HAB VENTER

Integrated Balloon Valve

Balloon Ascent Technologies

The sky's not the limit; it's where we start.

Overview

The HAB Venter is a high-flow multi-use valve and integrated termination system for latex weather balloons.

- High-flow, low-pressure valve
- Redundant termination systems
- Anti-collision strobes
- Switch a low-power device on/off via the AUX port
- Wireless BLE & LoRa Interfaces
- Wired UART Interface
- Wired external trigger to start activation sequence

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Operating Specifications

Parameter	Min	Typical	Max	Unit
Operating Parameters				
Temperature	-60	-	60	°C
Battery Voltage	1	-	5.1	VDC
Settings				
Internal Heater Set-point	-60	-	60	°C
UART Baud Rate	1,200	115,200	115,200	baud
Watchdog Timer	-	90	4,000,000	seconds
Sensors				
Battery Voltage	-	2.8	-	VDC
Internal Temperature	-55	-	125	°C
Super-cap Voltage	-	2.9	-	VDC
Time since power-on	0	-	-	seconds
Mechanical				
Bottom-mount, no v-clamp, batteries or balloon insert[1]	-	190	-	g
4X L92 Batteries (primary and backup termination)	-	30	-	g
V-clamp	-	20	-	g
3 cm Balloon Insert (Totex small)	-	45	-	g
5 cm Balloon Insert (Totex large)	-	55	-	g
8 cm Balloon Insert (Hwoyee small)	-	60	-	g
11 cm Balloon Insert (Hwoyee large)	-	85	-	g
Top-mount for 3 cm balloon insert, no batteries	-	130	-	g
2x L92 batteries (primary, no backup available)	-	15	-	g
Mechanical: Size, bottom-mount	14 cm diameter, 16 cm height			
Mechanical: Size, top-mount	11 cm diameter, 12 cm height			

---

1   After termination, with a standard flight-train, the bottom-mount HAB Venter, its batteries, and the v-clamp will remain attached to the parachute's apex. This will be approximately 240 g of mass as the balloon insert separates and stays with the balloon envelope.

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Interface

The *HAB Venter* can be controlled either via Bluetooth Low Energy (BLE, v 4 or 5) or via a hardware Universal Asynchronous Receive Transmit (UART) serial protocol interface. Each module uses an identifier character to permit multiple devices to be placed onto the same UART bus.

Bluetooth Low Energy Interface

HAB Venter uses the Nordic UART Service (NUS) for most Bluetooth communication. This permits using Adafruit's Bluefruit LE Connect App for ground-testing prior to launch.

> Android: https://play.google.com/store/apps/details?id=com.adafruit.bluefruit.le.connect

> iOS: https://apps.apple.com/app/adafruit-bluefruit-le-connect/id830125974

LoRa Radio Interface

The *HAB Venter* has an integrated LoRa radio based on a Semtech SX1262 chip. It can be configured to operate in the 862-928 MHz frequency range over a distance of many meters.

The radio interface can be configured to 'echo' commands to/from the other communication interfaces, permitting one HAB module to act as a 'gateway' to other HAB modules acting as as 'devices'. With this, the LoRa radio network is self-contained, negating the need to add a custom LoRa radio module to the flight computer. Example:

- A HAB Ballaster can be wired to the flight computer via the UART interface and configured as the 'gateway' with device identifier (ID) 'B'

- A HAB Clipper can be configured as a 'device' with ID 'C' and added above the parachute

- A HAB Venter can be configured as a 'device' with ID 'V' and added to the balloon

- Commands sent via UART to device 'B' are not echoed by the LoRa radio

- Commands sent via UART to ID 'C' are echoed by the LoRa radio. Any responses received from ID 'C' via LoRa radio are then echoed onto the UART interface so the flight computer can confirm that the command was received and acted on.

- The HAB Venter will also receive the ID 'C' commands via its LoRa radio but will ignore them because it is addressed to a different ID.

Hardware UART Interface

A low-level, unprotected interface is available via a 4-pin JST SH (1.0 mm pitch) connector.

