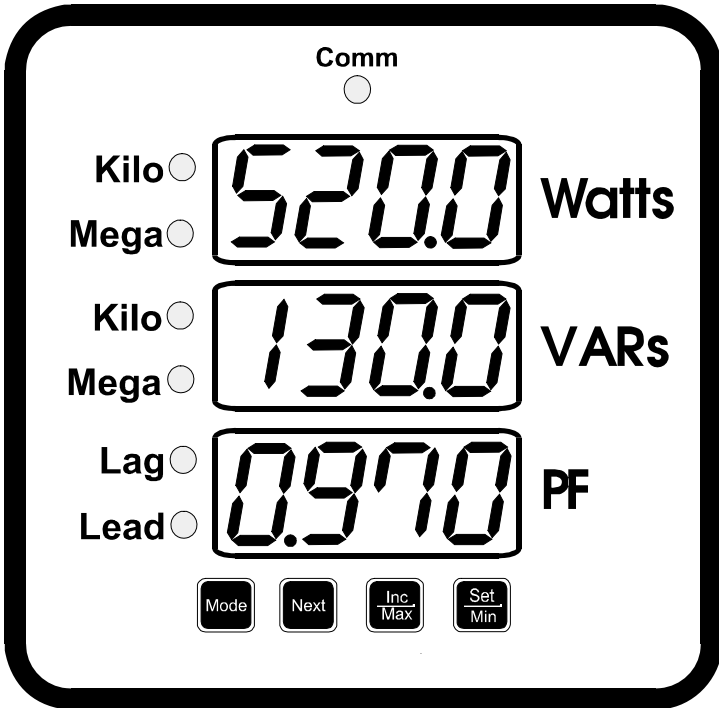
POWER SERIES Plus

Watt / VAR / Power Factor

Digital Switchboard Meter



User's Manual

WESCHLER INSTRUMENTS
DIVISION OF HUGHES CORPORATION

General Description

The POWER SERIES Plus digital switchboard meters incorporate the latest DSP microprocessor technology. Careful and thoughtful design has resulted in a family of user-friendly, field-adjustable meters.

When ordering the 2493 meter, the following options are available:

- AC Measuring Function(s): Volts, Amps, Watts, VARs, Power Factor, and/or Frequency.
- Input Range: 0-120, 0-240V, 0-480V, 0-1 A, 0-5 A, 40-70 Hz, 300-500 Hz
- Wiring Configuration: 1P2W, 1P3W, 3P3W, 3P4W, 3P4W 2½ element
- Analog Output Type: 0 to 1mADC, 4 to 20 mADC, or none
- Power Supply: Universal Power Supply (85VAC-265VAC/110VDC-340VDC), 24VDC, or 48VDC.
- Communications: MODBUS comm., ASCII protocol or no comm.

The meter display and output scaling are completely field-adjustable from the front panel. The meter does not need to be re-calibrated after adjusting the display or output scaling. There are no internal parts that the user needs to service or adjust. When a **POWER SERIES Plus** meter leaves the factory it will be calibrated to meet or exceed its published specifications.

⚠ **SAFETY NOTE**: There are no field-serviceable parts in the unit. If the unit is disassembled for any reason both Auxiliary Power and input voltages and currents must be de-energized.

LIMITED WARRANTY

This meter has been delivered to you after strict quality control and inspection. Weschler Instruments warrants its Equipment to meet applicable specifications and to be free from defects in material and workmanship for a period of one (1) year from date of shipment to the original Purchaser. Upon receipt of prompt notice from Purchaser, referencing the order number and detailing the claimed non-conformity or defect, Seller shall, at its option, repair or replace the Equipment. Equipment returned to Seller will only be accepted with a Returned Material Authorization (RMA) number issued by Seller or one of its authorized representatives. Inbound shipping charges to Seller's factory in Cleveland OH, or other designated facility, are the responsibility of Purchaser. Normal shipping charges for the return to Purchaser of repaired or replacement Equipment shall be the responsibility of the Seller (North American points only).

Repair or replacement of the Equipment in the manner described above is the exclusive warranty remedy and shall constitute complete fulfillment of all Seller's liabilities for breach of this warranty. The Seller assumes no responsibility hereunder for any equipment damage or failure caused by improper installation, operation and maintenance of the Equipment, or normal wear and tear on disposable or consumable parts. This warranty shall be void in the event of unauthorized modification or servicing of the Equipment.

The foregoing warranty is exclusive and in lieu of any other warranties of quality, whether expressed or implied (including any warranty of merchantability or fitness for a particular purpose). In no event shall Seller be liable hereunder for any special, indirect, incidental or consequential damages including the loss of revenue or production.

Watt / VAR / Power Factor Specifications

PRODUCT FUNCTION:	AC Watts/VARs/Power Factor 1 phase-2 wire, 1 phase-3 wire, 3 phase-3 wire, 3 phase-4 wire-2½ elements or 3 phase-4 wire-3 elements
ACCURACY:	Watts & VARs : ±0.2% of Reading ±0.1% of Full Scale (except 0.998 Lead < PF < 0.998 Lag) Power Factor: ±0.05
MEASUREMENT UPDATES RATE:	250 milliseconds
OPERATING TEMPERATURE RANGE:	-20 to +60 °Celsius
STORAGE TEMPERATURE RANGE:	-40 to +85 °Celsius
INPUT RANGES: (any combination of Volts & Amps)	0-120 VAC or 0-240 VAC or 0-480 VAC 0-1 Amp AC or 0-5 Amps AC 0.05 Lead to Unity to 0.05 Lag Power Factor

TRANSFORMER RATIO RANGES:

Potential Transformer:	1:1 through 9999:1
Current Transformer:	1:1 through 9999:1
Combined (PT*CT):	1:1 through 1666666:1

Displayed WATT and VAR values are Input WATTS (or VARs) * PT * CT

ANALOG OUTPUTS (Optional):	0 – 1 mADC	10 VDC compliance into 10 kΩ
	4 – 20 mADC	15 VDC compliance into 750 Ω

ANALOG OUTPUT RESPONSE TIME: within ±1% of final value within 1.0 sec

ISOLATION:

Input/Output and Case:	2500 VAC
Output to Aux. Power:	2000 VAC or 500 VDC for DC powered options
Aux. Power to Case:	2000 VAC or 500 VDC for DC powered options
Output to Case:	1000 VAC

CONFIGURING THE 2493 **POWER SERIES** [Plus] METER

The new triple-display POWER SERIES [Plus] can be configured for voltage and current inputs from instrument transformers, as well as analog outputs, Modbus or ASCII protocol Communications parameters and a rolling average display.

All set-up functions can be performed using the four push-buttons on the front panel (see below) or via ASCII or Modbus communications. You can also use the buttons to display the minimum and maximum readings and to change the display from phase to phase.

This button starts all operations.
When viewing or changing settings it is used to back out of a mode.

This button, when viewing or changing settings, moves between settings or between digits.

This button will increment the value being changed.
It is also used to display Max readings.

This button, when viewing or changing settings, is used to select a mode, save it, and then move to the next mode in the sequence.
It is also used to display Min readings.

