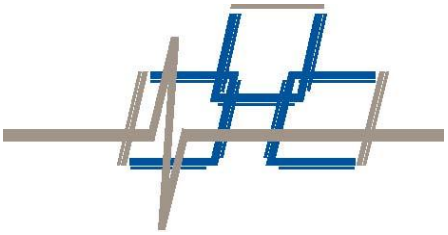
Fiber SenSys
PERIMETER SECURITY

Microwave Perimeter Security

Application Note



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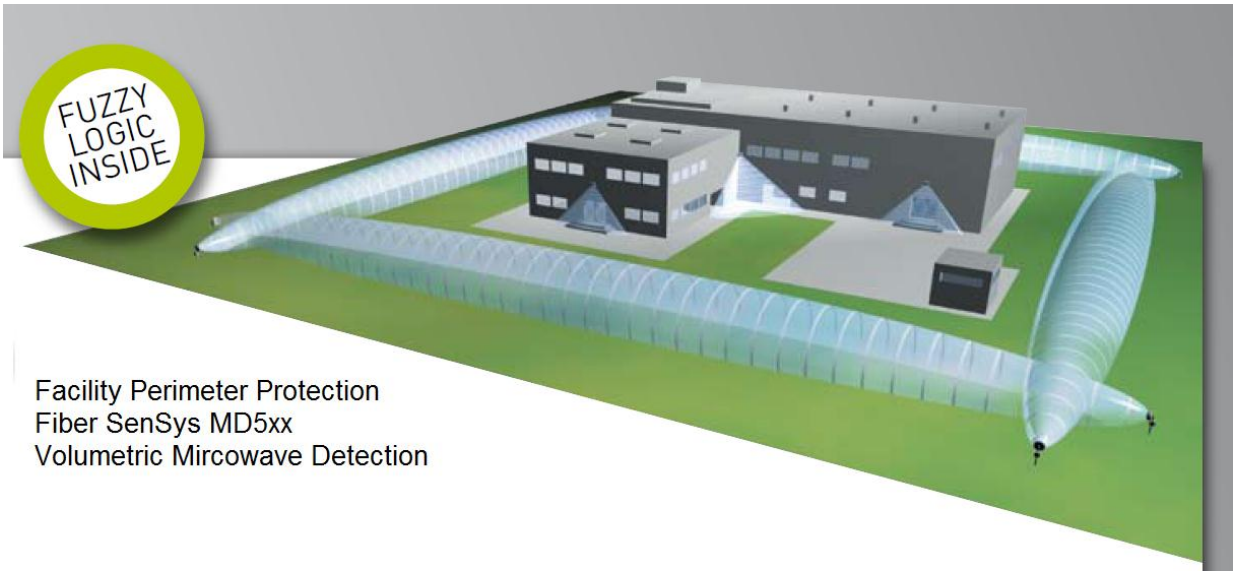


Facility Perimeter Protection
Fiber SenSys MD5xx
Volumetric Mircowave Detection

Introduction

The persistent threat of terrorist attacks and new global security directives are all contributing to increased spending on perimeter security systems throughout the world, as recently reported by Frost & Sullivan (http://www.frost.com/prod/servlet/press-release.pag?docid=258315033). This report reviews industry considerations for perimeter security, video surveillance, access control, technology integration, screening, command and control and security personnel.

According to the report, on-going threats of international terrorism has increased focus on perimeter security requirements, while the high value of corporate assets and the growing need for improved safety measures are driving the adoption of enhanced perimeter security standards. It is widely known that both commercial and military operations areas represent high security zones requiring dependable and versatile security solutions. As a result, security industry manufacturers are supporting these trends with efficient integrated solutions and improved industry partnerships.

One solution that addresses the unique challenges of the marketplace is microwave (or volumetric) perimeter protection. The emergence of X-band microwave technology provides a solution for long range perimeter detection while K-band microwave is designed for facilities like airports or military bases. These facilities are saturated with an abundance of radar and radio emissions over wide frequency ranges, making security detection systems that utilize electrical or electromagnetic sensors unreliable, because they are highly subject to electromagnetic interference (EMI). In such

environments, the most reliable solutions for perimeter security are frequently built on fiber-optic intrusion detection systems complemented with microwave sensors.

The purpose of this application note is to outline the most reliable and complete solutions for microwave perimeter security that employ the latest in complementary intrusion detection technologies. Fiber SenSys (FSI) is a full solution, perimeter security manufacturer offering everything needed to secure facilities according to the highest commercial and military standards, including priority level one (PL-1) configurations.

