

Interface Manual

Sentinel Node

Thermocouple

*SignalFire Model: Sentinel-yTherm-XXXX,
where y is TC type (K, J, etc.)*



The SignalFire Sentinel Node is an Intrinsically Safe device with the following features:

- Standard SignalFire Sentinel RS485-Modbus Node
- RS485 connection to a Thermocouple Interface Board
- Type K and J thermocouple boards are supported (other types on request)
- Low power operation from an intrinsically safe high capacity lithium primary battery pack
- Optional solar battery system for routing nodes or rapid data collection
- Sends data to a SignalFire Buffered Modbus Gateway
- AES 128Bit Encryption

Specifications

| | |
|--------------------|---|
| Enclosure Size | 3.5" tall × 5.0" wide × 5.0" deep |
| Power Source | Internal IS Lithium battery pack <i>SignalFire Part Number: 3BIS</i> External Solar battery system <i>SignalFire Part Number: Sentinel-HCSolar</i> DC-DC Converter <i>SignalFire Part Number: DCDC-Sentinel</i> Other external power supply meeting the power entity parameters from the control drawing. |
| Temperature Rating | -40°C to +60°C |
| Radio Frequency | 902-928MHz Ism Band, FHSS radio, internal antenna |
| Compliance | Certified for use in Class I, Division 1 groups C and D. EXi [EXi] FCC/IC Certified. |



WARNING: Use of this equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.

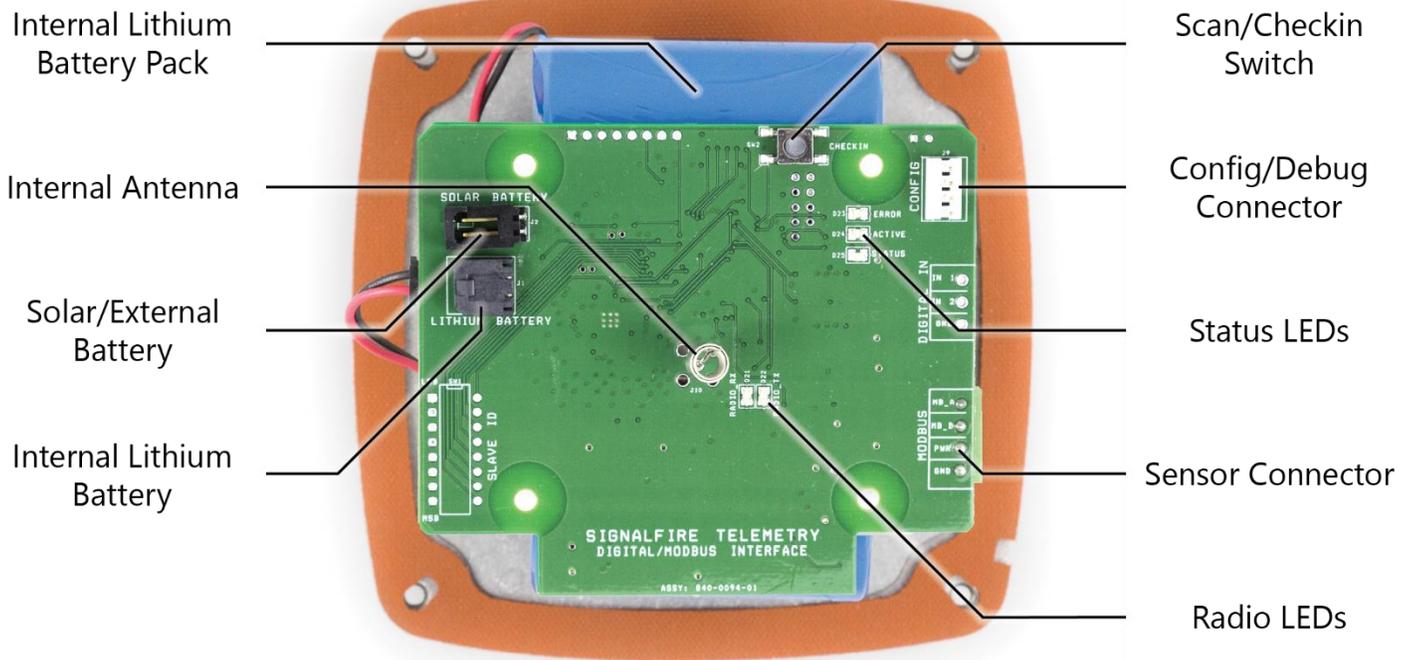


WARNING: The use of any parts not supplied by the manufacturer violates the safety rating of the equipment.

