



# NRG INSTRUCTIONS

## ▶ T60 Temperature Sensor

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## Sensors | T60 Temperature Sensor

### INTRODUCTION

The NRG T60 Temperature Sensor (introduced July, 2018) has the same form factor as the NRG 110S, and utilizes a new signal transducer which lowers uncertainty. Sensors are individually serialized, and compatible with NRG SymphoniePRO and SymphoniePLUS3 loggers. For traceability, a manufacturing quality certificate is available for each individual sensor. A calibrated version of the sensor is available which includes a calibration certificate from an ISO 17025 accredited laboratory.

### SENSOR IDENTIFICATION

The T60 can be identified by the label on the cable, which contains the “T60” model name, serial number (9400NNNNNN), wiring information, and barcode. Additionally, the T60 probe is potted into the aluminum housing using a blue epoxy (whereas the previous model 110S used black epoxy).



| NRGSystems Temperature Sensor |               | NRGSystems Temperature Sensor   |  |
|-------------------------------|---------------|---|--|
| Red (excitation)              | to EXC (+)    | Excitation: 5 V to 15 V constant or pulsed<br>Output: .02 V to 2.48 V (-40°C to 70°C)<br>Current: 1.25 mA Max |  |
| White (signal)                | to SIG (SIG+) |   |  |
| Black (ground)                | to GND (-)    |   |  |
| Braid (shield)                | to SHD        |   |  |



The T60 is available with the following cable lengths:

| NRG Item Number | Sensor Description                   |
|-----------------|--------------------------------------|
| 9400            | Sensor, T60 Temperature, 4.6m Cable  |
| 9402            | Sensor, T60 Temperature, 67 m Cable  |
| 9403            | Sensor, T60 Temperature, 90 m Cable  |
| 9404            | Sensor, T60 Temperature, 110 m Cable |
| 9411            | Sensor, T60 Temperature, 13 m Cable  |



## POWER REQUIREMENTS

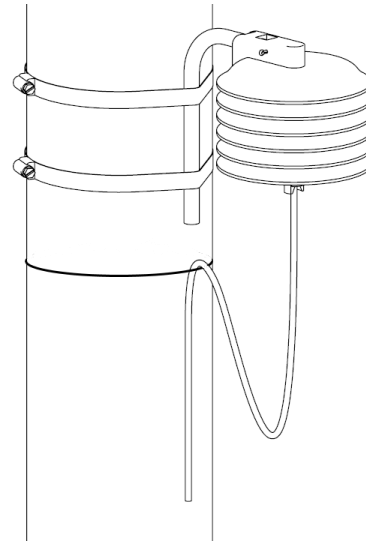
The T60 requires an excitation voltage of (5 to 15) V and consumes 1.25 mA of current maximum. For optimal performance, deploy the T60 on a channel with pulsed excitation. Because the sensor has a quick start-up time, it can be used with a pulsed excitation for both the SymphoniePRO and SymphoniePLUS3 loggers, further reducing overall power consumed to below 1 mA.

## MOUNTING

The T60 radiation shield and probe should be mounted above vegetation and expected snow fall.

The radiation shield is held in place with two hose clamps that can be tightened with a flat head screw driver or a 5/16" nut driver.

A drip loop should be left in the sensor wire to allow water to run off the cable.



## SYMPHONIEPRO

### Compatibility

The NRG T60 temperature sensor is compatible with SymphoniePRO Desktop Application 3.5.X and later. There are additional firmware requirements.

**NOTE: It is best practice to update your desktop software and logger firmware before performing logger configuration and/or data processing tasks. The latest versions of software, firmware and documentation can be downloaded from this page: <https://www.nrgsystems.com/support/product-support/>.**

### Wiring

Wiring the NRG T60 to the SymphoniePRO is straight forward and familiar. Please follow the table below.



## Sensors | T60 Temperature Sensor

## Built in Channels 13-15 and 16-19

| <i>Channels 13-15 and 16-19 (no SCM required)</i> |              |                                 |
|---|--------------|---------------------------------|
| <b>T60 Connection</b>                             | <b>Color</b> | <b>SymphoniePRO Logger</b>      |
| +   | Red          | Connect to 13-19 "EXC" terminal |
| Signal  | Clear        | Connect to 13-19 "SIG" terminal |
| -   | Black        | Connect to 13-19 "GND" terminal |
| Shield  | Braid        | Connect to 13-19 "SHD" terminal |

## P-SCM Channels 20-26

| <i>Channels 20-26 (use P-SCM #9130)</i> |              |                                   |
|---|--------------|-----------------------------------|
| <b>T60 Connection</b>                   | <b>Color</b> | <b>SymphoniePRO Logger</b>        |
| +                                       | Red          | Connect to 20-26 "EXC" terminal   |
| Signal                                  | Clear        | Connect to 20-26 "SIG +" terminal |
| -                                       | Black        | Connect to 20-26 "GND" terminal   |
| Shield                                  | Braid        | Connect to 20-26 "SHD" terminal   |

**Channel Configuration**

Create the following configuration in the SymphoniePRO Desktop Application (Version 3.5.X or later).

