GE Power Management

Modular Voltage Relays

TOV

Instructions

GEK 98834B

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The information provided herein does not intend to cover all details of the variations of the described equipment nor does it take into account the circumstances that may be present in your installation, operating or maintenance activities.

Should you wish to receive additional information, or for any particular problem which cannot be solved by referring to the information contained herein, please write to:

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1. DESCRIPTION

The TOV relays are over or undervoltage relays, single phase or three phase, instantaneous or fixed time adjustable from 0.1 to 25.5 s.

The settings are adjusted using the switches located on the front side of the relay.

The single phase type relays include a filter for the third harmonic. The three phase models do not include that filter.

The TOV relays are modular solid state relays and are supplied to the customer in a 1/8 rack case, allowing it to be a part of a distribution system.

2. MODEL LIST

2.1. Three Phase Model List

TOV	4	0	*	3	*	0	3	0	*	00	*	DESCRIPTION
			1									Voltage range: 20/275 VAC
			2									Voltage range: 50/305 VAC
					I							Undervoltage
					M							Overvoltage
									F			Vaux= 24/48 VDC/VAC
									G			Vaux= 48/125 VDC/VAC
									H			Vaux= 110/240 VDC 110/220 VAC
											C	Individual housing
											S	As part of a MID system

2.2. Single Phase Model List

TOV	5	0	*	3	B	*	1	0	*	00	*	DESCRIPTION
			1									20/275 VAC
			2									50/305 VAC
			3									3/66 VAC
						1						50 Hz filter
						2						60 Hz filter
									F			Vaux= 24/48 VDC/VAC
									G			Vaux= 48/125 VDC/VAC
									H			Vaux= 110/240 VDC 110/220 VAC
											C	Individual housing
											S	As part of a MID system

2.3. Special Models

TOV	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**-**	**0**	**1**	**-**	Timing: t=0.19 + 0.75 * ( )
TOV	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**-**	**0**	**2**	**-**	Timing: t=0.375 + 1.5 * ( )
TOV	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**-**	**0**	**3**	**-**	Instantaneous = 20 ms
TOV	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**-**	**0**	**4**	**-**	Number or tripping contacts increased

All of the models include one n.o. trip contact, three form C type relays, one for power supply alarm, one for pickup and one auxiliary trip.

The operating input voltage is as follows depending on the model:

- 20 to 275 VAC in 1 V steps
- 50 to 305 VAC in 1 V steps
- 3 to 66 VAC in 1 V steps

The relay power supply range can be selected from the following choices:

- 24/48 VDC/VAC ± 20%
- 48/125 VDC/VAC ± 20%
- 110/240 VDC ± 20%
  110/220 VAC ± 20%

3. APPLICATION

Some of the most common applications of the TOV when operating as an undervoltage relay are:

1. Instantaneous detection of undervoltage in automatic transfer equipment.
2. Fault detection for line protection equipment with a communication channel. If the line has three terminals, and one of them does not contribute to the fault.

Some of the most common applications of the TOV when operating as an overvoltage relay are:

1. Time delay devices, in which operation security depends on the voltage.
2. Protection against overvoltage in a three phase system, with the possibility of being delayed from 100 ms up to 25.5 s.
3. Protection against a phase to ground fault in three phase systems with an insulated ground and in ground fault protection of AC rotating machines.

4. TECHNICAL CHARACTERISTICS

4.1. Temperature Range

Operating: 14 °F to 131 °F (-20 °C to +55 °C)
Storage: -40 °F to 149 °F (-40 °C to +65 °C)

4.2. Insulation Test

Between any terminal and ground:

2 kV, 50/60 Hz, 1 min duration.

Between independent circuits:

2 kV, 50/60 Hz, 1 min duration.

4.3. Operating Range Depending on the Different Models

20 to 275 VAC in 1V steps
50 to 305 VAC in 1V steps
3 to 66 VAC in 1V steps

4.4. Auxiliary Power Supply

Rated Voltage VDC/VAC	Operating Range VDC/VAC
24/48	19/58
48/125	38/150
110/240	88/288

If the power supply falls below the values listed in the table, the relay disconnects automatically and activates a "power supply alarm" auxiliary contact.

The power supply variation included in the ranges established by the table cause a variation in the operating margins not greater than 3%. The relay consumption is less that 3W for any power supply value.

4.5. Trip Contact Capacity

Continuous: 3A
Make and carry: 30A
Break: 180 VA resistive at 125/250 VDC
60 VA inductive at 125/250 VDC.

4.6. Auxiliary Contacts Capacity

Continuous: 3 A
Make and carry: 5 A during 30 s.
Break: 25 W inductive at 125/250 VDC
Carry continuously: 20 W maximum of 250 VDC or 5 A.

4.7. Accuracy

Voltage: ±5%
Time: ±5% or 30 ms (whichever is greater).

4.8. Ambient Humidity

Up to 95% without condensation.

