TEXMATE INC

SINGLE PHASE SMART POWER MODULE

Current Input

Voltage Input

High Precision Shunt Resistor
Eliminates secondary current transformers and improves linearity.

State-of-the-art Electromagnetic Noise Suppression Circuitry
Ensures signal integrity under harsh EMC environments.

Zero Crossing Detector
Allows high resolution line-frequency measurement.

Header
Selectable 300 V or 600 V operation.

Differential Voltage Divider
Safe operation for direct connection to phase-to-phase voltages.

16-bit Dual Channel $\Sigma\Delta$ Synchronous A/D Converter
Delivers unmatched accuracy and performance.

Math Co-processor
Offloads work from Tiger 320 processor, leaving it free to perform advanced automation and control functions.

Interface to Tiger Meter

The complete solution to stand-alone low cost metering applications required in the power industry.

When combined with the powerful Tiger 320 Series controller, this module performs many common AC functions including:

• Power for single-phase 2-wire and single-phase 3-wire systems.
• R.M.S. voltage for both line-to-line and line-to-neutral systems.
• R.M.S. current via 1 amp or 5 amp CTs. Power factor (Cos ø).

The Tiger 320 Series controller can convert kW to kW hrs and amps to amp hrs using its dual totalizers and resolve the zero crossing detector line-frequency to 3 decimal places.

Input Module Order Code Suffix

IWO1 (300 V, 1 Amp)

IWO2 (300 V, 5 Amp)

IWO4 (600 V, 1 Amp)

IWO5 (600 V, 5 Amp)

| Hardware Module Specifications	
Voltage Range	50-300 VAC, 100-600 VAC header selectable.
Current Range	Either 1 amp or 5 amp current transformers.
Voltage Accuracy	0.1% of full scale input.
Current Accuracy	0.05% of full scale input.
Power Accuracy	± 0.2% of full scale input.
Cos ø Accuracy	± 0.5% of full scale output ± 0.3°.
Temperature Drift	60 ppm/ °C maximum.
Output Signal Rate	5 Hz.
Frequency Resolution	± 0.001 Hz

Software Module Features	
Current Gain	Selectable between 1.0 for typical systems, and 0.2 for systems with large crest factors.
Factory Calibrated	User need only scale results, no AC calibrator required.

Some Relevant Tiger 320 Series Operating System Features
Setpoint timer functions.
Setpoint register reset and trigger functions.
Totalizers.
Analog outputs.
Direct display of selected outputs.

INPUTS

Power Factor
kVA
kVAR
kWH
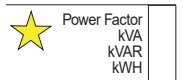
Volts AC

Amps AC

Watts AC
Watt hours
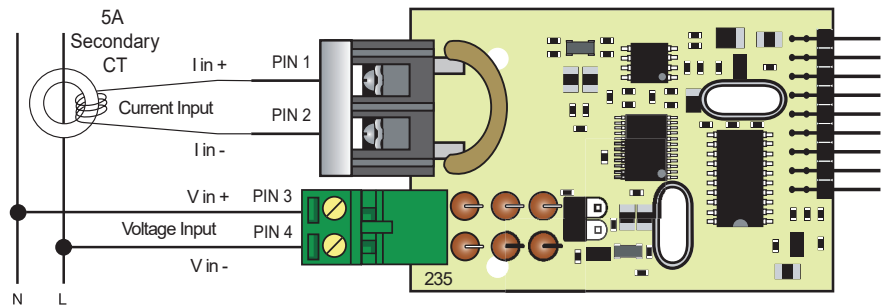
Frequency
Mains

Connector Pinouts

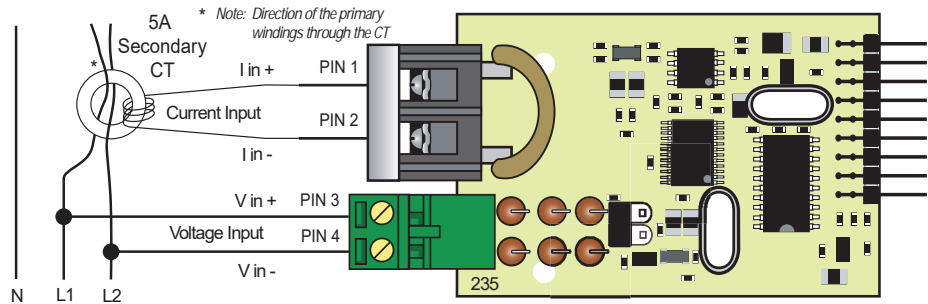**Figure 1 – Single Phase, 2-wire Configuration**

