

Interface Manual

Sentinel Modbus with 2DI

SignalFire Model: Sentinel-485/2DI-DC



The SignalFire Sentinel Node is a device with the following features:

- RS485 connection to a single Modbus RTU sensor device
- Configurable Modbus register polling map
- Two digital inputs, perfect for high level alarms
- Reports state of dry contact inputs, open/closed, totalizer. Report on state change
- Can power an attached Modbus sensor at 5.3V or 7.6V with configurable warm-up time
- Low power operation from an on board DC-DC power supply
- Sends data to a SignalFire Buffered Modbus Gateway
- AES 128bit Encryption

Specifications

2

Enclosure	3.5" tall × 5.0" wide × 5.0" deep
Ingress	Type 3
Power Source	DC-DC converter
Supply Voltage Range	9-36V DC
Compliance	Certified for use in Class I, Division 2 groups A,B,C and D. T4 FCC/IC Certified.
Location	Indoor and Outdoor use, Wet location
Temperature Rating	-40°C to +85°C
Relative Humidity	Operating and storage humidity 0-100%
Altitude	2000m Max
Pollution Degree	Pollution Degree II
Radio Frequency	902-928MHz ISM Band, FHSS radio, internal antenna



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


L'utilisation du produit d'une manière différente telle que décrite par la fabricant compromettra la protection intrinsèque de l'équipement.



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

L'utilisation de toute composantes différentes du fabricant élimine la sécurité intrinsèque du produit

Device Label



SIGNALFIRE
— WIRELESS TELEMETRY —

Marlborough, MA USA
www.signal-fire.com
Class I, Division 2
Groups A,B,C,D T4

Conforms to UL STDs 121201 and 61010-1
Certified to CSA C22.2 Nos. 213 and 61010-1

WARNING – EXPLOSION HAZARD
Substitution of components may impair suitability for Class I, Division 2

AVERTISSEMENT - RISQUE D'EXPLOSION. Le remplacement de toutes composantes peut affecter la sécurité intrinsèque de l'appareil et son utilisation dans une zone classifié Classe I Division 2

S/N: PAD001000

S/N BARCODE

Model: Sentinel-485/2DI-DC

Input: — 9 – 36 VDC, 200mA

Output: — 14.7V Max
100mA Max



Ambient Temp: –40°C to +85°C

FCC ID: W8V-SENTINEL
IC: 8373A-SENTINEL


Install per manual (Installer par manuel): 960-0033-11

WARNING – EXPLOSION HAZARD
Do not open enclosure unless area is known to be nonhazardous

AVERTISSEMENT - RISQUE D'EXPLOSION. Ne pas ouvrir le boîtier à moins que la zone n'est identifiée comme étant non-dangereuse

