4.1 Communication Network Overview

The SDUs connect to the central computer system via a TCP/IP LAN connection based on standard technologies such as copper or fiber. Xsight recommends using self healing rings (a daisy chain is also acceptable, although less reliable). The advantage of a self healing ring is that while in normal use, traffic is dispatched in the direction of the shortest path towards the server, in the event of the loss of a link, or of an entire station, the two nearest surviving stations "loop back" their ends of the ring. In this way, traffic can still travel to all surviving parts of the ring, even if it has to travel "the long way round".

Alternative options include splitting the power and network into two rings each with independent power sources. The SDUs are alternately connected to each of the two power sources so that if one power source completely fails, the runway will continue being monitored by the SDUs that are powered by the working power source (with a distance of 120/100 meters between SDUs instead of 60/50 meters). Another possibility is to create two separate rings, one on each side of the runway, so that no cable duct crossing the runway is necessary (**See** Figure 7 below).

Xsight Systems
11 Haavoda St., Bellers House,
Rosh-Haayin, Israel 48017
Tel: +972-3-9102562 Fax: +972-3-9030590

www.xsightsys.com
One Post Office Square, 30th Floor,
Boston, Massachusetts 02109
Tel.781-330-8466 US-sales@xsightsys.com

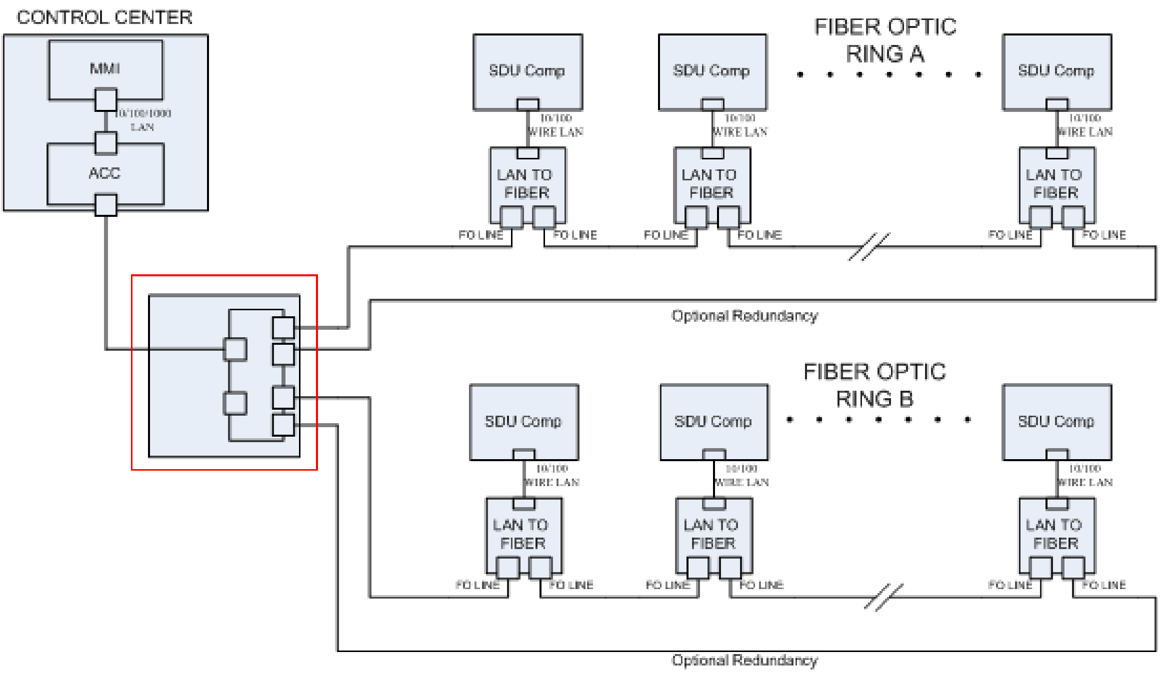

Figure 7: Communication network – A ring on each side of the runway

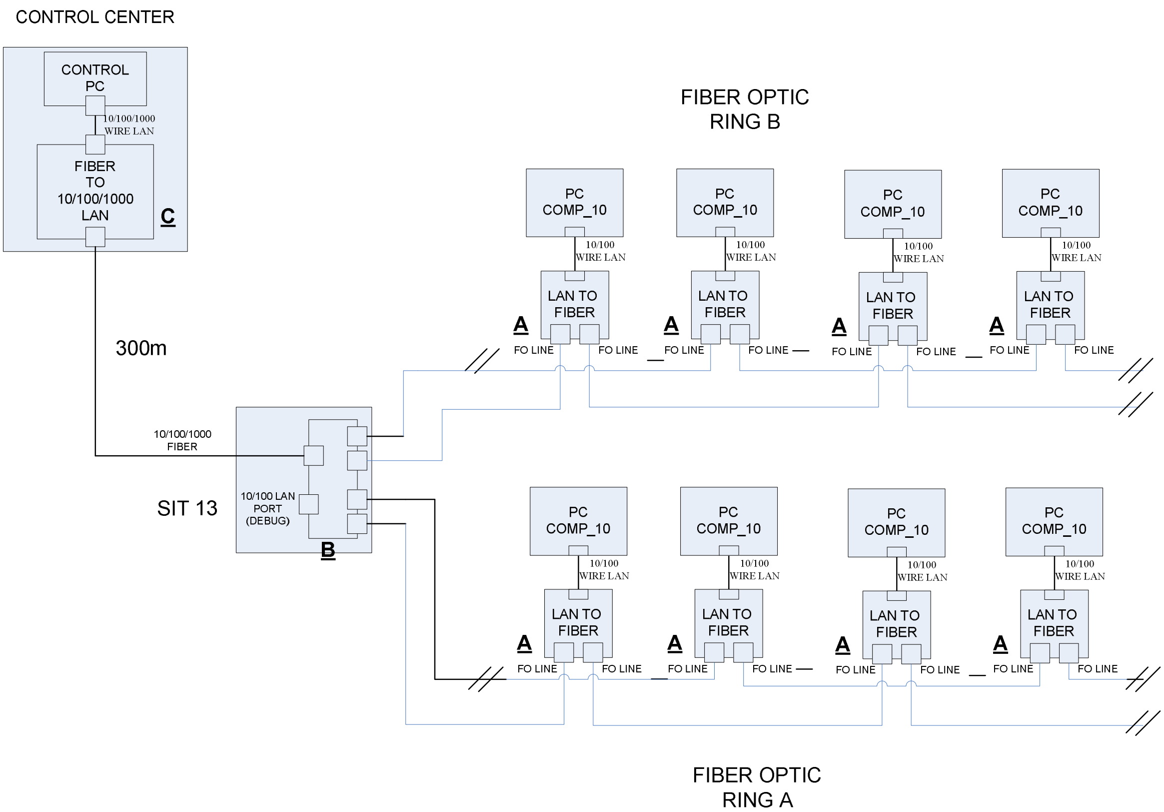

Figure 8: Communication network - interlaced topology

