ANT61 PTY LTD
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Beacon S

Datasheet

Hardware revision: F, Document revision date: 07.03.2025

Application

The Beacon is designed to provide a way to restore the normal operations of a satellite in the event of partial failure or anomaly. It independently collects and transmits satellite health data (telemetry), primarily for anomaly root cause analysis. This device has an independent power supply (batteries), an attitude determination system, and a GNSS module for precise orbital parameter estimation. It also provides a 2-way continuous connection to mission control.

The Beacon allows the satellite operations team to receive a constant stream of telemetry. It has been specifically designed to function during operational anomalies and outside of the normal operating conditions for the LEO satellites, providing a backup communication system that can be used for critical satellite firmware updates and regaining control of the satellite.

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Features

- Real-time[1] 24/7 telemetry independent of the orbital position or attitude control
- Designed to operate for up to 1 week after the main satellite bus failure
- Can sustain micro-debris collision
- Supports all common satellite internal networks (USART, CAN-FD, SPI, I2C)
- Can connect directly to satellite components
- Can send commands to the onboard computer and send back responses
- Can be used to update firmware on microcontrollers and OS-based OBCs
- All communication packets to and from the satellite bus are hardware-encrypted (AES 256-bit)
- ANT61 provides a real-time command and control interface for the customers, where commands remain cryptographically opaque to ANT61 and intermediaries
- Beacon is made in Australia, which means **light-weight export controls (**non-ITAR), and it doesn't require a separate spectrum license for data exchange[2]
- Tested in space in February 2024
- Compatible with CubeSat, PC/104 with additional compatibility with Pumpkin stack

[1] 5 to 10 seconds delay between the transmission of the message and its availability for consumption in the ANT61 real-time telemetry API.
[2] Beacon uses inter-satellite links for communication with RF license held by the constellation operator (Iridium)

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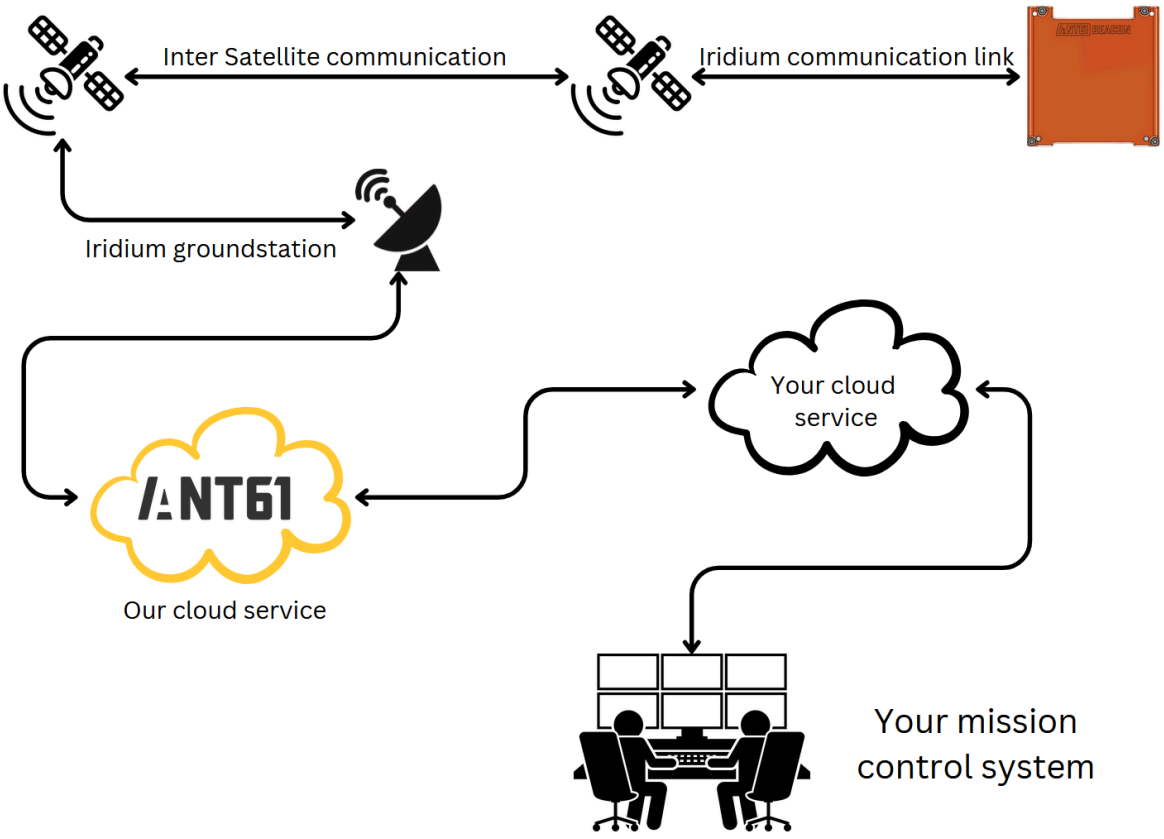
Operational description