4.9. Frequency Range

	SINGLE PHASE	THREE PHASE
Rated frequency	50 or 60 Hz	50/60 Hz
Effective range	48/51 Hz or 57/63 Hz	48/63 Hz
Operative range	46/53 Hz or 56/64 Hz	46/64 Hz

4.10 Burdens

20-275 VAC and 50-305 VAC ranges

Tap set to 50 VAC

V (VAC)	VA
30	0.012
120	0.100
210	0.291
300	0.783

3-66 VAC range

Tap set to 5 VAC

V(VAC)	VA
5	0.019
25	0.022
45	0.053
65	0.092

4.11. Maximum Voltage

Ranges 20-275 VAC and 50-305 VAC: 400 VAC continuously.

Range 3-66 VAC 200 VAC Continuously.

4.12. Type Tests

Insulation test:	2kV, 50/60 Hz for 1 min (IEC 255-5)
Impulse test:	5 kV peak, 1.2/50 μs, 0.5J (IEC 255-5)
1 Mhz noise test:	2.5 kV common mode, 1 kV differential mode, Class III (IEC 255-22-1)
Electrostatic discharge:	Class IV (IEC 255-22-2)
Radio interference:	Class III (IEC 255-22-3)
Fast Transient:	Class IV (IEC 255-22-4)

4.13. Timing

Instantaneous:	30 to 50 ms.
Definite time range:	130 ms to 25.5 s in 100 ms steps.

5. OPERATING PRINCIPLES

The different TOV relay models operation principles are shown in figures 1 and 2:

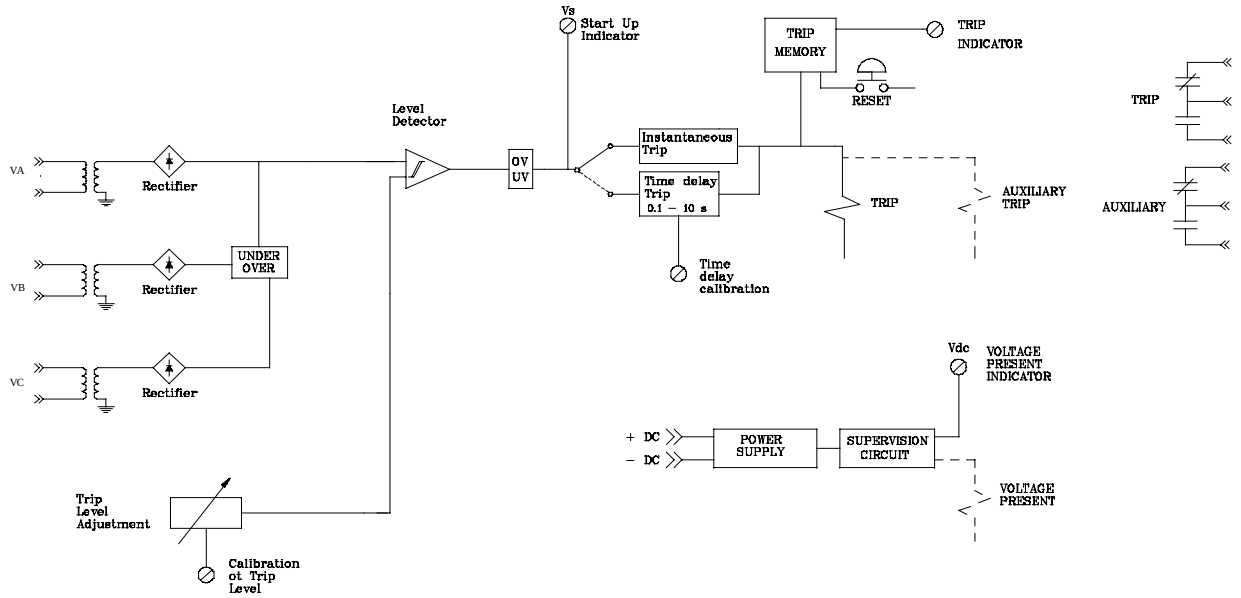


Figure 1. *Three Phase version block diagram*

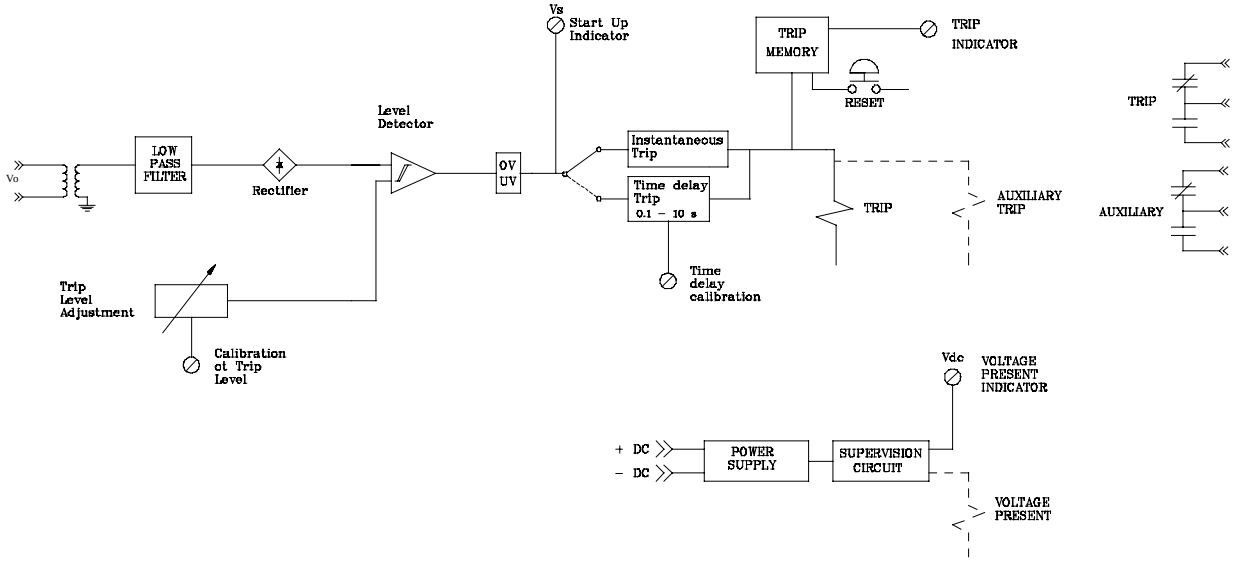


Figure 2. *Single phase version block diagram*

5.1. Three Phase Versions (TOV4000)

The input voltage transformers provide a secondary voltage adequate for the internal operation at low voltages as well as an electrical insulation with the internal electronic circuits.

The measuring signals are rectified and are compared with the trip level setting in the level detectors. Once a fault is detected (overvoltage or undervoltage), the pickup indicator Vs lights up.

When the fault has been detected, the trip can be instantaneous or time delayed. Selection of this option is performed by switches located on the front of the relay. If the fault situation remains once the set time has passed, the relay trips, and the trip indicator (TRIP) lights up. If the fault disappears, this indicator remains lighted until RESET button is pressed.

5.2. Single Phase Versions (TOV5000)

The single phase versions, different from the three phase versions, may include a filter for the third harmonic in the stage prior to the rectifiers, as well as the possibility of selecting the operating mode as undervoltage or overvoltage. As in the three phase case, the rectifier output signal is compared to the trip level.

Once the pickup has been produced, the operation is similar to the three phase model.

Both versions, single phase and three phase, have a power supply supervision circuit. If the power supply reduces by 20% of the rated voltage, the relay automatically turns itself off to prevent incorrect operations.

6. CONSTRUCTION

6.1. Case

The TOV case is made of steel. The general dimensions are provided in figure 3.

