

Keysight 11683A Range Calibrator

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- 1 Improper or inadequate maintenance, adjustment, calibration, or operation by Buyer;
- 2 Buyer-supplied software, hardware, interfacing or consumables;
- 3 Unauthorized modification or misuse;
- 4 Operation outside of the environmental and electrical specifications for the product;
- 5 Improper site preparation and maintenance; or
- 6 Customer induced contamination or leaks.

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Safety Symbols

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

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

Safety Information

This instrument has been designed and tested in accordance with publication IEC 61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

General Safety Information

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

- This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.
- DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.
- DO NOT use repaired fuses or short-circuited fuseholders: For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type.
- DO NOT perform procedures involving cover or shield removal unless you are qualified to do so: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only.
- DO NOT service or adjust alone: Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a Keysight Sales and Service Office for service and repair to ensure the safety features are maintained.
- DO NOT substitute parts or modify equipment: Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to a Keysight Sales and Service Office for service and repair to ensure the safety features are maintained.

Regulatory Information

The 11683A complies with the protection requirements of the European Communities Electromagnetic Compatibility (EMC) directives:

IEC61326-1:2012 / EN61326-1:2013

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification.

Noise Declaration

LpA<70dB

am Arbeitsplatz (operator position)

normaler Betrieb (normal position)

nach DIN 45635 pt.19 (per ISO 7779)

Regulatory Markings

 The CSA mark is a registered trademark of the Canadian Standards Association.	ICES/NMB-001 ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.
 This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.	

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

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

Product category:

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

The affixed product label is as shown below.



Do not dispose in domestic household waste.

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

Sales and Technical Support

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

- www.keysight.com/find/11683A
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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1 General Information

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General Information

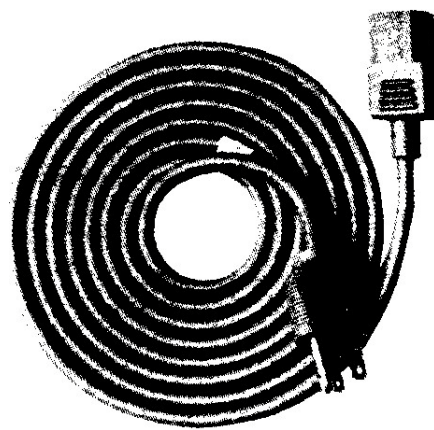
This operating and service manual contains information pertaining to incoming inspection, operation, performance tests, adjustments, and service for the Keysight Model 11683A Range Calibrator.

Equipment recommended for use in performance tests, adjustments, and service for the 11683A is listed in [Table 1-3](#). Test equipment which meets or exceeds the critical specifications of [Table 1-3](#) must be used for calibration if the 11683A is expected to conform to the published specifications.

The 11683A and all supplied accessories are shown in [Figure 1-1](#). The published specifications are listed in [Table 1-1](#).



Keysight Model 11683A



Power cable

(For Keysight part number refer to [Figure 2-2](#))

Figure 1-1 Keysight 11683A calibrator and accessories Supplied

Table 1-1 Specifications

Operational	Calibration functions:	Output voltage corresponding to meter readings at 3, 10, 30, 100 and 300 μ J.W; 1, 3, 10, 30, and 100mW.
	Range-to-range calibration uncertainty:	0.25% in all ranges
Environmental	Operating temperature:	0 to + 55 °C
	Storage temperature:	-40 to + 70 °C
	Humidity:	Up to 95% Relative Humidity to 40 °C.
	EMC:	IEC61326-1:2012 / EN61326-1:2013
Physical	Weight:	1.1 kg (2lb 8 oz) nominal
	Dimensions (height x width x depth):	88.9 x 133.3 x 215.90 mm (3.5 x 5.25 x 8.5 ins) nominal.

Instruments Covered in the Manual

This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual.

For information concerning a serial number prefix not listed on the title page, contact your nearest Keysight office.

Obsolete models and their replacements

The following table contains a list of equipment found in this manual that are obsolete, and their replacements:

Table 1-2 Replacements for obsolete models

Obsoleted model name	Replacement model
34410A Digital Multimeter, 6½ Digit	34465A Digital Multimeter
34411A Digital Multimeter, 6½ Digit	34465A Digital Multimeter
34401A Digital Multimeter, 6½ Digit	34461A Digital Multimeter
L4411A System Digital Multimeter, 6½ Digit High Performance	34465A Digital Multimeter
InfiniiVision 5000 Series Oscilloscopes	InfiniiVision 3000 X-Series Oscilloscopes
436A Power Meter	N1913A EPM Series Single-Channel Power Meter
435A Power Meter	N1913A EPM Series Single-Channel Power Meter

Description

The 11683A Range Calibrator is used to verify proper operation of compatible Power Meters such as the Keysight Model 435A. The Power Meter's range-to-range accuracy and proper auto-zero operation can be easily verified. The 11683A can supply a full-scale test signal to the Power Meter for each Range Switch setting.

When set to CALIBRATE, the FUNCTION switch applies a dc voltage to the Power Meter; the input is grounded in STANDBY. The POLARITY switch increases ease of testing and adjusting the Power Meter auto-zero feedback circuit.

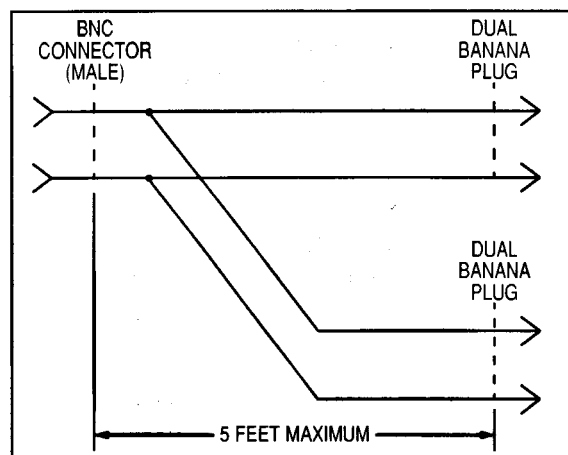


Figure 1-2 Four-wire cable

Table 1-3 Recommended test equipment

Instrument	Critical specification	Model	Use
Digital voltmeter	Readout: 5 digits DC measurement Range: 100 mV to 100 V full-scale Accuracy: $\pm 0.02\%$ Resistance measurement (four-wire measurement capability) Range: 100 Ω to 10 k Ω full-scale Sensitivity: 1 mil Accuracy: $\pm 0.02\%$	3455A	Performance, Adjustment, Troubleshooting
Oscilloscope	Vertical amplifier Bandwidth: DC to 5 MHz Deflection factor: 50 mV /division minimum Attenuator accuracy: $\pm 2\%$ Time Base – Time span/division: 1 ms to 1 s – Time base accuracy: $\pm 3\%$	180C/1801A/1821A	Adjustment, Troubleshooting
Four-wire cable	Recommended length: 5 feet maximum	See Figure 1-2	Performance