Typical operation

The Beacon collects data from its internal sensors, subsystem and the satellite bus and then sends it over a real-time link to the satellite operator's mission control software.
The Beacon also accepts commands to be sent to the satellite bus to enable the operator's team to control their satellite via the Beacon.

Operations overview

The Beacon users use relay constellations (inter-satellite links) to establish a continuous, two-way connection between your satellite in orbit and mission control software on the ground. This connection is then used to send Beacon telemetry as well as satellite telemetry and commands.



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Minimal integration

The Beacon needs direct access to the following:

- Satellite deployment switch in order to begin active operation right after the deployment
- Main power line to monitor the characteristics of the line that can be crucial in anomaly detection
- At least one (strongly recommended two) L1 antenna positioned on the side of the satellite that will be facing away from the Earth (towards higher orbit)

Recommended integration

In order to maximise the utility of the Beacon as a means to restore the normal operation of a failed satellite, the following additional integration is highly recommended:

- Access to the internal satellite bus network to collect additional telemetry data and provide a way for the satellite operator to interact with the satellite bus via the Beacon
- Integrated support for the satellite's flight computer firmware/software update. Most of the satellites can be restored after an anomaly by a software update.
- Direct redundant data lines to the critical satellite components (see Connectivity section)
- Direct access to de-orbiting hardware (thruster, dragsail, EM tether, etc) to allow the customer to de-orbit their satellite if it's impossible to recover from a failure and the onboard computer is damaged and is unable to control this hardware.

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Maximum ratings

Parameter	Value	Units
Operating temperature	-40 to +70	ºC
Shock	10	g
Voltage on the power line	3.5 to 36	V
Voltage on +3.3V IO lines	+2.9 to +3.6	V
Highest supported orbit	700	Km
Design life in LEO	6	years

Physical characteristics

Parameter	Comments	Value	Units
Mass	Without cables	275	g
Height		24.0 ± 0.2	mm
Width		90.2 ± 0.2	mm
Length		95.9 ± 0.2	mm
Compatibility	The corner hole pattern and connector placement match PC/104		

