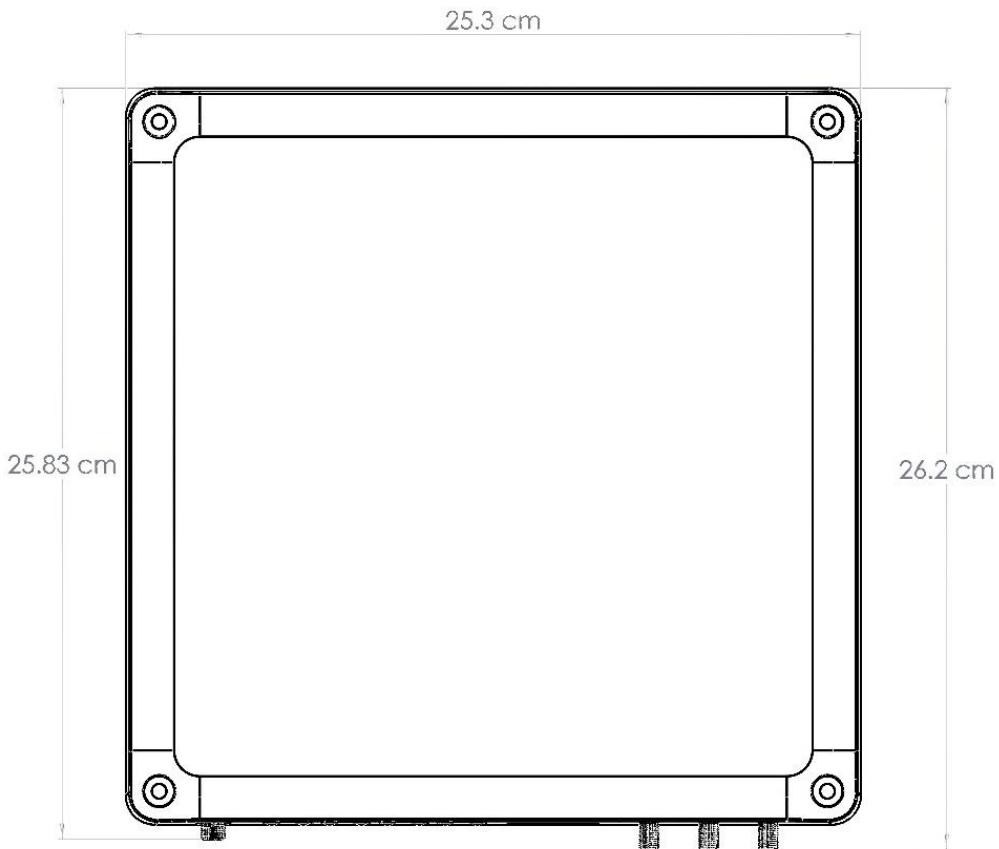


User Guide

SENSARRAY READERS (E3, ENTERPRISE, CORE)



Revision History

Version	Author	Date	Changes
1.0	J. Major	December 2017	Initial Document
2.0	J. Major	December 2018	Inclusion of Pro model
3.0	D. Stump	August 2021	Enterprise, CORE, reference documents
4.0	J. Major	August 2025	Enterprise 3 (E3)

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This equipment has been tested and found to comply 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.

Any change or modification to this product voids the user's authority to operate per FCC Part 15 Subpart A. Section 15.21 regulations.

Industry Canada Compliance

This device complies with Industry Canada License-exempt RSS standards. 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 has been designed to operate with a variety of different gain (dBi). The reader maximum output power is set by the gain of the antenna. Using an antenna having a higher gain is strictly prohibited per regulations of Industry Canada. In addition, using the reader at a power exceeding the maximum output power for a given antenna is also strictly prohibited. The required antenna impedance is 50 ohms. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

