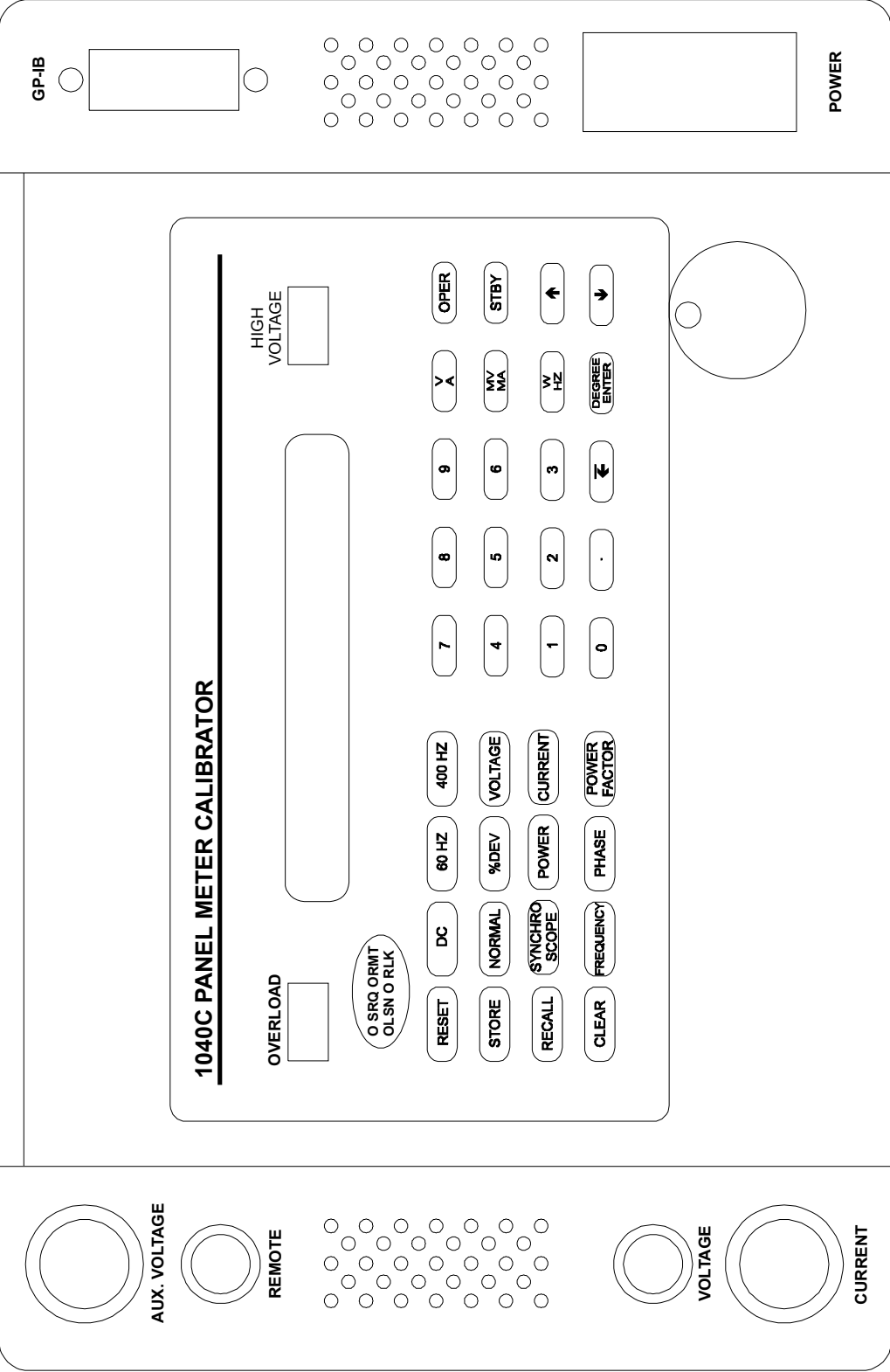
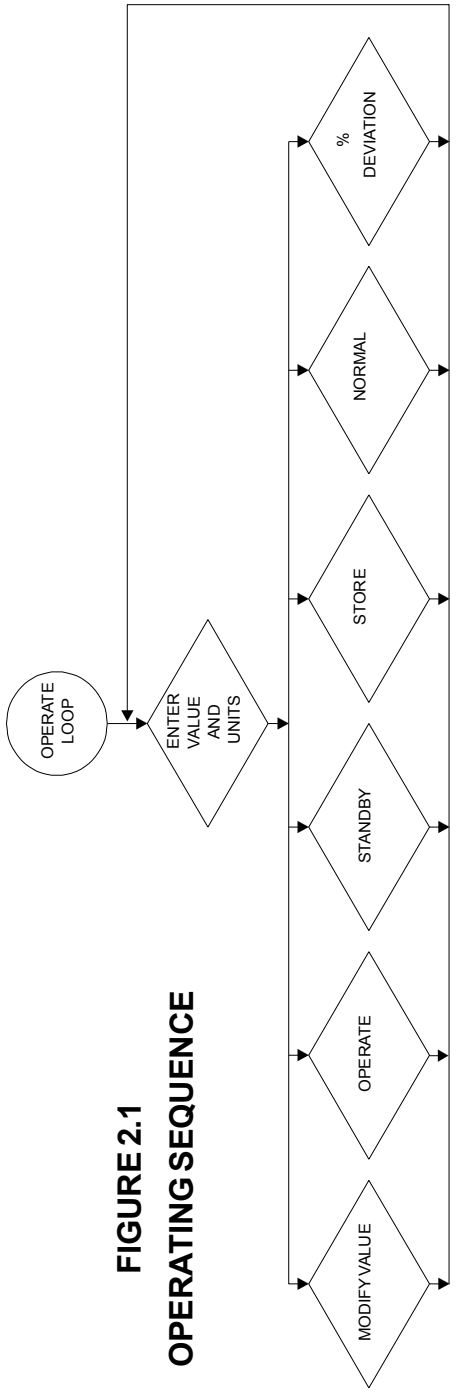
