Rapid Redfiber Kit Installation Guide

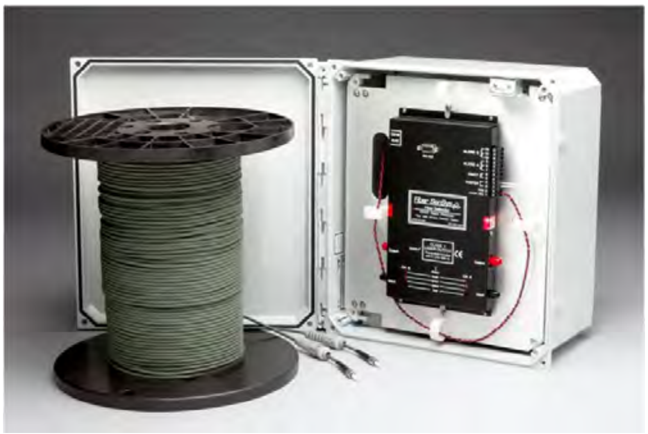


Table of contents

1. Safety information

Please read and keep these instructions and operate the product in accordance with the specifications outlined in appendix A. Please use only attachments and accessories that have been specified by the manufacturer, and refer all servicing to qualified service personnel.

Safety terms

Where appropriate, the following terms may appear in this manual:

Caution	Identifies conditions or practices that could result in damage to equipment or property, or possible loss of data or contamination of your files.
Warning	Identifies conditions or practices that could result in non-fatal personal injury.
Danger	Identifies conditions or practices that could result in loss of life or limb.

Electrical safety

The alarm-processing unit (APU) operates on 12-24 VDC. Do not use the APU if it:

- **shows visible damage**
- **does not operate as expected**
- **has been subjected to prolonged storage under adverse conditions**
- **has been damaged during shipment**

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

Class I laser product

Each APU has two output ports that emit Class I laser radiation, as defined by IEC 60825-1 and CFR 21 subchapter J. Class I laser radiation is insufficient to constitute a hazard according to established limits. However, avoid direct eye exposure to the output of this product and to the open end of any optical-fiber cable connected to this product.

The following stamp is found on the front panel of the APU:

Fiber-handling precautions

The optical fiber is made of glass and the ends of a broken fiber can be sharp and easily stick into your skin. Take appropriate glass-handling precautions.

Never bend the optical fiber to a diameter less than 2 inches (5 cm). Smaller-diameter bends can cause damage to the optical fiber.

Covers and panels

To avoid personal injury, do not remove any of the product's covers or panels. There are no user-serviceable parts inside and the warranty is void if the factory seal is broken. Do not operate the product unless the covers and panels are installed.

Inspection

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

2. Introduction

This application note will instruct the reader on the proper methods for installing the **Rapid Redfiber Kit**. Prior to installing the **Alarm Processing Unit (APU)** and deploying the sensor cable, the site to be protected must be assessed carefully so that all security needs are met and all potential threats are accounted for.

Ultimately, the method by which the sensor cable is installed and deployed is up to the end user. Optex does not mandate one particular installation design over another; however, the general procedure for installing the fiber optic perimeter security system is as follows:

1. **Assess:** Survey the site to be protected and record all information needed for the site design phase

2. **Design:** Create a strategy for protecting the site. This includes planning the level of security, choosing the location of the APUs, provision of electrical power, and planning cable routing

3. **Install:** Proper deployment of the fiber optic sensor and correct installation of the Rapid Redfiber system

The RAPID REDFIBER™ series offers cost-effective, high performance fibre-optic intrusion detection kits to be mounted on fences and includes all parts needed for the installation. The two zone kits have been developed to suit small to medium size perimeters with detection zones not exceeding 200m each.

A choice of two Alarm Processing Unit (APU) models, one analogue and the other PoE compliant version that includes an IP module integrated with all major Video Management Software (VMS) platforms* is available, as well as a number of set length pre-connected cables to match the length of each detection zone.

Harnessing the latest fibre-optic technology the RAPID REDFIBER uses sophisticated algorithms to detect intruders who are attempting to climb over, crawl under, or cut through a perimeter line. These algorithms are also able to distinguish between genuine intruders and nuisance alarms that might be caused by wind or small animals. Unlike metallic (coaxial) sensors, the advanced fibre-optic sensing cable is not affected by harsh environments, including UV radiation, moisture, salt, or even lightning strikes.

3 Product description

How to select your RAPID REDFIBER kit

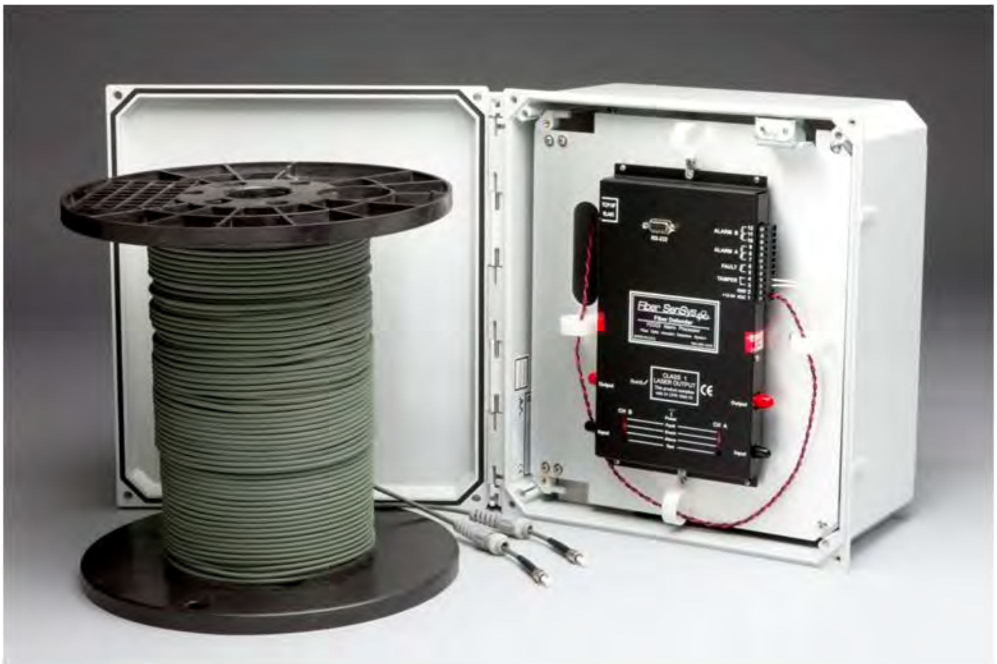
1- Select the Alarm Processing Unit (APU) kit model

	RRF-APU	RRF-APU -POE
	Two channel APU Kit	PoE/IP two channel APU kit
Items included		
two-zone RAPID REDFIBER APU	●	●
IP 66 rated enclosure box	●	●
Tuning software	●	●
POE-IP module	–	●

2- Select the sensing cable kit

Based on the length of each detection zone, please select separately the sensing cable kit needed for detection zone 1 and the one needed for detection zone 2. For instance if the first detection zone is 75m long, and the second 150m, please select 1 x RRF75 and 1 x RRF150.

	RRF75	RRF100	RRF150	RRF200
Sensing cable	pre-terminated sensing cable to cover a 75m zone	pre-terminated sensing cable to cover a 100m zone	pre-terminated sensing cable to cover a 150m zone	pre-terminated sensing cable to cover a 200m zone
Connectors	pre-fitted	pre-fitted	pre-fitted	pre-fitted
Plastic UV resistant zip ties	Included	Included	Included	Included
Strainers	Included	Included	Included	Included



The alarm processing unit - APU

The APU is an electro-optical Instrument that uses optical fiber as a distributed sensor for detecting intruders who are trying to cut, climb or crawl under a fence. The APU can be calibrated, or tuned, to disregard non-threatening phenomenon such as wind and animals, thus reducing nuisance alarms. When an intruder is detected, the APU sends out an alert via terminal contacts that can be used to switch on lights, cameras, sirens, or to signal an alarm panel (see figure 2).
Caution

Each APU supports two zones. The sensing cable for each zone connects to the APU using fiber-optic ST connectors. Using other types of connectors may reduce the product’s performance and/or damage it.

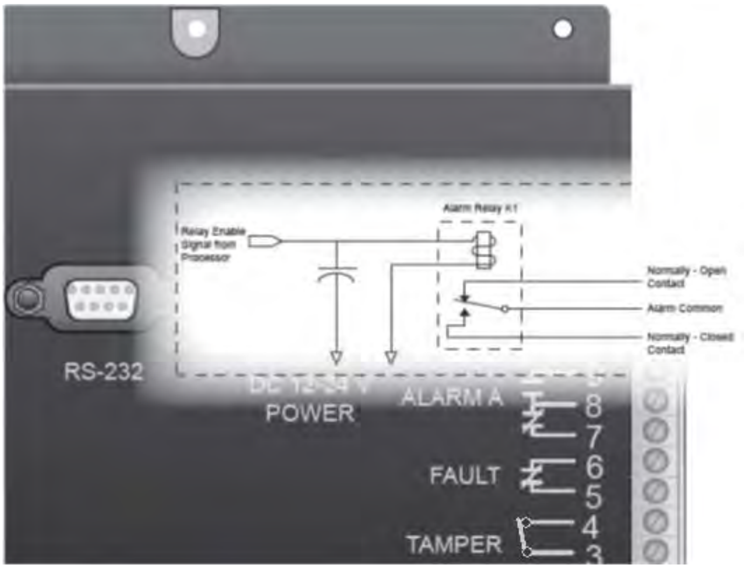


Figure 2. RRF APU alarm relay contacts schematic (unpowered state)

The APU also has an IP port, over which alarms can be sent to a head end for further processing and action.

