

 EFFORTECH TECHNOLOGY	ICON ST-0 User Manual	ELABORATED Beatriz Sabino	REV. 01
		APPROVED Giovanni Maciel	PAG 1/17 DATE 06/07/22

User Manual ICON ST-0

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 1/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Contents

1	Introduction	2
2	Product overview	2
2.1	Mainly advantages	2
2.2	Related documents	2
2.3	Physical specifications	2
2.4	Accessories	3
2.5	Environment	4
2.6	Connector	4
2.6.1	Part Numbers	4
2.6.2	Pinout	5
2.7	Cabinet	6
2.8	Assemble holes	7
2.9	Mass	8
3	Electrical specifications	8
3.1	Source interface	8
3.1.1	Load dump protection	8
3.1.2	Operational energy consumption	9
3.2	Serial interface	9
3.2.1	Baud Rate	9
4	Orientations referred to the coupling electric harness	10
5	Installation guide	10
5.1	Installer qualifications	10
5.2	IMEI	10
5.3	Choosing the assemble place	11
5.4	Assembling ICON ST-0	12
5.4.1	Fixation base	12
5.4.2	Cabinet fixation on the base	13
6	Connection flow and MO messages sending	14
7	Appendixes	15
7.1	Appendix A: Effortech's standard coupling electric harness	15
8	Modification Register	17

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 2/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

1 Introduction

Thank you for purchasing ICON ST-0.

In this manual you will find the procedures to correctly install and utilize ICON ST-0.

2 Product overview

ICON ST-0 is a bidirectional satellite communication device that allows remote asset to transmit and receive messages through satellites from all over the world. It uses Iridium™ low orbit constellation. It was idealized to work outdoor so the circular connector is waterproof and the cabinet has IP67 protection rate. The source voltage allowed is between 9 and 32 V making it possible to operate in automotive applications, agriculture, utilities, IoT and more. The device supports up to 340 bytes being sent of uplink to 270 of downlink, in other words, up to 340 bytes is for MO messages (originated by the module) and 270 bytes is for MT messages (sent to the module). The messages are directed to the Iridium™ Gateway that get connected safely with the application server. This device must be integrated to remote devices so it can control it with AT commands through RS232 serial interface. On the application side an IP connection is used with Iridium™ for the messages sending and receiving process. For more information regardless AT commands and how applications can get integrated with ICON ST-0 go to section 2.2.

2.1 Mainly advantages

The mainly advantages of utilizing ICON ST-0 are:

- IP67 protection rate cabinet;
- Sturdy voltage source protected against Load Dump;
- Low latency because a low orbit constellation is used;
- Anatel homologation.

2.2 Related documents

1. Iridium Short Burst Data Service Developers Guide - MAN0025;
2. ISU AT Command Reference - MAN0009 Version 5.

2.3 Physical specifications

In Fig. 1 is possible to see how the ICON ST-0's top and side view are like when is already base fixed.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 3/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Figure 1: ICON ST-0



2.4 Accessories

ICON ST-0 comes with some accessories so the base assemble can be done. See section 5 for more details on the installation process.

In Fig. 2 the complete kit is shown with the accessories that come along with ICON ST-0:

- 1 fixation sabe
- 1 cabinet's box and accessories
- 1 ICON ST-0 cabinet
- 1 connector counter part
- 3 fixation screws
- 3 screw hole covers
- 2 extra tags with module information

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 4/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Figure 2: ICON ST-0 complete kit



2.5 Environment

The environment conditions so the ICON ST-0 can be operated are listed in the following table.

Table 1: Operating Conditions - Environment

Parameter	Value
Operational temperature	-20 a +85°C
Dust and water ingress	IP67

2.6 Connector

2.6.1 Part Numbers

In Fig. 3 there is a sealed circular connector (male) M16 with 10 pins (LLT, Shenzhen Lilutong Connector). The part numbers can be seen in table 2 and also the recommended coupling connector.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 5/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Table 2: Connector specification

Parameter	Value
Connector type	M16 - 10 gauges (male)
Connector's part number	LLT-M16-05010M2861
Coupling connector	M16 - 10 pin (female) IP67
Recommended part number	LLT-M16-05010F1051

2.6.2 Pinout

The pin positions can be seen in fig. 3 and the pin descriptions are in the following table.

