# SFRSS  Modbus-in-a-Stick Instruction Sheet

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

- RS485 connection to Modbus devices
- Wide range DC power input.  6 to 40VDC
- 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 a SignalFire Modbus Gateway
- Integrated 500mW FHSS 900MHz ISM band radio and high gain antenna

## Modbus-in-a-Stick 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 40 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 |

## 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. |

**Operating Modes**

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 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.

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

This mode requires no Modbus setup, and can be used for smaller number of registers that only need to be read infrequently.

Upon initial power-up the Modbus stick will automatically poll all slave ID's (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 24 hours 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.

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 10 seconds to allow for maximum possible network delays. This limits the effective amount of data that can be pulled.

**Setup**

The Modbus-in-a-Stick requires initial configuration over the debug port.  The supplied SignalFire Modbus Configurator PC application will be used to configure the device over the serial port.

The following items must be configured:

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

The optional SignalFire Connector-Breakout-Board (CBB), pictured below provides an easy means to connect to the RS232 lines and power the device while configuring the system.
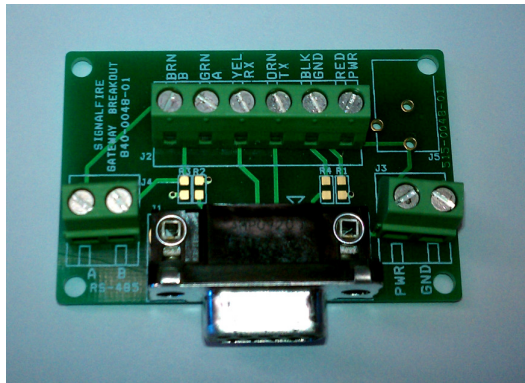
The unit is configured using a PC Windows configuration application shown below:
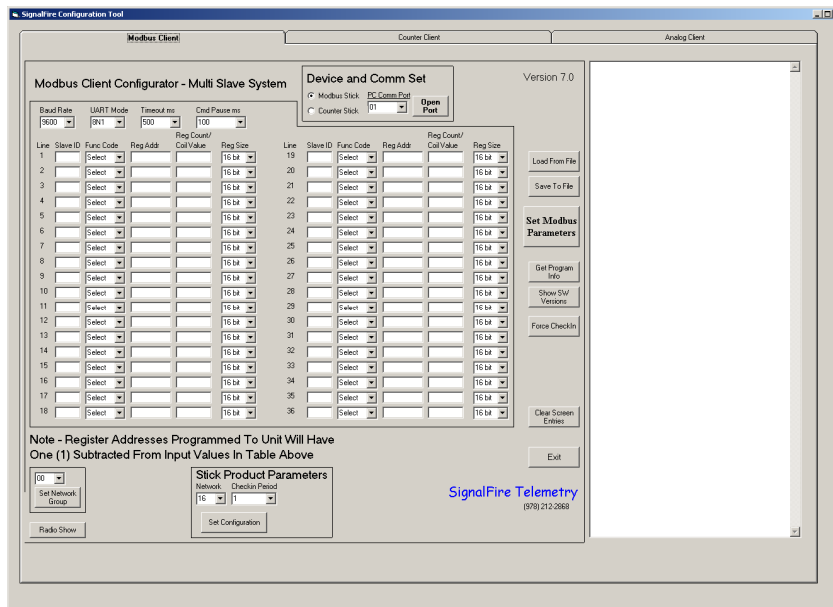


Network Setting

The network address can be used to create multiple networks using multiple gateways (that are in close proximity with one another).

The network setting must be the same on all units in the network including the gateway.

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 Slave ID and Register Configuration

Note that the Slave ID must be unique within any Network group to avoid duplication in the Gateway.

The Modbus-in-a-stick is configured by connecting the RS232 debug lines to a PC and running the client configurator application.  Two items must be configured.  First the Network and Check-in period should be selected and the "Set Configuration" button pressed.

Second the Modbus registers that the device is to poll and forward data from need to be configured.  Set the Modbus baud rate, UART Mode, and Timeout parameters.  Then, set the slave ID's and Modbus addresses, click the "Set Modbus Parameters" to load the settings into the device.

**Note that the register address entered is subtracted by 1 when**

**it is converted to the HEX modbus command.**
## Modbus Write Register Instructions

The Modbus Master device will issue a standard Modbus protocol command in RTU format to the Gateway. The register write command will be automatically forwarded over the air to the remote modbus device. The commands that are currently supported are as follows:

0x05 MODBUS_WRITE_BOOLEAN (1-bit coil)
0x06 MODBUS_WRITE_REGISTER(16-bit integer),
0x06 MODBUS_WRITE_REGISTER(32-bit integer or float),
0x10 MODBUS_WRITE_REGISTERS(16-bit integer),
0x10 MODBUS_WRITE_REGISTERS(32-bit integer or float).

*For issuing multiple writes, no more than ten(10) 32-bit registers and twenty(20) 16-bit register can be written in one command.

For more information on issuing modbus commands and their formats, please see the Modbus Protocol. For device specific information regarding Enron Modbus protocol, please see Enron Modbus Protocol for CB181 FCUs or Enron (AGA7) Modbus Protocol for 6400 (5333) FCUs.

**Remote Modbus Register Mapping**

Modbus Registers

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 of more Slave ID's connected 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) |

**Modbus-in-a-Stick Serial Configuration and Debug Commands**

The following table contains a list of useful configuration and debug commands that can be issued over the RS-232 connection from a standard terminal program such as Putty.

| Command | Description |
|---|---|
| **radio network X** | Sets the radio network to X.  Generally from 16 to 23. |
| **checkin** | Causes the node to read the modbus device and forward the data to the gateway |
| **radio show** | Displays current radio configuration information |
| **radio reset** | Forces a radio reset |
| **reboot** | Forces a system reboot |
| **info** | Displays the current firmware versions |
| **scan** | Starts an automatic Modbus ID scan |
| **scan show** | Displays list of discovered Modbus slave ID's |
|  |  |

## 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.*