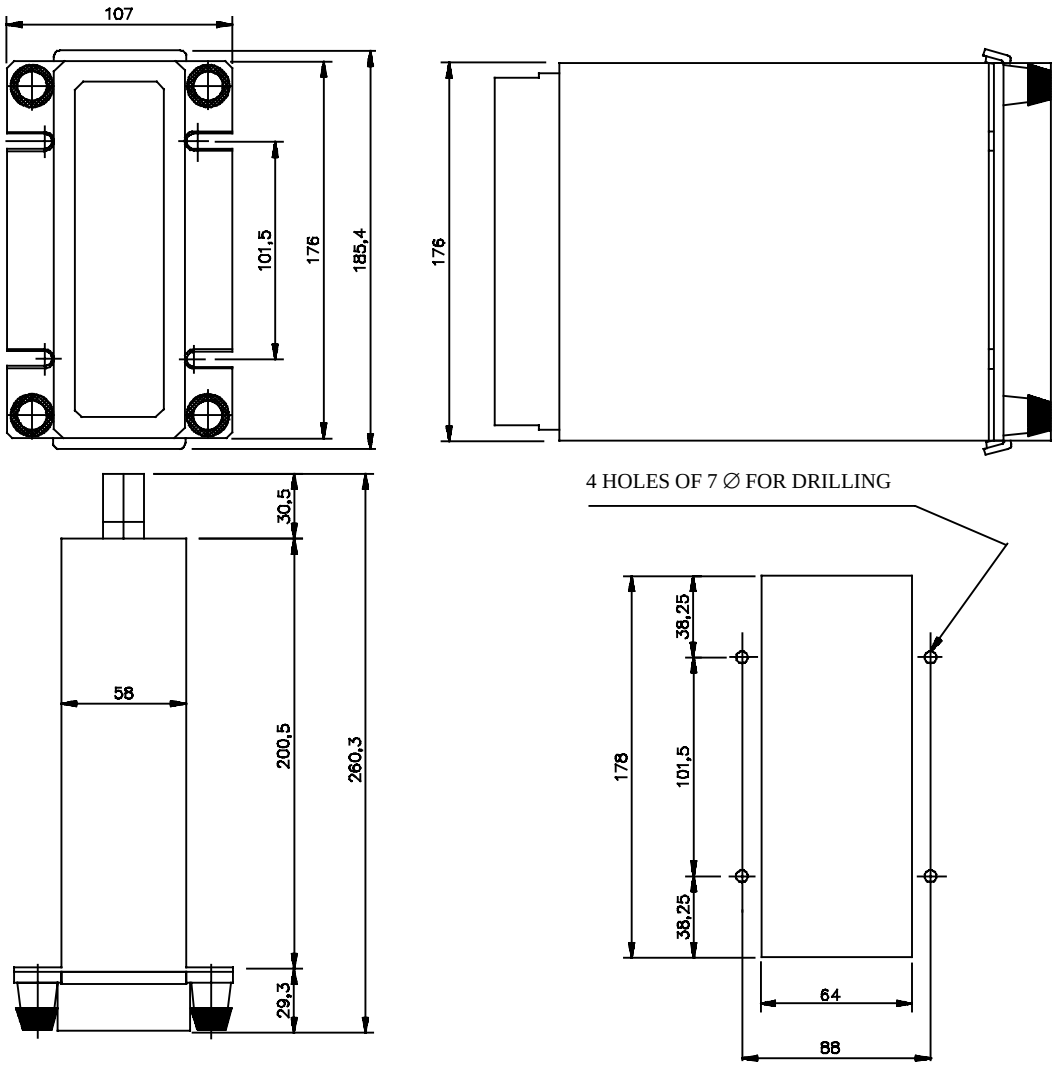


Figure 3. *Case dimensions in mm (226B6086H1)*

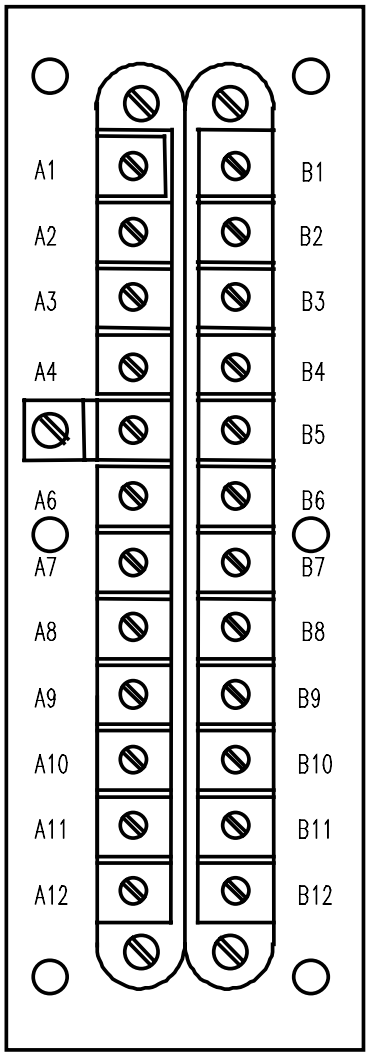


Figure 4. *Rear view (226B3205H1)*

Vertically mounted, the module contains a connector on the rear side that provides a mechanical support and electrical connections.

The case includes two plastic guides to ensure correct alignment.

6.2. Identification

The complete relay model is described on the nameplate. To ensure the correct identification, the model number should be checked so that it coincides with the number on the table in the description section.

6.3. External Connections

Figures 5 and 6 illustrate the TOV external connections for the three phase and single phase models respectively.

