FlexPI®

Interior Intrusion Detection Sensor

Product Guide

C8DA0402-001, Rev B
January 13, 2014

SENSTAR™

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Website: www.senstar.com
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Approvals

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

Any changes or modifications to the software or equipment that are not expressly approved by Senstar Corporation void the manufacturer’s warranty, and could void the user’s authority to operate the equipment.

Europe:

This device conforms to EN 61000-6-4: 2001 relating to Electromagnetic compatibility for emission standards for industrial environments.

This device conforms to EN 50130-4: 1995 + amendments A1: 1998 & A2: 2003 relating to Electromagnetic compatibility for immunity requirements for components of fire, intruder, and social alarm systems.

The use of shielded cables is required for compliance.

CE

Senstar Corporation’s Quality Management System is ISO 9001:2008 registered.

Service statement - We ensure that our products are correctly applied to achieve the maximum benefits for the end-user. We work hand-in-hand with our customers and remain accessible through all stages of a project - from concept to deployment to long-term support. We provide design assistance, site surveys, installation support, comprehensive documentation, training, post-installation annual calibration and maintenance visits, electronics and software extended warranty, rapid factory repair service and on-call/emergency service. Contact Senstar Corporation to inquire about how a package can be customized for your unique applications.

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System description

FlexPI is Senstar's interior intrusion detection sensor system that provides protection for assets inside buildings and other structures. FlexPI integrates easily into any existing alarm system and is typically used in unmanned installations in which an alarm will deter most intruders while alerting police or security. Each FlexPI system is a self-contained intrusion detection sensor consisting of a processor, an enclosure, up to 600 m of sensor cable and a terminator. The cable mounting hardware, power supply, alarm communication wiring and alarm annunciator are Customer supplied.

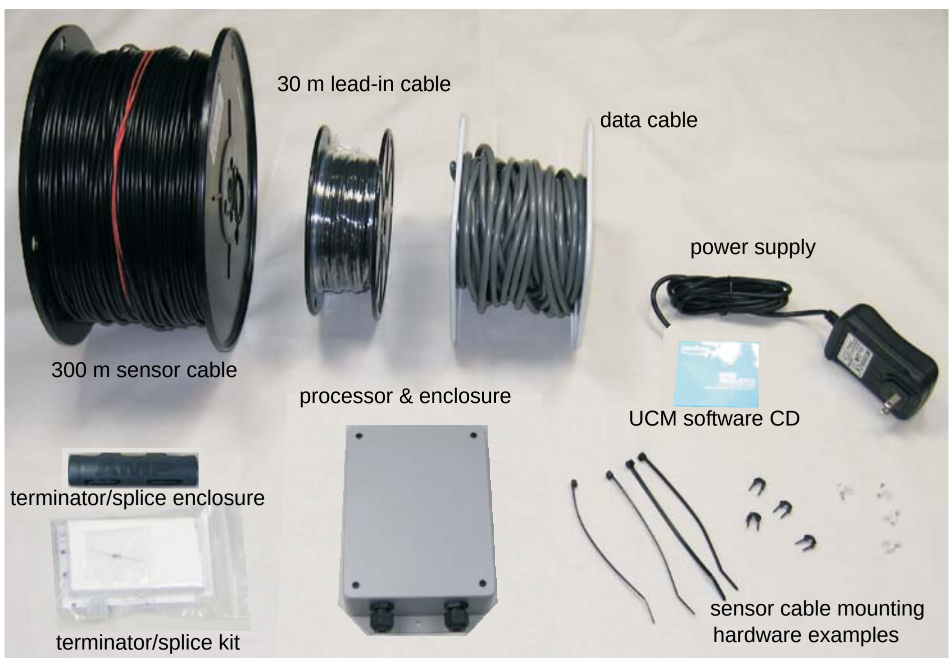


Figure 1: FlexPI system components

The basic FlexPI system requires the following components:		**The following optional components can be added to the basic system:**	
• FlexPI processor & enclosure	• power supply/cable (Customer supplied)	• Universal Configuration Module	• non-sensitive lead-in cable
• sensor cable	• alarm annunciator (Customer supplied)	• metal conduit (Customer supplied)	• cable splice kit
• cable terminator kit	• data cable (Customer supplied)		
• enclosure mounting hardware (Customer supplied)	• cable mounting hardware (Customer supplied)		

Operation & alarm outputs

The FlexPI processor operates on 12 - 48 VDC, and consumes 1 W max. It reports alarm and supervision conditions via two Form C relays. The ALARM relay changes state to indicate a sensor alarm. The SUPERVISION relay changes state to indicate an enclosure tamper condition, a cable fault condition, or a processor fault condition. FlexPI includes a user-selectable onboard audio alarm (beeper) that can be enabled or disabled via the configuration switches. When enabled, the audio alarm follows the state of the ALARM relay (ALARM relay ON = audio alarm ON). There is also a N.O. output labelled SONALERT that can be used to activate a remote alarm. The SONALERT output closes to signal a sensor alarm. The FlexPI processor includes an enclosure tamper switch and supervises the sensor cable, terminator, and lead-in cable (if used). The processor also runs diagnostic self-tests to monitor its internal electronic operation.

Calibration

FlexPI calibration and configuration adjustments are made with either onboard switches or Senstar’s Universal Configuration Module (UCM). The UCM is a Windows-based application that connects directly to the processor via USB and also provides real time diagnostics and sensor plot modes.

The processor includes an LED bar graph that indicates the received signal strength (from the sensor cable). Calibration adjustments include two selectable frequency response bands that optimize the sensor’s response for the protected surface and the expected type of attack. Other detection parameters include the Climb Alarm Settings (sustained attack) the Cut Alarm Settings (number of impacts) Time Window (time in which a sustained attack, or the number of impacts must occur to generate an alarm) Gain Settings (four discrete signal amplification levels).

FlexPI also includes four miscellaneous controls (MISC.) switches that allow you to select the frequency response band, setup the bar graph display, enable or disable the audible alarm output, and select the method of system calibration (onboard switches or UCM).

Sensor cable

The FlexPI sensor cable is a thin diameter (3.6 mm, 0.14 in. O.D. nominal) low profile coaxial cable that is easily mounted on virtually any surface using commercially available fasteners. The cable picks up minute vibrations in the surface, and converts the vibrations into electrical signals. The electrical signals are analyzed by the processor, and when the signals indicate a valid attack, an alarm is declared. Each processor can monitor the signals from up to 600 m (1970 ft.) of sensor cable.

Lead-in cable

The FlexPI lead-in cable is virtually identical to the sensor cable, but does not detect vibrations (non-detecting cable). Lead-in cable is available in 30 m (98 ft.) lengths for installations in which the processor must be located away from the start point of the detection zone. It can also be used to bypass sections of the mounting surface.

Applications

Note	The FlexPI processor is intended for indoor installation. However, it is possible to install the processor indoors, and use lead-in cable to connect the processor to sensor cable that is mounted outdoors.

The FlexPI sensor system provides penetration detection for virtually any type of building material (e.g., brick, stone, concrete slabs, poured concrete, cinder-block, stucco, wood, drywall, ceramic, steel) as well as for security cages, fences, vaults, window casings, doors, ceilings, floors, security grilles, etc. However, due to the different vibration transmission characteristics of each type of building material or surface, the sensor cable from one processor should be mounted on only one type of surface.

Installing a FlexPI system is a four step process:

1. Design the system and obtain the necessary components.
2. Install the sensor cable and terminator.
3. Install the processor and enclosure.
    - power supply
    - alarm communication wiring
    - optional lead-in cable if the processor will be located away from the protected surface
4. Setup and calibrate the system.

Security planning

With security systems, there is a trade off between a high probability of detection (Pd) and an acceptable nuisance alarm rate (NAR). It is important to determine the security requirements and expectations for a FlexPI installation. There are a number of factors, which must be considered when planning the installation. The primary factors are the value of the assets being protected, and the required level of security.

For a high-security application where a sophisticated attack is possible, the sensor cable spacing should be kept at a minimum. This will increase the number of cable passes on the protected surface, and provide the maximum level of protection. Most break-ins occur at the lower levels of a wall, or roof. Therefore, using additional cable passes on the lower 2 m (6.5 ft.) of the wall or roof can provide additional security. For lower security applications, where less sophisticated attacks are more likely (e.g., a smash through intrusion) fewer cable passes can be used to protect the same surface area. Figure 3:, Figure 4: and Figure 5: illustrate high, medium and low security applications.

Another factor is the type of surface. Different types of building materials have different vibration transmission characteristics. Metallic building materials conduct vibrations quite well. Wood, plasterboard, cladding and drywall tend to absorb vibrations. Hollow cinder-block walls are more sensitive than solid block, cement, brick, or stone walls. In addition, masonry and concrete are more difficult to penetrate than drywall, plaster or wooden building materials.

When attaching the sensor cable to the surface, the type and the spacing of the fasteners are both extremely important. The fasteners must hold the sensor cable firmly against the surface without pressing into the jacket. Most of the contact between the cable and the mounting surface occurs at the fasteners. Therefore, using a fastener every 30 cm (1 ft.) will provide good contact between the sensor cable and the mounting surface (see Figure 11:, Figure 13: and Figure 14:). Select fasteners that hold the cable directly against the surface. Do not use fasteners which place a layer between the cable and the mounting surface. This layer prevents direct contact and acts as an insulator.

There are a wide variety of commercially available cable fasteners for use on any type of building material. Even permanent tape can be used to attach the sensor cable. When selecting fasteners, remember that the outside diameter of the sensor cable is 3.6 mm (0.14 in.) nominal. Choose fasteners that hold the cable firmly against the protected surface without pressing into the cable jacket. If you are attaching cable to a stock cage, or fence, use cable ties that are pulled hand-tight. Do not use mechanical cable tie tools. For added security, you can use steel bar ties or twisted wire. However, do not overtighten the bar ties or wires.

Installation rules

- Use one processor and sensor cable on one type of building material. Do not use one processor and sensor cable to protect more than one type of surface.
- The maximum recommended cable spacing is 1.25 m (4 ft.).
- The minimum recommended cable spacing is 30 cm (1 ft.).
- Keep roofs separate from other parts of the installation.
- For roof installation on steel beams, the maximum recommended cable spacing is 1.8 m (6 ft.).
- On roofs with wooden trusses the cable spacing should match the spacing of the trusses, typically 61 cm (2 ft.).
- Sensor cable can be installed directly on the underside of a roof’s surface.
- For increased security, use additional cable passes on the lower levels of walls and roofs (i.e., the first 2 m, 6.6 ft.) which is where most break-ins occur.
- Keep floors separate from other parts of the installation.
- When attaching the sensor cable to a surface area, the cable must be in close contact with the protected surface.
- FlexPI sensor cable can be installed inside metal conduit. The conduit must be in close contact with the protected surface (maximum 1 m, 3.3 ft. separation between fasteners). After cutting the conduit, ensure that there are no burrs or sharp edges that could damage the sensor cable as it is pulled through.
- If windows are included as part of a protected surface, it is recommended that a security grille be installed over the windows. The sensor cable that is protecting the surface should then be installed along the outside edge of each window frame.
- For outdoor surface protection (e.g., fences, walls) install the processor indoors, then use lead-in cable to connect the processor to the sensor cable at the start of the zone. The maximum cable run for lead-in cable is 30 m (98 ft.).

Security cage protection

To protect security cages, attach the sensor cable to the security cage using nylon cable ties spaced 30 cm (1 ft.) apart. The cable spacing depends on the required level of security, with 1 m (3.3 ft.) spacing recommended. The cable should be attached to the secure side of the cage, and cable loops should be used at support posts for increased sensitivity.

Wall protection

To protect walls, FlexPI sensor cable is attached directly to the wall. The cable spacing depends on the required level of security, the building material, and the height of the wall. For areas where the cable may be subject to damage from vandalism or equipment, the cable can be installed inside metal conduit, which is attached to the protected surface. The type of cable fasteners used to attach the cable to the wall also depends on the building material. Cable spacing ranges from a maximum of 1.25 m (4 ft.) to a minimum of 30 cm (1 ft.) and the cable fasteners should be used every 30 cm (1 ft.).

Roof protection

Most roofing materials can be protected from inside the building (see Figure 7:). For large industrial buildings, steel beams are frequently used to support the roof. If the beams are 1.8 m (6 ft.) apart or less, the cable can be attached to the roof beams. If the spacing between beams is greater than 1.8 m, attach the cable to the underside of the roof. For wooden trusses, which are typically 60 cm (2 ft.) apart, the cable should be attached to each truss. This will provide a multiple pass installation which is often necessary on a wooden surface. Proper calibration is critical for roof installation to ensure adequate detection of a break-in attempt, while rejecting the noise and vibration caused by heavy rain.

Floor protection

To protect a floor, you must have access to the underside of the floor. Depending on the type of flooring, you can either attach the sensor cable to the support structure, or to the floor. As with other parts of the building, the type of building material dictates the number of cable passes required.

Embedding sensor cable

With careful planning, the sensor cable can be embedded in walls, floors, or even roofs during construction. The recommended method is to install metal conduit inside the structure during the construction phase. When the construction is complete, the sensor cable can be pulled through the conduit. Using conduit for this type of installation allows the cable to be replaced or repaired if there is cable damage, or a cable fault. Avoid any sharp bends in the conduit. Before installing the conduit, remove any burrs or sharp edges that were created when the sections were cut.