APU connections and indicators

The APU has several input/output connectors. There are two optical connectors (labeled Input and Output) for each channel/zone. In addition, each APU has a terminal connector strip for DC power, alarm and fault relays and tamper input. There is also an RS-232 connector and an RJ45 connection for Ethernet (see figure 3).

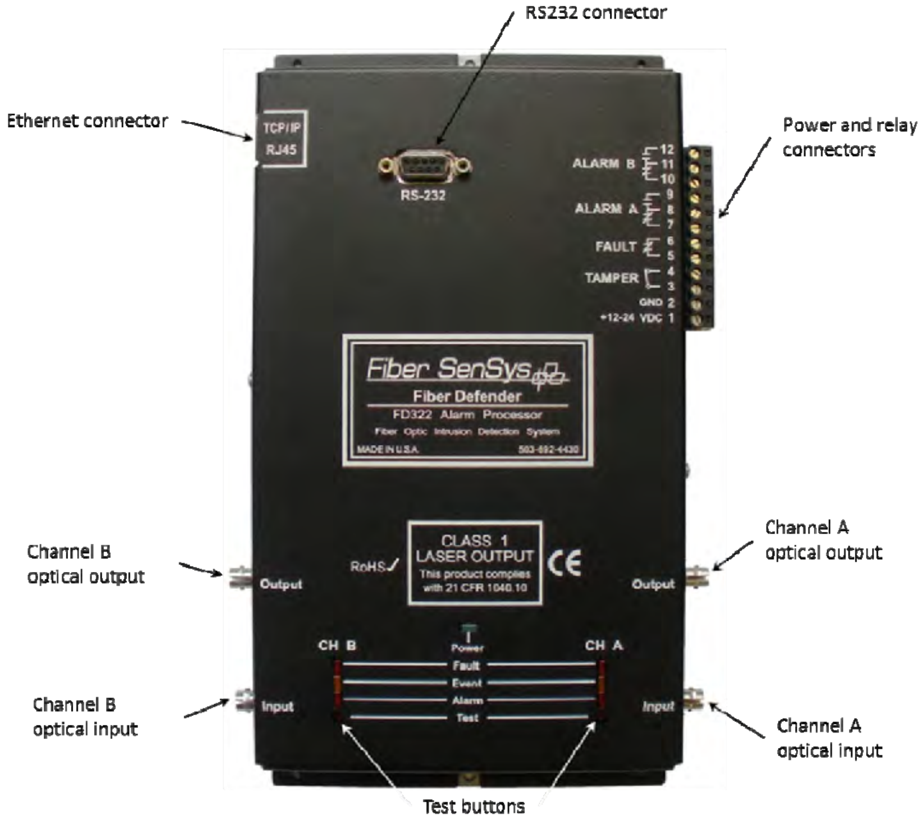


Figure 3. The RRF APU

The 12-pin terminal strip for connecting electrical power and alarm indicators is located on the right-hand side of the APU. Each pin is labeled and the terminal pins from bottom to top of the terminal strip are listed in Table 1.

Table 1. Power and relay terminal assignments

Terminal	Description
1	+12 - 24 VDC
2	Ground
3	Tamper Input
4	Tamper Input
5	Fault Relay Output
6	Fault Relay Output
7	Channel A Normally-Closed Relay Output
8	Channel A Relay Common
9	Channel A Normally-Open Relay Output
10	Channel B Normally-Closed Relay Output
11	Channel B Relay Common
12	Channel B Normally-Open Relay Output

Pins 1 and 2 – Power: 12 to 24 VDC is connected to these terminal pins. Positive lead is the bottom-most pin (Pin 1) and ground is the pin immediately above it (Pin 2).
Pins 3 and 4 – Tamper: The leads of the normally closed tamper switch on the IP enclosure are connected here. Whenever the tamper circuit opens (because the tamper switch is not set or the enclosure door opens, etc.), the alarm relay activates and remains activated until the circuit closes again or the tamper feature is disabled.
Pins 5 and 6 – Fault: These pins are used to connect the fault relay to a remote indicator. The normally closed fault relay contacts open if there is a loss of optical power or if the optical fiber is cut. The contacts are open when the APU is unpowered.
Pins 7 and 8 – Channel A, normally closed alarm contacts: When the APU determines that an alarm condition in the channel is met, the contact opens. When the system is powered down, this contact is open.

Pins 8 and 9 – Channel A, normally open alarm contacts: When the APU determines that an alarm condition in the channel is met, the contact closes. When the system is powered down, this contact is closed.
Pins 10 and 11 – Channel B, normally closed alarm contacts: When the APU determines that an alarm condition in the channel is met, the contact opens. When the system is powered down, this contact is open.
Pins 11 and 12 – Channel B, normally open alarm contacts: When the APU determines that an alarm condition in the channel is met, the contact closes. When the system is powered down, this contact is closed.

Caution

Do not apply AC voltage to these pins. The alarm relay contacts are rated for DC voltage only (100 mA at 24 VDC).

LED indicators. LED indicators for each available channel are found on the front panel of the module.

- FAULT **(red) indicates a loss or significant degradation of returning optical power.**
- EVENT **(yellow) indicates a disturbance or event has been detected in the sensor cable.**
- ALARM **(red) indicates that an alarm condition has occurred.**
- POWER **(green) indicates that the module is plugged in and receiving power.**

Pressing the Test **button (located below the LED indicators) causes the** ALARM **and** FAULT **LEDs to light up and the corresponding relay contacts to change state.**

The front panel of the APU has an RS-232 connector for connecting to a PC during calibration. The pin-out for the RS-232 connector is shown in figure 4 and table 2.

Figure 4. Pin-out for the RS232 connector

Table 2. RS-232 Pin Assignments

Pin Number	Description
1	No connection
2	T x D transmit
3	R x D receive
4	No connection
5	Ground
6	No connection
7	RTS
8	CTS
9	No connection

Note:

Connections to the APU's RS-232 interface should use straight-pin DB-9 serial cable

Sensor cable

The Rapid Redfiber sensor is a thin strand of multimode optical fiber in a 4-mm cable that is attached to the fence using zip ties.

When an intruder disturbs the fence and moves it slightly, this slight vibration is sensed by the fiber. The APU measures the amount as well as the frequency of the vibrations and (using proprietary algorithms) determines whether the shaking is caused by an intruder or some "nuisance" such as wind or animals.

The fiber, ties, connector kits, and installation tools necessary for a complete install are all available through Optex. Contact the factory for part numbers, kits**,** and pricing.

System block diagram

A block diagram of the APU and its system components is shown in figure 5.

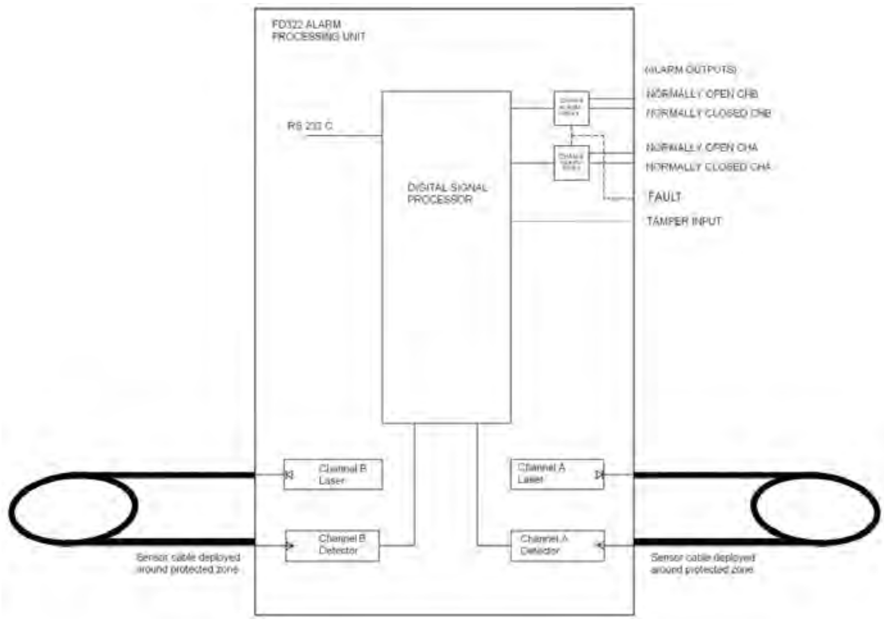


Figure 5. APU system block diagram

4 Site Assessment and Design

Before installing any equipment, carefully survey the area to determine how many zones will be required and where each zone will be located. The locations of zones should work with the locations of lights, cameras, and other security considerations. A map of the perimeter should be generated, showing the locations of gates, corners, security cameras, key assets, etc.

For detailed information about deployment techniques, refer to the application note: **AN-ENG-027 Site Design and Installation for FD300 Series**.

Zones extend in both directions along the fence from the zone start location. Below is a simplified illustration of a fence with the locations of two zones labeled.

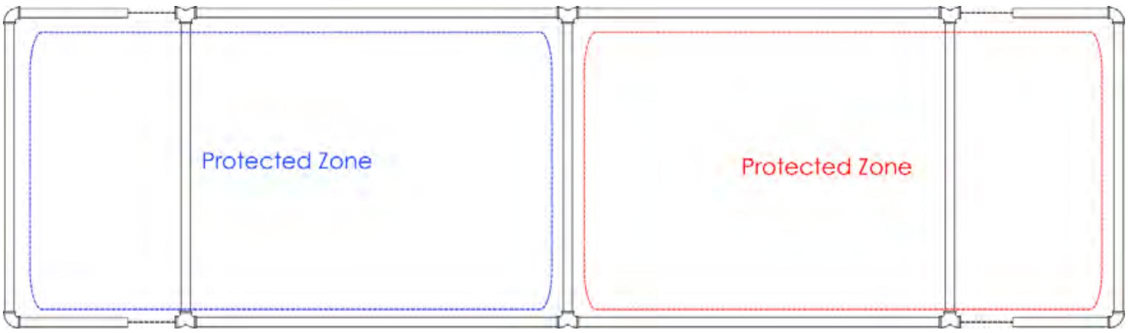


Figure 2-1. Simplified fence for FD322-Rapid Fiber Kit deployment.

