

TOHO ELECTRONICS INC.

Thyristor-type Single-phase Power Regulator (Zero Cross Control Mode)

TRV1-C015/TRV1-C025

Operation Manual

Thank you for purchasing our product. Before using this product, please read this manual carefully to understand its contents. Please keep this manual and use it whenever necessary. This document is intended for those with a basic knowledge of electrical and control circuits.

Safety Precautions

★ Meaning of Description

⚠ Warning

Improper handling may cause fire, loss of life, or physical injury.

⚠ Caution

Improper handling may cause damage to the product and its peripherals.

⚠ Warning

1. Risk of Electrocutation

- Always disconnect the product from the main power source before doing any wiring work.
- Make sure that the cover is attached while the product is energized.
- Do not open the case whether or not the product is energized.
- Do not touch the product while it is energized.
- Do not touch the terminal right after the power switch is turned OFF even if the product is not energized. (There is a risk of electrocution by the charged electricity in the condenser.)

2. Risk of Fire and Burn

- Do not touch the radiation fin while the product is energized or right after the power switch is turned OFF.
- Do not use the product in a place that is exposed to flammable and explosive gases.
- Do not leave combustible items near the place where the product is installed.
- Take necessary safety measures, such as external fuse and breaker, against overcurrent, short circuit, and breakdown.
- Make sure to properly attach the wire to the terminal by fastening them with the designated torque. (Failure to do so may cause abnormal heating of the terminal.)

3. Others

- Do not use this product for purposes beyond the scope of its specification.
- Be careful not to drop the product on your body.

⚠ Caution

- Do not soak the product in water, cleaning solvent, chemical solution, and such other similar liquids.
- Do not insert metal pieces and conductive materials into the product.
- Do not disassemble or alter the product.
- Select the electric wire with appropriate thickness according to the flowing current.
- Do not drop the product. Do not apply abnormal vibration or impact to the product.
- Use a power supply within the rated frequency range.
- Avoid using the product under the following environments to prevent the product from breakdown, malfunction, and characteristic degradation:
 - A place that is exposed to water, oil, and chemicals
 - Under the atmosphere of corrosive gas
 - A place with high temperature and humidity
 - A place with dust and metal powder
- When energized, the product produces heat. To release such heat outside, a heat sink is attached. Blocking the convective flow produced by the heat release at the heat sink may cause fire or breakdown due to abnormal heating. Arrange peripherals and parts in such a way that allows the heat release of the product.
- Make sure that the wiring polarity and the applied voltage are correct.
- The load to be applied must be within the rated range.

Precautions upon Usage

- Figures, sample values, and sample screens in this document are used for an easier understanding of the content and shall not compensate for any action that resulted therefrom.
- We shall not be held liable for the following damages that may be suffered by the user or third party:
 - Damage caused by the effect of the operation of this product
 - Damage caused by the unexpectable defect of this product
 - Damage caused by the use of a counterfeit of this product
 - All other indirect damages
- Regular maintenance is required to use the product continuously and safely. Some of the parts of this product have a service life and/or may degrade over the years.
- The contents of this document may change in the future without prior notice. We are sure about the quality of the document. However, please inform us if you are dissatisfied with the content or if you notice anything about the content.
- Unauthorized posting and reproduction of a part or all of the contents of this manual are prohibited.
- If the product is to be used in combination with other products, please check the standards, rules, and regulations that need to be complied with. We shall not be held liable for any noncompliance of the product unless these are implemented.
- In case the product is used for the following purposes, use the product within its capacity and take the necessary safety measures, such as the use of a safety circuit, to minimize risk in case of breakdown:
 - a) To be used outdoors or under potential chemical contamination or electrical disturbance, or to be used under the condition or environment that is not covered in this operation manual or delivery specification

- b) Nuclear power plant control system, incineration system, railways, aviation, vehicle maintenance, medical equipment, safety devices, and other facilities that conform to the rules and regulations of government and individual sectors
- c) Systems, machines, and devices that may be hazardous to human life and assets
- d) A facility that requires high reliability, such as gas, electricity, and water supply systems and systems that continuously run for 24 hours
- e) Other purposes that conform to items a) to d) above that require a high level of safety

