PoE Infrastructure Recommendations

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FCC Compliance

This equipment has been tested and found to comply with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

Industry Canada Compliance

This device complies with Industry Canada License-exempt RSS standards. Operation is subject to the following two conditions: (1) this device may not cause interference and (2) this device must accept any interference, including interference that may cause undesired operation of the device. This device has been designed to operate with a variety of different gain (dBi). The reader maximum output power is set by the gain of the antenna. Using an antenna having a higher gain is strictly prohibited per regulations of Industry Canada. In addition, using the reader at a power exceeding the maximum output power for a given antenna is also strictly prohibited. The required antenna impedance is 50 ohms. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that required for successful communication.

Conformité d'Industrie Canada

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

Caution

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.”

Vorsicht

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."

Introduction

All SensThys reader products incorporate Power over Ethernet (PoE). Indeed, the IP67 Extreme and the new Enterprise readers are only powered by PoE.

PoE is an extremely attractive technology delivering both power and data to devices. However, the structure of PoE does not inherently offer protection to products being driven by PoE.

This document describes recommendations for proper connection of PoE routers, switches, and injectors to SensThys products to provide reliable operation. Since the world of cabling, PoE routers, PoE switches, and many other aspects of installation are beyond SensThys control, this document should be viewed as simply a starting point for integrators and installers.

SensThys recommendations for proper operation are shown throughout this document in ***RED.***

Cabling, Ports and Connectors

The POE device providing power, i.e., the injector, switch, router, or SensThys reader, should have RJ45 ports with metal shields as shown in Fig. 1.

Key Point: The appliance delivering the power must be grounded. Normally this occurs when a grounded AC plug from the appliance is plugged into a ground outlet.

Fig. 1 also shows non-shielded RJ45 ports, on the left, which are not recommended for PoE applications.

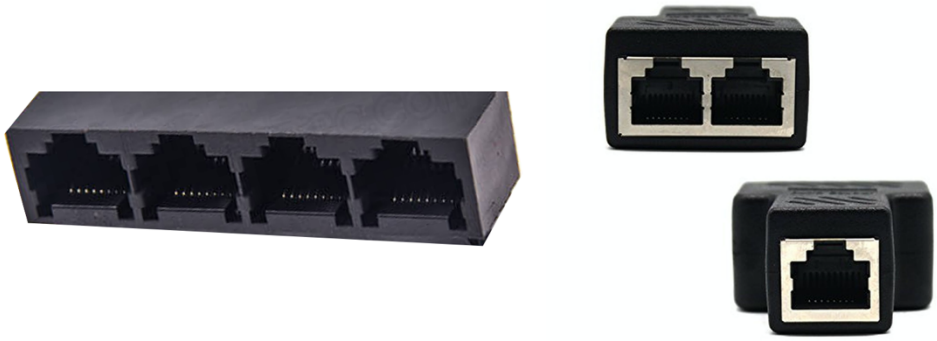

Figure 1 Un-shielded (left) and shielded RJ45 ports. ***Shielded RJ45 ports are recommended for all PoE applications***

CAT6 cabling should be used. The CAT6 cabling should include both a shield and a drain wire as illustrated in Fig. 2.

