# NRG R2-HV (HEATER/VENTILATOR)
## INSTRUCTIONS



**NRG**Systems®

# CONTENTS

# INTRODUCTION

The NRG R2-HV Heater/Ventilator (item #20215) increases the accuracy of solar radiation measurements while uniformly maintaining the operating temperature of the sensor. The unit can be used outdoors in any weather condition and avoids the formation of dew and frost on the optical part of the sensor. The R2-HV system minimizes the type "A" offset (present in pyranometers and pyrgeometers) by preventing dome cooling relative to the sensor body. The heating function of the unit can be used in extreme environmental conditions to avoid the accumulation of snow and ice on the sensor dome. It is equipped with two independently activated heating circuits to optimize the heating function for the climate of the installation site.

The built-in adjustable feet allow for accurate horizontal installation.  The unit can be used with the following sensors:

- NRG R2 Pyranometer (item #9461)

- NRG R2-D Pyranometer (item #9462)

The R2-HV is supplied with a standard 5 m integrated cable and the unit includes the following accessories:

- Two M5x10 mm screws to fix the sensor to the HV unit.

- Two M6x30 mm screws to fix the unit to the desired mounting solution.

## WARNINGS

THE UNIT CONTAINS PARTS THAT COULD BE AT HIGH TEMPERATURE (HEATER) AND MOVING MECHANICAL PARTS (VENTILATION FAN).

BEFORE PERFORMING INSTALLATION AND MAINTENANCE OPERATIONS, DISCONNECT THE POWER SUPPLY AND WAIT FOR THE HEATER TO COOL DOWN.

- The unit is not intended for use with sensors other than those specified.
- Respect the power supply values indicated in the technical specifications and pay attention to the indicated polarities.
- Do not use extension cables. If replacing the supplied cable with a longer cable, respect the characteristics of the supplied cable and use a low resistance cable.

## TECHNICAL SPECIFICATIONS

| Ventilation Power Supply | 12 V DC ± 10% / 1.6 W |
|---|---|
| Heating Power Supply | 12 V DC ± 10%<br>6 W (heater 1) + 6 W (heater 2) |
| Operating Temperature | -40 °C to +70 °C |
| Cable Length | 5 m standard (alternate lengths upon request)<br>ending with free wires |
| Increase of Air Temperature with Heaters On | ~2.2 °C with ventilation and both heaters on<br>~1.1 °C with ventilation and one heater on |
| Ingress Protection | IP54<br>IP67 (internal electrical connection) |
| Weight | Approx. 0.6 kg (1.3 lbs.) excluding cable |
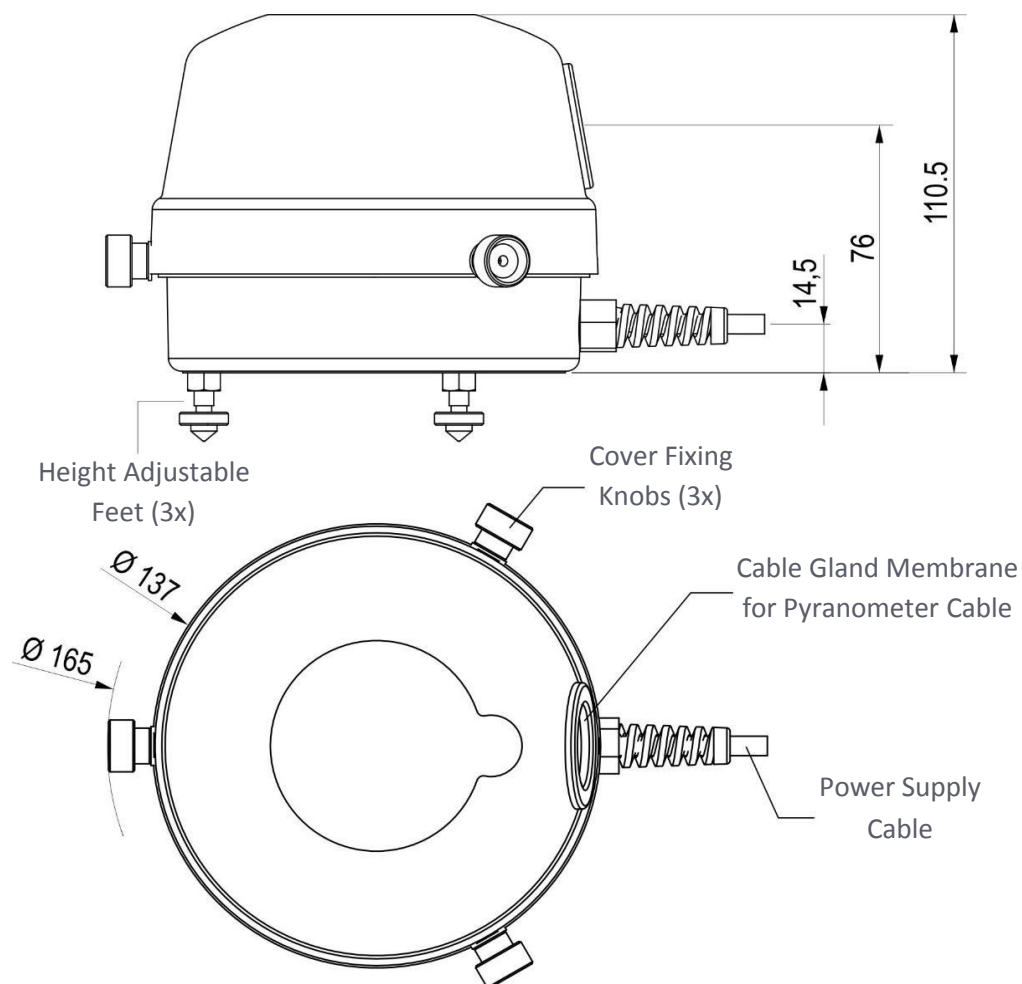
## INSTALLATION

