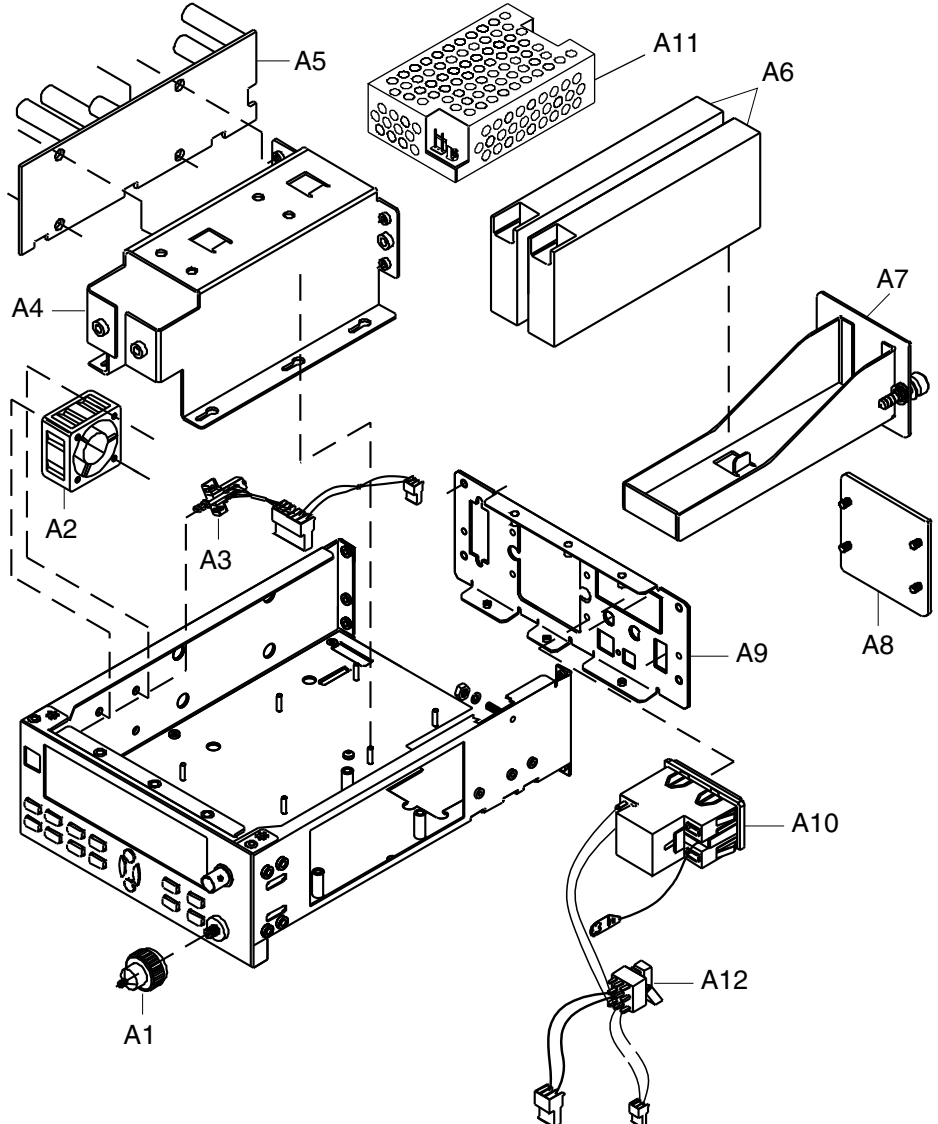


Figure 2-2 Replaceable Assembly Locations – Top Internal View

Troubleshooting the Counter

Power Supply Check

WARNING

HAZARDOUS VOLTAGES ARE PRESENT ON THE POWER SUPPLY ASSEMBLY. ONLY TRAINED AND QUALIFIED SERVICE PERSONNEL SHOULD PERFORM THE FOLLOWING PROCEDURE.

- 1 Remove the power cord from the back of the instrument.
- 2 Remove the cover as described in [Chapter 3](#).

NOTE

The DC Power Supply Assembly is fused for safety reasons. It must be assumed that, if the fuses are blown, the power supply has probably suffered damage and has therefore become unreliable. If the power supply fails, it must be replaced, even if the fuse in the power supply appears to be all that has failed.

- 3 Connect the Counter to the power source.
- 4 Connect the negative lead of a voltmeter to the chassis and measure each of the voltages listed in [Table 2-2](#) on Power Supply connectors TB1 and TB2 (see [Figure 2-3](#)).

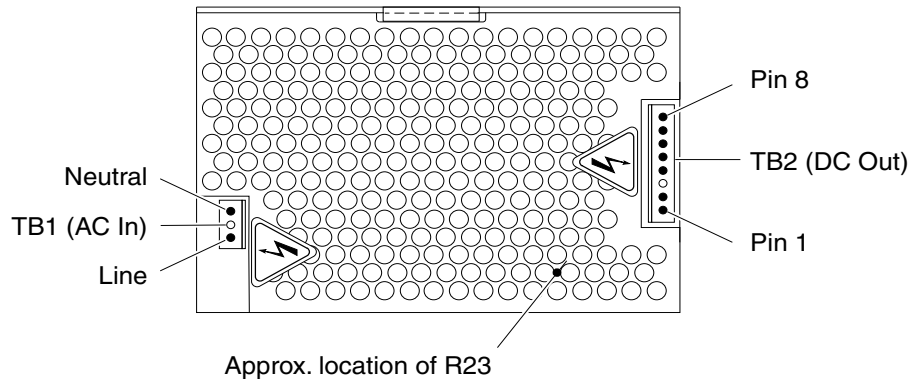


Figure 2-3 A4 DC Power Supply Test-Point Locations

Table 2-2 lists A4 Power Supply's input and output voltages, the corresponding wire color for each input and output, and the tolerances specified for these voltages.

Table 2-2 A4 Power Supply Inputs and Outputs

Input/Output Voltage	Connector and Pin Designation	Wire Color	Tolerance
AC-input (neutral) 0 VAC ^[a]	TB1, pin N	blue	–
AC-input (line in) 85 - 264 VAC ^[a]	TB1, pin L	brown	–
–15.0 VDC @ 0.7 A max.	TB2, pin 1	lavender	±3%
0.0 VDC (ground for –15 VDC)	TB2, pin 2	brown	–
N/A (unused)	TB2, pin position 3 (no pin)	N/A	–
N/A (unused)	TB2, pin 4		
+15.0 VDC @ 2 A max.	TB2, pin 5	blue	±5%
0.0 VDC (ground for +15 VDC)	TB2, pin 6	brown	–
+5.0 VDC @ 5A max.	TP 10 (bottom of motherboard)	red	±1%
0.0 VDC (ground for +5 VDC)	TB2, pin 8	black	–

[a] AC-input values are referenced to chassis ground.

Adjusting the +5 VDC Output

The +5 VDC output of the power supply is adjustable. If this voltage is found to be outside of the tolerance range listed in **Table 2-2**, it can be adjusted using R23, which is visible on the top surface of the power supply's circuit board. When adjusting the +5 VDC output, use a non-metallic or insulated adjustment tool.

Self-Test

The Counter performs a Self-Test procedure when it is powered on. The Self-Test can also be invoked from the Counter's Menu.