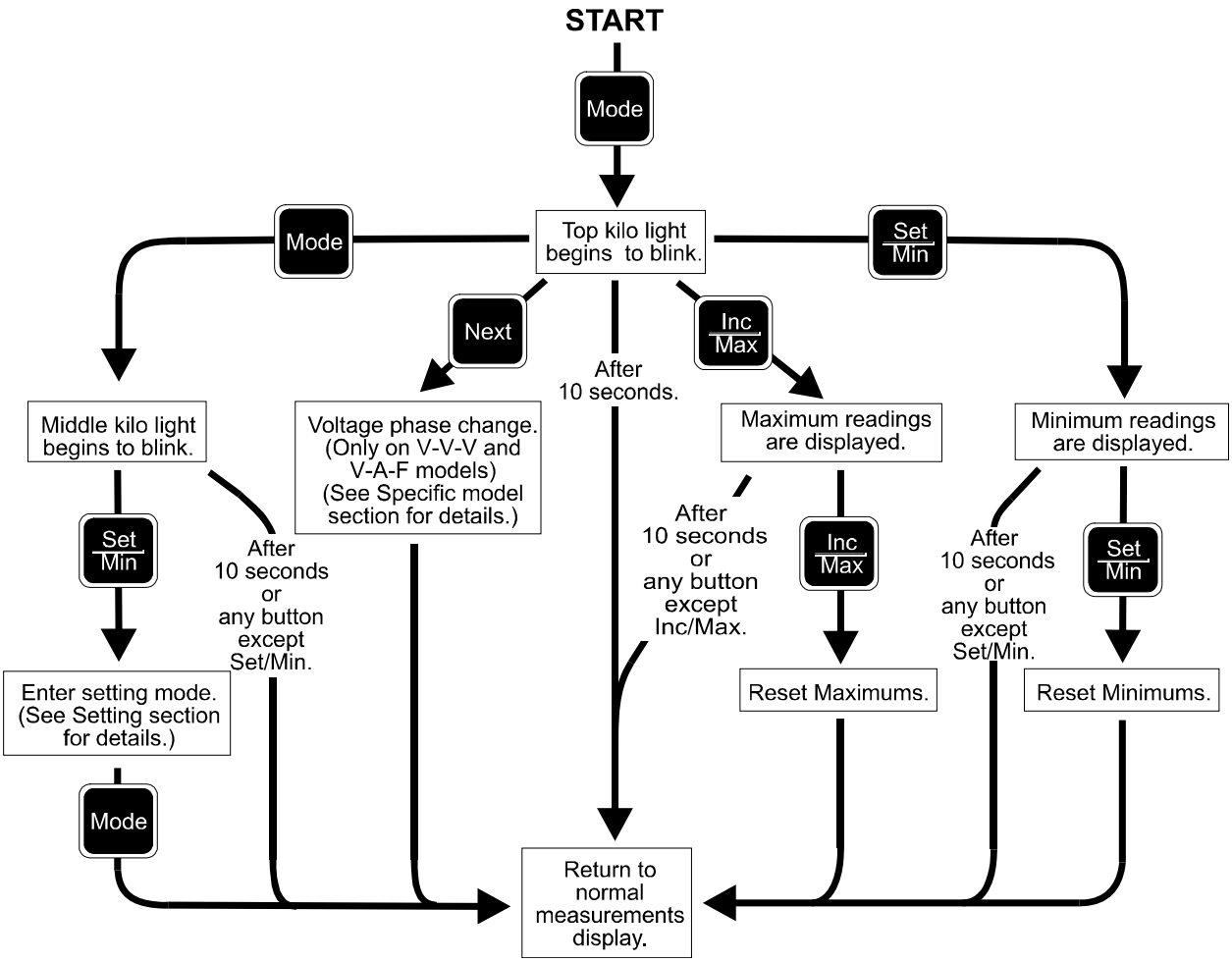
All button operations are begun with the **Mode** button.

To see the Min or Max, push the **Mode** button and then the button of the reading you want to see – **Min** or **Max**. The values will display for ten (10) seconds before reverting to the normal display. If you want to reset the values, push the **Min** or **Max** button again before the 10 seconds has expired.

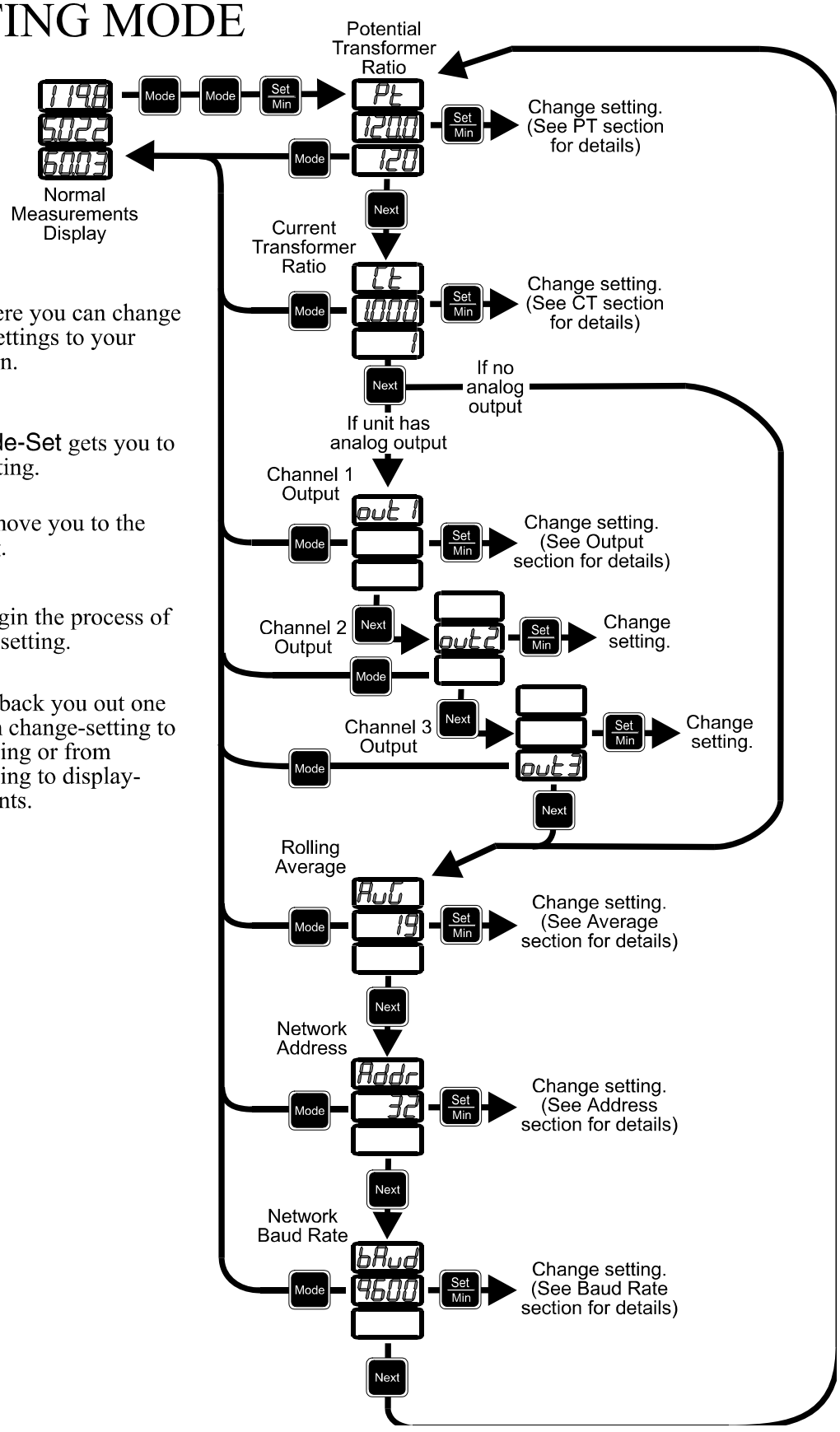
To view the configuration settings, press **Mode** twice (**Mode** – **Mode)** and then press **Set**. The first setting – the Primary Transformer (PT) ratio - will be displayed.. To see the other settings, press **Next**. You can scroll through all the settings by pressing **Next**. To go back to normal operations, press **Mode**. To change the setting being shown, press **Set**. See the specific sections on the following pages for details on how to change the settings. Once a setting is changed it will advance to the next setting. At any point while changing settings, pressing **Mode** will exit the mode without changing anything.

