Interface Manual
Flow Totalizer

SignalFire Model: SFTotalizer-1BIS

The SignalFire Flow Totalizer is an Intrinsically Safe device with the following features:

- Frequency range 1Hz – 4kHz (low gain), 1Hz – 2kHz (high gain)
- Input Sensitivity of 20mV or 5mV peak-to-peak (jumper selectable)
- Provides grand total, yesterday's total, today's total, and monthly total to individual Modbus registers
- Real time clock for daily contract hour setting
- Configurable pushbutton zeroing with optional batch mode
- Configurable K factor
- Flow rate reporting
- Display showing flow rates and flow totals
- Low power operation from an Intrinsically Safe high capacity lithium primary battery pack
- Sends data to a SignalFire Buffered Modbus Gateway
- On-board logging of 32 days of flow totals

Specifications

Overall Size	9.8" tall × 4.4" wide × 3.6" deep
Power Source	Internal IS lithium battery pack *SignalFire Part Number: 810-0030-01 (1BIS)*
Temperature Rating	-40°C to +60°C / -40°F to +140°F
Radio Frequency	902-928MHz Ism Band, FHSS radio, FCC Part 15 and IC Certified
FCC ID	W8V-FT
IC ID	8373A-FT
Compliance	Certified for use in Class I, Division 1 groups C and D. EXia. FCC/IC Certified.
Turbine Input	Sensitivity: 5mV peak-to-peak (high gain), 20mV peak-to-peak (low gain) Input Frequency: 1Hz to 2kHz (high gain), 1Hz-4kHz (low gain) 1" NPT swivel union connector. Includes standard 2-pin pickup connector

Battery Life

The table below gives battery life estimates assuming a new battery and good radio link.

Check in Interval	**LCD Off**	**LCD Always on**
5 Seconds	1.25 Years	1.0 Years
15 Seconds	3.0 Years	2.25 Years
1 Minute	5.5 Years	4.0 Years
2 Minutes	6.75 Years	4.5 Years
5 Minutes	7.5 Years	5.0 Years
10 Minutes	8.5 Years	5.25 Years
30 Minutes	9.0 Years	5.5 Years
60 Minutes	9.5 Years	5.75 Years

WARNING: Use of this equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment.

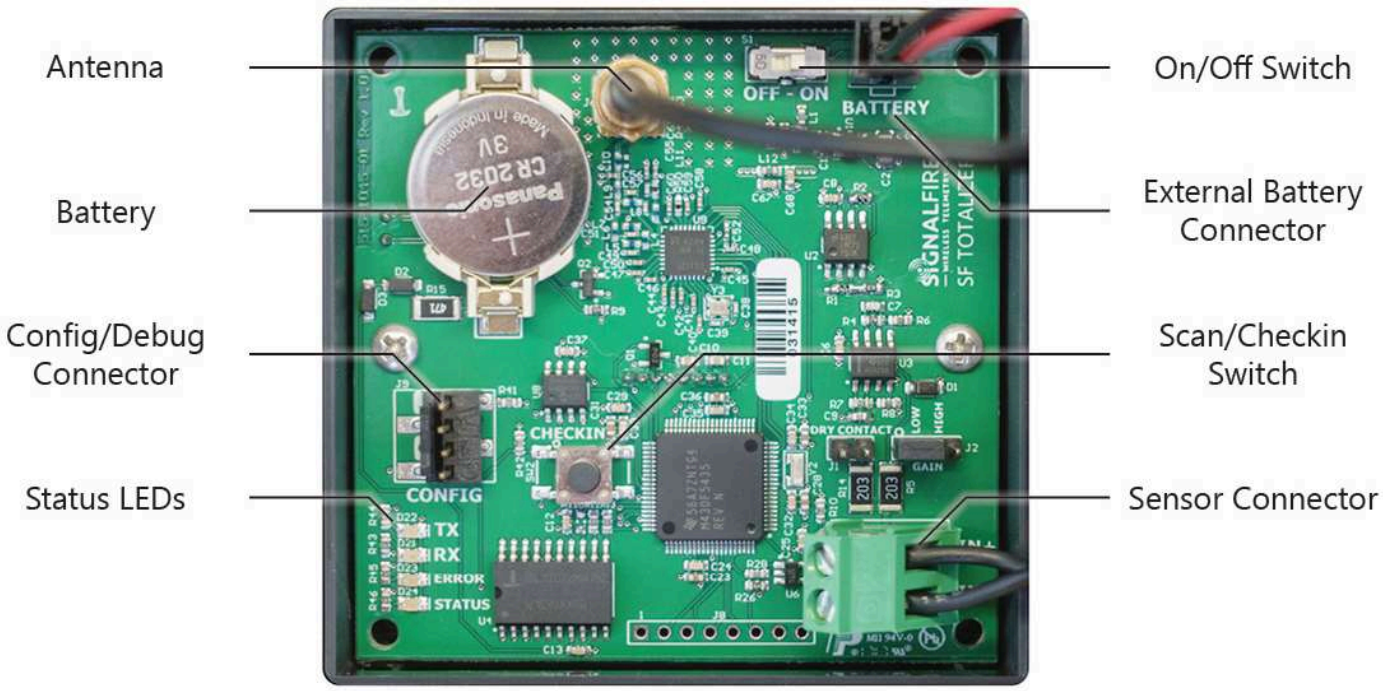
AVERTISSEMENT: L'utilisation et l'implémentation de cet équipement d'une manière non spécifiée part le manufacturier peut affecter son intégrité ainsi que sa protection