Running the Self Test

- 1** Disconnect all cables connected to the Counter's front and rear signal connectors.
- 2** Turn on the **Main ~ Power** switch on the Counter's rear panel.
- 3** Press and release the **Power** button on the front panel.
- 4** Observe the front-panel display and note any error messages displayed.
- 5** When **CH 2 NO SIGNAL** is displayed, press and release the **Shift** key, and then press and release the **Menu** key.
- 6** Press the up-arrow key or the down-arrow key repeatedly until **DO SELF TEST** is displayed, and then press and release the **Enter** key.
- 7** Observe the front-panel display and note any error messages displayed.

Self Test Error Messages

Table 2-3 lists and describes messages that are generated by the Counter during Self-Test to indicate whether a component passed or failed its test. These messages are sent via the RS-232 serial output only—they do not appear on the Counter's front-panel display.

Table 2-3 Self-Test Messages

Message	Description
ROM TEST FAIL	ROM failed read test.
ROM TEST OK	ROM passed read test.
RAM DATA LINES OK	RAM data lines passed test.
RAM DATA ERROR	RAM data lines failed test.
RAM ADDR LINES OK	RAM address lines passed test.
RAM ADDR ERROR	RAM address lines failed test.
RAM TEST OK	RAM tests completed with no errors detected.
EEPROM FAIL - CONFIGURATION DATA	The configuration data saved in EEPROM memory is defective.
ROM FAIL; Computed checksum does not match the value stored in EEPROM.	The checksum of the ROM data does not match the value stored in EEPROM.
EEPROM FAIL - CONFIGURATION DATA; Needs to be (re)initialized.	The EEPROM org code does not verify with current revision of ROM code.
EEPROM FAIL - POWER CAL DATA; Using default data	The checksum of the EEPROM power-calibration table is bad. Factory default calibration data will be used.
EEPROM FAIL - SAVED SETTINGS; Using default data	The checksum of the user settings stored in EEPROM is bad. Factory default settings will be used.
EEPROM FAIL - SAVED SETTINGS; Invalid EEPROM SAV n Data.	The checksum of one set of user settings (1 – 9) stored in EEPROM is bad.
GPIB FAIL; Conf. Test	The GPIB hardware failed its confidence test.

Table 2-4 and Table 2-5 list and describe the messages that are generated by the Counter during Self-Test or during operation to indicate that a problem has been detected. These messages are displayed on the Counter's front-panel display and are also sent via the RS-232 serial output (in many cases, the exact message text that is displayed on the front panel is a condensed form of the message that is sent via RS-232).

Table 2-4 Front Panel Display Error Messages

Message	Description
12V FAIL	The +12 VDC output from the power supply is not within specifications.
-12V FAIL	The -12 VDC output from the power supply is not within specifications.
-5V FAIL	The -5 VDC output from the power supply is not within specifications.
ADC FAIL	Failure detected in the ADC.
PATH FAIL	Failure detected in the Channel 1 signal path.
THRS FAIL	Failure detected in the Channel 1 threshold circuit.
THRS FAIL	Failure detected in the Channel 2 RF threshold circuit.
THRS THRU	Failure detected in the Channel 2 through-path threshold circuit.
THRS HET	Failure detected in the Channel 2 heterodyne-path threshold circuit.
EEP WRT FAIL	Failure detected while writing to EEPROM.
FPANEL FAIL	The front panel or its interconnecting cable is defective or not properly connected.
FPGA FAIL	Failure detected in the FPGA (Field Programmable Gate Array).
GPIB FAIL	Failure detected in the GPIB hardware.
HET PATH FAIL	Failure detected in the heterodyne-path circuit.
IIC FAIL	An attempt to write to the LCD display failed.
INSTCFG FAIL	The instrument's configuration data is missing or has become corrupted.
OVERTEMP	The Counter's internal temperature is above the acceptable limit.
PWR CAL FAIL	The instrument's power-calibration data is missing or corrupted.
PWR CKT FAIL	Failure detected in the Channel 2 power-measurement circuit.
RAM FAIL	Failure detected in RAM.
ROM FAIL	Failure detected in ROM.

Table 2-4 Front Panel Display Error Messages (continued)

Message	Description
SAV SET FAIL	One or more of the sets of user settings is missing or is corrupted.
SERVICE FAIL	The instrument's service data is missing or has become corrupted.
THRU FAIL	Failure detected in the through-path circuit of Channel 2.
VCO/CNT FAIL	Failure detected in the VCO or the Count Chain.

Table 2-5 RS-232 Error Messages

Message	Description
12V FAIL	The +12 VDC output from the power supply is not within specifications.
-12V FAIL	The -12 VDC output from the power supply is not within specifications.
-5V FAIL	The -5 VDC output from the power supply is not within specifications.
ADC FAIL	Failure detected in the ADC.
B1 SIGNAL PATH FAIL	Failure detected in the Channel 1 signal path.
B1 THRESHOLD FAIL	Failure detected in the Channel 1 threshold circuit.
B2 RF THRESHOLD FAIL	Failure detected in the Channel 2 RF threshold circuit.
B2 THROUGH-PATH THRESHOLD FAIL	Failure detected in the Channel 2 through-path threshold circuit.
B2 HETERODYNE PATH THRESHOLD FAIL	Failure detected in the Channel 2 heterodyne-path threshold circuit.
EEPROM FAIL - WRITE	Failure detected while writing to EEPROM.
FRONT PANEL FAIL	The front panel or its interconnecting cable are defective or not properly connected.
FPGA FAIL	Failure detected in the FPGA (Field Programmable Gate Array).
GPIB FAIL	Failure detected in the GPIB hardware.
HETERODYNE PATH FAIL	Failure detected in the heterodyne-path circuit.
IIC FAIL	An attempt to write to the LCD display failed.
INSTCFG FAIL	The instrument's configuration data is missing or corrupted.
OVER TEMPERATURE	The Counter's internal temperature is above the limit.

Table 2-5 RS-232 Error Messages (continued)

Message	Description
PWR CAL FAIL	The instrument's power-calibration data is missing or corrupted.
POWER METER FAIL	Failure detected in the Channel 2 power-measurement circuit.
RAM FAIL	Failure detected in RAM.
ROM FAIL	Failure detected in ROM.
SAV SET FAIL	One or more of the sets of user settings is missing or corrupted.
SERVICE FAIL	The instrument's service data is missing or corrupted.
THRU PATH FAIL	Failure detected in the through-path circuit of Channel 2.
VCO/COUNT CHAIN FAIL	Failure detected in the VCO or the Count Chain.

3 Replacing Assemblies – Disassembly and Reassembly

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Introduction

This chapter provides instructions for removing major assemblies in the Keysight 53150A/151A/152A. To install an assembly, apply the removal instructions in reverse.

The following disassembly and repair procedures are provided:

- Removing the Bumpers pg. 80
- Removing the Handle and Handle Mounts pg. 81
- Removing the Rear Bezel pg. 82
- Removing the Shroud pg. 84
- Removing the Rear Panel Assembly pg. 88
- Removing the Cooling Fan pg. 91
- Replacing the Power Supply pg. 92

WARNING

HAZARDOUS VOLTAGES ARE PRESENT ON THE POWER SUPPLY ASSEMBLY. DISCONNECT THE COUNTER FROM THE POWER SOURCE, AND WAIT AT LEAST SIX MINUTES BEFORE WORKING INSIDE THE INSTRUMENT.

CAUTION

Do not replace assemblies when the Counter is operating to prevent damage to components.

