



VolleyBoast

USER MANUAL

VoBo GP-1



Overview

The VoBo GP-1 is an industrial grade all-purpose LoRaWAN endpoint that converts wired industrial sensors and transmitters into wireless sensors. It operates on a timed wake/sleep cycle: it wakes up periodically to take and transmit sensor readings and minimizes power consumption when it is “sleeping”. A primary D cell battery powers the VoBo GP-1 and the connected sensors. This configuration allows for operational data to be collected inexpensively and transmitted to the cloud for further analysis and reporting.

Highlights/Features

- Provides three analog inputs, three dry contact inputs, one “wake-up” input, one RS-485 input (for Modbus RTU devices), and one open drain output.
- Three entry points for sensor cables are provided. Hole plugs are provided to seal the unused entry points.
- Analog output can be adjusted for gain and offset.
- Designed for rugged outdoor use with an operating temperature range of -40° C to 80° C.
- Expected battery life under normal operating conditions is 2 to 4 years.
- Range is up to 10 miles line-of-site to any LoRaWAN compliant gateway. From the gateway, data can then be forwarded to the user’s database or reporting system.
- Configuration can be done over-the-air or locally through a RS-232 connection.
- The datasheet is available here: <https://www.volleyboast.com/products/vobogp1/support/>

Important



For installation assistance contact the VolleyBoast Operations team at: support@volleyboast.com (+1) 250-412-5679

If assistance is desired, it is best to confirm an appointment ahead of the actual installation effort.

The VolleyBoast Limited Warranty (<https://www.volleyboast.com/products/vobogp1/support/>) covers only VolleyBoast supplied hardware and software for the duration of the warranty period as per the warranty terms and conditions.



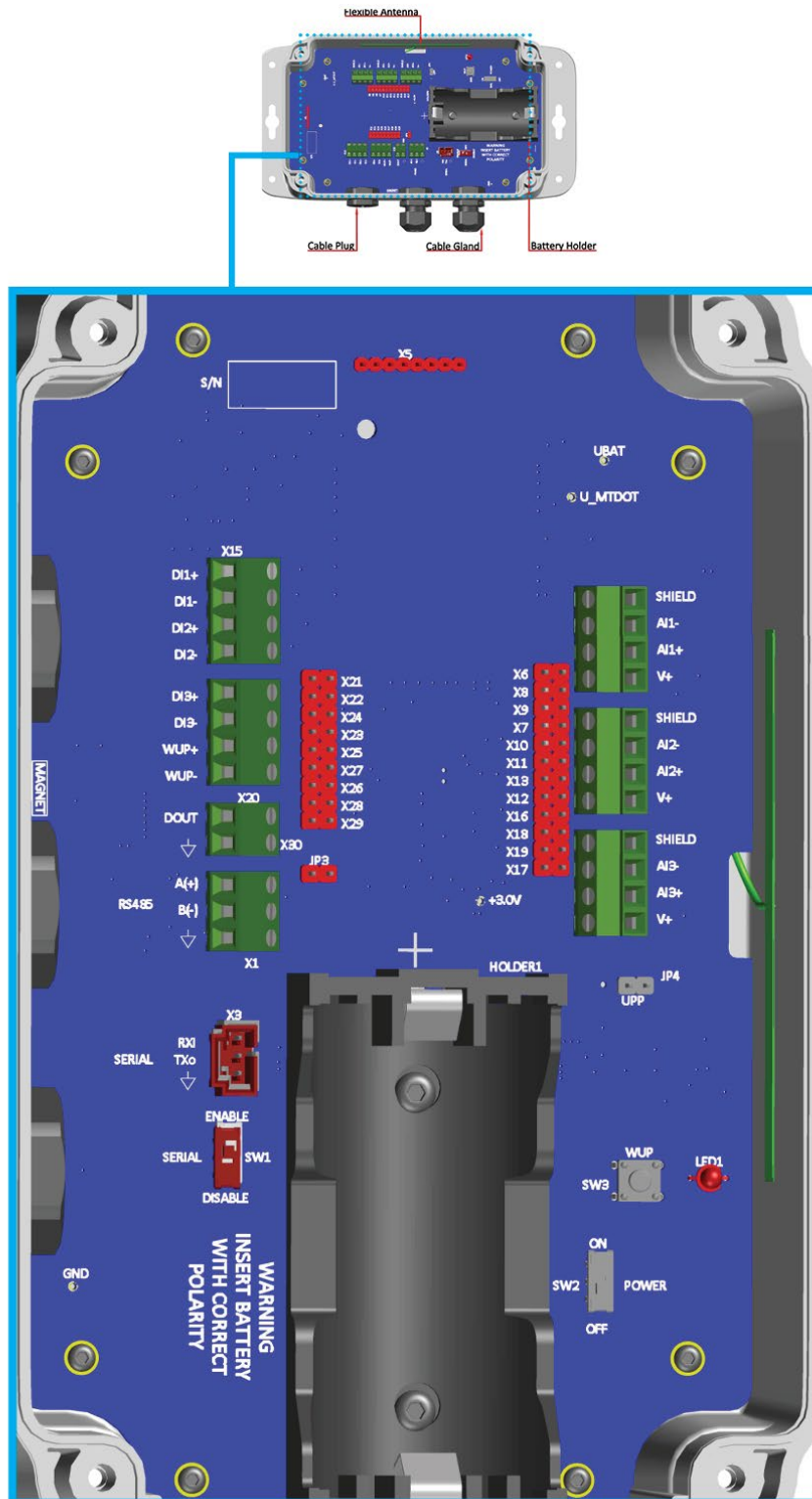
Dispose of the battery properly according to local laws and regulations. The supplied battery is a primary battery and cannot be recharged. Do not attempt to recharge the battery.

