User Guide

SENSARRAY ONE, ONE-PRO, PRO AND ENTERPRISE

SENSARRAY ONE

SENSARRAY ONE-PRO

SENSARRAY PRO

SENSARRAY ENTERPRISE

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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.

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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."

SensArray Product Compliance Notes

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. The SensArray+ has 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.

Industry Canada Notices - Pending

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 SensArray and SensArray+ is 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 - Pending

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 -Pending

In accordance with the WEEE Directive (2002/96/EC), SensArray and SensArray+ 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 - Pending

SensArray and SensArray+ 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 - Pending

SensArray and SensArray+ 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

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

SensArray is a registered trademark of SensThys.

Table of Contents

Chapter 1 Introduction

The SensArray RFID reader platform incorporates the SensyThys high performance RFID reader with a built-in UHF antenna with RF and power networking ports to deliver a robust solution for RFID applications while reducing deployment cost.

About this Manual

This Hardware Setup Guide provides instructions for installing and operating the SensArray.

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, the user can find substantial additional information about RFID, POE and the entire SensThys product portfolio. Please visit our website to explore these materials.

Updates to this User Guide will be made when new product features or modifications are available.

Product Overview

The SensArray platform consists of four models of readers with integrated antennas, PoE connections and additional RF antenna ports, each purpose-designed for increasingly complex tag reading activities:

- SensArray One: All-in-one Reader with integrated antenna for simple tag reading activities such as tag commissioning
- SensArray One-Pro: General purpose Reader with integrated antenna and three additional RF ports and GPIO connection for small or medium sized read-point networks
- SensArray Pro: Highly flexible integrated reader and antenna with extensive native connections for multiple read-points or large networks
- SensArray Enterprise: High performance integrated reader for enterprise-sized applications with Class 8 PoE connections

The SensArray platform integrates several functions into a thin-profile form factor. The capabilities included are:

- A high-power, high-sensitivity RFID reader integrated with an 8.5 dBiC internal antenna for reading and programming EPC Class 1 Generation 2 RFID tags;
- An Ethernet switch that allows for convenient IT networking of the SensArray to other SensArrays or IP devices. Up to three additional Ethernet ports are externally available on the SensArrray Enterprise model;
- A three-port power distribution system compatible with all current generation POE devices, including both PD and PSE devices. The SensArray can receive power through an IEEE 802.3af (POE), IEEE 802.3at (POE+) or IEEE 802.3bt compliant

network on any of the Ethernet ports, as well as through the 56VDC input. The SensArray can deliver power to an 802.3at or 802.3bt network device through the Ethernet ports on the Pro and Enterprise models;

- An additional DC input on the SensArray Pro to increase the power input choices for powering the unit;
- A 12-pin GPIO interface on the unit (except for the One model) to read digital inputs from up to 4 external devices and to control the operation of up to four external devices;
- Three reverse-polarity SMA connectors to power external antennas (except on the One model).

The PC-based SensThys RFID CONSOLE is designed to operate and control the readers, both in initial start-up and in basic applications such as portal readers.

The SensArray can power an internal antenna, which can excite tags in front of the SensArray. With the internal antenna and up to additional three external antennas, via RF cables to one of the SMA connectors, a complete reader network can be setup to illuminate tags in different directions and locations.

Power, Control and Antenna Equipment

To interface with the SensArray unit, the following equipment is needed:

- Power – SensThys recommends that power be delivered to any SensArray unit using a Power Injector, either the Class 4 (30W) or the Class 8 (90W) models. The SensArray Pro can be also powered using the SensThys 56vDC supply.
    - Because the SensArray platform is IEEE 802.3at and 802.3bt Power over Ethernet (PoE) compliant, each SensArray unit can be powered by any 802.3at or 802.3bt compliant PSE (power sharing equipment) unit
- Control – A Windows 7, 8, or 10 PC running the supplied RFID Console, or a server or reader running your own control system.

To operate the various communication, data and switching interfaces on the SensArray reader, the following additional cables is needed:

- Data cabling –
    - Ethernet: CAT5/6 shielded cabling with RJ45 connectors should be used to connect to the Ethernet ports
- RF cabling – The RF antennas connect to the SensArray readers through coaxial cabling with reverse polarity SMA connectors on one end for connecting to the jacks and compatible connectors on the antenna end.

- GPIO - Multi-wire cabling should be used to connect to the GPIO connection on the reader. The GPIO connection requires minimum of 12 wires for the 4-input/4-output digital connections, and two wires for the +24vdc and ground connection.

Note: Low-cost CAT5 (aluminum-based) cabling is not recommended for use with the SensArray unit.

To operate multiple sensors with the SensArray platform, the following additional antenna equipment is needed:

- External UHF RF Antennas – The SensArray platform has been qualified to run several industry standard UHF antennas with gain between 5dB and 12dB. The
- SensArray can drive up to three external UHF antennas.

Chapter 2 Product Specifications

The following is a detailed listing of the specifications for the SensArray platform of products.

SensArray Product Specifications

Power and Data Specifications

	SensArray			
	One	**One Pro**	**Pro**	**Enterprise**
Data Standard	10/100Base-T TCP/IP (1 x RJ-45)	10/100Base-T TCP/IP (1 x RJ-45)	10/100Base-T TCP/IP (3 x RJ-45)	10/100Base-T TCP/IP (4 x RJ-45)
Input Power	802.3at PoE+ Class 4[1] PD (receive power) PoE+ power supply, P/N SPOE29WC4	802.3bt PoE Class 8[2] PD (receive power) PoE+ power supply, P/N SPOE90WC8	802.3at PoE+ Class 4[1] PD (receive power on) on Port 0 RJ-45, Class 4 PSE on Port 1 and 2 PoE+ power supply, P/N SPOE29WC4	802.3bt PoE Class 8[2] PD (receive power on) on Port 0 RJ-45, Class 8 PSE on Port 1, 2 and 3 PoE+ power supply, P/N SPOE90WC8
DC power input	N/A	N/A	56 VDC input DC power supply, P/N SPS75W56VDC	N/A
LED Status Indicator	Flashes RED during booting, flashes GREEN when operational. Toggles between RED and GREEN when the “Locate” function is active			
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	APIs, DLL, sample code, RFID Console			
Power Consumption @30dBm/Idle	15W, excluding GPIO and PoE output			
Maximum supported RFID read zones, w/one zone at 33 dBm	N/A	N/A	16, with SensThys power Injector Max length of CAT6 at 100 meters	100, with SensThys power Injector Max length of CAT6 at 100 meters

[1]Class 4 (25.5-30W) [2]Class 8 (71.3-90W)

RFID Reader Specifications

	SensArray			
	One	**One-Pro**	**Pro**	**Enterprise**
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			
Modulation Methods	Phase Reversal – Amplitude Shift Keying (PR-ASK) Double Side Band – Amplitude Shift Keying (DB-ASK)			
20 db Modulation Bandwidth	< 100 KHz			
Read Architecture	Impinj R2000 chip, M Power			

Antenna and RF Interface Specifications

	SensArray			
	One	**One Pro**	**Pro**	**Enterprise**
External RF Antenna Ports	N/A	3 x RP-SMA	3 x RP-SMA	3 x RP-SMA
RF Transmit Power (dBm)	N/A	+33 dBm	+33 dBm	+33 dBm
Operating Frequency	N/A	902.75 MHz – 927.25 MHz (Region code is field assignable via software) Other regions: https://www.gs1.org/docs/epcglobal/UHF_Regulations.pdf		
Integrated Antenna	30W at antenna			
Polarization	Right-hand Circular			
Gain	8.5 dBiC			

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.