Conformité d'Industrie Canada

Cet appareil est conforme aux normes RSS exemptées de licence d'Industrie Canada. L'opération est soumise aux deux conditions suivantes: (1) cet appareil ne doit pas provoquer d'interférence et (2) cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil. Cet appareil a été conçu pour fonctionner avec une variété de gains différents (dBi). La puissance de sortie maximale du lecteur est définie par le gain de l'antenne. L'utilisation d'une antenne ayant un gain plus élevé est strictement interdite par règlement d'Industrie Canada. En outre, l'utilisation du lecteur à une puissance supérieure à la puissance de sortie maximale pour une antenne donnée est également strictement interdite. L'impédance d'antenne requise est de 50 ohms. Afin de réduire les interférences radio potentielles avec d'autres utilisateurs, le type d'antenne et son gain devraient être choisis de manière à ce que la puissance éloignée isotropiquement (EIRP) équivalente soit supérieure à celle requise pour une communication réussie.

Safety Recommendations

Reader antennas should be positioned so that personnel in the area for prolonged periods may safely remain at least 31 cm (12.2 in) in an uncontrolled environment from the antenna's surface. See FCC OET Bulletin 56 "Hazards of radio frequency and electromagnetic fields" and Bulletin 65 "Human exposure to radio frequency electromagnetic fields."

Sicherheitsempfehlungen

Reader Antennen sollten so positioniert werden, dass das Personal im Bereich über einen längeren Zeitraum kann sicher bleiben mindestens 31 cm (12.2 Zoll) entfernt von der Antenne Oberfläche, in einer unkontrollierten Umgebung. Siehe FCC OET Bulletin 56 "Gefahren der Radiofrequenz und elektromagnetische Felder" und Bulletin 65 "Human Exposition gegenüber hochfrequenten elektromagnetischen Feldern."

Product Compliance

FCC Notices

This equipment has been tested and found to comply 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.

Any change or modification to this product voids the user's authority to operate per FCC Part 15 Subpart A. Section 15.21 regulations.

1. 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.
2. These readers have been certified for use with an integrated flat antenna with a maximum gain of 8.5 dBic or an external flat antenna with a gain between 8 and 12.0 dBic.
3. The equipment provided with this product allow for transmission only in the frequency range 902.75 -927.25 MHz
4. The power for this device has been limited to <30 dBm after accounting for cabling loss.

Industry Canada Notices

This device complies with Industry Canada License-exempt RSS standards. 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.

1. The Enterprise and CORE are compliant with Industry Canada RSS-210.
2. This device has been designed to operate with a variety of different gain (dBi). The reader maximum output power is set by the gain of the antenna. Using an antenna having a higher gain is strictly prohibited per regulations of Industry Canada.
3. In addition, using the reader at a power exceeding the maximum output power for a given antenna is also strictly prohibited.
4. The required antenna impedance is 50 ohms.
5. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

Conformité d'Industrie Canada

Cet appareil est conforme aux normes RSS exemptées de licence d'Industrie Canada. L'opération est soumise aux deux conditions suivantes: (1) cet appareil ne doit pas provoquer d'interférence et (2) cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

1. L'SensArray doit être mis en oeuvre et maintenu par des professionnels.
2. L'SensArray est conforme à la spécification RSS-210 d'Industrie Canada.
3. Cet appareil a été conçu pour fonctionner avec une variété de gains différents (dBi). La puissance de sortie maximale du lecteur est définie par le gain de l'antenne. L'utilisation d'une antenne ayant un gain plus élevé est strictement interdite par règlement d'Industrie Canada.

4. En outre, l'utilisation du lecteur à une puissance supérieure à la puissance de sortie maximale pour une antenne donnée est également strictement interdite.
5. L'impédance d'antenne requise est de 50 ohms.
6. Afin de réduire les interférences radio potentielles avec d'autres utilisateurs, le type d'antenne et son gain devraient être choisis de manière à ce que la puissance éloignée isotropiquement (EIRP) équivalente soit supérieure à celle requise pour une communication réussie.

WEEE Directive

In accordance with the WEEE Directive (2002/96/EC), Enterprise and CORE is marked with the following symbol:



This symbol indicates that this equipment should be collected separately for the purposes of recovery and/or recycling.

