Thermistor String Installation and User Manual

Document Number: ICM0105B

Release Date: 22 October 2025

RST Instruments LTD.
11545 Kingston St.,
Maple Ridge, BC
Canada V2X 0Z5

SALES + SERVICE + MANUFACTURING

604-540-1100 | RST_sales@orica.com

Toll Free (USA & Canada):
1-800-665-5599

www.rstinstruments.com

TABLE OF CONTENTS

LIST OF FIGURES

REVISION HISTORY

Rev.	Revision History	Date	Prepared By	Approved By
A	Initial Release	10 June 2025	SM	DP, CA, SP, JP
B	Specification section updated and “22-gauge” changed to “22-24 gauge”	22 October 2025	SM	SP, GL, AB

1 Intended Audience

This guide is for the personnel responsible for operating the Thermistor String assemblies. This manual provides steps for installing the system, and how to take readings and interpret them.

2 Icons and Conventions Used In This Guide

This guide uses the following icons to call attention to important information.

	**WARNING:** This icon appears when an operating procedure or practice, if not correctly followed, could result in personal injury or loss of life.
	**CAUTION**: This icon appears when an operating procedure or practice, if not strictly observed, could result in damage to or destruction of equipment.
	**NOTE**: This icon appears to highlight specific non-safety related information.

3 Safety

	**WARNING:** Always follow safety precautions and use proper personal protective equipment (PPE) including safety glasses and high-visibility clothing when working in the field with this equipment.

4 INTRODUCTION

RST's Thermistor Strings are incorporated with overmolded, curve tracking, Negative Temperature Coefficient (NTC) thermistors. Thermistors are sensors made from semiconductors that provide resistance readings in response to changes in temperature. The measured resistance readings can then be converted to temperature using the Steinhart-Hart Linearization equation.

NTC thermistors are non-linear thermistors that experience a drop in resistance with increasing temperature. The integrated thermistors are pressed into black- colored beads at user-specified intervals along the length of the Thermistor String.

Thermistor Strings are environmentally hardened to provide accurate and reliable long-term measurements under demanding geotechnical conditions. The strings incorporate a triple encapsulation procedure to prevent water ingress.

The standard cable employed is a heavy-duty, direct burial rated 22 – 24 gauge, water blocked instrumentation cable.

RST Thermistor Strings are custom manufactured to user specifications for cable length, location and number of thermistors, and sensor accuracy.

The thermistor beads are tested up to ranges of 3.5 MPa. If additional pressures are to be exerted on the beads, RST recommends grouting in 2 or more stages.

Figure 1: Thermistor String Coil Assembly

NOTE: RST's DT series data loggers, FlexDAQ data loggers, and RSTAR Affinity Loggers can be used to monitor the Thermistor Strings.

4.1 FEATURES

- Compatibility with various readouts and data loggers provides flexibility
- Custom manufactured to user specifications
- Thermistors are curve-matched to desired temperature tolerance over selected ranges
- Cost-effective: multiple sensors read with a single readout or data logger
- Triple encapsulation process resists water ingress
- Direct burial cable standard
- Tested to withstand up to 3.5 MPa for reliable high-pressure performance, with grouting in stages recommended for excess pressure.

4.2 APPLICATIONS

Used with thermistors to obtain precise thermal gradient information for:

- Geotechnical applications
- Geothermal applications
- Marine, mining, and oil and gas applications

5 INSTALLATION

RST's Thermistor Strings are prepared ready for direct attachment to a structure or to burial underground or in concrete.

5.1 INSTALLATION PREREQUISITES

5.1.1 Visual Inspection

Carefully inspect the thermistor strings for any visible damage, such as cracks, breaks, or frayed wires.

Ensure that all connections are secure and that there are no signs of corrosion or wear.

5.1.2 Functionality Check

All Thermistor Strings must be checked for proper functioning prior to installation. Refer to Section 8: Taking Readings for instructions on connecting to a datalogger and obtaining readings.

5.2 REQUIRED AND OPTIONAL TOOLS AND COMPONENTS

Before installing the Thermistor String(s), ensure the following components and tools are present:

- Thermistor String(s)
- Sacrificial tremie pipe
- Duct tape
- Multimeter
- Cable ties

5.3 INSTALLATION GUIDELINES

NOTE: Two of the most common installation scenarios are outlined here. Specific installation guidelines would be reliant on drilling methods and/or ground conditions. For further information on different installation scenarios, please contact the site engineer or RST Instruments.

5.3.1 Installation in Boreholes Using a Sacrificial Tremie Pipe

1. Ensure that the borehole is drilled properly in accordance with the site conditions and project requirements. Consult the site engineer for the specifics.

   Ensure that it will accommodate the thermistor strings and the sacrificial tremie pipe.

2. Unroll the thermistor string from the cable reel or spool.

3. Measure the length required for the borehole and mark the cable accordingly.

Figure 2: Measuring Thermistor String Length Required for Borehole Installation

4. Attach the thermistor string to the outside of a 25 mm PVC grout sacrificial tremie pipe with a couple of wraps of duct tape every 2-3 m as it gets lowered down the borehole to the desired depth. This ensures that the thermistor string is securely positioned within the borehole. See Figure 3 below.