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2 Installation

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Initial Inspection

Inspect the shipping container for damage. If the shipping container or packing material is damaged it should be kept until the contents of the shipment have been checked mechanically and electrically. If there is mechanical damage or if the instrument does not pass the performance tests, notify the nearest Keysight office. Keep the damaged shipping materials (if any) for the carrier and a Keysight representative to inspect. The Keysight office will arrange for repair or replacement without waiting for claim settlement.

Power Requirements

The 11683A Range Calibrator requires a power source with an output of 100, 120, 230, or 240 Vac +5% -10%.

For 100 and 120 Vac, 48 to 66Hz or 360 to 440 Hz at 125 mA.

For 230 and 240 Vac, 48 to 66 Hz at 62 mA.

Power consumption is less than 12 VA.

Line Voltage Selection

Figure 2-1 provides instruction for line voltage and fuse selection. The Line Voltage Selection Card and fuse are factory installed for 120 Vac operation.

Power Cable

In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to **Figure 2-2** for the part numbers of the power cable plugs available.

WARNING

The protection provided by grounding the instrument cabinet may be lost if any power cable other than the three-pronged type supplied is used to couple the ac line voltage to the instrument.

Interconnections

Refer to the *Power Meter's operating and service manual* for hook-up instructions.

Operating Environment

The instrument is designed for Indoor use only. The instrument may be operated at temperatures from 0 °C to +55 °C at altitudes up to 4600m (15,000ft.). The instrument may be operated in environments up to 95% relative humidity to 40 °C, but should be protected from temperature extremes which may cause condensation.

CAUTION

This instrument is designed for use in Installation Category II and Pollution Degree 2 per IEC60364 and 60529 respectively.

Bench Operation

The instrument is equipped with plastic feet and a tilt stand for use on a bench.

Rack Mounting

The instrument can be rack mounted by using an adapter frame. The adapter frame is a rack frame that accepts several combinations of sub-modular units. For additional information, address inquiries to your nearest Keysight office.

Storage and Shipment

The instrument should be stored in a clean dry environment. The following environmental limitations apply to both storage and shipment:

- Temperature: -40 to +75°C
- Humidity: < 95% relative
- Altitude: < 25,000 feet



- Fuses 6.3 × 32 mm
- Voltage selector 100/120/230/240 V

Figure 2-1 Power inlet

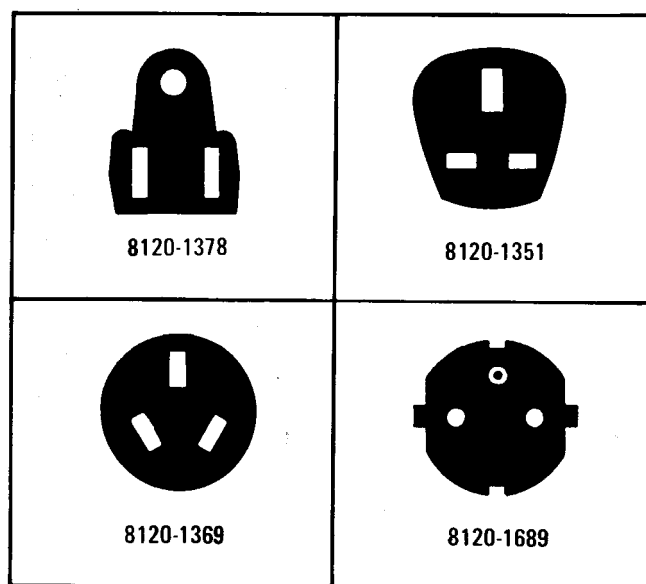


Figure 2-2 Power cable part numbers versus main plugs available

Original Packaging

Containers and materials identical to those used in factory packaging are available through Keysight offices. If the instrument is being returned to Keysight for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

Other Packaging

The following general instructions should be used for re-packaging with commercially available materials:

- 1** Wrap the instrument in heavy paper or plastic. (If shipping to a Keysight office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)
- 2** Use a strong shipping container.
- 3** Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide a firm cushion and prevent movement inside the container. Protect the control panel with cardboard.
- 4** Seal the shipping container securely.
- 5** Mark the shipping container FRAGILE to assure careful handling.

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3 Operating Instructions

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Operation of the Controls

Operation of the controls of the 11683A is explained in [Figure 3-1](#).

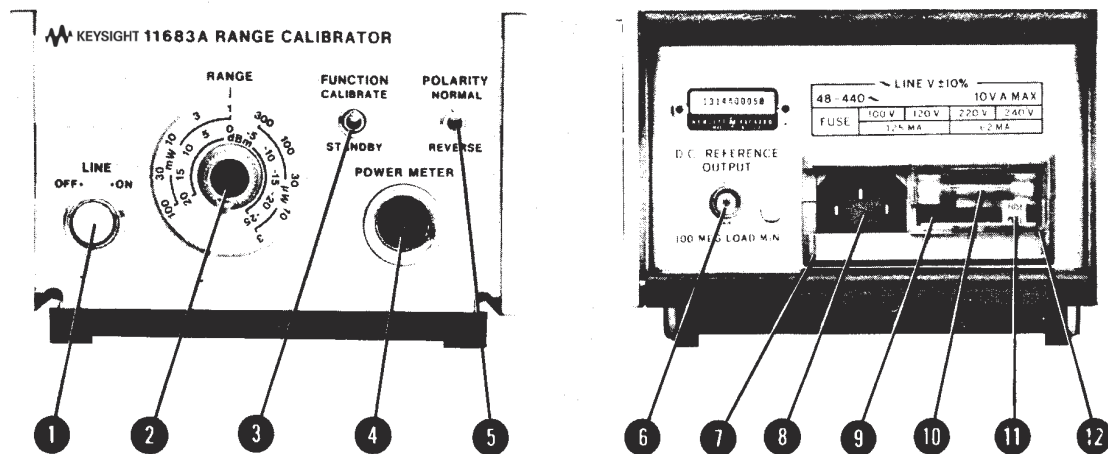


Figure 3-1 Front and rear panel features (illustrations for indication only)

