

**FLUKE®**

# **525A**

Temperature/Pressure Calibrator

## Service Manual

PN 1644492  
March 2002

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# 525A

## **Introduction**

This manual provides user-service information for the 525A Temperature/Pressure Calibrator (hereafter referred to as "the Calibrator"). Details regarding verification of the Calibrator's functionality and calibration, basic maintenance, contacting Fluke service centers, and important safety information are also contained within this manual.

## **Contacting Fluke**

To contact Fluke, order accessories, or locate the nearest Fluke Service Center or distributor, call:

- USA: 1-888-99-FLUKE (1-888-993-5853)
- Canada: 1-800-36-FLUKE (1-800-363-5853)
- Europe: +31-402-678-200
- Japan: +81-3-3434-0181
- Singapore: +65-738-5655
- Anywhere in the world: +1-425-446-5500

Or, visit Fluke's Web site at [www.fluke.com](http://www.fluke.com).

## **Safety Information**

The Calibrator complies with EN 61010, ANSI/ISA-S82.01-1994, and CAN/CSA-C22.2 No. 1010.1-92. Use the Calibrator only as specified in this manual, otherwise the protection provided by the Calibrator may be impaired.

CAT II equipment is designed to protect against transients from energy-consuming equipment supplied from a fixed installation, such as televisions, personal computers, portable tools, and other household appliances.

A “**⚠ Warning**” statement identifies hazardous conditions and actions that could cause bodily harm or death.

A “**⚠ Caution**” statement identifies conditions and actions that could damage the Calibrator or the equipment under test.












International symbols used on the Calibrator and in this manual are explained in Table 1.

**⚠ Warning**

To avoid possible electric shock or personal injury, follow these guidelines:

- Use the Calibrator only as specified in this manual or the protection provided by the Calibrator might be impaired.
- Inspect the Calibrator before use. Do not use the Calibrator if it appears damaged. Look for cracks or missing plastic. Pay particular attention to the insulation around the connectors.
- Have the Calibrator serviced only by qualified service personnel.
- Do not apply more than the rated voltage between the terminals, as marked on the Calibrator, or between any terminal and earth ground.
- Always use the power cord and connector appropriate for the voltage and outlet of the country or location in which you are working.
- Never operate the Calibrator with the cover removed or the case open.
- Never remove the cover or open the case of the Calibrator without first removing the power source.
- Use caution when working with voltages above 30 V ac rms, 42 V ac peak, or 60 V dc. These voltages pose a shock hazard.
- Use only the replacement fuse(s) specified in this manual.
- Use the proper terminals, function, and range for your measurements.
- Do not operate the Calibrator around explosive gas, vapor, or dust.
- When servicing the Calibrator, use only specified replacement parts.

Table 1. Symbols Used on the Calibrator

	AC (Alternating Current)		Earth ground
	DC (Direct Current)		Resistance
	Pressure		Conforms to European Union directives
	Chassis protective ground		Canadian Standards Association, NRTL
	Important Information. Refer to the manual.		International ON/OFF symbol.
	Caution, risk of electric shock		

## Calibrator Specifications

### General Specifications

Warm up time	Twice the time since last warmed up, to a maximum of 30 minutes
Settling time	Less than 5 seconds for all functions and ranges except as noted
Standard interface	RS-232
Optional interface	IEEE-488 (GPIB)
Temperature performance	Operating            0 °C to 50 °C Calibration (tcal)    18 °C to 28 °C Storage                -20 °C to 70 °C
Electromagnetic compatibility	CE: Conforms to EN61326
Temperature coefficient	Temperature coefficient for temperatures outside tcal $\pm 5$ °C is 10 % of the 90 day specification (or 1 year if applicable) per °C
Relative humidity	Operating    < 80 % to 30 °C, < 70 % to 40 °C, < 40 % to 50 °C Storage       < 95 % noncondensing
Altitude	Operating        3,050 m (10,000 ft) maximum Nonoperating    12,200 m (40,000 ft) maximum
Safety	EN 61010 Second, ANSI/ISA-S82.01-1994, CAN/CSA-C22.2 No. 1010.1-92, NRTL
Analog low isolation	20 V
Line power	Line Voltage (selectable)    100 V/120 V or 220 V/240 V Line Frequency                47 to 63 Hz Line Voltage Variation $\pm 10$ % about line voltage setting
Power consumption	15 VA maximum
Dimensions	Height 13.3 cm (5.25 in) plus 1.5 cm (0.6 in) four feet on bottom Width ¾ standard rack width Depth 47.3 cm (18.6 in) overall
Weight (without options)	4 kg (9 lb)

**DC Voltage Specifications, Output**

Ranges <sup>1</sup>	Absolute Uncertainty, tcal $\pm 5$ °C $\pm$ (ppm of output + $\mu$ V)				Stability	Resolution	Maximum Burden <sup>2</sup>
	90 days		1 year		24 hours, $\pm 1$ °C $\pm$ (ppm of output + $\mu$ V)		
0 to 100.000 mV	25	3	30	3	5 +2	1 $\mu$ V	10 mA
0 to 1.00000 V	25	20	30	20	4 +20	10 $\mu$ V	10 mA
0 to 10.0000 V	25	200	30	200	4 +200	100 $\mu$ V	10 mA
0 to 100.000 V	25	2 mV	30	2 mV	5 +1 mV	1 mV	1 mA

1. All outputs are positive only.  
2. Remote sensing is not provided. Output resistance is  $< 1\Omega$ .

Ranges	Noise	
	Bandwidth 0.1 to 10 Hz (ppm of output + $\mu$ V p-p)	Bandwidth 10 Hz to 10 kHz ( $\mu$ V rms)
0 to 100.000 mV	1 $\mu$ V	6 $\mu$ V
0 to 1.00000 V	10 $\mu$ V	60 $\mu$ V
0 to 10.0000 V	100 $\mu$ V	600 $\mu$ V
0 to 100.000 V	10 ppm+1 mV	20 mV

**DC Current Specifications, Output**

Ranges <sup>1</sup>	Absolute Uncertainty, tcal $\pm 5$ °C $\pm$ (ppm of output + $\mu$ A)				Resolution	Maximum Compliance Voltage	Maximum Inductive Load
	90 days		1 year				
0 to 100.000 mA	85	2	100	2	1 $\mu$ A	10 V	100 $\mu$ H

1. All outputs are positive only.

Ranges	Noise	
	Bandwidth 0.1 to 10 Hz p-p	Bandwidth 10 Hz to 10 kHz rms
0 to 100.000 mA	2000 nA	20 $\mu$ A

**Resistance Specifications, Output**

Ranges <sup>1</sup>	Absolute Uncertainty, tcal ±5 °C, ±(ppm of output ± Ω)		Resolution	Allowable Current <sup>2</sup>
	90 days	1 year		
5 to 400.00 Ω	0.025	0.03	0.01 Ω	1 to 10 mA
5 to 4.0000 kΩ	0.25	0.3	0.1 Ω	250 μA to 1 mA

1. Continuously variable from 0 to 4 kΩ.

2. For currents lower than shown, the floor adder increases by  $Floor_{(new)} = Floor_{(old)} \times I_{min}/I_{actual}$ .  
For example, a 500 μA stimulus measuring 100 Ω has a floor uncertainty of  $0.025 \Omega \times 1 \text{ mA}/500 \mu\text{A} = 0.05 \Omega$ .

**Resistance Specifications, Input**

Ranges	Absolute Uncertainty, tcal ±5 °C, ±(ppm of output ± Ω)				Resolution	Stimulus Current
	90 days		1 year			
0 to 400.00 Ω	35	0.003	40	0.003	0.001 Ω	1 mA
401 to 4001.00 Ω	35	0.03	40	0.03	0.01 Ω	0.1 mA

**Thermocouple Specification, Output and Input**

TC Type	Range (°C)		Absolute Uncertainty, tcal ±5 °C, ±(°C) <sup>1</sup>	
			Output/Input	
	Minimum	Maximum	90 days	1 year
B	600 °C	800 °C	0.42 °C	0.46 °C
	800 °C	1000 °C	0.39 °C	0.39 °C
	1000 °C	1550 °C	0.40 °C	0.40 °C
	1550 °C	1820 °C	0.44 °C	0.45 °C
C	0 °C	150 °C	0.25 °C	0.30 °C
	150 °C	650 °C	0.21 °C	0.26 °C
	650 °C	1000 °C	0.23 °C	0.31 °C
	1000 °C	1800 °C	0.38 °C	0.50 °C
	1800 °C	2316 °C	0.63 °C	0.84 °C
E	-250 °C	-100 °C	0.38 °C	0.50 °C
	-100 °C	-25 °C	0.16 °C	0.18 °C
	-25 °C	350 °C	0.14 °C	0.15 °C
	350 °C	650 °C	0.14 °C	0.16 °C
	650 °C	1000 °C	0.16 °C	0.21 °C
J	-210 °C	-100 °C	0.20 °C	0.27 °C
	-100 °C	-30 °C	0.18 °C	0.20 °C
	-30 °C	150 °C	0.14 °C	0.16 °C
	150 °C	760 °C	0.14 °C	0.17 °C
	760 °C	1200 °C	0.18 °C	0.23 °C
K	-200 °C	-100 °C	0.25 °C	0.33 °C
	-100 °C	-25 °C	0.19 °C	0.22 °C
	-25 °C	120 °C	0.14 °C	0.16 °C
	120 °C	1000 °C	0.19 °C	0.26 °C
	1000 °C	1372 °C	0.30 °C	0.40 °C
L	-200 °C	-100 °C	0.37 °C	0.37 °C
	-100 °C	800 °C	0.26 °C	0.26 °C
	800 °C	900 °C	0.17 °C	0.17 °C
N	-200 °C	-100 °C	0.33 °C	0.40 °C
	-100 °C	-25 °C	0.20 °C	0.24 °C
	-25 °C	120 °C	0.16 °C	0.19 °C
	120 °C	410 °C	0.14 °C	0.18 °C
	410 °C	1300 °C	0.21 °C	0.27 °C

1. Does not include thermocouple wire error.

**Thermocouple Specification, Output and Input (continued)**

TC Type	Range (°C)		Absolute Uncertainty, tcal ±5 °C, ±(°C) <sup>1</sup>	
			Output/Input	
	Minimum	Maximum	90 days	1 year
R	0 °C	250 °C	0.58 °C	0.58 °C
	250 °C	400 °C	0.34 °C	0.35 °C
	400 °C	1000 °C	0.31 °C	0.33 °C
	1000 °C	1750 °C	0.30 °C	0.40 °C
S	0 °C	250 °C	0.56 °C	0.56 °C
	250 °C	1000 °C	0.36 °C	0.36 °C
	1000 °C	1400 °C	0.30 °C	0.37 °C
	1400 °C	1750 °C	0.35 °C	0.46 °C
T	-250 °C	-150 °C	0.51 °C	0.63 °C
	-150 °C	0 °C	0.18 °C	0.24 °C
	0 °C	120 °C	0.13 °C	0.16 °C
	120 °C	400 °C	0.12 °C	0.14 °C
U	-200 °C	0 °C	0.56 °C	0.56 °C
	0 °C	600 °C	0.27 °C	0.27 °C
mV	-10 to 75.000 mV			

1. Does not include thermocouple wire error.

**TC mV Specifications, Input and Output**

Range (mV)	Absolute Uncertainty, tcal +/-5 °C +/- ( ppm of output + μV)		Stability 24 Hours +/-1°C +/- ( ppm of output + μV)	Resolution	Maximum Burden
	90 Days	1 Year			
-10 to 75.000	25 + 3μV	30 + 3μV	5 + 2μV	1μV	10 Ohms

**RTD and Thermistor Specification, Output**

RTD Type	Range (°C)		Absolute Uncertainty tcal ±5 °C, ±(°C) <sup>1</sup>	
	Minimum	Maximum	90 days	1 year
Pt 385, 100 Ω	-200 °C	-80 °C	0.06 °C	0.07 °C
	-80 °C	0 °C	0.08 °C	0.10 °C
	0 °C	100 °C	0.08 °C	0.10 °C
	100 °C	300 °C	0.07 °C	0.09 °C
	300 °C	400 °C	0.07 °C	0.09 °C
	400 °C	630 °C	0.08 °C	0.09 °C
	630 °C	800 °C	0.08 °C	0.10 °C
Pt 3926, 100 Ω	-200 °C	-80 °C	0.06 °C	0.07 °C
	-80 °C	0 °C	0.06 °C	0.07 °C
	0 °C	100 °C	0.06 °C	0.08 °C
	100 °C	300 °C	0.07 °C	0.08 °C
	300 °C	400 °C	0.07 °C	0.09 °C
	400 °C	630 °C	0.08 °C	0.09 °C
Pt 3916, 100 Ω	-200 °C	-190 °C	0.06 °C	0.07 °C
	-190 °C	-80 °C	0.06 °C	0.08 °C
	-80 °C	0 °C	0.06 °C	0.08 °C
	0 °C	100 °C	0.06 °C	0.08 °C
	100 °C	260 °C	0.07 °C	0.08 °C
	260 °C	300 °C	0.07 °C	0.08 °C
	300 °C	400 °C	0.07 °C	0.09 °C
	400 °C	600 °C	0.08 °C	0.09 °C
600 °C	630 °C	0.08 °C	0.09 °C	
Pt 385, 200 Ω	-200 °C	-80 °C	0.31 °C	0.38 °C
	-80 °C	0 °C	0.32 °C	0.38 °C
	0 °C	100 °C	0.33 °C	0.39 °C
	100 °C	260 °C	0.33 °C	0.39 °C
	260 °C	300 °C	0.36 °C	0.43 °C
	300 °C	400 °C	0.36 °C	0.43 °C
	400 °C	600 °C	0.42 °C	0.50 °C
	600 °C	630 °C	0.42 °C	0.50 °C
Pt 385, 500 Ω	-200 °C	-80 °C	0.13 °C	0.15 °C
	-80 °C	0 °C	0.13 °C	0.15 °C
	0 °C	100 °C	0.13 °C	0.16 °C
	100 °C	260 °C	0.14 °C	0.17 °C
	260 °C	300 °C	0.14 °C	0.17 °C
	300 °C	400 °C	0.15 °C	0.18 °C
	400 °C	600 °C	0.16 °C	0.19 °C
	600 °C	630 °C	0.16 °C	0.19 °C

1. 2-wire output



**RTD and Thermistor Specification, Output (continued)**

RTD Type	Range (°C)		Absolute Uncertainty tcal ±5 °C, ±(°C) <sup>1</sup>	
	Minimum	Maximum	90 days	1 year
Pt 385, 1000 Ω	-200 °C	-80 °C	0.06 °C	0.07 °C
	-80 °C	0 °C	0.06 °C	0.08 °C
	0 °C	100 °C	0.07 °C	0.08 °C
	100 °C	260 °C	0.07 °C	0.08 °C
	260 °C	300 °C	0.07 °C	0.09 °C
	300 °C	400 °C	0.07 °C	0.09 °C
	400 °C	600 °C	0.08 °C	0.09 °C
PtNi 385, 120 Ω (Ni 120)	-80 °C	0 °C	0.04 °C	0.05 °C
	0 °C	100 °C	0.04 °C	0.04 °C
	100 °C	260 °C	0.03 °C	0.03 °C
Cu 427, 10 Ω <sup>2</sup>	-100 °C	260 °C	0.63 °C	0.75 °C
YSI 400	15 °C	50 °C	0.005 °C	0.007 °C

1. 2-wire output  
2. Based on MINCO Application Aid No. 18.

