

Interface Manual

Modbus-Stick

SignalFire Number: MBS-CBBL



The SignalFire Modbus-in-a-Stick has the following features:

- RS485 connection to Modbus devices (RS232 Modbus interface can be special ordered)
- Wide range DC power input. 6 to 36VDC
- Configurable check-in period and network address
- Configurable Modbus register polling and/or transparent register mode
- Modbus register writes to remote nodes
- Full time mesh node can forward messages from other SignalFire devices including sleeping nodes
- Sends data to SignalFire Modbus Gateway
- Integrated 500mW FHSS 900MHz ISM band radio and high gain antenna
- AES 128bit Encryption

Connections

The Modbus-in-a-Stick is supplied with a 6 conductor cable. The connections are as follows:

Wire Color	Connection
RED	Positive Power (6 to 36 VDC)
BLACK	Ground
GREEN	RS-485 "A", 9600 Baud (default)
BROWN	RS-485 "B", 9600 Baud (default)
ORANGE	RS-232 Debug/Programming TX, 9600 Baud
YELLOW	RS-232 Debug/Programming RX, 9600 Baud

When configured as a RS232 Modbus stick (base stamped "232"), Green = Stick RX, Brown = Stick TX. Ground must also be connected when using RS232 interface.

Status LED

The Modbus-in-a-Stick has one LED available for field diagnostics.

LED	Description
Slow Flash (3 second pause)	System is running and in communication with radio network
Fast Flash (0.5 second pause)	System is running but no network found
Solid On	System Fault, needs service

Operation

The Modbus-in-a-Stick supports two modes of operation, a preconfigured register set, and an automatic scanning “transparent” mode. The Modbus stick can be used in either mode or a combination depending on the system requirements.

Pre-Configured Register Set Mode

This mode of operation is most useful for large data sets, and frequent polling of a set register map. This mode requires that the Modbus Stick be configured with the register map with the configuration utility at the time of installation.

In this mode the pre-configured 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. This is the most efficient and robust mode of operation.

Transparent Modbus Mode (version Modbus_r38 and Gateway version 7.37 and later only)

This mode requires no Modbus setup at the Modbus Stick, and can be used to smaller number of registers that only need to be read or written infrequently. All standard Modbus opcodes are supported.

Upon initial power-up the Modbus Stick will automatically poll all slave IDs (1-240) to discover attached devices. Any devices found will be reported to the gateway so that a wireless link will exist to the Modbus device. This scan is automatically repeated every hour in the event that an additional device is added to the bus. The scan may also be initiated from the Modbus Stick’s debug port, or remotely from the Modbus Gateway. See the Modbus Gateway manual for register details.

Alternatively one or more Modbus Program steps can be entered for a given slave ID so that the Slave ID will be known to the Gateway.

When the RTU polls the gateway for a Modbus register, if the register is buffered (meaning it was pre-configured) the buffered value is returned. If the register value is not buffered, but the Modbus slave ID is known, the request is forwarded over the SignalFire wireless network to the Modbus sensor, the response is forwarded back to the gateway and delivered to the RTU. Due to the multi-hop wireless network, latency will be introduced. It is required that the RTU’s timeout be on the order of 5-10 seconds to allow for maximum possible networks delays. This limits the effective amount of data that can be pulled.

Setup

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The Modbus-in-a-Stick requires initial configuration over the debug port. This is done using the SignalFire Toolkit PC application to configure the device over a serial port.

The following items must be configured:

- Network Selection / encryption settings
- Check-in Period Selection (*Pre-Configured Register set mode only*)
- Modbus Slave ID and register configuration (*Pre-Configured Register set mode only*)

