SIGNALFIRE
wireless telemetry

Sentinel Node HART Interface Manual
SignalFire Model: SENTINEL-HART

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

- Powers a single HART sensor at 12.5VDC or 18.7VDC (software selectable)
- Low power operation from an intrinsically safe high capacity lithium primary battery pack.
- Optional solar battery system for routing nodes, high power draw sensors, or rapid data collection
- Sends data to a SignalFire Buffered Modbus Gateway
- Settable (DIP switch) Modbus ID

Sentinel Node with cover removed

Specifications

Enclosure Size: 3.5" tall x 5.0" wide x 5.0" deep

Power Source: Internal IS Lithium battery pack. SignalFire Part Number:
                       810-0008-02

                       External Solar battery system. SignalFire Part Number:
                       SENTINEL-SOLAR

                       Other external power supply meeting the power entity parameters
                       from the control drawing.

Temperature Range: -40ºC to +60 ºC

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.*

⚠️*WARING: 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 960-0026-01 for requirements when used in a Class I Division 1 area.

SignalFire Telemetry   Hudson, MA USA   S/N: 00000001
www.signal-fire.com

Model: SENTINEL-HART

CLASS I, DIVISION 1 GROUPS C, D	ENTITY PARAMETERS	Exi [Exi]
TEMP CODE: T3		
AMBIENT TEMP: −40ºC to +60ºC		

C ETL US
LISTED
Intertek
4003827

INPUT POWER:	OUTPUT (J3):
Vmax = 5.9 Vdc	Voc = 21 Vdc
Imax = 1.93 A	Isc = 111 mA
Pmax = 0.8 W	Ca = 1.16 uF
Ci = 34.2 uF	La = 11.5 mH
Li = 14.2 uH	

CONFORMS TO UL STD 913
CERTIFIED TO
CAN/CSA STD C22.2 NO. 157
FCC ID: W8V-SENTINEL
IC: 8373A-SENTINEL

INTRINSICALLY SAFE	WARNING: POTENTIAL	AVERTISSEMENT: DANGER
SECURITE INTRINSEQUE	ELECTROSTATIC DISCHARGE	POTENTIEL DE DECHARGES
INTRINSICALLY SAFE WHEN CONNECTED	HAZARD! SEE INSTRUCTIONS	ELECTROSTATIQUES: VOIR LES
PER SIGNALFIRE DRAWING 960-0026-01		INSTRUCTIONS

WARNING: USE OF ANY BATTERY	AVERTISSEMENT: LA SUBSTITUTION	WARNING: SUBSTITUTION OF
OTHER THAN SIGNALFIRE 810-0008-02	DE COMPOSANTS PEUT COMPROMETTRE	COMPONENTS MAY IMPAIR
or SENTINEL-SOLAR	LA SECURITE INTRINSEQUE	INTRINSIC SAFETY
MAY IMPAIR INTRINSIC SAFETY		