Windows and skylights

Windows and skylights can create a vulnerability for intrusion attempts. The recommended method for window/skylight protection is to install a security grille over the opening, and run sensor cable completely around and in close proximity to the opening (see Figure 6:). In addition, other technologies such as glass breakage detectors and magnetic contacts can be used to increase the level of security for windows and skylights.

Pipes and data cables

The FlexPI system can be used to protect pipes and data cables (see Figure 8: and Figure 9:). To protect a pipe, the Flex sensor cable is attached directly to the pipe, typically in a spiral pattern around the outside of the pipe. Any attempt to drill, cut, or otherwise damage the pipe will trigger an alarm. Data cables that carry sensitive information are generally installed inside conduit. The addition of a FlexPI cable to the conduit will provide protection against the penetration of the conduit in an attempt to access the data cable.

Installation examples

The following figures illustrate FlexPI installation on security cages, walls, roofs, pipes and inside conduit.

CAUTION	The fasteners used to attach the sensor cable to the mounting surface must hold the cable firmly against the surface without pressing into the jacket or damaging the cable. The fasteners must be appropriate for the specific type of surface.

Figure 2: Double pass security cage installation

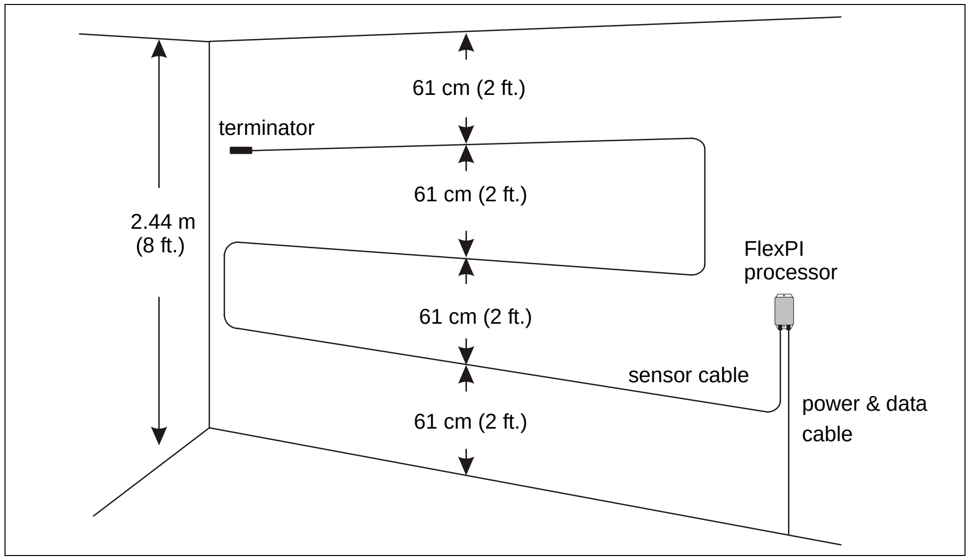


Figure 3: High-security application (triple pass on 8 ft. wall)

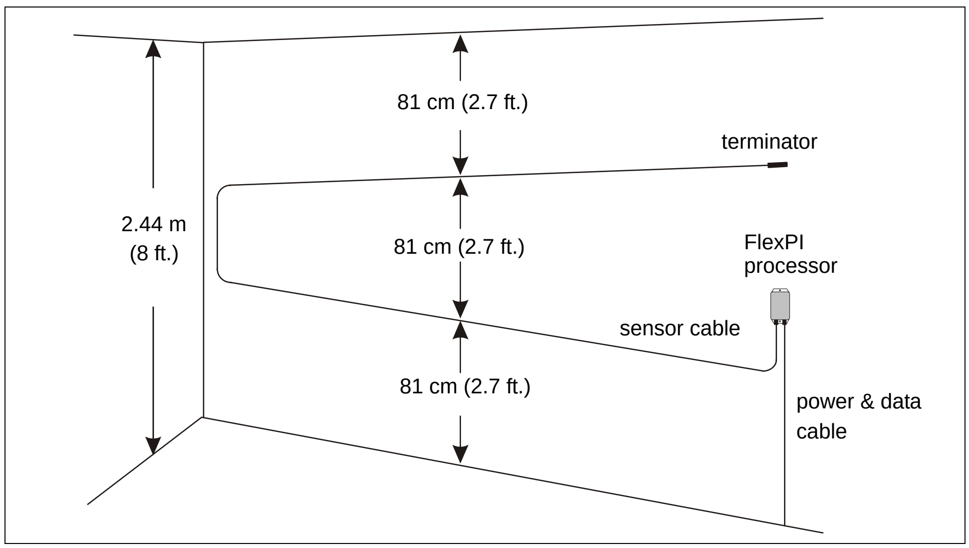


Figure 4: Medium-security application (double pass on 8 ft. wall)

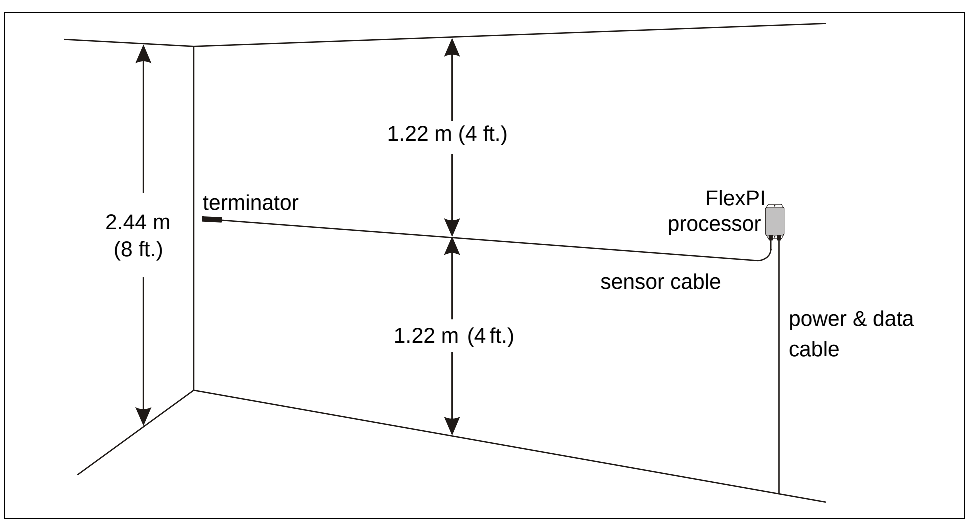


Figure 5: Low-security application (single pass on 8 ft. wall)