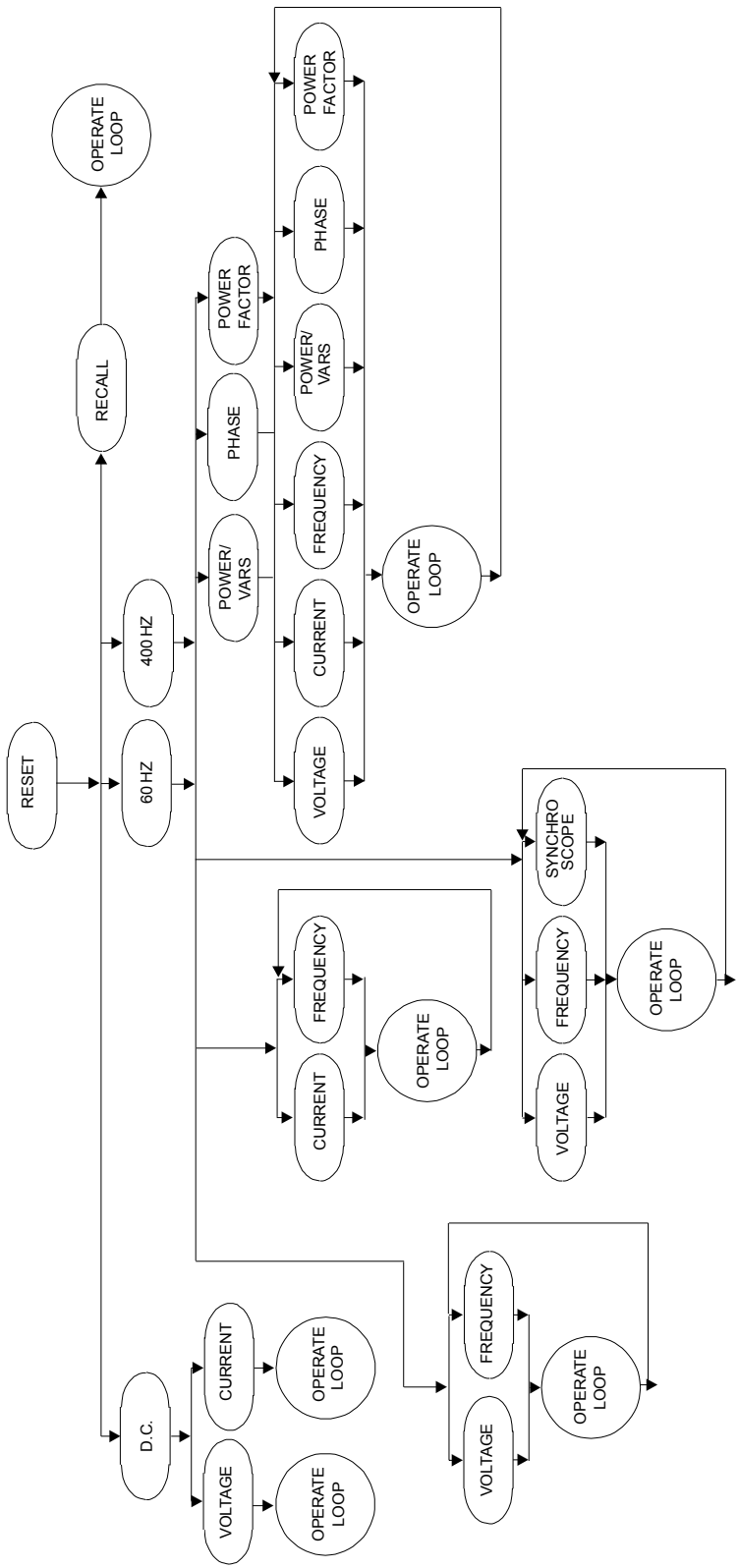