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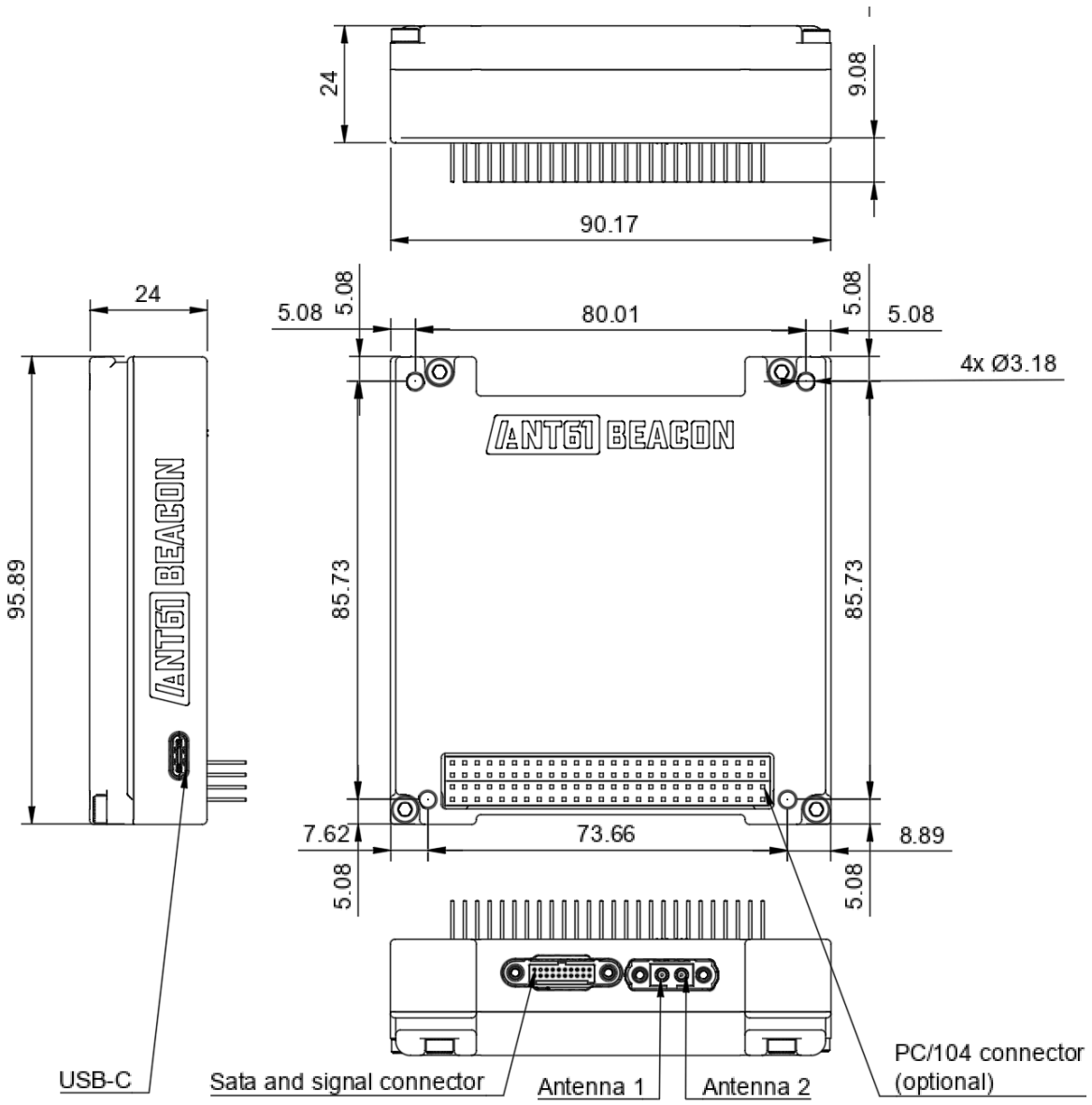
Mechanical layout



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Matching connectors and cabling