### Tools Required

- No. 1 Phillips screwdriver
- 4 mm Allen wrench/hex key
- 2x ½" wrench or socket

### Connecting the Pyranometer to the R2-HV

To install the sensor:

1. If present, remove the white solar radiation protection screen and leveling feet from the pyranometer; requires No. 1 Phillips screwdriver.

Solar Radiation Protection Screen

Leveling Feet
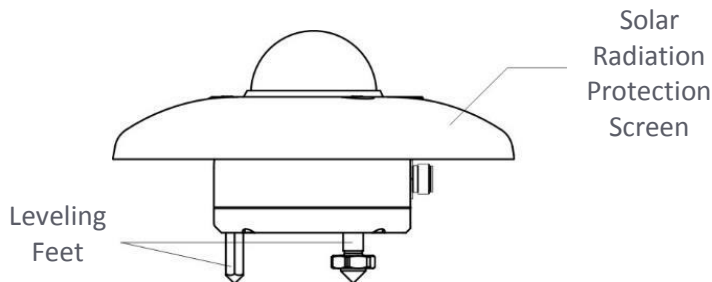
2. Remove the upper cover from the heater ventilator unit by loosening the three fixing knobs.
3. Using a 4 mm Allen wrench, remove the plate in the center of the unit by unscrewing the M5x10 mm socket head cap screws (2).
4. Fix the plate to the pyranometer base with the supplied M5x16 mm countersunk screws (2).
   a. Ensure the countersunk holes in the plate are on the side opposite the pyranometer.
   b. The pyranometer must be oriented so that the connector faces the cable gland.
5. Attach the plate with the pyranometer to the unit with the supplied M5x10 mm screws (2).

M5x10 (2x)

M5x16 (2x)
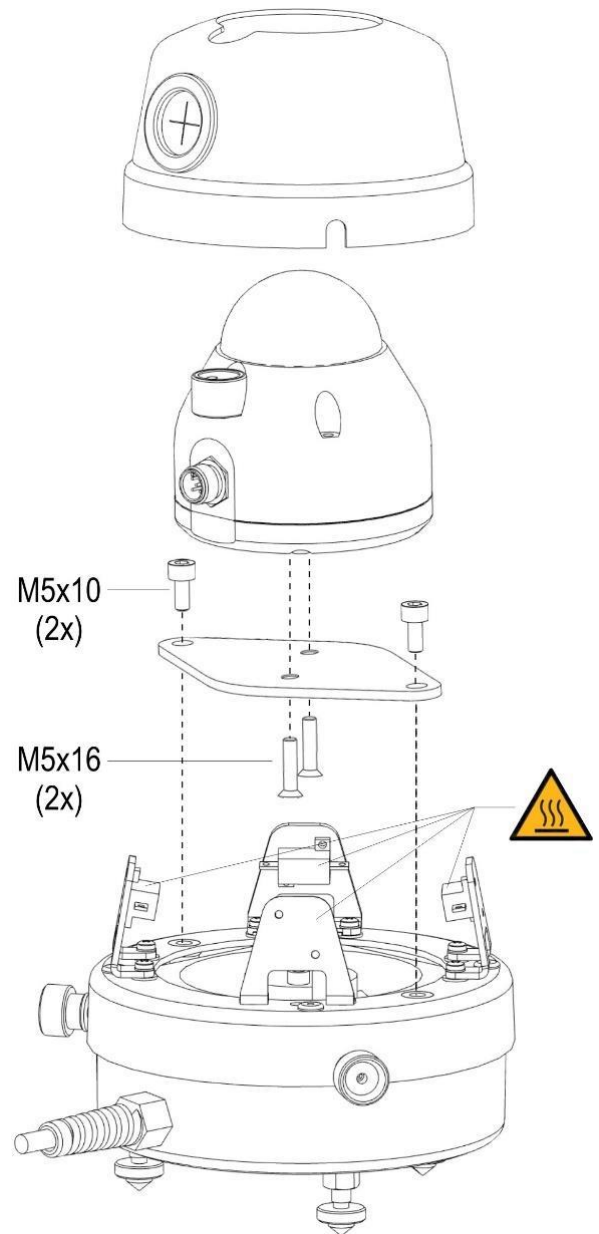
6. Pass the pyranometer cable through the cable gland membrane on the upper cover and attach it to the M12 connector on the pyranometer.
7. Replace the upper cover and tighten the three fixing knobs.
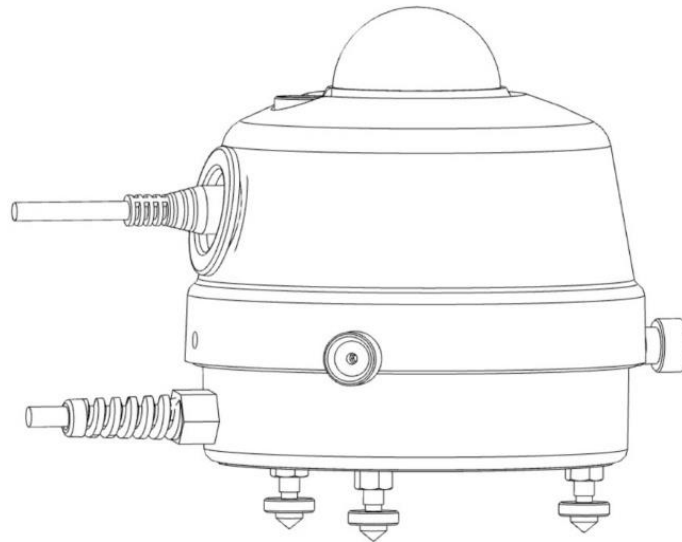