Figure 3: Male connector pin position

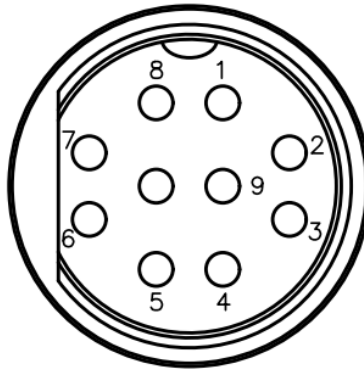


Table 3: ICON ST-0 pinout

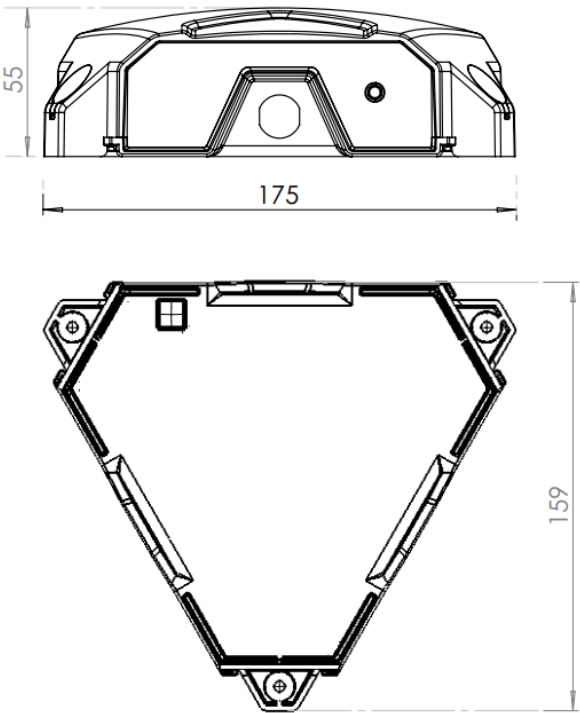
Pin	Signal	Signal direction	Description
1	RX-RS232	Input	Serial communication input
2	TX-RS232	Output	Serial communication output
3	-	-	-
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	-
9	GND	Input	Reference signal
10	VBAT	Input	9V-32V

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 6/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

2.7 Cabinet

In fig. 4 and table 4 is the ICON ST-0 cabinet dimension sketch along with its fixation base.

Figure 4: Side and bottom views



	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 7/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Figure 5: Cabinet side view with the fixation base

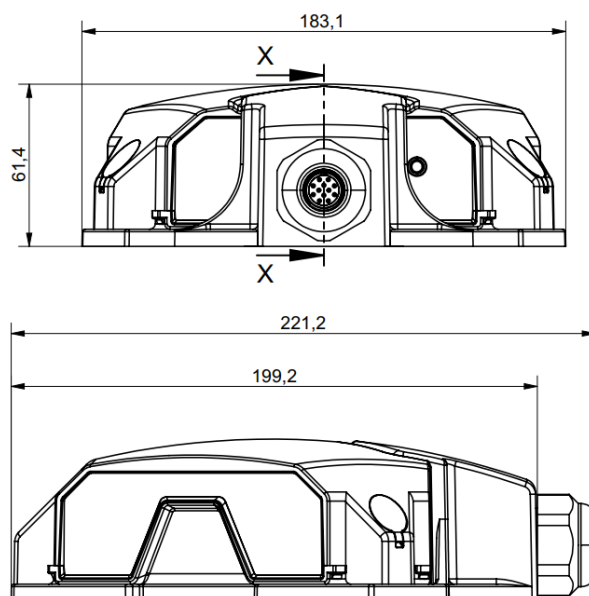


Table 4: Cabinet specifications

Parameter	Value
Length	159mm
Width	175mm
Height	55mm

2.8 Assemble holes

There are 3 holes on the ICON ST-0 extremities for the cabinet to be coupled on the fixation base. In the Table 5 there are the assemble hole specifications and the recommended fixation screw.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 8/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Table 5: Assemble hole specifications

Parameter	Value
Screw hole diameter	4mm
Screw head clearance diameter	8mm
Hole length	23,7mm
Remommended screw	Stainless steel M4 Allen Cylindrical Head Screw X 8mm

2.9 Mass

ICON ST-0 mass specifications are in the following table.