NOTE

Unless otherwise stated, directional referents in the procedures in this chapter are accurate when viewing the Counter from the front.

Part numbers for all replaceable parts and assemblies are provided in [Chapter 4, "Replaceable Parts"](#).

Tools Required

The following tools are required for the removal/replacement procedures in this chapter:

- #1 Phillips screwdriver
- #2 Phillips screwdriver
- TORX® 15 (T15) hand screwdriver
- 1/4-inch open-end or box wrench
- 1/4-inch nut driver
- 5/16-inch nut driver
- Needle-nose pliers

Do This First

Perform the following steps before beginning any of the removal and replacement procedures:

- 1** If the Counter is on, press and release the POWER button on the front panel, and then set the **Main ~ Power** switch on the rear panel to “0” (off).
- 2** Disconnect the AC power cord from the AC input socket on the rear panel.
- 3** If the Counter has the Battery Option (002) installed, remove the battery sled, and disconnect any DC input cable from the EXT DC connector on the rear panel.

CAUTION

While most of the hardware used in the Counter is SAE, the four TORX screws that attach the handle mounts to the Counter are metric. To avoid damage to the threaded holes in the chassis that handle mount screws fit in, be sure to use the correct screws.

Removing the Bumpers

Use the following procedure to remove the front and rear bumpers:

- 1 To remove the front bumper, lift the center of the top of the bumper upward, stretch a corner of the bumper diagonally, then slide it off the front of the Counter.



Figure 3-1 Removing the Bumpers

- 2 Use the equivalent procedure for the rear bumper.

NOTE

The bumpers can be used to support and protect the Counter after the shroud is removed. Place both bumpers on their inner edges on your work surface, and then place the Counter on top of them. The rear bumper can also serve as a holder for screws and other hardware temporarily removed from the Counter.

Removing the Handle and Handle Mounts

Use the following procedure to remove the carrying handle and handle mounts:

- 1 Rotate the handle to the vertical position above the Counter, pull the ends of the handle outward at the mounts to detach it, and set it aside.

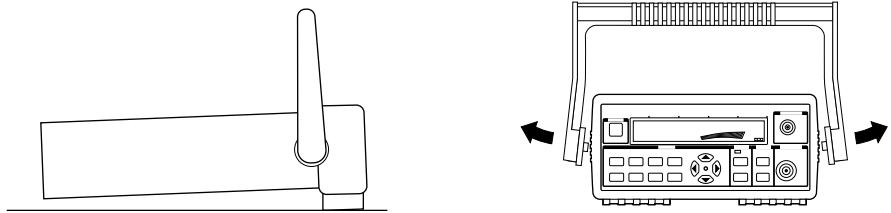


Figure 3-2 Removing the Handle

- 2 Remove the front bumper (see “[Removing the Bumpers](#)” on page 80).
- 3 Use a T15 TORX screwdriver to remove the two screws that attach each of the handle mounts to the Counter, and remove the mounts.

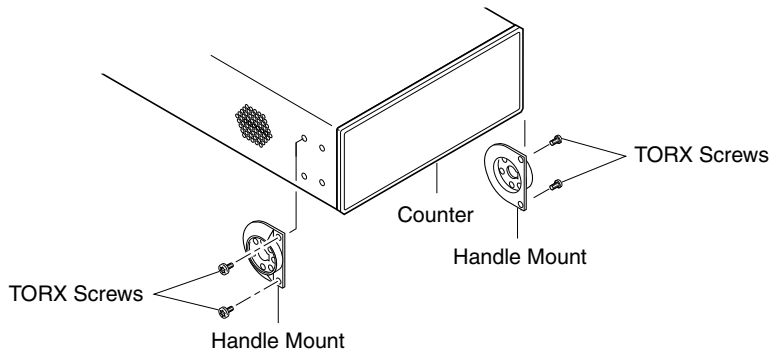


Figure 3-3 Removing the Handle Mounts

NOTE

When reattaching the handle mounts, limit the torque on the TORX screws to 4 to 5 inch-pounds.

Removing the Rear Bezel

Use the following procedure to remove the rear bezel:

- 1 Remove the rear bumper (see “[Removing the Bumpers](#)” on page 80).

NOTE

The rear bumper can be used as a holder for hardware and other small parts while they are temporarily removed from the Counter.

- 2 Use a #2 Phillips screwdriver to remove the two 6-32 pan-head machine screws that attach the rear bezel to the rear panel of the Counter (see [Figure 3-4](#)).

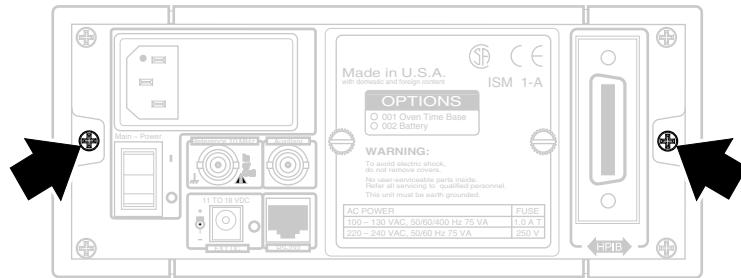


Figure 3-4 Rear Bezel Mounting Screws

- 3 Use a #1 Phillips screwdriver to remove the three 4-40 x 3/16-inch countersunk shroud screws on the top of the Counter near the back edge of the shroud (see [Figure 3-5](#)).

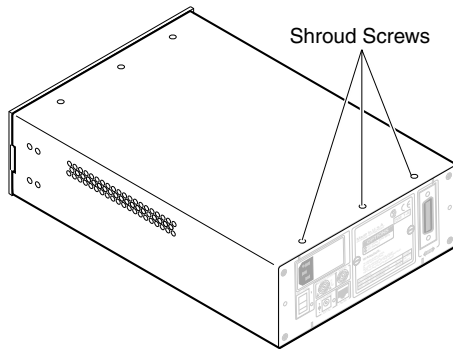


Figure 3-5 Top Rear Shroud Screws

- 4 Turn the Counter upside-down, and remove the three 4-40 x 3/16-inch countersunk shroud screws on the bottom of the Counter near the back edge of the shroud (see [Figure 3-6](#)).

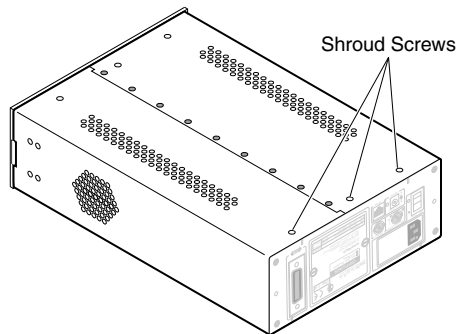


Figure 3-6 Bottom Rear Shroud Screws

- 5 Carefully work the rear bezel out of the back end of the shroud by alternately pulling opposite corners of the bezel away from the Counter a small amount at a time. Do not use tools to pry the bezel out of the shroud, since this could damage it.

Removing the Shroud

Use the following procedure to remove the shroud:

WARNING

WHEN THE SHROUD IS REMOVED FROM THE COUNTER, DANGEROUS LINE VOLTAGES THAT CAN CAUSE SERIOUS INJURY ARE EXPOSED. ALWAYS DISCONNECT THE POWER CORD BEFORE REMOVING THE SHROUD.

- 1 Remove the front and rear bumpers (see “[Removing the Bumpers](#)” on page 80).