- 1 LINE switch.** Controls primary power. Illuminated when instrument is ON.
- 2 RANGE switch.** Equivalent to compatible Power Meter's Range Switch; produces a full scale Power Meter reading when 11683A and Power Meter Range switches are set to same scale.
- 3 FUNCTION switch.** When the switch is set to CALIBRATE an output dependent on the RANGE switch setting is coupled to the Power Meter. In STANDBY mode the output is grounded.
- 4 POWER METER connector.** Connects the output to, and control signals from, compatible Power Meter via Power Sensor Cable.
- 5 POLARITY switch.** An upscale reading is obtained on the Power Meter when the switch is set to NORMAL. The REVERSE setting produces a down-scale reading.
- 6 D.C. REFERENCE OUTPUT connector.** DC reference voltage output from RANGE Switch. Load resistance must be $\geq 100\text{ M}\Omega$ for proper operation of the 11683A.
- 7 Power Module Assembly.**
- 8 Receptacle.** Couples transformer primary to line voltage via power cable.
- 9 Line Voltage Selection Card.** Matches transformer primary to line voltage. Refer to [Figure 2-1](#).
- 10 Fuse.** A 1/8 A fuse is used at 100/120 Vac; 1/16 A fuse at 230/240 Vac.
- 11 Fuse Pull Handle.** Mechanical interlock; fuse must be removed before extraction of Line Voltage Selection Card.
- 12 Window.** Safety interlock; fuse cannot be removed while power cable is coupled to Power Module Receptacle.

Operating and Hookup Instructions

Figure 3-2 provides operating and hookup instructions with a compatible Power Meter.

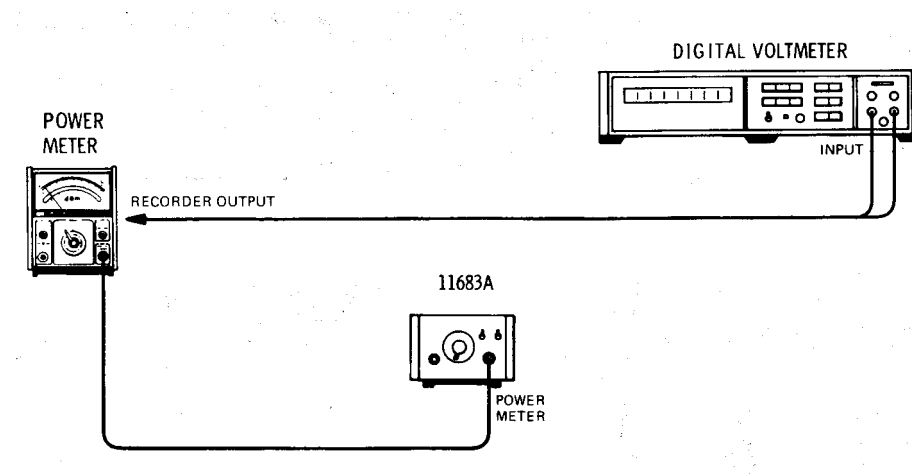


Figure 3-2 Operating and hookup

Turn on

- 1 Verify that the power transformer primary of the 11683A is matched to the line voltage. See [Figure 2-1](#).
- 2 Check the fuse, contained in the Power Module Assembly, for the correct rating. The voltage and amperage are shown on the rear panel. If necessary, change the fuse. See [Figure 2-1](#).
- 3 Connect the equipment together as shown in [Figure 3-2](#).
- 4 Connect the Power Cable to the power outlet and Power Module receptacles. Press the LINE switch and release. The switch should remain in, the lamp within the plastic lens should be illuminated, and the cursor on the curved portion of the switch should indicate ON.

Power meter performance test and adjustments

Refer to the Power Meter manual for Performance Test and Adjustment Procedures.

Power meter troubleshooting

The 11683A may be used as a test signal source which is capable of a full scale meter reading in any range. The POLARITY switch increases the ease of Auto-Zero circuit troubleshooting, and the 11683A may be substituted for the Power Sensor in order to isolate a malfunction to the Power Meter/Power Sensor Cable or the Power Sensor. Troubleshooting information is found in the *Power Meter Operating and Service Manual*.

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4 Maintenance Instructions

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Maintenance Instructions

Use a soft clean damp cloth to clean the front panel and side covers.

Maintenance by the operator consists of changing the fuse (refer to [Figure 2-1](#)), and line switch lamp replacement (refer to [Figure 4-1](#)).



Power requirements

Operating voltage range:	100/120/230/240 V
Operating frequency range:	48-66Hz/360-440 Hz at 100/120 Vac. 48-66 Hz at 230/240 Vac
Power dissipation:	12 VA (maximum)

CAUTION

Before switching on this instrument, make sure that the line voltage selector PCB board is set to the voltage of the power supply and the correct fuse installed. Assure the power supply voltage is in the specified range.

Mains supply voltage fluctuations should not exceed $\pm 10\%$ of the nominal selected line voltage.

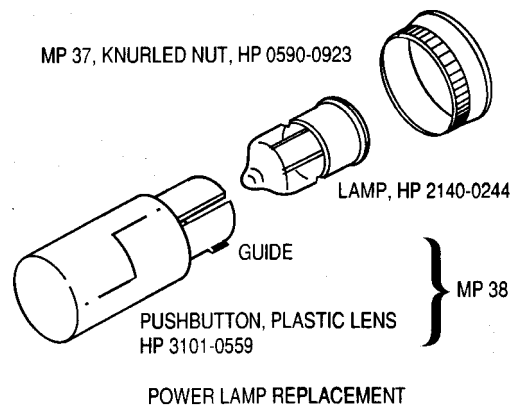
WARNING

Appliance coupler (mains input power cord) is the power disconnect device. Do not position the instrument such that access to the coupler is impaired.