WARNING: The use of any parts not supplied by the manufacturer violates the safety rating of the equipment.

AVERTISSEMENT: L'utilisation de composantes ne provenant pas du manufacturier compromette la sécurité et la certification du produit.

The associated apparatus provides Intrinsically Safe outputs.
L'appareil associé fournit des sorties à sécurité intrinsèque.

Refer to control drawing 960-0087-01 for requirements when used in a Class I Division 1 area.



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 STATUS LED (green) Currently not implemented – for future use.
- The ERROR LED (red) will blink to indicate an error condition.

Check-in Button

- If this button is pressed the Flow Totalizer will perform a check-in and send the current readings 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 Slave ID setting

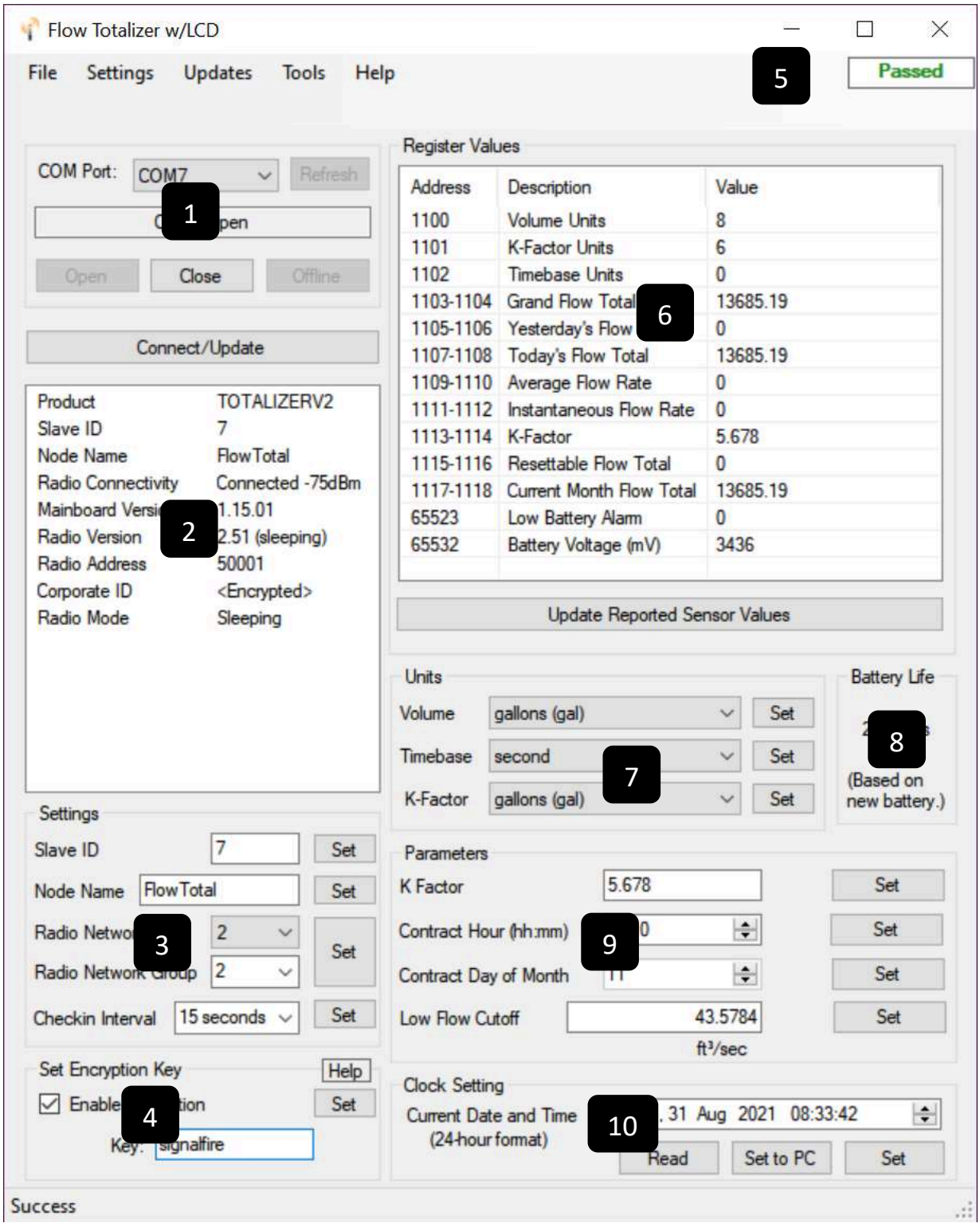
All settings are made using the SignalFire Toolkit PC application and a serial programming cable.

WARNING: Perform the steps in this section (Setup) in a safe location only.
AVERTISSEMENT: Les étapes de démarrage (setup) doivent être fait dans une zone sécuritaire.

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:

Select the COM port associated with the Flow Totalizer Node and click “Auto-Detect Device on COM Port.” This will open the device configuration window, where all device settings can be configured.



1	Serial Port Settings	6	Reported Sensor Values
2	Flow Totalizer Information	7	Units Settings
3	Network Settings	8	Battery Life Estimate
4	Encryption Settings	9	Parameters Settings
5	Status of Last Operation	10	Clock Settings

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**.

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.

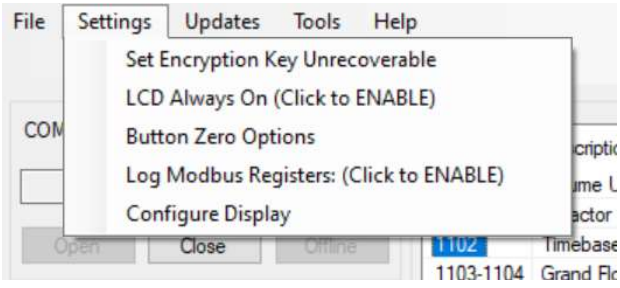
To set up a legacy Sentinel to use encryption, click the checkbox labeled **Enable Encryption** inside the **Set Corporate ID** box. All newer Sentinels come with this option enabled with "signalfire" as the default encryption key.

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.



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.

If "Disabled" is selected the Totalizer radio will be disabled to save power. This is for installations when the wireless feature is not used.

Modbus Slave ID

The Modbus Slave ID must be set with the SignalFire Toolkit. Each remote device connected to a SignalFire Gateway must have a unique Modbus Slave ID.