**RTD and Thermistor Specification, Input**

RTD Type	Range (°C)		Absolute Uncertainty, tcal ±5 °C, ±(°C) <sup>1</sup>	
	Minimum	Maximum	90 days	1 year
Pt 385, 100 Ω	-200 °C	-80 °C	0.031 °C	0.012 °C
	-80 °C	0 °C	0.018 °C	0.020 °C
	0 °C	100 °C	0.018 °C	0.020 °C
	100 °C	300 °C	0.027 °C	0.030 °C
	300 °C	400 °C	0.031 °C	0.035 °C
	400 °C	630 °C	0.042 °C	0.047 °C
	630 °C	800 °C	0.050 °C	0.057 °C
Pt 3926, 100 Ω	-200 °C	-80 °C	0.031 °C	0.031 °C
	-80 °C	0 °C	0.014 °C	0.015 °C
	0 °C	100 °C	0.018 °C	0.019 °C
	100 °C	300 °C	0.026 °C	0.029 °C
	300 °C	400 °C	0.031 °C	0.034 °C
Pt 3916, 100 Ω	-200 °C	-190 °C	0.026 °C	0.028 °C
	-190 °C	-80 °C	0.011 °C	0.012 °C
	-80 °C	0 °C	0.014 °C	0.015 °C
	0 °C	100 °C	0.018 °C	0.019 °C
	100 °C	260 °C	0.025 °C	0.028 °C
	260 °C	300 °C	0.026 °C	0.029 °C
	300 °C	400 °C	0.031 °C	0.034 °C
Pt 385, 200 Ω	-200 °C	-80 °C	0.071 °C	0.072 °C
	-80 °C	0 °C	0.075 °C	0.076 °C
	0 °C	100 °C	0.079 °C	0.081 °C
	100 °C	260 °C	0.082 °C	0.085 °C
	260 °C	300 °C	0.090 °C	0.093 °C
	300 °C	400 °C	0.093 °C	0.097 °C
Pt 385, 200 Ω	400 °C	600 °C	0.100 °C	0.105 °C
	600 °C	630 °C	0.101 °C	0.106 °C

1. 4-wire mode. Uncertainties listed do not include probe uncertainties.

**RTD and Thermistor Specification, Input (continued)**

RTD Type	Range (°C)		Absolute Uncertainty, tcal ±5 °C, ±(°C) <sup>1</sup>	
	Minimum	Maximum	90 days	1 year
Pt 385, 500 Ω	-200 °C	-80 °C	0.046 °C	0.047 °C
	-80 °C	0 °C	0.049 °C	0.050 °C
	0 °C	100 °C	0.043 °C	0.045 °C
	100 °C	260 °C	0.030 °C	0.033 °C
	260 °C	300 °C	0.032 °C	0.035 °C
	300 °C	400 °C	0.037 °C	0.041 °C
	400 °C	600 °C	0.047 °C	0.052 °C
	600 °C	630 °C	0.048 °C	0.076 °C
Pt 385, 1000 Ω	-200 °C	-80 °C	0.031 °C	0.032 °C
	-80 °C	0 °C	0.034 °C	0.035 °C
	0 °C	100 °C	0.039 °C	0.040 °C
	100 °C	260 °C	0.025 °C	0.028 °C
	260 °C	300 °C	0.027 °C	0.030 °C
	300 °C	400 °C	0.030 °C	0.034 °C
	400 °C	600 °C	0.041 °C	0.045 °C
	600 °C	630 °C	0.042 °C	0.047 °C
PtNi 385, 120 Ω (Ni120)	-80 °C	0 °C	0.209 °C	0.210 °C
	0 °C	100 °C	0.210 °C	0.211 °C
	100 °C	260 °C	0.211 °C	0.212 °C
Cu 427, 10 Ω <sup>2</sup>	-100 °C	260 °C	0.300 °C	0.069 °C
YSI 400	15 °C	50 °C	0.005 °C	0.304 °C
SPRT, 25 Ω	User Defined	User Defined	0.05 °C	0.06 °C
1. 4-wire mode. Uncertainties listed do not include probe uncertainties.				
2. Based on MINCO Application Aid No. 18.				

## **Pressure Measurement**

The Calibrator can accept either the Fluke 700 or 6100 series pressure modules. Pressure modules plug directly into the front panel Lemo connector. The Calibrator firmware automatically detects the type and value of the module you are attaching, and recognizes the following units of measurement:

- PSI  
(pounds per square inch)
- inH2O4°C  
(inches of water at 4 degrees Celsius)
- inH2O20C  
(inches of water at 20 degrees Celsius)
- cmH2O4°C  
(centimeters of water at 4 degrees Celsius)
- cmH2O20C  
(centimeters of water at 20 degrees Celsius)
- BAR  
(bars)
- mBAR  
(millibars)
- KPAL  
(kilopascals)
- inHG 0°C  
(inches of mercury at 0 degrees Celsius)
- mmHG 0°C  
(millimeters of mercury at 0 degrees Celsius)
- Kg/cm2  
(kilograms per square centimeter)

## **Theory of Operation**

The Calibrator serves as an accurate laboratory device for calibrating thermocouples, RTDs, pressure devices, and low-level dc voltages and currents. The main PCB assembly, and several subassemblies, work together to provide high-reliability and easy maintenance.

### **Micro-Controller Section**

The Atmel ATmega 103 micro-controller is the heart of the 525A. It contains all of the program memory, nv-ram, FlashROM, static RAM, and EEPROM. The micro-controller allows a minimal amount of external glue logic. The main external digital ICs are the RS-232 driver, relay drivers, LCD controller, and the digitally controlled analog switches. Many of the ICs are interfaced through the micro-controller's three-wire SPI bus minimizing interconnecting lines. Inputs or outputs begin with instructions entered through the keypad or through remote communications (serial or IEEE-488) into the micro-controller. The micro-controller processes the commands and sets conditions that are appropriate for the command.

### **Analog Section**

The Calibrator can source DC voltage to 100 V, DC current to 100 mA, resistances from 5 to 4000  $\Omega$ , and thermocouples and RTDs. The main components of the analog circuit consist of a precision 2.5-volt temperature compensated reference, 20-bit DAC and a 24-bit ADC. Precision metal foil resistor networks and several chopper-stabilized OP-AMPS are the most critical analog components.

When sourcing, the micro-controller, using stored calibration constants, adjusts the D/A to generate an output based on the function and range selected. To achieve high accuracy, a low drift 24-bit A/D converter is used as a feedback element near the output of the D/A converter. The scaled output DAC\_CK is routed to the A/D converter.

In the input mode, the A/D is used directly to measure either the T/C or the resistance (RTD) inputs. The A/D features an internal self-calibration function that continually nulls out zero drift due to temperature changes. A programmable gain stage in the A/D is adjusted by the micro-controller to allow direct T/C and RTD inputs without requiring external amplification. In the RTD mode, a constant current source is used to excite the RTD and the voltage developed across the RTD is measured by the A/D, then the resistance can be calculated.

### **Basic Maintenance**

#### **⚠ Warning**

**To avoid personal injury or damage to the Calibrator, use only the specified replacement parts and do not allow water into the case.**

#### ***Cleaning the Calibrator***

#### **⚠ Caution**

**To avoid damaging the case, do not use solvents or abrasive cleaners.**

Clean the Calibrator and pressure modules with a soft cloth dampened with water or mild soap and water.

#### ***Replacing a Line Fuse***

#### **⚠ Warning**

**To avoid electrical shock, disconnect line power before opening the case or line voltage selector.**

The line power fuses and line voltage selector switch are located in a compartment above the power switch on the right rear of the Calibrator. The fuse-rating label on the rear panel shows the correct replacement fuse for each line voltage setting.

Table 2 lists the fuse part numbers for each line voltage setting. Figure 1 shows how to remove the fuse compartment cover.

### To Check or Replace a Fuse

1. Disconnect line power.
2. Using a flat-blade screwdriver, pry the tab at the base of the line fuse compartment. The compartment cover will pop part way out.
3. Remove the compartment cover. The fuses come out with the compartment cover and can easily be checked or replaced.
4. To reinstall the fuse, push the compartment cover back into the compartment until the tab locks in place.

*Note*

*When changing the line voltage setting, make sure to verify that the appropriate line fuse is installed in the Calibrator. Replace the fuse as required.*

**Table 2. Replacement Fuses**

Part Number	Fuse Description	Line Voltage Setting
1645311	⚠ Fuse, 0.25 A fast fuse	120 V (90 V to 132 V)
1645327	⚠ Fuse, 0.125 A fast fuse	240 V (198 V to 264 V)

### Changing Line Voltage

The Calibrator arrives from the factory configured for the line voltage appropriate for the country of purchase or as specified when it is ordered. To verify the line voltage setting, check the line voltage indicator on the line power fuse compartment cover.

*Note*

*Confirm that the line voltage selection is set for 120 V for line voltages between 90 V and 132 V or that the selector is set to 240 V for line voltages between 198 V and 264 V.*

To change the line voltage:

1. Disconnect line power.
2. Using a flat-blade screwdriver, pry the tab at the base of the line fuse compartment. The compartment cover will pop part way out.
3. Remove the compartment cover.
4. Remove the line voltage selector assembly by gripping the line voltage indicator tab with pliers and pulling it straight out of the compartment.
5. Rotate the line voltage selector assembly to the desired voltage and reinsert.
6. Verify the appropriate fuse is being used for the selected line voltage (see Table 2) and reinstall the fuse compartment by pushing it in until the tab locks in place.

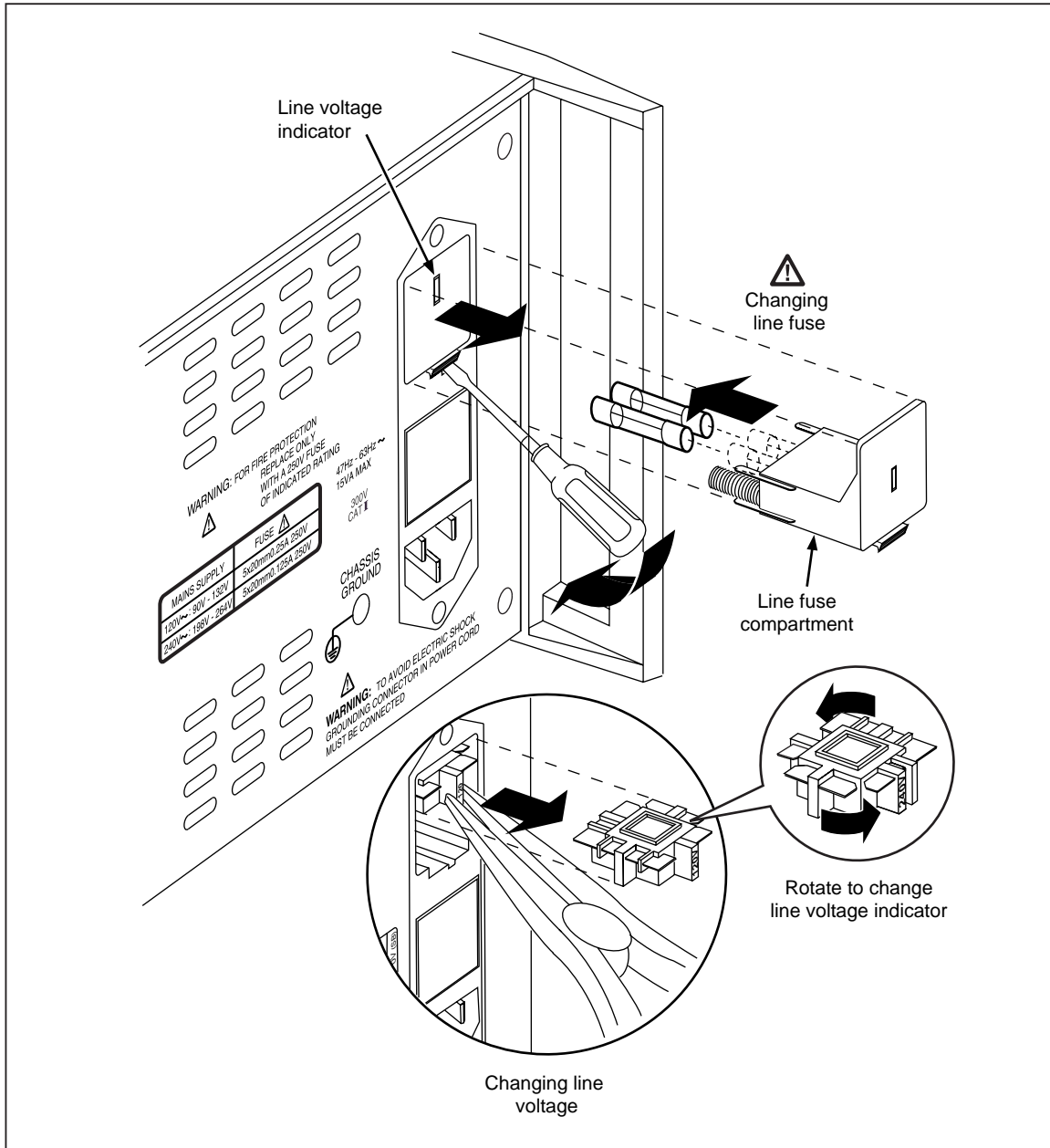


Figure 1. Accessing the Fuse

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## Modular-Level Maintenance

### ⚠ Warning

Do not attempt to complete the following procedures unless qualified to do so. This information is for use by qualified personnel only.

