

# Model PAXLI - PAX Lite Current Meters & Model PAXLV - PAX Lite Voltmeters



- FOUR MULTI-RANGE UNITS COVER:  
199.9  $\mu$ A to 1.999 A \*, 199.9 mV (AC or DC)  
1.999 V to 300 V (AC or DC)
- 3 1/2-DIGIT, 0.56" (14.2 mm) HIGH RED LED DISPLAY W/ POLARITY
- BUILT-IN SCALING PROVISIONS
- SELECTABLE DECIMAL POINT LOCATION
- AUTO ZEROING CIRCUITS
- OVER-RANGE INDICATION
- NEMA 4X/IP65 SEALED FRONT BEZEL
- OPTIONAL CUSTOM UNITS OVERLAY W/BACKLIGHT

\* Accessory Shunts Available For Higher Current Ranges.

## GENERAL DESCRIPTION

PAX Lite Current and Volt Meters are premium quality instruments designed for tough industrial applications. With multi-range capability, built-in provision for scaling, and DIP switch selectable decimal points, these meters offer the ultimate in application flexibility. Four models cover your voltage and current indicator needs. The meter can provide direct readout from pressure, speed or flow transducers, or any other variable that can be translated to voltage or current. The built-in scaling allows the display to be scaled to the desired engineering unit.

The 3 1/2 -digit bi-polar display (minus sign displayed when current or voltage is negative) features a 0.56" high, 7-segment LEDs for easy reading. The meter is also available with custom units label capability. Using the PAX label kit (PAXLBK30), the selected label is installed behind the panel, keeping it safe from washdown or other environmental conditions. A DIP switch is used to control the backlight for the units label.

The meters have a NEMA 4X/IP65 sealed bezel and extensive testing of noise effects to CE requirements, allowing the meter to provide a tough yet reliable application solution

## SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

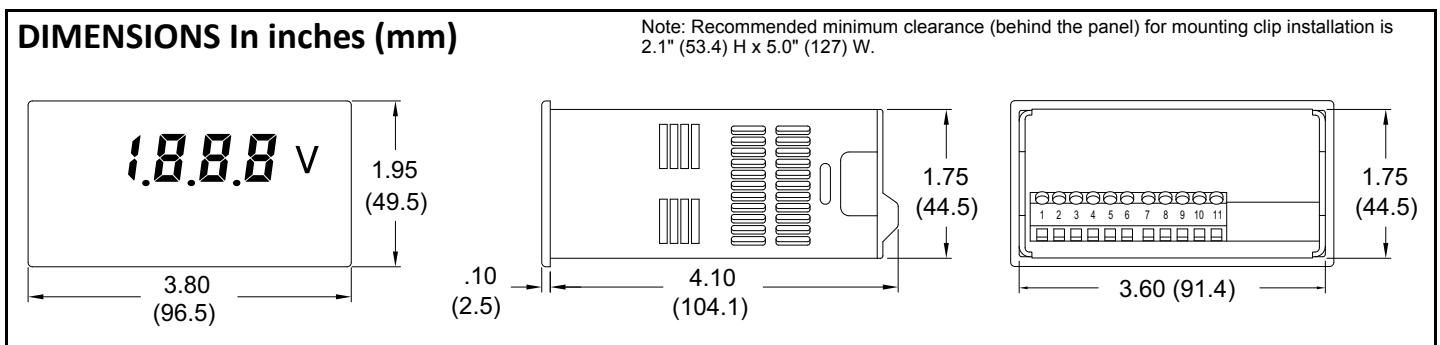
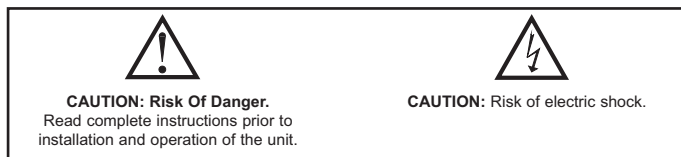
## DEFINITION OF TERMS

### INSTALLATION CATEGORY (overvoltage category) I, (CAT I):

Signal level, special equipment or parts of equipment, telecommunication, electronic, etc. with smaller transient overvoltages than Installation Category (overvoltage category) II. (See IEC 664 & IEC 61010)

### INSTALLATION CATEGORY (overvoltage category) II, (CAT II):

Local level, appliances, portable equipment, etc. with smaller transient overvoltages than Installation Category (overvoltage category) III. (See IEC 664 & IEC 61010)