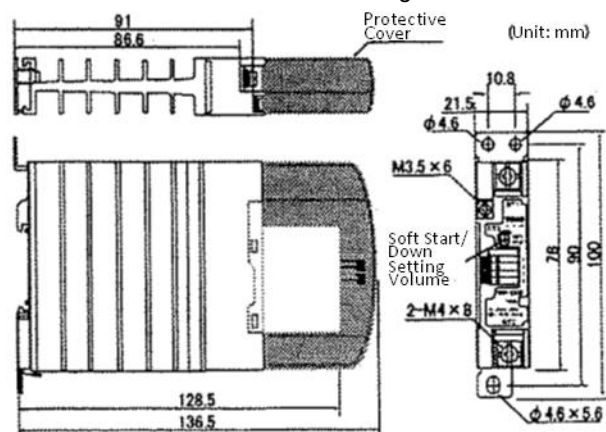
Important Reminder Regarding Export Trade Control Order

Please investigate the client and purpose of usage to make sure that the product will not be used as a weapon of mass destruction (e.g., for military purposes and military facilities). Be extra careful with reselling to prevent the product from being exported illegally.

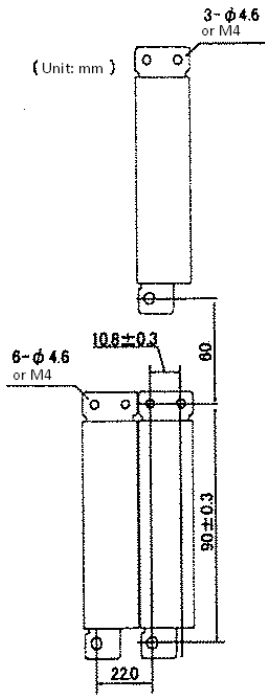
Proper Ways of Usage

1. Dimensions and Mounting

(1) Dimensional Outline Drawing



(2) Panel Machining Diagram

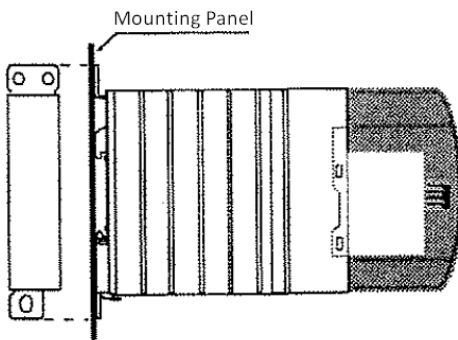


(3) Tightening Torque for the Panel

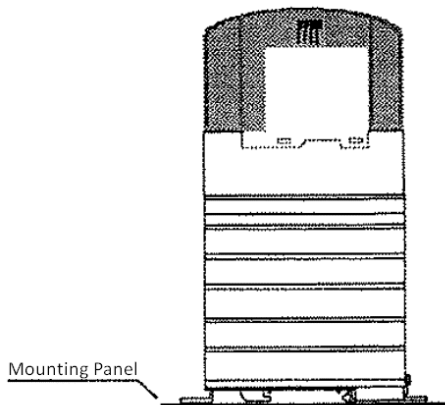
Mount the panel with a tightening torque of 1.18 to 1.47N · m.

(4) Installation

- Vertical Installation



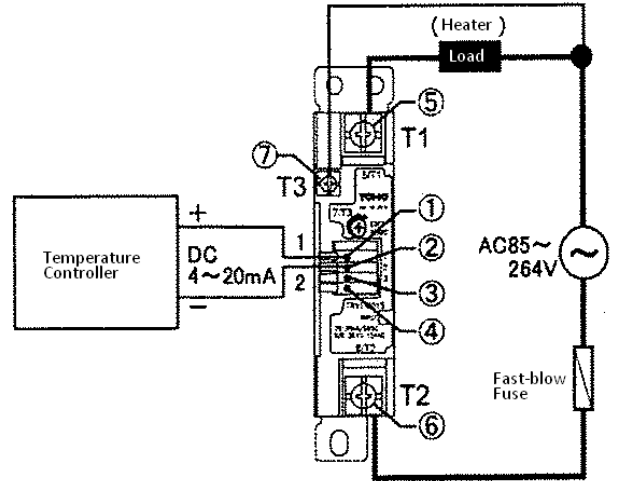
- Horizontal Installation



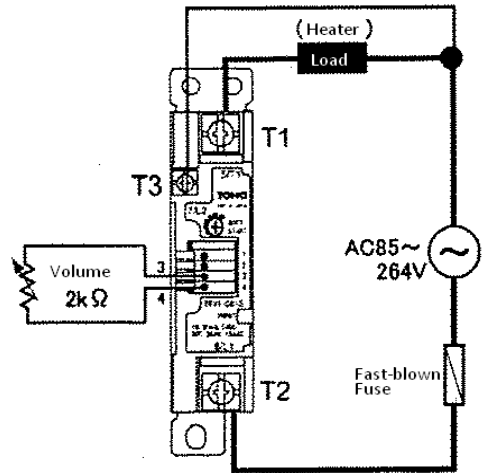
* Use the product within 70% of the rated load current.