4.2 Switch and Cables

The communication switch is responsible for the following processes:

- Converting between SM (Single Mode) and MM (Multi Mode).
- Rebuilding a spanning tree of the network when an SDU in the chain is breaking the chain. When the SDU is communicating again, for example after a maintenance action, the switch will re-build the spanning tree.

The communication cable used to connect the SDUs on the runway to the communication switch is generally fiber optic due to the long distance. Depending on the distance, either Single-Mode (SM) Fiber or Multi-Mode (MM) fiber will be used. Between the SDUs, MM is normally used, while the SDU connector is Huber Suhner ODC4 outdoor connector.

4.3 Connection from the Field to the ACC Server

A field patch panel is used at the point where both runway loops meet to connect the field with the ACC. The field patch panel collects the data from the runway units and transfers it to the ACC. It includes active equipment such as switches and transmission equipment, and passive equipment such as splice boxes. Street cabinets are used for hosting the field networking equipment and patch panels.

Figure 9: Field patch panel

Chapter 5 Upper Unit Components

The SDU upper unit combines a day/night Vision sensor with a FMCW W-band Radar sensor. The Radar sensor provides complementary performance even when the Vision sensor has limitations during low visibility conditions.

The SDU upper unit includes the following components:

- Millimetric Wave Radar (MMWR) Head
- Video Camera
- NIR Illuminator
- Laser Beam Line Pointer
- Door and Windshield Wiper Control Unit

