IDEAL INDUSTRIES, INC. TECHNICAL MANUAL

MODEL: 61-320

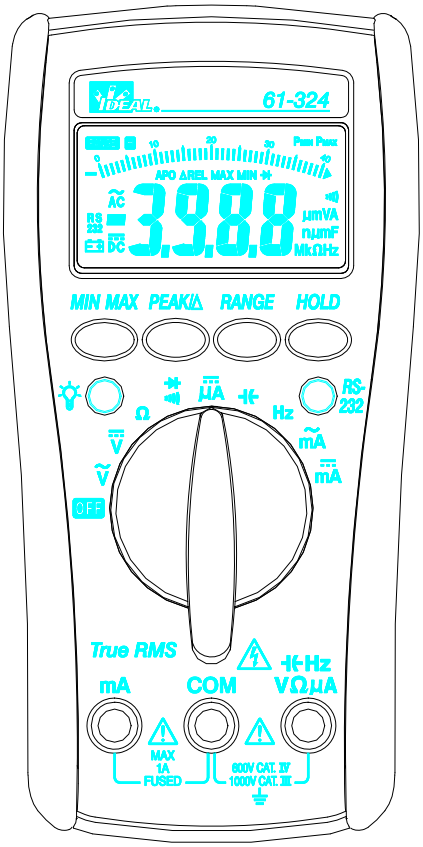
MODEL: 61-322

MODEL: 61-324

Multimeter Service Information

The Service Information provides the following information:

- Precautions and safety information
- Specifications
- Basic maintenance (cleaning, replacing the battery and fuses)
- Performance test procedures
- Calibration and calibration adjustment procedures



Form Number: TM61320-2-4

Revision: 4. Date: Feb 2008

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Introduction

⚠Warning

To avoid shock or injury, do not perform the verification tests or calibration procedures described in the manual unless you are qualified to do so.
The information provided in this document is for the use of qualified personnel only.

⚠Caution

The 61-320 serials contain parts that can be damaged by static discharge.
Follow the standard practices for handling static sensitive devices.

For additional information about IDEAL INDUSTRIES, INC. and its products, and services, visit IDEAL INDUSTRIES, INC. web site at:
www.idealindustries.com

Precautions and Safety Information

Use the meter only as described in the Service Manual. If you do not do so, the protection provided by the meter may be impaired. Read the “Safety Information” page before servicing this product.
In this manual, a ⚠**Warning** identifies conditions and actions that pose hazard (s) to the user; a ⚠**Caution** identifies conditions and actions that may damage the meter or the test instruments.

The Symbols

The symbols used on the meter and in this manual are explained in Table A.

Table A. The Symbols

⚠	Risk of electric shock
⚠	See instruction card
⎓	DC measurement
⧈	Equipment protected by double or reinforced insulation
⊟+	Battery
⏚	Earth
~	AC measurement
CE	Conforms to EU directives

SAFETY

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use the product only as specified.

⚠**CAUTION:** These statements identify conditions or practices that could result in damage to the equipment or other property.

⚠**WARNING:** These statements identify conditions or practices that could result in personal injury or loss of life.

Specific precautions

Use proper fuse. To avoid fire hazard, use only the fuse type and rating specified for this product.

Do not operate without covers. To avoid personal injury, do not apply any voltage or current to the product without covers in place.

Electric overload. Never apply a voltage to a connector on the product that is outside the range specified for that connector.

Avoid electric shock. To avoid injury or loss of life, do not connect or disconnect probes or test leads while they are connected to a voltage source.

Do not operate in wet/damp conditions. To avoid electric shock, do not operate this product in wet or damp conditions.

SPECIFICATIONS

All specifications are warranted unless noted typical and apply to the 61-320 & 61-322 & 61-324 Stated accuracies are at 23°C±5°C at less than 80% relative humidity and without the battery indicator displayed.