Turbine Meter Connection

The Flow Totalizer is supplied with a 1" NPT Union to allow it to be directly mounted to a standard turbine flowmeter. The nut on the union can be loosened to allow the totalizer to be rotated to the desired orientation. Also supplied is a 2-pin connector for connection to the turbine flow meter magnetic pickup. Teflon tape should be used on the NPT connections.

Pickup Sensitivity Selection

For most turbine flow meters, the gain selection jumper should remain in its default "LOW GAIN" position. This provides a sensitivity of 20mV p-p. If a high sensitivity is needed the jumper can be moved to the "HIGH GAIN" position which increases the sensitivity to 5mV p-p.

Flow Settings / Configuration

Clock Setting

The battery backed up real-time clock must be set. To set the clock to match the PC's clock, simply click "Set to PC". Alternatively, the time/date can be manually entered.

Volume Units

The Volume units set the units that the accumulated volumes and flow rate will be presented in. Volume units available are:

- Gallons ("gal")
- Barrels ("Bbl")
- Cubic Meters ("m^3")
- Liters ("L")
- Cubic Centimeters ("cc")
- Cubic Feet ("ft^3")
- Thousand Cubic Feet ("mcf")

Timebase Units

The Timebase units configure the units used for the flow rates. For example, if the volume units are set to 'gallons', and the timebase units are set to 'minute', the flow rates will be reported as gallons/minute. Timebase units available are:

- Seconds
- Minutes
- Hours
- Days

K-Factor Units / K-Factor

The K-factor units set the units that the flow meter uses for its K-factor. For a turbine flow meter that has a stated K-factor of 50,000 pulses/gallon, select 'gallons' for the K-factor units, and enter 50000 for the K-factor.

Flow Totals

Along with providing information about instantaneous and average flow rates, the Flow Totalizer also accumulates information about the day and month's total flow volume.

Contract Hour

The contract hour setting controls when the volume accumulated for today, rolls over to yesterday's volume. The contract hour is set in 24-hour hh:mm format, where 2:30PM would be entered as 14:30.

Contract Day

Starting with firmware version 1.09, the contract day setting controls when the volume accumulated for the current month resets to 0 and is stored in last month's total. The contract day can be set between 1 and 28, to account for February. If the contract hour is set to 7:00, and the contract day is set to 14, then the "Current Month Flow Total" register gets reset and moved to the "Last Month Flow Total" register on the 14th of every month, at 7:00AM.

32 Day Logging

The Flow Totalizer also keeps an on-board log of the last 32 days of flow totals, as well as the last month as of firmware version 1.09. This log can be accessed using the SignalFire ToolKit. From the Tools Menu, select 'Daily Flow Total Log'. On the daily log window click 'Refresh' to read the log file. The log can be saved as a .csv file.

This log can be sent to the Gateway every 6 hours. To do so, go to "Settings" and enable "Log Modbus Registers". Floating point registers for 32 days and the monthly totals will appear at the Gateway from address 2000 to 2065.

Flow Rate Reporting

The Flow totalizer reports two flow rates, average flow rate, and instantaneous flow rate. The average flow rate is the flow rate over the configured check-in period. For example, if the check-in period is configured as 2-minutes, each check-in will contain the average flow rate over the 2-minutes.

The Instantaneous flow rate is calculated every 2-seconds. At check-in the most recent instantaneous calculated flow rate will be reported.

Low Flow Cutoff

The low flow cutoff setting in the Parameters section allows the user to set a minimum required flow rate. While the instantaneous flow rate is below the cutoff, it will not be added to the accumulating volume and an asterisk will be displayed on the 'Inst Flow Rate' screen of the LCD. The units of the low flow cutoff are based on the device's Volume and Timebase settings.

