

Keysight 1143A Probe Offset Control and Power Module

User's Guide

Notices

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Manual Part Number

01143-97003

May 2017

Printed in Malaysia

Published by:
Keysight Technologies
1400 Fountaingrove Parkway
Santa Rosa, CA, 95403

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Safety Notices

CAUTION

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

WARNING

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

Contents

1 Using the 1143A

Safety Information / 8

Using the 1143A / 11

Remote Control / 14

Characteristics / 16

Testing Performance / 19

Contacting Keysight / 21

2 Servicing the 1143A

Making Adjustments / 25

Disassembling The 1143A / 30

Troubleshooting The Power Supplies / 32

Troubleshooting The Offset Circuitry / 33

Replaceable Parts / 34

Theory of Operation / 48

Returning the Instrument For Service / 58

Contents

1 Using the 1143A

Safety Information	8
Using the 1143A	11
Remote Control	14
Characteristics	16
Testing Performance	19
Contacting Keysight	21

The 1143A Probe Offset Control and Power Module is an alternate control and power source for active probes. When an active probe cannot be powered from a connector at the front of the oscilloscope, the 1143A is used to provide power, local offset control, and a remote offset interface.

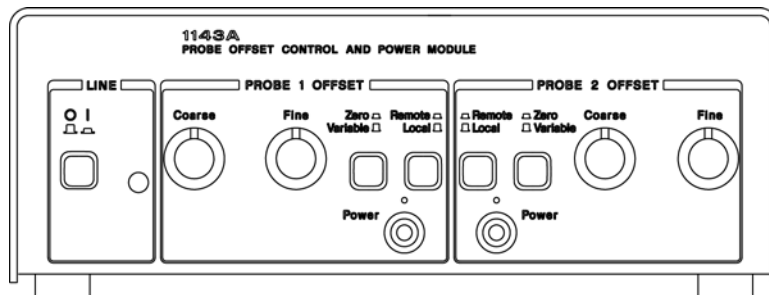


Figure 1 1143A Front Panel

The 1143A provides:

- Power and control for two probes
- +17.3 Vdc and -17.3 Vdc at 300 mA each
- Offset current source of ± 5 mA for each probe

- Remote input for offset control

Accessories Supplied

The following accessories are supplied.

- Power cable
- User and Service Guide (this manual)

Accessories and Options

The 01143-61602, 1.5 meter (59-inch) probe power extension cable is available. You can also order it with the 1143A as Option 001.

Initial Inspection

- 1** Inspect the shipping container for damage.
Keep a damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.
- 2** Check the accessories. If the contents are incomplete or damaged notify your Keysight Technologies sales office.
- 3** Inspect the instrument.
 - If there is mechanical damage or defect, or if the instrument does not operate properly or pass performance tests, notify your Keysight Technologies sales office.
 - If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as your Keysight Technologies sales office. Keep the shipping materials for the carrier's inspection. The Keysight Technologies office will arrange for repair or replacement at Keysight Technologies' option without waiting for claim settlement.

Service Strategy

The service strategy for the 1143A Probe Offset Control and Power Module is for field repair to the component level. Refer to **Chapter 2**, "Servicing the 1143A."








To Clean The 1143A

Use a soft cloth dampened with mild soap and water to clean the instrument. Care must be taken not to use a harsh soap which will damage the water-based paint finish of the instrument.

Safety Information

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

Table 1 Instrument Markings

Marking	Description
	Instruction manual symbol: the product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product. "Caution" or "Warning" risk of danger marked on product.
	Hazardous voltage symbol.
	Earth terminal symbol. Used to indicate a circuit common connected to grounded chassis.
	Indicates AC (Alternating Current).
	The CSA mark.
	This symbol indicates the Environmental Protection Use Period (EPUP) for the product's toxic substances for the China RoHS requirements.
	This product complies with the WEEE Directive marking requirements.

General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

This apparatus has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class I instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken as described in the following warnings. In addition, note the external markings on the instrument as described in [Table 1](#) on page 8.

WARNING

If the instrument is damaged, or if it fails to operate according to the characteristics in this manual, remove the power cord and contact Keysight Technologies.

WARNING

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.

WARNING

Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

WARNING

If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.

WARNING

Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.

WARNING

Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

WARNING

Do not install substitute parts or perform any unauthorized modification to the instrument.

WARNING

Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

WARNING

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

WARNING

Do not subject the unit to vibration or shocks during transport or handling. Be especially careful to avoid dropping the unit.

WARNING

When unplugging the power cord from the power receptacle or from the unit, grasp the plug, not the cord, in order to avoid damaging the cable.

WARNING

This unit is not constructed to be waterproof or dust proof, so do not use it in a very dusty environment or in one where it will get wet. For indoor use only.

WARNING

Do not use the instrument in a manner not specified by the manufacturer.

Using the 1143A

This section of the manual contains information and instructions for installation and use of the 1143A as an auxiliary power supply. Use of probe controls is covered in the guide for the probe.

Checking the Power Requirements and Fuse

The power module requires a power source of either 115 Vac or 230 Vac, 47 to 440 Hz, 40VA maximum. The rear-panel fuse (F1) is a 0.25A, 250V time-delay fuse. The fuse used is the same regardless of line voltage selection. To replace the fuse:

- 1 Locate the fuse holder shown in **Figure 2**. Gently push the fuse holder in using your finger or a flat-bladed screwdriver.
- 2 While the fuse holder is pushed in, gently turn the fuse holder counterclockwise.

CAUTION

BEFORE CONNECTING POWER TO THIS INSTRUMENT, be sure the line voltage switch on the rear panel of the instrument is set properly. Applying a voltage excessive to the setting may open the protective fuse.

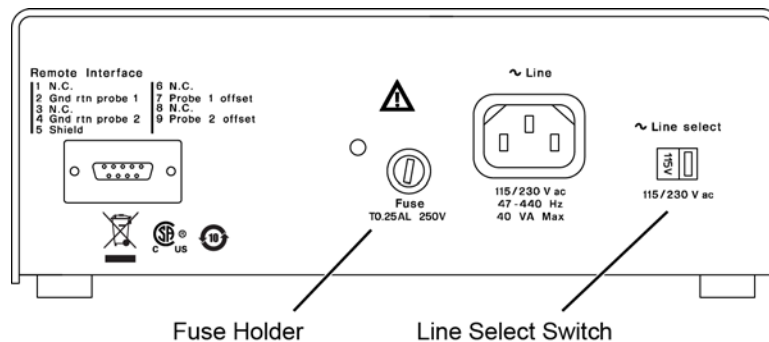


Figure 2 1143A Rear Panel

Setting Up the Line Voltage Selection

Before applying power, verify the setting of the LINE SELECT switch on the rear panel. If the switch is set incorrectly, set it to either 115V or 230V, whichever is appropriate for the voltage in your area. The fuse used is the same regardless of input voltage selection.

WARNING

SHOCK HAZARD! BEFORE YOU CONNECT THIS INSTRUMENT TO MAINS POWER OR LIVE MEASURING CIRCUITS you must provide a protective earth ground. The Mains plug must be inserted in a socket outlet provided with a protective earth contact. Do not use an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet does not provide an instrument ground. Failure to provide a protective earth ground could result in a shock hazard if there is a failure in this instrument or equipment connected to it.

NOTE

This instrument is provided with a three-wire power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument cabinet. The type of power cable plug shipped with the instrument depends on the country of destination.

Connecting The Probe

The following paragraphs cover system preparation using the 1143A. Refer also to the probe's user manual.

- 1 Set the line voltage selection.
- 2 Use the power cable to connect the power module to the ac mains.
- 3 Connect the probe power cable 1143A's front-panel **Power** connector. Red dots on the cable connector housing and 1143A are aligned with the connector keys. Align the dots when inserting the cable connector into the power connector.

CAUTION

The probe power cable connector automatically locks in the mating power connector. To separate the connectors, you must pull on the knurled part of the cable connector housing. This releases the lock. If you pull on the cable, the connectors won't release and you may damage the connector or cable.

- 4 Connect the output of the probe to the input of the oscilloscope or other instrument.

To Use Local Offset

When setting the 1143A front-panel controls, be sure to use the controls that correspond to the appropriate **Power** connector.

- 1 Turn on the 1143A power.
- 2 Set the appropriate Remote/Local switch.
 - To control the probe offset voltage with the 1143A, set the switch to **Local**.
 - To control the probe offset voltage remotely, set the switch to **Remote** and refer to “**Remote Control**” on page 14.
- 3 With **Local** control, set the appropriate Zero/Variable switch.
 - To enable the local offset control, set the switch to Variable.
 - To disable the local offset control, set the switch to Zero.
- 4 Connect the probe to the signal to be measured.
- 5 If you are using Variable offset, adjust the **Coarse** and **Fine** offset controls so the desired part of the signal is displayed on the oscilloscope.

When the knobs are turned clockwise, the output of the probe goes positive. For example, when using the probe with an oscilloscope, when the trace moves up, the horizontal center line of the screen represents a more negative voltage. This represents a negative offset.

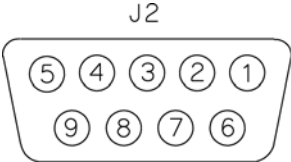
NOTE

If you intend to use the probe with an instrument other than an oscilloscope, you may find it easier to set up the probe with an oscilloscope first. This allows you to set the probe offset so the output of the probe is compatible with the signal requirements of the other instrument. After set-up, connect the output of the probe to the input of the other instrument.

Remote Control

For automatic test applications, the offset provided by the 1143A can be remotely controlled through the rear-panel a connector. This is a standard 9-pin, female, D-sub-miniature connector shown in **Table 2**. This style is the same as that used on some personal computer monitor cables, which provides an economical way to connect the remote input to the controller interface on an automatic test system. The following table gives the connections.

