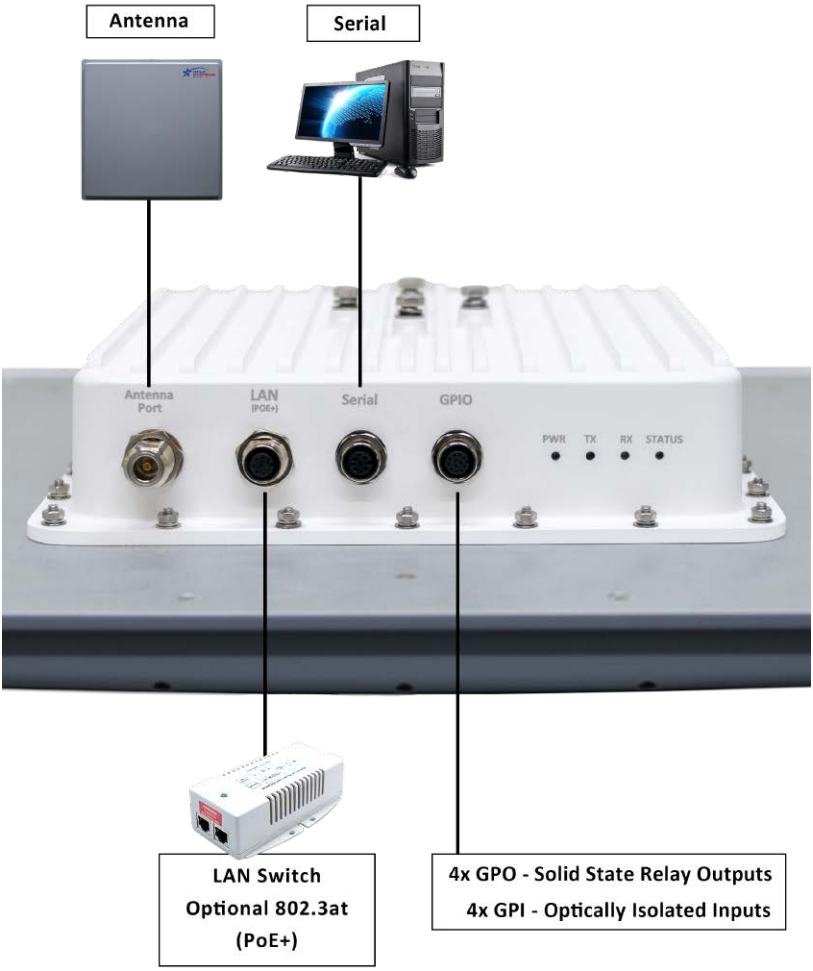
Electrical Precaution and Wiring Connection Guide

PLEASE READ THIS BEFORE CONNECTING THE **TARVOS PRO** READER

Enabling Smart Cities™

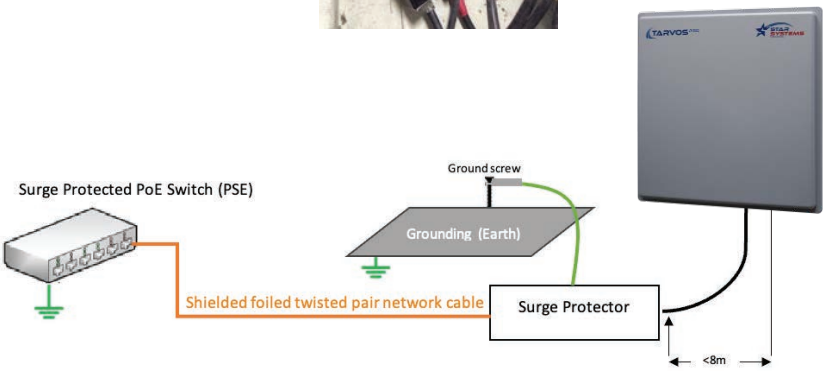
Cable Connection Diagram



Electrical Installation and Grounding Recommendations

1. We strongly advise using in-line surge protectors between the PoE power supply and the readers for installations using an Ethernet cable longer than 8m in length (therefore minimizing the risk of a cable discharge event), or installation expose to a risk of lightning strikes and electrical surges. Surge protectors are essential for safeguarding your equipment by intercepting and diverting potentially harmful voltage surges from reaching your devices. This protection is vital for preventing costly damage and downtime caused by electrical disturbances. You should ensure that the grounding wires of the surge protectors are connected properly (they should be connected to the same grounding point as to where the reader's enclosure grounding wire is connected).

   Regularly check if the surge protectors are still alive. If you find your reader is not powered up properly, you should check the surge protector. Try to power-cycle the surge protector (unplug the upstream and re-plug it again).