Default specs: 115,200 baud, 8n1, @ 3.3 V logic. Baud rate user selectable.

Power note: the available 3.3 V output is regulated, but should not be expected to source more than 20 mA. Use of it will impact expected battery life.
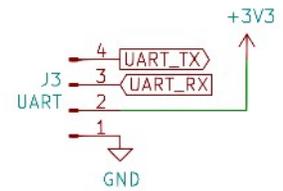
Power-On Buttons

First press and hold the primary power-on button down until the BLE LED flashes, usually within three (3) seconds. Then press and hold the backup power-on button down until the Backup STATUS LED flashes, usually within three (3) seconds

Repeated pressing or constant pressing of either will have no impact on the *HAB Venter* operation. It cannot turn off the *HAB Venter*. To shutdown the *HAB Venter* Primary System issue (!iSD=Y), the shutdown command.

The *HAB Venter* Backup System can not be shutdown and will take a considerable time to fully shutdown, even with the batteries removed—usually 5+ minutes. If the primary side is shutdown before it turns off, it will activate the backup cutter due to the lack of the primary's heartbeat signal.

BLE LED

The *HAB Venter* has one blue communication LED. Possible blink patterns are:

- Briefly flashing at 1-3 Hz to indicate BLE advertising (1285 ms advertising rate) and awaiting the first UART command since power-on

- Single, 100 ms second pulse to indicate command received

- Off once a BLE or UART command has been received

Status LED

The *HAB Venter* has one green Status LED. Possible blink patterns at 1 Hz are:

- **Pulsing** – super-cap is charging

- **Single** – Watchdog Timer is enabled

- **Double** – Venter currently active

- **Triple** – Venter is currently active and moving

- **Quintuple** – Venter error

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The green Status LED will flash briefly once ever 5 seconds to indicate it is powered on and operating correctly.

Backup Status LED

The *HAB Venter* has one orange Backup Status LED. Possible blink patterns are:

- Pulsing – super-cap is charging

- Brief single, at 2 Hz – Heartbeat signal received

- Alternating on/off at 2 Hz – Cutter active

- Rapid flashing –

  - At power-on, burn-wire continuity failed

  - After power-on, cutter about to activate

- Quintuple – Cutter Continuity Error

Checklist for Bottom-Vent Configuration

Setup

1) Remove battery covers, insert four batteries, reattach battery cover

2) Verify valve at least partially retracted   `!iVO=-1`

3) Attach balloon insert with v-clamp and secure with sacrificial line and zip-tie

4) Verify both cutters burn-wires

5) Slide balloon insert into balloon's top neck, secure neck on insert with two zip-ties

Power-On

6) Press the power-on button for 3 seconds   Status and BLE leds turn ON

7) Verify cutter continuity   No rapid status flashing

8) Connect with BLE, LoRa, or UART   BLE led turns off

9) Configure UART ID if desired   `!iSI=X`

10) Wait for Scap to charge, ~10 min

Test

11) Set to partial open   `!iVP=10`

12) Open briefly   `!iVO=5`

13) Confirm valve opens briefly and fully closes

14) Configure for desired opening   `!iVP=80`

15) Turn on strobes, if desired   `!iSS=1`

Launch

16) Command open to vent lift gas   `!iV0=60`

Flight Termination

17) Command balloon separation   `!iVT=Y`

Recovery

18) Shutdown   `!iSD=Y`

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Checklist for Top-Vent Configuration

