Perimeter Protection Systems

Break-ins at remote broadcast facilities continue to rise. Materials thefts, such as copper, are particularly notable. Generally broadcasters have responded with defensive measures such as increased building security, building alarm systems, stronger locks and doors, physical barriers, perimeter fencing, lighting and video surveillance.

As buildings have become more secure the vulnerability of towers, transmission lines, power and ground systems has become the major weakness in facility security. In the not too distant past one major FCC enforcement issue was public safety fencing around transmission towers. Today an unfenced tower is likely to be relocated to a local scrap dealer and fenced towers are only slightly more secure.

The logical next step is to implement an active perimeter fence security system. Research has found that active perimeter security fence systems have been greatly improved detection of climb or cut events while eliminating wind and animal cause false events. Classic proximity detection systems are notorious for false animal induced events. Several new systems are based on fiber optic cable, which changes the light pattern transmitted within the cable. Digital signal processing techniques are then used to evaluate the result and discriminate between real cut and climb events and false alarm events like wind or animals. Several different kinds of systems are available.

- Copper based detection systems. These systems use copper conductors to provide proximity detection. A typical system would be based on a leaky coax on or near the fence. These kinds of systems are problematic in high RF environments such as broadcast facilities. These systems are excluded from consideration for this reason.
- Fiber loop detection systems. These systems operate very much like copper closed loop systems used inside buildings where opening a window or door will break the loop. The loop break will indicate the intrusion. These systems provide a simple open closed detection.
- Fiber mechanical trap loop systems. These systems are an enhanced closed fiber loop system. They use mechanical traps (Mouse Traps) to disrupt the closed loop.
- Fiber intelligent motion loop systems. These systems transmit light through a fiber optic cable which is sensitive to motion and vibration which modulate the light beam. The detected modulation due to attempting to cut or climb the fence activates the alarm.
- Fiber intelligent motion reflectometery systems. These systems detect light reflections in a fiber optic cable which is sensitive to motion and vibration which cause reflections of the light beam due to attempting to cut or climb the fence. This system does not require the cable be looped back otherwise provides identical functionality to the motion sensitive closed loop system.

Analysis criteria

The perimeter is the very first line of defense in a comprehensive security strategy. In order to create an effective outdoor perimeter security system while evaluating the various technologies in a broadcast environment, an analysis should be conducted of the system suitability in terms of:

- Probability of entry detection.
- Vulnerability to defeat.
- Resistance to false alarms from the surrounding environment/ local wildlife.
- Day to day disruption to normal operations. Does the system make normal operations more difficult? Is the system hard to manage?
- Visual deterrent needs of the site. Entry detection VS entry barrier.
- Cost of implementation / operation.

A summary overview of each technology is listed below.

Fiber loop detection systems

The fiber loop system is the least expensive of the fiber technologies. Detection depends on the penetration of the perimeter causing a breaking or cutting the fiber cable, broken loop detection. While the fiber optic cable is difficult to bypass it is relatively easy to avoid cutting the cable to circumvent detection. Climbing the fence or cutting the fence fabric while leaving the fiber cable intact will not be detected. Increased fiber cable coverage of fence fabric will make avoidance more difficult. Effectiveness of this system can be increased using a covert installation to reduce evasion of the system. False alarms however are unlikely.

Use of this system is difficult when doors, covers and gates are involved. Some form of weather resistant quick disconnect would be required for this situation. Further discussion at Implementation.

Fiber mechanical trap loop systems

This system is similar to the fiber loop system and uses mechanical climb detectors to detect and locate climb attempts as well as breaking or cutting the fiber cable. Climbing the fence will be detected but is subject to false alarms from wind or animals. The system cannot be made covert to reduce evasion of the system. False alarms however are a problem. Use of this system is more difficult when doors, covers and gates are involved. The mechanical traps which require manual reset are the weak point of this system. Further discussion in the Implementation section.

Fiber intelligent motion loop systems

These systems transmit light through a fiber optic cable that is sensitive to motion and vibration which modulates the light beam. The light is transmitted through the cable and detected at the far end. (looped back to the transmitter.)

The detected modulation is analyzed by digital signal processing to detect intruders attempting to cut or climb the barrier, while ignoring the effects of environmental noise, animal and natural activity such as wind. They provide immunity to environmental alarms while still detecting the skilled intruder. These systems provide immunity to evasion with a minimum of disruption of normal activity.

The system can be installed covertly or signs used to create a barrier effect. Cost is relatively high.

Fiber intelligent motion reflectometery systems

These systems are functionally identical to the fiber intelligent motion loop systems except a detector is not required at the far end. This simplifies installation without compromising functionality.

Summary Chart

Technology	Detection	Vulnerability	False alarms	Operations	Deterrents	Cost
Fiber loop	Fair	Fair	Excellent	Problematic	Detection	Low
Fiber trap	Good	Good	Poor	Fair	Barrier	Medium
Fiber motion loop	Excellent	Excellent	Good-Excellent	Good-Excellent	Detection	High
Fiber motion reflectometery	Excellent	Excellent	Good-Excellent	Good-Excellent	Detection	High

Table 1, fiber systems comparison

Implementation

Barrier VS Apprehension

The implementation of a perimeter security system will depend on the objectives of the system. Building security systems are nearly exclusively implemented as a barrier to entry. That is the security alarm is a barrier to entry that, to the extent the intruder cares about detection, an intruder must circumvent to successfully gain access. Posted alarm permits, signs and audible alarms therefore become a part of the barrier to entry. Like locks and reinforced doors, if the system is circumvented all protection is lost.

It's worth noting here that deterrents and physical barriers are becoming less effective. Lights and security cameras are often ignored.

With a perimeter security system the potential exists to implement a more clandestine system. On the up side an intruder is less likely to attempt to circumvent the system increasing the potential for apprehension. The down side is potential damage during the response time. Note, a clandestine system can be converted to a barrier system with the inclusion of signage.

Monitoring

To be effective an entry alarm system must be monitored on a continuous basis. One drawback is the cry wolf syndrome. Any system which generates false or nuisance alarms will be ignored and ineffective. In fact generating repeat nuisance alarms would be a strategy to circumvent a security system although this would be unlikely for a theft of opportunity.

Problems of this nature can be handled by implementing zone dependent action. For example:

Fire Zone; Immediate notification of fire department followed by notification of station staff. Local audible alarm active.

Building Entry Zone; Notification of station staff. Followed by notification of police. Local audible alarm active.

Perimeter Zone; Notification of station staff. Followed by notification of on call private security. Local audible alarm inactive.

The last suggestion, the use of a private security firm, is based on four reasons. First, excessive false alarms will result in no police response. Second, most copper thieves are meth addicted and likely to be violent. Third, intruders are becoming better equipped. Bolt cutters (Mt. Scott) and weapons (Clear Channel) are becoming more the norm. Fourth, the cost of an on call security firm charged on a per call basis is likely to be cost effective. Private security firms are better equipped to deal with violent intruders than station staff.

Gates, Access and Alarm Implementation

Gates and access represent special requirements for a perimeter security system. The requirement is to allow staff and tenant access to the property without alarms and easily allow enabling the alarm system when leaving the area or zone. When an access gate operator (powered gate) is in use, activating the gate with an access code can be used to bypass or silence the alarm event for entry. Otherwise an alternative means of on access authentication is required.

Once entry to the building and alarm system deactivation is completed, secondary doors and tower access gates may be opened without alarms. Intelligent motion detecting fiber cable systems are transparently placed on the face of the gate and do not require special considerations.

However broken loop detection systems do require special considerations. In order to provide security to a gate opening, the open gate must break or open the loop. To date I have not found any hardware that will allow opening the gate and re-establishing the optical connection upon closing. In theory such products should exist and would be necessary for gates when a closed loop system is used. Additional research is necessary to find hardware to implement this technology.

- **Security Cameras**

In this evaluation I have not discussed security cameras. Short of continuous monitoring, cameras provide no real detection benefit. They do provide some deterrent value, however only to the extent that the intruder is apprehended and the video either aids apprehension or conviction. Cameras can be circumvented using a simple ski mask.

- **Cable trays and open raceways**

The RF and control cables at some stations are contained in elevated cable trays or open raceways that traverse unsecured areas. Fiber cable can intermingled along with the RF and control cables to detect tampering. While this approach may not prevent initial damage, early detection will prevent extensive damage.

Conclusions

In this evaluation I have excluded simple proximity detection systems and copper based systems. The former due to nuisance alarms and the latter due to RF interference.

- **Simple Fiber Loop Systems**

These systems are cost attractive, particularly for small remote fencing such as remote (from the transmitter building) tower bases where lower levels of detection (no climb protection) may be acceptable. A solution for the access gate problem is required to use this solution.

- **Mechanical Trap Systems**

Mechanical trap systems are unacceptable due to false trips and the need to manually reset the trap detectors.

- **Intelligent Fiber Motion Systems, loop and reflectometery**

While more costly, these systems are preferred for their insensitivity to false alarms, ability to detect many different types of penetration attempts, resistance to evasion, and a minimum of disruption of normal facility activity.

Appendix

Fiber security vendors

Smarter Security Systems, Ltd.
1515 S. Capital of Texas Highway #210
Austin, Texas
http://www.smartersecurity.com
Mark Ellsworth
(800) 943-0043
Mark@smartersecurity.com

Fiber SenSys, LLC.
2925 NW Aloclek Dr Suite 130
Hillsboro, OR 97124, USA
http://www.compudyne.com/ap/fiber_sensys/default.asp
Robert Hartley
503 692-4430
robert.hartley@fibersensys.com

Additional Resources

SmarterFence Datasheet.pdf
SmarterFence Installation Manual.pdf
FD332_specsheet.pdf
FD220p_specsheet.pdf
Fence Construction Application Note.pdf
FiberDefender_brochure_C.pdf

SmarterFence™
The Intelligent Fence-Mounted Solution

Fiber Perimeter Systems

SMARTERFENCE- FENCE SENSOR

SmarterFence is specifically designed to provide reliable, early warning of intruders by detecting any attempt to cut, climb, or crawl under perimeter fences.

SmarterFence Fence Sensor System consists of a processor module that transmits a laser beam through a fiber optic sensor cable that is sensitive to a wide range of vibration, flexing, compression, and cutting, while at the same time minimizing nuisance alarms from natural causes. Since SmarterFence relies on light as the detection method, it is intrinsically safe as it does not radiate signals, nor is it susceptible to electrical interference. This makes it particularly suitable for use in hazardous industrial locations where there is risk of fire or explosion.

SmarterFence cable is very easy to install and field repair or replacement of a damaged section of cable is remarkably straightforward, using a simple but effective splice connector.

FEATURES AND BENEFITS

- Protects fences, gates, walls, roofing, and covert buried applications
- Automatic environmental compensation minimizes nuisance alarms
- Performance is unaffected by lightning or other electromagnetic interference
- Provides cost-effective linear protection for zones up to 3000 feet in length
- Easy to set-up and install without test equipment
- Operating parameters can be remotely adjusted using optional software
- Integral data collection when used with SmarterFence Security Management Software

SMARTERFENCE- BURIED SENSOR

SmarterFence Buried Sensor provides the ideal solution for buried applications in sterile areas or over open ground where effective detection of intruders is essential. It exhibits all of the unique fiber-optic benefits of the SmarterFence - Fence Sensor system.

SmarterFence Buried Sensor is pressure sensitive and is suitable for covert application under grass, gravel or soil and can easily be installed in zones of various lengths, widths, and shapes. Once installed, SmarterFence Buried Sensor is invisible and cannot be detected using metal locators or other detection equipment.

SmarterFence Buried Sensor provides high operational reliability and a high probability of intruder detection despite varying ground conditions and humidity.

KEY BENEFITS

SMARTERFENCE FENCE SENSOR

- -MINIMIZES NUISANCE ALARMS
- -FIELD-PROVEN RELIABILITY
- -SENSITIVE TO CUT, CLIMB AND A WIDE SPECTRUM OF VIBRATIONS
- -EASY TO INSTALL AND MAINTENANCE-FREE IN OPERATION
- -SUITABLE FOR PROTECTION OF A WIDE RANGE OF FENCE FABRICS AND GATES
- -CAN ALSO BE USED TO PROTECT WALLS AND OTHER BUILDING FABRICS, EVEN ROOFS
- -SECURE FROM TAP OR TAMPER
- -EASY TO INSTALL AND MAINTENANCE-FREE IN OPERATION
- -FIELD-BASED REPAIRS CAN BE MADE USING SPLICE CONNECTOR

SMARTERFENCE BURIED SENSOR

- -PRESSURE SENSOR OFFERS A HIGH PROBABILITY OF DETECTION
- -FIELD-PROVEN RELIABILITY OVER VARYING GROUND CONDITIONS
- -UNDETECTABLE BY METAL DETECTORS
- -EASY TO INSTALL AND MAINTENANCE-FREE IN OPERATION
- -FIELD-BASED REPAIRS CAN BE MADE USING SPLICE CONNECTOR

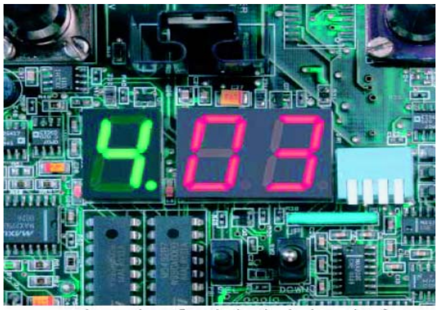
Smarter® Security Systems

SmarterFence™
The Intelligent Fence-Mounted Solution

SMARTERFENCE PROCESSOR MODULE

SmarterFence Processor is designed for use with both SmarterFence's proprietary fence-mounted and buried sensor cables.

Disturbance of the fiber-optic sensor cable is detected in the SmarterFence Processor and analyzed using a micro-controller with digital signal processor (DSP). When a disturbance exceeds pre-set conditions, an alarm will be generated. Automatic environmental compensation algorithms simultaneously ensure the highest probability of detection while also ensuring a minimum of nuisance alarms from natural causes.



settings can be configured using the simple user interface

SmarterFence Processor is factory set to enable rapid installation and commissioning. Application specific set-up parameters can be adjusted in the field using built-in switches and a LED display. If required, SmarterFence Processor can also be configured and adjusted remotely using the integral serial communications ports and optional software tools.

SmarterFence Processor is especially useful for integration with third party data collection and alarm management systems. It provides facilities for external alarm threshold adjustment as well as additional input/output for connection of sensors or control devices.

TECHNICAL SPECIFICATIONS

POWER REQUIREMENT

11.0 - 14.0 V DC @ 300mA.

PROCESSOR

High Performance micro-controller with integral digital signal processor (DSP) and Analog-to-Digital (A to D) converter.

SENSOR CABLE AND CONNECTIONS

The processor is designed for use with SmarterFence sensor cables.

METHOD OF DETECTION

Laser diode transmitter with optical interference pattern detection using photo diode receiver.

ALARM OUTPUT RELAY

Up to 1A @ 12 V DC.

ANCILLARY OUTPUTS (OPEN COLLECTOR)

Two open collector outputs with a maximum rating of 100mA @ 24V DC.

STATUS / DIGITAL INPUTS:

Three tamper protected status inputs are available which may be derived from switches or relay contacts, open collectors or CMOS / TTL level digital signal. The digital signal inputs provide the means by which external equipment may control the unit's auto-threshold values.

SERIAL COMMUNICATIONS PORTS

One isolated RS232 / RS485 serial port for alarm transmission, remote set-up or diagnostics. One non-isolated RS232 serial port for local high level diagnostics.

INSTALLATION, TEST AND DIAGNOSTIC AIDS:

The SmarterFence Processor Module incorporates a simple user interface comprising toggle switch, pushbutton and 3 seven-segment displays and allows all necessary settings to be easily configured without the need for specialist test equipment. A number of operation and diagnostic LED indicators are also included to facilitate test and commissioning. An audio monitor output is also available which may be used as an additional commissioning aid.

An optional PC based software package is available to enable local or remote, high level test, set-up and diagnostics.

CONNECTIONS

Electrical connections to the processor module are made via quick disconnect screw terminals. Serial communications is via a PCB mounted RJ 45 connector.

ENVIRONMENTAL SPECIFICATION

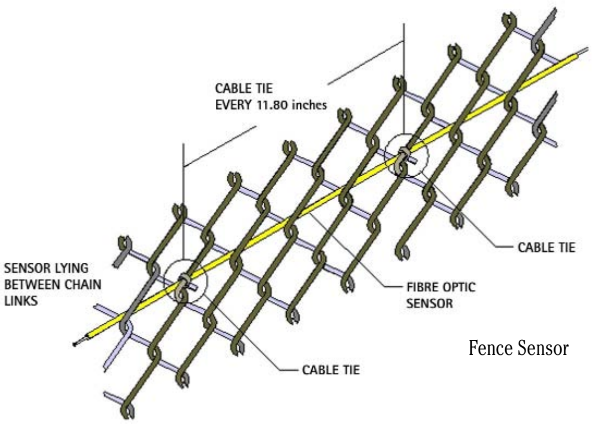
Operating Temperature Range: 14 degrees F to 158 degrees F.
Operating Humidity: Up to 95% at 104 degrees F non-condensing.
Storage Temperature Range: -40 degrees F to 158 degrees F.