General specifications

Characteristics	Description
Display count	3 3/4
Numeric update rate	1.5 times / sec
Polarity display	Automatic
Overrange display	"OL" is display
Low voltage indicator	is indicated
Automatic power-off time	Automatic backlight off = 30 minutes
Power source	9V×1 battery for 61-322 & 61-324; 1.5V×2 batteries for 61-320
Maximum input voltage	1000V CAT III between V and COM
Maximum floating voltage	1000V CAT III between any terminal and earth ground
Maximum input current	400mA between mA and COM
Maximum open circuit voltage (current inputs)	600V between mA and COM
Overload protection mA connector	1A (600V) fast blow fuse.
V connector	V~, V⎓, Ω, •))), →|, |←, Hz, μA
Temperature Coefficient	0.2×(Spec. Accuracy) / °C, <18°C or >28°C
Battery Life	Alkaline 9V 200 hours for 61-322 & 61-324 Alkaline 1.5V×2 AA size 600 hours for 61-320

Measurement Characteristics

Accuracy is ±(% reading + number of digits) at 23°C ± 5°C, less than 80% R.H.

(1) DC Volts

Range	Resolution	Accuracy	Over Voltage Protection
400.0mV	100µV	±(0.5% reading + 2 digit)	1000V rms
4.000V	1mV		
40.00V	10mV		
400.0V	100mV		
1000V	1V		

Input Impedance: 10MΩ (over 1000MΩ in 400mV range).

(2) AC Volts

Range	Resolution	Accuracy	Over Voltage Protection
400.0mV	100µV	Unspecified	1000V rms
4.000V	1mV	±(1.3% reading + 5 digits) *[1]	
40.00V	10mV	±(1.2% reading + 5 digits) *[2,3]	
400.0V	100mV		
750V	1V		

Input Impedance: 10MΩ // less than 100pF.

*[1] **Frequency Response:** 50Hz ~ 300Hz

*[2] **Frequency Response:** 50Hz ~ 500Hz

CMRR / NMRR: (Common Mode Rejection Ratio)
(Normal Mode Rejection Ratio)

V_{AC}: CMRR > 60dB at DC, 50Hz / 60Hz

V_{DC}: CMRR > 100dB at DC, 50Hz / 60Hz

NMRR > 50dB at DC, 50Hz / 60Hz

AC Conversion Type: 61-320: Average sensing rms indication calibrated to the sine wave input.

61-322 / 61-324: AC conversions are ac-coupled, true rms responding, calibrated to the sine wave input.

*[3] 61-322 / 61-324 The specified accuracy is for sine wave at full scale and non-sine wave at half scale with crest factor up to 2.

Crest Factor: C.F. = Peak/RMS

+1.5% addition error for C.F. from 1.4 to 3

+3.0% addition error for C.F. from 3 to 4.

(3) DC Current

Range	Resolution	Accuracy	Voltage Burden
400.0µA	0.1µA	±(1.0% reading + 2 digits)	5mV
4000µA	1µA		2V max.
40.00mA*	10µA		5mV
400.0mA*	0.1mA		2V max.

Overload Protection: mA Input : 1A (600V) fast blow fuse. (61-322 / 61-324)
µA Input : 600V rms.

* For 61-322 / 61-324 only.

(4) AC Current (61-322 / 61-324)

Range	Resolution	Accuracy	Voltage Burden
40.00mA	10µA	±(1.5% reading + 5 digits) *1 50Hz ~ 500Hz	5mV
400.0mA	100µA		2V max.

Overload Protection: mA Input : 1A (600V) fast blow fuse.

AC Conversion Type: AC conversions are ac-coupled, true rms responding, calibrated to the sine wave input.

*1 The specified accuracy is for sine wave at full scale and non-sine wave at half scale with crest factor up to 2.

(5) Resistance

Range	Resolution	Accuracy	Over Voltage Protection
400.0Ω *1	0.1Ω	±(1.0% reading + 5 digits)	600V rms
4.000KΩ	1Ω	±(0.7% reading + 2 digits)	
40.00KΩ	10Ω		
400.0KΩ	100Ω		
4.000MΩ	1KΩ		
40.00MΩ *2	10KΩ	±(1.5% reading + 5 digits)	

Open circuit Voltage: -1.3V approx.