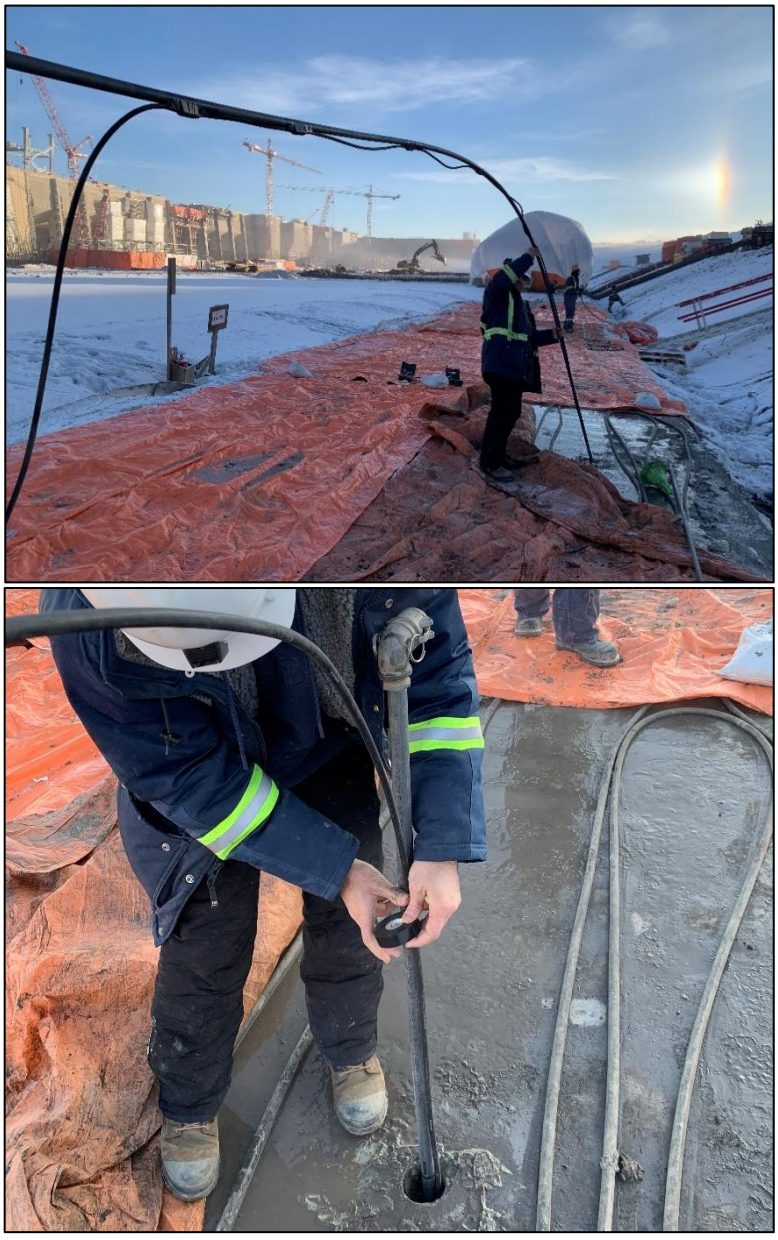


Figure 3: Lowering Thermistor String Assembly Attached to Sacrificial Tremie Pipe Down the Borehole

5. Fill the sacrificial tremie pipe with grout so that the borehole is filled from the bottom upwards to ensure no air pockets during the process. The grout stabilizes the borehole and ensures that the thermistor string remains in place.

6. After filling with grout, leave the tremie pipe in place as this helps to maintain the position of the thermistor string during the grout curing process. A quick functionality check of each Thermistor is advised during this step.

7. Coil the length of the thermistor string that remains above the ground surface and fasten it to a metal casing protector installed at the location. This prevents damage to the thermistor string and ensures that it is easily accessible for data collection. Attach the string to a readout or data logger to obtain measurements.

5.3.2 Installation by Embedment

5.3.2.1 Site Preparation

1. Ensure the area where the thermistor string will be embedded is clean and free of debris.

2. Mark the positions where the thermistor sensors will be placed.

5.3.2.2 Pre-Installation Checks

- **Inspect the Thermistor String:**
  - Check for any visible damage or defects.
  - Ensure all sensors are properly connected and functioning.
  - Test the resistance of each thermistor using a multimeter to confirm they are within the specified range.
- **Prepare the Embedment Material:**
  - Follow the manufacturer's instructions for mixing the embedment material.
  - Ensure the material is mixed thoroughly and check for proper adhesion.

5.3.2.3 Installation

- **Lay the Thermistor String:**
  - Carefully lay the thermistor string in the designated area.
  - Ensure the string is taut and not twisted to prevent damage to the sensors.

Figure 4: Laying the Thermistor String for Installation by Embedment

- **Mark the Positions:**
  - Once the string is laid, mark the positions of the thermistor sensors on the surface.

Figure 5: Marking the Positions of the Thermistor Sensors

- **Securing the Thermistor String:**
  - Use temporary supports (e.g., stakes, clamps) to hold the thermistor string in place during the embedment process.
  - Ensure the string is securely held to maintain the correct sensor positions.
- **Applying the Embedment Material:**
  - Slowly pour the embedment material around the thermistor string.
  - Use a tool to spread the material evenly.
  - Ensure the material completely covers the thermistor sensors and the connecting wires.

