MAN-00003

Subeca BLINC Module User Manual

Bluetooth LoRa Integrated Network Communication

Table of Contents

Change Log

Date	Revision	Author	Description
12/16/2019	1.0	MAF	Initial Release
4/6/2020	2.0	MAF	Release
1/13/2021	3.0	MAF	BLINC Updates
6/22/2021	4.0	MAF	Updates for release

Ordering Information

Model Number	LoRa	Bluetooth
SO-01-01		X
SO-01-02	X	X
SO-01-03	X	

Visit www.subeca.com to place an order.

Introduction

This document outlines the specifications for the Subeca Module. The Subeca Module is the brains of the Subeca product line and includes an application processor, Bluetooth Low Energy module and (optional) LoRa module (optional).

The Subeca module can be used in various configurations. The modes can be set digitally using the Subeca smartphone/tablet app. The first mode is that of a master (BLE central device), routing messages from a close-range (edge) network (using the Lerna Bluetooth Protocol) to the wider area network on the LoRa network (Argolis Wireless Protocol) and, ultimately, the web interface - Subeca Engage. All scheduling data and actions originate from this device which oversees operations of the system. This mode is used to run the Subeca Link.

The second mode is that of a slave (BLE peripheral mode) to another master. In this mode, the Subeca Module operates in a Bluetooth Low Energy Peripheral mode, simply sending out advertising packets until another device initiates a connection. This is used when connecting to a tablet/smartphone for configuration or when acting as a meter register or valve controller.

Features and Benefits

- Can operate as a smart water controller, smart meter or smart valve
- Long range IoT connection (LoRa functionality is optional)
- Can connect to up to 10 external devices in master mode
- Low current usage (long battery life)

FCC Information

FCC ID: 2AS4H-BLINC
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.

RF exposure considerations

This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
RF Exposure - This device is only authorized for use in a mobile application. At least 20 cm of separation distance between the module and the user's body must be maintained at all times.

Instruction to Integrator

Labelling
A label must be affixed to the outside of final commercial product with the following statements:
This device contains FCC ID: 2AS4H-BLINC

Antenna
The antenna gain of a new antenna should be of the same type as the originally approved antenna and the antenna gain should not be higher than the antenna gain of the originally tested antenna. The list of originally approved PCB antennas is the following
- P/N: WPANT10148-S1A (BLE antenna), peak gain: 2.3 dBi
- P/N: WPANT10144-S2A (LoRA antenna), peak gain: 1.8 dBi
- P/N: WPANT10123-S1B-01A (LoRA antenna), peak gain: 1.4 dBi

RF exposure considerations
Consistent with §2.909(a), the following text must be included within the user's manual or operator instruction guide for the final commercial product:
This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
This device is only authorized for use in a mobile application. At least 20 cm of separation distance between the module and the user's body must be maintained at all times.

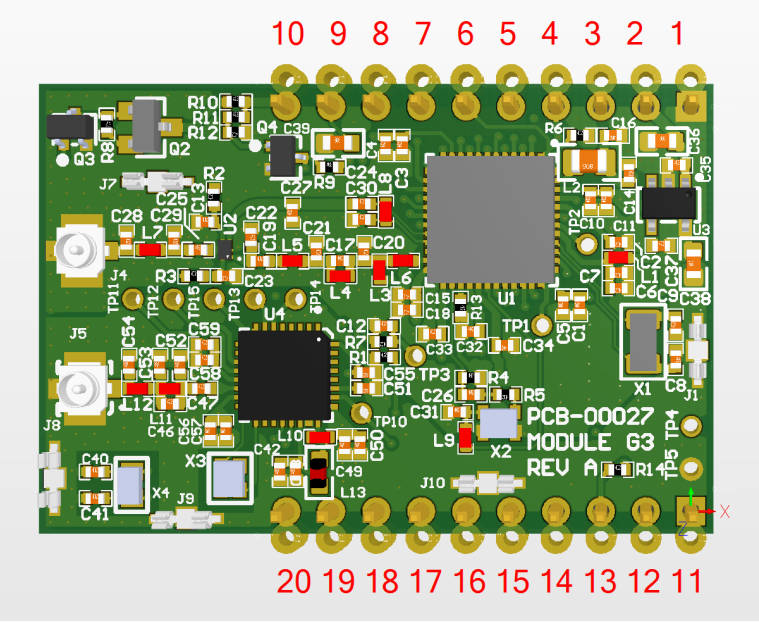
Additional testing, Part 15 Subpart B disclaimer
The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device. The FCC Part 15 Statement shall be included in the user manual of the final commercial product if applicable.