DC Converter

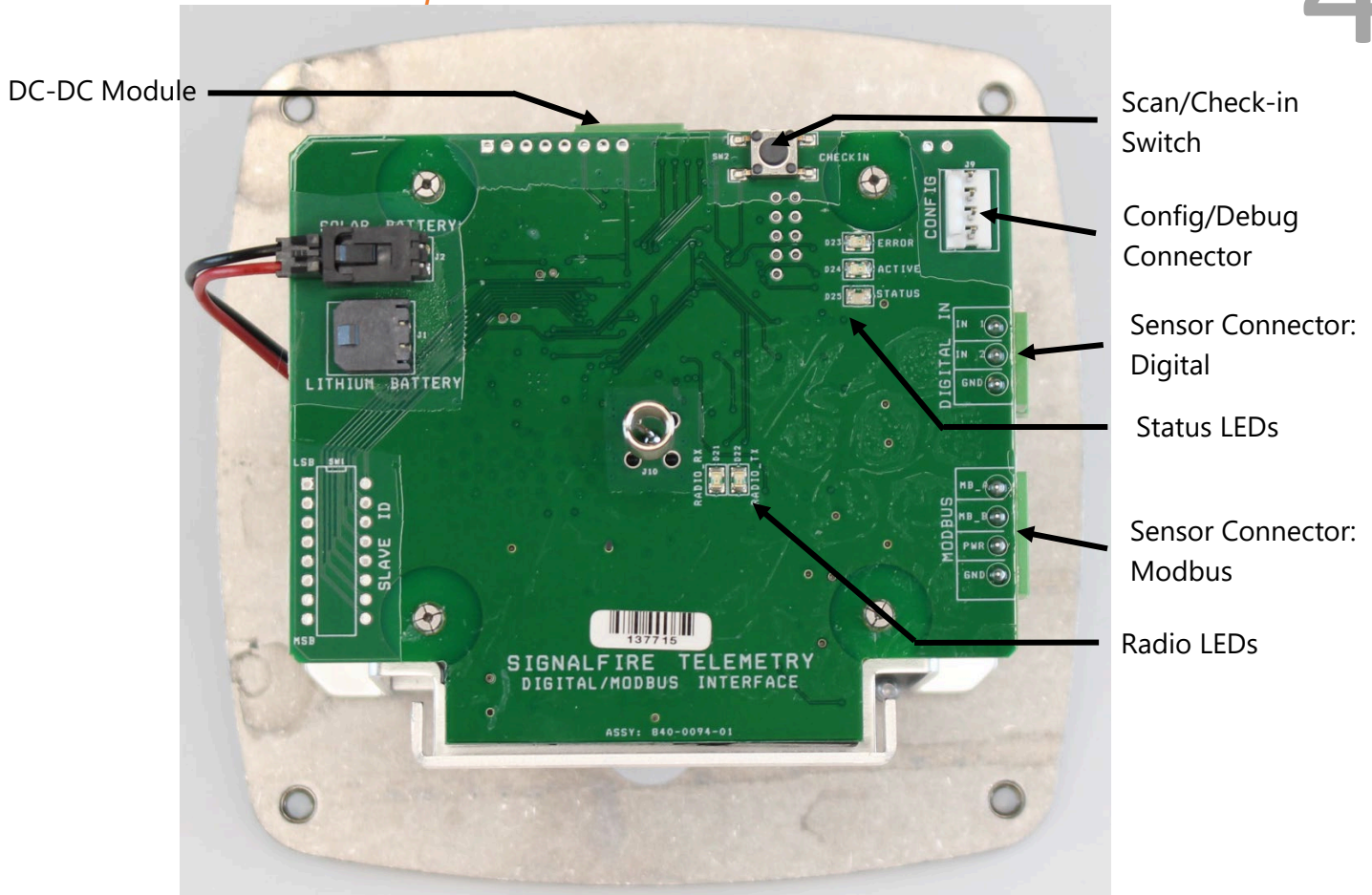


SIGNALFIRE
— WIRELESS TELEMETRY —

NC	3.3V OUT-
VIN-	NC
VIN+	3.3V OUT+

9-36VDC

- 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 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 power the sensor on for the configured time, read the pre-configured Modbus registers from the sensor, and forward 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
- Modbus registers to be polled
- Modbus sensor power on time

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



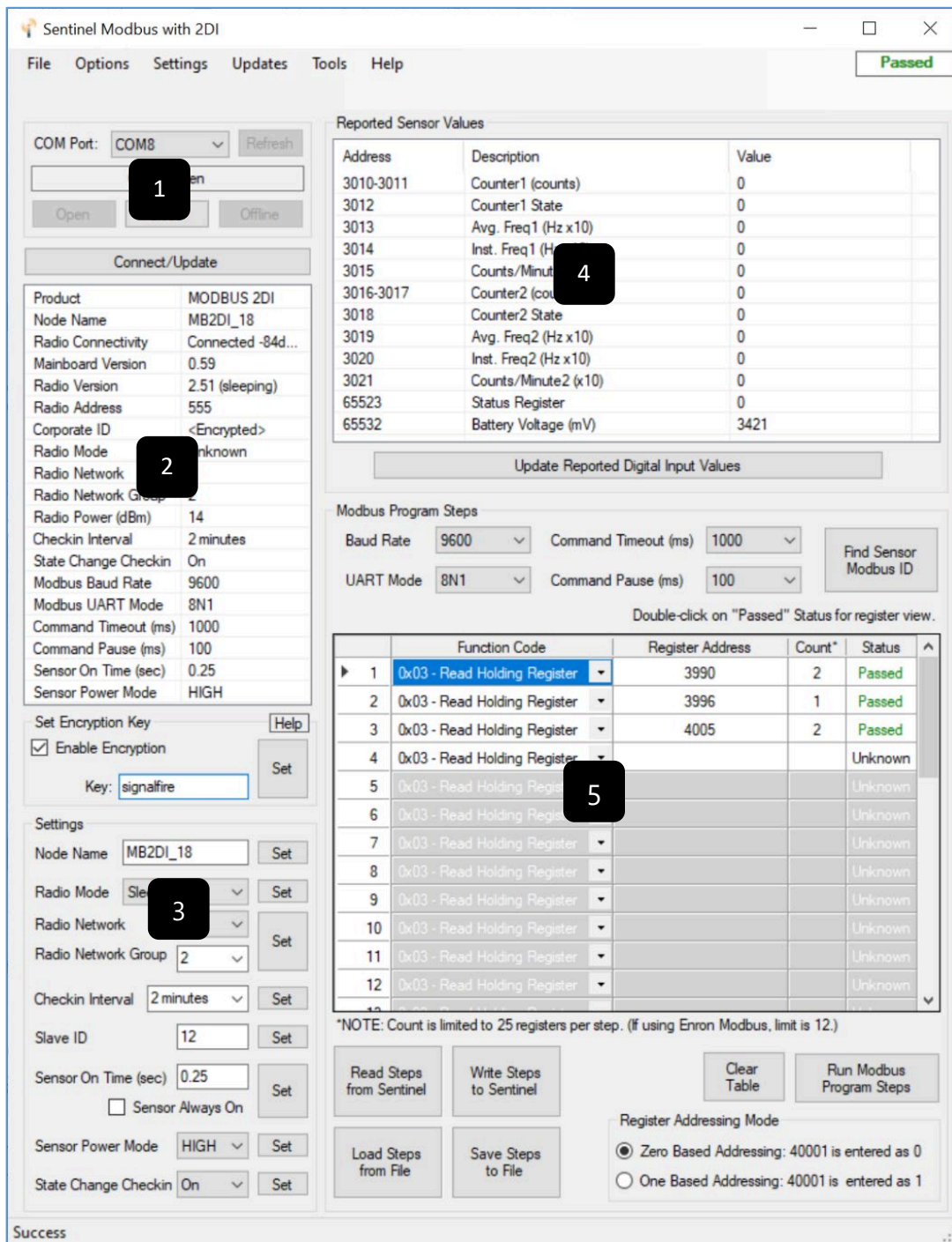
WARNING: Perform the steps in this section (Setup) in a safe location only.