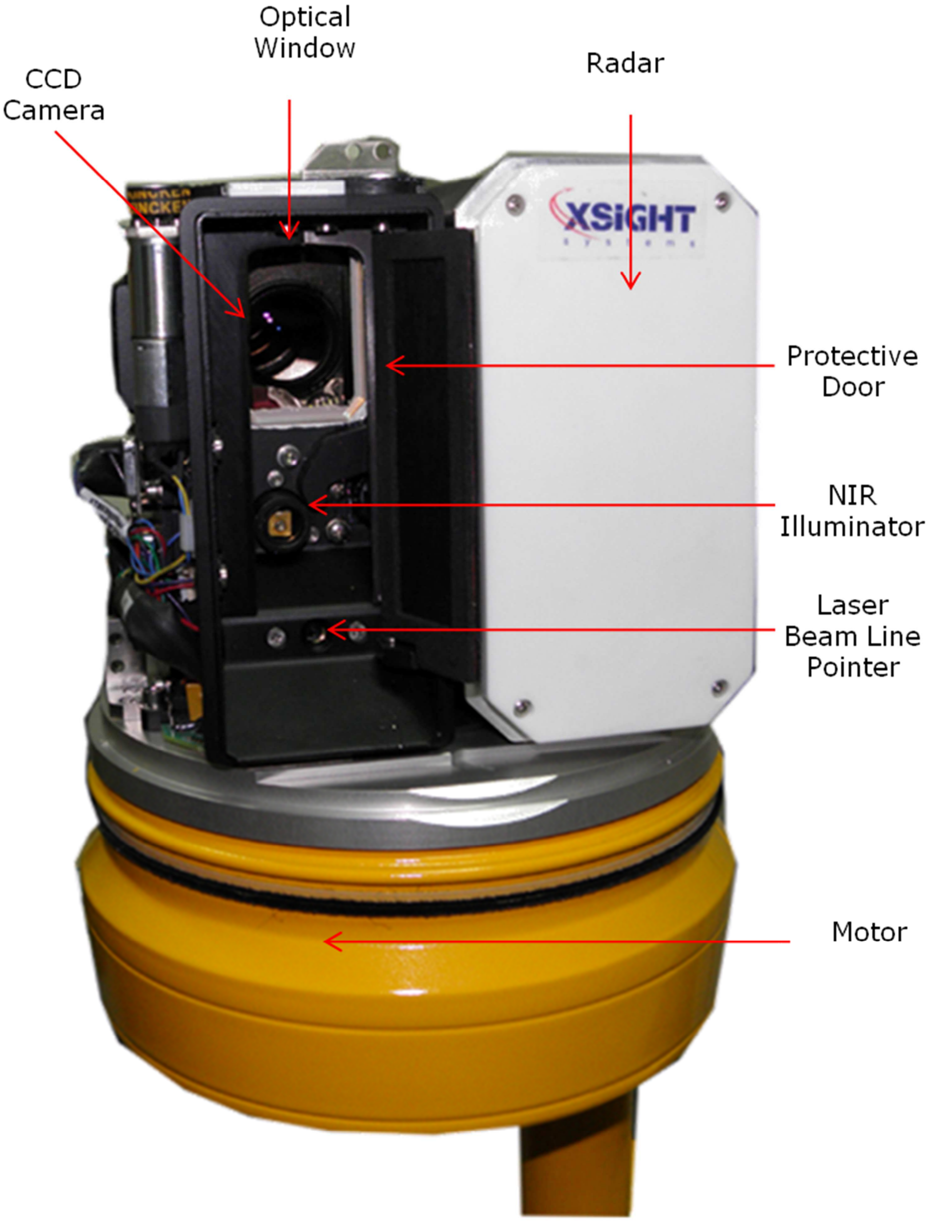

Figure 10: SDU upper unit front view

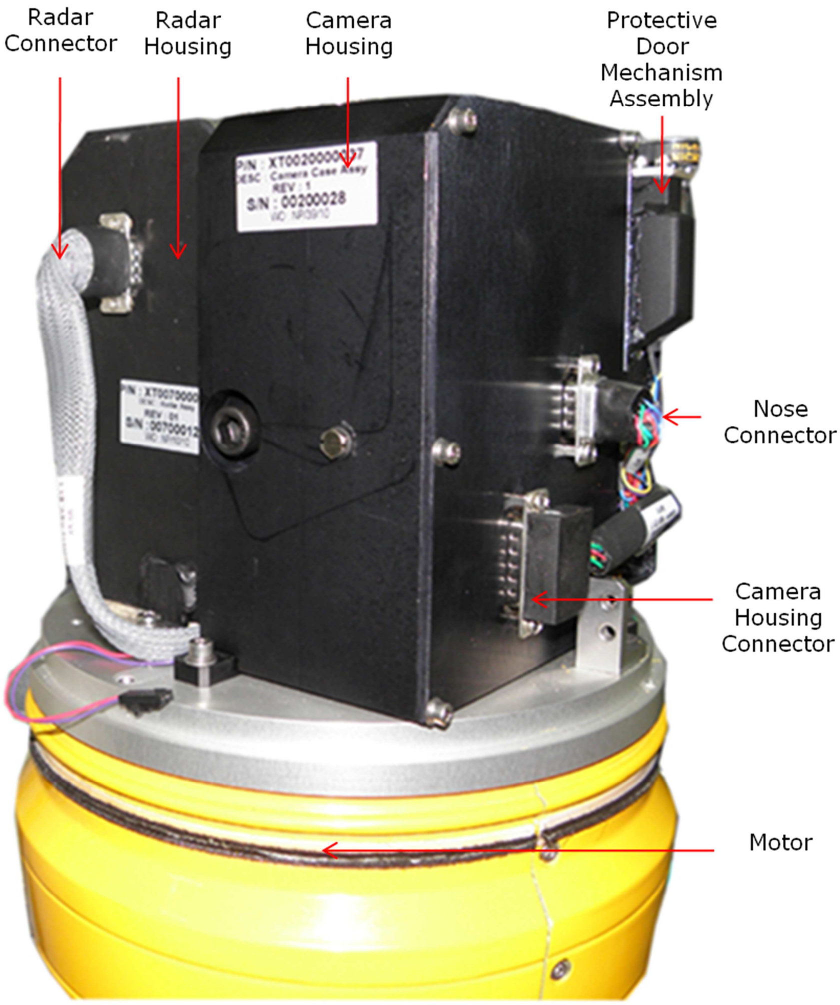

Figure 11: SDU upper unit rear view

5.1 Charge-Coupled Device (CCD) Camera

The Vision sensor camera uses image analysis software that compares images of the monitored area to previous images stored in memory, to determine the presence of a foreign object on the runway. Parameters including number of inspections per second number of images stored in memory, shutter speed and zoom are preset by Xsight. The camera can also be manually operated by operators, using the SOC.

The FODetect® camera offers 24/7 day-night functionality. As light diminishes below a certain level, the camera automatically switches to night mode to make use of near infrared (IR) light to deliver high-quality, black and white images.

Near-infrared light, which spans from 700 nanometers (nm) up to about 1000 nm, is not visible to the human eye but it can be sensed by the camera's sensor. During the day, a day and night camera uses an IR-cut filter, that filters out IR light so that it does not distort the colors of images as the human eye sees them. When the camera is in night (black and white) mode, the IR-cut filter is removed, allowing the camera's light sensitivity to reach down to 0.001 lux (measure of light intensity) or lower.

5.1.1 Specifications

SDU – Optical Component	
Imager	Color / Monochrome CCD
Horizontal FOV	2.6° (maximum zoom)
Synchronizing System	Internal
Minimal Illumination	0.05 lux - 0.7 lux
S/N Ratio	50 dB
NIR Beam	
Square Beam	8°- 12°
NIR Beam Power	2 W
NIR Beam Wavelength	808nm
NIR Laser Safety Class	4

5.1.2 NIR Illuminator

An NIR illuminator within the camera housing that provides near-infrared light is used in conjunction with the camera to further enhance the camera's ability to produce high-quality video in lowlight or nighttime conditions. This illuminator can be activated manually by an operator using the system operator console (SOC).

5.1.3 Door and Windshield Wiper Control Unit

A windshield wiper within the camera housing can be operated manually, from the system operator console (SOC), in order to clean the camera optical window. An operator can also activate a water spray pump located within the camera housing.