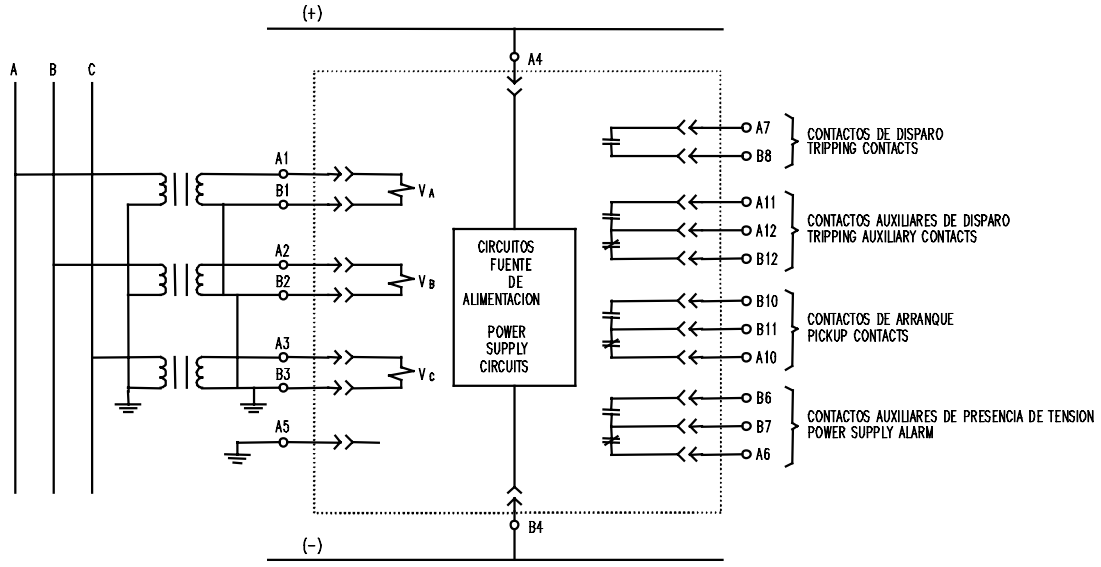


Figure 5. *Three phase version external connections (226B6083H1)*

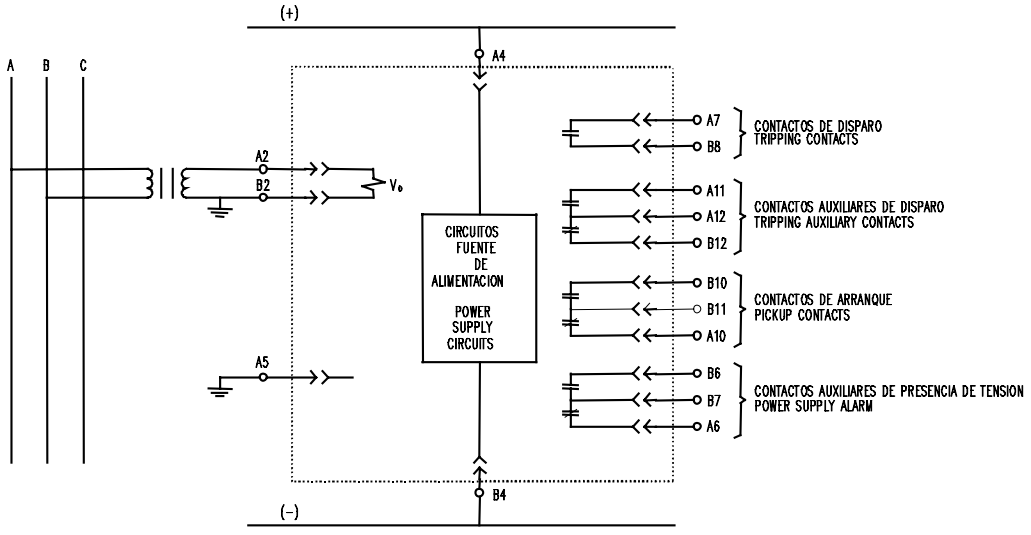


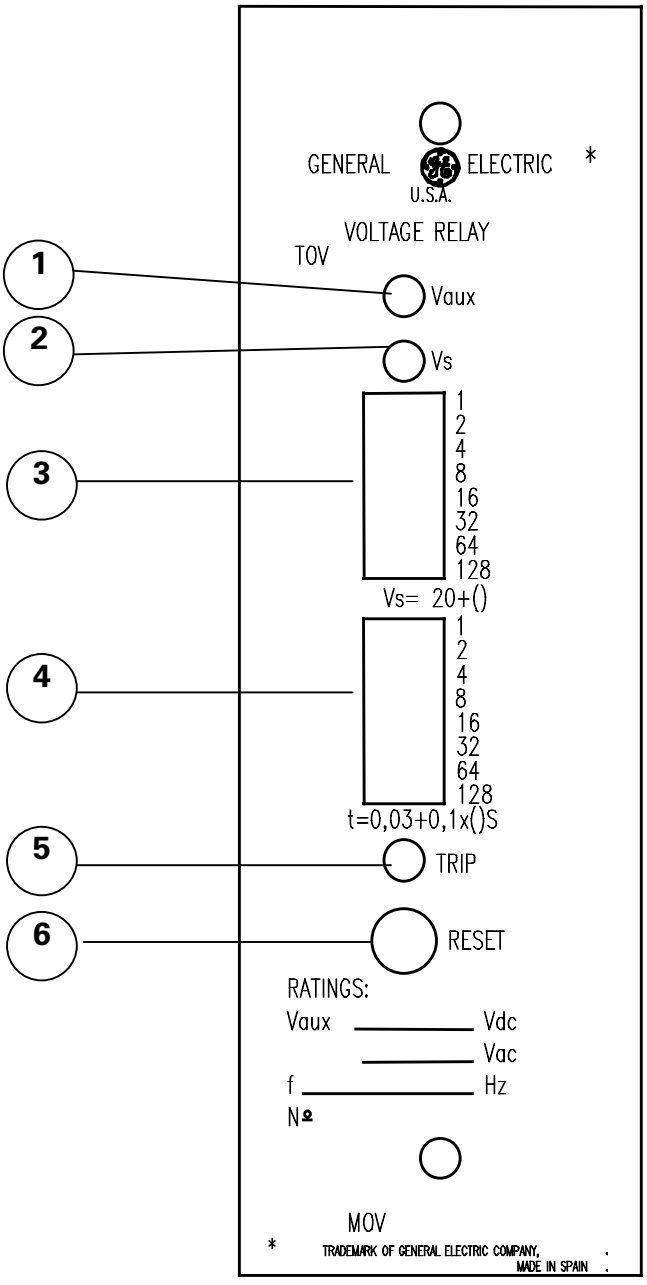
Figure 6. *Single phase version external connections (226B6083H2)*

