

Metering and Measurements Relay



Cooper Power Systems

Electrical Apparatus

150-75

MU30 Multifunction Measurement Relay

The MU30 Measurement and Metering module is a member of Cooper Power Systems' **Edison**® Series of microprocessor based protective relays and provides comprehensive measurement and metering functions from a common measuring point. The MU30 unit offers the following functions:

- Inputs for three phase currents and three phase to ground voltages.
- Comprehensive voltage, current, real power (W), reactive power (VAR), apparent power (VA), power factor, frequency, kilowatt-hour, and kVAR-hour measurements.
- Demand metering for currents, real power, reactive power, apparent power, kW-Hours, and kVAR-Hours.
- Two over/under instantaneous voltage elements (27/59)
- Two over/under instantaneous frequency elements (81O/81U)
- Two over/under instantaneous current elements (37I/50)
- Two over/under instantaneous power elements
- Two over/under instantaneous reactive power elements
- Two under/over instantaneous apparent power (kVA) elements
- Two watt-hour instantaneous threshold elements
- Two VAR-hour instantaneous threshold elements
- Time synch input.
- Single event, triggered, 12 cycle oscillographic capture on all six input channels.

The MU30 also shares the following features common to all Edison Series relays:

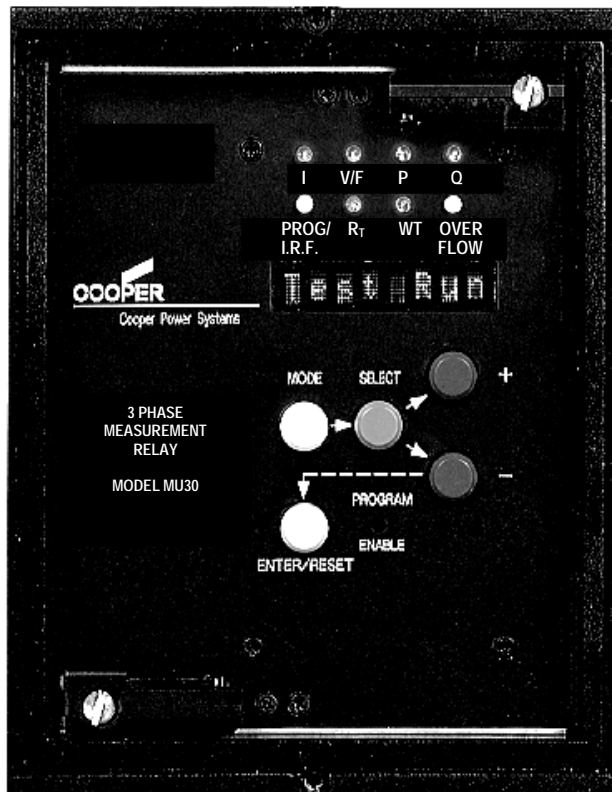


Figure 1
Front View of the MU30 Measurement Unit

- Simple five button man machine interface (MMI) allows access to all functions, settings, and stored data without the need for a computer.
- Bright electroluminescent display easily visible even in brightly lit environments.
- Draw-out design permits relay testing without disturbing connections to case.
- Modbus communication protocol and RS485 terminal on rear.
- Modular design allows the draw-out module to be fitted to a variety of space saving cabinet styles.
- Three programmable Form C (SPDT) output contacts and one Form A/B contact.
- Programmable reset characteristics.
- Dedicated power supply/relay fail output contacts.
- Basic event records.
- Cumulative trip counters.
- Auto-ranging power supplies.

APPLICATIONS

The MU30 is ideal for obtaining any type of metered value on a bus or feeder. Measured values may be displayed on the front panel of the MU30, or may be accessed via Modbus for use in a SCADA or data logging system. The ability to operate output contacts on the basis

of any measured quantity makes the MU30 an extremely flexible device for a wide variety of applications, such as: reverse power, reactive or voltage based control, frequency based load shedding, transformer overload (MVA) alarms, and so on. Any of the protective elements may be disabled if not required for a given application.

CURRENT AND VOLTAGE MEASUREMENTS

The MU30 provides the following current and voltage rms¹ measurements:

- A, B, and C phase current
- Three phase average current
- A, B, and C phase to neutral
- Three phase to phase voltages
- Average phase to neutral voltage
- Average phase to phase voltage

POWER MEASUREMENTS

The MU30 provides the following power measurements:

- A, B, and C phase power factor
- Three phase average power factor
- A, B, and C phase apparent power (VA)
- Total three phase apparent power
- A, B, and C phase real power (Watts)
- Total three phase real power
- A, B, and C phase reactive power (VAR)
- Total three phase reactive power

ENERGY MEASUREMENTS

The MU30 provides the following energy measurements:

- Three phase watt-hours and var-hours accumulated over a demand window adjustable between 5 to 15 minutes.
- Total watt-hours and var-hours from last relay reset

MAXIMUM VALUE DATA

For all current and power (real and reactive) quantities, the MU30 also records the maximum values measured since the relay had received a “reset maximum demand values” command. The time of this reset command is logged, as is the elapsed time from the reset that the maximum values were recorded². This allows the time at which the maximum value was recorded to be determined.

