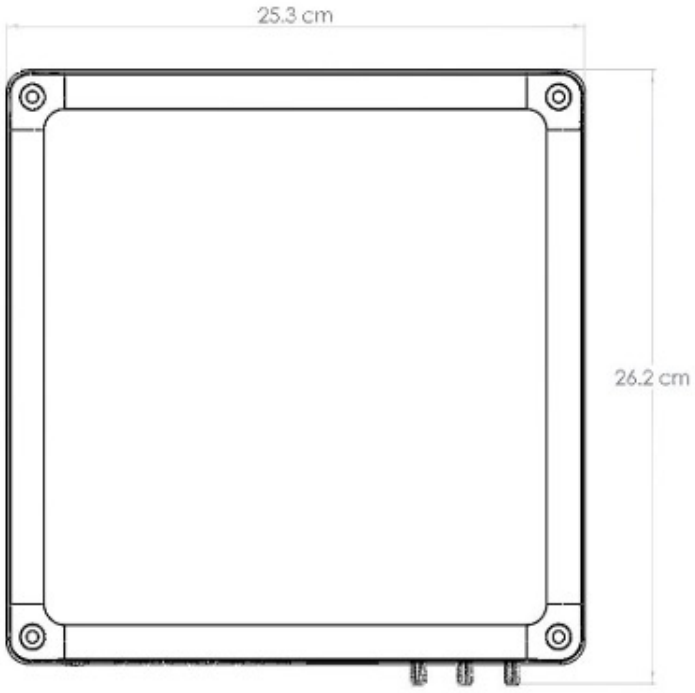
User Guide

SENSARRAY E3 READER



Top view of the SensArray E3

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	February 2026	Enterprise 3 (E3) — updated for current product

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Legal Notices

FCC Compliance

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.

- 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.
- The E3 has been certified for use with an integrated broadband flat antenna with a maximum gain of 9.0 dBic (FCC/ETSI) or an external flat antenna with a gain between 8 and 12.0 dBic.
- The equipment provided with this product allows for transmission in the frequency range 860–930 MHz (region-dependent; FCC: 902.75–927.25 MHz; ETSI: 865.6–867.6 MHz).
- The power for this device has been limited to less than +31.5 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.

- The E3 is compliant with Industry Canada RSS-210.
- 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.

- L'SensArray E3 doit être mis en oeuvre et maintenu par des professionnels.
- L'SensArray E3 est conforme à la spécification RSS-210 d'Industrie Canada.
- 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.

WEEE Directive

In accordance with the WEEE Directive (2002/96/EC), the E3 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

The E3 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

The E3 was 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

The E3 date of manufacture is controlled by serial number. Please contact SensThys helpdesk for information regarding serial number, format and date of manufacture.

CHAPTER 1 Introduction

Congratulations on your selection of the SensThys Enterprise 3 (E3) 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 User Guide provides instructions for installing and operating the SensArray 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 E3.

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

Overview

The Enterprise 3 (E3) integrates several functions into a slim-profile 10" × 10" form factor. The capabilities included are:

- A high-power, high-sensitivity RFID reader based on the Impinj E710 reader IC
- An integrated internal 9.0 dBic broadband antenna covering both FCC and ETSI frequency bands in a single unit
- A native EPIC data-integrity protocol that continuously verifies and corrects tag memory, guaranteeing no corrupt data is ever reported to the application layer
- An Ethernet switch with four RJ-45 ports that allows for enhanced IT security, including IP whitelisting
- A 12-pin GPIO interface, with four inputs and four outputs. The interface also provides 24 VDC power so that attached GPIO devices may be controlled and powered by the reader
- Three RP-SMA connectors for external antennas
- A USB-C port for control of external USB devices and USB thumb drives
- Four RJ-45 ports with full IEEE 802.3bt PoE++ capability on Port 0 (input) and PSE capability on Ports 1 and 2 (output), allowing the E3 to power downstream PoE devices

The E3 operates without an operating system, making it ideal for secure IoT operation. The SensThys ProSens Consoleis designed to operate and control the unit, both in initial start-up and in basic applications like portal readers. For larger applications, a server or host computer running the SensThys SD or REST API can handle interrogation and full control of the reader.