KEY MAP

This flowchart illustrates the operation of the **POWER SERIES** **Plus** meter using the push-keys on the front panel.



SETTING MODE



Here is where you can change the meter settings to your specification.

Mode-Mode-Set gets you to the first setting.

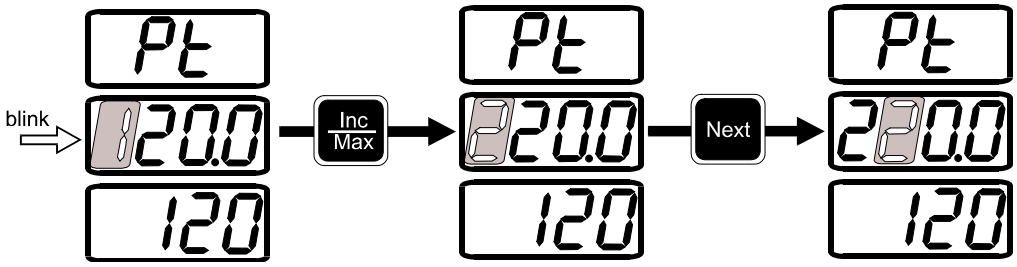
Next will move you to the next setting.

Set will begin the process of changing a setting.

Mode will back you out one level - from change-setting to display-setting or from display-setting to display-measurements.

CHANGING THE **POTENTIAL TRANSFORMER (PT)** RATIO SETTING

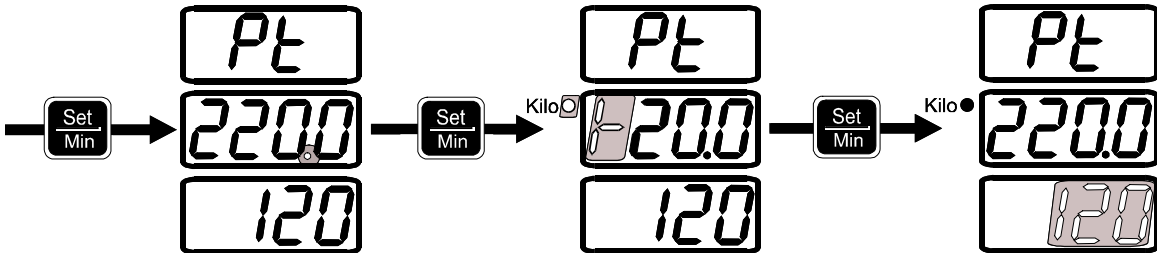
When you reach the PT setting, the primary value will be displayed in the middle row and the secondary value will be displayed in the bottom row. Press **Set** and the first digit of the primary value will begin blinking. You can increment the value of this digit by pressing **Inc**. Once a digit has reached 9 (nine) it will then go to 0 (zero). To move to the next digit press **Next**. You can return to the first digit by pressing **Next** while the last digit is blinking.



When you have the digits as you want them, press **Set**. The decimal point will now be blinking. You can then move the decimal point to the right by pressing **Inc**. Once it has reached the last position it will jump to the first position on the next **Inc**.

Pressing **Set** again will bring you to the Multiplier (Kilo) setting. In the leftmost digit you will see a blinking ' |- ' and if the multiplier light is on it will also blink. You can change the setting by pressing **Inc**.

The next time you press **Set** the value of the secondary will blink. To change the value, press **Inc**. There are only two choices: 1 or 120. (1 or 240 if the input range is 0-240V).



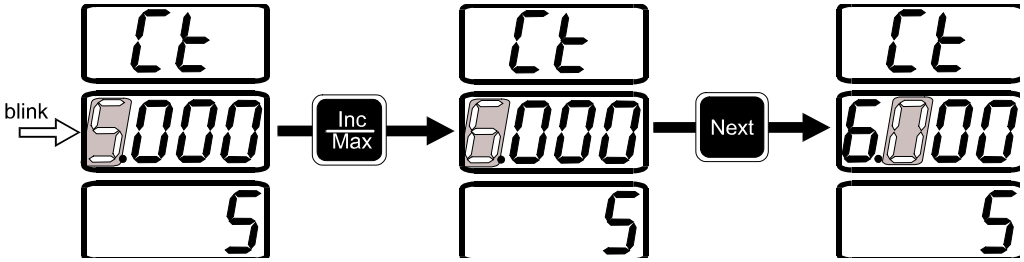
Pressing **Set** will now move you to the Confirm mode. All values will blink. If the values are correct press **Set** one last time to save them and move on to the Current Transformer settings. Pressing **Mode** at this time or at any other step in the process will restore the old PT settings.

The PT primary value can be set to any value between 1.000 and 4799520(480Volts X 9999 ratio). If it is not in this range you get the error "ErrH" (Too High) or "ErrL" (Too Low) when you try to advance to the secondary. The ratio of the Primary and Secondary must be between 1.000 and 9999. You will get "ErrH" or ErrL" if you try to advance to Confirm mode with an incorrect ratio. If the CT is also set, the combined ratio of CT * PT cannot exceed 1666666. This is the mathematical limit to the software. You will get "ErrH" or ErrL" if you try to advance to Confirm mode with an incorrect ratio.

If you try to save a ratio value that exceeds the precision of the unit that value will be automatically rounded off. For example, setting the PT to a ratio of 12.34k to 120 results in a value of 102.833333. The unit will round this to 102.8, and in the future display the ratio as 12.33k to 120. Setting the secondary to 1 will always avoid this.