*1 < 5 digit of reading rolling.

*2 < 2% of reading rolling.

(6) Diode Check and Continuity

Range	Resolution	Accuracy	Max. Test Current	Max. Open Circuit Voltage
⊣◀	1mV	±(1.5% reading + 5 digits) *	1.5mA	3V

*** For 0.4V ~ 0.8V**

Overload Protection: 600V rms.

Continuity: Built-in buzzer sounds when resistance is less than approximately 450Ω Response time is approximately 100 msec.

(7) Frequency

Range	Resolution	Sensitivity	Accuracy	Overload Protection
4.000KHz	1Hz	150mV rms *	Frequency: (± 0.1% + 1 digit)	600V rms
40.00KHz	10Hz			
400.0KHz	100Hz			
4.000MHz	1KHz	300mV rms		
40.00MHz	10KHz	1V rms		

* Less than 20Hz, the sensitivity is 1.5V rms.

(8) Capacitance

Range	Resolution	Accuracy	Over Voltage Protection
4.000nF	1pF	±(3% reading + 10 digits)	600V rms
40.00nF	10pF		
400.0nF	100pF	±(2% reading + 8 digits)	
4.000µF	1nF		
40.00µF	10nF		
400.0µF	100nF		
4.000mF *[1]	1µF	±(5% reading + 20 digits) *[2]	
40.00mF *[1]	10µF		

*[1] In this range the reading maybe rolling within specification.

*[2] Specify reading < half full scale of range.

(9) Auto Power Off (APO)

If the meter idles for more than 30 minutes, the meter automatically turns the power off.

(10) Peak Hold

Function	Range	Accuracy
ACV	400mV	Unspecified
	4.000V	±(1.5% reading + 300 digits) *[2]
	40.00V	±(1.5% reading + 60 digits)
	400.0V	
	750V	
ACA (61-322/61-324)	40.00mA *[3]	±(3% reading + 60 digits)
	400.0mA *[3]	

Note:

[1] With zero calibrated before measurement.

*[2] 4V range specifies readings above 10% of full scale of range.

*[3] Amp range specify reading <90% of full scale of range.

[4] In the noise generating field, may affect intervals.

Physical and Environmental Characteristics

Characteristics	Description
Dimensions (H×W×D)	158mm×76mm×38mm 164mm×82mm×44mm (with holster)
Weight (with battery)	0.3Kg
With holster	0.5Kg
Environmental characteristics	**Description**
Temperature operating	0 to +50°C
Non-Operating	-20 to +60°C
Humidity (operating)	<80% R.H.
Altitude Operating	2,000M (6560 ft.)
Non-Operating	12,300M (40354 ft.)
Vibration & shock Operating	MIL-T-28800E TYPE II Class 5 2.66gRMS, 5 to 500Hz, 3axes (10 minutes each)
Indoor Use	Indoor Use

Certifications and compliances

Safety	Designed to ICE 1010-1, UL3111-1 and CSA specifications
Input rating	V / Ω/μA: Category III 1000 Volts
	V / Ω/mA: Category III 600 Volts
Over voltage category	CAT III: Distribution level mains, fixed installation.
	CAT II: Local level mains, appliances, portable equipment
	CAT I: Signal level, special equipment or parts of equipment, telecommunication, electronics.
Pollution Degree 2	Do not operate in environments where conductive Pollutants may be present.
EC Declaration of Conformity	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility and Low Voltage Directive 73/23/EEC for product safety. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities: En 55011 Class A: Radiated and Conducted Emissions. En 50082-1 Immunity: IEC 801-2 Electrostatic Discharge IEC 801-3 RF Radiated En 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

Required Equipment

Required equipment is listed in Table B. If the recommended models are not available, equipment with equivalent specifications may be used.

Repairs or servicing should be performed only by qualified personnel.