EPC Class 1 Gen 2v2 UHF RFID Tags

The E3 is designed to read and program any EPC Class 1 Generation 2 (Gen 2v2 / ISO 18000-6C/63) 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 E3 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 E3 using the SensThys SPOE90WC8 or SPOE30WC4 Power Injector. The E3 can also be powered by any fully compliant IEEE 802.3at or 802.3bt PoE injector or switch connected to PoE Port 0. For using the E3 to power additional devices, please use the 802.3bt class injector or switch.

- Configuration — Any PC with network access running ProSens Console. Download from SensThys.com/Support/Download/Apps.

To operate multiple antennas with the E3, you will need the following additional equipment:

- External Antennas — We recommend the SensRF-101 antenna.
- Cabling — The antennas connect to the E3 through coaxial cabling with reverse-polarity SMA connectors on one end for connecting to the E3's RP-SMA jacks and compatible connectors on the antenna end.

CHAPTER 2 Installation and Operation

Connecting to the Unit

Power the E3 by connecting the OUT port of the SensThys PoE++ injector (Part Number SPOE90WC8) to PoE Port 0. The E3 can also be powered by connecting to the output port of a standard 802.3bt PoE++ enabled Ethernet switch, attached to PoE Port 0.

The host computer connects to the E3 through the network. The computer can connect to the IN port on the PoE++ injector or to the same switch that is providing power to the E3. Alternatively, the host computer can connect directly to one of the E3's downstream RJ-45 ports (Ports 1–3) if power is being delivered from an upstream switch.

New users are strongly encouraged to initially configure the unit using ProSens Console. ProSens Console may be downloaded from:

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

Installing ProSens Console

After downloading ProSens Console from SensThys.com, proceed with the following steps:

1. Open the installer package.
2. Double-click the file named "setup.exe".
3. Follow the on-screen installer instructions until finished.

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

For detailed technical information on installing ProSens Console on your PC:

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

GPIO (General Purpose Input/Output)

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

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

SensArray E3 GPIO Pin-out Specifications

Pin Number	Assignment
Pin 1	24 VDC 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 (5–24 VDC)
Pin 8	External Input 2 (5–24 VDC)

Pin 9	External Input 3 (5–24 VDC)
Pin 10	External Input 4 (5–24 VDC)
Pin 11	+24 V Internal (max sourcing current 1.25 A)
Pin 12	External ground

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

"SensThys Reader GPIO Deployment Guide"

Power Supplies

- We recommend using the SensThys SPOE90WC8 or SPOE30WC4 PoE Injector.
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The E3 has been certified to operate in accordance with FCC and other national requirements when powered by an 802.3at or 802.3bt compliant PoE device, and when the total power consumption of the device and all attached downstream devices is within the power budget available from the power supply.

Only compliant power supplies may be used with the E3. Operation with non-compliant power supplies is a violation of the conditions of the E3 FCC license.

Troubleshooting Guide

Description	Probable Cause	Recommended Actions
ProSens Console does not install completely	Installation process is halted or Console does not open. Bad or incomplete install.	Uninstall ProSens Console. Download the latest version from SensThys.com. Refer to Tech Note 18-101.
Status LED on E3 flashes Red or stays Red	Improper cable connections. During power-up and boot the Status LED will flash Red. Once boot is successful, the LED will flash Green.	Check Ethernet cable connections at PC, PoE injector, and at E3 Port 0. If LED remains Red after boot, contact SensThys.
ProSens Console does not discover any Readers	Firewall does not allow reader to see the network. Faulty reader. The reader list on the Console is empty; all hardware connections appear good; Status LED is flashing green.	Check that PC firewall has allowed ProSens Console to communicate with Public Networks. Refer to Tech Note 18-102 "Configuring PC Firewall for ProSens". Replace the reader.
ProSens Console does not see additional external antenna	RF cables connected incorrectly. Faulty antenna. After external antennas are connected, the Console does not show connection.	Check that RF cable is connected properly to the correct RP-SMA port. Restart the Console. Replace cable. Replace antenna.