For continued protection against fire hazard. replace the line fuse only with the same type and line rating (F125 mA 250 V at 100 V and 120 V, or F62 mA 250 V at 230 V and 240 V). The use of other fuses or materials is prohibited.

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

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



1. Remove lens by pulling straight out.
2. Replace lamp.
3. To replace lens, align guide with notch in receptacle. Push straight in.

Figure 4-1 Line switch lamp replacement

Range Switch Performance Test

The range-to-range accuracy of the 11683A Range Switch is checked to ensure a full-scale meter reading will be obtained when the 11683A and Power Meter Range Switches are set to the same scale.

Description

Voltage and resistance measurements are made at the rear panel output jack. Voltage measurements are made on the higher ranges. Because precise low voltage measurements are more difficult to make, resistance measurements are made at the lower RANGE switch settings. To achieve the needed accuracy, the four-wire resistance measurement technique is used.

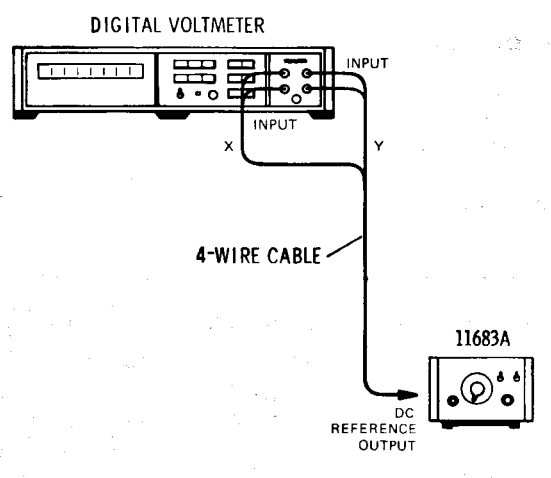


Figure 4-2 Range switch performance test setup

Equipment

Recommended equipment for performing these tests and adjustments are a digital voltmeter, 3455A, and a 4-wire cable for performing the resistance measurements (refer to [Table 1-3](#)).

NOTE

The 4-wire cable must connect directly to the 11683A. Do not use connectors or adapters because their series resistance will reduce measurement accuracy.

Procedure

- 1 Set the 11683A controls as follows:

RANGE:	100 mW
FUNCTION:	STANDBY
POLARITY:	NORMAL

- 2 Set the digital voltmeter controls so measurements of up to +20 Vdc may be made. All measurements are to be 5-digit resolution.
- 3 Connect the equipment together as shown in [Figure 4-2](#).
- 4 Set the 11683A FUNCTION control to CALIBRATE. On the table, record the dc voltage measured in each RANGE from 100 mW to 300 μ W. If the voltage measured at the 1 mW range is beyond the limits shown on the table, when this procedure is completed, perform the Power Supply Adjustments. Calculate and record the ratio of the voltages using the formula shown in the table below.

Range	Digital voltmeter reading			Ratio ($V_{100\text{ mW}} / V_{\text{range}}$)		
	Minimum	Actual	Maximum	Minimum	Actual	Maximum
100 mW		_____		----	1.0000	----
30 mW		_____		3.3457	_____	3.3604
10 mW		_____		10.768	_____	10.815
3 mW		_____		34.394	_____	34.545
1 mW	143.00 mVdc	_____	147.00 mVdc	108.76	_____	109.23
300 μ W		_____		343.95	_____	345.45

- 5 Set the 11683A FUNCTION switch to STANDBY. Set the digital voltmeter controls to measure resistance.
- 6 Measure the resistance at each RANGE setting from 300 to 3 μ W to 5-digit resolution and record the readings in the table below. Verify that each reading falls within the limits shown.

Range	Digital voltmeter reading (Ohms)		
	Minimum	Actual	Maximum
300 μ W	3143.3	_____	3157.1
100 μ W	995.90	_____	1000.2
30 μ W	315.14	_____	316.52
10 μ W	99.749	_____	100.18
3 μ W	31.580	_____	31.718

- 7 If any of the voltage ratios or resistance readings are incorrect, refer to the troubleshooting information.

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5 Adjustments

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Adjustments

WARNING

The operations in this section require the instrument is operated with its covers removed and should only be carried out by qualified service personnel.

Power Supply Adjustment

The dc output of the 11683A is set to a specified level to ensure Power Meter full-scale deflection occurs when the RANGE controls of the Calibrator and Power Meter are set to the same scale.

Description

The 11683A RANGE switch is set to the 1 mW scale and the dc voltage at the rear panel D.C. REFERENCE OUTPUT is set to a specified level.

Equipment

The model 3455A is the recommended Digital Voltmeter used to set the power supply voltage. A digital voltmeter that meets or exceeds the critical specifications of [Table 1-3](#) may be substituted.

Procedure

- 1 Connect the 11683A rear panel DC REFERENCE OUTPUT to the digital voltmeter INPUT.
- 2 Set the digital voltmeter controls to provide 5-digit resolution at 145 mVdc.
- 3 Remove the 11683A top cover.
- 4 Adjust A2R1 for a digital voltmeter reading of 145.00 ± 2.00 mVdc.

FET Balance Adjustment

A characteristic of a FET Sampling Gate circuit is transient spikes caused by an imbalance in gate-to-drain capacitance. The imbalance can be corrected by making the effective junction capacitance equal. A capacitor of correct value is coupled across the gate-to-drain leads of the active component with the lower junction capacitance. Other factors keep the transient from being eliminated completely, therefore, the amplitude is reduced to a minimum.

NOTE

This procedure normally will have to be performed only when the U1 assembly is replaced or if the white/black or white/brown wires which connect A3A1 to A3J1 are moved since their relative position is critical.

Description

Adequate FET gate-to-drain capacitance balance is achieved when the transient spike amplitude is found to be < 1.0 Vp-p at the appropriate test location (TP4 in the model 435A). Solder the selected capacitor in place.