Table 2 Remote Input Connections

Pin	Function	Connector
1	N.C.	
2	Probe 1 offset common	
3	N.C.	
4	Probe 2 offset common	
5	Shield	
6	N.C.	
7	Probe 1 offset	
8	N.C.	
9	Probe 2 offset	

Operating Range

The remote variable offset can be used when the Local/Remote function is set to **Remote**. The remote inputs for the two probe connectors are separate. The following conditions apply:

- The remote offset input range is -10 to $+10$ Vdc. This provides a current of -5 to $+5$ mA dc at the probe connector. With the 54701A Active Probe, this provides an offset of -57.5 to $+57.5$ Vdc referenced to the probe tip.
- A positive, remote voltage input provides a negative offset in the probe. The output of the probe goes positive. A negative, remote voltage input provides a positive offset in the probe. The output of the probe goes negative.
- The offset voltage must be referenced to the appropriate (Probe 1 or Probe 2) offset common of the remote input connector.

- To eliminate offset when using remote, the remote offset input must be set to 0.0V, disconnected, or grounded.

NOTE

To minimize dc offset errors and potential noise coupling caused by ground loops, electrically isolate all connections between the remote input connector and the controlling system.

Characteristics

Table 3 lists the performance characteristics for the 1143A. These characteristics are nominal and non-warranted. **Table 4** lists the operating characteristics. The remainder of this section provides general characteristics.

Table 3 Performance Characteristics

Item	Specification
Supply Output Voltage	+17.3 Vdc \pm 500 mV -17.3 Vdc \pm 500 mV
Supply Current	300 mA (for each supply)
Offset Voltage	Variable from 0 to \pm 5 mA (for each probe)

Table 4 Operating Characteristics

Item	Specification
Number of probes operated	2
Controls (for each probe)	Remote/Local Zero/Variable offset Coarse and Fine offset
Remote Offset Input (for each probe)	\pm 10 V for \pm 5 mA offset current

Table 5 Environmental Conditions (General Characteristics)

Item	Characteristic
Use	Indoor
Temperature	
Operating	0° C to +55° C (32° F to +131° F)
Non-operating	-40° C to +70° C (-40° F to +158° F)
Humidity	
Operating	Up to 95% relative humidity (non-condensing) at +40° C (+104° F)
Non-operating	Up to 90% relative humidity at +65° C (+149° F)
Altitude	
Operating	Up to 4,600 meters (15,000 ft)
Non-operating	Up to 15,300 meters (50,000 ft)
Vibration	
Operating	Random vibration 5 to 500 Hz, 10 minutes per axis, 0.3, Grms.
Non-operating	Random vibration 5 to 500 Hz, 10 minutes per axis, 2.41 Grms. Resonant search 5 to 500 Hz swept sine, 1 octave/minute sweep rate, (0.75g), 5 minute resonant dwell at 4 resonances per axis.

Table 6 Power Requirements (General Characteristics)

Item	Specification
Voltage	115/230 Vac, 47 to 440 Hz
Power	40 VA maximum

Table 7 Weight (General Characteristics)

Item	Specification
Net	approximately 1.5 kg (3.4 lb)
Shipping	approximately 2.4 kg (5.4 lb)

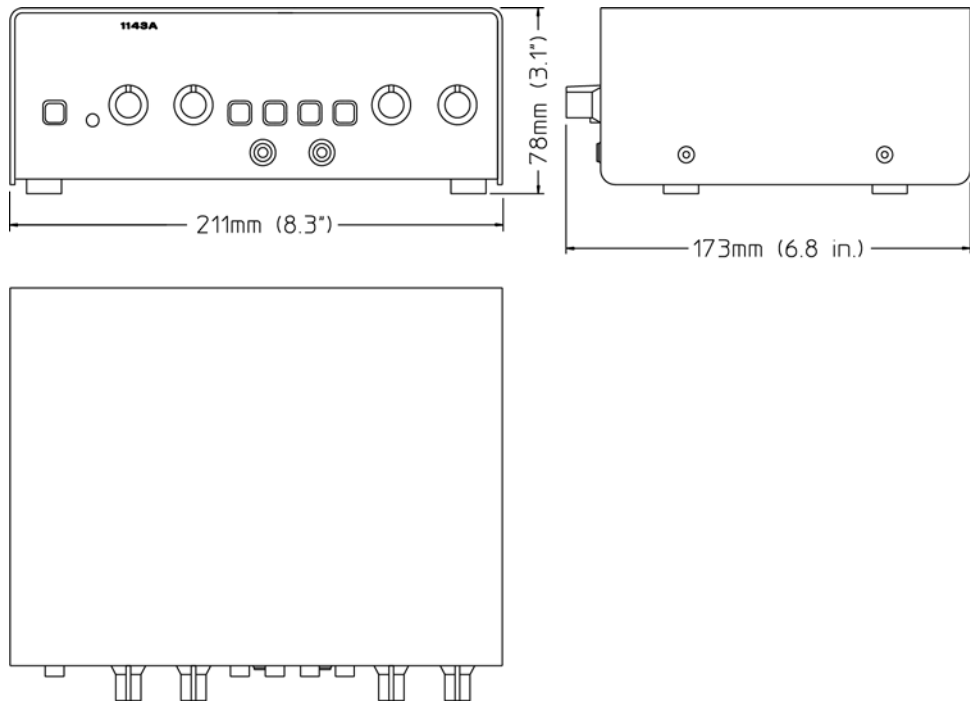


Figure 3 1143A Dimensions

Product Regulations

Safety

- CAN/CSA-C22.2 No. 61010-1-12
- ANSI/UL Standard 61010-1
- ANSI/ISA-61010-1 (82.02.01)

Testing Performance

The procedure in this section checks the probe power output voltage using the value given in **“Characteristics”** on page 16 as a standard. This procedure may be performed for incoming inspection of the 1143A and should be performed periodically thereafter to ensure and maintain peak performance. The recommended test interval is yearly or every 2,000 hours of operation. Amount of use, environmental conditions, and the user's experience concerning need for testing will contribute to verification requirements.

Equipment Required

The equipment required for this test is listed in the test. Any equipment satisfying the critical specifications listed may be substituted for the recommended model.

To Test Output Voltages

This test checks the output voltages of the supply. The voltage requirement is not a specification, but is checked to assure proper operation of the probes.

Requirement: +17.3 Vdc \pm 500 mV and -17.3 Vdc \pm 500 mV

Table 8 Equipment Required

Equipment	Critical Specification	Recommended Model/Part
Digital Multimeter	Better than 0.1% accuracy	3458A

Use **Figure 4** on page 20 to locate the correct pins of the probe power connectors. Either connector can be measured to check the voltage accuracy. Both can be measured to assure both connectors have power.

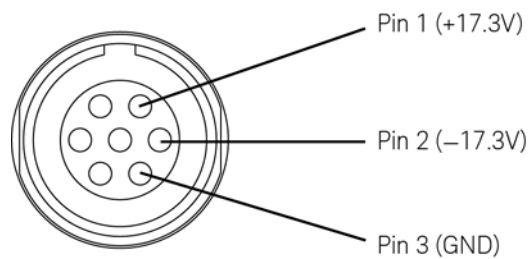


Figure 4 Probe Power Output Connector

- 1** Connect the mains power to the 1143A and turn the front-panel power switch on.
- 2** Measure the voltage between ground and pin 1 of the connector. It should be +17.3 Vdc, ± 500 mV.
- 3** Measure the voltage between ground and pin 2 of the connector. It should be -17.3 Vdc, ± 500 mV.

NOTE

If the test fails, the supplies may need adjustment. Refer to **"Making Adjustments"** on page 25.

Contacting Keysight

Keysight Technologies contact information can be found at:

www.keysight.com/find/contactus

When returning the product, observe the following tips:

- Write the following information on a tag and attach it to the power supply.
 - Name and address of the owner
 - Power supply model number
 - Description of service required or failure indications
- Retain all accessories.
- Return the power supply in its original shipping materials or pack the power supply in foam or other shock-absorbing material and place it in a strong shipping container. If the original shipping materials are not available, place 3 to 4 inches of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping.
- Seal the shipping container securely.
- Mark the shipping container as FRAGILE. In all correspondence, refer to the instrument by model number and full serial number.

Contacting Keysight

2 Servicing the 1143A

Making Adjustments	25
Disassembling The 1143A	30
Troubleshooting The Power Supplies	32
Troubleshooting The Offset Circuitry	33
Replaceable Parts	34
Theory of Operation	48
Returning the Instrument For Service	58

This chapter provides troubleshooting and repair techniques and information. Read **"Safety Information"** on page 8 before servicing the instrument. Before performing any procedure, review it for cautions and warnings.

Figure 6 on page 30 shows the internal location of the protective earth terminal.

The 1143A consists of simple power supplies and op-amp variable current sources. Circuitry is simple and components are available off the shelf, so the service strategy is component-level repair. The troubleshooting, parts lists, theory of operation, and schematics support this repair level.

WARNING

When power is applied there are dangerous voltages present in this equipment. Maintenance should be performed by trained service personnel. When maintenance can be performed without power applied, the power cord must be removed from the instrument. Maintenance by persons unaware of the hazards involved (for example, fire and electric shock) can result in injury or death.

Recommended Test Equipment

Table 9 on page 24 lists the test equipment required to service this instrument. The table indicates the critical specification of the test equipment and for which procedure the equipment is necessary. Equipment other than the recommended model may be used if it satisfies the critical specification listed in the table.

Table 9 Recommended Test Equipment

Equipment Required	Critical Specifications	Recommended Model/Part	Use ^a
DVM	Accuracy: $\pm 0.1\%$	3457A	P,A,T
Resistor	511 Ω , 0.5W, 1%	0757-0814	A
Resistor	50 Ω , 10W, 1%	0811-3707	A

a P = Performance Tests, A = Adjustments, T = Troubleshooting

Making Adjustments

This section provides adjustment procedures for the 1143A.