ELECTROMAGNETIC COMPATIBILITY (EMC)

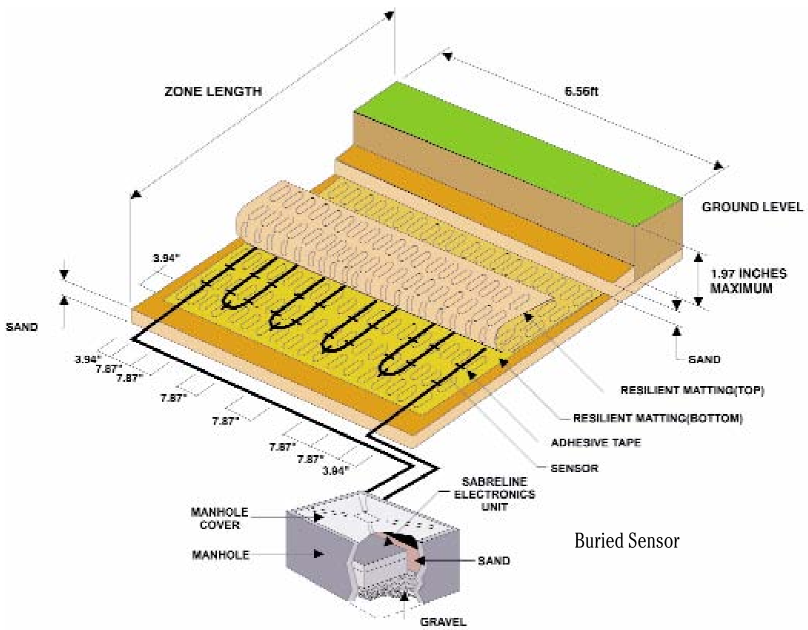
SmarterFence meets the requirements of EN55022:1998 and Low Voltage Directive 93/68/EEC.

DIMENSIONS

Printed Circuit Board: 6.22 inches x 4.37 inches. (158mm x 111mm)



Fence Sensor



Buried Sensor

IF YOU'RE UNWILLING TO COMPROMISE WHEN IT COMES TO SECURITY, please call us at 800.943.0043 to see how we might help you, or visit our web site www.smartersecurity.com for more information.

Smarter Security Systems

Smarter Security Systems

SmarterFence Perimeter Intrusion Detection System (PIDS) Installation and Commissioning Manual

SmarterFence™
The Intelligent Fence-Mounted Solution

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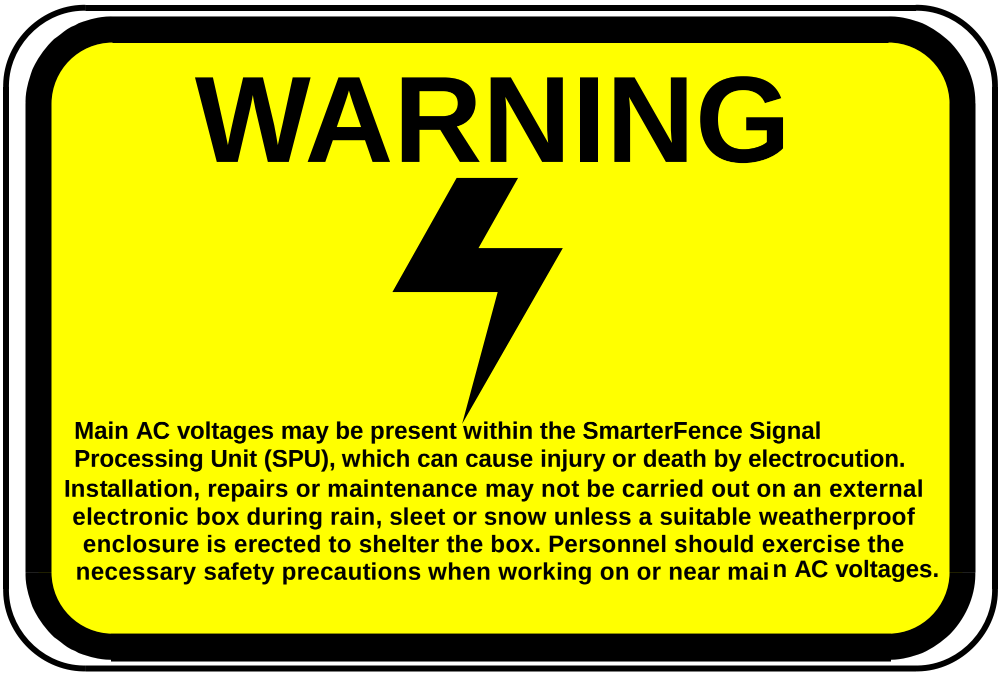
Safety Precautions



While every effort has gone into the accuracy and correctness of this manual, Smarter Security Systems Ltd. offer the manual as a guide only and cannot be held responsible for any specific problems experienced by an installer or user.

Note: It is important to be aware that, should it be viewed directly, the output from the laser diode could seriously damage your eyes.

Table of Contents

Section 1

Introduction

1.1 Overview

This manual provides details on how to commission and calibrate the SmarterFence Signal Processing Unit (SPU) as part of an above-ground Perimeter Intrusion Detection System (PIDS) for use on fences, walls, gates, barbed wire and barbed wire concertina. The SmarterFence system detects vibrations caused by disturbances. These disturbances also disturb the sensor cable in accordance with the magnitude and frequency of the disturbance created upon the physical barrier. This disturbance of the sensor cable is converted into electrical signals, which are then analyzed by the SmarterFence signal processing unit.

SmarterFence fiber optic sensor cable

The fiber optic sensor cable, which is highly sensitive to physical disturbances, is constructed with dual multi-mode 62.5/125 micron fiber optic wave guides, protected by a 4.8mm diameter loose tube, Kevlar reinforced outer jacket.

Figure 1-1 illustrates the layout of the fiber optic sensor cable used in a SmarterFence perimeter intrusion detection system:

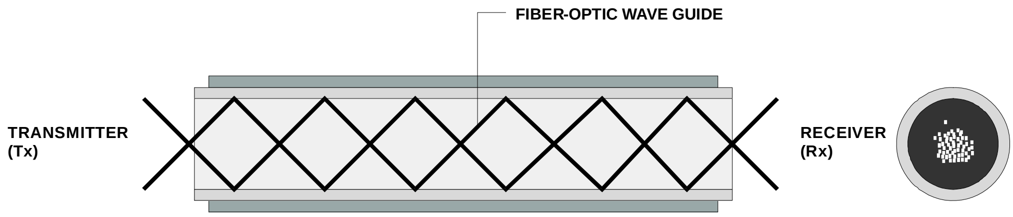


Figure 1-1: SmarterFence sensor cable

The sensor cable carries a light signal. Any disturbance of the sensor cable, as caused during an intrusion attempt, is detected by the signal processing unit. A volt-free contact output from this unit then signals an alarm state. Figure 1-2 illustrates a disturbed sensor cable:

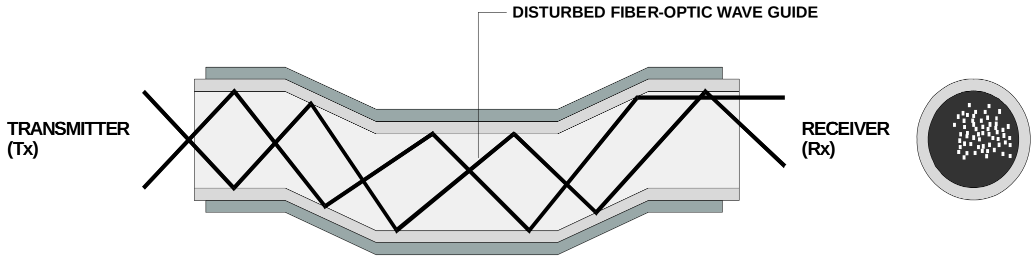


Figure 1-2: Disturbed SmarterFence sensor cable

Operating principles

The principles of operation of a SmarterFence perimeter intrusion detection system are as follows:

1. A laser diode (the transmitter in the signal processing unit) emits continuous patterned light waves into the sensor cable, as in Figure 1-1.
2. The light waves are trapped by the process of "Total Internal Reflection", which allows the light waves to appear at the receiver end of the sensor cable. The light waves appear as a speckled pattern of light and dark patches, called an " Optical Interference Pattern" or "Interferogramme".
3. If the sensor cable is disturbed, as in Figure 1-2, the pattern moves in amplitude and frequency, causing a redistribution of the light waves. This redistribution is detected by the photo-diode (the signal processing unit's PCB receiver).
4. The signal processing unit electronically processes the change in light pattern. A volt-free alarm contact is set when this change meets or exceeds a pre-set alarm threshold.

> **Note:**
> The SPU can be used for both types of system, selection of which is made via a Dual-In-Line (DIL) switch.

1.2 Documentation Conventions

Throughout the manual, the following conventions are used:

- Bulleted lists, such as this one, provide information
- Numbered lists provide sequential steps or hierarchial information

Smarter Security Systems, Ltd. strives to produce high quality documentation; however, we welcome your feedback and comments on the documents supplied. Please send your comments to the following:

sales@smartersecurity.com

Smarter Security Systems, Ltd. (or your supplier) will attempt to answer your queries.

This e-mail is for feedback on documentation only. If you have any technical questions, please address it to the following:

support@smartersecurity.com

You will receive a reply via e-mail.

> **Note:**
> When requesting technical support, ensure you provide the following information:
> Product Version Number
> The type of hardware you are using
> What happened and what you were doing when the problem occurred
> **How you tried to solve the problem**

1.3 Contacting Smarter Security Systems, Ltd.

There are a number of ways in which you can contact Smarter Security Systems, Ltd.:

1. By mail, at the following address:

   Smarter Security Systems, Ltd.
   1515 S Capital of Texas Hwy #210
   Austin, Texas 78746
   USA

2. By telephone, or fax, at the following numbers:

   Telephone 800-943-0043
   Fax 512-328-7280

3. Over the World Wide Web:

   Website www.smartersecurity.com

4. Technical Support, via e-mail or telephone:

   E-Mail – support@smartersecurity.com
   Telephone – 512-328-7277

5. Smarter Security's Marketing/Sales Team, via e-mail or telephone:

   E-Mail – sales@smartersecurity.com
   Telephone – 512-328-7277

1.4 Glossary of Terms

AC	Alternating Current
BTC	Barbed Tape Concertina
COM	Common
DIL	Dual In Line
DISP	Display
GND	Ground
IP	Input
LD	Laser Diode
LED	Light Emitting Diode
N/C	Normally Closed
N/O	Normally Open
mm	millimeter
m	meter
OP	Output
PB	PushButton
PC	Personal Computer
PD	Photo Detector
PDA	Photo Detector Amplifier
PIDS	Perimeter Intrusion Detection System
PSU	Power Supply Unit
SPU	Signal Processing Unit
SW	Switch
TAMP	Tamper
TB	Terminal Block
V	Volts
+ve	Positive
-ve	Negative

Section 2

Commissioning and Calibration

Pre-Installation

Installation of a Physical Barrier (SmarterFence) System requires a combination of the following materials (per zone):

- One Signal Processing Unit (SPU) Enclosure and associated equipment, e.g. Back-up Battery, PSU Monitor Board

> Note:
> **There are a number of build options available with SmarterFence. A full list can be found within the following manual, available from Smarter Security Systems, Ltd. or your supplier:**
> OPD00101 **- SmarterFence Fiber optic Perimeter Intrusion Detection System (PIDS) Technical Manual**

- One end-of-line splice box (used with Sensor Loop method only)

> Note:
> **There are a number of configuration methods available. For full details, refer to the relevant Application Guides listed below.**

- One pre-defined length of SmarterFence Fiber Optic Sensor Cable
- All necessary cable ties, glands etc. to secure the SmarterFence fiber optic sensor cable to the SPU enclosure and protected fabric. In higher security applications, stainless steel cable ties can be used, installed every third tie
- Any special equipment, e.g. Conduit Boxes/Conduit, for use on single and/or double gates/doors
- Relevant Applications Guide, from the following:
  - **INS00301** - Chain-Link Fence
  - **INS00401** - Welded Mesh Fence
  - **INS00501** - Building Fabrics
  - **INS00601** - Palisade Fence
  - **INS00701** - Barbed Wire/Barbed Tape Concertina (BTC)

Before starting installation, check the quantity and condition of all the components provided. If anything is missing or damaged, report the details to Smarter Security Systems, Ltd. or your supplier.

2.2 Physical Installation

2.2.1 Overview

The physical installation of a Physical Barrier SmarterFence system involves the following:

- Mounting the SPU Enclosure
- Attaching the fiber optic sensor cable to the fabric, e.g. Fence, Wall etc, along the length of the zone
- Mounting the Splice Boxes at the end of the fiber optic sensor cable (used with Fiber Loop method only). A method suitable for the type of fabric installed should be used

> Note:
> **There are a number of configuration methods available. For full details, refer to the relevant application guides.**

- Installing Junction Boxes (where required)
- Making of all electrical connections to the SPU
- Making of all fiber optic connections to the SPU and end of zone loop

> Note:
> **Termination procedures for SmarterFence are detailed in Appendix B.**

The installer should be competent, with knowledge of current SmarterFence installation techniques and have experience/knowledge of terminating fiber optic sensor cables. If in any doubt as to the correct procedure, reference should be made to the relevant manufacturer's installation instructions.

2.2.2 Mounting the SPU Enclosure

Prior to mounting, holes for the fiber optic sensor cables(s) and interconnection cable(s) may have to be drilled. These holes should be drilled at the base of the unit, adjacent to the SPU Terminal Blocks and with the Chassis Plate removed (so no damage is caused to the SPU electronics). The size of the holes should suit the type of cables/glands to be used in the installation.

The SPU enclosure should be mounted using the 4 holes in the corners of the unit. Figure 2-1 later illustrates a typical SPU enclosure. Opening the cover of the enclosure will provide access to the four mounting holes.

The SPU enclosure should, ideally, be mounted as follows:

- When protecting fences, it should be mounted directly onto a post approximately 3 feet (1 meter) from the fence, inside the protected area and preferably not obvious to potential intruders.

- When protecting building fabrics, mounted directly onto the protected (or adjoining) wall.

If the SPU enclosure needs to be located remotely to the fence or wall, de-sensitized cable may have to be used (dependent upon site specific criteria).

Figure 2-1 illustrates a dual SmarterFence SPU enclosure.

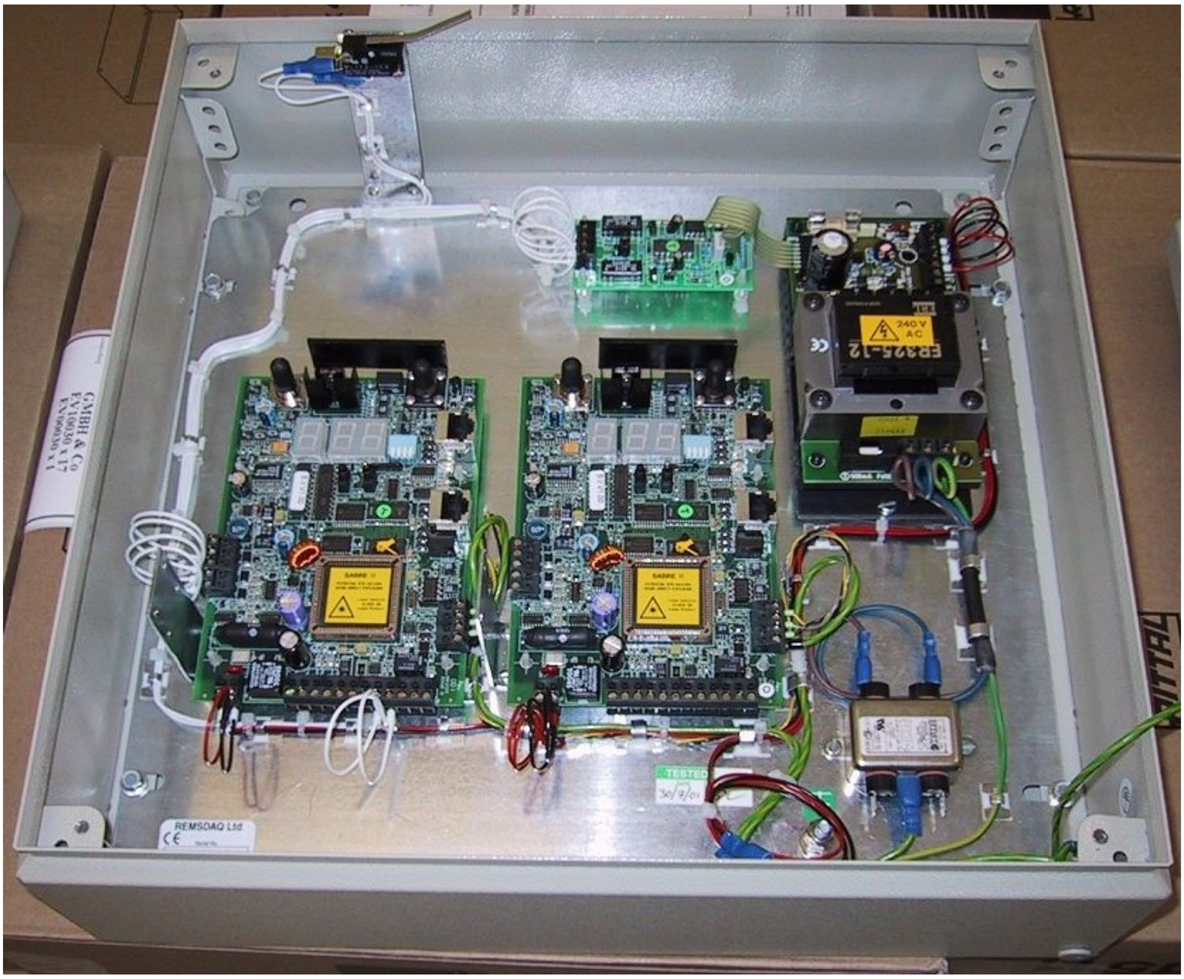


Figure 2-1: SmarterFence SPU Enclosure Arrangements (Dual SPU)

Note:
Depending upon build option, your SPU enclosure may look different to the one shown above.

2.2.3 Electrical Connections

Once installation is complete as per the relevant Application Guide, electrical connections to the SPU can be made, prior to commissioning and set-up. The following illustrates the wiring to be made for a typical SPU arrangement. Figure 2-2 later illustrates the locations of all terminal blocks.