Figure 2 – Single Phase, 3-wire Configuration

Smart Setup Registers

The meter uses three smart setup registers to configure all smart input modules. Input modules IW01 to IW05 require only smart register 1 to be set up. These modules produce four output registers.

One of these registers can be transferred to Channel 1 via Code 2, the same or another register to Channel 2 via Code 4, the same or another register to Channel 3 via Code 5, and the same or another register to Channel 4 via Code 6.

Input modules IW01 to IW05 have a zero crossing detector that is available for direct line-frequency measurement in Channel 2. The following resolution settings can be selected in Code 4:

• 0 to 99.999 Hz, 0.001 Hz resolution.

  Set Code 4 to [30X].

• 0 to 999.99 Hz, 0.01 Hz resolution.

  Set Code 4 to [31X].

Note, the direct line-frequency measurement setting for channel 2 is a hard-wired option and, if selected, means channel 2 is not available for selecting an output register.
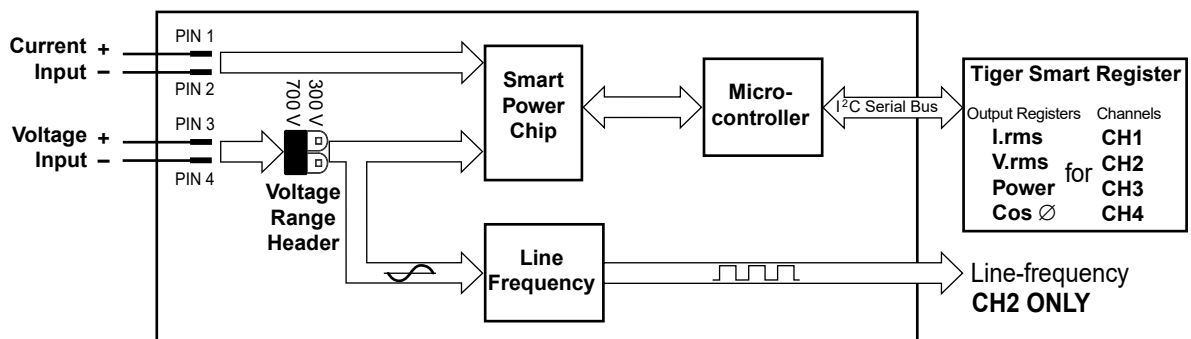

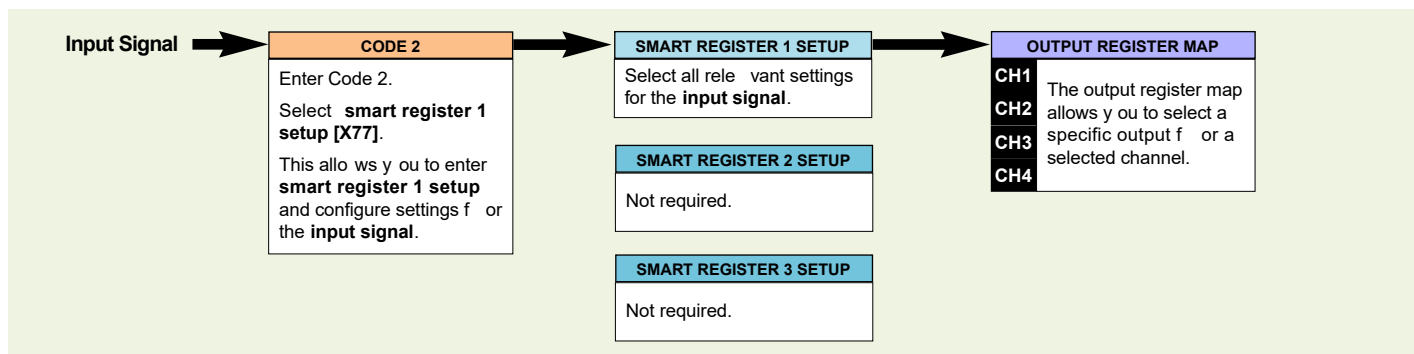**Figure 3 – Smart Input Module IW01 to IW05 Signal Flow Diagram**