Once the perimeter has been surveyed and the locations of zones approved, the physical locations of the edges of the zones should be marked in some way. A good way to mark these points is to tie a ribbon or a flag to the fence.

Orient the enclosure such that the power and optical entry ports are on the bottom to reduce the likelihood of moisture entering and remaining within the weatherproof enclosure. Locate the enclosure between two zones, as the zones will extend outward in either direction from the APU.

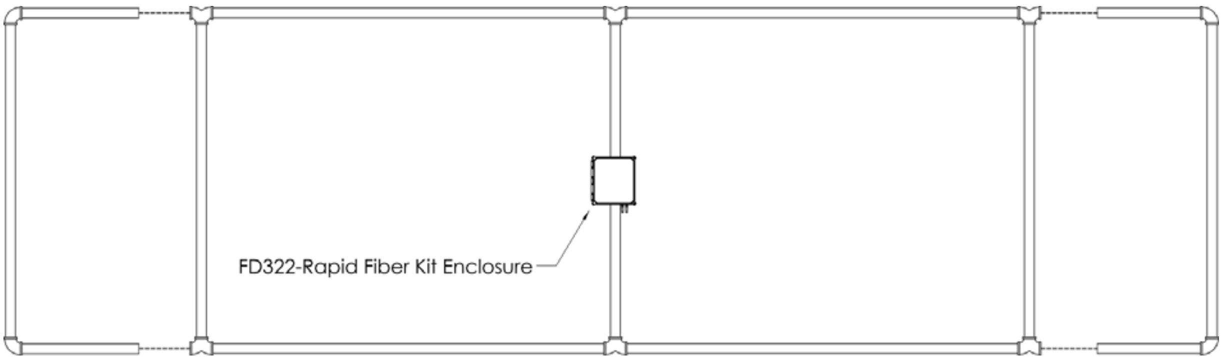


Figure 3-1. Rapid Redfiber™ Kit installed at the intersection of two zones.

5. Site planning and preparation

Successful installation and operation of Rapid Redfiber is accomplished by understanding all of the security needs of the site being protected as well as proper deployment of the sensor cable. This chapter outlines the site-planning and threat-assessment procedure.

Prior to installing the APU and deploying the sensor cable, carefully assess the site for all potential threats and security needs as well as system maintenance requirements and equipment compatibility. If, for example, the APU alarm relays are wired to activate remote video equipment, the maintenance requirements and compatibility of the APU and video equipment should be considered.

Fenced perimeters

The six threats against a fence line are:

- **Going over the top of the fence**

  1. **Climbing the fabric**
  2. **Climbing posts**
  3. **Ladder-assisted climbing**

- **Going through the fence**

  4. **Cutting the fabric**

- **Going under the fence**

  5. **Digging under the fence**
  6. **Lifting the fence fabric**

Successful protection against these threats depends on the proper deployment of the sensor cable and calibration of the APU.

Fence sensor cable deployment guidelines

When determining a strategy for protecting the site, there are three important issues regarding the sensor cable:

1. The sensor cable detects movement, so you want to install it in such a way that it vibrates when an intruder is present, but not when non-threatening things such as wind or animals are present.

2. The sensor cable has the same level of sensitivity throughout its entire length. Areas that are easily vibrated by intruders need less coverage by the sensor/conduit than areas that are not as easily vibrated.

3. The APU does not distinguish the intruder's location along the sensor cable. To localize the intruder, separate the perimeter into zones that are small enough to be quickly checked when an intruder trips the alarm.

Make the fence "quiet"

Wind is one of the biggest sources of nuisance alarms. The best way to avoid these notifications is to make the fence "quiet" when the wind blows. Here are some specific things you can do to accomplish this:

- **Install high-quality fence**
  - For chain link fences, re-tension the fence fabric if it is loose and add more ties to the fence fabric and the fence signs (as necessary) **to** prevent them from slapping or banging the fence and posts when the wind blows**.**
- **Deploy uniform zones**
  - Within a zone the type, quality, and tension of the fence should be uniform.
- **Keep the fence line clean**
  - Keep the area on both sides of the fence clear of tree limbs and other vegetation that might brush against the fence when the wind blows. Clear the outside perimeter of objects that might be used as climbing aids, such as trees, large rocks, etc. There should be no places where an intruder could easily crawl or dig under the fence.
- **Pay attention to man-made and natural barriers**
  - Buildings, structures, waterfronts, and other barriers used in place or as part of the fence line should provide adequate protection against intrusion. Ensure there are no windows, doors, openings, or unguarded means of access.

For a chain link fence to be most effective against intrusion, it must conform to the following nine specifications:

1. Use steel, nine-gauge fabric mesh with maximum openings of 5 in (12 cm), tensioned consistently across each zone.
2. Use nine-gauge fabric ties with at least four ties evenly spaced on each fence post.

3. If it exists, the top guard outrigger should be angled away from the protected area and covered with at least three strands of tensioned barbed wire.

4. The top of the fence fabric should be at least 7 ft (2.1 m) above the ground.

5. Pin or weld all posts, supports and hardware to prevent disassembly of the fencing or removal of its gates. Locate all posts and structural supports on the inner side of the fencing. Use concrete to secure posts in the ground to prevent shifting, sagging, or collapse. Additionally, place posts every ten feet or less.

6. The use of “hog rings” and aluminum wire is not recommended.

7. Install taut reinforcing wires interwoven or affixed with fabric ties along the top and bottom of the fence for stabilization of the fabric.

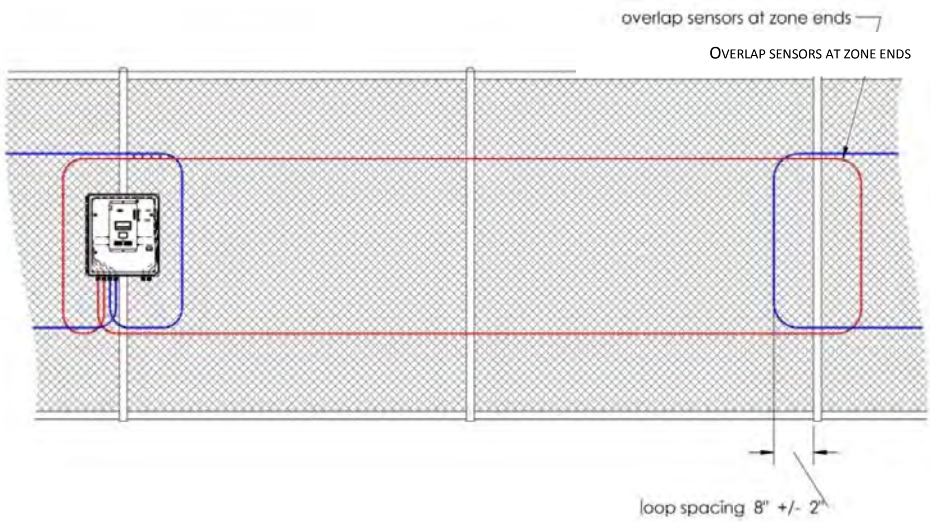
8. The bottom of the fence fabric should be less than 2 inches (5 cm) above firm soil or buried sufficiently in soft soil.

9. Ensure that culverts under or through a fence consist of pipe 10 in (25 cm) in diameter or less. If a larger pipe is used, properly grate and equip with sensors to prevent access.

Sensor deployment

Figure 6 shows the basic recommended loop-back installation of the fiber-optic sensor for the APU. In this configuration the sensor is routed down the zone, below the top of the fence, then looped back (approximately ¼ of the fence height) above the bottom of the fence. This maximizes the probability of detecting intruders that are trying to climb over, crawl under, or cut through the fence.

Install the sensor on the secured side of (inside) the fence and overlap it from one zone to the next to avoid any gaps in sensor coverage. For a standard loop-back configuration the fence should be less than 8 ft (2.4 m) high. Taller fences may require repositioning of the sensor cable or adding an additional sensor loop.



Figure

6. Sensor cable deployment types

LOOP SPACING 8” +/- 2”

Install service loops at regular intervals to allow the sensor cable to be re-spliced as necessary without having to remove and then redeploy the entire cable. A good rule of thumb is to add a service loop about every 300 ft (91.4 m) and to put an extra 5 ft (1.5 m) of cable in each loop (see figure 7).

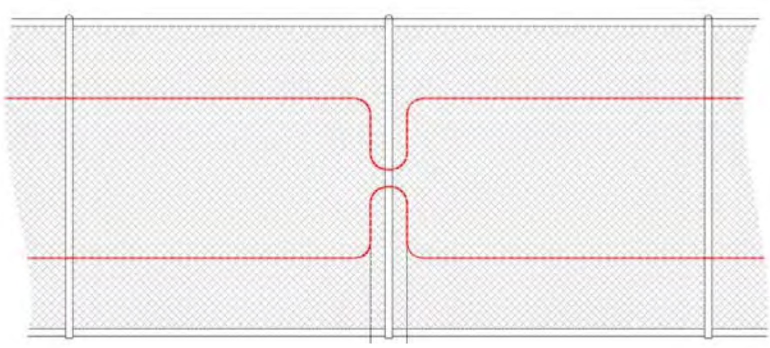


Figure 7. Adding a service loop

The standard loop-back configuration is an economical way to provide reasonable protection for most perimeters. The following techniques provide additional protection:

1. Run the fiber sensor between the fence fabric and the fence posts.
2. Add extra loops of sensing cable to reinforced panels, as shown below in figure 8.