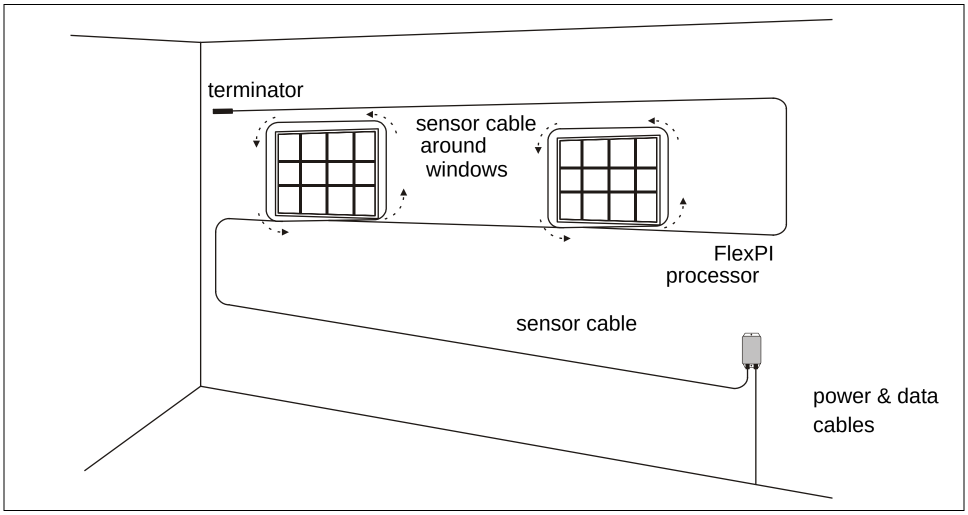


Figure 6: Wall & windows application

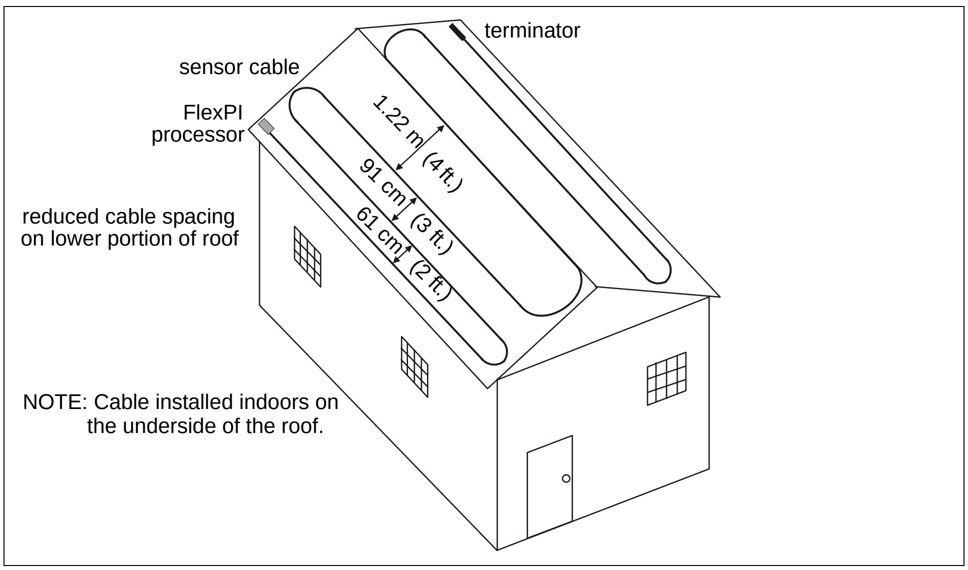


Figure 7: Roof protection

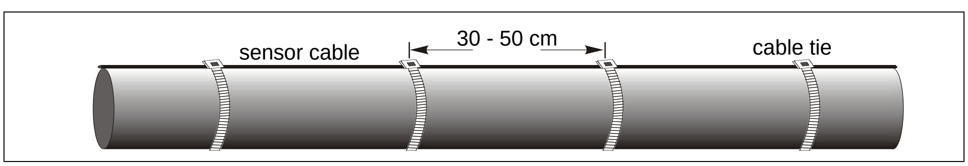


Figure 8: Protecting pipelines

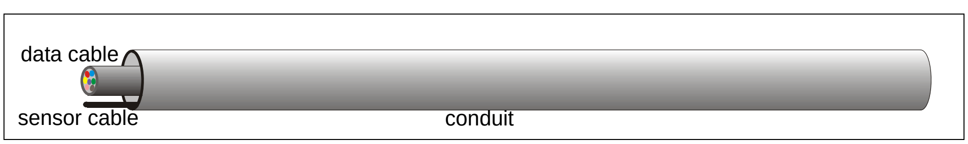


Figure 9: Protecting data cables

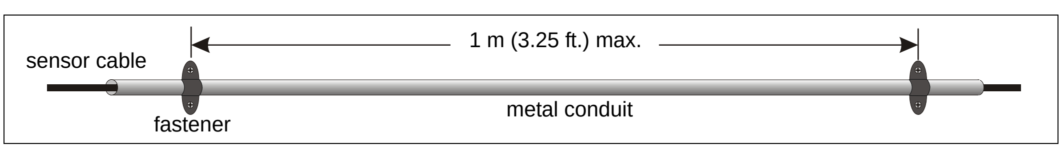


Figure 10: Installing sensor cable in conduit

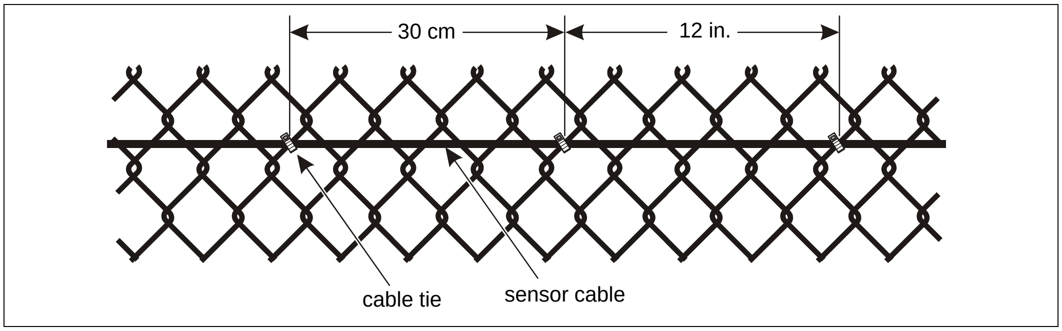


Figure 11: Mounting sensor cable on security cages/fences

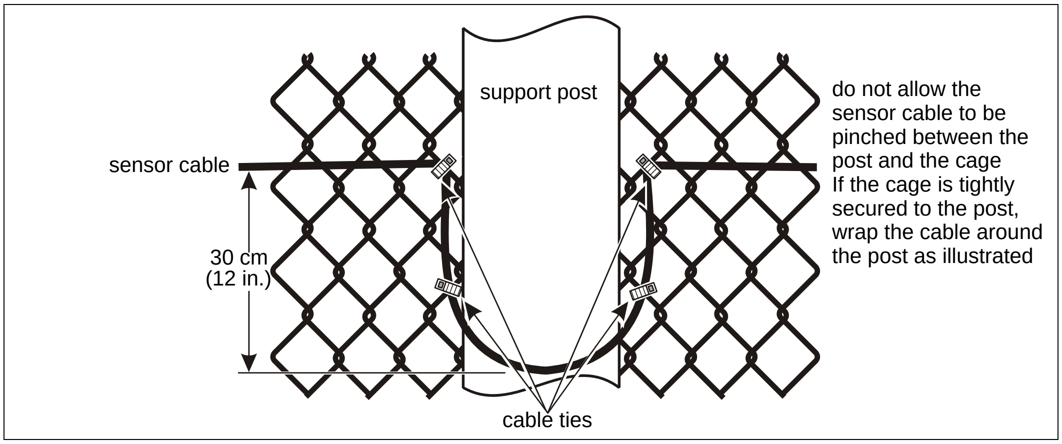


Figure 12: Using cable loops for increased sensitivity

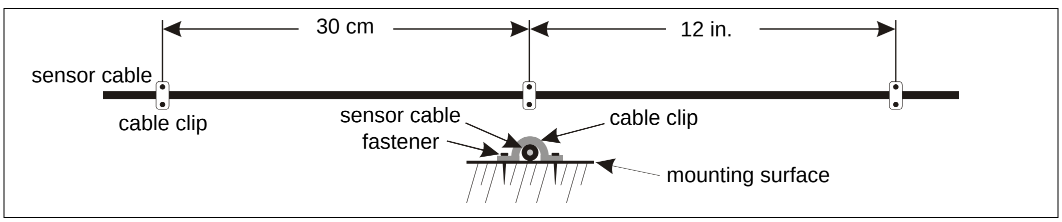


Figure 13: Mounting sensor cable on walls/flat surfaces

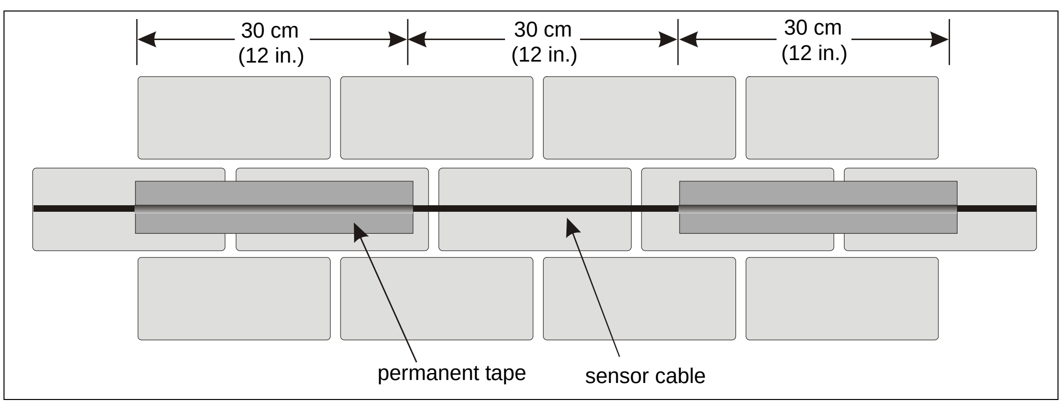


Figure 14: Installing sensor cable with permanent tape

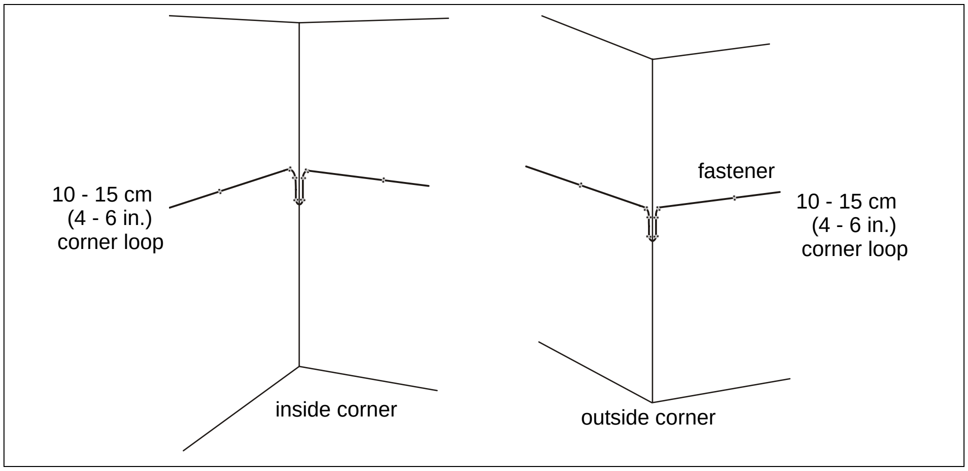


Figure 15: Using corner loops

2 Installation

Installing the sensor cable

The number of cable passes required on the mounting surface depends on the height of the mounting surface, the type of building material, and the required level of security.

- For single cable passes attach the cable horizontally at the half-way height of the mounting surface (see Figure 5:).
- For double cable passes, space the cable evenly between the bottom and the top of the mounting surface (e.g., for a 3 m {10 ft.} wall with two cable passes one pass should be at the 1 m {3.3 ft.} level and the second pass should be at the 2 m {6.6 ft.} level) (see Figure 4:).
- For a triple cable pass space the cable evenly between the bottom and the top of the mounting surface (see Figure 3:).

Cable handling

CAUTION	Handle the FlexPI sensor cable with care.

The FlexPI sensor cable converts vibrations in the mounting surface into electrical signals, which the cable carries back to the processor for analysis. Any damage to the sensor cable from mishandling or poor installation practices will have a negative effect on performance. The following is a list of cable handling Do’s and Don’ts.

- Apply consistent light tension (approximately 2.25 kg, 5 lbs) while mounting the sensor cable.
- Install the sensor cable in metal conduit if the cable is being installed in an area where it may be prone to damage from vandalism, equipment, or materials (see Figure 10:). DO NOT use plastic conduit.
- When using cable ties to attach the sensor cable to a security cage, install the ties by hand and pull them hand-tight until snug (see Figure 11:).
- DO NOT use mechanical tighteners to attach cable ties to a security cage.
- When attaching the sensor cable to a flat mounting surface, use fasteners that hold the cable firmly against the surface without squeezing or distorting the cable jacket (see Figure 13:).
- DO NOT use a staple gun to attach the sensor cable to a mounting surface.
- DO NOT allow the sensor cable to be pinched between the mounting surface and any object.
- DO NOT bend, twist, or kink the sensor cable.
- DO NOT place objects on the sensor cable or allow anyone to stand or walk on the cable.
- Use cable loops near support structures such as wooden studs, steel beams, posts, etc. as the support members can have a dampening effect on vibrations (see Figure 12:).

Installing cable on security cages

Figure 2: shows a double cable pass installation on a 3 m (10 ft.) security cage.

- Use nylon cable ties spaced about 30 cm (12 in.) apart to attach the FlexPI sensor cable to the security cage.
- Attach the cable ties to the center of each fence link (not at the junctions).
- Pull the cable ties until they are hand tight and the cable is snug to the fence.
- Attach the sensor cable to the secure side of the cage (the side opposite the threat).
- Space the sensor wire evenly on the security cage.
- The recommended separation between cable passes on security cages is 1 m (3.3 ft.).
- Create 30 cm loops at support posts for increased sensitivity.
- To install sensor cable on security cage doors or gates, run the cable from the cage to the door at the hinged side of the door. Ensure that there is enough slack in the cable to allow the door to fully open and close. Ensure that the cable cannot be caught and pinched when the door closes. Run the cable once completely around the door between 15 and 30 cm from the edge of the door. Run the cable from the door back to the cage at the hinged side of the door. Continue installing the cable on the security cage. Figure 16: illustrates sensor cable installation on a security cage door.

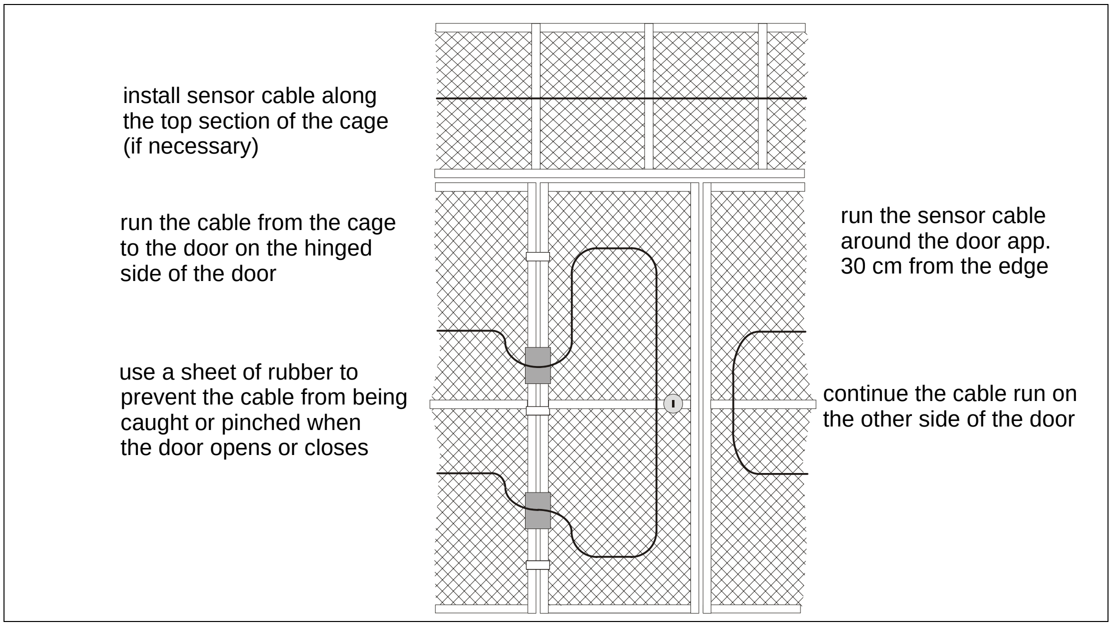


Figure 16: Installing sensor cable on cage doors and gates

Installing cable on walls

The cable spacing depends on the type of building material and the required level of security. The maximum recommended spacing for any type of wall surface is 1.25 m (4 ft.). The minimum recommended spacing is 30 cm (1 ft.) (see Figure 3:, Figure 4: and Figure 5:). When attaching the sensor cable to the mounting surface use fasteners that hold the cable firmly against the surface and space the fasteners approximately 30 cm apart (see Figure 13: and Figure 14:).

- Begin at the processor location, or if using lead-in cable, at the designated start point of the zone, and attach the cable to the wall. Leave 0.5 m (20 in.) of sensor cable at the start point, to make the connection.
- Run the cable along the surface parallel to the floor, using a fastener every 30 cm (1 ft.).

- To continue the cable run around corners, form 10 to 15 cm (4 to 6 in.) cable loops at the corners (see Figure 15:). Do not make a sharp bend in the cable to go around a corner.
- To double-back the sensor cable for multiple cable pass installations, use two smooth, rounded 90º turns.
- Cut the sensor cable approximately 15 cm (6 in.) past the specified terminator location. (For outdoor installation, leave 0.5 m (20 in.) of sensor cable to form a drip loop.

Installing cable on roofs

Install the sensor cable inside the building, on the underside of the roof (see Figure 7:).

- For large industrial buildings with steel beams, install the cable on the beams.
- Space the cable 1.8 m (6 ft.) apart or less.
- If the beams are farther apart, attach the cable to the underside of the roof.
- For wooden trusses, attach the cable to each truss.
- Proper calibration is critical for roof installation to ensure adequate detection of a break-in attempt, while rejecting the noise and vibration caused by heavy rain.

Installing cable on floors

Attach the cable to the underside of the floor, either directly to the subfloor, or to the support structure. Base the number of cable passes required, on the type of floor.

Embedding sensor cable in buildings and walls

This type of installation requires the installation of metal conduit inside the walls during the construction of the building. Senstar recommends hiring an electrical contractor with extensive experience in conduit installation to embed sensor cables.

Protecting windows and skylights

To use FlexPI to protect windows and skylights, run the cable along the wall or roof to the window or skylight and then loop the cable once around. The cable should be installed close to the opening and should be installed only on the same type of surface as the rest of the structure. In addition, install a security grille over the window/skylight to prevent a quick smash through intrusion. (see Figure 6:).

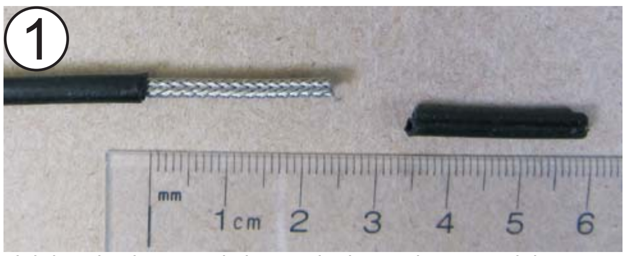
Protecting pipes and data cables

To protect pipes, attach the sensor cable directly to the outside of the pipe, in a spiral pattern (use 30 cm, 12 in. spacing). To protect data cables, install the sensor cable inside the conduit with the data cable (see Figure 8: and Figure 9:).