| Input Signal → | CODE 2 | → | SMART REGISTER 1 SETUP | → | OUTPUT REGISTER MAP |

Input Signal →

CODE 2

Enter Code 2.

Select **smart register 1 setup [X77]**.

This allows you to enter **smart register 1 setup** and configure settings for the **input signal**.

→

SMART REGISTER 1 SETUP

Select all relevant settings for the **input signal**.

SMART REGISTER 2 SETUP

Not required.

SMART REGISTER 3 SETUP

Not required.

→

OUTPUT REGISTER MAP

CH1
CH2
CH3
CH4

The output register map allows you to select a specific output for a selected channel.

Figure 4 – IW01 to IW05 Smart Setup Registers – Operational Flow Diagram

Programming Procedures

The following programming procedures cover all the steps required to configure smart input module IW02 (5 amp) as follows:

- Channel 1 to display current (I rms).
- Channel 2 to display direct line-frequency measurement.
- Channel 3 to display voltage (V rms).
- Channel 4 to display power usage (kW).

Steps **1** to **6** describe how to select the **current gain** setting through smart register 1.

Steps **7** to **13** describe how to select the output registers for channels 1, 2, 3, or 4 as required.

Steps **14** to **16** describe how to select line-frequency for channel 2.

1 Press the [P] and [↑] buttons at the same time to enter the main programming mode.

2 Press the [P] button three times to enter Code 2. Set Code 2 to [077].

`[ od_2    077 ]`

This setting enters the **smart register 1** code setup menu.

👉 **Note the output register map is different for each smart input module.**

FIRST DIGIT	SECOND DIGIT	THIRD DIGIT
Must be 0	**MEASUREMENT TASK**	**OUTPUT REGISTER MAP**
	0 **Voltage, Current**	0 I.rms
	1 TC (3rd digit selects type of TC)	1 V.rms
	2 RTD 3-wire (3rd digit selects type of RTD)	2 Power
	3 RTD 2- or 4-wire (3rd digit selects type of RTD)	3 Cos ∅
		4 -
	4 Frequency	5 -
	5 Period	6 -
	6 Counter	7 Smart input module **register 1** code setup
	7 Smart Input Module	

3 Press the [P] button.

`[ 5ʳʳƥ┤ i    000 ]`

FIRST DIGIT	SECOND DIGIT	THIRD DIGIT
Not relevant	**Not relevant**	**CURRENT GAIN**
		0 1
		1 0.2
		2 -
		3 -
		4 -
		5 -
		6 -
		7 -

4 Using the [↑][↓] buttons, select the relevant **current gain** settings.

This menu provides settings unique to input modules IW01 to IW05.

5 Press the [P] button.

This takes you back to the Code 2 menu.

`[ od_2    077 ]`

👉 **Note the output registers in the 3rd digit are specific to IW01 to IW05. These registers vary for each different smart input module.**

6 The next step is to select the appropriate output register from the output register map for a selected channel.

Select a Channel   Select the output register for the required channels

7 Press the [P] and [↑] button at the same time again to re-enter the main programming mode.

8 Press the [P] button three times to enter Code 2.

9 To select **channel 1**, set Code 2 to [X7X]. Select the required processing rate for **CH1** in the 1st digit and the required register map settings in the 3rd digit.