Equipment

The model 180C/1801A/1821A is the recommended oscilloscope for use in the balance adjustment. An oscilloscope that meets or exceeds the critical specifications of [Table 1-3](#) may be substituted.

Procedure

- 1 Remove the A3 assembly (refer to “[Disassembly of A3 sampling gate assembly](#)” on page 43). Reinstall the LINE and A1 RANGE switch in the front panel before proceeding.
- 2 Connect the equipment as shown in [Figure 5-1](#). (The oscilloscope probe will be coupled to TP4 if the 435A Power Meter is being used.)
- 3 Set the 11683A FUNCTION switch to STANDBY; the Power Meter RANGE switch to 3 μ W.
- 4 Press the 435A ZERO Switch and check the spike amplitude on the oscilloscope display. Remove A2C2 and replace it, in the same location, with the next higher value capacitor. A2C2 may be located in one of the two positions or it may be omitted; see [Figure 6-3](#).

NOTE

The 435A ZERO switch must be pressed for the duration of this adjustment procedure.

- 5 If the spike amplitude decreases, continue to increase the capacitor value, in sequence, until the minimum spike amplitude (balance point) is found. The capacitor normally will not be > 7 pF. After two or three capacitors are tried, if the spike amplitude is constant or increases, a smaller value capacitor may be tried. If the lowest value capacitor is reached without finding the balance point, remove the capacitor and check the spike amplitude. Next begin to insert capacitors, in sequence, in the other A2C2 location. When the spike amplitude of < 1.0 Vp-p at

the appropriate test point is found, the circuit is considered balanced and the capacitor may be soldered in place.

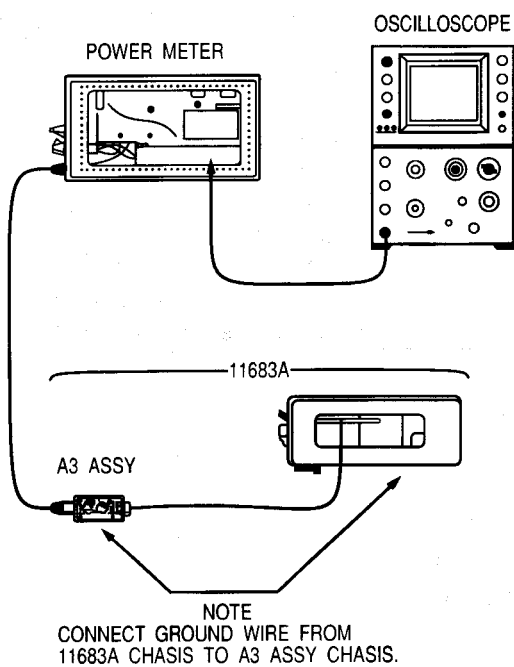


Figure 5-1 FET balance adjustment setup

6 Service

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Service Information

Service Information is composed of repair, principles of operation, and troubleshooting, followed by the assembly and component locations diagrams (Figure 6-3 and Figure 6-4).

Test equipment that meets or exceeds the critical specifications of Table 1-3 may be used in place of the recommended test instruments.

WARNING

The service information is often used with power supplied and protective covers removed from the instrument. Energy available at many points may, if contacted, result in personal injury or death

Repair

The repair information includes instructions for removing and installing the A3 Sampling Gate Assembly, and proper installation of the A3A1 Board.

Disassembly of A3 sampling gate assembly

- 1** Remove the top, bottom, and side covers of the 11683A.
- 2** Remove the right-sideframe which is adjacent to A2 and A3 assemblies after removing five 6-32 x 1/4" flat head machine screws.
- 3** Remove the RANGE switch knob after loosening the socket set screws. Remove the 3/8-32 x 7/16" hex nut from the RANGE switch; remove the RANGE SWITCH.
- 4** Remove the 1/2-32 knurled nut on the LINE switch and lift the A3 Assembly, which is attached only by the orange wire, from the 11683A chassis.
- 5** To remove the A3 Assembly plastic covers, insert the blade of a screwdriver into the seam on each side of the bulkhead feedthrough. Gently twist until the covers snap apart. Remove the covers and the magnetic shields.
- 6** Remove the two 0-80 x 0.312" flat-head machine screws which attach the sub-panel to the upper chassis.
- 7** Remove the two 0-80 x 0.188" socket cap screws which secure the feedthrough endbell to the upper chassis. Loosen the lower cap screws and remove the upper chassis.
- 8** To reassemble the A3 Assembly follow the preceeding instructions in reverse order.

A3A 1 assembly installation

The relative position of the installed circuit board and some components on the board are critical for proper operation.

- 1** Place the circuit board in the correct position and insert four 0-80 x 0.188" socket cap screws.
- 2** Center the circuit board so there is equal air gap between each side and the chassis. Tighten the cap screws.
- 3** Bend the 100 μ F capacitor, A3A1C6, so it touches A3A1Q1. Position A3A1C1 and A3A1C3 so they touch A3A1C6.

FET assembly removal

CAUTION

Excessive heat from the soldering iron when installing or removing the assembly may destroy the FET internal circuitry. Before removing the FET Assembly be sure that it must be replaced. The Troubleshooting information gives the correct procedures for verifying that the FET's are defective.

- 1 Remove the A3A1 Circuit Board Assembly. Refer to “Disassembly of A3 sampling gate assembly” on page 43.
- 2 Remove the 0-80 x 0.500" cap screw, spring, clamp, and A3R1.
- 3 Remove the RTV^[1] coating which covers the FET pin connections to the printed circuit board.
- 4 With a desoldering tool, remove the solder from the six pins which hold the FET Assembly in place.
- 5 Carefully break each pin loose from the printed circuit board with a soldering aid tool.
- 6 Gently lift the FET Assembly and spacer from the circuit board. Refer to Figure 6-2.