The associated apparatus provides intrinsically safe outputs.

L'appareil associé fournit des sorties à sécurité intrinsèque.

Refer to control drawing "Sentinel – Control Drawing – Modbus, Thermocouple, RTD, and Float Stick" for requirements when used in a Class I Division 1 area.



Radio LEDs

- The Radio TX LED (**green**) flashes each time a radio packet is sent. This LED will blink rapidly while searching for the radio network.
- The Radio RX LED (**red**) blinks on each received radio packet.

Status LEDs

- The Active LED (**green**) will blink at boot up and will blink rapidly when the sensor is being powered and read.
- The ERROR LED (**red**) will blink to indicate an error condition.

Scan/Checkin Button

- If this button is pressed the Sentinel will take a reading from the thermocouple and send those values to the gateway.

Setup

The nodes need to be set up for correct operation before being fielded. The configurable items include:

- Network selection
- Check-in period selection
- Thermocouple mode enable

All settings are made using the SignalFire Toolkit PC application and a serial programming cable.



WARNING: Perform the steps in this section (Setup) in a safe location only.

Using the SignalFire Toolkit

The SignalFire Toolkit application can be downloaded at www.signal-fire.com/customer. After installation, launch the software and the main toolkit window will open:



Select the COM port associated with the Sentinel Node and click “Auto-Detect Device on COM Port.” This will open the device configuration window, where all device settings can be configured.

Network Setting

The network is set using the SignalFire Toolkit. **The network, network group, and corporate ID/encryption key settings must match those of the gateway for them to communicate.**

Radio Network: 3
Radio Network Group: 0
Set

Encryption

To protect your over-the-air data and prevent tampering, SignalFire networks come with encryption. Legacy products use a Corporate ID, but can be switched over to use an encryption key if the firmware and ToolKit are up to date.

To set up a legacy Sentinel to use encryption, click the checkbox labeled **Enable Encryption** inside the **Set Corporate ID** box. All newer Sentinels come with this option enabled with "signalfire" as the default encryption key.

Set Corporate ID
 Enable Encryption
Corporate ID: 7
Set
Help

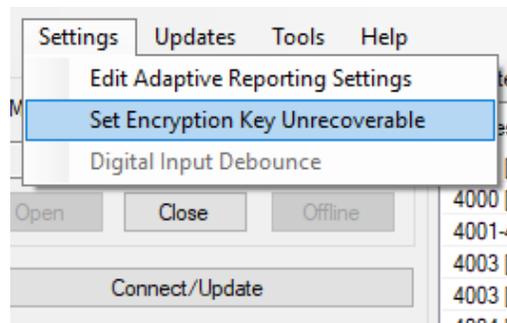
Corporate ID

Set Encryption Key
 Enable Encryption
Key: signalfire
Set
Help

Encryption Enabled

The box will then change into a **Set Encryption Key** box, and it will prompt instead for the encryption key you would like to use. Note that keys may not contain spaces or angle brackets. Enter it and then press **Set**. If you are setting up a new network, you will need to set the encryption key on all of your devices. If you are adding a Sentinel to a legacy network, you can simply set the Corporate ID without clicking the Enable Encryption box, and it will remain compatible with the older system.

It is also possible to hide your encryption key so it cannot be read. This is the most secure option, but if you forget your key, there is no way to recover it – you have to reset the key on every device on its network. To enable this option, select **Set Encryption Key Unrecoverable** under the **Settings** menu.



Setting the encryption key to be unrecoverable.