The picture below shows the connection and major components of the Sentinel Node.
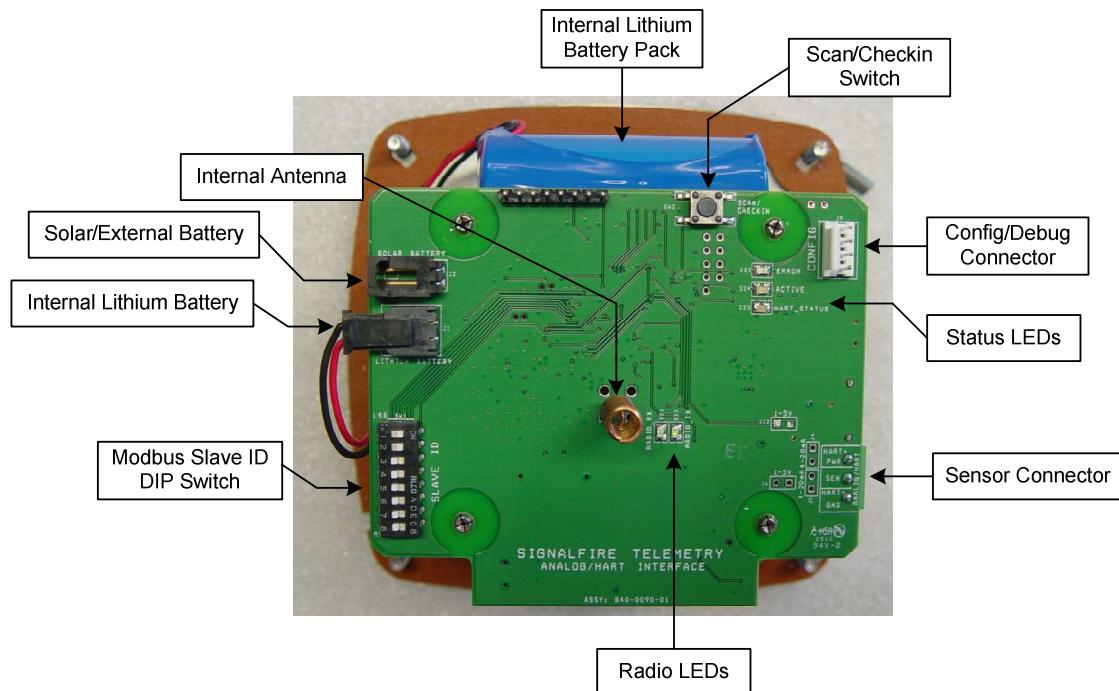
Radio LEDs:
- The radio TX LED (Green) flashes each time a radio packet is sent. This LED will blink rapidly while searching for the radio network.

- 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.
- The HART_STATUS LED will blink once to indicate a HART sensor is connected after a HART scan is completed. A HART scan is conducted at each power-up or when the Scan/Checkin button is pressed.
- The ERROR LED (Red) will blink to indicate an error condition, such as the Slave ID being set to 0 which is invalid.

Scan/Checkin Button:

- If this button is pressed the Sentinel will apply power to the sensor for the configured sensor on time and scan for the HART sensor. If the HART sensor is detected the HART_STATUS LED will blink once and its data will be read. The Sentinel will also send the collected sensor data to the gateway.

Section 1: Setup

⚠️**WARING:** *Perform the steps in section 1 setup in a safe location only.*

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

- Network Selection
- Check-in Period Selection
- Modbus Slave ID Setting
- Sensor on time/supply voltage

The Modbus slave ID is set using the DIP switch, all other setting are made using the SFToolKit PC application and a serial programming cable.

Network Setting

The network address can be used to create separate networks using multiple gateways (that are in close proximity with one another). The network is set using SFToolKit. The Network Group setting is used when more than 8 networks are needed. Both the network and network group must match for nodes to communicate.

Modbus Slave ID

The Modbus Slave ID is set using the DIP switch. The DIP switch takes an 8-bit binary input which is converted into a slave ID from 1 to 255. In the picture below switch 1 and 2 are on which is 00000011 and results in a slave ID of 3. The least significant bit (LSB) is on the left and is labeled 1 under the row of switches.
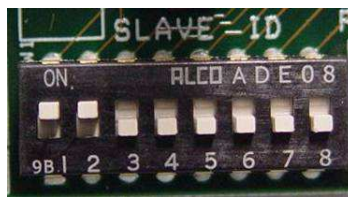
Sensor Settings

The Sentinel Node will supply either 18 Volts or 12 Volts to the sensor, this is selectable in the SFToolKit application. Also the sensor warm-up time must be configured. The default is 2 seconds which is used for most pressure and other simple sensors. Radar sensors often require a longer warm-up time. Contact your sensor manufacturer or SignalFire for details.

Selecting a sensor voltage of 12V will result in longer battery life; however some sensors require higher voltage.

Section 2: 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.