Setup

1) Remove battery cover and insert two batteries, then reattach battery cover

2) Slide balloon insert into balloon's top neck

3) Secure balloon neck on insert with two zip-ties

4) Attach foam boot for padding and insulation, if desired

Power-On

5) Press the power-on button for 3 seconds   Status and BLE leds turn ON

6) Connect with BLE, LoRa, or UART   BLE led turns off

7) Configure UART ID if desired   `!iSI=X`

8) Wait for Scap to charge, ~10 min

Test

9) Set to partial open   `!iVP=10`

10) Open briefly   `!iVO=5`

11) Confirm valve opens briefly and fully closes

12) Configure for desired opening percentage   `!iVP=80`

13) Turn on strobes, if desired   `!iSS=1`

Inflation

14) Command open indefinitely to inflate   `!iV0=-1`

15) Command closed once inflated   `!iVQ`

Launch

16) Command open to vent lift gas   `!iV0=60`

Recovery

17) Shutdown   `!iSD=Y`

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Operation

Bottom Vent Configuration

The standard configuration. The *HAB Venter* is mounted on the bottom of a single-neck balloon and is integral to the balloon flight-train connection. In this configuration it is equipped with a v-clamp and associated cutter to release the balloon during flight termination.

Separation Cutter Operation

The cutters can be activated with either the termination (`iVT=Y`) or separation commands (`iVS=Y`). The separation command will only activate the cutters, while the termination command will activate the cutters and then open the valve fully.

Terminate Sequence

The valve module can be used to terminate a balloon flight. It will first activate the primary and backup cutters, then open the valve fully.

Resulting activation sequence:

1. *HAB Venter* fires primary cutter for 8 seconds
2. Backup cutter will activate 2-6 seconds later, for 8 seconds
3. *HAB Venter* pauses until the super-cap recharges
4. Valve will open fully
5. Terminate sequence completion message sent

Cutter Checks

The *HAB Venter* checks the cutter continuity continuously. If the continuity check fails, then the Status LED will display a rapid-flash error pattern. A failed continuity check does not disable the cutter. It is only an indication to the operator that the resistance of that cutter's circuit is too high or open.

Top Vent Configuration

This is a light-weight, alternative configuration. The *HAB Venter* is mounted on a second balloon neck at the top of the balloon. The flight-train is mechanically connected to the bottom balloon neck so in this configuration the HAB Venter can not release the balloon during flight termination (a separate HAB Cutter is required for this) so is not equipped with a v-clamp, cutters, or a backup system.

The termination sequence is similar but no cutters are activated. The valve is opened indefinitely to ensure all the lift gas has vented from the balloon.

Non-Volatile Parameters

Most of the *HAB Venter's* parameters are saved in non-volatile memory. The value is not effected by powering the *HAB Venter* off, so values can be configured in advance of launch. See the Controls section for which parameters are saved to non-volatile memory.

During the boot sequence, the non-volatile memory is verified and then loaded. If the memory is found to be corrupted then it is reformatted and default values are loaded. This is indicated by:

- STATUS LED flashing the rapid, continuous error flash.

- The following message sent via the UART interface:
  `[SM, WARN] Non-volatile parameters have been reset to defaults`

System Measurements

Every thirty (30) seconds while powered on, the *HAB Venter* will measure the battery voltage, super-cap voltage, and internal temperature. Using this temperature measurement it will then enable/disable the battery heater.

Anti-collision Strobes

These high-power, white anti-collision LED strobes can be placed into one of three states:

0. Off, strobes will not activate

1. Strobes will activate when ambient light falls below a pre-set threshold. When activated, they will double-flash every 3 seconds

2. Strobes will always be active, regardless of ambient light levels. Strobes will triple-flash every 3 seconds.

Watchdog Cutter Operation

The *HAB Venter* can automatically start a termination sequence by an expiring watchdog timer. This can be used to ensure that the balloon is separated (or vented empty for the top-vent configuration) prior to parachute deployment.

Example: start watchdog timer, re-enable once (alternative method to the feed command), feed once, then stop feeding:

    !iSW=30   Start the watchdog timer counting down from 30 seconds

                   … can wait up to 29 seconds …

    iSW=30   Reset the watchdog timer, reseting the countdown from 30 seconds

                   … can wait up to 29 seconds …

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!iSW=F   Feed the watchdog timer, reseting the countdown from 30 seconds

… wait 30 seconds for watchdog time to expire …

Resulting activation sequence:

1. *HAB Venter* issues the **!iVT** command to itself

2. Command message receipt sent out via BLE/LoRa/UART

3. Termination sequence is activated

Redundancy Overview

The *HAB Venter* (bottom-vent configuration) is equipped with completely redundant termination systems. Both are powered independently and control independent hardware. The only connection is a one-way opto-isolated heartbeat from the *HAB Venter's* Primary System to the Backup System.

