Voltage/Current angle meter

Type FPFM/1

Description and User Instructions

Version	Date	Description
V1.0	14-09-2005	
V1.1	14-11/2007	Use with Robin clip-on CT added

Fundamentals Ltd

1. DESCRIPTION & PRINCIPLE OF OPERATION

The Fundamentals Angle /Power Factor meter has been developed as a commissioning aid for the SuperTAPP range of voltage control equipment. The instrument is self contained and powered from the voltage reference input to the device. Figure 1 shows the layout of the meter.

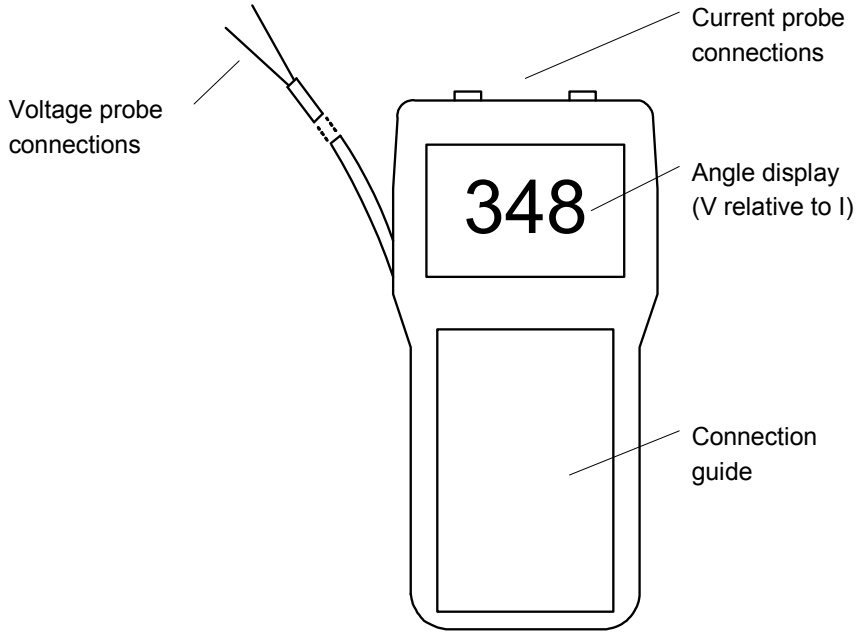

Figure 1 *Meter layout*

The voltage connection is wired directly into the instrument using a flexible power lead, nominally a 'live' and 'neutral'. If a phase to phase voltage is used (the normal case) the meter uses the convention that the 'live' leads the 'neutral.

For the current connection, a 10/0.01 clip-on CT is connected to the meter by two 4 mm sockets. The probe plugs must be connected to the same coloured sockets on the meter.

See note below if testing using a Robin 2A CT

When connected, the instrument will display the angle, in degrees, between the voltage (reference) and the current.

2. CONNECTION FOR MEASUREMENT

As described above, the voltage connections are made to the reference voltage source, normally two phases from the voltage transformer; the clip-on CT is clipped around the secondary wiring from the chosen current transformer. Again for convention, it is important that the clip-on CT is connected with reference to the direction of current flow. This is indicated on the clip-on CT label as shown in figure 2.

General use

If the meter is being used to determine a general phase angle, the assumed direction of current is based on a flow in the direction of the arrow.

For example, if the instrument is reading 270º and the voltage selected is **Vr-Vy**, then the current is in the blue phase and flowing in the direction of the arrow. If the reading is 90º the current is again in **blue** phase but flowing in the opposite direction to the arrow.

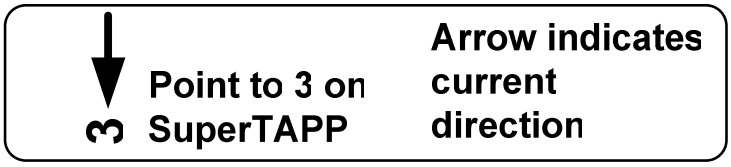

Figure 2 *Clip-on CT label*

Use with SuperTAPP

If the meter is being used to determine the connections for the SuperTAPP prior to installation, the nameplate on the instrument will determine the connections to be made, as follows: -

1. Ensure as far as possible that no reactive circulating current is flowing between transformers
2. Apply the voltage probe to terminal 21 as live and terminal 22 as neutral

Note: if testing using a Robin 2A CT the connections to the PF meter are to be reversed, i.e. Red to black and black to red.

3. Apply the current probe to the current connection from the selected CT **towards** terminal 3 on the SuperTAPP. This terminal is selected as it is always used regardless of the CT secondary connections (these may be on terminals 4, 6 or 7)
4. Take a reading of angle

3. INTERPRETATION OF READING

It should be noted here that the current should flow **out** of terminal 3.

For example, assume from the previous section that an angle of 348º was taken and the connections for voltage were Vr-Vy. From the instrument nameplate, figure 3, it is seen that connection is correct as it falls in the range 320º, through 0º, to 20º.

The SuperTAPP requires a connection pattern as follows: -

Voltage	Current Transformer	Current angle at terminal 3 (unity PF)
Vr-Vy	Y	330º
Vy-Vb	B	330º
Vb-Vr	R	330º

As a voltage Vr-Vy is used the current angle would be 330º (150º+180º) at terminal 3 at a unity PF load, indicating a CT in phase Y. The power factor of the load is, therefore 18º (348º -330º), or 0.95 lagging.

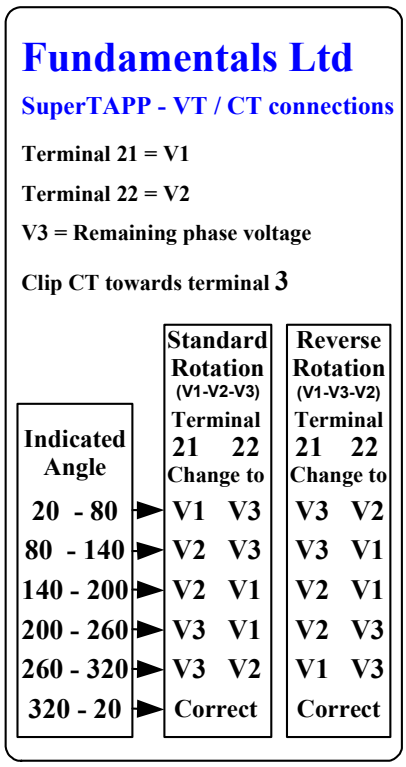

Figure 3 *Instrument nameplate*

For a second example, assume that an angle of 100º is taken and the connections for voltage were again Vr-Vy. From the instrument nameplate, figure 3, it is seen that connection is incorrect.

Assuming a standard rotation of R-Y-B the voltage phases used must be changed. At this point it should be remembered that the current transformers on each transformer in the group should be in the same phase for correct summation of load current.

1. Referring to the nameplate the reading of 100º falls is the range 80º - 140º.
2. For the test V1 is Vr and V2 is Vy. V3 must therefore be Vb

3. Connect Vy to terminal 21 and Vb to terminal 22 on the SuperTAPP relay
4. Check again to confirm the correct angle of 340º

In this example the power factor is 0.985 lagging.