

User Guide

SENSX EXTREME READER



Revision History

Version	Author	Date	Changes
1.3	J. Major	January 2020	Initial Released Document
1.4	N. Mitchell	November 2021	Updated Copyright

Legal Notices

Copyright ©2019-2021 SensThys Inc. All rights reserved.

SensThys has intellectual property rights relating to technology embodied in the products described in this document, including without limitation certain patents or patent pending applications in the U.S. or other countries. This document and the products to which it pertains are distributed under licenses restricting their use, copying, distribution and de-compilation. No part of this product documentation may be reproduced in any form or by any means without the prior written consent of SensThys Corporation and its licensors, if any. Third party software is copyrighted and licensed from Licensors. SensThys, Extreme and other graphics, logos, and service names used in this document are trademarks of SensThys in the U.S. and other countries. All other trademarks are the property of their respective owners. U.S. Government approval required when exporting the product described in this documentation.

Federal Acquisitions: Commercial Software -- Government Users Subject to Standard License Terms and Conditions. U.S. Government: If this Software is being acquired by or on behalf of the U.S. Government or by a U.S. Government prime contractor or subcontractor (at any tier), then the Government's rights in the Software and accompanying documentation shall be only as set forth in this license; this is in accordance with 48 C.F.R. 227.7201 through 227.7202-4 (for Department of Defense (DoD) acquisitions) and with 48 C.F.R. 2.101 and 12.212 (for non-DoD acquisitions).

DOCUMENTATION IS PROVIDED "AS IS" AND ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS AND WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT ARE HEREBY DISCLAIMED, EXCEPT TO THE EXTENT THAT SUCH DISCLAIMERS ARE HELD TO BE LEGALLY INVALID.

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 émise 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."

Extreme 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 Extreme has been certified for use with an integrated flat antenna with a maximum gain of 8.5 dBi or an external flat antenna with a gain between 8 and 12.0 dBi.
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 - 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 SensX Extreme 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'Extreme doit être mis en oeuvre et maintenu par des professionnels.
2. L'Extreme 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 émise isotropiquement (EIRP) équivalente soit supérieure à celle requise pour une communication réussie.

WEEE Directive - PENDING

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

SensX Extreme 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

SensX Extreme 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

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

SensX Extreme are registered trademarks of SensThys.

Table of Contents

LEGAL NOTICES	2
EXTREME PRODUCT COMPLIANCE NOTES	3
TABLE OF CONTENTS.....	5
CHAPTER 1 INTRODUCTION	8
About this Manual.....	8
Product Overview	8
Power, Control and Antenna Equipment.....	9
CHAPTER 2 PRODUCT SPECIFICATIONS	11
SensX Extreme Specifications	11
RFID Reader Specifications	11
Sensors Specifications	11
Antenna and RF Interface Specifications.....	11
Digital Interface Specifications	12
Physical and Environmental Specifications	12
Power Specifications	13
Compliance	13
Part Numbers.....	14
Power Supply.....	15
Physical Connections	16
RF Antenna Connectors.....	16
Ethernet Connector	17
Wi-Fi/Bluetooth Connector.....	17
GPS Connector.....	18
GPIO (General Purpose Input/Output) Connector.....	18

Communication Description	21
Ethernet (TCP/IP)	21
Wi-Fi	21
Bluetooth	21
Sensor Description	22
UHF RFID Reader	22
GPS Location	22
Physical Specifications	23
IP-67 Rating	23
Extended Temperature Range	23
Drawing Diagrams	24
Cable Description	25
 CHAPTER 3 INSTALLING THE SENSTHYS CONSOLE	 26
SensThys Console Installation	26
Identify the IP address of the Extreme Reader using SensThys Console	27
Configure the SensX Extreme Wi-Fi Settings (to connect to Reader via Wi-Fi)	27
Configure the SensX Extreme Reader to Pair with a Bluetooth device	29
 CHAPTER 4 SENSX EXTREME OPERATION	 31
Start-Up – Minimum Cable Connections	31
Introduction to SensThys Console	32
RFID Operation Using Console	34
RFID Reader Configuration	35
Reading Tags	40
Sensor Tab	41
Network Tab	41
Output Tab	42
GPS Tab	42

TROUBLESHOOTING GUIDE.....	44
-----------------------------------	-----------

CHAPTER 1 Introduction

The new SensX Extreme rugged reader is Senthys' highest performance RFID reader enclosed in the industry's highest rated IP-67 industrial-grade and weather-tight chassis for harsh environments. The Extreme can be deployed where traditional readers have previously not been suited to be located. Such installations would include those outdoors for agriculture, construction, mining, energy, heavy manufacturing and logistics where extreme temperatures and weather conditions are commonplace.

About this Manual

This User's Manual provides instructions for configuring and operating the Extreme reader.

This document is designed for use by RFID system integrators, IT networking professionals, and software developers.

At SensThys.com, you can find additional information about multiple sensors such as RFID and BLE Beacons, PoE, networking and the capabilities and benefits of the SensX Extreme reader unit. 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 Extreme integrates the new M-Power SensThys Advanced Reader into a weather-tight, IP-67-rated enclosure designed for reliable, 24-hour operation in harsh environments and temperatures ranging from -40°C to +55°C.

The Extreme is ideal for outdoor installations for shipping and logistics, agriculture and construction, as well as for indoor RFID detection applications such as in warehouses and agriculture nurseries. For indoor applications, the IP67 rating makes the Extreme ideal for high humidity or condensing environments, while the rugged housing makes the Extreme ideal for direct mounting to forklifts, equipment carts, etc.

The extensive capabilities of the Extreme are:

- M-Power – SensThys' advanced high-power, high-sensitivity multi-sensor reader designed for industry-leading tag read rates.
- Multiple sensors that are native to the Extreme include:
 - UHF RFID – Tag reader for EPC Class 1 Gen2 RFID tags
 - GPIO – 6-pin GPIO interface to read digital inputs from up to two (2) external devices and to control the operation of up to two (2) external devices
 - GPS – Location data is detected (antenna needed)

- Ethernet 10/100Base-T (TP/IP), including WiFi (802.3ac) and Bluetooth 4.1 connectivity for user-friendly control and configuration via various PC, tablet and hand-held user devices;
- Simplified power requirements: The Extreme is an IEEE 802.3at powered device (PD). Any IEEE 802.3at or 802.3bt power source (PSE), such as a PoE injector or any SensThys SensArray product (PSE), can fully power the Extreme;
- Weather-tight enclosure (IP-67-rated) that can be installed in harsh operating environments and operate reliably as an RFID reader or a BLE beacon reader for any number of applications

The PC-based SensThys Console is the main user interface to the Extreme unit. It is designed to configure and control the Extreme unit, as well as record and export the read tag data.

Power, Control and Antenna Equipment

To interface with the Extreme, the following equipment is needed:

- Power – The Extreme is an 802.3at compliant device (PD). Power can be delivered using PoE connection on the Ethernet RJ-45 port using the SensThys Power Injector (SPOE29WC4). The Extreme can also be powered by any 802.3at or 802.3bt PSE device. Additionally, the Extreme can also be powered by +24 VDC via the GPIO port.
- Control – A Windows 7, 8, or 10 PC or tablet running the supplied SensThys Console. Software applications to run Extreme may also be developed for Extreme using provided API and SDK documentation.

To operate the various data and RF interfaces on the Extreme, the following additional cables are needed:

- Data cabling –
 - Ethernet: CAT6 or CAT7 shielded cabling with RJ45 connectors should be used to connect to the Ethernet port on the Extreme unit.
- RF cabling – The RF antennas connect to the Extreme through coaxial cabling with reverse polarity TNC connectors on one end for connecting to the Extreme's jacks and compatible connectors on the antenna end.
- GPIO – IP67-rated multi-wire cabling is used to connect to the GPIO connection on the Extreme. The GPIO connection requires minimum of 6 wires for the 2-input/2-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 Extreme unit.

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

- External UHF RF Antennas – The Extreme has been qualified to run several industry standard UHF antennas with gain between 5dB and 12dB. The Extreme can drive up to four external antennas.
- WiFi /Bluetooth Antenna – A dual-use WiFi/Bluetooth antenna is used to connect to the Extreme via WiFi (via an access point) or Bluetooth. Because both WiFi and Bluetooth operate at similar frequencies a single antenna is used and a single RP-SMA connection is provided on the Extreme.
- GPS Antenna - The Extreme has GPS sensor that will provide location data. An active GPS antenna operating at 1575.42 MHz is required. The Extreme will provide the 3 volts necessary to power the GPS antenna.