Digital Interface Specifications

	SensArray			
	One	**One Pro**	**Pro**	**Enterprise**
Ethernet – Data and Power	1 x RJ-45; 10/100 Base-T TCP/IP) PoE+ port;	1 x RJ-45; 10/100 Base-T TCP/IP) PoE port;	3 x RJ-45; 10/100 Base-T (TCP/IP) PoE+ port;	4 x RJ-45; 10/100 Base-T (TCP/IP) PoE port;
GPIO (incl. Input power)	N/A	4 input/4 output, opto-isolated; +24 vDC output and ground, 1.2 A source	4 input/4 output; +24 vDC output and ground, 600 mA source +24VDC input and ground	4 input/4 output, opto-isolated; +24 vDC output and ground, 1.2 A source

Physical and Environmental Specifications

	SensArray			
	One	**One Pro**	**Pro**	**Enterprise**
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	0°C to +50°C			
Compliance Certifications	FCC Part 15; FCC ID: pending IC: Pending Safety tested to unified 60950-1 (CB Report): Pending	FCC Part 15; FCC ID: pending IC: Pending Safety tested to unified 60950-1 (CB Report): Pending	FCC Part 15; FCC ID: 2ANPR-M-PWRSENS IC: Pending Safety tested to unified 60950-1 (CB Report): Pending	FCC Part 15; FCC ID: pending IC: Pending Safety tested to unified 60950-1 (CB Report): Pending

Part Numbers

	SensArray			
	One	**One Pro**	**Pro**	**Enterprise**
North America Flat Mounting	SO21000FF	SO21330FF	SP13350FF	SE24370FF
North America VESA Mounting	SO21000FV	SO21330FV	SP13350FV	SE24370FV
Europe Flat Mounting	SO21000EF	SO21330EF	SP13350EF	SE24370EF
Europe VESA Mounting	SO21000EV	SO21330EV	SP13350EV	SE24370EV

PoE Networking with SensArray

The SensArray platform is IEEE 802.3at and 802.3bt Power over Ethernet (PoE) compliant. It is designed to deliver data and power from each PSE port, over Ethernet cables. The One and Enterprise models supply up to 90 watts of power per port for external devices such as another SensArray reader, PTZ (Pan Tilt Zoom) network cameras and VoIP telephony systems. The Pro model can deliver up to 30 watts of power per PSE port.

Each SensArray unit incorporates a 4-way Ethernet switch, with 3 or 4 Ethernet ports accessible on the unit. Labeled “PoE+0”, “PoE+1”, “PoE+2” and “PoE+3”, these ports can be daisy chained to form star and mesh networking architectures.

Port PoE+0 is a Class 4 (Pro) or Class 8 (One-Pro and Enterprise) powered device (PD) connection. For all SensArray models. this port PoE+0 is used to receive input power.

Ports PoE+1 and PoE+2 for the Pro are Class 4 power sending equipment (PSE) ports. These ports can supply power to standard PoE devices up to Class 4 (30W).

Ports PoE+1, PoE+2 and PoE+3 on the Enterprise model are Class 8 power sending equipment (PSE) ports. These ports can supply power to standard PoE devices up to Class 8 (90W)

To power a generic PoE device, simply connect a CAT6 cable from it to PoE+1, +2 or +3 with a CAT 6 cable.

Power Supplies

We highly recommend using the shielded Class 4 SensThys injector (P/N SPOE29WC4), as it is fully 802.3at compliant and delivers strong voltage and power, increasing the capability of powered networking. Also available is the shielded Class 8 PoE injector (P/N SPOE90WC8).

In addition, the SensArray+ may be powered through the +56VDC input. *We highly recommend using the SensThys (P/N SPS75W56VDC) that provides +56VDC.*

SensThys highly recommends that both shielded PoE injector AND shielded CAT6 cables be used for all SensArray installations.

Part Number	Description
SPOE29WC4	SensArray, CORD PACK Class 4 Power over Ethernet (PoE+) Power Injector, Shielded
SPOE90WC8	SensArray, CORD PACK Class 8 Power over Ethernet (PoE) Power Injector, Shielded
SPS75W56VDC	SensArray, CORD PACK 56 VDC AC/DC Power Supply

The SensArray platform has been certified to operate in accordance with FCC or other national requirements when powered by an 802.3at compliant POE device capable of supplying 25.5 watts minimum, or an 802.3bt compliant PoE device capable of supplying 90 watts maximum. This means that the unit may receive power from a Power over Ethernet enabled switch or the power injector listed above connected to Ethernet POE+ Port 0.

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

Figure 1: Metallic trim on RJ-45 ports on shielded RJ-45 connector on PoE+ injector P/N POE29U-1AT (left), 56VDC power supply (right)

Physical Connections

Figure 2: Connectors on the SensArray Pro (left) and Enterprise (right)

In Fig. 2, the various inputs and outputs of the SensArray reader can be seen. Starting from the left, the 56 VDC input (Pro only), the LED indicator light, PoE+ Ethernet ports (up to 4), the 12-pin GPIO interface, and 3 reverse-polarity SMA connectors for external antennas.

The One model has only a single RJ-45 Ethernet connection, whereas the One-Pro includes additional RP-SMA ports (3 each) and the GPIO 12-pin connection.

RF Antenna Connectors

The SensArray platform provides three (3) RP-SMA connectors (pins) on the unit for connecting up to three (3) external UHF RF antennas. The connectors are labeled “ANT1”, ANT2” and “ANT3” from left to right on the unit. The One model does not have any RF connectors for external antennas.

While the SMA connectors on the SensArrray are RP (pins), the cable connector on the reader end is RP-SMA (holes) and the connector on the antenna end is SMA (pins).

NOTE: The RF cables that are needed are built with SMA connectors on one end, and RP-SMA connectors on the reader end. Cable from SenThys are labeled “RDR” to indicate which end can correctly be connected to the Reader and not to the antenna. See Figure 4 below.

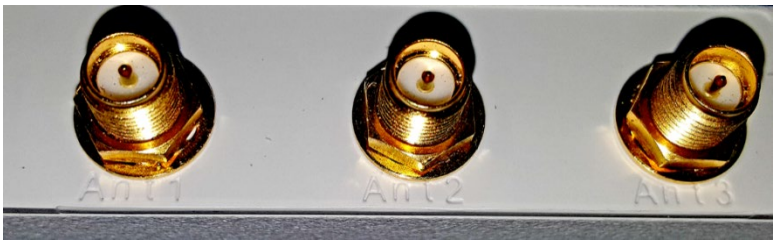


Figure 3: RP-SMA Connectors on the SensArray

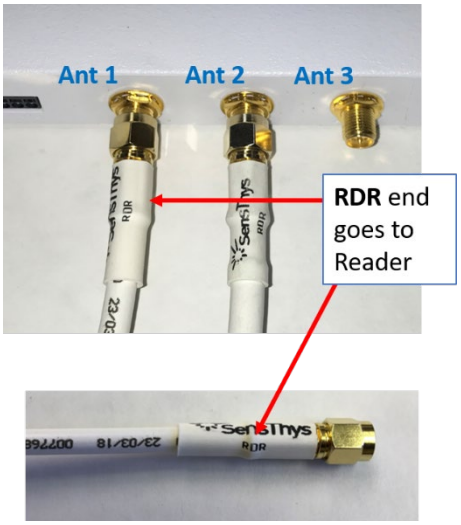


Figure 4: RP-SMA Connectors on the SensArray

Ethernet Connectors

The SensArray models all include at least one RJ-45 connector for standard Ethernet and PoE+ connectivity (3 x RJ-45 for Pro model, 4 x RJ-45 for Enterprise model). The Ethernet connection is

- Not crossover, not auto-MDIX sensing
- The One and Pro models are IEEE 802.3at Class 4 PoE+ compliant (30 W)
- The One-Pro and Enterprise models are IEEE 802.3bt Class 8 PoE compliant (90 W)
- "PoE+0" port, on all models, is the power input port, PD
- "PoE+1", "PoE+2" and "PoE+3" are PSE ports, used for delivering power to other devices via PoE