NOTE

The bumpers can be used to support and protect the Counter after the shroud is removed. Place both bumpers on their inner edges on your work surface, and then place the Counter on top of them. The rear bumper can also serve as a holder for screws and other hardware temporarily removed from the Counter.

- 2 Remove the handle and the handle mounts (see “[Removing the Handle and Handle Mounts](#)” on page 81).
- 3 Remove the rear bezel (see “[Removing the Rear Bezel](#)” on page 82).
- 4 Use a #1 Phillips screwdriver to remove the three 4-40 x 3/16-inch countersunk shroud screws from the top of the Counter near the front edge of the shroud (see [Figure 3-7](#)).

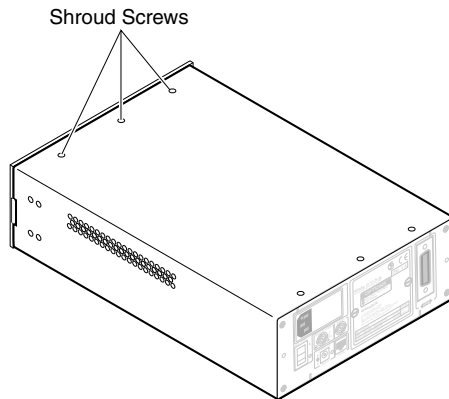


Figure 3-7 Top Front Shroud Screws

- 5 Turn the Counter upside-down, and remove the three 4-40 x 3/16-inch countersunk shroud screws on the bottom of the Counter near the front edge of the shroud (see [Figure 3-8](#)).

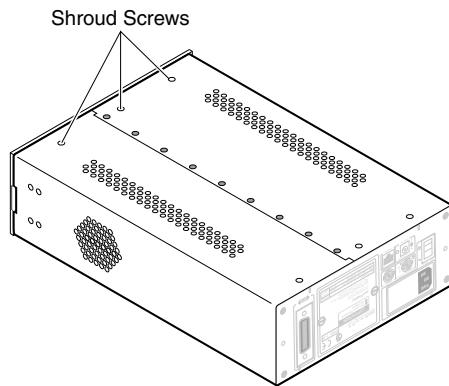


Figure 3-8 Bottom Front Shroud Screws

3 Replacing Assemblies - Disassembly and Reassembly

- 6 With the Counter resting upside-down on your work surface, grip the front edge of the shroud in the cutout of the front bezel with the fingers of one hand, and push the Counter's rear panel toward the front of the shroud with your other hand. Reduce the amount of pressure you apply to the rear panel when the shroud begins to slide off the Counter, and carefully remove the shroud the rest of the way (see [Figure 3-9](#)).

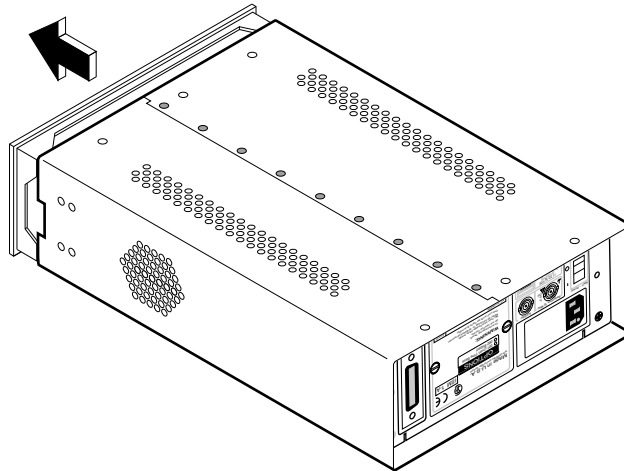


Figure 3-9 Removing the Shroud

Removing the Front Bezel

Use the following procedure to remove the front bezel:

- 1 Remove the shroud hardware and slide the shroud back far enough to fully expose the front bezel, or remove the shroud completely (see “[Removing the Shroud](#)” on page 84).
- 2 Remove the four 4-40 x 3/16-inch self-locking flathead machine screws that attach the front bezel to the front panel (two on top and two on the bottom as shown in [Figure 3-10](#)).

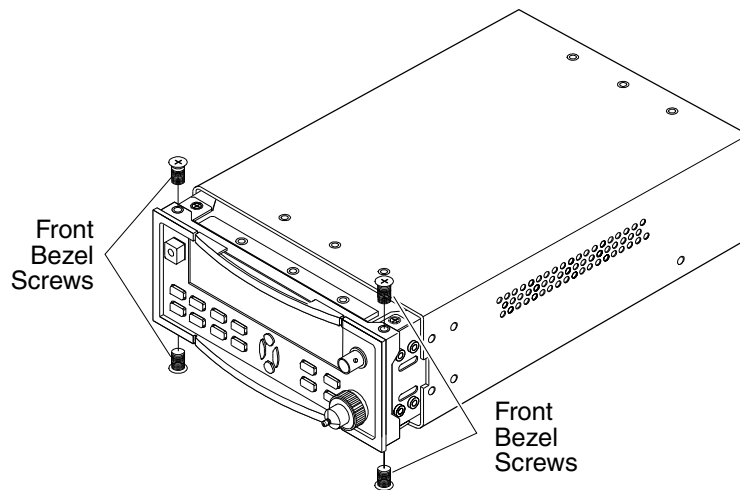


Figure 3-10 Front Bezel Screws

- 3 Carefully slide the front bezel off the front panel.

CAUTION

When reattaching the front bezel to the front-panel assembly, do not tighten the screws excessively to prevent damage to the bezel.

Removing the Rear Panel Assembly

Use the following procedure to remove the rear panel assembly:

- 1 Remove the shroud (see “[Removing the Shroud](#)” on page 84).
- 2 If the Battery Option is *not* installed, remove the four 4-40 self-locking hex nuts that attach the battery opening cover to the rear panel (these nuts are accessible from inside the chassis). Then, remove the battery opening cover, and skip to step 5.
- 3 If the Battery Option is installed, remove the battery sled from the Counter (for instructions on removing the battery sled, see Appendix C of the *Keysight 53150A/151A/152A Operating Guide*).
- 4 If the Battery Option is installed, remove the four 4-40 x 3/16-inch self-locking flathead machine screws that attach the rear panel assembly to the Battery Option chassis as shown in [Figure 3-11](#) (two screws on each side of the opening, and two more screws at the bottom of the opening).

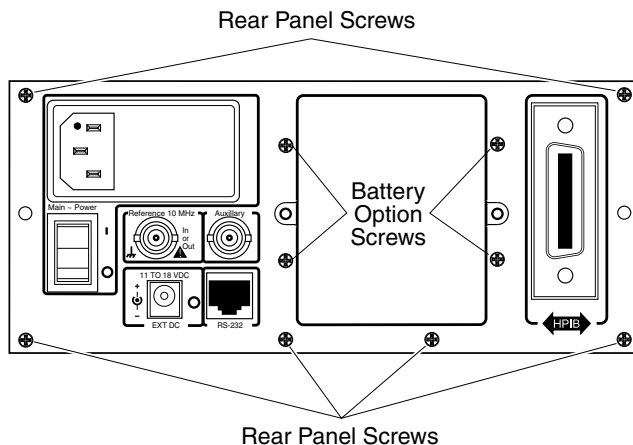


Figure 3-11 Rear Panel Assembly Screws

- 5 Remove the six 4-40 x 3/16-inch self-locking flathead machine screws that attach the rear panel assembly to the chassis (see [Figure 3-11](#)).