Thermal Management

The E3 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 slim form-factor E3 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 contact with a suitable mounting surface to help dissipate heat.

Illustrations

The E3 uses the same proven 10" × 10" footprint as previous SensArray readers. The E3 is slightly taller to accommodate the wideband integrated antenna.

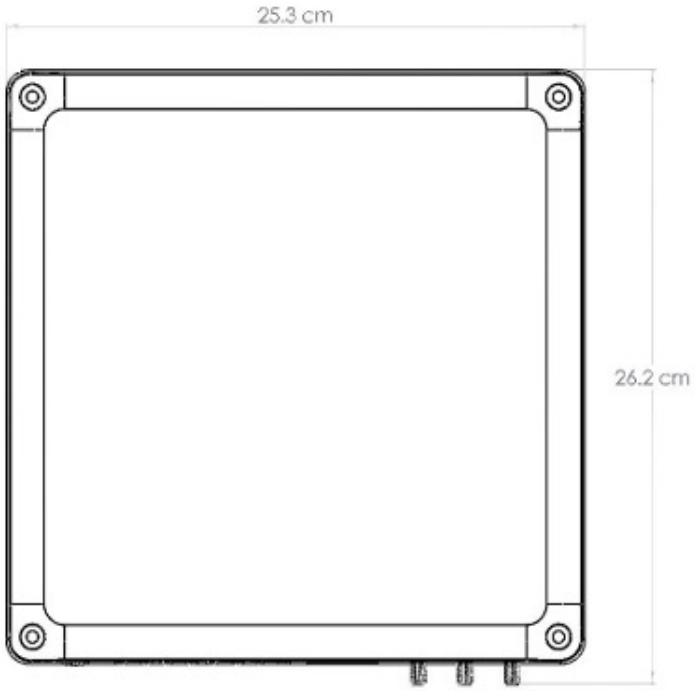

Figure 3: Plan view of the E3

Figure 4: Photograph of the E3 showing the connections of the unit.

In Figure 4, the various inputs and outputs of the E3 can be seen. Starting from the left: the LED indicator, the PoE Port 0 input (PD PoE++), PoE Port 1 (PSE PoE++), PoE Port 2 (PSE PoE++), the USB port, the reset button, the 12-pin GPIO interface, and three RP-SMA connectors for external antennas.

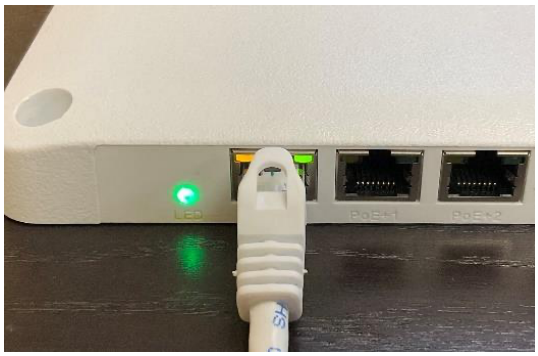

Figure 5: Status LED and Ethernet ports on the E3

Figure 5 shows greater detail. The Status LED is an indicator of device state.

Red LED flashes on bootup

Green LED flashes when operating normally, but not reading

When AutoSens operating (including reading tags through ProSens):

- First flash (longer pauses before & after) Green if data server is connected & receiving data, Red if the data server is not connecting.
- Next 4 flashes: Green if reading on the antenna, Red if reads requested, but antenna connection isn't detected, Blue if not in the read sequence

When firmware updates are being performed, the Blue LED flashes to indicate that the firmware is being written. The red light will light periodically as the reader reboots between update steps.