The enclosure is rated to IP68, NEMA 4X standards. These standards require that the gasket be properly positioned, and the screws tightened to 8.00 in-lbs. Do not over tighten the screws.

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VOBO GP-1 COMPONENT OVERVIEW



Description of Components

Cable Glands	<p>The VoBo comes with three (3) cable glands installed. The cable glands are designed for securing cables (or wires) 0.105 inch to 0.315 inch in diameter.</p> <p>Two (2) hole plugs are provided to seal unused entry points.</p>
Flexible Antenna	<p>The antenna is affixed to the edge of the enclosure with adhesive. It is not designed to be removed or repositioned. The antenna is omnidirectional and its orientation with respect to the gateway is largely immaterial. It is recommended that the label face towards the gateway to limit the likelihood of an obstruction blocking the signal.</p>
S/N	<p>This is the serial number for the VoBo. Please make note of the serial number and Dev EUl prior to contacting VolleyBoast with troubleshooting issues.</p>
Battery Holder	<p>The VoBo comes equipped with a D-size battery. Users can replace the battery per their preference. It is recommended that lithium-thionyl chloride [Li-SOCl₂] cells be used. The battery MUST BE 3.6 Volts. The battery MUST BE installed with the correct polarity. The slider switch should be in the “OFF” position while inserting or removing a battery. When replacing the battery, ensure the battery performance characteristics are suitable for your application. A listing of possible replacement batteries follows:</p> <ul style="list-style-type: none"> • Saft LSH20 • Saft LS33600 • Tadiran TL-5930 • Tadiran TL-2300 • Dynamis LIX-160-1550/W • Ultralife ER34615 • Ultralife ER34615M
Power Switch	<p>The switch activates/deactivates the power supply (the battery). It should be in the “OFF” position when installing or removing the battery. The power slider switch can also be used to reboot the microprocessor.</p>
LED1	<p>The LED indicates successful completion of firmware initialization after power is turned on and successful connection to the network has been made.</p>
WUP Button	<p>Press this button briefly to interrupt the preprogrammed sleep/wake cycle. This will immediately initiate the programmed reading of connected sensors and transmission of payload. This is useful for checking readings while in the field or when calibrating sensors.</p>
MAGNET	<p>There is a magnetic switch directly underneath this label. When the enclosure cover is on, a magnet can be used to activate this switch and the same function as pressing the WUP button will be performed. A red dot has been affixed to the exterior of enclosure marking the location of the magnet.</p>
AI1, AI2, AI3	<p>Analog terminal blocks. Each is jumper configurable for reading 4-20mA, 0-5V, or 0-10V sensors/transmitters. The terminals have a user configurable power supply of 5V to 24V DC. The terminal blocks accept 28-16AWG stranded or solid wires. Wire strip length should be 0.2 in (5-6 mm).</p>
DI1, DI2, DI3	<p>Discrete input terminals. Use DI3 for pulse counting. Any of the discrete inputs may be used for monitoring switches. The discrete terminals can be individually configured to act as dry contact or voltage. The terminal blocks accept 28-16AWG stranded or solid wires. Wire strip length should be 0.2 in (5-6 mm).</p>