NOTE

The screw in the lower-left corner of the rear panel assembly (as viewed from the rear of the Counter) may be covered by the serial-number sticker. If it is, carefully cut away the lower-left corner of the sticker to expose the screw head.

- 6 Disconnect the seven-wire cable that runs between the connector at the back end of the power supply (TB2) and connector PMAIN1 on the main board to provide better access to the cables that are attached to the back panel assembly.
- 7 Disconnect the GPIB ribbon cable from connector JP3 on the main board, and disengage the ribbon cable from the ribbon-cable clamps that are attached to the power supply and the inside of the left wall of the chassis. Position this cable so that it cannot catch on any other cables or other components of the Counter.
- 8 Disconnect the external-reference input/output cable (coaxial) from connector J8 on the main board. J8 is directly under the back edge of the power supply near the chassis wall.
- 9 A two-wire AC-input cable (brown and blue wires) runs between the **Main ~ Power** switch on the rear-panel assembly and the connector that is accessible through the cutout in the right-front corner of the power supply enclosure (TB1). Disconnect this cable from the power supply.

NOTE

When reinstalling the Rear Panel Assembly, be sure to route the two-wire AC-input cable (brown and blue wires) underneath the power supply.

- 10 If the Battery Option is installed, there is a two-wire cable (brown and white wires) that runs between the **Main ~ Power** switch on the rear panel assembly and connector J3 on the Battery Option circuit board (J3 is the third connector from the back edge of the board). Disconnect this cable from J3 on the Battery Option circuit board.

- 11 Use a 5/16-inch spin tight to remove the self-locking hex nut that attaches the rear panel assembly grounding wire (green/yellow) to the right wall of the chassis. Slide the grounding lug off the welded stud on the chassis wall, and thread the lock nut back onto the stud a few turns until it is finger-tight.

WARNING

AN ELECTRICAL SHOCK HAZARD EXISTS IF THE COUNTER IS OPERATED WITH THE REAR PANEL ASSEMBLY GROUNDING WIRE NOT PROPERLY CONNECTED TO THE CHASSIS. TO PREVENT SERIOUS INJURY AND/OR DAMAGE TO THE EQUIPMENT, NEVER OPERATE THE COUNTER UNLESS THIS GROUND WIRE IS SECURELY CONNECTED TO THE CHASSIS WALL AND THE REAR PANEL ASSEMBLY.

- 12 Extract the ends of all of the cables that you disconnected in Steps 7 through 9 from under the power supply, so that they are completely exposed and cannot catch on other cables and components when you remove the rear panel assembly.
- 13 Carefully pull the rear panel assembly away from the back end of the chassis. Guide the cables that remain attached to the rear panel assembly as you remove it to prevent them from catching on other cables or other components of the Counter.

CAUTION

When reinstalling the Rear Panel Assembly, position it carefully to avoid damage to the power LED, the serial-port connector (RJ-12), and the main board. If these components are not correctly aligned with the openings in the back panel, they may be damaged.

Removing the Cooling Fan

Use the following procedure to remove the cooling fan:

- 1 Remove the shroud (see “[Removing the Shroud](#)” on page 84).
- 2 Disconnect the two-wire cooling-fan power cable (blue and red wires) from J16 on the main board. J16 is the connector that is closest to the rear panel assembly near the right chassis wall and behind the power supply.
- 3 Open the two cable clamps that are attached to the floor of the chassis immediately behind the front panel assembly, and remove the cooling-fan cable from the cable clamps.
- 4 Extract the end of the cooling-fan cable from under the power supply by pulling it toward the front of the Counter with one hand while guiding the connector with your other hand.
- 5 Use a #1 Phillips screwdriver and a 1/4-inch wrench or spin tight to remove the four 4-40 x 1-inch panhead machine screws and 1/4-inch self-locking hex nuts that attach the cooling fan to the chassis (see [Figure 3-12](#)).

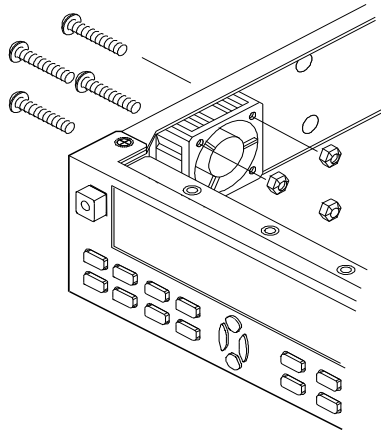


Figure 3-12 Cooling Fan Screws

- 6 While removing the cooling fan from the chassis, guide the cable to be sure it does not catch on other cables or other components of the Counter.

Replacing the Power Supply

Use the following procedure to replace the power-supply circuit board:

- 1** Remove the shroud (see “[Removing the Shroud](#)” on page 84).
- 2** Disconnect the two power-supply connectors (one at the front and one at the rear of the power supply).
- 3** Use a #1 Phillips screwdriver to remove the two pan-head screws and the two star washers that fasten the perforated power-supply cover to the power-supply chassis. The screws are accessible through the rectangular cutout in the side of the Counter’s chassis.
- 4** Use a small flat-bladed screwdriver to pry the power-supply cover toward the opening in the chassis to loosen it from the chassis.
- 5** Remove the power-supply cover by sliding it through the rectangular opening in the side of the counter’s chassis.
- 6** Use a ¼-inch nut driver to remove the two nuts used to fasten the circuit board to the power-supply chassis. You may have to hold the screws to prevent them from turning while removing the nuts. Do not discard the nuts, lock washers, ¼-inch spacers, and 5/8-inch flat-head screws.
- 7** Remove the two flat-head screws that are on both sides of the power-supply nameplate.
- 8** Lift the circuit board up until it clears the power-supply cover mounting tabs, and remove it from the chassis. Discard the defective circuit board.
- 9** Disassemble the replacement power supply in the same manner as described in steps 3 through 8.
- 10** Insert the circuit board from the new power supply into position in the power-supply chassis inside the Counter.
- 11** Insert the two screws removed in step 7 into the holes on both sides of the power-supply nameplate. Do not tighten these screws at this time.
- 12** Use a pair of needle-nose pliers to position one of the ¼-inch spacers removed in step 6 between the circuit board and the power-supply chassis, and align the spacer with the mounting holes in the circuit board and the chassis.

- 13** Insert one of the 5/8-inch, flat-head screws removed in step 6 up through the circuit-board mounting hole in the bottom of the power-supply chassis, through the spacer, and through the hole in the circuit board.
- 14** Place a lockwasher over the screw on top of the circuit board.
- 15** Thread a nut onto the screw, but do not tighten it fully at this time.
- 16** Repeat steps 12 through 15 for the other circuit-board mounting hole.
- 17** Tighten the two screws next to the power-supply nameplate.
- 18** Tighten the nuts on the circuit-board mounting screws.
- 19** Insert the power-supply cover through the rectangular hole in the side of the counter's chassis, and position it properly on the power-supply.
- 20** Insert the two screws that fasten the power-supply cover to the chassis and tighten them.
- 21** Reconnect the two power-supply connectors and the front and rear ends of the power supply.
- 22** Turn the Counter on, and perform the "Power Supply Check" procedure on page 70.
- 23** If necessary, adjust the +5 VDC output of the power supply using the procedure titled "Adjusting the +5 VDC Output" on page 71.
- 24** Reassemble the Counter.