Chapter 2 Product Specifications

The following is a detailed listing of the specifications for the Extreme reader.

SensX Extreme Specifications

RFID Reader Specifications

Feature	Specification
Product Name	SensX Extreme
Reader Protocol	EPC Class 1 Gen 2 and 18000 – 6C
Operating Frequency	902.75 MHz – 927.25 MHz (US Band) 920.00 MHz - 926.00 MHz (AU Band)
Hopping Channels	50
Channel Spacing	500 kHz
Channel Dwell Time	< 0.4 seconds
RF Transmitter	< 30 dBm
Modulation Methods	Phase Reversal – Amplitude Shift Keying (PR-ASK) Double Side Band – Amplitude Shift Keying (DB-ASK)
20 dB Modulation Bandwidth	< 100 kHz

Sensors Specifications

Feature	Specification
UHF RFID	EPC Class 1 Gen 2 and 18000- 6C
GPS	GNSS

Antenna and RF Interface Specifications

Feature	Specification
External RF Antenna Ports	4 x RP-TNC

RF Transmit Power (dBm)	+33 dBm
Operating Frequency	902.75 MHz – 927.25 MHz (Region code is field assignable via software)

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

Feature	Specification
Ethernet (Data, Power)	10/100Base-T (TCP/IP); Ethernet Rugged IP67 RJ-45 with dust cap, accepting Class 4 PoE
Wi-Fi and Bluetooth	802.11a/b/g/n/ac (2.4 and 5 GHz); Bluetooth 4.1 (BR+EDR+BLE); Rugged IP 67 RP-SMA (pin) with cap and chain
GPIO (incl. Input power)	2 input, 2 output, optically isolated; +12 to 24VDC input and gnd; Rugged IP67 6-pin circular male pin connector with dust cap
GPS	GNSS engine; Rugged IP67 SMA (hole) with cap and chain



Physical and Environmental Specifications

Feature	Specification
Dimensions (l-w-h) including interfaces	(mm) 240 x 55 x 125 / (in) 9.4 x 4.9 x 2.1
Weight	Approximately 1120 g (2.46 lbs)
Operating Temperature	-40°C to +55°C
Operating Environment	100% humidity

Power Specifications

Feature	Specification
Input Power (PoE)	802.3at PoE (25.5 - 30W) <ul style="list-style-type: none"> RJ-45, Class 4 PD (receive power) 802.3at Injector (P/N SPOE29WC4)
Software Support	SensThys Console, SDKs (VB.Net, C# and Java)
Power Consumption (33dBm)	Power into Extreme – 13-15W typical

Compliance

Feature	Specification
Compliance Certifications	IP-67 (designed to be compliant) UL: Safety tested to UL 60950-1 (pending) Shock and Vibration: MIL-810G
Country Compliance	US: FCC Part 15; FCC ID: MAD-RU00-M03  Australia: ACMA AS NZS 4268 New Zealand - TBD  China: CMIIT ID: 2019DJ1414 Industry Canada: pending

Part Numbers

	Extreme
North America	SX11480F
Europe	SX11480E

Power Supply

SensThys recommends using the shielded SensThys injector (P/N:SPOE29WC4), as it is fully 802.3at compliant.

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

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.

The shielded PoE+ injector has a metal trim around the RJ-45 connector. This shield makes contact with the shield on the CAT6 cable to provide a shielded, grounded connection.

Physical Connections

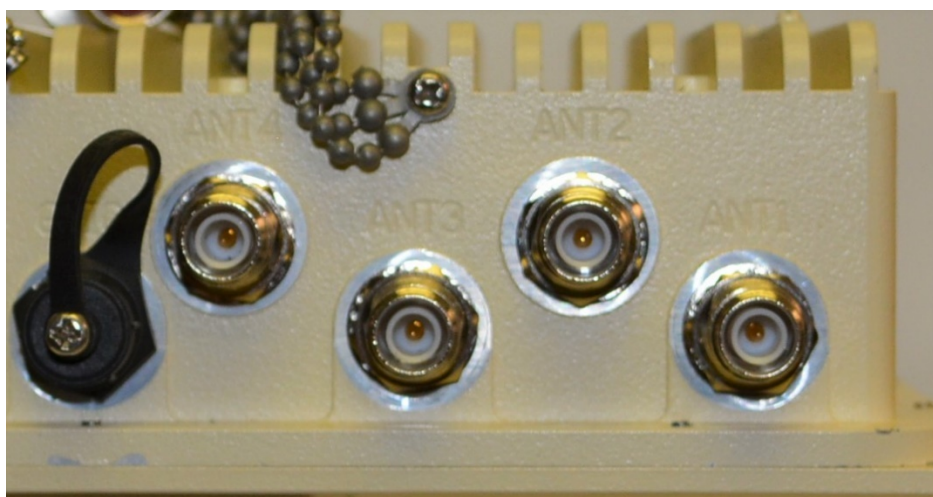


RF Antenna Connectors

The Extreme provides four (4) RP-TNC connectors (pins) on the unit for connecting up to four (4) UHF RF antennas. The connectors are labeled “ANT1”, “ANT2”, “ANT3” and “ANT4” from right to left on the unit.

The RP-TNC connectors are covered by cap and chain when not in use.

For most applications standard RF cabling is suggested. To maintain the IP-67 compliant integrity of the installation, RF cables that are built to be IP-67 compliant should be used.



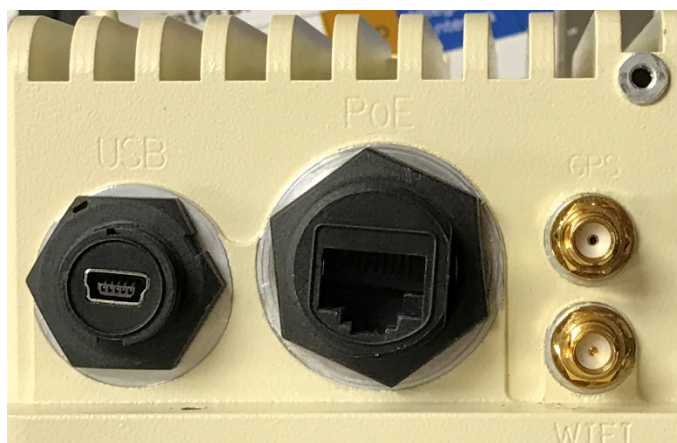
Ethernet Connector

The Extreme provides a ruggedized RJ-45 connector for standard Ethernet and PoE+ connectivity. The connector is labeled “PoE”.

The Ethernet connection is not crossover. It is not auto-MDIX port.

The Extreme accepts power from 802.3at or 802.3bt PSE units.

The RJ-45 connector should be covered by the duct cap when not in use.



Wi-Fi/Bluetooth Connector

Wi-Fi and Bluetooth connections on the Extreme uses the same RP-SMA connector and is located on the center of the unit. This connector is a RP-SMA, with a pin, labeled “WIFI”.

A dual-use Wi-Fi/Bluetooth antenna is used for both Wi-Fi and Bluetooth connectivity. The corresponding connector on the cable (from the antenna) is a RP-SMA (hole).

The cap and chain are used to cover the connector when not in use.

GPS connector (above)
and WIFI connector
(below)



GPS Connector

The GPS connection on the Extreme uses an SMA connector, with cap and chain, located in the center of the unit. The connector is labeled “GPS”.

The GPS function on the Extreme is active (i.e. display latitude and longitude on the SensThys Console) when a GPS (active) antenna is connected to the SMA port on the unit.

The GPS function requires an **active** GPS antenna (powered by 3 vdc from the SensX) with SMA male connector. The antenna operates at 1575.42 MHz. The 3 volts comes from the SMA center conductor.

Note: Proceed with caution when connecting the SMA cable end to Reader that the center pin does not come in contact with the grounded part of the connector on the Reader. Doing so could damage the GPS Antenna or the Reader.

The cap and chain are used to cover the connector when not in use.

CAUTION: Power to the Extreme should be turned off while connecting and disconnecting the GPS antenna to prevent damaging the antenna or the Extreme unit.