Table B. Required Equipment

Equipment	Required Characteristics	Recommended Model
Calibrator	**AC Voltage Range:** 0 ~ 750V AC **Accuracy:** ±0.07% (Basic) **Frequency Range:** 40 ~ 1KHz **Accuracy:** ±2% **DC Voltage Range:** 0 ~ 1000V DC **Accuracy:** ±0.006% (Basic) **Current Range:** 0 ~ 10A **Accuracy:** AC (40Hz to 1KHz): ±0.08% (Basic) DC: ±0.02% (Basic) **Frequency Source:** 5.00Hz ~ 100MHz **Accuracy:** ±0.001% **Amplitude:** 0.5V p-p ~ 1.0V p-p (square wave) **Accuracy:** ±5% **Resistance Range:** 1Ω ~ 100MΩ **Accuracy:** ±0.03% (Basic) **Capacitance Range:** 1pF ~ 10mF **Accuracy:** ±0.10% (Basic)	Fluke 5500 or Wavetek 9100 Calibrator or equipment

Basic Maintenance

⚠Warning

To avoid shock, remove the test leads and any input signals before opening the case or replacing the battery or fuses.

Opening the Meter Case

⚠Caution

To avoid unintentional shock circuit, always place the uncovered meter assembly on a protective surface. When the case of the meter is open, circuit connections are exposed.

To open the meter case, refer to Figure 1 and do the following:

1. Disconnect test leads from any live source, turn the rotary switch to OFF, and remove the test leads from front terminals.
2. Remove the battery door by using a flat-blade screwdriver to turn the battery door screws turn counter-clockwise.
3. The case bottom is secured to the case top by four screws and two internal snaps (at the LCD end). Using a Phillips-head screwdriver, remove the four screws.

Replacing the Battery

The meter is powered 1.5V x 2 batteries for 61-320 and a single 9V battery for 61-322 / 61-324. To replace the battery, refer to Figure 1.

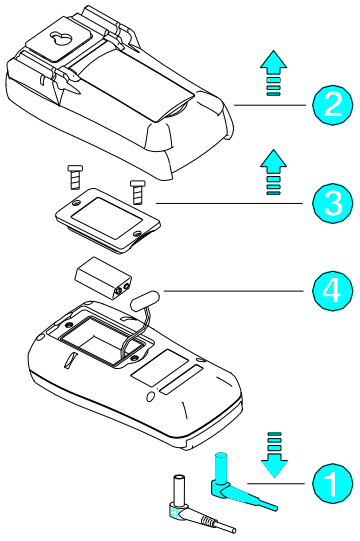

Figure 1

Testing Fuses

To test the internal fuses of the meter.

1. Turn the rotary selector switch to the Ω position.
2. To test FS1, plug a test lead into V Ω Hz input terminal, and touch the probe to the mA input terminal. The display should indicate between 0.0 to 0.2 Ω. FS1 (1A 600V) (Bussmann BBS-1 recommended). If display reads higher than 0.2 Ω, replace the fuse.

Fuse Replacement

Refer to the following Figure 2 to replace fuse:

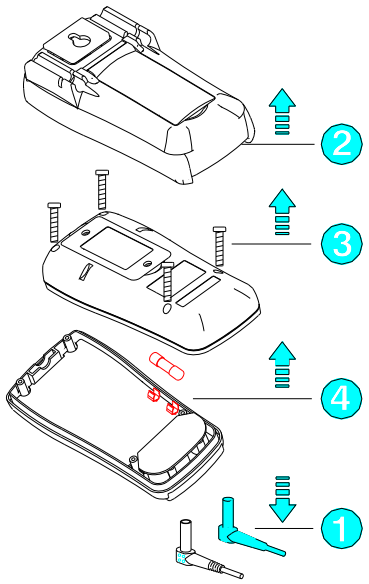

Figure 2

Use only a fuse with the amperage, interrupt, voltage, and speed rating specified.
Fuse rating: 1A, 600V, Fast blow

Replacing Fuses

⚠Warning

To avoid electrical shock, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, INSTALL ONLY quick acting fuses with the following Amp/Volt current interrupt rating:
FS1 Fuse: 1A, 600V, FAST BLO. Minimum interrupt rating 10,000A

Cleaning

⚠Warning

To avoid electrical shock or damage to the meter, never allow water inside the case. To avoid damaging the meter's housing, never apply solvents to the meter.