WUP Terminal	Performs the same function as the WUP button. Can be used to generate an alert when a switch position is changed. The terminal blocks accept 28-16AWG stranded or solid wires. Wire strip length should be 0.2 in (5-6 mm).
DOUT	An open drain output terminal. Used to communicate with external devices.
RS485	An RS-485 terminal. Used for communicating with Modbus RTU devices.
SERIAL	A UART terminal. Used for recovering logged data and performing local configuration of the VoBo.
SERIAL Switch	The switch used to enable or disable communication with the processor through the Serial terminal.
X6 thru X19	Jumpers used to configure analog terminals.
X21 thru X29	Jumpers used to configure DI1 thru DI3 terminals. These are normally all closed.
X5	JTAG connection. Used for installing custom software. Efforts to install your own firmware or otherwise use the JTAG connection will violate the terms of the Warranty
VBAT, V_MTDOT, VPP, GND, +3.0V	Test points for checking voltage levels at different points on the board.
JP4	The Jumper can be closed to connect the shield circuit to ground. Normally it is left open.
JP3	Jumper can be closed to add 143 ohms of resistance to the RS-485 circuit.
Other	The QR code on the label provides a link to the user documentation. The paper QR code affixed to the side of the enclosure provides the Dev EUI. The Dev EUI is essential for connecting a VoBo to a gateway or managing a VoBo on a third-party platform.



The WUP button and Magnetic switch only function when the WUP I/O terminal is not in a closed position.

Enclosure Mounting Holes

The VoBo can be secured to a platform by inserting screws or bolts through the enclosure mounting holes. It is recommended that the VoBo be installed with the cable glands facing down, particularly in those environments where moisture is a concern.

Please contact VolleyBoast if you would like to purchase a pole mounting kit or magnetic attachment kit.

SETTING UP

There are three key steps to setting up a VoBo:

1. Connecting to the gateway.
2. Configuring the software.
3. Connecting the sensors and arranging the jumpers (if needed).

Connection to the Gateway

Input the connection information for the VoBo into your gateway:

- Device ID (DevEUI)
- Application EUI (AppEUI)
- Application KEY (AppKey)

This information can be found on the paperwork included with the VoBo. The DevEUI is also provided on a label affixed to the exterior of the VoBo. The AppEUI (also referred to as the JoinEUI) is used for the joining the VoBo to a gateway. The AppKey is used for encryption purposes and should remain strictly confidential.

Please contact the gateway vendor or network provider for instructions regarding entering this information on their respective platforms.

The following connection parameters are set as defaults on the VoBo:

- Class: A
- Frequency Sub-Band (FSB): 2
- Network Mode: Public

The gateway or network server should reflect these settings. The Frequency Sub-Band can be changed in the configuration settings. The remaining settings are fixed. Please contact VolleyBoast at support@volleyboast.com if the default settings are inconsistent with the gateway or network settings.

To test whether the VoBo successfully joins the network:

1. Remove the enclosure top.
2. Ensure that the slider switch by the battery holder is switched to “OFF”.
3. Install the battery, ensuring the polarity is correct.
4. Move the slider switch to the “ON” position.

The LED will light green for 1 second after successful initialization.

The VoBo will transmit a payload automatically once it joins the network. The network server should register this and provide network information such as signal strength.

The LED will flash green each time the GP-1 attempts to join the network. Once the GP-1 has attempted to join the network 10 times it will show a 1 second red LED and then sleep for 30 minutes before attempting to join again.

The LED will light green for 1 second upon successfully joining the network.

The LED will flash red if the VoBo does not receive an acknowledgement from the gateway that it has received the payload.

The second transmission after successfully joining the network will contain MAC commands instead of the standard payload. The third transmission will contain the standard data payload. The VoBo will send transmissions at the default cycle time of 30 minutes (as described below). Pressing the WUP button any

time the VoBo is connected interrupts the cycle time and sends a transmission immediately. The cycle can be changed using either the online or local configuration manager.

