

Interface Manual Sentinel Modbus

SignalFire Model: Sentinel-485-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
- Can power an attached Modbus sensor at 8V or 13V with configurable warm-up time
- Low power operation from on board DC-DC power supply
- Sends data to a SignalFire Buffered Modbus Gateway
- AES 128bit Encryption

Specifications

Enclosure	3.5" tall \times 5.0" wide \times 5.0" deep
Ingress	Туре 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 manufacturier 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 manufacturier élimine la sécurité intrinsèque du produit

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Device Label



DC Converter

SiG	NALFIRE
NC) 3.3V OUT-
VIN-) NC
VIN+	3.3V OUT+
9-36VD(

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 preconfigured 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.



Using the SignalFire Toolkit

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

Auto-Detect		
COM Port:	COM12 V Refresh	
Calant	COM Port to Auto-Detect	
Select		
Auto-De	tect Device on COM Port - WIRELES Customer Login: N	S TELEMETRY -
Auto-De Select Devic	tect Device on COM Port — WIRELES Customer Login: N	S TELEMETRY -

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.

COM Port: COM8	✓ Refresh	Address							
Open Close				Description			Value		
Open Close		65523 S		Status Regis	ter 4		0		
Open	100 B 20 B	65532		Battery Volta	Battery Voltage (IIIV)		3421		
	Ottline								
Connect/Upda	ite			Upd	late Rep	orted Modbus V	alues		
Product MC	DBUS	Modbus Pr	rogram Ste	eps		10. 10.00			
Node Name my	SentMB	Baud Rat	e 960	00 V C	Command	d Timeout (ms)	1000	~	Find Sensor
Radio Connectivity Co	nnected -87d	UART Mode 8N1		1 4 0	ommano	Pause (me)	100		Modbus ID
Mainboard Version 0.6	56	UANT MC	de oiv		Johnmanic	i i duse (ilis)	100	<u> </u>	
Radio Version 2.5	51 (sleeping)					Double-clic	k on "Passed	d" Status f	or register view
Comorate ID	029			Function Code		Register	Address	Count*	Status ^
Radio Mode 2	eping	▶ 1	0x03 - Re	ad Holding Regi	ister 💌	39	90	2	Passed
Radio Network		2	0x03 - Re	ad Holding Regi	ister 🔹	39	96	1	Passed
Radio Network Group 2		3	0x03 - Re	ad Holding Regi	ister 🔹	40	05	2	Passed
Radio Power (dBm) 14		4	0x03 - Re	ad Holding Regi	ister -				Unknown
Checkin Interval 2 n	ninutes	5	0x03 - Be	ad Holding Reg	ister -				Unknown
Modbus Baud Rate 96	11	6			istor -				Unknown
Command Timeout (ms) 10	00								
Command Pause (ms) 100					5			_	Unknown
Sensor On Time (sec) 0.2	25	8		ad Holding Reg	iste	-			Unknown
Sensor Power Mode LO	W	9		ad Holding Reg	ister	•			Unknown
Set Encryption Key	Help	10	0x03 - Re	ad Holding Regi	ister	•			Unknown
Enable Encryption		11			ister !	•			Unknown
Key: signalfire	Set	12			ister 💌				Unknown
Ney. aigi		13			ister 🔄	,			Unknown
Settings		14			ister 🗖	•			Unknown
Node Name mySentMB	Set	15			ister 🔹				Unknown
Dadia Mada Slassing	Set.	16			inter 🖣				Unknown
Nadio Mode Sleeping	✓ Jei	17			int car				Liekaeure
Radio Network 2	✓ Set	10							
Radio Network Group 2	~ Jei	18			ister				
Slave ID 12	Set	*NOTE: C	ount is lim	ited to 25 registe	ers per st	ep. (If using Enro	on Modbus, I	imit is 12.)	
Checkin Interval 2 minutes	s 🗸 Set	Read St	eps	Write Steps		Clear Table	Run Mod	bus Progra	am Steps
Sensor On Time (sec) 0.25	5	from Sen	tinel	to Sentinel		Register Addre	essing Mode		
Sensor Alw	avs On				1	Zero Baser	d Addressing	: 40001 is	entered as 0
		Load St	Load Steps Sa			Ope Read Addressing: 4		40001 in	entered as 1
Sensor Power Mode LOV	N V Set	nom n	ic .	to nie		O One based	nuuressing.	4000115	children da i

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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	~	<u>.</u>
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 Help	Set Encryption Key Help
Enable Encryption	Enable Encryption
Corporate ID: 7	Key: signalfire
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.

