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

- Two counter/frequency inputs, up to 2kHz. Open drain or pulse input supported
- Reports state of dry contact inputs, open/closed
- Optional report on state change
- Two 32bit count totalizers
- 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
## Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure Size</td>
<td>3.5” tall × 5.0” wide × 5.0” deep</td>
</tr>
</tbody>
</table>
| Power Source             | Internal IS Lithium battery pack  
                          *SignalFire Part Number: 3BIS*  
                          External Solar battery system  
                          *SignalFire Part Number: Sentinel-HCSolar*  
                          DC-DC Converter  
                          *SignalFire Part Number: DCDC-Sentinel*  
                          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 – Digital and Turbine” under Technical Documents for requirements when used in a Class I Division 1 area.
INTRINSICALLY SAFE
SECURITE INTRINSEQUE

INTRINSICALLY SAFE WHEN CONNECTED
PER SIGNALFIRE DRAWING 960-0028-01

AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE

WARNING: USE OF ANY BATTERY OTHER THAN SIGNALFIRE 810-0008-02 or SENTINEL-SOLAR MAY IMPAIR INTRINSIC SAFETY

WARNING: POTENTIAL ELECTROSTATIC DISCHARGE HAZARD! SEE INSTRUCTIONS

ENTITY PARAMETERS

<table>
<thead>
<tr>
<th>Exi</th>
<th>Exi</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT POWER:</td>
<td>INPUT SIGNAL (J7):</td>
</tr>
<tr>
<td>Vmax = 5.9 Vdc</td>
<td>Vmax = 30 Vdc</td>
</tr>
<tr>
<td>Imax = 3.1 A</td>
<td>Imax = 100 mA</td>
</tr>
<tr>
<td>Pmax = 0.8 W</td>
<td>Cl = 0.01 uF</td>
</tr>
<tr>
<td>Ci = 23.3 uF</td>
<td>Li = 1.0 nH</td>
</tr>
<tr>
<td>Li = 4.08 uH</td>
<td></td>
</tr>
</tbody>
</table>

IN ambient temp: –40°C to +60°C

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

CLASS I, DIVISION 1 GROUPS C, D
TEMP CODE: T3

WARNING: USE OF ANY BATTERY OTHER THAN SIGNALFIRE 810-0008-02 or SENTINEL-SOLAR MAY IMPAIR INTRINSIC SAFETY

AVERTISSEMENT: DANGER POTENTIEL DE DECHARGES ELECTROSTATIQUES: VOIR LES INSTRUCTIONS

4003827

Marlborough, MA USA
www.signal-fire.com
S/N:SD000001
Model: SENTINEL-DI-XXXX

AVERTISSEMENT: POTENTIEL DE DECHARGES ELECTROSTATIQUES: VOIR LES INSTRUCTIONS

4003827
**Connections and Components**

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 for 2 seconds before the counter values are sent to the gateway.
- The ERROR LED (red) will blink to indicate an error condition.

Scan/Checkin Button
- If this button is pressed the Sentinel will send the current counter 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
- Modbus ID setting

All settings are made using the SignalFire Toolkit PC application and a serial programming cable. The Modbus ID can also be set using the DIP switch.

⚠️ 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.
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Serial Port Settings</td>
</tr>
<tr>
<td>2</td>
<td>Sentinel Information</td>
</tr>
<tr>
<td>3</td>
<td>Set Corporate ID / Encryption Key</td>
</tr>
<tr>
<td>4</td>
<td>Status of Last Operation</td>
</tr>
<tr>
<td>5</td>
<td>Reported Sensor and HART Values</td>
</tr>
<tr>
<td>6</td>
<td>Sentinel Settings</td>
</tr>
<tr>
<td>7</td>
<td>Battery Life Estimate</td>
</tr>
</tbody>
</table>
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.**

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.

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*
Modbus ID

The Modbus ID can be set with the SignalFire Toolkit, or with the DIP switch located on the device on older models. The DIP switch takes an 8-bit binary input which is converted into a Modbus ID from 1 to 240. In the picture below switch 1 and 2 are on, which is 00000011 and results in a Modbus ID of 3. The least significant bit (LSB) is on the right and is labeled 1 above the row of switches. The Sentinel must be power cycled after setting the DIP switch. Note: The DIP switch must be set to 0 (all switches off) in order to set the Modbus ID with the SignalFire Toolkit.
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 must be routed through the battery cable hold-down clamp.
- 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.

Plug the internal lithium battery pack into the connector labeled LITHIUM BATTERY as show below. Be careful to insert the battery connector as pictured with the locking tab facing up.

**Forcing the battery connector in backward or into the SOLAR BATTERY connector can damage the battery pack fuse making it inoperable.**

Only connect either the Lithium batter OR the Solay battery. **Never connect both at the same time.**
Sensor Connection

The Sentinel Node has two digital input channels; open or both may be used.

Each counter input may be open collector type (sinking ground), dry contact inputs, or voltage pulse type, note that voltage pulses must pull the input high/low. The inputs can count up to 2000 Hz.

The digital outputs may be connected to the board as shown in the following diagrams:

- **Dry Contact Connection**
- **Open Collector Connection**
- **Voltage Pulse Connection**

The counts accumulate, and the current counts are stored into non-volatile memory every 15 seconds. If the system is reset the counts will revert to the last stored value from non-volatile memory.

