Terrain Defender™

TD100™

Installation Manual

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FCC Interference Statement (Part 15.105 (b))

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Part 15 Clause 15.21:

“Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.”

“This device complies 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.”

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ISED Compliance Statement – Canada

Fiber SenSys Inc. has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Fiber SenSys Inc. n'a approué aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou toute modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

Industry Canada (IC) regulatory information

This device complies with Industry Canada licence-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.

Avis de conformité à la réglementation d'Industrie Canada

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Class B digital device notice

This Class B digital apparatus complies with Canadian ICES-003, RSS-Gen and RSS-210.

Cet appareil numérique de la classe B est conforme à la norme NMB-003, CNR-Gen et CNR-210 du Canada.

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Table of Contents

1. Introduction

TD100™ is a covert buried line intrusion detection sensor. It utilizes two parallel leaky coaxial cables to create an invisible electromagnetic field that follows the cables around corners and up and down hills. The transmit (TX) cable creates a field that couples into the parallel receiver (RX) cable. An intruder moving in proximity to the cables disturbs the coupled signal. Measuring the time delay between the onset of the coded pulse transmission and the receipt of the change due to the intruder allows the system to detect and pinpoint intruder's location.

Figure 1. TD100 Processing Unit

TD100 is unique in its use of Multiple Input and Multiple Output (MIMO) Digital Signal Processor (DSP) to detect and locate intruders using End-to-End Correlation (E2EC™), a patented Fiber SenSys technology. When fully operational to generate an alarm, the intruder must be detected at the same time and same location by both connected processors. The product provides high Probability of Detection (PD) and low Nuisance Alarm Rate and False Alarm Rate (NAR/FAR) detection with unprecedented fail-safe features.

This brief introduction to the technology provides a starting point for those who wish to install the TD100. It introduces the product components and the way that they can be interconnected to address various applications.

The information presented herein provides background for the more detailed and subject-focused manuals that describe the inner workings of TD100.

- Installation Manual
- Web User Interface (WUI) Manual
- Master Controller Manual

Theory of Operation

The basic concept behind E2EC is illustrated in Figure 2.

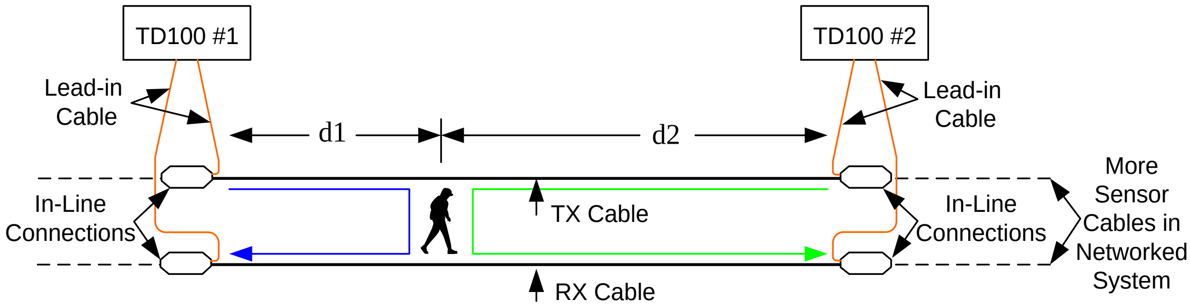


Figure 2. System E2EC

The leaky coaxial sensor cable is a standard coaxial cable with an aperture or a continuous slot in the outer conductor to allow Radio Frequency (RF) energy to couple between the signal traveling inside the cable to a surface wave traveling outside the cable but bound to the cable. There are two transmitters and two receivers in each processor - one TX/RX pair looking left and the second TX/RX pair looking right. The “Blue” trace in Figure 2 shows the TX 1 from TD100 #1 propagating down the cable to illuminate the intruder.

A portion of the energy is reflected along the RX cable to the receiver. This is referred to as “Out and Back” flow of energy as the contra-directional coupling. The time delay between the onset of the coded pulse and the receipt of the change due to the intruder determines the intruder’s location. The same process is repeated by TD100 #2 from the other end of the cables, “Green” trace. E2EC requires that the intruder be detected at the same time and at the same location to be declared as an alarm within one-meter accuracy.

As illustrated in Figure 3, the response measured in dB decays linearly due to cable attenuation.

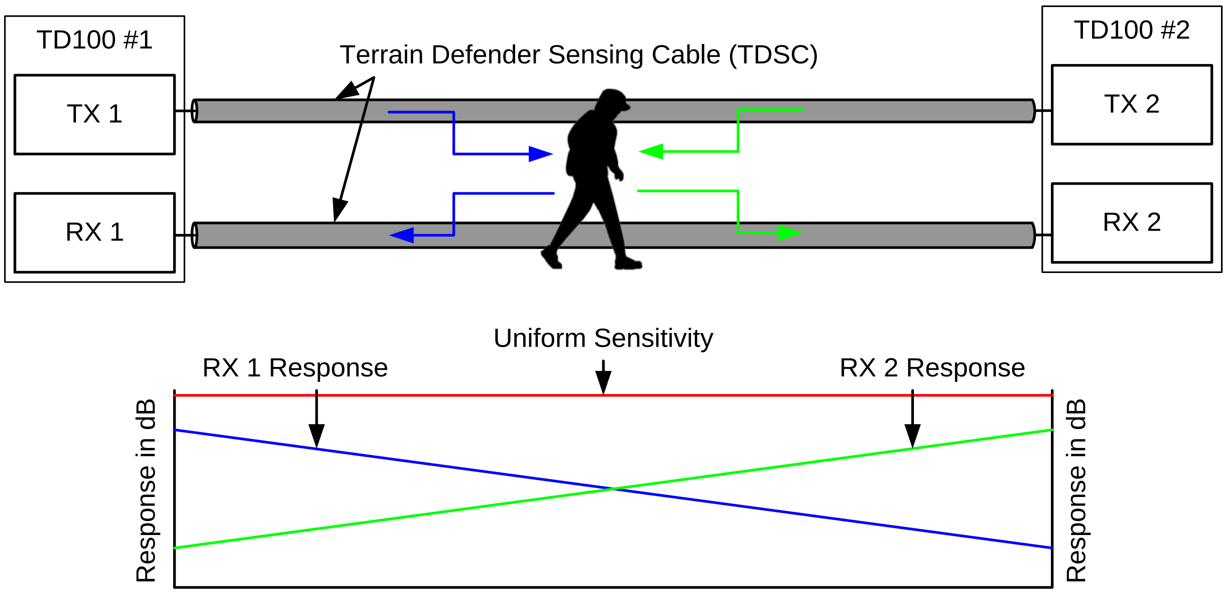


Figure 3. End-to-End Correlation (E2EC)

The E2EC process takes into account the complex product of the signal seen from both ends of the cables. The result is the uniform sensitivity shown in red on the above graph.

The detection zone created around the TX and RX cables is illustrated in Figure 4.

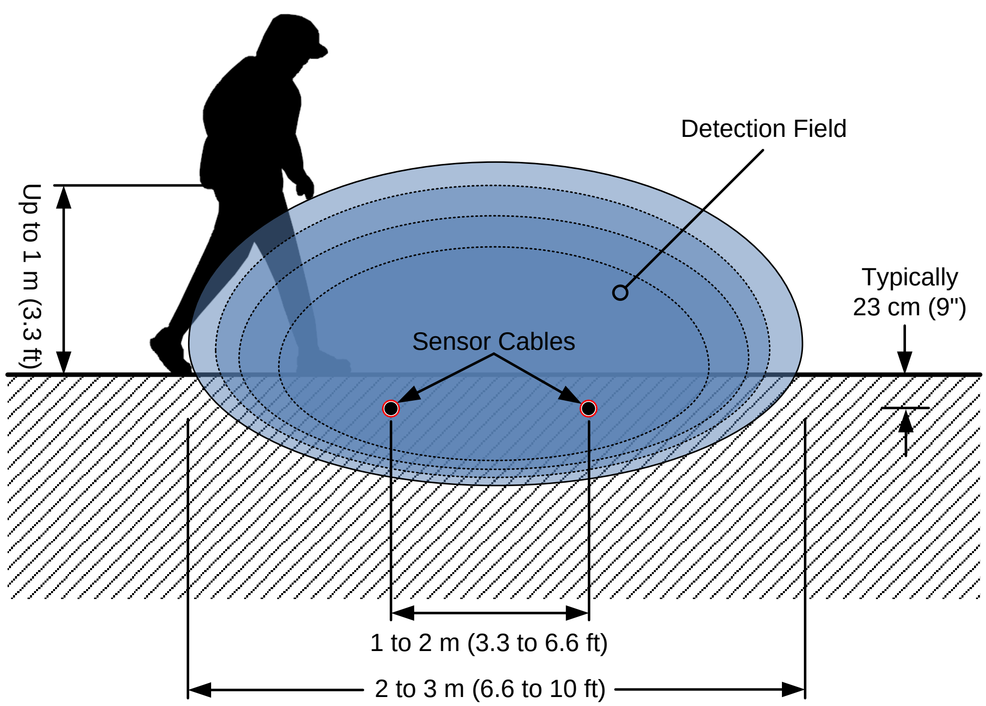


Figure 4. Detection Zone Cross Section

The blue ovals depict contours of equal sensitivity. The thresholds are typically set to detect a person up to 1 meter above ground and 0.5 meters on either side of the cable pair.

A TD100 system is composed of the following components:

- **TD100 Processor Kit**
  - Processor (Lead, Middle, or End) with SMA Terminators (SMAT)
- **Lead-in Cable** - pre-installed ferrite beads, 10 m (30 ft) pair *(included in TD100 kit)*
  - Additional lead-in lengths available, contact your Fiber SenSys sales rep for details
- **Start-Up Module Assembly (SUMA)** – in-line connections *(included in TD100 kit)*
  - Start-Up Module (SUM)
- **Sensor Cable**
  - TDSC 400M – A 400 m (1312 ft) spool of sensing cable (P# 600-44558)
- **Web User Interface (WUI)** – Calibration of the system through the TD100 TCP/IP connection
- **TD24PSU** – 24VDC Linear Power Supply w/ battery backup capability (P# 980-64560)
- **TD48PSU** – 48VDC Linear Power Supply w/enclosure (P# 980-94233)
- **TD Tool Kit** – Tools necessary for TDSC stripping and connecting lead-in and TD100 connections (P# 980-64263)
- **TD Enclosure** (Optional) – Enclosure for mounting TD100 (P# 980-84232)
- **TDR8 Relay Module** (Optional) – I/O module with 8 outputs and 4 inputs (P# 980-64241)
- **Master Controlle**r (Optional) – System management and monitoring (P# 980-04235)

Site Overview

Every site is unique. To properly plan for varying site conditions, aspects of the site such as soil type and condition, water flow, and metal structures should be noted so that the proper TD100 components and installation method can be selected to optimize performance.

Almost every site that can utilize TD100 can be described using the following terminology:

- Single or Multi-Processor Site – up to 400 meters of cable between processors
- Open or Closed Perimeters (Straight line or closed loop)

There are three possible processor positions:

- Lead – the first processor in any system
- Middle – a processor in a multi-processor site between the Lead and End
- End – the last processor in a system with more than one unit

There are two basic ways that a processor can detect and locate an intruder:

- Dual-Ended - E2EC – a processor on both ends of cables
- Single-Ended – system with cut cable, failed processor, or by design (No E2EC)

The RF Ports of each processor are terminated by one of the following:

- Sensor cable with a processor at both ends of cables
- SMA terminator on TD100 TX/RX ports
- Sensor cable with End of Line Terminators (EOLT)

There are many possible combinations of the above configurations to describe a perimeter and the mode of operation when one considers the possible ways to terminate a processor.

The concept of "Open" or "Closed" perimeters describes whether the sensor line encompasses the whole perimeter or only a part of the perimeter. In a "Closed" perimeter, an intruder cannot enter the perimeter without passing over the sensor cables. There are some exceptions, such as a perimeter that includes a building as part of the perimeter.

A four-processor "Closed" perimeter showing "Dual-Ended" and "Single-Ended" operation is shown in Figure 5.

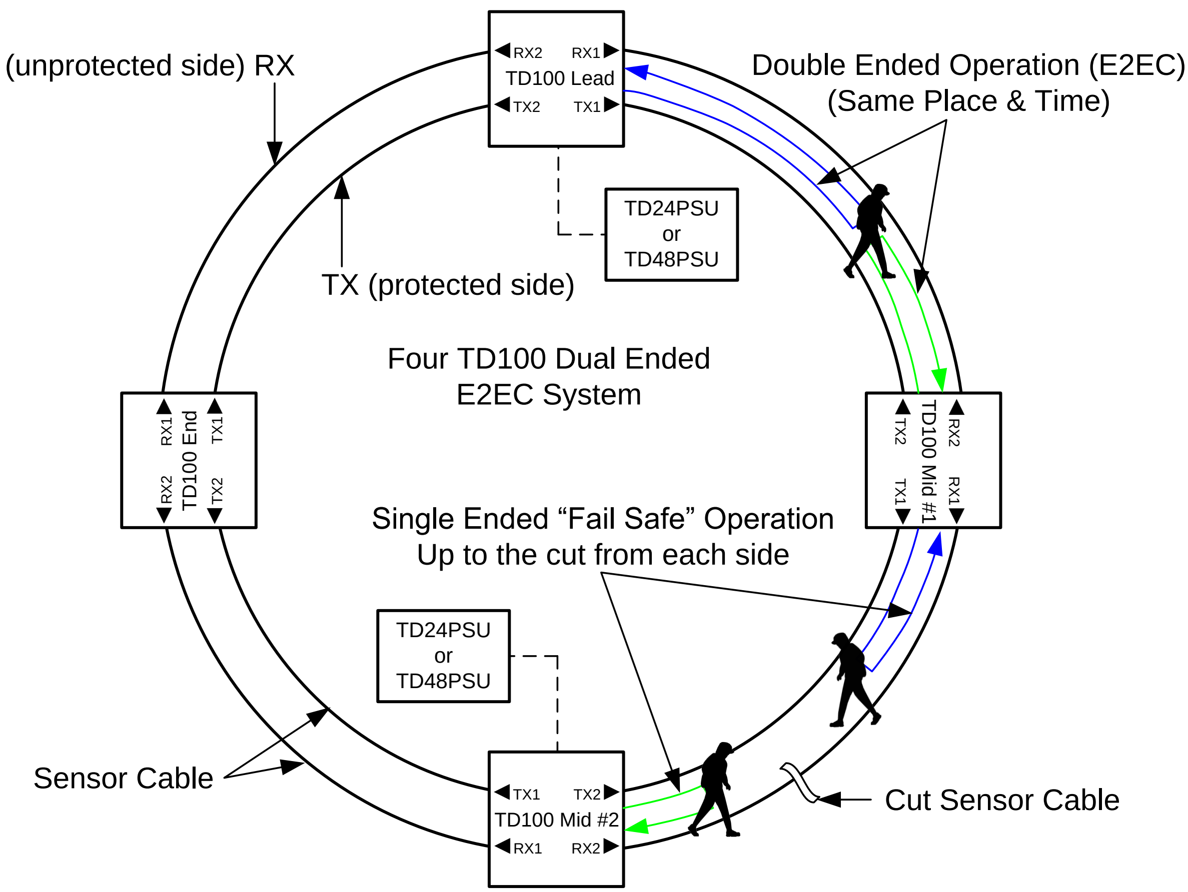


Figure 5. Four Processor Closed Perimeter

The TD100 processors are powered over the sensor cables. DC power is supplied over the RX and TX cables for redundancy. In high-security sites, it is common to install multiple TD24PSUs or TD48PSUs along the perimeter to provide additional redundancy in a power supply failure scenario. These redundancies would adapt for an open circuit or short circuit cable fault.

E2EC is unique to Terrain Defender products. E2EC describes a means of processing response information from both ends of the cables in a process referred to as Dual-Ended operation. To generate an alarm, the intruder(s) must be detected by the processors at both ends of the cables at the same time and the same physical location(s) along the length of sensor cables.

An important benefit of E2EC is its “Fail-Safe” operation. If a lead-in, sensor cable, or processor should fail, the two adjacent processors can revert to Single-Ended operation whereby each processor detects and locates intruders on either side of any cable or processor fault. The system will indicate the precise location of a cut or damaged cable.

The “Lead” processor on the perimeter is in the first position. The “End” processor is in the last position along the perimeter. All other processors are referred to as “Middle” processors – numbered from Lead to End.

Cables start at TX/RX 1 of a processor and terminate at TX/RX 2 of the following processor. Range Bin numbering increases with distance from each processor. The Range Bins for TX/RX 1 and 2 bisect to create Correlated Bins (C-Bins). C-Bin numbering is the sequence of the complementary TX/RX 1 and TX/RX 2 Range Bins. When the target location is annunciated in meters or feet, it is measured at the processor first in line. TX/RX 1 distances are positive, and TX/RX 2 distances are negative.

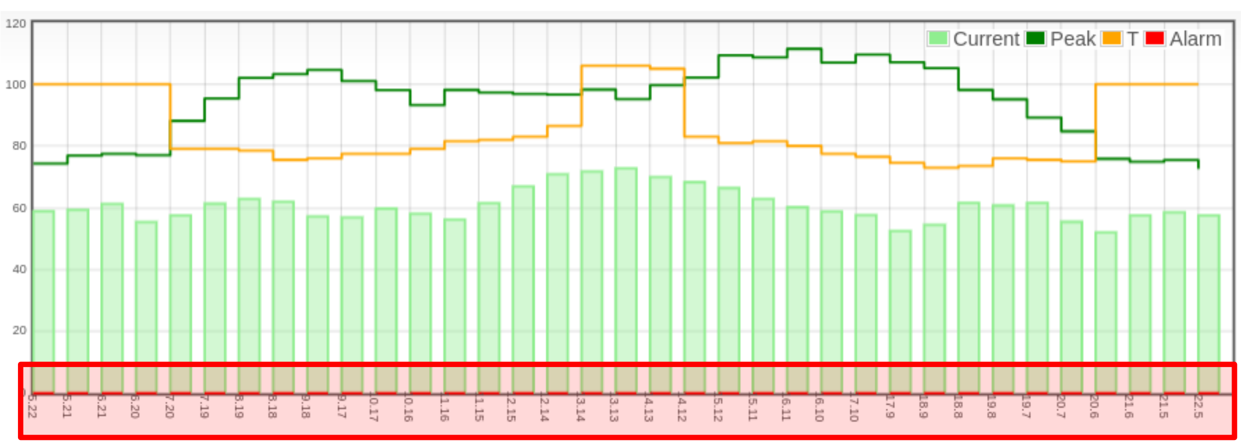


Figure 6. Graph showing C-Bins along the x-axis

The cut sensor cable in Figure 5 illustrates Fail-Safe Mode based on Single-Ended operation. Both TX/RX 1 and TX/RX 2 detect and locate intruders up to the cable cut. When a Cable Fault is annunciated, the processor will automatically switch into Single-Ended operation in case of a failure, or it may be done manually if preferred.

The different types of processor terminations are illustrated in Figure 7.

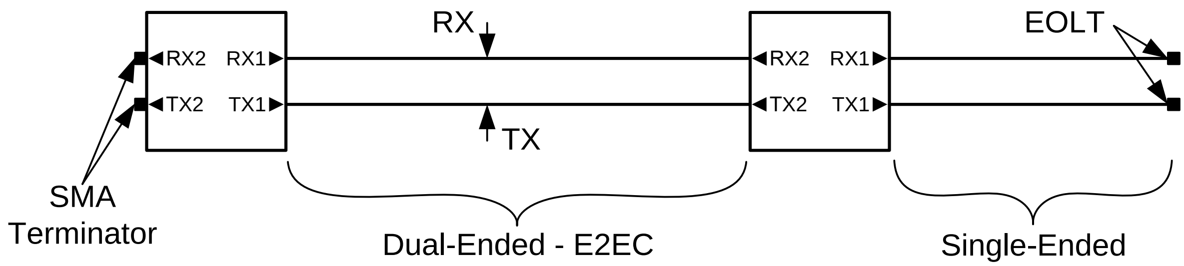


Figure 7. Processor Termination

When only one TX/RX pair of a processor is being used, the other pair should have SMA terminators installed.

As previously described Single-Ended operation allows TD100 to provide Fail-Safe operation. Other leaky coaxial cable sensors on the market today all operate in Single-Ended Mode.

Figure 8. SMA Terminator (left), installed on TD100 (right)

The various connections on a TD100 processor are illustrated in Figure 9.

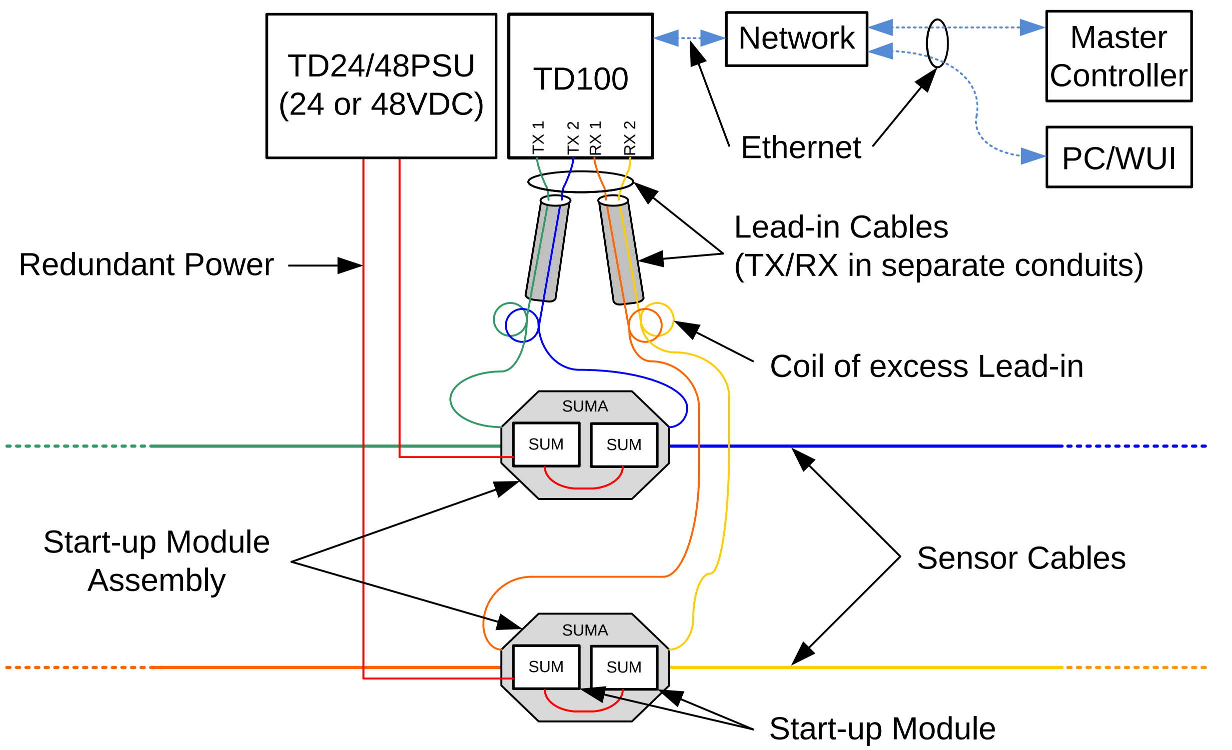


Figure 9. Connections to the TD100

The TD100 processor connects to the sensor cables using factory-made lead-in cables. The lead-in cables are 10 m (30 ft) long, with connectors and ferrite beads attached. For a Middle processor, two TX lead-in cables and two RX lead-in cables with the TX and RX cables are installed in separate PVC conduit. Power is provided to the processor from the Start-Up Module Assembly (SUMA) over the lead-in cables. Power cables may run inside the TX/RX conduits or inside their own isolated conduit(s).