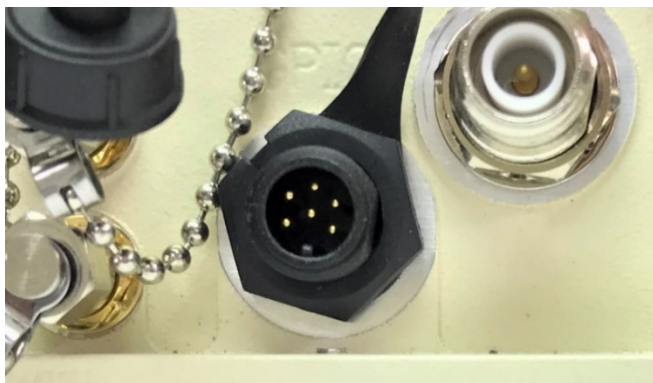
GPIO (General Purpose Input/Output) Connector

The SensX Extreme GPIO port provides two inputs and two outputs, which are all opto-isolated. A VCC input pin provides power and voltage level that is used on the two outputs when configured as *High*.

Toggling the GPIO outputs simply opens or closes an internal transistor switch inside the GPIO logic that allows/prevents current to flow from the VCC voltage pin to the external output pin to ground. (Please see the *Extreme GPIO Deployment Guide* for more information and example circuits).

See connector/pin description below.

GPIO Pin-out Definition (Note the socket orientation is upside down)



The GPIO consists of:

- 2 input pins that expect *Low* to be below $\frac{1}{2}V$ or *High* to be above 3V. **Voltage is not to exceed 24V.**
- 2 output pins that are 0V when representing *Low* or when *High* take on the voltage supplied on the VCC pin (anywhere from 5V to 24V).

Pin	Function	Wire Color	Description
1	Input 2	White	If Pin 1 (Input 2) < 0.5V: This is interpreted as <i>Low</i> If Pin 1 (Input 2) > 3V (but <24V): This is interpreted as <i>High</i> e.g. Both 3.3V and 5V would be <i>High</i>
2	Ground	Black	
3	Input 1	Blue	If Pin 3 (Input 1) < 0.5V: This is interpreted as <i>Low</i> If Pin 3 (Input 1) > 3V (but <24V): This is interpreted as <i>High</i> e.g. Both 3.3V and 5V would be <i>High</i>
4	Output 2	Yellow	When <i>High</i> , Pin 4 (Output 2) is set to voltage of VCC (Pin 5) otherwise is zero volts.
5	VCC	Red	GPIO Input voltage (5-24 VDC).
6	Output 1	Green	When <i>High</i> , Pin 6 (Output 1) is set to voltage of VCC (Pin 5) otherwise is zero volts.

Communication Description

Ethernet (TCP/IP)

Main communication interface with the Extreme is via Ethernet (TCP/IP) connection, typically through the CAT5/6 cable from your PC platform or through a Ethernet switch, or an WiFi access point.

The Ethernet connector is 10/100Base-T, RJ-45 on the Extreme unit.

Through the Ethernet connection, the SensThys Console (client program) will communicate, configure and collect data from the Extreme unit. This is detailed further in Chapter 3.

A CAT6/7 shielded cable is necessary to support Ethernet connectivity.

Wi-Fi

The Extreme unit can be connected via Wi-Fi, as a wireless Ethernet connection. The connection is compliant to 802.11a/b/g/n/ac (2.4 and 5 GHz).

Through the RF Console, the Extreme unit can be connected to a local access point. This is detailed in Chapter 3, Configure the SensX Extreme Wi-Fi Connection.

On the PC platform, go to the Network and Internet Settings to find the Access point (example: InSite_2p4GHz). Click on **Connect**. This will connect the PC to the SensX Reader via Wi-Fi thru the access point.

A Wi-Fi/Bluetooth antenna is necessary to support Wi-Fi connectivity.

Bluetooth

The Extreme unit can be connected by Bluetooth as a connected device, once it has been discovered by the pairing device. The procedure to pair any device to the Extreme is simple and only requires the MAC address of the pairing device. This procedure is detailed in Chapter 3, Configure the SensX Extreme Reader to Pair with a Bluetooth Device.

The Extreme complies to Bluetooth 4.1(BR+EDR+BLE). A Wi-Fi/Bluetooth antenna is necessary to support BT connectivity.

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 Extreme can power up to four (4) 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-TNC connectors, allowing illumination of tags in different directions and locations.

EPC Class 1 GEN 2 UHF RFID Tags

The Extreme 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 Extreme 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.

GPS Location

The GPS function on the Extreme is active when a GPS (active) antenna is connected to the RP-SMA port (hole) on the unit.

The GPS function requires an active GPS antenna (powered by 3 vdc from the SensX) with a male RP-SMA connector (pin). The antenna operates at 1575.42 MHz. The 3 volts comes from the SMA center conductor.

The GPS function is provided by Ublox MAX-7q GNSS module. Output from this circuit include the GPS/GNSS data and 3 volts (2.7 to 3.6 v) for the active GPS antenna.

GPS Latitude and Longitude data is displayed on the SensThys Console., GPS tab.

Note: Proceed with caution when connecting the SMA cable end to Reader that the center pin does not come in contact with the grounded part of the connector on the Reader. Doing so could damage the GPS Antenna or the Reader.

CAUTION: Power to the Extreme should be turned off while connecting and disconnecting the GPS antenna to prevent damaging the antenna or the Extreme unit.

Physical Specifications

IP-67 Rating

The Extreme unit has been designed to be IP-67 rated, that is, “dust tight” and protected against immersion in water. Specifically:

- The IP-67 electronic enclosure is rated to withstand complete immersion in up to 1 meter (3 ft. 3in.) of water for 30 minutes.
- The enclosure is protected against dust that may harm equipment.

The Extreme has a metal lid and gasketing to ensure seal integrity and to protect the electronics within.

The connectors on the unit are also rated for IP-67 compliance, and the caps and chains, and dust caps are also used to provide compliance.

To achieve or maintain IP-67 performance for any Extreme installation, all cabling, including Ethernet, RF antenna cabling, GPIO, GPS and Wi-Fi/Bluetooth ***MUST BE IP-67-compliant.***

Extended Temperature Range

The Extreme unit is designed with its heat sink properties integral to the housing. Unlike other readers on the market, the metal structure of the entire housing and the cooling fins all contribute to the industry-leading extended operating temperature of -40°C to +55°C, or -40°F to +131°F. This design makes the Extreme ideal for operating at extreme temperatures both cold and hot, but also where temperature swings can be significant.

The Extreme unit is also designed for deep cold start, that is, to start operation at -40°C. As well, the Extreme can also start operation at hot end, at +55°C.

Drawing Diagrams

The Extreme reader dimensions are presented below (in mm):

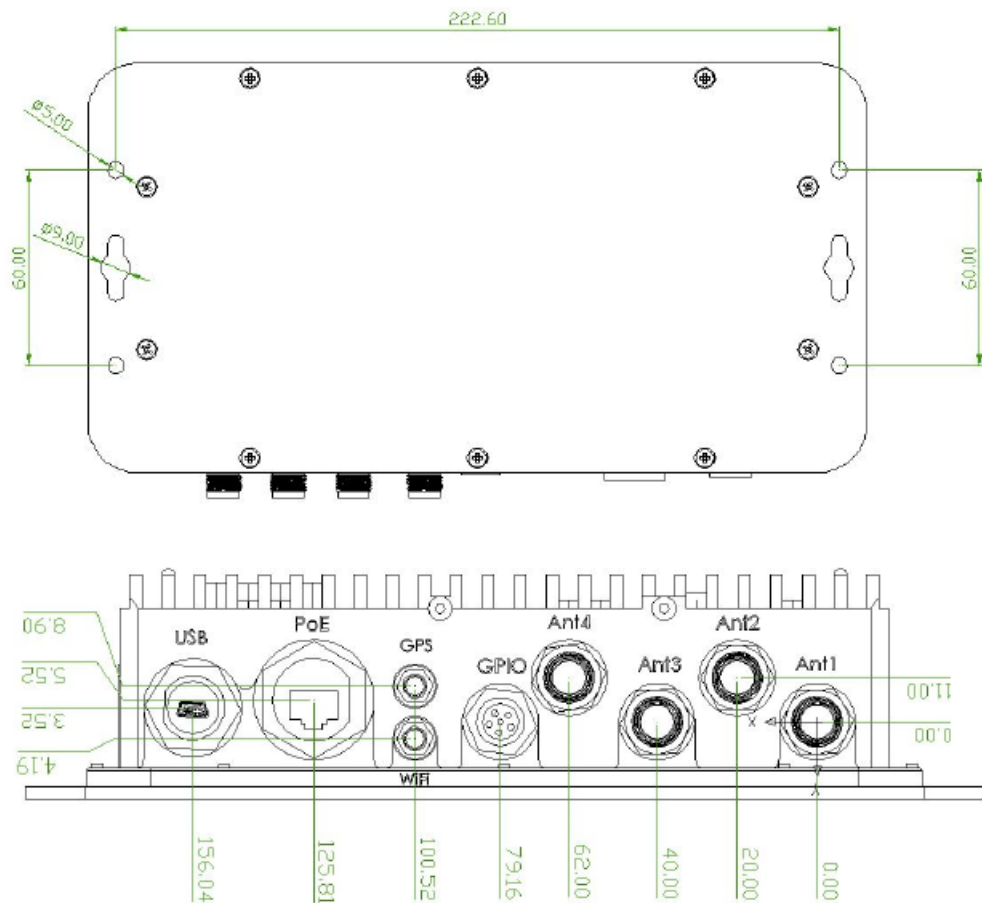


Figure 1: Dimensions of the Extreme

Cable Description

To ensure that the IP67 rating for the Extreme is maintained, the cables connecting to the Extreme should be constructed using hardware, i.e. cable connector hardware and cabling, that result in an IP-67-compliant cable.