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

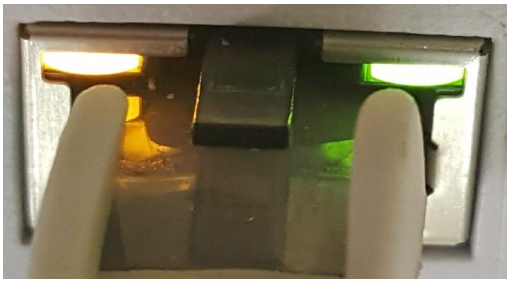

Figure 6: An Ethernet port operating at 100 Mb/s (yellow indicator, upper left) in full duplex mode (green indicator, right)

Figure 7: The 12-pin 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 wire to be easily pulled out. Pin 1 is marked at the far left.

Figure 8: The three RP-SMA connectors for external antennas (Ant1, Ant2, Ant3)

Specifications

The specification tables is based upon the E3 operating in FCC band. The E3 also a wide range of operating regions. These other regions may have different power levels, frequency of operation, and channel spacing in compliance with local regulation.

RFID Reader Specifications

Feature	Specification
Product Name	Enterprise 3 (E3)
Reader IC	Impinj E710
Reader Protocol	EPC Class 1 Gen 2v2; ISO 18000-6C/63
Operating Frequency (FCC)	902.75 MHz – 927.25 MHz
Operating Frequency (ETSI)	865.6 MHz – 867.6 MHz
Integrated Antenna Band	860 – 930 MHz broadband (FCC and ETSI in single unit)
Hopping Channels	50 (FCC), 4 (ETSI)
Channel Spacing	500 kHz (FCC), 600 kHz (ETSI), varies with region
Channel Dwell Time	< 0.4 seconds
RF Transmitter (max)	< +31.5 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	860 – 930 MHz broadband (covers FCC and ETSI)
Polarization	Right-hand Circular (RHCP)
Gain	9.0 dBic

Physical and Environmental Specifications

Feature	Specification
Dimensions	(cm) 25.4 × 25.4 × 3.5 / (in) 10.0 × 10.0 × 1.4
Weight	Approximately 1 kg (2.2 lbs)
Operating Temperature	-40°C to +50°C, non-condensing
Operating Environment	Indoor and outdoor (sealed enclosure)
Compliance Certifications	ETSI EN 302 208 Module FCC ID: 2ANPR-M-PWRSENS3 Reader FCC ID: 2ANPR-SAE3

Data and Power Specifications

Feature	Specification
Data Interface	TCP/IP (4× RJ-45)
USB	1× USB - C — control of external USB devices and USB thumbdrives
PoE Input	IEEE 802.3at or 802.3bt
PoE Output	IEEE 802.3bt PSE on Ports 1 and 2 (powers downstream PoE devices)
PoE Power Supply PN	SPOE30WC4, SPOE90WC8
GPIO	12-pin; 4 inputs (5–24 VDC), 4 outputs, 24 VDC @ 1.25 A
LED Status Indicator	Red LED flashes on bootup Green LED flashes when operating normally, but not reading When AutoSens operating (including reading tags through ProSens): • First flash (longer pauses before & after) Green if data server is connected & receiving data, Red if the data server is not connecting. • Next 4 flashes: Green if reading on the antenna, Red if reads requested, but antenna connection isn't detected, Blue if not in the read sequence When firmware updates are being performed, the Blue LED flashes to indicate that the firmware is being written. The red light will light periodically as the reader reboots between update steps.
RJ-45 Status Indicators	Green: full duplex (lit) / half duplex (dark). Yellow: 100 Mb/s (lit) / 10 Mb/s (dark)
Software Support	RESTful API, .NET(C#/VBA), Java SDK, ProSens Console, PhySens Console, EPIC, AutoSens
Power Consumption (TX)	15 W at +31.5 dBm transmit
Power Consumption (Idle)	5 W
SKU	SAE3