The *HAB Venter's* Backup System must see a heartbeat signal from the Primary System at least once ever 4 seconds, otherwise it will fire its independent cutter and release the balloon. The Primary System automatically sends this heartbeat twice per second when powered on and operating correctly. If the terminate command (`!iVT=Y`) is issued then it stops transmitting this signal to ensure rapid and complete balloon release.

In addition to the redundant hardware systems, the *HAB Venter* can also be configured to use a watchdog timer to monitor the health of the primary flight computer. If a feed command (ex `!iSW=60`) is not received within the timer window then the termination sequence will be initiated.

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Controls

Command Section

The *HAB Venter* uses the same commands for both the BLE and UART interfaces. All commands and responses are in easy-to-read ASCII text and follow predefined formats with searchable characters to aid with parsing.

Command Format

Commands follow the following format: !iMC=VAL

Where "**!**" (ox21) denotes a new command start

Where "**i**" is the device's UART address (A-Z)

Where "**M**" is the subsystem name (ex V or S)

Where "**C**" is the subsystem command (ex T or C)

Where "**=**" (0x3D) is only required when there is a VAL associated with the command

Where "**VAL**" is the optional command value

Note: no termination character is required.

Response Format

Responses use the following format: `[iMC,VAL] Description (unit)`

Where "**[**" & "**]**" (0x5B & 0x5D) enclose the command and it's formal response

Where "**i**" is the device's UART address (default is 'A')

Where "**M**" is the subsystem name (ex B or S)

Where "**C**" is the subsystem command (ex T or V)

Where "**,**" (0x2C) separates the command from its value

Where "**VAL**" is the command response value

Where "**Description**" and optional "**(unit)**" are only provided to help a human operator decipher the response

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Venting Commands

This is a list of commands to control the *HAB Venter's* venting functions.

CMD	VAL	Description	Reply	Non-Volatile
VB		Burn-wire → Query	`[iVC,ENABLE ? DISABLE]` Cutter State	X
	0	Burn-wire → Disable	`[iVC,DISABLE]` Cutter State	
	1	Burn-wire → Enable	`[iVC,ENABLE]` Cutter State	
VC		Cutter Continuity → Query	`[iVC,GOOD ? FAIL]` Cutter Continuity	
VD		Cutter Activation Period → Query	`[iVD,1]` Cutter duration (s) `[iVD,ERROR]` Cutter duration (s)	X
	8	Cutter Activation Period → Set		
VL		Limit Switches → Query	`[iVL,0]` Limit switch state → Neither `[iVL,1]` Limit switch state → Closed `[iVL,2]` Limit switch state → Open `[iVL,3]` Limit switch state → Both	
VM		Motor Polarity → Query	`[iVM,NORM ? REV]` Motor Polarity	X
	0	Motor Polarity → Set Reversed		
	1	Motor Polarity → Set Normal		
VO		Open Valve → Query	`[iVO,INACT]` Inactive, closed → Currently closed `[iVO,15]` Opening, % open → Current percentage open `[iVO,10]` Venting, sec @ 70% → Time left to remain open `[iVO,15]` Closing, % open → Current percentage open `[iVO,ERR-1]` Opening error → Failed to open last attempt `[iVO,ERR-2]` Closing error → Failed to close last attempt `[iVO,ERR-3]` Inactive, open → Inactive, but not fully closed `[iVO,ERR-4]` Already venting → Active, use !iVQ to stop	
	10	Open Valve for X-seconds	`[iVO,10]` Venting initiated	
	-1	Open Valve Indefinitely	`[iVO,-1]` Venting initiated	
VP		Valve Position Setting → Query	`[iVP,15]` Open position (%)	X