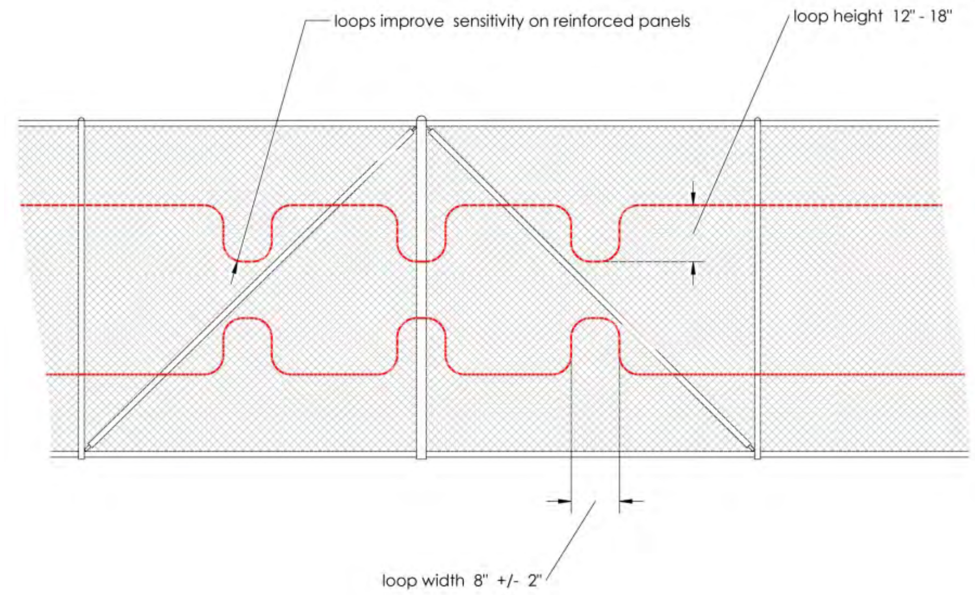


Figure 8. A loop of extra sensor cable on reinforced sections increases sensitivity.

3. Use additional loops of sensor cable on posts. When there are outriggers, extend the loops to the top of the outrigger to add protection against intruders climbing the fence posts (see figure 9).

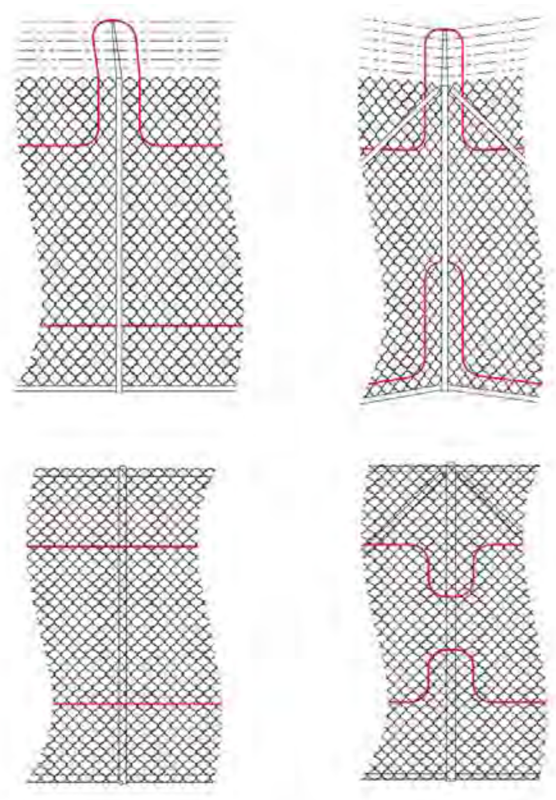


Figure 9. For extra security use additional loops of sensing cable for posts and corner posts.

4. Do not attach the sensor to coiled razor wire because razor wire is unstable and subject to movement in the wind. Protect high-security perimeters with razor wire on top the fence using the FD33X/34X/5X product.

APU deployment

The APU is designed for deployment on or near the fence line, outdoors, in an enclosure hung from the fence or mounted near the protected area. Because all optical fiber is sensitive, mount the APU in an area free of vibration to avoid generating nuisance alarms. If the fence on which the APU is mounted is prone to vibration (resulting, for example, from wind or traffic) it is acceptable to mount the APU enclosure on a pole or standoff next to the fence (figure 10).

Install a tamper switch on the IP enclosure and mount it securely to prevent unauthorized access. If possible, select a shaded location to avoid excessively heating the enclosure and the APU inside.

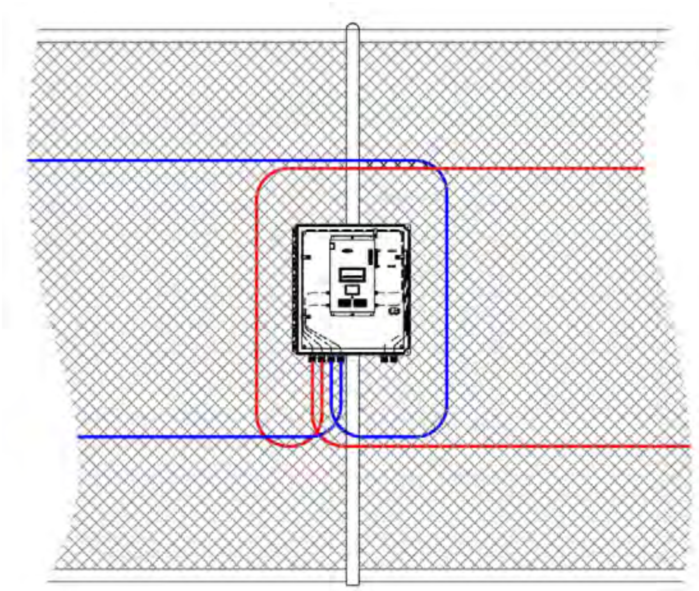


Figure 10. Mounting the APU in an IP enclosure, on a pole next to the fence.

6. Installation

Sensor installation

Ultimately, how the APU is installed and deployed is up to the end user. Optex does not recommend or mandate one particular installation setup over another. However, the general procedure for installing the APU is as follows:

1. Create a security plan, including the location of the APU, provision of electrical power, routing of sensor cable, insensitive leads, and relay or TCP/IP connections.

2. Determine the number of zones.

3. Create a strategy for protecting gates.

4. Determine the amount of cable needed.

5. Deploy the cable.

6. Connect the sensor cable to the appropriate APU channel.

   Planning the site

   When developing the site plan take note of these characteristics:

- The length of the fenced perimeter (not including the gates)
- The number and length of gates
- The number of reinforced sections and their lengths
- Planned locations of the APU(s)
- Power requirements including usage required by the APU(s)
- The width of roadways or walkways through the gate(s)

Keep a detailed list of these factors and their associated numbers. You will use them to calculate the amount of cable required later on in the procedure.

Number of zones

The number of zones is determined partially by the size of the location and the ability to respond quickly to intruders. Other factors include whether video surveillance will be used (requiring a separate zone for each camera), or whether there are any remote sections of the site that must be monitored, in addition to the main locale.

Protecting gates

Gates are designed to move, so they can be the source of nuisance alarms unless the installation is performed with the following points in mind:

- Secure all gates to avoid as much un-intended movement as possible. This prevents them from swinging on their hinges, striking restraining posts, locking mechanisms, or their own latches during high-wind conditions.
- Gates that are routinely opened for authorized access and that are equipped with a sensor cable should be installed with an alarm-disabling circuit.
- Establish a separate zone for all gates in order to maintain a secure perimeter while a gate is open. In addition, reinforce sections of the fence leading to the gate(s) by adding additional structural support or posts. Separate gate hinge posts and fabric supporting posts as necessary. This is recommended to prevent or reduce vibrations transmitted from the gate to the sections of the fence with active sensor cable.

There are several ways to deploy the sensor cable on gates. For a swinging gate, the **simplest** method is to run the cable from the fence fabric to the gate and loop it back. The sensor cable is then routed below the gate and buried in **hardened** PVC conduit 1 ft (0.3 m) below the roadway to make it insensitive to vibrations (see figure 11).

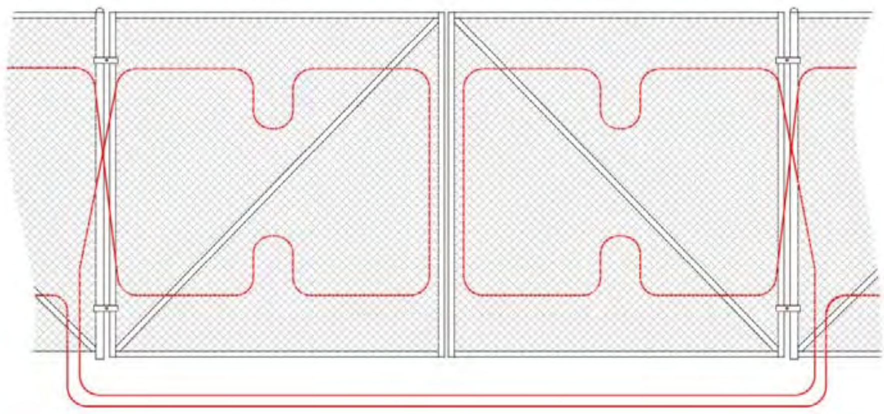


Figure 11. Installing the sensor on swinging gates.

