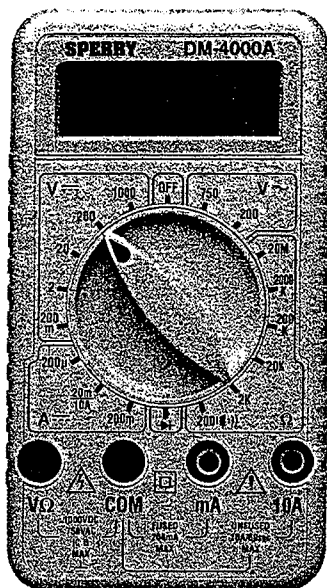


# OPERATING INSTRUCTIONS

## Models DM-4000A

### DIGITAL MULTIMETERS



**PLEASE READ THESE OPERATING INSTRUCTIONS CAREFULLY**  
Misuse and or 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.

## A.W.SPERRY INSTRUMENTS INC.

2150 Joshua's Path, Suite 302, HAUPPAUGE, NEW YORK 11788  
Phone: 800-645-5398 Toll Free (N.Y. and Alaska call collect) 516-231-7050  
Fax: 516-434-3128 Telex: 645104 SPERRYINC HAUP

### ONE YEAR LIMITED WARRANTY

A.W. Sperry Instruments, Inc., warrants that this AWS 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 A.W. Sperry Instruments, Inc., Attention: Customer Service Center, 2150 Joshua's Path, Hauppauge, New York 11788, postage prepaid for examination and verification of manufacturing defect under warranty. A.W. Sperry Instruments, Inc., shall be the sole judge of such defect. The liability of A.W. 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 EXCLUSIVE AND IN LIEU OF AND BUYER HEREBY WAIVES ALL OTHER REMEDIES, EXPRESS WARRANTIES, GUARANTEES OR LIABILITIES, OF AND FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OR WHETHER OR NOT OCCASIONED BY 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 AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIED LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.**

### WARRANTY REGISTRATION

To validate warranty, please complete the warranty registration card enclosed with your instrument and return to A.W. Sperry Instruments, Inc., 2150 Joshua's Path, Hauppauge, N.Y. 11788 within 10 days of purchase. No postage required.

### 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.

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## Sec. 1 DESCRIPTION

These exceptional 3-1/2 digit, handheld, digital multimeters have the capacity of reading up to 6 functions on up to 19 ranges. These DMM's offer 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 a prime consideration in the design of these DMM's. Housed in shock resistant ABS plastic, these instruments stand 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, combine with rugged construction make it a durable and reliable instrument.

## Sec. 2 FEATURES

6 Functions,  
19 Ranges

- Pocket-size
- Simple Operation
- Instant Continuity Buzzer
- 150 Hour Battery
- 10ADC Range
- Recessed safety designed input terminals
- Built in tilt stand
- Overload protection on all ranges
- Diode Test

## Sec. 3 SPECIFICATIONS

<b>Display:</b>	3-1/2 digit LCD, 0.5" numerals, maximum reading 1999 with automatic sign and "E" annunciators.
<b>Overrange Indication:</b>	"1" most significant digit blinks
<b>Sampling Rate:</b>	3 times per second.
<b>Operating Environment:</b>	0° to 45°C (32° to 122°F) at <70% relative humidity.
<b>Storage Environment:</b>	-20° to 60°C (-4° to 140°F) at <80% relative humidity.
<b>Power Source:</b>	One (1) 9V Transistor Type Battery, AWS Part #B-4 (NEDA #1604).
<b>Power Consumption:</b>	30mW typical.
<b>Battery Life:</b>	150 hours typical with zinc carbon.
<b>Battery Indicator:</b>	"E" symbol appears in display to indicate low battery voltage.
<b>Fuse:</b>	AWS Part F-17; 0.5A, 250V, 5 × 20mm fast acting.
<b>Dimensions:</b>	5.0"H × 2.8"W × 1.4"D (128H × 72W × 36Dmm).
<b>Weight:</b>	Approximately 7.0 oz. (200g) including battery.