	80	Valve Position Setting → Set Target	`[iVP,ERROR] Invalid position`	
VQ		Quit Venting, close valve	`[iVQ,GOOD] Venting stopped`	
VS	**Y**	Separate Balloon, fire cutters	`[iVS,GOOD] Balloon separation initiated` `[iVS,ERROR] Balloon separation failed`	
VT	**Y**	Start Termination Sequence	`[iVT,TERM] Termination initiated` `[iVT,ERROR] Use "iVT=Y" to terminate`	

LoRa Radio Commands

This is a list of commands to control the HAB Venter's LoRa Radio functions.

CMD	VAL	Description	Reply	Non-Volatile
RA		Preamble Setting → Query	`[iRA,n] Preamble length`	X
	6 to 65535	Preamble Setting → Set		
RB		Bandwidth Setting → Query	`[iRB,n] Bandwidth`	X
	7.8 to 500	Bandwidth Setting → Set		
RC		Coding Rate Setting → Query	`[iRC,n] Coding rate`	X
	5 to 8	Coding Rate Setting → Set		
RE		Echo Setting → Query	`[iRE,n] Radio Echo Setting`	X
	D	Echo Setting → Set as 'Device'		
	G	Echo Setting → Set as 'Gateway'		
	0-255	Echo Setting → Set bit mask manually		
RF		Carrier Frequency Setting → Query	`[iRF,n] Carrier Frequency`	X
	862.0 to 928.0	Carrier Frequency Setting → Set		
RG		Gain Setting → Query	`[iRG,n] Gain`	X
	0 = AGC	Gain Setting → Set		
RH		Latest Frequency Error (Hz) *DEPRECIATED*	`[iRH,n] Frequency error (Hz)`	
RN		Latest Signal to Noise Ratio	`[iRN,n] SNR (dB)`	
RO	**0**	Turn Radio Module OFF	`[iRR,ON] Radio State`	*if other setting later set
	1	Turn Radio Module ON	`[iRR,OFF] Radio State`	
RP		Output Power Level Setting → Query	`[iRP,n] Output Power`	X
	-17 to 22	Output Power Level Setting → Set		

RR		Latest RSSI Value	`[iRR,n] RSSI (dBm)`	
RS		Spreading Factor Setting → Query	`[iRS,n] Spreading Factor`	X
	6 to 12	Spreading Factor Setting → Set		
RW[2]		Sync Word Setting → Query (default = 0x12)	`[iRW,n] Sync Word (dec)`	X
	≤ 8 bytes	Sync Word Setting → Set		

---

2   The Sync Word is displayed in HEX during the boot sequence but set in DEC by the RW command. It can be up to 8 bytes in length but ≥2 bytes has not been tested yet.

System Commands

Below is a list of commands to control the HAB Venter's system functions.

CMD	VAL	Description	Reply	Non-Volatile
SA		AUX State → Query	`[iSA,n] AUX State`	
	0	AUX State → Set, low output		
	1	AUX State → Set, high output		
SC		Super-Cap Voltage → Query	`[iSC,2.78] Scap (V)`	
SD	**Y**	Shutdown	`[iSD,SHTDWN] Shutdown`	
SE		UART<->BLE Comm Echo → Query	`[iSE,ENBL ? DSBL] Comm Echo`	X
	D	UART<->BLE Comm Echo → Set to OFF		
	1	UART<->BLE Comm Echo → Set to ON		
SF		Display Settings	Returns multiple lines of text indicating Serial #, Sensors, and Parameters	
SG		Seconds since power-on	`[iSG, 0] Seconds = 10.17`	
SH		Heater Set Point → Query	`[iSH,-10] Heater Set Point (C)`	
	10	Heater Set Point → Set (°C)	`[iSH,10] Heater Set Point (C)`	
SL	**C**	Clear non-volatile settings, revert to default	`[iSL,Cleared] Shutting down`	
SI	**B**	Device Identification Letter → Set (A-Z)	`[BSI,B] Device ID`	X
SS		Strobe State → Query	`[iSV,1] Strobe State`	X
	0	Strobe State → Set to OFF		
	1	Strobe State → Set to ambient ON		
	2	Strobe State → Set to always ON		
ST		Internal Temperature → Query	`[iST,22.7] Temperature (C)`	
SU		UART Baud Rate → Query	`[iSU,115200] UART Baud Rate`	X