Safety

Read **"Safety Information"** on page 8 before servicing the instrument. Before performing any procedure, review it for cautions and warnings.

WARNING

When power is applied there are dangerous voltages present in this equipment. Maintenance should be performed by trained service personnel. When maintenance can be performed without power applied, the power cord must be removed from the instrument. Maintenance by persons unaware of the hazards involved (for example, fire and electric shock) can result in injury or death.

Adjustment Interval

There is no recommended adjustment interval for the 1143A. These adjustments are considered factory adjustments and do not require periodic maintenance. Make adjustments only when directed by other service procedures. Defining an adjustment interval will depend on the user's experience.

Equipment Required

The equipment required for all maintenance is listed in the **"Recommended Test Equipment"** on page 24. Equipment for individual procedures is listed at the procedure. Any equipment that satisfies the critical specification listed in the table may be substituted for the recommended model.

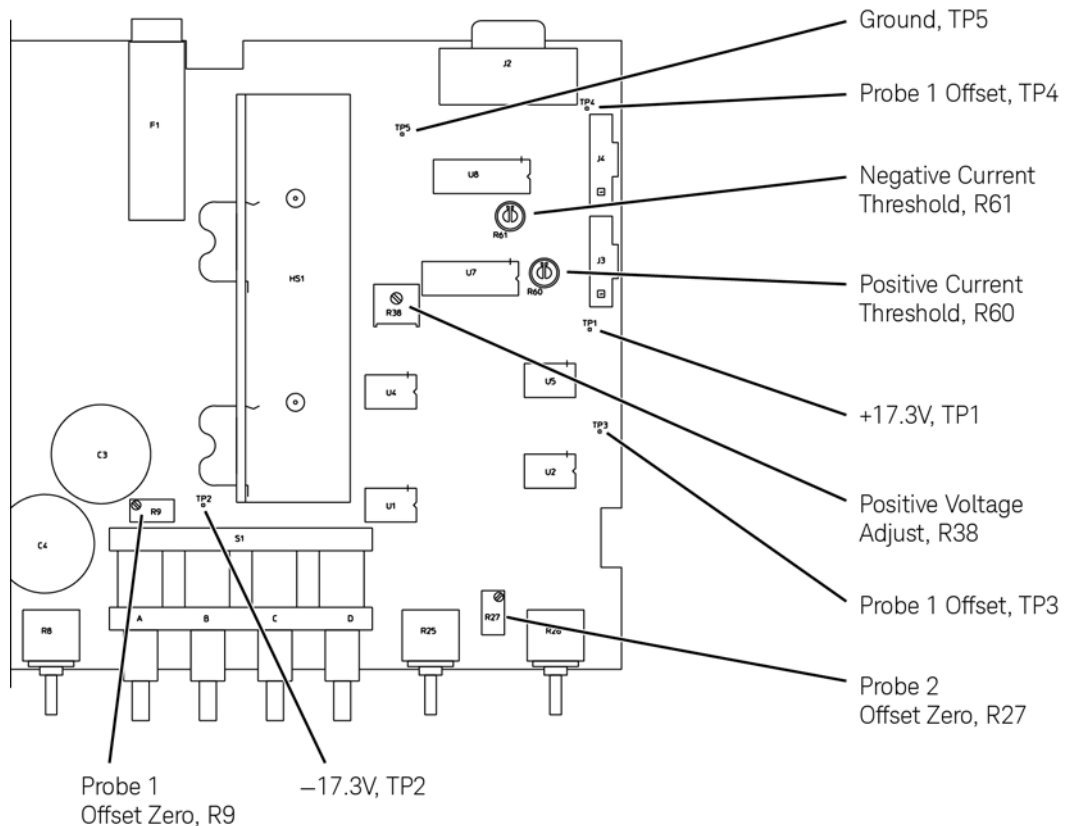


Figure 5 1143A Adjustment Locations

To Prepare The Equipment

- 1 Turn off the front-panel power switch and remove the power cord.

WARNING

When power is applied there are hazardous voltages inside the instrument. Observe reasonable safety precautions in order to avoid injury or death.

- 2 Disconnect any probes from the front panel.
- 3 With a T10 Torx driver, remove 4 flathead screws and remove the top chassis.

- 4 Check that the rear-panel line select switch is set for the correct line voltage.
- 5 Connect the input power and turn on the front panel power switch.

To Adjust Power Supply Voltages

This procedure adjusts the power supply voltages. The adjustment adjusts the +17.3V supply directly. The -17.3V supply tracks the +17.3V supply.

Table 10 Equipment Required

Equipment	Critical Specification	Recommended Model/Part
Digital Multimeter	Better than 0.1% accuracy	3458A

Make sure there is no load on the supplies. Use the adjustment locator on the previous page to find the test points and adjustments.

- 1 Connect the DVM between TP5 (ground) and TP1 (+17.3V). Refer to **Figure 5** on page 26.
- 2 Adjust R38 (Positive Voltage Adjust) for a reading of 17.3V \pm 50 mV.
- 3 Connect the DVM between TP5 (ground) and TP2 (-17.3V).
- 4 Check for a reading of -17.3V \pm 150 mV.

NOTE

If the supplies cannot be adjusted into tolerance, refer to **"Troubleshooting The Power Supplies"** on page 32.

To Adjust Power Supply Current Limits

This procedure sets the current limit of the supplies to approximately 330 mA for each supply. Refer to **Figure 5** on page 26 to find the test points and adjustments.

Table 11 Equipment Required

Equipment	Critical Specification	Recommended Model/Part
Digital Multimeter	Better than 0.1% accuracy	3458A

Table 11 Equipment Required

Equipment	Critical Specification	Recommended Model/Part
Resistor	50Ω, 10W, 1%	0811-3707

- 1 Connect the DVM between TP5 (ground) and TP1 (+17.3V).
- 2 Connect the 50Ω resistor between TP5 and TP1.
- 3 Adjust R60 (Positive Current Threshold) for a reading of +16.7V ±300 mV.
- 4 Connect the DVM between TP5 (ground) and TP2 (-17.3V).
- 5 Disconnect the 50Ω resistor from TP1 and connect it to TP2 (between TP5 and TP2).
- 6 Adjust R61 (Negative Current Threshold) for a reading of -16.7V ±300 mV (-16.4V to -17.0V).

If the supplies cannot be adjusted into tolerance, refer to **“There is a Current Limit Problem”** on page 32.

To Adjust Offset Zero

This procedure adjusts the probe offset drive current to zero when the offset is turned off. Refer to **Figure 5** on page 26 to find the test points and adjustments.

Table 12 Equipment Required

Equipment	Critical Specification	Recommended Model/Part
Digital Multimeter	Better than 0.1% accuracy	3458A
Resistor	511Ω, 0.5W, 1%	0757-0814

Do not make this adjustment while using a probe as a load on the offset circuit. It will give the wrong result.

- 1 Set the front-panel Probe 1 and Probe 2 offset controls for Zero and Local.
- 2 Connect the DVM between TP5 (ground) and TP3 (Probe 1 Offset).
- 3 Connect the 511Ω resistor between TP5 and TP3.
- 4 Adjust R9 (Probe 1 Offset Zero) for a reading of 0.0V ±100 μV.

- 5** Connect the DVM between TP5 (ground) and TP4 (Probe 2 Offset).
- 6** Disconnect the 511 Ω resistor from TP3 and connect it to TP4 (between TP5 and TP4).
- 7** Adjust R27 (Probe 2 Offset Zero) for a reading of 0.0V \pm 100 μ V.

If the offset zero cannot be adjusted into tolerance, refer to **"The +17.3 Supply Won't Adjust Into Tolerance"** on page 32.

Disassembling The 1143A

Use the following procedure to disassemble the 1143A.

WARNING

Hazardous voltages exist on the power module. Failure to adhere closely to the following procedures can cause electrical shock.

- 1 Remove the power cord.
- 2 Remove four flathead screws and remove the top cover.

WARNING

Be sure to reconnect the safety ground when reassembling the instrument. Failure to reconnect the safety ground can result in electrical shock.

- 3 Unplug the safety ground from the tab on the rear panel of the instrument.

Protective Earthing Terminal



Figure 6 Location of Protective Earth Terminal

- 4 At the PC board, disconnect the cables that connect the front panel probe power outputs.
- 5 Note the orientation of the knobs. Remove the four knobs.

- 6** On the bottom of the instrument, remove the 5 mm screw that fastens the transformer support.
- 7** Remove the following pan-head screws.
 - Three directly on the PC board.
 - Two on the ac input connector.
 - Two on the heatsink.
- 8** Remove the PC board. Slide it slightly forward so parts will clear the rear panel, then lift the rear of the board out while sliding it backwards.
- 9** Remove the two heat sink spacers from the standoffs that were directly under the hearing.
- 10** Reverse the procedure to reassemble the power module.

Troubleshooting The Power Supplies

The circuitry consists of simple power supplies. Use conventional troubleshooting techniques. A complete parts list, component locator, and schematics are provided later in this chapter. Following are some things to check first, given certain failure symptoms. This is not a comprehensive troubleshooting guide.

The +17.3V Supply Won't Adjust Into Tolerance

- Make sure the supply is not loaded into current limit.
- Check the +1.5V reference of the +17.3V regulator.
- Check the values of parts in the voltage divider stick that includes the adjustment potentiometer (R37 – R39).

The –17.3V Supply Is Out Of Tolerance

- Make sure the +17.3V supply is in tolerance.
- Make sure the supply is not loaded into current limit.
- Check the values of parts in the voltage divider sticks that feed the error amplifier of the –17.3V regulator (R47 – R51).

There is a Current Limit Problem

- Check that the supply is not loaded into current limit.
- Check the values of parts in the current sense circuit, particularly the current sense resistors (R42 and R53).