## Mounting and Leveling

The two M6 threaded holes on the bottom of the HV unit are used to mount the assembly to a support plate.



M6 Mounting Holes
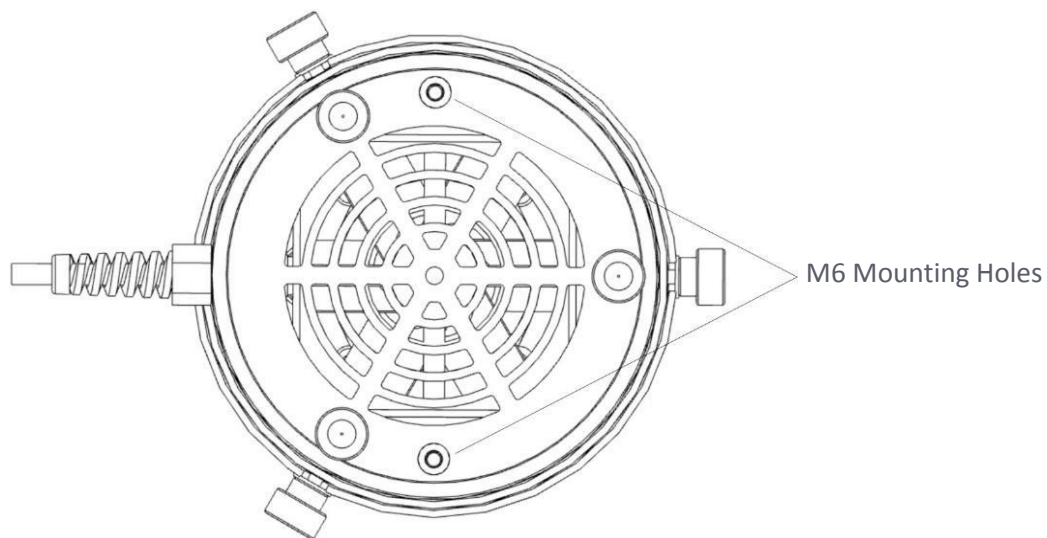
### 1.75" Pipe Mount

To mount the unit to a 1.75" horizontal pipe, the Universal Pyranometer Pipe Mount (item #14502) is used with the two provided M6x30 mm screws.
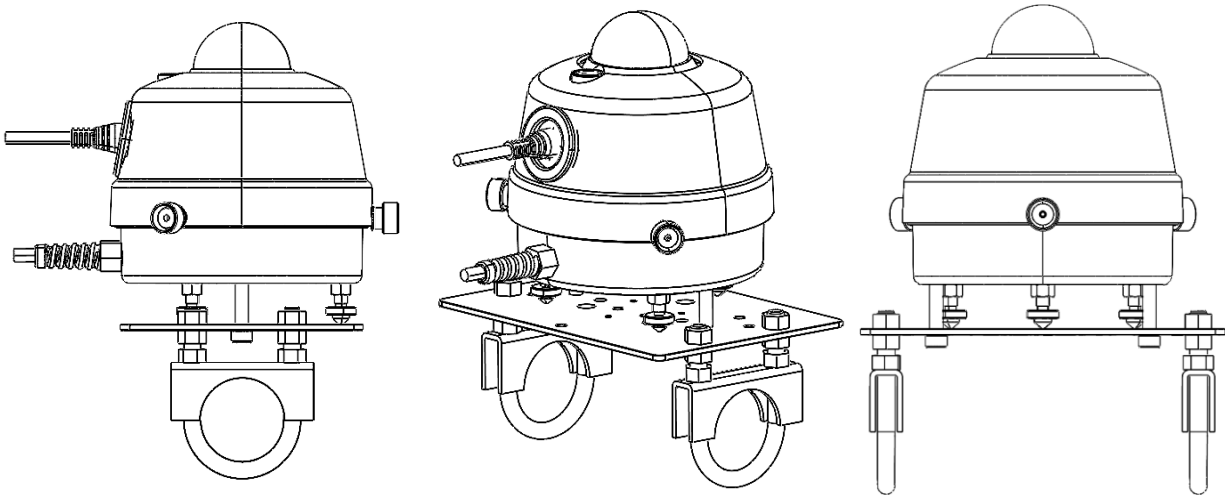
### 1.5" Square Mount