Installing terminators

The FlexPI sensor cable must be properly terminated, to enable processor supervision of the cable. To terminate the sensor cable, a terminal block is used to install a 1 MΩ resistor between the center conductor and the shield at the end of the cable (away from the processor). Once the sensor cable is mounted, you can install the terminator. Begin by cutting the cable at the specified termination point. For outdoor cable installation, cut the cable approximately 0.5 m (20 in.) past the specified termination point to allow for a drip loop. Create the drip loop by raising the enclosure 15 cm (6 in.) above the sensor cable run (see Figure 19:).

Remove 2.5 cm (1 in.) of the outer jacket.
DO NOT nick the braided shield.

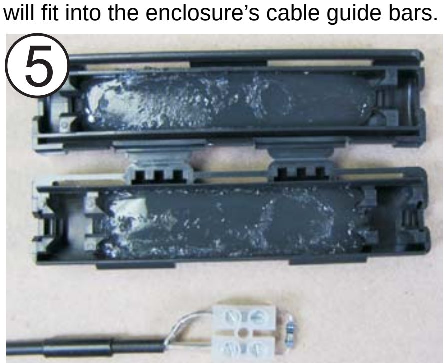


Carefully, separate the strands of the exposed braided shield.

Tightly twist the strands into a single conductor, and then carefully remove 6 mm (0.25 in.) of insulation from the center conductor. DO NOT nick the center conductor.

Insert the twisted shield into one of the terminals on the terminal block and tighten the screw. Insert the center conductor into the adjacent terminal and tighten the screw. Insert the termination resistor into the opposing two terminals and tighten the screws.

Line up the terminal block with the center of the enclosure and apply 3 or 4 wraps of electrical tape* where the cable will fit into the enclosure's cable guide bars. (*Or use 2 cable ties.)



Align the tape over the cable guide bars and press the terminal block into the gel in the center of the enclosure. Press the taped section of cable into the cable guide bars. DO NOT remove the gel in the enclosure.

Snap the enclosure shut, ensuring that both tabs are locked into the respective slots.

Using appropriate fasteners, attach the enclosure to the mounting surface.

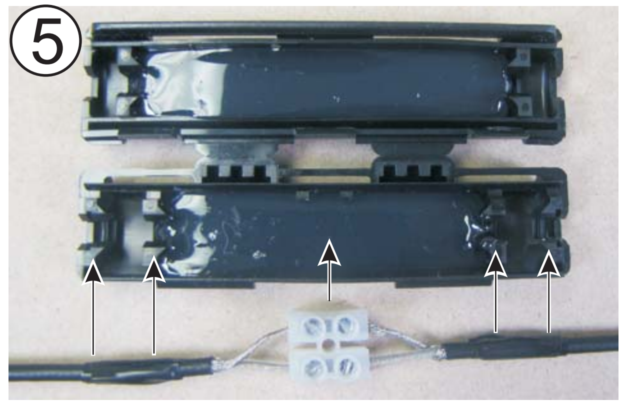
Figure 17: Terminating the sensor cable

Splicing cable

Cable splices are made the same way for sensor cable to sensor cable splices and for lead-in cable to sensor cable splices. Begin by installing the cables to the point where the splice will be made. Follow steps 1, 2 and 3 from the termination procedure to prepare the two cables for splicing (see Figure 17:). For outdoor cable-splices you must create 15 cm (6 in.) drip loops (see Figure 19:).

Insert the 2 twisted shields into 2 opposing terminals, and tighten the screws. Insert the 2 center conductors into the 2 adjacent, opposing terminals, and tighten the screws. Ensure that shield meets shield and center conductor meets center conductor.

Line up the terminal block with the center of the splice enclosure, and apply 3 or 4 wraps of electrical tape* at each of the 2 points where the cable will fit into the cable guide bars. (*Or use 2 cable ties.)



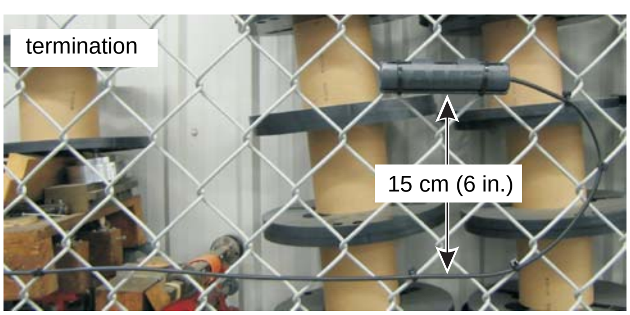
Align the 2 taped sections of cable with the 2 cable guide bars, and press the terminal block into the center of the gel cavity. Press the taped sections of cable firmly into the cable guide bars. Do not remove the gel from the enclosure.

Snap the enclosure shut ensuring that both tabs are locked into the respective slots.

Attach the enclosure to the protected surface using appropriate fasteners.

Figure 18: Splice-connecting sensor cable

Outdoor cable installation



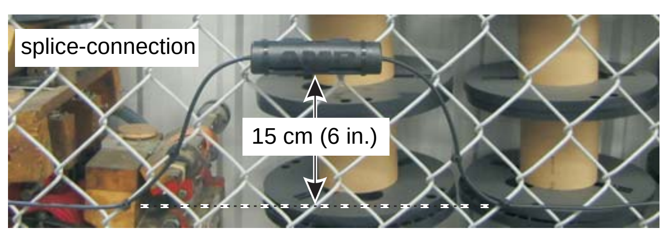


Figure 19: Creating drip loops for outdoor terminations/splice-connections

Installing the processor

FlexPI comes in a shielded, indoor-rated, plastic enclosure. The processor can be mounted at the beginning of the sensor zone by connecting the sensor cable directly to the processor. Alternately, the processor can be mounted up to 30 m away from the beginning of the zone by connecting lead-in cable to the processor and splicing the lead-in to the sensor cable. There are two flanges on the enclosure that include 5 mm (0.375 in.) holes for mounting the enclosure on a flat stable surface. Figure 20: illustrates the FlexPI processor features and Table 1 includes feature descriptions. Figure 21: shows a mounted enclosure. The mounting hardware is customer supplied.

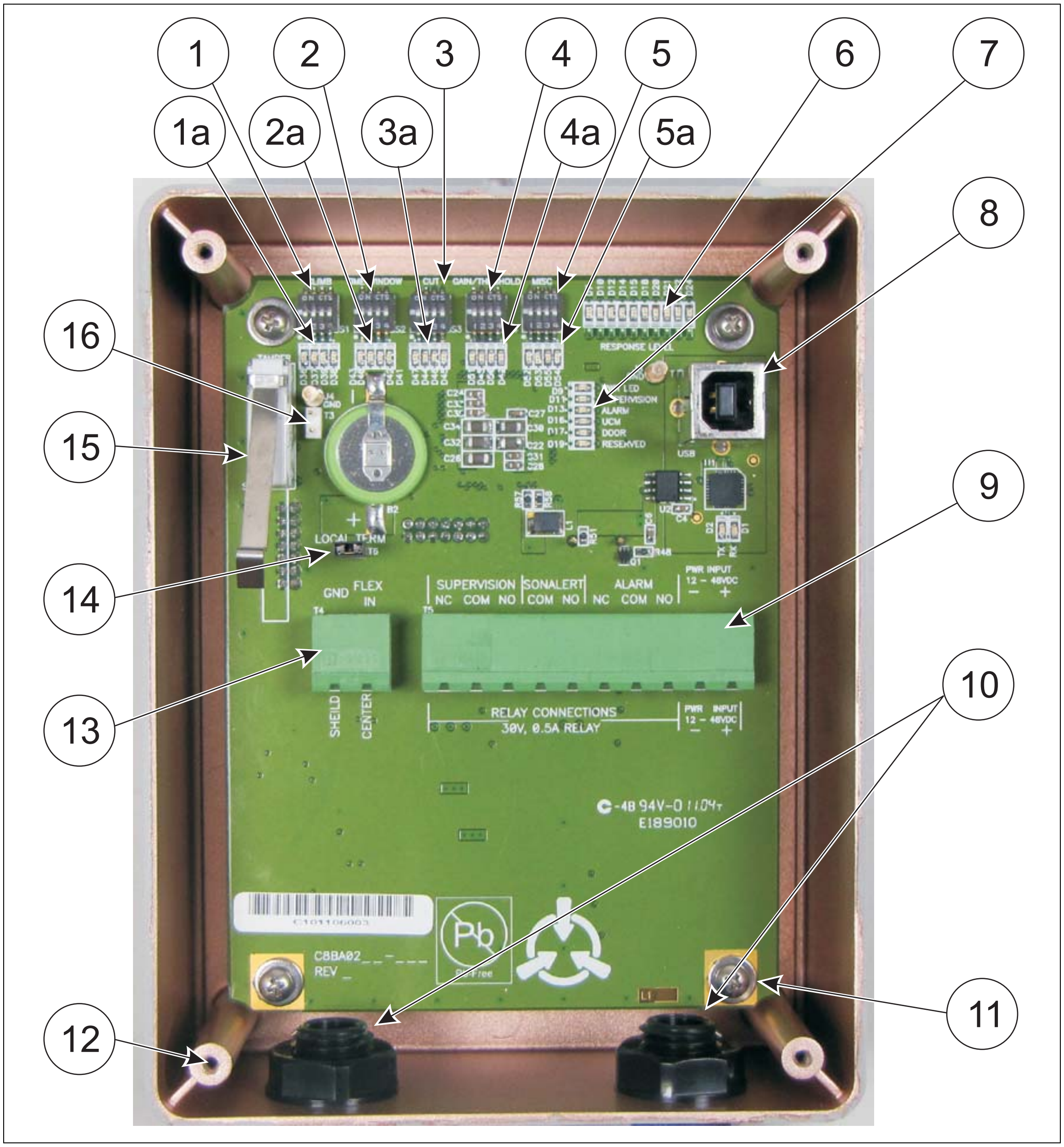


Figure 20: FlexPI processor features

Item	Description	Item	Description
1	S1 - CLIMB switch - Sets the minimum time of a sustained attack that must accumulate before an alarm is declared (0.5 to 7.5 seconds).	6	RESPONSE LEVEL - Bar LED graph indicates the received signal strength from the sensor cable.
1a	CLIMB LEDs - 4 LEDs correspond to 4 Climb switches, LED ON = switch ON.	7	Activity LEDs indicate Power, Supervision condition, Sensor Alarm, UCM, Door.
2	S2 - TIME WINDOW switch - Sets the time period during which the specified number of impacts must occur; OR the period in which the sustained attack time must accumulate before an alarm is declared (8 to 128 seconds).	8	T1 - USB connection to UCM PC.
2a	TIME WINDOW LEDs - 4 LEDs correspond to 4 TIME WINDOW switches, LED ON = switch ON.	9	T5 - RELAY CONNECTIONS - Supervision (P1 - P3); Sonalert (P4 & P5); Alarm (P6 - P8); T5 - POWER INPUT, 12 to 48 VDC, (P9 -VDC, P10 +VDC
3	S3 CUT switch - Sets the number of discrete impacts which must occur within a specified time period for an alarm to be declared (1 to 15 impacts within 8 to 128 seconds).	10	Cable entry port compression glands (power cable, alarm data cable, sensor cable).
3a	CUT LEDs - 4 LEDs correspond to 4 Cut switches, LED ON = switch ON.	11	PCB mounting screws (X 4).
4	S4 GAIN/THRESHOLD switch - Sets the input signal amplification before the signal is processed - 4 settings from 1 (low) to 4 (high)	12	Enclosure cover mounting holes (X4).
4a	GAIN/THRESHOLD LEDs - 4 LEDs correspond to 4 Gain settings, LED ON = switch ON.	13	T4 - SENSOR CABLE connection (GND/ SHIELD - connect twisted braided shield; FLEX IN/CENTER - connect center conductor).
5	S5 MISC switch (miscellaneous controls) S5-1 sets the frequency band filter response (OFF = high band 300 to 900 Hz; ON = low band 100 to 300 Hz) S5-2 sets the RESPONSE LEVEL bar LED graph mode (OFF = envelope mode; ON = peak mode) Envelope mode shows an averaged signal response for an impact; Peak mode shows the peak signal response for an impact S5-3 controls the onboard audio alarm (OFF = audio alarm disabled; ON = audio alarm enabled). S5-4 sets the processor calibration mode (OFF = UCM calibration; ON = onboard switch calibration).	14	T6 - LOCAL TERMINATION header, provides onboard cable termination for troubleshooting - remove the shunt if a properly terminated sensor cable is connected to the processor.
		15	Enclosure cover tamper switch and tamper switch lever. (When the tamper switch is closed, the onboard LEDs are OFF to conserve power.)
5a	MISC LEDs - 4 LEDs correspond to 4 MISC switches, LED ON = switch ON	16	T3 - Tamper switch bypass header. Installing a shunt on T3 disables the enclosure tamper circuit. Note that an enclosure tamper condition must exist for the UCM to connect to the processor.

