

# OPERATING INSTRUCTIONS

## Model DM-4100A

### DIGITAL MULTIMETER



#### PLEASE READ THESE OPERATING INSTRUCTIONS CAREFULLY

Misuse and abuse of these instruments cannot be prevented by any printed word and may cause injury and or equipment damage. Please follow all these instructions and measurement procedures faithfully and adhere to all standard industry safety rules and practices.

**SPERRY  
INSTRUMENTS**  
*The Professional's Choice®*

2150 Joshua's Path, Suite 302  
Hauppauge, New York 11788  
1-800-645-5398 | 631-231-7050  
Fax: 631-434-3128

# CONTENTS

SECTION	TITLE	PAGE
	<b>Warranty</b>	<b>1</b>
<b>1</b>	<b>Description</b>	<b>2</b>
<b>2</b>	<b>Features</b>	<b>2</b>
<b>3</b>	<b>Specifications</b>	<b>2-4</b>
<b>4</b>	<b>Safety Rules</b>	<b>5-6</b>
<b>5</b>	<b>Front Panel Controls</b>	<b>7</b>
<b>6</b>	<b>Preparation for Use</b>	<b>7</b>
<b>6.1</b>	Unpacking and Contents Check	<b>7</b>
<b>6-2</b>	Pre-Operation Procedure	<b>7-8</b>
<b>7</b>	<b>Battery Replacement</b>	<b>8-9</b>
<b>8</b>	<b>Fuse Replacement</b>	<b>10</b>
<b>9</b>	<b>Operation</b>	<b>11</b>
<b>9.1</b>	Voltage Measurements	<b>11</b>
<b>9.2</b>	Current Measurements	<b>12-13</b>
<b>9.3</b>	Resistance Measurements	<b>13</b>
<b>9.4</b>	Battery Test Measurements	<b>13</b>
<b>9.5</b>	Diode Tests	<b>14</b>
<b>9.6</b>	Non Contact Voltage (NCV) Tests	<b>14</b>
<b>10</b>	<b>Maintenance</b>	<b>15</b>
<b>10.1</b>	Cleaning	<b>15</b>
<b>10.2</b>	Battery Replacement	<b>15</b>
<b>10.3</b>	Fuse Replacement	<b>15</b>
<b>11</b>	<b>Calibration</b>	<b>16-17</b>
<b>11.1</b>	Calibration procedure	<b>17-18</b>
<b>12</b>	<b>Diagrams</b>	<b>19</b>
<b>12.1</b>	Circuit Diagram	<b>19</b>
<b>12.2</b>	Parts List	<b>20-21</b>
<b>13</b>	<b>Return For Repairs</b>	<b>21</b>

## **ONE YEAR LIMITED WARRANTY**

Sperry Instruments, Inc. warrants that this Sperry instrument has been carefully tested, inspected and warranted for one (1) year from the date of purchase by the original end user, provided the instrument has not been misused, damaged due to negligence, neglect or unauthorized repair, abused or used contrary to the operating instructions. Instruments and proof of purchase in the form of a legible copy or original of the sales receipt clearly identifying the distributor, model number and date of purchase must be returned to Sperry Instruments, Inc. Attention: Customer Service Center, 2150 Joshua's Path, Suite 302, Hauppauge, New York 11788, postage prepaid for examination and verification of manufacturing defect under warranty. Sperry Instruments, Inc., shall be the sole judge of such defect. The liability of Sperry Instruments, Inc., shall be limited to the repair or replacement at its sole option of any defective product.

**THIS WARRANTY AND THE OBLIGATIONS AND LIABILITIES OF SELLER THEREUNDER ARE EXCLUSIVWE AND IN LIEU OF AND BUYERS HEREBY WAIVES ALL OTHER REMEDIES, EXPRESS WARRANTIES, GUARANTEES OR LIABILITIES OF AND FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OR WHETHER OR NOT OCCASIONED BY'S SELLER'S NEGLIGENCE. THIS WARRANTY SHALL NOT BE EXTENDED, ALTERED OR VARIED EXCEPT BY A WRITTEN INSTRUMENT SIGNED BY SELLER AND BUYER. SOME STATES ALLOW LIMITATIONS ON HOW LONG AND IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIED LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY STATE TO STATE.**

## **WARRANTY RETURN**

Refer to section "Return for Repairs" for complete instructions. All Warranty returns must include a legible copy or original of the sales receipt clearly identifying the model number, serial number and date of purchase.