Troubleshooting The Offset Circuitry

The offset circuitry is essentially a string of op-amps and you can use conventional signal tracing techniques. A complete parts list, component locator, and schematics are provided later in this chapter.

- 1** Load the appropriate offset output circuit with a 511Ω resistor. For probe 1 connect the resistor between TP5 and TP3, and for probe 2 connect it between TP5 and TP4.
- 2** Measure the offset output voltage (TP3 for probe 1 or TP4 for probe 2).
 - With the controls set to Local and Zero, the voltage should be adjustable (R9 probe 1, R29 probe 2) to $0.0\text{ Vdc} \pm 100\ \mu\text{V}$.
 - With the controls set to Local and Variable, the voltage should be variable by the front panel controls greater than $\pm 2.58\text{ Vdc}$.

The offset output is a $\pm 5\text{ mA}$ current. Into a 511Ω resistor the nominal voltage swing should be $\pm 2.58\text{ Vdc}$ but it depends on the value of the resistor. For the most accurate test, measure the offset current swing directly.

Replaceable Parts

This section contains information for ordering parts. Service support for the 1143A Probe Offset Control and Power Module is to the component level.

Parts Lists

Table 14 on page 37, is an instrument-level parts list. **Table 15** on page 38, is a parts list for the PC assembly (A1) in the power module. The information given for each part consists of the following:

- Reference designator.
- Keysight Technologies part number.
- Part number Check Digit (CD).
- Total quantity (Qty) in instrument or on assembly. The total quantity is given once and at the first appearance of the part number in the list.
- Description of the part.
- Typical manufacturer of part in an identifying five-digit code.
- Manufacturer's part number.

Manufacturers' Codes

Table 13 on page 34 is a list of manufacturers' codes listed in **Table 14** and **Table 15**. The codes are given for parts in the parts lists. The table gives the manufacturer and address for each code.

Table 13 Manufacturers' Code List (Sheet 1 of 2)

Mfr. No.	Name	Address
00000	Any satisfactory supplier	
04713	Notarial Semiconductor Products	Phoenix, AZ 85008
06665	Precision Monolithic Inc	Santa Clara, CA 95050
01295	Texas Inst. Inc Semicond Cmpnt Div	Dallas, TX 75222
19701	Mepco/Electra Corp	Mineral Wells, TX 76067
24546	Corning Glass Works (Bradford)	Bradford, PA 16701

Table 13 Manufacturers' Code List (Sheet 2 of 2)

Mfr. No.	Name	Address
27014	National Semiconductor Corp	Palo Alto, CA 94304
28480	Keysight Technologies	Santa Rosa, CA 94403
73138	Beckman Industrial Corp	Fullerton, CA 92634
75915	Littlefuse Inc.	Des Plaines, IL 60016
9N171	Unitrode Computer Products Corp	Methuen, MA 01844

Component Locator

Table 16 on page 45 lists the location of components on the A1 power and control assembly shown in is shown in **Figure 7** on page 47. The table references the parts on the assembly to a grid location on the drawing.

Ordering Information

To order a part in the material list, quote the Keysight Technologies part number, indicate the quantity desired, and address the order to the nearest Keysight Technologies sales office. To order a part not listed in the material list, include the instrument part number, instrument serial number, a description of the part (including its function) and the number of parts required. Address the order to the nearest Keysight Technologies Service Center.

Direct Mail Order System

Within the USA, Keysight Technologies can supply parts through a direct mail order system. There are several advantages to this system:

- Direct ordering and shipment from the Keysight Technologies parts center in California, USA.
- No maximum or minimum on any mail order (there is a minimum amount for parts ordered through a local Keysight Technologies Sales Office when the orders require billing and invoicing).
- Prepaid transportation (there is a small handling charge for each order).
- No invoices.

Replaceable Parts

In order for Keysight Technologies to provide these advantages, please send a check or money order with each order.

Mail order forms and specific ordering information are available through your local Keysight Technologies office. Addresses and telephone numbers are located in a separate document shipped with the manuals.

Table 14 1143A Replaceable Parts

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
A1	01143-66501	4	1	PC ASSEMBLY-POWER AND CONTROL	28480	01143-66501
H1	0515-0374	4	7	SCREW-MACHINE M3 10MM-LG (PC board mounting)	00000	ORDER BY DESCR.
H2	0515-1031	2	4	SCREW-MACH M3 6MM-LG 90-DEG-FLH-HD (cover mounting)	00000	ORDER BY DESCR.
H3	0515-1579	3	1	SCREW-MACHINE M5 18MM-LG (transformer support mounting)	00000	ORDER BY DESCR.
F1	2110-0201	1	1	FUSE 0.25A 250V TD (part of A1)	28480	313.250HXP
MP1	01143-00602	8	1	BOTTOM CHASSIS	28480	01143-00602
MP2	01143-00601	7	1	TOP CHASSIS	28480	01143-00601
MP3	01142-24701	7	2	SPACER-HEAT SINK	28480	01142-24701
MP4	0370-1097	2	4	KNOB-POINTER	28480	0370-1097
MP5	0403-0727	4	4	FOOT	28480	0403-0727
MP6	5041-0234	5	4	KEYCAP-FUNCTION SELECT	28480	5041-0234
MP7	5041-0531	5	1	KEYCAP-POWER	28480	5041-0531
W1	8120-1521	6	1	POWER CORD 18-AWG 3-COND 90-IN-LG	28480	8120-1521
W2	01143-61601	5	2	CABLE- PROBE POWER	28480	01143-61601
W1	8120-1703	6	1	CABLE-POWER (Option 900-UK)	28480	8120-1703
W1	8120-0696	4	1	CABLE-POWER (Option 901-AUSTL)	28480	8120-0696
W1	8120-1692	2	1	CABLE-POWER (Option 902-EUR)	28480	8120-1692
W1	8120-0698	6	1	CABLE-POWER (Option 904-250V USA/CANADA)	28480	8120-0698
W1	8120-2296	4	1	CABLE-POWER (Option 906-SWIT)	28480	8120-2296
W1	8120-2957	4	1	CABLE-POWER (Option 912-DEN)	28480	8120-2957
W1	8120-4600	8	1	CABLE-POWER (Option 917-AFRICA)	28480	8120-4600
W1	8120-4754	3	1	CABLE-POWER (Option 918-JAPAN)	28480	8120-4754

Replaceable Parts

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 1 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
C1	0160-5578	7	4	CAPACITOR-FXD 0.022UF ±10% 63VDC	28480	0160-5578
C2	0160-5578	7		CAPACITOR-FXD 0.022UF ±10% 63VDC	28480	0160-5578
C3	0180-3298	6	2	CAPACITOR-FXD 2200UF+30-10% 50VDC AL	28480	0180-3298
C4	0180-3298	6		CAPACITOR-FXD 2200UF+30-10% 50VDC AL	28480	0180-3298
C5	0160-5578	7		CAPACITOR-FXD 0.022UF ±10% 63VDC	28480	0160-5578
C6	0160-5931	6	2	CAPACITOR-FXD 0.22UF ±10% 50VDC	28480	0160-5931
C7	0160-5469	5	2	CAPACITOR-FXD 1UF ±10% 50VDC MET-POLYE	28480	0160-5469
C8	0160-6500	7	10	CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C9	0160-5931	6		CAPACITOR-FXD 0.22UF ±10% 50VDC	28480	0160-5931
C10	0160-4835	7	1	CAPACITOR-FXD 0.1UF ±10% 50VDC CER	28480	0160-4835
C11	0160-5578	7		CAPACITOR-FXD 0.022UF ±10% 63VDC	28480	0160-5578
C12	0180-3831	3	2	CAPACITOR-FXD 10UF±10% 35VDC TA	28480	0180-3831
C13	0180-3831	3		CAPACITOR-FXD 10UF±10% 35VDC TA	28480	0180-3831
C14	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C15	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C16	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C17	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C18	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C19	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C20	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C21	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
C22	0160-5471	9	2	CAPACITOR-FXD 0.1UF ±5% 50VDC MET-POLYE	28480	0160-5471
C23	0160-5471	9		CAPACITOR-FXD 0.1UF ±5% 50VDC MET-POLYE	28480	0160-5471
C24-25				NOT ASSIGNED		

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 2 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
C26	0160-5469	5		CAPACITOR-FXD 1UF ±10% 50VDC MET-POLYE	28480	0160-5469
C27	0160-6500	7		CAPACITOR-FXD 0.01UF ±10% 100VDC CER	28480	0160-6500
CR1	1901-1087	8	2	DIODE-PWR RECT 600V 3A 200NS	04713	MR856
CR2	1901-1087	8		DIODE-PWR RECT 600V 3A 200NS	04713	MR856
CR3	1901-1098	1	1	DIODE-SWITCHING 1N4150 50V 200MA 4NS	9N171	1N4150
DS1	1990-0521	0	1	LED-LAMP GREEN LUM-INT=2.2MCD IF=50MA-MAX	28480	5082-4955
E1	2110-0642	3	1	FUSEHOLDER 6.3A 250 V	28480	2110-0642
E2	2110-0565	9	1	FUSEHOLDER CAP	28480	2110-0565
F1	2110-0201	1	1	FUSE 0.25A 250V TD	28480	313.250HXP
H1	0515-1579	3	1	SCREW-MACHINE ASSEMBLY M5 X 0.8 18MM-LG	28480	0515-1579
HS1	01142-211 01	5	1	HEAT SINK	28480	01142-2110 1
J1	1251-4743	0	1	CONNECTOR-AC PWR MALE	28480	1251-4743
J2	1252-1487	5	1	CONN-RECT D-SUBMIN 9-CONT (remote)	28480	1252-1487
J3	1252-4418	8	2	CONNECTOR-HEADER 7-PIN	28480	1252-4418
J4	1252-4418	8		CONNECTOR-HEADER 7-PIN	28480	1252-4418
MP1	1400-1604	3	1	SPACER-LED MOUNT	28480	1400-1604
MP2	01142-247 02	8	1	TRANSFORMER SUPPORT	28480	01142-2470 2
MP3	01142-288 01	6	1	WASHER-TRANSFORMER SUPPORT	28480	01142-2880 1
MP4	1205-0732	2	2	SPRING CLIP	28480	1205-0732
MP5	0361-0685	3	3	RIVET-BLIND DR-PIN RNDH 0.125DIA	28480	0361-0685
MP6	0340-1211	9	2	INSULATOR-THERMAL	28480	0340-1211