Local Display

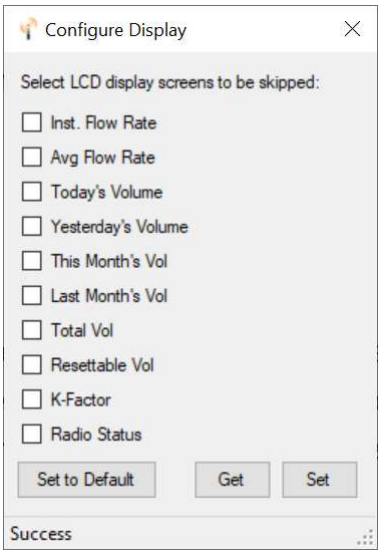
The Flow Totalizer has a local LCD display (with back-light) that allows for easy viewing of the flow totals and flow rates. The display is powered on only when the button under the display is pressed. Pressing the button when the display is on, cycles through the various information screens. The display and backlight will automatically turn itself off after 30 seconds.

LCD Always On

The default operation of the LCD is for it to time out and turn off after 30 seconds. It will come back on when the front button is pressed. If it is desired that the LCD remain on always, this can be selected from the 'Settings' menu. Leaving the LCD always on will impact the system battery life, see the table on page 2 for details. Note that the LCD backlight will still turn off after 30 seconds.

Screen Selection

The default configuration of the LCD is to rotate through and display all screens. The LCD can be configured to skip specific screens by selecting "Configure Display" from the Settings menu:



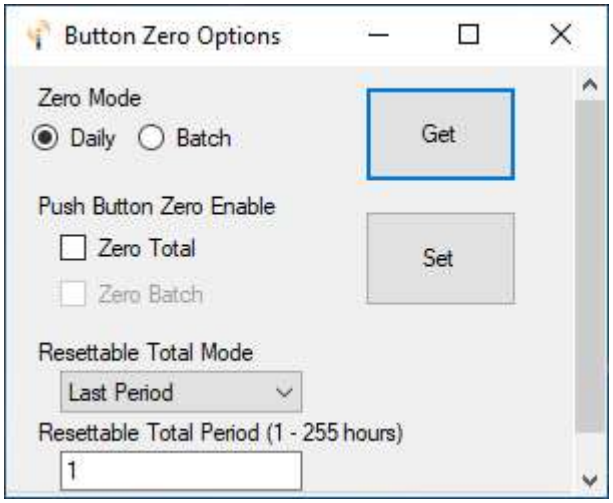
Pushbutton Zeroing and Batch Mode

The SignalFire Totalizer has two modes of operation – "Daily Mode" and "Batch Mode". By default, the Totalizer operates in "Daily Mode" which means that today's volume will be zeroed and stored into yesterday's volume at the configured contract hour.

Batch Mode Operation

In Batch Mode, the Daily Total screen is replaced with a "Current Batch" screen and the current batch total is not zeroed at the contract hour (the contract hour is meaningless in Batch Mode). It is only zeroed when a command is sent from the ToolKit or (if enabled) by holding down (for about 5 seconds) the front pushbutton while on the "Current Batch" screen. When the "Current Batch" is zeroed using the pushbutton, the current batch total is moved to the previous batch total.

The configuration of the Daily Mode / Batch Mode and pushbutton zeroing is set by selecting the "Button Zero Options" from the Settings menu:



Select the mode by selecting either the **Daily** or **Batch** zero mode.

Zeroing Selection

In **Daily** mode, if the **Zero Total** box is checked then all totals will be cleared by holding the pushbutton while on the "Total Vol" screen. The total volume, today's volume, and yesterday's volume registers are zeroed. If this box is not checked, then the totals can't be zeroed and the daily total will roll over (as standard) at the contract hour time.

In Batch mode, in addition to the **Zero Total** option, the **Zero Batch** option allows the current batch to be reset and moved to the previous batch by holding down the pushbutton while on the Current Batch screen. The two zeroing features are independent of each other and (if enabled) can be zeroed by holding down the button while on that particular screen.

Resettable Total

There is a resettable total that is available via Modbus registers and is displayed on the LCD. There are 3 options for this total.

Manual

In manual mode, the resettable can be reset to zero at any time by holding down the front-panel button for 3 seconds, or via the ToolKit.