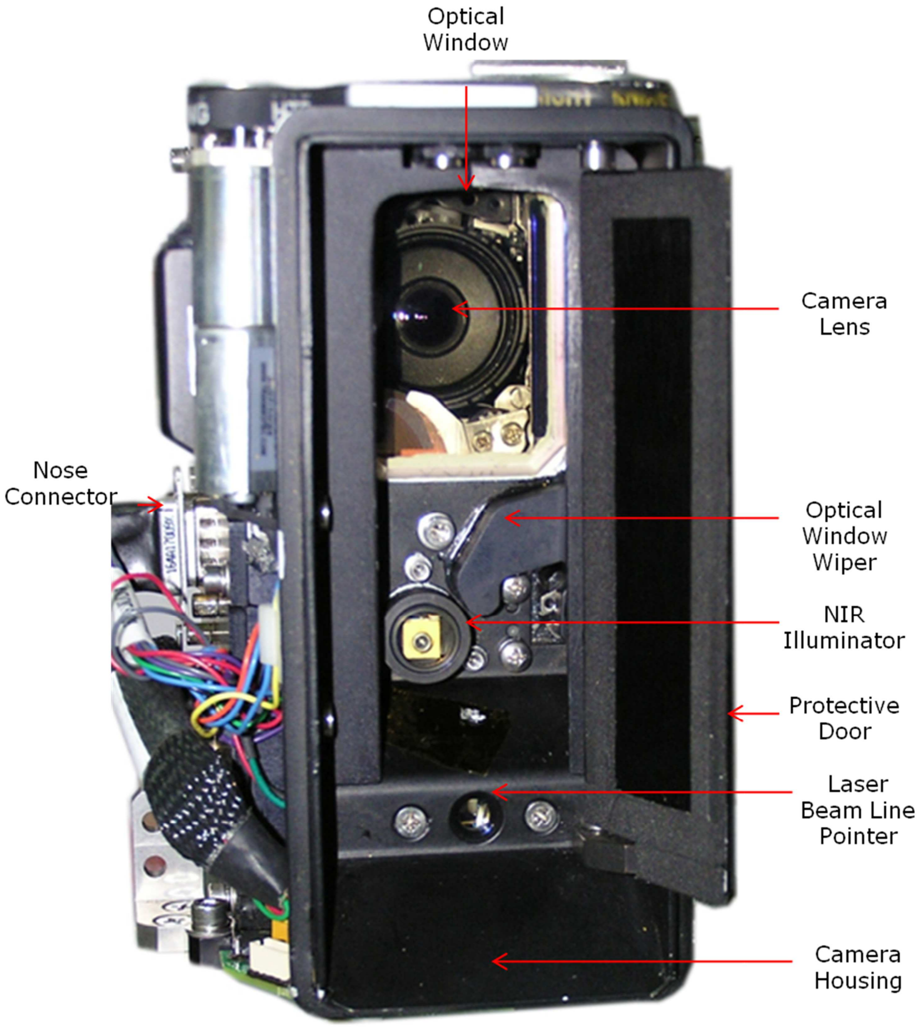

Figure 12: CCD camera components (Front View)