RF cables: RG-xx cables, shielded, ruggedized

RF connectors: Ruggedized.

Ethernet cable: CAT6 IP67 cable, shielded, ruggedized

Ethernet connector: Ruggedized.

GPIO cable: 6-pin power or I/O cable

GPIO connector: Ruggedized. Cylindrical connector (pins)

CHAPTER 3 Installing the SensThys Console

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

A wireless Ethernet connection through Wi-Fi can also be used in place of a direct CAT6 cable connection. Identifying the Wi-Fi connection is described below.

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 SensThys 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

4. The Console can be enabled by selecting the icon on the desktop, or from the windows program bar.

Once enabled the Console will open and start scanning for readers within the network. Otherwise proceed with the steps below to connect to the Extreme unit.

Identify the IP address of the Extreme Reader using SensThys Console

1. Connect PC Cat6 Ethernet cable to PoE (In) source. Connect PoE (out) to Extreme “PoE” port with CAT6 cable.
2. Connect the AC power supply to a power outlet. This power the Extreme unit.
3. Start the SensThys Console on PC. Check the Reader Table for SensX Extreme reader. Note the IP Address. Should be **192.168.xxx.xxx** with name “SensX Extreme”.

Configure the SensX Extreme Wi-Fi Settings (to connect to Reader via Wi-Fi)

1. Connect PC to Reader via Ethernet cable. Connect Wi-Fi antenna to Extreme Reader Wi-Fi port.
2. Open the RF Console and identify the Extreme reader from the Reader List.
3. Go to Workspace Screen, the *Network* tab on the Menu Bar.
4. Input the parameters for Wi-Fi in the Wi-Fi Configuration section:
 - a. Enter SSID of the Access Point/router to connect to. Example: **InSite_2p4GHz**
 - b. Enter the Password for this Access Point. Example: **12345678**
 - c. Click on “Connect”

RFID

Sensor(s)

Network

Output

IPv4 Setup

☒ Obtain IP address automatically

☐ Use the following IP address:

IP Address:

Subnet mask:

Gateway:

DNS Server:

Sensor Port:

Set IPv4 Info

Heartbeat Setup

Listener IP Address:

Port Number:

Repeat Interval (sec):

Heartbeat Count:

Set HB Info

WiFi Configuration

Access Point Name: InSite_2p4GHz

Password:

Connect

Reader Name

Name: Marla Regression Tester

Set Reader Name

Reboot Reader

Save Current Config

Restore Saved Config

Reset to Default Config

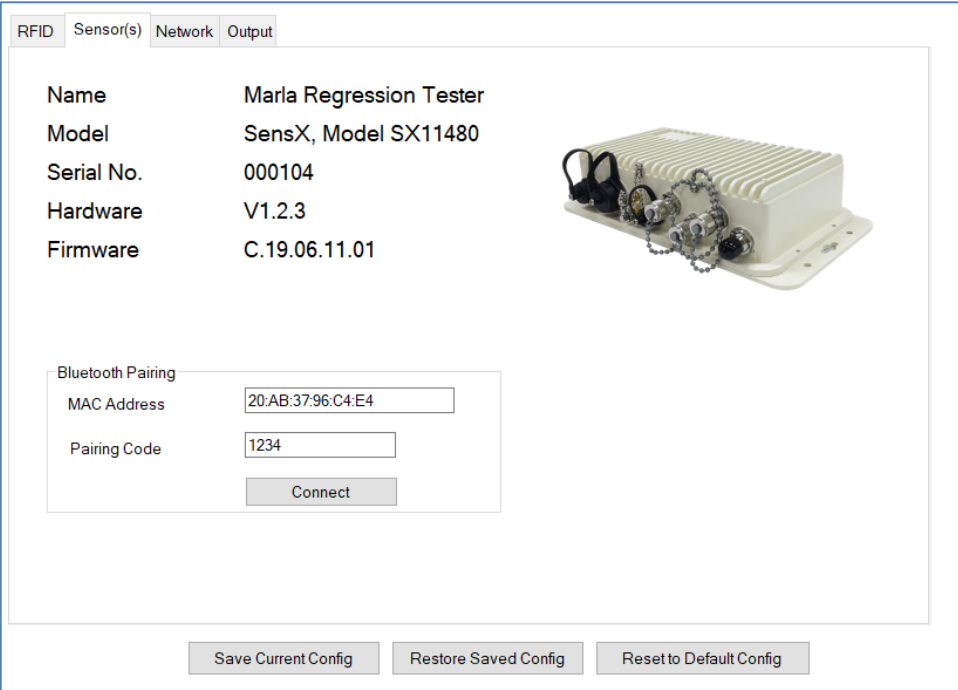
5. Successful connection will be indicated on the Status Window (left side) of the RF Console). In the reader list, the new Wi-Fi connected reader will show (WiFi) in the name, as another reader although it is the same reader:

Sensor Network				
Read Tags				
GPS				
About				
Name	IP Address	MAC Address	Up Time	
<input type="checkbox"/> SensX Regressor	192.168.1.91	00:1f7b:73:07:10	2.21:51:32	
<input type="checkbox"/> Marla Regression Tester	192.168.1.135	00:1f7b:73:07:3c	00:46:55	
<input type="checkbox"/> RFID Live SensX 2	192.168.1.90	00:1f7b:73:07:0f	4.03:28:16	
<input type="checkbox"/> GP Tag Tester	192.168.1.203	80:1f12:17:54:18	05:26:50	
<input type="checkbox"/> SA-Pro GShfr	192.168.1.119	80:1f12:17:3c:74	03:03:05	
<input type="checkbox"/> GP Mobile Tester	192.168.1.200	80:1f12:17:54:15	00:01:55	
<input type="checkbox"/> SA-Pro Tester	192.168.1.120	54:10:ec:89:31:7d	3.23:57:05	
<input type="checkbox"/> SensArray Pro Regressor	192.168.1.189	80:1f12:17:52:08	05:26:00	
<input type="checkbox"/> SensArray	192.168.1.53	80:1f12:17:39:f6	3.01:46:00	
<input type="checkbox"/> Marla Regression Tester (WiFi)		94:a1:a2:48:de:a8	00:45:38	
<input type="checkbox"/> SensX Regressor (WiFi)		94:a1:a2:48:d7:7f	2.21:46:45	

6. Save all changes: click “Save Current Config” (bottom of the page)
7. The SensX Reader now has a Wi-Fi connection to the Access Point/Router. Remove the CAT 5 cable from the PC to the SensX reader.
8. To connect the PC via Wi-Fi to the SensX reader, go to the Network and Internet Settings on the PC to find the Access point/Router (example: InSite_2p4GHz). Click on Connect. This will connect the PC to the SensX Reader via Wi-Fi thru the access point.

Configure the SensX Extreme Reader to Pair with a Bluetooth device

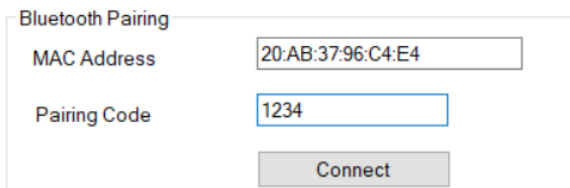
1. Connect a WiFi/Bluetooth antenna to the SensX reader.
2. Open the RF Console and identify the Extreme reader from the Reader List.
3. Go to the *Sensor(s)* tab on the Menu Bar. Identify the Bluetooth Pairing Section.