Excess lead-in cable is buried in a loop next to the respective TX or RX SUMA after the end of the conduit leading to them. Install clamp-on ferrite beads to the spare lead-in coils. Lead-in cable should maintain a bend radius of 9 cm (3.5 in) or greater, take note of this inside the TD100 enclosure and coils at the SUMA location.

The processor should be mounted in an outdoor metal enclosure or inside a site facility on the protected side of the perimeter. The TD100 enclosure can mount to a fence post or strut structure. The cables connecting to the processor enter through the bottom of the enclosure via conduit, as shown in Figure 10. The conduit is routed to the edge of the detection zone, about .5 m (1.6 ft) from the nearest cable. The conduit protects the cables from accidental cutting or crushing.

Figure 10. TD100 inside optional TD Outdoor Enclosure

Each lead-in cable connects to the sensor cable inside the SUMA, a waterproof enclosure. The SUMAs are installed “in-line” with the sensor cables. The connections inside the enclosures are made utilizing a Start-Up Module (SUM). The SUM uses spring-loaded lever-action terminal blocks to make the power and sensor connections, then an SMA bulkhead for the lead-in connection.

Lightning protection circuitry is provided at the SUM. The ground connection is made from the SUM’s stainless steel enclosures ground lug then routed to a ground rod or plate installed midway between the sensor cables and SUMAs.

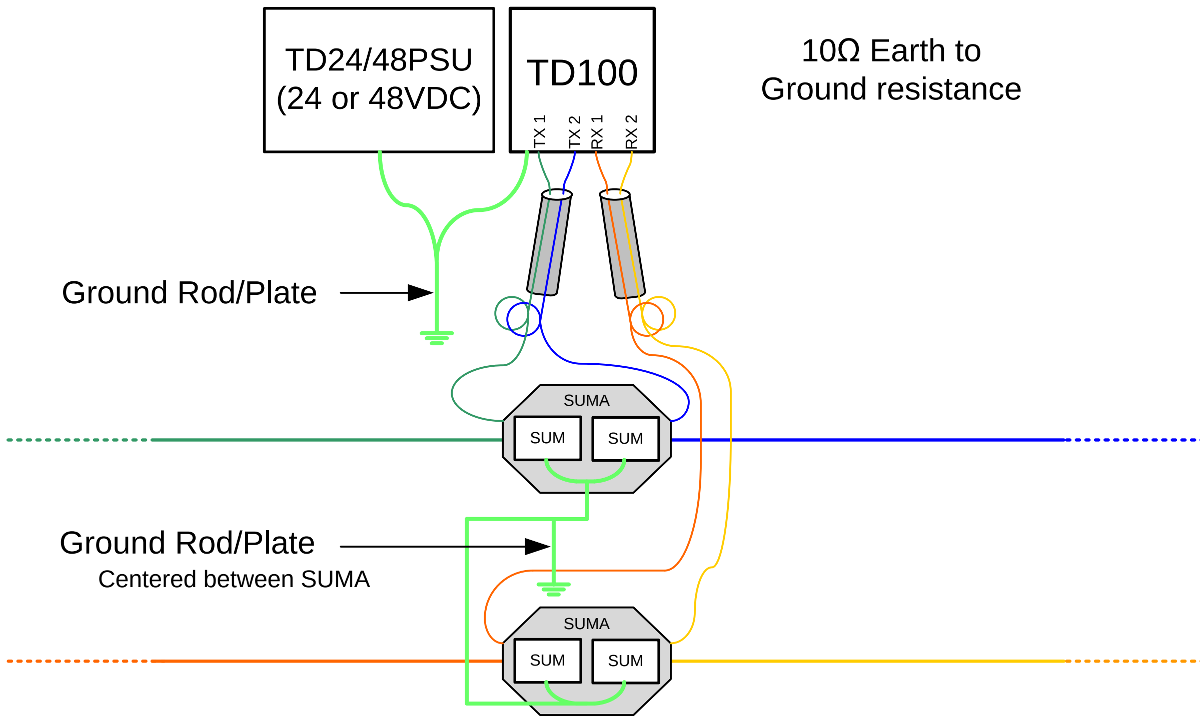


Figure 11. System grounding

Power is provided to the sensor cables at the SUM. For Fail-Safe operation, DC power is supplied independently to the TX and RX cables. Each processor collects its power over the lead-in cables with a diode “OR” arrangement so that one can withstand either an open or shorted sensor cable failure.

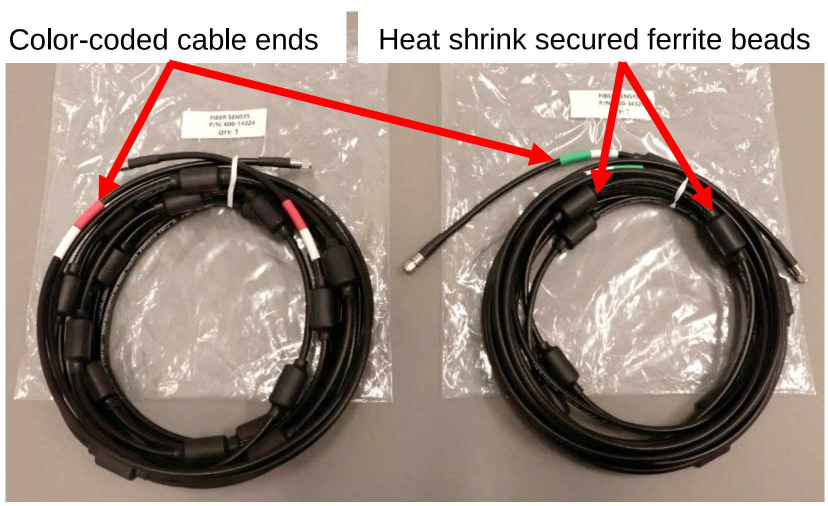


Figure 12. TX and RX Lead-In Cables

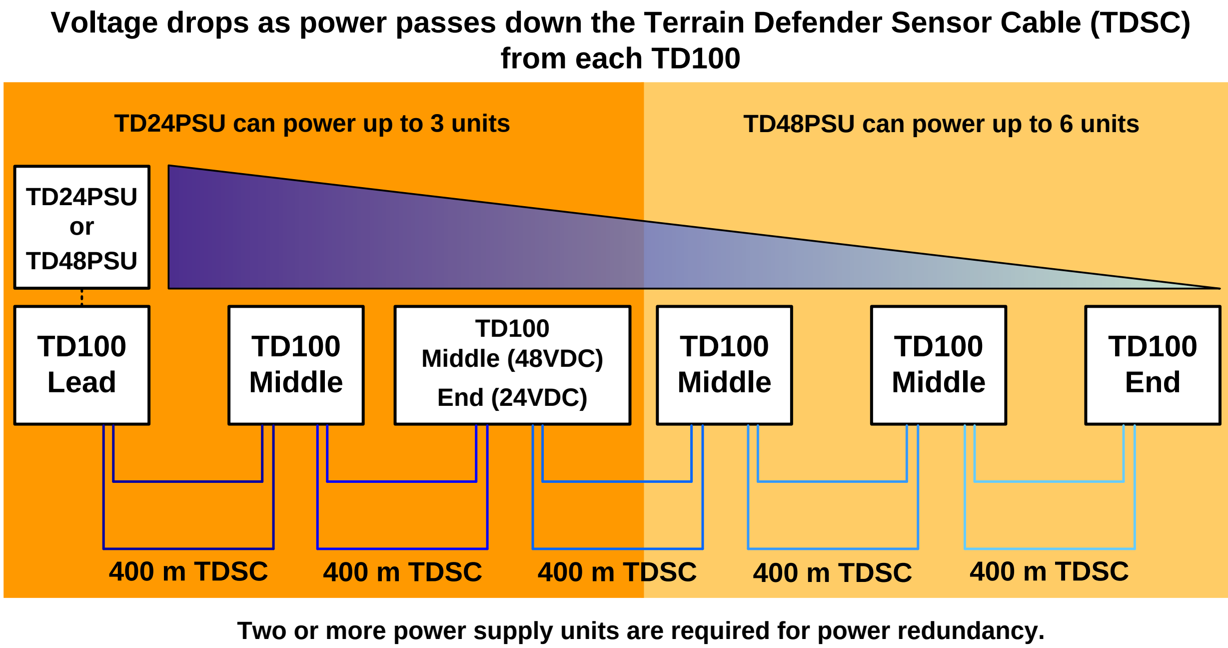


Figure 13. System power with single TD24PSU or TD48PSU

The Lead Processor typically connects to the Master Controller via Ethernet cable. For redundant operation, the End Processor can also connect to the same or a separate Master Controller.

During installation, connect a computer to a TD100 processor via the RJ-45 connector using a standard Ethernet cable and enter the TD100 default IP address **192.168.0.1**. Enter username: **Admin** password: **Admin** to connect to the Web User Interface (WUI). While the WUI has some of the same displays as the Master Controller, it is more focused on setting up a processor.

TD100 Default Password Table:

System Level	Username	Password
User 1	oper	oper
User 2	oper2	oper2
Administrator	admin	admin

Please see the Web User Interface (WUI) Manual for more information on the TD100 user interface, such as cable calibration, tuning for intrusion detection, and relay setup.

This Introduction to TD100 provides the background for the reader to be ready to understand and appreciate the detailed information provided in the following manuals:

1. **Installation Manual** – Describes how one should design and install TD100 at a specific site. It addresses how to install the cables and other components to optimize the sensor performance at that site.

2. **Web User Interface (WUI) Manual** – The TD100's Web User Interface (WUI) is a direct connection with the processor using a web browser. While some of its features are in common with those available using the Master Controller, the WUI is even more detailed. The manual walks through the pages and tabs with example screen captures and descriptions of how each feature can be used.

3. **Master Controller Manual** – Most sites with more than a couple of processors will benefit from a Master Controller. It provides the interface to the outside world. Often it is via a custom software interface to a Head-End Display and Control system. On other occasions, it drives a relay interface. Most importantly, it improves system performance and provides maintenance and diagnostic tools addressing all the processors from the Head-End location. The manual steps through all the pages and tabs, showing screen captures and describes how each feature can be used.

This section contains information to help ensure safety and the proper operation of equipment. Please follow these instructions carefully and keep them accessible for future reference. When using the TD100, use only attachments and accessories that have been specified by Fiber SenSys, and refer all servicing to qualified personnel.

2. Safety

As comprehensive as these manuals are, TD100 is intended to be installed by trained professionals having experience in security system construction and safety.

The following icons may appear throughout this manual:

CAUTION: Identifies conditions or practices that could result in damage to equipment and/or loss/contamination of data.

WARNING: Identifies conditions or practices that could result in non-fatal personal injury.

Restricted Access

The **TD100** (and associated accessories such as **TD24PSU, TD48PSU,** and **TDR8)** is intended only for installation in restricted access locations, where access is restricted using a lock and key (or other means of security) controlled by the authority responsible for the location, and where access can only be gained by service persons or other users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that need to be taken.

Electrical Safety

If the **TD100** is damaged or malfunctions, disconnect power to the APU. Do not use the APU if any of the following conditions exist:

- It is visibly damaged.
- It does not operate as expected.
- It has been subjected to prolonged storage under adverse conditions.
- It has been damaged during shipment.

Do not put the TD100 into service until qualified service personnel have verified its safety.

Covers and Panels

There are no user-serviceable parts inside the TD100. To avoid personal injury, do not remove any of the TD100’s covers or panels without being instructed to by Fiber SenSys. The product warranty is void if any factory seal is broken. Do not operate the product unless the covers and panels are installed. The TD100 has an internal tamper switch that registers the removal of the TD100 cover.

Inspection

The **TD100** should be inspected for shipping damage. If any damage is found, notify **Fiber SenSys** and file a claim with the carrier. Save the shipping container for possible inspection by the carrier.

FCC Rules

Note: FCC Part 15 Clause 15.21:

“Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.”

“This device complies 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.”

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the manufacturer, dealer, or an experienced radio/TV technician for help.

3. System Planning

Survey the Site

Every site is unique, and each with its challenges. To ensure the best performance of the TD100 system, this section will help guide you through the process and provide you the tools needed for the best design and solution.

Note: Please contact Fiber SenSys to help you with your TD100 site design
As comprehensive as these manuals are, the TD100 is intended to be installed by trained professionals. This is essential to optimize the performance of the system at any site.

Check List

CAD/PDF Drawings pertaining to Perimeter Intrusion Detection System

- Show location of:
    - Fences (Type, Height, Condition, Distance from sensor cable)
    - Proposed cable path on drawing
    - Gates (Single, Dual)
    - Driveways, Walkways
- Soil Type
    - Describe soil type. Example: sandy, dry granular, loam, clay, heavy clay, etc.
        - If more than one soil type, show change
- Concrete
    - Thickness
    - Reinforced Yes/No
- Asphalt
    - Thickness
    - Reinforced Yes/No, Fiber/Metal
- Stone/Crush Rock
    - Thickness
- Water
    - Irrigation Pipes (Metal/Plastic)
    - Drainage Pipes (Metal/Plastic)
    - Shoreline (Lake, River, Stream)
    - Run-Off Ditches
    - Sewer Pipes (Metal/Plastic)
- Electrical
    - Conduit Raceways (Metal/Plastic)

Photographs/Video

- If an existing site, provide pictures and/or video clips of the detection areas
- Description of local weather conditions
- Provide address and/or GPS coordinates

Site Desired Security Level

- Is TD100 being used as part of a layered perimeter security system?
- Detection flow – will the system be detecting intruders from outside to in or inside to out?
- What is the desired primary detection target?

Nuisance Sources

- Moving vehicles within 3 m (10 ft)
- Going under fences or within 2 m (6.6 ft)
- Standing or flowing water within 1 m (3.3 ft)

Processor Configuration(s)

A TD100 system can be configured to cover all manner of installations. Some examples are depicted below:

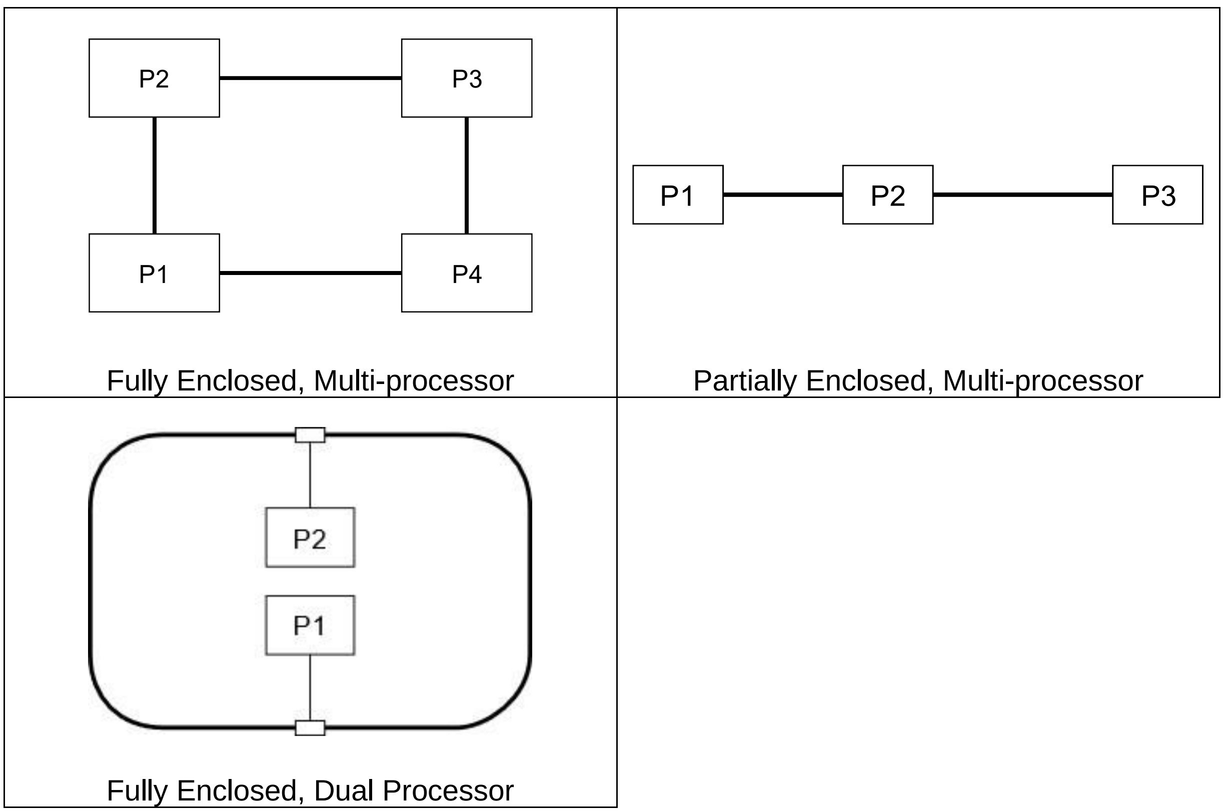


Figure 14. Processor Configuration Examples

4. Installing Sensor Cable

Cable installation overview

System performance starts with the proper installation of the sensor cables.

To install the cables and cable fittings, perform the following steps in order:

- Verify the site plans, cable routing, and note potential hazard areas from the check-list provided earlier, such as; underground water/electrical utilities.
- Mark the sensor cable route with marking chalk, a temporary, fast-drying, water-based spray paint. Chalk can be used to spray paint surfaces such as pavement, concrete, gravel, soil, and grass.
- Plow/dig trenches based on application and/or cut asphalt/concrete slots where applicable.
- Run the cables into the trenches or slots, verifying the depth every 2 m (6.6 ft) as installing.
  - Keep in mind the burial depth required for your application, cable spacing, and distance from potential hazards
  - Limit grade changes to <30°
  - Make gradual sweeping turns around corners, 7 m (23 ft) radius minimum
- Install Start-Up Module Assembly (SUMA) (includes direct bury enclosure, lead-in cable(s), Start-Up Module(s) (SUM)

Note: Keep TX cables separated from RX cables. The TX 1/2 lead-in cables will run together in one conduit and the RX 1/2 in the other; see Figure 7. The TX lead-in(s) will transition to TX sensor cable(s) on the protected side of the perimeter, RX sensor cable(s) on the unprotected side.

- Verify sensor cables with a continuity tester for shorts and grounds prior to termination.
- Replace soil to cover sensor cables where applicable, restore asphalt removed from trenching, and caulk any concrete slots.

Cable Plow/Trenchers

Using a cable plow to install the TD100 sensor cable is the most efficient and economical method. It helps control burial depth and width. The TD100 sensor was specifically designed for this method. However, traditional trenching methods can also be used when installing the TD100 Sensor Cables.

Attachments are available for adapting tractors into vibratory cable plow capable. Commercial cable trenchers and plows are also options.

Figure 15. Cable Plow (left) and Walk-behind Trencher (right)

Planning the Cable Installation

TD100 sensor cables must maintain a minimum spacing of **1 m (3.3 ft)**, and maximum of **2 m (6.6 ft)**. Spacing throughout the sensor run must be consistent. 1.5 m is standard for all military applications.

The Terrain Defender Sensing Cable (TDSC) is sold in a 400 m (1312 ft) length on a spool. Order a pair of 400 m spools (P#600-04356) to create a roughly 400 m sensor length, or any zone size larger than 200 m (656 ft). A single 400 m spool can be used to cover zone sizes of 200 m or less. The dimensions of a single TDSC spool are 81 cm (32 in) W x 40.5 cm (16 in) H, and the weight is 104 kg (230 lbs). Care must be taken when transferring and preparing to unspool and install the cable.

Figure 16. Two TDSC 400, 400 m spools

Once spacing has been determined for a site, that spacing must be consistent throughout the system.

Width of sensor cable trenches

- Using a cable plow, the cutting blade should be at a minimum, twice the width of the outer diameter of the sensor cable.
  - Cable diameter: 16.39 mm (.65 in)
  - Plow blade diameter width (minimum): 32.8 mm (1.3 in)
  - Observe a minimum cable installation bend radius of 15 cm (6 in)

- Use a trenching machine for sites or areas where the cable plow will not work. The trench width is determined by the width of the cutting teeth. Most are 10 to 15.2 cm (4 to 6 in) wide, which is more than required.
  - All installs utilizing a trench should have cable marker/caution tape installed 9 cm (3.5 in) above the TDSC.

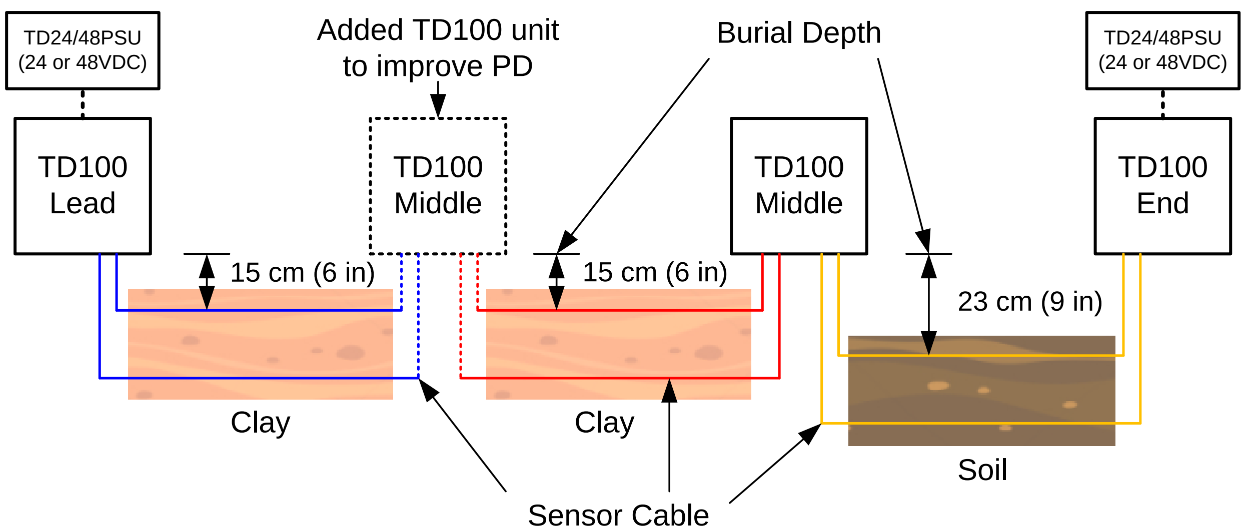
Figure 17. Cable trench examples

Figure 18. Caution Buried Cable Tape

Soil

Burial depths are dependent on soil type, asphalt, crushed stone, and concrete.