(WEEE is an acronym for Waste Electrical and Electronic Equipment)

RoHS Declaration of Conformity

Enterprise and CORE meets the requirements of RoHS directive 2002/95/EC (RoHS 1), 2011/65/EU (RoHS 2) and 2015/863 (RoHS 10) on restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

UL Notice

Enterprise and CORE were safety tested and meets the requirements for UL 60950-1 This standard specifies requirements to reduce risks of injury for users who may come into contact with the equipment.

Date of Manufacture

Enterprise and CORE date of manufacture is controlled by serial number. Please contact SensThys helpdesk for information regarding serial number, format and date of manufacture.

SensArray, Enterprise, and CORE are registered trademarks of SensThys.

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CHAPTER 1 Introduction

Congratulations on your selection of a SensThys reader! We have designed this equipment to be the foundation of next-generation IoT RFID systems. This is a highly integrated solution that fully supports your system integration and operation while reducing deployment cost. Let's get started!

This Owner's Manual provides instructions for installing and operating models in the SensArray family, including Pro, Core, Enterprise and Enterprise 3 (E3).

This document is designed for use by RFID system integrators, IT networking professionals, and software developers - those who wish to develop RFID, networking solutions, and agile power delivery systems to take full advantage of the unique capabilities of the SensArray.

At SensThys.com, you can find substantial additional information.

Overview

The Enterprise and CORE reader integrate several functions into a thin-profile form factor. The capabilities included are:

- A high-power, high-sensitivity RFID reader
- An integrated internal antenna
- An Ethernet switch that allows for enhanced IT security, including whitelisting of incoming IP connections
- A 12-pin GPIO interface, with four inputs and four outputs is standard on the SensArray. In addition, the interface includes 24V power so that attached GPIO devices may be controlled and powered by the reader
- Three connectors to power external antennas
- In the Enterprise, three RJ45 ports are provided with full IEEE 802.3bt (POE++) capability, allowing the Enterprise to provide data and power to suitable PoE devices

E3 is an integrated reader featuring:

- A high-power reader featuring the Impinj E710
- A broadband, 9 dBiC internal antenna
- An Ethernet switch that allows for enhanced IT security, including whitelisting of incoming IP connections
- A 12-pin GPIO interface, with four inputs and four outputs is standard on the SensArray. In addition, the interface includes 24V power so that attached GPIO devices may be controlled and powered by the reader
- Three connectors to power external antennas
- The E3 provides two RJ45 ports with full IEEE 802.3bt (POE++) capability, allowing the E3 to provide data and power to suitable PoE devices

All members of the SensArray family operate without an operating system, making it ideal for secure IoT operation and light on-board computational capabilities. SensThys provides an RFID Console tool, ProSens, designed to operate and control the units, both in initial start-up and in basic applications like portal readers. A reader with substantial computing power or a server running control software, can handle interrogation and control of the integrated RFID reader when used in larger applications.

EPC Class 1 GEN 2 UHF RFID Tags

The SensArray is designed to read and program any EPC Class 1 Generation 2 tag. Class 1 tags are “passive” devices, meaning they do not have a battery or other onboard power source. They are powered solely by the RF energy transmitted by an RFID reader.

Tags communicate with the SensArray through backscatter modulation. The tags do not transmit RF energy. Instead, they change their reflective characteristics in a controlled way and reflect RF energy back to the reader. An analogy to this is the way you can use a mirror to signal someone by reflecting light from the Sun.

Equipment

To get started, you'll need:

- Power – We recommend power be delivered to the SensArray using the SensThys Power Injector (SPOE29WC4). The SensArray can be powered by and fully compliant IEEE 802.3at or IEEE 802.3at injector or switch.

Configuration – A Windows 7, 8, or 10 PC running the supplied RFID Console.

To operate multiple antennas with the SensArray+, you will need the following additional equipment:

- External Antennas – We recommend the SensRF-101 antenna.
- Cabling – The antennas connect to the SensArray+ through coaxial cabling with reverse polarity SMA connectors on one end for connecting to the SensArray's jacks and compatible connectors on the antenna end.

CHAPTER 2 Installation and Operation

Connecting to the Unit

Power the E3, Enterprise or Core by connecting the OUT port of the SensThys PoE injector (Part Number SPOE29WC4) to PoE Port 0. The units can also be powered by connecting to the output of standard POE+ or POE++ enabled Ethernet switch, attached to PoE Port 0.

