Using a buried fiber optic cable and a centrally-located Sensor Unit, the FiberPatrol FP6100X for buried intrusion detection provides covert detection of intruders, vehicles, and tunneling over a distance of up to 80 km (49.7 mi).

No powered or conductive items are required in the field, making the sensor completely immune to EMI and lightning and impossible to detect through electronic means.

Detection and ranging of simultaneous intrusions

The FP6100X accurately locates intrusions even when there are multiple simultaneous intrusions or in the presence of non-localized environmental noise that would overwhelm the location capability of other long-range fiber optic sensors. The full length of the cable is continuously analyzed and disturbances at different locations are reported independently.

Continued detection and ranging after cable cut

If the sensor cable is cut, accidentally or in an attempt to defeat the sensor, the FP6100X immediately reports the incident and its location. Moreover, the sensor retains the ability to detect and locate intrusions right up to the point of the cut.

Field-adjustable detection settings

The FP6100X uses sophisticated algorithms to discriminate between real threats and vibrations from incidental sources. The advanced detection algorithms incorporate disturbance magnitude thresholds, spatial parameters, and timing parameters.

The FP6100X’s algorithms are easy to configure, enabling facility personnel to optimize the system for site-specific conditions.

HOW IT WORKS

FiberPatrol works by transmitting pulses of laser light into a single-mode optical fiber and accurately measuring the minute light reflections that occur along its length. A disturbance of the fiber caused by ground vibrations changes the amount of light returned from that point. FiberPatrol’s reflectometry-based technology does not require the light to traverse the full length of cable. If a cable is cut, FiberPatrol retains the ability to detect and locate intrusions up to the point of the cut, thus enabling the system to support cut-immune configurations.
Intruder detection

When an intruder moves across the ground above the fiber optic sensor cable, whether walking, running, or crawling, characteristic vibrations are created. The system distinguishes these from background vibrations, and the FP6100X declares an alarm.

The FP6100X not only detects soil compression and displacement in the vicinity of the buried sensor cable but also the minute seismic waves induced by human footsteps. The high sensitivity of the FP6100X provides flexibility in the burial depth of the sensor cable, enabling the system to not only detect footsteps directly above the sensor cable, but also those up to several meters away.

Vehicle detection

The FP6100X’s advanced algorithms enable vehicles moving in the vicinity of the sensor cable to be detected and their location and speed determined. The FP6100X can be configured to detect heavy vehicle engine noise, raise alarms if vehicles are detected, ignore vehicles if traffic is expected, or raise an alarm only if a vehicle stops suddenly within a configured distance.

Digging and tunneling detection

The FP6100X detects hand and machine digging and tunneling at distances of up to 20 m (66 ft) from the sensor cable in any direction. The sensor cable can be positioned several meters underground if necessary to extend coverage down to the required depth. Activities inside an existing tunnel such as movement of people, equipment, and vehicles can also be detected.

Fence detection

When the sensor cable is mounted to a fence the FP6100X detects and locates any attempt to cut, climb, or otherwise break through the fence. The FP6100X works on most fence types including chain-link, standard weld-mesh, expanded metal mesh, and palisade fences. The sensor cable can be mounted on swinging gates to provide gate protection.

Between buried and fence sections, a 30-meter (100 ft) buffer coil of sensor cable is recommended.

Sample installation in which buried FiberPatrol sensor works in conjunction with fence-mounted sensor
**Installation recommendations**

For detection of above ground activity the sensor cable is recommended to be direct-buried at a depth between 15 to 70 cm (6 to 28 in). For detection of tunneling a burial depth of at least 2 m (6.5 ft) is recommended to minimize the response to incidental sources of vibration. Due to the potential for nuisance alarms from incidental vibrations, the best performance is achieved when the sensor cable is installed 6 m (20 ft) or more away from trees, fences, and posts and 30 m (100 ft) or more from roadways.

**Typical detection ranges**

Typical detection ranges are shown in the table below. It is important to note that actual performance will depend on specific site conditions and can increase or decrease considerably from these typical values. Factors that can affect achievable detection ranges include:

- Nearby incidental sources of vibration
- Burial medium type (clay, gravel, sand, etc.), moisture content, and compaction level
- Presence of distinct layers within the burial medium
- Amount of vegetation

Typical detection ranges can vary from location to location at a given site and can vary over time depending on the moisture content and the depth of frost penetration.

<table>
<thead>
<tr>
<th>Intrusion Type</th>
<th>Typical distance from cable for detection†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human normal walking</td>
<td>1 to 5 m (3 to 16 ft)</td>
</tr>
<tr>
<td>Human running</td>
<td>5 to 10 m (16 to 33 ft)</td>
</tr>
<tr>
<td>Human crawling slowly</td>
<td>1 m (3 ft)</td>
</tr>
<tr>
<td>Light vehicle moving</td>
<td>3 to 10 m (10 to 33 ft)</td>
</tr>
<tr>
<td>Heavy vehicle moving</td>
<td>10 to 20 m (33 to 66 ft)</td>
</tr>
<tr>
<td>Heavy vehicle engine running</td>
<td>5 to 10 m (16 to 33 ft)</td>
</tr>
<tr>
<td>Manual digging (pickaxe)</td>
<td>10 to 20 m (33 to 66 ft)</td>
</tr>
<tr>
<td>Tunnel digging</td>
<td>20 m (66 ft)</td>
</tr>
</tbody>
</table>

**Sensor cables**

The FP6100X uses single-mode fiber within telecommunications-grade cable. The sensing function requires either one or two fibers depending on the sensor length – additional fibers within the cable can be used for other communications purposes like Ethernet and/or communication with other Senstar sensors, including FiberPatrol FP1100X, FlexZone® and Senstar LM100 fence sensors, UltraWave™ microwave, or XField® electrostatic sensors.