- Standard soil is the simplest of mediums to install. Maintain 23 cm (9 in) burial depth.
- There are various clay soil consistencies. Knowing which you are working with will help when planning the site civil work and TD100 components.
  - When a heavy clay medium is present, 15 cm (6 in) burial depth is optimal. It may be necessary to add additional processing to maintain the specific PD/NAR requirements. With TD100, if Probability of Detection (PD) is not favorable, add a middle TD100 Processor Kit, in-line anywhere along the detection cable to increase the gain between processors needed to reduce clay soil effects.



**Note: PSU connection is with SUMA. The above illustration is to depict that adding processors doesn't necessarily require adding power supplies.*

Figure 19: Burial in clay versus soil w/ added TD100

Asphalt

When an application requires sensor cables to be installed in asphalt, it is necessary to determine the thickness. Asphalt material properties do not contain the RF signal as much as soil, and in most cases, it would be like installing the cable on top of the ground. Also, avoid placing the sensor cable so deep that the height of the detection field is reduced.

- Asphalt will require cutting a wide section out, 15 cm+ (6 in+), that allows for the removal of spent materials and access to the soil below where manual digging or mechanical trenching can be used to reach the appropriate sensor cable depth.

- If the asphalt layer is <10 cm (<4 in), a 23 cm (9 in) burial depth is acceptable unless clay is present, then that would need to be factored in. Work with a Fiber SenSys Support Representative to determine the best method when installing TDSC.

- If the asphalt layer is >10 cm (>4 in), reduce the burial depth equally every additional inch up to 16.5 cm (6.5 in). For example, 12.7 cm (5 in) top cover in asphalt would require 20.3 cm (8 in) burial depth, 2.5 cm (1 in) additional asphalt reducing the total burial depth by 2.5 cm (1 in). If clay is present, then that would need to be compensated for. Work with a Fiber SenSys Support Representative to determine the best method when installing TDSC.

- If the asphalt layer is >16.5 cm (>6.5 in), the concrete installation procedure may need to be utilized. Work with a Fiber SenSys Support Representative in all cases where asphalt greater than 16.5 cm (6.5 in) to verify appropriate TDSC installation prior to deployment.

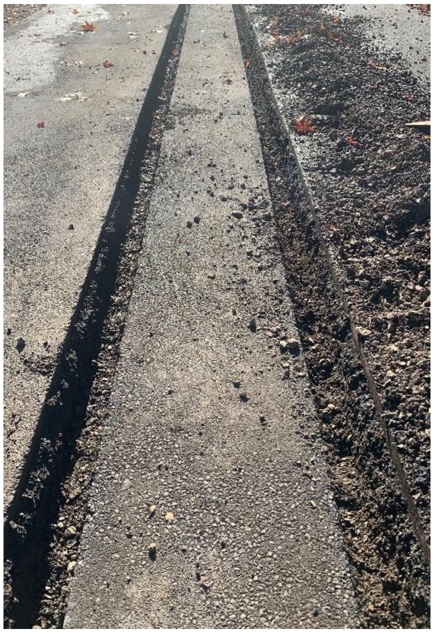


Figure 20. Asphalt Cut Total 23 cm (9 in) depth

Asphalt to Soil transition maintain 23 cm (9 in) depth

Crushed Stone

When installing in a crushed stone application, also referred to as gravel or basalt, there are some subtle differences between soil and asphalt. For a topping that is 10 cm (4 in) or less, use the standard soil guidelines and burial depths.

- If the crushed stone layer is <10 cm (<4 in), a 23 cm (9 in) burial depth is acceptable unless clay is present, then that would need to be factored in. Work with a Fiber SenSys Support Representative to determine the best method when installing TDSC.

- If the crushed stone layer is >10 cm (>4 in), reduce the burial depth equally every additional inch up to 16.5 cm (6.5 in). For example, 12.7 cm (5 in) top cover in crushed stone would require 20.3 cm (8 in) burial depth, 2.5 cm (1 in) additional crushed stone reducing the total burial depth by 2.5 cm (1 in). If clay is present, then that would need to be compensated for. Work with a Fiber SenSys Support Representative to determine the best method when installing TDSC.

- If the crushed stone layer is >16.5 cm (>6.5 in), the concrete installation procedure may need to be utilized. Work with a Fiber SenSys Support Representative in all cases of crushed stone greater than 16.5 cm (6.5 in) to verify TDSC installation prior to deployment.

- The maximum size for the crushed stone is 19 mm (0.75 in).

Concrete

Concrete installation significantly differs from the above installation methods due to its density.

- A 6.4 cm (2.5 in) deep, 1.8 cm (.71 in) wide slot will be required for concrete =>10 cm (>4 in) thick. For concrete <10 cm (<4 in), work with a Fiber SenSys Support Representative to determine the best installation method.

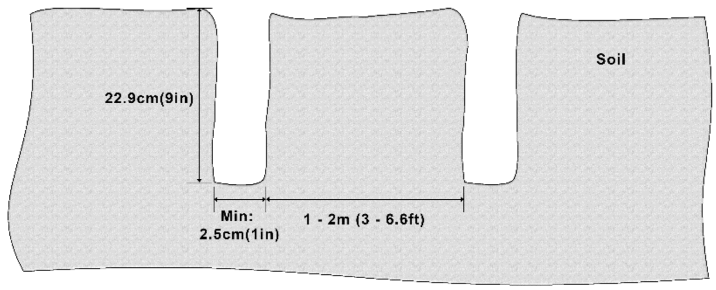
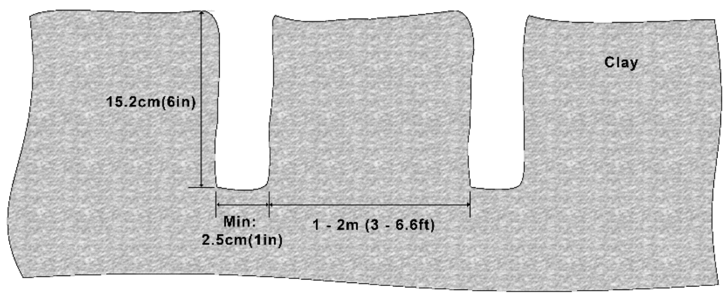
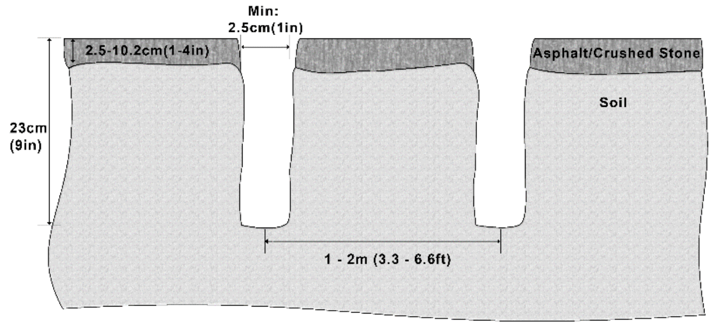
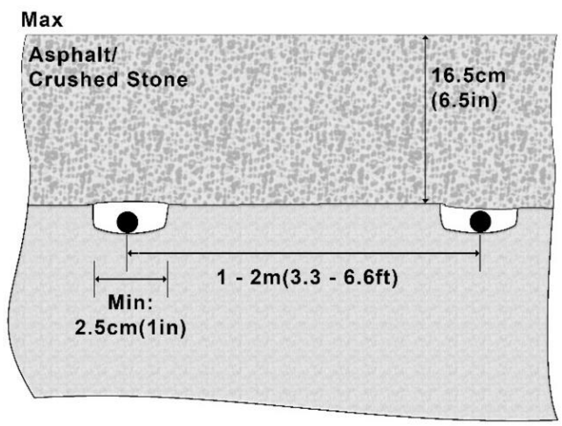
- Before placing the sensor cables into the slots, verify there are no sharp edges, and the slot is free from debris. Inserting a 1 m (3.3 ft) section of scrap sensor cable is a simple tool to verify your slot depth and width spot-checking every 2 - 3 m (6.6 – 10 ft) before handing the TDSC spool.

- Once the sensor cable is set into the slot, a 3/4 in (1.9 cm) foam backer rod is placed on top of the sensor cable then sealed with DOWSIL™ 888 Silicone Joint Sealant.

Figure 21. DOWSIL™ 888 Silicone Joint Sealant

CAUTION: Concrete reinforced with metal rebar can cause the detection field to stray away from the sensor lines. Greater than 5 cm (2 in) below TDSC is acceptable, otherwise, for proper field containment on reinforced concrete, consult with a Fiber SenSys Support Representative with details on the rebar placement and concrete design.

Note: 13 mm (1/2 in) space is necessary above the backer rod and slot top for proper sealant bonding.

Deployment Medium	Depth	Diagram
Soil	23 cm (9 in)	
Moderate to heavy clay soil (If needed, adding an additional TD100 Processor will improve performance in these conditions.)	10 cm (6 in)	
Asphalt or crushed stone that is <10 cm (>4 in) thick	23 cm (9 in)	
Asphalt or crushed stone and >10 cm (>4 in)	Reduce sensor depth 2.5 cm (1 in) from 23 cm (9 in) for every 2.5 cm (1 in) additional top layer	

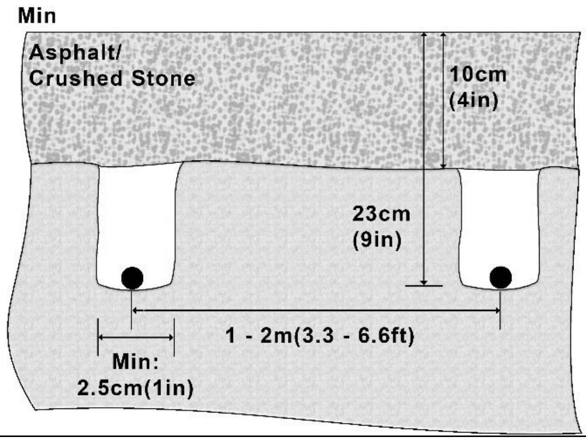
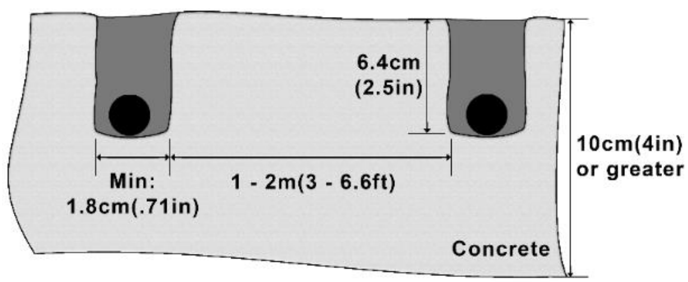
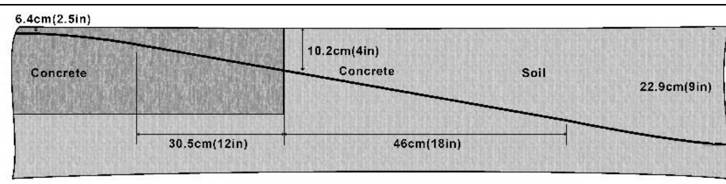
		
Concrete >10 cm (>4 in)	6.4 cm (2.5 in)	
Transition from concrete to soil	6.4 cm (2.5 in) concrete side transitioning to 23 cm (9 in) over a span of 76 cm (30 in)	

Figure 22. Burial Depth Table

5. Start-Up Module Assembly (SUMA) / Start-Up Modules (SUM)

The TD100 product uses a standard, modified coaxial cable sensor element. The cable has two outer jackets separated by a flooding compound designed for direct burial. Beneath the two jackets, there is an outer conductor which has two parts; a foil tape that allows for a slotted aperture and a braided conductor that provides a low resistance DC path to accommodate power supplied over the cable. Unlike other custom leaky coax cables, the slot width formed by the foil is constant over the length of the cable.

The leaky cable is connected to a coaxial lead-in cable which connects to the processor. The connection between the sensor and the lead-in is made inside the Start-Up Module Assembly (SUMA), which is designed for direct burial. The connection is made inside the SUMA in an RF shielded stainless steel box, called the Start-Up Module (SUM). This note describes how to install the shielded termination.

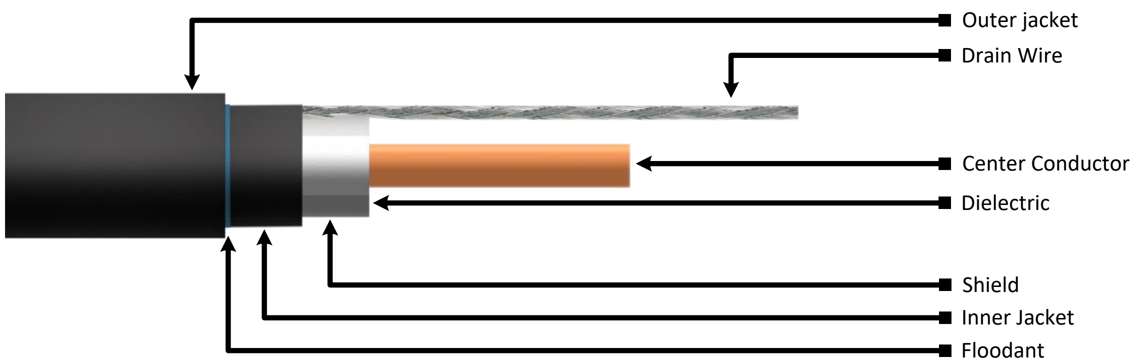


Figure 23. Sensor Cable Overview (Side)

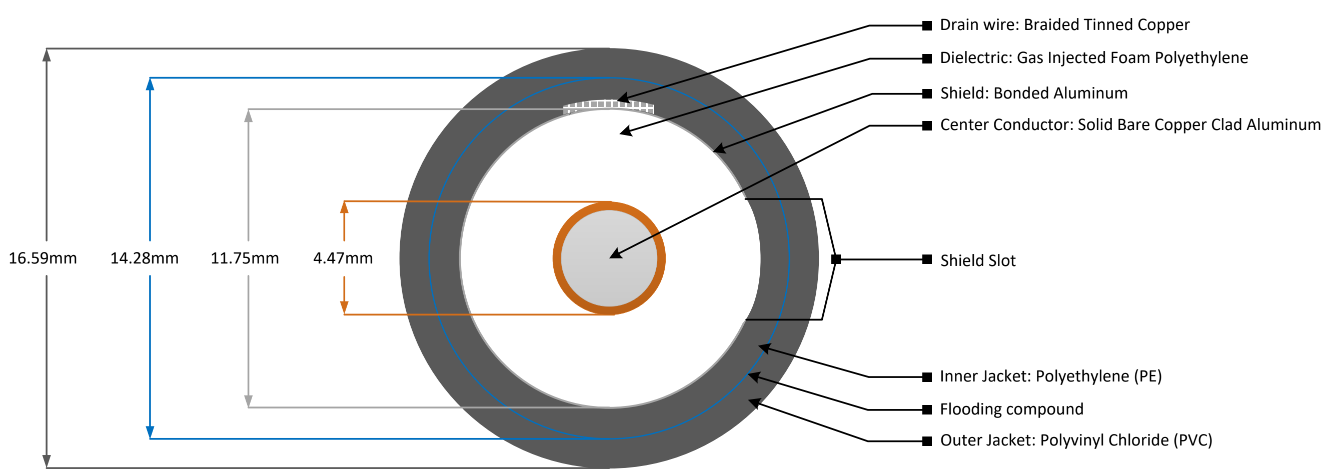


Figure 24. Sensor Cable Overview (Cross Section)

There is passive circuitry inside the SUM that connects the RF from the lead-in cable to the leaky sensor cable, providing lightning suppression and 24 or 48VDC power over each sensor cable. In most applications, there are two SUMs inside a SUMA to support sensor cables going in opposite directions. When the processor is at the end of an open perimeter there will only be one shielded termination per SUMA.

The processors on the perimeter, receive power over the sensor cables. The SUM allows power to pass through the SUMA from side to side directly from one pair of sensor cables to the next. The power is supplied in parallel over both the TX and RX sensor cables, providing redundancy. Each processor receives its power over the TX and RX lead-in cables from the SUMA. This ensures a redundant power connection with only the power going to the processor over the lead-in cables. This process ensures that power goes to all processors even if the lead-in cables are cut, or a processor should fail. The perimeter power disseminates from SUMA to SUMA redundantly on the TX and RX sensor cable, and in a closed perimeter, from both ends of the perimeter. This supports the hallmark redundancy of operation of the TD100.

The lead-in cables come in a standard 10 m (30 ft) lengths with factory-installed ferrite beads and SMA connectors at each end. When there is excess lead-in cable, bury to the outside of the detection zone created by the sensor cables; see Figure 29. The lead-in cable connects to the TX/RX SMA connector on the TD100 processor and then at the ferrite bead end to the SUM inside the SUMA.

Custom cable lengths available. Additional lead-in may affect maximum sensor length. Contact Fiber SenSys Sales or Technical Support for more information.

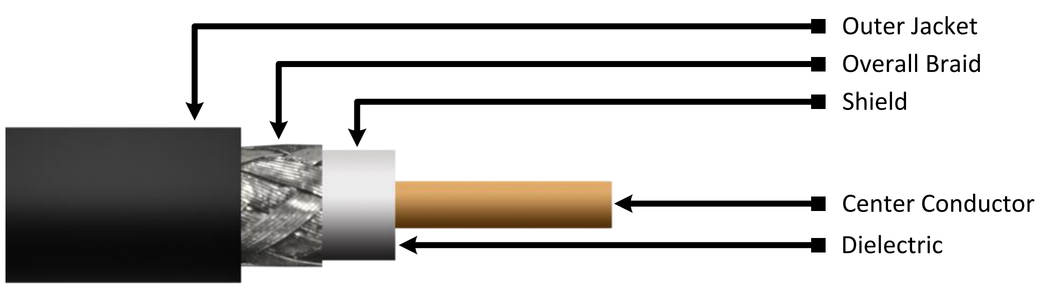


Figure 25. Lead-In Cable Overview (Side)

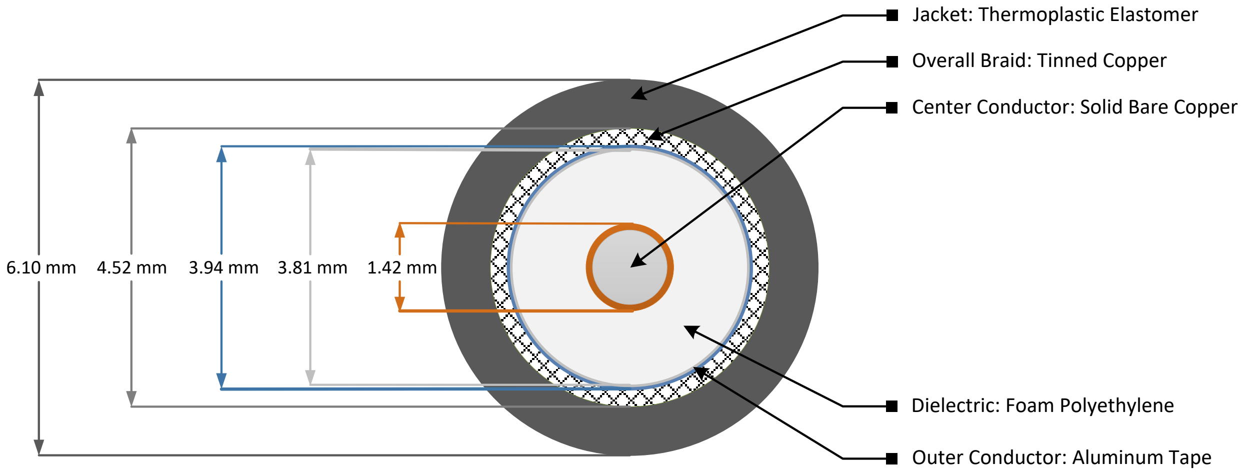


Figure 26. Lead-in Cable Overview (Cross Section)

The TD100 system was designed so that the sensor cable can be installed around the entire perimeter and then TD100 and SUMA units added after installing where they are needed to meet soil conditions or site infrastructure locations with its in-line processing design.

Preparing Installation of Start-Up Module Assembly (SUMA) to TD100 Processor Connection

Dig two parallel trenches from the TD100 Processor to the Start-Up Module Assembly (SUMA) location; see Figure 27. The outdoor TD100 enclosure has two pairs of knockouts 3.175 cm (1.25 in) / 3.81 cm (1.5 in) for conduits on the bottom side to feed the TX lead-in cable(s) in one and the RX lead-in cable(s) in the other. It is important to keep the TX and RX cables in separate conduits.

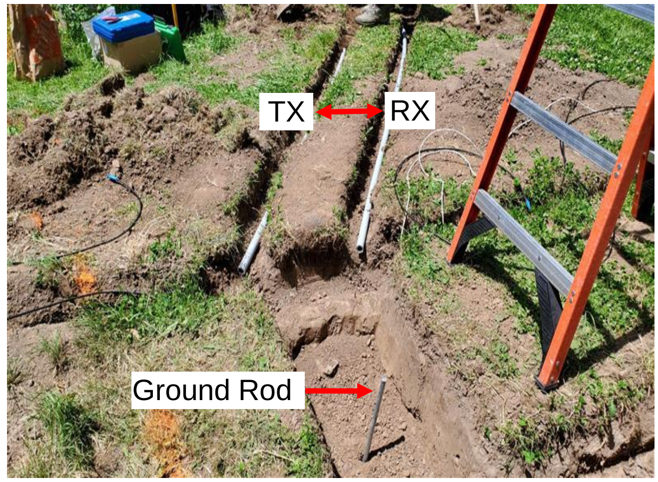


Figure 27. Trenches and Grounding Rod between BSEs

Figure 28. Sensor cables and lead-in cables in place

Start-Up Module Assembly locations

In this example, the SUMAs have sensor cables entering from both directions, requiring two SUMs inside each for the TX and RX cables. The ground rod or plate should have 10 Ω resistance maximum; see Grounding 10 for additional information.