Table 1 Processor features

Figure 21: Enclosure mounting

Connecting the sensor cable or lead-in cable

The processor to sensor cable connection is made on a removable terminal block. First, prepare the cable. Then install the cable in the terminal block and connect the terminal block to the sensor cable input (T4). Sensor cable and lead-in cable connections are made exactly the same way. Figure 22: illustrates the sensor cable connection procedure. Pass the sensor cable (or lead-in cable) through the left side cable gland. Prepare the cable for connection by following steps 1, 2 and 3 in Figure 17:.

Insert the twisted shield and center conductor into the terminal block, as indicated, and tighten the screws.

Insert the terminal block into T4, and tighten the cable gland.

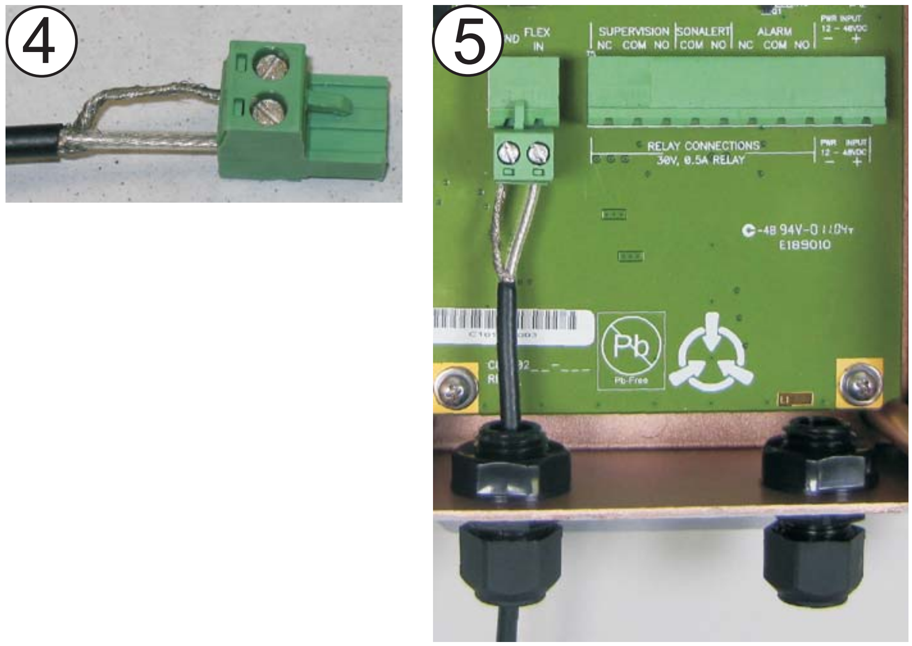
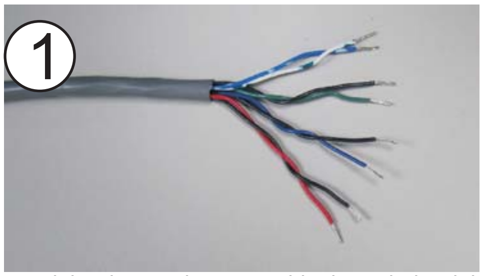


Figure 22: Connecting the sensor cable/lead-in cable

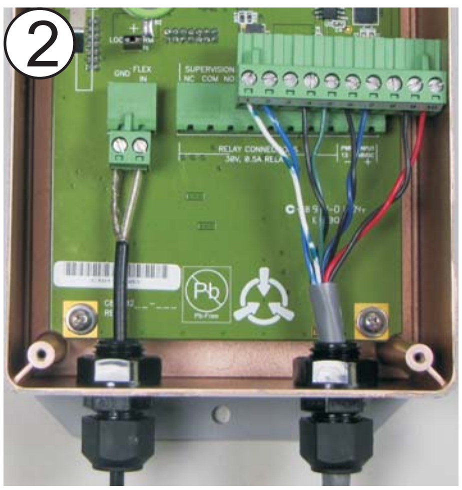
Wiring the processor

You make FlexPI processor wiring connections on removable terminal blocks. The screw terminals accept wire sizes from 12 to 24 AWG, with a 6 mm (0.25 in.) strip length. Remove the terminal blocks to make the wiring connections. Reinstall the blocks after the connections are complete, and verified. Figure 23: shows the sensor cable to processor connection procedure. Figure 24: shows the input/output wiring connections to the FlexPI processor.

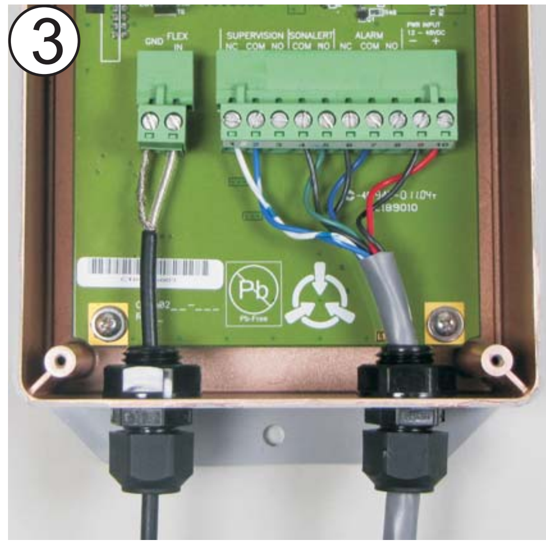
Carefully remove 6 mm (0.25 in.) of insulation from the alarm data and power wires.



Feed the data and power cable through the right side cable gland, remove terminal block T5 and install the wires in the appropriate terminals.



Replace terminal block T5, and tighten the cable gland.



sensor cable   alarm data and power cable

Figure 23: Connecting the data and power cables

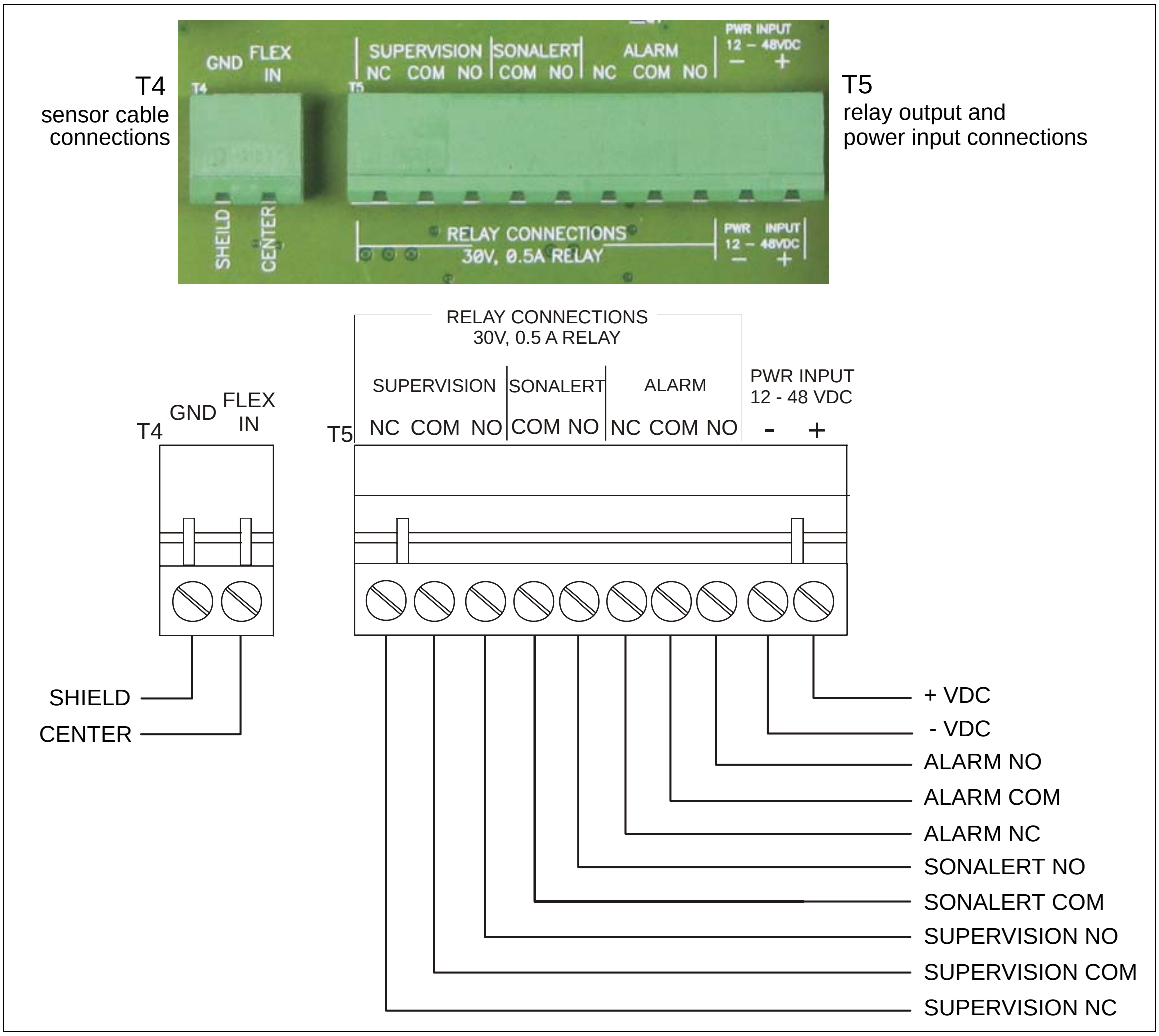


Figure 24: FlexPI wiring diagram

3 Calibration

Introduction

FlexPI calibration can be done two ways, using the onboard switches, or via Senstar's Universal Configuration Module (UCM). The sensor's detection parameters can be adjusted by either method. However, the UCM provides greater control over more features, and allows you to fine tune the sensor's response. The UCM also provides sensor diagnostics, a calibration tool, and detection plot modes.

The following table includes the detection parameter terminology used with E-Flex 3i (a previous generation indoor sensor), the equivalent terms used with FlexPI, and a brief description of each function.

E-Flex 3i term (switches/jumpers)	FlexPI term (switch calibration)	FlexPI term (UCM calibration)	Description
Frequency Band Selector (SW3)	Filter Settings (S5-1)	Filter Settings	sets the sensor's frequency response
Sensitivity Switch (SW2)	Gain/Threshold Settings (S4)	Gain Settings Cable	sets the amplification of the input signal received from the sensor cable, before processing
Impact (Count) Selector (JP4)	Cut (S3)	Cut Alarm Settings Window (sec) Threshold Count Cut Profile (%)	Sets the number and intensity of discrete impacts which must occur, within the specified time Window to trigger an intrusion alarm
Sustained-Attack Time Selector (JP3)	Climb (S1)	Climb Alarm Settings Window (sec) Threshold Time (sec)	Sets the minimum time and intensity of a sustained attack that is required to trigger an intrusion alarm
Impact Time Window Selector (JP5)	Time Window (S2)	For UCM calibration the time settings are included in the Cut Alarm Settings and the Climb Alarm Settings	Cut Alarm - Sets the maximum time in which the specified number of impacts must occur to cause an alarm; Climb Alarm - Sets the time period in which the specified Climb Alarm Time must accumulate to cause an alarm

Calibration setup

The FlexPI sensor is typically used in sites where the sensor is OFF during business hours, and ON when the business is closed. In addition, the activity, motion, vibrations, EMI, temperature and other effects of nearby equipment will vary over time. It is important to consider these changing factors when calibrating the system. FlexPI should be calibrated under the conditions in which it will operate (i.e., if nearby machinery will be OFF when the FlexPI is active, the machinery should be OFF during calibration). If possible, calibrate and test FlexPI for each variation of equipment operation, and for any other changing environmental conditions. For example, if the sensor will be close to heating or cooling equipment that turns ON and OFF regularly, ensure that it is tested with the equipment ON and OFF. A sensor cable mounted on or near a pipe can be calibrated to ignore the steady flow of fluid through the pipe. However, the additional noise created by the passage of fluid through a near-empty pipe could cause nuisance alarms.

During calibration:

- Activate any nearby systems or equipment that create noise or vibrations that will be in operation when the sensor is active.
- Disable any nearby systems or equipment that create noise or vibrations, that will not be in operation while the sensor system is active.

Alarm source simulations

To properly calibrate FlexPI, devise a simulated attack scenario that is a close approximation to the expected threat, and is suitable for the protected surface. For example, To simulate an impact attack (Cut Alarm) strike the surface, using moderate to strong force, with a hard object such as the handle, or blade of a large screwdriver. Wait approximately two seconds between impacts, and wait about four seconds after each Cut Alarm (to allow the processor’s filters to clear).

To simulate a sustained attack (Climb Alarm) on a hard surface (e.g., brick, cinder block, concrete, stone, etc.) press the head of a spinning masonry drill against the surface. For other mounting surfaces (e.g., security cages, drywall, plaster, wood, etc.) use a large screwdriver with a hard, grooved handle. Hold the handle firmly against the surface, and rotate the screwdriver. Wait approximately four seconds after each Climb Alarm (to allow the processor’s filters to clear).

Note	Ensure that the type of alarm simulation being used cannot damage the protected surface during the tests.