### ⚠ Caution

When making solder connections, use "no clean" solder.

At some point in time, it may be necessary to perform modular-level maintenance or troubleshooting of the Calibrator.

Evaluation of most problems can be made after the top cover is removed. Inside the chassis are six circuit boards. They are connected to one another with point to point wiring. The six circuit boards are the Main PCA, Keypad PCA, TC PCA, Lemo PCA, Opto RS232 PCA, and the Display PCA.

Most of the Calibrator circuitry is located on the Main PCA. The Display PCA, Keypad PCA, and Lemo PCA are mounted to the front of the chassis. The TC PCA is mounted in the Output Block, and the Opto RS232 PCA is mounted on the rear of the chassis.

If the Main PCA needs repair, it is recommended that all other circuit boards be removed from the chassis still assembled. Repair of the other circuit boards can be accomplished while leaving them inside the chassis.

### ***Disassembly***

To open the Calibrator case, remove the six screws from each end and lift off the top cover.

To remove all of the circuit boards while still assembled, do the following:

1. Stand the chassis on the front handles.
2. Remove the four nylon screws that attach the Display PCA to the front.
3. Remove the six screws that attach the Keypad PCA to the front.
4. Remove the five nuts that attach the Output Block to the front.
5. Remove the standoff nuts from the 9-pin D connector on the Opto RS232 PCA, if present.
6. Stand the 525A back on its feet.
7. Remove the screws attaching the Opto RS232 PCA to the back, if present.
8. Remove the four screws through the transformer.
9. Remove the six screws that attach the Main PCA to the chassis base.
10. Carefully lift all of the attached circuit boards out of the chassis.

### ***Reassembly***

It is easier to solder the wires interconnecting the circuit boards before placing the assemblies back into the chassis. The procedures in this section will explain how to reconnect each of the circuit boards.

There are two wire sets available from Fluke. These wire sets are used to connect the circuit boards. One set is for the front connections and the other set is for the rear panel connections. Refer to Figure 2 for wire locations and Tables 3 and 4 for the detailed list of front and rear panel connections.

**Table 3. Front Panel Wire Color Assignments**

<b>Wire Number</b>	<b>Color</b>	<b>Gage (all lengths are 6 inches)</b>
J5	Red	24 g Wire
J7	Black	24 g Wire
J16	Purple	20 g Wire *
J 17	Grey	20 g Wire *
J18 (1st 6 inches)	Red	20 g Wire *
J19	Black	20 g Wire *
J20	Blue	20 g Wire *
J21	Yellow	20 g Wire *
J22 (2nd six inches)	Red	20 g Wire *
J33	White/Red	20 g Wire *
J34	Green	20 g Wire *
J35	White	20 g Wire *
J36	Black/Red	20 g Wire *
* Connect With Terminal Lug		

**Table 4. Rear Panel Wire Color Assignments**

<b>Wire Number</b>	<b>Color</b>	<b>Gage (all lengths are 6 inches)</b>
AC3	Red	20 g Wire*
AC4	White	20 g Wire*
AC7	Red	20 g Wire *
AC8	Green	20 g Wire *
AC9	Black	20 g Wire *
AC10	White	20 g Wire *
* Connect With Spade Lug		



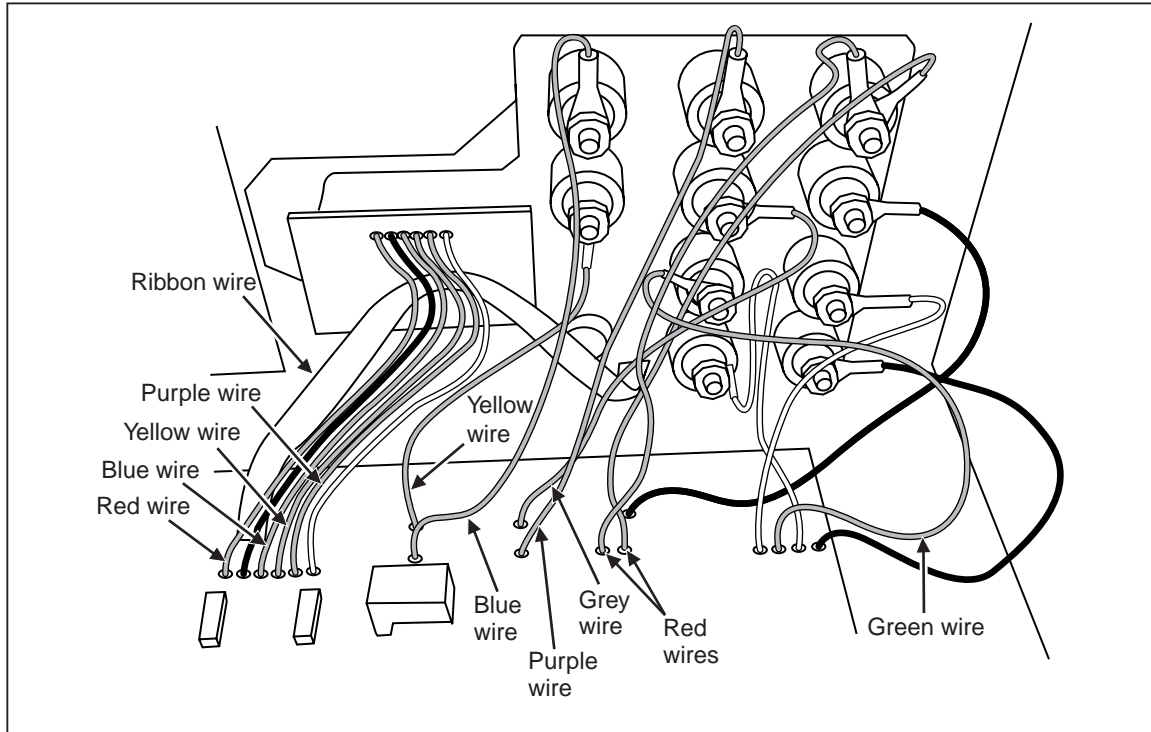


Figure 2. Wiring Connections

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*Output Block Subassembly Connections*

Table 5 lists the connections to be made when connecting the Output Block to the Main PCA. Use 8-32 low thermal nuts and 8-32 low thermal washers for these connections.

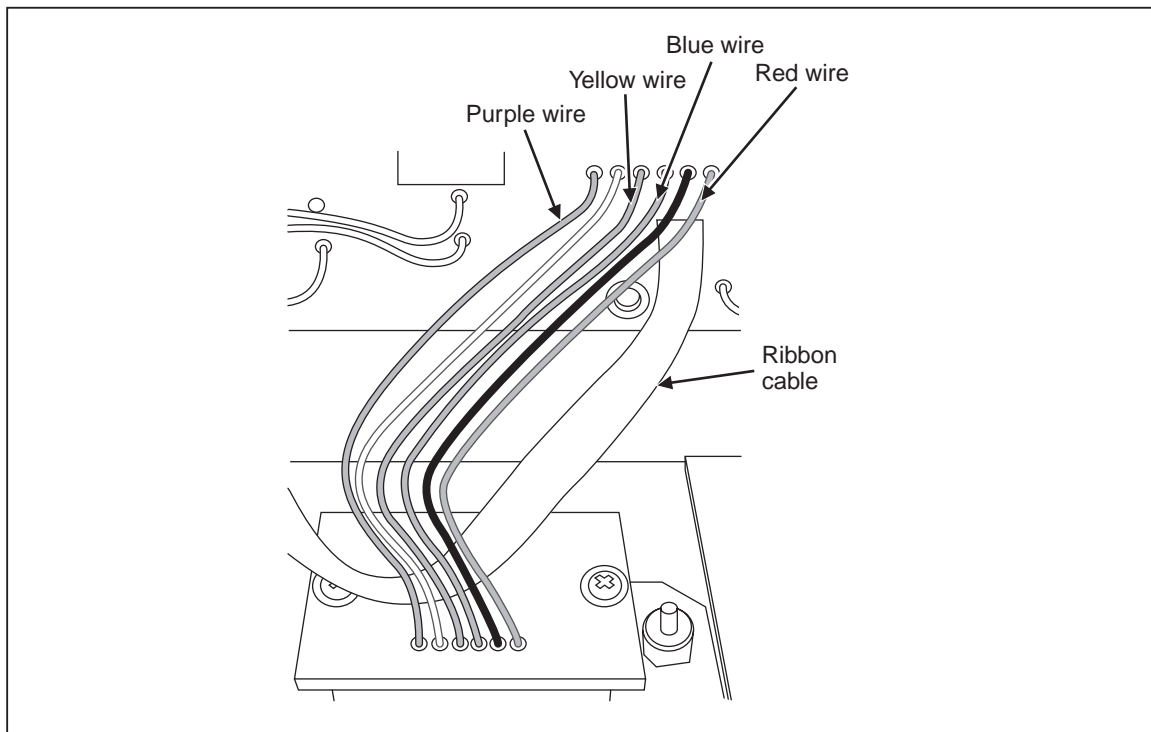
**Table 5. Output Block to Main PCA Connections**

Wire Color	Connect From	Connect To
Blue	J20	RTD HI
Yellow	J21	RTD LO
Purple	J16	mA HI
Grey	J17	mA LO
Green	J34	4 W RTD Sense HI
White	J35	4 W RTD Sense LO
Red (2 wires)	J18 & J22 one leg of the 0.1 $\mu$ F Cap	Volts HI
Black	J19 the other leg of the 0.1 $\mu$ F Cap	Volts LO
Black with red stripe	J33	4 W RTD HI
White with red stripe	J36	4 W RTD LO

The TC PCA needs to be connected to the Main PCA. Use the wire connections listed in Table 6. These connections require soldering. Refer to Figure 3.

**Table 6. TC PCA to Main PCA Connections**

Wire Color	Solder From TC PCA (from left to right)	Solder To Main PCA
Red	1st wire pad	J23
Black	2nd wire pad	J24
Blue	3rd wire pad	J25
Yellow	4th wire pad	J26
White	5th wire pad	J27
Purple	6th wire pad	J28



**Figure 3. Solder Connections for the TC PCA**

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### Keypad PCA to Main PCA

To connect the Keypad PCA to the Main PCA, solder the following connections (refer to Figure 4):

1. Solder the 12-conductor cable to the back of the Keypad PCA with pin 1 on the cable aligned with pin 1 on the Keypad PCA.
2. Solder the Keypad ribbon cable to J11 with pin 1 lined up with the square hole in J11.