Training Manual
Arbiter Systems
Model 1040C
Panel Meter Calibrator

ARBITER SYSTEMS, INC.
PASO ROBLES, CALIFORNIA
U.S.A.

Overview





**FIGURE 2.1
OPERATING SEQUENCE**

1040C Lab Session

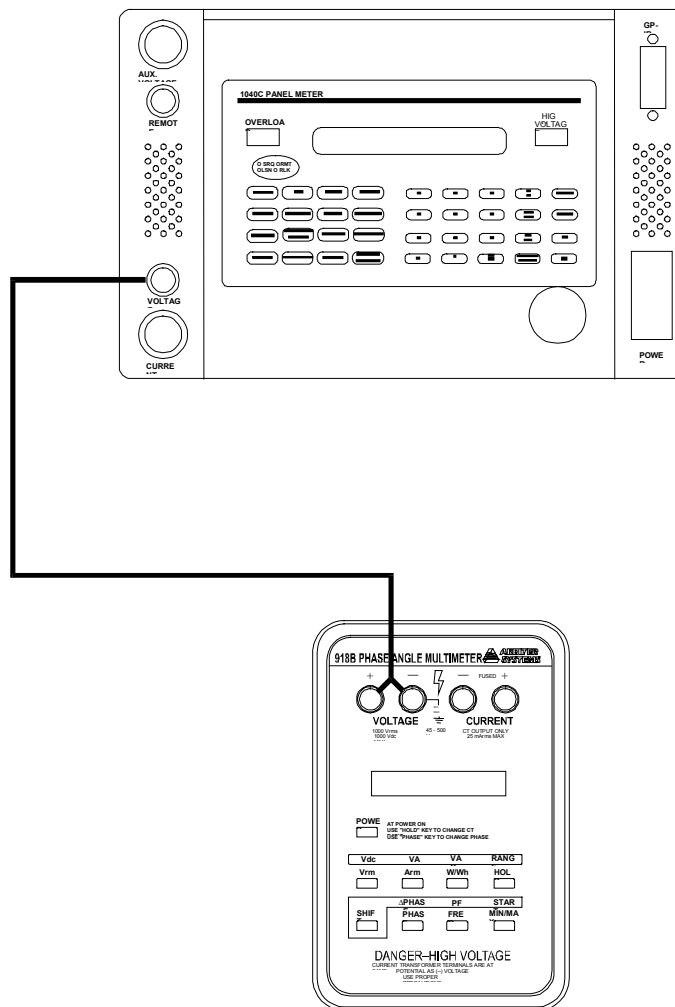
- ◆ **DC Voltage / Current**
- ◆ **AC Voltage / Current**
- ◆ **Power / VARS / PF**
- ◆ **% Deviation**
- ◆ **Store Recall**
- ◆ **Calibration**

DC Voltage Operating Procedure

CAUTION: Prior to making any connections, place the PMC in Standby Mode.

Connect the Model 918B to the PMC as shown below and perform the following steps:

1. Press DC.
2. Press VOLTAGE.
3. Enter the desired voltage using the keypad and the units key.
4. Press OPER.
5. MODIFY, MEMORY, or % DEV may be used.
6. To remove the output signal, press STBY when the measurement is complete.

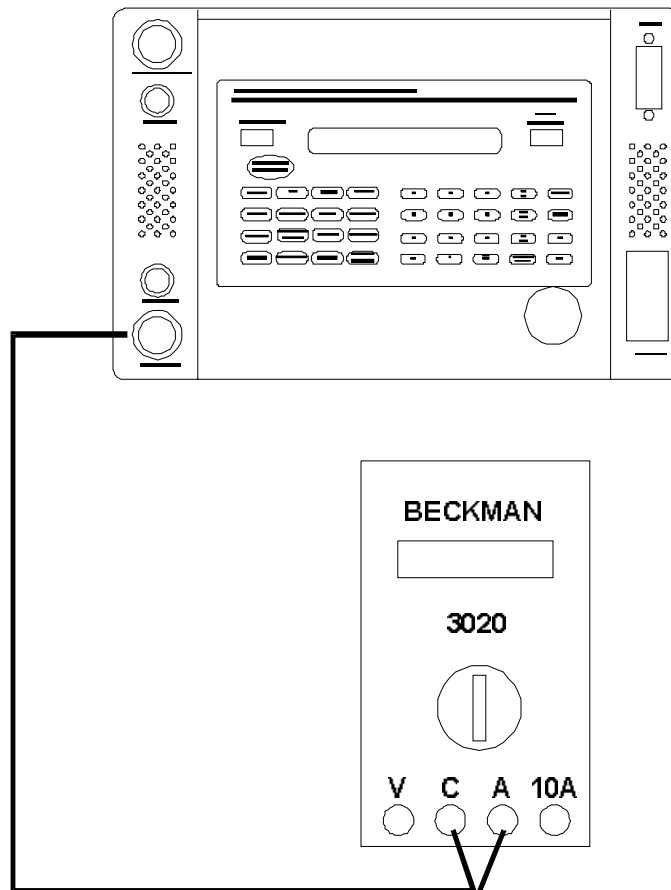


DC Current Operating Procedure

CAUTION: Prior to making any connections, place the PMC in Standby Mode.

Connect the Model 918B to the PMC as shown below and perform the following steps:

1. Press DC.
2. Press CURRENT.
3. Enter the desired current using the keypad and the units key.
4. Press OPER.
5. MODIFY, MEMORY, or % DEV may be used.
6. To remove the output signal, press STBY when the measurement is complete.