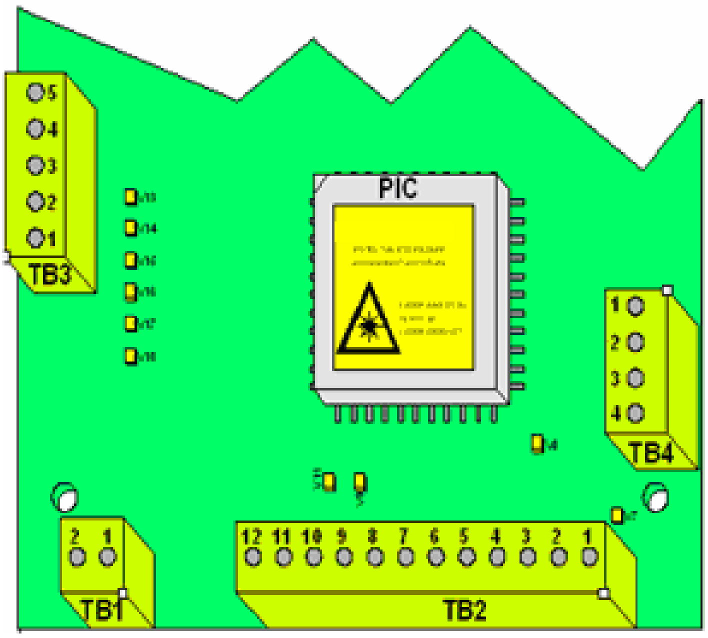


Figure 2-2: Location of terminal blocks TB1 through TB4

Terminal Block Wiring

TB1-1 - DC Supply -ve
TB1-2 - DC Supply +ve

TB2-1 - Relay Output N/C
TB2-2 - Relay Output COM
TB2-3 - Relay Output N/O

> Note:
> **These connections apply with no power applied to the SPU. However, when power is applied to the SPU, the Alarm Relay is energized, so the relay contacts change state, becoming:**
>
> TB2-1 **- Relay Output N/O**
>
> TB2-3 **- Relay Output N/C**

TB2-4 - Enclosure Tamper (TAMP)
TB2-5 - Enclosure Tamper (GND)
TB2-6 - Audio Output (AU1)
TB2-7 - Audio Output 0 Volts (AN0V)
TB2-8 - Audio Output (AU2)
TB2-9 - Open Collector Output (I/O1)
TB2-10 - Open Collector Output (GND)
TB2-11 - Open Collector Output (I/O2)
TB2-12 - Open Collector Output (GND)

TB3-1 - Tamper Protected Digital Input (IP1)
TB3-2 - Tamper Protected Digital Input (GND)
TB3-3 - Tamper Protected Digital Input (IP2)
TB3-4 - Tamper Protected Digital Input (GND)
TB3-5 - Tamper Protected Digital Input (IP3)

TB4-1 - Port 1 Isolated RS485 (-ve)
TB4-2 - Port 1 Isolated RS485 (+ve)
TB4-3 - Port 1 Isolated RS485 (0V)
TB4-4 - 0 Volts

In addition to the above wiring at the SPU, Tamper Loop Resistor Arrangements may need to be fitted at the input device end (if digital inputs are connected).

Figure 2-3 illustrates the resistor and contact layouts for both 2K/2K and 1K/1K resistor networks.

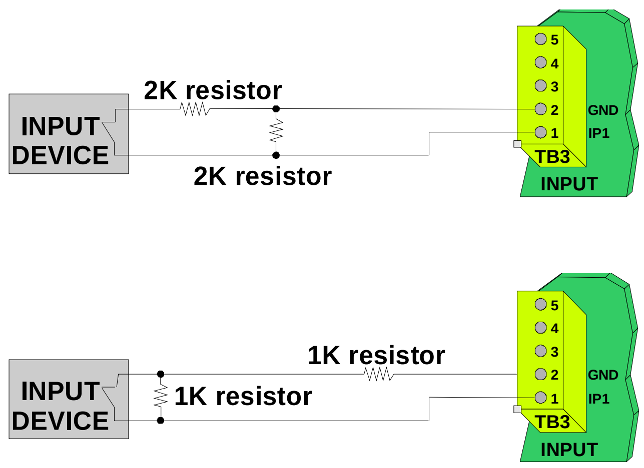


Figure 2-3: Tamper Loop Resistor Arrangements

Note
It is important that the resistor network is fitted across the input device, NOT **the SmarterFence Terminal Block.**

LEDs **V13**, **V14**, **V15**, **V16**, **V17** and **V18** indicate the status of the tamper loop. Table 2-1 illustrates the status of each LED for the different tamper loop conditions.

Resistors Fitted	State	Green LED (V13/V15/V17)	Red LED (V14/V16/V18)
1K/1K **OR** 2K/2K	Closed Contact	ON	OFF
1K/1K **OR** 2K/2K	Open Contact	OFF	OFF
-	Open Circuit	OFF	ON
-	Short Circuit	ON	ON

Table 2-1: Tamper Loop LED Status

Note**:**
The LEDs relate to the following tamper protected digital inputs:
V13/V14 **- Tamper Protected Digital Input 3**
V15/V16 **- Tamper Protected Digital Input 2**
V17/V18 **- Tamper Protected Digital Input 1**

2.3 Calibration

2.3.1 Overview

Once installation of the SmarterFence Perimeter Intrusion Detection System (PIDS) is complete, i.e. SPUs and fiber optic sensor cables are secured and all electrical connections have been made, the SmarterFence system can be functionally adjusted and set to the detection sensitivity and optimum operating levels required for each particular zone/system.

A Physical Barrier SmarterFence system can be commissioned in three ways:

- Via the User Interface Switches/Buttons on the SPU
- Local Configuration, via a Laptop PC connected to Serial Port 2 over non-isolated RS232 (Socket J1)
- Remote Configuration, via PC-StarWatch

Figure 2-4 overpage illustrates the layout of the SmarterFence SPU, showing locations of all commissioning components.

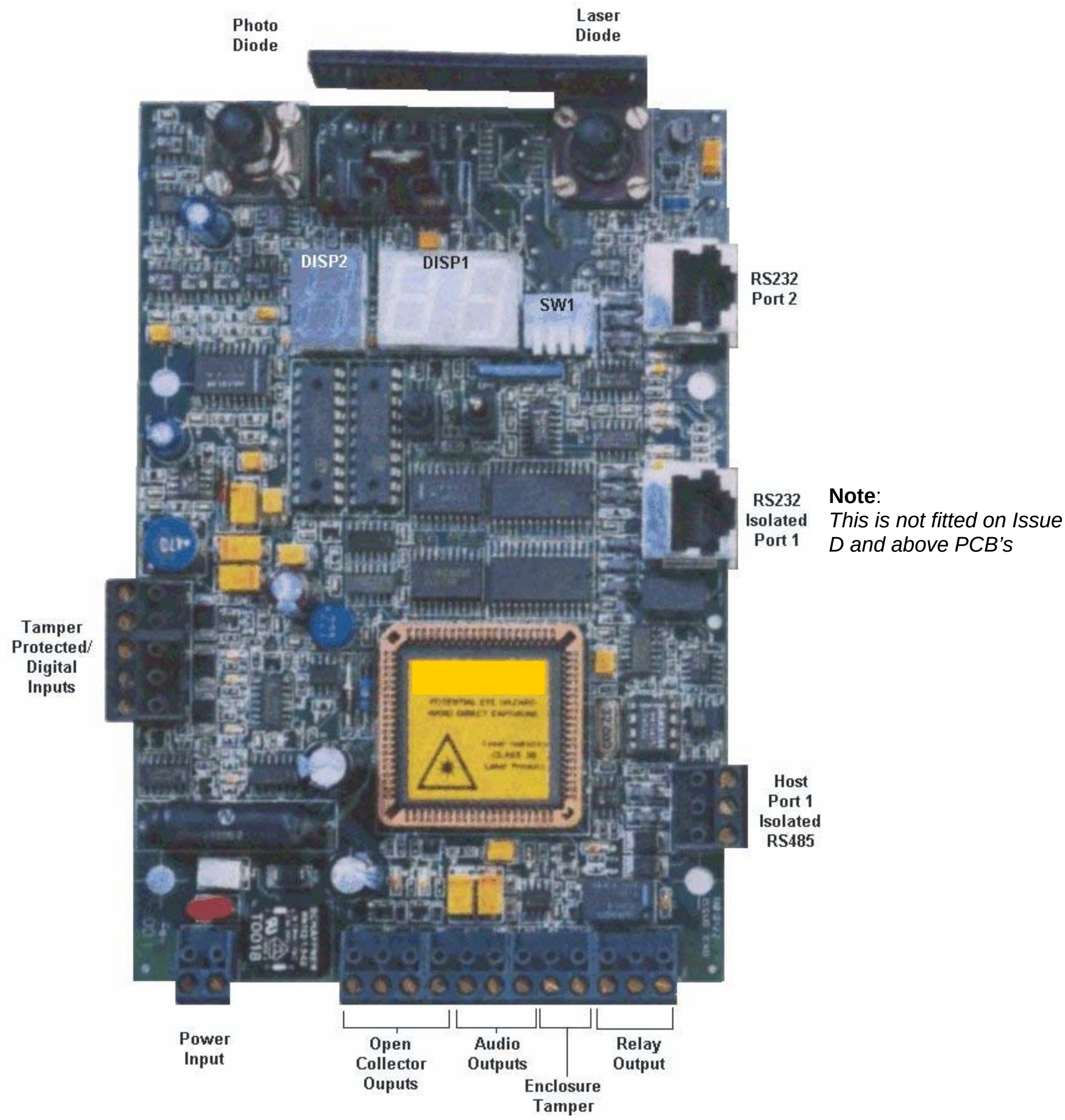


Figure 2-4: SmarterFence Set-Up Components

2.3.2 Commissioning via the User Interface

2.3.2.1 Overview

The SmarterFence SPU User Interface incorporates a 4-Way Dual-In-Line (DIL) switch, used to select operating modes, and a pushbutton/switch/LED combination to set the operational parameters of the SmarterFence SPU.

- **SW1** - this is a 4-Way DIL switch, which currently allows you to set the following:

- **SW1-1** - allows you to select the operating mode, i.e. **SmarterFence Fiber Sensor** or **SmarterFence Buried Sensor** - this is factory set to **OFF (SmarterFence)**

- **SW1-2 -** Factory set to **OFF**; it is recommended that this is **NOT** changed

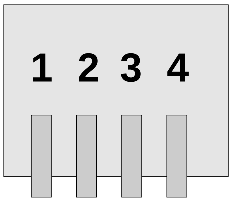
- **SW1-3 -** allows you to determine whether the **Environmental Compensation** function is turned **ON** or **OFF**. Push the switch DOWN to turn the function **ON** or UP to turn it **OFF**. Recommended setting is **ON**

> Note:
> **When set to** ON**, SmarterFence automatically compensates for changes in environmental conditions.**

- **SW1-4 -** Factory set to **OFF**; it is recommended that this is **NOT** changed

Figure 2-5 illustrates the layout of switch **SW1**.

SW1
(DIL SW)



1-Operating Mode(Fiber Sensor/ Buried Sensor)
2-Factory Set to OFF
3-Environmental Compensation ON/OFF
4-Factory Set to OFF

Select function by pushing the switch **DOWN**
i.e. into the **ON** position.

Figure 2-5: Layout of Switch SW1

- **DISP2 (Single Seven Segment Display) -** this is green in color and displays the selected user function, as listed below:

Function A	Station Address
Function 0	Photo Detector Voltage
Function 1	Photo Detector Attenuation Setting
Function 2	Channel 1 Peak Signal OR Channel 1 Current Event Count
Function 3	Channel 1 Event Threshold
Function 4	Channel 1 Event Count Limit
Function 5	Channel 1 Event Window
Function 6	Channel 2 Peak Signal OR Channel 2 Current Duration
Function 7	Channel 2 Event Threshold
Function 8	Channel 2 Max Event Duration
Function 9	Channel 2 Event Window

All user functions are described in sub-section 2.3.2.2, **Commissioning Procedure**.

- **DISP1 (Dual Seven Segment Display)** - this is red in color and displays the current value of the selected user function

- **PB1** - use this button to increment the selected user function; each time you press the button, the value displayed in **DISP2** will increase by 1

> Note
> PB1 **is also used to save settings, as described later.**

- **SW2** - this is a center-biased toggle switch, which allows the user to:

  - Increment/decrement the value of the selected 'setting' function (**Functions A**, **1**, **3**, **4**, **5**, **7**, **8** and **9**). To increment the value by 1, push the switch **UP** once and let go; the value will increase by 1 and the switch will return to its center position. Conversely, to decrement the value by 1, push the switch **DOWN** once and let go; the value displayed will decrease by 1 and the switch will return to its center position; **OR**

  - Display the current value of the selected 'measured' function (**Functions 2** and **6**). To display the current value, push the switch **UP** once and let go. Functions 2 and 6 display alternate values, as described in sub-section 2.3.3.2, **Commissioning Procedure**

> Note**: When incrementing/decrementing the value of the selected user function, you can carry on incrementing through 99 or decrementing through 01.**
>
> Example 1 **- Assume that the currently selected user function displays 02, yet you need to set it to a value of 98. You can decrement it through 02, 01, 99 to 98.**
>
> Example 2 **- Assume that the currently selected user function displays 97, yet you need to set it to a value of 03. You can increment it through 97, 98, 99, 01, 02 to 03.**

- **LEDs** - SmarterFence incorporates the following LED indications:

  - **V1 (RxData2)** - Receive Data Serial Port 2; this is a green LED, which flashes on and off when data is received on serial port 2
  - **V2 (TxData2)** - Transmit Data Serial Port 2; this is a yellow LED, which flashes on and off when data is transmitted on serial port 2
  - **V3 (GoodWd)** - Good Word; this is a red LED, which flashes once upon each successful receipt of data
  - **V4 (StnAdd)** - Station Addressed; this is a red LED, which flashes once upon successful receipt of data for a particular matching Station Address

- **V5 (RxData1)** - Receive Data Serial Port 1; this is a green LED, which flashes on and off when data is received on Serial Port 1
- **V6 (TxData1)** - Transmit Data Serial Port 1; this is a yellow LED, which flashes on and off when data is transmitted on Serial Port 1
- **V7 (Relay Output)** - Alarm Relay Activated; this is a red LED, which will extinguish for the duration of an alarm condition
- **V8 (Heartbeat)** - this is a red LED, which flashes on and off continuously (twice per second), in order to indicate a healthy condition
- **V9 (OP 1 Activated)** - Spare Output 1; this is a red LED, which will illuminate for the duration that control output **OP1** is activated
- **V11 (OP 2 Activated)** - Spare Output 2; this is a red LED, which will illuminate for the duration that control output **OP2** is activated
- **V13 (I/P 3 Healthy)** - Status Input 3; this is a green LED, which will illuminate when Status Input 3 is healthy
- **V14 (I/P 3 Tamper)** - Tamper Input 3; this is a red LED, which will illuminate when Status Input 3 is in a Tamper condition
- **V15 (I/P 2 Healthy)** - Status Input 2; this is a green LED, which will illuminate when Status Input 2 is healthy
- **V16 (I/P 2 Tamper)** - Tamper Input 2; this is a red LED, which will illuminate when Status Input 2 is in a Tamper condition
- **V17 (I/P 1 Healthy)** - Status Input 1; this is a green LED, which will illuminate when Status Input 1 is healthy
- **V18 (I/P 1 Tamper)** - Tamper Input 1; this is a red LED, which will illuminate when Status Input 1 is in a Tamper condition

In addition to the 16 diagnostic LEDs, the SmarterFence SPU incorporates 2 LEDs that are part of the circuitry that provides power to the Seven Segment Displays:

- **V10** - permanently **ON**; provides no function
- **V12** - permanently **ON**; provides no function
- **Test Points** - the SmarterFence SPU incorporates the following test points:

TP1 - Disable Laser Diode
TP2 - Laser Diode Current Monitor
TP3 - 0 Volts
TP4 - Receive Level Monitor
TP5 - Low Pass Filter Output

2.3.2.2 Commissioning Procedure

Pre-Commissioning

1. Connect the fiber optic sensor cables to the SmarterFence SPU, as illustrated in Figure 2-6:

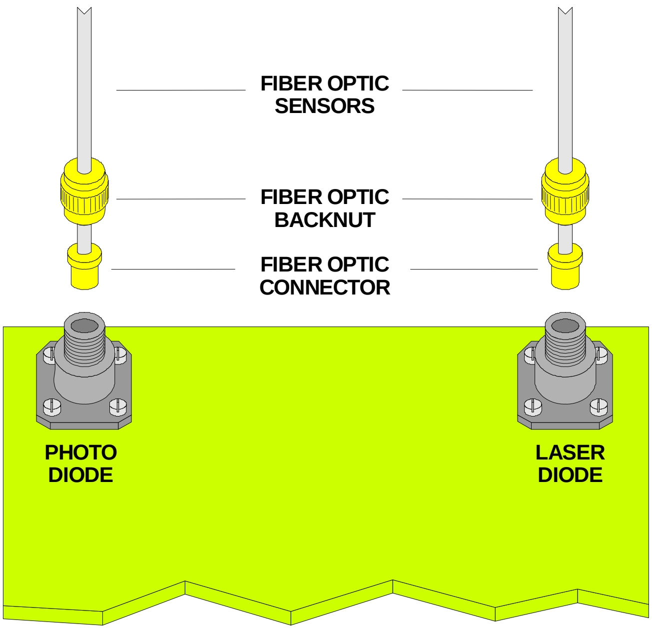


Figure 2-6: Connecting Fiber optic Sensor Cables to the SmarterFence SPU

2. Connect power to the SmarterFence SPU. The source of power is dependent upon the build option, and can be from either:
   - AC Mains, connected directly to the PSU, and then fed to Terminal Block TB1-1 and TB1-2
   - DC Supply, fed directly to TB1-1 and TB1-2

3. Check the positions on switch **SW1** are set as below:
   - **SW1-1** - OFF/UP (Physical Barrier - SmarterFence)
   - **SW1-2** - OFF/UP
   - **SW1-3** - ON/DOWN
   - **SW1-4** - OFF/UP

Configuration Settings

> Note**: Throughout the following commissioning procedure, all settings/adjustments made should be recorded on a Commissioning Sheet, a typical example of which is illustrated in Appendix A.**

1. Press and release **PB1**. **Function A - Station Address** will be displayed on **DISP2**. Using **SW2**, set to the required value, in the range **01-99**.