Antennas

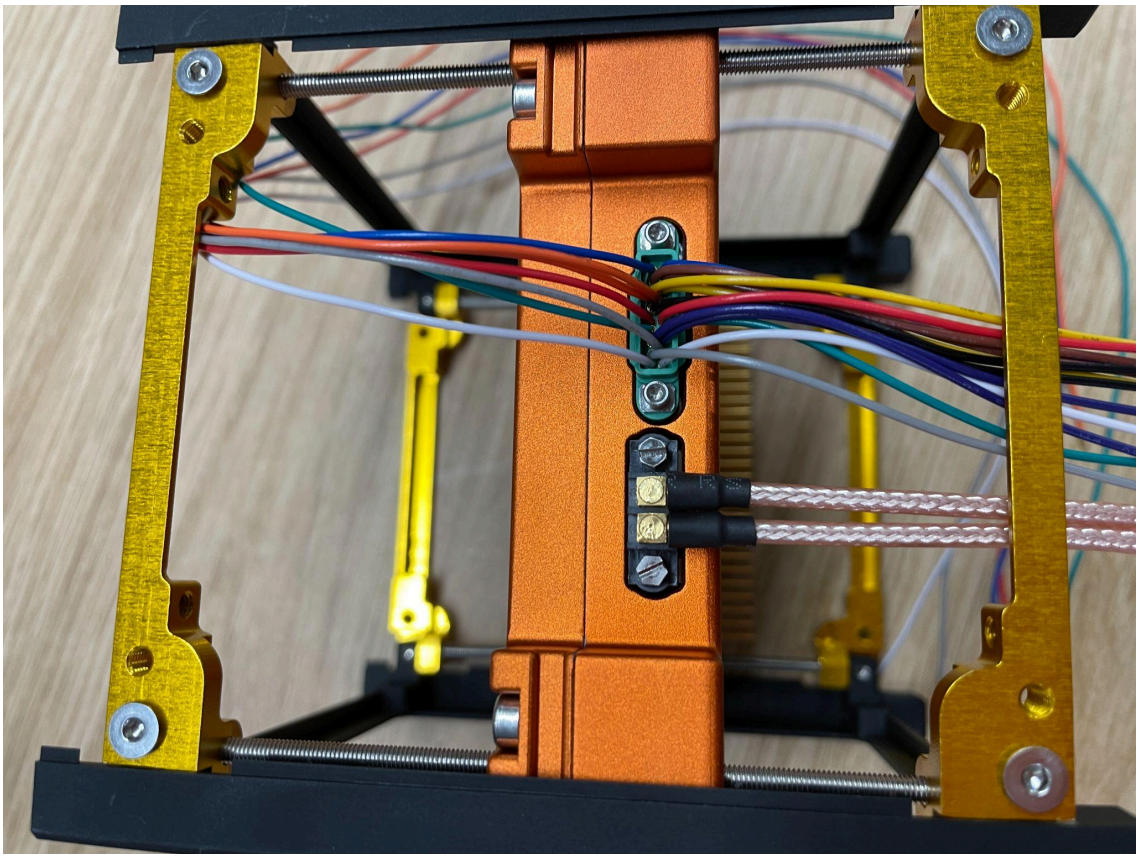
The matching connector for dual antenna coax lines is Harwin M80-FC305F1-02. The right-angle version is highly recommended for easier cable management.

Power and data

A PC104 connector can connect the Beacon to the CubeSat stack; however, a cable connection is preferred. The recommended matching connector for the cable is G125-2242096F1.
PC104 connector can be removed if not in use.

Cable management

It's recommended to run the cables between the plates using right-angle cable connectors for antennas, as shown in the photo below.



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Electrical characteristics

Parameter	Comments	Value	Units
Operating power consumption	Beacon works from the internal battery under normal operation	0	W
Charging power consumption	Charging is controlled by the satellite bus	4.20 to 5.0	W
USB-C bus current	When powered over USB-C	2.5	A

Radio characteristics

Parameter	Comments	Value	Units
Certification	Contains FCC, ICES and IC-certified transceiver		
Frequency Range	Transmission	1,616.0 to 1,626.5	MHz
Frequency Range	Reception	1,559.0 to 1,626.5	MHz
Input/Output Impedance		50	Ohm
Max Cable loss permitted		2	dB
Max antenna gain		3	dBi
Average RF power output		0.5	W
Peak RF power output		1.5	W

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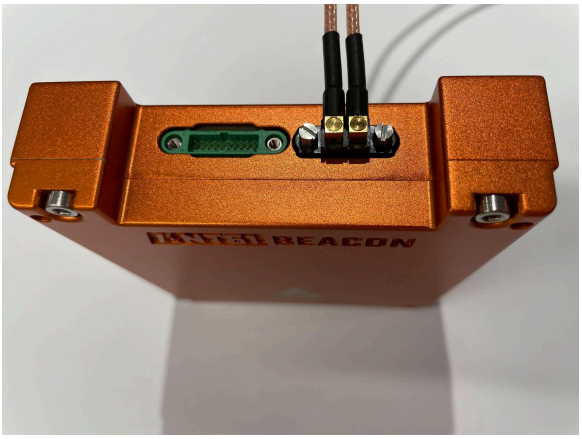
Connectors