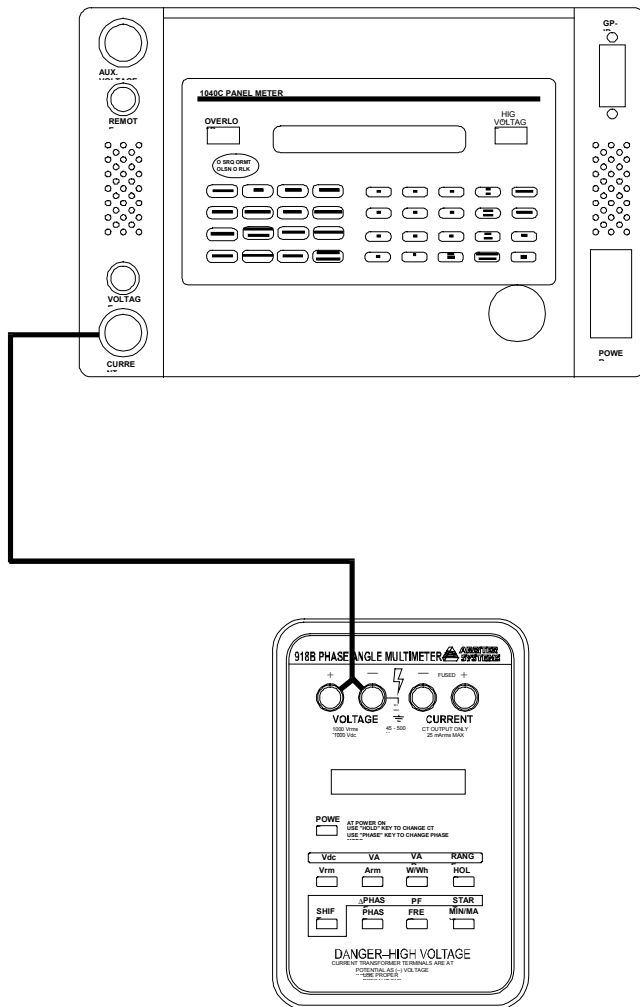


AC Voltage Operating Procedure

CAUTION: Prior to making any connections, place the PMC in Standby Mode.

Connect the Model 918B to the PMC as shown below and perform the following steps:

1. Press 60 or 400 HZ.
2. Press VOLTAGE.
3. Enter the desired voltage using the keypad and the units key.
4. Press OPER.
5. MODIFY, MEMORY, or % DEV may be used. The FREQUENCY or VOLTAGE may be modified.
6. To remove the output signal, press STBY when the measurement is complete.

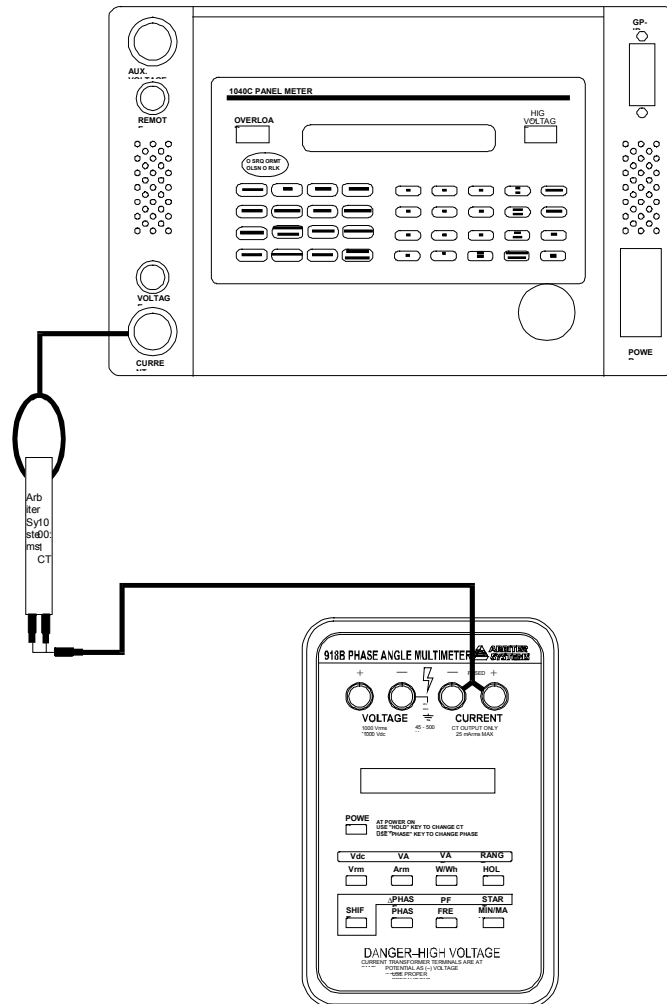


AC Current Operating Procedure

CAUTION: Prior to making any connections, place the PMC in Standby Mode.

Connect the Model 918B to the PMC as shown below and perform the following steps:

1. Press 60 or 400 HZ.
2. Press CURRENT.
3. Enter the desired current using the keypad and the units key.
4. Press OPER.
5. MODIFY, MEMORY, or % DEV may be used. The FREQUENCY or VOLTAGE may be modified.
6. To remove the output signal, press STBY when the measurement is complete.