> Note**: The** Station Address **is only relevant if the SmarterFence SPU is communicating with another device through serial port 1.**

2. Press and release **PB1**. **Function 0 - Photo Detector Voltage** will be displayed on **DISP2**. This function displays the level of received optical power, in the range **01** to **99** (where **01** is the minimum and **99** is the maximum), which corresponds to a value in the range **10** to **990mV**. The recommended value is **10 +/- 2**, which corresponds to a value of **80-120mV**.

> Note**:**
> **The level of received optical power is adjusted by incrementing/decrementing the value displayed within** Function 1 - Photo Detector Attenuation Setting**.**

3. Press and release **PB1**. **Function 1 - Photo Detector Attenuation Setting** will be displayed on **DISP2**, in the range **01** to **99**.

> Note:
> **The following example illustrates the procedure for adjusting Functions 0 and 1, so that the value of** Function 0 **will be within the recommended range of** 20 +/- 2**. A typical method is to adjust by 'half the difference'. For example, if the value displayed for** Function 0 **was** 36**, you could increment the value of** Function 1 **by** 8**, i.e.** 36-20=16**;** then**,** divided by 2=8**.**
>
> Note**:**
> **It is recommended that you set the value displayed for** Function 0 **as close as possible to** 20**.**

If the value displayed for **Function 0 - Photo Detector Voltage** is *greater* than the required value, follow the procedure below:

- Increment the value of Function 1. To increment the value displayed, push **SW2 UP** and let go (the switch will return to its center position); repeat until the required value is displayed
- Press and hold down **PB1** until **Function A** is displayed and both displays flash; release **PB1**. Wait until both displays go blank (approximately 3 seconds), then press and release **PB1** once to select **Function 0**; push **SW2 UP** once to check the current value
- If the value displayed for **Function 0** is still too high, press and release **PB1** to return to **Function 1**; use **SW2** again to further increment the value, again using half the difference
- Repeat the above until the value displayed for **Function 0** is within the required range

If the value displayed for **Function 0 - Photo Detector Voltage** is *less* than the required value, follow the procedure below:

- Decrement the value of Function 1. To decrement the value displayed, push **SW2 DOWN** and let go (the switch will return to its center position); repeat until the required value is displayed

- Press and hold down **PB1** until **Function A** is displayed and both displays flash; release **PB1**. Wait until both displays go blank (approximately 3 seconds), then press and release **PB1** once to select **Function 0**; push **SW2 UP** once to check the current value
- If the value displayed for **Function 0** is still too low, press and release **PB1** to return to **Function 1**; use **SW2** again to further decrement the value, again using half the difference
- Repeat the above until the value displayed for **Function 0** is within the required range

The following steps illustrate how to commission **Channel 1**, the **'Cut'** channel.

4. Press and release **PB1** three times to advance to **Function 3 - Channel 1 Event Threshold**. Using **SW2**, set the value on **DISP1** to **99**.
5. Press and release **PB1** to advance to **Function 4 - Channel 1 Event Count Limit**. Using **SW2**, set the value on **DISP1** to **99**.
6. Press and release **PB1** to advance to **Function 5 - Channel 1 Event Window**. Using **SW2**, set the value on **DISP1** to **99**.
7. Press and hold down **PB1** until both displays flash. Press and release **PB1**.
8. Function 2 will display, differentiated by the 'decimal point' of **DISP2**, either:

   - Channel 1 Peak Signal - no decimal point; OR
   - Channel 1 Current Event Count - decimal point illuminated

   To toggle between the two functions, push **SW2 UP** once each time you wish to change the function.

   To determine the Peak Signal value(s):

   - Select the **Channel 1 Peak Signal** function and reset to zero by pressing **SW2 DOWN** once
   - Simulate an attack on the fence material. Return to the SmarterFence SPU and push **SW2 UP** twice (once displays **Channel 1 Current Event Count**) to display the current Peak Signal; note the value displayed on **DISP1**
   - Reset the Peak Signal to zero again
   - Repeat the above for a number of simulated attacks on different parts of the fence, each time noting down the Peak Signal displayed in **DISP1**
   - From the set of readings recorded, determine the lowest Peak Signal generated and record

9. When you have an adequate number of peak signal readings, press and release **PB1** to advance to **Function 3 - Channel 1 Event Threshold**, which displays the level at which Channel 1 signal processing will decide that an event that could be an 'alarm event' has occurred (in the range **01** to **99)**. The setting you make here is dependent upon the environmental conditions and the type of attack. It is important to note that the Alarm Threshold setting **MUST BE BELOW** the lowest value noted for the Peak Signal in Step 8.

Typical Event Threshold Settings (Step 9)

Light Winds

If the protected material is installed in an area where light winds are expected, then the Event Threshold setting could be up to 10 less than the lowest peak signal. For example, if the lowest peak signal recorded is 40, then the Event Threshold could be set to a figure in the region of 30.

Moderate Winds

If the protected material is installed in an area where moderate winds are expected, then the Event Threshold setting could be up to 5 less than the lowest peak signal recorded. For example, if the lowest peak signal recorded is 55, then the Event Threshold could be set to a figure in the region of 50.

Heavy Winds

If the protected material is installed in an area where high winds are expected, then the Event Threshold setting should only be slightly below the lowest peak signal, e.g. 1 or 2. For example, if the lowest peak signal recorded is 62, then the Event Threshold could be set to a figure in the region of 60.

> Note**: The amount that the Event Threshold is set below the lowest peak signal is important. If the difference is too great, the system will be more sensitive to nuisance alarms.**
>
> **THE LARGER THE DIFFERENCE, THE MORE SENSITIVE THE SYSTEM WILL BE SET AND THE GREATER THE PROBABILITY OF NUISANCE ALARMS.**

10. Press and hold down **PB1** until both displays flash. When they go blank, press and release **PB1** once; **DISP1** will now display **Function 2**.

To display the current event count:

- Select the **Channel 1 Current Event Count** function and reset to zero by pressing **SW2 DOWN** once
- Simulate an attack on the fence material. Return to the SmarterFence SPU and push **SW2 UP** twice (once displays **Channel 1 Peak Signal**) to display the **Current Event Count**; note the value displayed on **DISP1**
- Reset the **Current Event Count** to zero again

- Repeat the above for a number of simulated attacks on different parts of the fence, each time noting down the **Current Event Count** displayed in **DISP1**
- From the set of readings recorded, determine the lowest **Current Event Count** generated

11. Press and release **PB1** again to advance to **Function 4 - Channel 1 Event Count Limit**. This function allows you to set the number of events (as determined in step 10 above, i.e. the lowest **Current Event Count** reading) that must occur within a configurable time period (refer to step 12 below) before an alarm will be generated. Using **SW2**, increment/decrement the value displayed in **DISP1**, until the required value is displayed. A typical value set for this function is **3**.

12. Press and release **PB1** again to advance to **Function 5 - Channel 1 Event Window**. This function allows you to set the time period, in seconds, during which the number of events set in Step 11 must occur before an alarm will be generated. Using **SW2**, increment/decrement the value displayed in **DISP1**, until the required value is displayed. A typical value set for this function is **20 (Seconds)**.

    Examples of Event Settings - Channel 1 (Steps 11 and 12)
    Example 1
    If you require an alarm to be generated when 3 events occur within a 20-second interval (typical), make the following settings:
    Function 4 - 3
    Function 5 - 20

    Example 2
    If you require an alarm to be generated when 4 events occur within a 15-second interval, make the following settings:
    Function 4 - 4
    Function 5 - 15

13. At this stage in the procedure, you should record the values set for Channel 1. **DO NOT** store the values until you have commissioned Channel 2, as described below.

    The following steps illustrate how to commission **Channel 2**, the **'Climb'** channel.

14. Press and release **PB1** until **Function 7 - Channel 2 Event Threshold** is displayed. Using **SW2**, set the value on **DISP1** to **99**.

15. Press and release **PB1** to advance to **Function 8 - Channel 2 Max Event Duration**. Using **SW2**, set the value on **DISP1** to **99**.

16. Press and release **PB1** to advance to **Function 9 - Channel 2 Event Window**. Using **SW2**, set the value on **DISP1** to **99**.

17. Press and hold down **PB1** until both displays flash. Press and release **PB1**. **DISP1** will now display **Function 6**.

18. Function 6 will display, differentiated by the 'decimal point' of **DISP2**, either:
    - Channel 2 Peak Signal - no decimal point; OR
    - Channel 2 Current Duration - decimal point illuminated

    To toggle between the two functions, push **SW2 UP** once each time you wish to change the function.

    To determine the Peak Signal value(s):
    - Select the **Channel 2 Peak Signal** function and reset to zero by pressing **SW2 DOWN** once
    - Simulate an attack on the fence material. Return to the SmarterFence SPU and push **SW2 UP** twice (once displays **Channel 2 Current Duration**) to display the current Peak Signal; note the value displayed on **DISP1**
    - Reset the Peak Signal to zero again
    - Repeat the above for a number of simulated attacks on different parts of the fence, each time noting down the Peak Signal displayed on **DISP1**
    - From the set of readings recorded, determine the lowest Peak Signal generated and record

19. When you have an adequate number of peak signal readings, press and release **PB1** to advance to **Function 7 - Channel 2 Event Threshold**, which displays the level at which Channel 2 signal processing will decide that an event that could be an 'alarm event' has occurred, in the range **01** to **99**. The setting you make here is dependent upon the environmental conditions and the type of attack. It is important to note that the Alarm Threshold setting **MUST BE BELOW** the lowest value noted for the Peak Signal in Step 18. Typically, this is set to approximately 50% of the lowest peak signal generated in step 18, provided this is also above the **Channel 1 Event Threshold**, otherwise it is set equal to the **Channel 1 Event Threshold** value.

20. Press and hold down **PB1** until both displays flash. Press and release **PB1** once. **DISP1** will now display **Function 6**.

    To display the Current Duration:
    - Select the **Channel 2 Current Duration** function and reset to zero by pressing **SW2 DOWN** once
    - Simulate an attack on the fence material. Return to the SmarterFence SPU and push **SW2 UP** twice (once displays **Channel 2 Peak Signal**) to display the **Current Duration**; note the value displayed on **DISP1**
    - Reset the **Current Duration** to zero again

- Repeat the above for a number of simulated attacks on different parts of the fence, each time noting down the **Current Duration** displayed in **DISP1**
- From the set of readings recorded, determine the lowest **Current Duration** value generated and record

21. Press and release **PB1** twice to advance to **Function 8 - Channel 2 Max Event Duration**, which allows you to set the minimum cumulative time period, in milliseconds, that the signal must remain above the alarm threshold in order for an alarm to be generated. Using **SW2**, increment/decrement the value displayed on **DISP1**. This should be set to less than the recorded minimum **Current Duration** value. A typical value set for this function is **30** (**milliseconds)**.

22. Press and release **PB1** to advance to **Function 9 - Channel 2 Event Window**, which allows you to set the time period, in seconds, during which the cumulative **Max Event Duration** time, as measured in step 21, must occur before an alarm will be generated. Using **SW2**, increment/decrement the value displayed in **DISP1**, until the required value is displayed. This will normally be just greater than the maximum time taken for a climbing attack and is typically set to **10 (Seconds)**.

Examples of Event Settings - Channel 2 (Steps 21 and 22)

Figures 2-7 and 2-8 illustrate examples of an alarm being generated and not being generated, using settings made for Functions 8 and 9.

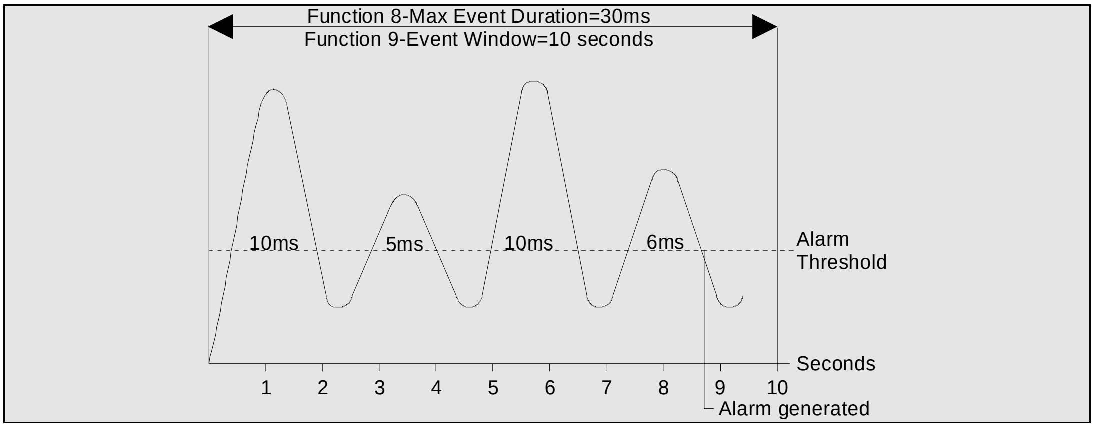


Figure 2-7: Typical Settings - Alarm Generated

In Figure 2-7 above, the following settings have been chosen:

Function 8 - 30 milliseconds
Function 9 - 10 Seconds

With these figures, the total amount of time that the signal is above the alarm threshold (10 + 5 + 10 + 6 = 31) has passed 30ms within the **Event Window** time of 10 seconds and so an alarm is generated at the point shown.

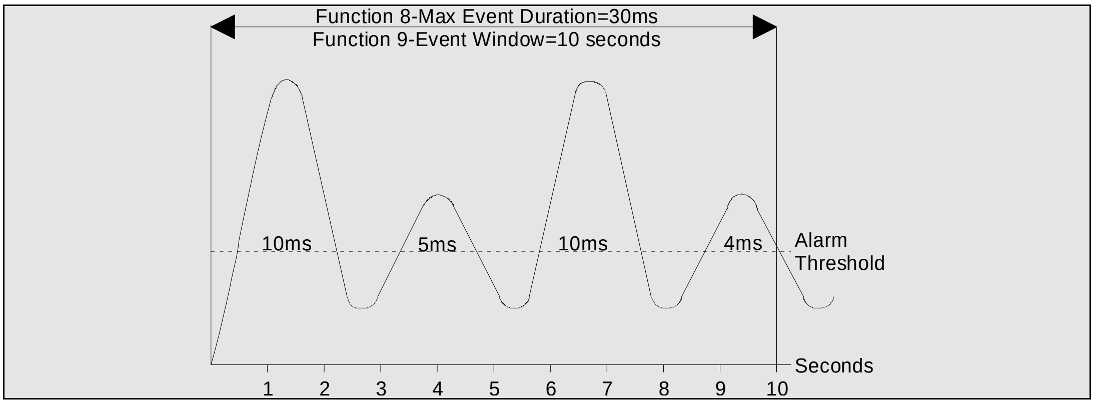


Figure 2-8: Typical Settings - No Alarm Generated

In Figure 2-8 above, the following settings are again assumed:

- **Function 8** - 30 milliseconds
- **Function 9** - 10 seconds

With these figures, the total amount of time that the signal is above the alarm threshold (10 + 5 + 10 + 4 = 29) has **NOT** exceeded 30ms before the **Event Window** time of 10 seconds has elapsed. In this case, an alarm is not generated.

23. At this stage in the procedure, it is recommended that you save the changes made for both **Channel 1** and **Channel 2**. Return to the **Channel 1** functions and set to the values recorded at step 13 earlier. Then, save the changes by pressing and holding down **PB1** until both displays flash. The changes will be saved in local memory.

24. Both channels must now be tested to ensure that all attacks are detected. To carry out these tests, the use of an audible and/or visual monitor, e.g. **Strobe**, **High-Volume Piezo Buzzer and Battery**, connected to the alarm relay output is recommended to enable the remaining procedure to be completed by one person.

> Note:
> **Ensure that the operating current of the audible/visual monitor does not exceed the current rating of the SmarterFence relay (Up to 1A@12V DC).**

- Perform an attack that meets the criteria set down for Channel 1; each time the criteria are met, the audible buzzer/visual aid will activate, informing you that an alarm has been generated
- Repeat the above on a different part of the fence material, checking that an alarm is generated for each attack
- Perform an attack that meets the criteria set down for Channel 2; each time the criteria are met, the audible buzzer/visual aid will activate, informing you that an alarm has been generated
- Repeat the above on a different part of the fence material, checking that an alarm is generated for each attack

25. The system is now set-up and fully operational.

2.3.3 Commissioning via Serial Port 2 (Local Configuration)

2.3.3.1 Overview

The SmarterFence SPU can also be configured locally, via the connection of a Laptop PC connected to Serial Port 2. To use the Local Configuration package, you will first need to install the software.