Configure the Software

The VoBo can be configured either remotely or locally.

Remote Configuration

The VolleyBoast configuration portal ("The VoBo Configurator") is accessed through VolleyBoast's customer portal found at: <https://portal.volleyboast.com>.

The VoBo Configurator creates hexadecimal messages which are downloaded through network servers to the gateways. Each time a message is sent to the gateway, the VoBo checks to determine if a downlink message is waiting for it. If there is a configuration message, the VoBo will receive it and update its configuration.

The VoBo Configurator can be used to configure VoBos deployed on networks managed by VolleyBoast (through its Remote Monitoring Service) as well as those deployed on third-party networks.

Hexadecimal formatted configuration information derived by the VoBo Configurator can be copied, downloaded, and otherwise provided to third-party networks.

The VoBo Configurator also provides a management system for the VoBos. It tracks the most recent configuration file "sent" from the portal and organizes the VoBos by groups and sites.

Configuration Process

- Initial Account Setup Step 1: Go to <https://portal.volleyboast.com/>
- Step 2: Select "Register"
- Step 3: Enter account information
- Step 4: Enter device DEV EUI (note that only a DEV EUI from a single VoBo is necessary to activate the user account even if multiple VoBos are being deployed)
- Step 5: Click the link on the confirmation email to activate the account
- Step 6: Add users to the account via the "Account Information" tab on the portal

Adding VoBos

- Step 1: Select "VoBo Configurator"
- Step 2: Select "Device Management"
- Step 3: In the Add Device section, select the desired "Group" and "Site". It is optional to use Groups and Sites. If they are used, they need to be set up first within the respective tabs found in the main menu. Once a VoBo is added the only way it can be removed is from Device Management.
- Step 4: Enter the name you have chosen for the VoBo.
- Step 5: Enter the DevEUI of the VoBo.
- Step 6: If desired, enter a description.
- Step 7: Select "Save Device"
- Step 8: Repeat steps 1-7 for each additional VoBo

Configuring VoBos

Step 1: Select VoBo Configuration in the dropdown menu

Step 2: Click the target Group and/or Site

Step 3: Select the VoBo

Step 4: Change default values where necessary

Step 5: A hexadecimal-equivalent string reflecting updates to the configuration changes dynamically as data is entered

Step 6: Select "Send Configuration" to transmit the configuration message to the selected Network Server Provider or to create a local download. This also saves the configuration for the chosen node for future use.

Note: The VoBo receives the updated configuration file the next time it communicates with the network. The VoBo will transmit its current payload, before receiving the message. The configuration changes will be implemented in the next wake-up cycle.

Local Configuration

It is important to follow all the steps outlined below.

- 1) Turn the power switch to the off position
- 2) Connect a computer to the UART terminal with a USB to RS-232 cable. (note: FTDI manufactures a RS232 to USB connector that works well for this purpose. The part number is TTL-232R-RP I). For ease of repeated use – it may be beneficial to connect the individual wires to a RS-232 connector housing (Molex part number 50-57-9403). The Molex part number for the respective crimp connectors is 16020102. Please contact VolleyBoast if you would like to purchase a preassembled connector.
- 3) Open a communication software such as TeraTerm or Putty
- 4) Set the following:
 - Baud Rate = 9,600
 - Data bits = 8
 - Parity = N
 - Stop bits = 1
 - Flow Control = Off
- 5) Set the SERIAL switch to "ENABLE"
- 6) Restore power the VoBo by switching the power switch to "ON"
- 7) Follow the prompts on your screen to change the configuration
- 8) Once the changes have been made follow the prompts to exit the local configuration mode and resume normal operation

Note: The serial switch must be set to "DISABLE" before exiting the local configuration mode else the VoBo will not resume normal operation.

At this point it is safe to remove the USB-RS232 cable.



THE VoBo IS DISABLED WHEN THE SERIAL SWITCH IS IN THE ENABLE POSITION. IT MUST BE RETURNED TO THE DISABLE POSITION TO RESUME FUNCTIONALITY!