RFID		Sensor(s)	Network	Output
Name	Marla Regression Tester			
Model	SensX, Model SX11480			
Serial No.	000104			
Hardware	V1.2.3			
Firmware	C.19.06.11.01			
<div>Bluetooth Pairing</div> <div> <div>MAC Address</div> <div>20:AB:37:96:C4:E4</div> </div> <div> <div>Pairing Code</div> <div>1234</div> </div> <div>Connect</div>				
<div>Save Current Config</div> <div>Restore Saved Config</div> <div>Reset to Default Config</div>				

4. Input the parameters for the pairing Bluetooth device:

- a. Enter the MAC address of the device that is to be paired with the SensX reader. Example: **20:AB:37:96:C4:E4**
- b. Enter a password of your choosing. Use at least 4 characters. Example: **1234**



Bluetooth Pairing

MAC Address 20:AB:37:96:C4:E4

Pairing Code 1234

Connect

5. Save all changes: click **Connect** (bottom of the page).
6. The SensX reader has now been set to be paired with the device identified by the MAC address.
7. On the device, go to the Bluetooth setting menu or page. Turn on Bluetooth.
8. Place your device in discovery mode. The device will scan the immediate proximity to find all Bluetooth enabled devices, including the SensX reader.
9. To pair, tap the SensX name when it appears on device screen.
10. Device will ask for PASSWORD. Enter the password or Pairing Code previously entered in Step 3b.
11. Device will indicate that the pairing is successful. If not, repeat Step 7 and 8.

Chapter 4 SensX Extreme Operation

This chapter details the operation of the various sensors available on the Extreme unit.

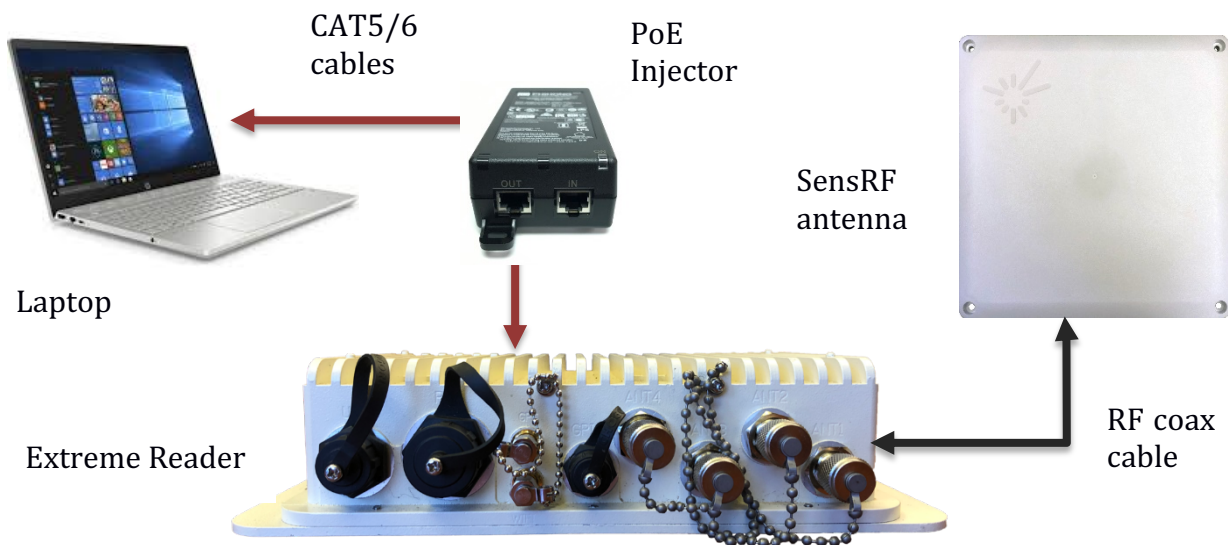
- UHF RFID

For all sensors, the SensThys Console is the main interface for the user, for configuring and operating the Extreme reader.

Start-Up – Minimum Cable Connections

To start up the Extreme, the minimum configuration is:

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



Introduction to SensThys Console

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

The Console is available from the SensThys web site. Instructions to download and install the Console are detailed in Chapter 2, Installing the SensThys Console.

Connect to the Extreme unit via CAT5/6 cable or via Wi-Fi. After a short period of time, less than one minute, the Console will find all SensThys or Extreme units on the network, populating the Reader list, on the left side of the Console.

Example of a populated list of readers is shown in Figure 2.

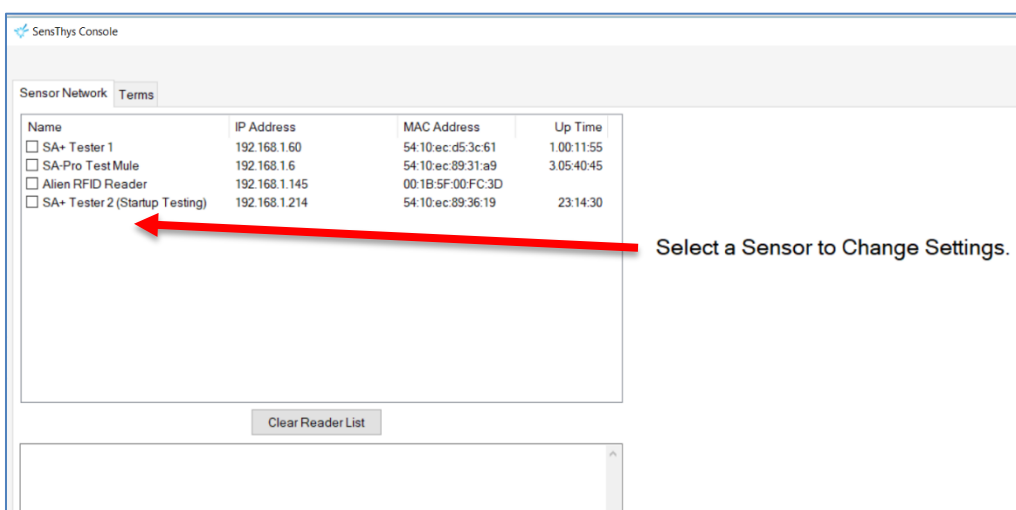


Figure 2: The main screen of the RFID Console

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.

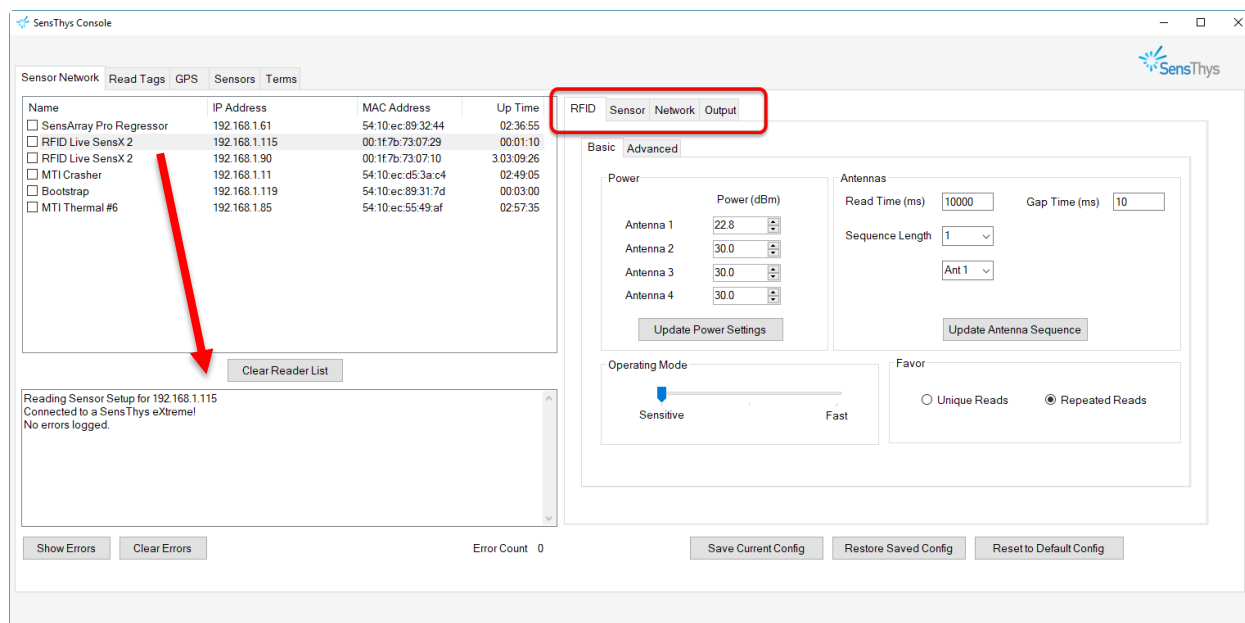


Figure 3: After selecting the unit, the RFID Console shows the network setup for that unit.