Figure 29. TX and RX SUMA

The bend radius for the lead-in cable is 9 cm (3.5 in). This should be adhered to for the coils of spare cable at the SUMAs and inside the processor enclosure. The coils of spare cable at the SUMA need ferrite bead clamps applied, as shown in, Figure 30.

Note: TX and RX coils are next to their respective SUMA, not on top of each other.


Figure 30. Ferrite Bead Clamp

The TX (protected side) SUMA will have a TX 1 connection to one SUM and TX 2 to the other SUM. The same applies to the RX SUMA, respectively.

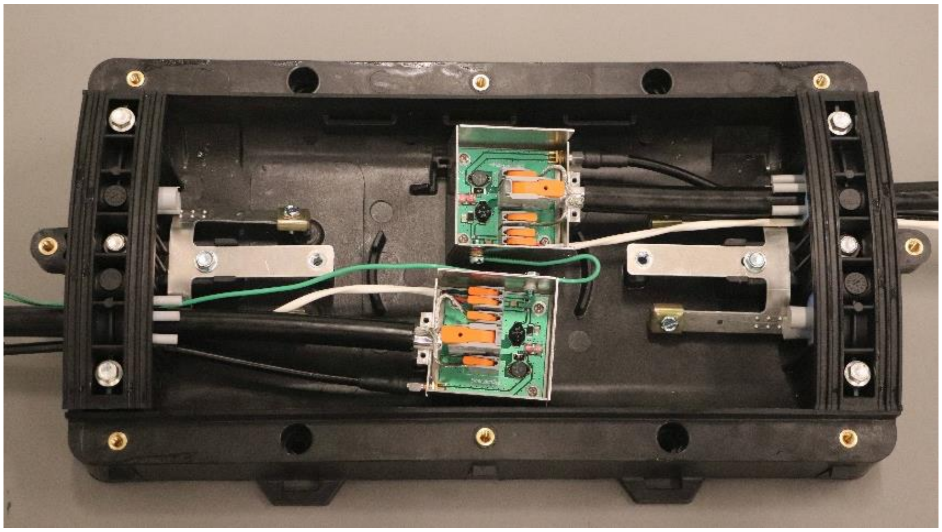


Figure 31. SUMA and STMs without covers

Start-Up Module Assembly (SUMA), Start-Up Module (SUM), and Sensor Cable Preparation and Installation

Figure 32. Tool Kit contents

Step 1

Remove the cover and endplate caps from the SUMA.

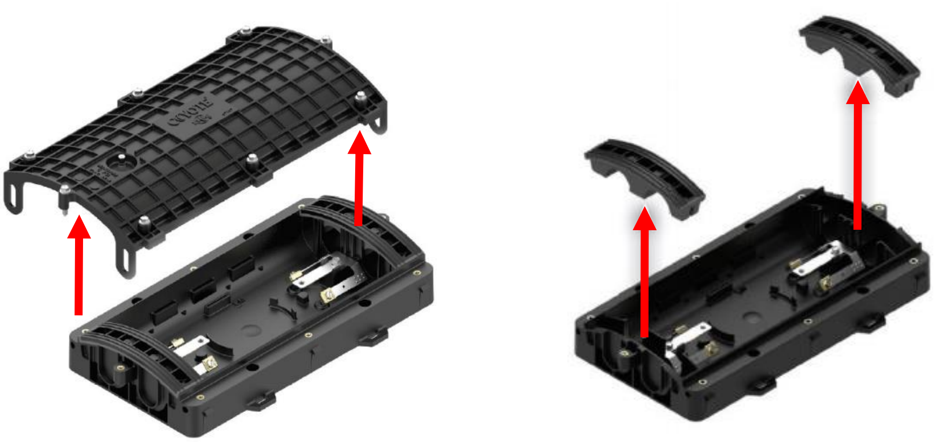


Figure 33. SUMA with cover and endplate caps being removed

Step 2

Remove two cable port tabs offset from one another for example, top left port and the lower right port. First, score the edges of each tab several times with a utility knife, then remove each tab by pulling it outwards from the SUMA with pliers.

Figure 34. SUMA tab removal

Step 3

The cable is cut in the middle of the SUMA location to create two cable ends. A coaxial cable cutter should be used.

Figure 35. Coaxial Cable Cutter

Rotate the tool around the sensor cable as you apply pressure. It only requires a small amount of pressure to cut through the jackets, the outer conductor, and the heavy copper-clad aluminum center conductor. Once the cutter's blade contacts the center conductor, score the outside of the center conductor. Remove the cutter, grab the sensor cable from both sides of the cut, and bend until it breaks in two leaving a clean square cut.

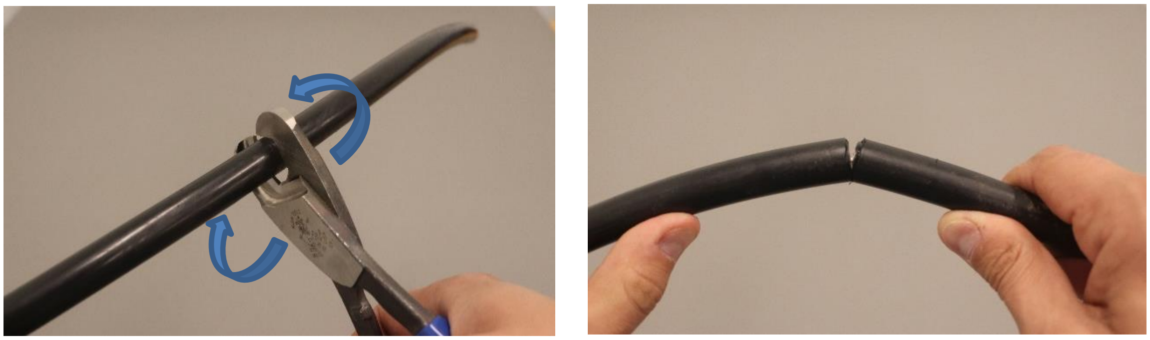


Figure 36. Cutting the sensor cable

Step 4

Remove one of the two seven-entry silicon grommets provided in the SUMA kit. Pull the sensor cable through the large center hole from the outside of the grommet, which does not have the markings for cable sizing, through to the inside of the grommet, which has sizing information.

Next, pull the lead-in cable with terminated SMA connector through one of the six smaller holes in the grommet, it's best to place this toward the SUMs female SMA connector side. Lastly, pull the ≥18AWG 2-conductor power cable and ≥12AWG ground wire, 3.175 mm (.125 in) or larger cable diameter each, through two of the remaining smaller holes to provide DC power to the SUM and grounding. Insert grommet plugs in the unused entry holes.

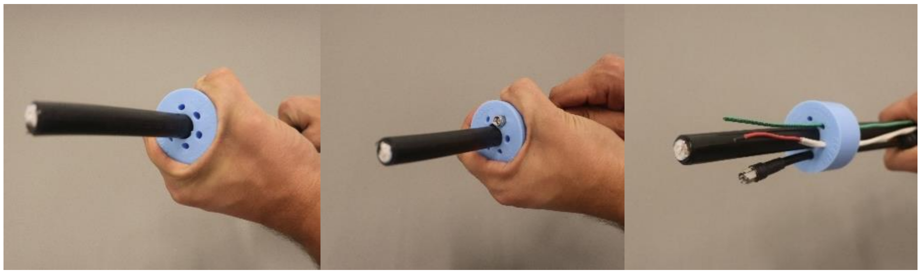


Figure 37. Inserting the sensor, lead-in, power, and ground cable(s) through the SUMA grommet

Pull a little extra sensor cable through to providing room for the following steps on cable preparation. The sensor cable, or any of the cables, can be pulled back for fitment when the SUMs are placed inside the enclosure.

Step 5

Remove the second of the two seven-entry silicon grommets, and repeat the process from Step 4. This grommet is used for the other side of the sensor cable.

Figure 38. Sensor, lead-in, power, and grounding cables inserted into offset opposite sides of the SUMA

Step 6

Using the TD100 Coax Cable Strip Template seen in, Figure 40, cut through the outer PVC jacket from the end of the cable 75 mm (3 in) using the adjustable blade ringer, Figure 41.

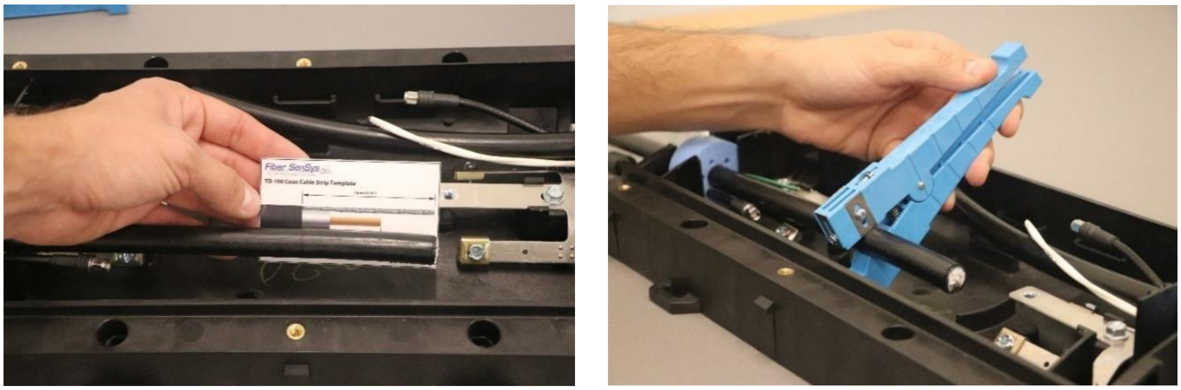


Figure 39. Stripping the sensor cable using the DW-ENG-51 template

It is preferable to score the second polyethylene (PE) jacket but DO NOT cut through the second jacket. Without caution, this procedure may sever the shield layer and/or drain wire; if either is cut, the process must be redone. Because of this, it is best to set the blade depth of the ringer using scrap sensor cable or the end ~10mm (.4 in) of the sensor cable before making the 75 mm (2.95 in) ring cut.

CAUTION: If the shield or drain wire is nicked or cut within the stripped cable end, the procedure must be restarted. There should be enough spare cable to attempt this process three times.

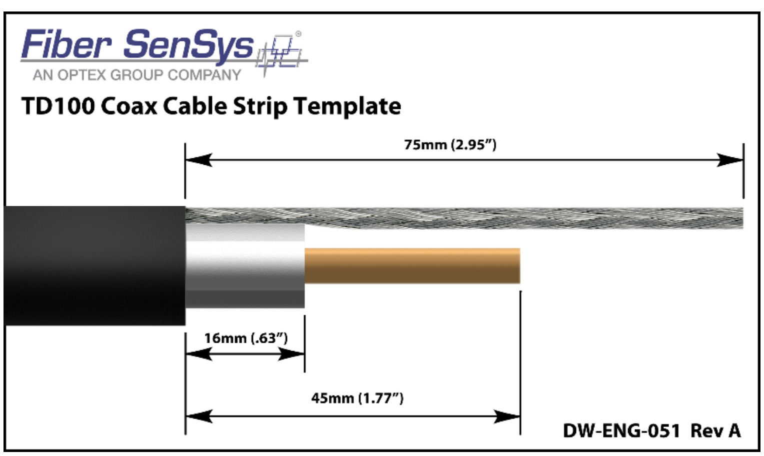


Figure 40. Sensor Cable Strip Template (not to scale)

Figure 41. Adjustable Blade Ringer

Step 7

Twist the outer PVC jacket and remove it from the sensor cable. This will expose the second jacket, which will be covered in flooding compound. The flooding compound can be easily removed using a cable gel solvent. The flooding compound is to seal any pin holes in the outer jacket resulting from direct burial.

Figure 42. Cable Gel Solvent Wipe

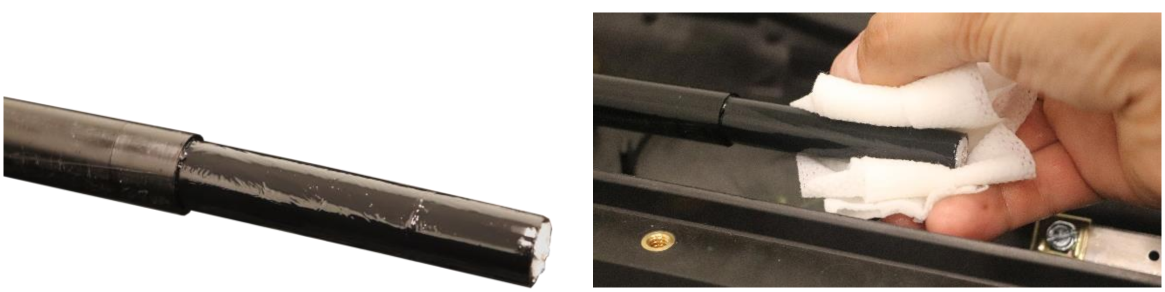


Figure 43. Sensor cable with outer jacket removed and cleaning process

Step 8

Looking at the end of the cable, identify where the drain wire is located along the circumference of the dielectric, also locate the slot in the shield, which is generally +/- 90 degrees or a ¼ turn rotated from the drain wire. Using a sharp utility knife cut lengthwise through the second PE jacket, avoiding cutting into the dielectric as best as possible. Cut while staying inside the shield slot from the beginning of the cable strip point to the cable end.

Figure 44. Cable end shield slot identification

Step 9

Using a pair of pliers, tear off the second layer of polyethylene jacket where it was scored to expose the slotted shield and drain wire.

Figure 45. Second jacket slit from cable end to first strip location, outer jacket

Step 10

Fold back the braided drain wire, then measure 16 mm (0.63 in) from the outer jacket and cut the remaining 59 mm (2.32 in) off the shield and foam dielectric using the second adjustable blade ringer. The ringer should be placed on the material to be removed, so the tool rotation does not damage the remaining shield.

Set the second ringer's blade by placing it on the cable end and adjusting the blade to ~2 mm (.08 in) away from the center conductor, be aware the dielectric can be deformed with pressure which will alter cutting depth. Use caution to not score the center conductor as this will affect performance. The shield and dielectric can then be pulled off the center conductor by twisting and pulling with pliers.

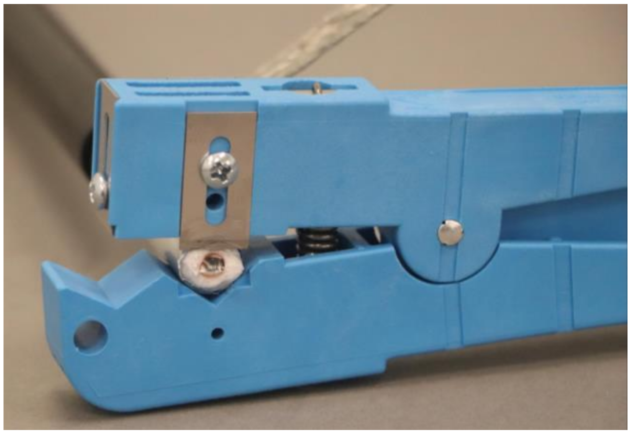


Figure 46. Setting the second adjustable blade ringer to a safe cutting depth

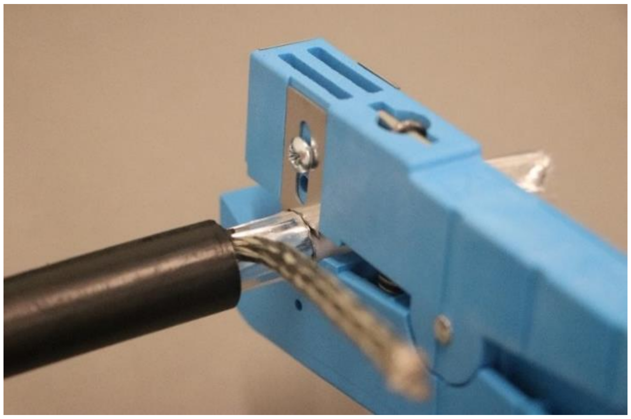


Figure 47. Ring cutting the shield and foam dielectric with adjustable blade ringer tool placed on the material to be removed

CAUTION: The cable shield and drain wire must not contact the center conductor, which will cause a short on the system. Be sure after stripping the dielectric that the shield has not been compressed toward touching the center conductor.

Step 11

Trim center conductor using the coaxial cable cutter, Figure 41, to 45 mm (1.77 in) from first strip mark as shown in Figure 40.

Figure 48. Marking the center conductor (top); the finished center conductor cut to length (bottom)

Step 12

Separate the drain wire into two equal portions and twist as shown in Figure 49.

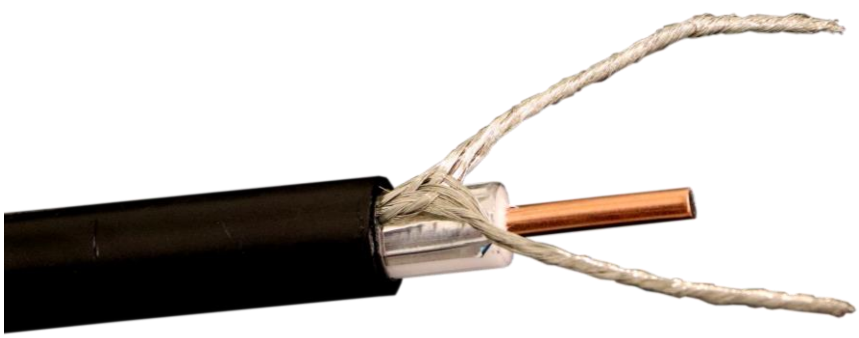


Figure 49. Equally divided drain wire and trimmed center conductor

Step 13

Remove the lid from the Start-Up Module (SUM) by removing the screws on the two-hole sensor clamp. Set it aside, being careful not to lose the screws.

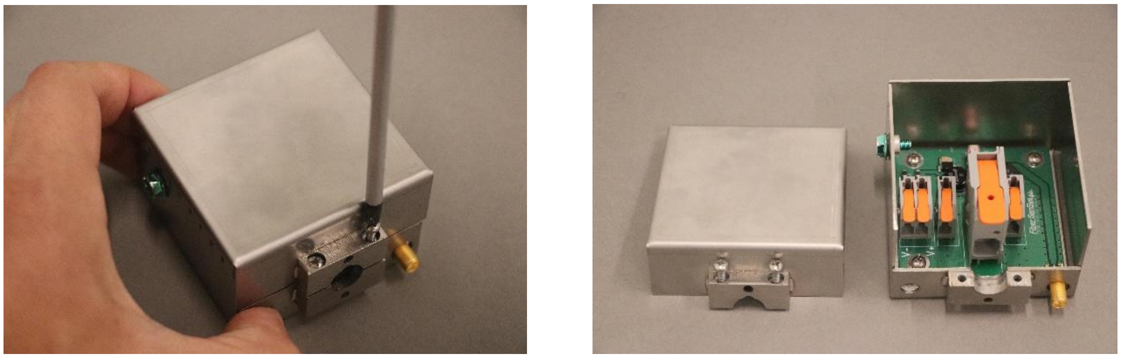


Figure 50. Removing the SUM lid

Step 14

Flip-up the large orange lever of the center conductor terminal block and the two smaller levers on each side of the large center block. Arrange the drain wire, so it is located on the top of the cable. Place the cable shield onto the bottom portion of the SUM clamp while inserting the center conductor into the large block. Once the center conductor is fully inserted, close the lever on the large orange terminal block, as seen in Figure 51.

Insert the separated drain wire into the left and right terminal blocks, Figure 51. Close the two smaller levers. With all three blocks snapped into place, now moderately pull on both braided wires and the center conductor to ensure a solid connection at each.

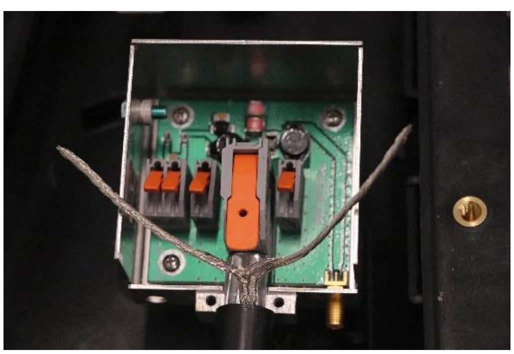
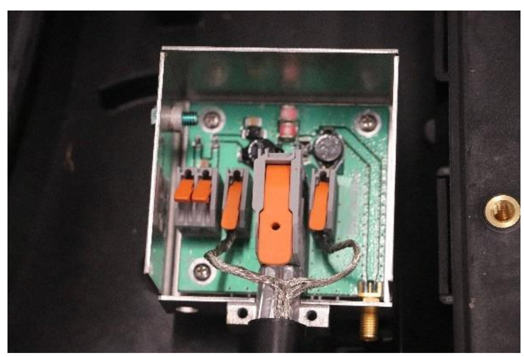


Figure 51. Center Conductor inserted



Drain Wire(s) inserted and secured

CAUTION: The cable shield and drain wire must not contact the center conductor, which will cause a short on the system. Be sure after inserting the drain wire there are no loose strands. Any loose strands should be trimmed using precision flush cutters.

Step 15

Connect lead-in to SMA female onto the board with fingers. These have fine threads, so care should be taken when beginning to screw connectors on, do not cross-thread. Once the connector is finger tight, use the 5/16 in (8 mm) wrench, turn until the connector is snug. Once snug, tighten an additional 90 degrees or ¼ clockwise turn approximately.

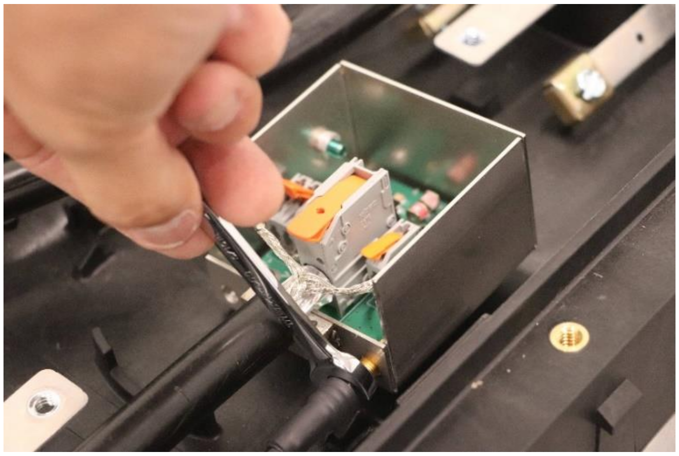


Figure 52. Lead-in cable connection

Step 16

Connect the power wire to the terminal block set to the left of the sensor cable connections. Left connector is -VDC, right +VDC.