To mount the unit to a 1.5" square tube, the EZ Lever Pyranometer Mount (item #20605) is used with the two provided M6x30 mm screws. The 1.5" square tube depicted below is not included with mounting hardware.
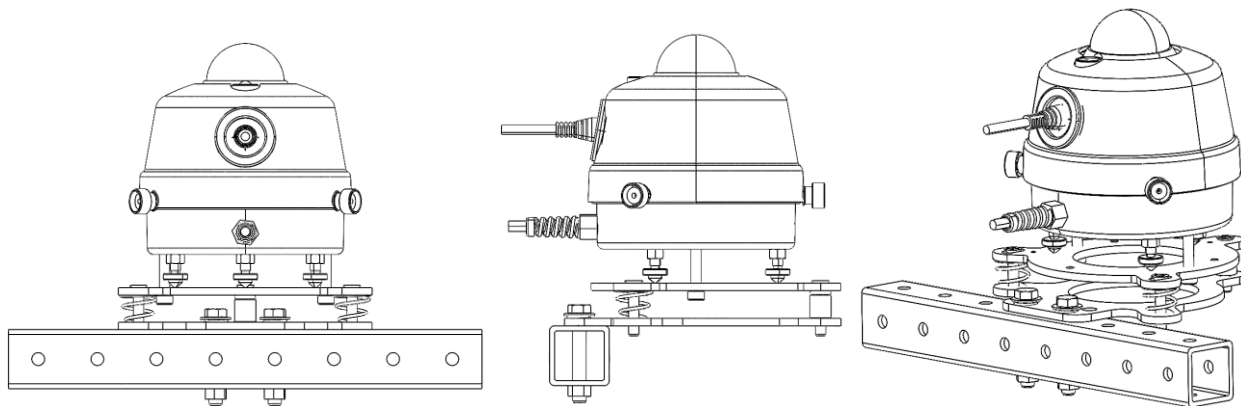
### Leveling

For accurate horizontal positioning, use the bubble level on the pyranometer along with the height adjustable feet.

Leave at least a 2 cm gap between the bottom of the unit and the mounting surface to allow adequate ventilation.

### Wiring Connections Table

| Function | Wire Color |
|---|---|
| Fan Positive | Red |
| Fan Negative | Black |
| Heater 1 | Yellow + Green |
| Heater 2 | White + Blue |

**NOTE:** To ensure proper air flow, ensure the polarity of fan wiring is correct.

## SYMPHONIEPRO LOGGER INTERFACE

### Compatibility

The NRG R2-HV does not directly interface with the SymphoniePRO data logger. Rather, the pyranometer connected to the R2-HV interfaces with the logger while the R2-HV unit is controlled by a Programmable Logic Controller (PLC) (item #4547). The PLC uses an NRG T60 ambient temperature sensor (item #9400) to control the heaters based on environmental temperature.

### Wiring

If purchased with a power supply system, the PLC will arrive mounted and wired in the power supply shelter box as diagrammed below. If retrofitting an existing station with the R2-HV, the PLC can be added to most NRG power supplies.
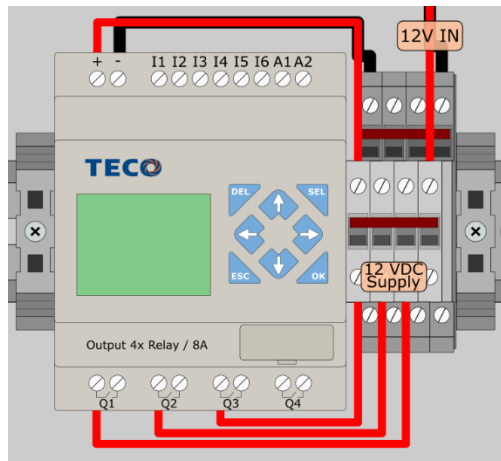


| TECO PLC Wiring Table | | |
|---|---|---|
| **PLC Terminal** | **Function** | **From** |
| + | Power | Power Supply +12V |
| - | Ground | Power Supply Gnd |
| Q1 (Left) | Relay 1 Source | Power Supply +12V |
| Q1 (Right) | Heater 1 Control | NRG R2 HV (Yellow) |
| Q2 (Left) | Relay 2 Source | Power Supply +12V |
| Q2 (Right) | Heater 2 Control | NRG R2 HV (White) |
| Q3 (Left) | Relay 3 Source | Power Supply +12V |
| Q3 (Right) | Fan Control | NRG R2 HV (Red) |
| A1 | Temp Sense Signal | T60 (White) |

The T60 ambient temperature sensor and R2-HV unit are wired to the power supply and PLC as diagrammed below and according to the tables provided.



| T60 Temp Sensor | | |
|---|---|---|
| **Wire Color** | **Function** | **Termination** |
| Red | Excitation | Power Supply +12V |
| Black | Ground | Power Supply Gnd |
| White | Signal | A1 (PLC) |
| Shield | Shield | Power Supply Gnd |

| NRG R2 Heater Ventilator | | |
|---|---|---|
| **Wire Color** | **Function** | **Termination** |
| Red | Fan + | Q3 Right (PLC) |
| Black | Fan - | Power Supply Gnd |
| Yellow | Heater 1 | Q1 Right (PLC) |
| Green | Heater 1 | Power Supply Gnd |
| White | Heater 2 | Q2 Right (PLC) |
| Blue | Heater 2 | Power Supply Gnd |

## Activating the Programmable Logic Controller (PLC)

⚠️ *The PLC must be properly configured and activated to ensure proper operation of the heater/ventilator unit.*

### Set the PLC Date and Time

The date and time must be programmed into the PCL within the RTC Set menu (the unit LCD screen defaults to this menu when first powered on).