6.4. Printed Circuits Board Module

The TOV relay consists of a single printed circuit board. The handles on the front allow the module to be removed from the case. The module's electrical connections are established through a male connector that is inserted inside a female connector located in the rear side of the case, allowing the module to be easily extracted.

6.5. Location of Controls and Targets

Figure 7 shows the location of the TOV's controls and targets.



1. Power On (Green LED)
2. Pickup indicator (RED LED)
3. Operating Voltage selection
4. Time selection
5. Trip indicator (RED LED)
6. Trip memory RESET pushbutton

Figure 7. *Location of controls and targets*

The green indicator located on the top of the module (Vaux) indicates the relay power supply status. When the power supply is operating correctly the indicator stays on, whereas if the power supply is disabled the indicator light is turned off.

The red LED below it (Vs) is the pickup indicator. This led remains lit as long as the relays detects a fault condition.

The red indicator labeled TRIP is a trip indicator that remains lit after a trip and can be turned off by pressing the RESET button once the cause of the trip has disappeared.

The microswitches on the front panel are divided into two groups, the upper group of microswitches is used to select the trip level while the lower group is used to select the timing.

6.6. Internal Controls and Test Points

The relays are calibrated before leaving the factory, therefore it is not necessary for the user to calibrate them.

Changing between overvoltage and undervoltage in the single phase models is performed through the use of jumpers as shown in figure 8:

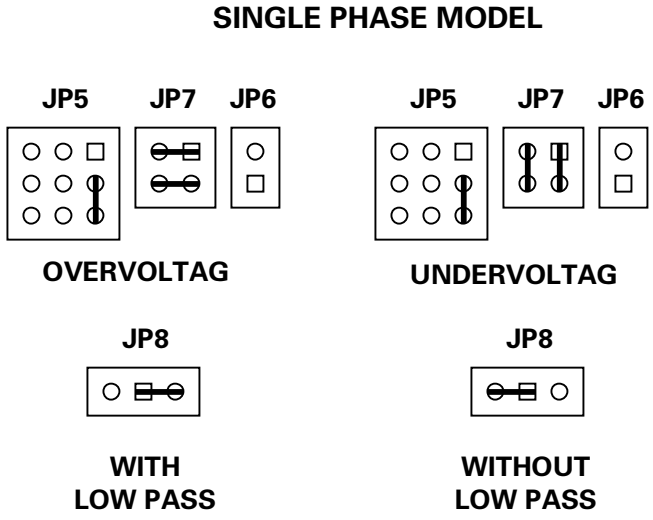


Figure 8a. *Under-overvoltage selection for equipments with PCB revision 4 or higher (for single phase models only)*

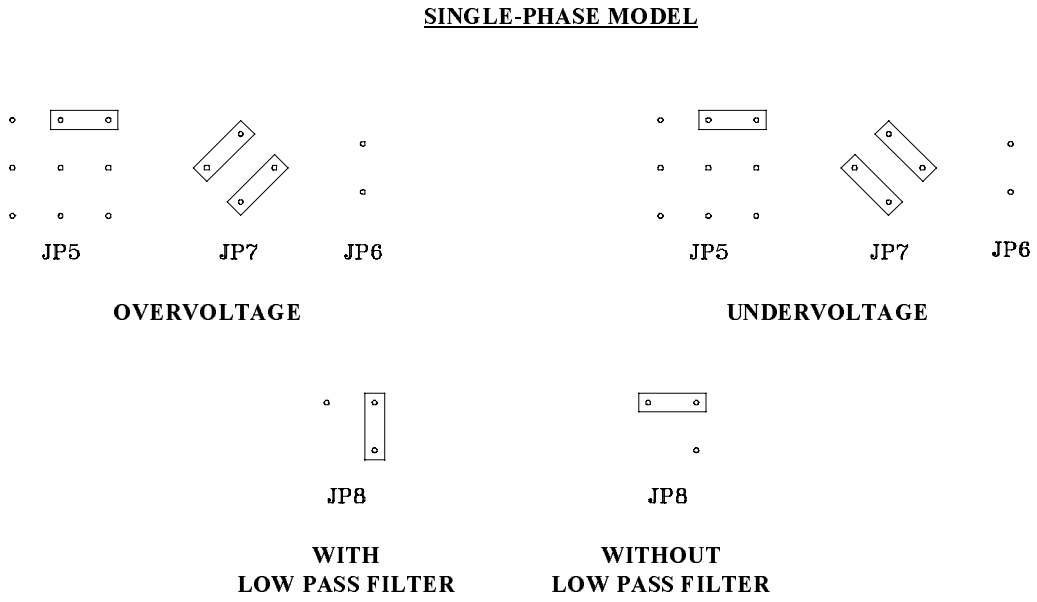


Figure 8b. *Under-overvoltage selection for equipments with PCB revision 3 or lower. (for single phase models only)*