CH1 `Cod_2  X7X`

☞ **Note the output register map is different for each smart input module type.**

FIRST DIGIT	SECOND DIGIT	THIRD DIGIT
TIGER PROCESSING RATE	**MEASUREMENT TASK**	**OUTPUT REGISTER MAP**
0 10 Hz	**0 Voltage, Current**	**0 I.rms**
1 10 Hz	1 TC (3rd digit selects type of TC)	1 V.rms
2 100 Hz	2 RTD 3-wire (3rd digit selects type of R TD)	2 Power
3 100Hz	3 RTD 2- or 4-wire (3rd digit selects type of RTD)	3 Cos ∅
	4 Frequency	4 -
	5 Period	5 -
	6 Counter	6 -
	7 Smart Input Module	7 Smart input module **register 1** code setup

10 To select **channel 2**, enter Code 4 and select the required register map settings for **CH2** in the 2nd digit.

CH2 `Cod_4  0X0`

☞ **Note**, If you require the **direct line-frequency measurement** setting, channel 2 will not a vailable f or selecting an output register.

FIRST DIGIT	SECOND DIGIT	
MEASUREMENT TASK	**FOR VOLTAGE & CURRENT**	*Note:
0 Voltage, Current	**0 Channel 2 Disabled**	*The logic for CH2 is not the same as CH1, CH3, or CH4. The 1st and 3rd digits must both be set to 0. Selecting 040 to 070 in the 2nd digit of Code 4 directly selects one of the f ollowing settings in the smar t register 1 map (3rd digit):*
1 TC (type as per 2nd digit)	1 Direct (no post processing)	
2 RTD (type as per 2nd digit)	2 Square Root of Channel 2	
	3 Inverse of Channel 2	
3 Second Digital Input Channel (type as per 2nd digit)	4 Output Register 1 (smart module)*	

2nd Digit	Output Register Map
4 selects	0 I.rms
5 selects	1 V.rms
6 selects	2 Power
7 selects	3 Cos ∅

(2nd digit continued: 5 Output Register 2 (smart module)*, 6 Output Register 3 (smart module)*, 7 Output Register 4 (smart module)*)

11 To select **channel 3**, enter Code 5 and select the required post processing settings for **CH3** in the 1st digit and the required register map settings in the 3rd digit.

CH3 `Cod_5  X7X`

FIRST DIGIT	THIRD DIGIT
CH3 POST PROCESSING	**OUTPUT REGISTER MAP**
0 Direct Display of Input (no processing)	**0 I.rms**
1 Square Root of Channel 3	1 V.rms
2 Inverse of Channel 3	2 Power
3 **Meters with 4 kB memory**	3 Cos ∅
NO Linearization	4 -
Meters with 32 kB memory	5 -
32-point Linear ization of CH3 using Table 3	6 -
	7 Smart input module **register 1** code setup
Note:	
All linear ization tab les are set up in the Calibration Mode [24X].	

☞ **Note the output register map is different for each smart input module type.**

12 To select **channel 4**, enter Code 6 and select the required post processing settings for **CH4** in the 1st digit and the required register map settings in the 3rd digit.

CH4 `Cod_6  X7X`

Press the `P` button to save the settings.

FIRST DIGIT
CH4 POST PROCESSING
0 Direct Display of Input (no processing)
1 Square Root of Channel 4
2 Inverse of Channel 4
3 **Meters with 4 kB memory**
NO Linearization
Meters with 32 kB memory
32-point Linearization of CH4 using Table 4
Note:
All linearization tables are set up in the Calibration Mode [24X].

13 Press the `P` and `⬆` buttons at the same time to retur n to the oper ational display.

Select the Line Frequency

Select the line frequency on Channel 2

☞ **Note**, the direct line-frequency meas urement setting f or channel 2 is a hard-wired option and, if selected, means channel 2 is not a vailable for selecting an output register.