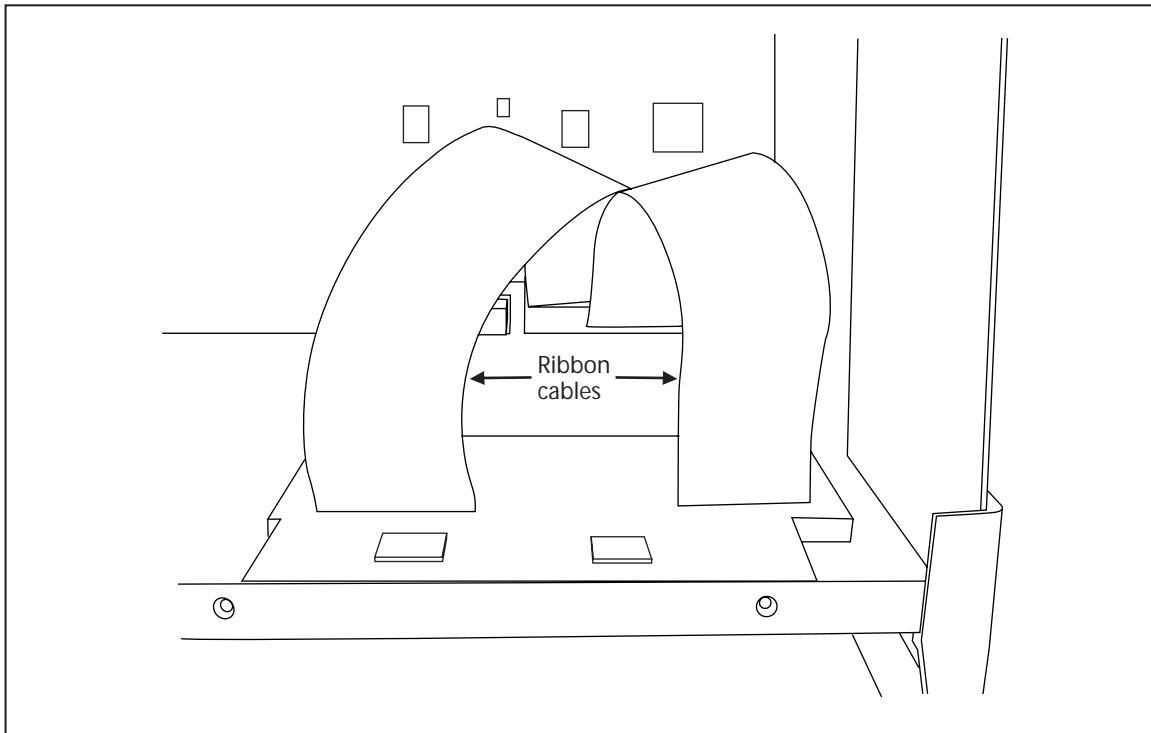


Figure 4. Keypad PCA Connections

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### Display Assembly to Main PCA

To attach the Display Assembly to the Main PCA, make the following connections:

1. Solder a red wire from J5 on the Main PCA to the "A" hole in the Display PCA.
2. Solder a black wire from J7 on the Main PCA to the "K" hole in the Display PCA.
3. Solder the 14-conductor cable to the back of the Display PCA with pin 1 on the cable aligned with pin 1 on the Display PCA.
4. Solder the 14-conductor ribbon cable to the LCD Display (J4) position on the right side of the Main PCA with pin 1 in the square hole in J4.

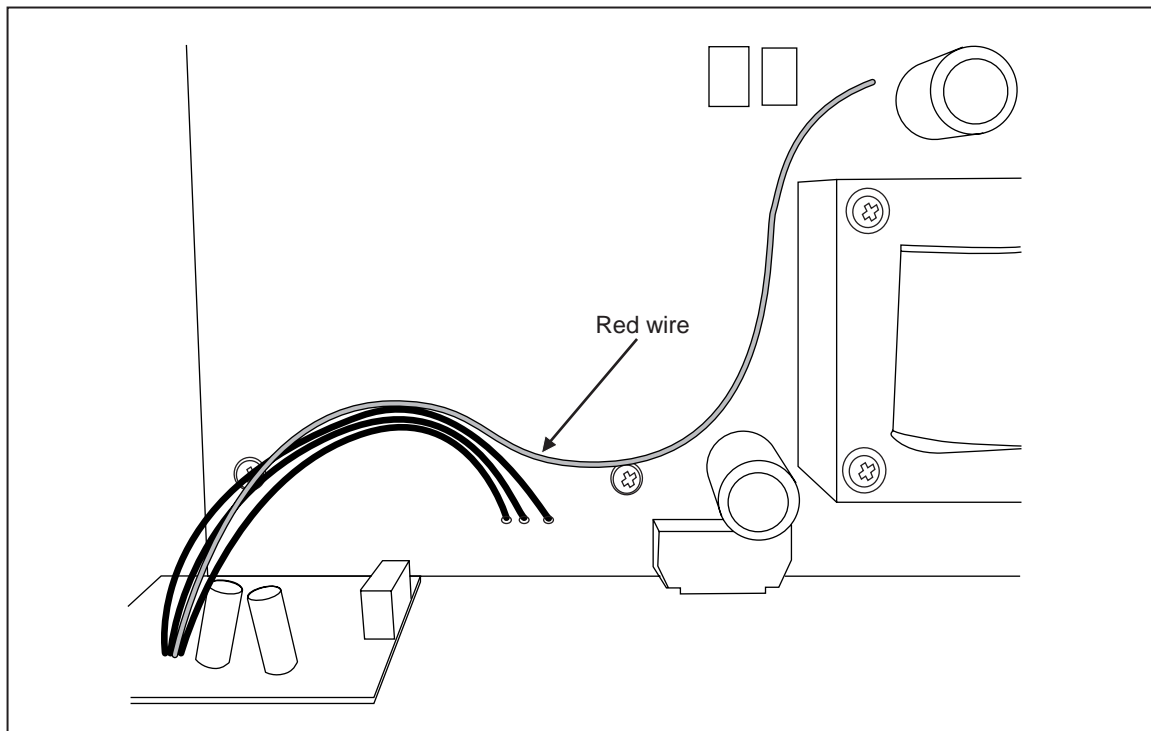
*Opto RS232 PCA to Main PCA*

Use 4 wires to connect the Opto RS232 PCA to the Main PCA. Refer to Table 7 and Figure 5.

**Table 7. Opto RS232 to Main PCA Connections**

Main PCA	Opto RS232
J38, pin 2	J1, pin 2
J38, pin 3	J1, pin 3
J38, pin 5	J1, pin 5
J63	J1, pin 4

After completing this task, the circuit board assembly is ready to reinstall into the chassis.



**Figure 5. Connections for the Opto RS232 PCA**

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***Reinstalling the Circuit Boards***

1. Place the Main PCA with all its attachments into the chassis base.
2. Put the Output Block into place in the front of the chassis.
3. Use five nylock nuts to secure the Output Block to the Chassis Base.
4. Lay the Main PCA down so that it is in place.
5. Use the (6) 6-32 5/8" screws and (6) lock washers to secure the Main PCA to the chassis base.
6. Use the (4) 6-32 X-former screws and (4) #6 nylon washers to secure the transformer to the chassis.
7. Using the (2) jack standoffs, attach the Opto RS232 PCA to the rear of the chassis.
8. Stand the unit on its front handles.
9. Insert the keypad into the front of the chassis.
10. Use (6) 6-32 x 3/8" screws to attach the Keypad PCA to the chassis base.
11. Remove the protective plastic from the LCD and put it over the lens on the front label (outside).
12. Use the (4) 6-32 nylon screws and the 4 nylon washers to attach the Display PCA to the chassis. The washers go between the Display PCA and the chassis base.

***Connecting the Power Module***

To attach the Power Module to the Main PCA, make the connections listed in Table 8. Refer to Figure 6.

**Table 8. Power Module to Main PCA Connections**

Wire Color	From	To
Red	AC3	Terminal 3 on Power Module
White	AC4	Terminal 4 on Power Module
Red	AC7	Terminal 7 on Power Module
Green	AC8	Terminal 8 on Power Module
Black	AC9	Terminal 9 on Power Module
White	AC10	Terminal 10 on Power Module

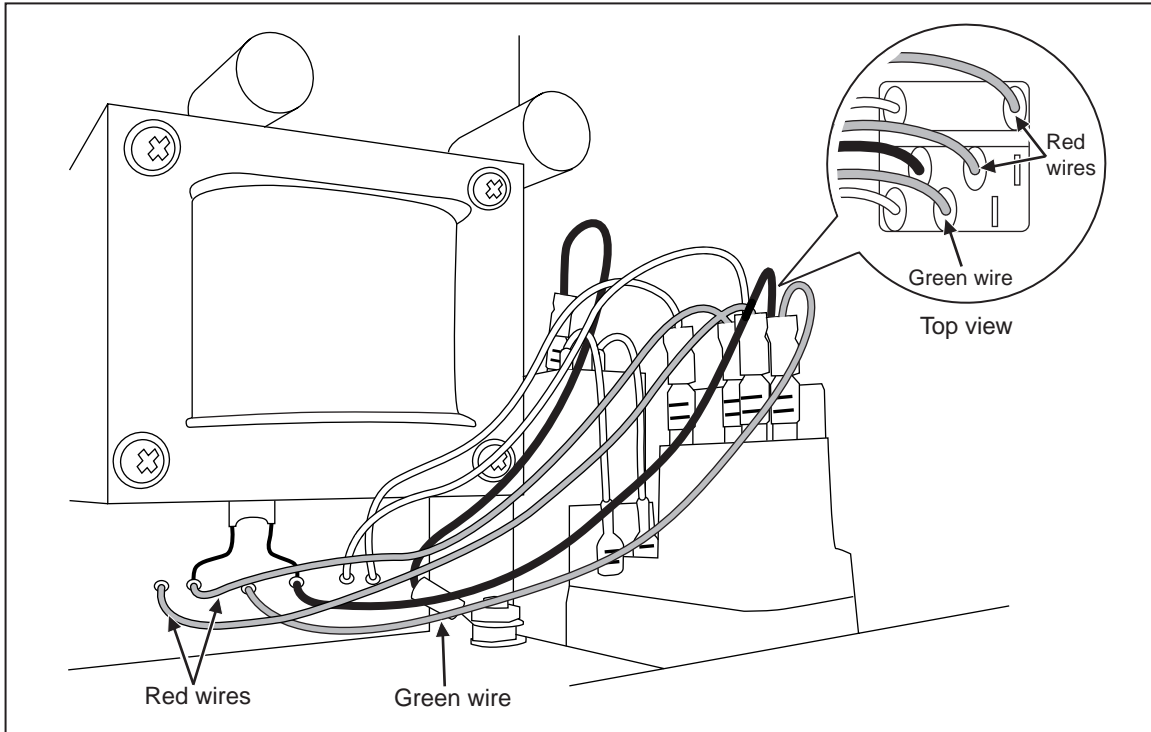


Figure 6. Power Module Connections

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### Final Assembly and Inspection

To complete final assembly and inspection, use a digital multimeter and verify the continuity of the connections listed in Table 9.

Table 9. Power Connections

Wire Color	Position B	Position on Main PCA
Red	Power Module Pin 3	AC3
White	Power Module Pin 4	AC4
Red	Power Module Pin 7	AC7
Green	Power Module Pin 8	AC8
Black	Power Module Pin 9	AC9
White	Power Module Pin 10	AC10
Red	J5	LCD J2 A
Black	J7	LCD J2 K
White	J62	Opto Pin 4
N/A	J52	Inside Chassis Base (no connection)

Install tie wraps around the AC wires, the Output Block wires, the LCD backlight wires, the 5-conductor cable, and the Opto-RS232 wires.

## Performance Tests

The following performance tests are used to verify the functionality of the Calibrator. If the Calibrator fails any part of the performance tests, calibration adjustment or repair by a Fluke Service Center is in order. For a list of service centers, refer to "Contacting Fluke" earlier in this manual.

### Required Equipment List

To complete the performance tests and calibration adjustment, the equipment listed in Table 10 is necessary. If the equipment listed is not available, equipment with the same or better specifications can be substituted.

**Table 10. Required Equipment**

Manufacturer	Model	Equipment	Purpose
Fluke	Fluke- 525A/Leads	Test Lead Set	All Functions
Fluke	742A-10	Resistance Standard, 10 $\Omega$	100 mA source calibration
Fluke	742A-100	Resistance Standard, 100 $\Omega$	Low Ohms Measure and SPRT Calibration.
Fluke	742A-10K	Resistance Standard, 10K $\Omega$	Hi Ohms Measure Calibration
Fluke	5520A	Calibrator	Low Ohms Measure and SPRT Calibration. Hi Ohms Measure Calibration.
Wavetek	1281	DMM	All functions except CJC
–	–	Ohms Shorting Block	Low Ohms Measure and SPRT Calibration. Hi Ohms Measure Calibration.
–	–	RTD Probe	TC CJC Calibration
Hart Scientific	1521	Precision Thermometer	TC CJC Calibration
Omega		J Thermocouple Probe	TC CJC Calibration
–	–	Lag Bath	TC CJC Calibration
–	–	Dewar Flask with lid	TC tests
–	–	Banana Jack to Copper TC Mini-Connector Cable	TC tests

**Testing DC Voltage**

The DC voltage amplitude accuracy test verifies the accuracy of DC voltage at the 525A calibrator front panel Volts Source output. See Table 11.

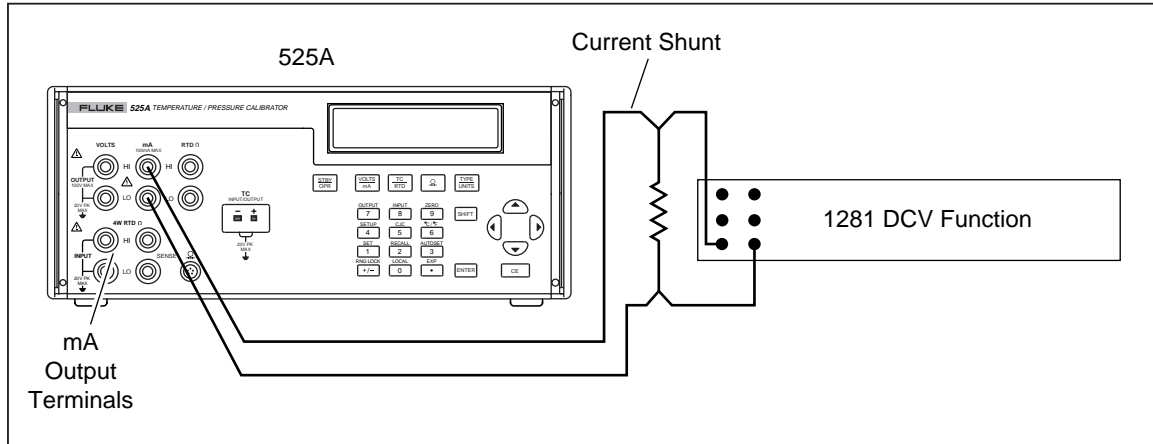
**Table 11. Testing DC Voltage**

Range	Nominal Value (V)	Measured Value	Deviation %	90 Day Spec. (V)	One Year Spec. (V)
100 mV	0			0.000003	0.000003
	0.025			3.63E-06	3.75E-06
	0.075			4.88E-06	5.25E-06
	0.1			5.5E-06	0.000006
1.0 V	0			0.00002	0.00002
	0.25			2.63E-05	2.75E-05
	0.75			3.88E-05	4.25E-05
	1			0.000045	0.00005
10.0 V	0			0.0002	0.0002
	2.5			0.000263	0.000275
	7.5			0.000388	0.000425
	10			0.00045	0.0005
100.0 V	0			0.002	0.002
	25			0.002625	0.00275
	75			0.003875	0.00425
	100			0.0045	0.005



### Testing DC Current

Use the Wavetek 1281 and the precision shunt to measure the 525A output as shown in Figure 7. Take the Voltage reading from the Wavetek 1281 and divide it by the 742A-1 actual value. See Table 12.