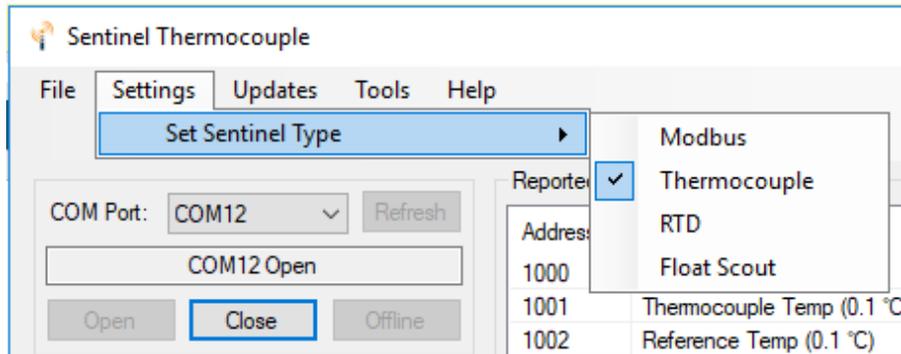
System Check-In Period

This setting controls how often the node will read the Modbus device and forward the register data to the gateway.

Checkin Interval 10 seconds

Configuration

Since the Sentinel Thermocouple uses a standard Sentinel Modbus Node with the Thermocouple interface card it is necessary to set the Sentinel type for Thermocouple operation if it is the default Modbus mode. To do this, select **Thermocouple** in the **Set Sentinel Type** option under the **Settings** pull down menu.

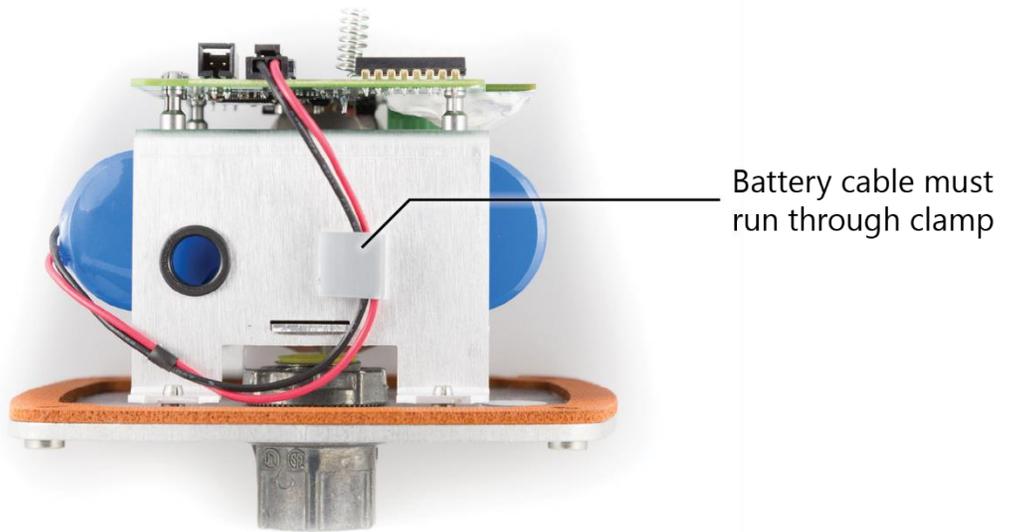


Sensor Connections

Wiring Requirements

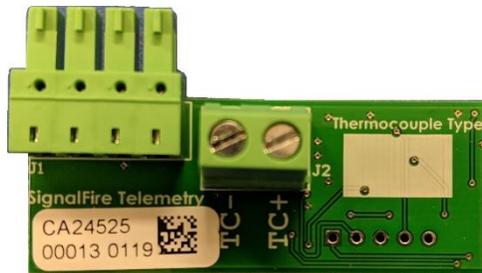
To ensure intrinsic safety is maintained it is required that the installer follow these guidelines when connecting sensors to the SignalFire node. See pictures for proper wire routing examples.

- Strip the wires so that there is minimal exposed un-insulated wire when inserted into the screw terminal.
- All wiring should be neat and orderly.



Sensor Connection

Connect the Thermocouple wires to the interface board. Any error with the thermocouple or interface board will be shown in the Status register. See table on Page 9 for details.



The polarity of the wires matters and the red wire is not necessarily positive. Consult the manual for your specific thermocouple for more details.