*Note: The NRG program <u>must not</u> be running when attempting to set the date and time. If the PLC is already running the program, the program must be stopped before proceeding. Press the **ESC** button to navigate to "**STOP**" on the screen, then press the **OK** button twice to confirm. Then arrow down to select the "**RTC SET**" menu to proceed with date and time programming.*

1. Press the **SEL** button.
2. Use the left/right arrows to navigate through YYYY-MM-DD HH:MM, and the up/down arrows to select the proper values.
3. Press the **OK** button to save the programmed date and time.

### *Start the PLC Program*

Once the date and time are set, start the PLC program. To start the program:



1. Press the **ESC** button.
2. Use the up and down arrows to navigate to the **RUN** menu.
3. Press the **OK** button.
4. The screen will show **YES** and **NO** for options.
5. Select **YES** and press the **OK** button.
6. With the PLC program activated, the menu will no longer show **RUN** as an option. Instead, it will show **STOP**. The system is now functional.

## Default PLC Control Algorithm

While the PLC can be added to Solar Resource Monitoring (SRM) power supplies, the PLC was originally configured for use in Solar Resource Assessment (SRA) applications, necessitating special considerations for low power consumption. Therefore, the PLC does not follow the recommendations provided in the Heating and Ventilation Control section of this document. The default control algorithm is as follows:

- Heaters turn **ON** from 6 AM to 8 AM (intended for morning dew clearing).
- Heaters turn **ON** between 8 AM and 8 PM when the ambient temperature is below 3 °C.
- Heaters turn **OFF** between 8 AM and 8 PM when the ambient temperature is above 5 °C.
- Ventilator turns **ON** between 6 AM and 8 PM (14 hours/day).

## Advanced User PLC Settings

The settings below are available for advanced users who want to customize the control algorithm of the PLC:

- Heater switch **ON** time
- Heater switch **OFF** time

- Temperature threshold for turning heaters **ON**
- Temperature threshold for turning heaters **OFF**
- Ventilator continuous operation (24 hours/day)

*Notes for Advanced Users:*

- *Be cautious when adjusting settings as there is no master reset which can restore the PLC to the original NRG factory default settings. A programming key is required for a factory reset.*
- *Adjustments to the default settings can significantly alter the power required to run the system. As a reference, the system runs on 12 V. The heaters consume 12 W, and the ventilator consumes 1.6 W. NRG power supplies are typically designed to provide a 4-day energy reserve (4 days without external power input) for the specified target climate conditions. Be sure to account for these specifications when making any changes to the control algorithm.*

*Note: The PLC needs to be in RUN mode in order to adjust the settings detailed below.*

## Heater Switch On/Off Time

1. Press the **ESC** button. This should navigate to the PLC home screen "**NRG Systems**".
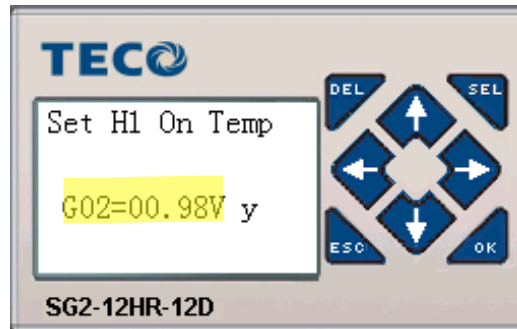2. Press the up arrow once to enter the Heater Switch Time menu.



3. Press the **SEL** button.
4. Use the left, right, up, and down arrows to make your selection. Once the setting to be modified has been selected, press the **SEL** button. Use the up and down arrows to adjust the value as needed.
5. Press the **OK** button to save the changes.

## Temperature Threshold for Switching the Heater ON

1. Press the **ESC** button. This should navigate to the PLC home screen "**NRG Systems**".
2. Press the up arrow twice to enter the Temperature Threshold menu.

The threshold values are displayed in the units of Volts. Use the table below to determine the voltage for the desired switch-**ON** temperature. If the desired temperature is outside of the values in the table, or a different ambient temperature sensor is being used, use the slope and offset provided to calculate the desired voltage.

## NRG R2-HV Heater/Ventilator



| Ambient Temperature (Degrees C) | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T60 Temperature Probe Signal Output (Volts) | 0.80 | 0.82 | 0.85 | 0.87 | 0.89 | 0.91 | 0.93 | 0.96 | 0.98 | 1.00 | 1.02 | 1.05 | 1.07 | 1.09 | 1.11 | 1.14 |

3. Press the **SEL** button.
4. Use the left/right and up/down arrows to make your selection. Once the setting to be modified is selected, press the **SEL** button. Use the up/down arrows to adjust the value for that setting.
5. Press the **OK** button to save any changes.

### *Temperature Threshold for Switching the Heater OFF*

1. Press the **ESC** button. This should navigate to the PLC home screen "**NRG Systems**".
2. Press the up arrow three times to enter the Temperature Threshold menu.

