



A few years ago police investigators in Europe discovered that the simple application of hair lacquer to a passive infrared motion detector in the bank vault disabled it long enough for the robbers to disarm the other security systems and steal diamonds and other valuables worth millions.



“The sophisticated ‘Fresnel’ lenses developed by Bosch for its Tri-Focus Optics also deliver better image quality than competitive systems using what was traditionally considered superior mirror optics.”

#### SENSOR DATA FUSION

Bosch also adopts this approach but takes it several stages further with its proprietary Sensor Data Fusion system. This uses a sophisticated set of algorithms to integrate the signals from the five sensors: Long-range and mid to short-range PIRs providing twice the signal strength for better detection capability, a range-adaptive microwave Doppler radar system, a white light sensor and a room-temperature sensor that provides data for the Dynamic Temperature Compensation feature. This highly advanced system doesn't only trigger when say two or more sensors signal the presence of an intruder; the data from all the sensors is processed and used to create synergy between the different sensor technologies, enhancing the performance of all of them.

For example, by integrating the information from the long, mid and short-range PIR sensors, the system is able to determine the range to the target and adjust the sensitivity of the Doppler radar system to reduce false alarms. As a result, the Professional Series can easily distinguish a rat at 5m from a human at 15m. In addition, the white-light sensor senses visible light levels to prevent false alarms from sources

## ADVANCED INTRUSION detection

Integrated Spray Detection. This includes through-the-lens metering which protects against materials slid in front of the detector, a bounce-back function with infrared emitters to protect against objects approaching the detector, as well as integrated spray detection.

But Multi-Point Anti-Mask with Integrated Spray Detection is just one of the major innovations Bosch has introduced to enhance detector catch performance. Many others have been introduced to address the perennial challenge facing alarm systems – false alarms.

#### BEATING FALSE ALARMS

Traditional motion detection has always been a balancing act between catch performance and false-alarm immunity. Eliminate false alarms and catch performance suffers. Improve catch performance by increasing sensitivity and false alarms increase. A good example here is the PIR motion detector. This relies on the temperature difference between the room and the intruder's body to trigger an alarm, so if the room is at human-body temperature, the intruder appears invisible to the detector.

Manufacturers attempt to resolve this by increasing

the detector's sensitivity as room temperature rises so that even tiny temperature differences are detected close to body temperature. The downside of this is that with most of these detectors, sensitivity continues to increase with room temperature even when the room is hotter than body temperature, which increases the chance of false alarms.

But Bosch has overcome this with a Dynamic Temperature Compensation feature embodying an advanced algorithm that progressively reduces sensitivity again at room temperatures above body temperature. This allows the detector to catch intruders at any temperature while keeping false alarms to a minimum.

External sources of false alarms include air-conditioner vents, windows, direct heat and white-light sources, moving and stationary objects, animals, insects and drafts. Obviously a moving object like a book falling over could set off a microwave Doppler radar system but will leave a PIR unaffected. Combining several technologies into a single detector and triggering an alarm only if all of them detect an intruder is therefore an effective way of reducing false alarms.

A MAJOR diamond heist 6 years ago could have probably been foiled by the simple installation of a Bosch Professional Series anti-mask intrusion detector. It's a story that illustrates the importance of taking full advantage of the latest intrusion detection technologies.

Anti-mask systems, which trigger an alarm if the detector lens is covered or blocked, have existed for some 20 years, and in today's detectors they've reached such a level of sophistication that they will trigger an alarm if the lens is coated with transparent lacquer.

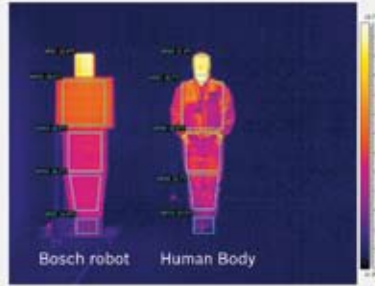
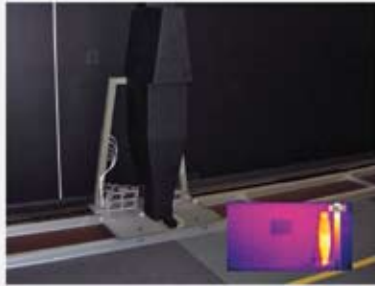
Several models in the Professional Series embody what Bosch calls Multi-Point Anti-Mask with



The Fresnel lenses used in Bosch's patented Tri-Focus optics produce better image quality (left) than the mirror lenses of traditional systems (right).