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4 Replaceable Parts

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Introduction

This chapter contains parts-ordering information for the Keysight 53150A/151A/152A Counter. [Table 4-1](#) lists the reference designations used in the parts list and throughout this guide, [Table 4-2](#) lists all replaceable assemblies and parts. [Figure 4-1](#) is an exploded view of the Keysight 53150A/151A/152A's internal parts, [Figure 4-2](#) is an exploded view of the cabinet and other external parts, and [Figure 4-3](#) is a top view of the chassis with the shroud removed. These illustrations are provided to help you locate and identify parts.

Replaceable Parts

Table 4-2 contains a list of replaceable parts that is organized as follows:

- 1** Electrical assemblies in alphanumeric order by reference designation.
- 2** Chassis-mounted electrical parts in alphanumeric order by reference designation.
- 3** Chassis-mounted mechanical parts in alphanumeric order by reference designation.

The information given for each part consists of the following:

- 1** Reference designation.
- 2** Keysight part number.
- 3** The quantity (QTY) of the part used in the instrument (field-replaceable items only).
- 4** Description of the part.
- 5** Typical manufacturer's part number for the part (when available).

How To Order A Part

Keysight Technologies wants to keep your parts ordering process as simple and efficient as possible. To order parts, perform the following steps:

- 1 Identify the part and the quantity you need.
- 2 Determine the ordering method to be used, and contact Keysight.

If the part you need is *not identified* in the guide, you can call Keysight for assistance (see the following section titled [Contacting Keysight Technologies](#)). Please have the following information available when you contact Keysight:

- Instrument Model Number (example, “Keysight 53151A”).
- Complete instrument Serial Number (example, “1234A56789”). Information about where to find the serial number is provided in the Preface portion of this guide in the section titled [How to Use This Guide](#).
- Description of the part(s) and its use.
- Quantity of the part(s) required.

Contacting Keysight Technologies

Depending on where you are in the world, there are one or more ways to obtain parts or parts information from Keysight Technologies.

- Outside the United States, contact your local Keysight Technologies sales office.
- Within the United States, we encourage you to order replacement parts or request parts information directly by telephone or mail from Keysight using the telephone numbers or address listed on the next page. (You can also contact your local Keysight sales office. Keysight sales offices are listed in “Sales and Technical Support” on page 7.)

By Telephone:

- For Parts Ordering, use our toll-free number, (800) 227-8164, Monday through Friday (except Holidays), 6 a.m. to 5 p.m. (Pacific Time).
- For Parts Identification Assistance, call us at (916) 783-0804. Our Parts Identification hours are from 6 a.m. to 3 p.m. (Pacific Time) on Monday through Thursday and from 6 a.m. to 2 p.m. (Pacific Time) on Friday.

For Mail Correspondence, please use the address below:

Keysight Technologies
P.O. Box 1145
Roseville, CA 95661-1145

Parts Identification

To identify the part(s) you need, refer to the exploded views in [Figure 4-1](#) and [Figure 4-2](#) and the top view of the chassis in [Figure 4-3](#).

When ordering from Keysight Technologies, the important numbers to note from the Parts List are the Keysight Part Number, the part-number check digit (in the “CD” column), and the quantity of the part(s) you need.

Reference Designations

[Table 4-1](#) lists the reference designations used in the parts lists.

Table 4-1 Reference Designations

A	= assembly	P/O	= part of
H	= hardware	S	= switch
J	= electrical connector (stationary portion); jack	T	= transformer
MP	= miscellaneous mechanical part	TP	= test point
P	= electrical connector (movable portion); plug	U	= integrated circuit; microcircuit
		W	= cable; transmission path; wire

Cabinet Parts and Hardware

To locate and identify cabinet and external parts and mounting hardware, refer to [Figure 4-2](#) (internal parts and mounting hardware are shown in [Figure 4-1](#)). These figures provide different views of the instrument, with the parts identified by reference designations; the reference designations correspond with the ones in [Table 4-2](#).

Accessories and Miscellaneous Items

[Table 4-3](#) lists all of the accessories available for the Counter and also lists some other miscellaneous items, such as power cords, rack mounts, and manuals.