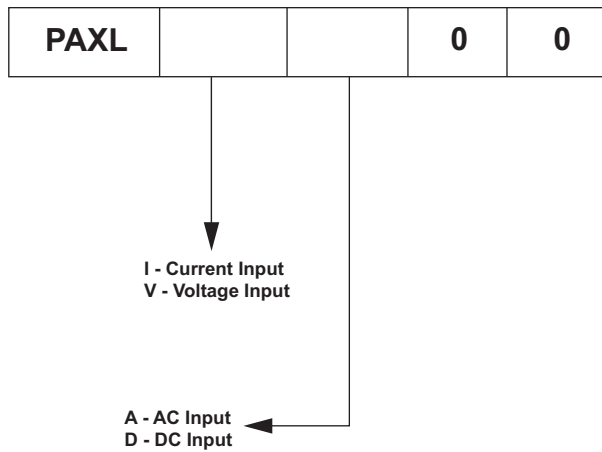


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## ORDERING INFORMATION

### Meter Part Numbers



### Accessories Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAXLBK	Units Label Kit Accessory	PAXLBK30
APSCM	10 Amp DC Current Shunt	APSCM010
	100 Amp DC Current Shunt	APSCM100

## GENERAL METER SPECIFICATIONS

- DISPLAY:** 3 1/2-digit, 0.56" (14.2 mm) high, 7-segment red LED, (-) minus sign displayed when current or voltage is negative. Decimal points inserted before 1st, 2nd, or 3rd least significant digits by DIP switch selection.
- POWER:** 115/230 VAC, switch selectable. Allowable power line variation  $\pm 10\%$ , 50/60 Hz, 6 VA.  
**Isolation:** 2300 Vrms for 1 min. between input and supply  
**Working Voltage:** 300 V max., CAT II
- INPUT RANGE/RESOLUTION:** (Selectable by jumper connections.):  
Input Impedance:  
**Voltage:** All ranges 1M $\Omega$   
**Current:**

199.9 $\mu$ A	1000.1 K $\Omega$
1.999 mA	100.1 $\Omega$
19.99 mA	10.1 $\Omega$
199.9 mA	1.1 $\Omega$
1.999 A	0.1 $\Omega$

  
**Working Voltage:** 300 V max., CAT II
- ACCURACY:**  
**AC Voltmeters:**  $\pm(0.1\%$  of Reading + 3 digits) (45-500 Hz)  
**AC Current Meters (45-500 Hz):**  
**199.9  $\mu$ A/199.9 mV, 1.999 mA, 19.99 mA:**  $\pm(0.1\%$  of Reading + 3 digits)  
**199.9 mA:**  $\pm(0.15\%$  of Reading + 3 digits)  
**1 A:**  $\pm(0.5\%$  of Reading + 3 digits)  
**DC Voltmeters:**  $\pm(0.1\%$  of Reading + 1 digit)  
**DC Current Meters:**  
**199.9  $\mu$ A/199.9 mV, 1.999 mA, 19.99 mA:**  $\pm(0.1\%$  of Reading + 1 digit)  
**199.9 mA:**  $\pm(0.15\%$  of Reading + 1 digit)  
**1.999 A:**  $\pm(0.5\%$  of Reading + 1 digit)  
*Note: Any individual range may be recalibrated (scaled) to 0.1% accuracy with appropriate calibration equipment.*
- OVER-RANGE INDICATION:** on all modes is indicated by blanking 3 least significant digits.
- MAX. VOLTAGE ON LOWEST INPUT RANGE:** 75 VAC or DC (Both voltmeters and current meters).
- MAX. VOLTAGE ON TERMINAL BLOCK:** 300 VAC or DC (Both voltmeters and current meters).
- MAX. CURRENTS (FOR CURRENT METERS):**  
**199.9  $\mu$ A through 19.99 mA:** 10 times max. range current  
**199.9 mA:** 1 A  
**1.999 A:** 3 A  
*Caution: In circuits where fault currents can exceed the maximum shunt current, a fast-blow fuse should be installed in series with the input signal. Otherwise, a slow blow 10 amp fuse is recommended that will allow for start-up over current situations, while still protecting the instrument.*
- TEMPERATURE COEFFICIENTS:**