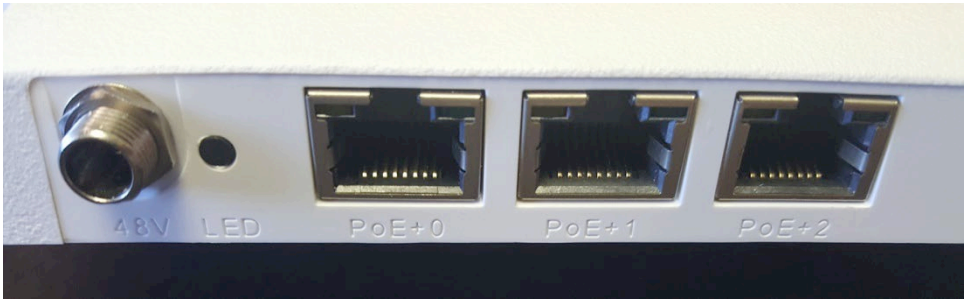


Figure 5: Detail of labels for the 56V input, the Status LED and the Ethernet ports on SensArray Pro unit.

Fig. 5 shows greater detail. The 56vdc input (labeled "48v") is available only on the Pro model.

All Ethernet port are identical with 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).

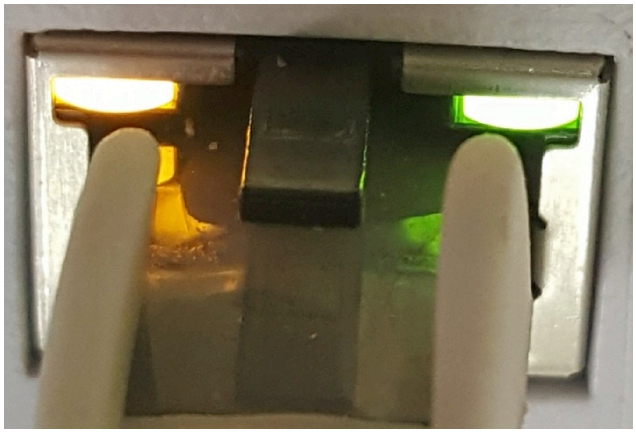


Figure 6: An Ethernet port operating at 100Mb/s, as shown by the yellow indicator light in the upper left, and full duplex mode, as shown by the green indicator light in the right.

LED Status Indicator

On all units, the Status LED is an indicator of device state. During the boot process, the LED flashes red. When the device is fully operational, the LED flashes green.

GPIO (General Purpose Input/Output) Connector

GPIO (General Purpose Input/Output) Connector

The GPIO function on the One-Pro and Enterprise are identical. The GPIO function on the Pro is identical to the SensArray+. The One model does not have a GPIO connector.

The SensArray GPIO port provides for four control inputs and four outputs. To use the GPIO, the SensArray should be connected to external ground via pin 2 and/or pin 12.

The SensThys One Pro and Enterprise offer optically isolated GPIO functionality, with four inputs and four outputs.

- The Outputs behave as relays that are open when "off" and closed when "on". Specifically, the pin is tied to ground when “on”, and is open when “off”.
- The Inputs translate high voltages as digital "1" that can be used in the control logic of the sensor.

The One Pro and Enterprise also provide a switchable 24Vdc, 1.2A power source to drive 24Vdc accessories. Pins 1 and 11 are tied together internally to source 1.2A.

The Pro model is different in that provides 24v, 600 mA power source to drive 24 Vdc accessories connected to Pin 11. An external 24 vdc power supply can also be connected to Pin 1 on the Pro model so that it can be switched across a load with an Output pin, such as Pin 3. This function is identical to the SensArray+ functionality.

Background

Power to energize external devices can be sourced in two different ways.

The SensArray is sourced either through POE input, or the external 56VDC (Pro model only).

SensArray One-Pro and Enterprise models can then power external devices via pin 1 or 11 on the GPIO connector, which provides +24 VDC to a maximum of 1200 mA.

Users should bear in mind that using GPIO power from the SensArray decreases the amount of power that can be provided to other POE devices connected to the SensArray.

GPIO Pin-out Specifications

Pin Number	SensArray One Pro, Enterprise	SensArray Pro
Pin 1	+24VDC output, max sourcing current 1.2 A	+24 VDC external (same as SensArray+)
Pin 2	External ground	
Pin 3	Output 1	
Pin 4	Output 2	
Pin 5	Output 3	
Pin 6	Output 4	
Pin 7	Input 1 (V<1 VDC = “0”, 5<V<24VDC = “1”)	
Pin 8	Input 2 (V<1 VDC = “0”, 5<V<24VDC = “1”)	
Pin 9	Input 3 (V<1 VDC = “0”, 5<V<24VDC = “1”)	
Pin 10	Input 4 (V<1 VDC = “0”, 5<V<24VDC = “1”)	
Pin 11	+24VDC output, max sourcing current: • 1.2 A for One Pro and Enterprise • 600 mA for Pro	
Pin 12	External ground	

Figure 7: The GPIO port, labeled “I/O”

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.

Sensor Description

UHF RFID Reader

The SensThys M-Power Reader is the engine that performs all the RFID tag reading functions, including sequencing through the antennas, setting RF power to each antenna, and collecting tags during any read period.

For high performance RFID operation, the SensArray platform can power up to three (3) UHF RF antennas, which can excite tags in front of them. These are powered via connection of a coaxial cable to one of the RP-SMA connectors, allowing illumination of tags in different directions and locations.

EPC Class 1 GEN 2 UHF RFID Tags

The SensArray reader 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 reader through backscatter modulation, received via the UHF antenna(s). 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.

Product Images

SensArray One

SensArray One-Pro

SensArray Pro

SensArray Enterprise

Drawings Diagrams

The SensArray models share many common features and are identical in physical size.

