

Interface Manual A2 SDI-12 V2 SignalFire Model: A2-SDI12-XXXX



The SignalFire A2 SDI-12 V2 node has the following features:

- One SDI-12 Interface that supports up to 10 measurements
- Supports the start measurement command and additional measurement commands (1 through 9)
- Low power operation from a 3 "D" cell lithium battery pack (external power from 3.5 to 5.0VDC may be used in place of the battery)
- Sends data to a SignalFire Modbus RTU/TCP Gateway

Specifications

| Enclosure Size | 6" tall \times 4.25" wide \times 3.0" deep (not including attached antenna) |
|--------------------|--|
| Power Source | Internal Lithium battery pack <i>SignalFire Part Number: Bat-3XD</i> Solar battery system <i>SignalFire Part Number: A2-HCSolar</i> |
| Output Voltage | Supplies 12.5V to attached sensor(s). 100mA max output current |
| Temperature Rating | -40°C to +85°C |
| Radio Frequency | 902-928MHz ISM Band, FHSS radio, internal antenna |
| Compliance | FCC Part 15 compliant 500mW radio |
| | |

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.
- The ERROR LED (red) will blink to indicate an error condition.

Check-in Button

- If this button is pressed the device will get the readings from the sensor and send the data to the gateway.

4

SDI-12 Sensor Connection

The SDI-12 sensor(s) may be connected to the system using the screw terminal connector on the connector daughterboard. SDI-12 sensors use two of the three terminals as shown in the following diagram:



The system will supply 12 Volts to the sensor for 4 seconds (by default) and then read the SDI-12 values.

Setup for Externally Powered Sensor

If the SDI-12 sensor is externally powered, configure the sensor on time to 0 seconds. 12V must be provided to the 12V terminal on the SDI-12 daughter card in this configuration.

Setup

The nodes need to be set up for correct operation before being fielded. The configurable items include:

- Network Selection
- Radio Range
- Encryption
- Check-in Interval
- Modbus Slave ID
- Sensor On-Time
- Registers

Settings are configured 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.

| 🛉 SignalFire Toolkit v2.2.15.01 — | \times |
|--|----------|
| File Options Updates Tools Help | |
| Auto-Detect Device COM Port: COM1 Refresh Select COM Port to Auto-Detect Auto-Detect Device on COM Port Customer Login: Superuser | E |
| Select Device | |
| Modbus Gateway V Open Device Window | N |
| Tech Support: support@signal-fire.com or (978)-212-2868 | |

Figure 1 - Toolkit Launch Window

Select the COM port associated with the A2 SDI-12 v2 node and click "Auto-Detect Device on COM Port." This will open the device configuration window (see Figure 2), where all device settings can be configured.

(Note: Toolkit version 2.2.15.09 or greater is required.)



Figure 2 - Device Configuration Window

| 1 | Serial Port Settings | 5 | SDI-12 Read Configuration |
|---|-----------------------|---|---------------------------|
| 2 | A2 SDI-12 V2 Settings | 6 | Connection Status |
| 3 | Radio Settings | 7 | Modbus Register Values |
| 4 | Device Settings | | |

Configuring the Settings

The configurable settings are described in the sections below. To apply the desired settings, click the **Apply All Settings** button.



Figure 3 - "Apply All Settings" Button

Radio Settings

The configurable radio settings include the network selection, radio range and encryption. The network, network group, and corporate ID/encryption key settings must match those of the gateway for them to communicate. Use "Short Range" mode if the A2 is to be located less than approximately 40' from the Gateway to prevent the signal from being too strong for communications.

| RADIO Settings | | | |
|---------------------------|-----------|------|------|
| Radio Network | | 2 | - |
| Radio Network Group | | 2 | • |
| Radio Range | Short R | ange | • |
| Enable Encryption Key: | signalfin | e | Help |

Figure 4 - Radio Settings Box

Encryption

To protect your over-the-air data and prevent tampering, SignalFire networks come with encryption. All A2 SDI-12 v2 nodes come with this option enabled with "signalfire" as the default encryption key. If you are setting up a new network, you will need to set the encryption key on all your devices. Note that keys may not contain spaces or angle brackets.

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 must reset the key on every device on its network. To enable this option, select **Set Encryption Key Unrecoverable** under the **Settings** menu.

| ү A2 | -SDI-12-V2 | | | | |
|------|------------|-------------|----------|----------|--|
| File | Settings | Updates | Tools | Help | |
| | Set E | ncryption K | ey Unrec | overable | |

Figure 5 - Setting the encryption key to be unrecoverable.