Figure 53. Power connections to the left of the sensor cable connections

Step 17

Verify that there are no strands of drain wire or shield shorting to the center conductor and that the connections are secure. Ensure the drain wire is positioned at the top of the sensor cable.

The SUM lid has an indent centered on the clamp to accommodate the drain wire. Carefully place the SUM cover onto the lower chassis making sure to align the clamp screws. Begin alternating between tightening screws until they are both tight and there is no gap between the lid and base. The enclosure provides RF shielding of the connection between the cable lead-in to and from processors and sensor cable.

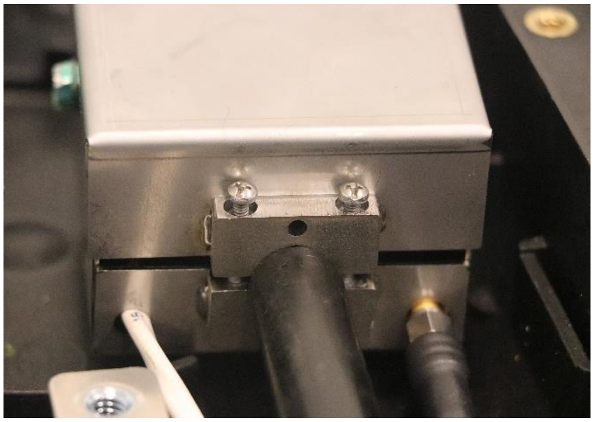
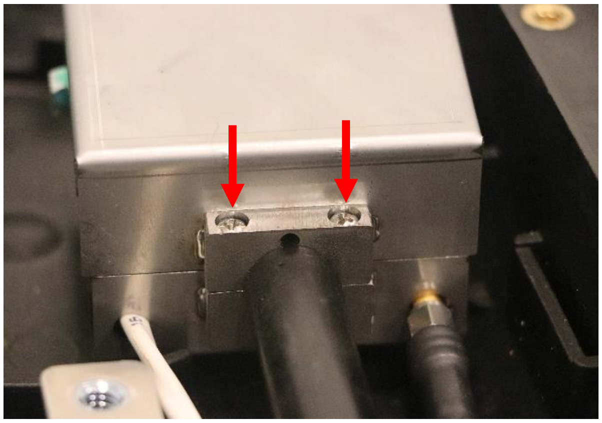


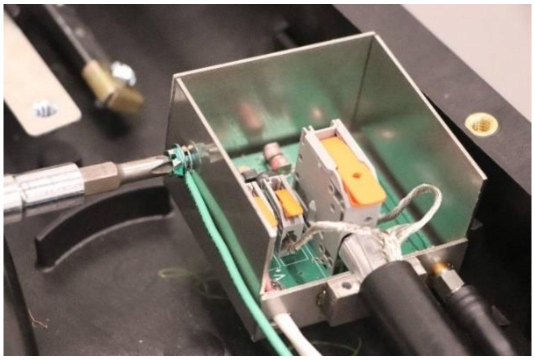
Figure 54. Securing SUM lid



Fastened SUM screws

Step 18

Attach the grounding wire to the grounding screw and fasten. When installing two SUMs, their ground connections may couple into a single ground cable exiting the SUMA.



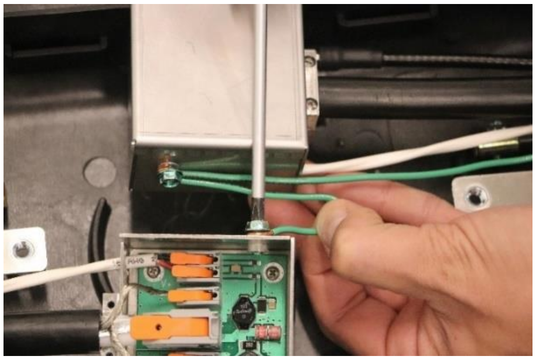


Figure 55. Securing a single ground connection wire to the SUM (left), securing two SUMs to a single exiting ground wire (right)

Step 19

Apply silicone grease to the grommets and reinsert them in the cable ports. This step includes inserting the unused grommets with silicone into the unused cable ports.

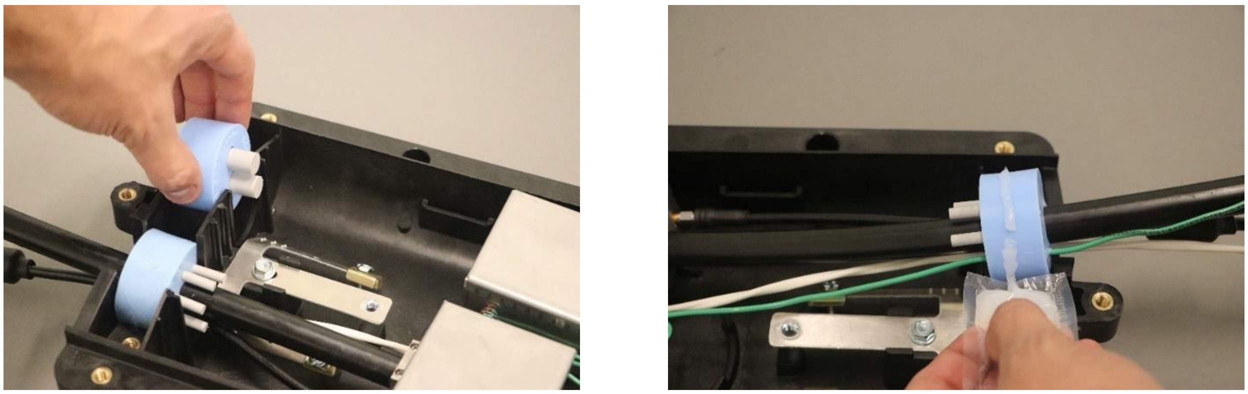


Figure 56. Applying silicone grease to the SUMA grommets

Lubricate underneath and around the sides of the endplate caps with the silicone lubricant.

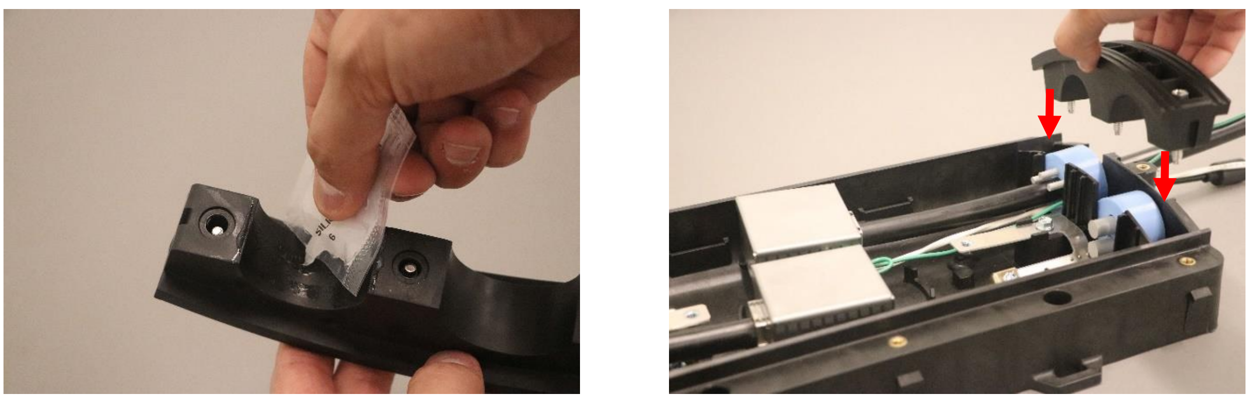
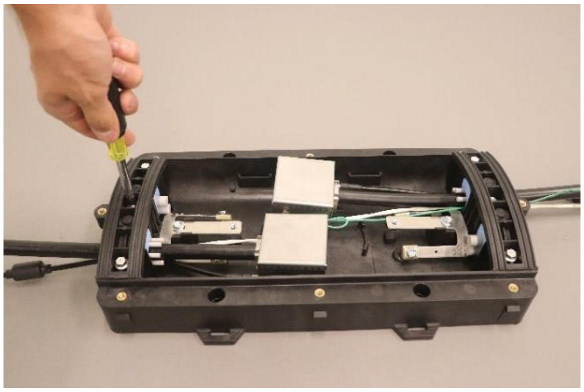


Figure 57. Applying silicone grease to the SUMA endplates

Install the endplate caps into the retaining partitions of the SUMA.

Step 20

Tighten the end cap bolts using a 3/8 in (9.5 mm) nut driver. Tighten evenly until the endplate cap is fully sealed.



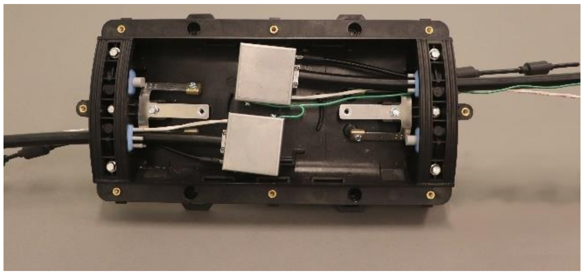


Figure 58. Securing the end cap bolts (left), the caps completely secure (right)

CAUTION: Do not use power tools to tighten bolts as this can damage the end caps and enclosure lid.

Step 21

Apply silicone grease evenly around all outer edges of the cover gasket.

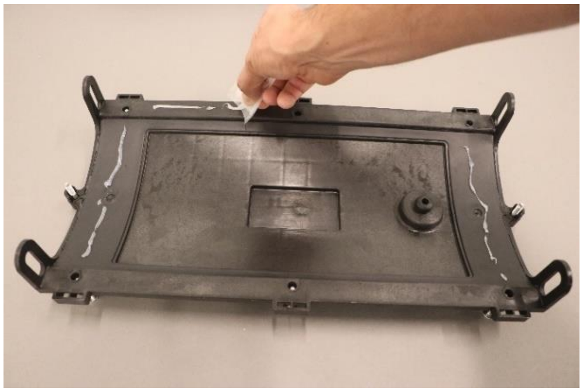


Figure 59. Silicone grease around outer edges of the cover gasket

Step 22

Seat the cover on top of the enclosure body and tighten all bolts using a 3/8 in (9.5 mm) nut driver. Tighten bolts in the order shown in Figure 60.

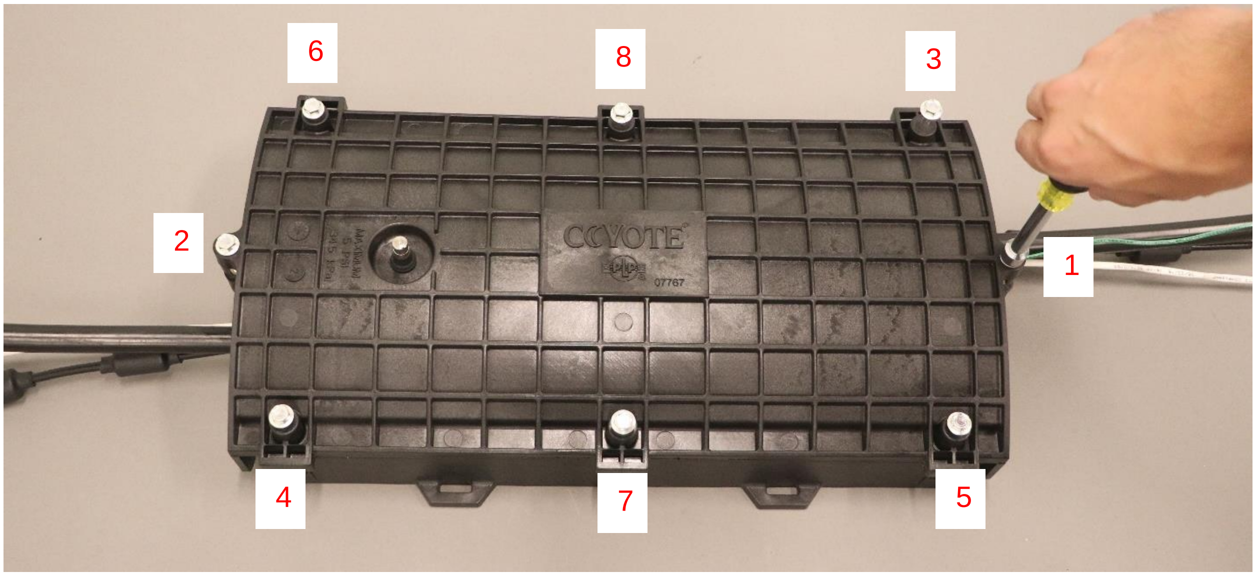
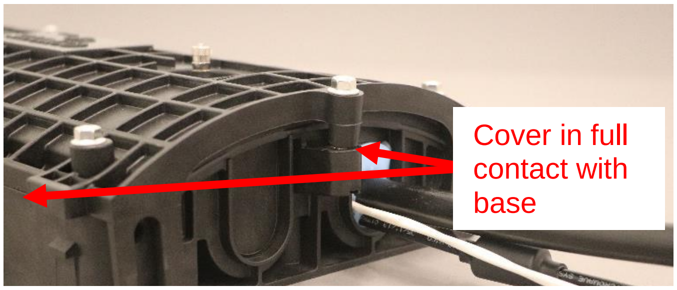


Figure 60. Tighten SUMA bolts in the order pictured



The cover and base will touch when the cover is fully seated

Figure 61. SUMA cover and base pairing

SUMA Flash Testing

Step 1

With the SUMA completed and enclosure lid fully secured using a 3/8 in (9.5 mm) nut driver, remove the air valve cap from the cover.

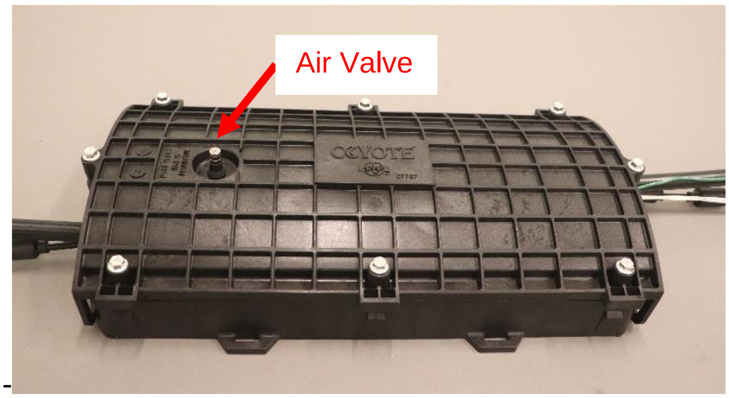


Figure 62. The air valve location

Step 2

Pressurize the enclosure up to 5 psi. A pump and pressure gauge will be needed.

Figure 63. Pressurizing the SUMA using a pump with gauge

CAUTION: Do not exceed 5 PSI when pressurizing the SUMA.

Step 3

Spray all sealing surfaces of the enclosure with all-purpose leak detector fluid or soapy water. Look for bubbles forming to determine if there are any leaks. If there are any failures in the seal, bubbles will appear and increase in size from any air escaping from the pressurized enclosure.

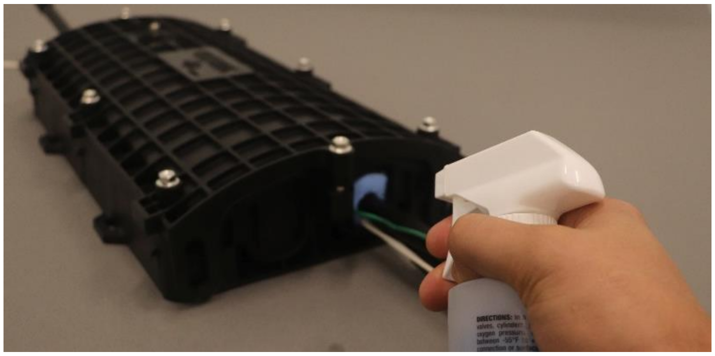


Figure 64. Spraying the enclosure with leak detector fluid.

Step 4

Release air pressure by pressing the bump on top of the air valve cap down on the enclosure's valve stem.

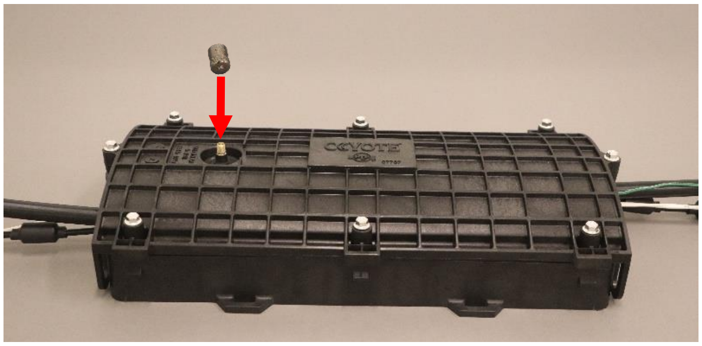


Figure 65. Using the air valve cap to release inner air pressure

In the case of air leakage, reseal the box according to Step 19. If there is no air leakage, reinstall the air valve cap back onto the air valve before burial.

6. TDR8 Relay Module

The TDR8 Relay Module connects to the TD100 and has available four inputs and eight outputs. Inputs will be annunciated via the Master Controller interface. Outputs are programable and are set by specifying a detected meter range per relay. This setting may be configured in the Master Controller or TD100 WUI. Voltage ranges for the relay outputs are also configurable.

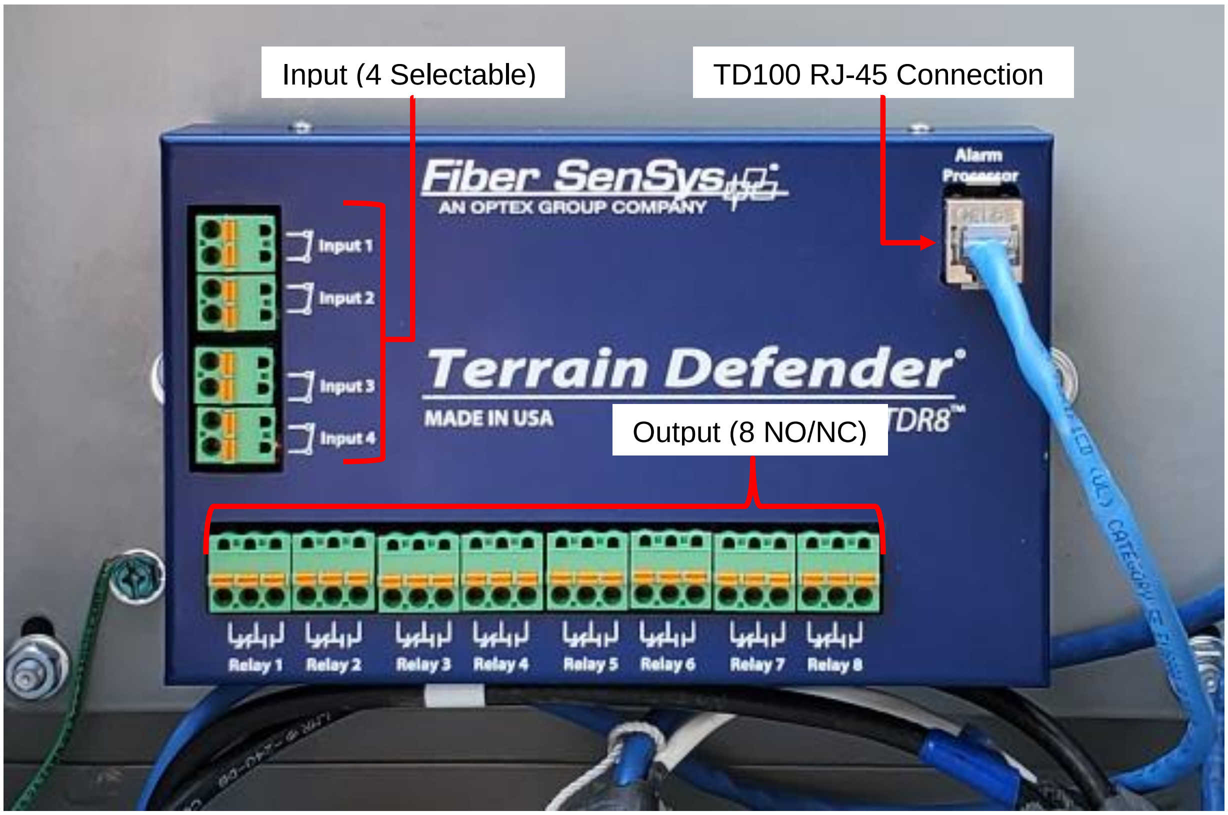


Figure 66. TDR8 relay module connections

7. TD100 Power Supply Units

The TD100 processor is powered through the attached lead-in cables and respective sensor cables, as explained in the earlier chapters. Because this system topology is flexible with where the power supply is located, the TD24PSU or TD48PSU can be installed at or away from the perimeter and TD100 processors.

When redundant (backup) power supplies and/or batteries are not used, a loss of AC will result in a loss of output voltage.

WARNING: Take precautions when working with AC/DC power. Only qualified technicians trained in electrical circuits and fundamentals should install the TD24PSU and TD48PSU. All wiring should be done with AC power OFF.

TD24PSU

The TD24PSU combines three main pieces to deliver power to the sensor cable and attached TD100 processors. These three pieces are an AC to AC transformer, AC to DC linear power supply (LPS5), and fused DC power distribution board (DP4). The TD24PSU can power up to three TD100 processors.

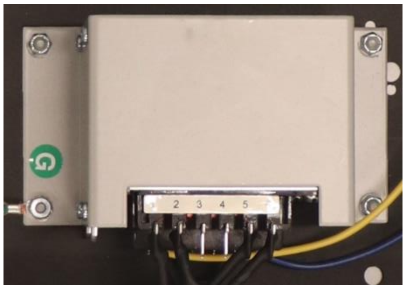


Figure 67. AC transformer

Figure 68. Linear Power Supply (LPS5)

These individual items can be installed alongside each other, DIN rail mounted with accessory backplates, or generally mounted in the configuration most convenient for the specific site's needs.

Figure 69. Fused DC power distribution board (DP4)

The typically black "Line" cable for 120 – 240 VDC and "Neutral," typically white, would wire to the transformer, as shown in Figure 74. Transformer connections are solder style, but the pre-attached transformer leads may be utilized. The transformer input cable should have 16 AWG or greater conductors. Verify AC power input using a multimeter prior to soldering. Once soldered, testing without potentially impacting the transformer is impossible.

The "Ground" green wire can be connected to the corner bolt on the transformer using a crimp-on ring terminal or the provided grounding pigtail to the bottom of the right two terminal blocks on the AC connection points, as shown in Figure 74.