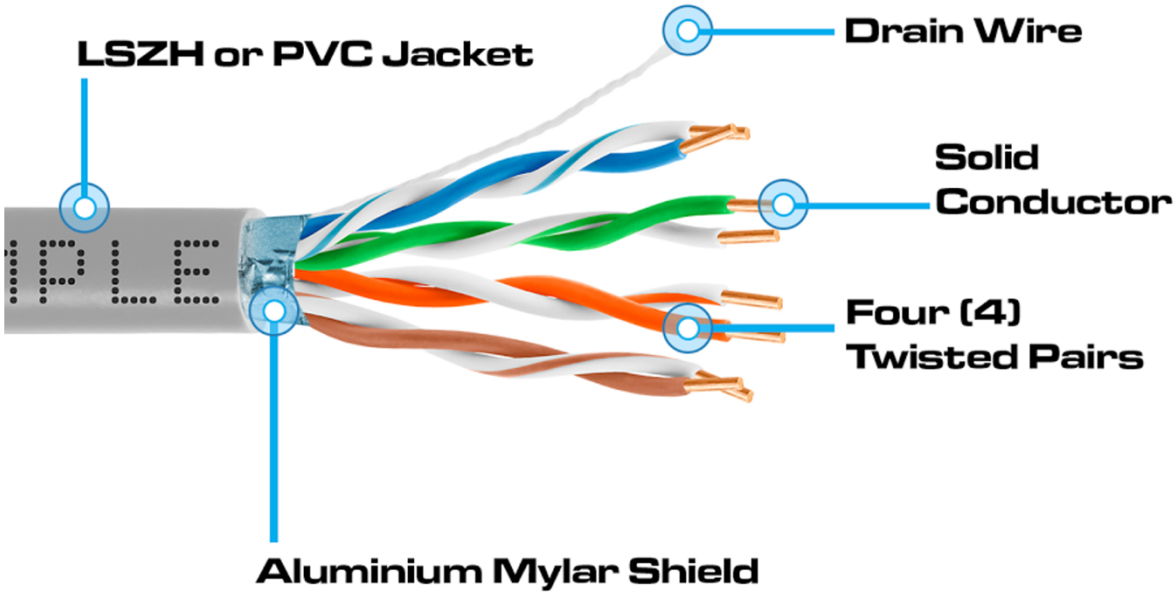

Figure 2 A shielded CAT6 with conductive drain wire. ***This is recommended for all PoE applications.***

Both sides of the CAT6 cabling should be terminated with RJ45 connectors with metal exteriors mechanically connected to the drain wire. The termination of the cabling should look as illustrated in Fig. 3.

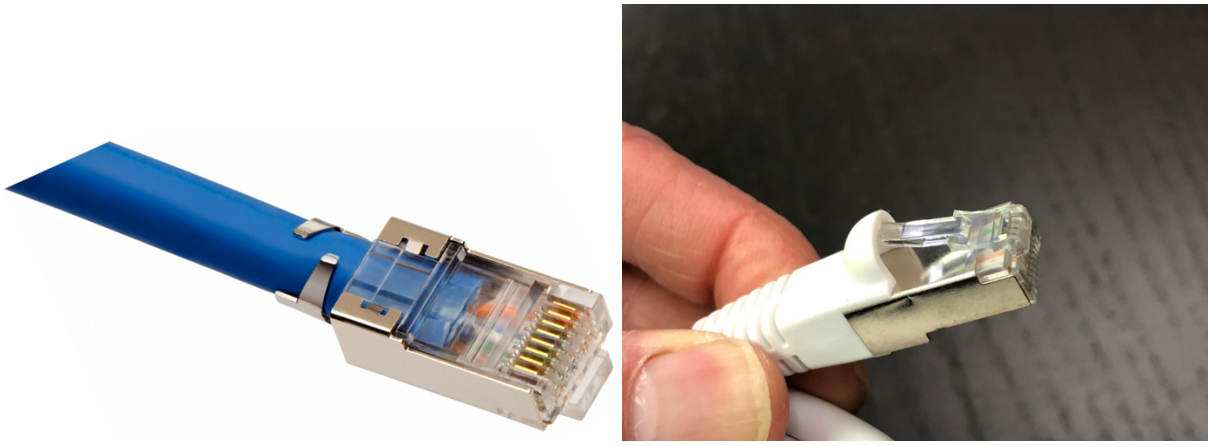

Figure 3 A shielded RJ45 connector. ***This is recommended for all PoE applications.***

If you choose to build your own cabling, the termination can be verified by direct measurement of the resistance between the two ends of the CAT6 cabling.

This has several benefits. First, shielded cabling provides better data delivery performance. Second, shielded cable with a drain significantly aids in routing charge associated with ESD and EMP events to the local ground at the two ends of the cabling, thus reducing the pulse transmitted in the magnetics and PoE circuit within PoE devices.

We recommend CAT6 or better cabling.

Key Point: For proper operation of the shielding and drain wire, the PoE devices at both ends must have shielded ports and the cabling must be terminated with shielded RJ45 connectors.