Figure 6: Applying the Embedment Material

- **Curing the Embedment Material:**
  - Allow the embedment material to cure according to the site engineer's recommendations.

5.3.3 Structural Installation Using a Rebar Cage

1. **Prepare the Rebar Cage**: Before attaching the thermistor string, prepare the rebar cage where the string will be installed. Ensure that the cage is structured to support the attachment of the thermistor string.

2. **Attach the Thermistor String**: Securely attach the thermistor string to the rebar cage. It is crucial to ensure that the string is firmly fixed to prevent any movement during the concrete pouring process, taking extra care not to damage the cable outer sheath or Thermistor bead(s). Use ties or appropriate fasteners to attach the string at designated points along the rebar cage.

3. **Embedding in Concrete**: Once the thermistor string is securely attached to the rebar cage, proceed with the concrete pour. Ensure that the concrete fully encases the rebar cage and the thermistor string without any air gaps or voids. Perform a functionality check on all thermistors.

4. **Connect to Monitoring Equipment**: After the concrete has cured, connect the thermistor string to a readout or data logger.

6 POST INSTALLATION CHECKS

1. **Continuity Test:**
   - Use a multimeter or Thermistor port on RST's VW2106 Readout to check for continuity across the entire thermistor string.
2. **Resistance Measurement:**
   - Measure the resistance of each thermistor in the string.
   - Compare the measured resistance values to the manufacturer's specifications to ensure they fall within the acceptable range.
3. **Insulation Test:**
   - Use an insulation resistance tester to check the insulation integrity of the thermistor string.
   - Ensure the insulation resistance is within the acceptable range to prevent electrical leakage.
4. **Functional Test:**
   - Connect the thermistor strings to the monitoring system and verify that they are providing accurate temperature readings.
   - Monitor the system for any anomalies or issues.
5. **Final Inspection:**
   - Conduct a final visual inspection to ensure that the thermistor strings are properly installed and secured.
   - Verify that all connections are secure and that there are no loose wires or damaged components.

7 TAKING READINGS

NOTE: For instructions on obtaining readings using a specific data logger, please refer to the corresponding logger manual.
For the purposes of this manual, steps to take readings using a DT2040 logger have been outlined.

Record thermistor readings directly after the thermistor string assembly has been placed, and again after some time has passed to allow temperature stabilization. This ensures reliable baseline temperature readings.

7.1 CONNECTING WITH DT2040 DATA LOGGER

NOTE: The information in this section is intended to be a supplement to the DT Logger Host software manual as it assumes users have a basic understanding of setting up DT series data loggers with DT Logger Host software.
Please refer to the DT Logger Host Instruction Manual, available for download at RST website: https://rstinstruments.com/product/dt-logger-host-software/

7.1.1 Making Connections

The DT2040 Data Logger features a circuit board with 20 ports, allowing for a maximum of 40 thermistor connections. Each port facilitates the connection of two sensors: one in the 1A/1B terminal connections and another in the 2A/2B terminal connections.

To prevent mix-ups, all wires are paired with heat shrink for easy identification and organization.

In an application where the Commons (White wires) are ‘ganged’, jumper wires are required to make connections between some of the common connections. The wires will have to be connected into the terminal blocks, which can then be connected to the appropriate port.

CAUTION: The middle position is only for a shield connection and should not be used for thermistor connections.

Below is an example of the wiring schematic that is delivered with the thermistor strings.

In this example, the colored wire connections are connected to the terminal port and the 'Ganged' white is connected to the connection beside it, a jumper is then used to connect to the other common position as shown in the wiring diagram.

NOTE: The following wiring chart only shows Ports 1 – 7, as demonstrated in the accompanying port overview image. Ports wherein 2 white wire connections are present are for grounding purposes. For a complete sample wiring diagram, please refer to Appendix B.