### RANGES:

#### DC Volts

Range	Resolution	Accuracy 18° To 28°C	Input Impedance
200mV	0.1mV	±(0.5% rdg+1d)	10MΩ
2V	1mV	"	"
20V	10mV	"	"
200V	100mV	"	"
1000V	1V	"	"

Normal Mode Rejection Ratio: Greater than 46dB at 50Hz. 60Hz(1K unbalance)  
Overload Protection: 1100VDC or Peak AC for 1 minute.

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#### AC Volts

Range	Resolution	Accuracy 18° To 28°C	Input Impedance
200V	100mV	±(1.2% rdg+4d)	4.5MΩ
750V	1V	"	"

Response: Average responding calibrated in RMS of sine wave.  
Overload Protection: 750 AC for 1 minute.

#### DC Current

Range	Resolution	Accuracy 18° To 28°C	Full Scale Burden Voltage
200μA	0.1μA	±(1.0% rdg+1d)	0.35V
20mA	0.01mA	"	"
200mA	0.1mA	±(0.75% rdg+2d)	"
10A	0.01A	±(2.0% rdg+3d)	0.70V

Overload Protection: 0.5A/250V fuse on mA inputs  
10A for 30 seconds on 10A input(unfused).

#### Resistance

Range	Resolution	Accuracy 18° To 28°C
200Ω	100mΩ	±(0.7% rdg+3d)
2KΩ	1Ω	±(0.7% rdg+2d)
20KΩ	10Ω	"
200KΩ	100Ω	"
2000KΩ	1KΩ	"
20MΩ	10KΩ	±(2.0% rdg+3d)

Overload Protection: 500VDC or peak AC - Electronic (NO FUSE BLOW).

#### Continuity

Range	Audible Indication	Response Time	Open Circuit Volts
200Ω	Less Than 100Ω	Approx. 100ms	2.8Vdc±0.4Vdc

Overload Protection: 500VDC or peak AC - Electronic (NO FUSE BLOW).

#### Diode Check

Range	Test Current	Open Circuit Volts
DCV 2V	1.0±0.6mA	2.8Vdc±0.4Vdc

Overload Protection: 500VDC or peak AC - Electronic (NO FUSE BLOW).

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## Sec. 4 SAFETY RULES

- 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.
- 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.
- 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.
- Never touch exposed wiring, connections or any live circuit conductors when attempting to take measurements.
- Never replace the protective fuse inside the DMM with any other than the AWS Part number specified or approved equal.
- Remember: Think Safety and Act Safely.
- 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.
- Calibration and repair should be performed by qualified maintenance personnel only.
- Do not attempt calibration or service unless another person, capable of rendering first aid and resuscitation is present.
- Do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to A.W. Sperry Instruments for service and repair to insure that safety features are maintained.
- To avoid electric shock use CAUTION when working with voltages above 40Vdc or 20Vac. Such voltages pose a shock hazard.

- Do not operate this instrument in an explosive atmosphere (i.e. in the presence of flammable gases or fumes, vapor or dust).

