

### ***Two Wattmeter Method for 3 Phase Power Measurement***

The two wattmeter (Blondel) method is often used to measure total three phase power. Individual phase power is not directly measurable when using the two wattmeter method. To measure individual phase power in a three phase system the three wattmeter method must be used. The two wattmeter method uses two line-line voltage measurements and two line current measurements. The three wattmeter method uses three line-neutral measurements and three line current measurements.

The three wattmeter method is recommended for three phase power measurement as it yields both individual phase power and total three phase power. It is also easier to confirm the correct connection for the three wattmeter method.

It is often assumed that if a three phase system has the voltage source connected in a delta configuration then the two wattmeter method must be used. This is not the case, the voltages can be measured line-ground if there is no neutral available. When using the PowerPro an external power supply must be used when measuring line-ground. This is because the PowerPro has an internal power supply that 'steals' power from V1, using an external power supply disconnects the internal power supply from V1. If this is not done the PowerPro will cause a small ground current to flow which may cause problems in an ungrounded system.

One case where it is not possible to use the three wattmeter method is when measuring on the secondary side of external PTs. If these PTs are connected line-line on the primary side then using the two wattmeter method is the only solution. (Note: when measuring on the secondary side of external PTs an external power supply must be used as the load from the PowerPro's internal power supply will be too large for most PTs). One connection scheme is to connect V1 from phase A to C, V2 from phase B to C, I1 to measure phase A current and I2 to measure phase B current. The correct voltage and current connection can be verified by examining the phase angles of V1, V2, I1 and I2. These can be viewed from the front panel of the PowerPro. For a proper connection V1 must be leading V2 by 60 degrees and, for unity power factor loads, I1 must be leading V1 by 30 degrees and I2 must be lagging V2 by 30 degrees. For non unity power factor loads the amount the current is leading/lagging by is adjusted by the power factor angle. For example, if the actual power factor is 0.92 lag (the corresponding angle is 23 degrees) then I1 will lead V1 by 7 degrees and I2 will lag V2 by 53 degrees. If the power factor is 0.92 lead then I1 will lead V1 by 53 degrees and I2 will lag V2 by 7 degrees.

Below is a picture of the PowerPro screen showing voltage and current magnitudes, and phase angles for a 3P3W connection with a unity power factor load. Channel 3 can be used to monitor voltage and current on the third phase but these measurements are not included in the total power calculation.

1	207.7	<sup>0</sup> V	8.45	<sup>-30</sup> A
2	208.9	<sup>60</sup> V	8.42	<sup>90</sup> A
3	0.0	<sup>0</sup> V	0.00	<sup>0</sup> A
FQ	60.01	Hz		

◀ Fig. 1- PowerPro screen shot