PROTECTIVE ELEMENTS

The MU30 provides a wide range of instantaneous protective elements based on the measured quantities. Two elements are provided for each measured value except power factor. Each of these elements may be programmed to behave as an under-, over-, or over/under³ element.

TRIP COUNTERS

A counter is maintained for each protective element which tallies the cumulative total number of trips each element has experienced.

TARGETS

Eight bright LED targets are provided as follows:

- Six red LEDs, one each for current, voltage/frequency, power, reactive power, watt-hours, and var-hours. The LEDs illuminate when one of the protective elements associated with that LED picks up. The LEDs reset only by manual reset or communication based reset command.
- One yellow LED (marked O.F) flashes if any of the measured quantities results in an overflow of its storage register.

² Up to 100 hours from the reset time. After 100 hours the delta timer rolls back to zero.

³ Absolute value of the difference of the measured value from the setting.

- A second yellow LED flashes when the relay is in programming mode, and illuminates constantly upon relay or power supply failure.

RESET CHARACTERISTICS

The output relays may be programmed to reset in one of two manners.

- Instantaneously upon the input or calculated quantities dropping below the pickup value.
- Manual reset (by front panel or computer command) only.

EVENT RECORDS

The MU30 records for the most recent protective element trip the values of the three phase currents and voltages, system frequency, and phase power factors.

TRIGGERED OSCILLOGRAPHIC CAPTURE

The MU30 will capture a single 12 cycle⁴ oscillographic record of all three current and voltage waveforms. The record is captured upon external signal (dry input) or by Modbus command. The data is recorded at 12 samples per cycles. The data must be retrieved by Modbus. The Edison relay interface software, EdisonCOM, provides such a retrieval facility.

TIME SYNCHRONIZATION

The MU30's clock can be set manually or be set through an external synchronization pulse. The pulse may be set to arrive at 5, 10, 15, 30, or 60 minute intervals. Time clock resolution is 10msec. The time clock feature may also be disabled.

ACCURACY

Voltage and current measurements are accurate to better than 1.0%. Power and power factor calculations are accurate to within 2%. Energy measurements (kW-Hour, etc) accuracy varies with the length of the energy calculation window and whether the MU30 clock is allowed

⁴ 6 pre-fault and 6 –post fault cycles.

¹ RMS through the 5th harmonic.

to free-run, or whether it is tied to a synchronizing signal. Frequency measurement resolution is 0.01 Hz.

ENERGY OUTPUT PULSE

If desired, one of the output relays can be set to toggle its status with a frequency proportional to the currently measured active power (watts). A 1Hz square wave corresponds to the nominal active power .

OUTPUT ELEMENTS

The following functions may be programmed to one or more of the output relays.

- First instantaneous voltage element.
- Second instantaneous voltage element.
- First instantaneous current element.
- Second instantaneous current element.
- First instantaneous frequency element.
- Second instantaneous frequency element.
- First instantaneous Watt element.
- Second instantaneous Watt element.
- First instantaneous VAR element.
- Second instantaneous VAR element.
- First instantaneous VA element.
- Second instantaneous VA element.
- First instantaneous kW-Hour element.
- Second instantaneous kW-Hour element.
- First instantaneous kVAR-Hour element.
- Second instantaneous kVAR-Hour element.

DIAGNOSTICS

Complete memory and circuit diagnostics are run upon powering the relay. The revision level of the firmware is displayed at this time.

The relay provides two manual test routines which may be run at any time. The first routine performs the same 15 minute test as in addition checks the target LEDs and the control circuitry to the output relays without operating the output relays.. The second test is identical but also operates the output relays.

During normal operation the relay suspends operation every 15 minutes for 10 msec and runs a comprehensive set of diagnostics that includes memory checksum, test of the A/D converters by injection of an internally generated reference voltage, and a check of the ALU.

Table 1: Functional Specifications

Nominal system frequency setting range	50 or 60 Hz
Programmable rated primary input current of phase and neutral CTs.....	1 - 9999A in 1A steps
Programmable rated primary system phase-to-phase voltage of PTs.....	0.1 – 655 kV in 10 kV steps
Rated PT secondary voltage	100 – 125 V in 1 V steps
Energy (Watt, VAR, and VA) integration time, (T_{int})	5 – 15 minutes in 1 minute steps
Differential Trip Elements⁵ (2 separately programmable elements available for each)	
<i>Note: All trip elements may be set to function as over-, under-, or over/under (Absolute value of the change) elements. In addition, any element or elements may be set to Disable.</i>	
Voltage elements trip setting	5 – 90% of rated PT voltage in 1% steps
Current elements trip setting.....	5 – 95% of rated CT current in 1% steps
Frequency elements trip setting.....	0.05 to 9.99 Hz in 0.01 Hz steps
Watt elements trip setting.....	5 – 95% of rated PT x CT quantity in 1% steps
VAR elements trip setting	Same as for Watt elements
VA elements trip setting.....	Same as for Watt elements
Watt-hour elements trip setting.....	5 – 95% of rated (PT x CT x T_{int} / 60) quantity in 1% steps
VAR-hour elements trip setting.....	same as for Watt-hour elements

⁵ The elements are set to detect changes from the default value of the appropriate quantity. The default values are the rated system frequency, voltage, and current. All are set in PU.