2.3.3.2 Software Installation

To install the Local Configuration software:

1. Insert the floppy disk containing the software into your laptop's floppy drive.

2. Using Windows Explorer, navigate to the relevant drive; then double-click over the **Setup.exe** file, which will display the following dialog:

Figure 2-9: Welcome dialog

3. Click over **Next**; the SmarterFence Configuration package will begin to load and a version of the following dialog will be displayed:

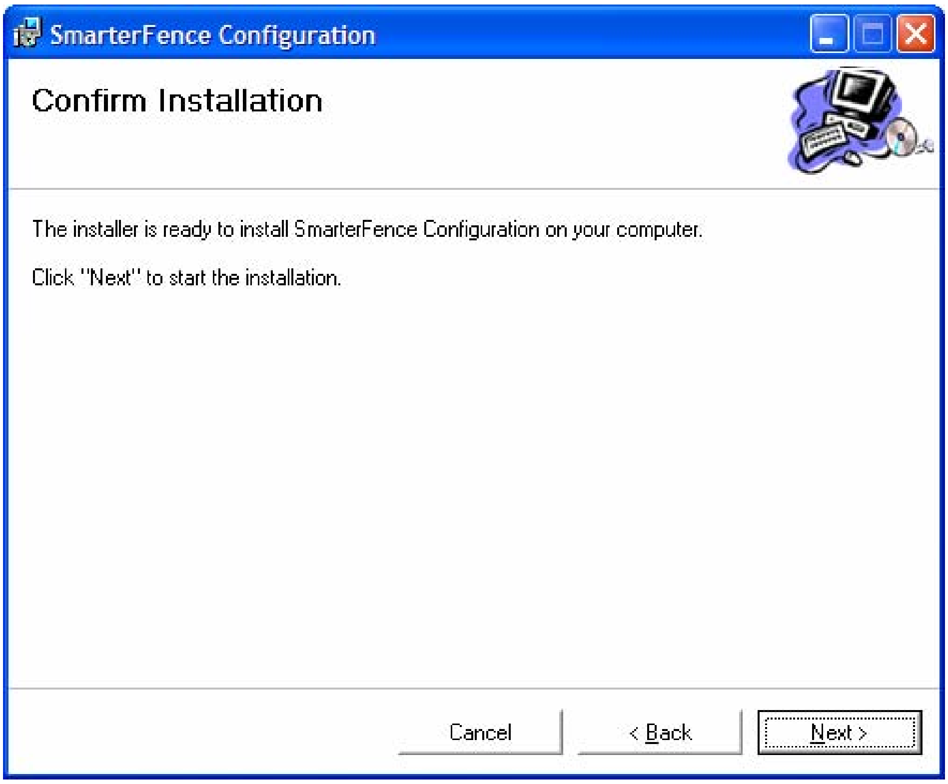


Figure 2-10: SmarterFence Configuration Setup dialog

4. When the installation procedure is complete, the following dialog will be displayed:

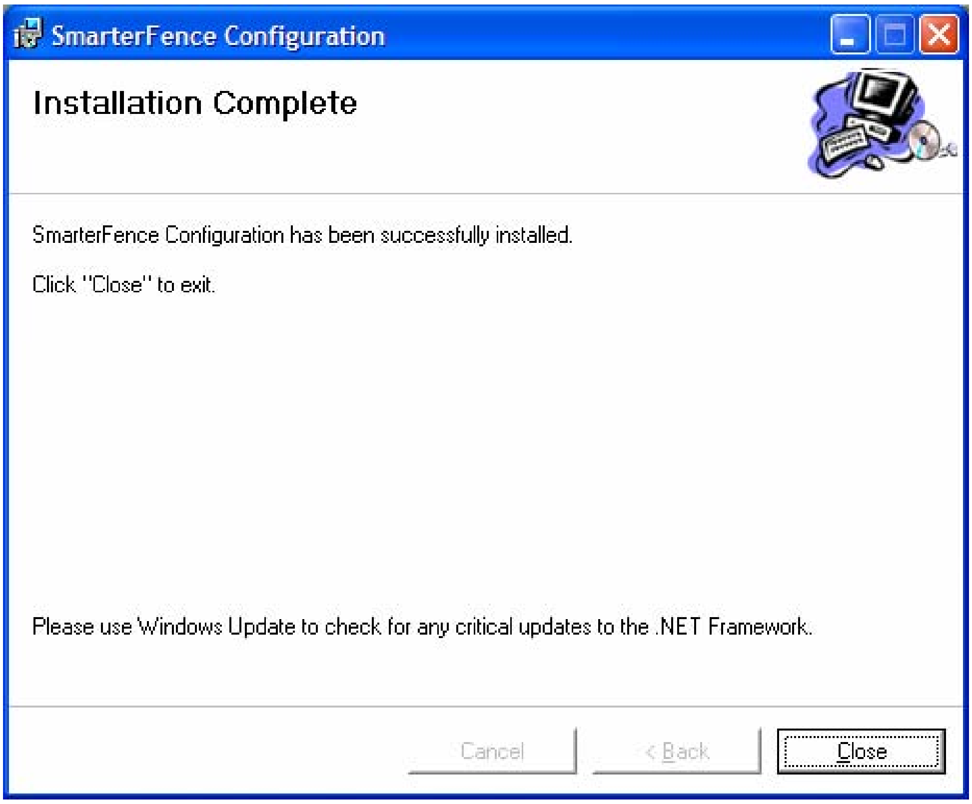


Figure 2-11: Setup Complete dialog

5. Click over **Finish** to complete installation. To run the local configuration program, click over **Start** at the bottom of your display, followed by **Programs** from the pop-up menu; then, click over **SmarterFence** from the pop-up list provided.

> Note:
> **Alternatively, you can navigate to the location where the SmarterFence Local Configuration software is installed and make the S2Config.exe file a shortcut on your desktop.**
> Note:
> **Ensure that the laptop you are using is set to the correct local time and date.**

2.3.3.3 Commissioning Procedure

Pre-Commissioning

> Note: **Before starting commissioning, ensure that you have connected the fiber optic sensor cables and power to the SmarterFence SPU, as described previously.**

1. Connect a serial communications cable between the laptop and **J1** on the SmarterFence SPU. Figure 2-12 illustrates a typical 9-Way communications cable and Figure 2-13 illustrates a typical 25-Way communications cable.

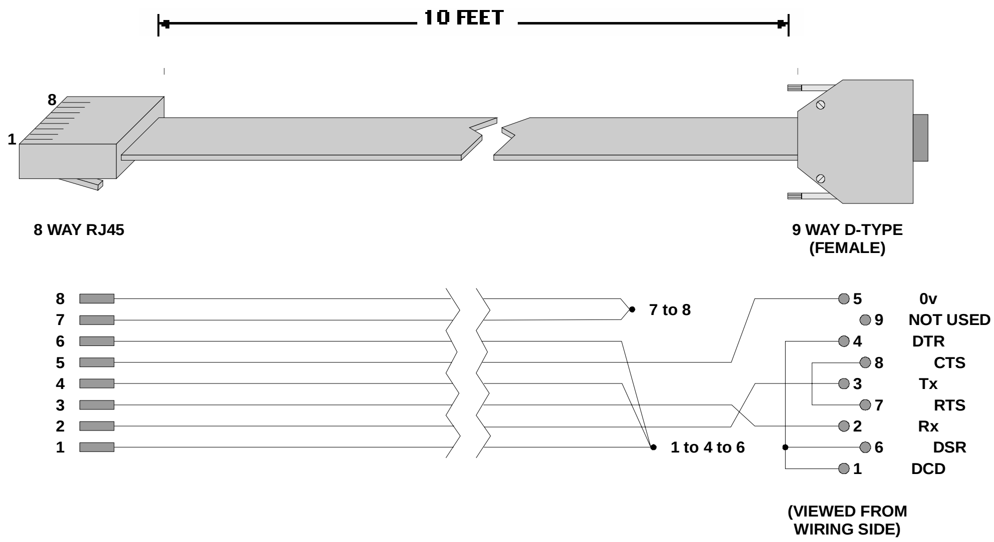


Figure 2-12: 9-Way Communications Cable Pinout

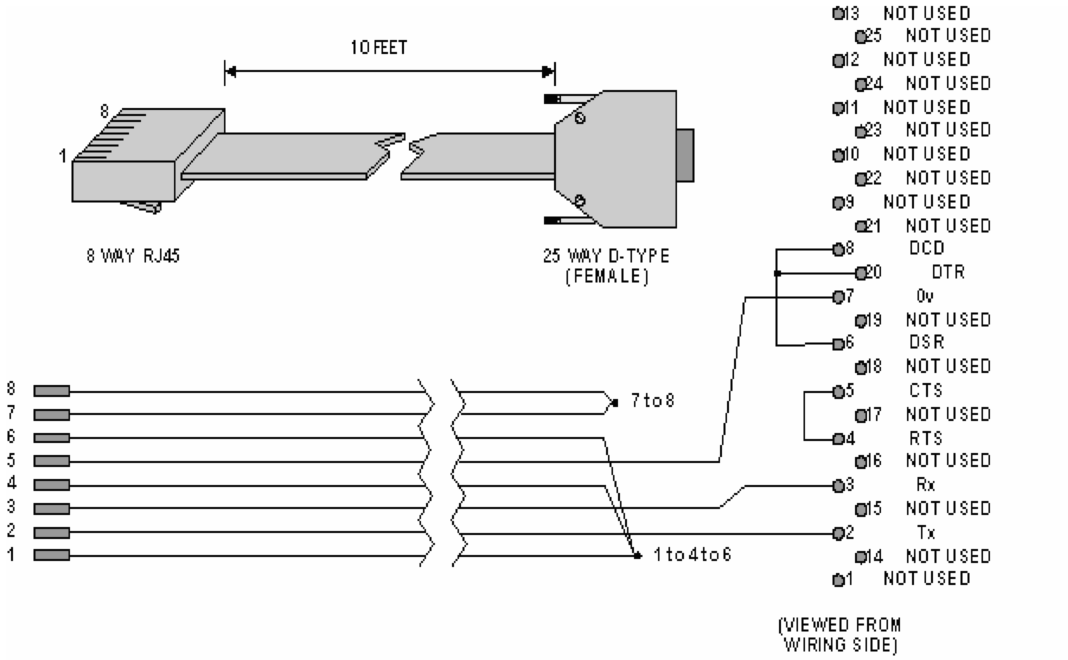


Figure 2-13: 25-Way Communications Cable Pinout

Note**: The length of the communications cable should not exceed 10 feet (3 meters).**

2. Using the Control Panel, set up the communications port to be used to communicate with the SmarterFence SPU. The port should be set up as follows:

   - Bits per second - set to 38400
   - Data bits - set to 8
   - Parity - set to None
   - Stop bits - set to 1
   - Flow control - set to None

3. Run the SmarterFence Local Configuration program; a version of the following dialog will be displayed:

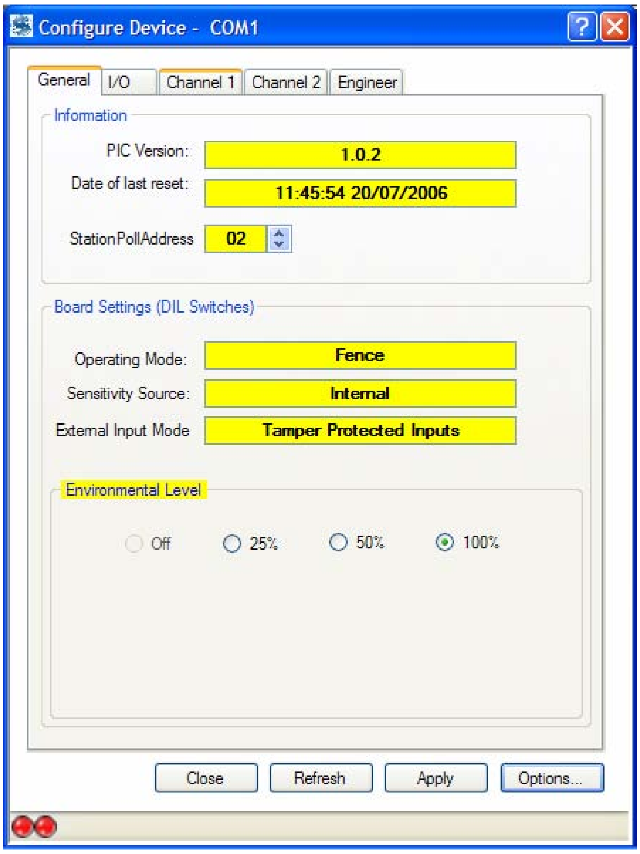


Figure 2-14: Configure SmarterFence - General Page

Note**: The two LEDs in the bottom left-hand corner of the dialog are** Transmit/Receive **LEDs, which will flash on and off when data is being sent/received between the laptop and the SmarterFence SPU.**

4. Click over **Options** at the bottom of the dialog; the following pop-up menu will be displayed:

   Query Device - use this option to obtain the current set of readings from the SmarterFence SPU

   Communications - use this option to select the communications port used to communicate with the SmarterFence SPU (as set up in step 2 above)

   Configuration - provides the following sub-menu:

      Load - allows you to load a pre-defined configuration, which is useful if you have a large system with a number of identical zones. When you click over **Load**, a version of the following dialog will be displayed:

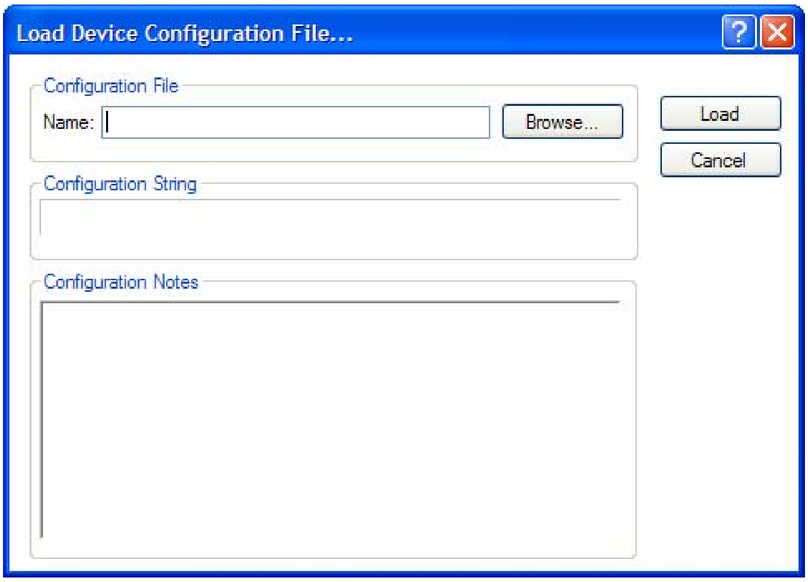


Figure 2-15: Configure SmarterFence - Load SmarterFence Configuration File dialog

- In the **Name** field, enter the name of the configuration file
- In the **Directory** field, navigate to the directory in which the file is located; click over the **Browse** button to assist you in this
- The **Configuration Notes** group box will contain, if created, a set of notes relevant to the configuration. These notes are useful when selecting the correct configuration to load and will have been created when the configuration was saved
- Click over **Load** to load the configuration; alternatively, click over **Cancel** to abort

Save - allows you to save changes to a configuration. When you click over **Save**, a version of the following dialog will be displayed:

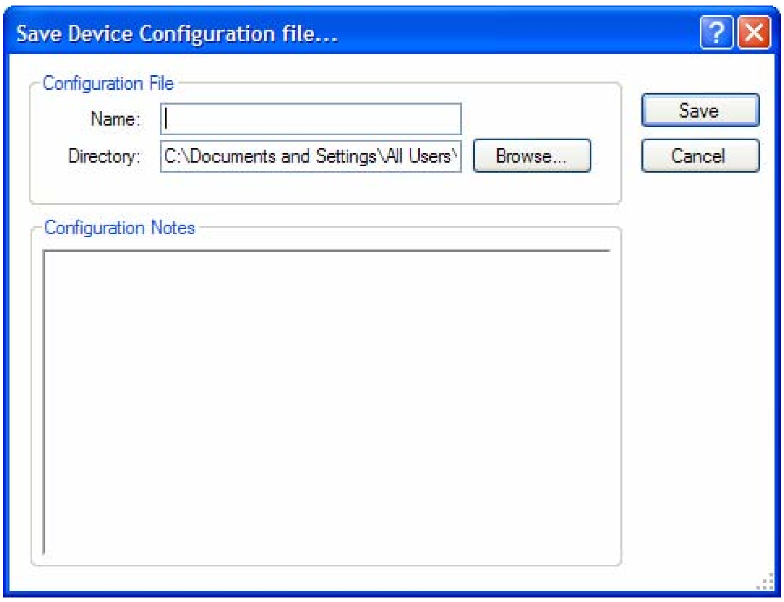


Figure 2-16: Configure SmarterFence - Save SmarterFence Configuration File dialog

- In the **Name** field, enter the name that you wish to save the file as
- In the **Directory** field, navigate to the directory in which the file is to be saved; click over the **Browse** button to assist you in this
- In the **Configuration Notes** group box, you can enter notes relevant to the configuration, which will assist you in locating the relevant configuration later
- Click over **Save** to save the configuration; alternatively, click over **Cancel** to abort

Save As - allows you to save a configuration under a different name. Clicking over **Save As** displays the same dialog as **Save**, and is used in exactly the same manner

Engineer Login - use this option to gain access to the Transmitter settings (this is **NOT** a user function)

5. Click over **Communications**; the following dialog will be displayed:

Figure 2-17: Configure Communications dialog

- Select the Comms Port used for communications with the SmarterFence SPU
- Click over **OK** to return to the **General dialog**

6. Click over **Options**, followed by **Query Device** from the pop-up menu; using the set-up communications port, the Laptop PC will query the SmarterFence SPU for its current settings and place them in the relevant fields.

> Note:
> **This will retrieve all parameters and update fields on all configuration pages.**

Commissioning

1. Referring to the **General** page (as illustrated in Figure 2-13), the following group boxes are available:

   Information - contains the following fields:

   - **PIC Version** - the version of PIC installed
   - **Date Of Last Reset -** the time and date that the PIC was last reset

Board Settings (DIL Switches) - contains the following fields:

- **Operating Mode** - the operating mode that the SmarterFence SPU is set to, i.e. **Fence**
- **Sensitivity Source** - the source of sensitivity control, i.e. **internal** or **external** (future - currently fixed as **Internal**)
- **Environmental Level** - the four radio buttons, i.e. **OFF**, **25%**, **50%** and **100%**, allow you to determine the level of **Environmental Compensation** to be made for outside influences. Select the relevant radio button from the options provided

> Note:
>
> **If the fence material is subject to light, moderate or high winds, the** Environmental Compensation **feature should be taken into consideration, which allows you to determine the level of compensation to be made for signals generated under the above conditions. The level of compensation selected is largely site dependent, but the following rules provide guidelines:**

Light Winds - consider selecting the **OFF** or **25%** radio button

Moderate Winds - consider selecting the **25%** or **50%** radio button

High Winds - consider selecting the **50%** or **100%** radio button

Now, when the wind disturbs the fence material, the Alarm Threshold will be automatically adjusted to compensate for the effects of the wind.