Current meters	Voltmeters
DC: $\pm 100$ PPM/ $^{\circ}$ C	DC: $\pm 75$ PPM/ $^{\circ}$ C
AC: $\pm 200$ PPM/ $^{\circ}$ C	AC: $\pm 150$ PPM/ $^{\circ}$ C
- ENVIRONMENTAL CONDITIONS:**  
**Operating Temperature:** 0 $^{\circ}$  to 60  $^{\circ}$ C  
**Storage Temperature:** -40 $^{\circ}$  to 80  $^{\circ}$ C  
**Operating and Storage Humidity:** 85% max. relative humidity (non-condensing)  
**Vibration to IEC 68-2-6:** Operational 5 to 150 Hz, 2 g.  
**Shock to IEC 68-2-27:** Operational 30 g.  
**Altitude:** Up to 2000 meters
- RESPONSE TIME TO STEP CHANGE INPUT:** 1 sec. nominal
- READING RATE:** 2.5 readings/sec., nominal
- NORMAL MODE REJECTION:** 50 dB 50/60 Hz (DC units only)
- COMMON MODE REJECTION:** 110 dB DC or 50/60 Hz (DC units only)
- COMMON MODE VOLTAGE (COMM. TO EARTH):** 350 volt peak
- CERTIFICATIONS AND COMPLIANCES:**  
**CE Approved**  
EN 61326-1 Immunity to Industrial Locations  
Emission CISPR 11 Class B  
Safety requirements for electrical equipment for measurement, control, and laboratory use:  
EN 61010-1: General Requirements  
EN 61010-2-030: Particular Requirements for Testing and Measuring Circuits  
RoHS Compliant  
UL Listed: File #E137808  
Type 4X Enclosure rating (Face only)  
IP65 Enclosure rating (Face only)  
IP20 Enclosure rating (Rear of unit)
- CONNECTIONS:** High compression cage-clamp terminal block  
Wire Strip Length: 0.3" (7.5 mm)  
Wire Gage: 30-14 AWG copper wire  
Torque: 4.5 inch-lbs (0.51 N-m) max.
- CONSTRUCTION:** This unit is rated for Type 4X/IP65 outdoor use. Installation Category II, Pollution Degree 2. One piece bezel/case. Flame resistant. Panel gasket and mounting clip included.
- WEIGHT:** 0.65 lbs. (0.24 Kg)

## ACCESSORIES

### UNITS LABEL KIT (PAXLBK)

Each meter has a units indicator with backlighting that can be customized using the Units Label Kit. The backlight is controlled by a DIP switch.

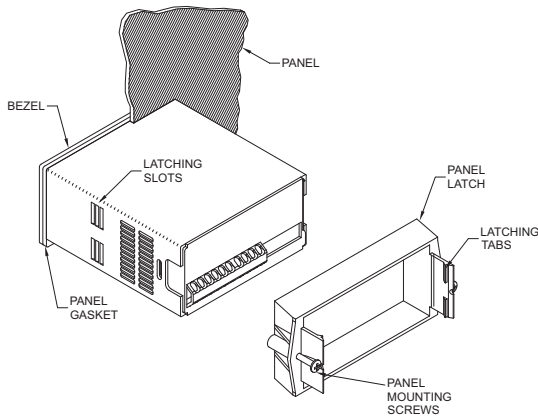
### EXTERNAL CURRENT SHUNTS (APSCM)

To measure DC current signals greater than 2 ADC, a shunt must be used. The APSCM010 current shunt converts a maximum 10 ADC signal into 100.0 mV. The APSCM100 current shunt converts a maximum 100 ADC signal into 100.0 mV. The continuous current through the shunt is limited to 115% of the rating.

# 1.0 INSTALLING THE METER

## INSTALLATION

The PAX meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.



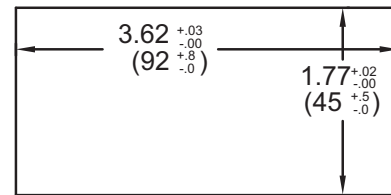
While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.

## INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

### PANEL CUT-OUT



# 2.0 SETTING THE JUMPERS AND SWITCHES

The meter has an input jumper and switches, which must be checked and/or changed prior to applying power. To access the input jumper and switches, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

### Power Selection Switch



Caution: Insure the AC power selection switch is set for the proper voltage before powering the meter. The meter is shipped from the factory in the 230 VAC position.

### Input Range Jumper

A jumper is used for selection of the voltage or current input range. Select the proper input range that will be high enough to avoid input signal overload. It is important that only one jumper position is used at a time. Avoid placing a jumper across two different input ranges.