2. Shielded foil screened twisted pair (Sc FTP)network cable should be used between the PoE power supply equipment and the in-line surge protector. Foil screened TP can prevent the network cable running outdoor from picking up any surges, and also can significantly reduce the signal noise transmitted within the network cable. It should also be grounded at the connectors end to prevent any surges or leaks picked up by the cable from transferring into the equipment/reader connected in the network. Sc FTP cable uses metal jacket which connects to the socket port with grounding.

   Only ground the jacket end which is connected to the surge protector's socket.

Normal UTP cable does not have foil screen protection and uses plastic jacket.

3. Grounding of the network switch is important. The reasons are as following:

    a. Prevents leak from any faulty equipment connected to the network spreading across the network, and potentially damaging other equipment (reader) connected to the same network.

    b. Prevents any surge coming from the WAN going into the LAN.

    c. Prevents surges and ground currents picked up by un-screened Ethernet cables going to connected network equipment (reader).

**The switch should have “ground isolation” capability ie: able to isolate any leak/surge running in the network cables to the ground to ensure it does not pass to other parts of the connected network.

If you are not able to control the grounding of the network switch, or are unable to verify the network switch is properly grounded, you must install an in-line surge protector between the PoE injector and the reader.

The following is an example of an ungrounded switch in the lane cabinet:

As you can observe, the grounding bolt of the switch has no wire connected to it.

Weatherproof Outdoor Installation

If the equipment is to be installed outdoors, it is important that users to pay attention to and take all necessary measures to weatherproof the antennas and cable connections. Per the Certified Wireless Network Administrator (CWNA) Study Guide, it is stated that "Water damage is often a serious problem with cabling and connectors." When conducting an antenna installation with cables, it is suggested to "Weatherproof the cables and connectors and secure them from movement".

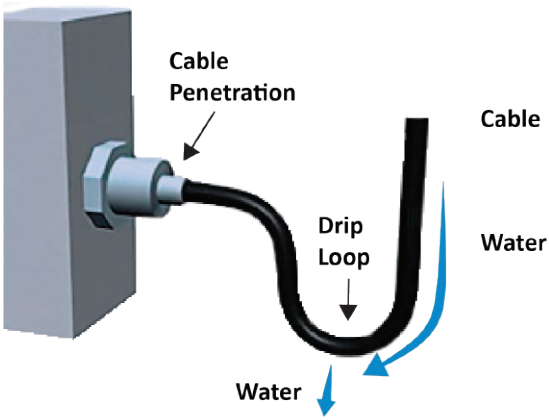
If your installation of equipment is exposed to outdoor weather, it is important that you take all necessary measures to weatherproof the antennas and cable connections. In this guide we will introduce methods to weatherproof the antenna and cable connectors. Customers can evaluate which is the best method to adopt, based on their installation setup.

Industry best practice suggests that antenna and cable connectors should be protected with drip loops and coax seals to prevent water seepage and damage.

In this guide we will provide procedures for adopting the following methods:

- making drip loops on cables
- protecting connectors using cold shrink tube
- protecting connectors using a combination of electrical tape and butyl rubber
- protecting coaxial cable connection using a combination of silicone and electrical tape
- Weatherproof Outdoor Installation

a. Cable Drip Loop

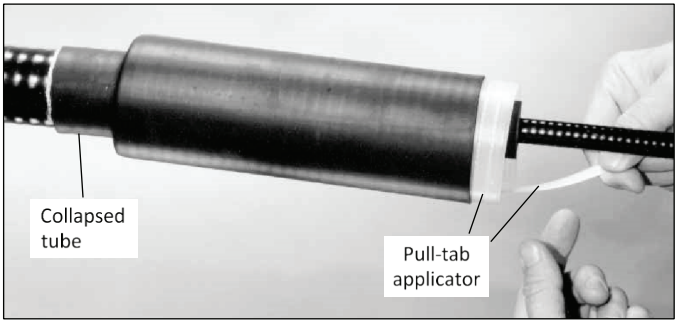


By adding a small drip loop or “U” shape before the cable connection to the antenna or reader, water flowing along the cable can be directed to flow away from the connector, preventing the water from flowing onto the connector. The drip loop should be positioned lower than the antenna/reader connector to effectively direct dripping water away.

b. Cold Shrink Tube

Cold shrink tube provides a fast and easy way for weatherproofing cable connections on the field. In addition, it can secure the cable connection from wind and vibration, preventing it from loosening up.

Cold shrink tube is typically constructed with an open-ended rubber sleeve, the plastic core can then be pulled off easily by hand.



Cold shrink tubes can be easily acquired from any local radio shop. If you have difficulty finding supplies of cold shrink tubes, please contact a STAR Systems sales representative.