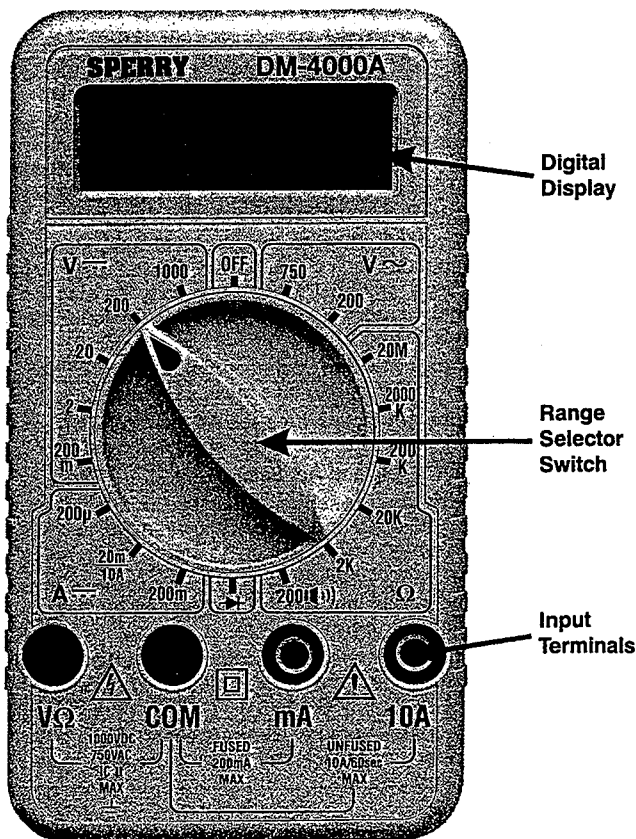


Fig. 1

## 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 " " annunciators.  
3-1/2 digit LCD with Automatic function and range annunciators including the following:  
" " " "
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-4000A 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 A.W. Sperry Instruments, Inc.

- Operating Instructions #188-1
- Test Leads TL-54 (one black, one red)
- 9V Transistor Type Battery (AWS Part #B-4) - See Battery Replacement section 10.2 for proper installation.
- One Fuse installed, One Spare Fuse AWS Part #F-17; 0.5A, 250V, 5mm x 20mm, Fast acting (See Fuse Replacement section 10.3.)

### Sec. 6.2 PRE-OPERATION PROCEDURE

1. Install the 9V transistor type battery (AWS Part #B-4). See Battery Replacement procedure in section 10.2.
2. Inspect the instrument for any external defects by comparing with the diagram on page 11. If any abnormal conditions exist, do not attempt to take any

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#### 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), AWS Part #B-4. For maximum battery life, alkaline cells are recommended.
6. Reverse the above procedure to complete battery replacement.

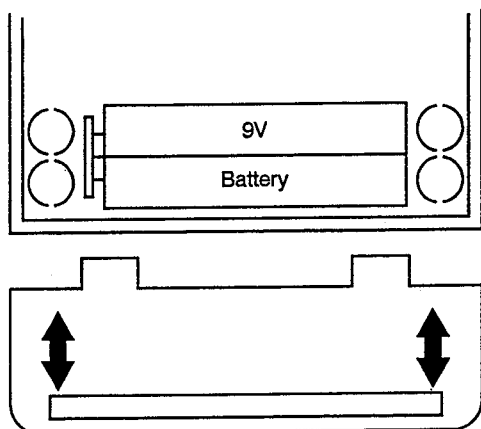


Fig. 2

measurements. Refer to sections 10 (Maintenance) and 14 (Return for Repairs).

3. Insert the test leads into the "COM" and "V-Ω" 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. Place the range selector switch into the following ranges shown in the chart below. Check for the appropriate meter response.

Range	Display Reading
1000DCV	000 ±4 digits
200DCV	00.0 "
20DCV	0.00 "
2DCV	.000 "
200Ω	1
2KΩ	1
20KΩ	1
200KΩ	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

These DMM'S have a self-contained power supply consisting of One 9V Transistor Type Battery (NEDA #1604, AWS Part #B-4).

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## Sec. 8 FUSE REPLACEMENT

A 0.5A, 250V, 5 x 20mm fast acting fuse, AWS 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 AWS 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. 3).
5. Install the replacement fuse being certain it meets the AWS Part #F-17 specifications.
6. Replace the battery cover.

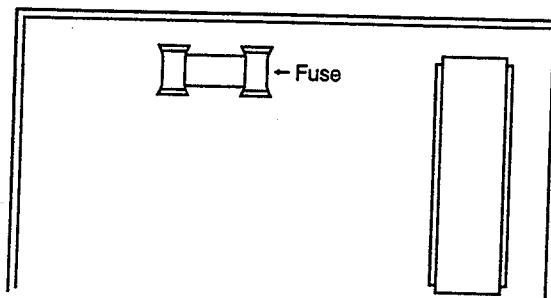


Fig. 3

## 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 into the 1000DCV position if a dc voltage is to be measured or into the 750ACV position if an ac voltage is to be measured. Always start in the highest range of the function to be measured.