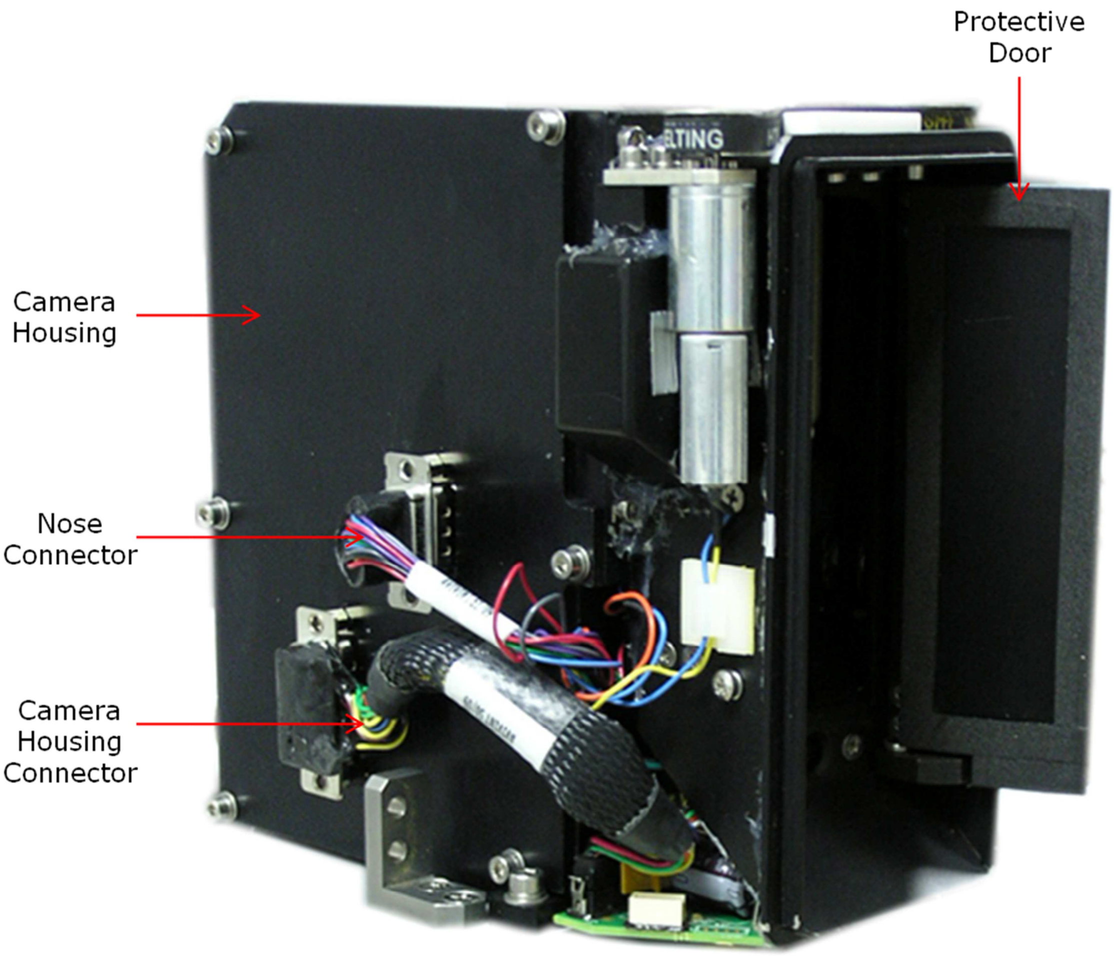

Figure 13: CCD camera components (Side View)

5.2 Radar Component

A Frequency Modulated Continuous Wave (FMCW) W-band radar, gimbaled together with the camera, performs independent monitoring, in order to achieve full performance at all times.

Through frequency modulation, the systematic variation of the transmitted frequency, it becomes possible to use a FMCW radar system to measure a target's range. By measuring the frequency difference of the transmission and reception return signals, the range can be estimated.

Xsight Proprietary Information / Secret Commercial Information

The FODetect® radar component is managed by a DSP-based processor, providing advanced processing features. It is optimized for high probability-of-detection (Pd) and low false-alarm-rate (FAR) of extremely low radar-cross-section (RCS) targets.

It can be customized to meet the customer's specific requirements including:

- Tailoring the MWR antennas to meet a required beam shape.
- Controlling (via a management port) many of the waveform parameters (such as chirp bandwidth, time, slope, PRF etc) for meeting a required performance envelope (Various target RCS, various ranges, various Doppler resolutions, various Pd/FAR, etc.).
- Shaping the physical size and form-factor to fit a variety of carrying platforms (Mobile, airborne etc.).

SDU-Radar Component	
Transmitter Characteristics	
Frequency	76.5 ± 0.5 GHz
Transmit Wave Form	LFMCW
Peak Power	14 dBm
Ramp Length	500 microseconds
Instantaneous Bandwidth	1 GHz
Receiver Characteristics	
Dynamic Range	80 dB
Noise Figure	12 dB
Antenna Characteristics	
Elevation Beam Width	4°

Azimuth Beam Width	4°
Gain	32 dBi

5.3 Laser Beam Line Pointer

The SDU includes a built-in laser pointer for highlighting FOD locations for efficient removal at night. The laser pointer is manually activated by an operator using the system operator console (SOC).

Line Laser Pointer	
Line Laser Pointer Power	8mW
Line Angle	56°
Line Laser Pointer Safety Class	1
Line Laser Pointer Wavelength	650nm (red)

Xsight Systems
11 Haavoda St., Bellers House,
Rosh-Haayin, Israel 48017
Tel: +972-3-9102562 Fax: +972-3-9030590

www.xsightsys.com
One Post Office Square, 30th Floor,
Boston, Massachusetts 02109
Tel.781-330-8466 US-sales@xsightsys.com

Chapter 6 Lower Unit Components

All FOD detection data received by the upper unit camera and radar is processed locally by internal processors in each individual SDU, so that the main server does not need to process high volumes of data simultaneously. While the sensor is scanning for FOD it only informs the server of its operating status.