The system also reports the state of the contact closure input (open or closed) at the time of check-in.
Digital Input Debounce

In cases where it is desired to accurately totalize digital input counts it may be necessary to enable the digital input debounce timer. The debounce timer is useful when dealing with dry contacts that may otherwise produce extra counts when they close. To enable the digital debounce, open the configuration window for the node in the SignalFire Toolkit and select **Digital Input Debounce** from the **Settings** menu. A typical value for a dry contact would be 100mS. Any extra counts due to contact bounce within the debounce time setting will be ignored.

Digital Input State Latch

The state latch feature is useful in cases when the state of one or both of the digital inputs is “latched” to a value for a configurable number of seconds. This is useful in cases where a fast transition would be sensed by the Sentinel by may happen too quickly to be read from the Gateway. The state latch feature is configured using the ToolKit. For example, with if the state latch is set to latch closed for 3 seconds, then any close sensed on the digital input will be reported as closed for 3 seconds even in the input opens in less than 3 seconds.
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 ID which the gateway will use to store its unique data.

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 below.

Register Map

<table>
<thead>
<tr>
<th>Register Number</th>
<th>Register Address (Offset)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>43011-43012</td>
<td>3010-3011</td>
<td>32-bit Hardware counter, 3010=high word (two registers)</td>
</tr>
<tr>
<td>43013</td>
<td>3012</td>
<td>Digital Input state (1=closed, 0=open)</td>
</tr>
<tr>
<td>43014</td>
<td>3013</td>
<td>Average frequency over the last check-in period times 10</td>
</tr>
<tr>
<td>43015</td>
<td>3014</td>
<td>Frequency over 2 seconds at check-in time times 10</td>
</tr>
<tr>
<td>43016</td>
<td>3015</td>
<td>Avg. counts per minute over the check-in period times 10</td>
</tr>
<tr>
<td>43017-43018</td>
<td>3016-3017</td>
<td>32-bit Hardware counter, 3016=high word (two registers)</td>
</tr>
<tr>
<td>43019</td>
<td>3018</td>
<td>Digital Input state (1=closed, 0=open)</td>
</tr>
<tr>
<td>43020</td>
<td>3019</td>
<td>Average frequency over the last check-in period times 10</td>
</tr>
<tr>
<td>43021</td>
<td>3020</td>
<td>Frequency over 2 seconds at check-in time times 10</td>
</tr>
<tr>
<td>43022</td>
<td>3021</td>
<td>Avg. counts per minute over the check-in period times 10</td>
</tr>
<tr>
<td>49987</td>
<td>9986 or 65523</td>
<td>Status (0=no errors, 1=low battery, 2=failed sensor read, 3=low battery and failed sensor read)</td>
</tr>
<tr>
<td>49988</td>
<td>9987 or 65524</td>
<td>Major revision number for the mainboard</td>
</tr>
<tr>
<td>49989</td>
<td>9988 or 65525</td>
<td>Minor revision number for the mainboard</td>
</tr>
<tr>
<td>49990</td>
<td>9989 or 65526</td>
<td>Major revision number for the radio</td>
</tr>
<tr>
<td>49991</td>
<td>9990 or 65527</td>
<td>Minor revision number for the radio</td>
</tr>
<tr>
<td>49992</td>
<td>9991 or 65528</td>
<td>High 16 bits of SFTS node address</td>
</tr>
<tr>
<td>49993</td>
<td>9992 or 65529</td>
<td>Low 16 bits of SFTS node address (the radio ID)</td>
</tr>
<tr>
<td>49994</td>
<td>9993 or 65530</td>
<td>Modbus ID readback</td>
</tr>
<tr>
<td>49995</td>
<td>9994 or 65531</td>
<td>Received signal strength of last packet from the Sentinel</td>
</tr>
<tr>
<td>49996</td>
<td>9995 or 65532</td>
<td>Battery voltage of the Modbus client, in millivolts</td>
</tr>
<tr>
<td>49997</td>
<td>9996 or 65533</td>
<td>Minutes until this Sentinel will time out, unless new data is received</td>
</tr>
<tr>
<td>49998</td>
<td>9997 or 65534</td>
<td>Number of registers cached for this device</td>
</tr>
<tr>
<td>49999</td>
<td>9998 or 65535</td>
<td>Remote device type. 44 for Sentinel Digital</td>
</tr>
</tbody>
</table>

Note: The status registers are only available from the 49987-499999 (9986-9998) address range if the gateway is running firmware 7.52 or higher.
**Mounting and Care**

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 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

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

SignalFire Telemetry
140 Locke Dr, Suite B
Marlborough, MA 01752
(978) 212-2868
support@signal-fire.com

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Changes/Updates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>10/09/12</td>
<td>Initial release</td>
</tr>
<tr>
<td>1.2</td>
<td>11/7/14</td>
<td>Updated entity parameters</td>
</tr>
<tr>
<td>1.3</td>
<td>1/22/15</td>
<td>Added digital input debounce setting</td>
</tr>
<tr>
<td>1.4</td>
<td>6/5/15</td>
<td>Updated Design</td>
</tr>
<tr>
<td>1.6</td>
<td>8/1/16</td>
<td>Added section on encryption</td>
</tr>
<tr>
<td>1.7</td>
<td>9/13/17</td>
<td>Updated warnings</td>
</tr>
<tr>
<td>1.8</td>
<td>2/5/19</td>
<td>Updated pictures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minor formatting updates</td>
</tr>
<tr>
<td>1.9</td>
<td>3/31/22</td>
<td>Update Register 49987 description.</td>
</tr>
<tr>
<td>1.10</td>
<td>6/3/22</td>
<td>Added detail on battery connection</td>
</tr>
</tbody>
</table>
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.i.r.p.) is no 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 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 isotope 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.