The computer is connected to the SensArray in one of three ways. The computer can connect to the IN port on the PoE+ injector (Part Number SPOE29WC4) or standard PoE+ switch that is providing power to the SensArray, with the output of the injector or switch connected to the unit as described above.

It is strongly suggested that new users of the SensArray initially control the unit with the provided RFID Console. The RFID Console, ProSens, can be loaded onto any computer running Windows 7, 8 or 10. The RFID Console may be downloaded from

<https://www.sensthys.com/software/>

Installing the RFID Console

After downloading the RFID Console from Sensthys.com proceed with the following steps:

1. Open zip file
2. Double click on the file named "RFID_Console"



3. Follow instructions on Installer until finished.

For convenience, the user may want to place an icon on the desktop of the computer.

For detailed technical information on installing the RFID Console on your PC:

[Installing RFID Console on Windows 10 PC](#)

[Configuring Firewall to Allow RFID Console to see all Readers](#)

GPIO (General Purpose Input/Output)

The GPIO port provides for four control inputs and four outputs. In addition, the GPIO provides 24V power for accessories.

The basic pin-out for the GPIO is listed here.

SensArray GPIO Pin-out Specifications

Pin Number	Assignment
Pin 1	24VDC External
Pin 2	External ground
Pin 3	External Output 1
Pin 4	External Output 2
Pin 5	External Output 3
Pin 6	External Output 4
Pin 7	External Input 1 (5-24VDC)
Pin 8	External Input 2 (5-24VDC)
Pin 9	External Input 3 (5-24VDC)
Pin 10	External Input 4 (5-24VDC)
Pin 11	+24V Internal (max sourcing current 1.2A)
Pin 12	External ground

Detailed instructions for GPIO use in SensThys products can be found here:

<https://www.sensthys.com/documentation/>

Power Supplies

- *We recommend using the SensThys injector IEEE 802.3at or IEEE 802.3bt or equivalent switches.*

The SensArray readers have been certified to operate in accordance with FCC or other national requirements when powered by an 802.3af/at/bt compliant POE device and when

the total power consumption of the device, and attached devices is lower than the power budget available from the power supply.

Only compliant power supplies may be used with the readers. Operation with other power supplies is a violation of the conditions of the SensArray FCC licenses.

TroubleShooting Guide

Description	Probable Cause	Recommended Actions
RFID Console does not install completely	Installation process is halted or Console does not turn on. Bad install. Improper install.	Uninstall RFID Console. Download latest version from SensyThys.com. Refer to Tech Note 18-101 "Installing RFID Console for Windows 10 PC"
Status LED on SensArray+, SensArray flashes Red, stays Red	<p>Improper cable connections. Faulty reader.</p> <p>During power up and boot, the Status LED will flash Red. Once boot is successful, the LED will flash Green.</p>	<p>Check Ethernet cable connections at PC, PoE injector and at SensArray ports.</p> <p>Replace reader.</p>
RFID Console does not discover any Readers	<p>Firewall does not allow reader to see the network.</p> <p>Faulty reader.</p> <p>The reader list on the Console is empty. All hardware connections are good. Status LED on SensArray are flashing green.</p>	<p>Check that PC firewall has allowed RFID Console to communicate with Public Networks.</p> <p>Refer to Tech Note 18-102 "Configuring PC Firewall for RFID Console"</p> <p>Replace the reader.</p>
RFID Console does not see additional external antenna	RF cables connected incorrectly. Faulty antenna. After external antennae are connected, the Console does not show connection.	Check that RF cable is connected properly. Restart the Console. Replace cable. Replace antenna.

Thermal Management

The Enterprise and Core provides great flexibility in the design of RFID detection, including antenna sequencing, pulse power and duration, and pulse train specifics. As the radio is quite powerful, the small form factor SensArray does get warm during operation.

This is normal and will not affect performance. If you intend to operate the reader at high power levels in particularly warm environments, it is advisable to provide air flow around the back of the unit or to provide it contact with a suitable mounting surface to help dissipate heat.