#### CAUTION

To avoid possible electrical shock, instrument damage and/or equipment damage, do not attempt to take voltage measurements if the voltage is above 1000Vdc/750Vac or if the voltage is unknown. 1000Vdc and 750Vac 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 instrument.

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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- $\Omega$ " terminals.
2. Place the range selector switch into the  $\Omega$  range desired for a measurement.

#### CAUTION

All resistance measurements should be taken on de-energized circuits only. To avoid possible electrical shock, instrument damage and/or equipment damage do not connect the "COM" and "V- $\Omega$ " 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  $\overline{1}$  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. 9.2 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 10ac/dc. The "COM" terminal potential should not exceed 500V measured to ground.

3. Completely de-energize 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. Energize 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 to a lower range, move the red test lead to the "mA" jack on the DMM and switch the range selector switch to the "200mA" position.

#### 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.

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### Sec. 9.4 CONTINUITY MEASUREMENTS

1. Place the range selector switch into the 200 $\Omega$ ,  $\rightarrow$  position.
2. Insert the black and red test leads into the respective "COM" and "V- $\Omega$ " terminals.

#### CAUTION

All continuity measurements should be taken on de-energized circuits only. To avoid possible electrical shock, instrument damage and/or equipment damage do not connect the common and ohm terminals to circuits having a potential difference exceeding 500Vdc/ac. Do not connect the common terminal to potentials exceeding 500V to ground.

3. Touch the test leads to the two points at which continuity is to be tested. The tone will sound if the reading on the display is approximately less than 100 $\Omega$ .

### 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 diode. 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. 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.

## Sec. 11 ACCESSORIES

The following accessories are available to expand the measurements capabilities of the DM-4000A. Refer to their respective data sheets or operating instructions for full specifications.

### Sec. 11.1 AC CURRENT MEASUREMENT - SJA-870

The Model SJA-870 is a split core current transformer capable of measuring AC currents up to 1200Aac.

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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.

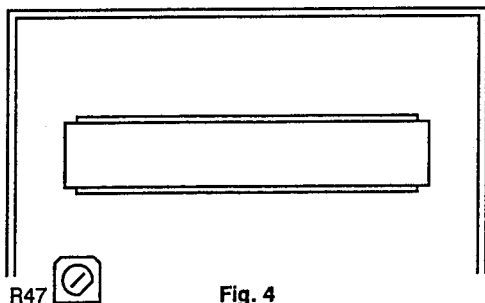


Fig. 4

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Input: 0-1200Aac max.  
Output: 0-12Vac at  $\geq 1m\Omega$  Load  
Accuracy:  $\pm(3\% rdg + 1A)$  with conductor in center of Jaw  
Frequency: 50-400Hz

### Sec. 11.2 HIGH VOLTAGE DC MEASUREMENT - HVP-860

The Model HVP-860 is a high voltage probe capable of measuring up to 50,000Vdc

Input: 0-50,000Vdc  
Output: 0-50Vdc at a  $10M\Omega$  load  
Accuracy:  $\pm(1.5\% \text{ of F.S.})$

#### CAUTION

The HVP-860 is designed to be used by technicians trained in High Voltage measurement techniques. It is designed for use on high impedance, low energy circuits only. These types of circuits are normally found in electronic equipment. It is not designed to be used on High Voltage electrical distribution equipment and circuits. These type of circuits have essential unlimited energy where special equipment is recommended. DO NOT use on these types of High Energy circuits!