Breakout Board

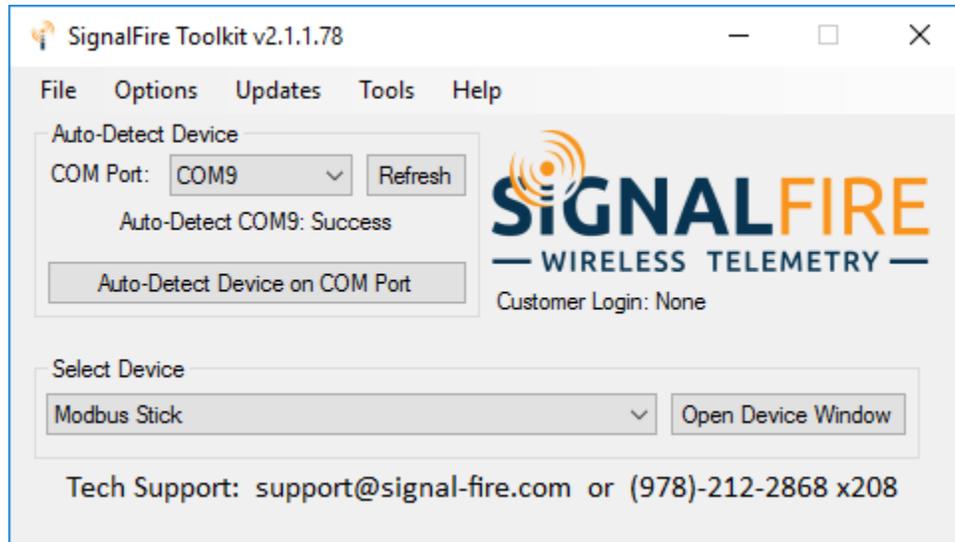


The breakout board above is included with the standard Modbus Stick and provides for easy wiring and a DIN rail mount. **PWR** and **GND** can be wired in to the breakout board, as well as RS485 A/B.

The **STATUS LED** will blink at 1 sec when offline, and 3 sec when connected. The **Signal Strength** LEDs give a relative RSSI reading. The breakout board also has a built in DB9 RS232 port for easy configuration via the SignalFire Toolkit.

Configuration

To begin configuration, open 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 Modbus Stick and click "Auto-Detect Device on COM Port." This will open the device configuration window, where all device settings can be configured.

Modbus Stick

File Options Settings Updates Tools Help

Passed

COM Port: COM9 Refresh

COM9 Open

Open Close Offline

Connect/Update

Product	MODBUS
File Transfer	not supported
Radio Connectivity	Connected -51d...
Mainboard Version	0.72
Radio Version	2.50
Radio Address	20795
Corporate ID	<Encrypted>
Radio Network	3
Radio Network Group	0
Radio Power (dBm)	5
Radio Range	Long Range
Modbus Baud Rate	9600
Modbus UART Mode	8N1
Command Timeout (ms)	1000
Command Pause (ms)	100
Node Name	MB-STICK
Checkin Interval	1 minute

Settings

Radio Range Long Range Set

Radio Network 3 Set

Radio Network Group 0 Set

Checkin Interval 1 minute Set

Node Name MB-STICK Set

Set Encryption Key Help

Enable Encryption Set

Key: signalfire

Current Program Steps

Baud Rate 9600 Command Timeout (ms) 1000

UART Mode 8N1 Command Pause (ms) 100

Run Modbus Program Steps

Double-click a Step to View Registers

	#	SlaveID	Func	Address	Count	Status
<input type="checkbox"/>	1	52	03	1001	1	Passed
<input type="checkbox"/>	2	52	03	1113	1	Passed
<input type="checkbox"/>	3	52	03	1115	1	Passed
<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					
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<input type="checkbox"/>	20					
<input type="checkbox"/>	21					
<input type="checkbox"/>	22					
<input type="checkbox"/>	23					

SlaveID

Set Checked

Check All

Uncheck All

Move Up

Move Down

Incr. Address

Decr. Address

Delete

Delete All

Read Current Program Steps from Device

Write New Program Steps to Device

Slave ID Function Code Address Reg Count Register Size

0x03 16-bit

Add New Program Step

Example: Holding Register Address 40001 is entered as 1

Success

Modbus-in-a-Stick configuration window

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 the SignalFire Toolkit. The Network Group setting is used when more than 8 networks are needed. Both the network and network group must match those of the gateway to communicate.