CHANGING THE **CURRENT TRANSFORMER (CT)** RATIO SETTING

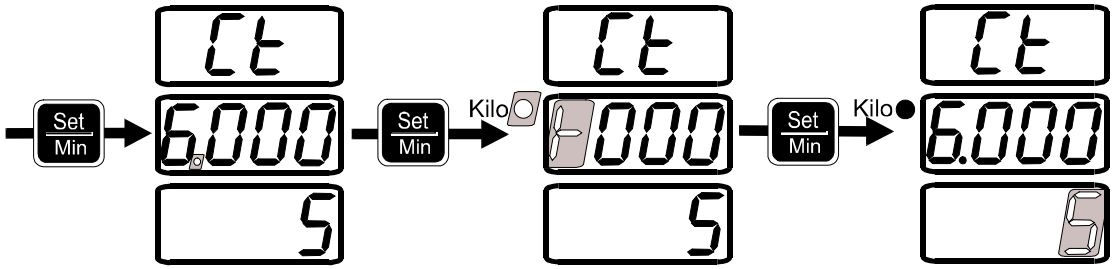
When you reach the CT setting, the primary value will be displayed in the middle row and the secondary value will be shown in the bottom row. Press **Set** and the first digit of the primary value will begin blinking. You can increment the value of this digit by pressing **Inc**. Once a digit has reached 9 (nine) it will then go to 0 (zero). To move to the next digit press **Next**. You can return to the first digit by pressing **Next** while the last digit is blinking.



When you have the digits as you want them, press **Set**. The decimal point will now be blinking. You can then move the decimal point to the right by pressing **Inc**. Once it has reached the last position it will jump to the first position on the next **Inc**.

Pressing **Set** again will bring you to the Multiplier (Kilo) setting. In the leftmost digit you will see a blinking ' |- ' and if the multiplier light is on, it will also blink. You can change the setting by pressing **Inc**.

If you have a 5 Amp unit, the next time you press **Set** the value of the secondary will blink. To change the value, press **Inc**. There are only two choices: 1 or 5.



If you have a 1 Amp unit, or you have set the secondary on a 5 Amp unit, pressing **Set** will now move you to the Confirm mode. All values will blink. If the values are correct press **Set** one last time to save them and move on to the Analog Output settings. Pressing **Mode** at this time or at any other step in the process will restore the old CT settings.

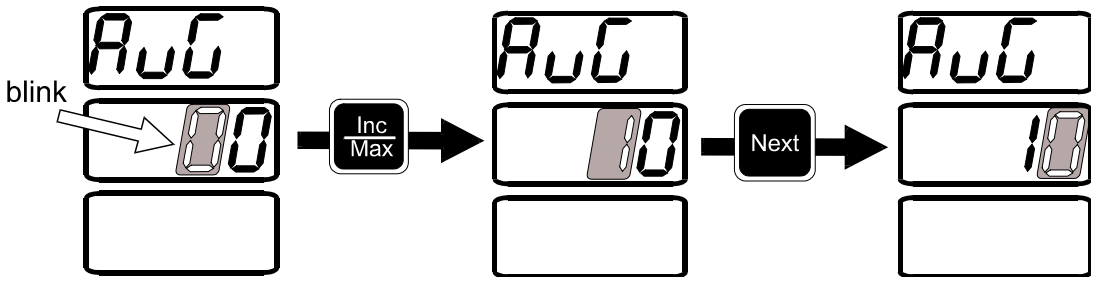
The CT primary value can be set to any value between 1.000 and 49995 (5 Amps X 9999 ratio). If it is not in this range you get the error "ErrH" (Too High) or "ErrL" (Too Low) when you try to advance to the secondary. The ratio of the Primary and Secondary must be between 1.000 and 5000. You will get "ErrH" or ErrL" if you try to advance to Confirm mode with an incorrect ratio. The ratio of the Primary and Secondary must be between 1.000 and 5000. If the PT is also set, the combined ratio of CT * PT cannot exceed 1666666. This is the mathematical limit to the software. You will get "ErrH" or ErrL" if you try to advance to Confirm mode with an incorrect ratio.

If you try to save a ratio value that exceeds the precision of the unit, that value will be automatically rounded off. For example, setting the CT to a ratio of 5.367 to 5 results in a value of 1.0734. The unit will round this to 1.073, and in the future display the ratio as 5.365 to 5. Setting the secondary to 1 will always avoid this.

CHANGING THE **ROLLING AVERAGE** SETTING

The rolling average causes the displayed value to be an average of the number of samples to which this parameter is set. Increasing this setting will reduce digit bounce, but will slow the display response time. The analog output response time is not affected by this setting.

When you reach the Average setting, press **Set** and the first digit will begin blinking.



To increment the value of the digit, press **Inc**. Once a digit has reached 9 (nine), it will then go to 0 (zero). To move to the second digit press **Next**. To return to the first digit press **Next** again. When you have set the desired value, press **Set**. Both digits will blink, showing you are now in Confirm mode. If the value is correct press **Set** one more time to save the value and move on to the Address setting. Pressing **Mode** at any time before this will restore the old setting.

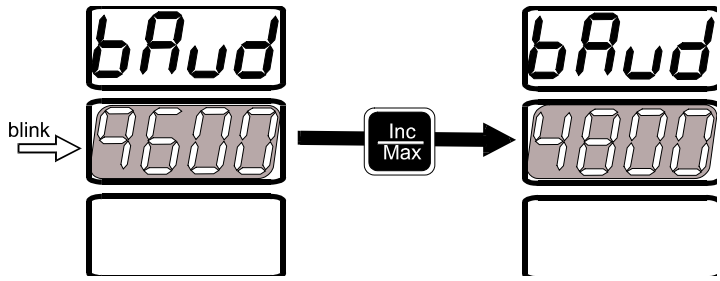
The average can be set to any value from 0 to 29.

CHANGING THE **NETWORK ADDRESS** SETTING

The Address setting is changed in exactly the same way as the Average setting.
The address can be set to any value from 01 to 32. **NOTE** – Please make sure that no two units have the same address. After saving the value you will move to the Baud Rate setting.

CHANGING THE **BAUD RATE** SETTING

When you reach the setting, press **Set** and the whole value will begin blinking.



To change it to the next choice, press **Inc**. You can scroll through all the choices with the **Inc** key. Those choices are 9600 (default), 4800, 2400 and 1200. When you have reached the desired choice, press **Set**. The new setting will be saved and the unit will proceed to the next mode.

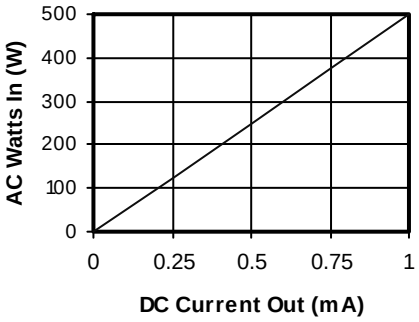
Analog Output Scaling

The **POWER SERIES** **Plus** has the option of analog output, which can provide an analog signal relative to the input of the meter. The relationship between the input and the output can be scaled by the user using the front panel. Analog Output 1 is always proportional to the value shown on the top display (Watts). Output 2 is always proportional to the middle display (VARs), and Output 3 will always be proportional to the bottom display (Power Factor).