> Note:
>
> **If** SW1-3 - Environmental Compensation **is turned** OFF**, all four radio buttons will be grayed-out, with the** OFF **button 'selected' to illustrate that the function is turned** OFF**. If** SW1-3 **is turned** ON**, the** OFF **radio button will be grayed out and the three remaining radio buttons will be activated.**

> Note:
>
> **The** Environmental Compensation **function is factory set to 100%.**

2. Selecting the **I/O** page will display a version of the following dialog:

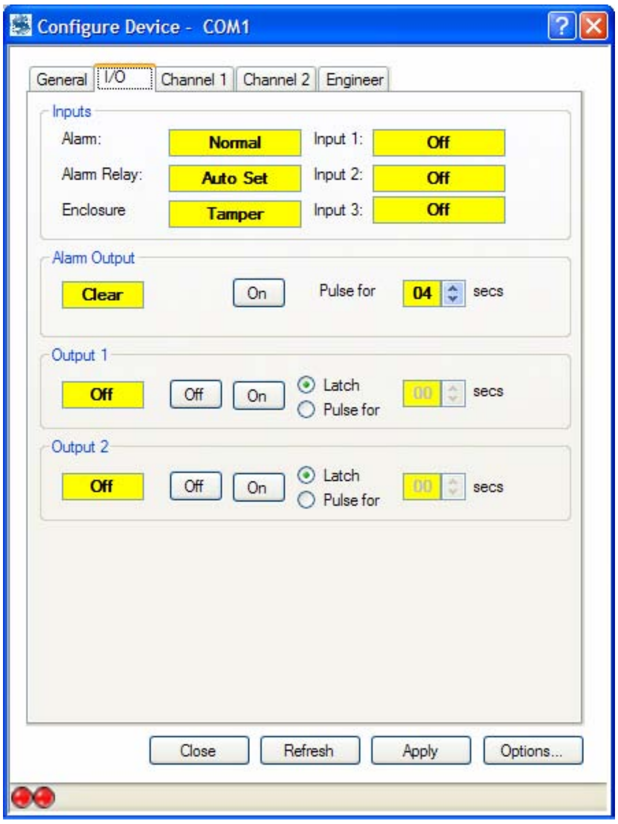


Figure 2-18: Configure SmarterFence - I/O Page

> Note:
> **The two LEDs in the bottom left-hand corner of the dialog are** Transmit/Receive **LEDs, which will flash on and off when data is being sent/received between the laptop and the SmarterFence SPU.**

- The **Inputs** group box contains the following fields:
  - **Alarm -** the current alarm state of the SmarterFence SPU, i.e. **Normal**, **Cut**, **Climb**, **Cut/Climb** or **Break**
  - **Alarm Relay** - the current state of the alarm relay, i.e. **Auto Set, Manual Set**
  - **Enclosure -** the current state of the enclosure, i.e. **Tamper**, **Normal**
  - **Input 1 -** the current state of Status Input 1, i.e. **Tamper, On, Off**
  - **Input 2 -** the current state of Status Input 2, i.e. **Tamper, On, Off**
  - **Input 3 -** the current state of Status Input 3, i.e. **Tamper, On, Off**
- The **Alarm Output** group box allows you to set the alarm relay drop-out time, in seconds (in the range **01** to **99**). Enter the time in the field to the right and use the **On** button to test the operation, i.e. observe the alarm LED (**V7**), which will extinguish for the length of time that the alarm relay is de-energized

- The **Output 1** and **Output 2** group boxes allow you to set the states of output 1 and 2 respectively. Select either the **Latch** or **Pulse for** radio button, then select **Options - Apply** to activate the selected mode. The outputs can then be set by using the **Pulse for** time and/or the **On/Off** buttons as required

> Note:
> **Clicking over** Options**, followed by** Query Device**, will query the SmarterFence SPU for its current settings and place them in the relevant fields. If you make any changes to this page, the** Apply **button will be highlighted; click over the button to transmit the changes to the SmarterFence SPU and the software will download and save the changes automatically. The seven-segment displays will flash for approximately 3 seconds and the system will then operate with the new settings. To read the new settings, click over** Options - Query Device**.**

3. Selecting the **Channel 1** page will display a version of the following dialog:

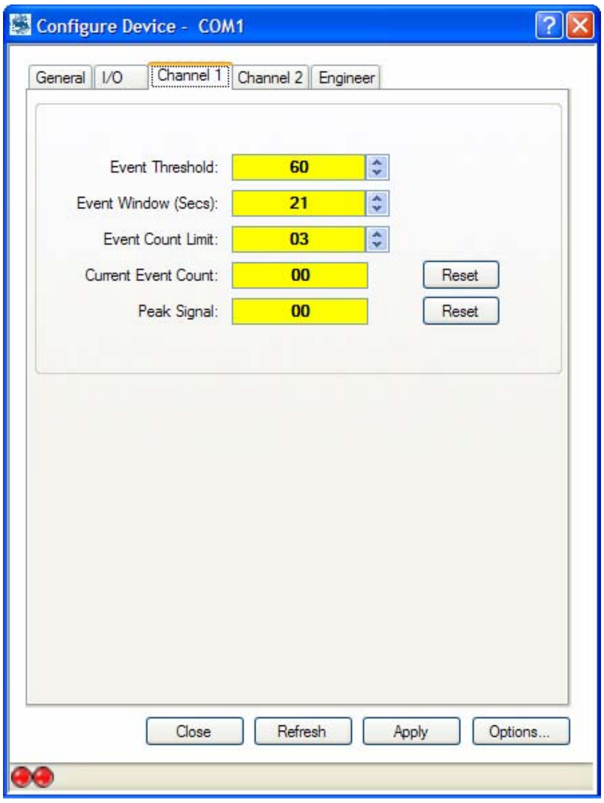


Figure 2-19: Configure SmarterFence - Channel 1 Page

> Note:
> **The two LEDs in the bottom left-hand corner of the dialog are** Transmit/Receive **LEDs, which will flash on and off when data is being sent/received between the laptop and the SmarterFence SPU.**

This page provides details on the current settings (clicking over **Options - Query Device** will query the SmarterFence SPU for its current settings and place them in the relevant fields) made for **Channel 1** and contains the following fields:

- **Event Threshold** - the value that the **Peak Signal** must exceed before being classed as an alarm event, in the range **01** to **99**

- **Event Window** - the time, in seconds, during which the **Event Count Limit** must be reached before an alarm will be generated, in the range **01** to **99**
- **Event Count Limit -** the number of events that must occur within the **Event Window** period before an alarm will be generated, in the range **01** to **99**
- **Current Event Count -** the current number of alarm events that have occurred within the **Event Window** time period. When this value reaches the **Event Count Limit** within the **Event Window** time, an alarm will be generated and the **Current Event Count** will reset to zero
- **Peak Signal** - the highest value of the Peak Signal recorded since it was last reset

Channel 1 can be commissioned using the same basic procedure as described in sub-section 2.3.3.2, **Commissioning Procedure**:

- Simulate a number of attacks to determine the lowest peak signal value (step 8)
- Set the Event Threshold (step 9)
- Determine the Current Event Count (steps 10 and 11)
- Set the Event Window time (step 12)

However, instead of using the user interface switches/buttons to change the values, the **Up/Down** arrow keys and the **Reset** buttons are used.

> Note**:**
>
> **If any changes are made to this page, the** Apply **button will be highlighted; click over the button to transmit the changes to the SmarterFence SPU and the software will download and save the changes automatically. The seven-segment displays will flash for approximately 3 seconds and the system will then operate with the new settings. To read the new settings, click over** Options - Query Device**.**

4. Selecting the **Channel 2** page will display a version of the following dialog:

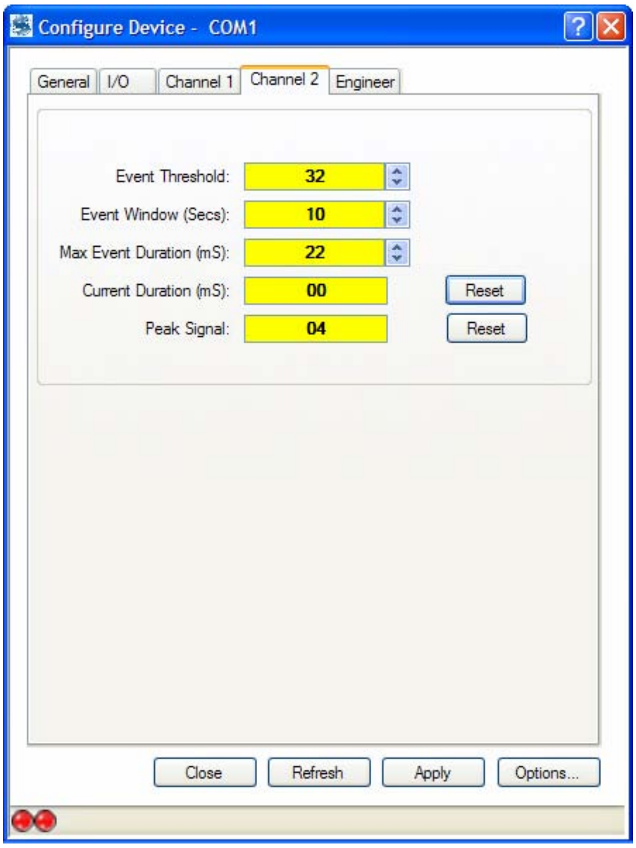


Figure 2-20: Configure SmarterFence - Channel 2 Page

> Note:
> **The two LEDs in the bottom left-hand corner of the dialog are** Transmit/Receive **LEDs, which will flash on and off when data is being sent/received between the laptop and the SmarterFence SPU.**

This page provides details on the current settings (clicking over **Options - Query Device** will query the SmarterFence SPU for its current settings and place them in the relevant fields) made for **Channel 2** and contains the following fields:

- **Event Threshold** - the value that the **Peak Signal** must exceed before being processed, in the range **01** to **99**
- **Event Window** - the time, in seconds, during which the **Max Event Duration** time must be exceeded before an alarm will be generated, in the range **01** to **99**
- **Max Event Duration** - the cumulative time, in milliseconds, that the signal must remain above the **Event Threshold** within the **Event Window** time period in order for an alarm to be generated, in the range **01** to **99**

- **Current Duration** - the maximum total time, in milliseconds, that an alarm event has lasted for within the **Event Window** time since the value was last reset. This value is reset to zero whenever Channel 2 goes into alarm

- **Peak Signal** - the highest value of the Peak Signal recorded since it was last reset

Channel 2 can be commissioned using the same basic procedure as described in sub-section 2.3.2.2, **Commissioning Procedure**:

- Simulate a number of attacks to determine the lowest peak signal value (step 18)
- Set the Event Threshold (step 19)
- Determine the Current Duration time (steps 20 and 21)
- Set the Event Window time (step 22)

However, instead of using the user interface switches/buttons to change the values, the **Up/Down** arrow keys and the **Reset** buttons are used.

> Note**:**
>
> **If any changes are made to this page, the** Apply **button will be highlighted; click over the button to transmit the changes to the SmarterFence SPU and the software will download and save the changes automatically. The seven-segment displays will flash for approximately 3 seconds and the system will then operate with the new settings. To read the new settings, click over** Options - Query Device**.**

5. Selecting the **Engineer** page will display the following dialog:

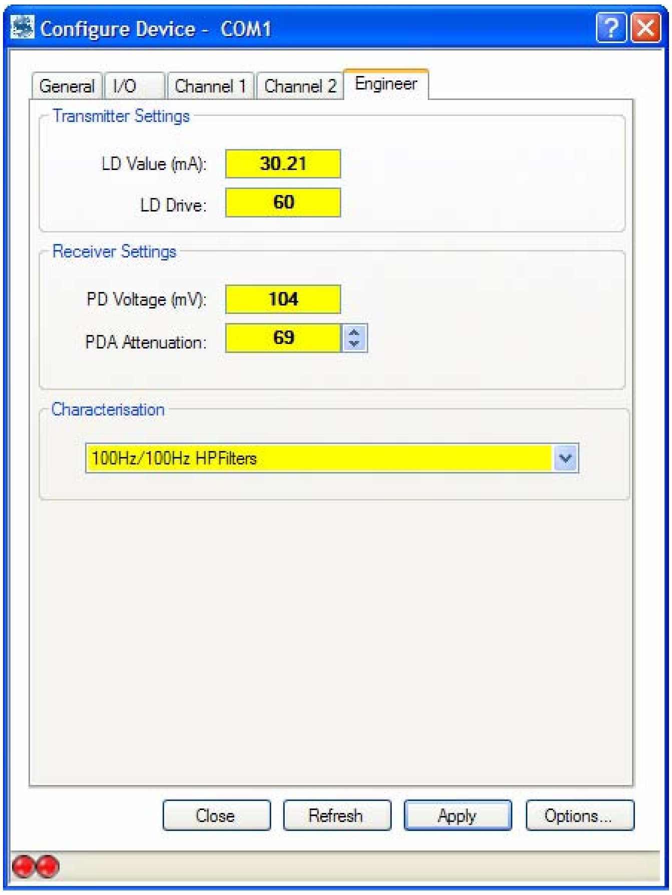


Figure 2-21: Configure SmarterFence - Engineer Page

> Note:
> **The two LEDs in the bottom left-hand corner of the dialog are** Transmit/Receive **LEDs, which will flash on and off when data is being sent/received between the laptop and the SmarterFence SPU.**

This page provides details on the current technical settings (clicking over **Options - Query Device** will query the SmarterFence SPU for its current settings and place them in the relevant fields) for the **Transmitter** and **Receiver**; the page contains the following group boxes:

- **Transmitter Settings** - this group box contains the following fields:
  - **LD Value** - the measured current flowing through the Laser Diode, in the range **00.0** to **99.9mA**
  - **LD Drive** - the excitation setting of the Laser Diode, in the range **01-99**; altering this value will change the current flowing through the Laser Diode and, hence, the transmitted power output

> Note**: The** LD Value **is a Read-Only field and is always visible; the** LD Drive **field function is password protected and is** NOT **a user function.**

- **Receiver Settings** - this group box contains the following fields:

- **PD Voltage** - the value of the Photo Detector Amplifier output in the range **001** to **999** millivolts
- **PDA Attenuation** - the attenuation setting of the Photo Detector Amplifier, in the range **01-99**; altering this value alters the output of the Photo Detector Amplifier

- **Characterization** - this group box displays a list of pre-set application settings which relate to the characteristics of the digital filters configured in the PIC and may be different for each fence type. The default setting is **100Hz/100HzHPFilters**, which is suitable for all fence types

The Transmitter and Receiver can be commissioned using the same basic procedure as described in sub-section 2.3.3.2, **Commissioning Procedure**:

- Set the Photo Detector Voltage (step 2)
- Set the Photo Detector Attenuation Setting (step 3)

However, instead of using the user interface switches/buttons to change the values, the **Up/Down** arrow keys are used.

> Note**:**
>
> **If any changes are made to this page, the** Apply **button will be highlighted; click over the button to transmit the changes to the SmarterFence SPU and the software will download and save the changes automatically. The seven-segment displays will flash for approximately 3 seconds and the system will then operate with the new settings. To read the new settings, click over** Options - Query Device**.**

2.3.4 Calibration Tool Setup

The Calibration Tool can be used to simulate an attack on the protected fabric and is held lightly against the fabric with the bottom pin positioned as close as possible to the sensor cable, preferably on the next fence crossover point or horizontal bar. Use the same relative position for each panel in the fence.

> **Note:**
>
> **Ensure that the Calibration Tool is positioned in such a way that the weight does not strike the sensor cable on its way to the bottom pin.**

Figure 2-22 illustrates the Calibration Tool.

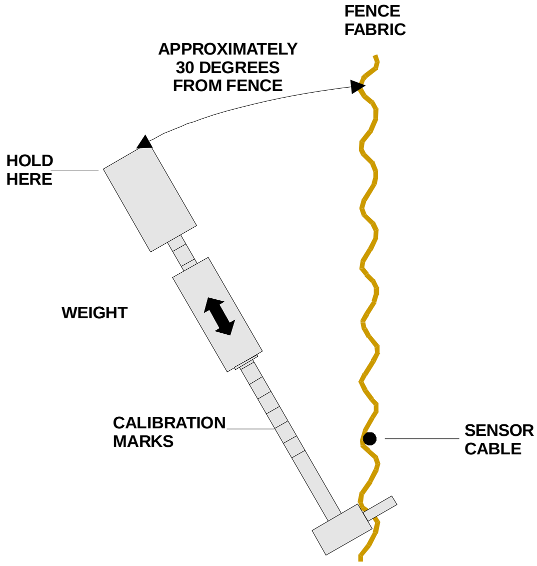


Figure 2-22: Calibration Tool

> Note:
> **If you need to test the same fence panel again, use the same position as the initial test.**

1. Balance the bottom pin as described. Use the same approximate position on the pin for each test.

2. Grip the top head of the Calibration Tool firmly, at an angle of approximately 30° to the fence.

3. Set the simulated attack, as required. To increase the intensity of the simulated attack, move the weight up the shaft; to decrease the intensity of the simulated attack, move the weight down the shaft.

> Note:
> **The higher the calibration mark used, the greater will be the force of the impact on the fence.**

4. Drop the weight onto the bottom pin from the set position.

Appendix A

Introduction

A.1 Overview

Commissioning Sheets allow you to record, in a systemized way, all readings made while commissioning a SmarterFence system. As you progress through the procedure, make a note of each reading in the relevant field of the sheet so that you have a record of ALL commissioning activities.