Figure 3 shows a Console with one SensX Extreme at 192.168.1.115 that is now highlighted.

The status box in the lower left corner will indicate successful connection to the selected reader.

The right side of the console presents the four tabs for various controls and configuration parameters for the reader.

The unit is now ready to be addressed to change or update its configuration, or enabled to start reading tags.

RFID Operation Using Console

This section presents how to operate the SensX Extreme as a UHF RFID Reader.

The SensThys Console is the primary interface with the Extreme. Through this interface the Extreme 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

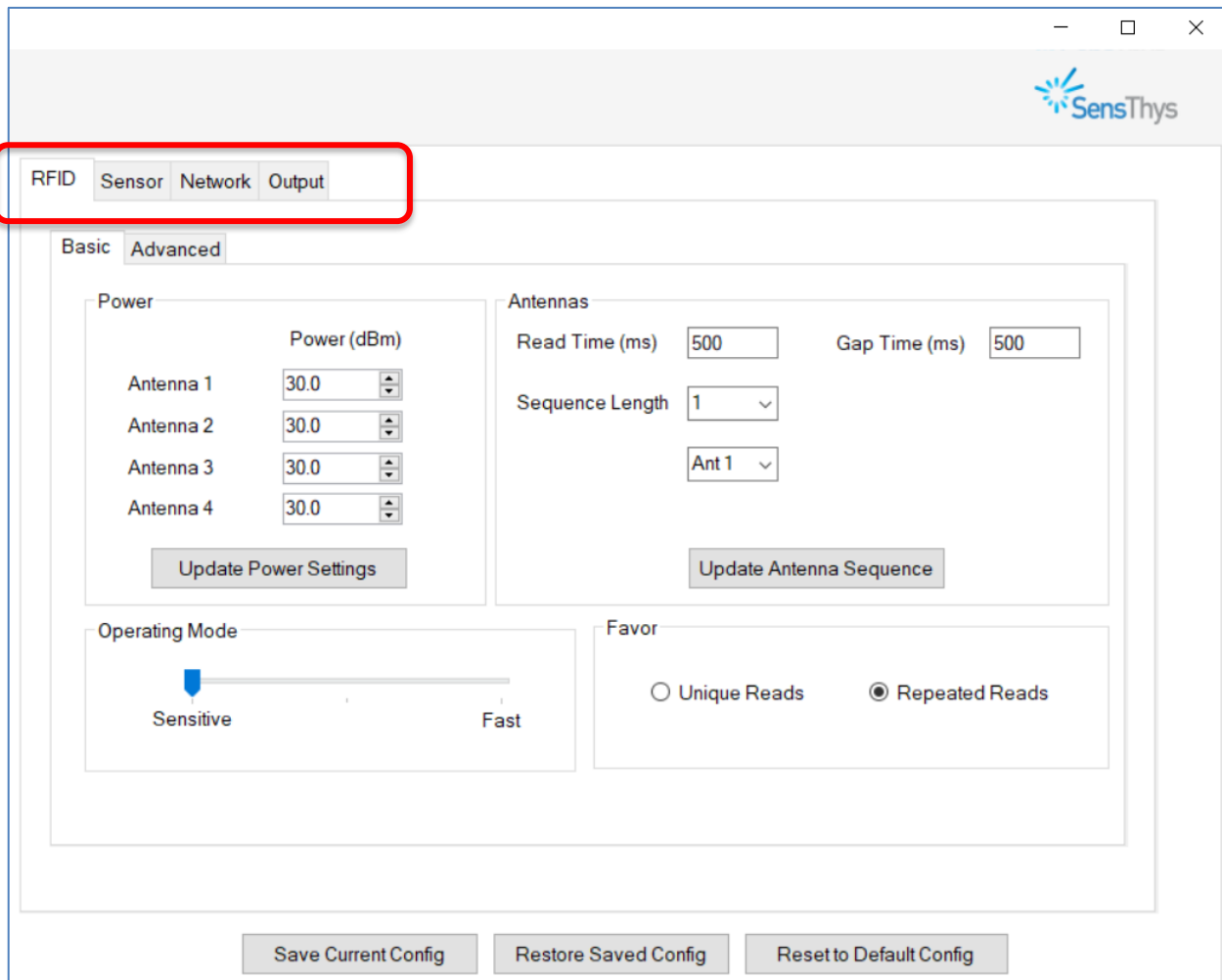


Figure 4: The Workspace on the SensThys Console.

The right side of the Console is displayed in Figure 4 above. Within the Configure Readers workspace of the Console, there are four subsets of parameters that can be customized for your application: RFID Setup (the default when the Console first launches), Sensor, Network and Output.

A second set of tabs – Basic and Advance – are used to address specific parameters for the RFID configuration on the Extreme.

To configure the Extreme RFID reader, proceed to each tab as necessary under Basic and Advance to select, change and then update settings.

RFID – Basic

Power – Setting Each Antenna’s RF Power

The antenna power setting for each of the four (4) RF outputs of the Extreme 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.

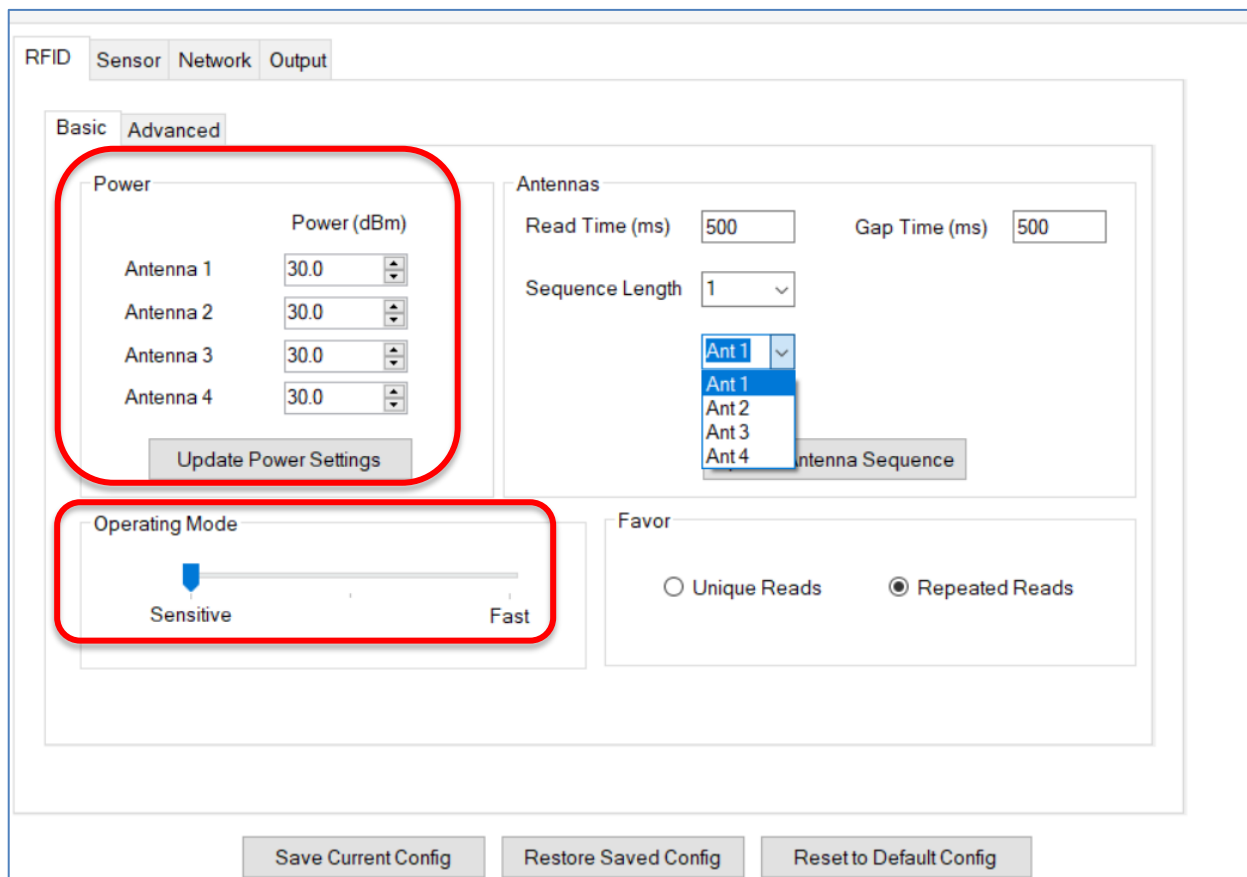


Figure 5: Choosing to drive all antennas of the Extreme with the same power level. Operating mode is set to SENSITIVE (default)

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 as quickly as possible, but the reader may not read tags that are difficult to read.
- SENSITIVE: 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.