A 1phase/2wire/120Volt/5Amp wattmeter with 0 to 1 milliamp output, for example, has the following default settings:

PT ratio: 1 to 1
CT ratio: 1 to 1
Analog Output LO: 0 Watts
Analog Output HI: 500 Watts

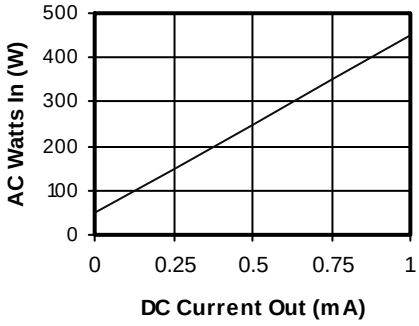
The LO is the input value at which the output will be 0 mA. The HI is the input value at which the output will be 1 mA. The charts at right show the relationship of input and output.



When the settings are changed to:

PT ratio: 1 to 1
CT ratio: 1 to 1
LO: 50 Watts
HI: 450 Watts

The new relationship of input and output is shown at right.

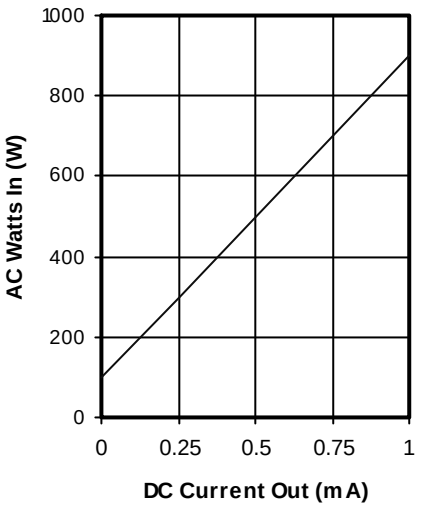


Next the PT ratio is changed to 2 to 1 (2:1). **Note** that the HI and LO for input **automatically** change to match the new ratio whenever the PT ratio or CT ratio is changed. The HI and LO for Power Factor are not affected by PT and CT.

So now the settings are –

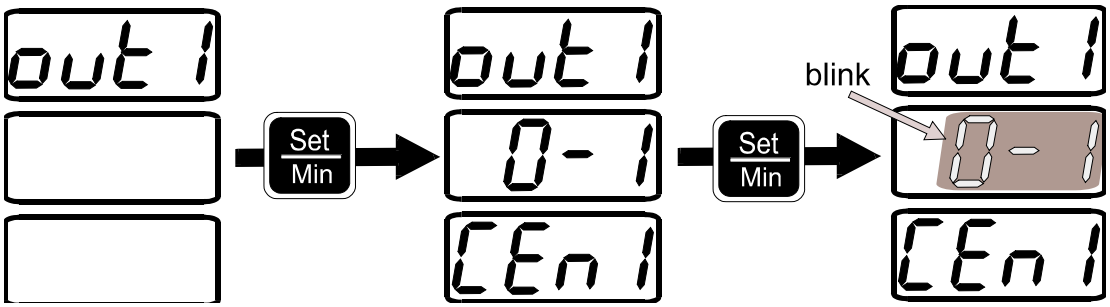
PT ratio: 2 to 1
CT ratio: 1 to 1
LO: 100 Watts
HI: 900 Watts

And the relationship is shown at right.

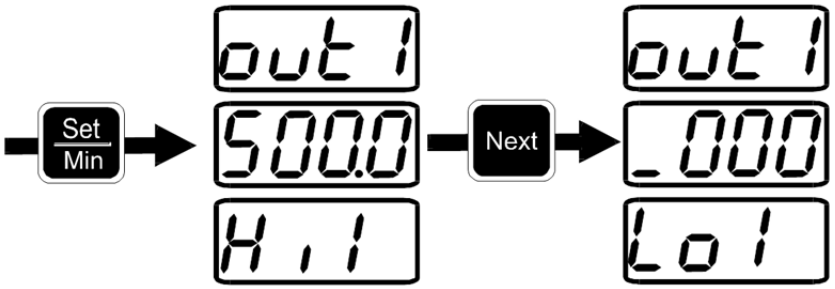


CHANGING THE **ANALOG OUTPUT** SETTINGS

When you reach the 'out1' (Watts) display, press **Set** and the value of CEN1 will be displayed if the unit has 0-1 mA output. A 4-20 mA unit will display the value of HI1. If you have a 4-20 mA unit disregard the instructions for CEN1.



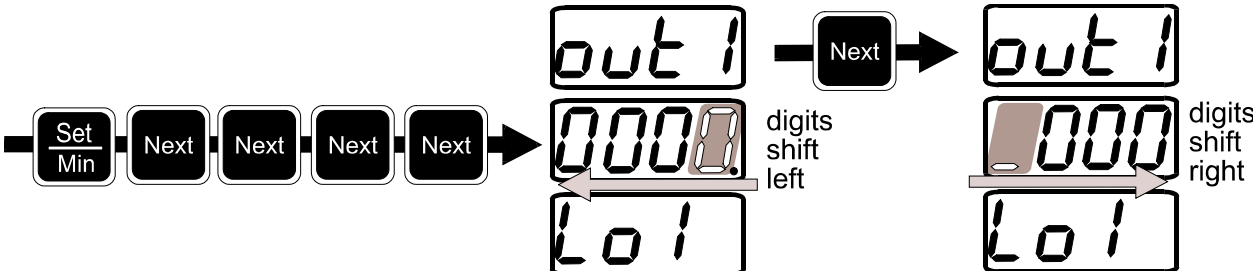
Changing the HI value is done in the same manner as changing the primary for PT or CT. First the digits, then the decimal point, then the multipliers (Kilo/Mega), and finally confirm the new setting.



After pressing **Set** to confirm the new setting, the LO1 value will be displayed. To enable you to set either a negative or positive value for LO1 there is a "sign dash". If the bottom segment is displayed it means the value is positive. The middle segment means the value is negative. The sign dash is changed with the **Inc** button, just like the other parts of the value. The value still has four digits of precision, but now one of them is "hidden". When the third digit is blinking, press **Next** and the digits will shift left revealing the fourth digit. Now the sign dash is hidden and the fourth digit is blinking. Another press of **Next** will make the digits shift back right and the sign dash will be visible and blinking.

This shift will also occur when setting the decimal point. When the decimal point is with the first, second or third digit the fourth digit will not be visible. When the decimal point is with the fourth digit the sign dash will not be visible.

The rest of the procedure for changing LO1 is identical to the procedure for HI1. After reaching the confirm mode of LO1, pressing **Set** will save all values for Out1 and move you to Out2. None of your changes will be saved until you reach this point. If you only wish to change the HI value, you still must go through the LO steps to save your changes.



OUT2: The only difference between Out1 (watts) and Out2 (VARs) is that there is no sign dash for LO2. Instead, after setting the multiplier for HI2 or LO2, the Lead/Lag lights on the bottom display will start blinking. Both the HI2 and LO2 values can be set as either Lead or Lag. All other steps are the same as Out1.

OUT3: There is no multiplier for Out3 (Power Factor). The first digit only toggles between '0' and '1'. The decimal point cannot be changed.

Note that the output settings have a precision of four (4) digits only. When the PT or CT ratio is large, this will result in rounding if you try to set a value too precisely. For example: If a 1phase/2wire/120V/5A meter has a PT ratio of 1000:1, then the output settings for watts and VARs must be in units of 100, because you are now dealing with a range of values from –900,000 to 900,000. Trying to set a value to 124 or another value not divisible by 100 will result in the value being rounded to the nearest 100's.