Drawings and Specifications

The SensArray models share many common features and are nearly identical in physical size. The Enterprise has four PoE Ethernet ports. E3 has three PoE ports, and includes a USB type C connection and a reset pin.

The lateral dimensions of all readers are 25.3 x 25.3 cm. The height of the Enterprise and Core are 2.1 cm, while the height of E3 is 3.5 cm.

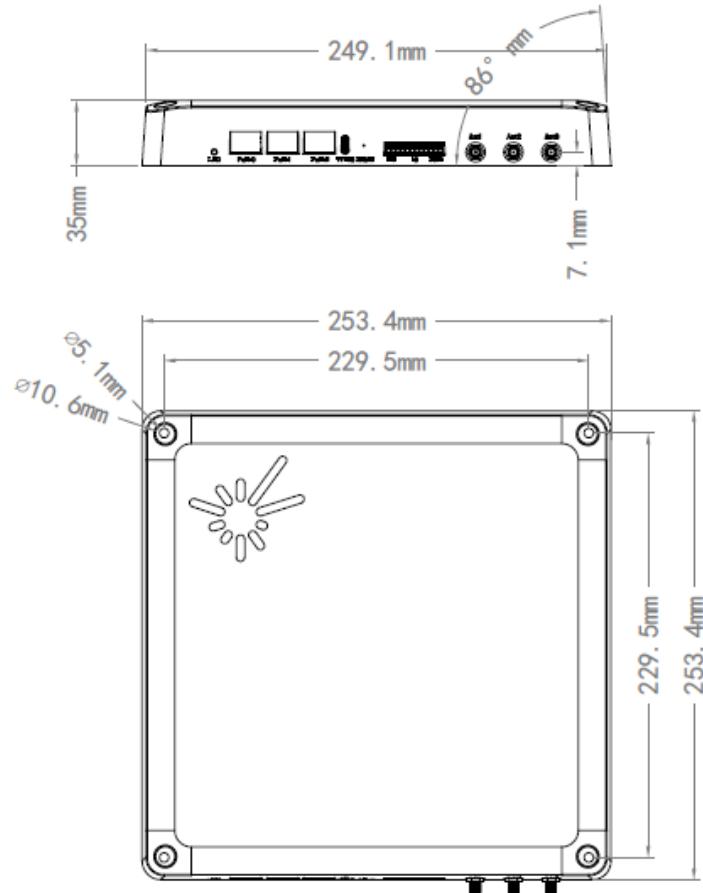


Figure 1 The top and side view of E3.