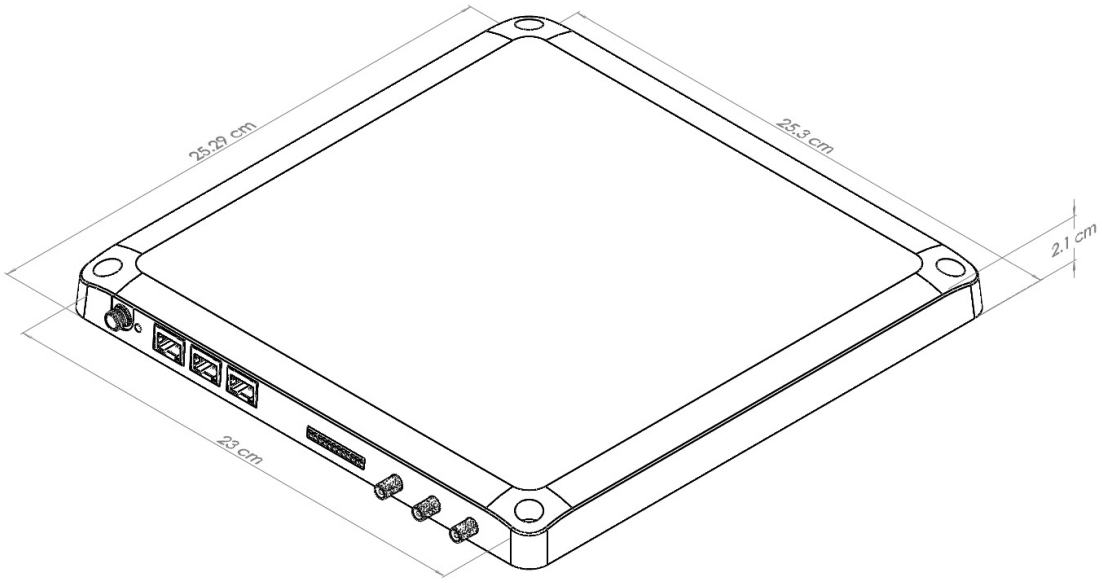


Figure 8: Perspective view of the SensArray Pro

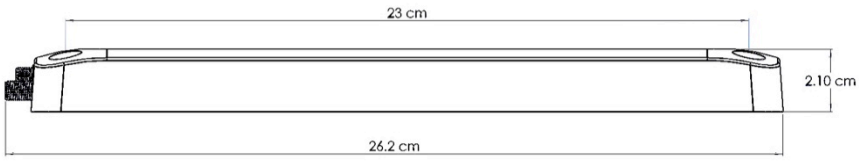


Figure 9: Side view of the SensArray Pro

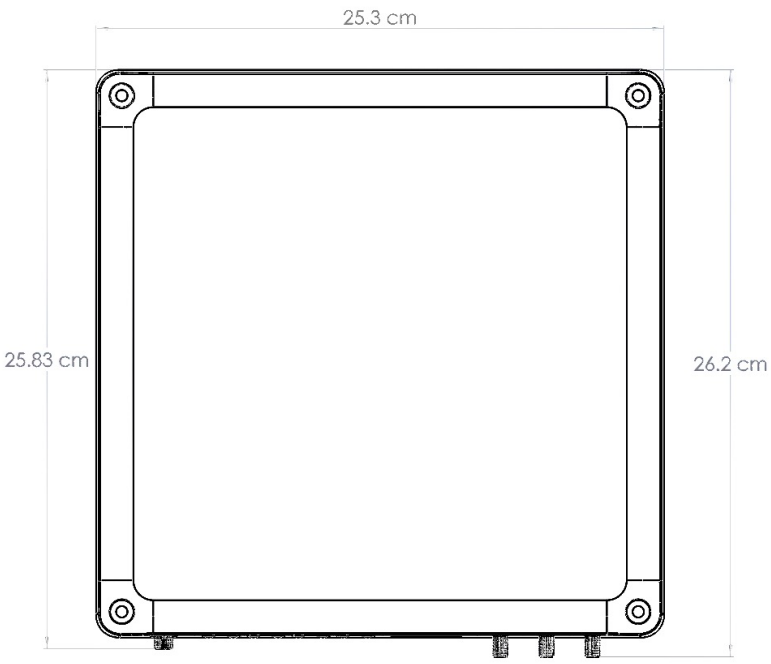


Figure 10: Plan view of the SensArray Pro

Cable Description

SensThys recommends that shielded CAT6/7 cables be used to connect to any of the PoE ports. SensThys also recommends that any Class 4 and Class 8 PoE injectors used to power the units be shielded as well. Providing a continuous ground to the SensArray unit is in accordance to best practices for powered reader installations.

RF cables: RG-xx cables, shielded, ruggedized (optional)
RF connectors: RP-SMA on reader end, TBD on antenna end

Ethernet cable: CAT6 cable, shielded, ruggedized (optional)
Ethernet connector: RJ-45

GPIO cable: 12-pin power or I/O cable
GPIO connector: 12-pin

Chapter 3 Installing the SensThys Console

The SensThys Console is the main User Interface (UI) to any of the SensArray readers. This software is available for download from SensThys.com. The RFID Console can be loaded onto any computer running Windows 7, 8 or 10.

Note: To access the technical support areas of the website, including downloads, the user will need to register for notifications.

SensThys Console Installation

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, refer to:

Tech Note 18-101: Configuring Firewall to Allow RFID Console to see all Readers

Tech Note 18-102: Installing RFID Console on Windows 10 PC

Chapter 4 SensArray Operation

Power and Computer Connections to the SensArray unit

The SensArray reader may be powered in three ways.

- Connect power injector attached to PoE+ Port 0, via CAT6 cable
- Connecting power from a standard POE+ enabled Ethernet switch, attached to PoE Port 0.
- Connect a 56V supply (Part Number SPS75W56VDC) to 48v port on the reader (Pro only)

For maximum deployment flexibility, we highly recommend powering the SensArray by connecting the OUT port of the SensThys PoE injector to PoE Port 0.

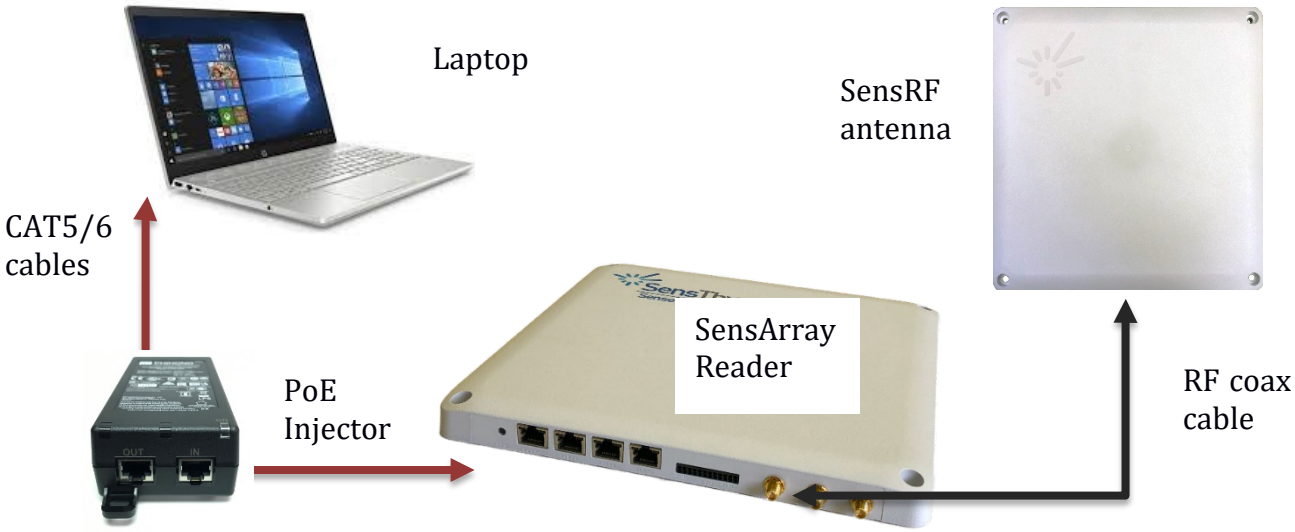
The computer is connected to the SensArray in one of three ways.

- Connect to the IN port on the PoE+ injector, output of the injector to Port PoE+0 on the SensArray reader
- Connect to a standard PoE+ switch, with the output of the switch (PSE) connect to the Port PoE+0
- If the DC supply (Part Number SPS75W56VDC) is used to power the unit, then the computer should directly connect to Port PoE+0.

Start-Up – Minimum Cable Connections

To start up the SensArray reader, the minimum configuration is:

- Ethernet connection from a PC or tablet, running SensThys Console, to PoE
- PoE to SensArray reader
- RF cable and connection to a UHF RF antenna



Hardware Startup

Connect all cables to the PC, power injectors and SensArray reader as shown in figure above.

Launch the Console on the PC.

Upon power up, the reader will commence the hand-shaking procedure with the Console, culminating in the SensArray being fully powered. Next, the CPU boots up, setting up its power architecture and becoming ready for operation.

During the power up and boot process, the primary status indicator LED will flash red. Once booted, the LED will flash green.

Figure 11: The SensArray in the process of booting. The LED flashes red.

Figure 12: The SensArray has finished booting and is ready for operation.

Introduction to SensyThys Console

SenThys Console is the main user interface with the SensArray unit.

The Console is available from the SenThys web site. Instructions to download and install the Console are detailed in Chapter 3, Installing the SensThys Console.