### Set-Up DIP Switches

A DIP switch is located inside the meter. It is used for the selection of decimal points, backlight annunciator, and scaling. Selecting the "ON" position enables the function.

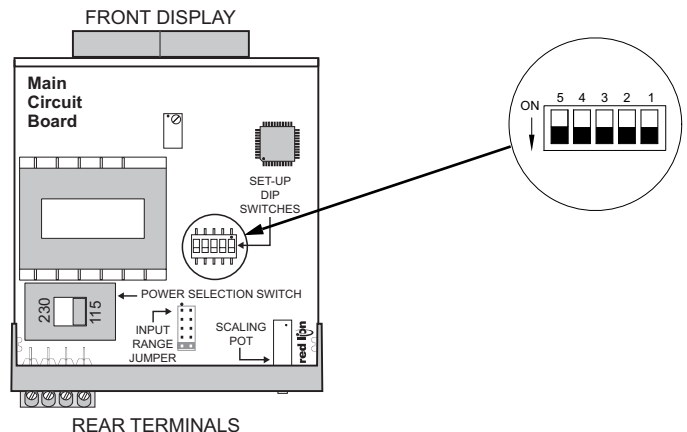
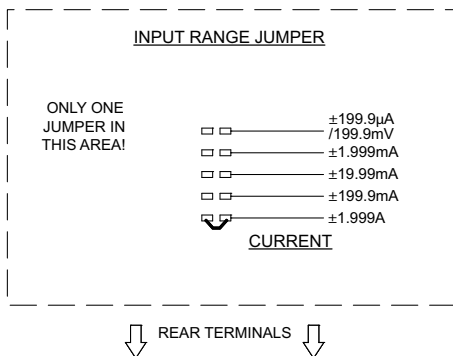
SWITCH	FUNCTION
1	Decimal Point 1 (000.0)
2	Decimal Point 2 (00.00)
3	Decimal Point 3 (0.000)
4	Backlight Annunciator for Units Label
5	Enables the Scaling Pot

\* Turn scaling pot fully clockwise (25 turns max.) when scaling is disabled. Factory setting is the fully clockwise position.

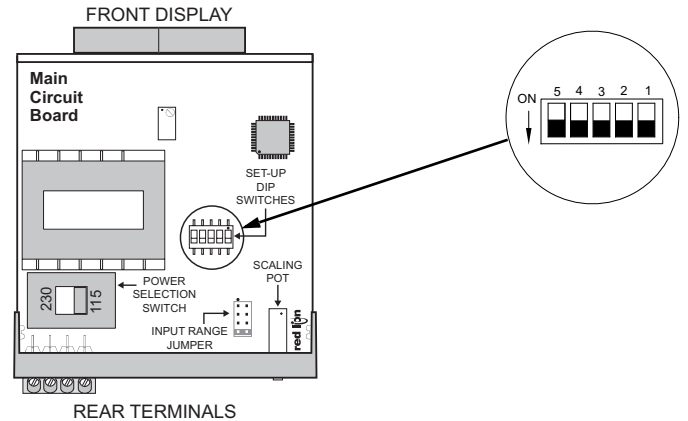
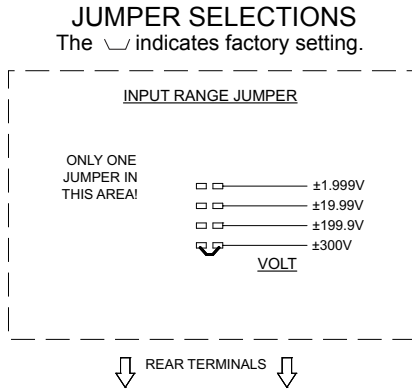
## PAXLI Jumper Selection

### JUMPER SELECTIONS

The  indicates factory setting.



## PAXLV Jumper Selection



## 3.0 WIRING THE METER

### WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the meter (AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure. (Pull wire to verify tightness.)

### EMC INSTALLATION GUIDELINES

Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
  - a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
  - b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.

4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:

Fair-Rite part number 0443167251 (RLC part number FCOR0000)

Line Filters for input power cables:

Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)

6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
  - a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
  - b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.

RLC part numbers: Snubber: SNUB0000

Varistor: ILS11500 or ILS23000

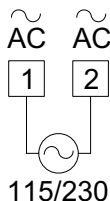
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

Visit RLC's web site at <http://www.redlion.net/emi> for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

### 3.1 POWER WIRING

#### AC Power

Terminal 1: VAC  
Terminal 2: VAC

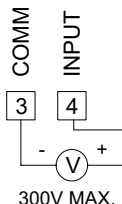


### 3.2 INPUT SIGNAL WIRING

Before connecting signal wires, the Input Range Jumper should be verified for proper position.