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Figure 7. Measuring DC Current

Table 12. Measuring DC Current

100 mA Output (A)	Volt	Current (I=E/R)	742A-1 Shunt Value	90 Day (A)	1 Year (A)
0.000			Direct Into 1281 Input	0.000002	0.000002
0.025				0.0000041	0.0000045
0.075				0.0000083	0.0000095
0.100				0.0000105	0.000012

### Testing Thermocouple Output

For this test the TC mV specifications will be used. When this test is combined with the CJC test, all functions of the TC output will have been checked. Typically, the cable needs to connect the 525A to the 1281 and will need to be fabricated. The TC mini-connector will need to be copper - copper (white). Using copper wire, connect the TC mini-connector to standard banana jacks. See Figure 8 for a connection diagram.

For this test, the CJC (cold junction compensation) must be turned off. Press **SHIFT** **5** to turn off the CJC. XCJC on the display indicates that the CJC is turned off. Select TC, and Output. Press **TYPE UNITS** until mV/°C is shown on the display. Output the mV values listed in Table 13.

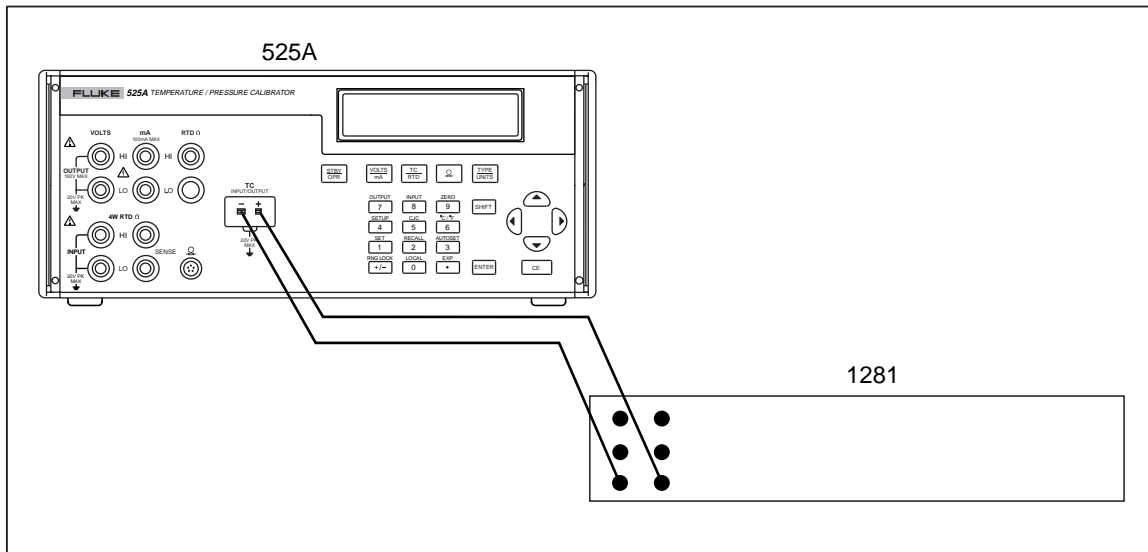


Figure 8. Testing TC Output

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Table 13. TC Temperatures

Nominal Voltage (mV)	90 Day Spec. (mV)	1 Year Spec. (mV)
-5.000	0.003125	0.00315
15.00	0.003375	0.00345
30.00	0.00375	0.0039
50.00	0.00425	0.0045
70.00	0.00475	0.0051

### Testing CJC (Cold Junction Compensation)

Connect a Type-J thermocouple to the TC terminal on the 525A. Immerse the thermocouple and a precision thermometer into a mineral oil lag bath. The test set-up is shown in Figure 9.

Verify that the readings of the 525A and the precision thermometer are within the Type-J specifications:

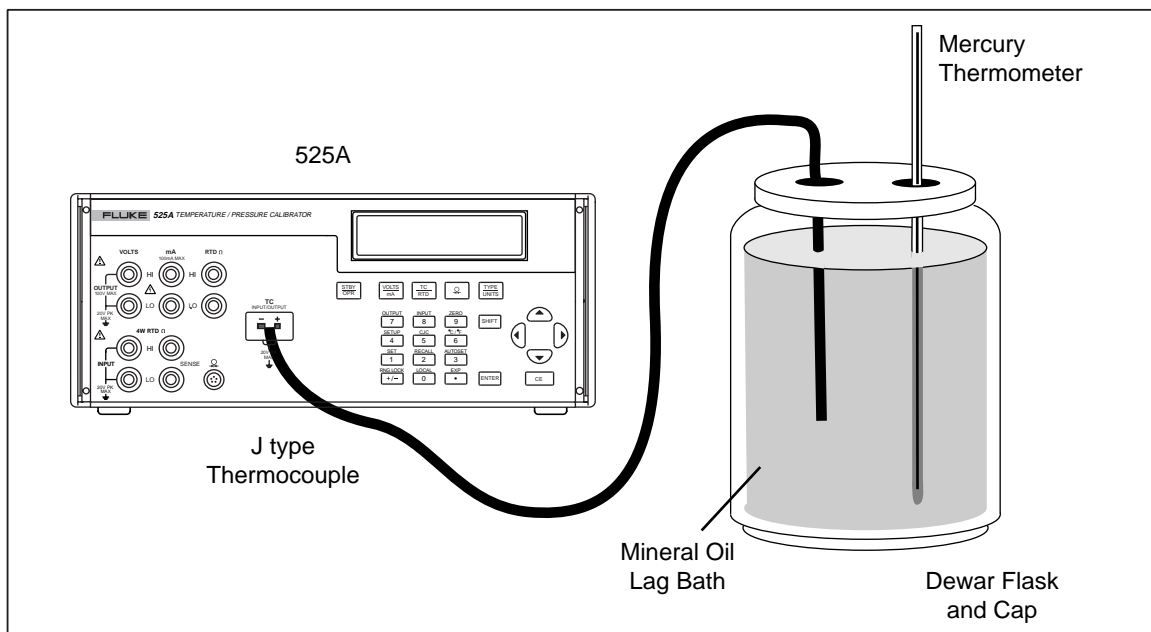
- The 90 day spec is 0.14 °C
- The 1 year spec is 0.16 °C

#### Note

*Typical Type-J thermocouples Do not have specifications accurate enough to be used as a standard. To maintain a good Test Uncertainty Ratio (TUR) a characterized Type-J thermocouple may need to be used.*

### CJC (Cold Junction Compensation) Calibration

Connect a Type-J thermocouple to the TC terminals on the Calibrator, and immerse the thermocouple and a precision thermometer in a mineral oil lag bath. The test setup is shown in Figure 9. Verify that the readings of the thermometer and the Calibrator are within the thermocouple specifications listed in the Specifications section.



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Figure 9. Connections for CJC Calibration

### Testing Thermocouple Input

Set the 525A to TC input by pressing **SHIFT** then **7**. All other 525A conditions will be the same as the thermocouple output test, CJC off, mV/°C mode.

Connect the 525A to the 5520A as shown in Figure 10. Set the 5520A to output the mV values in Table 13.

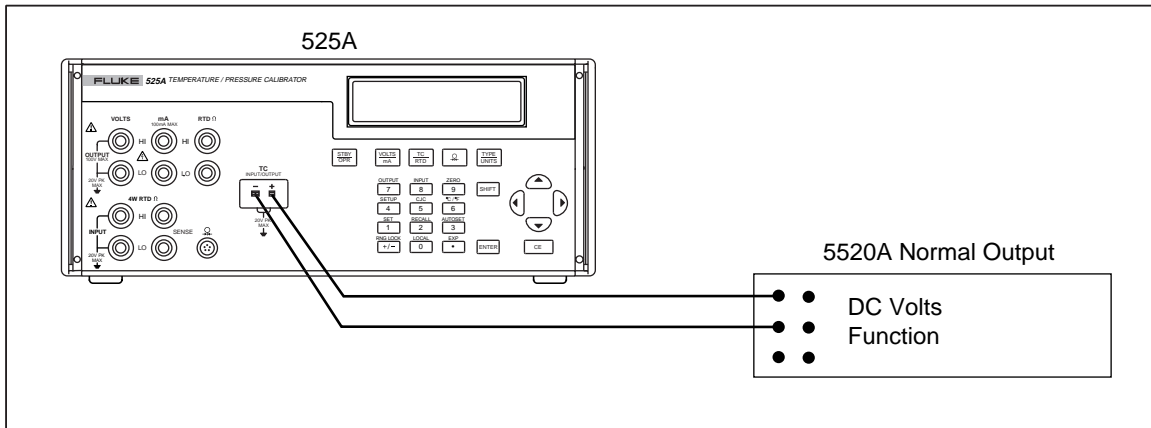


Figure 10. Connections for Measuring TC Input

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### Testing Ohms Output

Use the precision digital multimeter (DMM) to measure the resistance output. Figure 11 shows the four-wire connections. See Table 14.

*Note*

*The Wavetek 1281 must be in the “loI” (low current mode) when measuring 5 Ω in the 4 kΩ range or an overload will occur.*

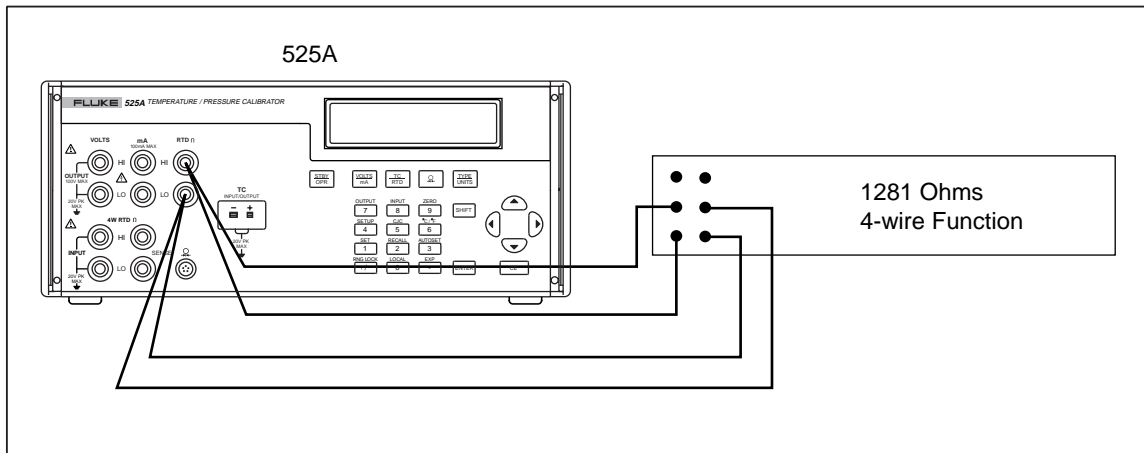


Figure 11. Connection for Measuring Resistance Output

Table 14. Ohms Output Ranges

Range (Ω)	Output (Ω)	1 Year (Ω)
400	5	0.03
	100	
	200	0.03
	300	0.03
	400	0.03
4000	5	0.3
	1000	
	2000	0.3
	3000	0.3
	4000	0.3

### Testing Ohms Input

Before measuring ohms input, the ohms output of a 5520A must be “characterized”. To achieve the needed accuracy, the Wavetek 1281 is used as a transfer standard and the 742A is used as the reference standard. To find the true value of the 5520A output, the ratio-input function of the Wavetek 1281 is used. The ratio function of the 1281 is located on the rear panel and is designated as Channel A and Channel B. Connect Channel A to the 742A and connect the 5520A to Channel B, both using four-wire measure. See Figure 12 for a connection diagram.