7. RECEPTION, HANDLING AND STORAGE

This relay is supplied to the customer in a special package, which adequately protects it during transportation, as long as this is performed under normal conditions.

Immediately after receiving the relay, the customer should check whether it shows any signs of transportation damage. If injury or rough handling is evident, a damage claim should be filed at once with the Transportation Company and the nearest General Electric Sales Office should be notified promptly.

When unpacking the relay, care should be taken not to lose the screws supplied in the box.

If you do not intend to install the relay immediately, it is recommended that the relay is stored in its original package and kept in a dry, dust-free place.

It is important to check that the data on the nameplate coincides with the data from the order.

8. ACCEPTANCE TESTS

Immediately after receiving the relay, the customer should perform a visual check and perform the acceptance tests in this chapter to ensure the relay has not suffered transportation damage and that the factory calibration has not been altered.

These tests can be performed as installation or acceptance tests in accordance with user criteria. Given that the majority of users utilize different procedures for installation and acceptance tests, this section includes all of the necessary tests that may be performed with these relays.

8.1. Visual Inspection

Verify that the data on the nameplate coincides with the data from the order. Disassemble the relay and check that the parts have not been broken or damaged during transportation.

8.2. Electrical Tests

8.2.1. General Considerations about the Network

All devices that are powered by alternating current are affected by the frequency. Because a non-sine wave is the result of a fundamental wave and a series of harmonics belonging to this fundamental wave, the devices that are powered by alternating current are affected by the form of wave applied.

To correctly test relays that operate on alternating current it is necessary to use a voltage and/or a current sine wave. The purity of a sinusoidal wave (absence of harmonics) cannot be expressed specifically for any given relay. However, in any relay that includes tuned circuits, circuits R-L and R-C are affected by the non-sine waves as in the case of the TOV relay.

These relays respond to the voltage waveform differently from the majority of alternating current voltmeters. If the AC source used for the test contains many harmonics the voltmeter and the relay readings will be different.

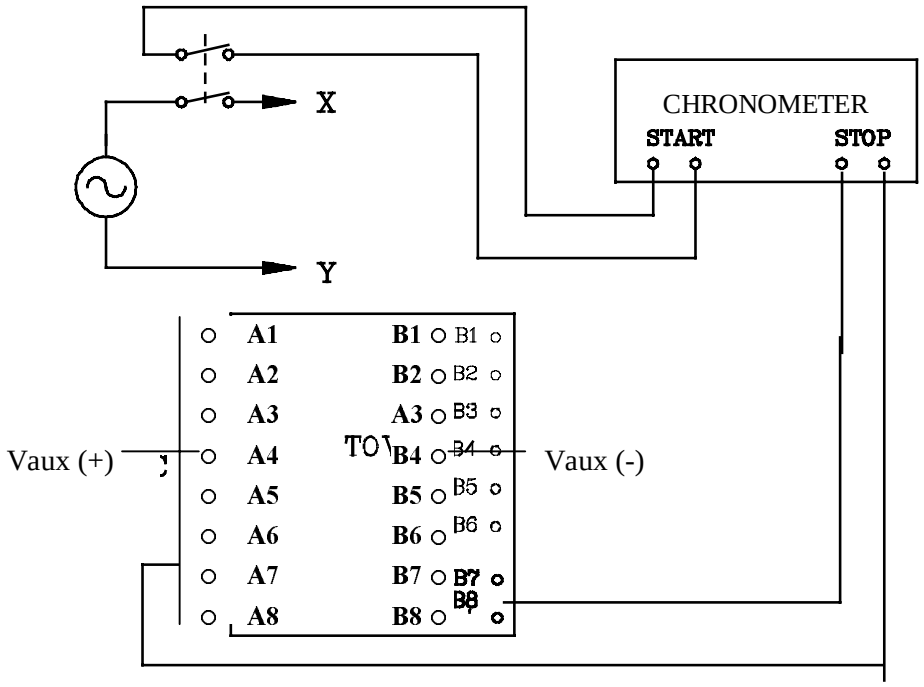
The relays are calibrated in the factory using a network of 50 or 60 Hz containing a minimum amount of harmonics. When testing the relay, you should use an AC source whose waveform does not contain harmonics.

The voltmeters and chronometers used to perform trip tests and operating time must be calibrated and their precision should be better than that of the relay. The network power used in the tests must remain stable, mainly in the levels near the pickup voltage.