The following values apply to the POWER SERIES[Plus] Watt-VAR-PF meters:

For Output 1 (Watts):

Input	Defaults		LO1 Minimum	HI1 Maximum	Span Minimum
	LO1	HI1			
2Wire 120V 1A	0.0	100.0	-180.0	180.0	50.00
2Wire 240V 1A	0.0	200.0	-360.0	360.0	100.0
2Wire 480V 1A	0.0	400.0	-720.0	720.0	200.0
2Wire 120V 5A	0.0	500.0	-900.0	900.0	250.0
2Wire 240V 5A	0.0	1000	-1800	1800	500.0
2Wire 480V 5A	0.0	2000	-3600	3600	1000
3Wire 120V 1A	0.0	200.0	-360.0	360.0	100.0
3Wire 240V 1A	0.0	400.0	-720.0	720.0	200.0
3Wire 480V 1A	0.0	800.0	-1440	1440	400.0
3Wire 120V 5A	0.0	1000	-1800	1800	500.0
3Wire 240V 5A	0.0	2000	-3600	3600	1000
3Wire 480V 5A	0.0	4000	-7200	7200	2000
4Wire 120V 1A	0.0	300.0	-540.0	540.0	150.0
4Wire 240V 1A	0.0	600.0	-1080	1080	300.0
4Wire 480V 1A	0.0	1200	-2160	2160	600.0
4Wire 120V 5A	0.0	1500	-2700	2700	750.0
4Wire 240V 5A	0.0	3000	-5400	5400	1500
4Wire 480V 5A	0.0	6000	-10.8K	10.8K	3000

For Output 2 (VARs):

Input	Defaults		Range Limits	Span Minimum
	LO2	HI2		
2Wire 120V 1A	100.0 lag	100.0 lead	180.0 lag – 0 – 180.0 lead	50.00
2Wire 240V 1A	200.0 lag	200.0 lead	360.0 lag – 0 - 360.0 lead	100.0
2Wire 480V 1A	400.0 lag	400.0 lead	720.0 lag – 0 - 720.0 lead	200.0
2Wire 120V 5A	500.0 lag	500.0 lead	900.0 lag – 0 - 900.0 lead	250.0
2Wire 240V 5A	1000 lag	1000 lead	1800 lag – 0 – 1800 lead	500.0
2Wire 480V 5A	2000 lag	2000 lead	3600 lag – 0 – 3600 lead	1000
3Wire 120V 1A	200.0 lag	200.0 lead	360.0 lag – 0 - 360.0 lead	100.0
3Wire 240V 1A	400.0 lag	400.0 lead	720.0 lag – 0 - 720.0 lead	200.0
3Wire 480V 1A	800.0 lag	800.0 lead	1440 lag – 0 - 1440 lead	400.0
3Wire 120V 5A	1000 lag	1000 lead	1800 lag – 0 – 1800 lead	500.0
3Wire 240V 5A	2000 lag	2000 lead	3600 lag – 0 – 3600 lead	1000
3Wire 480V 5A	4000 lag	4000 lead	7200 lag – 0 – 7200 lead	2000
4Wire 120V 1A	300.0 lag	300.0 lead	540.0 lag – 0 - 540.0 lead	150.0
4Wire 240V 1A	600.0 lag	600.0 lead	1080 lag – 0 – 1080 lead	300.0
4Wire 480V 1A	1200 lag	1200 lead	2160 lag – 0 – 2160 lead	600.0
4Wire 120V 5A	1500 lag	1500 lead	2700 lag – 0 – 2700 lead	750.0
4Wire 240V 5A	3000 lag	3000 lead	5400 lag – 0 – 5400 lead	1500
4Wire 480V 5A	6000 lag	6000 lead	10.8K lag – 0 – 10.8K lead	3000

For Output 3 (Power Factor):

Input	Defaults		Range Limits	Span Minimum
	LO3	HI3		
All 0-1 mA units	0.000 Lead	0.000 Lag	0.000 Lag – 1 – 0.000 Lead	0.250
All 4-20 mA units	0.000 Lead	0.000 Lag	0.000 Lag – 1 – 0.000 Lead	0.250

The above values are without any scaling by the PT ratio or CT ratio. If the PT ratio is greater than 1 to 1, than the output setting values for watts and VARs above must be multiplied by the PT ratio. For example, if the PT ratio is changed to 3 to 1, then all the values in the chart above will be multiplied by 3. Likewise, a change in the CT ratio will proportionally change the values in the chart above. Power Factor is not affected by the transformer ratios.

You cannot set a value lower than the minimum LO or higher than the maximum HI.

The span between the LO and HI must not be smaller than the minimum span. So with a 2 Wire 120V 1A wattmeter, you could set the LO to 0 and the HI to 50. Or you could set the LO to 110 and the HI to 160. But you could not set the LO to 60 and the high to 90. 90 minus 60 is less than 50.

If a value is too low you will get the error "**ErrL**". If the value is too high you will see the message "**ErrH**". If the span is not big enough or if the span is too big (goes out of range) the message is "**ErrS**".

If the input is greater than the HI setting the output will match it until it reaches the limit of the unit. For a 0-1mA unit that limit is 1.06mA. For a 4-20mA unit that limit is 20.96mA. Likewise, if the input drops below the LO setting, the lower end of the output is limited to 3.04mA for a 4-20mA unit. A 0-1mA unit can never go below 0mA.

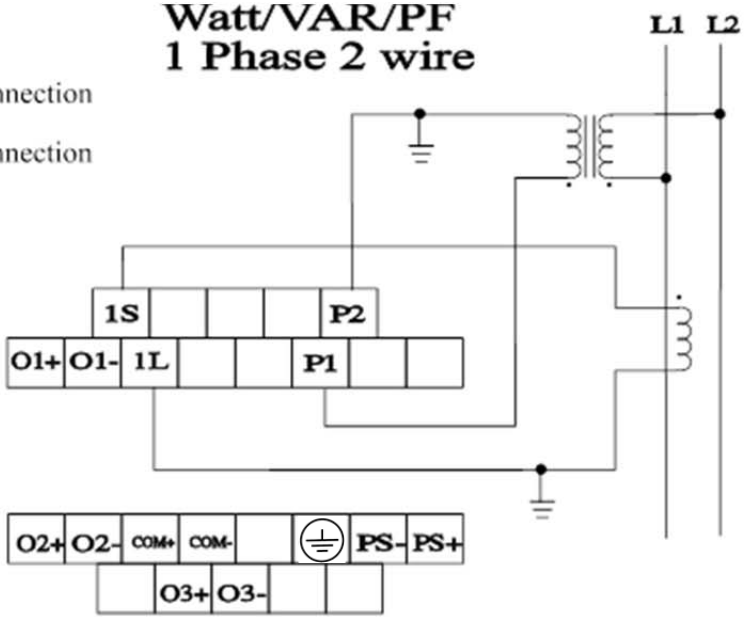
Connection Diagrams – Part 1

All circuits should be de-energized when making connections to the rear terminal block.