If you are adding a A2 SDI-12 v2 node to a legacy network, you can simply uncheck the **Enable Encryption box** and the prompt will change from "Key" to "Corporate ID". Set the Corporate ID of the legacy network and the node will remain compatible with the older system.

| Enable Encryption | [| Help |
|-------------------|----|------|
| Corporate ID: | 33 | |
| _ | | |

Figure 6 - Setting the corporate ID.

Device Settings

The configurable device settings include the check-in interval, Modbus slave ID, node name and sensor on-time.

| DEVICE Settings | |
|-------------------------------|--|
| Checkin Interval 30 minutes - | |
| Slave ID 5 | |
| Node Name SDI-12-V2 | |
| Sensor On Time (sec) | |
| Sensor Always On | |

Figure 7 - Device Settings Box

Check-In Interval

The check-in intervals are available in a drop-down list. The default setting is 1 minute.

| DEVICE Settings | | |
|---|---|---|
| Checkin Interval | 1 minute | • |
| Slave ID 5 Node Name SDI Sensor On Time (sec) | 1 minute 2 minutes 4.5 minutes 10 minutes 30 minutes 60 minutes 5 seconds 15 seconds | |

Figure 8 - Check-in interval selections.

Note: 5 seconds or 15 seconds should only be used for testing or a non-battery pack powered node as they will have a higher power draw.

Modbus Slave ID

Each remote device connected to the gateway must have a unique Modbus Slave ID (1-240).

Node Name

The node name must be 1 to 10 characters long and cannot include spaces.

Sensor On-Time

The sensor on-time is the number of seconds that the sensor is powered on prior to starting measurements. The default is 4 seconds which is used for most simple sensors. Some SDI-12 sensors may require a longer warm-up time. Contact your sensor manufacturer or SignalFire for details. Minimalizing the sensor on time will increase the battery life.

Once the first measurement is started, the sensor will remain powered until all measurements are complete. This includes any time required by the sensor until the measurement(s) is ready. A measurement is complete when either the requested data is received, or a time out occurs waiting for a command response.

Register Configuration Settings

The A2 SDI-12-v2 supports up to ten data points which are reported to a SignalFire gateway in standard Modbus format. Each data point will be assigned a Modbus register address and the associated SDI-12 sensor reading will be configured with the sensor address, measurement command number and measurement data number. Each data point read from the attached sensor will appear at the gateway in a pair of registers as a 32bit floating point value.

| Enable | Register Address | Sens Addr | or | Measu # | ire. | Mea Data | s. # |
|--------------|---------------------|--------------|----|------------|------|-------------|---------|
| \checkmark | 1000 | 0 | - | 1 | - | 1 | - |
| \checkmark | 1002 | 0 | - | 2 | - | 1 | - |
| \checkmark | 1004 | 0 | - | 3 | - | 1 | - |
| | 1006 | | - | | - | | - |
| | 1008 | | - | | - | | - |
| | 1010 | | - | | - | | - |
| | 1012 | | - | | - | | - |
| | 1014 | | - | | - | | - |
| \checkmark | 1016 | 0 | - | 4 | - | 4 | - |
| \checkmark | 1018 | 0 | • | 4 | - | 1 | - |
| Clear Table | | | | | | | |

Figure 9 - Register Configuration Window

Sensor Address

SDI-12 sensor addresses 0 to 9 are supported.

Measurement Command

The default measurement command "aM!" as well as additional measurement commands "aM1!" to "aM9" are supported. ("0" is the default measurement command.)

Measurement Data

Each measurement command can have up to 9 data points returned. The data number indicates which of the measurement values returned is requested.

Example

The configuration set in Figure 9 would request pressure, temperature and power supply voltage in the first three registers and average temperature and average pressure in the last two registers for a sensor with an address of 0 and the following available commands:

M1: Pressure Measurement
M2: Temperature Measurement
M3: Power Supply Voltage
M4: Averaged Data (Returns 4 measurements in this order: average pressure, maximum pressure, minimum pressure, average temperature)

To read the measurements from this example device, the SignalFire node will perform the following commands:

| <a>M1! <a>0021 <a>D0! <a>+7.15863 | Request pressure measurement only. Read pressure. |
|---|--|
| | |
| <a>M2! <a>0021 | Request temperature measurement only. |
| <a>D0! <a>+25.0000 | Read temperature. |
| <a>M3! <a>0021 | Request power supply voltage. |
| <a>D0! <a>+12.0512 | Read power supply voltage. |
| <a>M4! <a>ttt4 | Request averaged data. |
| <a>D0! | Read: avg/max/min pressures and, avg temp |
| <a>+7.15863+7.23215+7.051283+25.0000 | |
| | |