	1200	UART Baud Rate → Set	`[iSU,1200] UART Baud Rate` `[iSU,ERROR] UART Badu range: 1,200 to 115,200`	
SV		Battery Voltage → Query	`[iSV,2.78] Battery (V)`	
SW		Watchdog → Query	`[iSW,-1] WDT Inactive` `[iSW,n] WDT Remaining (s)`	
	D	Watchdog → Disable	`[iSW,-1] WDT Disabled` `[iSW,ERROR] Failed to stop WDT`	
	F	Watchdog → Feed	`[iSW,n] WDT Remaining (s)` `[iSW,ERROR] WDT not Fed`	
	60	Watchdog → Set	`[iSW,n] WDT Enabled/Feed (s)` `[iSW,ERROR] WDT invalid interval (1-4000000 s)`	
SX		System Status → Query	`[iSW,n,n,n] STV`	

System Status Message Details:

Description: This message is intended to be called regularly to both check on the module's status as well as keep the watchdog timer feed (if enabled, same as **iSW=F**). It returns a bitmapped Status byte as well as the module's internal temperature and battery voltage.

Example: [ASX,130,16.00,5.03] STV

Status Field: A bitmapped byte is returned as a decimal number:

7	6	5	4	3	2	1	0
SCap Charging	ERROR	Valve Active - Moving	Valve Active - Waiting	WDT Active	Open LS	Closed LS	Heater ON

Temperature Field: Board temperature in degrees C, two decimal places

Voltage Field: Battery voltage in volts, two decimal places

Unprompted Messages

The *HAB Venter* normally only sends information after a command is issued. Below are the three exceptions to that:

Terminate Sequence Completion

The following command is issued when the *HAB Venter* finishes a termination sequence

```
[iVT,TERM] Termination completed
```

Watchdog Timer

The following command is issued if the *HAB Venter's* watchdog timer expires

```
[iVT,TERM] Termination initiated
[iVT,TERM] Termination completed
```

External Trigger

The *HAB Venter* will transmit a message when the external trigger is activated.

```
[iVE,START] EXT Trigger Activation
```

LoRa Message Information

The *HAB Venter* currently displays a line of information each time it echos a LoRa interface message to/from the BLE and UART interfaces:

```
<LORA> RSSI: val, SNR: val
```

Note: These LoRa messages should be considered deprecated and expected to be removed in future firmware versions.

Power-On UART Message

At power-on, the *HAB Venter* will transmit an introductory message over the hardware UART interface that includes basic parameters. This information is also available via the Bluetooth Device Information Service (0x180A) & TBD Service (0x???):

```
--------- HAB Venter, rev 2.1 ---------
  SERIAL NO   : XXXXXXXXXXXXXXXX
  FIRMWARE    : Jul  4 2025
------------ Settings ------------
  ID CHARACTER: A
  HTR SET PNT : -10 (C)
  COMM ECHO   : ENBL
  VNTR MTR P  : NORM
  VNTR POSN   : 80 (%)
  CTR  STATE  : ENBL
  CTR  PERIOD : 10 (s)
------------- Sensors -------------
  INT TEMP     : ENBL
  BATTERY VOLT: ENBL
  SCAP VOLT    : ENBL
---------- LoRa Settings ----------
  FREQUENCY   : 915.0000
  BAND WIDTH  : 125.0000
  SPREAD FACT : 9
  CODE RATE   : 7
  SYNC WORD   : 0x12
  POWER       : 2
  PREAMBLE    : 8
  STATE       : 7
---------- Loonatec.com ----------
```

LoRa Radio

LoRa Settings & Effects

Below is a simplified overview of the basic LoRa and its chirp spread spectrum modulation settings. Default values are shown on the previous page in the *Power-On UART Message*.