FET assembly installation

- 1 Insert the FET Assembly leads through the spacer and printed circuit board. Refer to Figure 6-1.
- 2 Insert the clamp and cap screw to hold the spacer and assembly in place against the printed circuit boards.
- 3 Quickly solder the FET leads to the circuit board.
- 4 With hypodermic needle place RTV^[1] into the hollow portion of the spacer. For this purpose the needle is inserted into the hole in the circuit board directly beneath the FET Assembly.
- 5 Cover the soldered connections from the FET Assembly with RTV^[1].
- 6 Cover the rest of the circuit side of the A2 assembly circuit board with Krylon^[2].

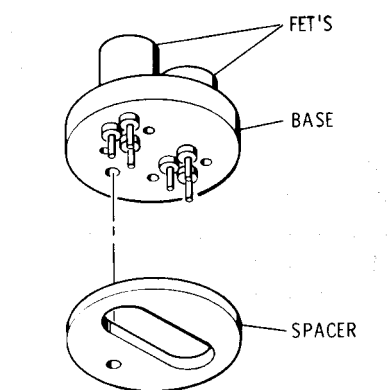


Figure 6-1 FET assembly and spacer

[1] RTV - 732 RTV Silicone Rubber Adhesive/Sealant by Dow Corning Corp., Midland, Michigan, 48640.

[2] Krylon- No. 1302 Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp., Woodside 77, New York. Krylon Inc., Norristown, Pennsylvania

Principles of Operation

The principles of operation are intended to give the user a basic understanding of circuit operation and is, therefore, the most important troubleshooting aid available.

Power supply

The A4 Power Module Assembly contains the Line Voltage Selector Card which matches the line voltage to power transformer primary. A line filter reduces line surge and transients.

The A2 Power Supply Assembly contains a bridge rectifier A2CR1-4, filter capacitor A2C1, a packaged voltage regulator circuit A2U1, and its associated components.

Within the IC package is a reference voltage generator, an operation amplifier, regulator driver, series regulator, and current limiting transistors. The reference voltage output, pin 4, is coupled to the non-inverting operational amplifier input, pin 3. The amplifier output drives the regulator driver and series regulator transistors and the regulated output is coupled from the emitter, through the current sense resistor A2R2, to the POLARITY switch A2S1. A2R3, R1, and R4 form a voltage divider through which the feedback bias is coupled to A2U1 pin 2, the inverting input.

If the current flow through A2R2 exceeds 20 mA, the current limiting transistor is turned-on and the drive voltage to the regulator driver is reduced which drops the regulated voltage toward zero.

A2C2 provides high frequency rolloff which reduces the feedback loop tendency to support spurious oscillations.

A1 range switch assembly

The Range switch is a voltage divider which changes the output voltage by a factor of approximately $\sqrt{10}$ for each sequential range change.

A3 sampling gate assembly

The dc input from the Range Switch assembly is divided by one thousand and is coupled to the A3A1U1 Sampling Gate circuit. A 220 Hz square wave drive signal from the Power Meter is coupled to the FET gates. When A3A1U1Q1 is conducting, the dc input is coupled to the Input Amplifier A3A1QL. When A3A1U1A2 is conducting, the input to the amplifier is essentially ground. The signal coupled to the Input Amplifier is 220 Hz ac, with the amplitude directly proportional to the dc input level.

The Input Amplifier and the first amplifier in the Power Meter are the component parts of a Hybrid Operational Amplifier. The Amplifier, which has a gain of approximately 730, is shown in [Figure 6-2](#).

Troubleshooting

The troubleshooting information is intended to supplement the principles of operation and schematics. This information should reduce troubleshooting time and increase the ease of solving problems that do not have obvious answers.

Power supplies

If the output noise level has increased and the dc voltage at A2U1 pin 8 has decreased slightly, one of the bridge rectifier diodes or A2C1 may be defective.

If the output voltage has decreased, 0.6 Vdc measured across A2R2 indicates the current limiter is operating.

Measure the voltage on A2U1 pins 2 and 3. If the voltage difference is >10 mVdc, verify that the regulated output has correctly followed the change in input levels. The regulated output's relative change from normal should follow the non-inverting input change and be opposite to the inverting input change. If the preceding statement is not true, the integrated circuit is probably defective, otherwise, the problem is probably with the associated components of A2U1.

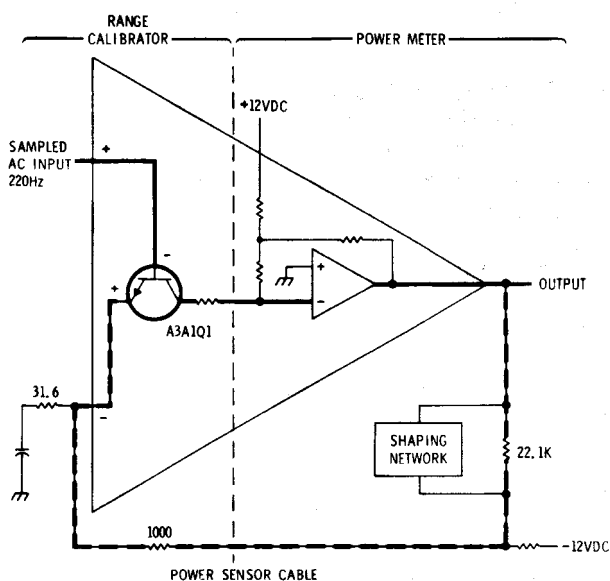


Figure 6-2 Hybrid operational amplifier

A1 range switch assembly

Voltages and/or, resistance measurements, taken while performing the Range Switch Performance Test, may be out of the specified tolerances. This may be due to a definite change-in-resistance of one of the resistors mounted on the switch, high resistance contacts on the FUNCTION or RANGE switches, or a soldered connection which exhibits high resistance.

A3 sampling gate assembly

The input to the A3 assembly is normally +15.8 mVdc with the RANGE switch set to a 100 mW.

NOTE

The following instructions apply after the A3AI Circuit Board Assembly has been exposed. Refer to **“Disassembly of A3 sampling gate assembly”** on page 43.

The multivibrator drive from the Power Meter to the FET Sampling Gate circuit may be checked on pins 4 or 6 of U1. This drive voltage is a 220 Hz square wave whose most positive level is -0.05 ± 0.05 Vdc with the most negative level >9 V more negative.