## Sec. 1 DESCRIPTION

This exceptional 3-1/2 digit handheld, digital multimeter has the capacity of reading up to 6 functions on up to 18 ranges. This DMM offers a powerhouse of measurement capability in a small self-contained housing. It is designed for the professional at work, in the field or in the laboratory. Yet simple enough to operate, making it perfect for the hobbyist too.

Safety was prime consideration in the design of this DMM. Housed in shock resistant ABS plastic, this instrument stands up to the use and abuse of everyday service and electrically insulates the user from potential shock hazards. Electronic overload protection against accidental application of voltage to resistance and continuity circuits, combined with its rugged construction make it a durable and reliable instrument.

## Sec. 2 FEATURES

- *Pocket-size*
- *Simple Operation*
- *1000 hour battery life*
- *10 ADC Range*
- *Recessed safety designed input terminals*
- *Built-in tilt stand*
- *Overload protection on all ranges*
- *Diode test function*
- *Battery test function*
- *Non contact Voltage detection*

## Sec. 3 SPECIFICATIONS

<b>Display:</b>	3-1/2 digit LCD, 0.5" numerals, maximum reading 1999 with automatic sign and " $\boxed{+}$ " " $\boxed{-}$ " annunciators.
<b>Overrange</b>	
<b>Indication:</b>	"1" most significant digit blinks.
<b>Sampling Rate:</b>	3 times per second.
<b>Operating</b>	
<b>Environment:</b>	5°C to 40°C (32°F to 104°F)
<b>Relative humidity:</b>	80% for temperatures up to 31 degrees C Decreasing linearly to 50% relative humidity at 40 degrees C.

## Storage

**Environment:** -20° C to 60° C (-4 F to 140° F) at 80% relative humidity.

**Power Source:** One (1) 9V Transistor Type Battery.  
(NEDA #1604).

## Power

**Consumption:** 30mW typical

**Battery Life:** 1000 hours typical with zinc carbon.

**Battery Indicator:** " $\boxed{+ -}$ " symbol appears in display to indicate low battery voltage.

**Fuse:** Part F-17; 0.5A, 250V, 5 x 20mm fast acting.

**Dimensions:** 5.0"H x 2.8"W x 1.4"D  
(128H x 72W x 36Dmm).

**Weight:** Approximately 7.0 oz. (200g) including battery.

## RANGES:

### DC Voltage

Range	Resolution	Accuracy (18°C to 28°C)	Input Impedance
2V	1mV	$\pm(0.5\% \text{ of rdg} + 2D)$	1M $\Omega$
20V	10mV	"	"
200V	100mV	"	"
1000V	1V	"	"

**Normal Mode Rejection Ratio:** Greater than 46dB at 50 Hz (1K unbalance).

**Overload Protection:** 11000VDC or 500VAC rms for 1 minute.

### AC Voltage (Average Responding, Calibrated in RMS of Sine Wave)

Range	Resolution	Accuracy (18°C to 28°C) (50Hz-500Hz)	Input Impedance
200V	100mV	$\pm(1.2\% \text{ of rdg} + 4D)$	4.5M $\Omega$
500V	1V	"	"

**Response:** Average responding calibrated in RMS of a sine wave.

**Overload Protection:** 500VAC for 1 minute.

## DC Current

Range	Resolution	Accuracy (18°C to 28°C)	Full Scale Burden Voltage
2mA	1 $\mu$ A	$\pm(1.0\%$ of rdg + 1D)	0.35V
20mA	10 $\mu$ A	"	"
200mA	100 $\mu$ A	"	"
10A	10mA	$\pm(2.0\%$ of rdg + 3d)	0.70V

**Overload Protection:** 0.5A/250V fuse on mA inputs  
10A for 60 seconds on 10A input (unfused)

## Resistance

Range	Resolution	Accuracy (18°C to 28°C)	Open Circuit Voltage
200	10m $\Omega$	$\pm(1.2\%$ of rdg + 3d)	2.8V
2K	1 $\Omega$	$\pm(1.0\%$ of rdg + 1d)	0.3V
20K	10 $\Omega$	"	"
200K	100 $\Omega$	"	"
2M	1K $\Omega$	$\pm(1.5\%$ of rdg + 2d)	"