All LPS5 power connections require 18 AWG wire or greater. The "Line" and "Neutral" cables wire to the LPS5's AC terminals. The AC fail and low battery relays may be wired for supervision on the LPS5. These relay outputs are dry form C contacts. Lastly, the LPS5's DC terminals would wire to the DP4's AC/DC input terminals at the bottom of the board. The LPS5 DC voltage can be slightly adjusted using the VR1 trim pot (blue with white center).

The DP4's fused 24 VDC output terminal connections use two cables, each with two 20 AWG sub-cables. These are labeled 1A and 1B, 2A and 2B, and so on. Terminals marked A are "Positive," typically red, (+), and terminals marked B are "Negative," typically black, (-). Using the first two output pairs, install the cables running to the TD100 SUMA TX and RX enclosures as shown in Figure 74. Fuses on outputs 3 and 4 may be used as spares and have the same fuse rating.

Battery Backup (Optional)

The TD24PSU, unlike the TD48PSU, offers the ability to utilize a battery backup feature where two 12 VDC batteries are connected in series to the LPS5 module.

To determine the type of batteries to purchase, first establish or verify the site's required uptime for the system. The below table has precalculated the most common requirements:

TD100 Units / Hours Uptime	1	2	3
4 Hr	3 AH	5.5 AH	8 AH
12 Hr	8 AH	16 AH	24 AH
24 Hr	16 AH	32 AH	48 AH

Referencing the above table, a site needing 12 hours of uptime for three TD100 units would purchase two 12 VDC 24 amp-hour (AH) batteries. Uptime extending past the above table should consider alternatives to batteries such as backup generators.

WARNING: Do not touch exposed metal parts with battery leads. Turn off (Shut) branch circuit power before installing or servicing equipment. Be aware that while making the battery connections to the LPS5, sparking may occur.

To connect batteries in series one “Negative,” typically black, (-) terminal from one battery would connect to the “Positive,” typically red, (+) terminal of the second battery.

The remaining negative and positive terminals would connect to the “BAT” screw terminals located next to the “AC” LED on the LPS5. The positive terminal is on the left and negative on the right regarding the PCB “BAT” label.

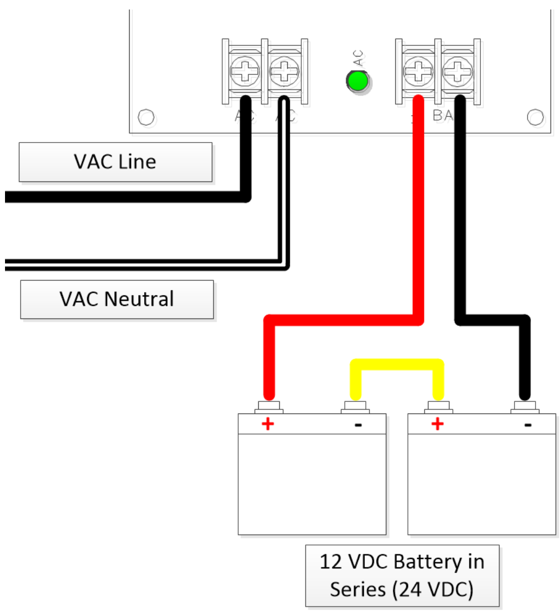


Figure 70. Battery connection to the LPS5

Once all wiring is complete, the unit should be tested before attempting to power the sensor and TD100 processor. Turn off the DP4 ON/OFF switch and confirm field DC cable ends are taped over, capped, or inserted into the relevant SUM. Testing points for the TD24PSU are the terminal screws which can be measured by making contact with the multimeter probe tips.

TD24PSU Test Procedure

Step 1

With the DP4 ON/OFF switch in the off position, engage the previously tested AC input and then measure and verify the AC voltage is 120 – 240 VAC and that the AC power LED on the LPS5 is illuminated.

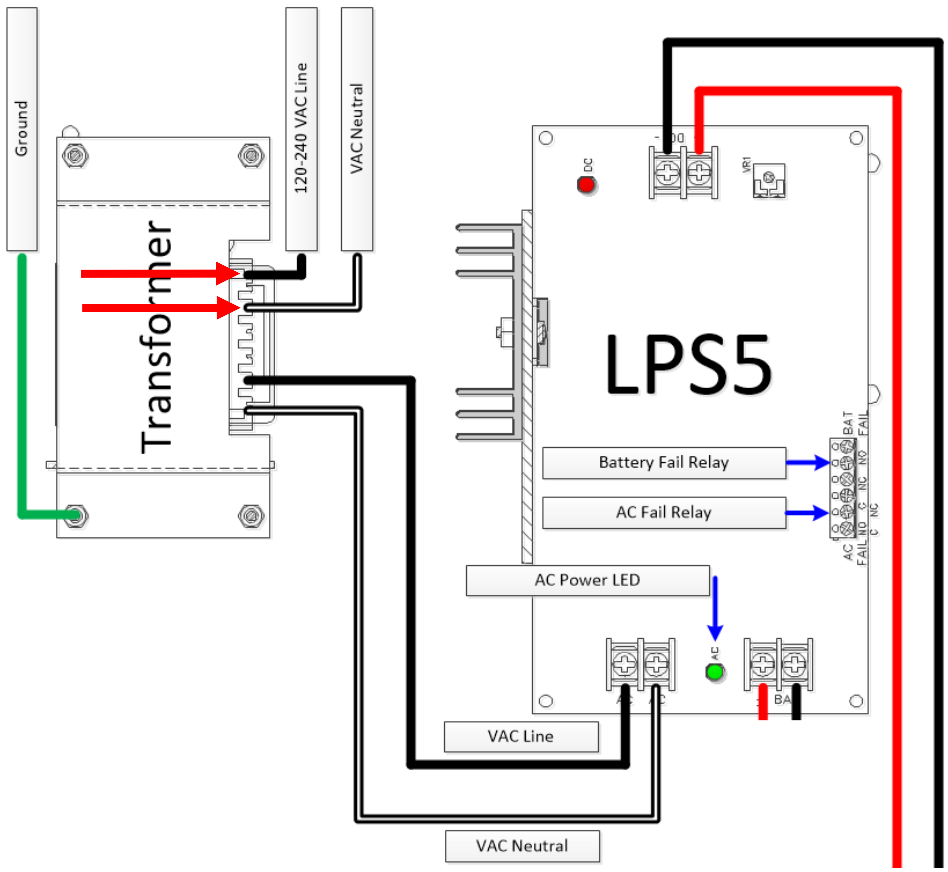


Figure 71. AC power testing points (red arrow)

Step 2

Verify DC power LED is illuminated on the LPS5 and verify the LPS5 DC output is 24 VDC.

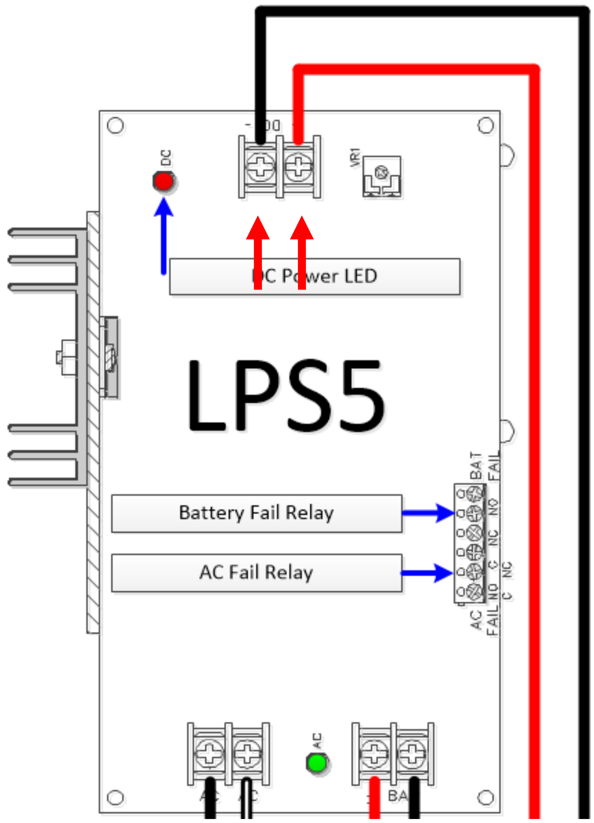


Figure 72. DC power testing points (red arrow)

Step 3

Ensure field DC cable ends are taped over, capped, or inserted into the relevant SUM.

Measure and verify the DP4 DC input voltage is 24 VDC by measuring the input points at the bottom of the board. Once verified, turn the DP4's power switch to the ON position. Verify the AC/DC power LED is illuminated.

Measure and verify the DP4 DC output voltage is 24 VDC on screw terminals 1A/B and 2A/B.

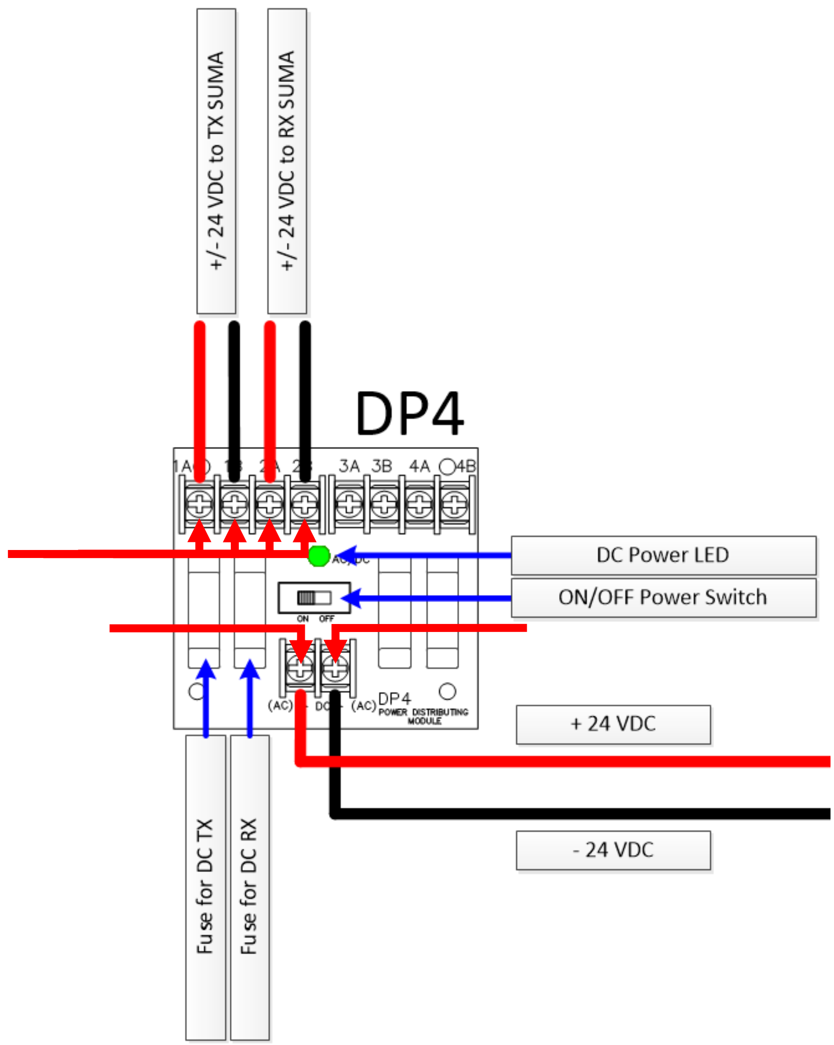


Figure 73. DC power testing points (red arrow)

Lastly, if applicable, measure the DC cable ends or verify TD100 power.

Step 4 (Optional)

If installed once the system is functioning a Battery Operational Test may be conducted. Be sure batteries have had time to charge to full capacity before continuing. Typically, 24 - 48 hours are needed, note the TD24PSU's maximum charge current is 0.3 A.

First conduct an AC Power Loss Test. Note the time. Turn off (Shut) AC branch circuit power. The LPS5's green AC power LED should turn off. If battery power is functional the LPS5 red DC power LED and DP4 power LED should remain illuminated. Zero system down time is required. The AC fail relay must change states.

Next perform the Battery Endurance Test. With the previous step complete conduct intrusion testing to verify the TD100 is annunciating alarms as usual. Monitor the TD100 for the set total hour uptime goal with the previously noted time as the start time.

Once the uptime goal is reached continue monitoring the system until the low battery alarm is received. Restore AC power before the batteries completely discharge. Once the AC fail, low battery, and uptime goal have been met the test is passed.

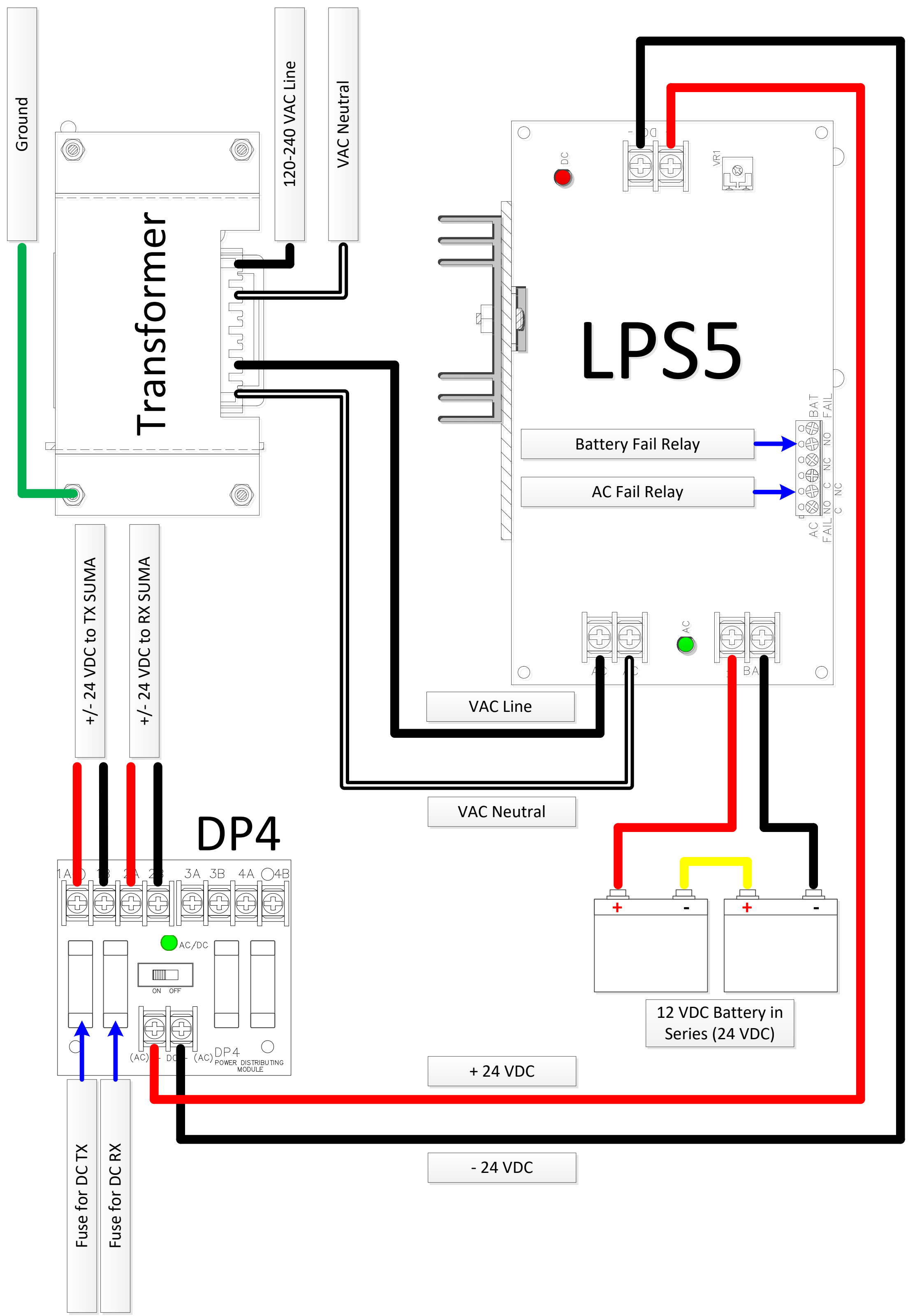


Figure 74. TD24PSU Product Wiring Diagram

TD48PSU

Installing the TD48PSU enclosure is similar to mounting any typical box enclosure. There is the option of using attached feet or going without and mounting directly to the enclosure's inset nuts.

The TD48PSU provides enough watts to power up to six TD100 processors, as shown in Figure 13. It has a large AC to DC linear power supply mounted at the top of the plate and power distribution and fusing handled by DIN rail mounted circuit breaker and terminal blocks on the bottom half.

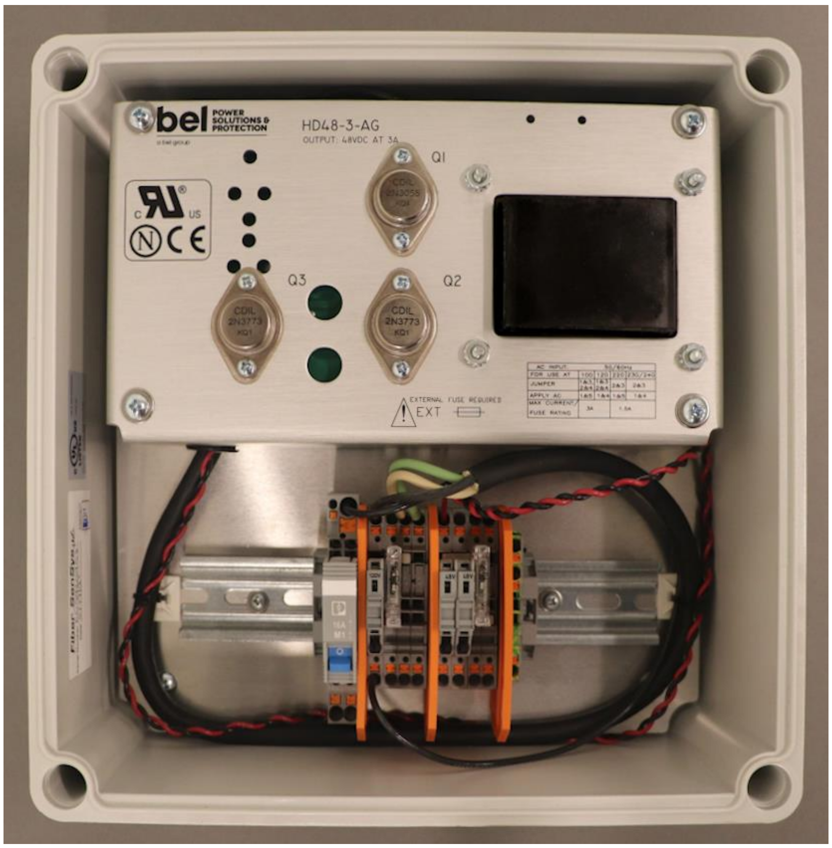


Figure 75. TD48PSU

All user wiring will be on the bottom cable insertion points on the din rail mounted blocks. Wire insertion points are all push-in style; simply press the orange square button, insert cable, then release.

The typically black "Line" cable for 120 – 240 VDC would enter the circuit breaker at the bottom right point, as shown in Figure 80. The line cable should be 14 AWG and have its jacket stripped 12 mm (.47 in) for insertion.

“Neutral,” typically white, and “Ground,” green, wires can be connected to the bottom of the right two terminal blocks on the AC connection points as shown in Figure 80.

The bottom 48 VDC connections on the rightmost DC terminal block section run to the TD100 SUMA TX and RX enclosures. Two cables, each with two 20 AWG sub-cables, “Positive,” typically red, (+) and terminals marked B are “Negative,” typically black, (-) are wired at these bottom points. Positive on the fused points left and negative on the right, as shown in Figure 80. Strip the sub-cable jackets 10 to 12 mm (.39 to .47 in) for insertion.

Once all wiring is complete, the unit should be tested before attempting to power the sensor and TD100 processor. Disconnect all pivoting fuse holders, see Figure 76 and confirm field DC cable ends are taped over, capped, or inserted into the relevant SUM. Testing points for inserting multimeter probe tips are located next to the orange buttons as seen in Figure 77 and by using the adjacent spare wire insertion points on the circuit breaker.

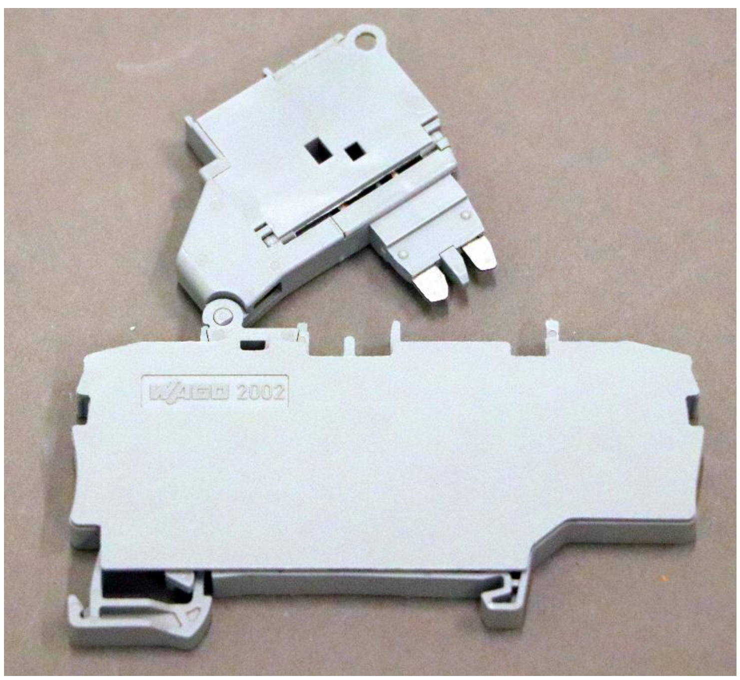


Figure 76. Fuse holder disconnected from terminal block

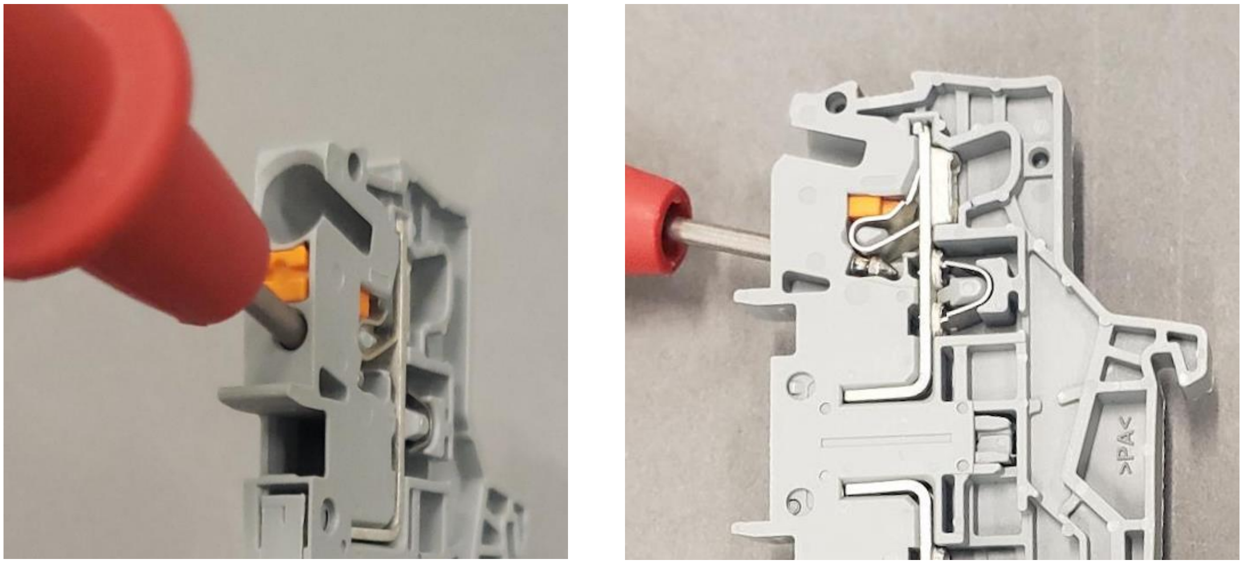


Figure 77. Test probe in terminal block test port

TD48PSU Test Procedure

Step 1

With all pivoting fuse holders disconnected and circuit breaker off, engage AC input power.