Performance Tests

The following performance tests verify the complete operability of the meter and check the accuracy of each meter function against the meter's specifications.

Accuracy specifications are valid for a period of one year after calibration, when measured at an operating temperature of 18°C to 28°C and a maximum of 80% relative humidity.

To perform the following tests, it is not necessary to open the case. No adjustments are necessary, merely make the required connections, apply the designated inputs, and determine if the reading on the meter display falls within the acceptable range indicated.

If the meter fails any of these tests, it needs calibration adjustment or repair.

Testing the Display

Press "HOLD" key while turning the meter on from the "OFF" position to hold the display in the Display Test Mode. Compare the display with the example in Figure 3. Turn off the meter to escape the test mode.

LCD Graphics 61-324

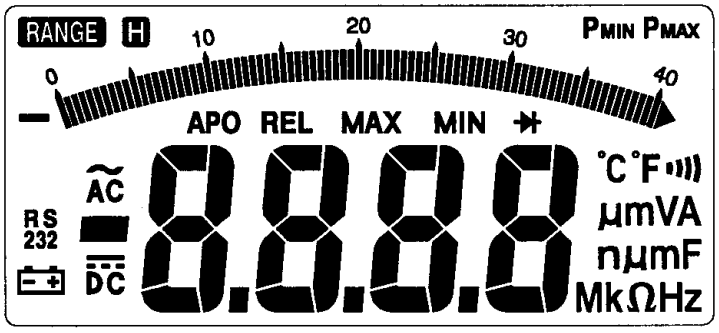

Figure 3 Display Test

Testing the Voltage Function

To verify accuracy in the AC and DC voltage ranges, do the following:

1. Turn the rotary switch to **"V~"** position.
2. Connect the calibrator to the **VΩ** and **COM** inputs on the meter.
3. Set the calibrator for the voltage and frequency from step 1 to 8 in Table 1.
4. Compare the reading on the meter display with the display reading shown in Table 1.
5. If the display reading falls outside of the range shown in Table 1, the meter does not meet specification.

Table 1 AC Voltage Test:

Step	Input	Frequency	Reading
1	3.000V	50Hz	2.956 to 3.044
2	3.000V	500Hz	2.956 to 3.044
3	30.00V	50Hz	29.59 to 30.41
4	30.00V	500Hz	29.59 to 30.41
5	300.0V	50Hz	295.9 to 304.1
6	300.0V	500Hz	295.9 to 304.1
7	700V	50Hz	687 to 713
8	700V	500Hz	687 to 713

6. Turn the rotary switch to "**V⎓**" position.
7. Set the calibrator for the voltage from step 1 to 6 in Table 2.
8. Compare the reading on the meter display with the display reading shown in Table 2.
9. If the display reading falls outside of the range shown in Table 2, the meter does not meet specification.

Table 2 DC Voltage Test:

Step	Input	Reading
1	300.0mV	298.3 to 301.7
2	-300.0mV	-298.3 to -301.7
3	3.000V	2.983 to 3.017
4	30.00V	29.83 to 30.17
5	300.0V	298.3 to 301.7
6	900V	894 to 906

Testing the Resistance Function

To verify the accuracy of the resistance function, do the following:

1. Connect the calibrator to **VΩHz** and **COM** on the meter.
2. Turn the rotary switch to **Ω.**
3. Apply the inputs for step 1 to 6 in Table 3.
4. Compare the meter display readings to the display readings in Table 3.
5. If the display reading falls outside of the range shown in Table 3, the meter does not meet specification.

Table 3 Ω Resistance Test:

Step	Source	Reading
1	300.0Ω	296.5 to 303.5
2	3.000KΩ	2.977 to 3.023
3	30.00KΩ	29.77 to 30.23
4	300.0KΩ	297.7 to 302.3
5	3.000MΩ	2.977 to 3.023
6	30.00MΩ	29.50 to 30.50

Lead resistance on the 400Ω range is not included in error.