Configurable Fields

Cycle Time

- Time between readings
- Default: 30
- Units: Minutes
- Range: 5 – 2880
- Source: user determined

Voltage Input

- Voltage applied to sensors ADC channels
- Default: 12
- Units: Volts
- Range: 5 – 24 (whole numbers)
- Source: sensor documentation

Settling Time

- Time necessary for sensors to be sufficiently powered to take an accurate reading
- Default: 1.0
- Units: Seconds
- Range: 0.1 – 20.0
- Source: sensor documentation

Resend Attempts

- Number of times node will attempt to resend readings not acknowledged by gateway
- Default: 1
- Range: 0 - 3
- Source: user determined

Resend Delay

- Time delay between resend attempts
- Default: 5
- Units: Seconds
- Range: 1 - 10
- Source: user determined

Failed Transmissions Before Rejoin

- Number of failed send attempts allowed before initiating a new join process

- Default: 1
- Range: 1 – 3
- Source: user determined

Frequency Sub-Band

- Network's FSB Default: 2
- Range: 1 – 8
- Source: network provider
- Note: some networks use a preset sub-band whereas others allow devices to scan all available sub-bands

Modbus configuration

- Enter the device address, the tag register, the delay between send and receive, the Baud Rate and the register type (3 or 4). The Modbus functionality must be enabled to read Modbus registers. This is because there is normally a time delay associated with reading Modbus registers that will shorten the battery life unnecessarily if you are not reading a Modbus device.

Analog Calibration

- Adjusts the output from the analog terminals for Gain and Offset. Additionally, the output can be modified to report in engineering units instead of raw ADC counts (or millivolts)
- Default: Gain =1, Offset = 0.
- Range: Positive or negative number up to 5 significant digits

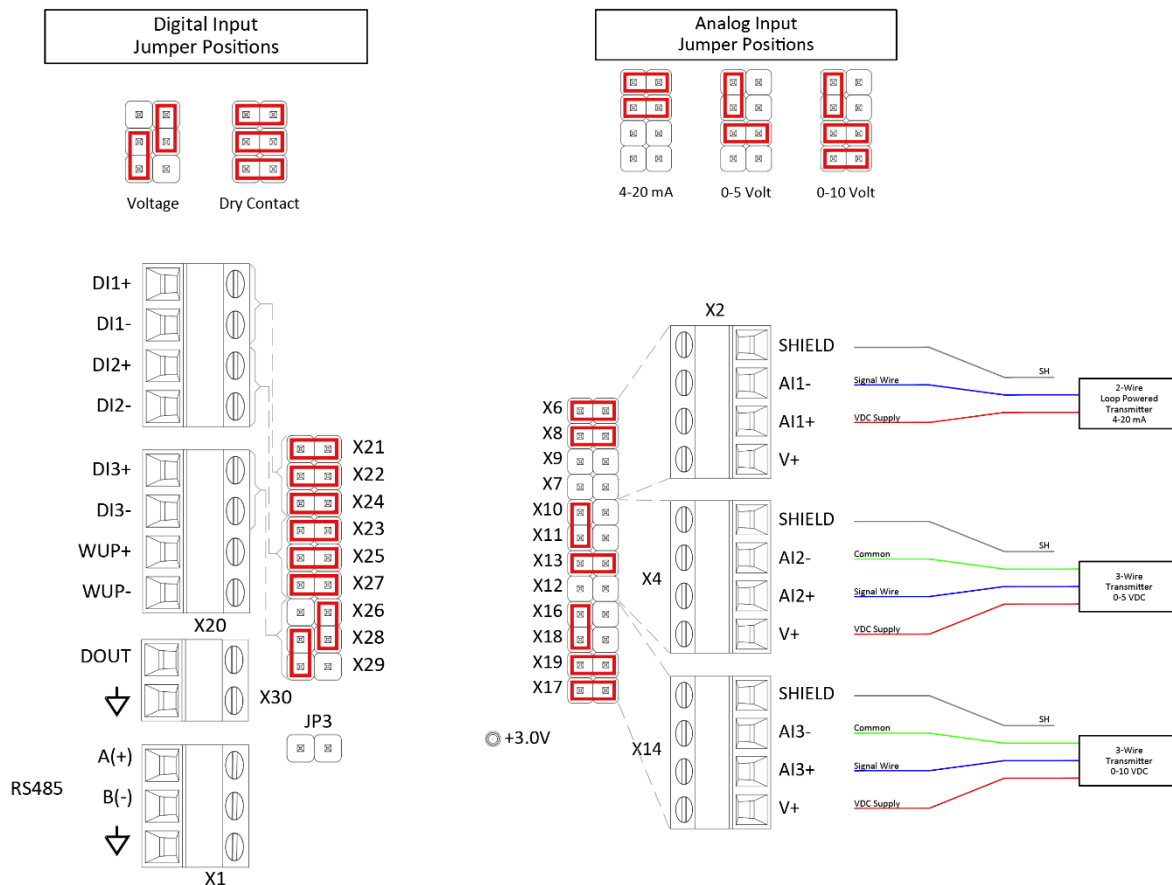
Arranging the Jumpers and Connecting the Sensors