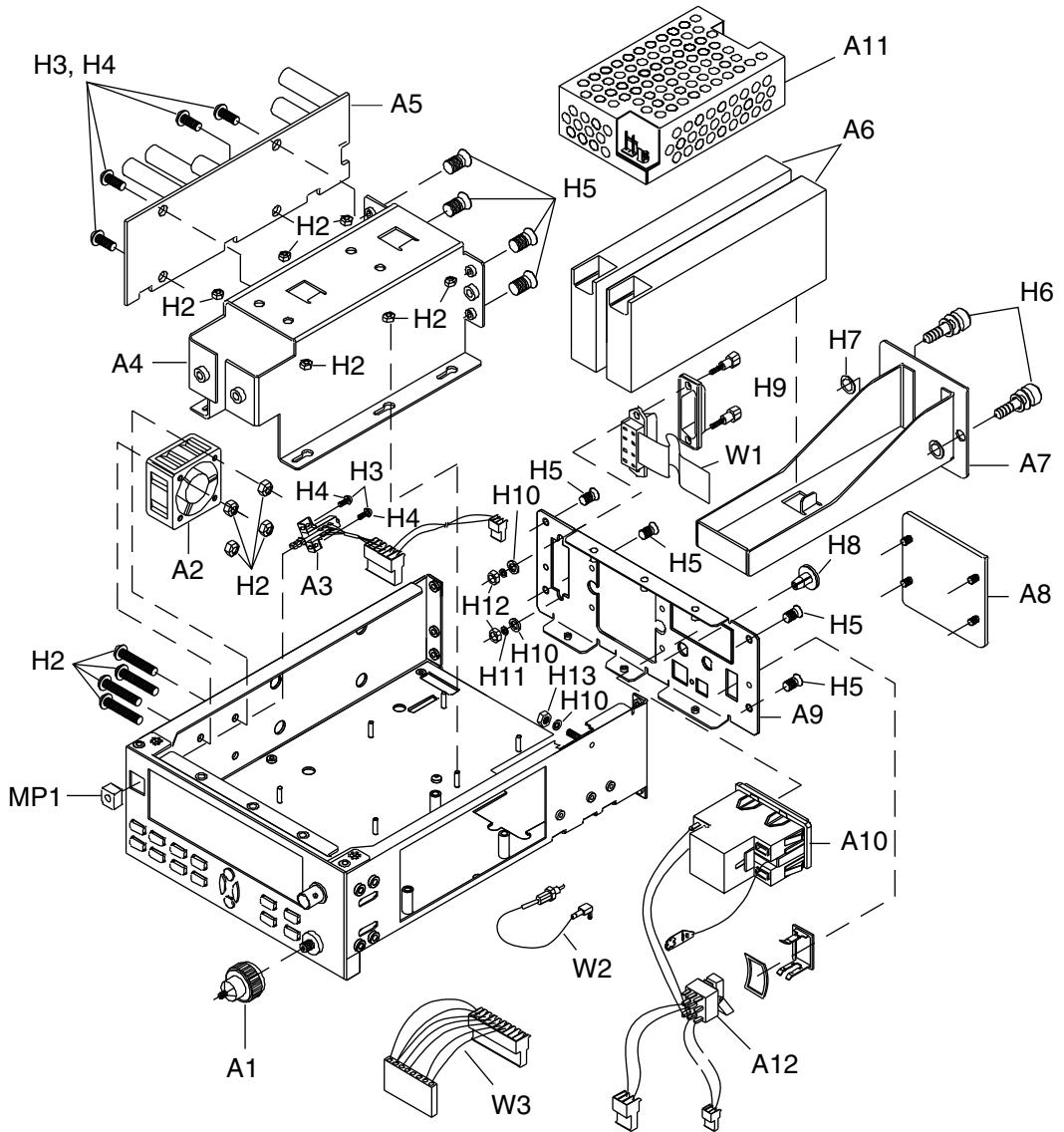


Figure 4-1 Keysight 53150A/151A/152A Exploded View – Internal Parts

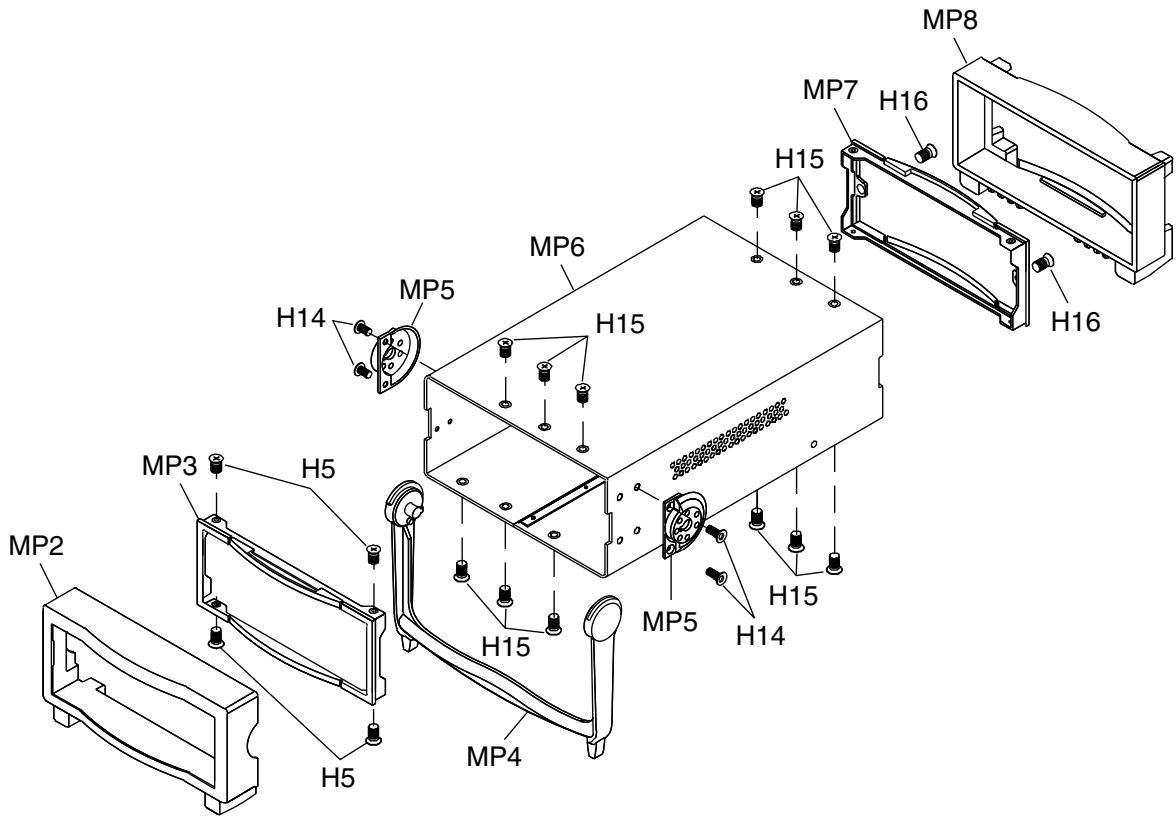


Figure 4-2 Keysight 53150A/151A/152A Exploded View – Cabinet and External Parts

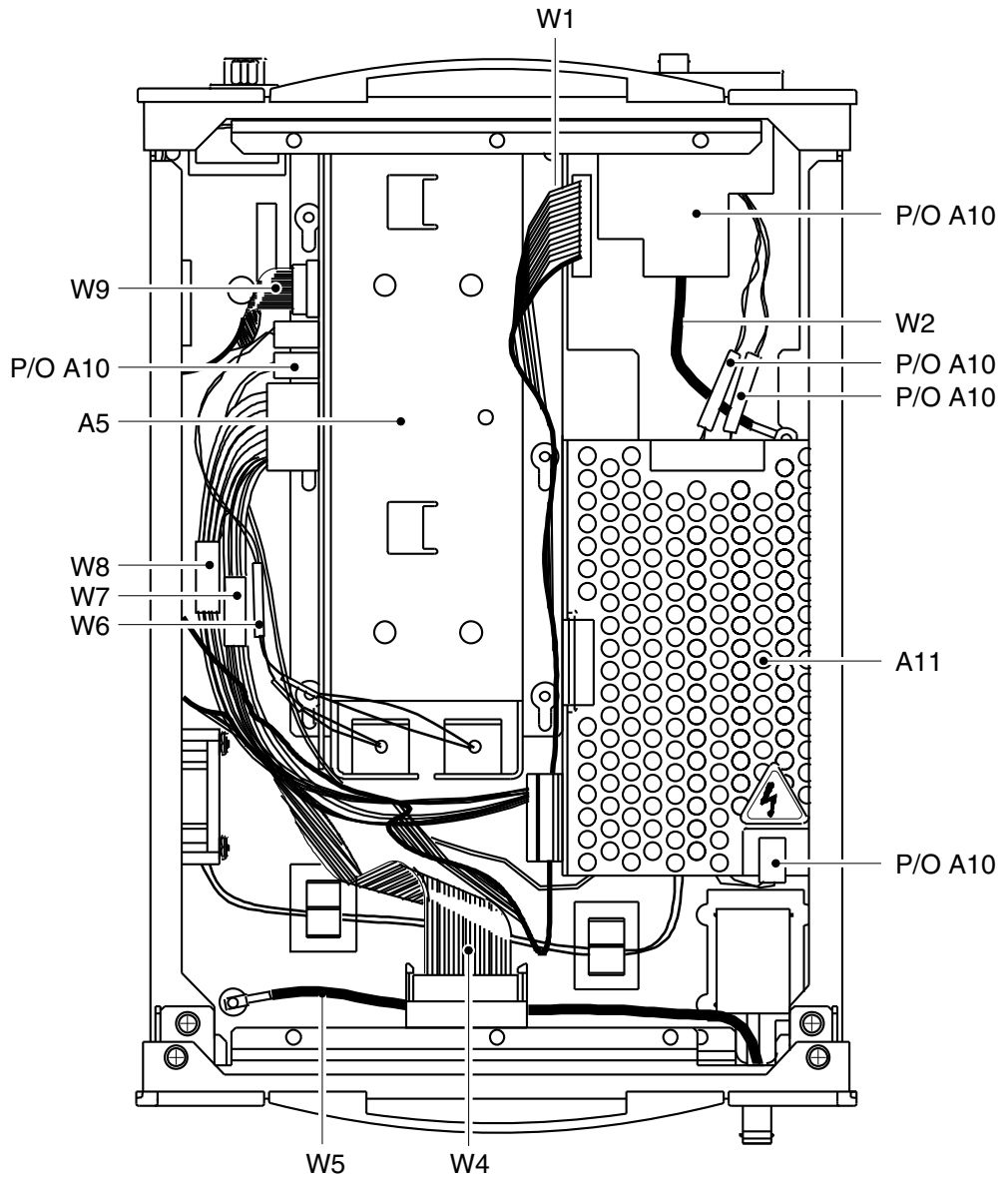


Figure 4-3 Keysight 53150A/151A/152A Top View

Table 4-2 Keysight 53150A/151A/152A Replaceable Parts

Reference Designation	Keysight Part Number	Qty.	Description	Mfr. Part Number
A1	53152-80001	1	ADAPTER, 2.92 mm FEMALE ^[a]	2610181-00
A2	53150-80012	1	FAN, COOLING	2011151-01
A3	53150-80013	1	SWITCH ASSY., FRONT PANEL POWER	2010306-01
A4	53150-00002	1	HOUSING ASSY., BATTERY ^[b]	5211156-01
A5	53150-60004	1	DC/DC CONVERTER PCB ^[b]	2020543-04
A6	53150-80010	2	BATTERY, LEAD-ACID, RECHARGEABLE ^[b]	5000410-00
A7	53150-00004	1	SLED ASSY., BATTERY ^[b]	5218025-01
A8	53150-00003	1	COVER, BATTERY OPENING ^[c]	5218019-01
A9	–	1	PANEL ASSY., REAR ^[d]	2011146-01
A10	53150-40007	1	POWER ENTRY MODULE ASSY.	2011148-01
A11	0950-3299	1	POWER SUPPLY ASSY., 45 W	2011156-01
A12	53150-60220	1	SWITCH ASSY., REAR PANEL POWER	2041089-01
H1	2200-0155	4	SCREW, PANHEAD, 4-40x1	5120004-16
H2	0590-0076	10 ^[e]	NUT, HEX, SELF-LOCKING, 4-40	5184004-40
H3	2200-0143	6	SCREW, PAN HEAD, 4-40x3/8	5174004-06
H4	2190-0004	6	WASHER, LOCK, #4 (USE WITH H3)	–
H5	2200-0165	12	SCREW, FLATHEAD, SELF-LOCKING, 4-40x1/4	5134004-04
H6	1390-0832	2	SCREW, KNURLED HEAD, CAPTIVE, W/WASHER	5110101-00
H7	1390-0473	2	WASHER, RETAINING (USE WITH H6)	5000420-00
H8	6960-0045	1	HOLE PLUG, REAR PANEL	5000246-02
H9	0380-0643	2	SCREW, HEX STANDOFF, 6-32	–
H10	3050-0010	3	WASHER, FLAT, #6	–
H11	2190-0007	4	WASHER, LOCK, #6	–
H12	2420-0003	2	NUT, HEX, 6-32	–

Table 4-2 Keysight 53150A/151A/152A Replaceable Parts (continued)

Reference Designation	Keysight Part Number	Qty.	Description	Mfr. Part Number
H13	0590-0157	1	NUT, HEX, SELF-LOCKING, 6-32	5000046-00
H14	0515-1101	4	SCREW, TORX, FLATHEAD, m4x8	5138007-01
H15	2200-0164	12	SCREW, FLATHEAD, SELF-LOCKING, 4-40x3/16	5134004-03
H16	2360-0197	2	SCREW, PANHEAD, 6-32x3/8	5171006-06
MP1	53150-40008	1	SWITCH CAP, FRONT PANEL POWER	5230012-00
MP2	53150-40001	1	BUMPER, FRONT	5211122-01
MP3	53150-40009	1	BEZEL, FRONT	5211124-01
MP4	53150-40004	1	HANDLE	5211125-01
MP5	53150-40005	2	MOUNT, HANDLE	5218014-01
MP6	53150-00001	1	SHROUD	5218018-01
MP7	53150-40003	1	BEZEL, REAR	5211123-01
MP8	53150-40002	1	BUMPER, REAR	5211121-01
W1	53150-60209	1	CABLE ASSY., GPIB INTERFACE	2041084-01
–	53150-40006	1	CABLE ASSY., AC SWITCH INTERFACE ^[e]	2041089-01
W2	53150-60210	1	CABLE ASSY., COAXIAL, 10 MHz I/O	2041086-02
W3	53147-60224	1	CABLE ASSY, HARNESS, OUTPUT, DC SUPPLY	2041083-01