Replaceable Parts

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 3 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
MP7	1400-0249	0	1	CABLE TIE 0.062-0.625-DIA 0.091-WD NYL	16956	08-465/GRAY
Q1	1853-0431	1	1	TRANSISTOR PNP SI PD=65W	01295	TIP42C
Q2	1854-0456	2	1	TRANSISTOR NPN SI PD=65W FT=3MHZ	01295	TIP41A
Q3	1853-0036	2	2	TRANSISTOR PNP SI PD=310MW FT=250MHZ	27014	2N3906
Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	27014	2N3906
R1	0698-3161	9	2	RESISTOR 38.3K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-3832-F
R2	0698-3271	2	2	RESISTOR 115K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1153-F
R3	0698-4517	1	2	RESISTOR 127K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1273-F
R4	0757-0458	7	2	RESISTOR 51.1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-5112-F
R5	0699-1301	7	2	RESISTOR 4.7M 5% 0.25W CF TC=0-900	28480	0699-1301
R6	0698-8961	7	2	RESISTOR 909K 1% 0.125W TF TC=0±100	28480	0698-8961
R7	2100-4250	6	4	RESISTOR-VARIABLE 10K 20%	28480	2100-4250
R8	2100-4250	6		RESISTOR-VARIABLE 10K 20%	28480	2100-4250
R9	2100-3659	7	2	RESISTOR-TRMR 20K 10% TKF TOP-ADJ 17-TRN	28480	2100-3659
R10	0757-0199	3	2	RESISTOR 21.5K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-2152-F
R11	0757-0280	3	3	RESISTOR 1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1001-F

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 4 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
R12	0698-8827	4	4	RESISTOR 1M 1% 0.125W TF TC=0±100	28480	0698-8827
R13	0757-0442	9	5	RESISTOR 10K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1002-F
R14	0698-6322	0	4	RESISTOR 4K 0.1% 0.125W TF TC=0±25	28480	0698-6322
R15	0698-6322	0		RESISTOR 4K 0.1% 0.125W TF TC=0±25	28480	0698-6322
R16	0698-6362	8	4	RESISTOR 1K 0.1% 0.125W TF TC=0±25	28480	0698-6362
R17	0698-6362	8		RESISTOR 1K 0.1% 0.125W TF TC=0±25	28480	0698-6362
R18	0698-6624	5	2	RESISTOR 2K 0.1% 0.125W TF TC=0±25	28480	0698-6624
R19	0698-3161	9		RESISTOR 38.3K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-3832-F
R20	0698-3271	2		RESISTOR 115K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1153-F
R21	0698-4517	1		RESISTOR 127K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1273-F
R22	0757-0458	7		RESISTOR 51.1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-5112-F
R23	0699-1301	7		RESISTOR 4.7M 5% 0.25W CF TC=0-900	28480	0699-1301
R24	0698-8961	7		RESISTOR 909K 1% 0.125W TF TC=0±100	28480	0698-8961
R25	2100-4250	6		RESISTOR-VARIABLE 10K 20%	28480	2100-4250
R26	2100-4250	6		RESISTOR-VARIABLE 10K 20%	28480	2100-4250
R27	2100-3659	7		RESISTOR-TRMR 20K 10% TKF TOP-ADJ 17-TRN	28480	2100-3659
R28	0757-0199	3		RESISTOR 21.5K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-2152-F

Replaceable Parts

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 5 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
R29	0757-0280	3		RESISTOR 1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1001-F
R30	0698-8827	4		RESISTOR 1M 1% 0.125W TF TC=0±100	28480	0698-8827
R31	0757-0442	9		RESISTOR 10K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1002-F
R32	0698-6322	0		RESISTOR 4K 0.1% 0.125W TF TC=0±25	28480	0698-6322
R33	0698-6322	0		RESISTOR 4K 0.1% 0.125W TF TC=0±25	28480	0698-6322
R34	0698-6362	8		RESISTOR 1K 0.1% 0.125W TF TC=0±25	28480	0698-6362
R35	0698-6362	8		RESISTOR 1K 0.1% 0.125W TF TC=0±25	28480	0698-6362
R36	0698-6624	5		RESISTOR 2K 0.1% 0.125W TF TC=0±25	28480	0698-6624
R37	0757-0288	1	1	RESISTOR 9.09K 1% 0.125W TF TC=0±100	19701	5033R-1/8-T0-9091-F
R38	2100-3211	7	1	RESISTOR-TRMR 1K 10% TKF TOP-ADJ 1-TRN	28480	2100-3211
R39	0757-0422	5	3	RESISTOR 909 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-909R-F
R40	0757-0422	5		RESISTOR 909 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-909R-F
R41	0757-0453	2	2	RESISTOR 30.1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-3012-F
R42	0699-2403	2	2	RESISTOR 0.33 5% 0.7W MO TC=0±200	28480	0699-2403
R43	0698-4413	6	4	RESISTOR 154 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-154R-F
R44	0757-0818	3	2	RESISTOR 825 1% 0.5W TF TC=0±100	28480	0757-0818

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 6 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
R45	0757-0442	9		RESISTOR 10K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1002-F
R46	0757-0818	3		RESISTOR 825 1% 0.5W TF TC=0±100	28480	0757-0818
R47	0698-6347	9	4	RESISTOR 1.5K 0.1% 0.125W TF TC=0±25	28480	0698-6347
R48	0698-6348	0	1	RESISTOR 3K 0.1% 0.125W TF TC=0±25	28480	0698-6348
R49	0698-6347	9		RESISTOR 1.5K 0.1% 0.125W TF TC=0±25	28480	0698-6347
R50	0698-6347	9		RESISTOR 1.5K 0.1% 0.125W TF TC=0±25	28480	0698-6347
R51	0698-6347	9		RESISTOR 1.5K 0.1% 0.125W TF TC=0±25	28480	0698-6347
R52	0698-4413	6		RESISTOR 154 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-154R-F
R53	0699-2403	2		RESISTOR 0.33 5% 0.7W MO TC=0±200	28480	0699-2403
R54	0698-4413	6		RESISTOR 154 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-154R-F
R55	0757-0453	2		RESISTOR 30.1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-3012-F
R56	0757-0422	5		RESISTOR 909 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-909R-F
R57	0757-0280	3		RESISTOR 1K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1001-F
R58	0698-4413	6		RESISTOR 154 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-154R-F
R59	0757-1078	9	1	RESISTOR 1.47K 1% 0.5W TF TC=0±100	28480	0757-1078
R60	2100-2497	9	2	RESISTOR-TRMR 2K 10% TKF TOP-ADJ 1-TRN	73138	82PR2K

Replaceable Parts

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 7 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
R61	2100-2497	9		RESISTOR-TRMR 2K 10% TKF TOP-ADJ 1-TRN	73138	82PR2K
R62	0757-0442	9		RESISTOR 10K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1002-F
R63	0698-8827	4		RESISTOR 1M 1% 0.125W TF TC=0±100	28480	0698-8827
R64	0757-0442	9		RESISTOR 10K 1% 0.125W TF TC=0±100	24546	CT4-1/8-T0-1002-F
R65	0698-8827	4		RESISTOR 1M 1% 0.125W TF TC=0±100	28480	0698-8827
S1	3101-3132	4	1	SWITCH-4 STATION ASSEMBLY	28480	3103-3132
S2	3101-0555	9	1	SWITCH-PUSH BUTTON DPDT 4A 250 VAC	28480	3101-0555
S3	3101-2609	8	1	SWITCH-SLIDE DPDT 5A 250VAC PC	28480	3101-2609
T1	9100-4750	8	1	TRANSFORMER-POWER (with mounting hardware)	28480	9100-4750
TP1	0360-0535	0	5	TERMINAL-TEST POINT	28480	0360-0535
TP2	0360-0535	0		TERMINAL-TEST POINT	28480	0360-0535
TP3	0360-0535	0		TERMINAL-TEST POINT	28480	0360-0535
TP4	0360-0535	0		TERMINAL-TEST POINT	28480	0360-0535
TP5	0360-0535	0		TERMINAL-TEST POINT	28480	0360-0535
U1	1826-1992	4	2	IC OP AMP	06665	OP-200
U2	1826-1049	2	2	IC OP AMP PRCN 8-DIP-C PKG	06665	OP-27GZ
U3	1826-0774	8	2	IC V RGLTR-V-REF-FXD 1.22/1.24V T0-92	27014	LM385BZ-1.2
U4	1826-1992	4		IC OP AMP	06665	OP-200
U5	1826-1049	2		IC OP AMP PRCN 8-DIP-C PKG	06665	OP-27GZ
U6	1826-0774	8		IC V RGLTR-V-REF-FXD 1.22/1.24V T0-92	27014	LM385BZ-1.2

Table 15 A1 Power and Control Assembly Replaceable Parts (Sheet 8 of 8)

Ref. Des.	Part Number	CD	Qty	Description	Mfr. Code	Mfr. Part Number
U7	1826-1327	9	2	IC V RGLTR-ADJ 5/35V 16-DIP-P PKG	9N171	UC3834N
U8	1826-1327	9		IC V RGLTR-ADJ 5/35V 16-DIP-P PKG	9N171	UC3834N
VR1	1902-0964	0	2	DIODE-ZNR 18V 5% DO-35 PD=0.4W TC=+.09%	28480	1902-0964
VR2	1902-0964	0		DIODE-ZNR 18V 5% DO-35 PD=0.4W TC=+.09%	28480	1902-0964
W1	01141-61602	4	1	WIRE ASSEMBLY-SAFETY GROUND	28480	01141-61602

