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 × 4.25" wide × 3.0" deep (not including attached antenna)
Power Source	Internal Lithium battery pack *SignalFire Part Number: Bat-3XD* Solar battery system *SignalFire Part Number: A2-HCSolar*
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
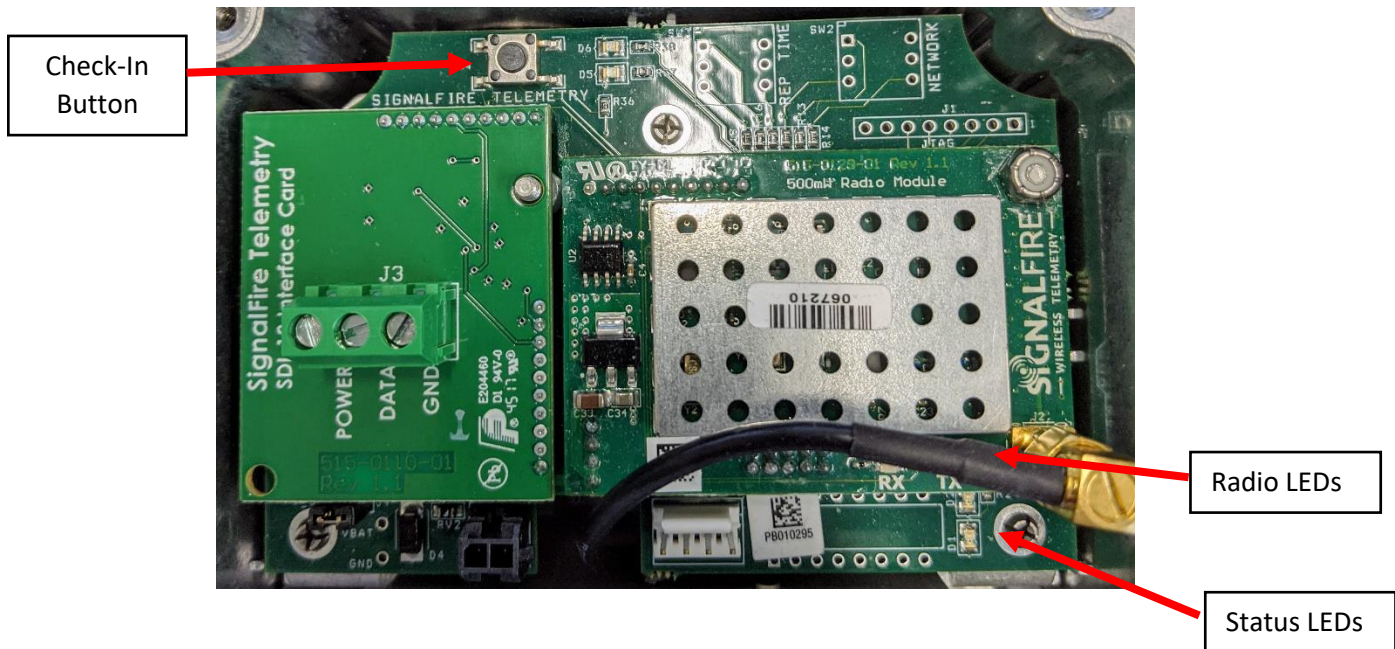
Radio LEDs
- The Radio TX LED (green) flashes each time a radio packet is sent. This LED will blink rapidly while searching for the radio network.
- The Radio RX LED (red) blinks on each received radio packet.

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.

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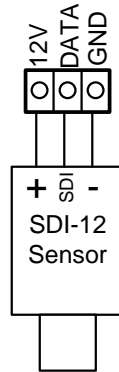
The system will supply 12 Volts to the sensor for 4 seconds (by default) and then read the SDI-12 values.

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 www.signal-fire.com/customer.

After installation, launch the software and the main toolkit window will open.

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.