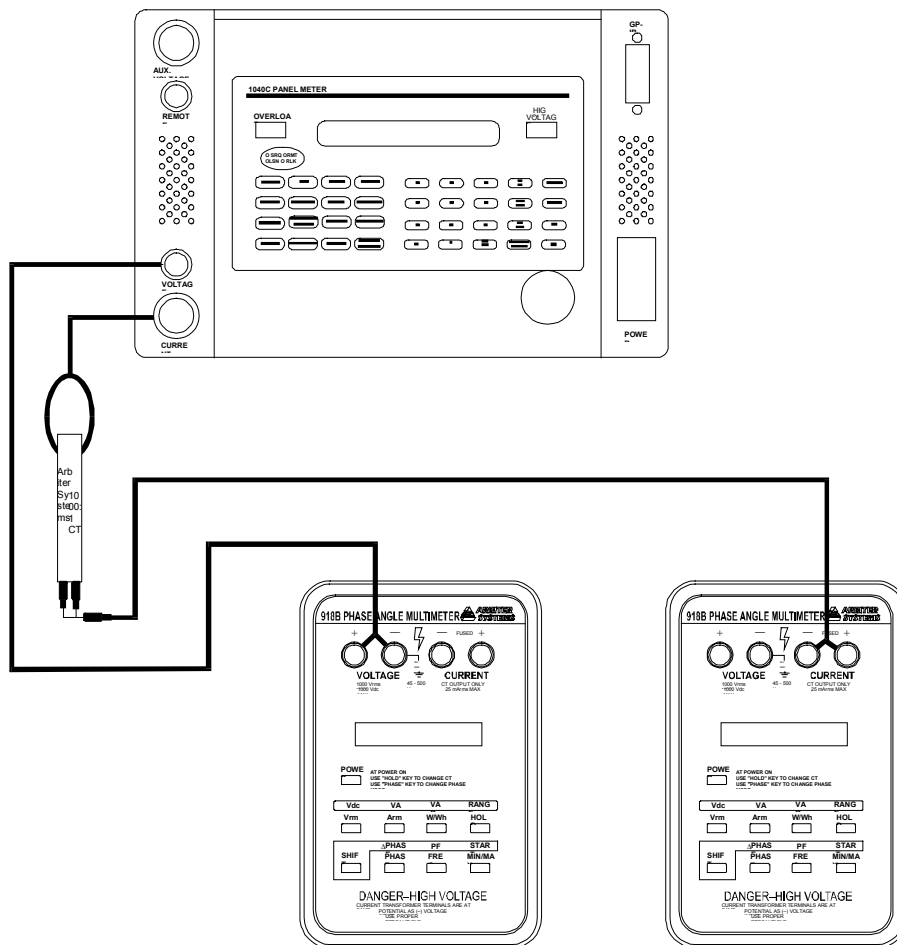


AC Power / VARS Operating Procedure

CAUTION: Prior to making any connections, place the PMC in Standby Mode.

Connect the Model 918B to the PMC as shown below and perform the following steps:

1. Press 60 or 400 HZ.
2. Press POWER.
3. Press VOLTAGE.
4. Enter the desired voltage using the keypad and the units key.
5. Press CURRENT.
6. Enter the desired current using the keypad and the units key.
7. Press POWER. The power calculated from the entered voltage, current, and phase values will be displayed. Press POWER again and VARS will be displayed. Note that modifying Power or VARS changes the current output while leaving the voltage and phase fixed.
8. Press OPER.
9. MODIFY, MEMORY, or % DEV may be used. POWER, VARS, CURRENT, VOLTAGE or FREQUENCY may be modified. Note that modifying Power changes the current output while leaving the voltage fixed.
10. To remove the output signal, press STBY when the measurement is complete.



Power Factor / Phase Operating Procedure

CAUTION: Prior to making any connections, place the PMC in Standby Mode. The following procedure employs initial output values of 120 volts and 5 amps at 60 Hz and 0°, 30° and 60° phase values. A full meter calibration would include other values.

The Phase Convention in the PMC is determined by the following equations:

Voltage: $V(t) = V_o \sin \omega t$

Current: $(t) = V_o \sin (\omega t + \Theta)$

Power: $V_{rms} I_{rms} \cos \Theta$

VARs: $V_{rms} I_{rms} \sin (-\Theta)$

Power Factor: $\cos \Theta$

Where: Θ = phase angle in degrees between voltage and current.