Table 6: Mass specifications

Parameter	Valor
Main module mass	376g($\pm$ 0.5g)
Fixation base mass	144g($\pm$ 0.5g)
Set mass	520g($\pm$ 0.5g)

3 Electrical specifications

3.1 Source interface

Table 7: Source specifications

Parameter	Value
Input range	9-32V DC
Protection against reverse bias	40V DC

3.1.1 Load dump protection

The voltage source has protection against Load Dump according to the norm ISO 7637-2:2004 – Pulso 5.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 9/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

3.1.2 Operational energy consumption

Table 8: Operational energy consumption

Parameter	Value
Stand by (data reception)	~50mA
Transmission	Mean 150mA, peak 2A

3.2 Serial interface

The communication between the host device and ICON ST-0 is established through RS232 serial interface.

3.2.1 Baud Rate

The host device connected to the ICON ST-0 must have the baud rate configurations showed in the following table:

Table 9: Baud rate configurations

Parameter	Value
Baud Rate	19200 b/s (default)*
Data Bits	8
Parity	None
Stop Bits	1

*Baud rate value can be changed using the **AT+IPR=<rate><autoflag>** command. If *autoflag* is 0, the automatic adjustment is disabled and if it is 1, it is enabled.

Table 10: **AT+IPR=<rate><autoflag>** command parameter

<rate>	Value
1	600 b/s
2	1200 b/s
3	2400 b/s
4	4800 b/s
5	9600 b/s
6	19200 b/s(default)
7	38400 b/s

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 10/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

4 Orientations referred to the coupling electric harness

ICON ST-0 kit comes with a connector's counter-piece which can be used for the manufacturing of a coupling electric harness. The electric harness that Effortech provides is a standard type of electric harness for aquisition according to the specifications in the apendice 7.1.

5 Installation guide

5.1 Installer qualifications

The installation must be done by a qualified installer.

5.2 IMEI

Before the installation, the ICON ST-0 IMEI number and its installing localization must be registered. The IMEI number is the ICON ST-0 network address and it is used for provisioning, charging, sending or receiving messages from the device or to the device. The IMEI number can be found in the tag that is under the cabinet (fig. 6).

Figure 6: IMEI tag



There are 2 more tags along with the IMEI number, it can be seen in Fig. 7. Therefore, if the device is installed in a place that the access is difficult or in a way that the tag is covered, those 2 extra tags can be fixated in a more accessible side where the IMEI number can be seen.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 11/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

Figure 7: Extra tags



5.3 Choosing the assemble place

The assemble place is a very important matter for the installation to be succeeded. The following orientations must be followed:

- The place must provide a safe installation.
- ICON ST-0 goal is not destined to work near people. You must always confirm if the device is assembled in a place that is more than 20cm far from people because of the conformity that established the RF exposure limits.
- The place chosen must be horizontal and flat if you want a ideal uniform performance of the satellite.
- Check if the assemble place has a clear and unblocked vision by 360 degrees sky related in all directions. Usually, it means to choose a assemble place in the top of an asset.
- Do not install ICON ST-0 inside a construction zone or on a metallic surface.
- Check if the assemble place does not heat the device in a way that the maximum operational temperature is exceeded. If the surface can become warm, specifically by the sun, a insulating material must be used between the assemble surface and ICON ST-0.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 12/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

- Never assemble ICON ST-0 near other devices or communication antennas.
- Never install ICON ST-0 in a place where water can be accumulated.