Antennas

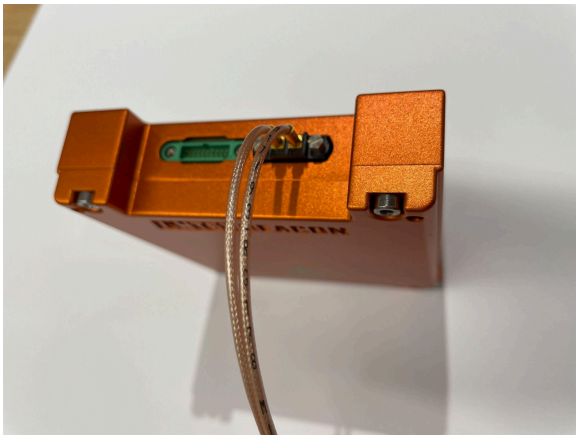
The Beacon supports up to two L1 antennas for data transmission and reception. It is recommended that both antennas are placed at opposite sides of the spacecraft with a clear view of higher orbit. The Beacon is using a male Harwin Datamate 2-coax contact connector for the antenna connection. The matching cable connector housing part is M80-263F102-00-00 and can be used with different female coax contacts depending on the type of cable used and the desired cable orientation (see the table below for more information). Most of the Cubesat integrations use **right angle** contacts to minimise the cable bending and simplify the harnessing. This allows coaxial cables to route up or down, depending on the contact orientation.

Cable type and orientation	RG178	RG174, RG179, RG316	UT047
Right angle	M80-308	M80-309	M80-310
Straight	M80-305	M80-307	N/A

Right angle



Straight



20-pin Harwin Gecko connector (preferred)

The Beacon has a male 20-pin cable connector recommended as a primary way of integrating with the satellite bus and subsystems. The matching cable connector housing part is G125-2242096F1, with female contacts depending on the preferred wire gauge: G125-0020005 for 28-32 AWG and G125-0010005 for 26 AWG. See the Pinout section for more details about peripheral connection options.

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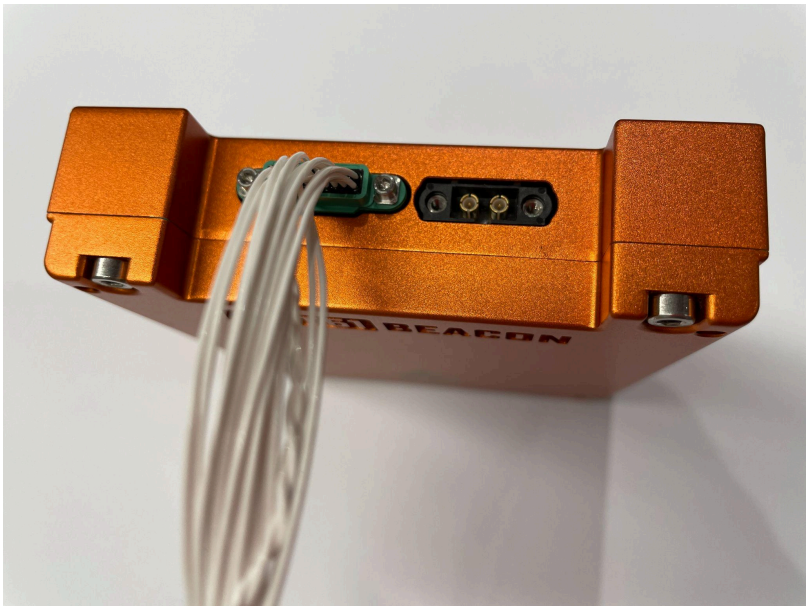

104-pin connector (optional)

The Beacon has a 104-pin connector, compatible with the PC/104 standard.
It consists of SAMTEC-ESQ-126-39-G-D and supports board stacking.

USB-C connector

For easy integration, the Beacon provides one USB-C port for charging the Beacon and isolated functional testing prior to full integration into the satellite bus.

Satellite bus connectivity options

Beacon provides the following connectivity options that can be set up to maximise compatibility with the satellite bus. All data lines have ESD protection.

USART

External devices can be connected via double-redundant USART lines

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CAN-FD

The Beacon can be connected to one CAN-FD network with bandwidth up to 5Mbit/s

SPI

Up to 5 SPI devices can be connected with a bandwidth of up to 50Mbit/s

I2C FM+

Up to four I2C devices can be connected with bandwidth up to 1Mbit/s

GPIO

Up to 13 general-purpose digital I/O pins can be configured for connection to various devices and sensors

Analog IO

Up to 8 analog I/O pins can be configured for integration with external devices.

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Connectors pinout

20-pin connector pinout

The 20-pin connector has two types of pins

- Fixed pins (**marked in red**) — is set and can not be changed without hardware modification (such modification is possible, but will add 8 weeks to the lead time and may incur additional cost)
- Flexible pins (**marked in blue**) — can be adjusted based on your connectivity preferences without any increase in lead time or cost

The pin number corresponds to the G125-2242096F1connector datasheet.