Monitoring nuisance alarm sources

For an indoor sensor, the most common sources of nuisance alarms are the equipment and machinery inside the building, and the weather conditions outside the building. If machinery and equipment turn ON and OFF while the FlexPI is active, the accompanying vibrations can affect the sensor. Extreme weather conditions such as strong winds, heavy rain and hail, can also affect the sensor (especially when the sensor is used to protect roofs and exterior walls). You can monitor the effects of machinery and equipment by turning it ON for a period and then OFF with the sensor active (running a UCM Response plot is recommended as an aid to analyzing the effects of the equipment). Monitoring weather effects can also be accomplished by running a UCM Response plot during periods of inclement weather, while the FlexPI system is active.

UCM Calibration

CAUTION	Some of the UCM parameters are available through the Advanced parameters view and should be adjusted only by qualified personnel.

Note	Consult the online help for additional details on UCM operation.

UCM calibration overview

Note	An enclosure tamper condition must exist to establish a UCM connection to the FlexPI processor (enclosure cover - OFF, tamper switch lever - UP, shunt not installed on T3, D17 DOOR LED - ON).

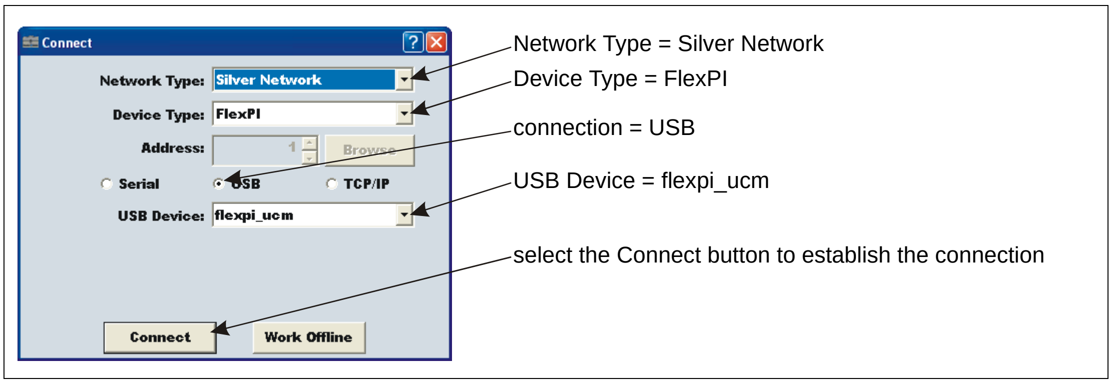


Figure 25: UCM Connect dialog

1. Open the enclosure and set switch S5-4 to the OFF position (UCM calibration).

Note	Switch S5-4 must be set to OFF to operate the FlexPI processor with UCM configuration settings.

2. Cycle the processor power OFF, then ON.
3. Connect the UCM computer to T1 on the processor via USB.
4. Start the UCM software.
5. Select the connect button on the UCM Connect dialog.
   The FlexPI UCM status window opens. The Status window provides information on the current status of the processor and sensor cable.
   FlexPI UCM calibration is done under the Cable Cfig tab. Select the Cable Cfig tab and the Cable Configuration Window opens.
6. Adjust the Filter Settings, set the Gain, and adjust the Cut Alarm and Climb Alarm detection parameters.
7. Save the UCM file and download the settings to the processor.

The Calibrate tool

Use the Calibrate tool to see the effects of Gain and Filter adjustments before changing the processor's settings. First, make the changes using the calibrate tool. Then, view a magnitude or frequency response plot using the new settings while testing the installation. If the changes do not result in the required level of detection, continue making and reviewing adjustments. When the results are satisfactory, download the new parameters to the processor.

UCM detection parameters

UCM Parameter	Parameter description	Default
Cut Alarm Settings	Parameters used to detect an intrusion attempt using cutting, hacking, smash-through, etc. (impact attack)	
Window (sec)	The time period in which the specified number of impacts (Count) must occur to cause an alarm.	30
Threshold	The received signal strength at which an impact is added to the Count total.	10
Count	The number of impacts with signal magnitudes above the Threshold setting that must occur within the specified Window to cause an alarm.	4
Cut Profile (%)	A percentage of the Window setting that is added to the time remaining in the Window each time an impact is added to the Count total.	20%
Climb Alarm Settings	Parameters used to detect an intrusion involving a continuous action such as drilling, boring, sawing, cutting, chiselling, climbing, etc. (sustained attack)	
Window	Sets the time period in which the specified Time of a sustained attack must accumulate to cause an alarm.	30 sec.
Threshold	The received signal strength at which sustained activity is added to the total Time.	10
Time	Sets the period of Time that the received signal must exceed the climb Threshold to cause an alarm. The Time must be accumulated within the climb alarm Window setting.	2 sec.
Filter Settings	The filter settings are used to customize the sensor’s frequency response to the type of mounting surface and the installation environment. Correct adjustment of the Filters increases the signal to noise ratio and helps to screen out the ambient background noise. There are two slider controls, which enable you to set the processor’s frequency response band between 100 Hz and 900 Hz.	lower corner 300 Hz upper corner 700 Hz
Gain Settings	Four settings that amplify/attenuate the received signal from the sensor cable before processing.	
Cable	Sets the processor’s input signal Gain based on the type of mounting surface and installation conditions (1 = low to 4 = high).	2
Misc Settings	A setting used to screen out ambient noise from environmental effects.	
Ambient Compensation	When Ambient Compensation is enabled, the processor evaluates the signals from the sensor cable to obtain data on environmental activity (background noise) that is typically gradual and of long duration. This ambient signal can effectively be ignored and only the signals which are outside this ambient, consistent region, are evaluated for Cut and Climb Alarm significance.	ON
Output Configuration	Two settings used to set the minimum time that the relays remain active following an event.	
Hold/Active Time	The length of time, in seconds, that the alarm relay will activate when an intrusion alarm occurs (0.125 s to 10 s).	2 sec.
	The minimum length of time that the supervision alarm relay will activate when a supervision alarm occurs (0.125 s to 10 s).	2 sec.

Step 1 - Setting the filters

The Filter Settings are used to discriminate between vibrations (frequency response) caused by environmental effects, and vibrations caused by an actual attack. The most important factor when making the Filter Settings is the type of surface on which the sensor cable is mounted. For example, if the sensor cable is installed on a rigid surface that has a dampening effect on vibrations (e.g., wood, drywall, plasterboard, cement, brick, stone, masonry, etc.) the system may benefit from excluding the high frequencies. However, a sensor cable mounted on a stock cage, or sheet metal, or steel structure that conduct vibrations quite well would benefit from excluding the lower frequencies and using the high band.

To verify the sensor's frequency response, open the Calibrate tool and start a Frequency plot. Select Auto Scale and use the vertical magnification buttons to fit the frequency response plot in the window. With the system in a quiescent state with little environmental noise, the response should be minimal. Any frequency spikes on a quiet system indicate a potential problem (interference or mounting surface vibrations).

Note	In most cases, the frequency created by an impact does not vary significantly from that of a sustained attack.

Note	If either the protected surface or any nearby equipment resonates at a frequency within the selectable band (100 to 900 Hz) adjust the Filter Settings to exclude the resonant frequency.

1. Using the sensor's default settings, open the Calibrate tool and start recording a Frequency Response plot.
2. Look at the Frequency Response while the system is quiet. The Frequency Response should be low and flat.
3. Simulate impact attacks along the protected surface using similar levels of force in each test area.
4. Review the Frequency Response looking for any frequencies at which the results were significantly higher or lower than the average response.

Note	The response should be similar throughout the zone for impacts of similar force. If the response increases, or decreases, dramatically in an area even though the force used is consistent and the mounting surface conditions are unchanged, there may be a "sweet spot" or a "low spot" affecting the signal. If this occurs, use the filters to exclude the affected frequencies.

5. If required, adjust the Filter Settings, apply the changes and repeat the tests to obtain a fairly consistent Frequency Response over the length of the cable.
6. Once the Frequency response is adequate close the Calibrate tool, save the UCM file, and download the new settings to the processor.

Step 2 - Calibrating the Gain Settings

The Cable Gain is used to amplify the input signal from the sensor cable before it is processed. FlexPI has four Cable Gain Settings ranging from 1 (lowest) to 4 (highest).

Note	Although the Cable Gain amplifies the received detection signal it also amplifies the environmental background noise. Use care when adjusting the Gain.

1. Using the sensor's default Gain Setting (2) open the Calibrate tool and start recording a Magnitude Response plot.
2. Simulate impact attacks along the protected surface using different levels of force in each test area (e.g., two heavy impacts, followed by two light impacts, followed by two heavy impacts, etc.)

3. Review the Magnitude Response plot. Note the peak responses from the impacts.

Note	The response should be similar for impacts of similar force (heavy impacts = high magnitude, light impacts = low magnitude).

4. If required, adjust the Cable Gain Setting and repeat the tests (i.e., if both the light impacts and the heavy impacts are registering high magnitude responses, lower the Gain one level; if both the light impacts and the heavy impacts are registering low magnitude responses, raise the Gain one level).
5. Once the Gain Setting results in a consistent response with each heavy impact being recorded as a Cut Count, and the light impacts registering with significantly lower magnitudes, the Gain Setting is correct for the installation.
6. Save the UCM file and download the new settings to the processor.

Setting the Cut Alarm parameters (impact attacks)

To properly set the FlexPI detection parameters, simulate a valid attack that is a close approximation to the expected threat. Once the system always alarms in response to the simulated attacks, monitor the system for nuisance alarms (see Monitoring nuisance alarm sources on page 28).

Setting the Threshold

Note	Strike the protected surface close to and away from the cable, Use the lower reading of the two results when setting the Threshold.

1. Start recording a UCM Magnitude response plot tool, and perform the simulated attack scenario along the protected surface.
2. If any of the attack simulations (impacts) do not register as Cut Counts, lower the Cut Alarm Threshold.
3. Repeat this process until each simulated attack (impact) registers as a Cut Count and leads to an alarm.
4. Once the Threshold is set, monitor the system for nuisance alarms. If the nuisance alarm rate (NAR) is unacceptable, try to determine and correct the source. Otherwise, raise the Threshold and continue monitoring the NAR.

Note	If the Threshold is at or very close to the minimum value, and the simulated attack is still not causing an alarm, raise the Cable Gain setting one level, reset the Cut Alarm Threshold to 10, and repeat the tests. If the Threshold is at, or close to the maximum value, and the nuisance alarm rate is unacceptable high, lower the Cable Gain setting one level, reset the Cut Alarm Threshold to 10, and repeat the tests. If performing the above recommendations does not correct the situation, redeploy the sensor cable using reduced cable spacing, while ensuring that the cable is in close contact with the protected surface. Repeat the entire calibration process after modifying the sensor cable layout.

CAUTION	If the Cable Gain setting is adjusted it will also affect the Climb Alarm Threshold. Retest, and if required, adjust the Climb Alarm Settings after changing the Cable Gain.

Setting the cut Count and time Window

The default settings for the cut Count and time Window are based on years of field experience. However, if the security regulations at your facility mandate a specific cut Count and time Window, then adjust the settings accordingly and monitor the system for nuisance alarms. To customize these parameters for your site, set the cut Count and time Window according to the probability of nuisance impacts occurring within a given timeframe. For example, if nuisance impacts can occur, but not in rapid succession, then the Cut Count can be set to 2 with a short Time Window. If nuisance impacts should never occur, a Cut Count of 1 is recommended so that an intruder cannot defeat the system by waiting between impacts.

The Cut Profile

The Cut Profile is an advanced parameter that is used to prevent an intruder with indepth knowledge of the sensor from defeating the system by waiting a specific amount of time between impacts. At the default setting, 20% of the Window setting is added to the time remaining in the Window after each impact. Raising the Cut Profile increases the time added to the time Window each time an impact is recorded. Lowering the Cut Profile decreases the time added to the time Window each time an impact is recorded.

Note	Save the UCM file and download the new settings to the processor after making configuration changes with the UCM.

Setting the Climb Alarm parameters (sustained attack)

1. Start recording a UCM Magnitude response plot tool, and perform the simulated sustained attack scenario along the protected surface.
2. If the attack simulation does not cause an alarm, lower the Climb Alarm Threshold and repeat the tests.
3. Repeat this process until the simulated attack always causes a Climb alarm.
4. Once the Threshold is set, monitor the system for nuisance alarms. If the nuisance alarm rate (NAR) is unacceptable, try to determine and correct the source. Otherwise, raise the Threshold and continue monitoring the NAR.

Note	If the Threshold is at or very close to the minimum value, and the simulated attack is still not causing an alarm, try raising the Gain one level, reset the Climb Threshold to 10, and repeat the tests. If the Threshold is at, or close to the maximum value, and the nuisance alarm rate is unacceptable high, lower the Cable Gain setting one level, reset the Climb Threshold to 10, and repeat the tests. If performing the above does not correct the situation, you will have to redeploy the sensor cable using reduced cable spacing, while ensuring that the cable is in close contact with the protected surface. Repeat the entire calibration process after modifying the sensor cable layout.

CAUTION	If the Cable Gain is adjusted it will also affect the Cut Alarm Settings. If the Cut Alarm parameters have already been set, retest, and if required, adjust the Cut Alarm parameters after changing the Cable Gain setting.