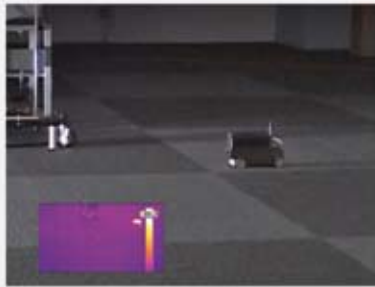


Bosch designed and built a custom simulated walk test target, including variable speed control. This "robot" exceeds all regulatory standard test method requirements and enhances Bosch performance verification testing capabilities.



This IR image shows the versatility of the Bosch robot, which allows independent temperature control of each body segment to more closely match the IR signature of a human.

Legendary Bosch False alarm immunity is further enhanced with the development of a simulated small animal test target with independent temperature control, as well as variable speed and direction control.



High capacity, dedicated heating, ventilation, and air conditioning units are strategically located throughout the range room to allow detector performance testing at any temperature desired, resulting in best in class temperature compensation.

such as passing headlights, without reducing the system's sensitivity to infrared signals. In contrast, competitive systems use filters to block the light, which reduces the signal to their PIR sensor as well, thus making it less likely to spot an intruder.

The Bosch Sensor Data Fusion system is a highly sophisticated concept capable of distinguishing the characteristics of humans (body temperature profile, electromagnetic reflection characteristics) from those of insects and small animals such as dogs and cats – providing bug immunity and pet immunity as well. The effectiveness of the system is further enhanced by the fact that the microwave modules employed in the Doppler radar are designed to take full advantage of the Data Fusion system – with microwave energy fields customized to cover exactly the areas required and with the required sensitivity. This contrasts with many competitor detector systems which use off-the-shelf microwave modules.

Sensor Data Fusion technology is the result of many years' research and development by Bosch in Fairport, USA and at the Bosch Research and Technology Center (Bosch RTC). Established in 1999 with offices in Palo Alto, CA and Pittsburg, PA, the Bosch RTC was the first Bosch operation outside Germany devoted exclusively to research and development. The strategic location of the offices in the USA enables close collaboration between Bosch RTC researchers and renowned US universities including Stanford, Berkeley and Carnegie Mellon on development of cutting edge technologies.

To optimize the performance of its PIR sensors Bosch has also introduced a novel optics system embodying three specially designed Bosch lenses covering the short, mid and long-range areas to eliminate gaps in coverage all the way from the mounting wall to the detector's maximum stated detection range. By dividing the job between three

lenses and using multiple PIR sensors, the quality of the optical signal for each range is vastly improved, resulting in greater resolution and enhanced ability to distinguish intruders from false alarm sources. With this patented Tri-Focus Optics technology, it is possible to monitor up to 86 detection zones and combine them to form 11 solid curtains of detection over the area of coverage.

The sophisticated 'Fresnel' lenses developed by Bosch for its Tri-Focus Optics also deliver better image quality than competitive systems using what was traditionally considered superior mirror optics.

**REDUCED INSTALLATION TIME**

The effort Bosch has put into the development of its intrusion detectors hasn't focused solely on advanced technologies to improve catch performance. Based on decades of experience in developing detectors, speaking with customers and installing and testing detector units themselves, Bosch engineers have also created a range of smart design features aimed at simplifying the installation of its detectors.