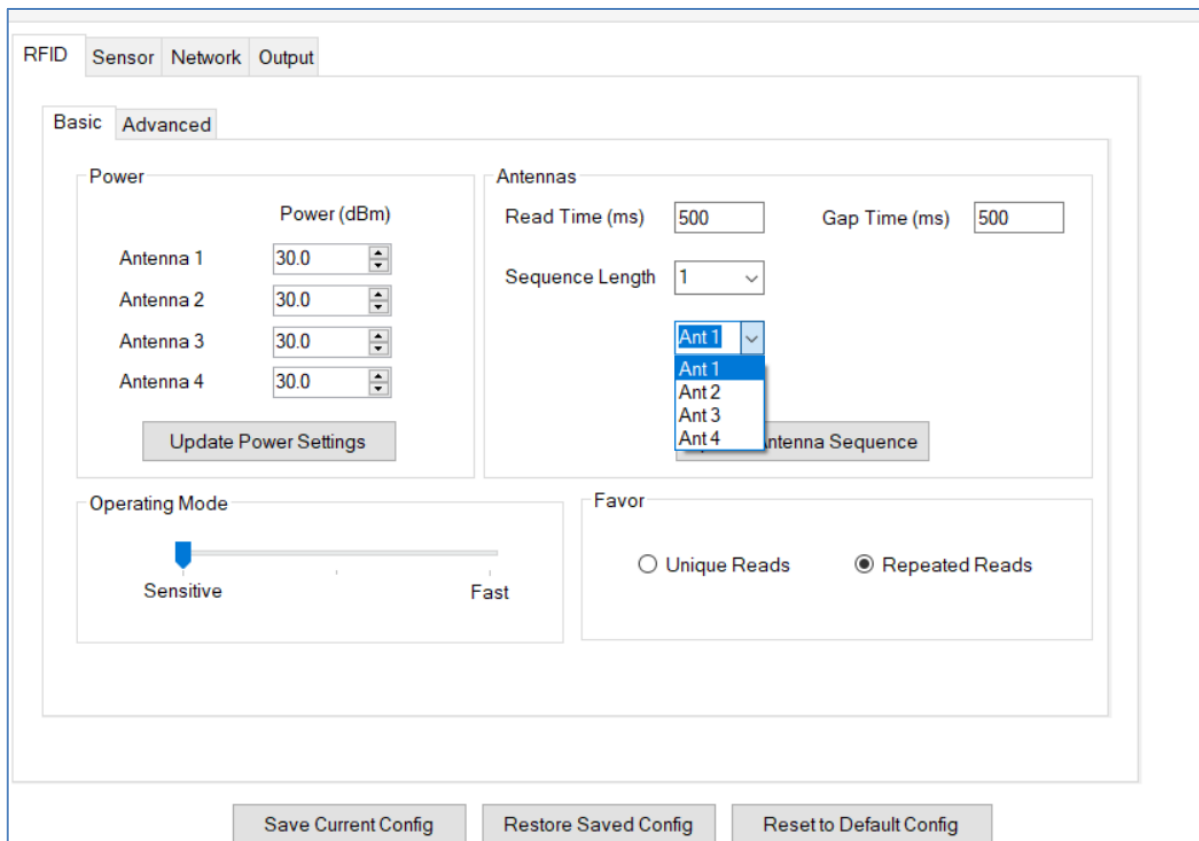


Figure 6: The unit is set for 500ms read, 500ms gap.

Basic Antenna Read Timing

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

Basic Antenna Sequencing

The Extreme reader will sequence through any active antennas that are connected to the unit using this configuration. Each antenna will be active for the *READ TIME (in msec)*, and then there will be a *GAP TIME (in msec)*, then the reader will sequence to the second antenna that is in the *Sequence Length*.

Default settings 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, selected from the drop down choices.

Click on “Update Antenna Sequence” to save the changes.

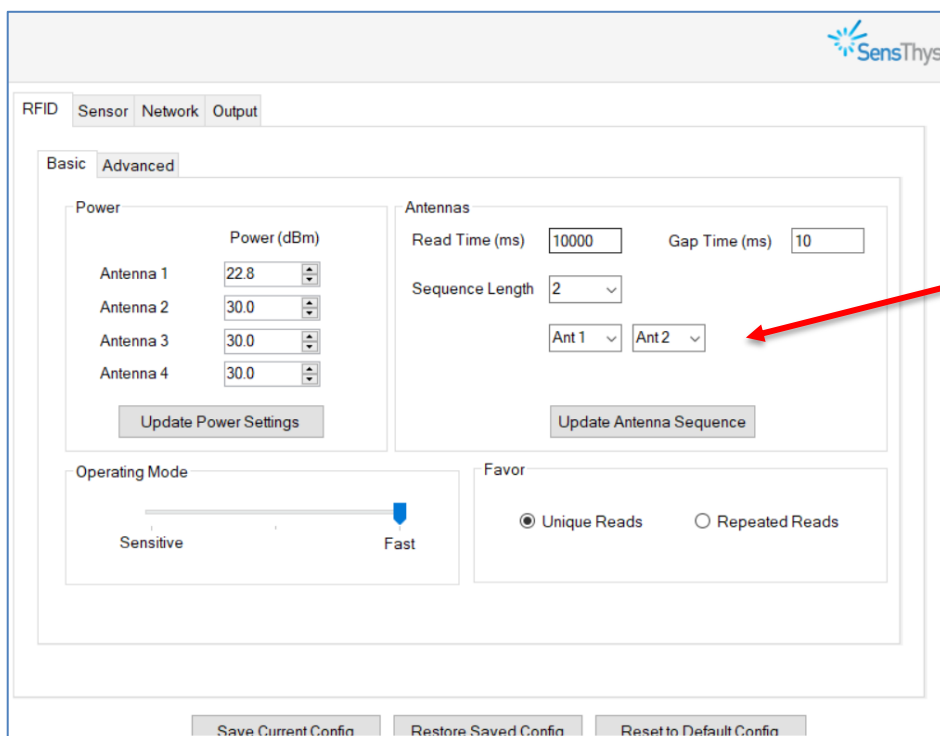


Figure 7: Sequence set up for 2 antennas

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

RFID – Advanced

The Advanced tab under RFID allows you to configure the Extreme 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.

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.

Sensor Network							
Read Tags							
GPS							
Sensors							
Terms							
Rdr #	Ant #	EPC	RSSI	Count	Unique	First Read Time	Last Read Time
		Total Read		1190	18		
	Ant 1	Antenna Total		1190	18		
3	Ant 1	18-72-09-29	-70.0	29		10:46:27.890	10:46:46.735
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-05	-75.3	11		10:46:27.890	10:46:46.588
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-07	-74.4	4		10:46:27.821	10:46:46.635
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-09	-74.7	6		10:46:32.306	10:46:37.772
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-21	-75.6	8		10:46:27.943	10:46:46.435
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-23	-74.2	5		10:46:45.748	10:46:46.334
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-25	-71.3	89		10:46:27.040	10:46:46.688
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-27	-78.6	6		10:46:27.473	10:46:36.954
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-29	-75.7	2		10:46:27.303	10:46:27.574
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-43	-76.6	20		10:46:28.090	10:46:46.588
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-45	-70.3	2		10:46:28.606	10:46:43.229
3	Ant 1	53-65-6E-73-54-68-79-73-00-00-00-91	-76	1		10:46:28.143	10:46:28.143
3	Ant 1	D5-D5-DE-AD-BE-EF-CA-FE-FA-CE-00-01	-81.0	4		10:46:27.821	10:46:46.635
3	Ant 1	E2-00-32-6A-53-9A-6C-71-20-CB-D9-B1	-35.8	257		10:46:27.102	10:46:46.788
3	Ant 1	E2-00-32-6A-53-9B-AD-71-20-CB-DE-B5	-58.3	146		10:46:27.155	10:46:46.835
3	Ant 1	E2-00-32-6A-53-9C-4A-B1-20-CB-E1-2A	-56.3	190		10:46:27.155	10:46:46.835
3	Ant 1	E2-00-32-6A-53-9C-4B-B1-20-CB-E1-2E	-60.3	159		10:46:27.102	10:46:46.735
3	Ant 1	E2-00-32-6A-53-9C-EA-B1-20-CB-E3-AA	-42.9	251		10:46:27.102	10:46:46.835

IP for Cont. Read: 192.168.1.90
 Stop After (s): 20
 Read Time (s): 20
 Reader Dwell Time (ms): 500000
 Read
Clear Tag List

Figure 8: The “Read Tag” 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.