3. Wiring and Connection

(1) Sample Connection with Temperature Controller



(2) Sample Connection with External Volume (Manual Setting)



* Volume shall be provided by the customer.

* The product cannot be used as an inclination setting unit in combination with the temperature controller.

- ① : Input Terminal (1) ② : Input Terminal (2) ③ : Volume Terminal (3)
- ④ : Volume Terminal (4) ⑤ : Output Terminal (T1) ⑥ : Output Terminal (T2)
- ⑦ : Power Terminal (T3)

The input impedance of the product is 250Ω. ③ 5V is outputted from the volume terminal. Therefore, the input voltage of the product shall be $5V \times (250\Omega \div (\text{External Resistance Value} + 250\Omega))$. Select the value of the resistance of an external volume according to the required amount of power for the adjustment.

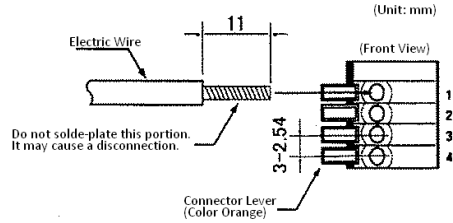
The figure of the sample connection shows the usage of 2kΩ external volume, which allows the adjustment of input voltage between 1VDC and 5VDC with an external volume.

(3) Wiring of Input

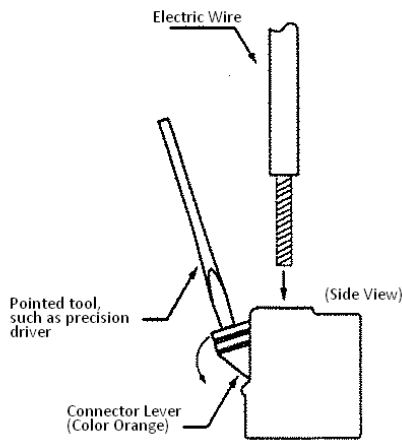
a) Size of Electric Wire

- Single Wire : 0.14 to 0.5mm²
- Twisted Wire : 0.14 to 0.5mm²
- AWG : 20 to 26

b) Tip Treatment



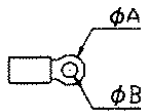
c) How to Insert



Insert the electric wire after pushing the connector lever inside as shown in the figure above. Pushing the electric wire inside with force without pushing the lever may lead to contact failure or disconnection.

(4) Wiring of Output

a) Type of Crimp Terminal



Terminal No.	Terminal Name	φA	φB
⑤/⑥	Output Terminal (T1/T2)	9.5mm or lower	4.3mm or higher
⑦	Power Terminal (T3)	6.5mm or lower	3.7mm or higher

b) Tightening Torque

Terminal No.	Terminal Name	Max. Value	Recommended Value
⑤/⑥	Output Terminal (T1/T2)	1.47N · m	1.18 to 1.37N · m
⑦	Power Terminal (T3)	0.78N · m	0.64 to 0.74N · m

4. Precaution from the Viewpoint of the Design of Electrical Circuit

(1) Protection Circuit of the Output Side

a) This product is composed of semiconductors and may break down by surge voltage and current. Upon such, most of its mode of breakdown is "short mode (breakdown by a short circuit)" where control is no longer possible under the condition of which the load is turned ON. Therefore, in case of a product abnormality, the failsafe circuit must be designed in such a way that it disconnects the load circuit not by the product itself but by a safety device, such as a breaker and a contactor.

b) In case a short-circuit current or overcurrent is flown into the output side of the product, it will destroy the built-in output element.

Please add the quick-blow fuse within the range below to the load circuit.

$$I_{\text{surge}} > I_{\text{ff}} > I_{\text{r}}$$

- I_{surge} : One-cycle Surge ON Current of the Product
- I_{ff} : Fusing Current of Quick-blow Fuse
- I_{r} : Rush Current of Load

(2) Precaution on the Type of Load

- a) In the case of a small current load and sensitive load, leakage current during OFF may prevent the product from turning itself OFF. In such a case, reduce the leakage current during OFF that flows into the load by connecting the shunt resistance (Rp) in parallel to the load. Shunt resistance (Rp) can be calculated by the formula below.
 Shunt Resistance (Rp) < IR × RL / ILEK – IR
 IR: Load OFF Current
 ILEK: Leakage Current at Open Circuit
- b) This product is designed to control the resistance load. In case of a load with high inductance, such as transformer, make sure to verify the normality of the operation with the actual device to avoid malfunction during the commutation due to the delay of the current phase against the voltage.