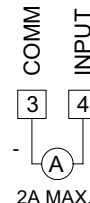
#### PAXLV Voltage Signal (self powered)

Terminal 4: + Volts DC/AC  
Terminal 3: - Volts DC/AC



#### PAXLI Current Signal (self powered)

Terminal 4: + Amps DC/AC  
Terminal 3: - Amps DC/AC



## 4.0 SCALING THE METER

### PAXLV

#### DIRECT VOLTMETER READOUT

When the application requires direct voltmeter readout, the Scale Switch should be set in the "OFF" position and the Input Range Jumper set to the voltage range being applied. To reduce display resolution, the jumper can be set to a higher range than the input range being applied. Set the Decimal Point switches according to the resolution of the selected Input Range.

#### SCALING VOLTMETER READOUT

In many industrial applications, a voltmeter is required to display a reading in terms of PSI, RPM, or some other unit of measure. The voltage signal being measured can be generated by a transducer that senses the variations and delivers a linear output voltage. To provide the desired readout at the specified voltage, the voltmeter must be scaled.

Place the Scale Switch in the "ON" position. This enables the Scale Potentiometer which is accessible from the back of the meter. (Enabling the Scale Potentiometer does NOT affect the calibration of the meter.) Place the Decimal Point Switches to the proper location. To properly set the Input Range Jumper, the Division Factor must be determined by first using the below formula. After the Division Factor is calculated, use the Division Factor Range Selection Chart to choose the proper Input Range Jumper setting. Apply the meter power and the voltage signal. Adjust the Scale Potentiometer to the desired value.

This scaling only effects the span. There is no offset scaling. This means that only zero voltage input can produce a display value of zero.

DIVISION FACTOR FORMULA:

$$\frac{VT \times D.D.P.}{D.R.} = D.F.$$

#### WHERE:

- VT = Maximum Transducer Output
- D.D.P. = Display Decimal Point
- D.F. = Division Factor
- D.R. = Desired Reading (without regard for decimal point)  
Display of x.xxx = D.R. of xxxx

#### D.D.P.

- 0.000 = 1 The Display Decimal Point (D.D.P.) is determined by the desired decimal point placement in the readout.
- 00.00 = 10
- 000.0 = 100
- 0000 = 1000

After the Division Factor for the application has been calculated, the

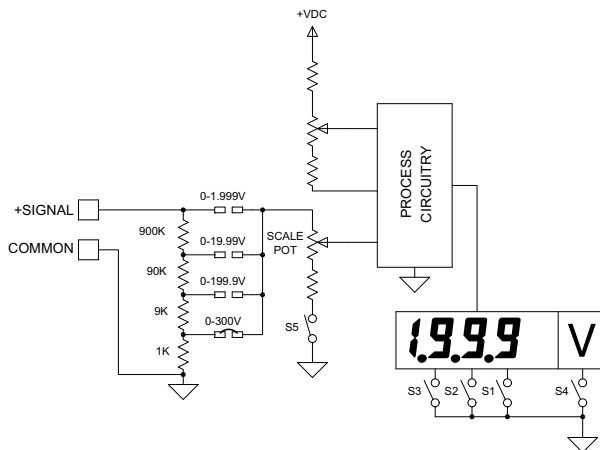
proper voltage range jumper can be selected. Use the "Division Factor Range Selection Chart" to choose the proper jumper setting.

#### DIVISION FACTOR RANGE SELECTION CHART

D.F.	Use Input Position
0.1 to 1.2	Pos 1: 0-1.999 VDC
1.2 to 10.5	Pos 2: 0-19.99
10.5 to 100.5	Pos 3: 0-199.9
100.5 to 1300	Pos 4: 0-300

Note: Only one voltage jumper should be selected. Install the jumper before the voltage signal is applied.

#### BLOCK DIAGRAM PAXLV



EXAMPLE: A relative humidity transducer delivers a 7.0 VDC voltage at a relative humidity of 75%.

$$D.F. = \frac{VT \times D.D.P.}{D.R.} = \frac{7.0 \times 1000}{75} = 93.3$$

This Division Factor is between 10.5 and 100.5, therefore jumper position 3 (199.9 V) is selected. The Scaling Potentiometer is then adjusted for the desired readout at a known relative humidity.