ſ	Settings	Updates	Tools	Help		
	Set S	entinel Type	2		•	1
	Set E	ncryption K	ey Unrec	overable		
N	Cont	figure Sentir	nel for Ele	ectrolab DI	S2100	tion
X	Cont	figure Radio	Stats			Register
-	Close	Offline	655	32	Batten	Voltage

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.

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.

Operating Mode

The Sentinel Modbus node requires that the Sentinel is configured with a list of Modbus registers to be read from the attached sensor using the SignalFire Toolkit application prior to installation.

The preconfigured set of registers is automatically read from the 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 at the same Modbus ID as the attached Modbus device. Unlike other Sentinels, **the Sentinel Modbus will not appear on the Gateway's list of nodes unless it has at least one program step**.

Checkin Interval 10 seconds - Set

Sensor On Time (sec)	2	
Sensor	Always On	Set

Sensor Connections

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.



SignalFire Telemetry



Sensor cable should be routed as shown

Sensor Connection



The Sentinel Modbus node has a single terminal block for connection to a Modbus sensor.

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:



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RS-485 Modbus Communication

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 9600bits/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 Progra	m Steps					
Baud Rate	9600	\sim	Command Timeout (ms)	1000	~	Find Sensor
UART Mode	8N1	\sim	Command Pause (ms)	100	~	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.

03 - Read Holding Register 03 - Read Holding Register	• • • •	3990 3996 4005	2 1 2	Passed Passed Passed Unknown
03 - Read Holding Register 03 - Read Holding Register 03 - Read Holding Register 13 - Read Holding Register	•	3996 4005	1	Passed Passed Unknown
03 - Read Holding Register 03 - Read Holding Register 03 - Read Holding Register	•	4005	2	Passed Unknown
03 - Read Holding Register 03 - Read Holding Register	•			Unknown
	-			
	•			
	•			
	•			
	•			
	-			
	-			
	-			
	-			
	-			
	-			
	-			
	-			
	 33 - Read Holding Register 34 - Read Holding Register 35 - Read Holding Register 36 - Read Holding Register 37 - Read Holding Register 38 - Read Holding Register 39 - Read Holding Register 30 - Read Holding Register 31 - Read Holding Register 32 - Read Holding Register 33 - Read Holding Register 34 - Read Holding Register 35 - Read Holding Register 	O3 - Read Holding Register To O3 -	03 - Read Holding Register 03 - Read Holding Register	O3 - Read Holding Register O3 - Read Holding Register O O3 - Read Holding Register O O - Read Holding Register - O - Read Holding Register -

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 1 <- Slave ID used for all steps below									
Double	e-clic	k a Step	to View F	legisters					
	#	Func	Address	Count	Status	3	-		
	1	03	1	5	Unkn	own			
	2								
	3								
	4								
	5								
	6						E		
	7								
	8								
	9						_		
	10						- 11		
	11								
	12						- 1		
	13						_		
	14						_		
	15								
	15								
	10								
	10								
	20						- 1		
	~								
	F	Read Cu	urrent Prog	ram Step	s from	Device			
		Write	New Progr	am Step	s to De	vice			
Fun	ction	Code	Address	Reg C	ount	Register	Size		
0x0)3	•	1	5		16-bit	•		
			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

Rev 1.13

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.

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.

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.

12 Slave ID Starting Address 3990 Apply to Table 10 Number of Registers

Sensor	power	must be ON.	
	Click	Sensor Power is ON for 04 to add 5:00, Right-click to t	18 um OFF
		Sensor is ext	emally powered.
Slave ID	12		
Starting Address	990	Apply to	Load Table from F
Number of Registers	10	Table	Save Table to Fi
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
		Display	Address in HEX 🗌 Display Value in I
READ Re	gisters		WRITE Registers

🔮 Edit Configuration	1	
Additional Settings	Tools	
Node Type: Sentinel Modbus	Electrolab DLS2100 Configuration	
	Read/Write Modbus Registers	

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.

Status Registers

Register Number	Register Address (Offset)	Description
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. 45 for Sentinel Modbus

Note: The status registers are only available from the 49987-49999 (9986-9998) address range if the Gateway is running firmware 7.52 or higher. 49986 (9985) is available if the Gateway is running firmware 8.28 or higher.

Mounting and Care

The unit comes with a watertight 1/2" 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.



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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 éviter.

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.



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

Configuration / Debug



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:

- <u>Call2Recycle</u> (USA, Canada)
 - <u>Earth911</u> (USA, Canada)
 - <u>SERI</u> (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
1.12	5/2/2024	Initial release – Forked from Sentinel Manual
1.13	11/1/2024	Add disposal information

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.