Overleaf is a typical Commissioning Sheet. It may not meet your particular needs, in which case we suggest that you develop your own Commissioning Sheet, using ours as a benchmark.

Table A-1 Typical Commissioning Sheet

		Zones									
Function	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
General											
0	PD Voltage:										
	- adjustment 1										
	- adjustment 2										
	- adjustment 2										
	- adjustment X										
1	PD Attenuation Setting:										
	- adjustment 1										
	- adjustment 2										
	- adjustment 3										
	- adjustment X										
Channel 1-1											
2	Peak Signal:										
	- attack 1										
	- attack 2										
	- attack 3										
	- attack X										
	Current Event Count:										
	- attack 1										
	- attack 2										
	- attack 3										
	- attack X										
3	Event Threshold:										
	- light winds										
	- moderate winds										
	- high winds										
4	Event Count Limit										
5	Event Window										

Continued overleaf…

		Zones									
Function	**Parameter**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Channel 1-2											
b	Peak Signal:										
	- attack 1										
	- attack 2										
	- attack 3										
	- attack X										
	Current Event Count:										
	- attack 1										
	- attack 2										
	- attack 3										
	- attack X										
c	Event Threshold:										
	- light winds										
	- moderate winds										
	- high winds										
d	Event Count Limit										
e	Event Window										
Channel 2											
6	Peak Signal:										
	- attack 1										
	- attack 2										
	- attack 3										
	- attack X										
	Current Duration:										
	- attack 1										
	- attack 2										
	- attack 3										
	- attack X										
7	Event Threshold										
8	Max Event Duration										
9	Event Window										

Appendix B

Fiber optic Terminations

B.1 Sensor Cable Terminations

B.1.1 Introduction

After following the correct installation procedures, sensor cable terminations will need to be performed before the system can be calibrated and commissioned.

B.1.2 Two-Way Splitter

The standard SmarterFence sensor cable contains a pair of fiber optics within the PVC sheath. When using the **Fiber Loop** method of deployment, it is necessary to securely divide the two sensor elements mechanically, using a standard **Two-Way "Y" Splitter**, so that one fiber optic is attached to the Tx connector on the Zone Processor PCB and the other is attached to the Rx connector.

B. 1.3 The following materials are required to perform the split:

- **1 Off - Wrench (6 mm)**
- **1 Off - Razor blade or similar object**
- **1 Off - Crimping tool**
- **1 Off - Heat gun**
- **1 Off - Two way splitter**
- **3 Off - Brass ferrules**
- **3 Off - Crimps**
- **8 inches of .190 inch (4.8 mm) diameter outer sheath**
- **8 inches of .087 inch (2.2 mm) diameter sleeving**
- **2 inches of .195 inch (5 mm) diameter heat shrink tubing**
- **Cyanoacrylate adhesive - As required**

The following installation procedure should be followed.

(a) Using the razor blade or similar object, carefully remove approximately 16 inches (400mm) of the sensor cable outer sheath to reveal the pair of fiber optic elements:

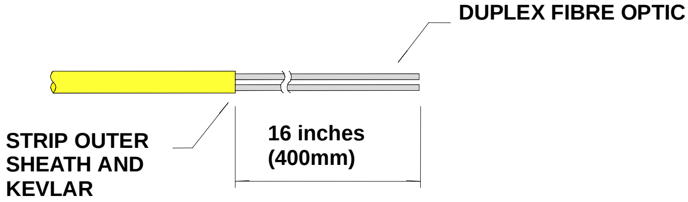


Figure B-1: Outer Sheath Removal

(b) Slide one of the crimps over the cable jacket. Screw one of the brass ferrules into the single channel of the Two-Way ‘Y’ Splitter and tighten using the spanner:

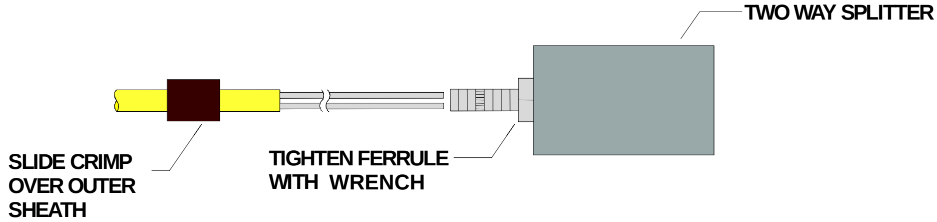


Figure B-2: Positioning Brass Ferrules

(c) Carefully part the two fiber optics and insert them into the brass ferrule. Ensure that the "Y" shaped channel has caused one fiber optic to emerge from each channel:

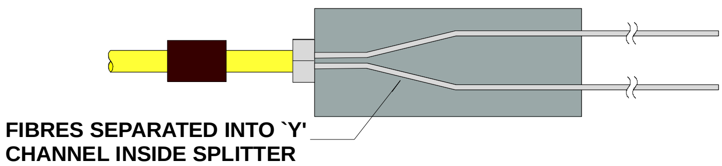


Figure B-3: Parting Fiber optics

(d) Push the sensor cable outer sheath over the brass ferrule until it butts up against the shoulder. Then, slide the crimp up to the shoulder and secure it, using the crimping tool:

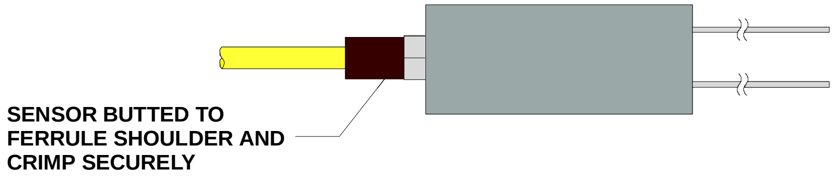


Figure B-4: Securing The Crimp

(e) Slide a brass ferrule over each of the fiber optics (threaded end first) and screw them into the Two-Way ‘Y’ Splitter. Tighten, using the 6mm wrench:

Figure B-5: Fitting Fiber optics into the Two-Way Splitter

(f) Cut two 4 inch (100mm) lengths of the sensor cable outer sheath (from step a) and slide the lengths over each of the fiber optics. Push the outer sheath over the brass ferrule until it butts up to the shoulder. Slide the crimps over each of the sheaths up to the shoulder and secure using the crimping tool.

(g) Cut two 4 inch (100mm) lengths of .087 inch (2.2mm) sleeving and slide them over each of the fiber optics. Apply cyanoacrylate adhesive to approximately .195 inch (5mm) of the .087 inch (2.2mm) sleeving (end nearest to the outer sheath) and insert into the outer sheath. Slide a 1 inch (25mm) length of heat shrink tubing over each of the joints of the sleeving and outer sheath then gently heat using the heat gun.

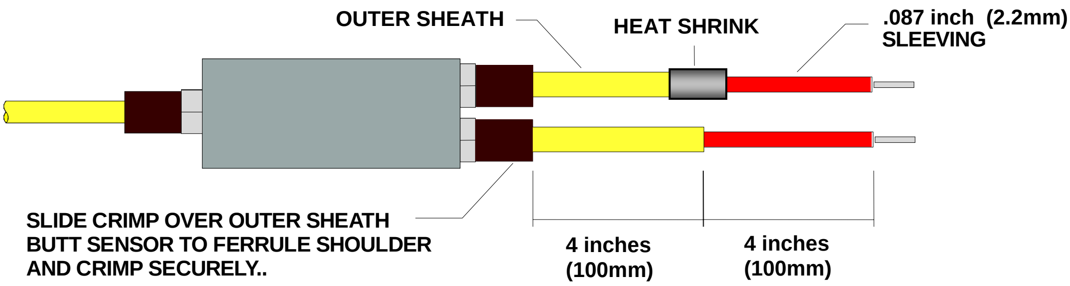


Figure B-6: Completed Assembly

B.1.4 Fiber optic Terminations

To enable the fiber optic to effectively transmit and receive data, it must be properly terminated with the correct connector.

The following materials are required for fiber optic termination:-

- **1 Off – Fiber Optic Cable Strippers**
- **1 Off - Cleaving Tool**
- **1 Off - Epotek 353 ND Adhesive**
- **1 Off - Flash Gun**
- **1 Off - Heat Gun**
- **1 Off - Microscope**
- **2 Off - Polishing Plate**
- **1 Off - Polishing Pad (grey)**
- **1 Off - Polishing Pad (pink)**
- **1 Off - Polishing Pad (dark blue)**
- **1 Off - Polishing Pad (light blue)**
- **1 Off - Polishing/Viewing Block**
- **1 Off - Side Cutters**
- **1 Off per termination – SMA Brass Connector**
- **1 Off per termination – Connector Back Nut**

The following procedure should be followed.

(a) Cut back the fiber optic to reveal 1.2 inches (30mm) protruding from the .087 inch (2.2mm) sleeving and, using the cable strippers, remove the buffer coating:

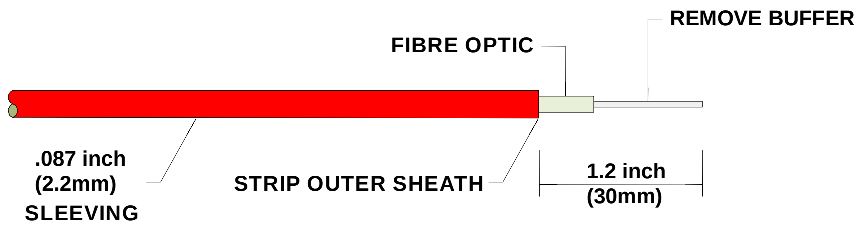


Figure B-7: Removing The Buffer Coating

(b) Slide the back nut over the .087 inch (2.2mm) sleeving, ensuring correct orientation. Mix the Epotek 353 ND adhesive as described on the packet. Apply a small amount of adhesive along the length of the protruding fiber optic and also to within .195 inch (5mm) of the .087 inch (2.2mm) sleeving:

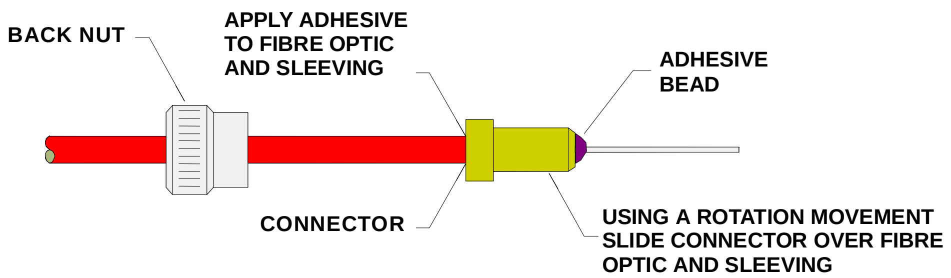


Figure B-8: Fiber optic Bonding

NOTE: To allow the adhesive the bond with the fiber optic, apply a heat source to the adhesive.

(c) Using a gentle rotation movement, slide the connector from the front to the rear until the connector is snug over the sleeving. Now add a small bead of the adhesive to the top of the connector where the fire optic exits. Next, using the heat gun, gently apply heat until the adhesive has cured. The adhesive will change colour from yellow to purple when cured. Allow to cool for several minutes.

(d) Using the cleaving tool, cleave the fiber optic in line with its exit from the connector.

To complete termination, you will need to polish the fiber optic. Follow the procedure below.

(a) Remove the backing paper from the self-adhesive *dark blue* polishing pad and place it on one side of the Polishing Glass. Remove the backing paper from the *light-blue* polishing pad and place it on the other side of the Polishing Glass. Ensure that the pads are securely attached to the Polishing Glass by pressing down firmly.

(b) Liberally soak the dark blue polishing pad with clean water, screw the connector into the polishing block and place the block onto the polishing pad. Polish the end of the fiber optic five times using a figure of eight motion, as illustrated in Figure B-9 below:

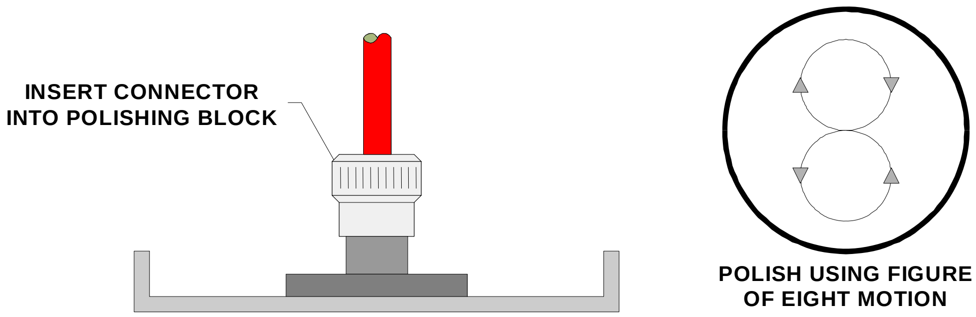


Figure B-9: Polishing Techniques

(c) Repeat the procedure for the other grades of polishing pad in the following order:

- **Pink** Ten Times
- **Gray** Fifteen Times

The polishing pads must be liberally soaked in clean water while polishing is taking place.

(d) Insert the polishing block, complete with polished connector, into the microscope housing and, after focusing the microscope, inspect the polished end of the fiber optic for cracks or blemishes which would make the fiber optic unusable. If cracks or blemishes are found, repeat the procedure until all defects have been polished out. If the defect is major, it may be necessary to cut off the old connector using the side cutters, fit a new connector and repeat the termination procedure.

B.1.5 Fibrlok Optical Fiber Splicing

The Fibrlok optical fiber splicing system provides permanent mechanical splices for single or multi mode fiber with 125µm diameter cladding. Three color coded versions of the Fibrlok splice are available for splicing 250µm and 900µm diameter plastic coated fiber:

- **The 2525 Fibrlok splice is for splicing 250 µm fiber to 250 µm fiber**
- **The 2590 Fibrlok splice is for splicing 250 µm fiber to 900 µm fiber**
- **The 2599 Fibrlok splice is for splicing 900 µm fiber to 900 µm fiber**

The 2500 Fibrlok assembly tool is used to assemble all three versions of the Fibrlok splice.

The following tools and materials are needed:

- **1 Off - Cleaving Tool**
- **1 Off - Razor Blade or similar**
- **1 Off - Cable Stripper**
- **1 Off - Fiberlok Assembly Tool**
- **1 or 2 Off - Fiberlok Splice**
- **1 or 2 Off - Enclosure Plastic**
- **2 or 4 - Cable Tie**
- **1 or 2 - Self-Adhesive Clip**
- **Cyanoacrylate - as required**

To prepare the fiber for a Fibrlok splice:

(a) Open the buffer tube and/or fiber bundle to provide at least 5.9" (15cm) of fiber. More may be required depending on the work area layout, the amount of slack fiber stored in an organizer etc.

(b) Strip 2 to 3" (5 to 8cm) of plastic coating from the fiber using a cable stripper. Take care to form a square shoulder on the coating:

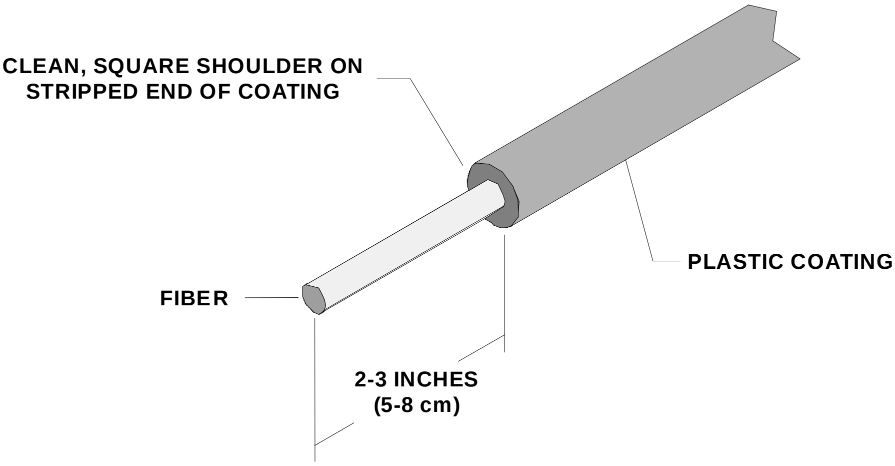


Figure B-10: Forming a Square Shoulder

(c) The cable stripper used should be in good operational condition to prevent scratches or other damage to the glass cladding.

(d) Clean the bare glass by pulling the fiber through a clean, alcohol-soaked pad. This will remove any fragments of plastic or dirt remaining on the fiber.

The best method for cleaning fiber is to use lint-free wipes and isopropyl alcohol and to limit the number of times you wipe the fiber to twice. Also, the bare fiber should be exposed to the atmosphere for a minimum amount of time.

> **NOTE**: Storage and use of isopropyl alcohol should be according to company practice. Carefully follow the health and safety instructions on the isopropyl alcohol label or the material safety data sheet.

(e) Cleave the fiber to the length indicated on the table overpage. The cleaver should be in good operating condition and used in accordance with the manufacturer's instructions. A cleave angle within 1.5 degrees of perpendicular to the fiber axis is necessary for a low loss splice. Dispose of cleaved fiber ends according to company practice.