Caution Statement for Modifications
CAUTION: Any changes or modifications not expressly approved could void the user's authority to operate the equipment.

Specifications

Item	Min	Nominal	Max	Description
RF				
Short Range Protocol		BLE 5.2		
Bluetooth Range	50	100	300	Meters
Bluetooth Antenna Type				U.FL Connector
Bluetooth update rate		900		ms
Long Range Protocol		LoRa		
LoRa Frequencies	860	902-928	930	MHz
LoRa Antenna Type				U.FL Connector
Environment				
Ingress Protection				IP67
Operating Temperature	-10		55	Celcius
Storage Temperature	-10		55	Celcius
Mechanical				
Weight				Pounds
Dimensions		1.5 x 1		Inches
Electrical				
Input Voltage	3.1	3.6	6	V
Current draw	0.05	0.1	100	mA
Digital Logic Voltage		3		V
Firmware				
Processor Family				STM32
Programmer				ST-Link V2

Electronics



Pin	Description	Description
1	GND	Ground
2	VIN	Input Voltage (3.1V - 6V)
3	ADE_TX/CK	ADE clock (Synchronous) or UART RX (Asynchronous)
4	ADE_RX	ADE input
5	GPIO	Configurable GPIO
6	OUT_I_SENSE	Output current sense
7	BAT_SENSE	Battery voltage sense
8	BOOST_M_ENABLE	Meter voltage enable
9	VBOOST_M	Boosted meter voltage
10	METER	Pulsed meter input
11	SOLAR_SENSE	Solar panel voltage sense
12	VALVE_COM	Valve driver common line
13	MAG_SENSE	Magnet sensor (for user interaction)
14	VALVE_4	Valve 4 driver signal
15	VALVE_3	Valve 3 driver signal
16	VALVE_2	Valve 2 driver signal
17	VALVE_1	Valve 1 driver signal
18	ADE_ENABLE	ADE power supply enable
19	BOOST_24V	Valve voltage select
20	BOOST_ENABLE	Valve voltage enable

Vin (Pin 2)

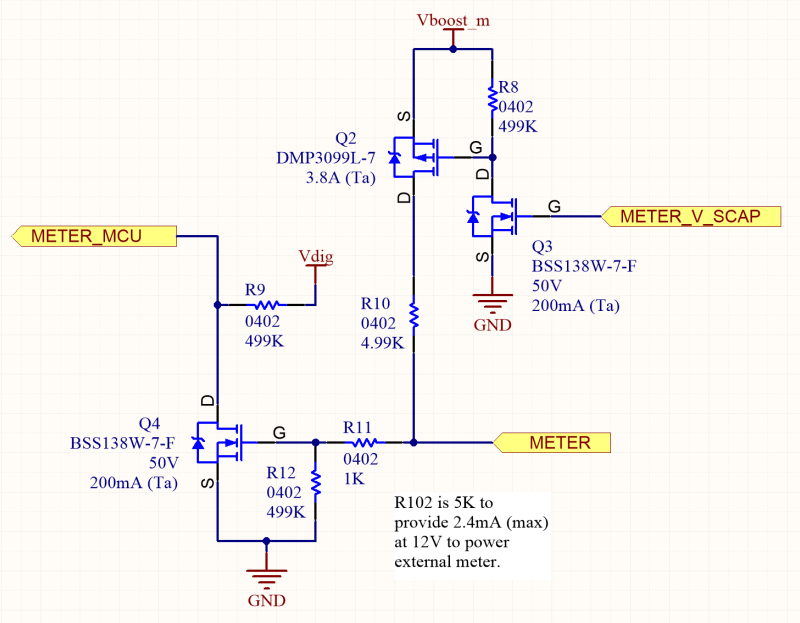
Vin is the power input line to the Subeca Module. The device sleeps at about 300uA, runs around 20mA and can pull as much as 50mA of power during LoRa transmissions. The power input range is 3.1-6V.

ADE (Pins 3, 4, 18)

The Subeca Module has the ability to connect to a serial ADE meter. Only one wired meter may be connected at any one time, so either the ADE or pulsed-meter input may be used, but not both. Connect pin 3 (ADE_TX/CK) to the clock line and pin 4 (ADE_RX) to the receive line. Then, enable the ADE functionality using the Subeca Android App. Pin 18 (ADE_ENBLE) can be used to enable the ADE power supply.