Radio Network 1 Set
Radio Network Group 0 Set

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Encryption

Starting with Modbus-Stick version r72, it is possible to encrypt over-the-air transmissions to prevent tampering. Encryption keys replace the Corporate ID system, so it is important that all devices connected to a Gateway have the same encryption key as well as network and network group number.

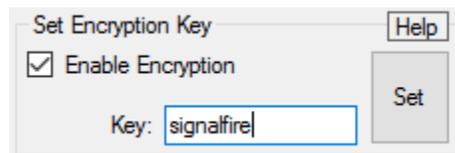
To set up a Modbus-Stick to use encryption, click the checkbox labeled **Enable Encryption** inside the **Set Corporate ID** box:



Set Corporate ID Help
 Enable Encryption Set
Corporate ID: 7

The encryption key box. For more details, click the Help button.

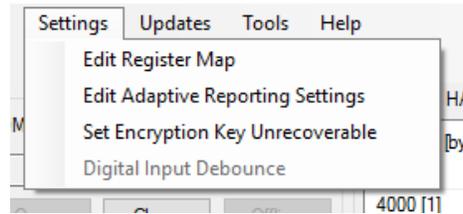
The box will then change into a **Set Encryption Key** box, and it will prompt instead for the encryption key you would like to use. Note that keys may not contain spaces or angle brackets. Enter it and then press **Set**. This will cause the Modbus-Stick to drop its network, and only attempt to join networks that use the same encryption key. 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 Modbus-Stick 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.



Set Encryption Key Help
 Enable Encryption Set
Key: signalfire

Setting the encryption key.

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

Modbus Program Steps Configuration

If using **pre-configured register set mode**, the register set to poll on each check-in must be defined using program steps. A program step consist of one of the following Modbus opcodes:

- 0x01 MODBUS_READ_COILS (limit: 1 coil)
- 0x03 MODBUS_READ_HOLDING_REGISTERS
- 0x04 MODBUS_READ_INPUT_REGISTERS
- 0x05 MODBUS_WRITE_SINGLE_COIL

Up to 34 program steps can be programmed, each program step can read up to 25 16bit registers. Any valid response from a Modbus device will be forwarded to the Modbus Gateway and cached. Use the **Read Current Program Steps from Device** button to view the current program steps in the table.

The program steps can be deleted or re-ordered using the buttons to the right of the table. To add a new program step, fill in the 5 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.

All program steps should return **PASS** in the toolkit window if the Modbus stick receives valid response. A **TIMEOUT** or **EXCEPTION** error message indicates an issue on the Modbus communication to the slave device. To view the register data from any passed read, double click on the Modbus program step and register view window will open.

Note: All registers address are offset by 40000 from the Modicon address format. For example register 40001 is entered as 1 in the Modbus program steps.

It is important to make sure that, in a given network, there are no duplicate Slave IDs. The gateway will only cache one set of data for each Slave ID, so the duplicate will be overwritten.

Remote Modbus Register Mapping

In addition to any pre-configured registers, the Modbus Stick will send system information in 16-bit registers in the table below. This data is accessible at any of the one or more Slave IDs connected to the Modbus Stick.

Register	Name	Description
65524	AP rev# major	Major revision number for the mainboard
65525	AP rev# minor	Minor revision number for the mainboard
65526	Radio rev# major	Major revision number for the radio
65527	Radio rev# minor	Minor revision number for the radio
65528	NodeAddr (high)	High 16 bits of SFTS node address
65529	NodeAddr (low)	Low 16 bits of SFTS node address (the radio ID)
65530	Slave ID	Slave ID readback
65531	RSSI	Received signal strength of last packet from the slave
65532	Voltage	System voltage of the Modbus client in millivolts
65533	Timeout Value	Minutes until this slave will time out, unless new data is received
65534	Register Count	Number of registers cached for this slave device
65535	Device Type	Remote device type (0 for Modbus Client Node)

Revision History

Revision	Date	Changes/Updates
5.4	7/23/13	
5.5	6/24/15	Updated Design
5.6	8/3/16	Added section on encryption

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.

This device has been designed to operate with only the permanently attached internal antenna, having a maximum gain of 5 dB. No other antenna may be used.

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.