Measure and verify the AC voltage is 120 – 240 VAC and that the AC LED is illuminated.

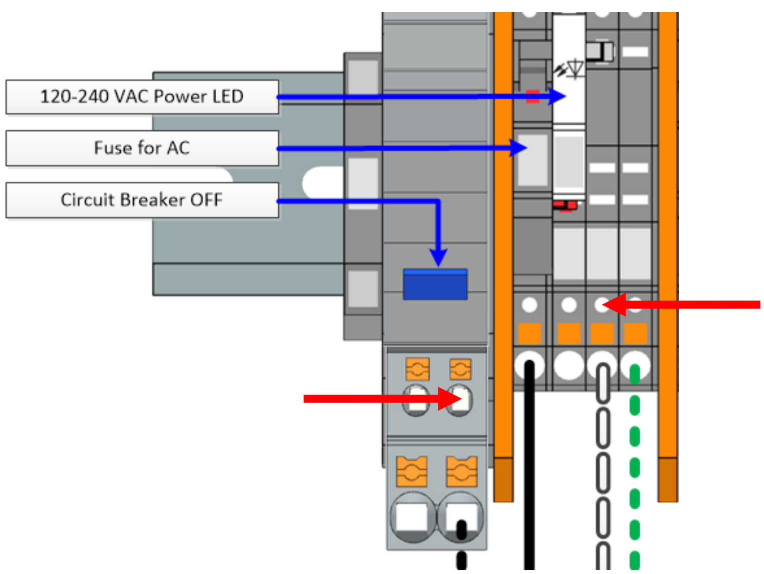


Figure 78. AC power testing points (red arrow)

Step 2

Engage the AC fuse holder and then the circuit breaker. AC fuse holder should not be illuminated. Fuse holder illumination indicates a blown fuse.

Verify DC power LED is illuminated.

Step 3

Ensure field DC cable ends are taped over, capped, or inserted into the relevant SUM.

Engage the DC fuse holders, then measure and verify the DC voltage is 48 VDC by measuring the user input points.

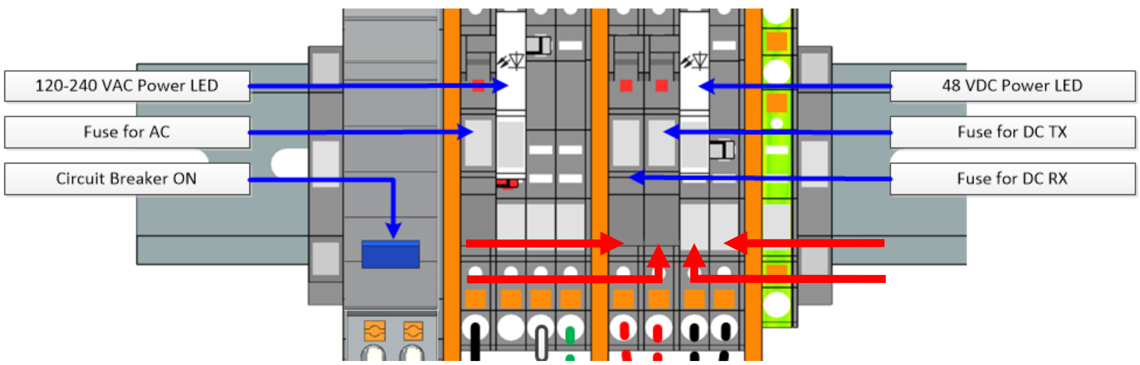


Figure 79. DC power testing points (red arrow), fuse holder blocks are positive; others are negative

Lastly, if applicable, measure the DC cable ends or verify TD100 power.

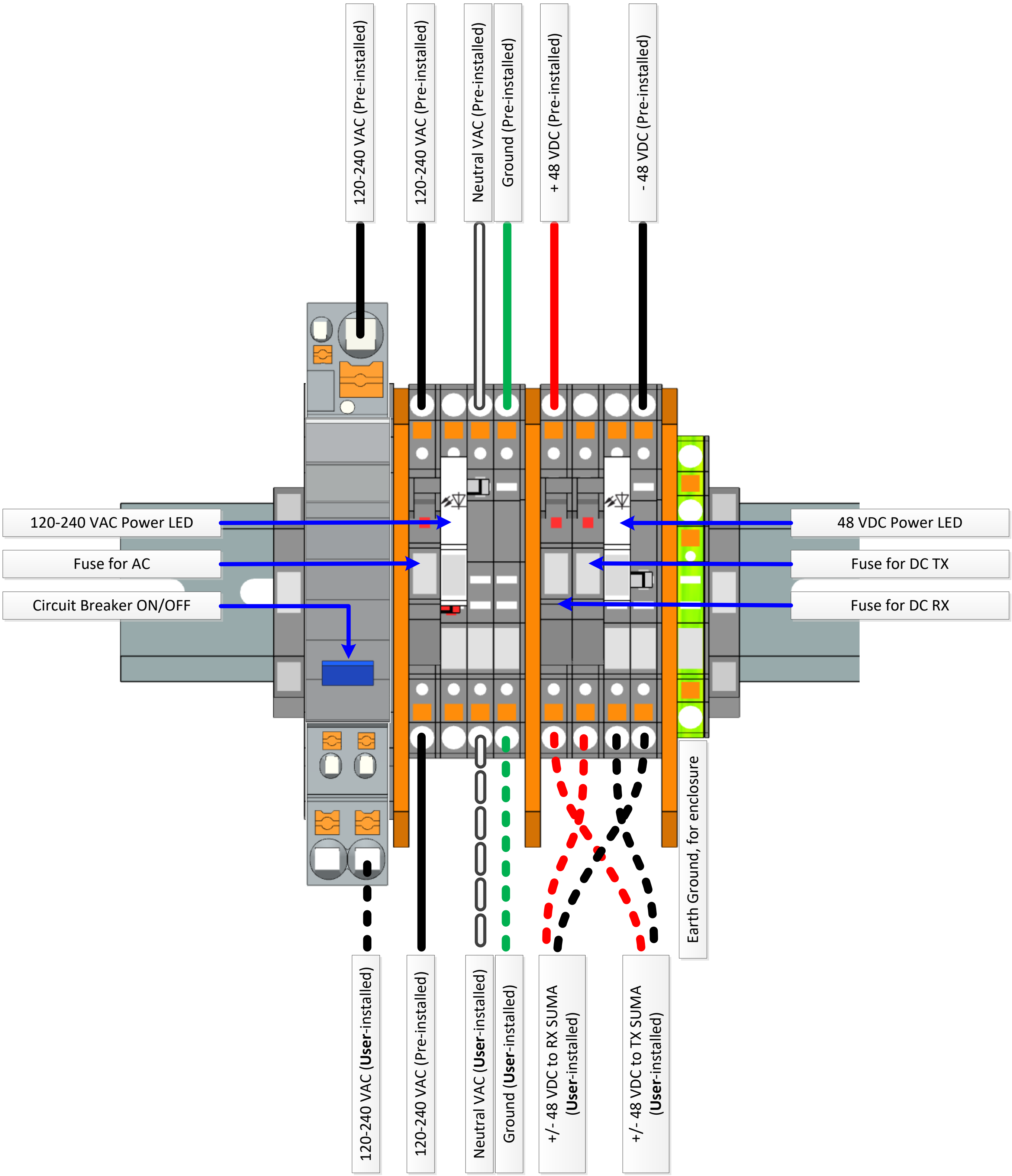


Figure 80. TD48PSU product wiring diagram, user installed (dashed), Fiber SenSys installed (solid)

8. Intrusion Testing

Upon the successful installation of a TD100 system, testing for intrusions and adjustment of sensitivity thresholds follows. This chapter provides information on intrusion testing only. For WUI interaction and setting parameters that affect the systems alarm thresholds, please see the WUI Manual.

Basic Tests

There are two standard tests that every installation should capture. These are walking and running. As a buried line sensor is ideally hidden from the average intruder these are the two most likely scenarios to occur.

Walk Testing:

Using a typical walking pace of roughly 5 – 6.5 kph (3 – 4 mph), cross each sensor run at a minimum of 10 times per 100 m (328 ft) length. For sectors smaller than 100 m (328 ft), 10 crossings are still required. Begin the walk 3 m (10 ft) from the closest TX or RX sensor line. Cross the sensor ending the test 3 m (10 ft) from the opposite sensor line. Verify an alarm was received, ideally before crossing both sensor lines.

Walking intrusions may be done perpendicular to the sensor or at an angle. The test intrusions should be relative to what an actual intruder might do, i.e., crossing the sensor at an angle leading to the closest structure to the sensor line. The WUI alarm log will show the location where the intruder enters the sensing field and exits.

Allow 30 seconds to pass between each test intrusion.

Run Testing:

Very similar to walk testing, however, the running pace should be 16 – 24 kph (10 – 15 mph) as safety, work attire, and athleticism permits. Other than the increased running pace, all the same other criteria from walking should be followed.

Basic Testing Reference Table:

Intrusion Type	Walking or Running
Walk Speed	5 – 6.5 kph (3 – 4 mph)
Run Speed	16 – 24 kph (10 – 15 mph)

Start Location	3 m (10 ft) from the closest sensor line
End Location	3 m (10 ft) from the closest sensor line
Entry and Exit Angle	Steep, shallow, or perpendicular angles are all acceptable
Number of Tests	Minimum of 10 test intrusions, 10 test per 100 m (328 ft) of sensor for cable lengths greater than 100 m (328 ft)
Test Interval	Minimum 30 seconds between test intrusions

Advanced Tests

For perimeters protecting critical assets and/or personnel, additional testing may be required. Tuning the system for some or all the following intrusion types will confirm the system's ability to detect.

Crawl Testing:

Crawl intrusions should be done with the tester's torso in close proximity, roughly 2.5 – 15 cm (1 – 6 in) to the ground. This position is often referred to as a military or commando crawl. Crawl intrusions should not be done with the torso lifted on hands and knees, similar to a baby crawl which is more easily detected.

Figure 81. Commando crawl (left) and baby crawl (right)

Because crawling intrusions can be difficult, the test can conclude at the alarm annunciation.

The crawling pace should be approximately 15 cm/s (6 in/s). The speed of the crawl should be as consistent as possible. The test intruder should continuously crawl through the area until being detected or reaching the protected side of the perimeter outside of the detection field.

Intrusion attempts should be towards the protected resource or perpendicular to the line of detection.

Crawl Testing Reference Table:

Intrusion Type	Crawling
Crawl Speed	~15 cm/s (6 in/s) consistent throughout test
Body Position	Prone with chest .5 – 15 cm (1 – 6 in) from ground
Start Location	3 m (10 ft) from the closest sensor line
End Location	3 m (10 ft) from the closest sensor line or upon alarm activation
Entry and Exit Angle	Steep, shallow, or perpendicular angles are all acceptable
Number of tests	Minimum of 10 test intrusions, 10 test per 100 m (328 ft) of sensor for cable lengths greater than 100 m (328 ft)
Test Interval	Minimum 30 seconds between test intrusions

Run and Jump Testing:

If not restricted by a barrier such as a wall or a fence, the starting position of a run and jump test should be approximately 7.5 m (25 ft) from the closest sensor run. Using a running pace, 16 – 24 kph (10 – 15 mph), the test intruder should quickly approach the sensor and, as nearing the first detection line, jump across the cables as high and far as possible.

Upon landing, continue following through, running, and decelerating approximately 3 – 7.5 m (10 – 25 ft) beyond the cable to complete the test and come to a safe stop. Verify the alarm was received.

If a barrier restricts the starting position, the tester should take a starting position adjacent to the barrier, maximizing the approach distance to the sensor. It is acceptable for the test intruder to run along the barrier parallel to the cable to pick up the required speed before turning towards the sensor cable and initiating the jump. The starting point should be adjusted for the runner to perform consistent jumps across the cable at speed.

Run and Jump Testing Reference Table:

Intrusion Type	Run and jump
Run Speed	16 – 24 kph (10 – 15 mph)

Jump Height and Speed	As high and far as physically possible for test intruder
Start Location	7.5 m (25 ft) from the closest sensor line as space allows
End Location	3 – 7.5 m (10 – 25 ft) from the closest sensor line as space allows
Entry and Exit Angle	Steep, shallow, or perpendicular angles are all acceptable
Number of tests	Minimum of 10 test intrusions, 10 test per 100 m (328 ft) of sensor for cable lengths greater than 100 m (328 ft)
Test Interval	Minimum 30 seconds between test intrusions

9. Maintenance, Troubleshooting, and Repair

The TD100 product is relatively maintenance-free but does require some upkeep over the system lifespan to maintain a fully operational security system. If there are issues such as a broken sensor cable or a TD100 processor the following sections will help.

Maintenance

Visual Inspection – Every 90 Days:

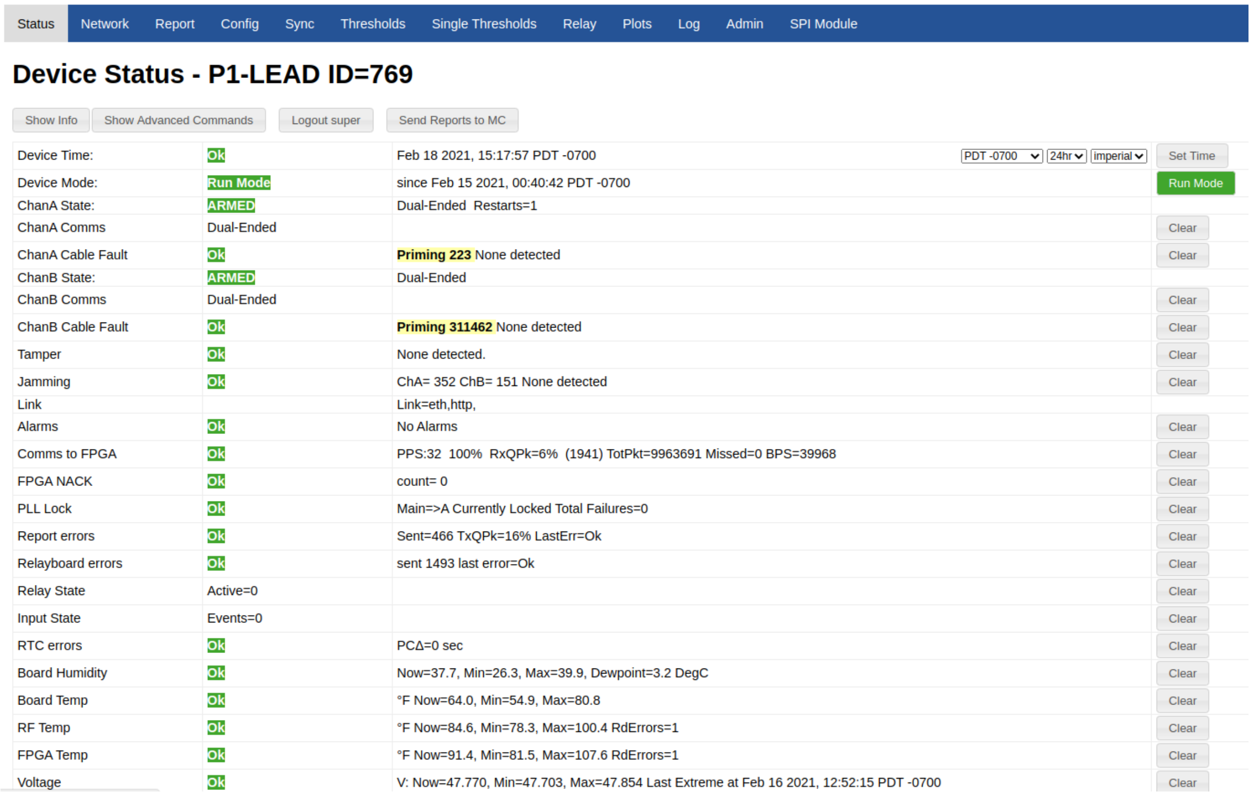
The first step in preventive maintenance is a visual inspection of the installed sensor system. The on-site security and maintenance personnel should be familiar with the system and notice if anything appears out of specifications. Fiber SenSys recommends performing a thorough inspection approximately every 90 days. As available, this should include examining each TD100 processor; each TX/RX sensor cable run, all non-sensing lead-in cables, tamper switches, relay wiring, power supply, and backup battery.

In concrete installations, the sealant on top of the cable slot should be checked for cracks and breakdown.

In addition to inspecting the equipment, the area around the sensor run should be inspected for vegetation that may enter inside the detection field or new construction that may have had nuisance alarm causing materials installed. Repair any issues as they are discovered.

TD100 Processor Status Check – Every 180 Days:

Checking the health of TD100 processors and their associated sensor cables is a quick task. By selecting the “Status” tab in the Web User Interface (WUI), a dashboard with the processor’s diagnostics will be displayed. This device status dashboard gives the user green or red indicators for each field.



Device Time:	Ok	Feb 18 2021, 15:17:57 PDT -0700 PDT -0700 24hr imperial	Set Time
Device Mode:	Run Mode	since Feb 15 2021, 00:40:42 PDT -0700	Run Mode
ChanA State:	ARMED	Dual-Ended Restarts=1	
ChanA Comms	Dual-Ended		Clear
ChanA Cable Fault	Ok	**Priming 223** None detected	Clear
ChanB State:	ARMED	Dual-Ended	
ChanB Comms	Dual-Ended		Clear
ChanB Cable Fault	Ok	**Priming 311462** None detected	Clear
Tamper	Ok	None detected.	Clear
Jamming	Ok	ChA= 352 ChB= 151 None detected	Clear
Link		Link=eth,http,	
Alarms	Ok	No Alarms	Clear
Comms to FPGA	Ok	PPS:32 100% RxQPk=6% (1941) TotPkt=9963691 Missed=0 BPS=39968	Clear
FPGA NACK	Ok	count= 0	Clear
PLL Lock	Ok	Main=>A Currently Locked Total Failures=0	Clear
Report errors	Ok	Sent=466 TxQPk=16% LastErr=Ok	Clear
Relayboard errors	Ok	sent 1493 last error=Ok	Clear
Relay State	Active=0		Clear
Input State	Events=0		Clear
RTC errors	Ok	PCΔ=0 sec	Clear
Board Humidity	Ok	Now=37.7, Min=26.3, Max=39.9, Dewpoint=3.2 DegC	Clear
Board Temp	Ok	°F Now=64.0, Min=54.9, Max=80.8	Clear
RF Temp	Ok	°F Now=84.6, Min=78.3, Max=100.4 RdErrors=1	Clear
FPGA Temp	Ok	°F Now=91.4, Min=81.5, Max=107.6 RdErrors=1	Clear
Voltage	Ok	V: Now=47.770, Min=47.703, Max=47.854 Last Extreme at Feb 16 2021, 12:52:15 PDT -0700	Clear

Figure 82. Status check using the Status tab in the Web User Interface (WUI)

Items to note are Voltage, Current, Uptime, ChanA, and ChanB Cable Fault.

Performance Testing – Every 180 Days:

Performance testing is a must for maintaining an alarm system that consistently performs at a high level over time. At regular intervals, each sensor cable length should be tested to verify that it captures intrusions and that the respective intrusions are being annunciated at the head-end. Test each zone or sector using the basic and/or advanced techniques described in Intrusion Testing. Test at random locations to test any spots that have shown lower Probability of Detection (PD) in the past.

Perform a minimum of 10 test intrusions, 10 test per 100 m (328 ft) of sensor for cable lengths greater than 100 m (328 ft). The PD should be calculated based on these performance tests and recorded into a test log.

Maintenance and Test Log:

A written log containing the results of system inspections and intrusion tests will assist in maintaining accountability for the security team. The maintenance log can help identify performance trends over time. Systems can be configured based on seasonal trends to minimize nuisance alarms. The maintenance and/or test log should include the date, name(s) of the test personnel, inspection criteria, pass/fail assessment for output relays, and pass/fail assessment for simulated intrusions.

Other optional data that can be recorded are the weather at the testing time, the number of days in operation, uptime for each TD100, and the threshold for each sensor cable at the testing time.

Troubleshooting

Cut/Broken Sensor Cable:

A cut or broken sensor cable may be discovered during the visual inspection, installation, or need to be located as a result of a cable fault alarm. In any case, the break needs to be found and excavated for repair. If notified via a cable fault alarm, the location would be visible by a persistent alarm location in the WUI alarm log or threshold. There can be no more than two cable splices per any length of sensor cable.

Disconnect power from the damaged Terrain Defender Sensing Cable (TDSC). This can be done by turning off all associated TD24PSU or TD48PSU using the respective DP4 or circuit breaker, ON/OFF switch, or by disconnecting the ends of the power lead-in cable.

WARNING: Using a multimeter, test the cable ends to be repaired to verify the circuit is not energized before handling and continuing with the repair process.

Using a TDSC Repair Kit, center the back half of the enclosure under the cable break. Placing a tarp or other material to stop dirt from interfering with the build and trap any tools or parts that inadvertently drop is helpful.