Note, if you do not see the T60 in the "Load From Defaults" drop-down menu, please update your software from the "Services and Support" section of our website (<https://www.nrgsystems.com>).

**Default Scale Factors**

The SymphoniePRO Desktop Application contains default scaling information for the T60 temperature sensor in Degrees Celsius (C).

- Scale Factor: 44.74364
- Offset: -40.85555

\*If using the calibrated version of the T60 Temperature Sensor, refer to the sensor's calibration report for the calibrated scale factor and offset.



## Sensors | T60 Temperature Sensor

### Built in Channels 13-15, and 16-19

The T60 can be installed on logger channels 13-15 and 16-19 without the need for a P-SCM. Choose “NRG T60 Temp” from the “Load From Defaults” drop down menu.

16 Off Analog NRG T60 Temp 0063 0.00m 0.0° (N)

**Data Logging Mode** Load From Defaults

**Channel Type** Off

**Channel Type** Analog

A channel of type Analog records the following statistical information:

- Average
- Standard Deviation
- Min
- Max

**Description** NRG T60 Temp

**Serial Number** 0063

**Height** 0  Meters

**Boom Bearing** 0  Degrees ⓘ

**Scale Factor** 44.74364  C per V

**Offset** -40.85555  C

**Units** C

**Excitation**

**Mode** Pulsed On

**Voltage** 5 V

### P-SCM Channels 20-26

The T60 can be used on channels 20-26 when the logger is equipped with P-SCM item #9130 [P-SCM #9130, (0 to 5) V, SE Input, Pulsed 5V EXC]. This is useful if Channels 13-19 are already in use for other sensors. Choose “NRG T60” from the “Load From Defaults” drop down menu.

20 Statistics Analog NRG T60 Temp 0063 0.00m 0.0° (N)

**Data Logging Mode** Load From Defaults

**Channel Type** Statistics

**Channel Type** Analog

A channel of type Analog records the following statistical information:

- Average
- Standard Deviation
- Min
- Max

**Description** NRG T60 Temp

**Serial Number** 0063

**Height** 0  Meters

**Boom Bearing** 0  Degrees ⓘ

**Scale Factor** 44.74364  C per V

**Offset** -40.85555  C

**Units** C

**SymphoniePRO Signal Conditioning Module (P-SCM)**

P-SCM #9130, (0 to 5) V, SE Input, Pulsed 5V EXC



## SYMPHONIEPLUS3

### Install SCM card

In order to use the T60 temperature sensor on the SymphoniePLUS3 logger, Symphonie SCM Card 110S #3153 is required.



This SCM can be installed in any of the 7 SCM slots which correspond to channel ranges 4-6 and 9-12.



### Wiring

#### Channels 4-6 or 9-12

Wire the sensor according to the following table and diagrams.

| <b>Channels 4-6, 9-12 (requires SCM 3153)</b> |              |                                   |
|---|--------------|-----------------------------------|
| <b>T60 Connection</b>                         | <b>Color</b> | <b>SymphoniePLUS3 Logger</b>      |
| +   | Red          | Connect to channel "EXC" terminal |
| Signal  | Clear        | Connect to channel "SIG" terminal |
| -   | Black        | Connect to channel "GND" terminal |
| Shield  | Braid        | Connect to channel "SHD" terminal |

### Channel Configuration

The T60 has a different default scaling than the 110S. *Do not use the 110S settings found in SDR!*



## Sensors | T60 Temperature Sensor

### Example

To configure the T60 on channel 4 (for example) do the following:

- On the logger keypad, press [Home > 4. Settings > 2. Analog Settings > Press “4” to configure channel 4 > Press the “↓” arrow to see the default list of sensors]
- Scroll down the list of default sensor settings and choose “NRG 110S Temp C” by pressing “Set”.
  - Edit the name to “NRG T60 Temp C” by using the keypad. The ↑ arrow will capitalize the “T” and the “1” button will erase characters. Press “Set” when finished.
  - Enter the scale factor “0.1092” and press “Set” (unless using the calibrated scale factor)
  - Enter the offset “-40.8555” and press “Set” (unless using the calibrated offset)
  - Leave the units as “C” and press “Set”.
  - Set the sensor height (in meters) and press “Set”.
  - Enter the sensor’s serial number (or the last 5 digits of it) and press “Set”.
- With the sensor programmed and the wires connected to the logger, verify the sensor’s functionality by pressing [Home > 1. Measurements > Press the “↓” arrow until you see the channel that the sensor has been installed on. Check the current temperature from a different source and confirm that the sensor is reading accurately.

Please refer to the SymphoniePLUS3 manual for more detailed information on entering information directly into the logger.