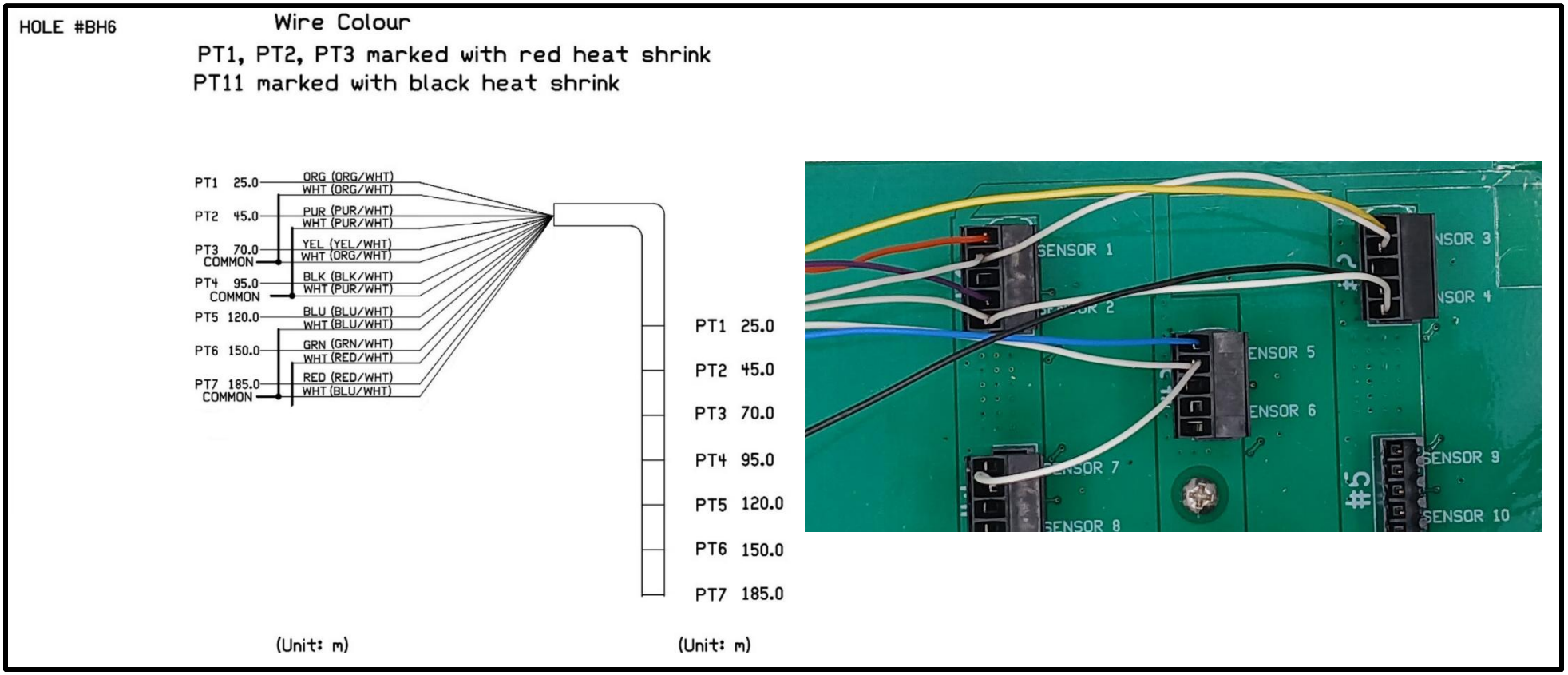


Figure 7: Sample Wiring Diagram (Left) and Corresponding Ganged Connections Wiring (Right)

7.1.2 Reading Using DT Logger Host

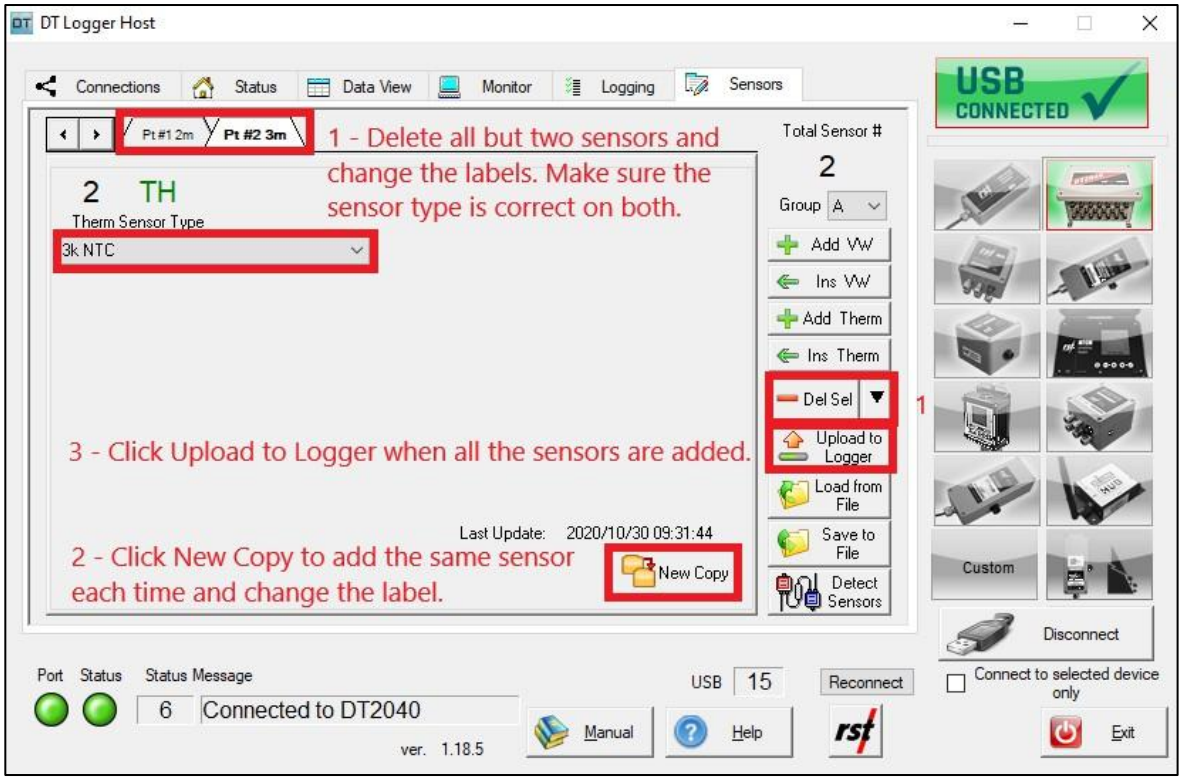
Once the thermistors are connected in order on the circuit board, the sensors can be setup on the Sensor tab in the DT Logger Host software.