**DIRECT CURRENT METER READOUT**

When the application requires direct current meter readout, the Scale Switch should be set in the "OFF" position and the Input Range Jumper set to the current range being applied. To reduce display resolution, the jumper can be set to a higher range than the input range being applied. Set the Decimal Point switches according to the resolution of the selected Input Range.

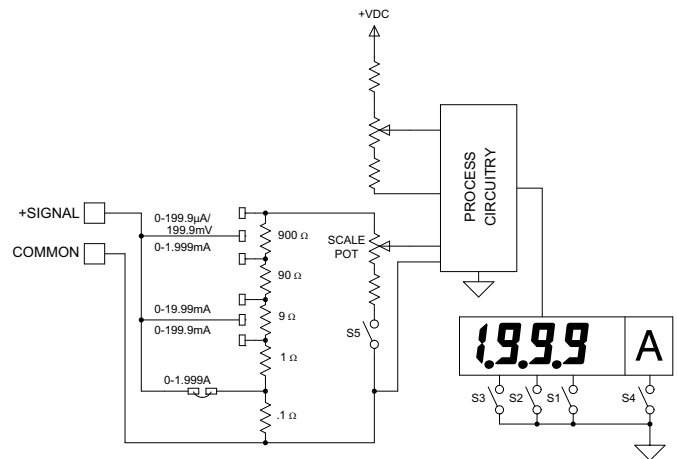
**SCALING CURRENT METER READOUT**

In many industrial applications, a current meter is required to display a reading in terms of PSI, RPM, or some other unit of measure. The current signal being measured can be generated by a transducer that senses the variations and delivers a linear output current. To provide the desired readout at the specified current, the current meter must be scaled.

Place the Scale Switch in the "ON" position. This enables the Scale Potentiometer which is accessible from the back of the meter. (Enabling the Scale Potentiometer does NOT affect the calibration of the meter.) Place the Decimal Point Switches to the proper location. The Input Range Jumper is set to the current range being applied. Apply the meter power and the current signal. Adjust the Scale Potentiometer to the desired value. Scaling to obtain a numerical readout higher than the normal value of the current can also be accomplished, in most cases, by selecting a lower current range. However, the maximum current for the range must not be exceeded. (See Specifications for maximum input currents.)

This scaling only effects the span. There is no offset scaling. This means that only zero current input can produce a display value of zero.

**BLOCK DIAGRAM PAXLI**



**EXAMPLE:** The PAX Current Meter has been connected to measure a circuit current to 120.0 mA maximum. However, in this application, the display is to indicate percent of load current with 120.0 mA equivalent to 100.0 percent. The scale potentiometer is adjusted to reduce the normal 120.0 mA signal input display reading of 120.0 to indicate the desired reading of 100.0 on the display. Scaling to obtain a numerical readout higher than the normal value of the current can also be accomplished in most cases by selecting a lower current range. However, the maximum current for the range must not be exceeded. (See Specifications for maximum input currents.)

**5.0 TROUBLESHOOTING**

PROBLEM	REMEDIES
NO DISPLAY	<b>CHECK:</b> Power switch and line voltage
INCORRECT DISPLAY	<b>CHECK:</b> Input jumper position <b>CHECK:</b> Scaling adjustment pot DIP switch position <b>ADJUST:</b> Scaling pot <b>VERIFY:</b> Input Signal
OVER-RANGE INDICATION	<b>CHECK:</b> Input jumper position <b>VERIFY:</b> Input signal

**6.0 CALIBRATION**

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed by enabling the scale pot DIP switch. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter.

When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment.

**Input Calibration**



**WARNING:** Calibration of this meter requires a signal source with an accuracy of 0.01% or better and an external meter with an accuracy of 0.005% or better.

Before starting, verify that the Input Range Jumper is set for the range to be calibrated. Also verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter.

Then perform the following procedure:

1. Place jumper in 2 V range (PAXLV) or 2 mA range (PAXLI).
2. Set the DIP switch off to disable the scaling pot.
3. Apply half scale input signal.
4. Adjust calibration potentiometer as necessary for the display to read 1000 (ignore decimal point).
5. Apply zero signal and ensure display reads zero.
6. Apply full scale signal and ensure display reads 9999.

*Note: Any individual range may be recalibrated to 0.1% accuracy with appropriate calibration equipment.*