Installation Considerations

Typical perimeter security projects include provisions for several phases of work culminating in a successful perimeter security installation. Design and support teams are engaged during all phases of a project to guide and train end users and systems integrators, and if requested, will visit the area to be secured. Getting started begins with a detailed site drawing showing building and perimeter layouts with dimensional lengths. It is best to establish preliminary security goals and objectives prior to conducting a site walk-through with consideration for the unique areas to be secured and the location of control room equipment. These can include open fields, fences, runways, fuel storage areas, buildings, information technology considerations and command & control requirements.

During the walk-through, supporting personnel observe details not contained in the drawings such as hills, dips and other topography issues. They will also note any objects that would facilitate intruder bypass of the intrusion detection system, such as tall grass, trees or other vaulting aids. Analysis of the data obtained during the threat assessment and the site evaluation is used to determine the number of zones, zone layouts, intrusion detection sensor types and equipment quantities.



Microwave Systems

Microwave sensors, also known as Radar, RF or Doppler sensors, detect walking, running or crawling intruders in an outdoor environment. This type of solution provides high probability of detection, low nuisance alarm rates and resistance to rain, fog, wind, dust, falling snow and temperature extremes.

Microwave security systems are based on volumetric designs. The microwave sensor provides a semi-conical detection area, referred to as a barrier curtain, and is defined by the volume of the area protected. Microwave security systems tend to be self-contained solutions that stand alone or can be integrated with existing facility and perimeter security systems.

Integration with other technologies requires an analysis of desired alarm response criteria, and security testing and monitoring procedures should be a part of designing the solution. For example, a microwave system reduces the threat of trespass into long-range, open field areas. Microwave technology is used to complement fence perimeter security such as a fiber sensor mounted to the fence or buried in gravel inside or outside the perimeter. Microwave relays can be tied into new or pre-existing alarm annunciation equipment to initiate audible alarms, activation of flood lights and other incident response measures. Microwave integrated solutions can also support local guard and patrol services that can be notified through an auto-dialer enabled by the alarm output technology.

Mono-static vs. Bi-static Microwave Sensors

The two most prevalent volumetric microwave security system designs can be classified into Mono-static and Bi-static system designs, where the name is descriptive of the number of sensors required for operation. Mono-static designs require a single transceiver unit that includes both transmitter (Tx) and receiver (Rx) elements. Mono-static units typically offer a short barrier curtain, less than 50 m, where security is enhanced with a wide the area of coverage. These units are ideal for short ranges or downward looking applications and are frequently used to monitor unauthorized access to doors & windows. Systems can be expanded with multiple units to add protection coverage to several areas.

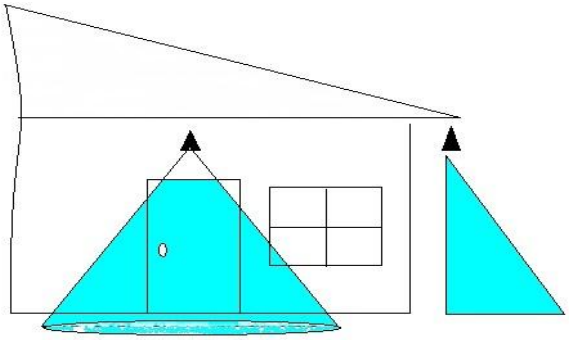


Figure 1: Mono-static sensors offer a low-cost solution for close-in, microwave barrier curtains less than 50 m.

Bi-static microwave detection systems require two units, a transmitter (Tx) and a receiver (Rx) to protect an area. Bi-static systems provide long-range "invisible fence" coverage where the volumetric barrier is a focused, narrow beam, curtain for open area intrusion detection. The bi-static designs provide asset protection at distances ranging from 50 m to 500 m.