Remote Modbus Register Mapping

The Sentinel Node sends data to a SignalFire Telemetry Modbus Gateway. The data that is sent to the gateway is available at the gateway in registers where it can then be read by a Modbus RTU.

The following Thermocouple data is sent to the Gateway:

| Register Number | Register Address (offset) | Register Type | Description |
|-----------------|---------------------------|---------------|--|
| 41001 | 1000 | 16bit INT | Thermocouple Type (1=J, 2=K) |
| 41002 | 1001 | 16bit INT | Thermocouple Temperature (0.1 °C) |
| 41003 | 1002 | 16bit INT | Internal Reference Temperature (0.1 °C) |
| 41004 | 1003 | 16bit INT | Fault – TC Interface board not detected |
| 41005 | 1004 | 16bit INT | Fault - Thermocouple shorted to Ground |
| 41006 | 1005 | 16bit INT | Fault - Thermocouple is open (not connected) |
| 41007 | 1006 | 32bit FLOAT | Thermocouple Temperature degC (Float, High Word) |
| 41008 | 1007 | 32bit FLOAT | Thermocouple Temperature degC (Float, Low Word) |
| 41009 | 1008 | 16bit INT | Thermocouple Temperature (0.1 °F) |
| 41010 | 1009 | 16bit INT | Internal Reference Temperature (0.1 °F) |
| 41011 | 1010 | 32bit FLOAT | Thermocouple Temperature degF (Float, High Word) |
| 41012 | 1011 | 32bit FLOAT | Thermocouple Temperature degF (Float, Low Word) |

In addition to the registers read from the thermocouple board, the Sentinel will send system information in 16-bit registers listed in the table on the next page. This data is accessible at the same Slave ID as the connected Modbus device.

If any of the three system faults are detected all temperature values will fail high. The 16bit integer registers will fail to 32768 and the float registers will fail to +infinity.

Status Registers

| Register Number | Register Address (Offset) | Description |
|-----------------|---------------------------|---|
| 49987 | 9986 or 65523 | Status (0=no errors, 1=low battery, 2=failed sensor read, 3=low battery and failed sensor read) |
| 49988 | 9987 or 65524 | Major revision number for the mainboard |
| 49989 | 9988 or 65525 | Minor revision number for the mainboard |
| 49990 | 9989 or 65526 | Major revision number for the radio |
| 49991 | 9990 or 65527 | Minor revision number for the radio |
| 49992 | 9991 or 65528 | High 16 bits of SFTS node address |
| 49993 | 9992 or 65529 | Low 16 bits of SFTS node address (the radio ID) |
| 49994 | 9993 or 65530 | Slave ID readback |
| 49995 | 9994 or 65531 | Received signal strength of last packet from the slave |
| 49996 | 9995 or 65532 | Battery voltage of the Modbus client, in millivolts |
| 49997 | 9996 or 65533 | Minutes until this slave will time out, unless new data is received |
| 49998 | 9997 or 65534 | Number of registers cached for this slave device |
| 49999 | 9998 or 65535 | Remote device type. 0x32 for Sentinel Thermocouple |