After launching the Console, the Console will find all SensThys units on the network, populating the Reader list, on the left side of the Console

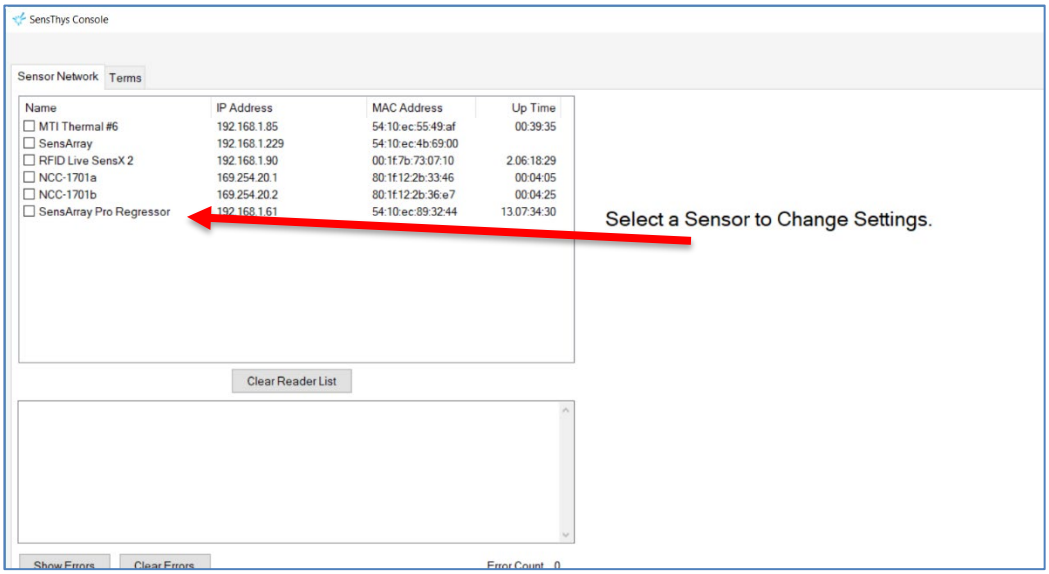


Figure 13: Example of the main screen of the RFID Console

As instructed, select a sensor to change or configure settings. Check the box or click on the name of the Reader. The Reader selected will be highlighted.

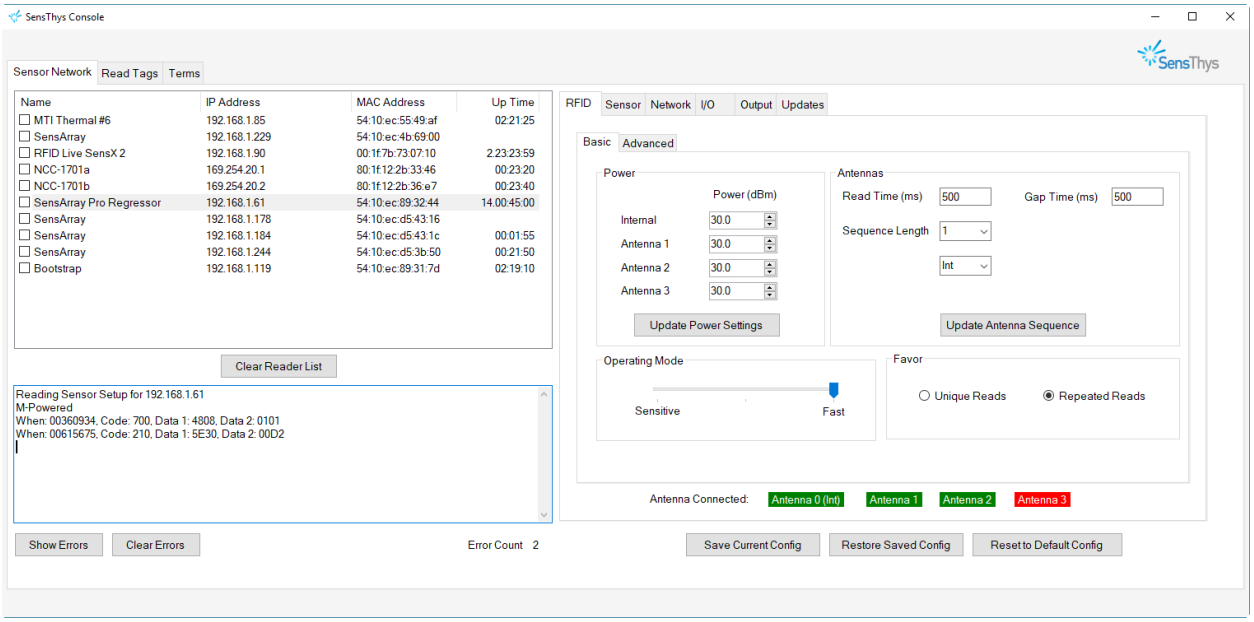


Figure 14: After selecting the unit, the RFID Console shows the Control Page for that unit

Figure 14 shows a Console with one SensArray Pro at 192.168.1.61 that is now active and ready to read tags.

The right side of the screen is a Control Page that displays the parameters that can be addressed for the selected Reader.

By selecting different tabs in the two menu bars, the operator can proceed to Reading tags or change various configurations of the reader, antenna sequence and GPIO connections.

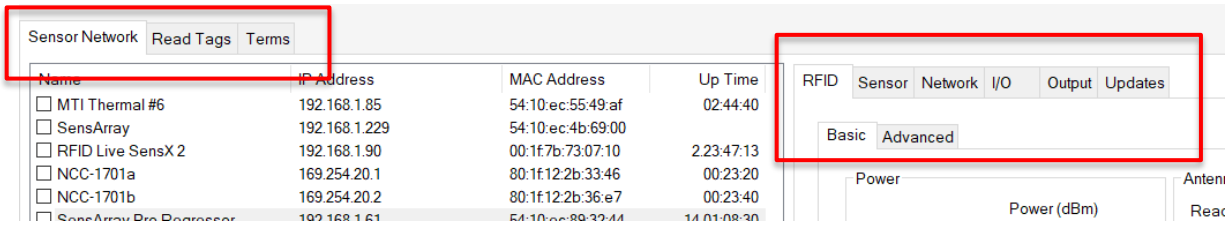


Figure 15: Two sets of tabs for Operation (left) and Configuration and Status (right)

RFID Operation Using Console

This section presents how to operate the various SensArray readers as a UHF RFID Reader.

Each SensArray model operates nearly identically with regard to the interface with the Console. Differences between the models are noted where necessary.

The SensThys Console is the primary interface with the SensArray. Through this interface the reader can:

- Scan for active readers
- Configure basic and advanced settings for specific readers
- Configure the sequence for connected Antennas
- Set Antenna RF power, for each antenna
- Read tags
- List all tags read
- Configure additional housekeeping and operational settings

The SensThys Console's default mode is for RFID operation. Default setting for RFID operation are set to most common tag-read scenarios. Change the Basic and Advanced setting as necessary to configure the reader to perform differently under varying operating conditions and tags scenarios.

Users can skip the configuration steps and go right to reading tags by going to the READ TAGS tab on the main Tag bar above the list of readers.