Electromagnetic Interference (EMI) and Electro-static Discharges (ESD)

The occurrence of EMI and ESD events can overwhelm the capability of a router, switch, or our readers' protection circuitry. This is just a short overview; an internet search can provide much more information to curious readers from people with experience installing PoE infrastructure.

Here are some known sources of EMI and ESD

- Electrical motors, and the surges that occur when turned on (HVAC, electric vehicles)
- Electrical surges associated large lighting systems (factories, stadiums)
- Rapid charging or discharging events
- Lightning strikes

Here are general guidelines

- Don't run cabling past sources of EMI/ESD
- Where practical, run cabling along conductive materials that have a path to ground
- Longer runs are more prone to experience EMI/ESD events

If your installation can't avoid these risks, you should install PoE surge protectors. For maximum protection the device should be as close to the reader as possible, normally 1-2m. The surge protector should have shielded ports and be attached to ground with a grounding wire.

There are many choices in PoE surge protectors, with pricing ranging from $10 to $100/unit. We have researched the circuitry on a several products. They are used quite widely. Many of the low-cost units are suitable for general use. The high-end units feature a different protection scheme, generally used in the situation where lightning strikes are fairly common.

As a side-note, many of these manufacturers offer schematics, including the specific components used.

Challenges

The installer can often face challenges.

CAT6 Plant is non-compliant (cable, ports, and connectors)

The legacy plant does not conform to the recommendations in this document. The most common problem here is that the CAT6 plant is not shielded with a drain line. In this condition, the ONLY return electrical connection between the PoE power source and the device is the data lines of the CAT6 cabling.

PREFERRED: Use a separate injector, plugged into a grounded outlet. The Ethernet cable from the router/switch goes into an injector with shielded ports. The output of the injector, with both power and data, is connected to the reader with CAT6, with shield and drain wire, and shielded connectors on both ends.

SECONDARY: If this is not possible, a PoE surge protector, with shielded ports, with the ground wire of the surge protector wired to ground, can be used. The PoE surge protector should be connected with a short CAT6 jumper, with shield and drain wire, to the reader.

Ground Loops

An electrical ground loop occurs with the “ground” at one point in a circuit with a voltage different from “ground” at another point in the circuit.

In a PoE install, particularly with long cabling spans such that the reader and the router/switch/injector are on different electrical power circuits, the voltage difference can be large enough that the low-voltage “handshaking” process of PoE will not function. Stated more precisely, if the reader, or its antennas, are grounded locally, and the router/switch/injector are grounded where they reside, a PoE device may not power up.

Before we discuss potential solutions, it should be noted that using cabling with a drain eliminates this issue, in that there is a conductive path between the two grounds that serves to normalize the situation.

It is conceivable to allow the reader and antennas to NOT be attached to local ground and allowing them to electrically “float”. Here the electrical return path or “ground” to the reader is effectively asserted by the remote router after handshaking. This implies that the charge from any ESD can only be discharged by traveling all the way back to router end.

To protect the reader, a grounded PoE surge protector can be installed, and grounded to local ground. A shielded, with drain wire, CAT6 jumper is then used to connect the surge protector to the device.

Surge protectors effectively take no action unless a voltage more than 70V away from local ground is detected, and then the surge protectors direct all of the excess charge into the local ground (and away from the reader or router/switch). Since the reader can tolerate voltages of more the 70V, protection is created. Most variations in “ground” voltages are much less than 70V, thus, the protection circuit does not interfere with PoE handshaking.

Key Point: Ground loops definitely exist, and in larger installs they can stop PoE handshaking from occurring. They are often complicated to understand and detect, and because of that, it is not possible for us to offer simple recommendations.

Outdoor Environments

1. ***Use high quality cabling. It must be shielded with a drain.***
2. ***Use shielded connectors.***
3. ***All equipment should have shielded ports.***
4. ***Use a solid PoE surge protector.***
5. ***If in a region prone to lightning strikes, please install lightning-specific protection.***

Disclaimer

All SensThys products are designed and manufactured to high standards for robustness and reliability when operated as per recommendations provided here and in other documentation. When operated outside of these guidelines, SensThys has no responsibility for product performance or reliability.

SensThys, Inc., 2020