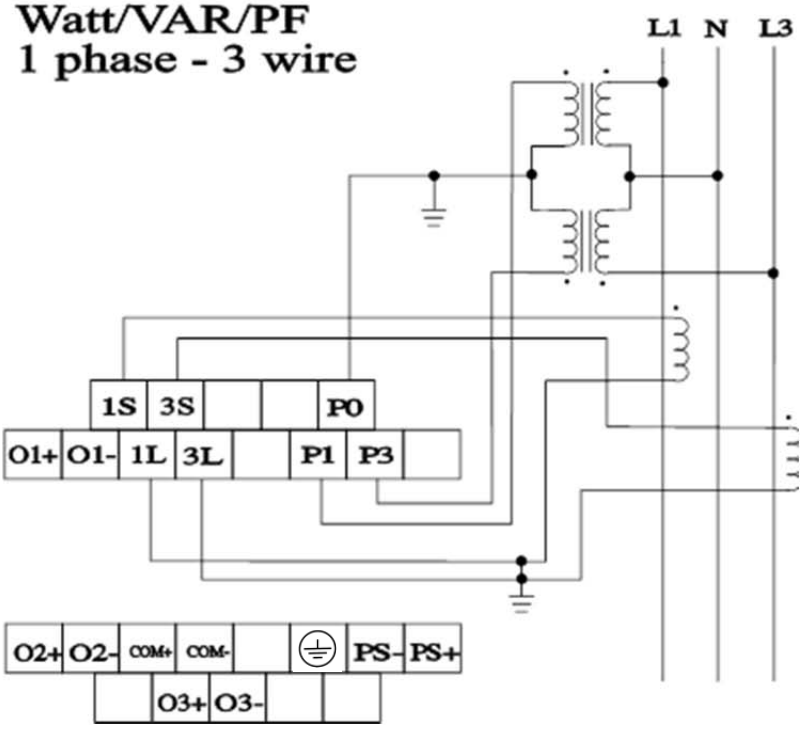
PS+ is the positive Power Supply connection (line voltage for AC supplies).
PS- is the negative Power Supply connection (neutral for AC supplies).

COM is RS-485 communications.

Watt/VAR/PF
1 Phase 2 wire



Watt/VAR/PF
1 phase - 3 wire



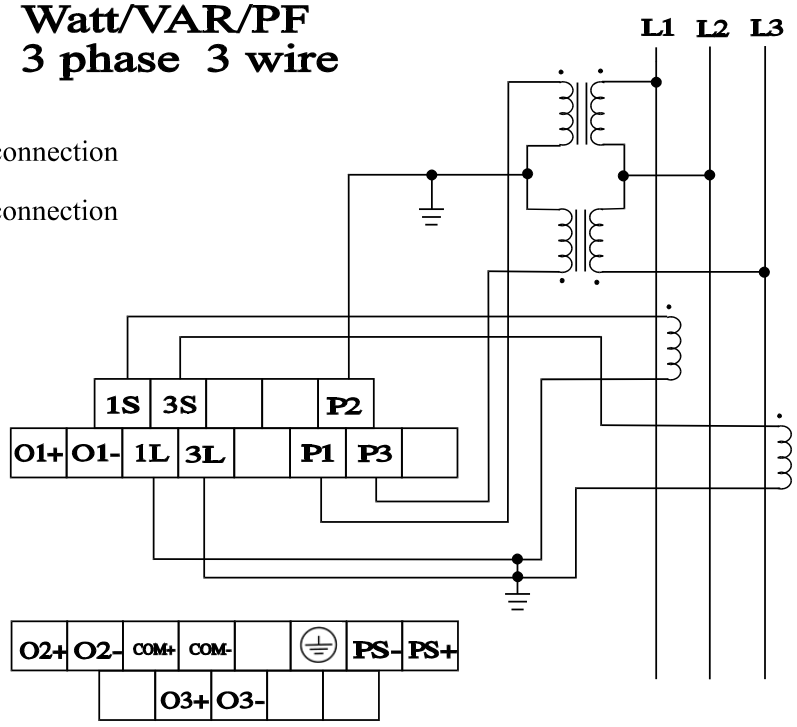
Analog Outputs are assigned as follows:

- O1 - Watts
- O2 - VARs
- O3 - Power Factor

Connection Diagrams – Part 2

All circuits should be de-energized when making connections to the rear terminal block.

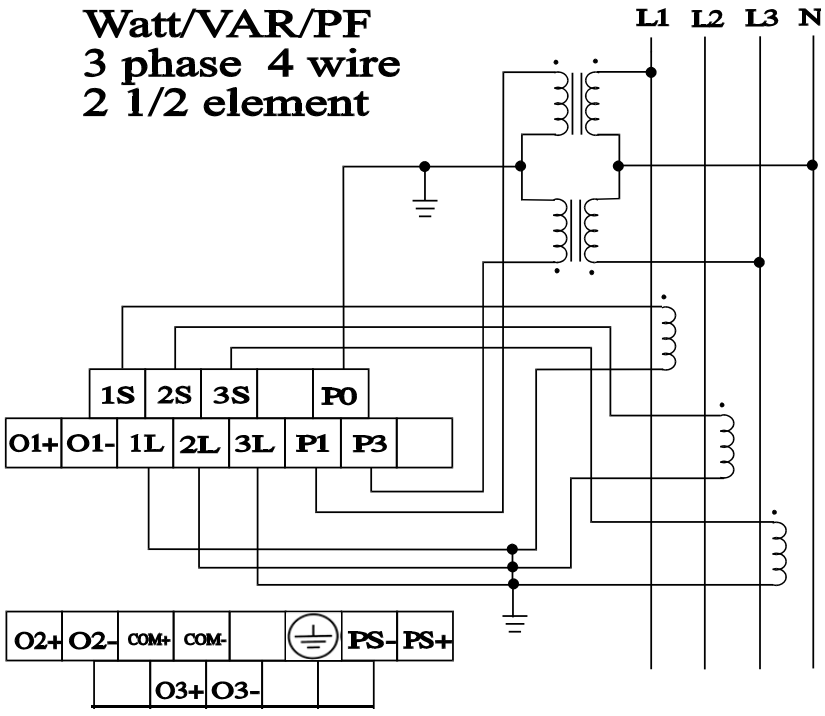
Watt/VAR/PF
3 phase 3 wire



PS+ is the positive Power Supply connection (line voltage for AC supplies).
PS- is the negative Power Supply connection (neutral for AC supplies).

COM is RS-485 communications.