**Overload Protection:** 250VDC or peak AC – Electronic (No fuse blow).

## Diode Check

Range	Test Current	Open Circuit Volts
DCV 2V	1.0 $\pm$ 0.6mA	2.8Vdc

**Overload Protection:** 250VDC or peak AC – Electronic (No fuse blow).

## Battery Check

Range	Resolution	Approximate Load Current
1.5V	.001V	100mAdc
9V	.01V	6mAdc

**Overload Protection:** 0.5A/250V fuse on mA inputs.

## Non Contact Voltage (NCV Test)

Range	Frequency	Dielectric Strength
100-600VAC max to ground	50/60Hz	2000V, 1 minute, 100 $\mu$ A or less during dielectric strength test

## Sec. 4 SAFETY RULES

1. Read these operating instructions thoroughly and completely before operating your DMM. Pay particular attention to **WARNINGS** and **CAUTIONS**, which will inform you of potentially dangerous procedures. These instructions must be followed.
2. Always inspect your DMM, test leads and accessories for any sign of damage or abnormality before every use. If any abnormal conditions exist (e.g. broken test leads, cracked cases, display not reading, etc.), do not attempt to take any measurements. Refer to section 14 Return for Repair.
3. Never ground yourself when taking electrical measurements. Do not touch exposed metal pipes, outlets, fixtures, etc., which might be at ground potential. Keep your body isolated from ground by using dry clothing, rubber shoes, rubber mats or any approved insulating material.
4. Never touch exposed wiring, connections or any live circuit conductors when attempting to take measurements.
5. Never replace the protective fuse inside the DMM with any other than the AWS Part number specified or approved equal.
6. Remember: Think Safety and Act Safely.
7. When testing for the presence of voltage, make sure the voltage function is operating properly by reading a known voltage in that range before assuming that a zero reading indicates a no-voltage condition.
8. Calibration and repair should be performed by qualified maintenance personnel only.
9. Do not attempt calibration or service unless another person, capable of rendering first aid and resuscitation is present.
10. Do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to Sperry Instruments for service and repair to insure that safety features are maintained.
11. To avoid electric shock use CAUTION when working with voltages above 40Vdc or 20Vac. Such voltages pose a shock hazard.
12. Do not operate this instrument in an explosive atmosphere (i.e. in the presence of flammable gases or fumes, vapor or dust).
13. For indoor use only.
14. Altitude up to 2000 meters.
15. This equipment has been evaluated to INSTALLATION CATEGORY II. Pollution Degree 2, and according to EN61010-1.