In most cases it may be assumed that the operational amplifier, made up of the Input Amplifier and the first amplifier in the Power Meter, is operating correctly if the dc voltage found on the metal cover of A3A1Q1 is -70 ± 30 mVdc.

The FET's in A3A1U1 may be checked by the following procedure:

- 1 Disconnect the cables from the 11683A.
- 2 Remove the upper chassis from the A3 assembly. (Refer to disassembly procedures.)
- 3 Measure the resistance between pins 1 and 2 of the A3A1U1. The resistance should be 15 ± 0.75 ohms. The same resistance should be found between pins 8 and 9 of A3A1U1.
- 4 Short pins 4, 6, and 9 of A3A1U1. While the pins are shorted, measure the resistance between pins 2 and 3, and between pins 3 and 8, of A3A1U1. The resistance should be less than 40 ohms.
- 5 Set a power supply to 10 Vdc.
- 6 Connect the positive side of the power source to A3J1 pin E signal ground. Connect the negative power supply lead to pins 4 and 6 of A3A1U1.
- 7 Measure the resistance between pins 2 and 3 of A3A1U1. Also measure the resistance between pins 3 and 8 of A3A1U1. In both cases, the resistance should be several hundred times the resistance found in [step 4](#).

If A3A1U1 is replaced it is recommended that the FET BALANCE ADJUSTMENT be performed to ensure the 11683A is operating at maximum capability.

A4 power switch and rear panel assembly

In 2017, the 11683A and 11683AZ-H01 had a new power switch design. If the user replaces the old power switch with the new design (11683-60004), the old rear panel should be replaced with the new rear panel as well.

The new rear panel has switch bracket opening in a vertical position compared to the old design which opened horizontally.

Part numbers for the new power switch design and the new rear panel design are as follows:

- 11683A-FG: 11683-60004 (New Power Switch) + 11683-00001 (New rear panel)
- 11683AZ-H01: 11683-60004 (New Power Switch) + 11683-00012 (New rear panel)