5.4 Assembling ICON ST-0

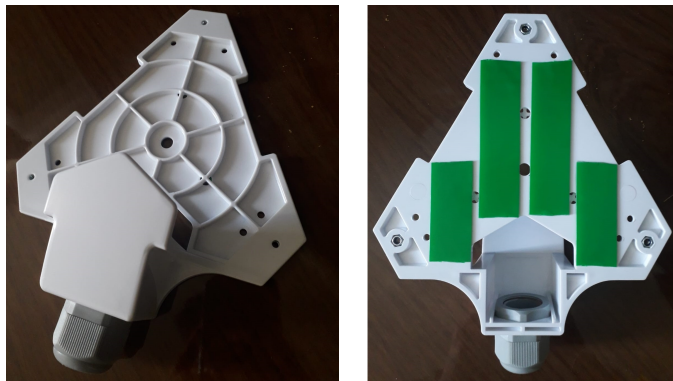
The assembling using double sided tape is for permanent installations. The device installed can't have the fixation base removed or the double sided tape removed without being damaged.

5.4.1 Fixation base

ICON ST-0 fixation base allows the cabinet to be removed if necessary and it does not impact the device's assurance.

Figure 8 represent ICON ST-0 fixation base.

Figure 8: Fixation base top and bottom view



- You must be sure of where the fixation base with the double sided tape is, the stability is permanent.
- Check if the assemble place is clean and flat making sure there aren't abrasions on the surface.
- Mark the fixation place and the edges to the wanted place for ICON ST-0.
- Clean with alcohol the assemble surface.
- Remove the plastic guides that cover the double sided tape.
- Carefully presses ICON ST-0 on the marked place.

If ICON ST-0 fixation base need to be removed does not remove it from the asset by force. Lifting or pulling it can damage the base and the surface assemble. It's recommended to remove the base sawing it with a fine wire so the double sided tape can be cutted.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 13/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

The recommended fixation method is the one that uses the double sided tape, but the device can also be fixated with strews, there are holes that allows that and the strew needed is one with 4mm of diameter.

5.4.2 Cabinet fixation on the base

- The cabinet is fixated on the base with the ICON PRO ST-I kit strews.
- Remember to pass the electrical whip through the fixation base with the screwing cable gland according to Fig. 9.
- After the screwing process, the kit's lids must be fitted in as in Fig. 10.

Figure 9: Fixation base with the uncouple cable gland



Figure 10: Base fixed cabinet with the lids



	ICON ST-0 User Manual	ELABORATED Beatriz Sabino	REV. 01 PAG 14/17
		APPROVED Giovanni Maciel	DATE 06/07/22

6 Connection flow and MO messages sending

It is necessary to send AT commands so ICON ST-0 does MO messages sending. The AT commands sending is done through configuration and connection serial sequence, signal check and message sending, following the flow that is illustrated below:

1. **AT&D0<CR>**: Disable flow control (highly recommended)
2. **ATE0<CR>**: Disable eco messages
3. **AT+CIER=1,1,0<CR>**: Enable event report indicator, 1 signal force bar and disable service availability report.
4. **AT+SBDAREG=1<CR>**: Automatic register mode
5. **AT+SBDMTA=1<CR>**: MT message alert (module destined)
6. **AT+SBDREG<CR>**: Begin register*
7. **AT+SBD0<CR>**: Clean MO messages buffer (modulo originated)
8. **AT+SBDWB=N<CR>**: Signalize message to be sent size **N** in bytes.
9. **N bytes X Y**: Message to be sent to the server along with the terminators where X and Y are, respectively, the bytes more and less significant of the N bytes sum (checksum).
Example: if the hexadecimal message is 74 65 73 74 65, the sum will be 225 and the X and Y bytes correspond to 02 and 25, respectively.
10. **AT+SBDIX<CR>**: Begin SBD extended session
11. **AT+CSQ<CR>**: Signal level requirement**

Every command answer is: **OK<CR>**.

The character **<CR>** is referred to the ASCII table carriage return, which its value in hexadecimal is 0x0D.