Pulsed Meter Connection (Pin 10) and Meter Boost Voltage (Pin 8)

The pulsed meter input is highly configurable and versatile. It can handle inputs as high as 50V. It is possible to apply a voltage to this meter line if the metering device requires external power. If the Subeca Module is configured to use apply power to the pulsed meter input line, then an external supply should be connected to pin 9 (V_BOOST_M) and the Subeca Module will enable this supply line using the (BOOST_M_ENABLE) logic line. It can also monitor this voltage with the V_BOOST_M_SNS line. There is a 4.99K ohm pullup resistor to this voltage which can provide up to 2.4mA (at 12V) of current to an external metering device. The circuit is shown below, where METER is the pulsed-meter input line and METER_MCU is the line that goes to the processor.



GPIO (Pin 5)

This configurable GPIO can be set up as an input or output but is not currently functional without additional application code.

Output Current Sense (Pin 6)

This line is used to detect the current output to drive a valve. It can be used to detect when the valve is actuating and cut power when it is finished.

Battery Sense (pin 7)

This line monitors the battery voltage and sends an alert when there is low battery power.

Solar Sense (Pin 11)

If solar power is used in addition to or in place of a battery or external input, then the SOLAR_SENSE line can be used to detect the voltage from the solar panel to make informed decisions about update rates and other variables that can be optimized due to this excess power. The actual solar input voltage should be diode ORd with any other power sources into the VIN pin.

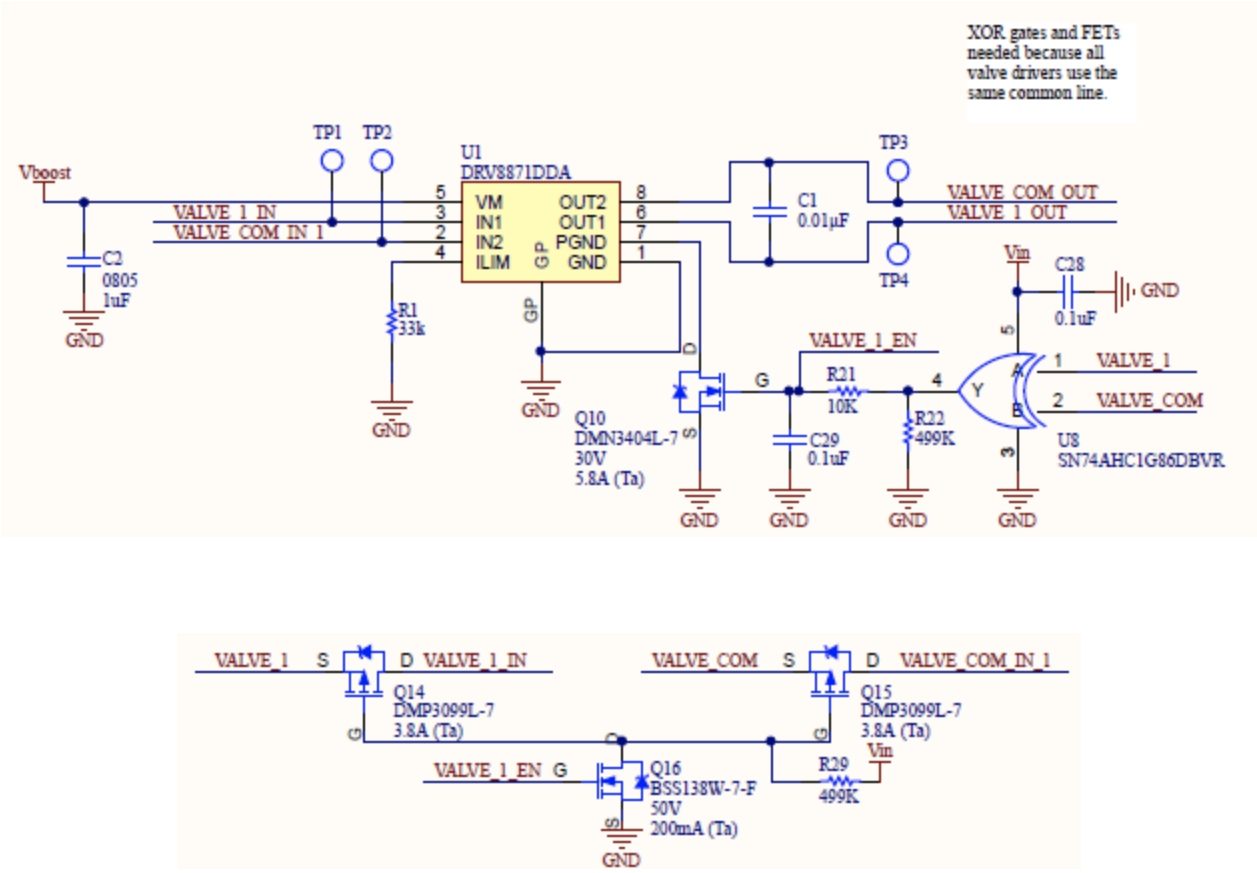
Valve Drivers (Pins 12, 14, 15, 16, 17) and Boost Enable (Pins 19, 20)