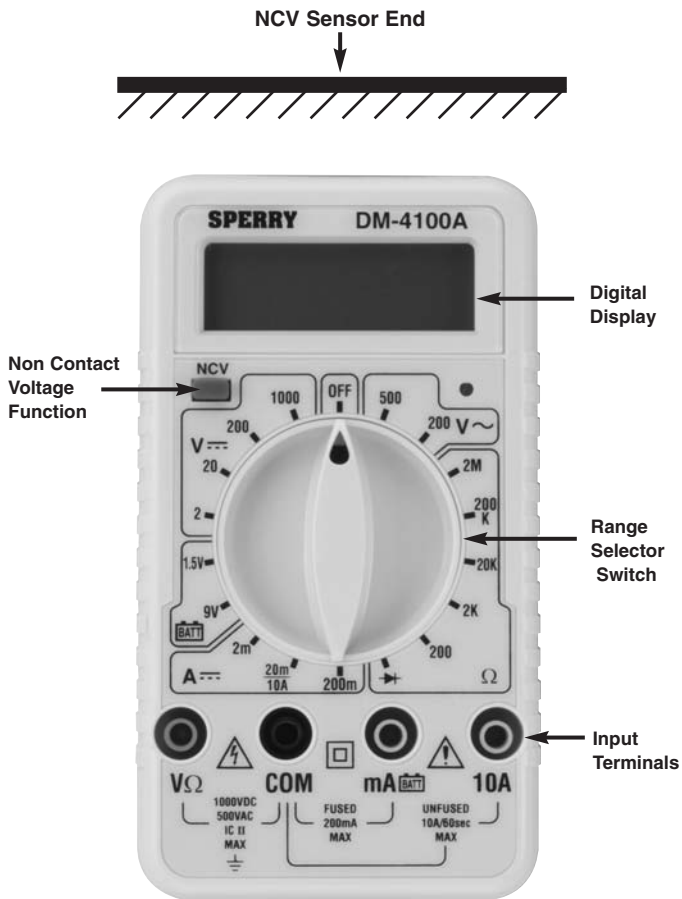


Fig. 1



## **Sec. 5 FRONT PANEL CONTROLS (See Fig. 1)**

1. Digital Display: 3-1/2 digit LCD, 0.5" numerals, maximum reading 1999 with automatic sign and " $\boxed{+}$ " annunciators. 3-1/2 digit LCD with Automatic function and range annunciators including the following: " $\boxed{+}$ " "-".
2. Range Selector Rotary Switch: Rotating this switch will turn the DMM on or off as well as change the function. For the available functions your DMM has refer to section 3 (Specifications).
3. Input Terminals: These terminals should be used in conjunction with the position of the function switch.

## **Sec. 6 PREPARATION FOR USE**

### **Sec. 6.1 UNPACKING AND CONTENTS CHECK**

The DM-4100A comes complete and ready to use. Check the following contents list when unpacking. If any pieces are missing notify the distributor you purchased the instrument from or Sperry Instrument, Inc.

- Operating Instructions # 414
- Test Leads TL-54 (one black, one red).
- 9V Transistor type Battery (Part #B-4) See Battery replacement section 10.2 for proper installation.
- One Fuse installed, one spare FusePart # F-17; 0.5A, 250V, 5mm X 20 mm, fast acting (See Fuse Replacement section 10.3)

### **Sec. 6.2 PRE-OPERATION PROCEDURE**

1. Install the 9V transistor type battery See Battery Replacement procedure in section 10.2.
2. Inspect the instrument for any external defects by comparing with the diagram on page 6. If any abnormal conditions exist, do not attempt to take any measurements. Refer to sections 10 (maintenance) and 14 (Return for Repairs).

3. Insert the test leads into the "COM" and "V- $\Omega$ " jacks. Connect the two ends of the test leads together.
4. Place the range selector switch into the off position. Nothing will appear on the display. Replace the range selector switch into the following ranges shown in the chart below. Check for the appropriate meter response.

Range	Display	Readings
1000DCV	000	$\pm 4$ digits
200DCV	00.0	"
20DCV	0.00	"
2DCV	.000	"
200 $\Omega$	1 .	
2K $\Omega$	1.	
20K $\Omega$	1 .	
200K $\Omega$	1 .	

5. As you can see, the decimal point moves as the ranges are changed. The maximum display reading is 1999. The 200DCV range will actually only read 199.9Vdc. We call this the 200DCV range for convenience only.
6. You can now check the decimal point on each range by referring to sec. 3 Specifications where the ranges are all listed. Refer to the Range and Resolution columns to compute the decimal point location.
7. If any abnormal conditions exist, do not attempt to take any electrical measurements. Instead refer to sec. 14 Return for Repairs.

## Sec. 7 BATTERY REPLACEMENT

The DM-4100A has a self-contained power supply consisting of One 9V Transistor Type Battery (NEDA #1604).

### WARNING

Before attempting to replace the battery, first disconnect the test leads from any energized circuit and then disconnect the test leads from the instrument.

1. Disconnect the test leads from any energized circuit and then from the instrument.
2. Turn the range switch to the "OFF" position
3. Slide off the back case battery cover.
4. Remove the battery from the compartment and unsnap the battery connector. (See Fig. 2)
5. Replace the battery with a 9V transistor type battery (NEDA # 1604),  
For maximum battery life, alkaline cells are recommended.
6. Reverse the above procedure to complete replacement.

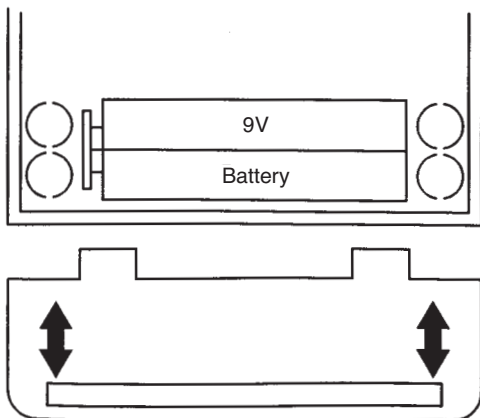


Fig. 2

## Sec. 8 FUSE REPLACEMENT

A 0.5A, 250V, 5 x 20mm fast acting fuse, Part # F-17 is installed in the instrument and used to protect the ampere ranges (other than the 10A range) along with other solid state components.