The messages 1 to 5 are the configuration ones, after its sending, Iridium™Gateway will start to report the signal level every time there is a changing through the answer **+CIEV:0,<rssi>**, where **<rssi>** is the signal level.

*After the configuration messages sending it is necessary to wait the signal level higher than 2 or equals 2 to return so the register process and the MO message sending can start.

**The signal level request command can be sent at any moment.

For more information about AT commands and its answers go to section 2.2.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 15/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

7 Appendixes

7.1 Appendix A: Effortech's standard coupling electric harness

The standard coupling electric harness for ICON ST-0 that is available for acquisition at Effortech is the **"EXTERNAL ELECTRIC HARNESS ICON 4 GAUGE 6.5M LLT"**, the specifications can be seen at Fig. 11, 12 and table 11.

Figure 11: Effortech's standard coupling electric harness ICON ST-0 pinout specifications

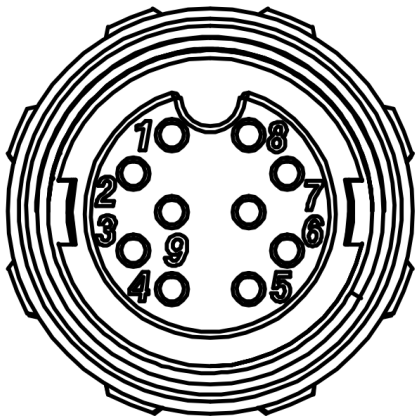
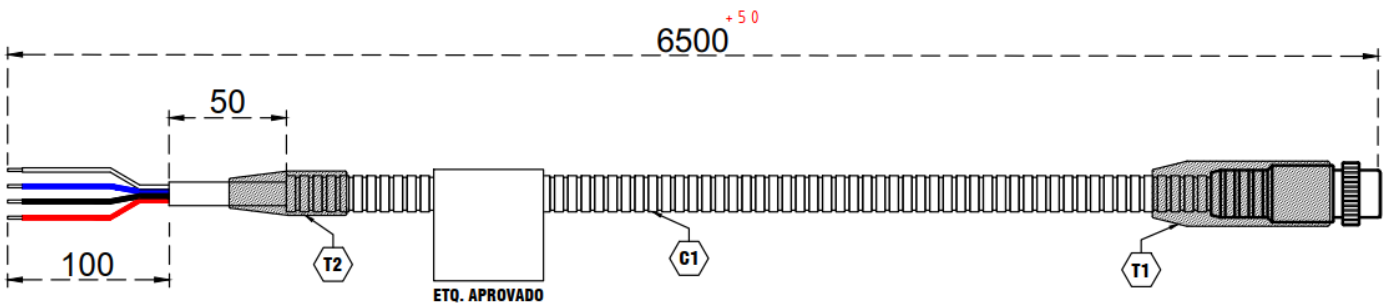


Figure 12: Effortech's standard coupling electric harness ICON ST-0 specifications



	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 16/17
		APPROVED Giovanni Maciel	DATE 06/07/22

Table 11: Effortech's standard coupling electric harness ICON ST-0 pinout description

CAV. A	COLOR	CIRC	END B	CAV. B
01	WHITE	RX-RS232 (input)	FREE END	-
02	BLUE	TX-RS232 (output)	FREE END	-
03	-	-	-	-
04	-	-	-	-
05	-	-	-	-
06	-	-	-	-
07	-	-	-	-
08	-	-	-	-
09	BLACK	GND	FREE END	-
10	RED	VBAT	FREE END	-

For more details about the technical specifications and standard electric harness price get in touch with Effortech.

	ICON ST-0 User Manual	ELABORATED	REV. 01
		Beatriz Sabino	PAG 17/17
		APPROVED	DATE
		Giovanni Maciel	06/07/22

8 Modification Register

Date	Modification	Person in charge
07/07/2022	Section 6 item 9 alteration and alteration at table 10.	Beatriz Sabino
17/05/2023	English translation	Lorena C. Carvalho