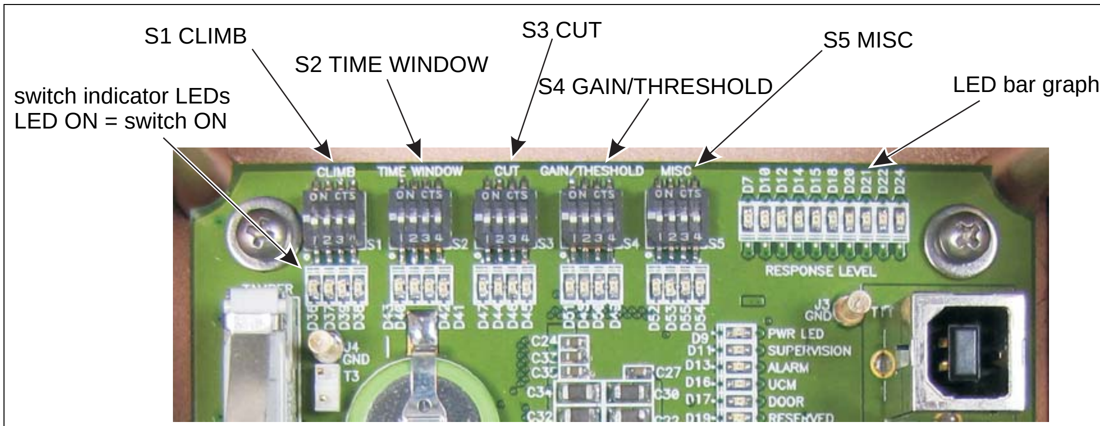
Setting the climb Time and Window

If the security regulations at your facility mandate a specific climb Time and Window, then adjust the settings accordingly and monitor the system for nuisance alarms. To customize these parameters for your site, set the climb Time based on the estimated period of time that it would take an intruder to gain access to the protected area or facility. Be sure to set the climb Time high enough to prevent nuisance alarms, but low enough to ensure an intruder cannot gain access to the site. Set the time Window to include the possibility that an intruder might pause and wait during an attempted break-in.

Onboard Switch calibration

Note	For settings available via the UCM that are not adjustable using the onboard switches, the default values listed in the UCM apply.

FlexPI includes five onboard switches that are used to setup and adjust the processor’s detection parameters, gain, and frequency response filters. Figure 26: illustrates the switches and the switch settings. The label on the inside of the enclosure cover also shows the switch settings.



calibration switch settings

S1 CLIMB

1	2	3	4	
■	■	■	■	DISABLED
□	■	■	■	0.5 SEC
■	□	■	■	1.0 SEC
□	□	■	■	1.5 SEC
■	■	□	■	2.0 SEC
□	■	□	■	2.5 SEC
■	□	□	■	3.0 SEC
□	□	□	■	3.5 SEC
■	■	■	□	4.0 SEC
□	■	■	□	4.5 SEC
■	□	■	□	5.0 SEC
□	□	■	□	5.5 SEC
■	■	□	□	6.0 SEC
□	■	□	□	6.5 SEC
■	□	□	□	7.0 SEC
□	□	□	□	7.5 SEC

S2 TIME WINDOW

1	2	3	4	
■	■	■	■	8 SEC
□	■	■	■	8 SEC
■	□	■	■	16 SEC
□	□	■	■	32 SEC
■	■	□	■	64 SEC
□	■	□	■	128 SEC

S4 GAIN/THRESHOLD

1	2	3	4	
■	■	■	■	GAIN = 1
□	■	■	■	GAIN = 2
■	□	■	■	GAIN = 3
□	□	■	■	GAIN = 4

S3 CUT

1	2	3	4	
■	■	■	■	DISABLED
□	■	■	■	1 IMPACT
■	□	■	■	2 IMPACTS
□	□	■	■	3 IMPACTS
■	■	□	■	4 IMPACTS
□	■	□	■	5 IMPACTS
■	□	□	■	6 IMPACTS
□	□	□	■	7 IMPACTS
■	■	■	□	8 IMPACTS
□	■	■	□	9 IMPACTS
■	□	■	□	10 IMPACTS
□	□	■	□	11 IMPACTS
■	■	□	□	12 IMPACTS
□	■	□	□	13 IMPACTS
■	□	□	□	14 IMPACTS
□	□	□	□	15 IMPACTS

S5 MISC

S5-1	■	HIGH BAND FILTER RESPONSE 300 Hz TO 900 Hz
	□	LOW BAND FILTER RESPONSE 100 Hz TO 300 Hz
S5-2	■	BAR GRAPH IN ENVELOPE MODE
	□	BAR GRAPH IN PEAK MODE
S5-3	■	AUDIO ALARM DISABLED
	□	AUDIO ALARM ENABLED
S5-4	■	UCM CALIBRATION
	□	CONFIGURATION SWITCH CALIBRATION

NOTE:

■ = SWITCH OFF LED OFF = SWITCH OFF

□ = SWITCH ON LED ON = SWITCH ON

Figure 26: Calibration switches

To calibrate the FlexPI sensor via the onboard switches:

1. Set switch S5-4 to the ON position (switch calibration).

Note	Switch S5-4 must be set to ON to operate the FlexPI processor with switch configuration settings.

2. Reboot the processor (cycle the power OFF, then ON).
3. Toggle the on-board switches to adjust the detection parameters, gain, and filters, as required.
4. Test the settings.

Switch/Parameter	**Parameter description**
S1 Climb (Sustained Attack)	Sets the minimum period of a sustained attack that must accumulate within the specified Time Window to cause an alarm (0.5 to 7.5 seconds). (A sustained attack refers to a continuous action such as drilling, boring, sawing, cutting, digging, chiselling, climbing.) If the Time Window lapses before the Time setting is exceeded, the processor resets both parameters.
S2 Time Window	Sets the maximum time in which the specified Climb Time must accumulate to cause an alarm. AND Sets the maximum time in which the specified number of Cuts (impacts) must occur to cause an alarm. (8 to 128 seconds)
S3 Cut	Sets the number of impacts, which must occur within the specified Time Window to cause an alarm. (1 to 15 impacts)
S4 Gain/Threshold	Sets the processor’s input signal Gain based on the type of mounting surface and the installation conditions. (1 = low, 4 = high)
S5 Misc (controls)	S5-1 OFF sets the filter response to the high band (300 Hz to 900 Hz) S5-1 ON sets the filter response to the low band (100 Hz to 300 Hz) use the low band filter for rigid structures that do not conduct vibrations well such as cement, brick, masonry, wood, drywall, etc. use the high band filter for surfaces that conduct vibrations well such as fencing, sheet metal, steel, etc. S5-2 OFF sets the onboard bar graph to envelope mode S5-2 ON sets the onboard bar graph to peak mode envelope mode shows an averaged response from the sensor cables and provides the most realistic indication of signal strength for calibration; peak mode shows the maximum received signal strength at the processor’s sampling rate S5-3 OFF disables the audio alarm S5-3 ON enables the audio alarm S5-4 OFF selects UCM calibration and UCM run-mode S5-4 ON selects onboard switch calibration and switch run-mode

Area Preparation

See Calibration setup on page 28.

Bar graph (received signal strength indicator)

For switch calibration, the bar graph provides a visual indication of the sensor cable response. The bar graph is comprised of 10 LEDs. The 5th LED (D15) is yellow, and the 6th LED (D18) is green. All other LEDs are red. The yellow and green LEDs are indicators of the alarm Threshold. When the yellow LED is illuminated, the signal is just below the Threshold. When the green LED is illuminated, the signal has exceeded the Threshold. When the Threshold is exceeded the input (impact or sustained attack) is added to the Cut Count or Climb Time.

Step 1 - Setting the Filter Response

The Filter Response setting depends primarily on the type of surface on which the sensor cable is mounted:

- If the sensor cable is installed on a surface that can have a dampening effect on vibrations (e.g., wood, drywall, plasterboard, cement, brick, stone, masonry, etc.) select the low band filter response (SW5-1 ON - 100 to 300 Hz).
- If the sensor cable is mounted on a stock cage, or sheet metal, or a steel structure that conducts vibrations quite well select the high band filter response (S5-1 OFF - 300 to 900 Hz).

Note	In most cases, the frequency created by an impact does not vary significantly from that of a sustained attack.

Note	If either the protected surface or any nearby equipment resonates at a frequency included in the processor’s Filter Response bands, select the band that excludes the resonant frequency.

Step 2 - Calibrating the FlexPI Gain/Threshold

The Gain/Threshold is used to amplify the input signal from the sensor cable before it is processed. FlexPI has four Gain/Threshold Settings ranging from 1 (lowest) to 4 (highest). Refer to Figure 28: for a flow chart of the Gain/Threshold calibration procedure.

Note	Although the Gain/Threshold Setting amplifies the received signal it also amplifies the environmental background noise. Use care when adjusting the Gain/Threshold.

1. Begin by setting the switches as indicated in Figure 27:.

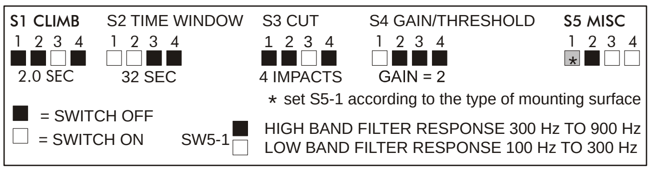


Figure 27: Recommended switch settings

2. With S4-1 ON and all other S4 switches OFF (Gain = 2). View the bar graph and verify that either, only the first red LED is illuminated, or that all LEDs are OFF.
3. Test the signal response with a series of impacts on the protected surface, along the length of the sensor cable. Look for a response that is above the Threshold (6th LED is illuminated) but below the top of the bar graph (10th LED is OFF).
4. If the signal response does not illuminate the green LED, increase the Gain setting one level and repeat the test.
   OR
   If the signal response always reaches the top of the bar graph, decrease the Gain setting one level and repeat the test.
5. When the impacts consistently result in a response that is above the Threshold (green LED ON), and does not always reach the top of the Bar graph, the Gain/Threshold setting is correct for the installation.

Note	If there is no Gain setting that provides a consistent response, select the other Filter Response band and repeat the tests.

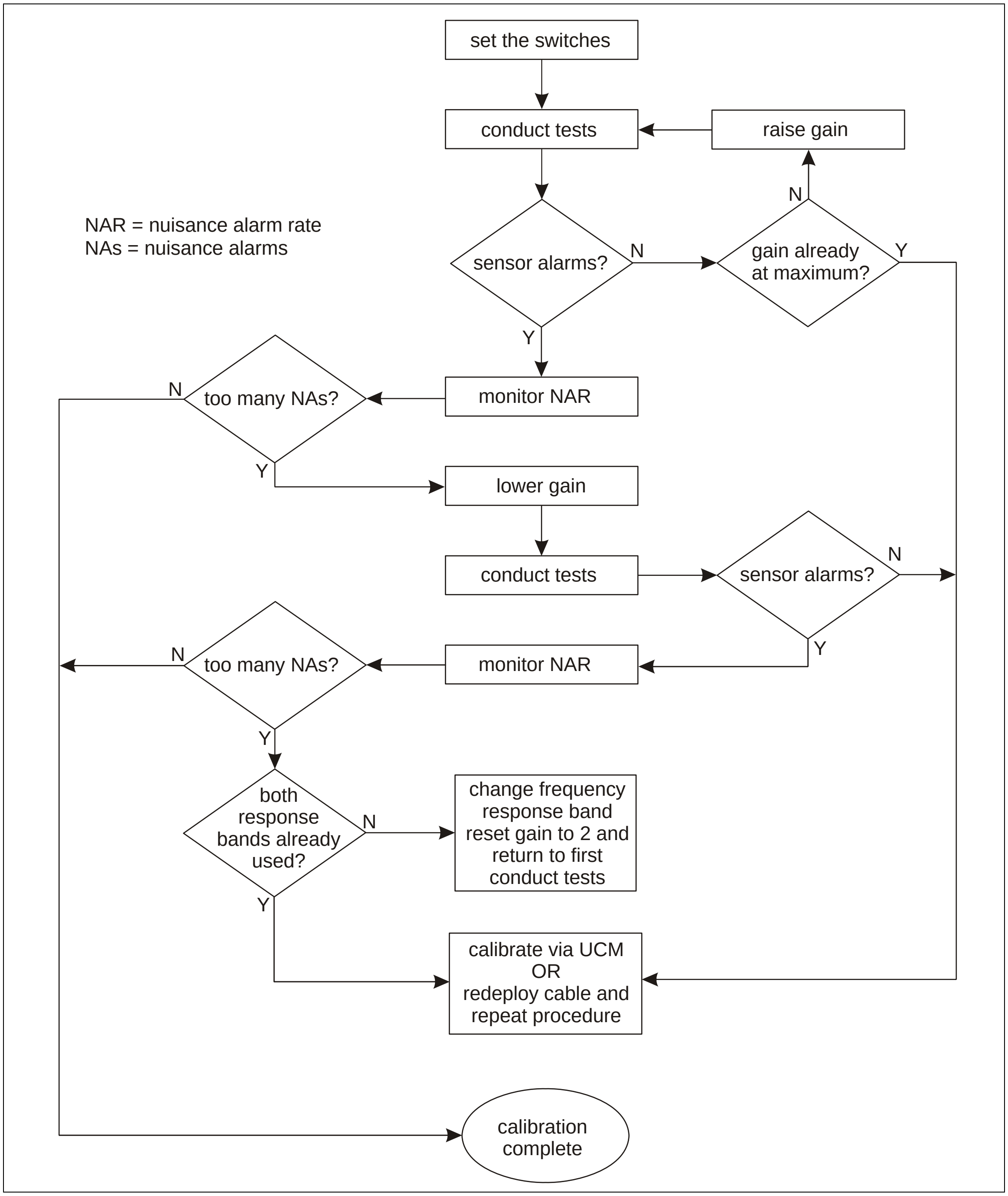


Figure 28: Gain/Threshold setting flow chart

Setting the Climb Alarm parameters (sustained attack)

Note	While setting up and testing the climb alarm parameters you can disable cut alarm reporting by setting all S3 switches to OFF.