The Professional Series, for example, incorporates special features that reduce installation time by as much as 25 per cent compared with traditional units. Thanks to their proprietary optics, and the use of separate long-range and mid- to short-range

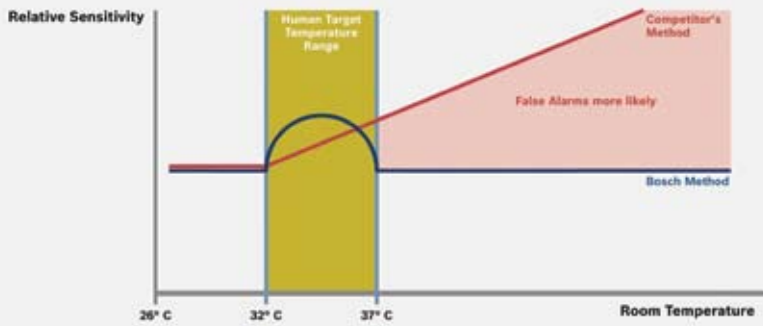




**Multi-Point Anti-Mask with Integrated Spray Detection**



Bosch's Multi-Point Anti-Mask with Integrated Spray Detection feature protects against materials slid in front of the detector, objects approaching the detector and material sprayed on the detector.



Bosch's Dynamic Temperature Compensation feature allows the detector to catch intruders at any temperature. Most other detectors simply increase gain as temperature rises, which increases the likelihood of false alarms at higher room temperatures.

“The detectors also provide a self-adjusting LED illumination level to ensure that the alarm condition is visible at any room lighting level without being too bright in dark rooms.”

PIR sensors that can be independently adjusted, it is possible to tweak the gain and alarm threshold of the detectors to allow them to be mounted anywhere between 2 and 3 meters from the floor – providing convenient positioning with no adjustments necessary. The two-piece ergonomic housing simply slides into place and automatically locks, requiring only seconds to mount. Once locked, it can only be opened with the appropriate tools.

The housing also provides more room for wires, and a specially designed removable terminal block with angled wire entries makes wiring easy, reducing the chances of errors; and a built-in bubble level allows accurate horizontal and vertical alignment without extra tools.

The detectors also provide a self-adjusting LED illumination level to ensure that the alarm condition is visible at any room lighting level without being too bright in dark rooms.

Finally, the 'lookdown' lens can be disabled and re-enabled repeatedly simply by turning a screw, thus eliminating cumbersome and unreliable tape masking. This feature is particularly useful in difficult installations where it is not clear whether the 'lookdown' feature is needed or not.

detectors to enable further improvements in catch performance and false-alarm immunity and ensure that they comply with international standards.

Facilities include the construction of a special 'Range Room' for simulating any type of environment that an intrusion detector might be exposed to. The room features two dedicated and independent high-capacity heating, ventilation and air-conditioning systems, allowing room temperature to be controlled to within half a degree Celsius over a range from 0 to 46 °C. The ability to control temperature to this level of precision has been key to the developments of Bosch's superior temperature-compensation algorithms. The room also has a grid pattern on the floor to allow accurate determination of detector distances for precise walk tests over all distances and all angles demanded by international standards.

And as well as using human subjects for these walk tests, Bosch has also developed a simulated walk test target "robot" in which the temperature of each part of the robot head, torso, legs and feet can be independently controlled to perfectly simulate the temperature profile of a human being. Facilities are also available for anti-mask testing and for testing bug and small-animal immunity – including a remote-controlled electronic 'rat', the temperature of which can also be precisely controlled. In addition, Bosch tests its detectors for immunity to all kinds of disturbances including disturbances from white-light, drafts and ceiling-mounted fan noise.

Bosch detectors have been designed and manufactured to fulfill the requirements of international standards from all over the world including EN5013x series, CE, Afnor, VdS, Incert, SBSC, FG, NCP, CCC, A-tick, UL639 and FCC part 15 Sub part B, Class B and many more. The laboratory tests all detectors against the most stringent tests within each standard. Bosch has also designed its own tests that are even more stringent than those demanded by the regulations, including customized EMI and RF tests, making the detectors virtually immune to environmental disturbances. ▀ ▄ ▄ ▄

\* Michael Reimer, product manager, Bosch Intrusion Detection Systems

**TESTING TIMES**

Bosch has also invested heavily in state-of-the-art test facilities to evaluate the performance of its intrusion