### WARNING

Before attempting to replace the fuse, disconnect the test leads from any energized circuit and then disconnect the test leads from the instrument. Replace the fuse with Part # F-17 or approved equal only. Always use fast acting, high interrupting type fuses.

1. Disconnect the test leads from any energized circuit and then from the instrument.
2. Turn the range selector switch to the "OFF" position.
3. Remove the battery cover.
4. Remove the fuse from the clip on the end of the PCB. (See Fig. 5).
5. Install the replacement fuse being certain it meets the Part # F-17 specifications.
6. Replace battery cover.

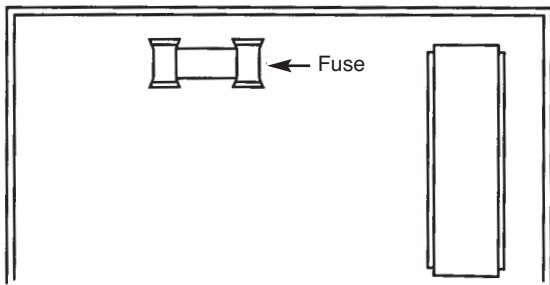


Fig. 3

## Sec. 9 OPERATION

Before making any measurements always examine the instrument and accessories used with the instrument for damage, contamination (excessive dirt, grease, etc.) and defects. Examine the test leads for cracked or frayed insulation and make sure the lead plugs fit snugly into the instrument jacks. If any abnormal conditions exist do not attempt to make any measurements. Instead refer to sec. 14 Return for Repairs.

### Sec. 9.1 VOLTAGE MEASUREMENTS

1. Insert the black and red test leads into the respective "COM" and "V- $\Omega$ " jacks
2. Place the range selector switch to the 1000DCV position if a DC voltage is to be measured or into the 500ACV position if an arc voltage is to be measured.

#### **CAUTION**

To avoid possible electric shock, instrument damage and/or equipment damage, do not attempt to take any voltage measurements if the voltage is above 1000Vdc/500Vac or if the voltage is unknown. 1000Vdc and 500Vac is the maximum voltages that this instrument is designed to measure. The "COM" terminal potential should not exceed 500V measured to ground.

3. Apply the test leads to the two points at which the voltage reading is to be taken. Be careful not to touch any energized conductors with any parts of your body.
4. Turn the range selector switch to the next lower range for a more accurate reading only if the reading is within that next lower range.
5. When measurements are completed, disconnect the test leads from the circuit under test. Remove the test leads from the instruments.

## Sec. 9.2 CURRENT MEASUREMENTS

1. Insert the black and red test leads into the respective "COM" and "10A" terminals.
2. Place the function switch to the 10A position. Always start with the highest range of the function to be measured.

### CAUTION

The 10A range is unprotected and has a very low internal resistance. Do not attempt to take a current measurement if the current is unknown or above 10A. The "COM" terminal potential should not exceed 500V measured to ground.

3. Completely de-energized the circuit in which the current is to be measured. Place the DMM in series with the conductor carrying the current, which is to be measured. Energized the circuit.
4. If the reading is less than 0.20 Amps, you can switch to a lower range for greater accuracy. If not, you have completed your measurement and skip to step 7.

### CAUTION

Before changing ranges, always de-energize the circuit completely. An open circuit exists between the test leads during range change on the DMM.

5. To change ranges, always de-energize the circuit completely. An open circuit exists between the test leads during range change on the DMM.

### CAUTION

The mA ranges are fuse protected. To avoid possible electrical shock, instrument damage and/or equipment damage do not:

1. Attempt to take mA current readings on circuits having more than 0.2A current flow.
2. Impress a voltage between the "COM" and "mA" terminals exceeding 250Vac/dc. Some circuit damage may result for voltages below 250Vac/dc

3. Raise the "COM" terminal potential above 500V to ground.
4. Energize the circuit. If the reading is within the next lower range, switch to that range after completely de-energizing the circuit under test. Continue changing to lower ranges if the reading is within the next lowest range to obtain the best accuracy.
5. Completely de-energize the circuit before removing the test leads.

### Sec. 9.3 RESISTANCE MEASUREMENTS

1. Insert the black and red test leads into the respective "COM" and "V-W" terminals.
2. Place the range selector switch into the W range desired for a measurement.