(3) Explanation of the Movement

- a) This product controls the output, which is proportional to input (4 to 20mADC), by the cycle control mode. It can also be connected to the external volume, which allows the user to use the product without the analog input.
- b) “Soft Up” and “Soft Down” are functions that limit the sudden change of the output power by changing the output gradually whenever the input setting changes.

(4) Others

This product is not designed for a series connection to improve voltage endurance and for parallel connection to increase electric capacity.

Specifications

1. Rated Value

Item	TRV1-C015	TRV1-C025
Maximum Input Current	24mA DC	
Maximum Load and Power Voltages	264Vrms AC	
Maximum Load Current	15Arms AC	25Arms AC
1 Cycle Surge ON Current	146A	250A
Insulation Resistance	100MΩ or higher (500VDC)*	
Voltage Endurance	2500V AC rms, 1 minute *	
Working Ambient Temperature	-20 to +60°C (without freezing and condensation)	
Storage Temperature	-30 to +70°C (without freezing and condensation)	

* Between input (①, ②), volume (③, ④) - output (⑤, ⑥), power supply (⑦) - case

2. Electrical Characteristic

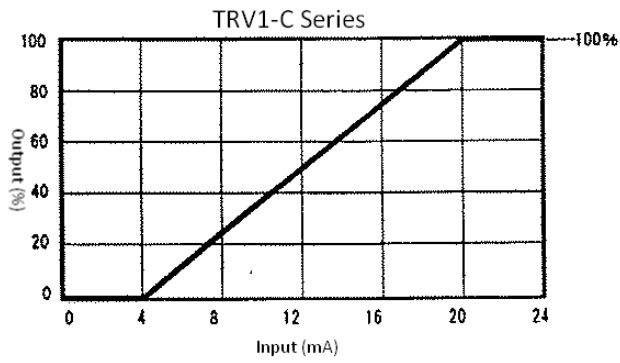
(Ta=25°C)

Item	TRV1-C015	TRV1-C025
Input Impedance	250Ω±20%	
Input Movement Current Range	4 to 20mA DC	
Range of Load and Power Voltages	85 to 264Vrms AC	
Range of Load Current	100mA AC rms-Max. Load Current *1	
Voltage Drop During Output ON	1.5V AC rms or lower (at maximum power output)	
Leakage Current at Output OFF	9mA AC rms or lower (load voltage of 200V rms, 50Hz)	
Power Adjustment Range	0 to 100%	
Load Power Voltage Frequency Range	50Hz/60Hz(Automatic switching) 47 to 53Hz/57 to 63Hz	
Consumption Current (Between ⑥ and ⑦)	For Analog Input If Volume is Used	5.1mA rms (100V rms, 50Hz) 7.0mA rms (100V rms, 50Hz)
Soft Up and Down Time	Approx. 0.5 to 40 seconds *2	
Mass	Approx. 260g	

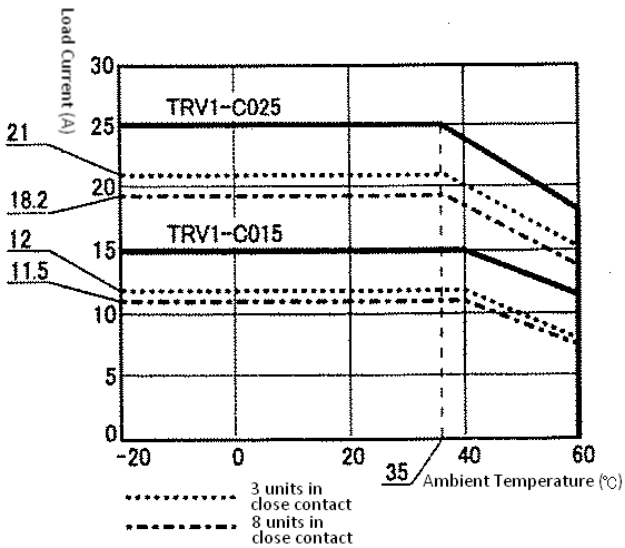
*1 Conduction angle will get narrow under fine current load. Please check the actual usage with the actual unit.

*2 Turn the top face volume clockwise to maximize and turn it counterclockwise to minimize. The rated value of “Approximately 0.5 to 40 seconds” refers to the time duration before the power changes from 0% to 100% or vice versa.

3. Input Current - Output Power Characteristic



4. Load Reducing Curve (if 3 units are mounted close to each other)



First Edition: June 2007



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