- Sensor wires entering the enclosure must be run as pictured
- The battery wire much be routed through the battery cable hold-down clamp.
- Strip the wires so that there is a minimum exposed un-insulated wire when inserted into the screw terminals.
- All wiring should be neat and orderly.
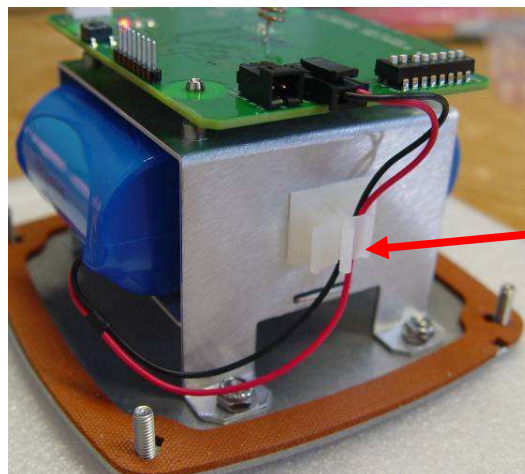
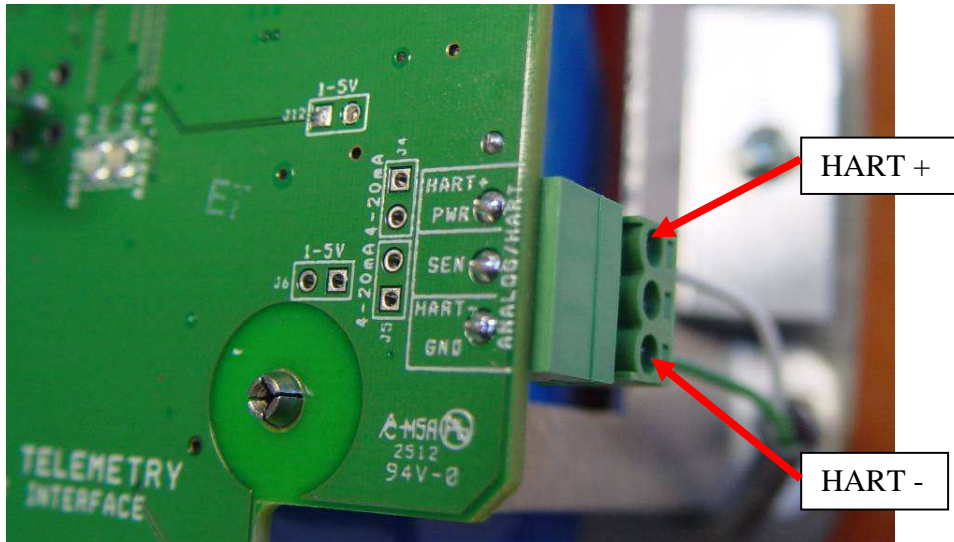Battery cable must run through clamp

Battery cable routing
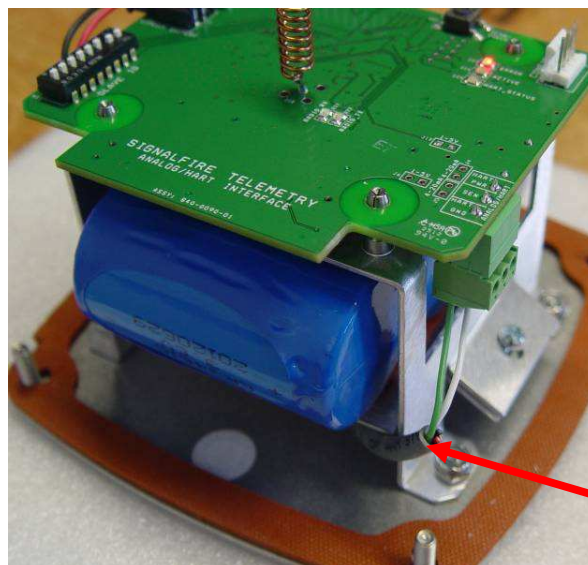
Sensor cable should be routed as shown

Sensor Cable Routing

HART Sensor Connection

A single sensor operating in HART multi-drop mode may be connected to the Sentinel node. The HART sensor must be configured for HART ID 1.