14 Press the `P` and `⬆` button at the same time again to re-enter the main prog ramming mode.

15 Press the `P` button five times to enter Code 4.

16 Set Code 4 to [3X0]. Select the required line frequency measurement in the 2nd digit.

CH2 `Cod_4  0X0`

FIRST DIGIT	SECOND DIGIT	THIRD DIGIT
MEASUREMENT TASK	**DIGITAL INPUT**	**OUTPUT REGISTER MAP**
0 Voltage, Current	**0 Frequency - 99.999 Hz range from 0.001 Hz**	**0 I.rms**
1 TC (type as per 2nd digit)	1 Frequency - 999.99 Hz range from 0.01 Hz	1 V.rms
2 RTD (type as per 2nd digit)		2 Power
		3 Cos ∅
		4 -
3 Second Digital Input Channel (type as per 2nd digit)		5 -
		6 -
		7 Smart input module **register 1** code setup

Recalibration Procedures

The following recalibration procedures describe how to recalibrate the scale factors for CH1, CH3, and CH4 if they are different from the Texmate factory default settings. See the new scale factor calculations on the example on Page 8.

1 Press the [P] and [⬆] buttons at the same time to enter the main programming mode.

2 Press the [P] button once to enter the calibration mode.

[CAL] [000] →

FIRST DIGIT	SECOND DIGIT	THIRD DIGIT
	CALIBRATION MODES FOR INPUT & OUTPUT	OBJECT FOR 2ND DIGIT
0 **Functions Activated by Pressing the PROGRAM Button**	0 **Manual Calibration** (requires NO input source)	0 **Result**
	1 Two-point Calibration (requires dual input source)	1 Channel 1
1 Calibration Procedures	2 Calibrate Thermocouple (requires K type thermocouple input source)	2 Channel 2
		3 Channel 3
2 Related Calibration Functions	3 Calibrate RTD (requires RTD 385 input source)	4 Channel 4
	4 Calibrate Smart Input Module. *Note: This function is not available on all input modules*	5 -
3 -	5 Calibrate Analog Output mA/V (requires multimeter connected to pins 16 and 17)	6 -
	6 -	7 -
	7 -	

3 Using the [⬆][⬇] buttons, set the **Calibration Mode** to [101] to reset the **scale factor for CH1**.

The display toggles between [CAL] and [101].

[CAL] [101]

The COS ∅ value does not require any user scaling. However, make sure that the appropriate channel scaling register is set to 1.0 and the offset set to 0.

4 Press the [P] button.

The display toggles between [OFF_1] and [0.0].

[OFF_1] [0.0]

5 Press the [P] button.

The display toggles between [SCA_1] and [1.0000].

[SCA_1] [1.0000]

6 Using the [⬆][⬇] buttons, reset the **Scale Factor** for **CH1** to the new settings.

[0.6666] **Example**

7 Press the [P] button once to return to the calibration mode.

The display toggles between [CAL] and [101].

[CAL] [101]

8 Using the [⬆][⬇] buttons, set the **Calibration Mode** to [103].

The display enters the offset and scale factor setting menu for **CH3**.

[CAL] [103]

9 Repeat Steps 4 to 6, but set the **Scale Factor** for **CH3** to the new settings.

[1.0000] **Example**

10 Press the [P] button once to return to the calibration mode.

The display toggles between [CAL] and [103].

[CAL] [103]

11 Using the [⬆][⬇] buttons, set the **Calibration Mode** to [104].

The display enters the offset and scale factor setting menu for **CH4**.

[CAL] [104]