RFID Reader Configuration

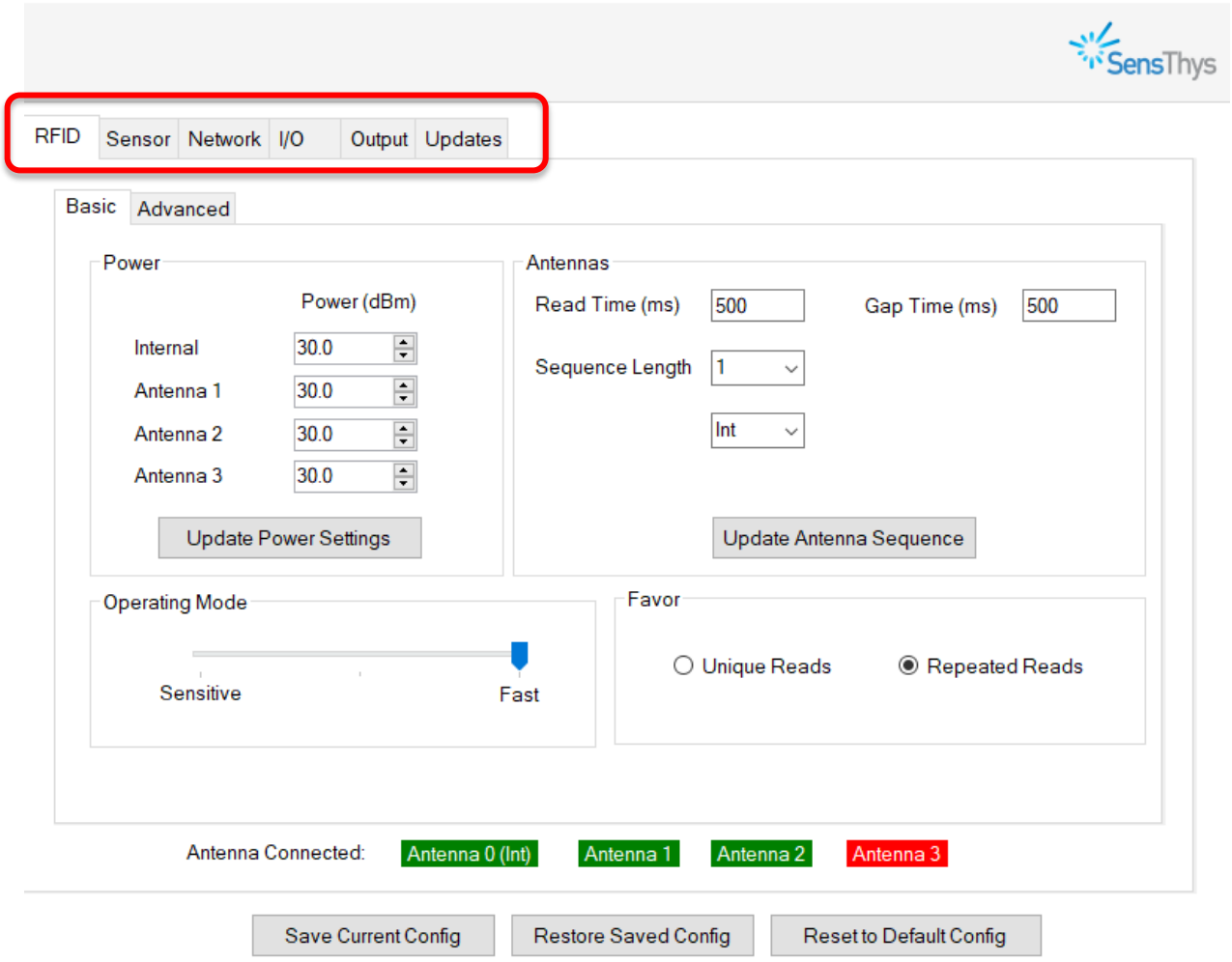


Figure 16: The antenna power menu within RFID setup. Example for SensArray Pro with two external antennas connected.

Within the Configure Readers workspace of the Console (right side), there are six subset of parameters that can be customized for your application:

- RFID Setup (the default when the Console first launches),
- Sensor – Model and Serial Number
- Network – IP Address, Heartbeat and Reboot
- I/O – GPIO Input and Output enable and selection
- Output – Data Output download
- Updates – Firmware and Bootloader access

RFID- Basic

RFID Setup has four sections:

- Antenna Power – Set RF power for each antenna, including internal antenna
- Antenna Sequencing – Set the Sequence of antennas used for reading tags
- Operating Mode – Select Reader Sensitivity or ability to read
- Favor – Select the reader to list only unique tags or list all tags read

Each SensArray has an internal antenna. Except for the One model, all other Readers have RF ports for 3 additional external antennas that can be addressed individually.

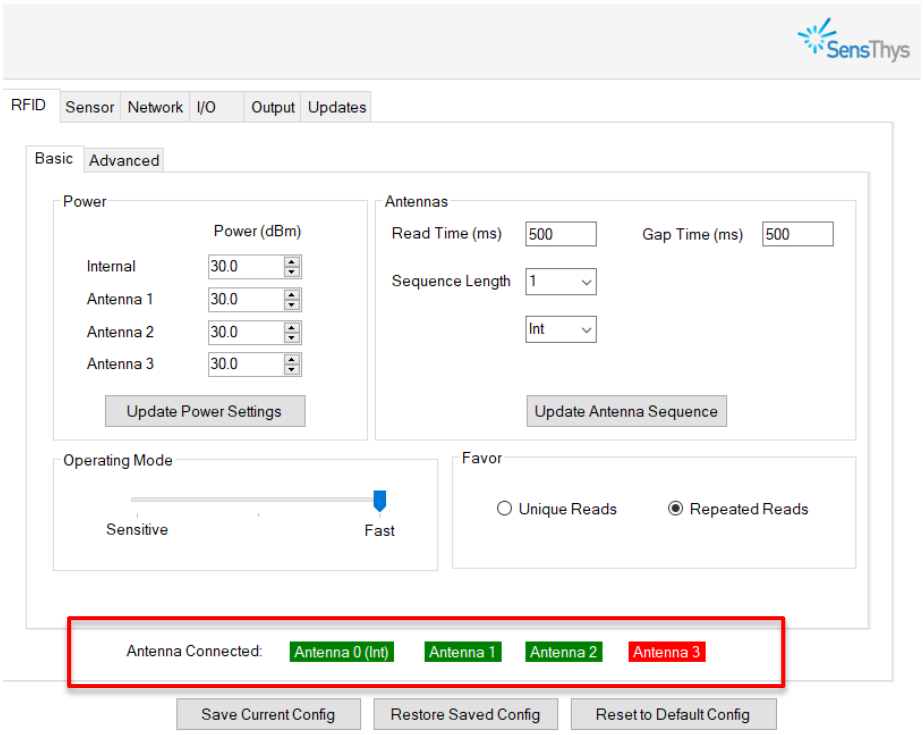


Figure 17: SensArray Pro example with 3 antennas

In Figure 17 example above, the RFID menu also shows the status of any antenna connected to the reader. The internal antenna "Antenna 0 (Int)" should always be green. Any additional antenna connected by RF cable to the reader will also be highlighted green. Red indicates no antenna connected to that RF port.

Power – Setting Each Antenna's RF Power

Setting the RF power is required for at least the Internal antenna and any External antennas that are connected to the Reader.

The antenna power setting for each of the four (4) RF outputs of the reader can be set independently from one another. Using the dropdown menu next to each antenna's *POWER* setting, select the RF transmit power for each antenna connection. +33dBm is the maximum setting. Default is +30 dBm.

Click on "Update Power Settings" to save the changes.