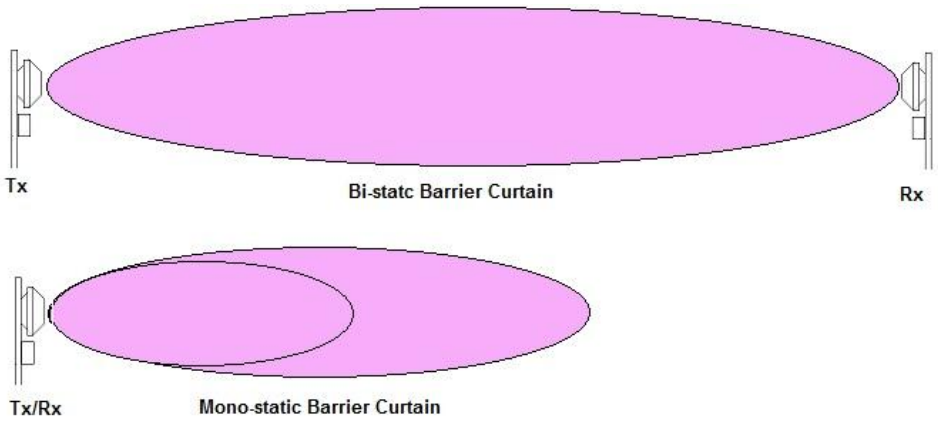


Figure 2: Volumetric microwave barrier curtains. Bi-static microwave models range from 50 m to 500 m.

Modern volumetric microwave detection sensors offer leading-edge digital technology for accurate & effective wireless intrusion detection. Units combine "fuzzy" digital logic technology that provides enhanced detection reliability by analyzing the received microwave signals. The microwave detection sensor offers bi-state operation, in either X-band or K-band frequencies. K-band operation offers optimal performance at military bases or commercial airports with high levels of background (RF) radiation with enhanced immunity to RF interference (RFI) that X-band cannot.

The microprocessor based design uses “fuzzy” logic to create behavior models based on received signals that are compared with those generated by a potential intruder. Some digital microwave designs also provide multi-frequency crystal designs with anti-masking capability to prevent tampering. These advanced units are immune to temperature changes with microprocessor controlled environmental adjustments.

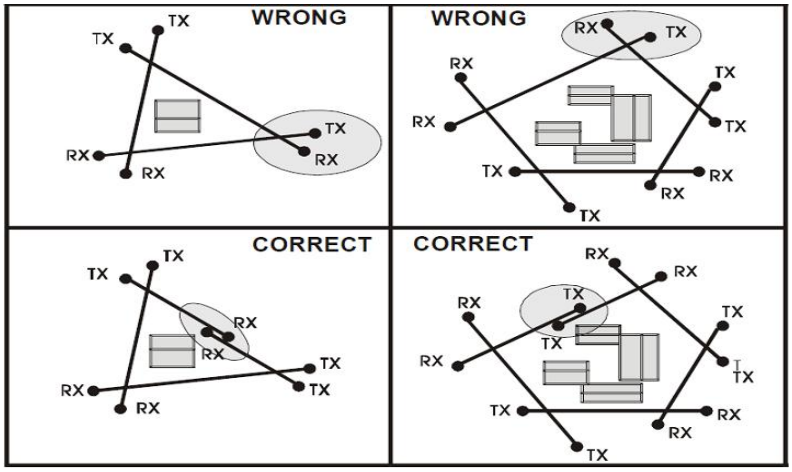


Figure 3: Examples of increasing effective coverage using multiple Bi-static barrier zones.

Bi-static Volumetric Microwave Installation

There are many reasons to design a perimeter system with multiple volumetric zones. Large equipment, facility walls or other obstructions require the perimeter to be divided into smaller zones of protection. In multiple zone applications, it is preferable to install an even number of protected area zones to avoid crossing signals between Rx & Tx units mounted closely together. Best practices have shown that overlapping the coverage zones is an effective way to fill in the zone curtain “holes” that exist near the Rx & Tx units. Please refer to the illustrated examples, showing installations with multiple zones crossing in the shape of a polygon. Whenever possible, precautions should be taken to avoid signal interference where Rx & Tx units are in close proximity, as shown in the figures below.

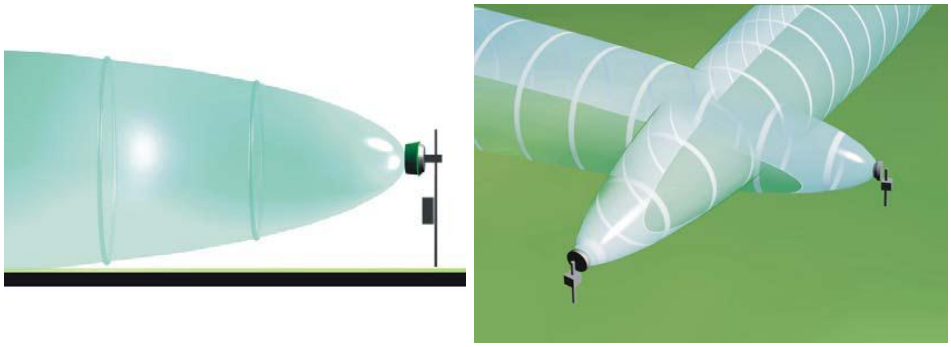


Figure 4: Illustration of optimizing zone coverage by crossing the bi-static sensor curtains.