Testing the Capacitance Function

The meter measures capacitance by charging the capacitor with a known direct current, measuring the resultant voltage, and calculating the capacitance. If the same capacitance is measured on an impedance bridge, a different reading may result. This variance is likely to be greater at higher frequencies.

To verify the accuracy of the capacitance measuring function, do the following:

1. Apply the capacitor to the **VΩHz** and **COM** inputs on the meter. For steps 1 to 7 in Table 4.
2. Turn the rotary switch ⊣⋲.
3. Compare the reading on the meter display to the reading in Table 4.
   Note : The meter selects the proper range automatically. Each measurement takes about one second per range, 5mF takes about 4.5 seconds.
4. If the display reading falls outside of the range shown in Table 4, the meter does not meet specification.

Table 4 Capacitance Test:

Step	Source	Reading
1	3.000nF	2.900 to 3.100
2	30.00nF	29.00 to 31.00
3	300.0nF	293.2 to 306.8
4	3.000µF	2.932 to 3.068
5	30.00µF	29.32 to 30.68
6	300.0µF	293.2 to 306.8
7	3.000mF	2.830 to 3.170

Checking the Diode Test / Continuity Function

To check the diode test function, do the following:

1. Connect the calibrator to the **VΩHz** and **COM** inputs on the meter.
2. Turn the rotary switch to →|– •)))).
3. Apply .500V DC. The meter display should read approximately .500V dc.
4. Apply a 50Ω resistor to meter. The built-in beeper turns on.

Testing the milliamp (mA) Function (for 61-322 and 61-324)

To verify the accuracy of AC current measurement functions, do the following:

1.Connect the calibrator to the **mA** and **COM** inputs on the meter.
2. Turn the rotary switch to **mA**
3. Apply the inputs for steps 1 to 4 in Table 5.
4. For each input, compare the reading on the meter display to the reading for your meter in Table 5.
5. If the display reading falls outside of the range shown in Table 5, the meter does not meet specification.

Table 5 AC mA Test:

Step	Source	Frequency	Reading
1	30.00mA	50Hz	29.50 to 30.50
2	30.00mA	500Hz	29.50 to 30.50
3	300.0mA	50Hz	295.0 to 305.0
4	300.0mA	500Hz	295.0 to 305.0

6. Turn the rotary switch to **mA⎓.**
7. Set the calibration for the voltage from step 1 to 2 in Table 6.
8. For each input, compare the reading on the meter display to the reading in Table 6.
9. If the display reading falls outside of the range shown in Table 6, the meter does not meet specification.

Table 6 DC mA Test:

Step	Source	Reading
1	30.00mA	29.68 to 30.32
2	300.0mA	296.8 to 303.2

Testing the microamp Function

1. Turn the rotary switch to **µA⎓.**
3. Apply the inputs for steps 1 to 2 in Table 7.
4. For each input, compare the reading on the meter display to the reading for your meter in Table 7.
5. If the display reading falls outside of the range shown in Table 7, the meter does not meet specification.

Table 7 DC microamp Test:

Step	Source	Reading
1	300.0µA	296.8 to 303.2
2	3000µA	2968 to 3032

Testing the Frequency Function

To verify the accuracy of the meter's frequency function, do the following:

1. Connect the calibrator to the **VΩ** and **COM** inputs on the meter.
   Note: The accuracy of the calibrator's frequency function must be appropriate for the specified accuracy of the meter.
2. Set the rotary switch to **Hz.**
3. Set the function generator for the square wave voltage and frequency for steps 1 to 5 of Table 8.
4. Compare the reading on the meter display with the display reading shown in Table 8.
5. If the display reading falls outside of the range shown in Table 8, the meter does not meet specification.