This Period

In 'This Period' mode the user enters a number of hours. The resettable total will count up for the configured number of hours and will automatically reset to zero after the configured number of hours at the configured contract minute setting.

Last Period

This mode is similar in operation to the 'This Period' mode, however the total displays the last period total and is only updated once a period elapses. This is useful to display the last hours' worth of flow for example.

Remote Modbus Register Mapping

Every check-in period, the sensors are read and data is sent to the 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. The register map for this system is below.

Register Map

Register Number	Register Address	Description
41001	1100	Volume Units (2=gal; 3=bbl; 4=cc; 6=L; 7=m^3; 8=ft^3; 9=mcf)
41002	1101	K-Factor Units (2=gal; 3=bbl; 4=cc; 6=L; 7=m^3; 8=ft^3; 9=mcf)
41003	1102	Time Base Units (3=day, 2=hour, 1=min, 0=second)
41004-41005	1103-1104	Flow Total
41006-41007	1105-1106	Yesterday's Flow Total
41008-41009	1107-1108	Current Day Flow Total
41010-41011	1109-1110	Avg Flow Rate
41012-41013	1111-1112	Instantaneous Flow Rate
41014-41015	1113-1114	Gear Meter K Factor
41016-41017	1115-1116	Resettable Flow Total
41018-41019	1117-1118	Current Month Flow Total
49987	9986 or 65523	Low Battery Alarm (0 = battery above 3.0V, 1 = battery below 3.0V)
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	Slave ID readback
49995	9994 or 65531	Received signal strength of last packet from the slave
49996	9995 or 65532	Battery voltage, in millivolts
49997	9996 or 65533	Minutes until this slave will time out, unless new data is received
49998	9997 or 65534	Number of registers cached for this slave device
49999	9998 or 65535	Remote device type. (60 for Flow Totalizer)

Register Map Added when Logging Configuration Enabled

Register Number	Register Address	Description
42001-42002	2000-2001	Day 1: Flow Total
42003-42004	2002-2003	Day 2: Flow Total
42005-42006	2004-2005	Day 3: Flow Total
42007-42008	2006-2007	Day 4: Flow Total
42009-42010	2008-2009	Day 5: Flow Total
42011-42012	2010-2011	Day 6: Flow Total
42013-42014	2012-2013	Day 7: Flow Total
42015-42016	2014-2015	Day 8: Flow Total
42017-42018	2016-2017	Day 9: Flow Total
42019-42020	2018-2019	Day 10: Flow Total
42021-42022	2020-2021	Day 11: Flow Total
42023-42024	2022-2023	Day 12: Flow Total
42025-42026	2024-2025	Day 13: Flow Total
42027-42028	2026-2027	Day 14: Flow Total
42029-42030	2028-2029	Day 15: Flow Total
42031-42032	2030-2031	Day 16: Flow Total
42033-42034	2032-2033	Day 17: Flow Total
42035-42036	2034-2035	Day 18: Flow Total
42037-42038	2036-2037	Day 19: Flow Total
42039-42040	2038-2039	Day 20: Flow Total
42041-42042	2040-2041	Day 21: Flow Total
42043-42044	2042-2043	Day 22: Flow Total
42045-42046	2044-2045	Day 23: Flow Total
42047-42048	2046-2047	Day 24: Flow Total
42049-42050	2048-2049	Day 25: Flow Total
42051-42052	2050-2051	Day 26: Flow Total
42053-42054	2052-2053	Day 27: Flow Total
42055-42056	2054-2055	Day 28: Flow Total
42057-42058	2056-2057	Day 29: Flow Total
42059-42060	2058-2059	Day 30: Flow Total
42061-42062	2060-2061	Day 31: Flow Total
42063-42064	2062-2063	Day 32: Flow Total
42065-42066	2064-2065	Last Month Flow Total

Internal Lithium Battery Replacement

Battery Packs can be changed with the node in place.

1. Open the cover.
2. Slide the power switch to the off position
3. Unplug the battery from the PCB, by depressing the locking clip on the connector.
4. Remove the battery from the clip and replace with new battery.
5. Connect the battery to the main PCB battery connector.
6. Slide the power switch to the on position.
7. Close and snap shut the enclosure cover.