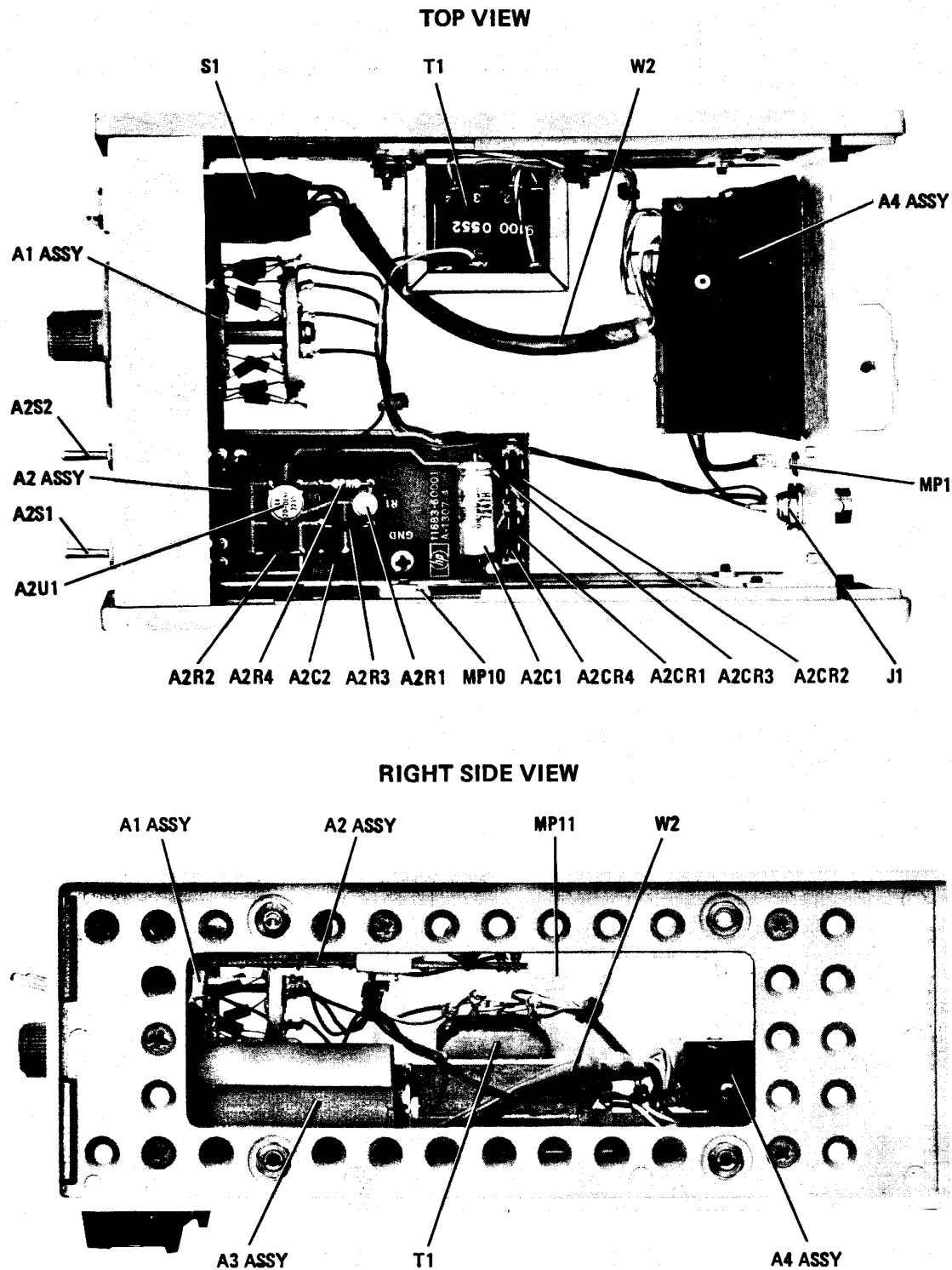


Figure 6-3 11683A assembly and component locations

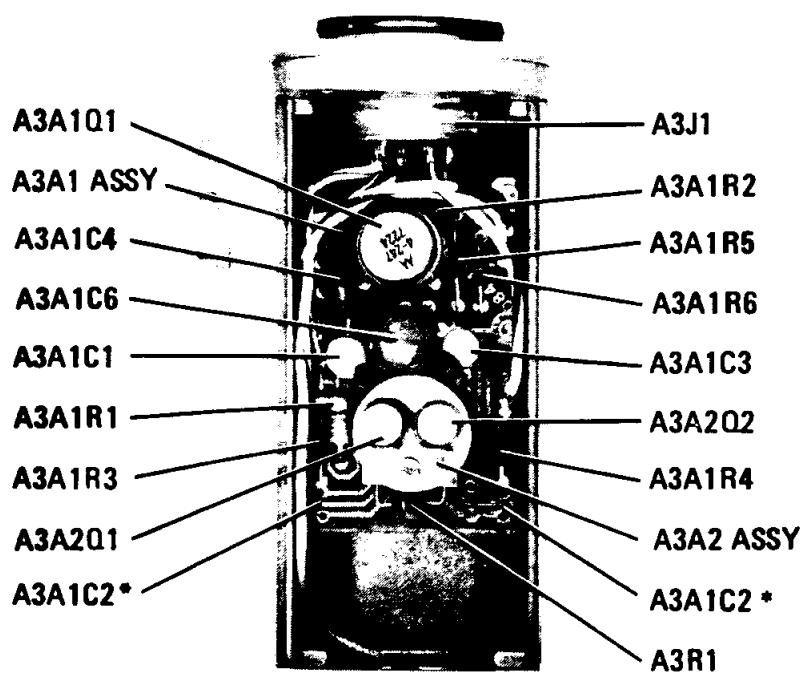


Figure 6-4 A3 assembly component location



Figure 6-5 11683A-FG old rear panel



Figure 6-6 11683A-FG new rear panel



Figure 6-7 11683AZ-H01 old rear panel

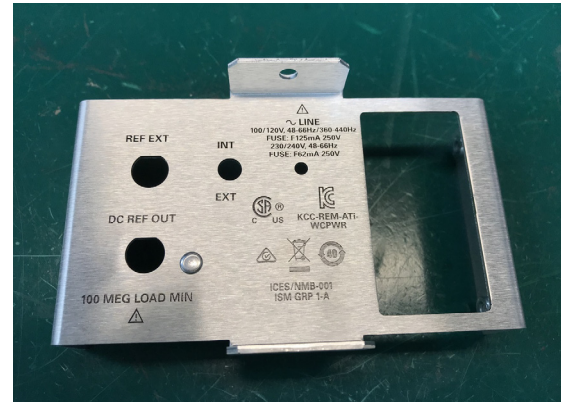


Figure 6-8 11683AZ-H01 new rear panel (11683-00012)

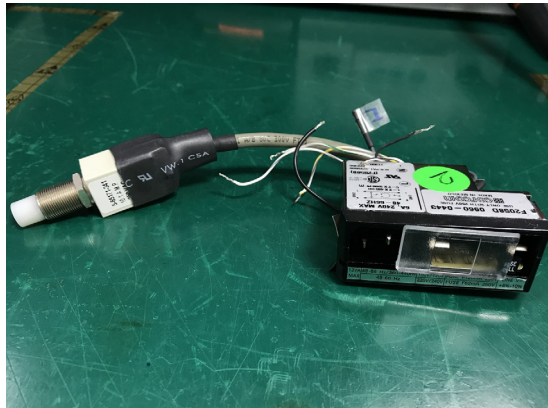


Figure 6-9 Old power switch

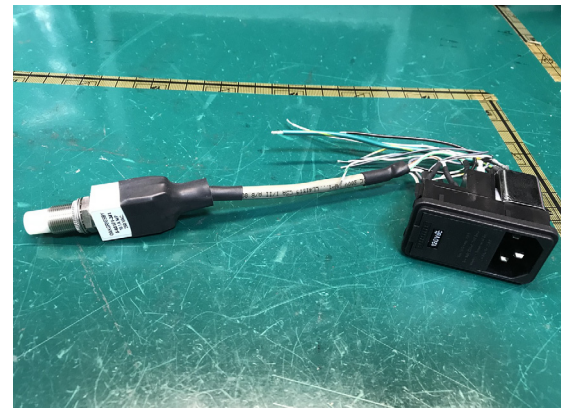


Figure 6-10 New power switch (11683-6004)

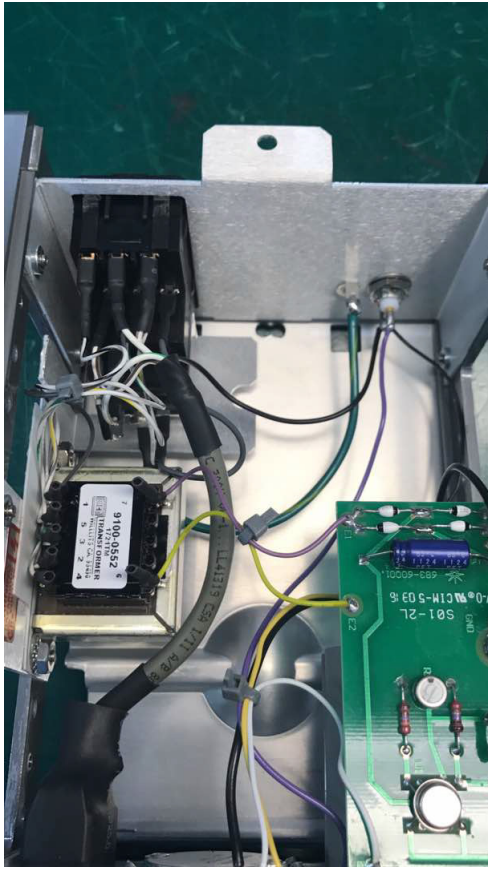


Figure 6-11 11683A-FG top view



Figure 6-12 Unit with old power switch
Upgrade kit: 11683AZ-K02



Figure 6-13 Unit with new power switch
Upgrade kit: 11683AZ-K01

Both the upgrade kits convert the standard unit to H01. If the existing model has an old power switch - user must order the 11683AZ-K02 upgrade kit, which includes the new power switch and rear panel. If the existing model already has the new power switch, user needs to order 11683AZ-K01.