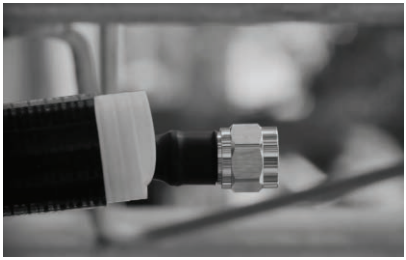
i. Tools and Equipment

To weatherproof an antenna cable connection using a cold shrink tube, the following tools are recommended:

1. Torque wrench (15-20 lbf·in or 1.7-2.3 N·m for N-type connector)
2. Cold shrink tube

ii. Procedures

1. Run the coax cable through the cold shrink tube



2. Connect the cable connector with the antenna. Tighten the connection properly with a torque wrench to ensure the correct internal seals and surface contacts are made.

3. Align the cold shrink tube such that it seals the base of the antenna connector. Then pull the rip cord of the plastic core while holding the tube in position.

c. Tape and Butyl Rubber

Using electric, vinyl or plastic tape in combination with butyl rubber or mastic wrap is a widely adopted practice for outdoor cable connection weatherproofing procedures.

These materials are often supplied in a bundle as weatherproofing kits which are widely available from the market. If you have difficulty finding supplies of weatherproofing kits, please contact a STAR Systems sales representative.

i. Tools and Equipment

To weatherproof an antenna cable connection using tape and butyl rubber the following tools are needed:

1. Torque wrench (15-20 lbf·in or 1.7-2.3 N·m for N-type connector)
2. Electric, vinyl or plastic tape
3. Butyl rubber or mastic wrap

ii. Procedures

1. Connect the cable connector with the antenna. Tighten the connection properly with a torque wrench to ensure the correct internal seals and surface contacts are made.

2. Using 3/4” (19mm) electric, vinyl or plastic tape to wrap the connection, starting at the cable side at about 1” (25mm) from the connector. Overlap the tape to a half-width. Extend the wrapping to the antenna connector base.

3. Cut a piece of butyl rubber large enough to wrap around the connector and extended past the first layer of tape, stretching it so that it will wrap completely around the connector and cable. Press the rubber against the connection and cable, ensuring there are no gaps at the edges.

4. Start below the rubber, using electric, vinyl or plastic tape overlapping at half-width, wrap up towards the base of the antenna connector. Repeat this process to create 4 layers, each layer should start 1” (25mm) below the previous layer. After completing each layer of tape, check your work to ensure there are no places where water can collect. If there are, you must smooth out those areas.

d. Silicone and Electrical Tape for Coaxial Cable Connection

Use self-fusing silicone tape, which is designed for low voltage electrical insulating and moisture sealing applications. For outdoor use, it should be protected from UV deterioration with an overwrap of vinyl tape.

Electrical tape can be used indoors or outdoors. With outdoor use, environmental conditions should be considered. Clean and dry the surface and take adequate precautions to protect the assembly being weatherproofed.

These materials are widely available from the market. If you have difficulty finding supplies of weatherproofing kits, please contact a STAR Systems sales representative.

i. Tools and Equipment

To weatherproof an antenna cable connection using tape and butyl rubber the following tools are needed:

1. Silicone tape
2. Electrical tape
3. Scissors or utility knife

ii. Procedures - Silicone Tape Wrap

1. Cut a piece of silicone tape long enough to complete the job. If the length is too short, extra can be easily added.

2. Peel back a length of the protective barrier and trim off if needed. Minimize contact with the surface to ensure proper adhesion.

3. Starting at a connector end, hold the self-fusing silicone tape in place about one inch from the connector and stretch out until half its original width. While maintaining tension, double cover the first wrap, overlap the remaining and double wrap the last.

4. Completed wrap using Self-Fusing, Silicone Tape.

iii. Procedures - Electrical Tape Wrap

About one inch before the silicone tape, overlap the previous wrap by half. Use firm pressure to ensure no wrinkles or gaps. Continue wrapping as in the silicone tape example until the item is completely covered.

The completed wrap should consist of two layers:

1. Self-Fusing Silicone Tape
2. Electrical tape

Each tape should overlap the previous about half its width, with the beginning and end being double wrapped. If during the wrap, you should be short, the silicone tape will self-seal with no compromise at the splice location.

iv. Wrap Removal

Removing the weatherproofing is quick and easy. Using a sharp blade, slice the length of the wrap, being cautious not to cut the cable. The silicone tape has no adhesive and will not leave a sticky residue. The cable can be immediately rewrapped if needed.

FCC Radiation Exposure Statement

The antennas used for this transmitter must be installed to provide a minimum separation distance of at least 1 meter from any person and must not be co-located with any other transmitter.

Site License Disclaimer

Users of the Tarvos Pro acknowledge that a site license is required when the device is configured for FCC Part 90 regulations. It is the user's responsibility to file for the site license and submit the appropriate fees and payments to the regulating authority. United States filings require submission of FCC Form 601 with Schedule D and H. Canadian filings require submission of Industry Canada forms IC2365BB and IC2430BB.