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.



❶ COM Settings

❷ Register Values

❸ Node Information

❹ Current Program Steps

❺ Configurable Node Settings

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.

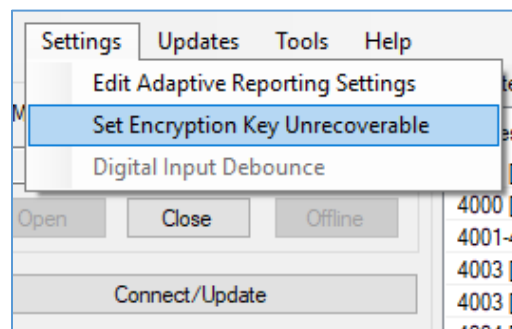
To set up a legacy Sentinel to use encryption, click the checkbox labeled **Enable Encryption** inside the **Set Corporate ID** box. All newer Sentinels come with this option enabled with "signalfire" as the default encryption key.

Corporate ID

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 ▼	Set
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Modbus Sensor Warm-up Time

The sensor warm-up time controls how long power is applied to the Modbus sensor prior to data collection. The default is 2 seconds which is used for most simple sensors, some may require longer warm-up times. Contact your sensor manufacturer or SignalFire for details.

Sensor On Time (sec)	2	Set
<input type="checkbox"/> Sensor Always On		

Operating Mode

The Sentinel Modbus-2DI node will report the status of the digital inputs as a set of Modbus registers at its configured Modbus ID. The Sentinel may also be configured using the SignalFire Toolkit application with a list of Modbus registers to be read from the attached sensor. Note that the attached Modbus sensor must be set to the same Modbus ID as the Sentinel.

The preconfigured set of registers is automatically read from the attached Modbus sensor device and forwarded to the Modbus gateway on a pre-defined schedule (1 minute to 5 minutes is typical). The register data is then buffered in the gateway and is available to be read by the RTU at any time.

If the check-in on state change option is set, the Sentinel will read the programmed Modbus register set and forward all data to the Gateway on any state change on either of the digital inputs.

When configured for a non-sleeping radio (i.e., radio always on) real-time Modbus reads/writes may be done from the Gateway to the end Modbus device.