There are 4 valve logic lines that are to be hooked up to an external driver circuit. These are logic lines only and no valve drivers are located on the module itself. All 4 share the same common signal so special circuitry is required to use this single common line.

There is another line BOOST_24V that can be used to set the output voltage to the valve drivers. For the Subeca Link and Subeca Pin, a low signal on this line sets the output voltage to 12V and a high signal sets it to 24V.

There is also a boost circuit enable line (BOOST_ENABLE) which helps reduce power draw by shutting down the (external) valve driver boost regulator when not driving valves.

The logic of the valve driver lines is designed to work with 4 valves sharing one common line, and only one to be actuated at any given time. So, in order to make the external circuit design possible while sharing this common line, an XOR gate can be used to enable only the valve that is intended to be actuated. When not operational, both input to a valve driver should be the same logic level to avoid enabling the XOR gate, and therefore it's valve driver circuit. A high logic level on the particular drive line, combined with a low level on the common line, will open a particular valve. The opposite, a high logic level on the common line and a low level on that particular valve drive line will close a valve. The remaining valve logic lines will have to follow the logic level of the common line in order to keep their particular driver circuits disabled. Once any intended valves are actuated, the logic of all 4 driver signals and the common line return to 0. For example, if we want to open valve 3 then the valve 3 logic line will go high and all other valve logic lines (1, 3 and 4) will go low, as well as the common line. If we want to close valve 4 then valve logic lines (1, 2, and 3) will go high, as well as the common line and the valve 4 logic line will go low. See example circuits below. These extra gates can be omitted if only 1 valve driver is used.

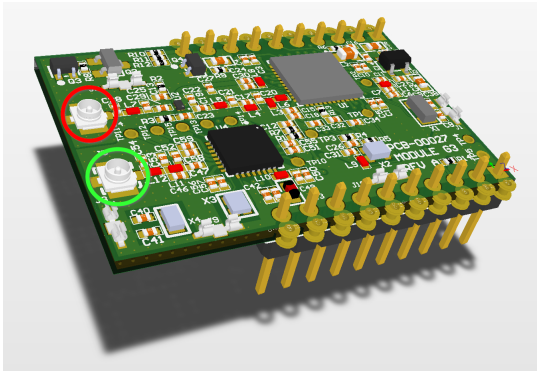


Mag Sense (Pin 13)

On the Subeca Link and Pin, this line is hooked up to a hall-effect-type sensor which can detect a magnet placed in close proximity. A physical momentary switch or logic line may be used as well. This line is used to place the Subeca Module into configuration mode. When pulled low, the Bluetooth chipset is set to peripheral mode to allow for connections from a smartphone or tablet running the Subeca Android app. This line has a 499K pullup resistor.