Bandwidth

The bandwidth is the frequency range each chirp covers. Decreasing this value increases the data rate, lowers transmit power consumption, but requires better oscillator tolerances between units. Frequency tolerances are typically ±25 % of this bandwidth to maintain a packet error rate below 10 %.

Spreading Factor

The spreading factor is the number of RF chirps per symbol (encoded 4-bit data packet). Increasing this value makes the data more resistant to noise but lowers the data rate.

Coding Rate

The coding rate is the total number of bits in encoded symbol—4-bit data packet plus bits added as a forward error correction. Increasing this value increases reliably while decreasing the data rate.

Sync Word

The sync word can be used to isolate groups of LoRa devices. For instance if more HAB modules are installed on a flight train than device IDs (A-Z) permit then two groups, each with their own 'gateway' HAB module, could be created by using different sync words. Note that there are some restrictions on valid sync words, for instance 0x34 is reserved for LoRaWAN.

Power

This is the transmit power level, in decibel-milliwatts. Its range spans transmit powers of approx 20 uW (-17 dBm) to 150 mW (22 dBm).

Preamble

The preamble is used to detect the start of a data packet. It is the number of symbols that a long constant chirp is transmitted prior to data being sent to alert and allow the receive to achieve lock. Increasing this value increases the time on air.

Gain

A value of 0 will permit the LoRa radio to use automatic gain control. In most circumstances this is best.

State

This is an internal bit-mask value that controls the following:

0. Transmit Enabled → Enable LoRa TX echoing from BLE/UART

1. Receive Enabled → Enable LoRa RX echoing to BLE/UART

2. Send Reply Messages → TX device reply messages over LoRa

3. Forward Other Messages → TX received messages over LoRa

4. Forward My Messages → Also TX messages that match device ID over LoRa

5. Forward Reply Messages → Also TX reply messages that match device ID over LoRa

There are two preset options for State:

- Device → State = 7 → Tx & Rx enabled, send reply messages

- Gateway → State = 15 → Tx & Rx enabled, send reply messages, and forward other messages

Note: some care and experimentation with these settings may be required to avoid creating an echo chamber between multiple modules.

Additional LoRa Resources

See: https://www.semtech.com/products/wireless-rf/lora-tranceivers/sx1262#download-resources

LoRa Country Restrictions

Frequencies, transmit power, and duration restrictions vary from country-to-country. Below are the basic restrictions of two common regions.

Region	North America	Europe
ISM Band	902-928 MHz	863-870 MHz
Regulated by	FCC	ETSI
TX Restriction	400ms tx time	Generally 1% tx duty-cycle
Payload sizes	11 – 242 bytes	51 – 242 bytes
Spreading factors	7 – 10	7 – 12
Data rates	1 – 12.5 kbps	0.3 – 5.5 kbps
Max transmit power	21 dBm	Generally 14 dBm

Spreading Factor & Bandwidth	Transmit Data rate	Maximum Payload Size	
		North America	Europe
SF_8 500kHz(AT+SENDH)	12.5 kbps	242 bytes	-
SF_7 125kHz	5.47 kbps	242 bytes	242 bytes
SF_8 125kHz	3.125 kbps	129 bytes	242 bytes
SF_9 125kHz	1.76 kbps	53 bytes	115 bytes
SF_10 125kHz	0.98 kbps	11 bytes	51 bytes
SF_11 125kHz	0.44 kbps	-	51 bytes
SF_12 125kHz	0.25 kbps	-	51 bytes

From Differences Between North America & Europe

Note: All HAB Module messages are ≤ 50 bytes with the exception of displaying the system log (`!iSL`) which can only be transmitted over the BLE or UART interfaces.