Be sure to remove the battery or ensure the "POWER" slider switch is in the "OFF" position before arranging jumpers and/or connecting sensors.

Arranging Jumpers

Each input terminal is associated with a set of jumpers. The jumpers are not perfectly aligned with the associated terminal. The terminals and their associated jumpers are shown below. The position of the jumpers is also indicated for the various sensor types. The red boxes indicate which pins should be connected (i.e., closed) with a jumper. Note: The terminal blocks can be configured individually. The VoBo, unless requested otherwise, is shipped with the AI1 terminal set for a 4-20mA, AI2 set for a 0-5V, and AI3 set for 0-10V.



Insert sensor cable into the cord grip. The cord grips accept cable diameters of between 0.105 inch and 0.315 inch.

Connect the sensor wires as described below.

Analog Sensors

4-20mA sensor

- Two-wire loop powered sensor: insert the VDC supply wire (typically red) in the AI+ and the signal wire (typically black) in AI- of the analog input terminal block. Bare or shield goes into SH.

Voltage sensors

- Insert the VDC supply wire (typically red) in the V+ and the signal out (typically black) wire in AI+, and the ground wire (typically bare) goes in AI- of the analog input terminal block.

Discrete Sensors (Switches, pulse counters, etc.)

- Insert the plus and minus wires in the D+ and D- connections.

Modbus RTU Sensor

The VoBo has an RS-485 serial port for Modbus RTU sensors. It is programmed to pick up and transmit one 16-bit register. Please contact VolleyBoast to poll multiple tags or if your register is larger than 16-bits.

The VoBo can transmit Modbus sensor data for sensors powered both externally as well as by the VoBo. In both powering scenarios, the signal wires are connected to the RS-485 terminal. A Modbus sensor can be powered through one of the VoBo's analog terminals.

Connect the RX, TX, and Ground wires of the Modbus sensor to the respective RS-485 terminals. If the VoBo is powering the sensor, connect the voltage supply wire to an analog V+ terminal and the shield wire to the SH terminal.

Note that closing jumper JP3 allows for reading multiple Modbus devices. JP3 is normally left open when reading a single device.

Once the jumpers are configured and the sensors installed, reinstall the battery and turn the "POWER" slider switch to "ON".

DECODING THE PAYLOAD

Payload Structure

The mDot sends an 11-byte payload. The microprocessor uses a little-endian format and the payload is broken down as follows:

BYTE	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	Last 4 Bits of adcCh1				WKUP	DI3	DI2	DI1
2	First 8 Bits of adcCh1							
3	Last 8 Bits of adcCh2							
4	Last 8 Bits of adcCh3				First 4 Bits of adcCh2			
5	First 8 Bits of adcCh3							
6	Last 8 Bits of adcCh4							
7	Last 4 Bits of adcTemperature				First 4 Bits of adcCh4			
8	First 8 Bits of adcTemperature							
9	Last 8 Bits of Modbus							
10	First 8 Bits of Modbus							
11	CRC8							

Notes:

- Digital Inputs - when circuit is open (or voltage is not detected) the payload is 1, when closed (or voltage is detected) the payload is 0.
- WKUP - when the circuit is open the payload is 0, when closed the payload is 1.
- adcCh1, adcCh2, adcCh3 correspond to the AI1, AI2, and AI3 analog terminal blocks.
- adcCh4 is raw battery voltage. Raw battery voltage * 4 = actual battery voltage. Voltage is read while analog terminals are powered.
- adcTemperature is the reading from the temperature sensor integrated into the ADC. Temperature is in Celsius. When the first bit (left most) in the adcTemperature[0] is 0, the temperature is greater than zero. To convert to temperature multiply by 0.125. When the first bit in adcTemperature [0] is 1 the temperature is below zero and use $[(4096 - \text{adcTemperature}) * (-1) * 0.125]$ to get the temperature.