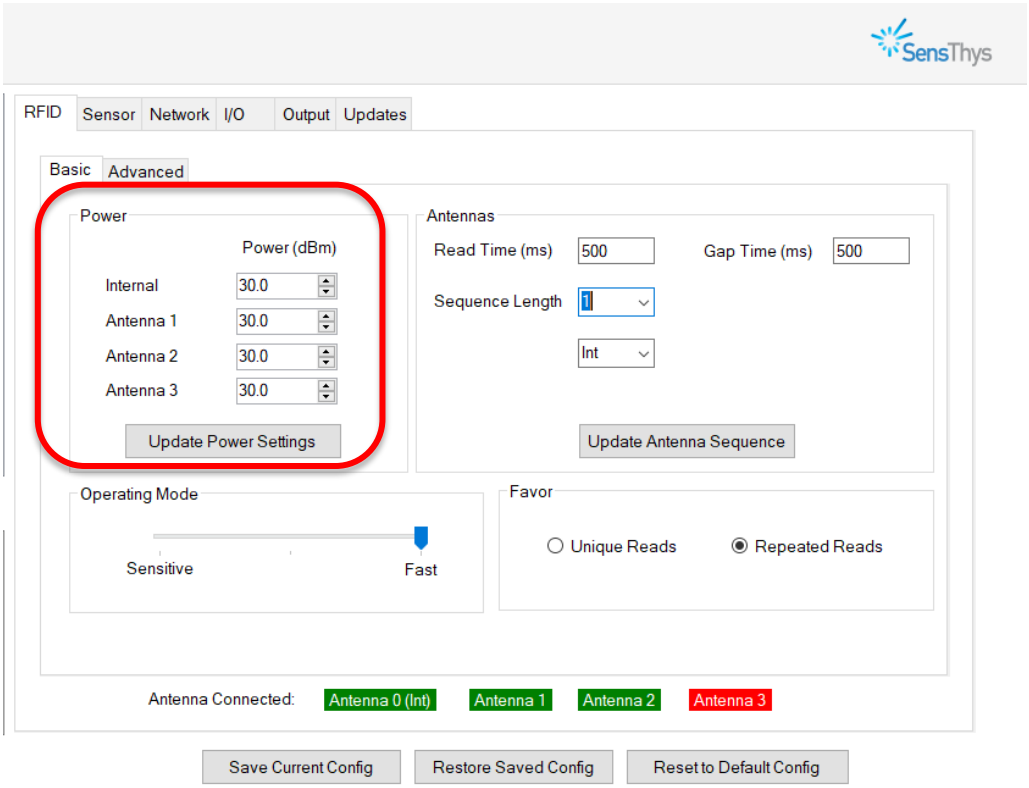


Figure 18: Setting antenna RF power to the same power level.

Operating Mode

RFID operating mode can be set to either FAST or SENSITIVE (default):

- FAST: The RFID reader is set to operate to read tags a quickly as possible, but the reader may not read tags that are difficult to read.
- SENSTIVE: The RFID reader is set to operate in more sensitive mode to read tags that are difficult to read, and subsequently, take more time to read.

Antennas – Read Time, Gap Time and Sequencing Antenna Order

The next action is to program the order and timing of the power delivery to the antennas.

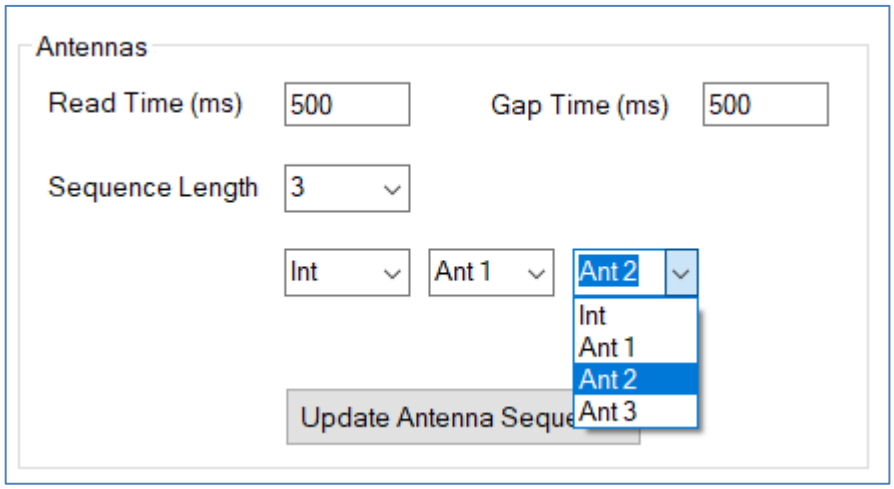


Figure 19: The unit is set for 500ms read, 500ms gap with three antennas.

Basic Antenna Read Timing

The SensArray reader will deliver power to the UHF antenna so that it can read tags during the *Read Time (in msec)*, and then pause (cut power) for a *Gap Time (in msec)* before initiating another read period. These two times are set to 500 ms by default.

Basic Antenna Sequencing

The *Sequence Length* specifies the number of antennas in the read sequence.

The SensArray reader will sequence through the number of active antennas in the length, and then repeated the sequence. Sequence Length can be less than the total number of connected antennas.

The sequence order is determined using the drop down menu for each antenna, selecting the order of the antennas from left to right. See Figure 19 above.

For example, in the Figures above, the default setting are 500ms read and 500 ms gap time. For one antenna, the *SEQUENCE LENGTH* is 1. For two antennas, the *SEQUENCE LENGTH* is 2. For three antennas, the *SEQUENCE LENGTH* is 3, etc. The sequence will typically start at Antenna 1 then through to Antenna 4, as indicated on the Console from left to right. A different antenna can be the start of the sequence.

Click on "Update Antenna Sequence" to save the changes.

CAUTION! Do not enable RF power to any external antenna port (Ant 1, Ant 2, or Ant 3) without connecting an antenna to the port.

Favor

Unique Reads setting is selected for fast read requirements. In this setting unique tags are read once and counted, and then not counted again when the reader sequences again to that tag. This can enable an effective fast read sequence by "ignoring" tags a second time.

Unique Reads can also be selected for dense tag environments where tags that are once read will not be read again, instead the reader will concentrate on finding new tags.

Repeated Reads setting is selected for reading all tags each time the reader sequences

RFID – Advanced

The Advanced tab under RFID allows you to configure the SensArray readers for the following:

- RF Link Setting
- Search
- Query Parameter
- Q
- Select Parameters

These parameters are for advanced users and are configured for specific reading scenarios. In some cases, the BASIC tab will already set these Advanced parameters for proper use.

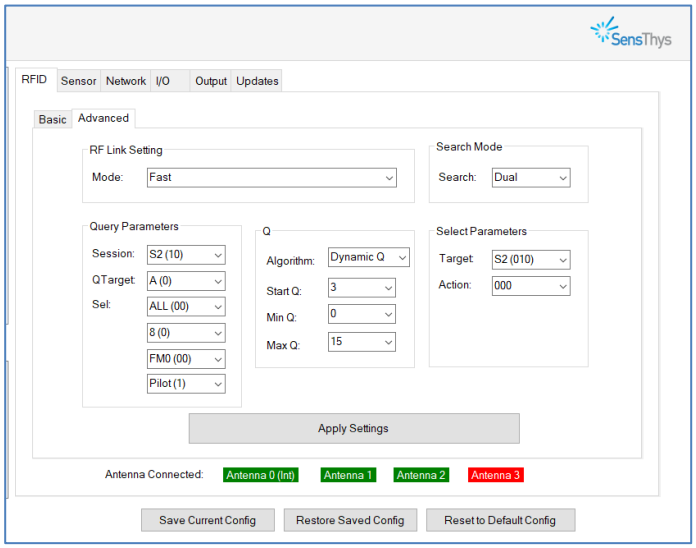


Figure 20: Menu for Advanced RFID Configuration

For additional information on these ADVANCED parameters, contact SensThys Technical Support.

Reading Tags

This section describes how to read RFID tags.

Place an RFID tag, or tags, in front of the unit. In the upper left Console, click on the “Read Tags” tab. At the bottom of that screen, click on the “Read” tab. The unit will then begin moving through its test sequence displaying results.

Set a period of time for Read to stop in the STOP AFTER (secs), e.g. 20 seconds. The value displayed in READ TIME will show the elapse time of the read cycle.