For gates that do not require protection, bury the cable at least 1 ft (0.3 m) below the roadway, routed through rigid PVC conduit, thus creating a gate bypass that is insensitive to vibration from the roadway.

Deploying the cable

Caution

Ensure that no zone covers more than one type (or quality) of fence.

Optical fiber is fragile because it is made of glass. It will break if it is twisted or bent into too tight of a **radius**. The following precautions should be kept in mind when handling fiber-optic cable:

Caution

Be sure to follow these precautions, as failure may result in damage to the fiber and degraded or poor system performance.

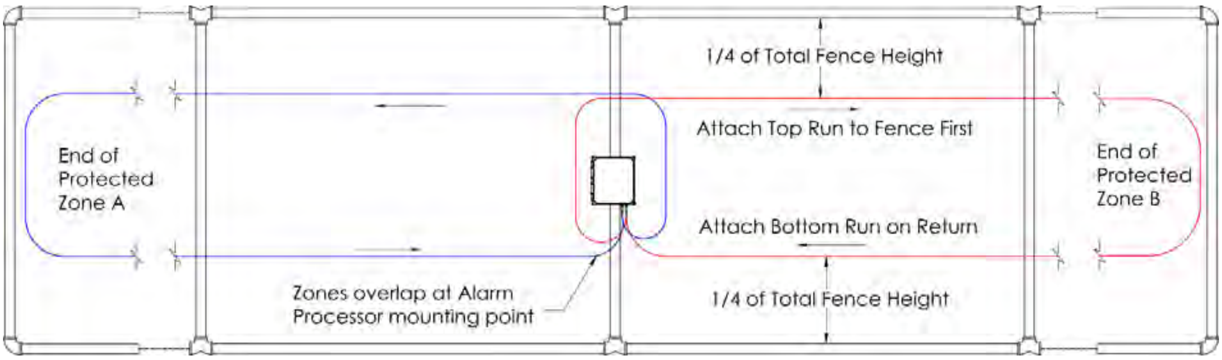
- **Do not pull the cable by the connectors as this can damage the connectors and result in degraded performance.**
- **Avoid twisting the cable or bending it into a radius tighter than 2 in (5 cm). Tighter bends might damage the fiber or break it.**
- **Dirty connectors can damage the APU. Keep the connectors capped until you are ready to make a connection, and always clean them with an approved fiber-optic cleaning kit. After cleaning you should also inspect the connectors for damage or dirt before connecting them to the APU.**

Attaching the sensor to the fence

Route the fiber once around the base of the enclosure then pass the cable up to the upper level through the slot cut out of the hinged panel and connect to the optical outputs of the APU (shown in figure 4-1). Do not bend the fiber in a radius less than 5 cm (2 inches) when routing the fiber. Run the cable through the nylon cable restraints located along the edges.

Be sure to make one full pass around the base before routing the fiber to the upper level. This extra loop of fiber is intended to facilitate repairs to the sensor cable should it ever get damaged. Do not make more than one full pass, however, as storing excessive amounts of cable in the enclosure will cause it to become overly sensitive and may act as a source of nuisance alarms. Once the fibers have been routed and connected, secure and tighten the weatherproof fittings.

The kit also comes with packs of UV-rated nylon cable ties. Use the ties to route and secure the fiber optic sensor cable to the fence. It is easiest to un-spool the fiber as it is installed, attaching the top run of the loop first. The fiber should be routed around the enclosure once before routing to the end of the zone so that the two zones overlap at the enclosure (see figure 4-2).



Attach the sensor cable to the fence ¼ the total fence height from the top. Attach cable ties every 12" (30 cm), which is typically 4 fence diamonds. Be sure there is enough tension in the cable to prevent it from sagging.

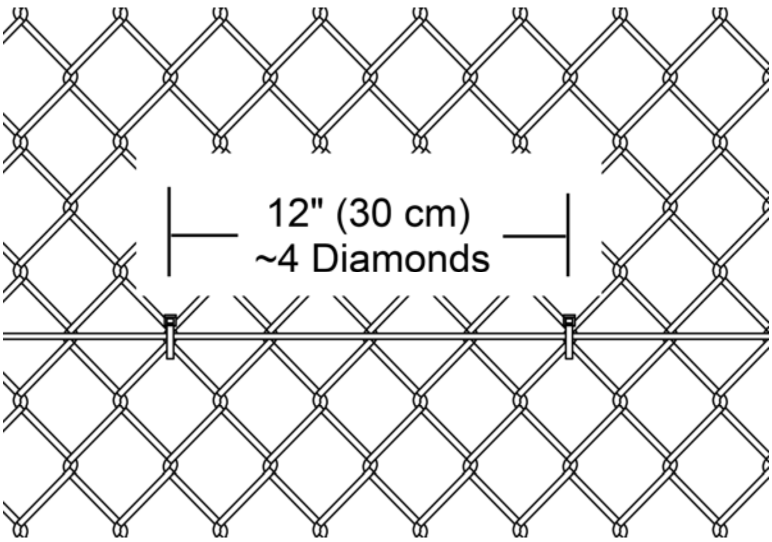


Figure 4-1. Cable tie spacing.

When fastening the cable to the fence, loop the ties between two vertically adjacent diamonds; do not loop diagonally as diagonally routed ties can kink the cable. Excessive kinking of the cable can cause optical loss, which will adversely affect the system's nuisance alarm rate and ability to detect intrusions.

Figure 4-2. Correctly tied through vertically adjacent diamonds.

Continue unrolling the spool and attaching the cable to the fence until you reach the marker indicating the edge of the zone. At this point, route the cable down to ¼ the total fence height from the bottom rail and begin the loop back to the IP Enclosure**.**

Once the fiber has been routed back to the enclosure, un-spool the remaining fiber. Route the remaining end of the sensor cable into the enclosure. Do not store more than 3 meters of excess cable within the enclosure. If more than 3 meters of fiber remains after reaching the enclosure, the excess must be removed to prevent the enclosure from becoming overly sensitive and a potential nuisance alarm source.

Removing Excess

Pull all the fiber through optical port into the enclosure. Measure out 3 meters of cable from the entry port and cut the fiber. Re-connectorize the end of the 3 m of fiber with an industry-standard ST-type connector. Connector kits are available from Optex for terminating SC-4 sensor cables. For detailed instructions on how to connectorize SC-4, watch the training video: **TM-ENS-002 Fiber Optic Cable Termination Video.**

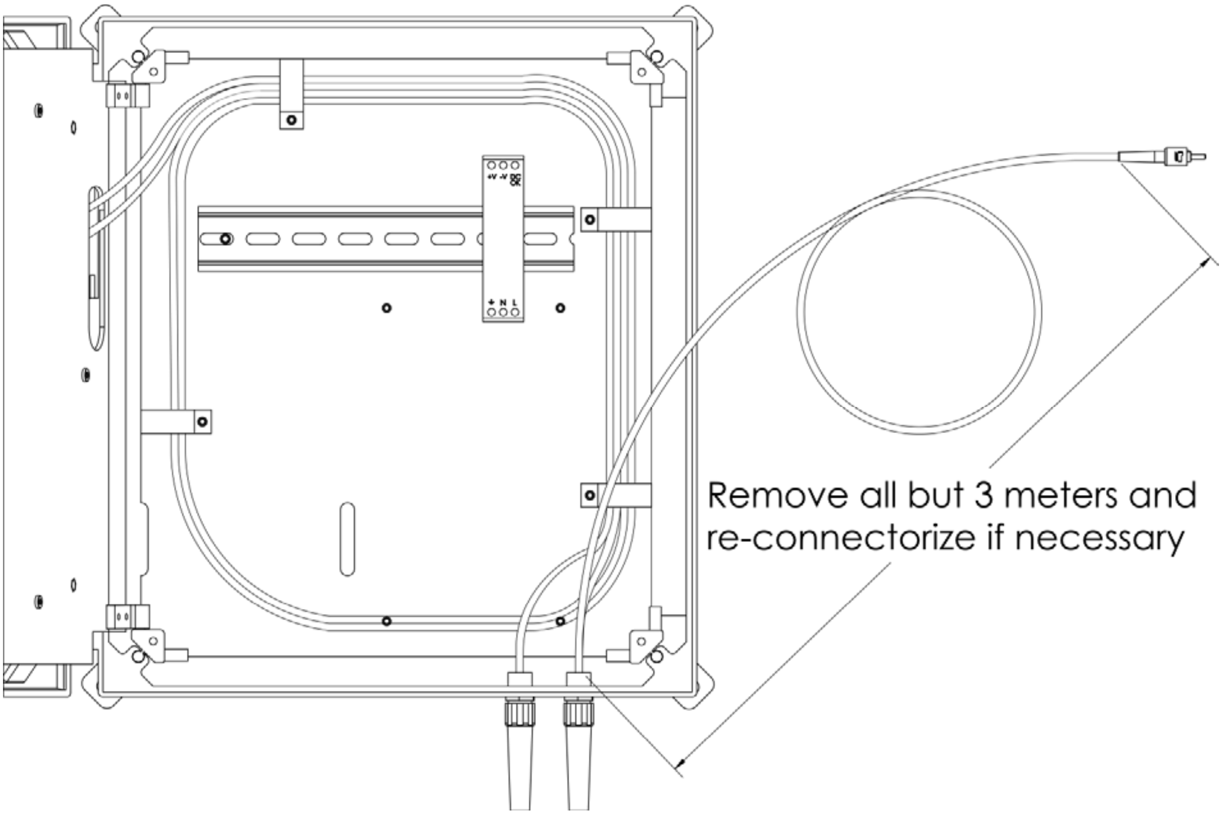


Figure 4-3. Removing excess fiber at the APU enclosure.