It is important to stress that the precision used in the tests depends on the network power and the instruments used. Operating tests performed with inadequate power and instruments are useful to test that the relay operates correctly and that it's characteristics are verified approximately. However, if the relay is calibrated under these conditions, it's operating characteristics may be outside the tolerance levels.

8.2.2. Testing the LED Targets

Perform the connections in accordance with figure 9 without connecting the X and Y terminals and apply a DC voltage to the relay. Press the RESET button and check that all three LEDs on the front panel light up.



PHASE	A	B	C
X	A1	A2	A3
Y	B1	B2	B3

Note: In the single phase version connect X and Y to A2 and B2.

Figure 9. *Test connections.*

8.2.3. Trip Level Testing

Once the connections indicated in figure 10 are performed, (for a single phase relay connect the measuring voltage to terminals A2 and B2) connect the auxiliary power supply and set the relay for instantaneous trip.

Depending on the relay model (single phase, three phase, undervoltage or overvoltage) connect the X and Y terminals to the corresponding phases in accordance with figure 10. Vary the alternating voltage and check that the relay trips in accordance with the values in table 1.

In the same way, check that when the relay trips the TRIP indicator is lit and remains lit once the cause for fault disappears. Press the RESET button and check that the TRIP LED is turned off.

TABLE 1

Range 20 to 275

SWITCHES TO RIGHT (SW1)	Umin (VAC)	Umax (VAC)
8 (top)	19.95	22.05
7	20.9	23.1
6	22.8	25.2
5	26.6	29.4
4	34.2	37.8
3	49.4	54.6
2	79.8	88.2
1	140.6	155.4

Range 50 to 305

SWITCHES TO RIGHT (SW1)	Umin (VAC)	Umax (VAC)
8 (top)	48.45	53.55
7	49.4	54.6
6	51.3	56.7
5	55.1	60.9
4	62.7	69.3
3	77.9	86.1
2	108.3	119.7
1	169.1	186.9

Range 3 to 66

SWITCHES TO RIGHT (SW1)	Umin (VAC)	Umax (VAC)
6 (top)	3.8	4.2
5	4.75	5.25
4	6.65	7.35
3	10.45	11.55
2	18.05	19.95
1	33.25	36.75

8.2.4. Instantaneous Unit Test

Set the trip level to the minimum range of the setting, and the timing to instantaneous mode (all switches to the left). Establish the connections as indicated in figure 10, including the chronometer. Apply the rated voltage to the relay. Apply to points X and Y a voltage higher that the trip level in the case of an overvoltage relay, and lower than the trip level in the case of an undervoltage relay.

Check that the time indicated by the chronometer is less that 50 ms.

8.2.5. Timing Test

Apply a fault and check that the results are in accordance with the following table:

SWITCHES TO RIGHT (SW2)	Tmin (ms)	Tmax (ms)
1 (top)	123	157
2	218	242
4	788	872
8	12158	13441
None	30	40

9. INSTALLATION

9.1. Introduction

The place where the relay is to be installed must be clean, dry, free of dust and excessive vibration, and well illuminated to facilitate inspection and tests.

The relay must be mounted on a vertical surface. Figures 3 and 4 represent the dimensions and drilling diagram of the TOV relays.

9.2. Input Setting

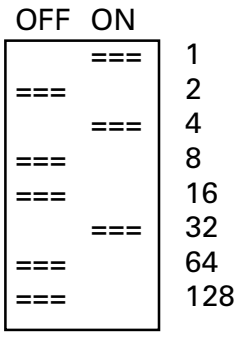
9.2.1. Trip Level Setting

The following example is for setting a relay with a range of 20/275 V. The setting procedures are the same for models with other ranges.

This setting is performed through the upper switch block which has the following inscription below it:

Vs = 20 + ( )

To set the selected trip voltage move the corresponding switches to the right (ON position). The input value range is in 1V steps. If, for example, we would like the relay to trip at 57 V, the switches would be situated as follows:



Vs = 57 = 20 + ( )
( ) = 37 = 32+4+1

9.2.2. Timing Setting

The following inscription appears on the nameplate:

$$t = 0.03 + 0.1 * ( ) \text{ s}$$

The value indicated between parenthesis is formed by the lower block of microswitches on the front of the relay, by adding the value of the microswitches placed to the right. To select the instantaneous trip just place all switches to the left.

9.3. Tests

Given that the majority of users use different procedures for installation tests, the section ACCEPTANCE TESTS includes all necessary tests to be performed as installation tests according to the user's criteria.

10. TESTS AND PERIODIC MAINTENANCE

Given the primary role that protection relays have in any installation, it is recommended that a periodic test program is followed. Given that the intervals between these tests vary for different types of relays and installations as well as the experience of the user performing the tests, it is recommended that the points described in the section INSTALLATION are checked at intervals of 1 to 2 years.