RFID
Sensor(s)
Network
Output

Name	RFID Live SensX 2
Model	SensX, Model SX11480-FCC
Serial No.	000104
Hardware	V1.2.3
Firmware	C.19.03.19.01



Bluetooth Pairing

MAC Address

Pairing Code

Connect

Network Tab

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

RFID
Sensor(s)
Network
Output

IPv4 Setup

☒ Obtain IP address automatically

☐ Use the following IP address:

IP Address:
Subnet mask:
Gateway:
DNS Server:
Sensor Port:

Set IPv4 Info

Heartbeat Setup

Listener IP Address:
Port Number:
Repeat Interval (sec):
Heartbeat Count:

Set HB Info

WiFi Configuration

Access Point Name:
Password:

Connect

Reader Name

Name:

Set Reader Name

Reboot Reader

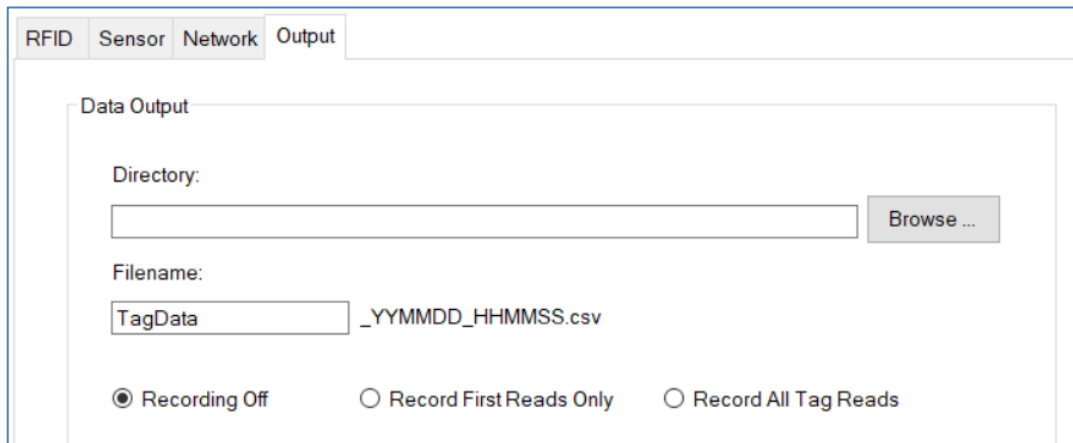
Save Current Config

Restore Saved Config

Reset to Default Config

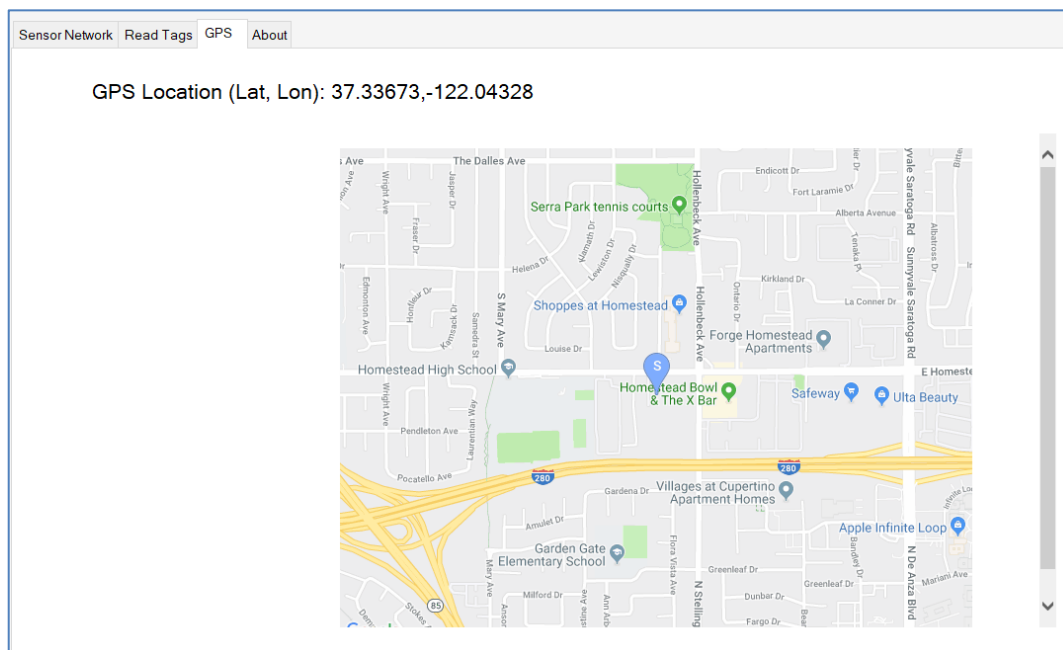
Output Tab

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



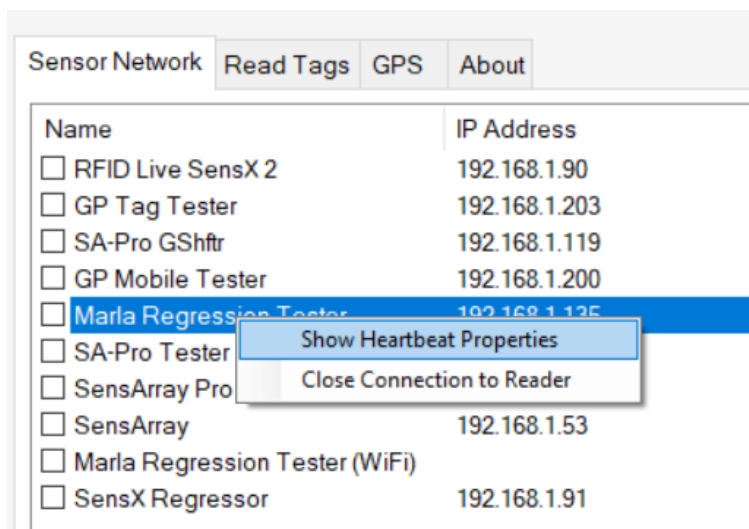
GPS Tab

This tab displays the GPS location of the Extreme reader's GPS antenna.

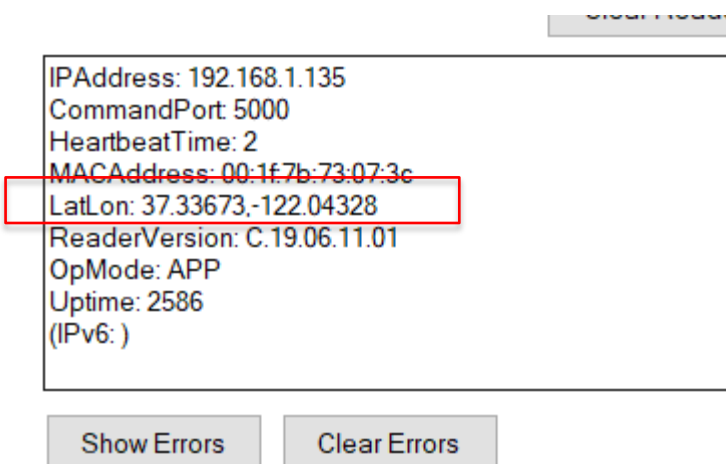


The above GPS location is the SensThys Inc office in California.

Another way to retrieve the GPS data is to right click the reader in the Reader list, and select “Show Heartbeat Properties”:



In the Status window, the GPS data is listed as “LatLon:”



TroubleShooting Guide

Description	Probable Cause	Recommended Actions
Console does not install completely	Installation process is halted or Console does not turn on. Bad install. Improper install.	Uninstall Console. Download latest version from SensyThys.com. Refer to Tech Note 18-101 "Installing RFID Console for Windows 10 PC"
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 Extreme are flashing green.	Check that PC firewall has allowed Console to communicate with Public Networks. Refer to Tech Note 18-102 "Configuring PC Firewall for RFID Console" Replace the reader.
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.