Installing the APU

- **Connect one end of the sensing cable to the** Output **port of the APU.**
- **Connect the other end of the sensing cable to the** Input **port of the APU.**

The APU is mounted in an IP enclosure, which is designed to be waterproof and resistant to weather extremes. The APU is rated to 70° C (131° F). However, it is recommended (when possible) to locate the APU indoors or in a shaded area when installed in hot climates. When locating the APU away from the protected perimeter, ensure that the sensing cable that stretches between the APU and the perimeter cannot be disturbed so as to cause alarms.

Mounting the enclosure

The IP Enclosure is IP66 rated, measures 40 cm x 40 cm x 20 cm and made of powder coated steel. Four holes on the back of the enclosure allow for mounting. In all cases, mount the APU so it is free of vibration, which can cause nuisance alarms.

Wiring the APU

Whenever the APU is mounted in an enclosure there must be holes through which the conduit/sensor enters and exits. Once the conduit/sensor is fed through these openings you should seal them to prevent exposing the APU to dirt or moisture. The optical cables are secured as they are passed into the enclosure by routing them through the strain relief feed-through

With the IP enclosure, the optical cables must be routed through the strain reliefs along the back plate to prevent stress at either the input or output entryways and connectors of the APU. The use of similar strain reliefs is recommended for any enclosure in which the APU is mounted.

Ensure the 2 in (5 cm) minimum radius is observed while routing optical cable to the APU.

Although the conduit entryways are generally drilled into the bottom of the IP enclosure as shown in figure 14, they may be placed anywhere the application requires.

Once the optical connections have been made, wire the APU for electrical power and relay connections. These connectors are located on the right-hand side of the APU.

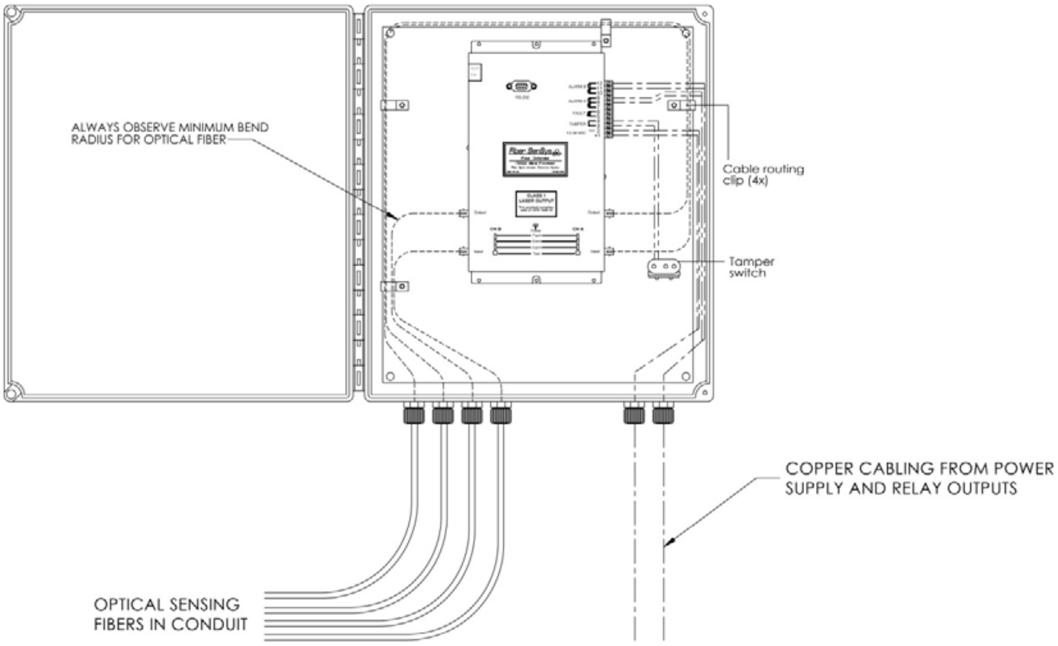


Figure 14. Wiring the APU.

It is recommended that power leads and relay leads be routed separately through the enclosure.

Note:

There may be a significant DC voltage drop in smaller diameter wiring. Ensure the input voltage at pin 1 is at least 12 VDC following installation, with the APU powered up.

To increase the security of the installation, it is recommended that either series or parallel resistors (known as supervisory resistors) be added to the relay wiring as necessary. This ensures that a closed contact condition cannot be simulated by shorting the external relay contact leads, and that an open contact condition cannot be simulated by cutting them or removing power. Install these resistors inside the IP enclosure as close to the terminal connector pins of the APU as possible.

If the supply voltage fails, or the optical fiber is cut or disconnected, the fault relay contacts open, the normally closed alarm relay contacts open, and the normally open alarm contacts close.

As a final step in the wiring procedure, connect the leads of the tamper switch to the tamper terminals on the APU (pins 3 and 4).

Adding supervisory resistors

Adding a series resistor to the normally closed alarm relay contacts ensures a closed-contact condition cannot be simulated by shorting the external alarm relay contact lead.
Adding a parallel resistor to the normally open alarm relay contacts ensures an open-contact condition cannot be simulated by cutting the external alarm relay contact leads.
With the Rapid Redfiber system properly installed, it is now ready for calibration.

7. Calibration

Before the system can be tuned to maximize Probability of Detection (PD) while minimizing nuisance alarms, the APU needs to be calibrated to compensate for the optical loss of the sensing fiber installation. Connect RS-232 communication between the APU and a laptop. The APU has a standard DB-9 connector, located on the front of the APU as shown below:

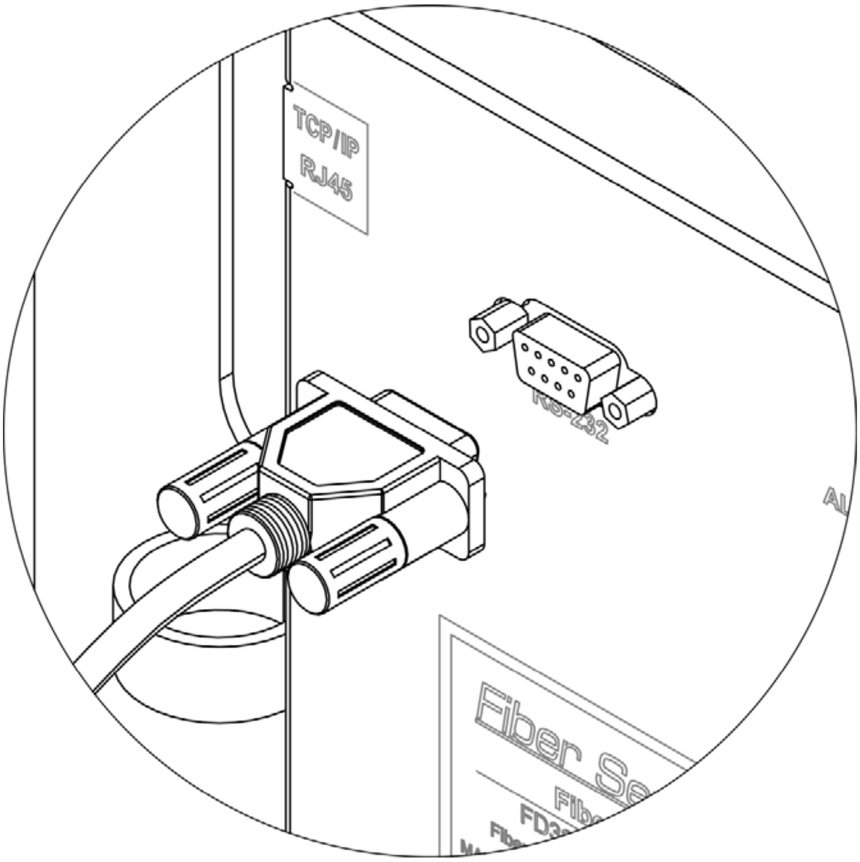


Figure 5-1. Connecting RS-232 communication to the APU.

Insert the CD and install FD322 Tuning Software on the laptop. For detailed calibration instructions, watch the training video: **TM-ENS-004E-FD322 Training-Cal & Tuning** located on the CD. This video gives detailed information and step by step instruction on the calibration and tuning process for the **FD322 APU**.

The system tuning software is found on the CD that is included with the APU. The installation disk contains:

- Setup.exe
- Install.msi
- Image (folder)
- User's manual
- Printable mounting template

Installation can be performed either by running SETUP.EXE or manually by copying the contents of the IMAGE folder to the location of your choice on your computer's hard drive. For manual installation you must create your own start menu entries and shortcuts.

Automatic Installation

Run SETUP.EXE. The default installation path is C:\Program Files\Fiber SenSys\FD322 Tuning SW. This program writes data to a folder located within the program folder.

If the computer is running User Account Control (Vista, Windows 7) the program will be prevented from writing data to this folder, so you must specify a location for the program that is not protected. Generally this means a location not under C:\Program Files. It is also possible to disable User Account Control.

Manual Installation

For manual installation, simply copy the contents of the IMAGE folder to a location on the hard drive. To run the program, double-click FD322TuningSw.exe. No other configuration is required, however you may wish to create a shortcut or start menu entry to facilitate launching the program.

The same issues regarding User Account Control discussed above apply to manual installations.

Using the FD322 tuning software

System calibration depends strongly on the quality of the fence on which the sensor is installed, including things such as the fence tension and overall condition. Consequently, the system can only be properly calibrated after installing the sensor on the fence and connecting it to the APU. Additionally, since each zone is on a physically distinct part of the fence, each zone must be calibrated and tested separately.