Drawings

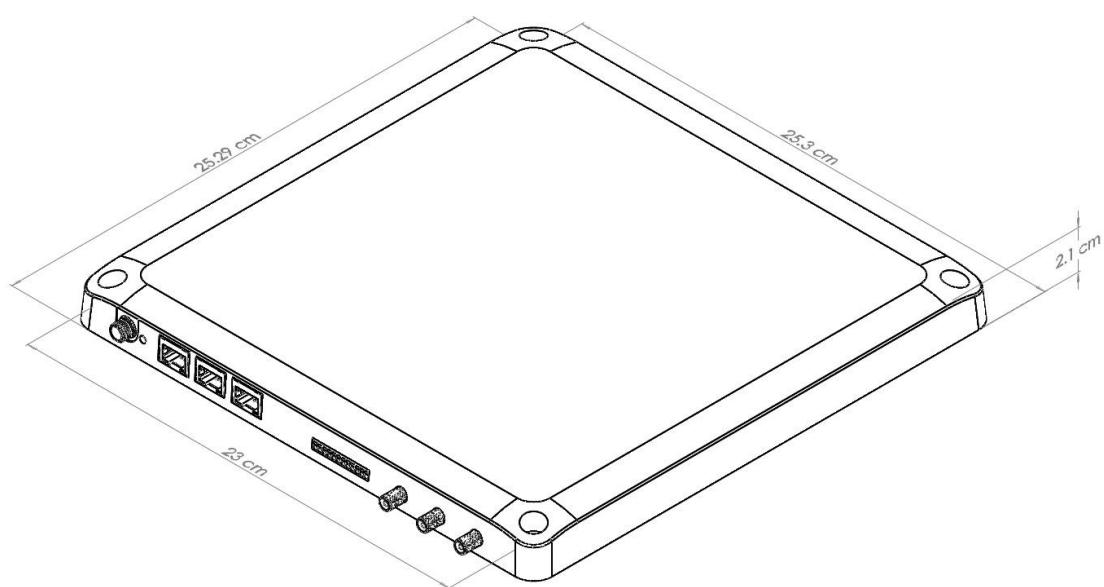


Figure 2: Perspective view of the SensArray+

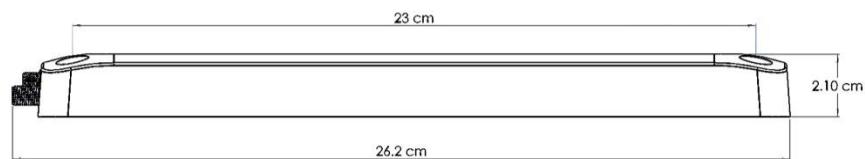


Figure 3: Side view of the CORE

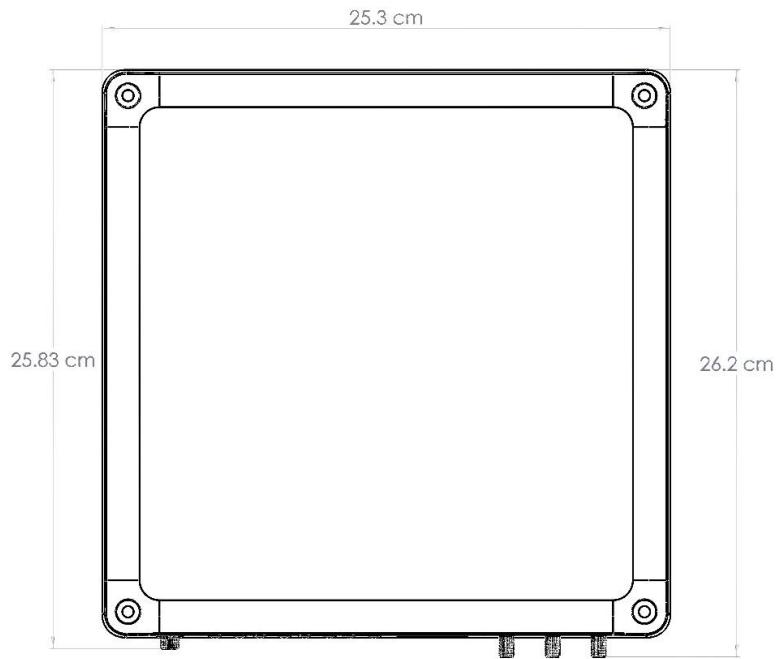


Figure 4: Plan view of the SensArray+



Figure 5: A photograph of the top of the CORE.

The input/output features of the SensArray product can be discussed by looking at the side view of E3 and comparing this view to the Enterprise and Core.

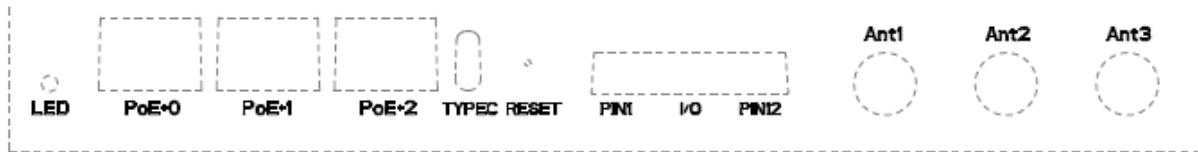


Figure 6 The input and output ports of E3.

Starting from the left we see an indicator LED, the power “in” port PoE 0, the type power “out” or PSE ports, PoE 1 and PoE 2, a Type C USB port, a reset pin, the GPIO ports, and then the three output antenna ports Ant1, Ant2 and Ant3.