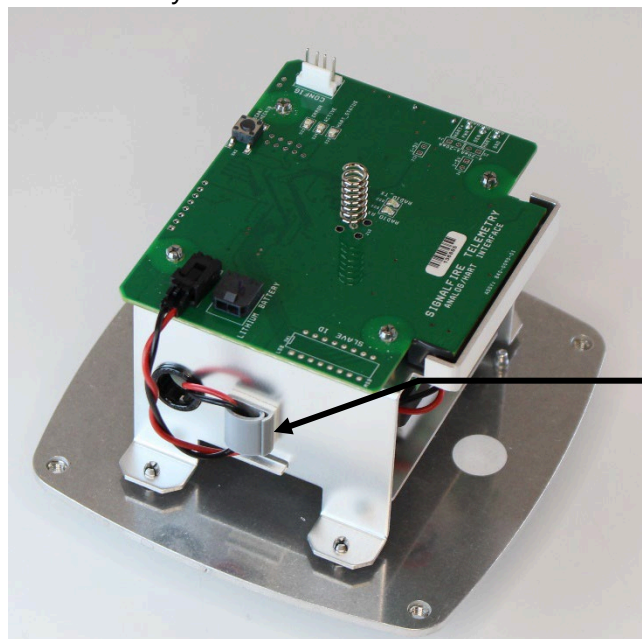
Sensor Connections

9

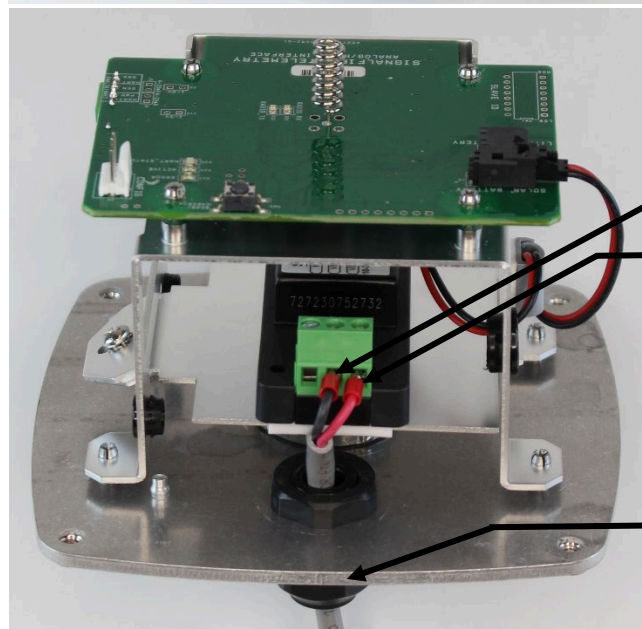
Wiring Requirements

Follow these guidelines when connecting sensors to the SignalFire node. See pictures for proper wire routing examples.

- Cables entering the enclosure must be run as pictured.
- DC power cable should be run through the cable gland and gland should be tightened.
- The DC-DC adapter wire must be routed through the cable hold-down clamp.
- Strip all wires so that there is minimal exposed un-insulated wire when inserted into the screw terminal.
- All field wiring must have a 18-16 AWG, with a minimum rating of 36VDC, 85°C.
- All wiring should be neat and orderly.



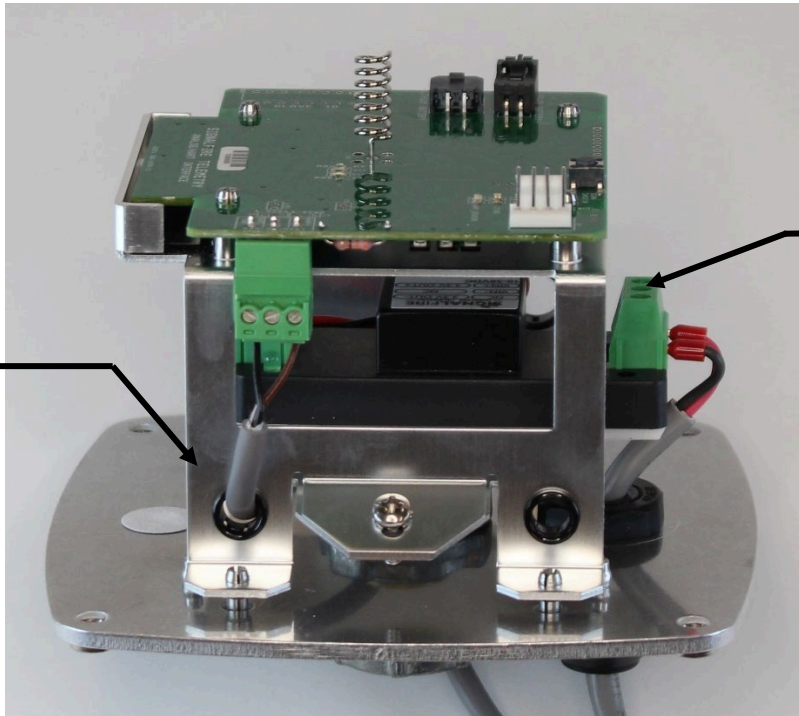
DC-DC cable must
run through clamp



Vin-
Vin+

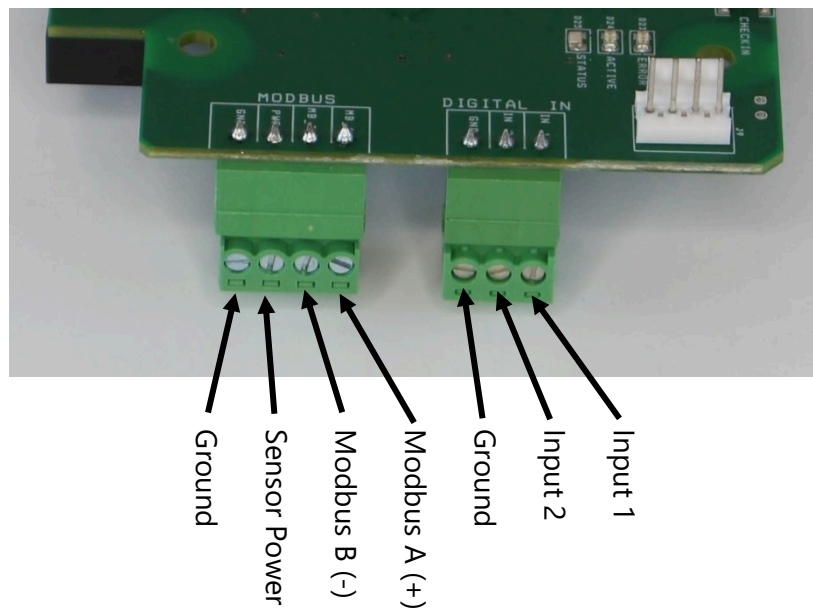
Tighten Gland,
Follow terminal
markings on module