Consumables

Batteries

The *HAB Venter* has been designed to use primary lithium batteries in the 'AAA' size. The Lithium/Iron Disulfide (Li/FeS2) chemistry has proven to work well, even at the low temperatures experienced on balloon flights. Possible suppliers of these batteries include:

- Energizer Ultimate Lithium L92 AAA Battery

While the *HAB Venter* will operate on standard alkaline batteries, it is strongly recommended against using them during flight due to their poor performance at cold.

Line

The *HAB Venter* burn-wires have been designed to cut 50# Dacron fishing line. Below are some of the rigging line options that we have used and liked. The Nano cord holds knots well and comes in a wide variety of colors.

Atwood Rope Nano Cord: https://atwoodrope.com/collections/nano-cord

Green-Spot Dacron Fishing Line. Some manufacturers include: Izorline or Cortland

Burn-Wire

The burn-wire used on the *HAB Venter* can normally be expected to last between one at twenty activations. After which time, it will need to be replaced. Replacement burn-wire was included at time of purchase. If additional burn-wire is required, please contact Balloon Ascent Technologies, LLC.

Replacement instructions:

1. Loosen the two nuts (use 5/32" or 4 mm socket) holding the wire.
2. Remove the pieces of broken wire.
3. Finger-tighten the nuts down, then loosen approximately 1-turn so that a gap just big enough for the wire exists between the nut and washer.
4. Stretch the new wire between the two posts as shown below:

5. Wrap each end of the new wire in a clock-wise direction around each post. The wrap should end at least 180° and no more than 270° from where it started on each post.
   - Limiting to one wrap will prevent the wire from breaking as nuts are tightened.
   - The direction ensures that the wire will be tightened as the nuts are tightened.
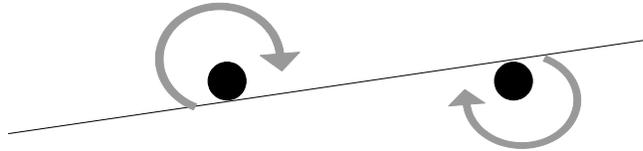
6. Carefully tighten the nuts back down onto the wire.
   - Excessive torque may break the newly installed burn-wire.
7. Trim the excess wire as close to the nuts as possible.

Burn-wire test
1. Insert a battery and wait until the Status LED stops flashing
2. Command a separation (iVS=Y)
3. Once the replaced burn-wire is glowing, further carefully tighten down on the nuts holding it.
   - This will ensure that the wire is fully stretched tight, even when it heats up.

Mechanical Orientation:
   The burn-wire should go between the washer and the brass nut. Vertically it should be, from top-to-bottom:
   1. Brass nut
   2. Burn-Wire
   1. Brass nut
   1. Brass nut
   2. PCB

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Inflation Sleeve

The *HAB Venter's Inflation Sleeve* is a ground device that allows for quick balloon inflation through a valve that is already fitted on the balloon's neck. It is a thin-walled tube that seals onto the HAB Venter on one end and with a hose-barb on the other for connecting to the lift-gas manifold via a hose.

Usage Overview:

1. Install the HAB Venter and Balloon Spindle onto the balloon

2. Disconnect the flight-line from the valve

3. Attach the temporary retaining line around the Balloon Spindle

4. Slide the *Inflation Sleeve* up over the *HAB Venter*

   1. Ensure the *HAB Venter's* flight-line connection sits inside of the *Inflation Sleeve*

   2. Ensure the *Inflation Sleeve* rides up over the sealing ridge

5. Command the valve open

6. Inflate balloon to desired point

7. Command the valve closed

8. Slide the *Inflation Sleeve* off of the *HAB Venter*

9. Reconnect the flight-line to the HAB Venter's flight-line connection

10. Remove the temporary retaining line

Safety Precautions and Recommendations

Regulatory

Always adhere to the regulations governing high-altitude ballooning applicable in the country of operation. In the United States, high-altitude balloon flights are governed by "FAA Part 101".

Falling Payload Hazard

Always clear the launch area prior to launch. While unlikely, balloon or line failure after release may result in a falling payload impacting the ground before the parachute fully deploys.

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