<u>Phase Angle</u>	<u>Sign of Power</u>	<u>Sign of VARs</u>	<u>Power Factor</u>
$0 < \Theta \leq 90$	+	-	Lead +
$90 < \Theta \leq 180$	-	-	Lead -
$-180 < \Theta \leq -90$	-	+	Lag -
$-90 < \Theta \leq 0$	+	+	Lag +

Turn-OFF the PMC and connect to the Model 931A System Analyzer as shown below and perform steps of Table 1:

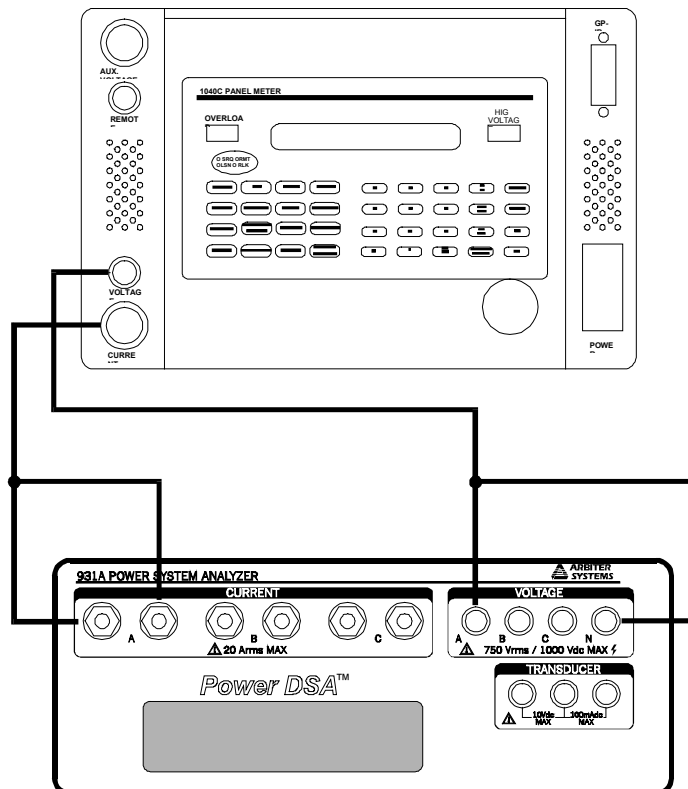


Table 1. Power Factor/Phase Operating Procedure

STEP	OPERATOR ACTION	RESULTS
1.	Apply power to PMC	After successful completion of Function Tests the PMC will momentarily display PASSED FUNCTION TEST. The PMC will return to RESET mode and display DC, 60 Hz, or 400 Hz? The RESET, STBY, and NORMAL LED's (and the STORE LED if user settings are presently stored in the user memory) will be illuminated.
2.	Press 60 HZ	RESET LED will extinguish, the 60 HZ and FREQUENCY LED's will illuminate. The PMC now displays FREQUENCY 60.00 Hz. (The Frequency may now be modified or a new value entered).
3.	Press POWER FACTOR	FREQUENCY LED will extinguish, the POWER FACTOR LED will illuminate and the PMC now displays POWER FACTOR 1.000 (Power Factor may now be modified or a new value entered).
4.	Press VOLTAGE	VOLTAGE LED is illuminated and the PMC now displays VOLTAGE 15.00V (15 Volts rms is the lowest range available for Power Factor/Phase output mode).
5.	Press 1	The PMC displays ENTRY = 1
6.	Press 2	The PMC displays ENTRY = 12
	Press 0	The PMC displays ENTRY = 120. (The MINUS/BACKSPACE key may be used to erase incorrect entries).
7.	Press V/A	Pressing the units key V/A completes the entry of the voltage setting. The PMC now displays VOLTAGE 120.0 V (The voltage may now be modified using the rotary Knob or the Up/Down modify keys.).
9.	Press CURRENT	The VOLTAGE LED will extinguish, the CURRENT LED will illuminate, the PMC displays CURRENT .1000A (.1 amps rms is the lowest current available for Power Factor/Phase output mode).
10.	Press 5	PMC displays ENTRY = 5

Table 1. Power Factor/Phase Operating Procedure - cont'd

STEP	OPERATOR ACTION	RESULTS
11.	Press V/A	Pressing the units key V/A completes the entry of the current setting. The PMC displays CURRENT 5.000A (The current may now be modified).
12.	Press OPER	The OPER LED will illuminate, the HIGH VOLTAGE indicator will flash On and Off, and a <, =, or > will appear on the display indicating the status of the output. Within the specified settling time the display should show = and the meter should read a power factor of 1.000.
13.	Press PHASE	The POWER FACTOR and CURRENT LED's will extinguish, the PHASE LED will illuminate, and the PMC displays PHASE 00.000.
14.	Adjust Phase to 300	The PMC will display PHASE 30.000 (adjustments of the output value is accomplished by either entering a new value from the keypad, Sec. 2.4.2, or using the modify controls, Sec. 2.4.5). The meter shows a lagging power factor of .8661.
15.	Press POWER FACTOR	The PHASE LED will extinguish, the POWER FACTOR LED will illuminate, and the PMC displays POWER FACTOR .8661.
16.	Adjust Power Factor to .4999	The PMC display POWER FACTOR .4999 (Due to the minimum phase increments some Power Factor values such as .5000 are not allowed). The meter should show .5 lag.
17.	Press PHASE	The POWER FACTOR LED will extinguish, PHASE LED will illuminate, and the PMC displays PHASE 60.000.
18.	Press POWER FACTOR, PHASE, POWER/VARS, FREQUENCY, VOLTAGE or CURRENT as desired.	New values for any of these functions may be entered using the keypad or the old settings may be modified. The PMC will remain in Operate mode unless the new Voltage or Current settings entered are outside of the present operating range.
19.	Press STBY	The STBY LED will illuminate, and OPER LED will extinguish. No output signals will be present at the output terminals.