Table 16 Component Locations for A1 Assembly

Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc
C1	G-2	C19	G-3	Q1	E-2	R15	G-2	R33	H-3	R51	F-4	T1	B-4
C2	F-3	C20	F-3	Q2	E-4	R16	H-2	R34	H-4	R52	H-4	TP1	H-3
C3	D-2	C21	G-3	Q3	G-5	R17	H-3	R35	H-4	R53	G-4	TP2	E-2
C4	C-2	C22	H-4	Q4	H-4	R18	G-2	R36	H-3	R54	G-4	TP3	H-3
C5	E-3	C23	H-1	R1	G-1	R19	G-3	R37	H-4	R55	G-4	TP4	H-6
C6	E-3	C26	F-5	R2	G-1	R20	G-3	R38	F-4	R56	F-4	TP5	F-5
C7	F-4	C27	F-5	R3	G-1	R21	G-3	R39	F-4	R57	H-5	U1	F-2
C8	H-4	CR1	B-1	R4	G-1	R22	G-2	R40	D-2	R58	G-4	U2	H-2
C9	E-4	CR2	B-2	R5	G-1	R23	G-2	R41	G-4	R59	B-1	U3	G-1
C10	H-5	CR3	H-4	R6	G-2	R24	G-3	R42	F-3	R60	H-4	U4	F-3
C11	E-3	DS1	B-1	R7	B-1	R25	G-1	R43	F-3	R61	G-4	U5	H-3
C12	E-3	E1	D-5	R8	C-1	R26	H-1	R44	D-3	R62	H-5	U6	G-3
C13	E-2	E2	D-5	R9	D-2	R27	G-1	R45	F-5	R63	H-4	U7	G-4
C14	H-2	F1	D-5	R10	H-2	R28	G-3	R46	G-5	R64	H-1	U8	G-5

Table 16 Component Locations for A1 Assembly

Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc	Ref Des	Grid Loc
C15	G-2	J1	C-6	R11	H-2	R29	H-3	R47	G-5	R65	H-1	VR1	F-4
C16	F-2	J2	G-6	R12	G-2	R30	G-3	R48	F-5	S1	E-2	VR2	F-5
C17	F-2	J3	H-4	R13	G-2	R31	G-3	R49	F-5	S2	A-1		
C18	H-3	J4	H-5	R14	G-2	R32	H-3	R50	F-5	S3	A-6		

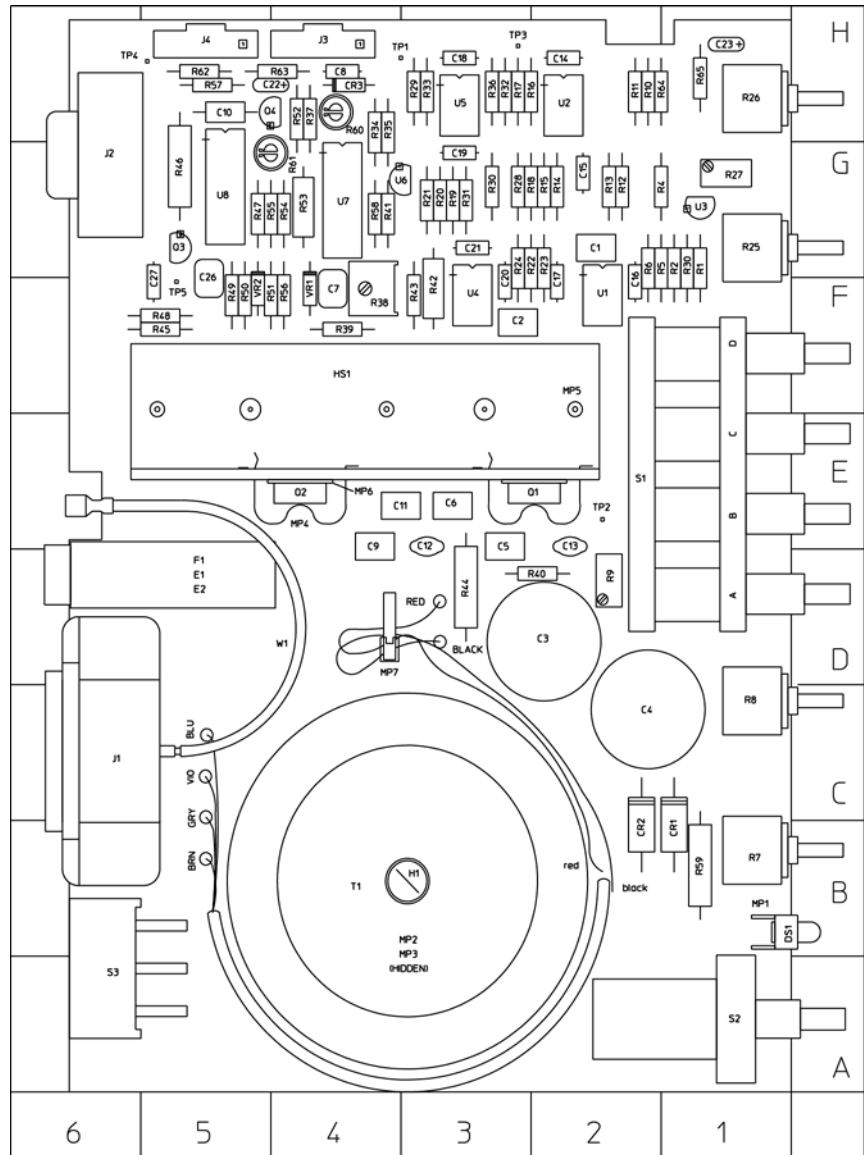


Figure 7 A1 Assembly Component Locations

Theory of Operation

The schematics in this section cover the power and control assembly A1. The only electrical parts not on this assembly are the two probe power cables. Refer also to **Figure 7**, “A1 Assembly Component Locations,” on page 47 and **Table 16** on page 45.

Schematic Diagrams




The following schematic diagrams are located in this section:

- **Figure 8**, “Voltage Regulator IC Simplified Diagram,” on page 51
- **Figure 9**, “Schematic 1. Line Input and Positive Supply,” on page 53
- **Figure 10**, “Schematic 2. Negative Supply,” on page 54
- **Figure 11**, “Schematic 3. Probe 1 Offset Control,” on page 55
- **Figure** , “,” on page 56
- **Figure 13**, “Probe Power Cable Diagram (W2),” on page 57

Schematics for the power and control assembly are sequentially numbered in the figure title at the bottom of the page. Schematic numbers are used to cross reference signal connections between the schematics. On schematic 3 is a table showing the power connections, power grounds, and nonfunctional pins of ICs (integrated circuits). This helps avoid nonfunctional clutter on the schematic and gives one place to show IC power connections when IC sections are split between schematics.

Unless otherwise noted, resistance is in ohms, capacitance is in microfarads, and inductance is in microhenries. Symbols on schematics are based on current ANSI and IEEE standards.

Table 17 Additional Schematic Symbols

Symbol	Description
	Tool-aided adjustment.
	Test point with measurement aid.
	Connection through machine screw.

Power Supplies

Use the following figures when reading this section.

- **Figure 8**, “Voltage Regulator IC Simplified Diagram,” on page 51
- **Figure 9**, “Schematic 1. Line Input and Positive Supply,” on page 53
- **Figure 10**, “Schematic 2. Negative Supply,” on page 54

Two power supplies provide +17.3 Vdc and –17.3 Vdc. The voltage of both supplies is set by an adjustment on the +17.3V supply. The negative supply follows the positive supply so that a voltage increase in the positive supply causes a voltage increase in the negative supply. Each supply has a current limit adjustment which is adjusted at the factory for limiting at 330 mA.

The supplies use a linear regulator that allows a low differential between the input voltage and the regulated output voltage. The output drives a pass transistor which drives the load with it's collector. A simplified diagram of the voltage regulator IC is shown in the figure below.

Table 18 IC Pin Descriptions

Pin	Function	Pin	Function
1	+ Input Voltage	9	Inverting Input
2	-2.0V Reference	10	Fault Alert (not used)
3	+1.5V Reference	11	Fault Delay
4	Current Threshold Adjust	12	Driver Sink
5	- Input Voltage	13	Driver Source
6	- Current Sense	14	Compensation/Shutdown
7	+ Current Sense	15	O.V. Latch Out/Reset
8	Non-Inverting Input	16	Crowbar Gate

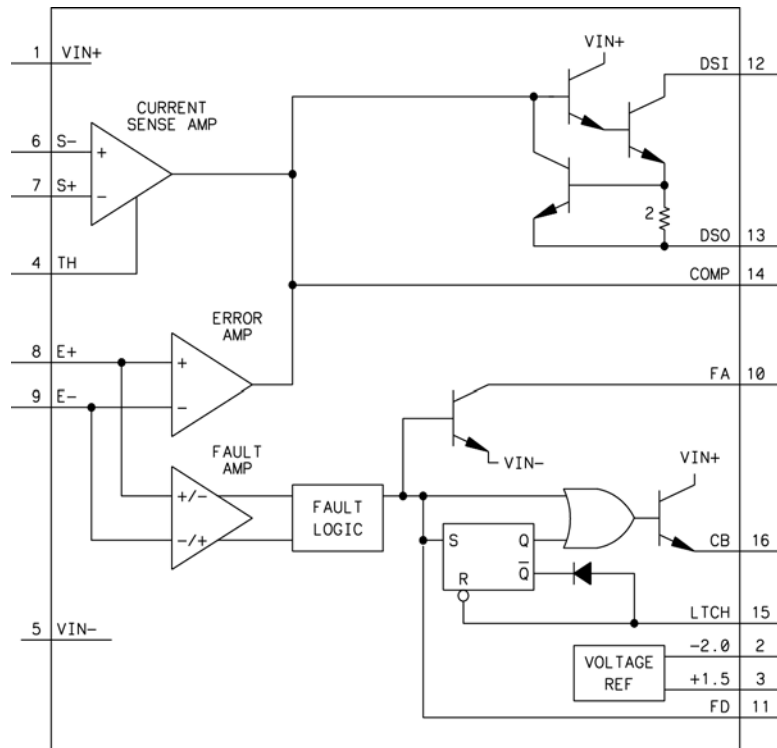


Figure 8 Voltage Regulator IC Simplified Diagram

Positive Supply

When reading this section, refer to **Figure 9**, “Schematic 1. Line Input and Positive Supply,” on page 53. The reference for the positive supply is the +1.5V reference from the IC, fed to the non-inverting input of the error amplifier. The output voltage is divided through the POSITIVE VOLTAGE ADJUST and fed to the inverting input of the error amplifier. The output of the regulator IC is fed to pass transistor Q1. For additional gain, Q1 is operated with the collector as the output.