For buried perimeter and tunneling detection applications, single-armored double-jacket cable construction is recommended.

**Sensor cable composition**

- Outer jacket
- Water-blocking tape
- Inner jacket (double-jacket designs only)
- Central strength member
- Outer strength members (where applicable)
- Gel-filled buffer tube containing up to 12 fibers
- Ripcord
- Corrugated steel armor (where applicable)

**ALARM DISPLAY AND INTEGRATION OPTIONS**

Several options are available for alarm display and integration with third-party devices.

Customers requiring a single display dedicated to perimeter monitoring can use the processor’s built-in alarm display. Senstar’s StarNet 2 Security Management System (SMS) provides enhanced capabilities for those requiring multiple workstations and maps as well as the management of additional security equipment.

The FP6100X can be configured to report alarm locations by zone number, cable distance and/or GPS coordinates.

Senstar’s UltraLink sensor integration components are used to integrate FiberPatrol with third-party sensors.

The Network Manager software provides an IP-based interface that is common to Senstar’s other industry-leading sensors, including the FiberPatrol FP1100X fence-mounted sensor, FlexZone® cable-based fence sensors, Senstar LM100 intelligent perimeter lighting and sensing solution, OmniTrax® buried RF cable sensors, XField® electrostatic sensors, and UltraWave™ microwave sensors.

Alarms and status can also be presented on relays or open-collector outputs using Senstar’s UltraLink I/O modules.

† Detection performance depends on site conditions
Technical specifications

SENSOR UNIT

Main features
- Provides intrusion detection for covert perimeter protection from a central location
- Sensor is buried and cannot be detected as it has no electromagnetic signature
- Localization of intrusion and software assignment of detection zones
- Dual sensing channels
- Reflectometry-based operation provides industry-leading resilience to cut or damaged cable
- Central adjustment of all sensor parameters over long distances
- Simple integration with SMS and CCTV systems
- Single processor required for distances up to 48 km (29.8 mi)
- MTBF: greater than 87,000 hours

SPECIFICATIONS

Detection performance
- Up to 80 km (49.7 mi) for fiber attenuation (installed) of 0.25 dB/km or less @1550 nm
- Up to 72 km (45 mi) for fiber attenuation (installed) of 0.28 dB/km or less @1550 nm
- Detection accuracy: ±5 m (16 ft) typical
- Up to 1,440 software-definable detection zones
- Typical detection range – see detection range table
- Detection resolution: 45 m (150 ft) (minimum separation for two disturbances to be reported separately)
- Pd: 95% typical
- FAR: less than 1/km/month typical
- NAR: site dependent

Cut cable detection
- Operation: as specified up to the cable cut
- Accuracy of cut location: 30 m (100 ft)

Optical
- Class 1, 1550 nm wavelength
- Connector type: FC/APC

Interfaces and software
- Networking: Dual Gigabit Ethernet
- Operating system: Windows 10 Pro 64-bit
- HDD: minimum 2 × 1TB RAID 1 array
- Standard alarm interface – Senstar

standard API over TCP/IP from Network Manager
- Optional alarm interface – Relay closures via UltraLink I/O modules, ASCII over IP

Environmental (sensor unit)
- Operating temperature: 10 to 35 °C (50 to 95 °F)
- Humidity: 20% to 80% non-condensing

Energy consumption
- Voltage, frequency: 100–240 VAC, 50/60 Hz
- Power (maximum):
  - 24, 36 and 48 km systems (one processor): 250W
  - 60 and 80 km systems (two processors): 450W

Mechanical
- Standard 19-inch rack-mount, 51 cm (20 in) deep
- Height: processor 4U (each), Controller 3U, splice enclosure 1U, KVM 1U (two processors required when coverage range exceeds 48 km)
- Rack clearance required: 5 cm (2 in) front, 15 cm (6 in) back
- Weight:
  - Single-processor: 48 kg (105 lbs) total with single processor, controller and 1U splice enclosure
  - Dual-processor: 71 kg (157 lbs) total with two processors, controller and 1U splice enclosure

FIBER OPTIC SENSOR CABLE

- Senstar provides fiber optic sensor cable that is tailored to meet the requirements of the specific application.
- Existing optical cable may be used for sensor cable providing requirements regarding positioning, attenuation and reflective discontinuities are met

General characteristics
- Gel-filled loose tube construction
- 12 fibers per tube
- Central strength member
- Single mode fiber
- Single corrugated steel tape (CST) armor
- Double polyethylene jacket

Environmental
- Temperature: −40 to 70 °C (−40 to 158 °F)
- Humidity: no restrictions

FiberPatrol FP6100X for Buried Intrusion Detection

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