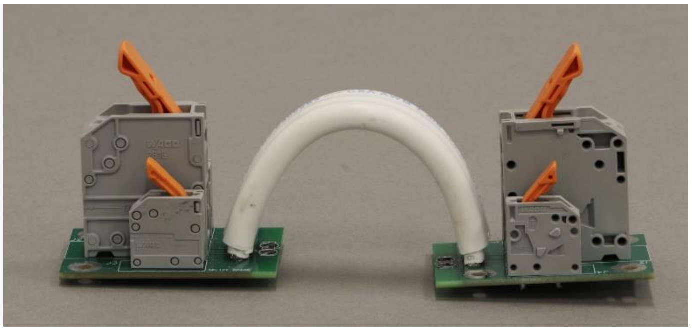


Figure 83. Cable Splice Assembly

Feed the cable ends through the enclosure grommets center hole. Next, prep the cable by stripping 60 mm (2.36 in) of both jackets and dielectric foam, exposing the center conductor and braided drain wire. Cut the center conductor back 30 mm (1.18 in). This would leave the total lengths at 60 mm (2.36 in) of braided drain wire and a 30 mm (1.18 in) center conductor. Split the drain wire into two halves, as seen in Figure 49.

Insert the center conductor into the large terminal block on the cable splice assembly and clamp it shut. Insert and clamp the drain wire halves to each of the smaller terminal blocks on each side of the center conductor terminal block. Repeat the process on the other half of the cable splice assembly.

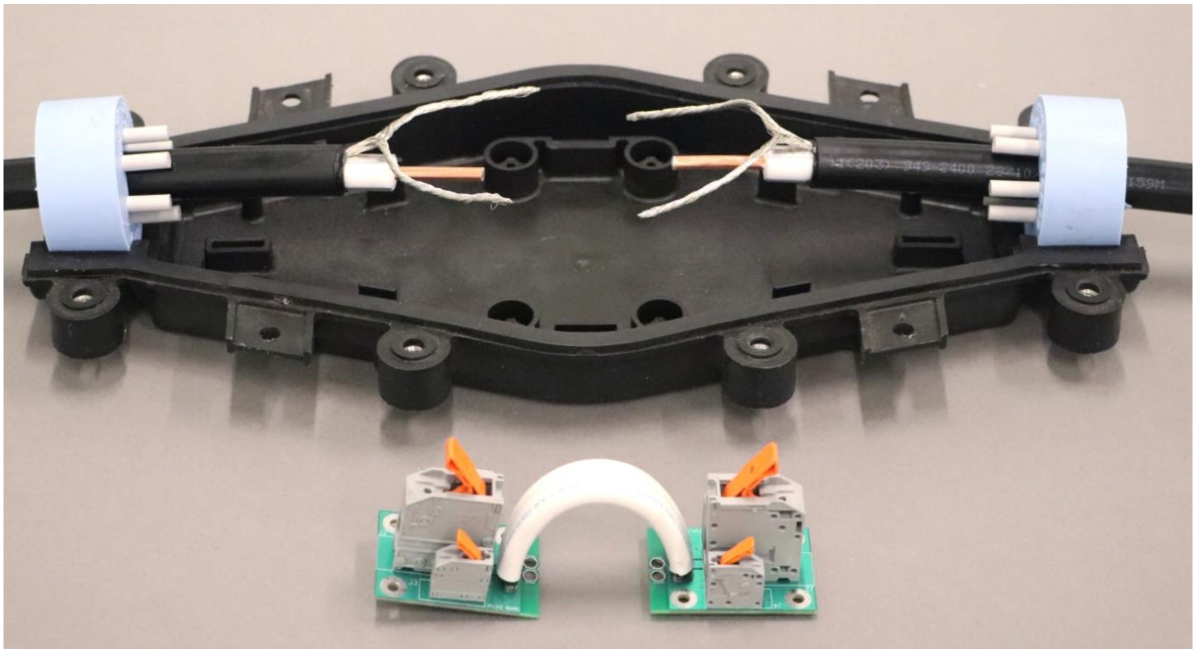


Figure 84. TDSC Repair Kit with cable preparation complete

Apply silicone grease to the grommets and reinsert them in the cable ports. Apply silicone grease evenly around all outer edges of the cover and enclosure base gasket. Seat the cover on top of the enclosure body and tighten all bolts using a 3/8 in (9.5 mm) nut driver. Bury the assembled repair kit enclosure and test the sensor cable.

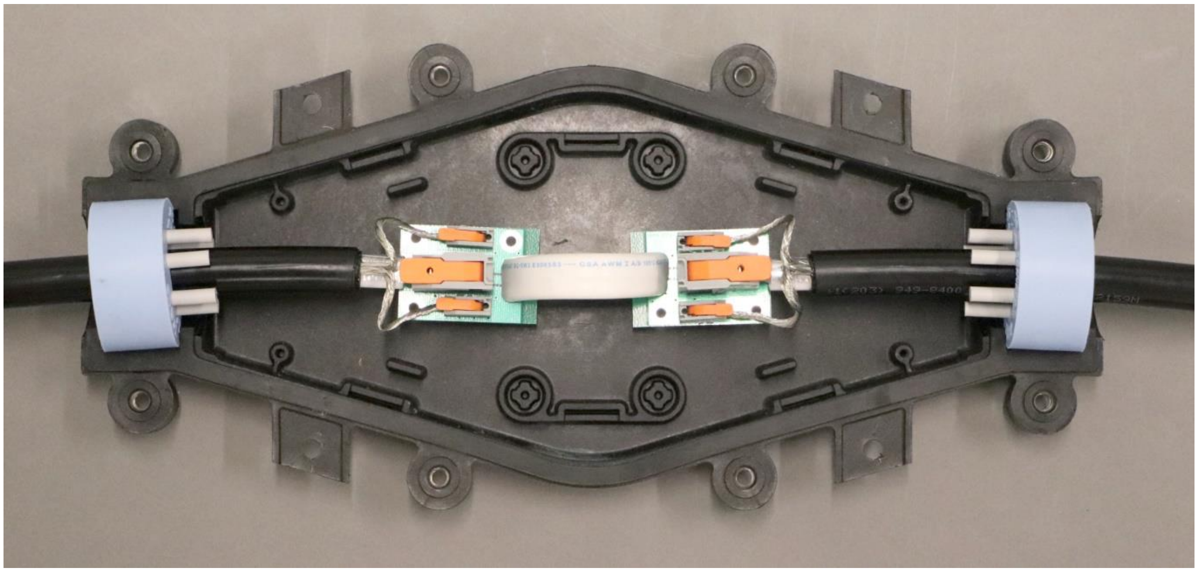


Figure 85. TDSC Repair Kit with connection completed

For larger breaks and cuts than can be joined together via a single repair kit's terminal block board, use both provided repair assemblies in the kit with a length of cable between two good sections of cable. Follow the above process for both ends of the newly inserted cable length.

Password Reset:

If a TCP/IP connection with the unit is possible, but the set username and passwords are not granting access, a password reset may be necessary. To reset the passwords, first remove the cover of the TD100 processor. Once removed, identify and hold down the test button for 7 seconds.

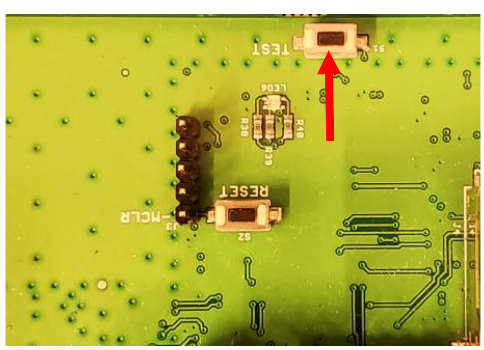


Figure 86. Test button on TD100 PCB

Access is time-limited to 10 minutes after the reset. The reset sets the passwords back to the factory defaults; see TD100 Default Password Table.

TD100 LED Status Table:

Stage	Task	Color 1	Color 2	Color 3
Bootloader	Waiting/Programming	Red		
Initialization	Power up, waiting for ethernet	Blue		
Initialization	Failure	Red		
Initialization	Synchronizing	Blue	Green	
Operating	Armed	Green		
Warning	Warning/Alert	Green	Red	
Tamper	TD100 cover removed	Red		
Password Editing enabled	Passwords at default and editable for 10 minutes	Blue	Green	Red

For issues indicated via LED, refer to the TD100 WUI manual for troubleshooting steps.

Elevated Nuisance Alarms:

Nuisance alarms can be caused by numerous sources such as improper installation, flowing water, or medium-sized animals.

As with any alarm system finding the nuisance source is the first objective. If the nuisance source can be eliminated or resolved, this is always better than adapting for the issue with tuning, which can affect the Probability of Detection (PD).

If unavoidable environmental effects cause the nuisance alarms, follow the tuning process outlined in the WUI manual. During and after the tuning process, refer to Intrusion Testing.

For troubleshooting assistance, contact **Fiber SenSys** Technical Support Service: telephone, 1-503-726-4455; email, **support@fibersensys.com**; or go to the **Fiber SenSys** website, **www.fibersensys.com**

10. Grounding

Lightning protection circuitry for the Terrain Defender Sensor Cable (TDSC) is provided at the Start-Up Module (SUM). The ground connection is made from the SUM stainless steel enclosures ground lug, Figure 55, then routed to a ground rod or plate installed midway between the sensor cables. Grounding protects the system from damage but does not affect detection or system function in any way.

The SUM ground wire passes through the grommet of the SUMA, as shown in Figure 56. The ground rod or plate should have a 10 Ω resistance maximum. In the event of lightning striking the ground and conducting through the sensor, this provides a direct path to ground.

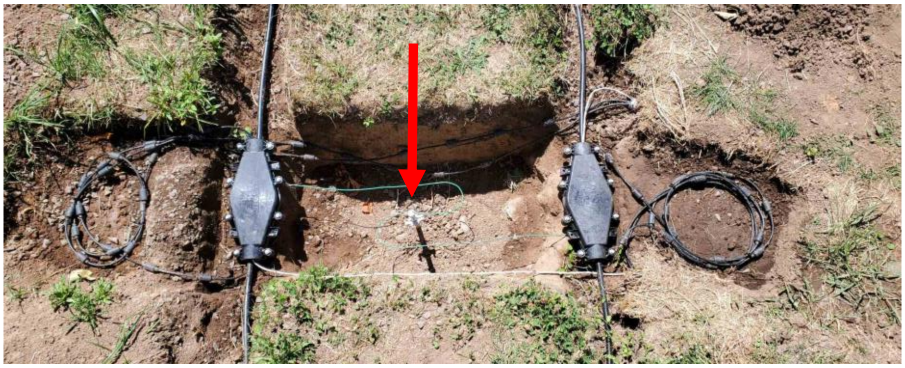


Figure 87. Ground rod or grounding plate centered between SUMA

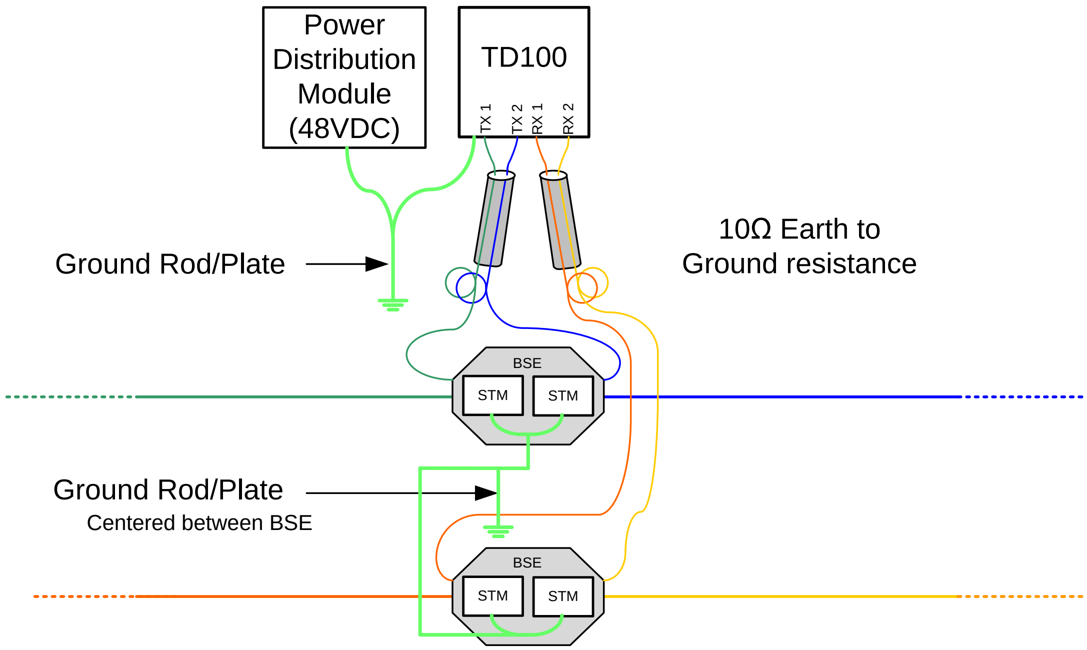


Figure 88. System grounding

11. Product Specifications

TD100™ Processor

System Type	Buried line, point locating, sensor for perimeter security
Sensing TX/RX	• Two fully independent TX/RX pairs • 15 m (49 ft) virtual zone minimum
Power Specifications	Input: 24 – 48 VDC, 12 Watts
Communications	• TCP/IP port for remote configuration and alarm output *(future)* • RJ-45 port for TDR8
Front-Panel Display	LED indicators for initialization, armed, warning, and tamper
Environmental	Temperature: -40˚ C to 70˚ C (-40˚ F to 158˚ F) Humidity: 0 to 95% non-condensing
Dimensions	Height: 14.78 cm (5.82 in) Width: 25.43 cm (10.01 in) Depth: 8.20 cm (3.23 in)
Point Resolution	Within 1 m (3.3 ft) location accuracy
Detection Field	Height: 1 m (3.3 ft) Width: 2 – 3 m (6.6 – 10 ft)
Sensing Cable	Length: Up to 400 m (1312 ft) per RX/TX pair **See **TDSC and Lead-in Cables** specification section*
Insensitive Lead-in	Length: 10 m (30 ft) standard ○ Contact Fiber SenSys for custom lengths **See **TDSC and Lead-in Cables** specification section*
Standards and Certifications	FCC Part 15 Class B, ISED, IEC 62368-1:2018

TDR8™ Relay Module

System Type	Relay I/O, TD100 optional accessory
Power Specifications	• Powered via TD100 connection
Communications	• RJ-45 Port for connection to TD100 processor, 30 ft cable length maximum
Relay Outputs	• 8 Individual, configurable (Alarm, Tamper, Fault) dry contact relays • Normally Open (NO) and Normally Closed (NC), Form C • 24 to 12 AWG • 1 A, 30 VDC non-inductive • Dry Contact Resistance .100 Ω max
Relay Inputs	• 4 Individual dry contact relays

	• Normally Open (NO) and Normally Closed (NC) configurable via WUI • 24 to 12 AWG
Environmental	Temperature: -40˚ C to 70˚ C (-40˚ F to 158˚ F) Humidity: 0 to 95% non-condensing
Dimensions	Height = 10.9 cm (4.3 in) Width = 19.60 cm (7.72 in) Depth = 4.24 cm (1.67 in)
Standards and Certifications	FCC Part 15 Class B, IEC 62368-1:2018

TD24PSU

System Type	TD100 Power Supply Unit 3 Units upported (Max)
Power Input	• 115 – 240 VAC • Input Frequency: 50/60 Hz • Short circuit and thermal overload protection • Filtered and regulated
Power Output	• Output: 24 VDC, 3.5 A • Output Fuse Rating: 400 VDC – 2.0 A, Time Delay / Slow Blow • Fuse Size / Case: 6.3 mm x 32 mm (25 in x 1.25 in) – 3AG / Cartridge Fuse
Battery	• Built-in charger for sealed lead acid or gel type batteries • Automatic switch over to stand-by battery when AC fails (zero voltage drop) • PTC battery protection • Maximum charge current 0.3 A
Relay Outputs	Dry Relay Outputs 1A @ 28 VDC Form “C” contacts (NC, NO, C) • AC Fail Supervision • Low Battery
Front-Panel Display	LED indicators for AC power and DC power
Environmental	Temperature: 0° C to 49° C (32° F to 120° F) Humidity: 85% +/- 5% non-condensing
Dimensions	**AC Transformer:** Width = 14 cm (5.5 in) Length = 7.4 cm (2.9 in) Depth = 7.3 cm (2.9 in) **LPS5:** Width = 17.8 cm (7 in)

	Length = 10.2 cm (4 in) Depth = 6.27 cm (2.47 in) **DP4:** Width = 8.3 cm (3.25 in) Length = 7.6 cm (3 in) Depth = 1.9 cm (0.75 in)

TD48PSU

System Type	TD100 Power Supply Unit 6 Units supported (Max)
Power Input	• 120 – 240 VAC • Input Fuse Rating: 250 VAC – 1.5 A, Time Delay / Slow Blow • Input Frequency: 47 Hz to 63 Hz
Power Output	• Output: 48 VDC, 3 A • Output Fuse Rating: 300 VDC – 2.0 A, Time Delay / Slow Blow • Fuse Size / Case: 5 mm x 20 mm / Cartridge Fuse
Front-Panel Display	LED indicators for AC power, DC power, and fuse blow (3)
Environmental	Temperature: 0˚ C to 55˚ C (32˚ F to 131˚ F) Up to 6 total TD100 (Max) 0˚ C to 70˚ C (32˚ F to 158˚ F) Up to 3 total TD100 Humidity: 5 to 95% non-condensing
Dimensions	Height = 28 cm (11 in) Width = 28 cm (11 in) Depth = 4.24 cm (5.07 in)

Terrain Defender Sensing Cable (TDSC) and Lead-in Cable

Insensitive Lead-in Cable	• Standard Length: 10 m (30 ft)
	  ○ Contact Fiber SenSys for custom lengths
	• The are 10 ferrite beads per lead affixed with adhesive heat shrink
	  ○ Ferrite bead diameter ~19.5mm (.77 in)
	• Maximum pull tensile strength: 27kg (60 lbs)
	• Minimum bend radius: 9 cm (3.5 in)
	• Pre-terminated with SMA connectors, both ends
	• Color-coded ends:
	  ○ Green = RX 1
	  ○ Red = TX 1
	  ○ Green/White = RX 2
	  ○ Red/White = TX 2

Sensing Cable	• Length: 400 m (1312 ft) maximum
	• Maximum pull tensile strength: 27kg (60 lbs)
	• Minimum bend radius: 15 cm (6 in)
	• Dimensions on spool:
	  ○ 91 cm (36 in) W x 43 cm (17 in) H
	• Weight on spool; 400 m (1312 ft)
	  ○ 112.5 kg (248 lbs)

TD Enclosure

Material	Painted steel, grey
Cover	Slides on from the top, vented with screens, secured by screws on sides
Base	Front and top opening, backplate with mounting swage nuts for TD100 processor
Dimensions	Height = 49.07 cm (19.32 in) Width = 31.32 cm (12.33 in) Depth = 24.69 cm (9.72 in)
Weight	8.6 kg (19 lbs)

12. Glossary of Technical Terms

Several technical terms are often used to describe TD100. These include the following:

Correlated Bin (C-Bin)	A C-Bin is the combination of a Range Bin as seen from TX/RX 1 with is complementary C-Bin from TX/RX 2. Each C-Bin corresponds to approximately 6 meters of sensor cable
Contra-Directional Coupling	A signal traveling down the cable (TX) is reflected and received (RX) in the opposite direction it was originally transmitted, also referred to as “Out and Back” flow.
Dual-Ended	Processing the responses from processors on both ends of the cables using E2EC.
End-to-End Correlation (E2EC™)	Two processors, one at each end of the sensor cable, detect the same intruder at the same time and at the same location.
End-of-Line Terminator (EOLT)	Termination board placed on the end of single-ended cables.
Leaky Cable	Implying the sensor coaxial cable is designed to radiate RF energy. This is accomplished by the continuous slot in the shield that wraps around the dielectric inside the TDSC.
Master Controller	A Linux server with pre-loaded software that monitors and interacts with all TD100 processors on the network. Some functions, such as virtual zoning between adjacent sectors, require this unit. P# 980-04235
Range Bin	Each tap of the correlator output is referred to as a Range Bin. Each Range Bin corresponds to approximately 12 meters of sensor cable.
Single-Ended	Processing the response to the PN-coded pulse sent along the TX cable as seen by the receiver on the parallel RX cable. This is based on contra-directional coupling.
SMA Connector	SubMiniature version A coaxial connector as seen on both ends of the lead-in cable and TD100 processor.
SMA Terminator	Screw on terminators that are affixed to any TD100 processor port that is not in use.
Start-Up Module (SUM)	Interconnects power from TD24PSU or TD48PSU and RF from lead-in to the sensor cable inside a grounded stainless-steel enclosure.
Start-Up Module Assembly (SUMA)	Direct-bury rated enclosure containing one or two SUM(s) and relevant connections. P# 980-64230
Terrain Defender	The Fiber SenSys product line consisting of buried sensor technologies.

TD100™ Processor Lead Processor Middle Processor End Processor	Terrain Defender Buried line sensor for intrusion detection. P# 980-34227 The first processor in any Terrain Defender system. Kit P# 980-04345 A processor in a multi-processor site located between the Lead and End. Kit P# 980-14346 The last processor in a Terrain Defender system with more than one unit. Kit P# 980-24347
TD24PSU	A 24VDC Power Supply Unit that distributes power to SUMA. Can daisy-chain up to three TD100 processors. Features battery backup capability with AC fail and low battery outputs. Includes enclosure. P# 980-64560
TD48PSU	A 48VDC Power Supply Unit that distributes power to SUMA. Can daisy-chain up to six TD100 processors. Comes with enclosure. P# 980-94233
Terrain Defender Sensing Cable (TDSC) TDSC 400M	Direct-bury sensor cable for use with the TD100 buried line intrusion detection system. A 400 m (1312 ft) spool of TDSC for creating a single < 200 m (3.3 – 656 ft) zone. Order a pair for zones 200 – 400 m (656 – 1312 ft) in length. Includes buried line caution tape. P# 600-44558
TDSC Repair Kit	Terrain Defender Sensing Cable Repair Kit includes two enclosures, two splice boxes with terminal blocks, and a 10-meter cable segment. P# 980-54262
TD Outdoor Enclosure	Vented outdoor enclosure designed for use with the TD100 processor. P# 980-84232
TDR8 Relay Module	I/O relay unit connecting to the TD100 via ethernet cable with 8 programmable outputs and 4 inputs. P# 980-64241
TD Tool Kit	Tool kit with all the tools needed for TDSC preparation and SUMA flash testing. P# 980-64263
Web User Interface (WUI)	Direct TCP/IP connection with the TD100 processor using a web browser for accessing calibration, detection settings, and more.

For troubleshooting assistance, contact **Fiber SenSys** Technical Support Service: telephone, 1-503-726-4455; email, **support@fibersensys.com**; or go to the **Fiber SenSys** website, **www.fibersensys.com**