SDI-12 Command Nomenclature

- <a> Sensor Address
- ttt Specified time, in seconds, until the sensor will have the measurement(s) ready

The data is then transmitted to the SignalFire SDI-12 gateway in the corresponding registers.

| Register | Data |
|----------|-----------|
| 1000 | 7.15863 |
| 1002 | 25.0000 |
| 1004 | 12.0512 |
| 1006 | -INFINITY |
| 1008 | -INFINITY |
| 1010 | -INFINITY |
| 1012 | -INFINITY |
| 1014 | -INFINITY |
| 1016 | 25.0000 |
| 1018 | 7.15863 |

Remote Modbus Register Mapping

Modbus Registers

At every check-in interval, the sensor(s) are read and the A2 SDI-12 v2 node sends the data to a SignalFire Telemetry Modbus Gateway. The gateway will save the data under the set Modbus ID in 16-bit 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 slave ID which the gateway will use to store its unique data. If a register is disabled or if the SDI-12 sensor reading fails, the value reported will be -INFINITY.

Register Map

| Register# | Register Addr | Description | Data Type |
|-----------|---------------|---|-------------|
| 41001 | 1000 | Data Point #1, High byte | 32Bit Float |
| 41002 | 1001 | Data Point #1, Low byte | 32Bit Float |
| 41003 | 1002 | Data Point #2, High byte | 32Bit Float |
| 41004 | 1003 | Data Point #2, Low byte | 32Bit Float |
| 41005 | 1004 | Data Point #3, High byte | 32Bit Float |
| 41006 | 1005 | Data Point #3, Low byte | 32Bit Float |
| 41007 | 1006 | Data Point #4, High byte | 32Bit Float |
| 41008 | 1007 | Data Point #4, Low byte | 32Bit Float |
| 41009 | 1008 | Data Point #5, High byte | 32Bit Float |
| 41010 | 1009 | Data Point #5, Low byte | 32Bit Float |
| 41011 | 1010 | Data Point #6, High byte | 32Bit Float |
| 41012 | 1011 | Data Point #6, Low byte | 32Bit Float |
| 41013 | 1012 | Data Point #7, High byte | 32Bit Float |
| 41014 | 1013 | Data Point #7, Low byte | 32Bit Float |
| 41015 | 1014 | Data Point #8, Low byte | 32Bit Float |
| 41016 | 1015 | Data Point #8, High byte | 32Bit Float |
| 41017 | 1016 | Data Point #9, Low byte | 32Bit Float |
| 41018 | 1017 | Data Point #9, High byte | 32Bit Float |
| 41019 | 1018 | Data Point #10, Low byte | 32Bit Float |
| 41020 | 1019 | Data Point #10, Low byte | 32Bit Float |
| 49988 | 9987 or 65524 | Major revision number for the mainboard | 16Bit UINT |
| 49989 | 9988 or 65525 | Minor revision number for the mainboard | 16Bit UINT |
| 49990 | 9989 or 65526 | Major revision number for the radio | 16Bit UINT |
| 49991 | 9990 or 65527 | Minor revision number for the radio | 16Bit UINT |
| 49992 | 9991 or 65528 | High 16 bits of SFTS node address | 16Bit UINT |
| 49993 | 9992 or 65529 | Low 16 bits of SFTS node address (the radio ID) | 16Bit UINT |
| 49994 | 9993 or 65530 | Slave ID readback | 16Bit UINT |
| 49995 | 9994 or 65531 | Received signal strength of last packet from the slave | 16Bit INT |
| 49996 | 9995 or 65532 | Battery voltage of the Modbus client, in millivolts | 16Bit UINT |
| 49997 | 9996 or 65533 | Minutes until slave times out unless new data is received | 16Bit UINT |
| 49998 | 9997 or 65534 | Number of registers cached for this slave device | 16Bit UINT |
| 49999 | 9998 or 65535 | Remote device type (?? for Cathodic Protection Sensor Node) | 16Bit UINT |

Support

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 Drive, Suite B Marlborough, MA 01752 (978) 212-2868 support@signal-fire.com

Revision History

| Revision | Date | Changes/Updates |
|----------|-------------|---|
| 1.0 | 12 Dec 2019 | Initial Release |
| 1.1 | 12 Dec 2019 | Fix reference links and make formatting adjustments. |
| 1.2 | 13 May 2020 | Added information about length of time sensor is powered in Sensor On- Time. |
| 1.3 | 04 Aug 2020 | Added sub-header for externally powered sensors to highlight setup. |
| | | |
| | | |