12 Repeat Steps 4 to 6, but set the **Scale Factor** for **CH4** to the new settings.

[2.0000] **Example**
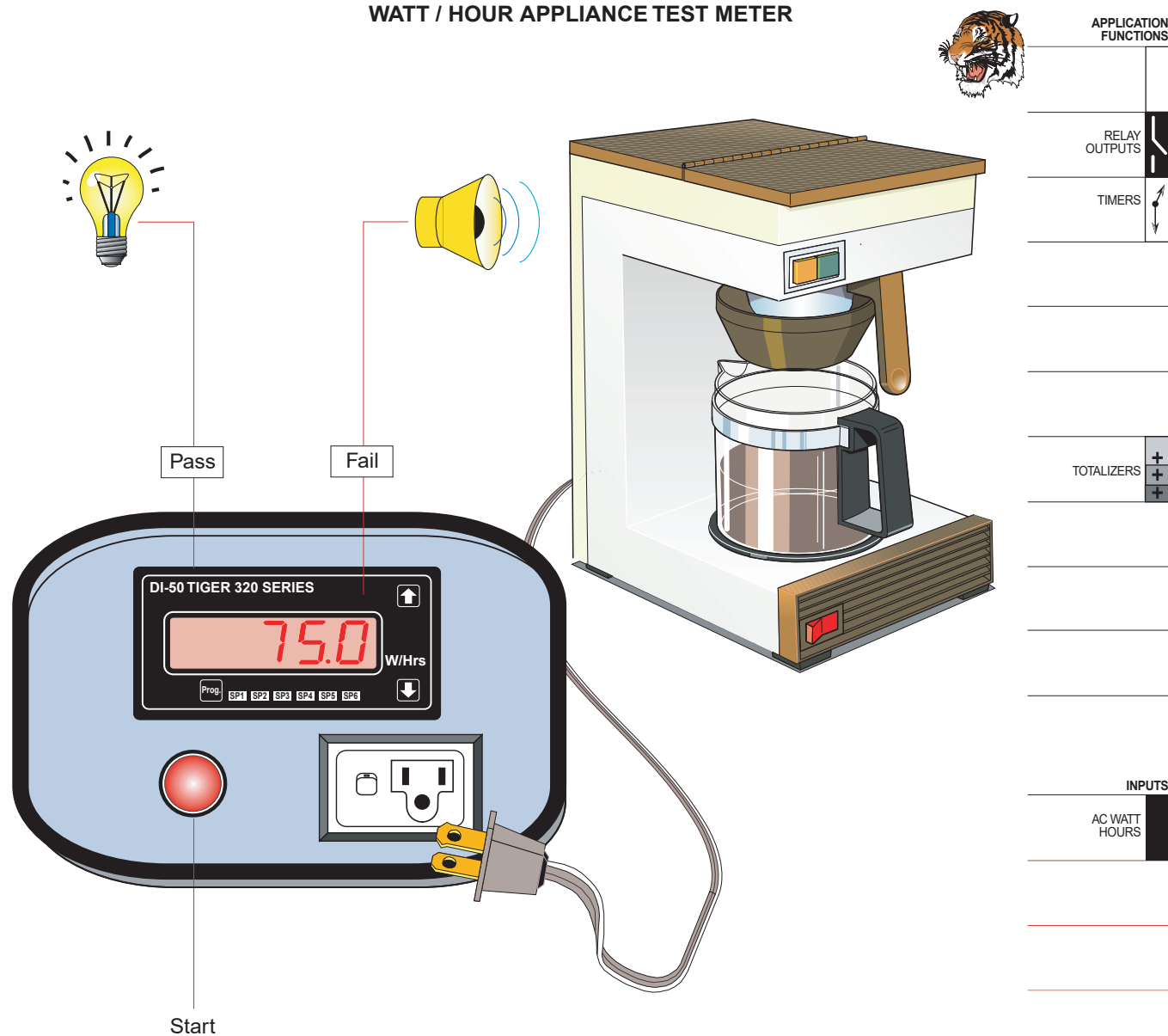
13 Press the [P] button to save the settings.

14 Press the [P] and [⬆] buttons at the same time to return to the operational display.

The scale factor for CH1, CH3, and CH4 has now been reset.

Our customer requires a quality control test f or watt/hour rating of electrical appliances. The test is carr ied out o ver 5 min utes. A Texmate DI-50E meter with a w att input module is installed. The meter is prog rammed to totaliz e the w att/hours when the start b utton is pressed. The meter totaliz es the w atts f or 5 minutes and the watt/hour rating is held on the display.

When the ne xt appliance is connected, the star t b utton is pressed, the meter is reset to 0 and counts the w atts f or 5 minutes again. A setpoint is prog rammed in the de viation mode to indicate P ASS/ F AIL. The appliance ON-time is programmable to suit your application.