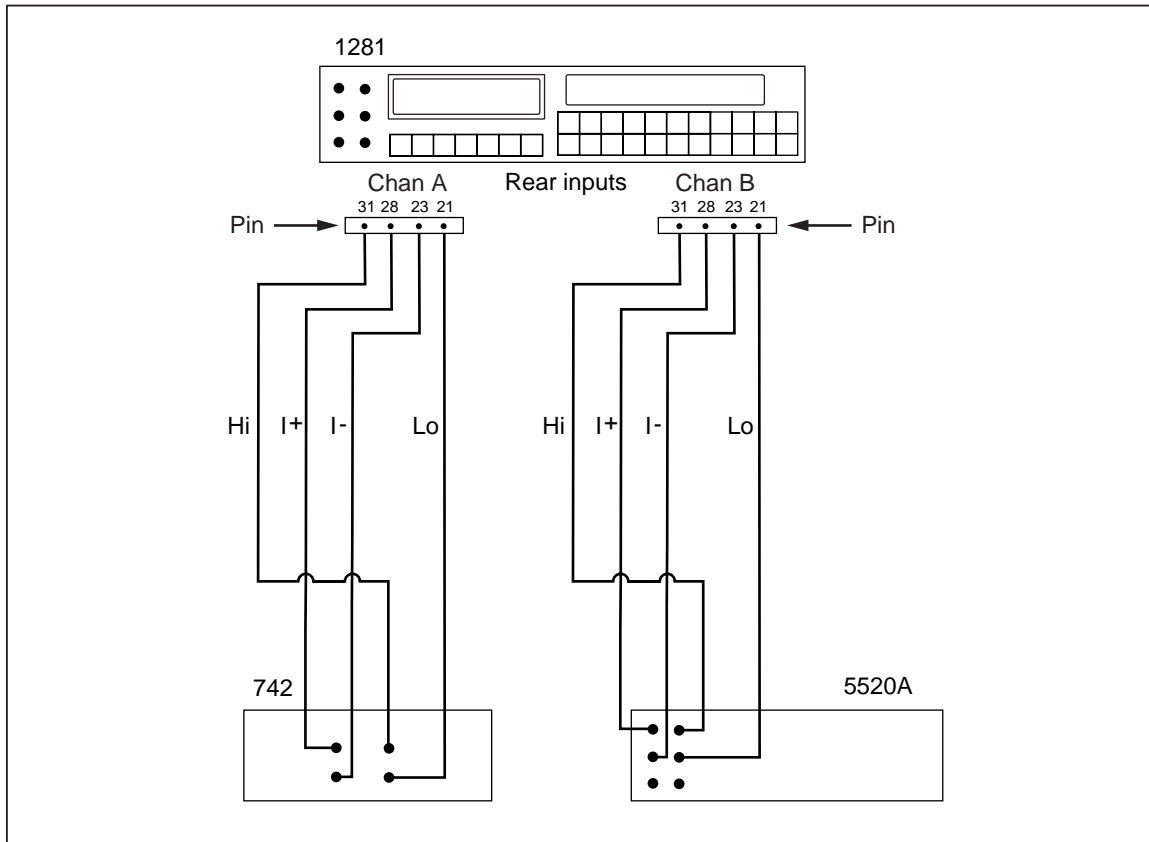


Figure 12. 1281 Connection Diagram

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For the 400 Ω range use the 742A-1K and for the 4 kΩ range use the 742A-10K. For more information on the correct usage of ratio mode refer to the 1281 Operators Manual. Use Table 15 to note the ratio indication on the 1281. Ignore the 0 Ω value. Use the formula (742A actual value/ratio indication \* 100 = actual 5520A value) and enter that ohm value into the 5520A actual value column.

Table 15. Ohms Ratio Table

Range (Ω)	742A Value (Ω)	Ratio	5520A Actual Value (Ω)	525A Reading	Specification	90 Day Specification	1 Year Specification
<b>400</b>							
0					0.002	0.003	0.003
100					0.006	0.0065	0.007
200					0.01	0.010	0.011
300					0.014	0.0135	0.015
400					0.018	0.017	0.019
<b>4000</b>							
0					0.02	0.03	0.03
1000					0.06	0.065	0.07
2000					0.1	0.10	0.11
3000					0.14	0.135	0.15
4000					0.18	0.17	0.19

First apply a four wire short to the 525A 4W RTD Ohm input. Set the 525A to the 400 Ω range. Note the reading. Set the 525A to the 4000 Ω range. Note the reading. Move the 525A 4W RTD Ohm input to the output of the 5520A. Output the same nominal values and note the 525A readings in the 525A reading column. Subtract the actual 5520A value from the 525A reading and ensure that it is within the specified tolerance.

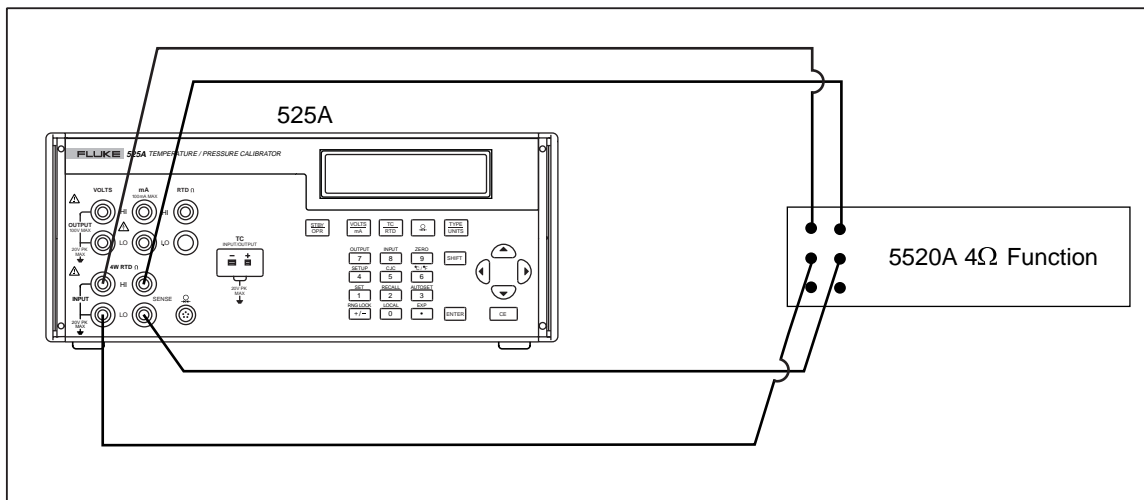


Figure 13. Connection for Measuring Ohms

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### **Testing Pressure Modules**

The Fluke 700 series pressure modules are calibrated separately from the 525A. The calibration follows the pressure module, so only a performance test is needed. Connect any of the Fluke 700 series pressure modules to the pressure module connector. Verify that the Calibrator reads pressure.

### **Calibration Adjustment**

Adjusting the Calibrator requires no mechanical adjustment. All adjustments are performed electronically. The calibration is performed via serial communications port. The adjustments take place over the normal RS232 interface. Refer to Table 6 for a list of required equipment for performing the following procedures. Note that the adjustment for the Resistance Measure was designed to be especially flexible, allowing for the use of fixed resistors.

### **Initiating Communication**

Terminals can be set up using terminal communications software on a personal computer (PC). Connect a 9-pin null modem cable to the RS232 connector on the back of the Calibrator. Connect the other end of the cable to the PC/PC serial port. An adapter may be needed for terminals that use 25 pin D serial connectors. A terminal program such as Window HyperTerminal may be used in the PC.

The terminal settings need to be set as follows:

Bits per second: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

Local echo: on

### **Starting Adjustment Mode**

The Calibrator needs to warm up for at least 30 minutes before performing these procedures. This will allow any thermal changes in the Calibrator to stabilize. If the unit has been repaired or is new, it should be given 24 hours to burn in. To initiate the calibration mode, use the PC to send the CAL\_START command. The following will be displayed on the PC:

```
Calibration is password protected
Enter Password:
```



The password is 525. Enter the password through the PC keyboard and the following is displayed on the PC monitor:

```

Calibration Menu:
1: 100 mV Source
2: 1 V Source
3: 10 V Source
4: 100 V Source
5: 100 mA Source
6: Hi Ohms Source
7: Low Ohms Source
8: Hi Ohms Measure
9: Low Ohms Measure
10: SPRT 25
11: TC SOURCE
12: TC READ
13: TC CJC
14: Calibrate DAC
    
```

Enter Selection:

### **Adjustment Sequence**

Manual calibration of the Calibrator is a menu driven process. The menu consists of 14 different menu selections for calibration of the different operating modes.

Certain functions must be calibrated before others. Table 16 lists the calibration dependencies and tells which functions are dependent on others being calibrated first. An X in a row indicates that the step in that column must be before the step in that row can be completed. These dependencies are only related to calibration adjustment. They are not intended to show the relationship between normal functionality and calibration.

**Table 16. Calibration Dependencies**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N/A													X
2		N/A												X
3			N/A											X
4				N/A										X
5					N/A									X
6						N/A								
7							N/A							
8								N/A						
9									N/A					
10										N/A				
11											N/A			X
12											X	N/A		X
13											X	X	N/A	X
14														N/A

**14: Calibrate DAC, Digital to Analog Converter Adjustment**

If all of the functions that are affected by the digital to analog converter (DAC) adjustment are going to be adjusted, start with step 14 which adjusts the DAC. Do not adjust the DAC unless all of the ranges affected are going to be readjusted. During normal calibration adjustment, it is necessary to adjust the DAC. However, for example, if a mistake were made in the 100 V range, the user would not want to readjust the DAC. If it were readjusted, the user would have to readjust everything that depends on that range.

To adjust the calibration of the DAC from the menu, type 14 and then press the Enter key on the PC keyboard. No external connection is necessary. The DAC adjust will execute, save the calibration constants, then display the Calibration Menu on the PC.

**1: 100 mV Source to 4: 100 V Source, Adjusting DC Source**

Adjusting the voltage output breaks down into four distinct ranges; each can be adjusted separately using menu selections 1-4. The adjustments are done in 2 parts. The first part sets the 0 and span values. The second part is to fine adjust the zero, span, and adjusts the linearity. The example below is for the 1 V range. The other ranges use the same steps with different voltage values. Refer to Table 17 for a list of equipment used in this section.

**Table 17. List of Equipment for Voltage Calibration Adjustments**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test Lead Set
Wavetek	1281	DMM

1. Connect the calibrator VOLTS HI and LO to the DMM input.
2. Set the DMM to DC Volts.
3. Type 2 and push the Enter key on the PC. The following is displayed on the PC:  

```
First Calibration Point. Enter the Volts displayed:
```
4. When the reading on the DMM stabilizes, type the reading value on the PC and press Enter. After the value has been entered, the following is displayed on the PC:  

```
Second Calibration Point. Enter the Volts displayed:
```
5. When the reading on the DMM stabilizes, type the reading value on the PC and press Enter. After the value has been entered, the following is displayed on the PC:  

```
Second Calibration Point. Enter the Volts displayed:  
Adjust the 0 Percent of Scale, 8 for up 2 for down, Press Enter When Stable
```

The second part of the calibration adjustment follows. In the 10 key section of the PC keyboard, use the 8 (up arrow) to increase the output voltage displayed or 2 (down arrow) to decrease the output voltage displayed. Keep in mind the lag time between a change in output voltage to a stable display on the DMM. Make small changes then wait for a stable reading. Adjust the output so that you get a good, stable 0 V reading. When satisfied with the reading, press the Enter key.

The PC display shows:

```
Please Wait...
25755
```

Adjust to 25 Percent of Scale, 8 for up 2 for down, Press Enter When Stable

The value is the raw A/D counts for this calibration point, followed by a prompt to adjust the 25 % of scale value. Use the 8 (up) and 2 (down) key on the PC to adjust the output to get a reading very close to 25 % of the range full scale.

- For the 100 mV range, 25 % is 25 mV
- For the 1 V range, 25 % is 250 mV
- For the 10 V range, 25 % is 2.5 V
- For the 100 V range, 25 % is 25 V

When satisfied with the reading, press Enter and the PC shows:

```
Please Wait...
2083980
```

Adjust to 50 Percent of Scale, 8 for up 2 for down, Press Enter When Stable

The value is the raw A/D counts for this calibration point followed by a prompt to adjust the 50 % of scale value. Use the 8 (up) and 2 (down) key on the PC to adjust the output to get a reading very close to 50 % of the range full scale.

- For the 100 mV range, 50 % is 50 mV
- For the 1 V range, 50 % is 500 mV
- For the 10 V range, 50 % is 5.0 V
- For the 100 V range, 50 % is 50 V

This process continues until the user goes through the 100 % range. Use the same procedures for those ranges.

After the raw A/D counts are displayed, this calibration step is complete. The calibration constants for the range have been saved. Press Enter to return to the Calibration menu.

### 5: 100 mA Source, Adjusting DC Current Source

Adjusting the DC current output is similar to the voltage source calibration adjustment. Just like the voltage calibration adjustment, this adjustment is executed in 2 parts. Part 1 sets the 0 and span values. Part 2 is to fine adjust the zero, span, and adjusts the linearity. Refer to Table 18 for a list of equipment used in this section.

**Table 18. List of Equipment for Current Calibration Adjustments**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test Lead Set
Fluke	742A-10	Resistance Standard, 10 Ω
Wavetek	1281	DMM

The voltage is measured across a 10  $\Omega$  shunt resistor instead of measuring current directly.

Readings taken from the DMM need to be converted to mA (multiplied by 100) before they can be entered in at the PC.

1. Set the DMM to read DC Volts.
2. Use the test leads for the following connections:
  - a. Connect the mA HI jack of the Calibrator to the high side of the current input of the 742A.
  - b. Connect the mA LO jack of the calibrator to the low side of the current input of the 742A.
  - c. Connect the high side of the sense output of the 742A to the high side of the voltage input of the DMM.
  - d. Connect the low side of the sense output of the 742A to the low side of the voltage into the DMM.

3. Type 5 and then press the Enter key on the PC. The following will be displayed on the PC:

```
First Calibration Point. Enter the mAmps displayed:
```

4. When the reading on the DMM stabilizes, calculate the mA (multiply the voltage reading by 100) and type the mA on the PC then press the Enter key. After the value has been entered, the following shows on the PC:

```
Second Calibration Point. Enter the mAmps displayed:
```

5. When the reading on the DMM stabilizes, calculate the mA (multiply the voltage reading by 100) and type the mA on the PC then press the Enter key. After the value has been entered, the following shows on the PC:

```
Second Calibration Point. Enter the volts displayed  
Adjust the 0 Percent of Scale, 8 for up 2 for down, Press Enter When Stable
```

The second part of the calibration adjustment follows. In the 10 key section of the PC keyboard, use the 8 (up arrow) to increase the output voltage displayed or 2 (down arrow) to decrease the output voltage displayed. Keep in mind the lag time between a change in output voltage to a stable display on the DMM. Make small changes then wait for a stable reading. Adjust the output so that you get a good, stable 0 V reading. When satisfied with the reading, press the Enter key.