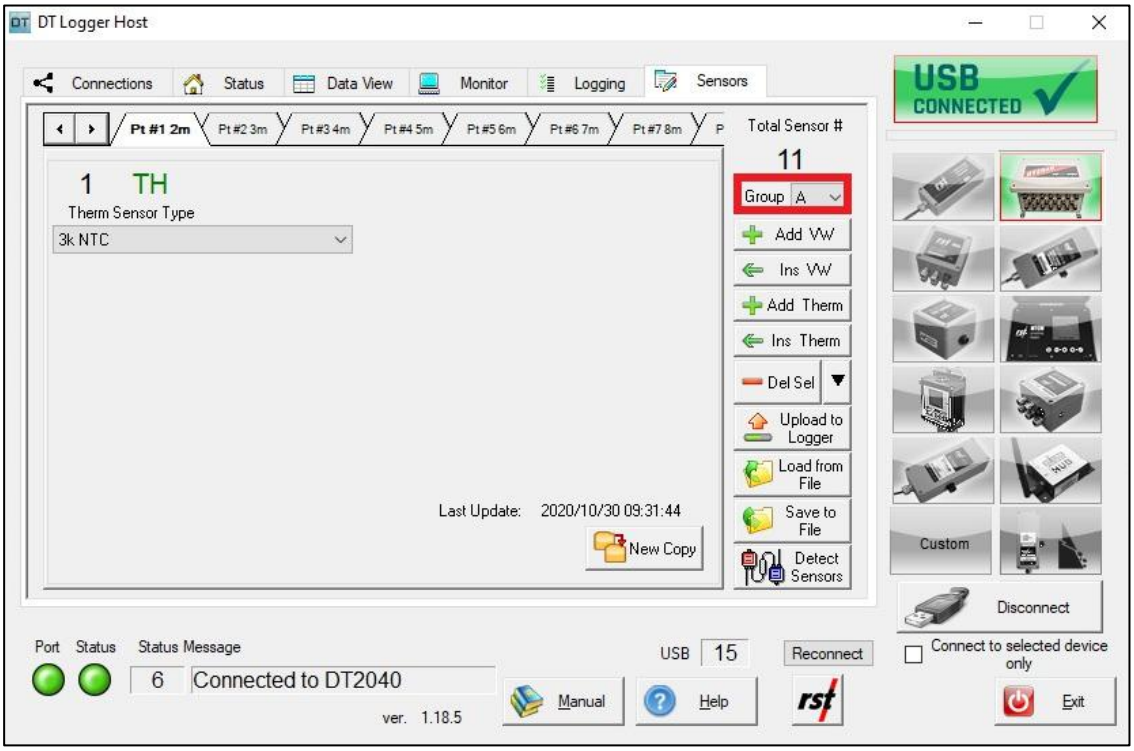
Refer to the screenshots provided and follow the instructions.

1. Leaving the first two tabs, delete every other tab using the ‘Del Sel’ button.
2. Ensure that the proper sensor type is selected.

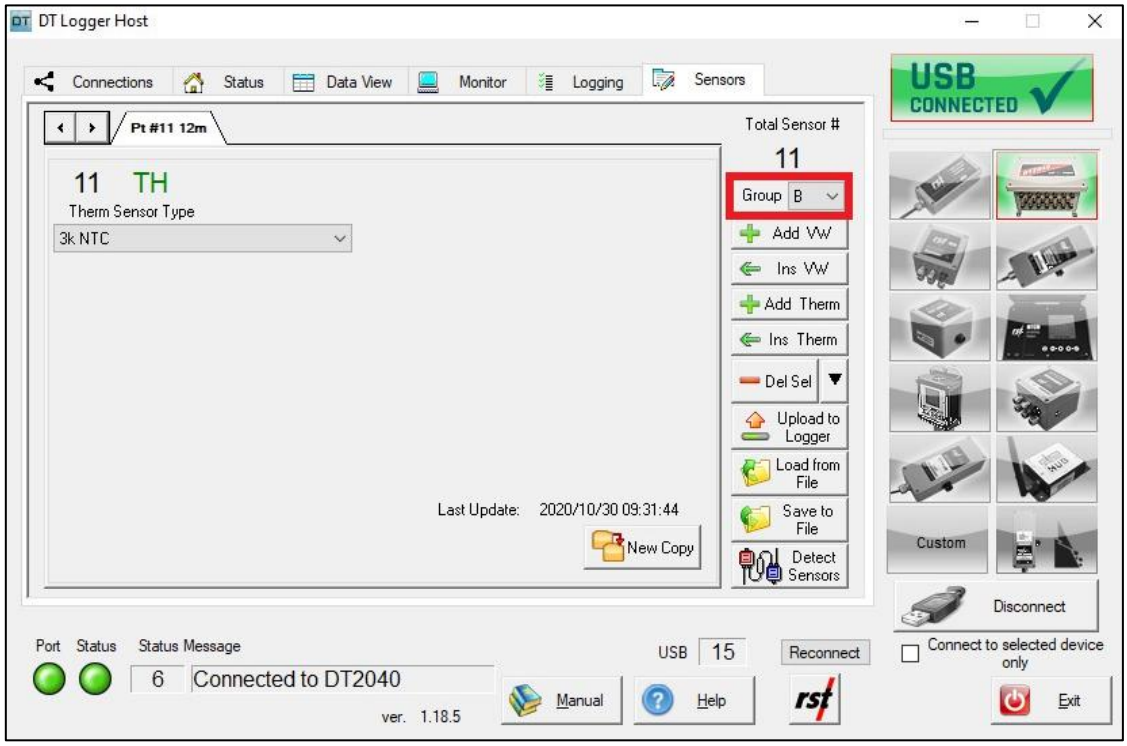
> **NOTE**: 3 kΩ is the default standard sensor type, however, this can be designated by the customer prior to the purchase.

