On-Load Tap-Changer Relay

COOPER Power Systems

Electrical Apparatus

MTR33 Transformer On-Load Tap-Changer Relay

150-29

The MTR33 Transformer On-Load Tap-Changer relay is a member of Cooper Power Systems' **Edison**® Series of microprocessor based protective relays and provides voltage regulating control of transformer on-load tap changers. The MTR33 relay offers the following functions:

- Automatic voltage regulation with proportional control pulse.
- Over / Under current lock-out and protection levels.
- Over / Under voltage lock-out and protection levels.
- Line voltage drop compensation.
- Modbus Communication Protocol.
- UL /CSA listed.

The MTR33 also shares the following features common to all Edison Series relays:

- 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.
- Pick-up (start-time) elements.
- Dedicated power supply/relay fail output contacts.
- Event records.
- Cumulative trip counters.
- Auto-ranging power supplies.
- Programmable reset characteristics.

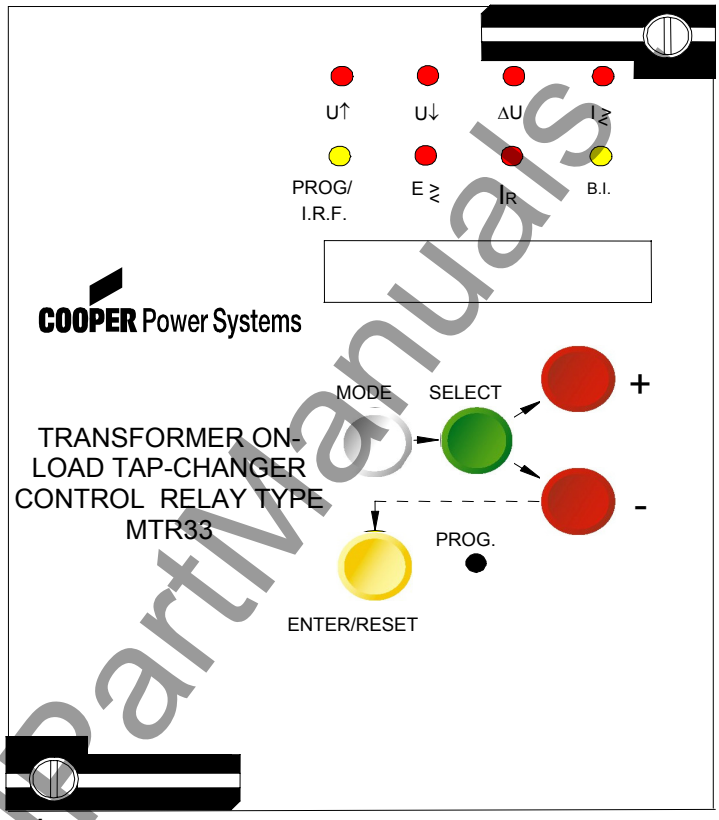


Figure 1
Front View of the MTR33 Transformer On-Load Tap-Changer Relay

APPLICATIONS

The MTR33 is a voltage-regulating relay for the control of transformer on-load tap changers. The MTR33 requires three voltage and three current inputs. The settings required for the tap-changer control element are reference voltage, regulator insensitivity (minimum operation voltage difference), drop out level (reset voltage differential), minimum operation wait time, period of pulse to voltage regulator, minimum pulse duration, maximum pulse duration, and gain for proportional pulse duration. The MTR33 provides a pulsed contact output to control the tap-changer. The regulator will lock-out if the undervoltage or overvoltage element is below the defined limit. The lock-out action prevents unnecessary control actions and helps increase the life of the tap-changer. Two digital inputs are provided: the circulation current control element and the regulator control relays (R3 and R4). Five output relays are provided, four of which are programmable. Independent pickup and time-delayed functions are provided which may be assigned to operate any of the two programmable output relays. The remaining two programmable output relays (R3 and R4) are reserved for voltage regulation.

TAP-CHANGER CONTROL

Voltage regulator control starts operating when the difference between the input voltage U and the set reference voltage [Ub] exceeds the set level [ΔU]: U< [Ub] - [ΔU]; U> [Ub] + [ΔU]. Voltae regulator control stops operating when the voltage difference becomes smaller than [ΔU] - [ΔR]: U> [Ub- (ΔU-ΔR)]; U< [Ub+(ΔU-ΔR)]

Voltage regulation is inhibited:

- When the voltage is out of the set limits: [E<]>E>[E>].
- When the current is out of the set limits: [I<]>I>[I>].
- When lock-out input 3 is active. (Terminals 1-3 shorted)
- When the current exceeds the set value “Ib”. The variable “Ib” represents the rated current of the controlled transformer as per unit of the CT rated current: Ib = (0.3 – 1.2)In.