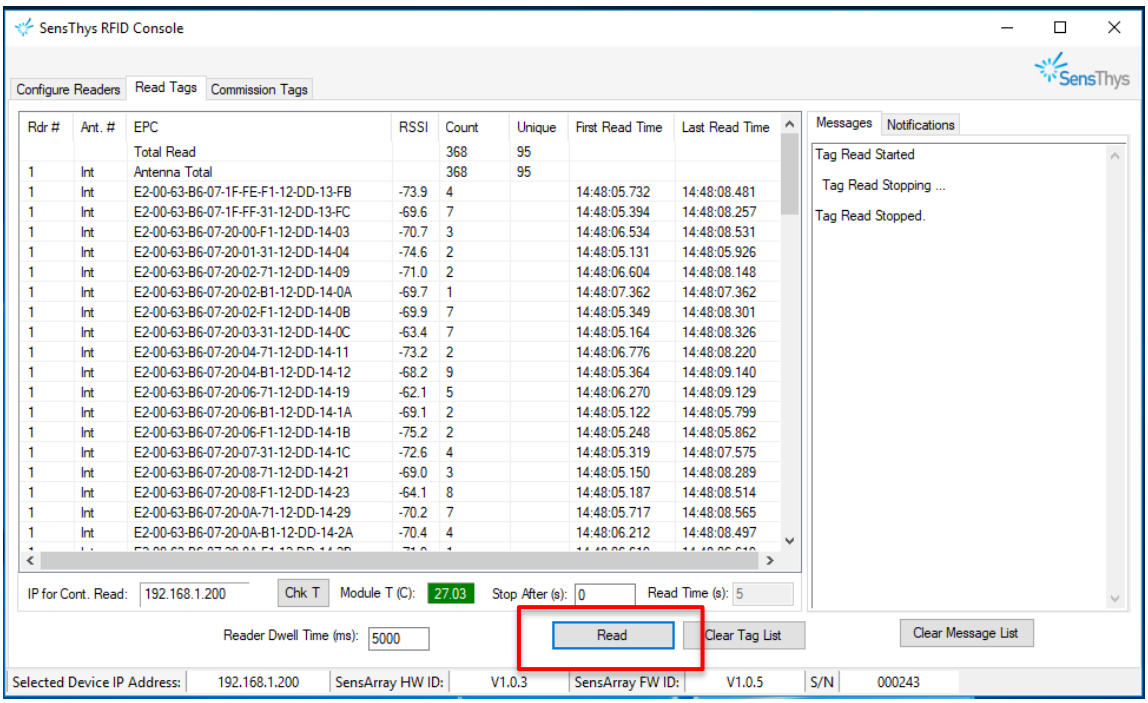


Figure 21: The "Read Tags" section. The antenna(s) in operation, with the tags being read, are shown.

The tag table shows the “Total Read” which is the total number of read events. In addition, for each antenna in the sequence of testing, the tag EPC and RSSI (Return Signal Strength Indicator) and the number of times the tag has been counted are shown.

The UNIQUE reads value indicates the number of unique tags that have been illuminated.

The COUNT will continually increment as the reader cycles through the antenna sequence, for the total number of reads until STOP.

To stop reading tags, click on “Stop”. CLEAR TAG List will clear the list so that another read cycle can be started.

Sensor Tab

This tab identifies the Reader unit that is currently being addressed by the SensThys Console.

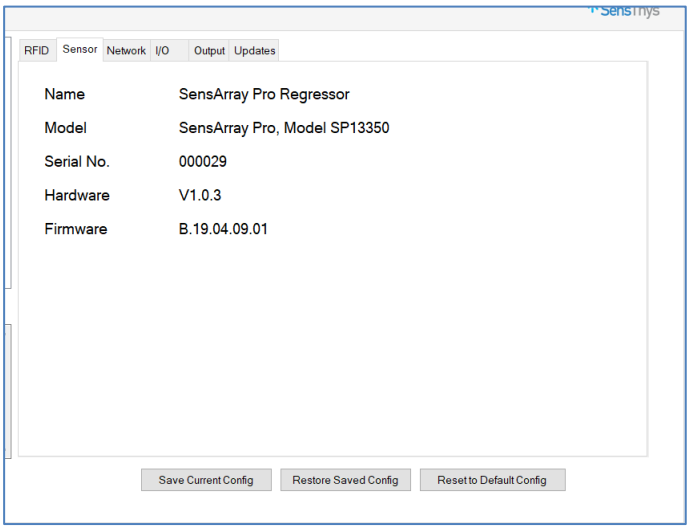


Figure 22: Model Number and Serial Number

Network Tab

This tab is displays the network IPv4 setup information and other housekeeping items

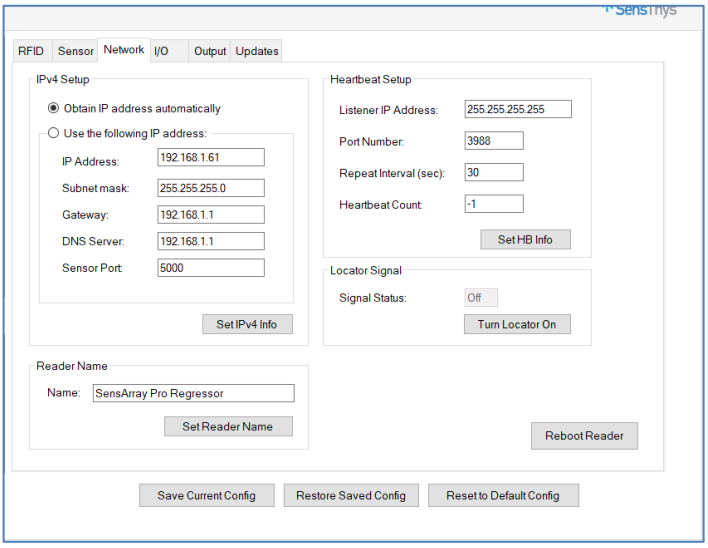


Figure 23: Networking Information for the Reader

Output Tab

The data output from the SensArray reader can be exported as shown below. The file can be saved as .xls or other format after saving it as a .csv file.

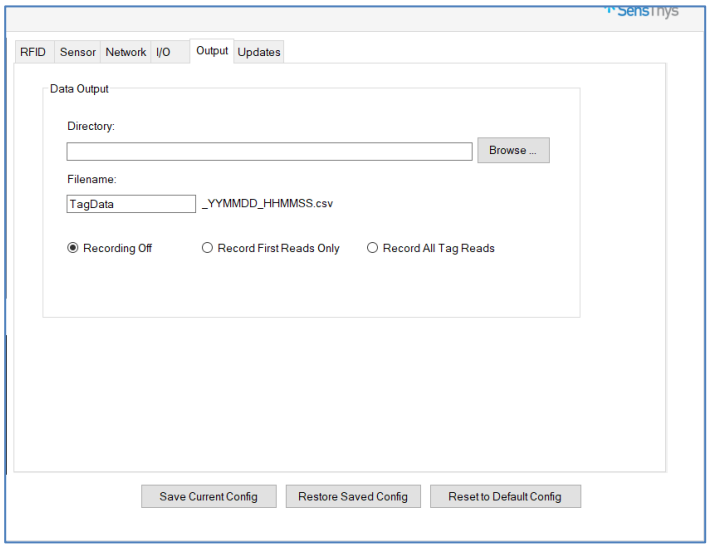


Figure 24: Networking Information for the Reader

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	Improper cable connections. Faulty reader. 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 SensArray ports. Replace reader.
RFID 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 are good. Status LED on SensArray are flashing green.	Check that PC firewall has allowed RFID Console to communicate with Public Networks. Refer to Tech Note 18-102 “ Configuring PC Firewall for RFID Console” Replace the reader.
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.