Table 8 Frequency Test:

Step	Source	Level	Reading
1	3.000KHz	150mV rms	2.996 to 3.004
2	30.00KHz	150mV rms	29.96 to 30.04
3	300.0KHz	150mV rms	299.6 to 300.4
4	3.000MHz	300mV rms	2.996 to 3.004
5	30.00MHz	1V rms	29.96 to 30.04

Calibration Procedure

Recalibrate your meter:

It is recommended that the multimeter be calibrated once each year.

1. Perform calibration at an ambient temperature of 23°C±2°C and a relative humidity of 73% or less.
2. Disconnect the test leads and turn the meter off. Remove the test leads from the front terminals.
3. Position the meter face down. Remove the three screws from the case bottom.
4. Lift the end of the case bottom until it gently unsnaps from the case top at the end nearest the LCD.
5. Lift the circuit board from the case top. Do not remove the screws from the circuit board.

(A) DCV Calibration (Adjust VR1) ***(refer to Figure 4 & 5)***

1. Set the circuit board rotary switch **"arrow"** to the **"V"** position of circuit board.
2. Set the output of DC calibrator for 300.0V±0.02% and connect to **VΩHz** and **COM** input terminals on meter.
3. Using a small flat-tipped screwdriver adjust the potentiometer **VR1** until the display reads 299.0 or 300.1.
4. Disconnect the DC calibrator from the meter.

(B) ACV Calibration (Adjust VR2) ***(refer to Figure 4 & 5)***

1. Set the circuit board rotary switch **"arrow"** to the **"V"** position of circuit board.
2. Set the output of AC calibration for 300Vrms 50Hz (61-320) 300Vrms 50Hz (61-322/61-324) and connect to **VΩHz** and **COM** input terminals on meter.
3. Using a small flat-tipped screwdriver adjust the potentiometer **VR2** until the display reads 299.9 or 300.1 (61-320) / 299.9 or 300.1 (61-322/61-324).