The actual pulse duration **tp** is proportional to the measured voltage difference according to the set value of the gain [Gs/V].

CURRENT CIRCULATION CONTOL

Multiple transformers and multiple MTR33 regulating relays in parallel on a common bus-bar share and compare the load current to minimize current circulation.

REGULATOR’S CONTROL RELAYS

The regulator’s control relays R3 and R4 block the digital input operation when the relevant terminals are shorted.

UNDER VOLTAGE

An undervoltage element is provided that blocks from attempting to regulate any further.

OVER VOLTAGE

An overvoltage element is provided that blocks from attempting to regulate any further.

UNDER CURRENT

An undercurrent element is provided that blocks from attempting to regulate any further.

OVER CURRENT

An overcurrent element is provided that blocks from attempting to regulate any further.

TARGETS

Eight bright LED targets are provided as follows:

- Voltage increase (Red)
- Voltage decrease (Red)
- Change in voltage is outside limits (Red)
- Current is outside upper and lower limits (Red)
- Programming mode / Internal fault (Yellow)
- Voltage is outside upper and lower limits (Red)
- Circulation Current (Red)
- Blocking Input (Yellow)

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.

MEASUREMENTS

All measured values displayed are continuously refreshed.

- Input Frequency
- Input Voltages (Phase A,B,C)
- Voltage Difference
- Input Current (Phase A,B,C)
- Phase Displacement
- Transformer Current
- Bus-Bar Average Current

OUTPUT ELEMENTS

The following functions refer to the output relay programming display definitions.

- Delayed element of undercurrent and overcurrent operated relays R1 and/or R2.
- Delayed element of undervoltage and overvoltage operated relays R1 and/or R2.
- The reset after tripping of the relays associated to the time delayed elements can take place automatically when current drops below the trip level, or manually by the operation of the “Enter/Reset” key.
- Decrease in voltage operates relay R3.
- Increase in voltage operates relay R4.

BLOCKING LOGIC

MTR33 has two inputs, which perform blocking functions. The open circuit voltage across the terminals of these inputs is 15VDC. The internal resistance is 2.2K. When the external resistance across these terminals is less than 2.0K, they are considered to be shorted. These two blocking inputs provide functionality as defined above.