When metallic mesh or link fences are present, these precautions are suggested:

- Ensure that the fence has been properly fixed and does not move excessively
- Microwave beam should not be parallel to fence, should be at an angle to it
- Locating fences behind the equipment can also cause distortions to the sensitive beam
- Microwave barrier curtain requires a minimum of 5 meter clearance for metallic fence corridors

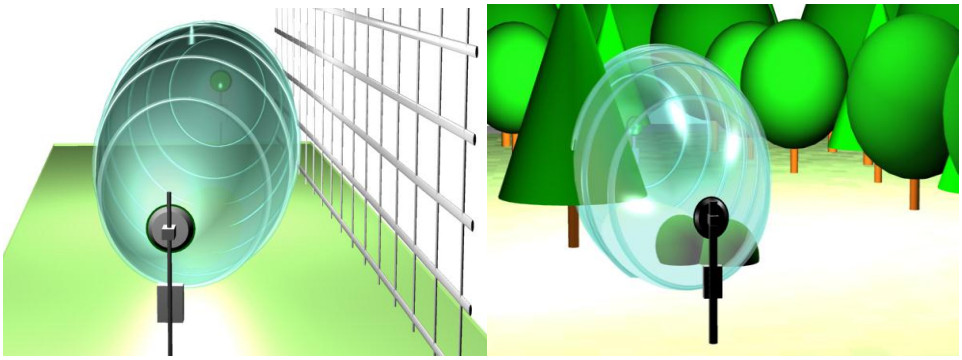
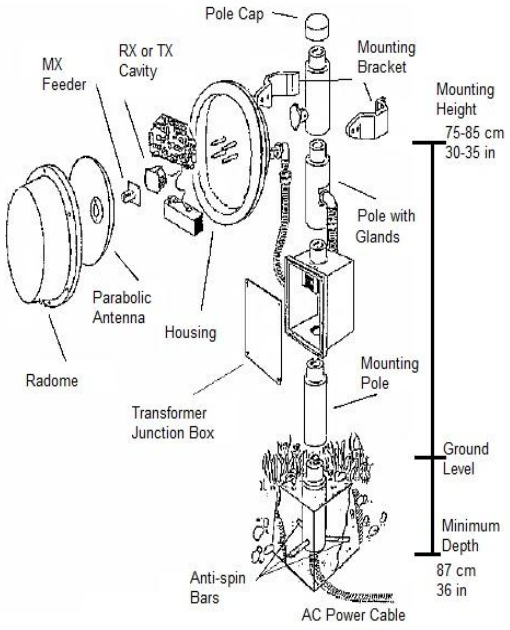


Figure 5: Avoid areas that will interfere with proper operation of Bi-static detection zones.

Trees, hedges, bushes in general, should be removed if they are near or within the protective barrier curtain. These obstacles vary in size and since they grow, they can intersect the zone curtain by the wind. It is advisable not to allow tall grass (more than 10 cm), into the zone curtain. Avoid ponds, longitudinal waterways, and all mutable types of ground surfaces. Ridged metal pipes, poles and posts are permitted in the zone's protective curtain.

Most microwave sensor units are powered with standardized AC voltages from around 19 VAC to 24 VAC. Many units can also be powered with rechargeable back-up batteries that provide up to 12 or more hours of power for back-up operation.



Microwave Component Detail

Antenna Installation

It is imperative to properly secure the antenna mounting pole to avoid movement due to high wind or problematic weather conditions. The ideal pole depth will vary depending on soil conditions, rocky vs. soft topsoil, etc. Please refer to the manufacturer's user's manual for specific installation guidelines.

Integrating Microwave Solutions

The most effective security systems include multiple technologies. Solutions that complement each other give a layered approach to the perimeter security system. For example, in heavy fog, microwave technology combined with a photoelectric infrared sensor can provide effective coverage. Since photoelectric infrared sensors can be affected by heavy fog, a microwave sensor, which is not affected, can be used in combination to provide a "back-up" solution. Another example would be one where there is a fiber-optic sensor installed on a fence, plus the microwave sensor, plus a camera system with lighting enhancements. As potential intruders approach the fence, they will cross the path of the microwave beams that will signal the cameras, which will turn on the lighting system, which will signal the head end that will send a signal to the overall alarm system.

