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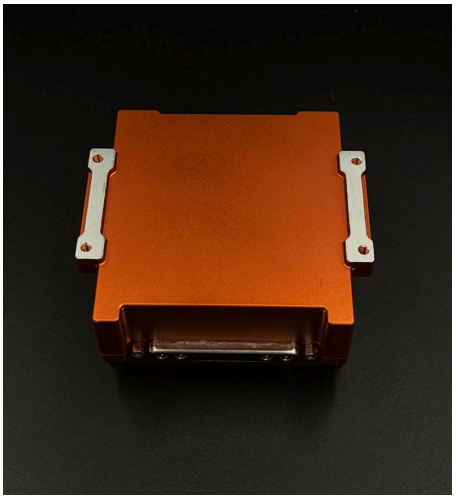
Beacon M

Datasheet

Hardware revision: A, Document revision date: 20/01/2025



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 telemetry stream. 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.

For cable selection/manufacturing assistance, additional connectivity options (Ethernet, Spacewire, etc.), CAD models, or additional information, contact us at enquiries@ant61.com

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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 3 weeks after the main satellite bus failure
- Can sustain micro-debris collision
- Supports all common satellite internal networks (USART, CAN-FD, SPI, and I2C)
- Can connect directly to satellite components
- Can send commands to the onboard computer and send back responses
- It 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]
- TRL-7 from February 2024, TRL-9 in Q4 2025

Operational description

Typical operation

The Beacon collects data from its own internal sensors and satellite subsystem as well as telemetry coming from the OBC and then sends this data over 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.

[1] 5 to 10 seconds delay between the transmission of the message and it's 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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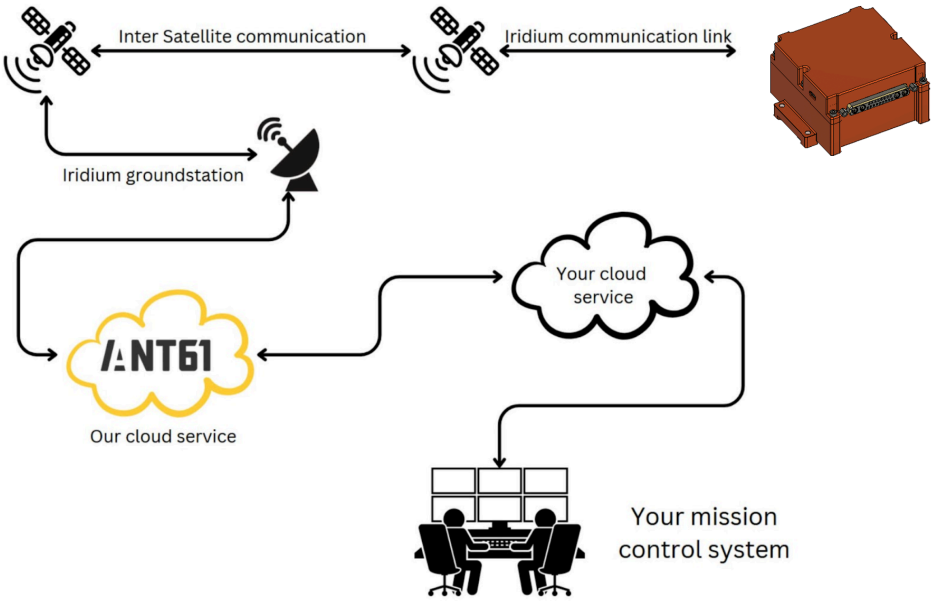
Operations overview

The Beacon users use relay constellation(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.



Minimal integration

The Beacon needs direct access to the following:

- Satellite deployment switch (Normally Closed) in order to begin active operation right after the deployment and satisfy launch provider requirements
- Main power line to monitor the characteristics of the line that can be crucial in anomaly detection
- At least two (and up to four) L1 antennas positioned on the opposite sides of the satellite that will be facing away from the Earth (towards higher orbit or horizon)

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 satellites can be restored after an anomaly by a software update.

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- Direct redundant data lines to the critical satellite components (see Connectivity section)
- Direct access to de-orbiting hardware (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	-45 to +70	ºC
Shock	10	g
Voltage on the power input line	3.5 to 56	V
Voltage on +3.3V IO lines	+2.9 to +3.6	V
Highest supported orbit	700	Km
Design life in LEO	7	years

Physical characteristics

Parameter	Comments	Value	Units
Mass with half battery stack		1,000	g
Mass with full battery stack		1,500	g
Height		51.0 ± 0.2	mm
Width		96.0 ± 0.2	mm
Length		110.0 ± 0.2	mm