3. Rename the tabs to reference the preferred naming convention for the thermistor string.
4. The subsequent thermistors can be added by clicking ‘New Copy’, following by updating the tab name. Ensure to click ‘Upload to Logger’ to save the settings to the data logger memory.





5. When all the sensors have been added, only ten sensors will be displayed at a time. The groups will be designated as A, B, C and D.

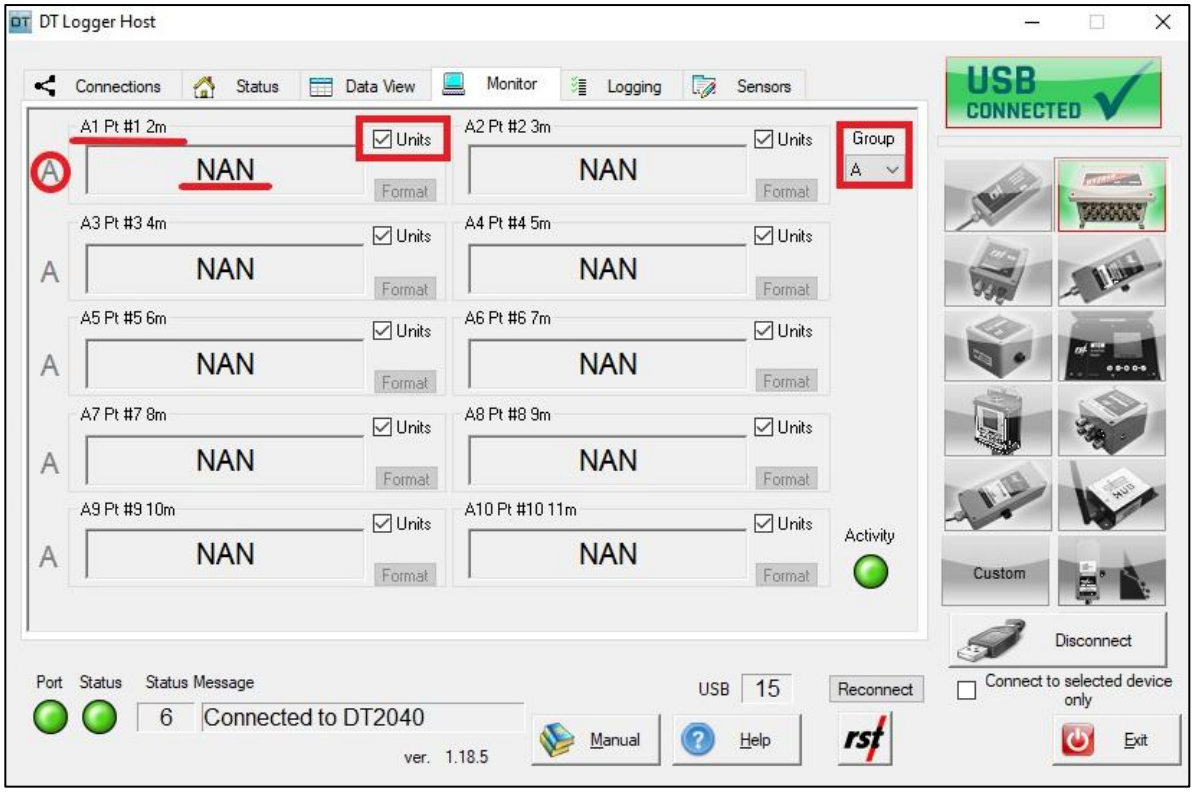


6. Once the sensor tab is set, enter the information in the Logging tab and choose ‘Apply Settings’ to start the data logger’s operation.

   Refer to the DT Logger Host software manual for preferred Logger Options.