Normal/Deviation

In the % deviation mode the PMC computes and displays the output value according to the formula:

$$\text{PMC Display Value} = \frac{(\text{METER C.P.} - \text{PMC output value}) \times 100 \%}{\text{METER F.S.}}$$

The PMC must have both the meter full scale value (Meter F.S.) and the meter calibration point (Meter C.P.) to perform the necessary calculation.

To enable this function, press %DEV and set the PMC output value to the meter's full scale value (it is not necessary to press OPER) . The display will read **METER F.S. = XXXXX YY** where XXXXX YY represents the meter's full scale value and units.

Press %DEV again and the display will change to **METER C.P. = XXXXX YY**. Enter the meter calibration point by using the keypad or RECALLing a stored setting. Do not use the Modify Controls.

Press the %DEV key again to display **METER = 00.00%**. The PMC now displays the deviation from the selected calibration point in percent of meter full scale. The previous displays can be reviewed and/or changed by pressing the %DEV key.

Repeatedly press the % DEV key until the **METER = XX.XX%** is displayed again. Press OPER to initiate the output. Use the rotary knob or the modify keys to change the output level and the % deviation displayed. Do not enter a value from the keypad or use the RECALL feature. A new full scale or calibration point must be entered using the keypad or RECALL feature. Changing the full scale or calibration point resets the percent deviation to zero.

Memory

The Memory feature is useful for storing frequently used output settings and quickly recalling them later. An output setting can be entered into the memory by simply pressing the STORE key. Illumination of the STORE LED indicates that stored values are present. Up to 99 settings can be stored. The display will flash memory store # after each entry and will continue to flash on and off if all of the memory locations have been filled.

Output settings in memory are recalled by pressing the RECALL key. The memory operates on a first in, first out (FIFO) basis. This sequence will continue whereby the first setting stored will also follow the last when recalling through all of the stored settings. Pressing the CLEAR key clears all memory settings.

The keypad may be used to help move through the stored settings. Pressing 0 then RECALL recalls the first stored setting. Entering a number other than zero and pressing RECALL recalls the output setting at that location.

Calibration

External Adjustments

This section consists of test procedures that check the PMC's output amplitude and phase. If a discrepancy with the specified tolerances is encountered, modifications are made to the stored calibration constants.

Calibration Mode

The stored calibration constants can only be modified while in the calibrate mode. The calibrate mode is identified by a circle with a cross character appearing in the right-hand position of the display, usually after the units designator. While in the calibrate mode any or all of the stored constants may be modified. There are two methods of exiting the calibrate mode. If STORED is pressed, all of the modified calibration constants will be stored in non-volatile memory for use during regular operation. If RESET is pressed, the modified calibration constants will be discarded and the PMC will revert to normal operation using the previously stored constants.

PMC operation in the Calibrate Mode differs from normal operation. Only five output amplitude levels are available for each range. These are 1/10, 1/4, 1/2, 3/4 and top of range. Once in the desired range, the CLEAR key cycles the output through these five values. Also, only 60 and 400 HZ frequencies and 30° phases are available.

Calibration Constants

There is one calibration constant for the bottom and one for the top of each range. When the output is at 1/10 of range, the bottom constant may be modified. The top of range constant may be modified only while the output is set to top of range. No adjustments can be made at the 1/4, 1/2, or 3/4 settings.

Make modifications by entering a number on the keypad and pressing ENTER. During amplitude alignment the output will change approximately .01% times the number entered. For phase the factor is 0.1°. A long settling time should be allowed (10 seconds or more) after each adjustment is made.

NOTE: the two calibration constants for each range affect each other. A +0.1% change at the top of range will produce a 0.1% change at the bottom of range . A +1.0% change at the bottom of range will produce a +0.1% change at the top of range.

After aligning the top and bottom of ranges, recheck both outputs to find any interaction in the alignments.

Entering Calibration Mode

To access the calibrate mode, the operator must know the *Key Code* for the particular instrument. The *Key Code* is set to the instrument's serial number when shipped from the factory. Access the calibrate mode in the following manner:

1. With the PMC in the reset mode, press and hold the MODIFY UP arrow key. Press RESET. The display will show: ENTER KEY #0000.
2. Use the numeric keypad to enter the Key Code and press ENTER.

NOTE: If an incorrect Key Code is entered the PMC will revert to Reset.