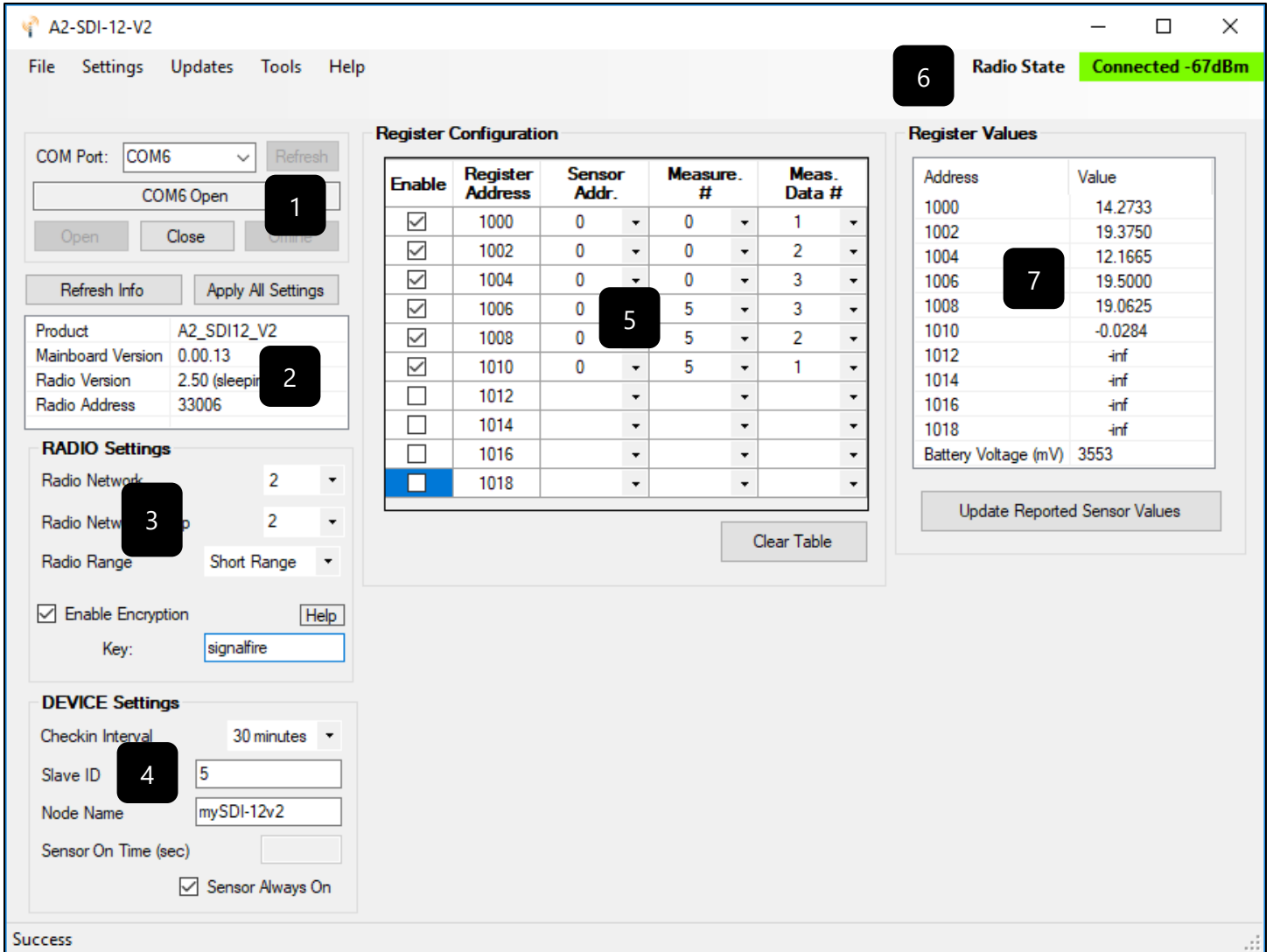*(Note: Toolkit version 2.2.15.09 or greater is required.)*

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.
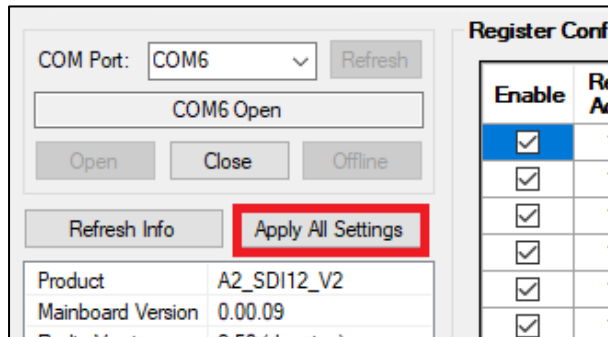

Figure 3 - "Apply All Settings" Button

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.
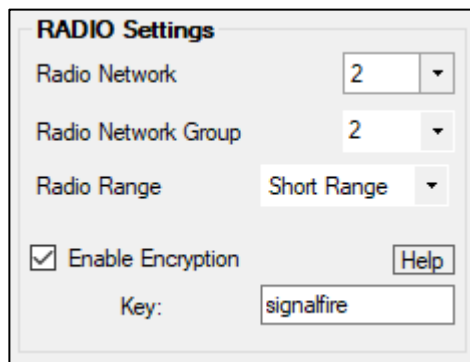

Figure 4 - Radio Settings Box

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.
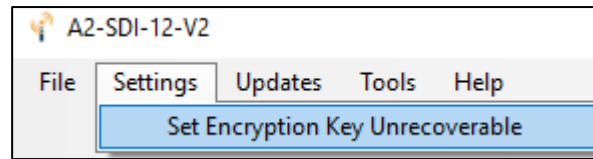
Figure 5 - Setting the encryption key to be unrecoverable.

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.
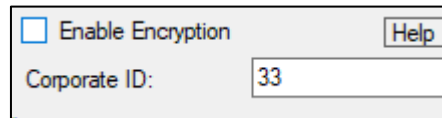
Figure 6 - Setting the corporate ID.

Device Settings

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

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.

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

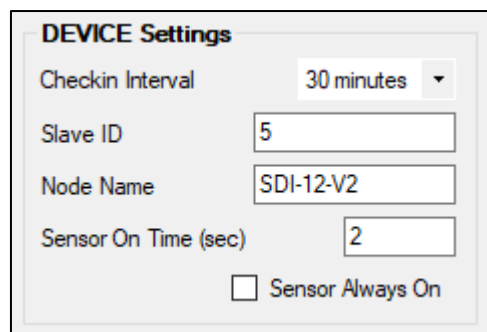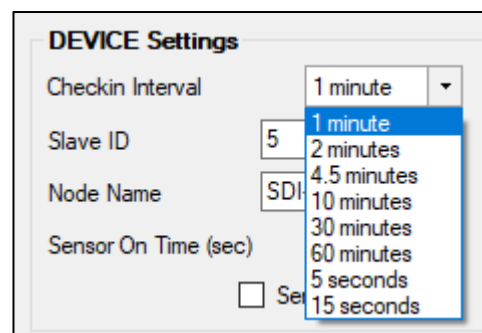Each remote device connected to the gateway must have a unique Modbus Slave ID (1-240).

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.

Register Configuration

Enable	Register Address	Sensor Addr.	Measure. #	Meas. Data #
☑	1000	0	1	1
☑	1002	0	2	1
☑	1004	0	3	1
☐	1006			
☐	1008			
☐	1010			
☐	1012			
☐	1014			
☑	1016	0	4	4
☑	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	Request pressure measurement only.
<a>D0! <a>+7.15863	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

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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.