W4	–	1	CABLE ASSY, RIBBON, FRONT PANEL	2041085-01
W5	53150-60216	1	CABLE ASSY, COAXIAL, BAND 1 INPUT	2041086-01
W6	53150-60208	1	CABLE ASSY., BATTERY INTERCONNECT ^[f]	2041088-01
–	–		CABLE ASSY., HARNESS, INTERCONNECT ^[g]	2041082-01
W7	53150-60212	1	CABLE ASSY., HARNESS, RETURN ^[b]	2041087-02
W8	53150-60211	1	CABLE ASSY., HARNESS, INTERCONNECT ^[b]	2041087-01
W9	53150-60213	1	CABLE ASSY., STATUS INTERFACE ^[b]	2041092-01

[a] 53152A only

4 Replaceable Parts

[b] With Option 002 only

[c] Without Option 002

[d] Includes Rear Panel, Power Entry Module, GPIB Cable, 10 MHz I/O Cable, Power Switch, Hole Plug, and Fuse.

[e] Qty. = 8 without Option 002

[f] Part of A8

[g] In Counters without Option 002, this harness is used in place of W7 and W8.

Table 4-3 Keysight 53150A/151A/152A Accessories and Miscellaneous Items

Description	Keysight Part Number
BATTERY 12 V	53150-80010
CABLE ASSY., EXT. DC POWER	53150-60214
CABLE ASSY., POWER (AUSTRALIA)	8120-0696
CABLE ASSY., POWER (CANADA)	8120-1692
CABLE ASSY., POWER (DENMARK)	8120-2957
CABLE ASSY., POWER (ENGLAND)	8120-1703
CABLE ASSY., POWER (GERMANY)	8120-2296
CABLE ASSY., POWER (JAPAN)	8120-4754
CABLE ASSY., POWER (S. AFRICA)	8120-4600
CABLE ASSY., POWER (USA)	8120-1521
CABLE ASSY., RS-232, DB-25/RJ-12	53150-60215
CARRYING CASE, SOFT	53150-80016
FUSE	2110-0007
GUIDE, OPERATING	53150-90001
GUIDE, PROGRAMMING	53150-90002
GUIDE, SERVICE	53150-90003
GPIB CABLES	10833A/B/C/D
RACK MOUNT, SINGLE	53150-67001

5 Backdating

Introduction 108

Introduction

As of the third edition of this guide, this chapter does not contain any information for adapting this guide to apply to older instruments.

As engineering changes are made, newer instruments may have higher serial prefix numbers than the ones shown on the title page of this guide. These instruments may be supplied with a *Manual Updating Changes* package containing the required information, or they may be supplied with newer editions of this guide that contain information about adapting that edition of this guide to older instruments.

If a *Manual Updating Changes* package is included with your Counter, modify existing guide information or replace the affected pages as directed in the pages of the *Manual Updating Changes* package. For additional information, contact the nearest Keysight Sales and Support Office.

6 Specifications

For the specifications and characteristics of the 53150A/151A/152A Microwave Frequency Counter, refer to the datasheet at <http://literature.cdn.keysight.com/litweb/pdf/5966-3118E.pdf>

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