3. Once the correct Key Code is entered, the display will change to CHANGE KEY #XXXX. The key Code may now be modified.

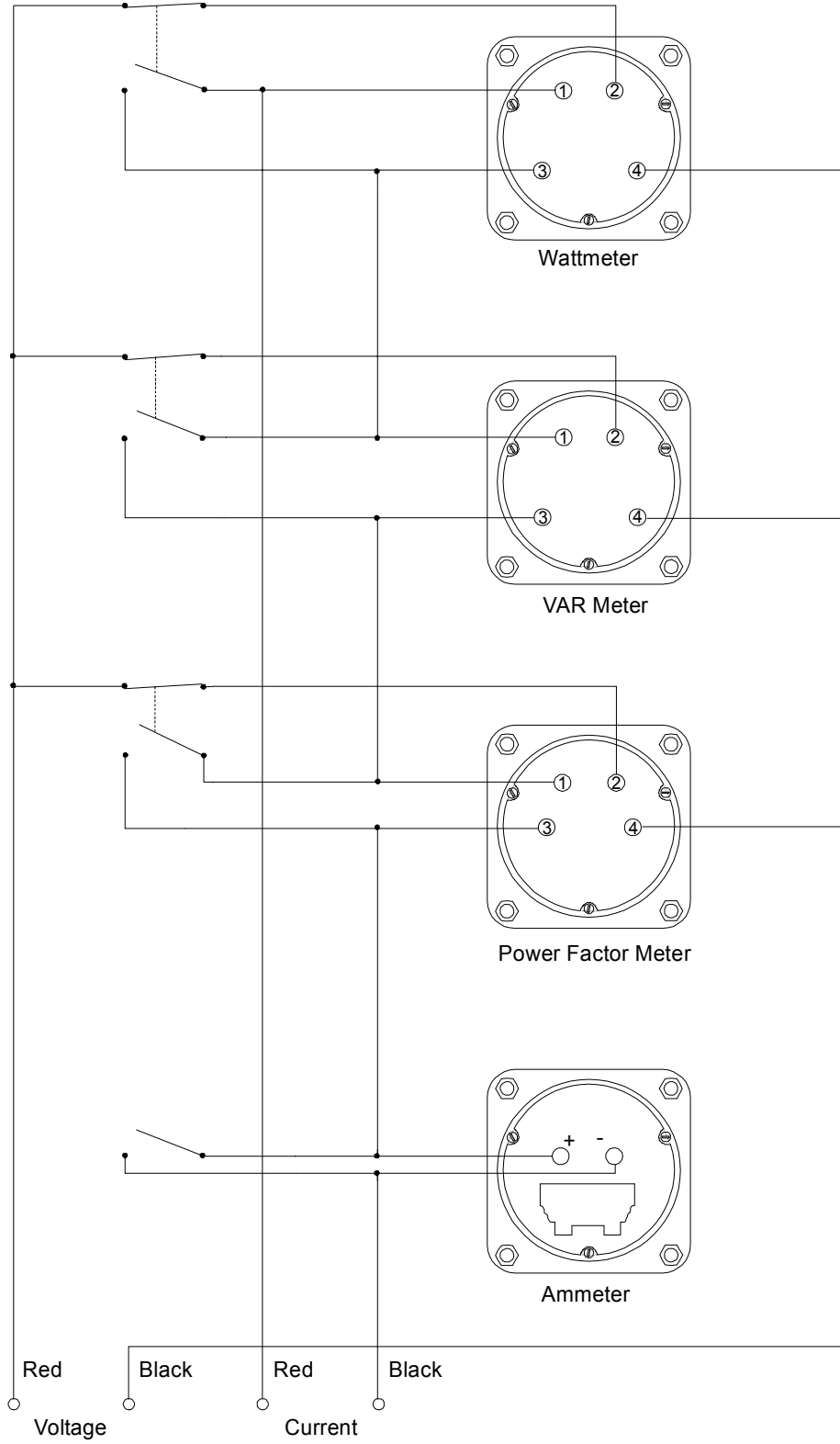
CAUTION: Ensure to properly record the Key Code if modified and restored.

4. Press ENTER for calibrate mode operation signified by a circle with a cross character in the right-hand portion of the display.

Typical Calibrate Routine

1. Enter Calibrate Routine as previously described.
2. Set the PMC for operation in desired mode and range using the top of the range value. As an example, use the following sequential steps to test the top of the 100-volt DC range:
 - a. Press DC.
 - b. Press VOLTAGE.
 - c. On the numeric keypad, enter 100.
 - d. Press V.
 - e. Press OPER.
 - f. Allow the output to settle and perform measurement.
3. The top of range calibration constant and the output level can now be modified by entering a number on the numeric keypad and pressing ENTER. During amplitude alignment the calibration constant and the output level will change approximately 0.01% times the number entered. For phase corrections the factor is 0.01°. Adjustments to calibration constants may be made at the top of range and 1/10 settings only.
4. The 1/10, 1/4, 1/2, 3/4, and top of range outputs are programmed and available by pressing the Clear Key. The PMC will not revert to Standby when CLEAR is pressed, but the output will change to the newly displayed value.
5. To adjust Voltage or Current during Power, setup Power using the normal sequence, e.g., 60 Hz, POWER, VOLTAGE, 150V, CURRENT, and 1A. Then select either VOLTAGE or CURRENT to monitor. The Clear Key will cycle the setting selected.
6. While most functions operate in their normal fashion in calibrate mode, several characteristics are worth noting: Frequency and phase are not adjustable; only 60 / 400 Hz are available and the phase is set to 30°.

Meter Interconnect Diagram



Interconnect Diagram Demonstration Meters