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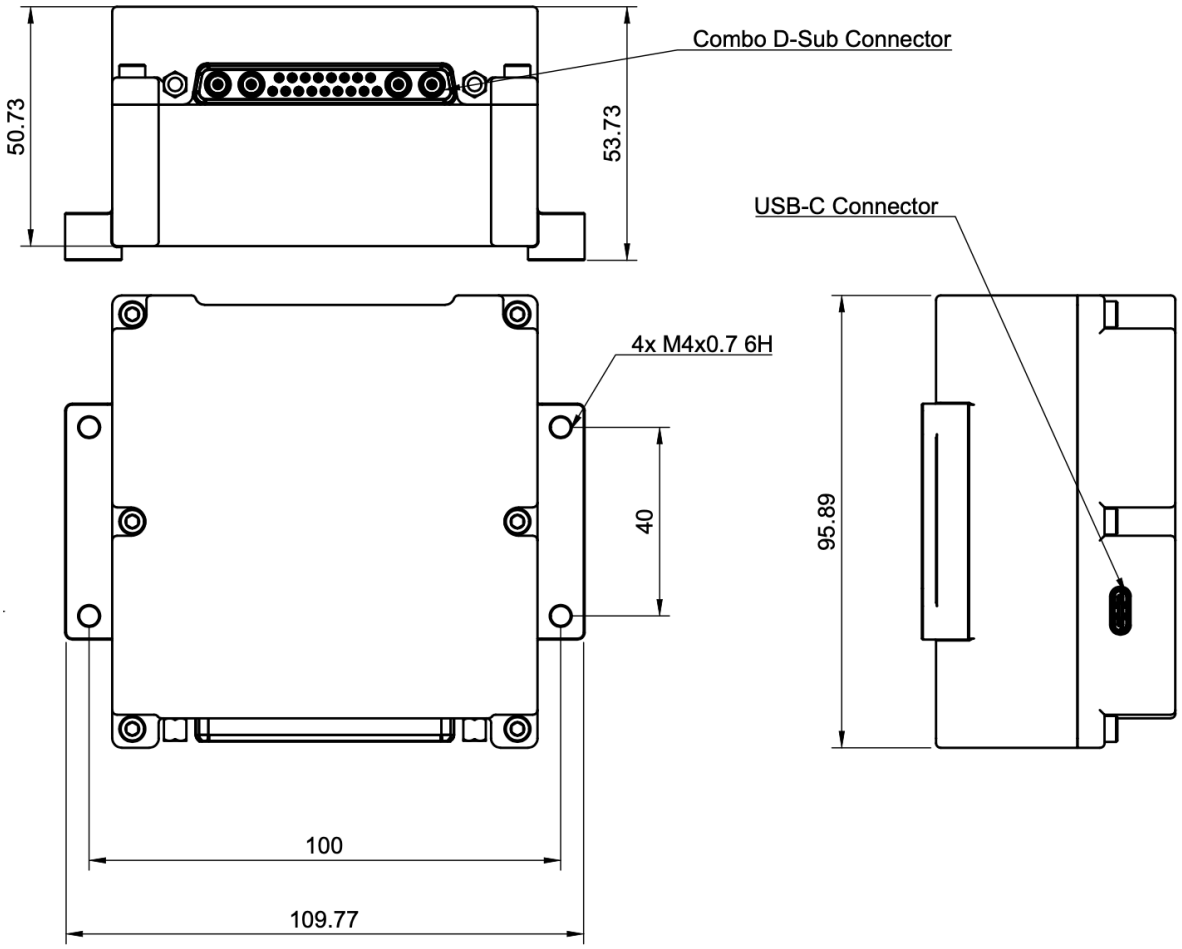
Mechanical layout



Matching connectors and cabling

Combo D-Sub connector

The Combo D-Sub connector is used to connect antennas, power and data lines.
Any male 21W4 D-Sub connector with 50Ohm coaxial contacts can be used, for example, Norcomp 682M21WA4PL001.

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USB-C connector

The USB-C umbilical connector is used for ground testing and allows your team to start using the Beacon the day it is delivered. The Beacon operation logs can be accessed via USB-C via serial interface. Additionally, the Beacon can be charged via the USB-C port as well.

Connectors pinout

Combo D-Sub connector

The Combo D-Sub connector has four coaxial contacts that are used for antenna connection and 17 signal and power pins that are divided into two groups:

- The function of the 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)
- The function of the 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	SPI_A_MOSI	10	I2C_A_SDA
2	SPI_A_MISO	11	I2C_A_SCL
3	SPI_A_CSK	12	CAN_FD_L
4	SPI_A_NSS	13	CAN_FD_H
5	Ground	14	Ground (supply return) 0V
6	USART_A_TX	15	Ground (supply return) 0V
7	USART_A_RX	16	Supply +3.5V to +56V
8	Deployment Switch (normally closed)	17	Supply +3.5V to +56V
9	Shutdown signal input 3.3V	shell	Ground

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UART-maximising pinout with PPS

Pin	Function	Pin	Function
1	USART_B_TX	10	I2C_A_SDA
2	USART_B_RX	11	I2C_A_SCL
3	GPIO A	12	CAN_FD_L
4	PPS	13	CAN_FD_H
5	Ground	14	Ground (supply return) 0V
6	USART_A_TX	15	Ground (supply return) 0V
7	USART_A_RX	16	Supply +3.5V to +56V
8	Deployment Switch (normally closed)	17	Supply +3.5V to +56V
9	Shutdown signal input 3.3V	shell	Ground

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	10	Custom
2	Custom	11	Custom
3	Custom	12	CAN_FD_L
4	Custom	13	CAN_FD_H
5	Ground	14	Ground (supply return) 0V
6	Custom	15	Ground (supply return) 0V
7	Custom	16	Supply +3.5V to +56V
8	Deployment Switch (normally closed)	17	Supply +3.5V to +56V
9	Shutdown signal input 3.3V	shell	Ground

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Electrical characteristics

Parameter	Comments	Value	Units
Average power consumption	Beacon uses internal power management to smooth out peaks in consumption	3	W
Charging power consumption	Charging is controlled by the satellite bus	6	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		
Bandwidth (receiving from mission control)		2	kbps
Bandwidth (sending to mission control)		2	kbps
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		0.6	W
Peak RF power output		7	W

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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 three double-redundant USART lines

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

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

Analog IO

Two analog I/O pins can be configured for integration with external devices.

Telemetry

Data collected by the Beacon

The Beacon collects the orbital parameters and attitude information, as well as collisions, vibrations and temperature, and characteristics of the power bus using built-in hardware. Additionally, when connected to the satellite bus, the Beacon can collect telemetry data from the bus and the individual devices it is integrated with.

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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