Fibrlok Splice Designation	**Cleave Length for End of Splice with Black Plug & ◊ Symbol**	**Cleave Length for End of Splice with White Plug & ◊ Symbol**
3M 2525 Fibrlok (250 µm x 250 µm)	0.492" ± 0.20" (12.5 mm ± 0.5 mm)	
3M 2590 Fibrlok (250 µm x 900 µm)	0.492" ± 0.20" 12.5 mm ± 0.5 mm)	0.551" ± 0.20" (14.0 mm ± 0.5 mm)
3M 2599 Fibrlok (900 µm x 900 µm)		0.551" ± 0.20" (14.0 mm ± 0.5 mm)

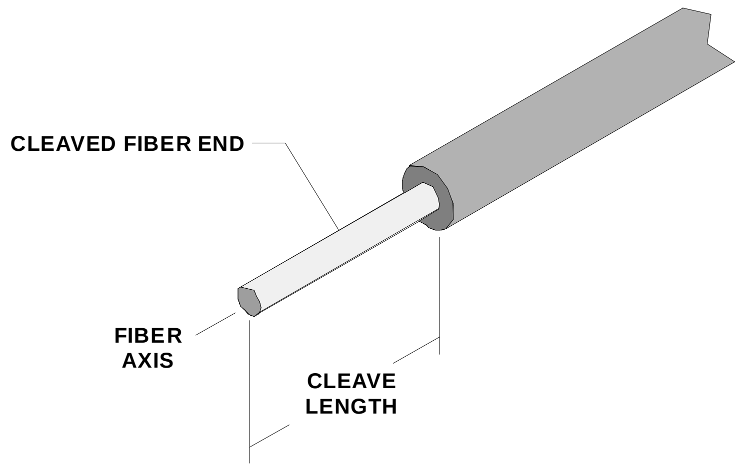


Figure B-11: Fiber/Cleave Length

(f) Check the cleave length using the cleave length gauge on the Fibrlok assembly tool. Adjust the cleaver to provide the prescribed cleave lengths. Check cleave lengths periodically during subsequent splicing operations.

To assemble the Fibrlok splice, follow the procedure below.

NOTE: The Fibrlok splice assembly area should be clean, dry and well lit. Organization of preparation and assembly tools should be such that each tool may be used as described in practice without interfering with other fibers or splices or increasing the risk of contamination of fibers or splice with dirt. Use a lint-free cloth to wipe off any gel or debris from the fiber alignment guides on the Fiberlok assembly tool before beginning splice assembly.

(a) Remove the Fibrlok splice from the protective package. Do not remove the seals on other splices until ready for use. Carefully follow the health and safety instructions on the Fibrlok splice label or the material safety data sheet.

(b) Place the Fibrlok into the holding cradle on the Fibrlok assembly tool. Note the fiber designation circles on the splice; they indicate which ends receive the 250 µm and 900 µm coatings. Do not push down on the cap when inserting the splice into the holding cradle. Instead, push down on the ends of the splice.

(c) Prepare the first fiber to be inserted into the splice. Note that when a 250µm fiber splices to a 900µm fiber, the 250µm fiber should be prepared and inserted first. Push the fiber down into the fiber retention pad on the correct side of the splice. Do not allow the fiber's cleaved end to contact any surface before insertion into the splice.

(d) Grasp the coated fiber about ¼" (6mm) from the bare glass and move the fiber end onto the fiber alignment guide on the assembly tool, such that the end is resting on the alignment guide outside of the splice.

The Fiber should be inserted into the splice immediately following cleaning and placing in the retention pad to minimize exposure to the atmosphere and reduce the risk of contamination.

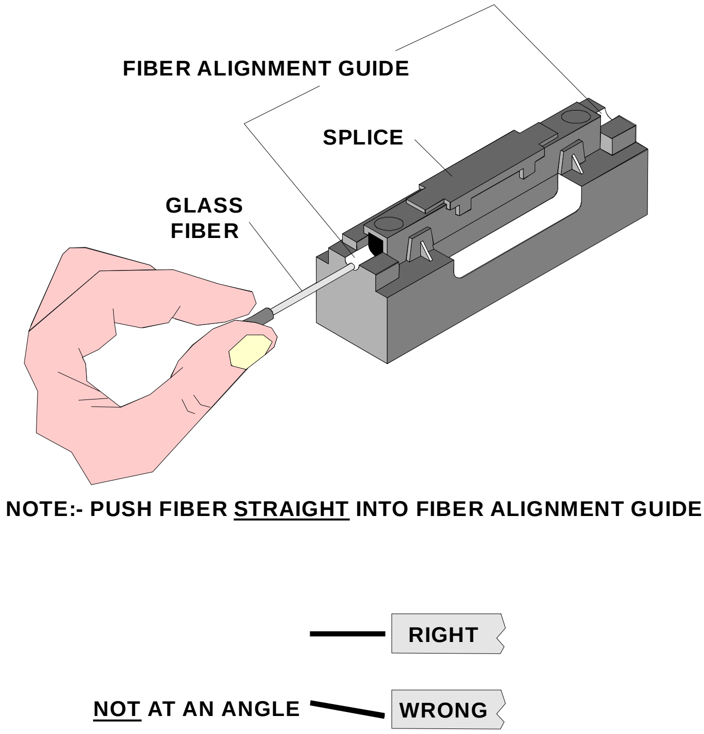


Figure B-12: Inserting Fiber

Push the fiber straight into the fiber alignment guide, as illustrated in Figure B-12.

(e) Continue to gently push the fiber in small increments straight through the alignment guide into the fiber entry port until resistance is felt. Bare glass should **NOT** be visible outside of the splice when the fiber is correctly inserted.

If bare glass is visible outside the splice, pull back slightly on the fiber and continue insertion until resistance is met. Never *fully* remove fibers from the splice after initial insertion.

(f) Following proper insertion, the first fiber should be approximately straight but may have up to a 1" (3mm) bow in it. Prepare the second fiber to be inserted into the splice. Repeat the above for the second fiber.

(g) Gently push the second fiber in small increments through the alignment guide into the fiber entry port. As the coating of the second fiber enters the port, watch for the bow in the first fiber to increase; this occurs when the end face of the second fiber contacts the first fiber and pushes the first fiber slightly to the back of the splice. Continue gently pushing the second fiber until it meets resistance. Following proper insertion the second fiber will be approximately straight but may have up to a 1" (3mm) maximum bow. At this point, the first fiber will have a larger bow than the second fiber (and larger than it had initially).

(h) Push the first fiber back against the second fiber until there are equal bows in both fibers. Do not pull on either of the fibers following establishment of the bows in the first and second fibers. The fiber ends must be held together by the compressive forces induced by the bows to produce a low loss splice.

When installing the 2590 Fibrlok splice, the 250μm coated fiber must be installed first, followed by installation of the 900μm fiber.

Be sure to check cleave lengths, due to the different requirements for 250μm and 900μm coated fibers.

(i) Pivot the handle of the Fibrlok assembly tool downwards until it makes contact with the cap of the Fibrlok splice. Squeeze the handle of the assembly tool as shown in order to close the cap and operate the splice. When possible, secure the tool to a work surface for added support. A snap sound will be heard when the splice is operated.

    It might be necessary to hold down the back of the assembly tool while the handle is pivoting in order to prevent motion of the tool base. Check that the cap is fully closed. If not, press the handle down again on the splice.

(j) Remove the Fibrlok splice from the assembly tool by first removing the fibers from the foam pads and then lifting the splice from the splice holding cradle. No extra step is required to provide strain relief for the fiber. Strain relief is provided by the metal element clamping onto the bare glass fiber.

Do not attempt to "tune" or optimize the splice loss. Fibrlok splices optimize fiber alignment within the metal element inside the splice, when they are properly installed in accordance with the previous instructions.

If the fiber bows are *not* observed as described, repeat the splicing assembly instructions but *do not* fully remove the fibers from the splice. If the bows are *still* not observed, remove the fibers, strip, and recleave, checking for a correct cleave length. Resplice in accordance with the splicing procedure *using a new splice*.

In the event that a splice must be refabricated, cut the fibers at each end of the splice (this will remove 1½" of fiber from the loop) and resplice in accordance with the instructions. Splice refabrication requires a 2" length on each fiber.

NOTE: **NEVER** reuse Fibrlok splices!

B.1.6 Final On-Site Assembly

First, insert the sealing gland into the hole in the electronics unit and lay down a bed of waterproof sealant, as illustrated in Figure B-13.

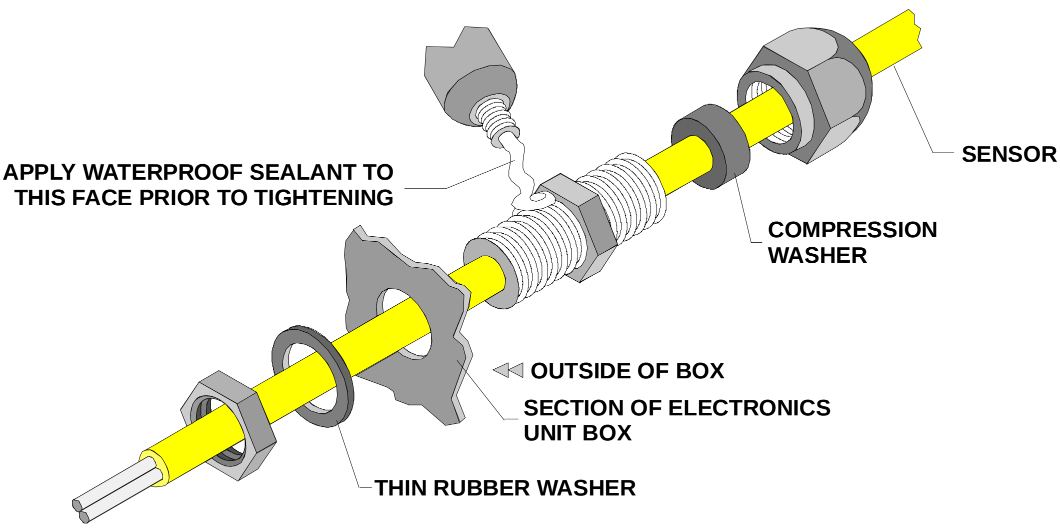


Figure B-13: Final On-Site Assembly

Appendix C

Introduction

C.1 Overview

SmarterFence uses a robust, reinforced fiber optic cable that is regularly pulled through cable ducts and is quite difficult to cut. However, occasionally, you may need to repair the cable, perhaps because to modify the system or repair a cut or break. This requires you to splice the fiber optic cable in such a way that allows continuity of light across the joint.

One splice that can be used for this purpose is the 3M Fibrlok splice.

This section assumes that you are using 3M Fibrlok splices. It does not explain how to perform splicing using this equipment; for this see Appendix C (Section C.5) or refer to the 3M documentation.

C.1.1 Tools and materials required

You need the following tools and materials to insert a repair splice joint:

Smarter Security Part No.	Item	Quantity
SFH100572	cleaving tool	1 off
SFH100586	razor blade or similar	1 off
SFH100579	cable stripper	1 off
SFH100571	Firbrlok assembly tool	1 off
SFC103555	Fibrlok splice	1 or 2 off
SFH100533	enclosure plastic	1 or 2 off
SFH100876	cable tie	2 or 3 off
-	self-adhesive clip	1 or 2 off
-	cyanoacrylate adhesive	-
-	reference literature for the Fibrlok Optical Fiber Splice, supplied by 3M	-

C.1.2 Procedure

The repair procedure differs depending on whether you have used a Cable Loop, Box-to-Box or Fiber Loop deployment.

Cable Loop or Box-to-Box deployments

For a Cable Loop or Box-to-Box deployment, there are two ways to insert a repair splice joint:

- If there is *sufficient* sensor cable left in repair loops to perform a splice, you should joint optically the two fiber optic cables, end-to-end. The repair splice joint is housed in a plastic splice box enclosure, which can be either circular or square, and this enclosure is then attached to the fabric using suitable fixings:

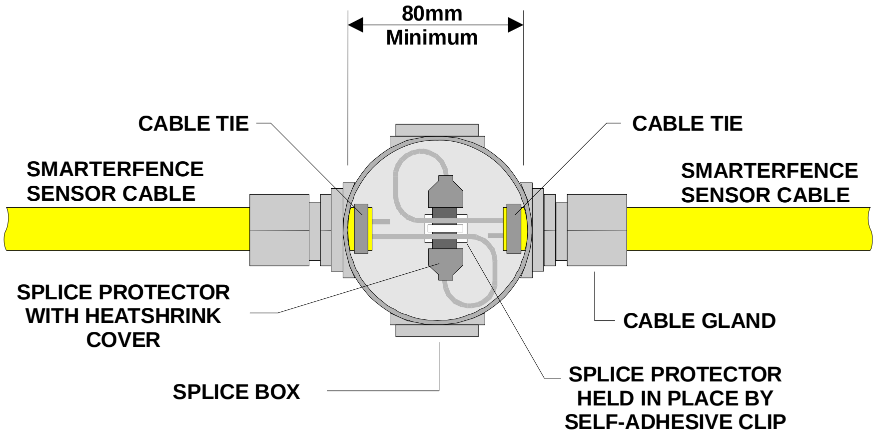


Figure C-1: Repair (Cable Loop/Box-to-Box) with sufficient sensor cable

- If there is *insufficient* sensor cable left to perform a splice, you need to splice a length of spare sensor cable between the two ends of the damaged sensor. This time, the two repair splice joints are housed in separate plastic splice box enclosures, again either circular or square, which are then attached to the fabric using suitable fixings:

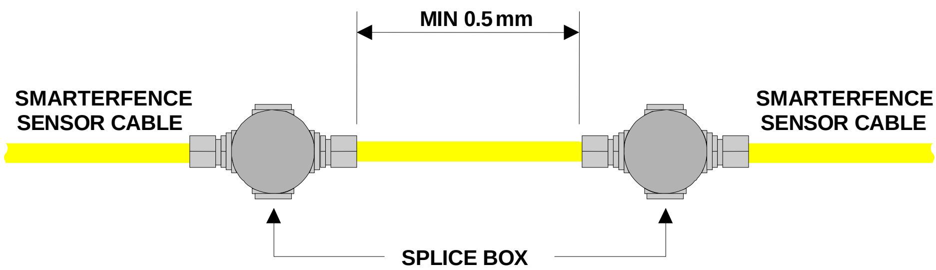


Figure C-2: Repair (Cable Loop and Box-to-Box) with insufficient cable

C.1.3 Fiber Loop deployment

With a Fiber Loop deployment, you need to install two Fibrlok splices in a plastic splice box enclosure, one for each of the two fiber optics. The enclosure can be either circular or square. You then attach the enclosure to the fabric using suitable fixings:

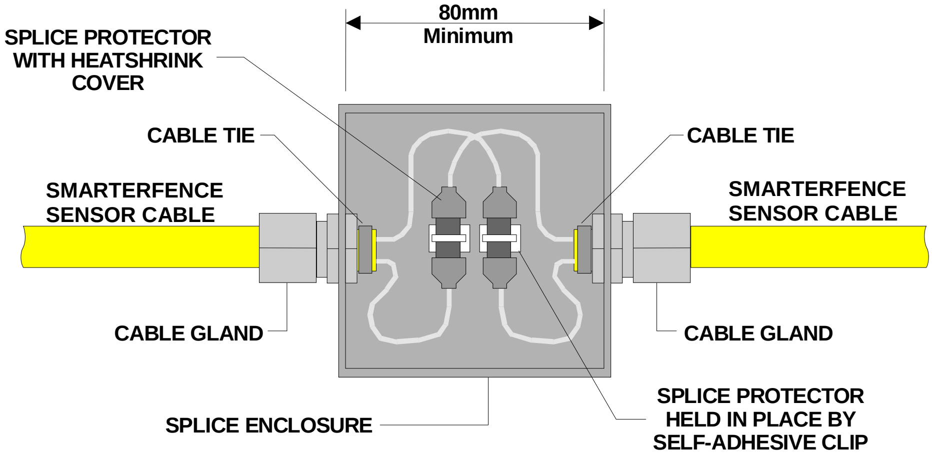


Figure C-3: Repair (Fiber Loop)

Appendix D

Reference	SMARTERFENCE KIT LISTS	Quantity
SF**K100001**	***SmarterFence Splice Kit (Loop)***	
SFH100533	Enclosure	1 off
SFC103555	Fibrlok	1 off
SFH100601	Gland	1 off
SF**K100002**	***SmarterFence Splice Kit (Repair)***	
SFH100533	Enclosure	1 off
SFC103555	Fibrlok	2 off
SFH100601	Gland	2 off
SF**K100003**	***Gate Kit (Pedestrian 3 foot)***	
SFH100602	Box	3 off
SFH100601	Gland	4 off
SFH100706	Conduit	13.5 feet
SFH100705	Conduit Gland	4 off
SFH100994	Gland Nut	4 off
SF**K100004**	***Gate Kit (6 foot)***	
SFH100602	Box	2 off
SFH100601	Gland	3 off
SFH100706	Conduit	16.5 feet
SFH100705	Conduit Gland	3 off
SFH100994	Gland Nut	3 off
SF**K100005**	***Gate Kit (12 foot)***	
SFH100602	Box	4 off
SFH100601	Gland	6 off
SFH100706	Conduit	23 feet
SFH100705	Conduit Gland	6 off
SFH100994	Gland Nut	6 off
SF**K100011**	***Gate Kit (20 foot)***	
SFH100602	Box	4 off
SFH100601	Gland	6 off
SFH100706	Conduit	30 feet
SFH100705	Conduit Gland	6 off
SFH100994	Gland Nut	6 off
SF**K100012**	***SmarterFence Splice Kit (Desensitized Cable)***	
SFH100602	Box	1 off
SFC103555	Fibrlok	2 off
SFH100601	Gland	2 off
SF**K100014**	***SmarterFence Termination Kit, Series (Cable, or Box to Box)***	
SFH100459	Connector	2 off
SFH100592	Connector Nut	2 off
SFH100601	Gland	2 off
SFH100700	Heatshrink	2 off
SFH100703	2.2 Sleeve	0.4 meters
SFC103571	Epotek	1 off
SF**K100015**	***SmarterFence Termination Kit, Sensor (Fiber Loop)***	
SFH100459	Connector	2 off
SFH100592	Connector Nut	2 off
SFH100601	Gland	3 off
SFH100700	Heatshrink	2 off
SFH100703	2.2 Sleeve	0.4 meters
SFC103569	Y-Splitter	1 off
SFH100533	Enclosure	1 off
SFC103555	Fibrlok	1 off
SFC103571	Epotek	1 off

Note:
The parts used in SmarterFence Pre-termination Kits SFK100007 and SFK100008 are the same as those used in Termination Kits SFK100014 and SFK100015 respectively.