Figure 14: SDU lower unit in canister

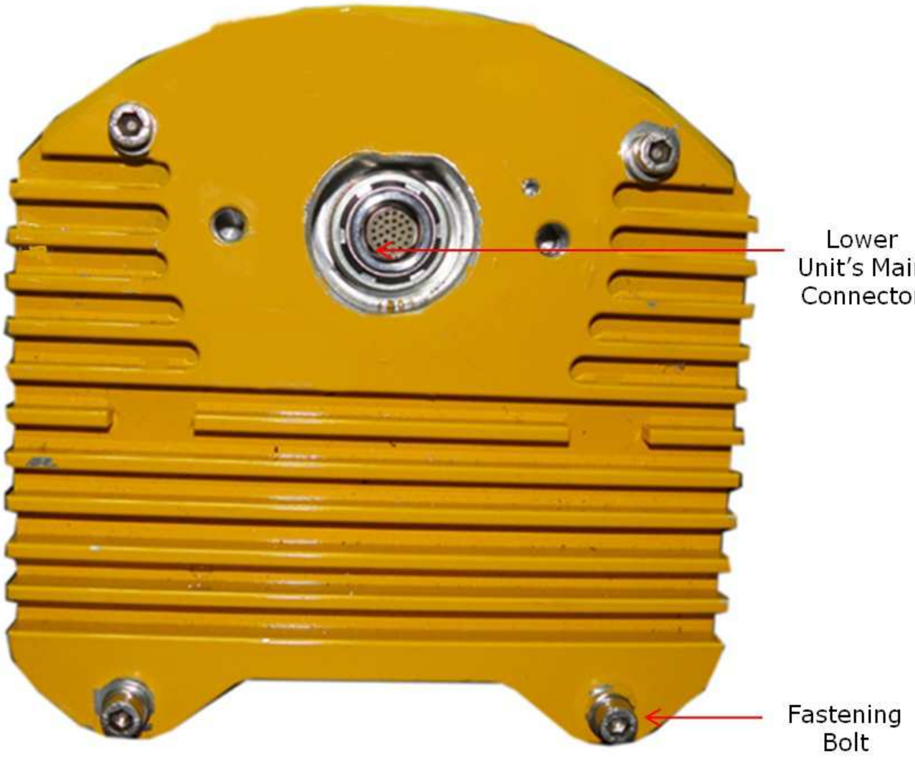

Figure 15: Lower unit module top plate

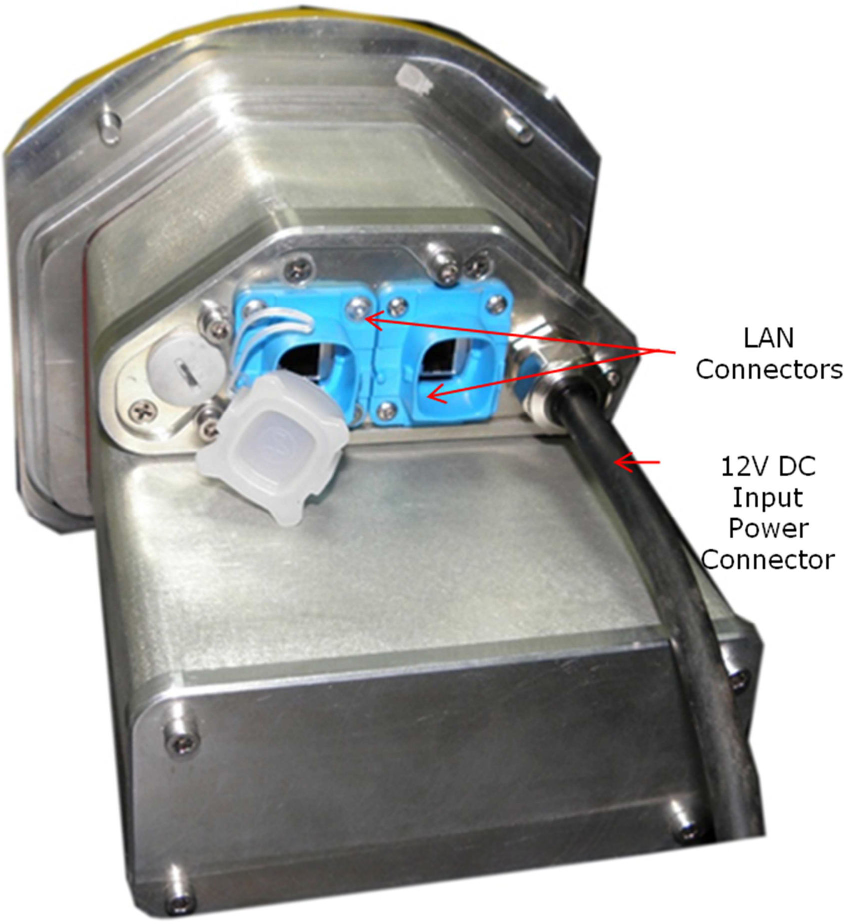

Figure 16: Lower unit module components (rear View)

6.1 Processor

The FODetect® processor uses a proprietary main board (carrier) and an off-the-shelf, high-performance COMExpress Single Board Computer (SBC).