Antennas

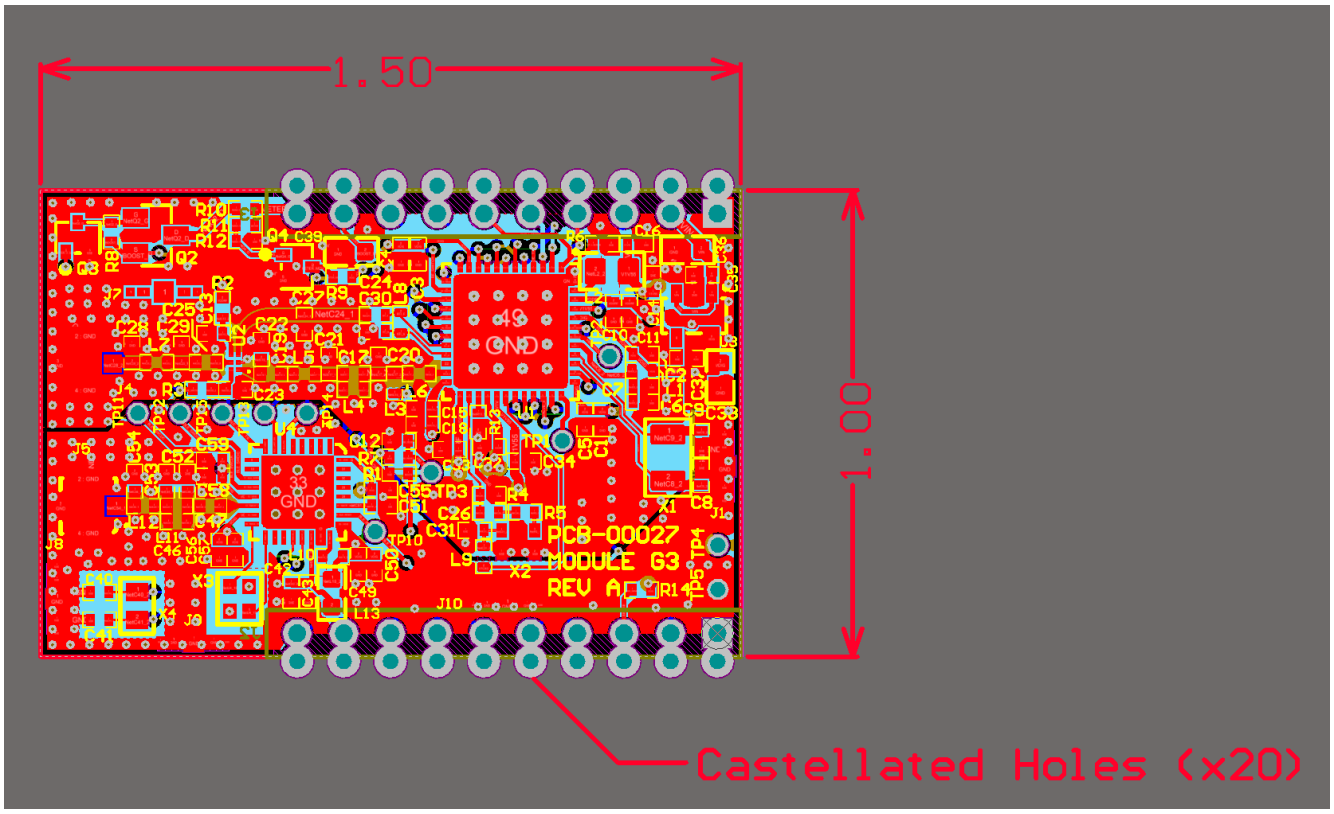
An appropriate antenna should be connected to the U.FL connector on the top of the board if LoRa or Bluetooth (BLE) communications is used. LoRa antenna is shown below in Red and BLE antenna in Green. Users must use one of the following approved antennas:



P/N: WPANT10148-S1A (BLE antenna), peak gain: 2.3 dBi
P/N: WPANT10144-S2A (LoRA antenna), peak gain: 1.8 dBi
P/N: WPANT10123-S1B-01A (LoRA antenna), peak gain: 1.4 dBi

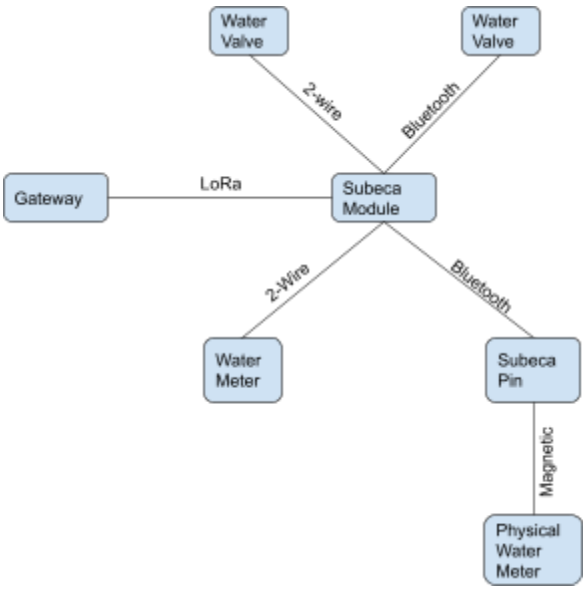
Mechanical Dimensions

The Subeca Module measures 1.5 x 1 Inches and the pins are 0.1” on center.