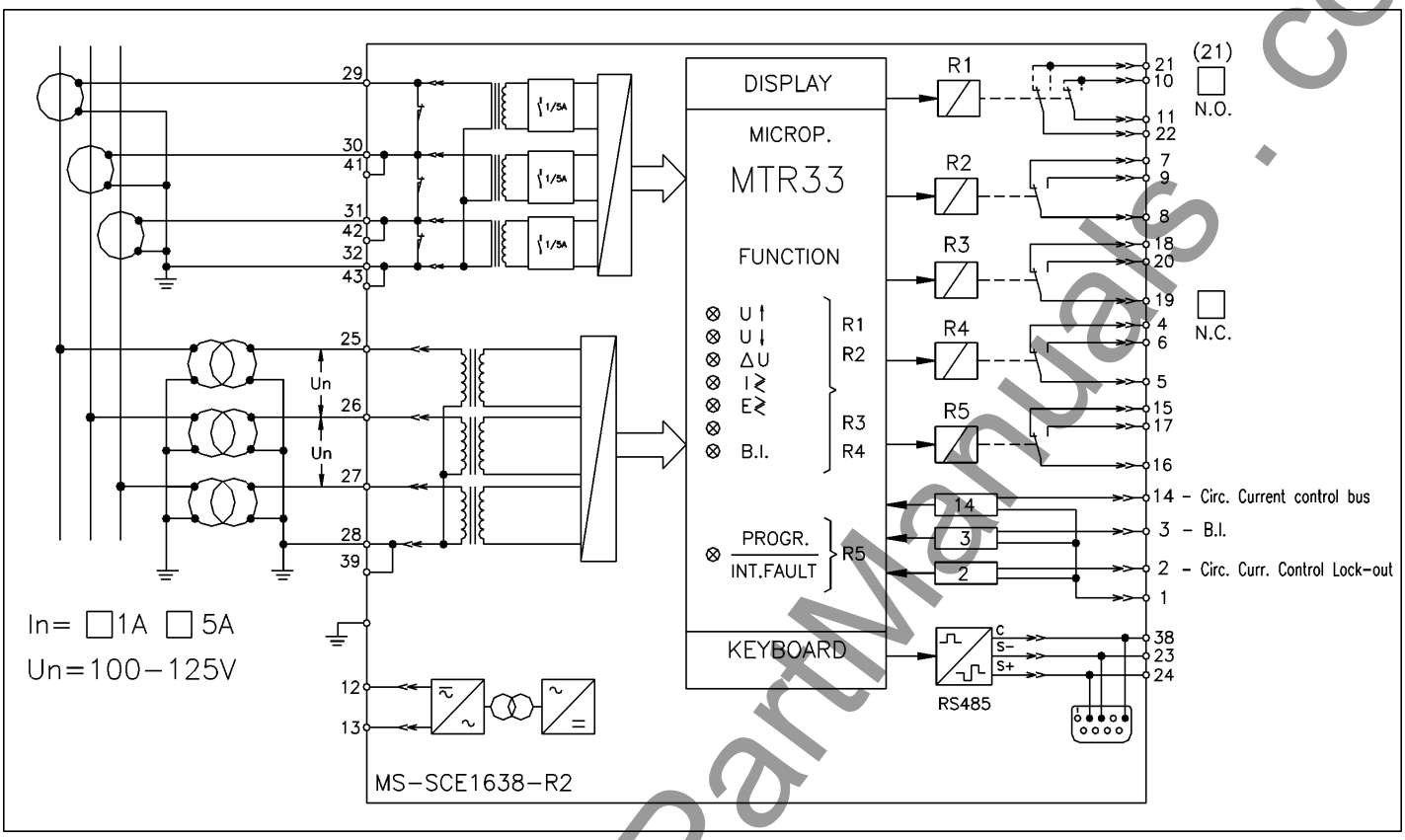
MODBUS COMMUNICATION

Modbus RTU protocol is included which provides access to metering, settings and event data.

Table 1: Program Setting Variables

Display	Description	Setting Range
Fn 50 **Hz**	Mains frequency: setting range	50 or 60 Hz
Un 100**V**	Rated input voltage	100-125 V
In 500**A**	Rated primary current of CT's	0-9999 Amps in 1A steps
Ib 1.00 **In**	Transformer rated current (control lock-out level)	0.30-1.2 pu of In in 0.01 steps
E< 80**%En**	Undervoltage level for regulation Lock-out (En=Un/√3)	15-120 % En in 1% steps, or Disable
tE< 3 **s**	Undervoltage alarm time delay	0.1-30 seconds in 0.1 second steps
E>120**%En**	Overvoltage level for regulation Lock-out (En=Un/√3)	15-120 % En in 1% steps, or Disable
tE> 3 **s**	Overvoltage alarm time delay	0.1-30 seconds in 0.1 second steps
Ub100**%Un**	Reference voltage	70-150 V
ΔU 10**%Ub**	Regulator insensitivity (minimum operation voltage difference) U%>(100+ΔU-ΔR); U%<(100-ΔU)	1-20 In % Ub in 1% steps
ΔR1.0**%Ub**	Drop out level (reset voltage differential) U%<(100+ΔU-ΔR); U%>(100-ΔU+ΔR)	0.1-9.9 V In % Ub in 0.1% steps
a	Operation level of the Reactive Current Control	0.10-0.50 in 0.01 steps or Disable
b	Reset level of the Reactive Current Control	0.05-0.45 in 0.01 steps
to 10 **s**	Minimum operation wait time	1-600 seconds in 1 second steps
Tp 10.0 **s**	Period of pulse to voltage regulator	0.1-60 seconds in 0.1 second steps
tp< 0.5 **s**	Minimum pulse duration	0.1-60 seconds in 0.1 second steps
tp> 6.0 **s**	Maximum pulse duration	0.1-60 seconds in 0.1 second steps
G 0.2 **s/V**	Gain for proportional pulse duration	0-9.9 (s/V in 0.1 steps)
I> 1.5 **In**	Overcurrent level for regulation Lock-out	0.1-5 In, in 0.1 steps or Disable
tI> 2.0 **s**	Overcurrent alarm time delay	0.1-30 seconds in 0.1 second steps
I< 0.2 **In**	Undercurrent level for regulation Lock-out	0.1-5 In units in 0.1 steps or Disable
tI< 10.0 **s**	Undercurrent alarm time delay	0.1-30 seconds in 0.1 second steps
NodAd 1	Identification number for connection on serial communication bus	1 – 250 in steps of 1

Figure 2 - Wiring Diagram for the MTR33 Relay



ORDERING INFORMATION

Construct the catalog number from the following table:

Base Relay Model	Power Supply[1]		Rated CT Input[2]		Case Style	
	Code	Description	Code	Description	Code	Description
PRMTR33	L	24-110V AC/DC	1	1A	S	Single case
	H	90-220V AC/DC	5	5A		

Example: PRMTR33H5S is an MTR33 with high range power supply, 5A CT inputs, in a single relay case.

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[1] The power supplies are user replaceable and interchangeable. See catalog section 150-99.

[2] The rated CT input is jumper selectable. If ordered incorrectly, the user may draw the relay out of its case and change the jumper setting.