The processor includes the following components/

- Video grabbing
- Copper / Fiber optic LAN connection

- High performance, general purpose CPU
- Serial ports and USB interface
- Power management, command & control

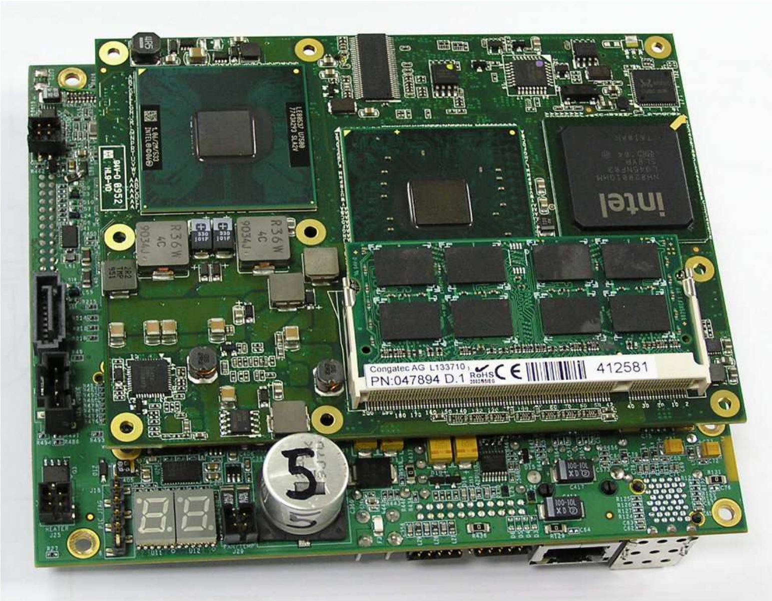

Figure 17: SBC with carrier board

6.2 SBC Specifications

Component	Specification
Backplane	Active carrier board
Power Supply	Single input voltage
Processor	Intel® Core™ 2 Duo SU9300 1.2GHz with 3-MByte L2 cache
Memory (RAM)	2 memory cards, 2GB each
Ports	3 10/100/1000 Ethernet ports, 2 100/1000 Fiber ports, 3 USB, 1 VGA, 2 S-video, 1 RS485, 1 RS232, 1 Audio line out,

Component	Specification
	1 Mic in
Chipset	Graphics and Memory Controller Hub (GMCH) Intel® GS45 Intel® I/O Controller Hub 82801IUX-SFF (ICH9M-SFF)

Chapter 7 Pre-Installation Procedures

As part of the boot process of the lower unit, if needed it downloads software from the server. Then, it burns this software into the various SDU elements, such as PDU, Frame grabber, MCU etc. If there is a power failure during this burn, at certain points of time, these units might fail.

Therefore, during installation period, when the power is not stable and might fail, the ACC should be configured to "installation mode" in which the "USYS server" (the ACC service that updates the SDUs with the latest software packages) is turned off.

Xsight Systems
11 Haavoda St., Bellers House,
Rosh-Haayin, Israel 48017
Tel: +972-3-9102562   Fax: +972-3-9030590

www.xsightsys.com
One Post Office Square, 30th Floor,
Boston, Massachusetts 02109
Tel.781-330-8466   US-sales@xsightsys.com

It is recommended to install the power supply in the canister during the infrastructure work, prior to the installation of the system. **See** "Power Supply" in the "Power Requirements" chapter for power supply specifications.

Figure 18: Power supply

To install the power supply:

1. Connect a grounding cable to its place on the power supply panel, and tighten the screw.
2. Connect the grounding cable to a grounding fastener on the inside of the canister.
3. Connect the power supply input connector to the CCR series line connectors, and locate it on the bottom of the canister.

If using a power supply without an embedded transformer, connect the power supply (P/N – XT1050000027) to a standard 200Watt transformer that is connected to the CCR series. **See** "Power Supply" in the "Power Requirements" chapter for further information.

4. Connect the power supply output cable to the lower unit input power connector. The unit supplies 12VDC power to the SDU system (up to 5.5A). Apply the yellow insulation tape to connection points to achieve a weatherproof and airtight seal.

   Make sure to **completely** connect the cable to the power connector, leaving absolutely no gap, to prevent the power supply from overheating and burning out.

   If the lower unit is not installed as part of the power supply installation, place a cap on the secondary connector and secure it with insulation tape.

5. When applying CCR power, the "Input" LED on the power supply panel will be lit if the input power is valid. See the power supply panel in the following image:

Figure 19: Power supply panel