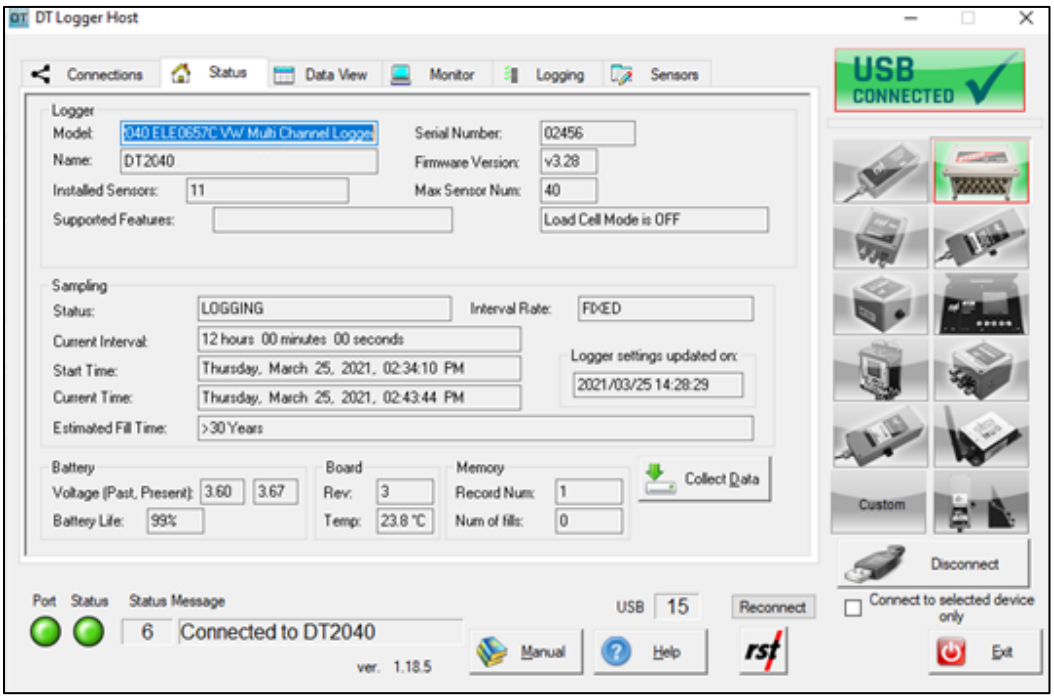
7. To view real-time readings, click on the ‘Monitor’ tab.

   Since only 10 sensors can be displayed at a time, choose a different letter group to view different sensors, choose the letter group. The title on the tab for each sensor will be displayed, and the Units checkbox can be unchecked to display the raw resistance readings.



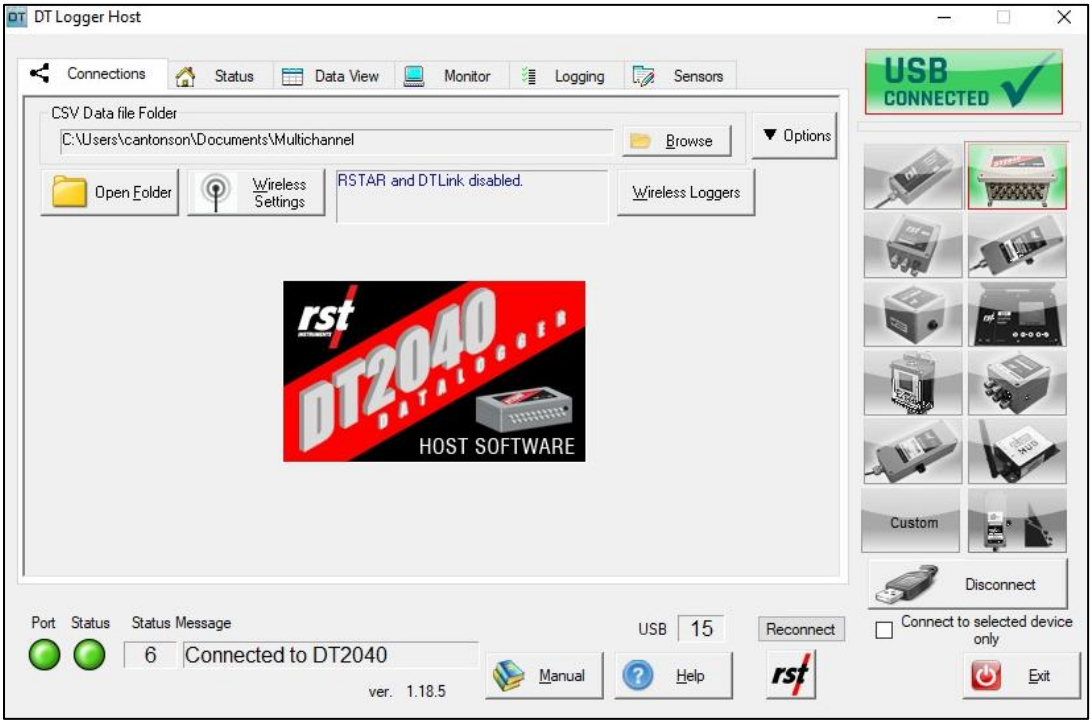
NOTE: The screenshots were captured solely for demonstration purposes. It is important to note that the thermistors were not connected to a data logger while the software was running and when the screenshots were taken. Therefore, the screenshot above does not display any resistance values, indicated by "NAN".