The threshold values are displayed in the units of Volts. Use the table below to determine the voltage for the desired switch-**OFF** temperature. If the desired temperature is outside of the values in the table, or a different ambient temperature sensor is being used, use the slope and offset provided to calculate the desired voltage.
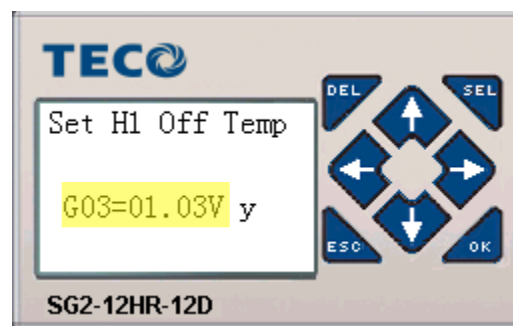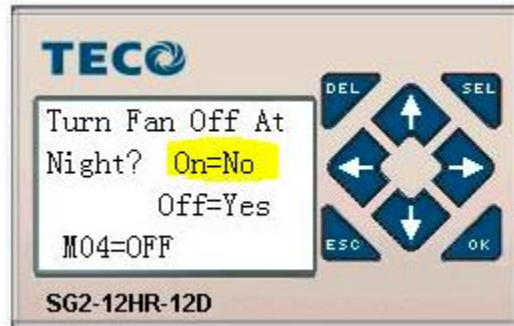


3. Press the **SEL** button.
4. Use the left/right and up/down arrows to make your selection. Once the setting to be modified is selected, press the **SEL** button. Use the up/down arrows to adjust the value for that setting.
5. Press the **OK** button to save any changes.

*Ventilator (Continuous Operation ON or OFF at Night)*

- Press the **ESC** button. This should navigate to the PLC home screen "**NRG Systems**".
- Press the up arrow four times to enter the Ventilator menu.



- Press the **SEL** button.
- The default selection of "Turn Fan Off At Night" will be displayed.
- To change the fan to run continuously (24 hours/day):
  - Press the **SEL** button.
  - Use the left/right and up/down arrows to navigate to the selection "On=No".
    - The display below should now show "M04=ON".
  - Press the **OK** button to save.

## LOGR LOGGER INTERFACE

### Compatibility

The NRG LOGR product line provides configurable output controls; however, the NRG R2-HV heaters exceed the power capacity of the output channels. To safely control the heaters, two 12 V relays (item #19745) must be used. The ventilator, due to its lower power consumption, can be controlled directly by the data logger. Alternatively, if system autonomy is not a concern and the ventilator is to be run continuously, it can be wired directly to the 12 V terminal of the power supply. To enable automatic heater control based on a temperature threshold, the data logger requires an ambient temperature sensor such as the NRG T60 (item #9400).
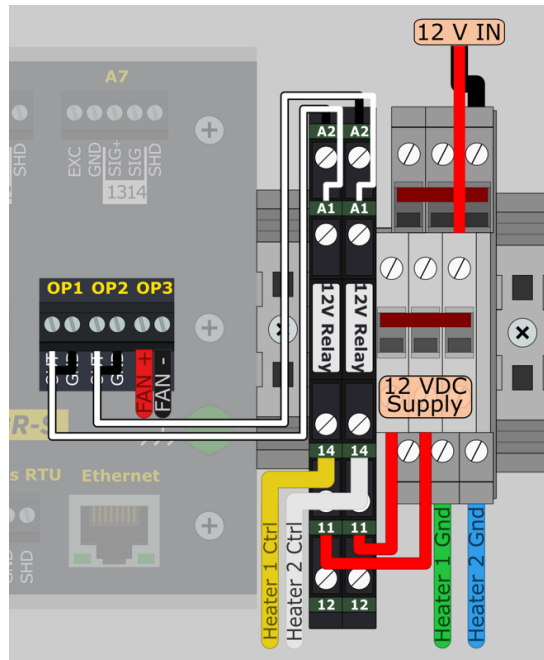
### Wiring

If purchased with an NRG power supply, the 12 V relays (item #19745) will arrive installed in the power supply as diagrammed below, and according to the tables provided. If required, relay terminals can be added to other NRG power supplies.
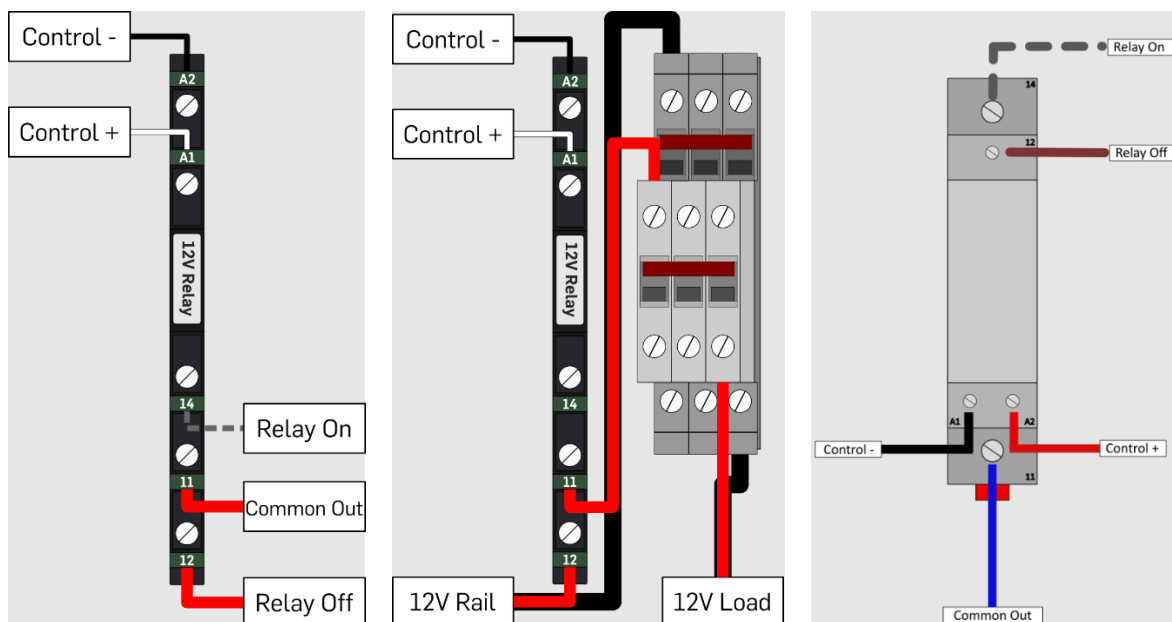