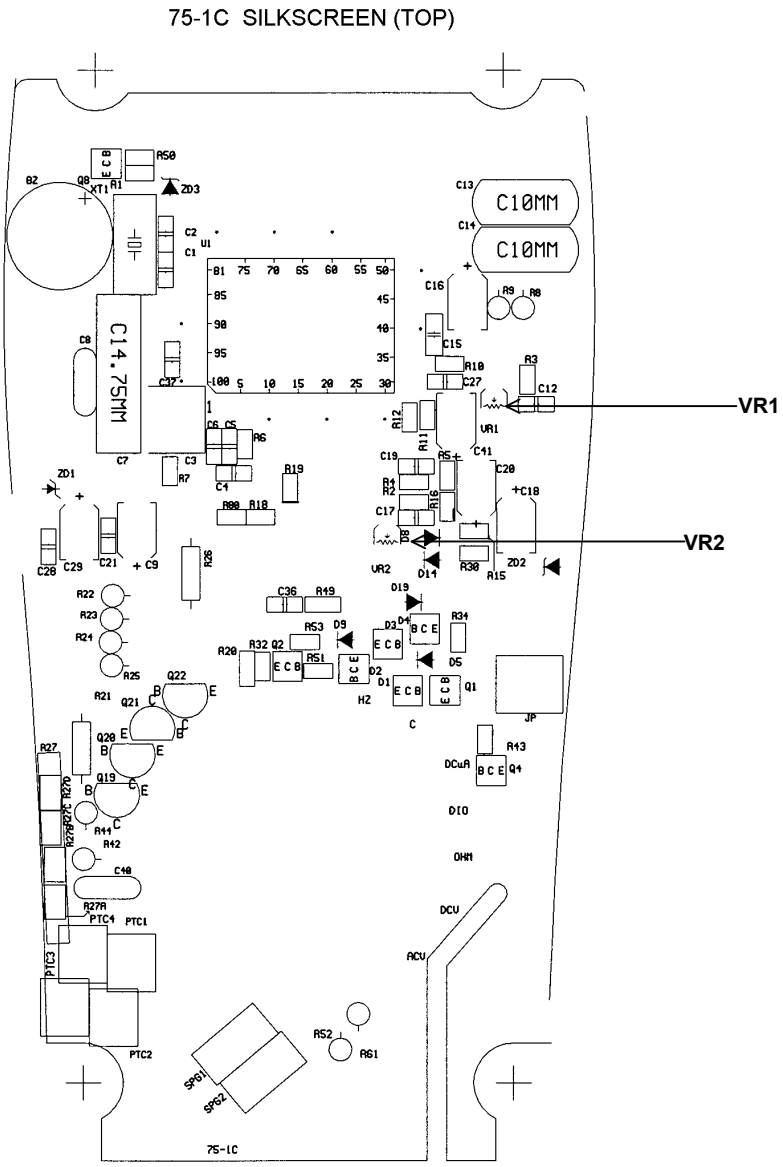

Figure 4 61-320 Calibration Adjustment Points

324-5 SILKSCREEN (TOP)

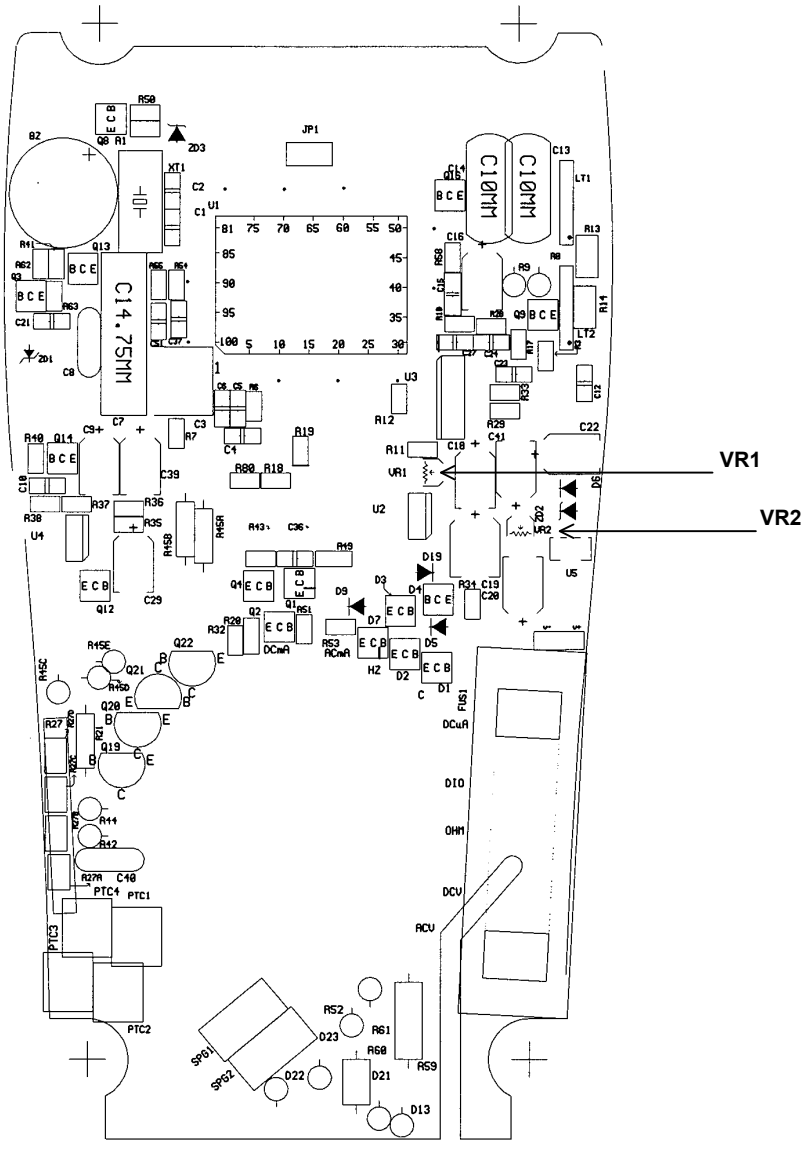

Figure 5 61-322/324 Calibration Adjustment Points