WATT / HOUR APPLIANCE TEST METER

APPLICATION FUNCTIONS

RELAY OUTPUTS

TIMERS

Pass   Fail

TOTALIZERS

DI-50 TIGER 320 SERIES

75.0 W/Hrs

Prog. SP1 SP2 SP3 SP4 SP5 SP6

INPUTS

AC WATT HOURS

Start

WATTS AC

APPLICATION VARIATIONS

• Print quality control receipt.

• RS 232 output to computer for PASS/FAIL analysis for production records.

• For current applications above 5 A, a current transformer is required.

It is no longer necessary to use combinations of transducers to achieve a power measurement and control system.
A Texmate Tiger 320 Series DI-503 meter, installed with a single-phase power input module, calculates and displays volts, amps, Hz, watts, watt hours, and power factor from a single-phase 2 or 3-wire voltage and current input.

The optional relay, analog and serial outputs can be configured from all the above parameters to interface with a control or alarm system.
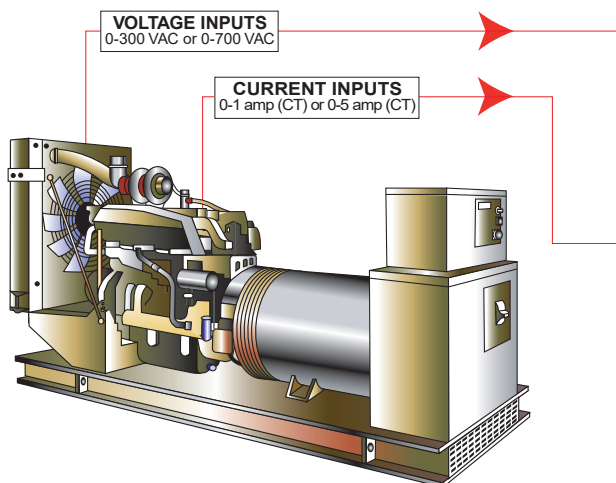
SINGLE PHASE MEASUREMENT AND CONTROL

VOLTAGE INPUTS
0-300 VAC or 0-700 VAC

CURRENT INPUTS
0-1 amp (CT) or 0-5 amp (CT)

TIGER 320 SERIES DI-503

240.0
VOLTS

100.00
AMPS

59.999
Hz

P ▲ ▼

APPLICATION FUNCTIONS

RELAY OUTPUTS

TIMERS

ANALOG OUTPUTS

SERIAL OUTPUTS

TOTALIZERS

CALCULATIONS

SEQUENCE CONTROLS

TEXT MESSAGING

INPUTS

SINGLE PHASE SMART POWER MODULE

OPTIONS

• Up to 6 super smart relay outputs, digitally programmable upper and lower limits.
• Programmable deviation mode, hysteresis mode, latch ON or latch OFF.
• Built-in super smart timers on each setpoint.
• Programmable DOM to eliminate nuisance tripping.
• Power ON inhibit to avoid tripping during power up.
• Dual 4-20 mA or 0-10 V, 16-bit analog output.
• RS-232 or RS-485.
• DeviceNet / ModBus.
• Direct serial printer output.
• Data logging with real-time clock.

DISPLAY AND CALCULATE

Voltage (R.M.S.).
Current (R.M.S.).
Frequency.
Watts, kilowatts.
Watt hours, kilowatt hours.
Power factor monitoring
for precise load sensing.*

MULTIPLE TRANSDUCERS NO LONGER REQUIRED

Voltage Transducer   Current Transducer   Frequency Transducer   Watt, Watt.hrs Transducer   Power Factor