HART Sensor Connection

The HART sensor is a 2-Wire interface between the Sentinel Node and the HART sensor. The positive (HART+) at the sensor is connected to the top terminal on the Sentinel Node. The negative terminal (HART-) is connected to the bottom terminal of the Sentinel Node, the middle terminal should be left unconnected.

Section 3: 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. Consequently, the node needs to have a unique (to the network it is in) Modbus slave ID which the gateway will use to store its unique data. The ID is set via the DIP switch on the board.

Modbus Registers

Every check-in period, the sensors are read and data is sent to the gateway. The gateway will save the data under the set Modbus ID in 16-bit registers. The register map for this system is:

Register Map

| Register Number	Register Address (Offset)	Description
44001	4000	HART ID 1: Manufacturer's ID Code/Device Type (ID=MSB, Device=LSB)
44002	4001	HART ID 1: Device ID Number (ID high bite = MSB, ID mid byte = LSB)
44003	4002	HART ID 1: Device ID Number, HART Status (ID low byte = MSB, Status = LSB)
44004	4003	HART ID 1: PV & SV Units Code (PV=MSB, SV=LSB)
44005	4004	HART ID 1: TV & QV Units Code (TV=MSB, QV=LSB)
44006-44007	4005-4006	HART ID 1: Primary Variable (PV) (two registers) (float)
44008-44009	4007-4008	HART ID 1: Secondary Variable (SV) (two registers) (float)
44010-44011	4009-4010	HART ID 1: Tertiary Variable (TV) (two registers) (float)
44012-44013	4011-4012	HART ID 1: Quaternary Variable (QV) (two registers) (float)
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. 43 for Sentinel HART

[1]The status registers are only available from the 49988-49999 (9987-9998) address range if the Gateway is running firmware 7.52 or higher.

Section 4: Mounting

The unit comes with a 7/8" hole on the bottom mounting plate. A watertight conduit fitting should be installed into this hole. The sensor 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.
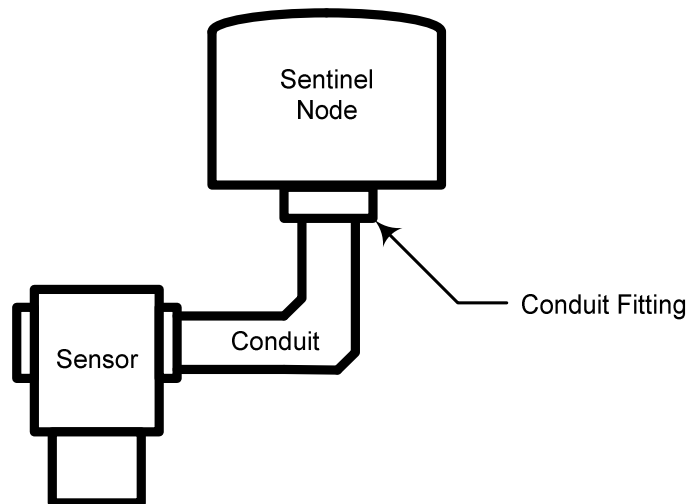
Internal Lithium Battery Replacement

Battery Packs can be changed in 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 and a mild soap with 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 change on the enclosure or antenna. Do not wipe with a dry cloth. Do not brush against the enclosure with clothing or gloves.*

Configuration/Debug

⚠️*WARING: 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 RS232 converter cable (available from SignalFire) must be used for this interface.

Debug and advanced configuration may be done using the SignalFire SFToolKit PC application. See the SFToolKit users manual for details on its use.

Technical Support Contact Information

SignalFire Telemetry
43 Broad St. A-403
Hudson, MA 01752
978-212-2868

APPENDIX - FCC and IC Statements

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.