Instead, configure as follows:

- Scale Factor: 0.1092
- Offset: -40.8555

\*If using the calibrated version of the T60 Temperature Sensor, refer to the sensor’s calibration report for the calibrated scale factor and offset.

| Site Information               |                            | Sensor Information |                             |
|--------------------------------|----------------------------|--------------------|-----------------------------|
| Site #                         | 2222                       | Channel #          | 9                           |
| Site Desc                      | Windy Meadows              | As of              | Baseline                    |
| Project Code                   | MVT1                       | Description        | NRG T60 Temp                |
| Project Desc                   | Late Stage Prospecting     | Details            | mounted north side of tower |
| Site Location                  | Meadowville, VT            | Serial Number      | 000075                      |
| Site Elevation                 | 300                        | Height             | 2,2m                        |
| Base Time Zone                 | (UTC-05:00) Indiana (East) | Scale Factor       | 0.10917                     |
| Latitude                       | 44.3292 N                  | Offset             | -40.8943                    |
| Longitude                      | 73.1107 W                  | Print Precision    | 0.1                         |
| Serial Number (5-digit suffix) | 12222                      | Units              | C                           |
| Hardware Rev.                  | 009-009-014                | Encryption Code:   | 0000                        |
|                                |                            | History            | Delete                      |
|                                |                            |                    | Make New Change             |





## SPECIFICATIONS

|                          |                             |   |
|--------------------------|-----------------------------|---|
| Description              | Sensor type                 | Integrated circuit ambient temperature sensor with six plate radiation shield   |
|                          | Applications                | <ul style="list-style-type: none"> <li>• Wind and solar resource assessment</li> <li>• Wind and solar plant operations</li> <li>• Meteorological studies</li> <li>• Environmental monitoring</li> </ul>   |
|                          | Sensor range                | -40 °C to 70 °C (-40 °F to 158 °F)  |
|                          | Instrument compatibility    | All NRG loggers   |
| Output signal            | Signal type                 | Linear analog voltage   |
|                          | Transfer function           | Temperature (°C) = (Voltage x 44.743639) - 40.855549 °C<br>Temperature (°F) = (Voltage x 112.538550) - 41.539989 °F<br><br>Note: Transfer function above applies to 4.6-meter cable. For sensors with cable lengths longer than 4.6 meters, subtract 0.002922 °C (0.0052596 °F) per additional meter from the transfer function offset. |
|                          | Accuracy                    | Uncertainty (k=2): ±0.200 °C (±0.360 °F)  |
|                          | Output signal range         | 0.020 to 2.480 V DC   |
|                          | Turn on time                | <20 ms  |
|                          | Resolution                  | 0.0025 °C (0.0045 °F)   |
| Response characteristics | Thermal time constant       | 5.38 minutes  |
| Power requirements       | Supply voltage              | 5 to 15 V DC  |
|                          | Supply current              | <ul style="list-style-type: none"> <li>• 1.2 mA max. (no load on output)</li> <li>• SymphoniePRO Pulsed: 0.85 mA average</li> <li>• SymphoniePLUS3 Pulsed: 0.43 mA average</li> </ul>   |
| Installation             | Mounting                    | Attaches to tower with included hose clamps   |
|                          | Tools required              | <ul style="list-style-type: none"> <li>• 8 mm (5/16 inch) nut driver or flat blade (-) screwdriver (to install hose clamps)</li> <li>• Sheet metal shears or similar (for trimming hose clamps)</li> </ul>  |
| Environmental            | Operating temperature range | -40 °C to 70 °C (-40 °F to 158 °F)  |
|                          | Operating humidity range    | 0 to 100% RH  |
|                          | Lifespan                    | 10 years +  |
| Physical                 | Connections                 | Wire leads: <ul style="list-style-type: none"> <li>• Signal (clear wire)</li> <li>• Ground (black wire)</li> <li>• Excitation (red wire)</li> <li>• Shield wire for earth ground</li> </ul>   |
|                          | Cable lengths               | 4.6 m (15 ft), 13 m (43 ft), 67 m (220 ft), 90 m (295 ft), 110 m (361 ft)   |
|                          | Weight                      | 4.6 m: 0.47 kg (1.04 lbs)<br>67 m: 2.53 kg (5.6 lbs)<br>90 m: 3.29 kg (7.2 lbs)   |



Sensors | T60 Temperature Sensor

|           |            |  |
|-----------|------------|--|
| Materials |            | 110m: 3.94 kg (8.7 lbs)<br>13m 0.75 kg (1.65 lbs)  |
|           | Dimensions | <ul style="list-style-type: none"> <li>Probe only: 51.6 mm (2") height x 12.7 mm (0.5") diameter</li> <li>Radiation shield: 124 mm (4.9") height x 127 mm (5 inches) diameter</li> </ul> |
|           | Cable      | 3 conductor 22 AWG, with overall foil shield and drain wire, chrome PVC jacket   |
|           | Probe      | Aluminum, epoxy filled   |
|           | Shield     | UV-stabilized thermoplastic solar radiation shield   |