Default pinout

Pin	Function	Pin	Function
1	I2C_A_SDA	11	SPI_A_MOSI
2	I2C_A_SCL	12	SPI_A_MISO
3	GPIO_A	13	SPI_A_CSK
4	USART_A_TX	14	SPI_A_NSS
5	USART_A_RX	15	GPIO_B
6	Ground	16	Shutdown signal input 3.3V
7	Deployment Switch (normally closed)	17	CAN_FD_L
8	N/C (floating)	18	CAN_FD_H
9	Ground (supply return) 0V	19	Ground (supply return) 0V
10	Supply +3.5V to +36V	20	Supply +3.5V to +36V

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UART-maximising variant

Pin	Function	Pin	Function
1	I2C_A_SDA	11	USART_B_TX
2	I2C_A_SCL	12	USART_B_RX
3	GPIO_A	13	USART_C_TX
4	USART_A_TX	14	USART_C_TR
5	USART_A_RX	15	GPIO_B
6	Ground	16	Shutdown signal input 3.3V
7	Deployment Switch (normally closed)	17	CAN_FD_L
8	N/C (floating)	18	CAN_FD_H
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I2C-maximising variant

Pin	Function	Pin	Function
1	I2C_A_SDA	11	I2C_B_SDA
2	I2C_A_SCL	12	I2C_B_SCL
3	GPIO_A	13	I2C_C_SDA
4	USART_A_TX	14	I2C_C_SCL
5	USART_A_RX	15	GPIO_B
6	Ground	16	Shutdown signal input 3.3V
7	Deployment Switch (normally closed)	17	CAN_FD_L
8	N/C (floating)	18	CAN_FD_H
9	Ground (supply return) 0V	19	Ground (supply return) 0V
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Custom variant

If you are after particular connectivity options, we can customise the pinout for you based on the connectivity options.

Pin	Function	Pin	Function
1	Custom	11	Custom
2	Custom	12	Custom
3	Custom	13	Custom
4	Custom	14	Custom
5	Custom	15	Custom
6	Ground	16	Shutdown signal input 3.3V
7	Deployment Switch (normally closed)	17	CAN_FD_L
8	N/C (floating)	18	CAN_FD_H
9	Ground (supply return) 0V	19	Ground (supply return) 0V
10	Supply +3.5V to +36V	20	Supply +3.5V to +36V

104-pin connector pinout

In the default configuration, all 104 pins are set as feed-through, connecting each pin from the component above the Beacon to the corresponding pin at the component below the Beacon.
If you want to use the 104-pin connector, we will customise the Beacon to use your existing pinout for the 104-pin stack. This customisation incurs no additional cost but adds 8 weeks to the lead time.

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Telemetry

Data collected by the Beacon

The Beacon uses built-in hardware to collect a range of data, including orbital parameters, attitude information, collisions, vibrations, temperature and power bus characteristics. When connected to the satellite bus, it also gathers telemetry from the bus itself and the devices it's integrated with.

Data provided by the Beacon to the satellite

If required, the Beacon can provide raw data from GNSS, such as NMEA messages, PPS, accurate time, current orbit parameters and attitude.

Data security

ANT61 takes utmost care when dealing with the customer's data processed by the Beacon. The data is encrypted and protected from interference throughout the whole transmission process.
The Beacon uses an inter-satellite Iridium network that uses FIPS-140-2 and ASC22FO encryption, protected against interference and is currently used[3] by the US DoD and the US Government for transmission of sensitive data. On the ground, there is a secure connection between the Iridium network and ANT61 infrastructure secured by Amazon Web Services. In addition, all customer-originated or customer-terminated data is encrypted with hardware encryption on the Beacon and is only accessible to the customer, remaining completely opaque to the ANT61 team.

Data integrity

ANT61 uses multiple redundant layers of storage and telemetry processing, ensuring that no message is lost even in a catastrophic event.

Missing anything?

We're happy to provide more information about the Beacon.
Contact us at enquiries@ant61.com or via the form at https://ant61.com/beacon

[3] See Iridium for National Security for more details