Modern security systems derive the greatest value from flexibility and scalability, integrating a variety of technologies, not based a single technology. Smart manufactures have expanded system scope to include complementary products through partnerships with other industry manufacturers, resulting in enhanced systems with multiple sensor technologies and modern communications capability.

In response to increasing need for integrated communications, and considering industry trends toward more and more security devices operating over an IP network infrastructure, organizations today are looking to integrate various electronic systems. The integration of indoor security, perimeter security, camera systems and video management systems (VMS) combined into one centrally monitored and controlled solution is a documented industry trend. Such integration has many benefits for the end-user including the simplification of common operating methods and lowering of the system costs.

Security monitoring and control systems that provide comprehensive and intelligent integration of industry-leading technologies are an important part of any design. A head end system that ensures low nuisance alarm rates, the highest probability of detection, and the lowest overall total cost of ownership represents a value leader among security monitoring and control systems. PC-based command & control with internet protocol (IP) communications capability provides an efficient platform for integrating the components of a system, which can include fiber-optic cable alarm processing units and volumetric microwave sensors. When an alarm occurs, it is automatically displayed on the relevant site map, making the job of responding to the alarm much more efficient.

Integrated perimeter security solutions typically provide:

- Command & control – computer monitoring, controls and alert notifications
- Alarm processing units – with alarm priority coding
- Detection sensors – with continuous tamper/fault detection, with nuisance alarm discrimination
- Remote operation capability, with barrier & obstruction mediating
- Long-range lighting – deters intruders & supports camera image resolution
- Camera & video management systems (VMS) – with video/camera infrastructure

Summary

Perimeter intrusion detection systems are a key part of securing sensitive facilities. Industries such as power, water, oil, gas, transportation, correctional and government facilities all require perimeter protection in order to ensure that intruders do not gain entry. As demonstrated in this document, there are several applications where microwave intrusion detection systems are the solution of choice, especially where the use of fences is not desired or practical.

Integrated microwave solutions are revolutionizing security systems requiring enhanced security measures. Microwave technology can be easily integrated and offers "bolt-on" scalability to existing systems, while providing increased cost savings to new build-outs. In some instances, facility managers can begin with a low-cost basic initial security investment that can be scaled-up with other communications and detection technologies at a later date.

For unparalleled configuration and operating convenience, integrated microwave intrusion detection employs a set of features including common communications protocol, universal set-up software and system controllers, integrated I/O modules and a broad input voltage range - eliminating the costly and complicated task of integrating multiple technologies. Any organization that has facilities, employees or information to protect can benefit from an intrusion detection system. Too often, end-users and systems integrators believe that one type of detector or sensor can cover an entire perimeter when, in fact, a better and more cost effective method might be available by combining technologies. While it may be desirable to use one technology on a project, a more effective way of protecting an area is often found in a combination of technologies.

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High Performance – High Reliability – High Security

Appendix A: Microwave Defender Selection Table

Volumetric Microwave Selection Table										
	MD505A	MD505D	MD508A	MD508D	MD512A	MD512D	MD520A	MD520D	MD525D	MD550D
Digital MW		●		●		●		●	●	●
Analog MW	●		●		●		●			
Range in Meters	50	50	80	80	125	125	200	200	250	500
Operating Frequency	X-band								K-band	
Temp. Range	-35°C to +65°C (-31°F to +149°F)									
Humidity	0 to 100%									
Power	19-Volt AC, Battery/DC supply 13.8-Volt DC, 24-Volt DC									
Compliance	RoHS, CE, UL, CSA									
Volumetric Microwave Accessories										
MD-WT	Alignment Instrument for Analog barrier									
MD-TEST	Software for Digital Barrier Set up and maintenance									
AD10	1 adaptor for mounting barrier heads on 10cm poles									
MDA Back	MD analog back cover									
MDD Back	MD digital back cover									
MDA RADOME	MD analog front cover									
MDD RADOME	MD digital front cover									
Microwave Kits										
MDA Tx Kit	MD Analog TX electronic board w/ MW cavity - oscillator									
MDA Rx Kit	MD Analog RX electronic board w/ MW cavity - detector									
MDD Tx Kit	MD Digital TX electronic board w/ MW cavity - oscillator									
MDD Rx Kit	MD Digital RX electronic board w/ MW cavity - detector									
Software										
Fiber Commander	Security Command & Control with integration									