The PC display shows:

```
Please Wait...  
111260  
  
Adjust to 25 Percent of Scale, 8 for up 2 for down, Press Enter When Stable
```

The value is the raw A/D counts for this calibration point, followed by a prompt to adjust the 25 % of scale value. Use the 8 (up) and 2 (down) key on the PC to adjust the output to get a reading very close to 25 % of the range full scale.

- For the 100 mA range, 25 % is 250 mV

When satisfied with the reading, press Enter and the PC shows:

Please Wait...  
2147203

Adjust to 50 Percent of Scale, 8 for up 2 for down, Press Enter When Stable

The value is the raw A/D counts for this calibration point followed by a prompt to adjust the 50 % of scale value. Use the 8 (up) and 2 (down) key on the PC to adjust the output to get a reading very close to 50 % of the range full scale.

- For the 100 mA range, 50 % is 500 mV

Repeat this process until the user goes through the 100 % range. Use the same procedures for those ranges.

- For the 100 mA range, 75 % is 750 mV
- For the 100 mA range, 100 % is 1 V

After the raw A/D counts are displayed, this calibration step is complete. The calibration constants for the range have been saved. Press Enter to return to the Calibration menu.

### *6: Hi Ohms Source, Adjusting High Resistance Source*

When calibrating the 5-4000  $\Omega$  output range (High Ohms Source), the calibrator outputs two calibration points. After the output becomes stable, the values are entered at the PC.

1. Use the same test equipment listed in Table 16.
2. Make the following connections:
  - a. Connect the HI RTD  $\Omega$  jack of the Calibrator to the high side of the Ohms measure sense jacks on the DMM.
  - b. Connect the LO RTD  $\Omega$  jack of the Calibrator to the low side of the Ohms measure sense jacks on the DMM.
  - c. Connect the HI RTD  $\Omega$  jack of the Calibrator to the high side of the Ohms measure current source jacks on the DMM.
  - d. Connect the LO RTD  $\Omega$  jack of the Calibrator to the low side of the Ohms measure current source jacks on the DMM. It is important that the sense leads be on the bottom of the stack on the Calibrator Ohms source jacks.
3. Set the DMM to measure 4-wire ohms.
4. Type 6, then the Enter key on the PC. The PC will display:
 

First Calibration Point. Enter the Ohms displayed:
5. When the reading displayed on the DMM stabilizes, type the reading value on the PC and press the Enter key. After the value has been entered, the PC displays the following:
 

Second Calibration Point. Enter the Ohms displayed:
6. When the reading displayed on the DMM stabilizes, type the reading value on the PC and press the Enter key. After the second value has been entered, the Calibrator will return to the calibration menu.

### 7: Low Ohms, Adjusting Low Ohms Source

When calibrating the 5-400  $\Omega$  output range (High Ohms Source), the calibrator outputs two calibration points. After the output becomes stable, the values are entered at the PC.

1. Use the same test equipment listed in Table 16.
2. Use the same connections as in 6: Adjusting High Resistance Source.
3. Set the DMM to measure 4-wire ohms.
4. Type 7, then press the Enter key on the PC. The PC will display:

First Calibration Point. Enter the Ohms displayed:

5. When the reading displayed on the DMM stabilizes, type the reading value on the PC and press the Enter key. After the value has been entered, the PC displays the following:

Second Calibration Point. Enter the Ohms displayed:

6. When the reading displayed on the DMM stabilizes, type the reading value on the PC and press the Enter key. After the second value has been entered, the Calibrator will return to the calibration menu.

### 8: Hi Ohms, Adjusting High Resistance Measure

When adjusting the calibration for the 5-4000 Ohms Measure range (High Ohms Measure), the Calibrator will first measure a short and then two resistances. Refer to Table 19 for a list of equipment used in this section.

**Table 19. List of Equipment for High Ohms Measure Calibration Adjustments**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test Lead Set
Fluke	742A-10K	Resistance Standard, 10K $\Omega$
Fluke	5520A	Calibrator
Wavetek	1281	DMM

1. Insert a 4-wire short into the 525A 4W RTD  $\Omega$  jacks.
2. Type 8 then press the Enter key on the PC. The following will show on the PC:

Input 0 Ohms, Press Enter When Stable

3. Allow a few seconds for stabilization, then press the Enter key. In a few moments the following appears on the PC:

Input ~2000 Ohms, Enter the actual value when stable:

The ~2000 indicates that the desired resistance is about 2000  $\Omega$ . The actual resistance is not as important as the accuracy with which the value is known. The method described below uses the 1281 to establish a ratio between the 5520A output and the 742 to improve the accuracy with which the 5520A's output resistance is known.

1. Connect channel A of the 1281 to the resistance standard as follows:
  - a. Connect I+ of the DMM to the high side of the current input of the resistance standard.
  - b. Connect I- of the DMM to the low side of the current input of the resistance standard.
  - c. Connect the high side (HI) of the DMM sense input to the high side of the sense output of the resistance standard.
  - d. Connect the low side (LO) of the DMM sense input to the low side of the sense output of the resistance standard.
2. Connect channel B of the 1281 to the 5520A as follows:
  - a. Connect I+ of the DMM to the high side of the current input of the 5520A.
  - b. Connect I- of the DMM to the low side of the current input of the 5520A.
  - c. Connect the high side (HI) of the DMM sense input to the high side of the sense output of the 5520A.
  - d. Connect the low side (LO) of the DMM sense input to the high side of the sense output of the 5520A.
3. Connect the 525A to the 5520A as follows:
  - a. Connect the HI INPUT 4W RTD  $\Omega$  jack of the Calibrator to the high side of the current input of the 5520A.
  - b. Connect the LO INPUT 4W RTD  $\Omega$  jack of the Calibrator to the low side of the current input of the 5520A.
  - c. Connect the HI SENSE 4W RTD  $\Omega$  jack of the Calibrator to high side of the sense output of the 5520A.
  - d. Connect the LO SENSE 4W RTD  $\Omega$  jack of the Calibrator to the low side of the sense output of the 5520A.
4. Set the 5520A to source 2000  $\Omega$ .
5. Using the 2 channels on the DMM, calculate the actual value of the 5520A's output. This is done by using the ratio of a known standard to the output of the 5520A. The 1281 can be used to calculate the ratio or proceed as follows:

$$\text{Ratio} = A/B$$

$$RA = RS/\text{Ratio}$$

Where:

A = The reading from channel A of the DMM

B = The reading from channel B on the DMM

RS = The value of the resistance standard (in this case 10K)

RA = The actual output of the 5520A

After the actual output value, the PC displays the following:

Input ~4000 Ohms, Enter the actual value when stable

1. Set the 5520A to source 4000  $\Omega$  (nominal) and enter the actual value calculated as described above.

After the value is entered, the calibration constants will be saved and the display returns to the main Calibration Menu.

### 9: Low Ohms, Adjusting Low Resistance Measure

When adjusting the calibration for the 5-400 Ohms Measure range (Low Ohms Measure), the Calibrator will measure 3 resistances. Refer to Table 20 for a list of equipment used in this section.

**Table 20. List of Equipment for High Ohms Measure Calibration Adjustments**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test Lead Set
Fluke	742A-100	Resistance Standard, 100 $\Omega$
Fluke	5520A	Calibrator
Wavetek	1281	DMM

The method described below uses the 1281 to establish a ratio between the 5520A output and the 742 to improve the accuracy with which the 5520A's output resistance is known.

1. Connect channel A of the 1281 to the Resistance Standard as follows:
  - a. Connect I+ of the DMM to the high side of the current input of the Resistance Standard.
  - b. Connect I- of the DMM to the low side of the current input of the Resistance Standard.
  - c. Connect the high side (HI) of the DMM sense input to the high side of the sense output of the resistance standard.
  - d. Connect the low side (LO) of the DMM sense input to the low side of the sense output of the resistance standard.
2. Connect channel B of the 1281 to the 5520A as follows:
  - a. Connect I+ of the DMM to the high side of the current input of the 5520A.
  - b. Connect I- of the DMM to the low side of the current input of the 5520A.
  - c. Connect the high side (HI) of the DMM sense input to the high side of the sense output of the 5520A.
  - d. Connect the low side (LO) of the DMM sense input to the low side of the sense output of the 5520A.
3. Connect 525A to the 5520A as follows:
  - a. Connect HI INPUT 4W RTD  $\Omega$  jack of the 525A to the high side of the current input of the 5520A.
  - b. Connect LO INPUT 4W RTD  $\Omega$  jack of the 525A to the low side of the current input of the 5520A.
  - c. Connect the HI SENSE 4W RTD  $\Omega$  jack of the 525A to the high side of the sense output of the 5520A.
  - d. Connect the LO SENSE 4W RTD  $\Omega$  jack of the 525A sense input to the low side of the sense output of the 5520A.
4. Type 9 {enter} on the PC. The following will be displayed on the PC.

Input ~100 Ohms, Enter the actual value when stable:



The ~100 indicates that the desired resistance is about 100 Ω. The actual resistance is not as important as the accuracy with which the value is known.

5. Set the 5520A to source 100 Ω.
6. Using the two channels on the DMM, calculate the actual value of the 5520A's output. This is done by using the ratio of a known standard to the output of the 5520A. You can use the 1281 to calculate the ratio or proceed as follows.

$$\text{Ratio} = A/B$$

$$RA = RS/\text{Ratio}$$

Where:

A = The reading taken from channel A on the DMM.

B = The reading taken from channel B on the DMM.

RS = The value of the resistance standard (in this case 100 Ω).

RA = The actual output of the 5520A.

After the actual output value is entered, the PC displays the following:

Input ~200 Ohms, Enter the actual value when stable:

7. Set the 5520A to source 200 Ω (nominal) and enter the actual value calculated as described above.

Set Input ~400 Ohms, Enter the actual value when stable:

8. Set the 5520A to source 400 Ω (nominal) and enter the actual value calculated as described above.

After the value is entered, the calibration constants will be saved and the display will return to the main Calibration Menu.

### 10: SPRT 25, Adjusting SPRT Low Resistance Measure

The SPRT 25 range is used for measuring SPRTs (typically 25 Ohm R0) and Ohms from 0 to 100 Ohms in the 0-400 Ohms range. The 525A will measure a short, and 2 resistances. Refer to Table 21 for a list of equipment used in this section.

**Table 21. List of Equipment for Low Ohms Measure Calibration Adjustments**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test lead set
Fluke	742A-100	Resistance Standard, 100 Ω
Fluke	5520A	Calibrator
Wavetek	1281	DMM

1. Insert a good 4-wire short into the 525A 4W RTD Ω jacks.
2. Type 10 and press the Enter key on the PC. The following is displayed on the PC.

Input 0 Ohms, Press Enter When Stable

3. Allow a few seconds for everything to stabilize, then press the Enter key. In a few moments the following is displayed on the PC:

Input ~50 Ohms, Enter the actual value when stable:

The ~50 indicates that the desired resistance is about 50  $\Omega$ . The actual resistance is not as important as the accuracy with which the value is known. The method described below uses the 1281 to establish a ratio between the 5520A output and the 742 to improve the accuracy with which 5520As output resistance is known.

4. Connect channel A of the 1281 to the Resistance Standard as follows:
  1. Connect I+ of the DMM to the high side of the current input of the Resistance Standard.
  2. Connect I- of the DMM to the low side of the current input of the Resistance Standard.
  3. Connect the high side (HI) of the DMM sense input to the high side of the sense output of the resistance standard.
  4. Connect the low side (LO) of the DMM sense input to the low side of the sense output of the resistance standard.
5. Connect channel B of the 1281 to the 5520A as follows:
  - a. Connect I+ of the DMM to the high side of the current input of the 5520A.
  - b. Connect I- of the DMM to the low side of the current input of the 5520A.
  - c. Connect the high side (HI) of the DMM sense input to the high side of the sense output of the 5520A.
  - d. Connect the low side (LO) of the DMM sense input to the low side of the sense output of the 5520A.
6. Connect 525A to the 5520A as follows:
  - a. Connect HI INPUT 4W RTD  $\Omega$  jack of the 525A to the high side of the current input of the 5520A.
  - b. Connect LO INPUT 4W RTD  $\Omega$  jack of the 525A to the low side of the current input of the 5520A.
  - c. Connect the HI SENSE 4W RTD  $\Omega$  jack of the 525A to the high side of the sense output of the 5520A.
  - d. Connect the LO SENSE 4W RTD  $\Omega$  jack of the 525A sense input to the low side of the sense output of the 5520A.
7. Set the 5520A to source 50  $\Omega$ .
8. Using the two channels on the DMM, calculate the actual value of the 5520A's output. This is done by using the ratio of a known standard to the output of the 5520A. The 1281 can be used to calculate the ratio or proceed as follows.

$$\text{Ratio} = A/B$$

$$RA = RS/\text{Ratio}$$

Where:

A = The reading taken from channel A on the DMM.

B = The reading taken from channel B on the DMM.

RS = The value of the resistance standard (in this case 10K).

RA = The actual output of the 5520A.

9. After the actual output value is entered, the PC displays the following:

Input ~100 Ohms, Enter the actual value when stable:

10. Set the 5520A to source 100  $\Omega$  (nominal) and enter the actual value calculated as described above.

After entering the value, the calibration constants will be saved and the display returns to the main Calibration Menu.