#### CAUTION

**All resistance measurements should be taken on de-energized circuits only.** To avoid possible electric shock, instrument damage and/or equipment damage do not connect the "COM" and "V-Ω" terminals to circuits having a potential difference exceeding 250VDC/AC. Do not connect the "COM" terminal to potentials exceeding 500V to ground.

3. Completely de-energize the circuit or device, which is to be measured. Connect the test leads to the device (the red test lead is positive with respect to the black test lead). A reading of  indicates an overrange condition. This will occur with the test leads open on all resistance ranges. If overrange occurs when taking a reading, switch to the next highest range.

### Sec. 9.4 BATTERY TEST MEASUREMENTS

1. Insert the black and red test leads into the respective "COM" and "mA" terminals for 1.5Vdc and 9Vdc.
2. Place the range selector switch into the 1.5V or 9V battery test range. The load current is approximately 200mA at 1.5Vdc and 6mA at 9Vdc.

### **CAUTION**

To avoid electric shock, instrument damage and/or equipment damage. Do not exceed 10Vdc while set to take measurements in the battery test range.

3. Connect the test leads to the 1.5Vdc battery under test. Normally a good 1.5Vdc battery will read above 1.25Vdc. Consult the battery manufacturer for complete battery specifications to determine actual battery life remaining and condition of battery

## **Sec. 9.5 DIODE TESTS**

1. Connect the red test lead to the "V $\Omega$ " jack and the black test lead to the "COM" jack.
2. Set the Function/Range switch to the " $\rightarrow$ " position.
3. Turn off power to the circuit under test. External voltage across the components causes invalid readings.
4. Touch probes to the diodes. A forward-voltage drop is about 0.6V (typical for a silicon diode).
5. Reverse probes. If the diode is good, "1" is displayed. If the diode is shorted, ".000" or another number is displayed.
6. If the diode is open, "1" is displayed in both directions.
7. If the junction is measured in a circuit and a low reading is obtained with both lead connections, the junction may be shunted by a resistance of less than 1k $\Omega$ . In this case the diode must be disconnected from the circuit for accurate testing.

## **Sec. 9.6 NON CONTACT VOLTAGE (NCV) TESTS**

1. Switch to "OFF", push "NCV" button.
2. Check device with a known live current source (wall receptacle or cord). The Volt Sensor is operative if the red LED light remains on and the "beep" sound continues in close proximity of a cord connected to a power source.
3. After checking the above performance, you may now test the circuitry in question.




## **Sec. 10 MAINTENANCE**

Maintenance consists of periodic cleaning, battery replacement, fuse replacement and recalibration.

### **Sec. 10.1 CLEANING**

The exterior of the instrument can be cleaned with a soft clean cloth to remove any oil, grease or grime from the exterior of the instrument. Never use liquid solvents or detergents. If the instrument gets wet for any reason, dry the instrument using low pressure "clean" air at less than 25 PSI. Use care and caution around the LCD display protector and areas where water or air could enter the interior of the instrument while drying.

### **Sec. 10.2 BATTERY REPLACEMENT**

Required when " " appears on display or nothing appears. See BATTERY REPLACEMENT in section 7.

### **Sec 10.3 FUSE REPLACEMENT**

Required when current ranges other than 10Aac/dc range do not function. See FUSE REPLACEMENT in section 8.

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## **Sec. 11 CALIBRATION**

Calibration on these meters should be performed every year. This can be done by sending the instruments prepaid to:

Sperry Instruments, Inc.  
Customer Service Center  
2150 Joshua's Path, Suite 302  
Hauppauge, New York 11788

Specify in writing that calibration is necessary. The instrument will be returned to you normally within one week. Estimates will be furnished upon request

### CAUTION

The following procedure should be performed by persons trained and qualified in electronics and electronic equipment service. DO NOT attempt this procedure if not qualified.

### WARNING

Do not attempt calibration or service unless another person, capable of rendering first aid and resuscitation is present.

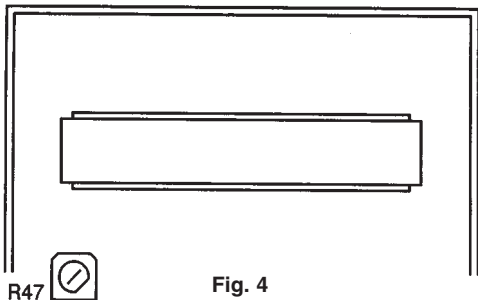


Fig. 4

## Sec. 11.1 CALIBRATION PROCEDURE

The procedure should be performed at an ambient temperature of  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and at a relative humidity of less than 80%. Allow the instrument to stabilize at this temperature for a minimum of 30 minutes.