## Sec. 12 CALIBRATION

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

A.W. Sperry Instruments, Inc.  
Customer Service Department  
3150 So Shaws Path, Suite 302  
Hauppauge, N.Y. 11788

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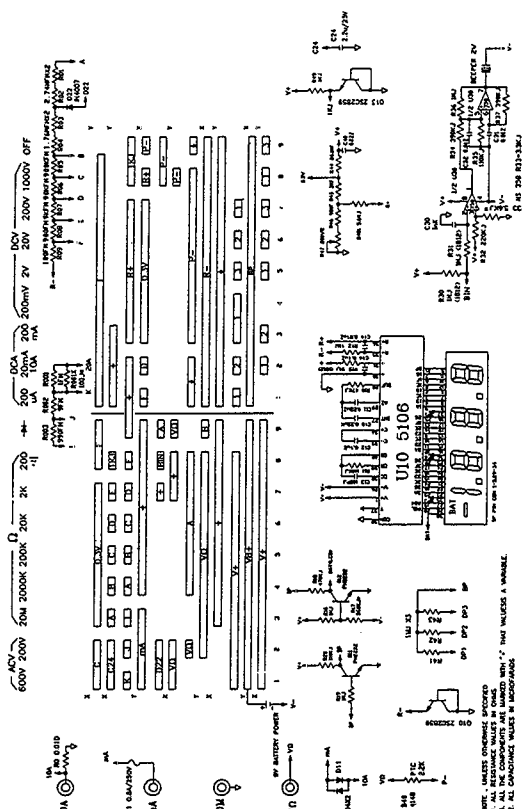
### Sec. 12.1 CALIBRATION PROCEDURE

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  $190.0mV \pm 0.02\%$  and connect it to the "V- $\Omega$ ", and "COM" input terminals.
4. Adjust R47 until the display reads  $190.0mV \pm 1$  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  $1.9A \pm 0.02\%$  and connect it to the "10A", and "COM" input terminals.
9. Adjust R0 (shunt resistor) until the display reads 1.9A.
10. If the reading is over 1.9A, add solder to R0. If the reading is under 1.9A, shave away lightly some of the solder and metal from R0.
11. Carefully inspect the other DCA ranges. Your readings should be within specification  $\pm 1\% + 1$  digit.
12. Turn off calibrator and disconnect from the DMM.
13. Install the back case and insert the back case screw.

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### Sec. 13.1 CIRCUIT DIAGRAM



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C13	100pF/25V	SMD
C14,C15,C31,C32	10nF/25V X4	SMD
C24	2.2uF/25V	SMD
C30	1000pF/25V	SMD
D10,D11	1N4004 X2	SMD
D22	1N4007	SMD
D40	1N4148	SMD
Q10,Q13	2SC2859 X2	SMD
Q11,Q12	PN2222 X2	SMD
F1	0.5A/250V	
PTC	PTC 2.2K	500V
U10	A/D 5106	
U30	358	SMD

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Part	Description	Size
R0	Cu	Cu
R001	1F	1/4W C
R001X	100J*	SMD
R002	9F	1/4W C
R003	990F	1/4W C
R01 R02	2.74MF X2	1/4W C
R03 R04	1.76MF X2	1/4W C
R05	900KF	1/4W C
R06	90KF	1/4W C
R07	9KF	1/4W C
R08	900F	1/4W C
R09	100F	1/4W C
R10	47KJ	SMD
R11,R20,R35	110KJ X3	SMD
R12,R16,R19,R36	1MJ X7	SMD
R41,R42,R43		
R14,R30,R31	1MJ X3	SMD 1/2W
R17	560KJ*	SMD
R18	470KJ	SMD
R32	220KJ	SMD
R33,R401	5.6KJ X2	SMD
R34,R37	390KJ X2	SMD
R44	26.1KF	SMD
R45	2KF	SMD
R46	900F	SMD
R47	VR 200Ω	
R49	1KJ	SMD
C10	0.22uF/50V	Met
C11,C40	0.22uF/25V X2	SMD
C12	0.1uF/25V	SMD

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**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:

A.W. Sperry Instruments, Inc.  
Customer Service Department  
2150 Joshua's Path, Suite 302  
Hauppauge, N.Y. 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.