The voltage across current sense resistor R42 is fed to the current sense amplifier. The current is fold-back limited by R41 and VR1. The POSITIVE CURRENT THRESHOLD adjustment sets the current limit threshold in the amplifier.

Negative Supply

When reading this section, refer to **Figure 10**, “Schematic 2. Negative Supply,” on page 54. The negative supply uses the same IC as the positive supply. The control voltages however, are a sum of the voltage from the positive supply, used as a reference, plus the feedback from the output of the negative supply. The voltage input from the positive supply makes the negative supply voltage track the positive supply. Q3 is an additional gain stage in the output and Q4 assures a clean start when power is applied.

The current limit circuit works the same as the one in the positive supply.

Offset Control

The probe 1 and probe 2 offset circuits are virtually identical. The probe 1 circuit will be described. When reading this section, refer to **Figure 11**, “Schematic 3. Probe 1 Offset Control,” on page 55.

U3, a 1.23V voltage reference, provides a reference for the internal offset control. A fixed portion of the reference feeds the non-inverting input of op-amp U1A. The fine and coarse offset controls also use the reference and feed the variable offset into the inverting input of U1A. The output of U1A swings $\pm 10V$, depending on the offset setting.

S1A selects the Variable offset or Zero (ground) and S1B selects the Local or Remote offset voltage.

Op-amp U1B combines the selected offset signal with an offset adjustment. PROBE 1 OFFSET ZERO is adjusted for zero offset current output when the offset input selection is Local and Zero. To reduce introduction of errors from ground loops, the ground from the remote input is returned to the input circuits of U1B.

The output of U1B drives current source U2. The output of U2 swings ± 5 mA, depending on the offset control input. The offset control drives a 500Ω load in the 54701A active probe.