1. Remove the back case screw and carefully pry up the back case.
2. Set the range switch to the "200mVdc" position.
3. Set the output of the DC calibrator for  $190.0\text{mV} \pm 0.02\%$  and connect it to the "V- $\Omega$ " and "COM" input terminals.
4. Adjust R47 until the display reads  $190.0\text{mV} \pm 1$  digit.

5. Carefully inspect the other DCV ranges. Your readings should be within specification  $\pm 0.5\%$  + 1 digit.
6. There is no adjustment for ACV. Calibrate DCV first.
7. Carefully inspect the ACV ranges. Your readings should be within  $\pm 1.2\%$  + 4 digits of the ACV calibration source.
8. Set the output of the DC calibrator for  $1.9 \pm 0.02\%$  and connect it to the "10A" and "COM" input terminals.
9. Adjust R001 (shunt resistor) until the display reads 1.9A.
10. If the reading is over 1.9A, add solder to R001. If the reading is under 1.9A, shave away lightly some of the solder and metal from R001.
11. Carefully inspect the other DCA ranges. Your readings should be within specification  $\pm 1.0\%$  + 1 digit.
12. Turn off calibrator and disconnect from the DMM.
13. Install the back case and insert the back case screw.



## Sec. 12.2 PARTS LIST

Part	Description	Size
R001	Cu	Cu
R002	100J*	SMD
R003	1F	1/4WC
R004	9F	1/4WC
R005	90F	1/4WC
R01 R02	274KF X2	1/4WC
R03 R04	176KF X2	1/4WC
R05	90KF	1/4WC
R06	9KF	1/4WC
R07	900F	1/4WC
R08	100F	1/4W C
R10,R98	47KJ X2	SMD
R11,R13,R20	110KJ X3	SMD
R12,R16,R19	1MJ X6	SMD
R41,R42,R43		
R14	1MJ	SMD 1/2W
R17	560KJ*	SMD
R18,R95	470KJ X2	SMD
R401	5.6KJ	SMD
R402	3.9J	SMD 1/4W
R44	27KF	SMD
R45	2KF	SMD
R46	900F	SMD
R47	VR 200Ω	SMD
R49,R97,R100	1 KJ X3	SMD
R90	2.7MJ	SMD
R91	22MJ	SMD
R92	100KJ	SMD
R93	15KJ*	SMD
R94	220KJ	SMD
R96	300J	SMD
C10	0.22uF/50V	Met
C11	0.22uF/25V	SMD
C12,C16	0.1uF/25V X2	SMD
C13	100pF/25V	SMD

**Note: subsequent revisions to this document may exist.  
Use for general references only.**

C14	10nF/25V	SMD
C24	10uF/16V	SMD
C40,C90	1uF/25V X2	SMD
C91	330PJ	SMD
D10,D11,D12,D13	1N4004 X4	SMD
D22	1 N4007	SMD
D40,D90	1N4148 X2	SMD
D91	LED (red)	3mm
D92	Zn 3.6VB	SMD 1/2W
Q10	2SC2859	SMD
Q11,Q12,Q90,Q91	PN2222 X4	SMD
F1	0.5A/250V	
PTC	PTC 2.2K	500V
U10	A/D 5106	
U90	4069	S0-8
BEEPER	3V	

## Sec. 13 RETURN FOR REPAIR

Before returning your digital Multimeter for repair be sure to check that the failure to operate properly is not due to the following:

1. Weak battery
2. Open fuse
3. Open, loose or intermittent test leads.

If these conditions do not exist and the instrument fails to operate properly return the instrument and accessories prepaid to:

Sperry Instruments, Inc.  
Customer Service Center  
2150 Joshua's Path, Suite 302  
Hauppauge, New York 11788

**State in writing what is wrong with the instrument.** All warranty repairs must include proof of purchase in the form of a legible or original copy of the sales receipt clearly identifying the distributor, model number and date of purchase and must have a warranty card on file. See warranty statement on page 1 for full warranty disclosure. Repair estimate will be furnished if requested for out of warranty instruments. Be sure to include all accessories, which may be related to the problem and a note describing the malfunction you observed.