WARNING: Use of any battery other than the SignalFire part number 810-0030-01 (1BIS) will impair the protection provided by the equipment.
AVERTISSEMENT: La sécurité intrinsèque et la protection du produit seront compromis par l'utilisation de batteries autres que celle fournie par SignalFire ayant comme numéro de pièce 810-0030-01(1BIS).

Coin Cell Battery Replacement

The coin cell is used to backup the real time clock in the event that the main battery pack is unplugged. The battery is a CR2032 coin cell battery

WARNING: Use of any battery other than a Panasonic CR2032 coin cell battery will impair the protection provided by the equipment. The coin cell battery may be replaced only in a non-hazardous location.
AVERTISSEMENT: La sécurité intrinsèque et la protection du produit seront compromis par l'utilisation de batteries autres que celle fournie par SignalFire ayant comme numéro de pièce Panasonic CR2032. La pile à pièces ne peut être remplacée que dans un endroit non dangereux.

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.
AVERTISSEMENT: Danger de décharges électrostatiques! Utilisez les précautions nécessaires pour éviter l'accumulation d'électricité statique sur l'antenne. Ne pas nettoyer l'antenne avec un linge sec. Ne pas frotter le boitier avec des vêtements ou des gants.

Mounting Instructions

WARNING: The Flow Totalizer must be mounted in a location free of high vibrations. Over time vibrations can damage the Flow Totalizer or battery pack, which could impair its safety ratings. Do not mount directly to continuous vibrating equipment such as pumps or compressors.
AVERTISSEMENT: Le Totalisateur de débit doit être monté dans un endroit sans vibrations élevées. Au fil du temps, les vibrations peuvent endommager le Flux Totalizer ou la batterie, ce qui pourrait nuire à ses cotes de sécurité. Ne pas monter directement sur des équipements vibrants continus tels que des pompes ou des compresseurs.

Configuration / Debug

WARNING: Only connect to the debug port in a safe area! Ensure that the maximum voltage applied to the configuration port is less than 5 VDC!
AVERTISSEMENT: Branchez le port de déboggage que dans une zone secure. Assurez-vous que la tension électrique sur le port de configuration soit moins de 5 volt DC.

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 configuration is done using the SignalFire Toolkit PC application.

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Revision History

Revision	Date	Changes/Updates
1.0	6/26/17	Initial release
2.0	7/11/17	Added units info, updated ToolKit screenshot
2.1	7/17/17	Minor edits
2.2	8/8/17	Added battery life table, added detail on LCD always on setting
2.3	8/15/17	Updated warnings
2.4	8/28/17	Added FCC/IC details
2.5	8/30/17	Added unit codes to register map table
2.6	9/13/17	Updated Warnings
2.7	9/26/17	Removed pending certification notice as certification is now complete
2.8	11/14/17	Added section on pushbutton zeroing and batch mode
2.9	12/03/17	Added section on Resettable Total screen and Modbus registers for this
2.10	12/07/17	Added configuration option to send the log to the gateway (Section - 30 Day Logging) and the register map included when this option is enabled. Added Low Battery Alarm register 65523.
2.11	9/4/18	Added Current Month Flow Total register
2.12	12/19/18	Added resettable total options and disable radio option
2.13	10/2/19	Added Cubic Centimeters (“cc”) and Cubic Feet (“ft^3”) to volume units and register map.
2.14	8/23/21	Added Screen Selection setting, Low Flow Cutoff setting and Thousand Cubic Feet ("mcf") to volume units.

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 the antenna listed below, and having a maximum gain of 5.8 dBi. Antennas not included in this list or having a gain greater than 5.8 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.
San Jose Technology Inc. Model EEH-915

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.i.r.p.) is not more than that permitted for successful communication.

To comply with FCC's and IC's RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) & user's/nearby person's body at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with Industry Canada's licence-exempt RSSs. 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'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.