To begin using the system tuning software, connect the APU to a PC using a nine-pin RS-232 cable, and then launch the tuning software from the PC.

Note:

If the PC does not have an RS-232 port, a USB/RS-232 converter must be used. Fiber SenSys sells an optional converter if needed.

The first step is to establish communication between the system tuning software and the APU by selecting the proper serial port. Do this by clicking on the upper left-hand tab (labeled **Serial Port**), select the appropriate Com Port, click **Connect to Com Port** and then click **Close**.

Once the system is fully installed and communication is established between the APU and the tuning software, the system can be calibrated and tested.

Calibration begins by checking system loss, adjusting the sensitivity, then making adjustments to other system parameters as necessary to ensure the APU operates at top effectiveness. After each adjustment is made, the system should be tested at length to verify performance.

Calibrating system loss

System loss is a measure of the optical loss in the fiber-optic sensor, including the loss due to connectors and any **breaks** or tight bends. The system automatically adjusts its gain every time you measure the loss, up to a loss of 6 dB. If the system loss exceeds 6 dB, make any repairs necessary to reduce the loss to below that threshold.

To measure loss, select **Terminal** mode and then type **CALIB**. Type **ML** and, when **prompted**, type **Y**. This places the APU in the loss calibration mode and the following prompt appears:

Cha Loss(dB)= xxx@ mm/dd/yy hh:mm

This prompt lists the optical loss along with the date and time it was measured. To measure the current loss, simply shake the sensing cable vigorously for about ten seconds and then (within about two seconds after shaking the fiber) press the **Test** button for the correct zone (channel).

After pressing the **Test** button, the status line changes to read:

Cha Loss(dB)= xxx SAVED @ mm/dd/yy hh:mm

The word **SAVED** indicates that the system has been successfully calibrated and the new loss setting (**xxx**) is displayed along with the current date/time.

Repeat this procedure two or three times, ensuring that the loss measurement does not change by more than ±1 dB, and that the loss does not exceed 6 dB. Once the system loss has been calibrated for channel A the same procedure is used to calibrate channel B.

If the loss consistently measures higher than 6dB you can use a test cable, that is known to be good, to determine if the excess loss is caused by a damaged APU or a damaged sensing cable. To do this, connect the test cable directly between the **Input** and **Output** ports on the APU and then follow the process just described (using **Terminal** mode and **CALIB**) for measuring loss. If the loss is still high, refer to the trouble-shooting section of this manual

Tuning the zones

To set the tuning parameters, select the APU parameter editor in the Modes tab (see figure 15). The tuning software defaults to channel A. If you want to tune channel B, click the button that’s labeled “Switch Channels” (located on the right side of the display, in the “Process” bar). Once the proper channel is displayed above the “Switch Channels” button, click the button labeled “Receive” to load the current tuning parameters from the APU.

The header in the main body of the APU parameter editor shows the model number, serial number, manufactured date, and firmware. Below the header are the tuning parameters that are set in order to tune the APU. Change the tuning parameters as desired, but make certain not to select values outside the limits shown on the screen.

No data is written to the APU until the “Send” button is clicked. Closing the application, switching channels, or any other action that takes you away from the parameter editor, without first pressing the “Send” button, will not update the tuning parameters in the APU.

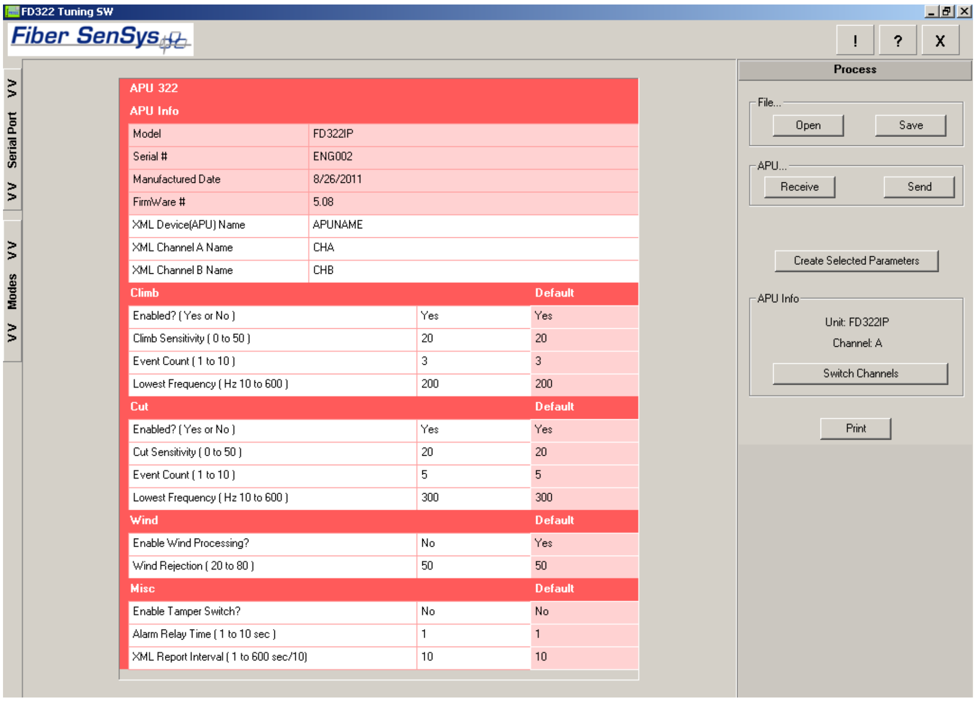


Figure 15. Screenshot showing the APU parameter editor.

In addition to receiving/sending tuning parameters, and switching from one channel (zone) to another, buttons in the "Process" bar can also be used for opening/saving spectral files.

The APU has independent tuning parameters that can be adjusted to detect an intruder cutting the fence or climbing over it. For both the cut and climb processors, the available tuning parameters are shown in the following table.

Table 3. Tuning Parameters

Parameter	Function
Enabled	Turns the corresponding processor on or off. Note: turning off both processors will disable the APU.
Sensitivity	Adjusts the overall sensitivity
Event count	Changes the number of “events” that must be generated to trigger an “alarm.”
Lowest frequency	Defines a low-frequency threshold. Sensor signal below the low-frequency threshold is not used by the algorithms when detecting events/alarms.

Sensitivity

Adjusting the sensitivity of either the cut or the climb processor raises or lowers the overall sensitivity of that processor. Although raising the sensitivity level increases the likelihood of detecting an intruder, it also makes it more likely that something such as wind or animals might generate a nuisance alarm. When setting the sensitivity it is necessary to strike a balance so that the processor is sensitive enough to detect the sort of intrusions you are looking for, but not so sensitive that it triggers alarms from local nuisances. For these reasons, the sensitivity setting can only be determined through adjustment and subsequent system testing. Generally the processor sensitivity should be adjusted for the minimum value that adequately detects a simulated intruder, ensuring the system is no more sensitive than necessary.

Event count

One of the best ways to differentiate valid threats from nuisances is by the number of times a signal is generated in a given period of time. Generally, a nuisance such as an animal or tree branch doesn’t make consistent disturbances as an intruder does.

The event count specifies the number of times an event must occur, within a specific amount of time, before the APU generates an alarm. For the event counter to increment, one event must be followed by a second event within five seconds, otherwise the event counter resets. In other words, if the event counter is set for three, this means at least three events must occur, each no more than five seconds apart for a maximum total time of ten seconds between the first event and the third event, in order to generate an alarm.

Lowest frequency

In addition to sensitivity and event count, another tool for differentiating between nuisance alarms and real intruders is frequency-domain filtering using the Lowest Frequency parameter.

The APU algorithms are designed to ignore all signals that occur at frequencies lower than the Lowest Frequency setting. This can help distinguish between real threats and nuisances because the sources of many nuisances have acoustic characteristics that are different from those of real threats. For example, wind noise tends to cause low-frequency signals. On the other hand, cutting and climbing the fence generate higher-frequency signals.

By setting the Lowest Frequency parameter properly, the system can be tuned to ignore many sources of nuisance alarms while maintaining good sensitivity to actual intrusions.

The system tuning software provides a powerful tool to help visualize the frequency content of different sensor signals, called Real Time, in the Modes section (see figure 16).

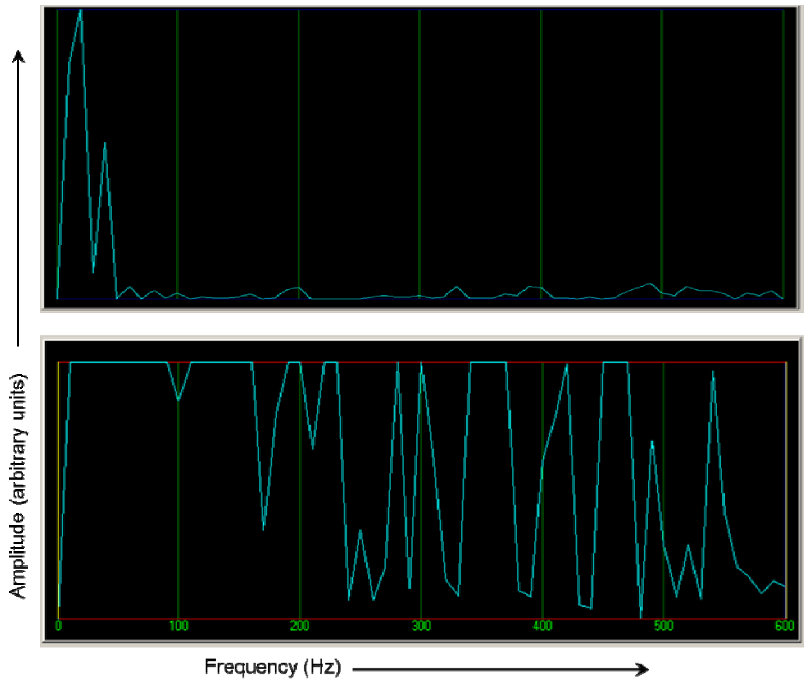


Figure 16. Signal with low frequency content (top) caused by wind, and a signal with high-frequency content (bottom) caused by cutting the fence fabric.