| Terminal: | Call Out: | Connects to: | Use: |
| --- | --- | --- | --- |
| A1 | Control + | OP Out | Relay Trigger |
| A2 | Control - | OP GND | Relay Trigger Ground |
| 11 | Common Out | To Power Rail (heaters) | When relay is triggered, DC power flows from this terminal the load (heaters) |
| 12 | Relay Off | From 12 V+ power supply | Feeds 12 V+ power to the relay from the power supply |
| 14 | Relay On | Not used | Not used |

| T60 Temp Sensor on LOGR Analog Channel | | |
|---|---|---|
| **Wire Color** | **Function** | **Termination** |
| Red | Power Excitation | EXC |
| Black | Power Ground | GND |
| White | Sensor Output | SIG |
| Shield | Shield | SHD |

| NRG R2 Heater Ventilator | | |
|---|---|---|
| **Wire Color** | **Function** | **Termination** |
| Red | Fan + | OP3 OUT |
| Black | Fan - | OP3 GND |
| Yellow | Heater 1 | 14 (Relay 1) |
| Green | Heater 1 | Power Supply GND |
| White | Heater 2 | 14 (Relay 2) |
| Blue | Heater 2 | Power Supply GND |

| LOGR OP Channels | | | |
|---|---|---|---|
| **Wire Color** | **LOGR OP Channel** | **Function** | **Termination** |
| N/A | OP1 OUT | Relay 1 Control | A1 (Relay 1) |
| N/A | OP1 GND | Relay 1 Ground | A2 (Relay 1) |
| N/A | OP2 OUT | Relay 2 Control | A1 (Relay 2) |
| N/A | OP2 GND | Relay 2 Ground | A2 (Relay 2) |
| Red | OP3 OUT | R2 HV Fan + | OP3 OUT (or PSU 12 V rail for constant) |

| Black | OP3 GND | R2 HV Fan - | OP3 GND (or PSU ground for constant) |
|---|---|---|---|

## LOGR Channel Configuration

### *Analog Channel Configuration*

This process allows for the configuration of the necessary ambient temperature sensor which controls the output relay ON/OFF threshold.

1. Navigate to the **Sensor** menu at the top of the page and select **Analog Channels** from the dropdown options. Select **Configure** next to the desired channel.



2. Selecting **Configure** for a specific channel will redirect the page to the **Analog Channel Configuration** for the specified channel.

3.  Using the **Sensor Type** drop-down menu, select the NRG T60 and edit the provided fields as necessary. Click the yellow **Done** button, then scroll down to click the yellow **Save** button in the bottom right corner to confirm the channel configuration.

**Analog Channel Configuration**

Port A1-Ch 1

Enable Configuration

☑ Enabled

| Sensor Type | Description | Units | Slope ⓘ | Offset ⓘ |
|---|---|---|---|---|
| NRG T60 ⌄ | NRG T60 | deg_C | 44.67629 | -40.92151 |

| Serial Number | Height (m) | Elevation Angle | Azimuth Angle | Modbus Address |
|---|---|---|---|---|
| 000000000 | 0.00 | 0.0 | 0.0 | 10028 |

Back   Reset   Done

### *Output Relay Configuration*

1.  Navigate to the **Sensor** menu at the top of the page and select **Output Control Setup** from the drop-down options.
2.  Check the **Enabled** box next to the output number to create an output control scheme.
3.  Name the scheme as desired.
4.  Check the box to **Enable an Input Channel** that will control the relay. For the heaters, this will be the ambient temperature sensor configured on the analog channel in the previous section.
5.  Select the **Input Channel** from the dropdown menu and set the desired temperature threshold value.
6.  If specific timing conditions are required for this Output Control, check the **Enabled Time Condition** box, and input a **Start** and **End Time**.

The screen-capture images below show **Output 1** and **Output 2** configured to control the heaters according to the conservative guidance outlined in the Heating and Ventilation Control section of this manual. Additionally, the heaters are set to activate daily from 6 AM to 8 AM to help clear morning dew. Both the activation times and temperature thresholds can be adjusted based on the specific installation location and environmental conditions.

**Output 1**  ☑ Enabled

Heater 1

☑ Input Channel Enabled

Input Channel

1-NRG T60 ⌄     < ⌄     Threshold

25

☑ Time Condition Enabled

Start Time

06:00 AM 🕐

End Time

08:00 AM 🕐

**Output 2**  ☑ Enabled

Heater 2

☑ Input Channel Enabled

Input Channel

1-NRG T60 ⌄     < ⌄     Threshold

0

☑ Time Condition Enabled

Start Time

06:00 AM 🕐

End Time

08:00 AM 🕐

The image below shows Output 3 configured to run the ventilator 24 hours/day. The activation time can be adjusted for power conservation.