Breakdown of the Payload

Base64 string - "9zA/EwBKlwvSBF8="

Converted to Binary

```
11110011 00110000 00111111 00010011 00000000 01001010 00100011 00001011 11010010
00000100 01011111
```

Using the payload structure detailed above and keeping in mind the use of little-endian, the payload is broken up as follows:

Din1 – 1 - "1"

Din2 – 1 - "1"

Din3 – 0 - "0"

WKUP – 0 - "0"

adcCh1 – 001100001111 - "783"

adcCh2 – 001100111111 - "831"

adcCh3 – 000000000001 - "1"

adcCh4 – 001101001010 - "842"

adcTemperature – 000010110010 - “178”
 modbus – 0000010011010010 - “1234”
 crc8 - 01011111 - “95”

Analog Channels

Each analog channel is read by a 12-bit ADC. Each channel can be configured with jumpers to go through one of three different circuits.

The circuit for reading a 0-5V sensor includes a voltage divider (R2 = 20,000 ohm, R1 = 30,000 ohm). The actual voltage output from a 0-5V sensor is reduced by 2/5 at the ADC input. The ADC output (adcChx) for a 0-5V sensor then will have a scale of between 0 and 2000 raw counts.

The circuit for reading a 0-10V sensor includes a R2 = 7,500 ohm, R1 = 30,000 voltage divider. The actual voltage output from a 0-10V sensor is reduced by 1/5 at the ADC input. The ADC output for a 0-10V sensor will also have a scale of between 0 and 2000 raw counts.

The circuit for reading a 4-20mA sensor has a current divider which includes a 250 Ohm resistor. 4mA of current from the sensor results in a voltage at the ADC input of 398mV and 20mA of current results in 1990mV at the ADC input.

Converting ADC Raw Counts to Sensor Units for a 0-5V Sensor

Example: A 0-5V pressure sensor, pressure range of 0-100psi, output load of 20,000 Ω .

Step 1: Calculate the slope (gain)

$m = (\text{Sensor Pressure at 5V} - \text{Sensor pressure at 0V}) / (\text{Voltage Range of the Sensor}) * ((50,000 \Omega + \text{Output Load}) / 20,000 \Omega)$

$m = (100 / 5) * [(50000 + 20000) / 20000]$

$m = 70$

Step 2: Calculate the y-intercept (offset)

$b = (-1) * (0.4) * m * (\text{Output Voltage Min}) + (\text{Measurement Value Min})$

$b = (-1) * (0.4) * m * (0) + (0)$

$b = 0$

Resulting Equation:

$\text{Pressure} = 70 * (\text{ADC raw counts} / 1000)$

Using adcCh1 raw counts of 783, sensor is measuring a pressure of 54.81psi.

Converting ADC counts to Sensor Units for a 0-10V Sensor

Example: A 0-10V pressure sensor, pressure range of 100 - 500psi, output load of 30,000 Ω .

Step 1: Calculate the slope (gain)

$m = (\text{Sensor Pressure at 10V} - \text{Sensor pressure at 0V}) / (\text{Voltage Range of the Sensor}) * ((37,500 \Omega + \text{Output Load}) / 7,500 \Omega)$

$m = (400 / 10) * [(37,500 + 30,000) / 7,500]$

$m = 360$

Step 2: Calculate the y-intercept (offset)

$b = (-1) * (0.2) * m * (\text{Output Voltage Min}) + (\text{Measurement Value Min})$

$b = (-1) * (0.2) * m * (0) + (100)$

$b = 100$

Resulting Equation:

$\text{Pressure} = 360 * (\text{ADC raw counts} / 1000) + 100$

Using adcCh1 raw counts of 783, sensor is measuring a pressure of 381.8 psi.

Converting ADC counts Sensor Units for a 4-20 mA Sensor

Example: A 4-20mA pressure sensor, pressure range of 0 - 2000psi.