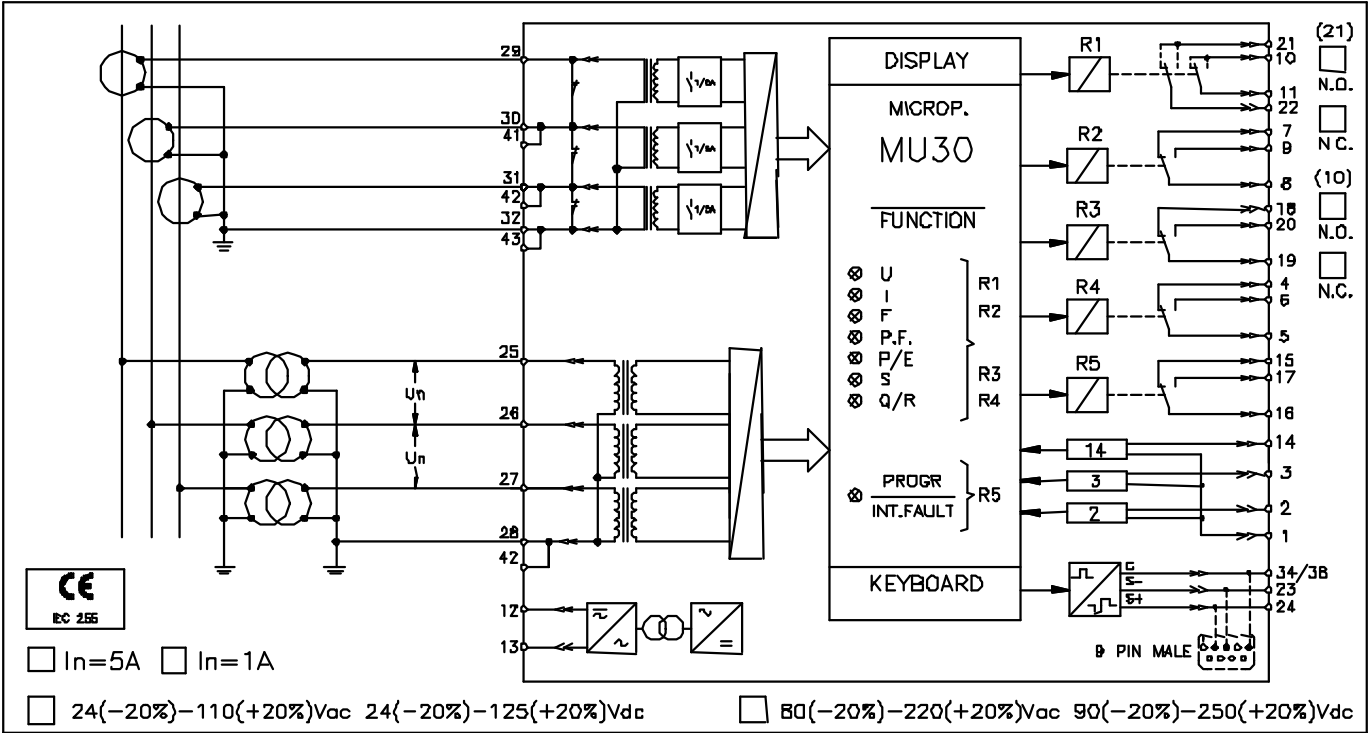


Figure 2 - Wiring Diagram for the MU30 Relay

ORDERING INFORMATION

Construct the catalog number from the following table:

Base Relay Model	Power Supply ¹		Rated CT Input		Case Style ²	
	Code	Description	Code	Description	Code	Description
PRMU30J	L	24-110V AC/DC	1	1A	D	Draw-out relay only, no cabinet supplied
	H	90-220V AC/DC	5	5A	S	Single case
					T	Double case
					N	19" rack mount
					C2 C3 C4	Denotes mounting position in either a double case or 19" rack along with other relays ordered at the same time.

Example: PRMU30JL5S is an MU30 with low range power supply, 5A CT inputs, in a single relay case.

If ordering two or more relays to be fit in a common case, the first relay ordered should indicate the case style desired. This relay will be located in the leftmost bay of the case. Subsequent relays should use the C2, C3, or C4 suffixes to denote their position in the case using the leftmost bay as a "C1" reference.

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⁶ The power supplies are user replaceable and interchangeable. See catalog section 150-99.
⁷ The relay itself may be drawn out of any of the listed cases and plugged into any of the other case styles. The catalog number specified during ordering denotes the type of cabinet in which the relay will be shipped.