The Ethernet ports also have two indicator lights. The indicator to the left describes the bit rate capability of the port (10Mb/s is not illuminated, 100Mb/s is yellow). The indicator to the right describes the duplex state of the port (1/2 duplex is not illuminated; full duplex is green).

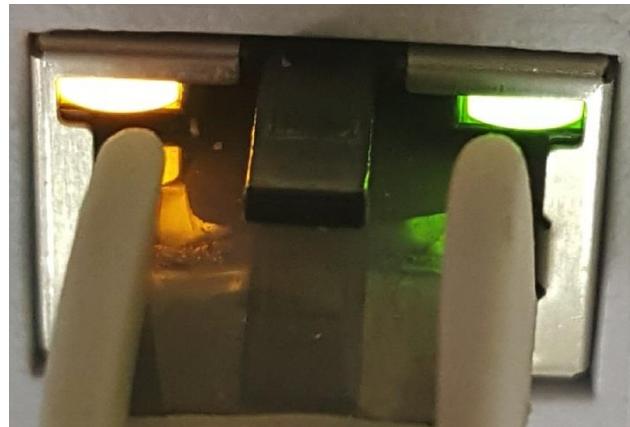


Figure 7: An Ethernet port operating at 100Mb/s, as shown by the yellow indicator light in the upper left, and full duplex mode, as shown by the green indicator light in the right.



Figure 8: The GPIO port.

Wires, recommended 20-26 AWG, are inserted into the round openings. To remove the wires, a small tool is inserted into the rectangular slot above, allowing the wired to be easily pulled out. Pin 1 is marked at the far left.



Figure 9: The three reverse-polarity SMA connectors for external antennas.

Specifications

The reader table refers to US and Canadian specifications only. Reader models released for the other countries may have different power levels, frequency of operation, and channel spacing in compliance with local regulations where the product is sold.

RFID Reader Specifications

Feature	Specification
Product Name	Enterprise and CORE
Reader Protocol	EPC Class 1 Gen 2 and 18000 – 6C
Operating Frequency	902.75 MHz – 927.25 MHz
Hopping Channels	50
Channel Spacing	500 KHz
Channel Dwell Time	< 0.4 seconds
RF Transmitter	< 33 dBm
Modulation Methods	Phase Reversal – Amplitude Shift Keying (PR-ASK) Double Side Band – Amplitude Shift Keying (DB-ASK)
20 dB Modulation Bandwidth	< 100 KHz

Internal Antenna Specifications

Feature	Specification
Operating Frequency	902.75 MHz – 927.25 MHz (FCC, other regions are different)
Polarization	Right-hand Circular
Gain	8.5 dBiC

Physical and Environmental Specifications

Feature	Specification
Dimensions	(cm) 25.4 x 25.4 x 2.0 / (in) 10 x 10 x 0.8
Weight	Approximately 0.79 kg (1.73 lbs)

Operating Temperature	-20°C to +45°C (20% Duty Cycle) --- 50°C for <5% average duty cycle
Maximum Duty Cycle (30 dBm)	50% at 35°C, 30% at 45°C, 20% at 50°C
Operating Environment	Indoor operation only
Compliance Certifications	ENTERPRISE and CORE ETSI FCC Part 15; FCCID: 2ANPR-SENSARRAY IC: 23135-SENSARRAY UL: Safety tested to UL 60950-1 UC
Compliance Certifications	ENTERPRISE 3 (E3) In Progress, will eventually certify to the same standards as above

Data and Power Specifications

Feature	Specification
Data Interface	TCP/IP (RJ-45) , 1 port on Core, 4 ports on Enterprise
POE	RJ-45, Class 8 PD (receive power) on Port 0 RJ-45, Class 8 PSE (deliver power) on Port 1, 2, and 3 (Enterprise)
LED Status Indicator	Flashes RED during booting, flashes green when operational
RJ45 Status Indicators	Green indicates full duplex when lit, half duplex when dark, Yellow indicates 100 MBS when lit, 10 MBS when dark
Software Support	RESTful API, AutoSens, DLL, sample code, RFID Console, Sensor Console
Power Consumption (33dBm)	12W typical
Power Consumption (Idle)	3W typical