Communications

As the central controller for communications in the Subeca system, the Subeca Module can connect to several devices, both at short and long range, simultaneously. For wide-area network communications with the gateway, the Subeca Module uses LoRa LPWAN technology. For local control of various other devices, the Subeca Module supports Bluetooth Low Energy (BLE) and various wired interfaces to connect local water meters, water valves and other third-party devices. As such, the Subeca Module communicates to the Subeca Pin (a smart Bluetooth water meter register) using Bluetooth or a wired, pulsed-output meter, and can control up to 4 2-wire valves as well.



LPWAN

The Subeca Link uses LoRa as the main LPWAN technology to communicate with the gateways throughout a city. LoRa works in many countries on different frequencies. In the US this is the 902-928 MHZ ISM band. LoRa uses frequency hopping to obtain reliable communications and the Subeca Link uses class A (low power mode where the end node, the Subeca Link in this case, initiates communications with the gateway), to attain the specced battery lifetime.

The custom Argolis Protocol describes all LoRa functionality.

Bluetooth (Lerna Protocol)

Bluetooth Low Energy (BLE) is the core platform for the short-range communications. The Subeca Module uses BLE to communicate with other Lerna-enabled devices.

The custom Lerna Protocol describes all Bluetooth functionality.

Device Table

Each Subeca Module can communicate with up to 16 devices. The first 5 devices are onboard the Subeca Module and devices 6-15 are configurable Bluetooth-connected devices. Device 16 is for a bluetooth pressure sensor. This table is stored in non-volatile memory on the Subeca Module and can be accessed through the Bluetooth connection.

Index	Device Type	ID
0	This device	AA:BB:CC:DD:EE:FF **
1*	“m” - wired meter	AA:BB:CC:DD:EE:FF **
2*	“v” - local valve 1	AA:BB:CC:DD:EE:FF **
3*	“v” - local valve 2	AA:BB:CC:DD:EE:FF **
4*	“v” - local valve 3	AA:BB:CC:DD:EE:FF **
5*	“v” - local valve 4	AA:BB:CC:DD:EE:FF **
6	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
7	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
8	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF

9	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
10	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
11	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
12	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
13	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
14	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
15	“m” - Pin or “v” - Valve	AA:BB:CC:DD:EE:FF
16	Pressure Sensor	AA:BB:CC:DD:EE:FF
Property ID		(LoRaWAN) AppKey

* the first 5 devices are internal to the device (the device has a hard-wired meter and 4 valve drivers built in).
** this address matches the device’s BLE MAC

Power

Power Systems

The Subeca Module is designed to last many years from a single battery. As with any IOT device, power systems must be carefully designed to ensure proper operation and a long lifetime. All power sources are monitored by the processor to enable smart control of these power systems. For example, when the solar panel is producing sufficient power, it is possible to achieve faster wireless transceiver times because the device is not draining extra power from the batteries.

Power Input

Vin is the power input line and supports 3.1V - 6V inputs. The power supply should be able to handle 100mA of input current but the device normally sleeps at about 300uA.

Solar Panel

The Subeca Module has the ability to monitor a solar panel and adjust update rates accordingly.

Sleep Modes

Sleeping is crucial to the extended lifetime of any battery powered product. In order to last 10+ years from a single battery, the Subeca Module, and any device it is integrated into, must sleep for most of its life. The device sleeps until a timer triggers various operations such as a LoRa transmission or a reading session. It then wakes up to transmit each message to complete a full communication session and also sleeps in between each LoRa message. The LoRa update rate is settable through both the Bluetooth smartphone/tablet app and Argolis (LoRa) protocol. The Subeca Link also wakes up intermittently to check local Bluetooth devices for alarm conditions and initiates an off-schedule communication session if an alarm is triggered. The rest of the time, it goes into deep-sleep mode.

Setup

Configuration Mode

The Subeca Module can connect to tablets and smartphones (and PCs) over Bluetooth to configure settings and update the firmware on both (LoRa and BLE) processors.

Remaining setup can then be accomplished via the Subeca App. Certain parameters can be set over LoRa as well.