8. Selecting the ‘Status’ tab will allow the operator to view the status of the data logger and to download the data.

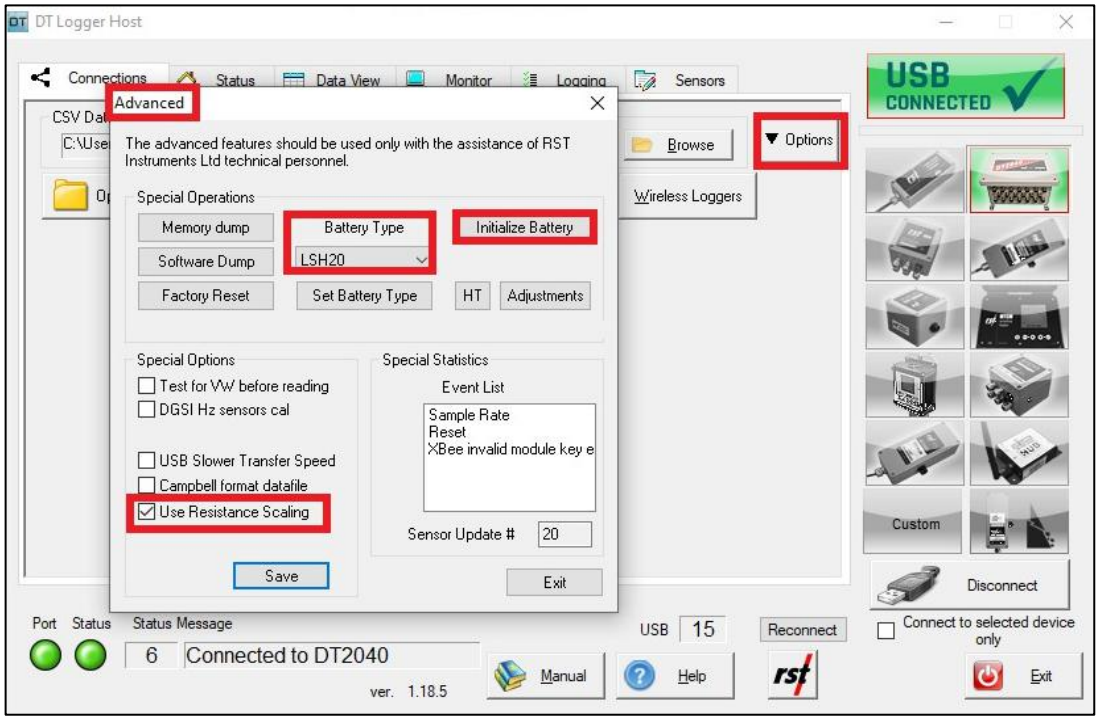


7.1.3 More Settings

1. The ‘Connections’ tab is used to setup the data logger for the type of connection (DTLink Wireless, RSTAR Wireless or USB).



2. Select the ‘Options’ tab, then select ‘Advanced’ to set and initialize the battery. Check the ‘Use Resistance Scaling’ factor box for the thermistors.



8 RESISTANCE TO TEMPERATURE CONVERSION

NOTE: The following is for the 3 kΩ thermistor (standard).
If another thermistor type is used in the thermistor string, please contact RST for further support.

The following equation may be used to convert the measured thermistor resistance R (Ω) into temperature T (°C).

$$T = \frac{1}{1.4051 * 10^{-3} + 2.369 * 10^{-4} * \ln(R) + 1.019 * 10^{-7} * (\ln(R))^3} - 273.2$$

Equation 1: Thermistor Temperature Derivation

Alternatively, the values may be looked up directly in the table below:

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.11	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342..2	83	107.9	123
77.99K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-35	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	282.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	56.92	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.	53	250.9	93	83.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	3000	25	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

9 MAINTENANCE

For thermistor strings that are not connected to a datalogger and are left unconnected, care should be taken to protect the conductors or connector from damage.

10 PRODUCT SPECIFICATIONS

NOTE: For the most recent and complete list of specifications for the Thermistor String, please refer to the product page (Thermistor Strings - RST Instruments Ltd.).

11 SERVICE, REPAIR AND CONTACT INFORMATION

This product does not contain any user-serviceable parts. Contact RST for product services or repairs.

- For sales information: RST_sales@orica.com
- For technical support: RST_support@orica.com
- Service portal: https://support.rstinstruments.com/support/tickets/new
- Website: www.rstinstruments.com
- Toll free: 1-800-665-5599

RST Canada Office (Head Quarters)

Address: 11545 Kingston Street, Maple Ridge, BC, Canada V2X 0Z5

Telephone: 604-540-1100

Fax: 604-540-1005

Business hours: 8:00 a.m. to 4:00 p.m. (PST) Monday to Friday, except holidays

RST UK Office

Address: Unit 4 Charles Industrial Estate Stowupland Road, Stowmarket Suffolk, UK, IP14 5AH

Telephone: +44 1449 706680

Business hours: 9:00 a.m. to 6:30 p.m. (GMT) Monday to Friday, except holidays

APPENDIX A: SAMPLE CERTIFICATE OF COMPLIANCE

Certificate of Compliance

RST Instruments Ltd., 200 - 2050 Hartley Ave., Coquitlam, British Columbia, Canada V3K 6W5

Thermistor Strings

Customer: [redacted]
Work Order: [redacted]
Thermistor Type: 3 kΩ

Number of Points: 26
Length: 42 m

This is to certify that Thermistor String S/N: TS2787 meets the RST Instruments specifications for the product.

Technician: [redacted] Date: 20 August 2008

THM0008A

Applied Science Technologists and Technicians of British Columbia [redacted]

APPENDIX B: COMPLETE SAMPLE WIRING DIAGRAM