* APPLICATION CONCEPT

MI

EUF-C

LOADGUARD CONNECTIONS

1,pf

pf

1

Load

LOAD v CURRENT and POWER FACTOR
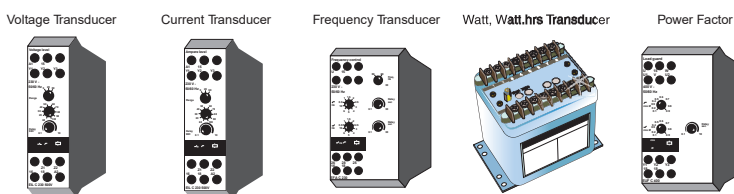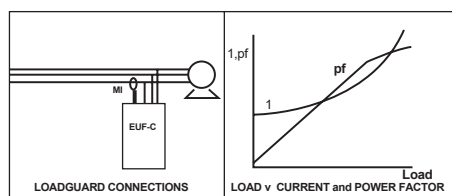
Power factor gives an accurate measure of load change, particularly at low to medium loads, where current is dominated by it's magnetizing element. Where prompt action is required the optional relays in the Tiger 320 Series meter can be used for protection against broken belts, pump cavitation, conveyor stalling and general overloads.

Example Single Phase Power Module Setup Procedure

Our customer has a powerful single phase motor connected to the 120 V rms supply. The motor can draw up to 200 A rms under full load. As part of the supervisory program, the owner requires to monitor the line voltage, current draw, and resultant power usage simultaneously.

A Tiger 320 Series triple display meter is installed to display:

- Channel 1:   Current (I rms) on the top (primary display).
- Channel 3:   Voltage (V rms) on the middle display.
- Channel 4:   Power usage (kW) on the bottom display.
- Channel 2:   Configured to read the line frequency at 0.01 Hz resolution (displayable in the view mode).

Because there is a 5 A rms maximum current limit on smart power module IW02, a 200:5 current transformer is used to sense the load current.

The meter is calibrated at the factory to the following default settings with a scale factor of 1 and an offset of 0:

- 30,000 counts for 5 A rms.
- 1000 counts for 100 V rms.
- 10,000 counts for 500 W.

To accommodate the customer's specifications, the offsets remain at 0, but the scale factors must be adjusted to display (See **Recalibration Procedures** on Page 7):

- 20,000 counts for 200 A on CH1.
- 1,200 counts for 120 V on CH3.
- 24,000 counts for 24 kW on CH4.

The new scale factors are calculated as follows:
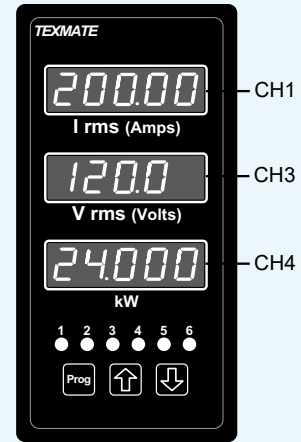
1 CH1 Scale Factor

Our **200 A** load is reduced to **5 A** to suit the smart input module's maximum current limit by passing it through a 200:5 current transformer (CT).

The original factory setting was **30,000** counts for the maximum load.

We now want to display **20,000** counts for the same load. Therefore, the scale factor is calculated as:

$$\text{CH1 Scale Factor} = \frac{20,000}{30,000} = \textbf{0.666} \text{ (I rms)}$$

2 CH3 Scale Factor

Our original factory setting for the **100 V** line voltage was **1,000** counts. Applying a new line voltage of **120 V** to the original settings for CH3 displays **1,200** counts on the meter. Therefore, no adjustment is necessary and the scale factor remains unchanged at **1.0**.

3 CH4 Scale Factor

Our original factory setting for the power reading on CH4 is:

5 A load & 100 V line voltage = 500 W over 10,000 counts

Our load has now increased to 200 A, which is passed through a 200:5 CT effectively retaining a 5 A load. Our line voltage has increased to 120 V displayed over 1,200 counts. This means we now have:

5 A load (actual 200 A) & 120 V line voltage = 600 W over 12,000 counts

We wish to double the resolution of the power reading on the display to 24,000 counts for the maximum load. Therefore, the scale factor is calculated as:

$$\text{CH4 Scale Factor} = \frac{24,000}{12,000} = \textbf{2.0}$$

TEXMATE

200.00 — CH1
I rms (Amps)

120.0 — CH3
V rms (Volts)

24.000 — CH4
kW

1 2 3 4 5 6

Prog ⬆ ⬇

USER'S RESPONSIBILITY

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