Sensor cable should
be routed as shown



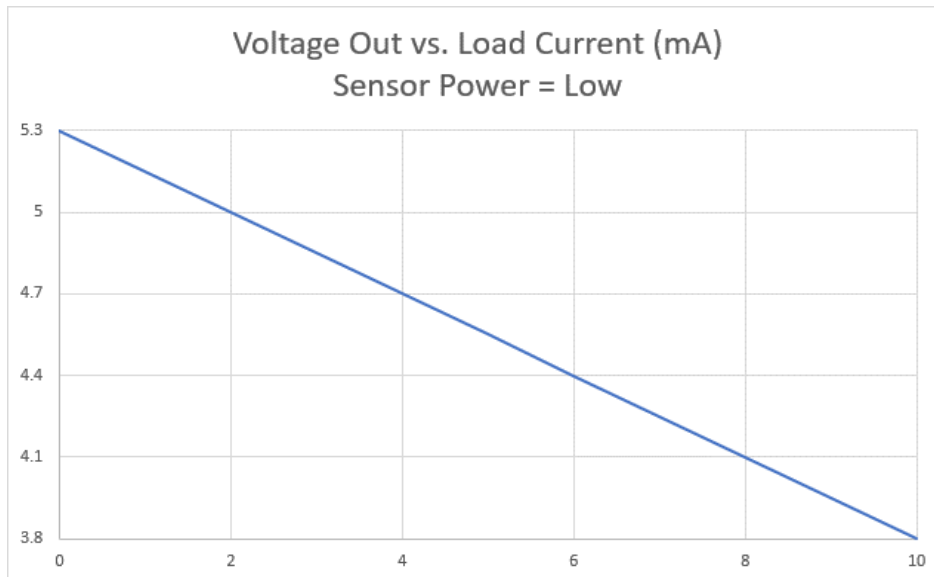
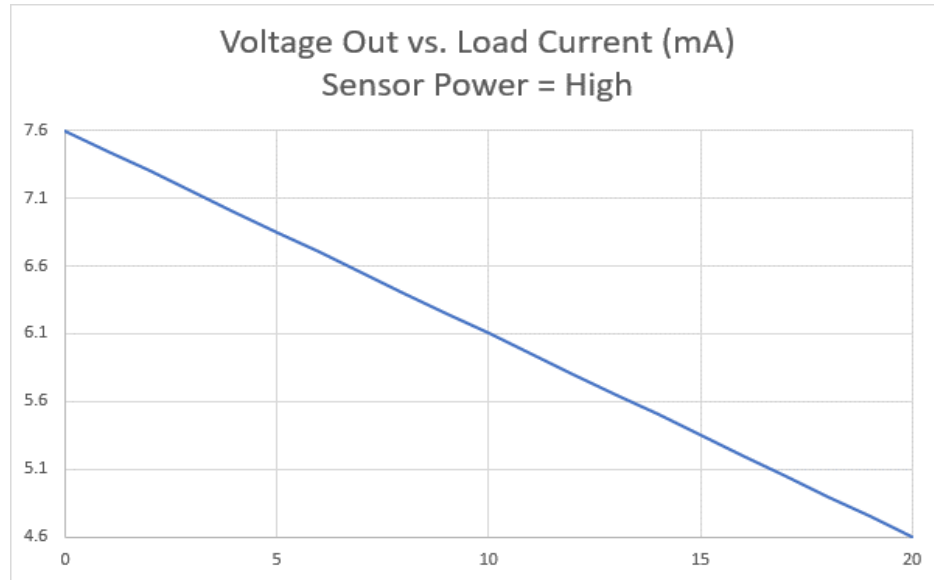
Tightening torque:
max 0.4 N*m

Sensor Connection



The Sentinel Modbus-2DI node has a single terminal block for connection to a Modbus sensor, and a separate terminal block for digital signals

The Sentinel has a current limiting resistor of 150 ohms. The voltage available to the sensor depends on the sensor current load. See the graphs below for details:

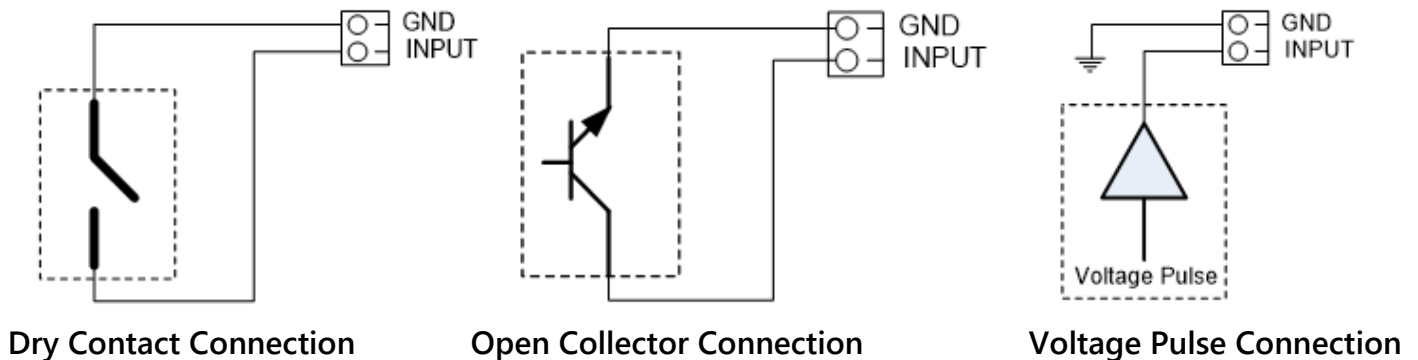


Digital Inputs Connection

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

Each counter input may be open collector type (sinking ground), dry contact inputs, or voltage pulse type. The inputs can count up to 2000 Hz.

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



The counts accumulate, and the current counts are stored into non-volatile memory every two hours. 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 a 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, 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.

Communication Settings

The Sentinel Modbus needs to have its serial RS-485 parameters set to match the device it's communicating with. Default settings are a baud rate of 9,600bits/s, UART mode 8N1 (8 data bits, no parity bit, 1 stop bit), command timeout of 1000ms, and command pause of 100ms. This should be sufficient for most devices but check your device's datasheet to confirm. Note that the Gateway and Sentinel's RS-485 settings are unrelated and do not need to match.

Modbus Program Steps

Baud Rate: 9600 Command Timeout (ms): 1000

UART Mode: 8N1 Command Pause (ms): 100

Find Sensor Modbus ID

The Modbus ID should match the ID of the connected Modbus device. Click **Find Sensor Modbus ID** if the ID of the connected sensor is unknown.

Slave ID: 12 Set

Make sure that there are no duplicate Modbus IDs in a given network; the gateway will only cache one set of data for each Modbus ID, so the duplicate will be overwritten.

Modbus Program Steps Configuration

The register set to poll on each check-in must be defined using program steps. The Sentinel Modbus can have up to 34 program steps. A program step consists of a function code, starting address, and number of consecutive registers.

Possible function codes are:

- 0x01: Read discrete output (limit: 1 coil)
- 0x02: Read discrete input (limit: 1 coil)
- 0x03: Read holding register
- 0x04: Read input register
- 0x05: Write discrete output

The register address entered is subtracted by the offset in the Register Addressing Mode. The offset can be 0 or 1. For example, with One Based Addressing, a holding register of address 3990 should be entered as function code 0x03, address 3991.

Double-click on "Passed" Status for register view.

	Function Code	Register Address	Count*	Status
1	0x03 - Read Holding Register	3990	2	Passed
2	0x03 - Read Holding Register	3996	1	Passed
3	0x03 - Read Holding Register	4005	2	Passed
4	0x03 - Read Holding Register			Unknown
5	0x03 - Read Holding Register			Unknown
6	0x03 - Read Holding Register			Unknown
7	0x03 - Read Holding Register			Unknown
8	0x03 - Read Holding Register			Unknown
9	0x03 - Read Holding Register			Unknown
10	0x03 - Read Holding Register			Unknown
11	0x03 - Read Holding Register			Unknown
12	0x03 - Read Holding Register			Unknown

*NOTE: Count is limited to 25 registers per step. (If using Enron Modbus, limit is 12.)

Read Steps from Sentinel Write Steps to Sentinel Clear Table Run Modbus Program Steps

Load Steps from File Save Steps to File

Register Addressing Mode

☒ Zero Based Addressing: 40001 is entered as 0

☐ One Based Addressing: 40001 is entered as 1

A count of 25 registers per step can be set unless using Enron Modbus. In that case, the limit is 12 registers per step. Keep in mind that one 32-bit floating point register should be read as two 16-bit registers. When writing the steps to the Sentinel, a warning will pop-up if too many registers are requested.

Click **Read Steps from Sentinel** to view the current program steps in the table. To add a new program step, fill in the next empty line. To delete a step, click on the line number and press the Delete key. Lines can also be copy/cut and pasted. Once all the desired program steps have been entered, click **Write Steps to Sentinel** to save the changes.

Modbus Program Steps Configuration (Legacy)

If using toolkit version 2.2.18 or earlier, the menu to enter program steps will be different.