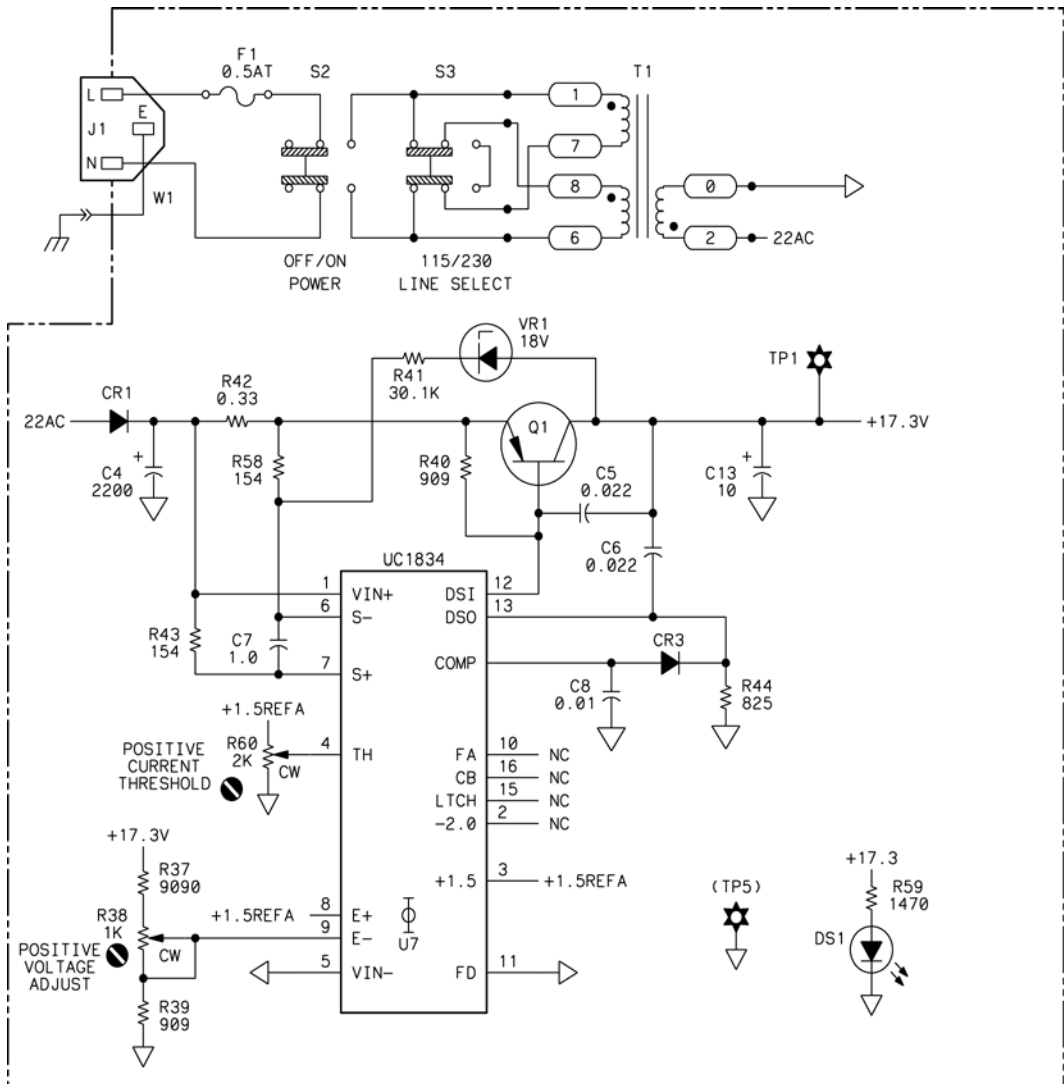


Figure 9 Schematic 1. Line Input and Positive Supply

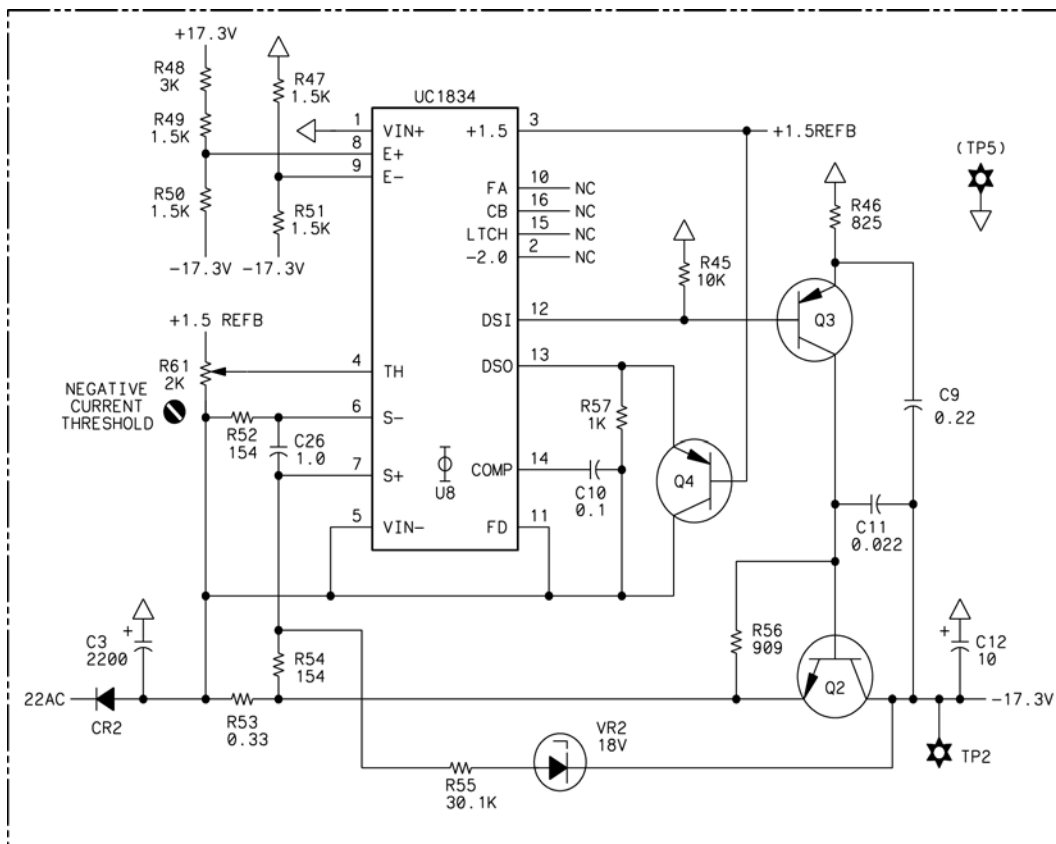


Figure 10 Schematic 2. Negative Supply

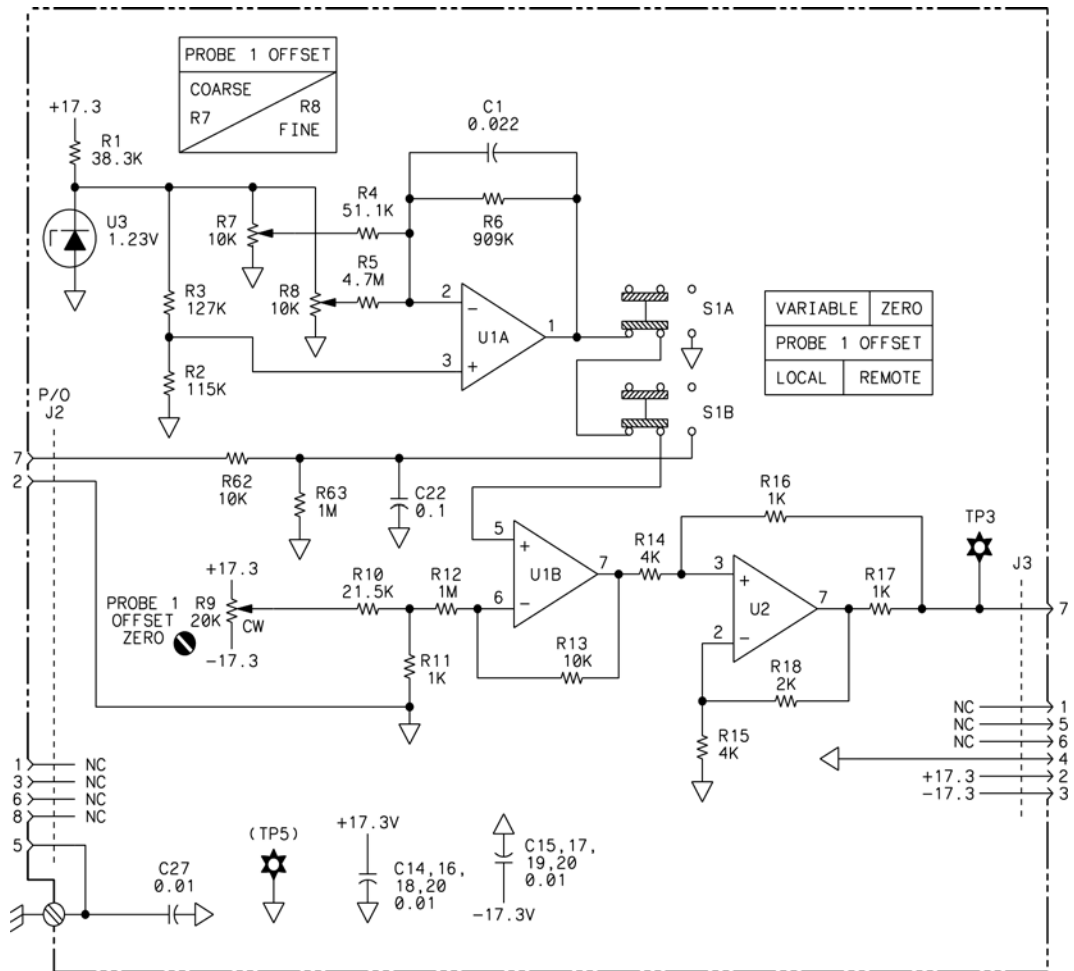


Figure 11 Schematic 3. Probe 1 Offset Control

Table 19 IC Connections Not Shown (Schematics 3 & 4)

Connection	Pin	IC Group	Connector
+17.3V	8	U1, U4	
-17.3V	4		
+17.3V	7	U2, U5	
-17.3V	4		
NC	1, 5, 8		

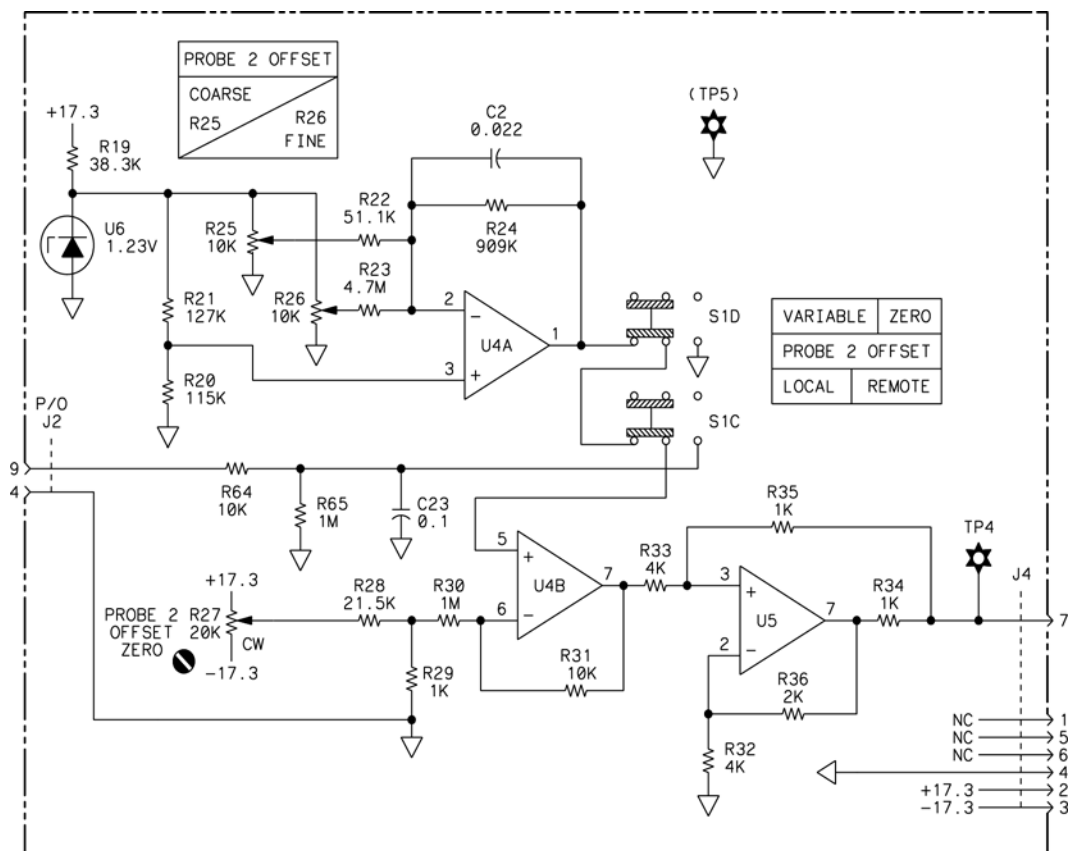


Figure 12 Schematic 4. Probe 2 Offset Control

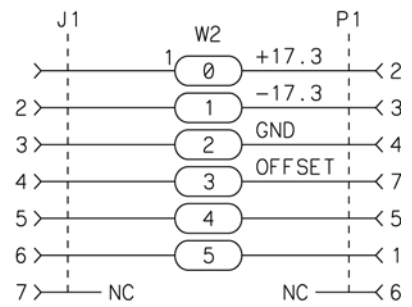
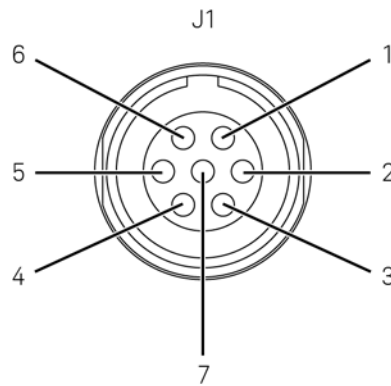


Figure 13 Probe Power Cable Diagram (W2)

Returning the Instrument For Service

Before shipping the instrument to Keysight Technologies, contact your nearest Keysight Technologies sales office for additional details.

- 1** Write the following information on a tag and attach it to the instrument.
 - Name and address of owner
 - Instrument model number
 - Instrument serial number
 - Description of the service required or failure indications
- 2** Remove all accessories from the instrument. Accessories include all cables. Do not include accessories unless they are associated with the failure symptoms.
- 3** Protect the instrument by wrapping it in plastic or heavy paper.
- 4** Pack the instrument in foam or other shock absorbing material and place it in a strong shipping container. You can use the original shipping materials or order materials from an Keysight Technologies sales office. If neither are available, place 3 to 4 inches of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping.
- 5** Seal the shipping container securely.
- 6** Mark the shipping container as FRAGILE. In any correspondence, refer to instrument by model number and full serial number.

Index

A

accessories supplied, 6
adjustment interval, 25
Adjustment Locations, 26
adjustment procedures, 25
altitude, 17

C

cable connector, 12
characteristics, 16
cleaning, 7
Coarse adjust, 13
connector dots, 12

D

dimensions, 18
disassembly, 30

F

Fine adjust, 13
front panel, 5
fuse, 11
fuse holder, 11

G

Grounding, 9
grounding, 9

H

humidity, 17

I

initial inspection, 6
instrument markings, 8

K

knobs, 13

L

line voltage selection, 12
line voltage switch, 11
Local button, 13

O

offset, 13
Offset Voltage, 16
offset voltage, 14
options, 6

P

performance test, 19
power cable, 12
Power connector, 13
Power Requirements, 17
probe power output connector, 20
probe, connecting, 12
protective earth terminal, 30

R

rear panel, 11
regulations, 18
Remote, 13, 14
remote control, 14
remote variable offset, 14
repair, 23
replaceable parts, 34

S

safety information, 8
Schematic 1, 53
Schematic 2, 54
Schematic 3, 55
Schematic 4, 56
schematic diagrams, 48
Supply Current, 16
Supply Output Voltage, 16

T

temperature, 17
test equipment, recommended, 24
theory of operation, 48
troubleshooting, 23

V

voltages, hazardous, 23

W

weight, 17

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Printed in Malaysia
Second Edition, May 2017



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01143-97003

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