With the switches set as illustrated in Figure 27:, the Climb time is 2 seconds and the Time Window is 32 seconds. Therefore, if there is 2 seconds of sustained attack activity within a 32 second period, the processor signals a Climb alarm. If the security regulations at your facility do not define a specific Climb time and Time Window, then these parameters should be set according to the possibility of nuisance alarms occurring in a specific timeframe. Once the Climb Alarm parameters are set, monitor the system for nuisance alarms. If nuisance alarms occur, determine the source of the nuisance alarms and either correct the source, or adjust the Climb Alarm parameters to ignore the source (i.e., extend the Climb time, extend the Time Window).

1. Adjust the Climb Alarm parameters, if required (S1 = Climb time, S2 = Time Window).
2. Test the Climb Alarm settings by performing a series of simulated sustained attacks along the protected surface.
3. If the attack simulations always cause alarms, use the current settings and monitor the system for nuisance alarms.
4. If the attack simulations do not cause alarms, adjust the Climb Alarm parameters and repeat the tests.
   OR
   Increase the Gain/Threshold setting 1 level, and repeat the Climb Alarm tests.

Note	If no Gain/Threshold setting functions for both Cut alarm and Climb alarm detection, change the Filter Response band, and repeat the calibration procedure. If the Gain/Threshold setting is at the maximum level, and detection is not adequate, redeploy the sensor cable using reduced cable spacing. Ensure that the cable is in close contact with the protected surface. Repeat the calibration process after modifying the sensor cable layout. OR If a functional Gain/Threshold setting cannot be found, calibrate the system with the UCM.

Setting the Cut Alarm parameters (Impact attack)

Note	While setting up and testing the cut alarm parameters you can disable climb alarm reporting by setting all S1 switches to OFF.

With the switches set as illustrated in Figure 27:, the Cut Count is 4 impacts and the Time Window is 32 seconds. If the security regulations at your facility do not define specific Cut Count and Time Window settings, then these parameters should be set according to the probability of nuisance impacts occurring within a specific timeframe. For example, if nuisance impacts can occur, but never in rapid succession, then the Cut Count can be set to 2 with a short Time Window (e.g., 8 seconds). If nuisance impacts should never occur, an impact count of 1 can be used so that an intruder cannot defeat the system by waiting between impacts. Once the Cut Alarm parameters are set, monitor the system for nuisance alarms. If nuisance alarms occur, determine the source of the nuisance alarms and either correct the source, or adjust the Cut Alarm parameters to ignore the source (i.e., extend the Time Window, increase the Cut Count).

Note	The Cut Profile is an advanced parameter, which can be adjusted only through the UCM, For switch calibration, the Cut Profile is ON at the default setting of 20%. This means that each time an Impact is recorded, 20% of the Climb Window setting is added to the time remaining in the Climb Window. (see Figure 29:).

1. Adjust the Cut Alarm parameters, if required (S2 = Time Window {S2 also affects the Climb Alarm settings} S3 = Cut Count).
2. Test the Cut Alarm settings by making a series of impacts along the protected surface.
3. If each of the Cut simulations register as Cut Counts and lead to alarms, use the current settings and monitor the system for nuisance alarms.
4. If the Cut simulations do not register as Cut Counts and do not cause alarms, adjust the Cut Alarm parameters and repeat the tests.
   OR
   Increase the Gain/Threshold setting 1 level, and repeat the Cut Alarm tests.

Note	If there no Gain/Threshold setting functions for both Cut alarm and Climb alarm detection, change the Filter Response band, and repeat the calibration procedure. If the Gain/Threshold setting is at the maximum level, and detection is not adequate, redeploy the sensor cable using reduced cable spacing. Ensure that the cable is in close contact with the protected surface. Repeat the calibration process after modifying the sensor cable layout. OR If a functional Gain/Threshold setting cannot be found, calibrate the system with the UCM.

Calibration concepts

The following figures illustrate various FlexPI calibration functions. Figure 29: illustrates the Cut Alarm Settings. The Window is set at 30 seconds, the Threshold is set at 10, the Count is set at 4 and the Cut Profile is set to 20%. The first part of the figure shows how 4 impacts within 30 seconds triggers a Cut Alarm (without the Cut Profile parameter). In the second part of the example the Cut Profile is set to 20%, thereby, extending the Window by 6 seconds for each recorded Count. Note that without the extra time created by the 20% Cut Profile, the second attack would not cause an alarm.

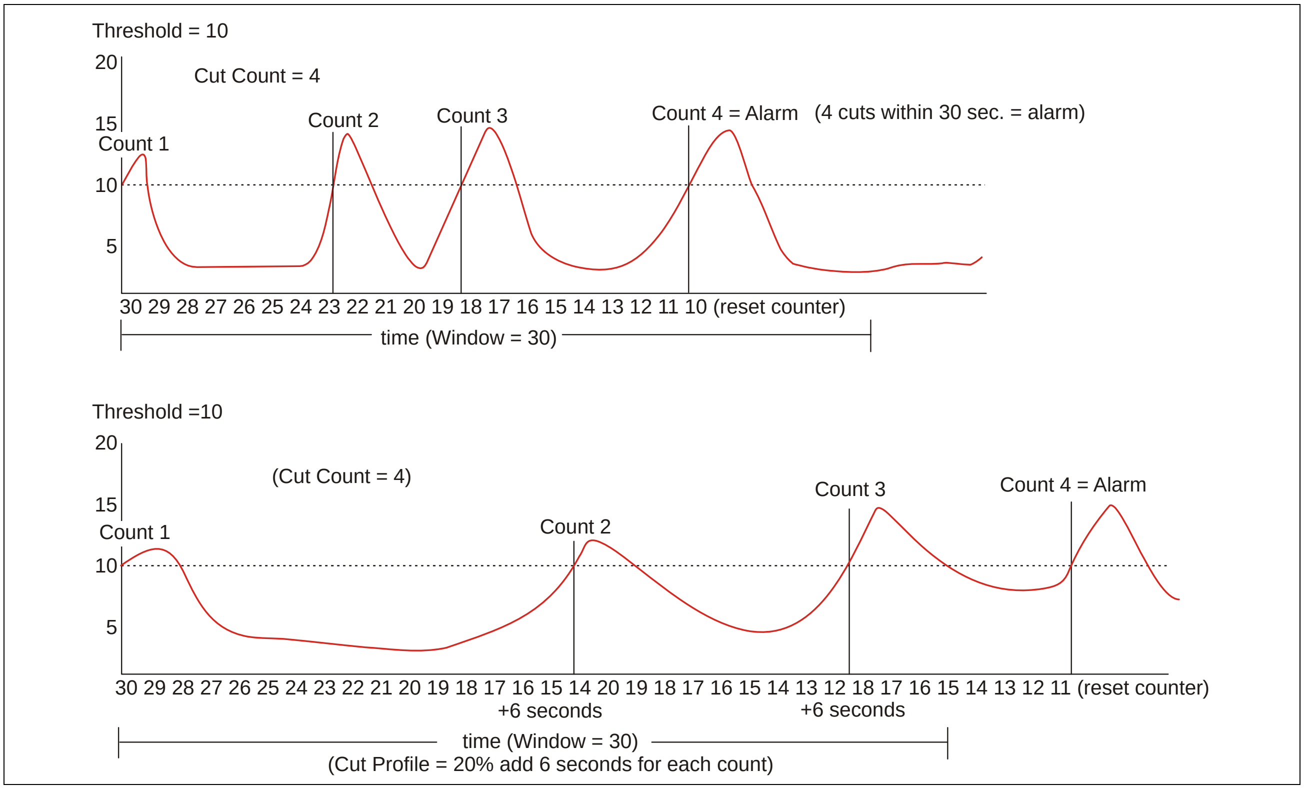


Figure 29: Understanding the Cut Alarm

Figure 30: illustrates the Climb Alarm concept of a sustained attack within a specified time.

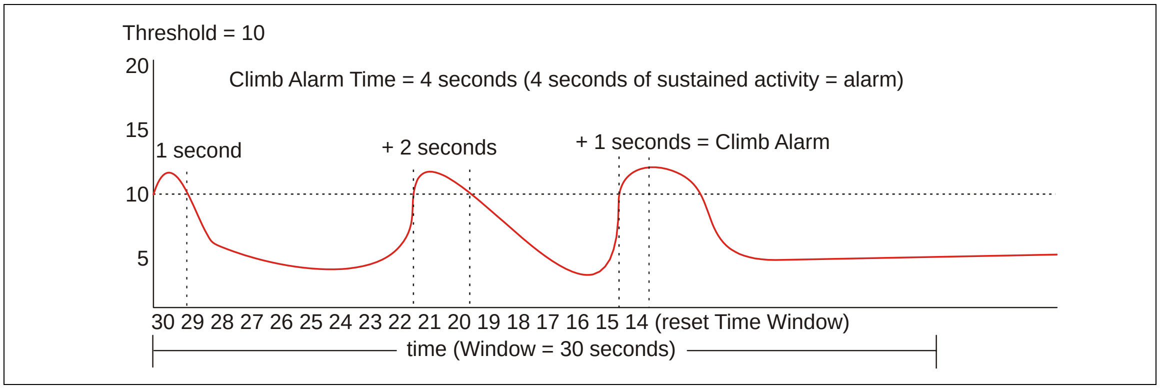


Figure 30: Understanding the Climb Alarm

a Parts list

Component	Part Number	Description
FlexPI processor		
Processor and enclosure	C8EM0100	FlexPI processor mounted in an indoor use enclosure, provides electronic processing for one sensor zone with up to 600 m (1970 ft.) of sensor cable
Processor	C8BA0200	FlexPI processor printed circuit board assembly
FlexPI sensor cable		
300 m sensor cable	G5FG0203	MEX cable with black jacket, 300 m (984 ft.) reel (when ordering, allow for an overage of 5%)
30 m lead-in cable	G5SP0201	Non-sensitive lead-in cable with black jacket, 30 m (98 ft.) reel
FlexPI accessories		
termination/splice kit	C6KT2600	single zone termination/splice kit
cable ties	GH0916	nylon tie-wraps, 1000 piece bag
double loop bar ties	82-130020	steel bar ties 15 cm (6 in.) long 18 AWG, 1000 pieces
UCM software		
UCM cable	GE0444	UCM interface cable, 3 m, USB (connects PC running UCM to processor)
UCM	00SW0100	Universal Configuration Module software, Windows-based application, setup, calibration and diagnostic tool

b Specifications

Processor	Model	• processor card and indoor enclosure
	PCB dimensions (L x W)	• 12 x 9 cm (4.7 x 3.5 in.)
	Quantity	• one per sensor zone
	Probability of detection	• greater than 95% with a 95% confidence factor
	Maximum Zone length	• 600 m (1970 ft.)
	Power consumption	• 1 W maximum
	Power input	• 12 to 48 VDC
	Connectors	• removable terminal block for power input • removable terminal block for relay output connections • removable terminal block for sensor cable input • USB port for UCM connection
	Controls	• calibration adjustments via the Universal Configuration Module (software application) • calibration adjustments via onboard switches • adjustable filter settings - frequency response

	Alarm outputs	• 2 form C relays rated 30 VDC @ 1 A max. non-inductive load
		  • 1 ALARM relay - activates to signal sensor alarm condition
		  • 1 SUPERVISION relay - activates to signal enclosure tamper condition, cable fault condition, processor fault condition
		• 1 normally open SONALERT alarm output rated 30 VDC @ 1 A max. for remote alarm annunciation (follows the state of the ALARM relay)
		• 1 user-selectable onboard audible alarm (beeper) - follows the state of the ALARM relay; beeps to signal sensor alarm - SW5-3 ON enables beeper; SW5-3 OFF disables beeper

<table>
<tr><td rowspan="5">Processor</td><td>LED indicators</td><td>• 10 LED bar graph - received signal strength indicator
• 1 LED per onboard switch - LED ON = Switch ON
• power LED
• Supervision Alarm LED
• Alarm LED
• UCM connected LED
• Enclosure door open LED</td></tr>
<tr><td>Supervision</td><td>• mechanical enclosure tamper switch
• sensor wires
• lead-in cable
• processor operation</td></tr>
<tr><td>Temperature</td><td>• 0º to +70ºC (0º to +158º F)</td></tr>
<tr><td>Relative humidity</td><td>• 0 to 95%, non-condensing</td></tr>
<tr><td>Frequency response</td><td>• switch-selectable frequency response bands
    • 100 - 300 Hz
    • 300 - 900 Hz
• UCM adjustable frequency response band
    • 100 - 900 Hz</td></tr>
</table>