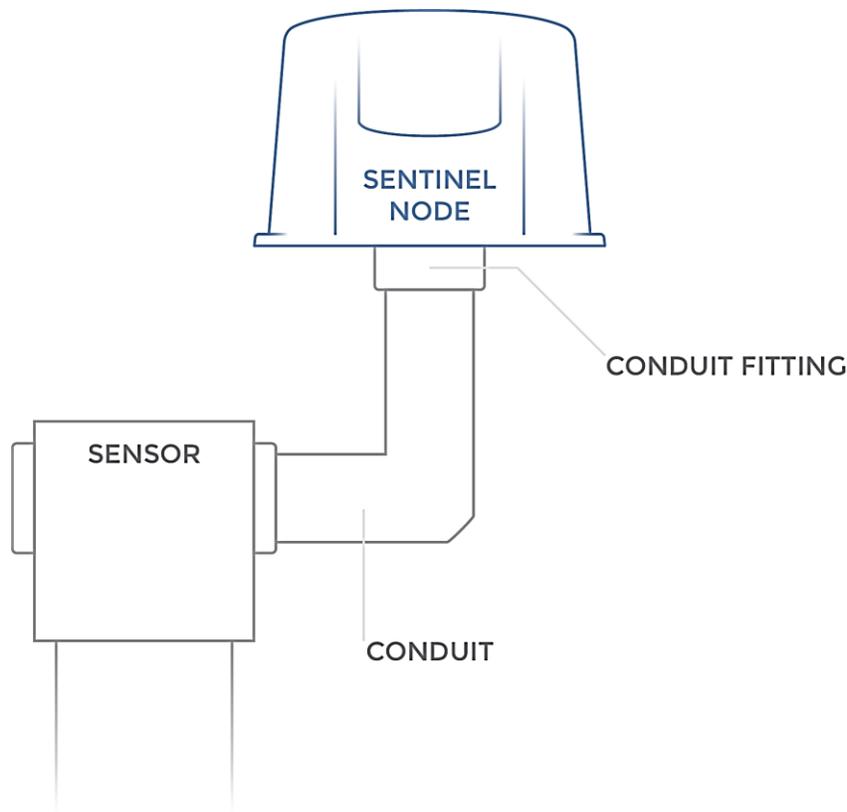
Mounting and Care

10

The unit comes with a watertight ½" NPT conduit fitting on the bottom mounting plate. The Sentinel is then directly mounted to the sensor with a short section of conduit.

Direct Mount to Sensor with Short Conduit

This mounting method uses a short conduit run from the sensor and the unit is held in place by the conduit.



WARNING: The Sentinel must be mounted in a location free of high vibrations. Over time vibrations can damage the Sentinel or battery pack, which could impair its safety ratings. Do not mount directly to continuous vibrating equipment such as pumps or compressors.

Internal Lithium Battery Replacement

Battery Packs can be changed with the node in place.

- 1 Open the cover from the enclosure.
- 2 Unplug the battery from the PCB, by depressing the locking clip on the connector.
- 3 Loosen the screw holding the battery door and slide the old battery out.
- 4 Slide in the new battery pack and tighten the battery door screw.
- 5 Connect the battery to the main PCB battery connector.
- 6 Install the enclosure cover.



WARNING: Use of any battery other than the SignalFire part number 810-0008-02 will impair the protection provided by the equipment.



WARNING: If the internal battery is installed the external solar battery system or other power source may not be connected!

Cleaning Instructions

The outside of the enclosure may be cleaned with water, mild soap, and a damp cloth as needed. High pressure washing is not recommended.



WARNING: Electrostatic Discharge Hazard! Care must be taken to avoid the potential of creating a charge on the enclosure or antenna. Do not wipe with a dry cloth. Do not brush against the enclosure with clothing or gloves.



WARNING: Only connect to the debug port in a safe area!

Debug and configuration information is available if a connection is made via the debug port on the main board. A USB converter cable (available from SignalFire) must be used for this interface.

Debug and advanced configuration may be done using the SignalFire Toolkit PC application.

Technical Support and Contact Information

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| Revision | Date | Changes/Updates |
|----------|----------|--|
| 1.0 | 10/16/14 | Initial release |
| 1.1 | 4/27/15 | Updated to new operation mode for TC Sentinel, added degrees F registers |
| 1.2 | 5/13/15 | Added details for C1D1 certification |
| 1.3 | 6/5/15 | Updated Design |
| 1.5 | 9/13/17 | Added section on encryption, updated warnings |
| 1.6 | 2/7/19 | Updated screenshots Added Status register Minor formatting updates |

APPENDIX - FCC and IC Statements

13

Changes or modifications not expressly approved by SignalFire Telemetry, Inc could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Only the supplied coil antenna (Part number 810-0012-01) which is permanently soldered to the PCB may be used. This antenna has a maximum gain of 3dB.

WARNING!

FCC and IC Radiation Exposure Statement:

This equipment complies with FCC's and IC's RF radiation exposure limits set forth for an uncontrolled environment under the following conditions:

1. This equipment should be installed and operated such that a minimum separation distance of 20cm is maintained between the radiator (antenna) & user's/nearby person's body at all times.
2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a maximum (or lesser) gain approved for this transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.r.i.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.