Click **Read Current Program Steps from Device** to view the current program steps in the table. They can then be deleted or re-ordered using the buttons to the right of the table. To add a new program step, fill in the 4 boxes at the bottom, and click **Add New Program Step**. If the step is valid, it will be added to the table. Finally, click **Write New Program Steps to Device** to save the changes.

SlaveID <-- Slave ID used for all steps below

Double-click a Step to View Registers

	#	Func	Address	Count	Status
<input type="checkbox"/>	1	03	1	5	Unknown
<input type="checkbox"/>	2				
<input type="checkbox"/>	3				
<input type="checkbox"/>	4				
<input type="checkbox"/>	5				
<input type="checkbox"/>	6				
<input type="checkbox"/>	7				
<input type="checkbox"/>	8				
<input type="checkbox"/>	9				
<input type="checkbox"/>	10				
<input type="checkbox"/>	11				
<input type="checkbox"/>	12				
<input type="checkbox"/>	13				
<input type="checkbox"/>	14				
<input type="checkbox"/>	15				
<input type="checkbox"/>	16				
<input type="checkbox"/>	17				
<input type="checkbox"/>	18				
<input type="checkbox"/>	19				
<input type="checkbox"/>	20				
<input type="checkbox"/>	21				

Read Current Program Steps from Device

Write New Program Steps to Device

Function Code Address Reg Count Register Size

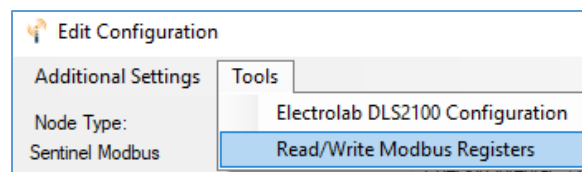
Add New Program Step

Note: In the legacy menu, the Register Addressing Mode is locked to One Based Addressing, so 3990 should be entered as 3991.

Read/Write Modbus Registers

Modbus registers of devices that have an RS-485 interface can be read and written through the Gateway when the device is in remote configuration mode. This is useful for testing or for setting configuration parameters in the end Modbus device.

For information on remote configuration, see the Gateway manual. Once the Modbus remote configuration window has been brought up, select 'Tools' and then 'Read/Write Modbus Registers.'



Create the register list by entering the Modbus ID (defaults to the Modbus id of the device), starting address, number of registers and click Apply to Table. The form will populate with the number of registers starting at the start address and a default data type of unsigned 16-bit integer.

The dialog box shows fields for 'Slave ID' (12), 'Starting Address' (3990), and 'Number of Registers' (10). An 'Apply to Table' button is present.

Click 'READ Registers' to read the current Modbus registers from the device. The Data Type and Register Value fields can be edited, and the changes will be highlighted. Click WRITE Registers to write the changes to the Modbus registers in the device.

The window displays a table of Modbus registers. At the top, there is a green box indicating 'Sensor power must be ON.' and a green box stating 'Sensor Power is ON for 04:18. Click to add 5:00. Right-click to turn OFF.' Below this, there is a checkbox for 'Sensor is externally powered.' The table has columns for 'Data Type', 'Register Address', and 'Register Value'. The 'Data Type' column is set to '16bit UINT' for all entries. The 'Register Address' column ranges from 3990 to 3999. The 'Register Value' column shows values: 1250, 150, 1100, 20, 18, 2, 68, 0, 0, 0.

Data Type	Register Address	Register Value
16bit UINT	3990	1250
16bit UINT	3991	150
16bit UINT	3992	1100
16bit UINT	3993	20
16bit UINT	3994	18
16bit UINT	3995	2
16bit UINT	3996	68
16bit UINT	3997	0
16bit UINT	3998	0
16bit UINT	3999	0

At the bottom, there are checkboxes for 'Display Address in HEX' and 'Display Value in HEX', and buttons for 'READ Registers' and 'WRITE Registers'.

Both 16-bit (default) and 32-bit register sizes are supported. Whenever Modbus registers are read, the register size is changed to match the incoming data. The Data Type pull-down only lists data types that support the register size and unsupported data types in the register list are changed to the default data type for the register size.

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.

In addition to the pre-configured registers read from the attached sensor, the Sentinel will send system information in 16-bit registers listed in the table below. This data is accessible at the same Modbus ID as the connected Modbus device.