Alternatively, the ventilator can be wired directly to the 12 V DC supply rail of the power supply unit to enable constant operation.

**Output 3**  ☑ Enabled

Fan

☐ Input Channel Enabled

Input Channel

1-NRG T60 ⌄     < ⌄     Threshold

0.0

☑ Time Condition Enabled

Start Time

12:00 AM 🕐

End Time

11:59 PM 🕐

## HEATING AND VENTILATION CONTROL

For optimal performance, ventilation should always be in operation to keep the temperature of the pyranometer uniform and to prevent dust from settling on the dome. If power consumption is a concern, ventilation can be turned off during hours with no sunlight.

Heating circuits can be operated independently and should be controlled based on ambient temperature. The diagram below provides conservative guidance on when heating activation is recommended.
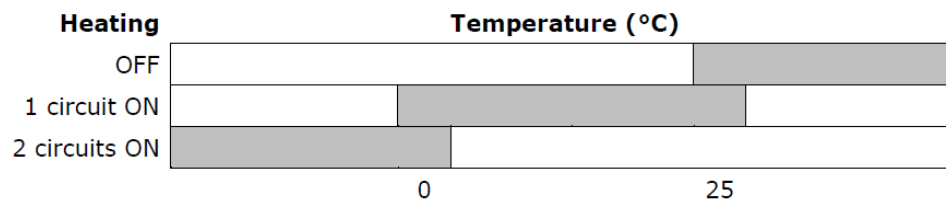


The exact temperature at which the heating elements should be activated may vary depending on environmental conditions. For example, humidity levels can influence the likelihood of dew forming on the dome. To ensure optimal performance, the activation temperature should be adjusted based on the specific installation location.

When the heating elements are switched on or off, the pyranometer readings may temporarily fluctuate by approximately 1 to 3 W/m² due to temperature changes. The sensor requires about 20 minutes to stabilize under the new operating conditions. During this period, the pyranometer continues to function normally; however, users should account for the potential additional measurement error.

## MAINTENANCE

Periodically check the cleanliness of the lower grids to ensure proper airflow. The maintenance period will depend on the degree of pollution at the specific installation location.

If necessary, remove the upper shell for thorough cleaning.

Regularly check and clean the dome of the connected pyranometer per manufacturer guidelines.

## SAFETY CONSIDERATIONS

The R2-HV has been manufactured and tested in accordance with the safety standard 61010-1: "Safety requirements for electrical equipment for measurement, control and laboratory use" and has left the factory in perfect safety technical conditions.

To ensure proper operation and safety, all standard safety precautions, along with the specific measures outlined in this manual, must be followed.

The unit will function correctly and safely only when used within the climatic conditions specified in this manual.

Do not use the unit in places where there are:

- Corrosive or flammable gases.

- Direct vibrations or shocks to the instrument.

- High-intensity electromagnetic fields, static electricity.

## NRG R2-HV SPECIFICATION

| | | |
|---|---|---|
| **Description** | Sensor Type | Pyranometer Heating and Ventilation Unit |
| | Applications | Solar resource assessment and monitoring in moderate to cold climates |
| | Sensor Compatibility | • NRG R2 Pyranometer<br>• NRG R2-D Pyranometer |
| **Power Requirements** | Power Required | • 12 V DC Fan (1-1/2 W)<br>• 12 V DC Heater 1 (6 W)<br>• 12 V DC Heater 2 (6 W) |
| **Installation** | Mounting | Mounts to 1-3/4 inch (44 mm) diameter boom or 1-1/2 inch square boom on SRA and SRM towers using NRG's #14502 mounting assembly or #20605 mounting assembly respectively |
| | Tools Required | • 4 mm hex key for mounting pyranometer and HV unit<br>• 2x ½" wrench or socket for mounting items #14502 or #20605<br>• Phillips screwdriver (No. 1) for removing pyranometer solar radiation protection screen |
| **Environmental** | Operating Temperature Range | -40 °C to 70 °C (-40 °F to 158 °F) |
| **Physical** | Connections | Separate pairs of screw terminals for Fan and each Heater (2); three pairs total |
| | Cable Length | 5 m |
| | Weight | Approx 0.6 kg (without cable) |
| | Dimensions | 165 mm diameter (including knobs) x 111 mm (excluding feet) |

## NRG R2-HV ASSOCIATED ITEMS LIST

These items are commonly used in conjunction with the NRG R2 Heating and Ventilating Unit. Please contact NRG for further information.

| Item # | Description |
|--------|-------------|
| 14502 | Assembly, Boom Mount, R2-HV |
| 20605 | EZ Level Pyranometer Mount |
| 9461 | Sensor, Pyranometer, NRG R2, Analog |
| 9462 | Sensor, Pyranometer, NRG R2-D, Digital |
| 4547 | TECO Programmable Logic Controller (PLC) |
| 19745 | 12V Relay |
| 11492 | Terminal Block End Stop- Din Rail |
| 9400 | T60 temperature sensor, 4.6m cable |
| 11368 | SRA, SymphoniePRO, Power Supply |
| 19786 | SRA, LOGR, Power Supply |
| 18773 | SRM, LOGR, Power Supply |