Wind rejection

The APU has built-in algorithms that reduce the probability of wind-generated nuisance alarms. Increase or decrease the effect of the wind-rejection algorithm by adjusting the Wind Rejection parameter.

The wind-rejection algorithm works by effectively reducing the system sensitivity as wind speed (inferred from sensor signals) increases. As wind noise increases, the APU automatically lowers the processor sensitivity value in accordance with the wind rejection factor; a higher wind-rejection setting means a greater reduction in sensitivity for a given amount of wind-generated noise (see figure 17). Experimentation on the installed system is necessary to determine the proper wind-rejection parameter for a given site.

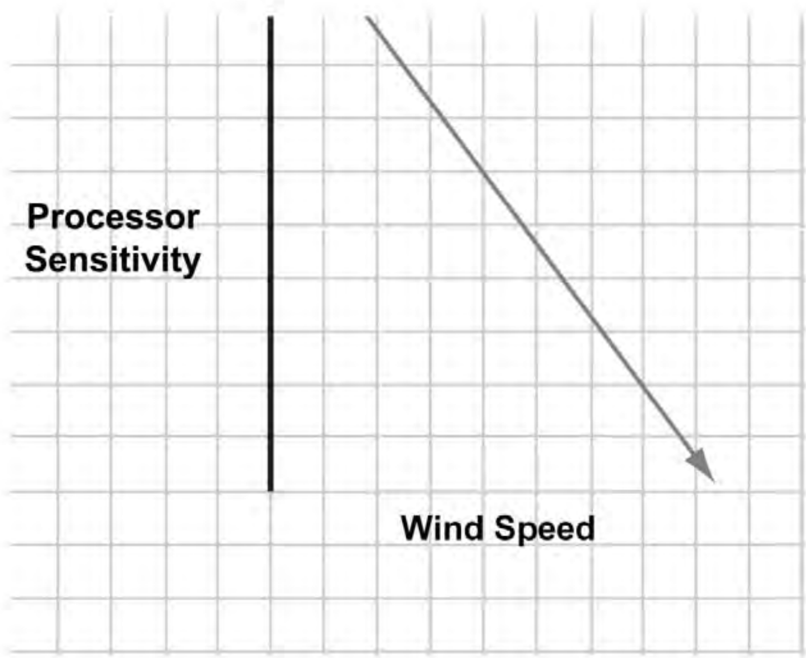


Figure 17. The wind-rejection algorithm helps to avoid wind-related nuisance alarms by reducing the sensitivity as the wind increases.

System testing

As the last step of the installation /calibration process, test the system to determine its effectiveness.

Zone detection

System testing begins with reviewing the list of threats against the site. To determine the probability of detection (PD) for those threats, begin by simulating each threat.

Perform each simulation 20 times and monitor the response of the APU. For example, to determine the PD of an intruder climbing over the fence, have a volunteer climb over the fence in the same manner 20 times. Don't tell the volunteer if an alarm is being generated to prevent them from using that knowledge to alter their simulated intrusion.

Record the number of climbs that produce an alarm, and then divide this number by 20. Multiply the result by 100 to calculate the PD. If the PD is too low, adjust the sensitivity, event count, and low frequency parameters as necessary until the PD reaches the desired level (refer to the previous sections that discuss Sensitivity, Wind Rejection and Event discussed earlier in this chapter). Repeat this test for each installed zone/APU and record the results in your test log.

Tamper test

The tamper feature on APUs installed in the IP enclosures must also be tested. Perform this test for each APU in an IP enclosure.

1. Verify that all alarms and alarm-indicating LEDs are reset.
2. Proceed to the first IP enclosure to be tested. Open the door and observe the tamper alarm at the APU (if the APU is connected to annunciator equipment, verify that the alarm registers there, too). The alarm should occur before a gap of more than 1/8 in (3.2 mm) exists between the door and the enclosure.
3. Record the results in your test log.
4. Close and latch the IP enclosure door.

Fault test

This test verifies that the APU registers a fault condition when the optical sensor is broken. This test should be performed for each APU.

1. If the APU is mounted in an IP enclosure, open the enclosure door and set the tamper switch to the maintenance position by pulling on the actuator rod.

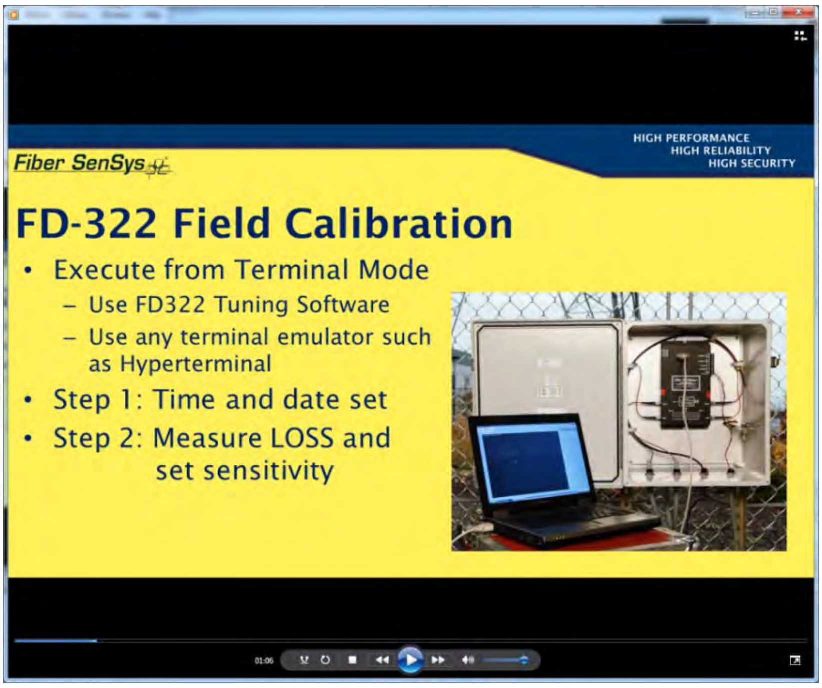
2. Ensure that no fault-, tamper- nor alarm-indicating LED is lit on the APU.

3. Disconnect the optical cable from the APU input connector. Verify that a fault alarm is generated.

4. Record the results in your test log.

5. Reconnect the cable and verify that the fault clears.

Watch TM-ENS-004E-FD322 Training-Cal & Tuning video for detailed instructions on how to perform APU calibration and tuning



8-System Specification

	RRF-APU	RRF-APU-PoE
Application	Fence	
Zones	2 zones of max 200m each 2 zones	
Sensor	Passive, optical fibre, resistant to EMI and corrosion	
Installation	The sensing fibre –optic cable can be attached directly to the fence using wire ties	
Length of sensing cable delivered	Refer to the sensing cable kits listed above	
APU electrical power	Input 12-24 Volts Power: 3 Watts	PoE(IEEE802.3af/at compliant)
Light source	Laser	
Communications	RS-232 serial communications, IP/XML.	RS-232 serial communications, IP/XML, IPv4, ARP, UDP, TCP, ICMP, HTTP
Alarm output	• Fault relay – Normally Closed (NC) • Alarm relay – Normally Open or Normally Closed (NO/NC)	REDWALL Event Code
Optical connectors	ST	
Loss calibration	Automatic	
Tuning parameters	• Sensitivity for cuts and climbing • Number of events setting before alarming (for cuts and climbing) • Low-frequency cutoff (for cuts and climbing) • Wind rejection • Tamper (enable/disable) • Alarm relay time	

Parameter	Specification
Application	**Perimeter fence**
Sensor	• **Multimode optical fiber cable** • **Passive, inert, intrinsically safe** • **Resistant to EMI and corrosion** • **-40 ˚C to +70˚C operating range (APU)** • **-40 °C to +85°C operating range (sensing cable)**
Installation	• **Sensing cable in conduit** • **Conduit attached to fence with wire ties** • **Loop-back zone configuration**
Number of zones per APU	**2**
Max. sensing cable per zone	**500 meters**
APU electrical power requirements	• **Input voltage: 12-24 volts DC** • **Power: 3 Watts (250 mA @ 12 VDC)**
Programming method	**RS-232 using PC**
Communications	**IP/XML**
Fault and alarm relays	**Contact ratings:** • **28 to 14 AWG** • **100 mA, 24 VDC non-inductive** **Relay defaults when the APU is in secured status:** • **Fault relay - Normally Closed (NC)** • **Alarm relay - Normally Open or Normally Closed (NO / NC)**
Light source	• **Type = laser** • **Average power = 2 mW max** • **Wavelength = 1310 nm** • **Class 1 laser**

Parameter	Specification
APU dimensions	• **Width = 5.6 in (14.3 cm)** • **Length = 10.1 in (25.7 cm)** • **Height = .94 in (2.4 cm)**
APU operating temperature	**-40 ˚C to +70˚C**
Humidity	**0 to 90%, non-condensing**
Optical connectors	**ST, PC polish**
Insensitive lead-in fiber	**No**
Regulatory compliance	**CE, FCC Part 15 Class B, RoHS**
Product compatibility	**Fiber Commander™**

OPTEX (EUROPE) LTD
EMEA HEADQUARTERS
www.optex-europe.com
Tel +44 (0) 1628 631000