Register Map

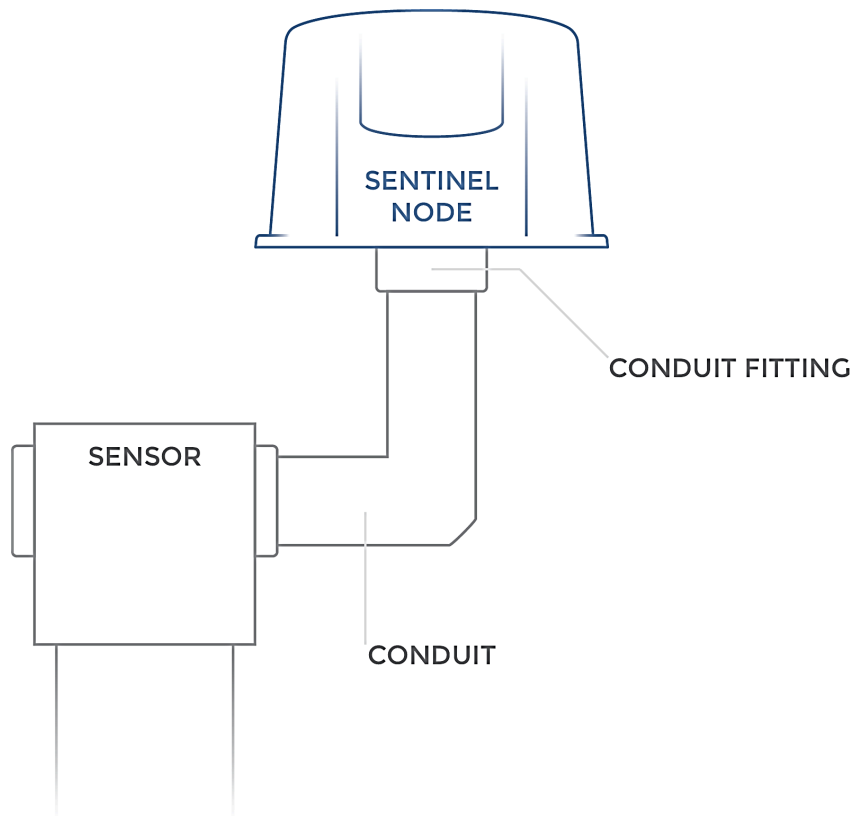
Register Number	Register Address (Offset)	Description
43011-43012	3010-3011	32-bit Hardware counter 1, 3010=high word (two registers)
43013	3012	Digital Input 1 state (1=closed, 0=open)
43014	3013	Average frequency over the last check-in period times 10
43015	3014	Frequency over 2 seconds at check-in time times 10
43016	3015	Avg. counts per minute over the check-in period times 10
43017-43018	3016-3017	32-bit Hardware counter 2, 3016=high word (two registers)
43019	3018	Digital Input 2 state (1=closed, 0=open)
43020	3019	Average frequency over the last check-in period times 10
43021	3020	Frequency over 2 seconds at check-in time times 10
43022	3021	Avg. counts per minute over the check-in period times 10
49986	9985 or 65522	Checkin Interval (in seconds)
49987	9986 or 65523	Status (0=no errors, 1=low power (3V Threshold), 2=failed sensor read, 3=low power 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	Modbus ID readback
49995	9994 or 65531	Received signal strength of last packet from the Sentinel
49996	9995 or 65532	Supply voltage of the Modbus client, in millivolts
49997	9996 or 65533	Minutes until this device will time out, unless new data is received
49998	9997 or 65534	Number of registers cached for this device
49999	9998 or 65535	Remote device type. 53 for Sentinel Modbus with 2DI

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.

Tighten cover screws to 8 in-lbs. Do not use power tools. Anti-seize recommended.

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, which could impair its safety ratings. Do not mount directly to continuous vibrating equipment such as pumps or compressors.

ATTENTION: Le produit Sentinel doit être installé dans un endroit libre de hautes vibrations. Sans quoi avec le temps, des possibles dommages pourraient compromettre la sécurité intrinsèque du produit. Les installations sur équipement en vibration constante (pompes, compresseurs) doit à tout prix être évité.

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.

ATTENTION : Décharge électrostatique ! Il faut prendre soin d'éviter l'accumulation de charge électrostatique sur le boîtier ou l'antenne du produit. Ne pas essuyer le produit avec un chiffon sec. Ne pas frotter le boîtier avec des vêtements ou des gants

Configuration / Debug



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

ATTENTION : La connexion sur le port de débogage doit être faite que dans un endroit classifié non-dangereux

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

Product Disposal Information

To ensure environmental safety and compliance, please follow these disposal instructions for the product and its components:

Electronic Components:

This product contains electronics that must be recycled through approved e-waste recycling programs. Electronics can contain harmful materials and should be prevented from entering landfills. Do not place electronics in regular trash.

Metal Parts:

Any metal components can be separated and recycled through your local metal recycling facility.

Packaging Materials:

Recycle or reuse packaging materials such as cardboard or plastics, following local recycling guidelines.

For local disposal sites refer to:

- [Call2Recycle](#) (USA, Canada)
- [Earth911](#) (USA, Canada)
- [SERI](#) (International)

In the USA or more information, visit:

- [EPA’s battery disposal guide](#)
- [EPA’s electronics recycling page](#)

By following these guidelines, you help reduce waste and support environmental sustainability.

Revision History

Revision	Date	Changes/Updates
1.8	5/2/2024	Initial release – Forked from Sentinel Manual
1.9	11/1/2024	Add disposal information

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 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.