### 11: TC SOURCE, Adjusting TC mVolt Source

The adjust of the TC Source output range is similar to the first part of the voltage source calibration, the 525A outputs two Adjust points, after the output becomes stable the values can be entered at the PC. Refer to Table 22 for a list of equipment used in this section.

**Table 22. List of Test Equipment for Adjusting TC Source**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test lead set
Wavetek	1281	DMM

1. Use a copper TC mini-plug cable with low thermal EMF jacks on the other end to connect the Calibrator to the DMM. Make certain the polarity is correct. Set the DMM to read DC Volts.
2. Type 11 and press the Enter key on the PC. The following is displayed on the PC:
 

First Calibration Point. Enter the Volts displayed:
3. When the reading displayed on the DMM stabilizes, type the reading value on the PC and press the Enter key. After the value has been entered, the following is displayed on the PC.
 

Second Calibration Point. Enter the Volts displayed:
4. When the reading displayed on the DMM stabilizes, type the reading value on the PC and press the Enter key.

After the calibration constants are saved, the Calibration Menu is displayed on the PC.

### 12: TC Read, Adjusting TC mVolt Measure

The adjust of the TC Source output range is similar to the first part of the voltage source calibration, the Calibrator outputs 2 adjustment points, after the output stabilizes, the values can be entered from PC. Refer to Table 23 for a list of equipment used in this section.

**Table 23. List of Test Equipment for Adjusting TC Read**

Manufacturer	Model	Equipment
Fluke	FLUKE-525A/LEADS	Test lead set
Wavetek	1281	DMM

Use a copper TC mini-plug cable with low thermal EMF jacks on the other end to connect the 525A to the DMM. Make certain the polarity is correct.

1. Set the DMM to read DC Volts.
2. Type 12 and press the Enter key on the PC. The following is displayed on the PC:  

```
Adjust to -10 mV, 8 for up 2 for down, Press Enter When Stable
```
3. In the 10 key section of the PC keyboard, use the 8 (up arrow) to increase the output voltage displayed or 2 (down arrow) to decrease the output voltage displayed. Keep in mind the lag time between a change in output voltage to a stable display on the DMM and make small changes. Wait for the reading to stabilize.
4. Adjust the output so that there is a stable -10 mV reading. When satisfied with the reading, press the Enter key on the PC. The PC display will show:  

```
Please Wait...  
-1073806
```

```
Adjust to 15 mV, 8 for up 2 for down, Press Enter When Stable
```
5. The value is the raw A/D counts for this calibration point, followed by a prompt to adjust for 15 mV. Use the 8 (up) and 2 (down) key on the PC to adjust the output so that a reading very close to 15 mV is obtained.
6. When satisfied with the reading, press the Enter key. The PC display shows:  

```
Please Wait...  
1610975
```

```
Adjust to 40 mV, 8 for up 2 for down, Press Enter When Stable
```
7. The value is the raw A/D counts for this calibration point, followed by a prompt to adjust for 40 mV. Use the 8 (up) and 2 (down) key on the PC to adjust the output so that a reading very close to 40 mV is obtained.
8. When satisfied with the reading, press the Enter key. The PC display shows:  

```
Please Wait...  
4295762
```

```
Adjust to 65 mV, 8 for up 2 for down, Press Enter When Stable
```
9. The value is the raw A/D counts for this calibration point, followed by a prompt to adjust for 65 mV. Use the 8 (up) and 2 (down) key on the PC to adjust the output so that a reading very close to 65 mV is obtained.
10. When satisfied with the reading, press {enter}. The PC display will show:  

```
Please Wait...  
6980475
```

```
Adjust to 75 mV, 8 for up 2 for down, Press Enter When Stable
```
11. The value is the raw A/D counts for this calibration point, followed by a prompt to adjust for 75 mV. Use the 8 (up) and 2 (down) key on the PC to adjust the output so

that a reading very close to 75 mV is obtained. When satisfied with the reading, press the Enter key. The PC display will show:

```
Please Wait...
8054372
```

12. After the raw A/D counts are displayed, the calibration step is complete. The calibration constants for the range have been saved. Press the Enter key to return to the Calibration Menu.

### 13: TC CJC, Adjusting TC Cold Junction Temperature

The Calibration of the TC CJC (cold junction compensation) is a critical part of the calibration adjustment process. It is important that the thermocouple junction be allowed to completely stabilize. Refer to Table 24 for a list of equipment used in this section.

**Table 24. List of Test Equipment for Adjusting TC CJC**

Manufacturer	Model	Equipment
Hart Scientific	1521	Precision Thermometer
Omega		J Thermocouple Probe
–	–	Lag Bath
–	–	RTD Probe

The precision thermometer's probe should already be in the lag bath along with the J thermocouple probe.

1. Plug the mini-plug on the J thermocouple probe into the TC jack on the Calibrator.
2. Type 12 and press the Enter key on the PC. The following is displayed on the PC:

```
Input a Type J Thermocouple. Enter temperature when stable.
```

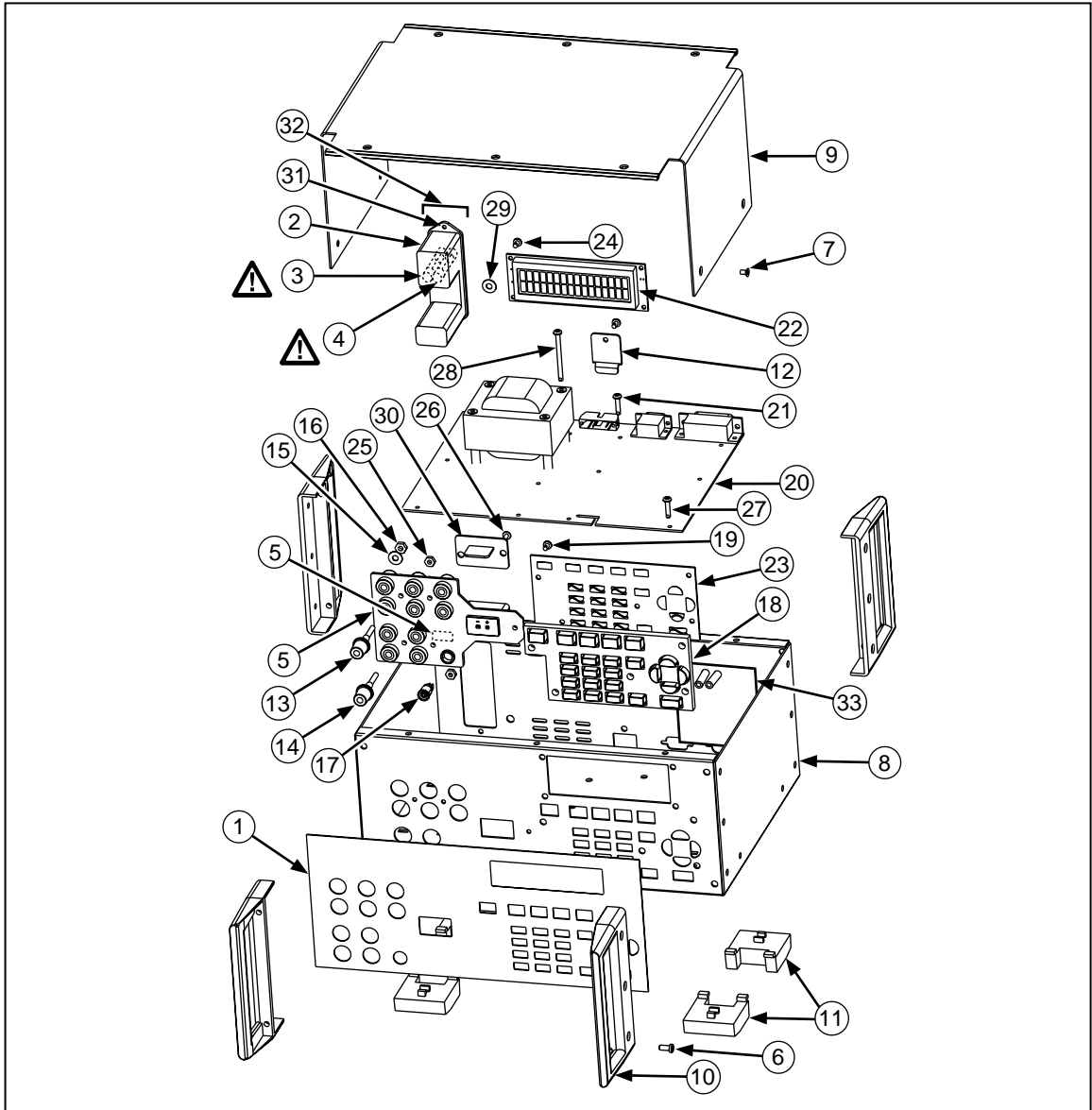
3. Allow about three minutes for all of the thermal junctions to stabilize.
4. Enter the temperature from the temperature reference. The final display should look like the following.

```
Input a Type J Thermocouple. Enter temperature when stable. 377376 26.699269
1103.936911
1124.668121
0.000000
-20.731080
26.698029
```

5. Press the Enter key to return to the Calibration Menu.

## **Customer Replaceable Parts**

Replacement parts are shown in Figure 14. Table 25 provides a description and part number of each replacement part. Table 26 lists optional accessories.



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Figure 14. Exploded View of the 525A

**Table 25. Replacement Parts**

Item #	Part Number	Description	Location	Quantity
1	1601576	525A Front Panel Decal	Front Of Top Chassis	1
2	1617918	Fuse Drawer	Power Module	1
△3	1645311	Fuse, (1/4A), FB For 1x0 VAC	Fuse Drawer	2
△4	1645327	Fuse, (1/8A), FB For 2x0 VAC	Fuse Drawer	2
5	1601601	525A Output Block	Front Plate	1
6	295105	Allen Head Screw	Handles To Case	20
7	320093	Flathead Screw	Top Cover	10
8	1601583	525A Chassis Base		1
9	1601590	525A Instrument Top Cover		1
10	886341	Chassis Handles	Front/Rear Chassis	4
11	868786	Plastic Feet	Bottom of Chassis	4
12	1601078	Programming Door	Back of Chassis Base	1
13	886382	Red 5-Way Binding Post	Output Block	5
14	886379	Black 5-Way Binding Post	Output Block	5
15	859939	#8 Washer, Low Thermal	Output Block	10
16	850334	8-32 Nut, Low Thermal	Output Block	10
17	942714	Pressure Conn, Circ, 5 Socket	Output Block	1
18	1601565	525A Keypad	Front Of Top Chassis	1
20	1618591	Main PCA		1
20*	1642173	PEP Main PCA		1
22	1617941	Display PCA		1
23	1618617	Keypad PCA		1
24	1640190	6-32 X 3/8" Screw, Nylon, Pan,	Display To Chassis	4
25	1640305	Nylock Nut 6-32	Block To Chassis	5
25	1640305	Nylock Nut 6-32	Power Module to Chassis	2
26	494641	5-20 X .312, Screw	TC PCA To Output Block	2
27	110338	#6, Int Tooth Lock Washer	Main PCA To Chassis	6
27	152181	6-32 X 5/8" Screw, Round	Main PCA To Chassis	6
28	1640225	6-32 X 2-1/2" Screw, Ph	Transformer To Chassis	4
29	1640202	#6 Nylon Washer	Display PCA To Chassis	4
29	1640202	#6 Nylon Washer	Transformer	4
30	1618600	TC PCA		1

Table 25. Replacement Parts (continued)

Item #	Part Number	Description	Location	Quantity
31	1617929	Power Module	Back Of Chassis	1
32	1617907	Voltage Selector	Power Module	1
33	1638939	Opto RS232 PCA	Back of Chassis	1
Not shown	271973	.1uf/250V Cap., Polyester	Output Block	1
Not shown	1617866	14 Cond Ribbon Cable	J4 To Display	1
Not shown	1617882	5 Cond Ribbon Cable	Lemo PCA To Main PCA	1
Not shown	1627364	12 Cond Ribbon Cable	J11 To Keypad PCA	1
34	1640331	Pressure-Lemo PCB	Lemo Connector	1
Not shown	172080	Cable Tie, 4"		4
Not shown	1618621	Line Cord, 3 COND		1
Not shown	110338	#6, Int Tooth Lock Washer	Keypad PCA to Chassis	5
Not shown	152165	#6 X 3/8" Screw, PH	Keypad PCA to Chassis	5
Not shown	152165	#6 X 3/8" Screw, PH	Power Module to Chassis	2
Not shown	152165	#6 X 3/8" Screw, PH	Program Door to Chassis	1
Not shown	721266	Lug, Closed, Round, #8 Stud	Output Block	11
Not shown	110619	1/4"-28 Nut	Ground Lug Stud	2
Not shown	448092	Jack Screw RS232 Conn	9 Pin D-Sub	1
Not shown	110338	1/4" Int Tooth Lock Washer	Binding Post Stud	2
Not shown	102889	Binding Head Thumbscrew	Binding Post Stud	1
Not shown	102707	Binding Post Jack	Chassis Back	1
Not shown	1601541	525A Getting Started Guide		1
Not shown	1601552	525A User Manual (on CD)		1
<p>⚠ For safety, use exact replacement only.</p> <p>* PEP is an exchange of a repairable assembly for a factory repaired one.</p>				

Table 26. Accessories

Description	Part Number
Fluke 525A/LEAD, Lead wire set	1616018
Fluke Y525 Rack Mount Kit	1622027
RS43, RS232 Null Modem Cable	946470
525A Service Manual	1644492