Licence d'Etat-client Avertissement

Client (utilisateur final) reconnaît que le site d'une licence est requise pour chaque lecteur emplacement du système. Il incombe au client de déposer pour la licence d'exploitation et soumettre le paiement du dépôt approprié. Unis dépôts États exigent l'achèvement et la soumission du formulaire FCC 601 à l'annexe D et H. dépôts canadiennes exigent l'achèvement et la soumission de Industrie Canada Formulaires IC2365BB et IC2430BB.

Changes or Modifications

Changes or modifications to the Tarvos Pro not expressly approved by STAR Systems International Ltd. could void the user's authority to operate the Tarvos Pro.

WARNING: FCC Part 90 & 15

This equipment complies with FCC Part 90 and Industry Canada RSS-137 rules. This device complies with FCC Part 15 and Industry Canada license exempt RSS standard(s). 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.

Cet appareil est conforme à FCC Partie15 de Industrie Canada RSS standard exempts de licence (s). Son tilisation est soumise à Les deux conditions suivantes: (1) cet appareil ne peut pas provoquer 'interférences et (2) cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

WARNING: Class A Devices

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. Operation of this equipment in a residential area is likely to cause harmful interference, in which case users will be required to correct the interference at their own expense.

Information on Regulatory Regions

The Tarvos Pro is designed to operate in various regulatory regions. The regulatory region is locked by the manufacturer such that the reader may only operate on authorized frequencies for that regulatory region. The regulatory region is not configurable by end users or professional installers.

Professional Installation

The Tarvos Pro RFID Integrated Reader has integrated a 13 dBi gain, 36° beamwidth antenna and one external antenna port. Professional installation or authorized service personnel is required to configure radio parameters of the transmitter using the software for adjusting total EIRP (30W) power at local installation to ensure compliance with FCC Rules.

RF Cable Option

For the applications in Parking and Secure Access control, cable length is limited. Cable with attenuation of maximum 4dB will typically be used.
For the applications of Electronic Toll Collection (ETC), cable length would be site orientated that could lead to extended cable length. Cable with attenuation of maximum 12dB will typically be used.

FCC Part 90

This information applies to Tarvos Pro that have been configured by the manufacturer for the FCC Part 90 regulatory region.

Pursuant to FCC Part 90.205, the Tarvos Pro's radiated power is limited to +44.8dBm (30 Watts) ERP (Effective Radiated Power). The professional installer must enter the cable loss and antenna gain at the time of installation. Using this information, the Tarvos Pro will automatically calculate and limit the maximum conducted output power that is allowed, based on the following equation:

Maximum conducted power (dBm) = 44.8 (ERP in dBm) – Antenna Gain (in dBd) + Cable Loss (in dB)

Note that Part 90 specifies the radiated power limit in terms of ERP and the Antenna Gain is specified in dBd, which is gain relative to an ideal half-wave dipole antenna.

FCC Part 15.247

This information applies to Tarvos Pro that have been configured by the manufacturer for the FCC Part 15 regulatory region.

Pursuant to FCC Part 15.204, the Tarvos Pro may only be operated with antennas approved by STAR Systems International Ltd..

Pursuant to FCC Part 15.247, the Tarvos Pro's radiated power is limited to +36dBm EIRP (Equivalent Isotropically Radiated Power). The Tarvos Pro's conducted power may be increased above +30dBm to compensate for cable loss, so long as the +36dBm EIRP limit is still met. The professional installer must enter the cable loss and antenna gain at the time of installation. Using this information, the Tarvos Pro will automatically calculate and limit the maximum conducted output power that is allowed, based on the following equation:

Maximum conducted power (dBm) = 36 (EIRP in dBm) – Antenna Gain (in dBi) + Cable Loss (in dB)

Note that Part 15.247 specifies the radiated power limit in terms of EIRP and the Antenna Gain is specified in dBi, which is gain relative to an ideal (theoretical) isotropic antenna.

About Us

Founded in 2013, STAR Systems International is a global leader in Automatic Vehicle Identification (AVI) Technologies. Our primary focus is to deliver best-in-class transponders, readers, and professional consulting services for Smart City Initiatives. Our expertise lies in a wide range of applications, including Electronic Tolling (ETC), Congestion/Road Use Charging, Electronic Vehicle Registration (EVR), Express/HOT Lane, Fleet Management, Parking, and Secure Access Control.

At STAR Systems, we are driven by a customer-centric approach. Our goal is to ensure the success of our customers by leveraging our technical expertise and implementation experience. Guided by three core principles - Outstanding People, Innovative Products, and Service Excellence - we strive to advance Smart City Technologies and contribute to the long-term growth of the AVI industry.

STAR Systems International Companies

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