Watt/VAR/PF
3 phase 4 wire
2 1/2 element



Analog Outputs are assigned as follows:

- O1 - Watts
- O2 - VARs
- O3 - Power Factor

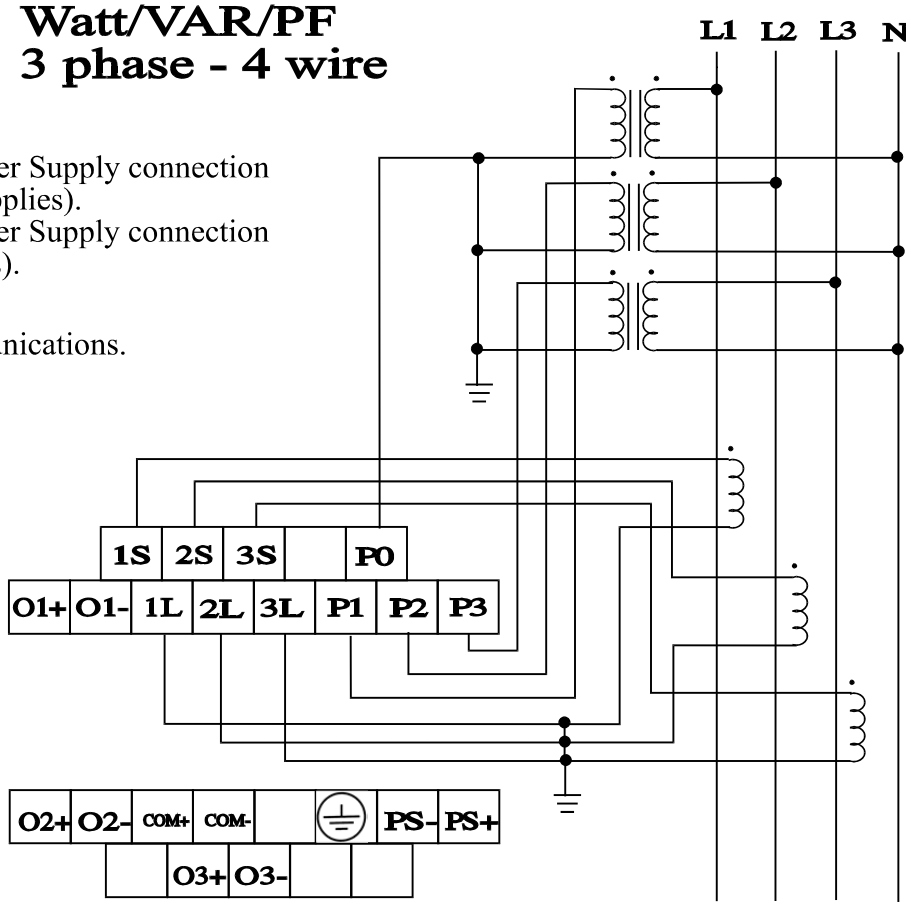
Connection Diagrams – Part 3

All circuits should be de-energized when making connections to the rear terminal block.

Watt/VAR/PF
3 phase - 4 wire

PS+ is the positive Power Supply connection (line voltage for AC supplies).
PS- is the negative Power Supply connection (neutral for AC supplies).

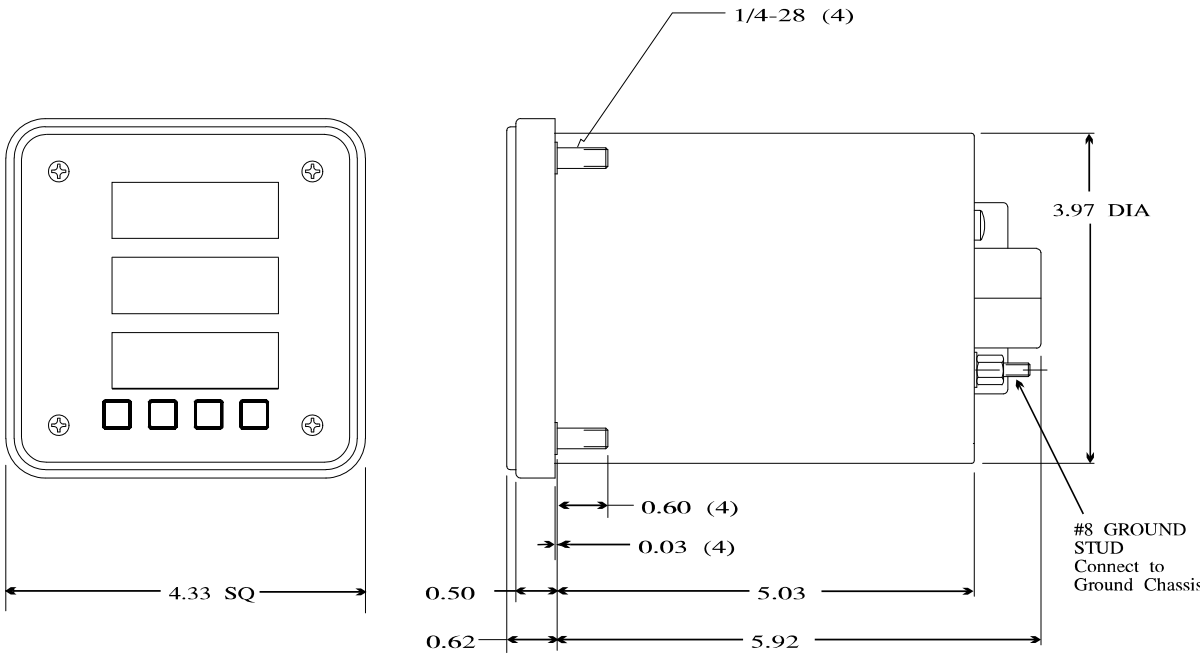
COM is RS-485 communications.

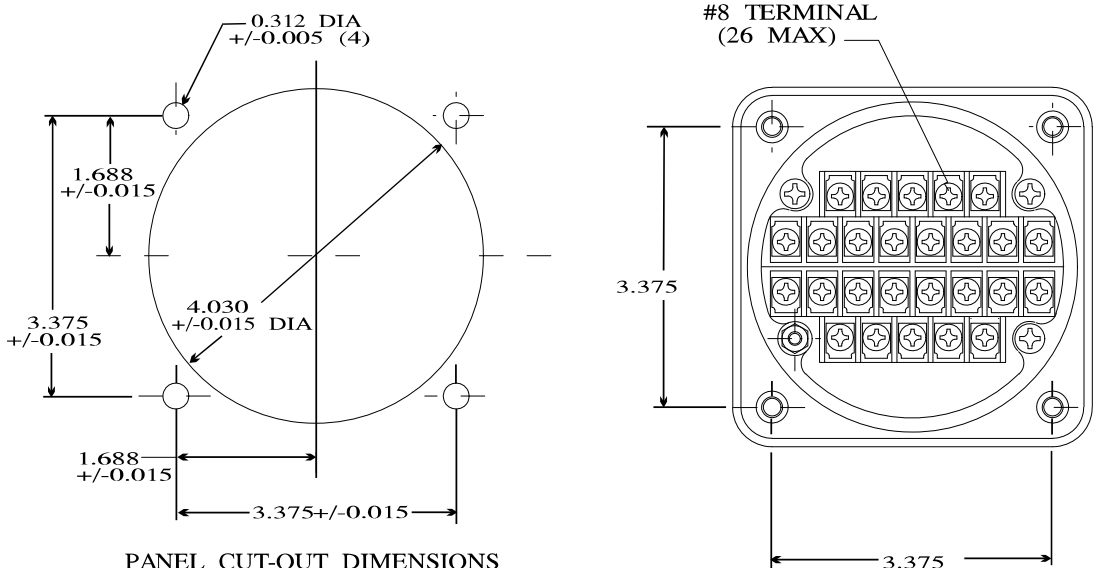


Analog Outputs are assigned as follows:

O1 - Watts
O2 - VARs
O3 - Power Factor

Mounting and Outline





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