Step 1: Calculate the slope (gain)

$m = (\text{Sensor Pressure at 20 mA} - \text{Sensor pressure at 4 mA}) / (1.980 - 0.396)$

$m = (2000 / 1.584)$

$m = 1262.63$

Step 2: Calculate the y-intercept (offset)

$b = (-0.396 * m) + \text{Sensor Pressure at 4 mA}$

$b = (-0.396 * 1262.63) + 0$

$b = -500.0$

Resulting Equation:

$\text{Pressure} = 12562.63x(\text{ADC raw counts} / 1000) - 500.0$

Using adcCh1 raw counts of 783, Sensor is measuring a pressure of 488.64 psi.

ANALOG CALIBRATION

The ADC raw count from the three analog terminals can be adjusted for gain and offset. This permits storing the calibration points at the VoBo level and using one conversion formula for a particular model sensor in the cloud or server. The gain and offset values can be entered through remote or local configuration parameters.

To have the payload report in engineering units, enter the gain expressed as (engineering units/adc raw counts) and the offset in engineering units. The engineering units should be from test instrumentation and the ADC raw counts should be the actual ADC raw counts reported from the installed sensor that correspond to the test points.

To have the payload continue to report in ADC raw counts, the gain should be expressed as (equivalent ADC raw counts from the test instrumentation/ADC raw counts from the installed sensor that corresponds to the test points). The offset should also be expressed in ADC raw counts.

Note the default Gain is set to 1 and the default Offset is set to 0. This provides the default payload explained above.

TEST POINTS

There are several voltage measurement points provided on the board.

VPP is the voltage provided to the analog terminal blocks. No voltage is applied to VPP when the VoBo is in its sleep cycle. VPP should be equal to the configured supply voltage when it is awake and for the duration of its settling time.

VBat provides the current battery voltage.

+3.0 Volt should measure 3.0 volts when the VoBo is awake. Many of the components on the board function at 3.0 volts.

V_MTDOT is the reference voltage from the microprocessor, it is 3 volts.

FIELD INSTALLATION

Mount the enclosure on a nearby pole or another surface. The enclosure has several mounting holes that can be used to secure the VoBo in place. The more open the line of sight is to the gateway, the better the connectivity. This may become an issue if there is some distance between the VoBo and the gateway or if the gateway is located near the ground.

Please contact VolleyBoast if you would like to purchase pole mounts or mounting magnets. The cable glands should point downwards to minimize the possibility of water entry through the cable gland.

Install the sensors/transmitters

- Run the sensor/transmitter cable through the cable gland and connect the individual wires to the appropriate terminal block.
- Tighten the cable gland.

Install the provided battery, taking care to have the correct polarity. Slide the power switch to on.

Check LED for join status. A one second green light indicates the VoBo is in communication with the gateway. A Red LED light indicates a communication fault.

Press WUP button after one minute (or after a time period that is greater than the configured settling time plus 5 seconds). Repeat.

From this point forward the payload and sensor readings should be sent to your LoRaWAN network server and, assuming it is set up, you should be able to ascertain the sensor readings from the network.

Attach the VoBo cover with the provided screws. The screws should be tightened to 8 in-lbs. Holding the screwdriver with just your thumb and first two fingers and then torqueing the screwdriver seems to approximate 8 in-lbs.

Note: if you want to test the VoBo at different locations for connectivity, the VoBo is programmed to transmit temperature and battery voltage without connecting to external sensors. The Network Server will likely report signal strength from the endpoint. In this manner you can assess the quality of connectivity on the w network.

Problems: Contact VolleyBoast at: support@volleyboast.com

REGULATORY

- **Federal Communications Commission**

- Per FCC 15.19(a)(3) 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.
- Per FCC 15.21, changes or modifications not expressly approved by VolleyBoast for compliance could void authority to operate the device.
- Per FCC 15.105, This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
- This device contains FCC AU792U13A16857

- **Industry Canada Radio Standards Specification**

- Per RSS-Gen 7.1.2, Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the 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 isotopically radiated power (e.i.r.p.) is not more than that necessary for successful communication.
- Per RSS-Gen 7.1.2, This radio transmitter, 125A-0054, has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.
- Per RSS-Gen 7.1.3, This device complies with Industry Canada license-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.

- This device contains IC: 125A-0054

REVISION HISTORY

Revision Date	Section	Revision

CONTACT

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