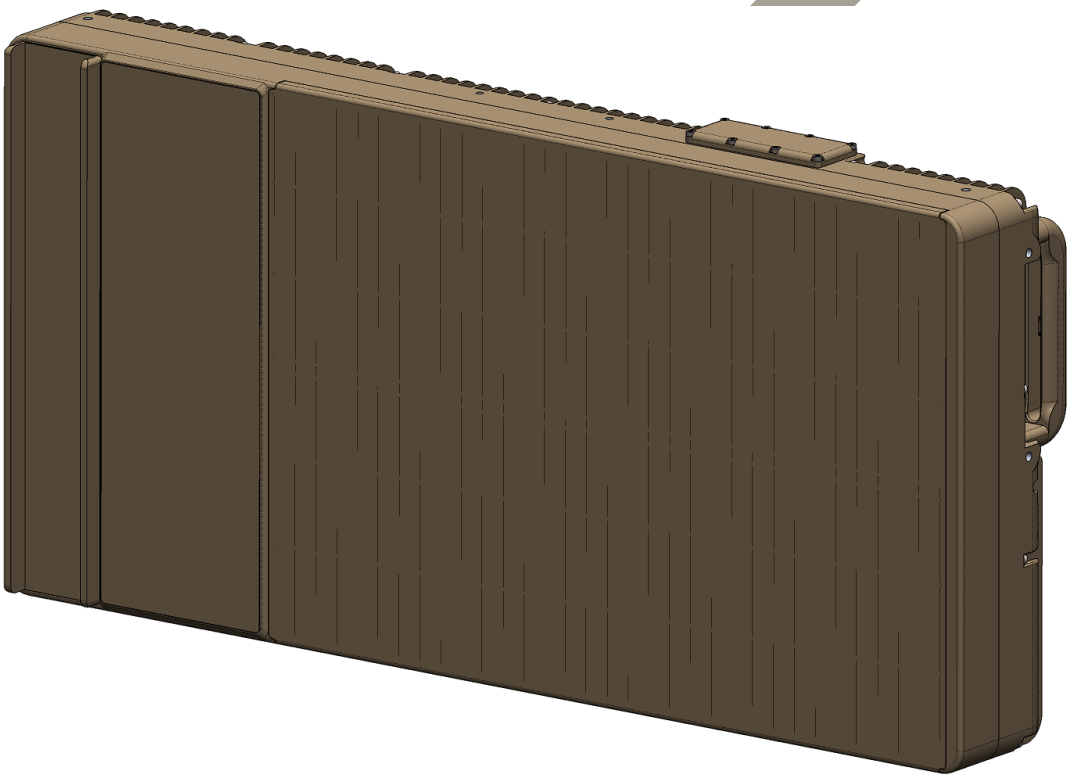
Ranger® R Series Radars

R20SS Installation and Maintenance Manual



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Information contained in this document pertains to a Canadian origin product that is controlled as "dual use" by the Canadian government. However, when in the United States or possessed by a US person, it may be considered a defense article from the US Government's perspective. US government authorization may be required for re-transfer to a foreign person. If you have any questions, please contact FLIR's Global Trade Compliance group at *exportquestions@flir.com*.

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When sending an e-mail (✉), please include:

- Contact info (e-mail, phone, fax, other as required)
- Product model and software version number
- If possible, the serial number of the product
- A description of the problem/issue
- Data recordings and/or log files, if available
- Any other pertinent information

DISPOSAL

Dispose in accordance with the laws and regulations applicable in your jurisdiction.

REVISION RECORD TABLE

Manual Revision	ECO #	Pages	Description of Modification
1.0	13-008	All	PSR Software Version 6.1.0
2.0		All	Insertion of ITAR Statement
3.0		All	Safety distances added

The following symbols are used throughout this document:

Caution!
The CAUTION symbol is used to alert the reader to situations where a hazard to personnel safety may arise.

WARNING!

The WARNING symbol is used to alert the reader to situations where equipment damage is imminent if a recommended process is not followed or alert the reader of a process that will alter or reset current configuration of a specific setup.

DANGER!

The DANGER symbol is used to alert the reader to situations where a hazard to personnel may result in serious injury possibly leading to death.

Disclaimer!
Disclaimers provide a means of specifying limitations or other requirements on equipment.

Note
Notes comprise additional information to assist the reader in the use or understanding of the equipment or subject.

DEFINITIONS AND ACRONYMS

AXML	Amphitech eXtensible Markup Language
BIT	Built-in Test
CE	Refers to CE marking, a conformity mark in Europe
Doppler	Doppler effect. Also refers to Doppler radar operation mode, where target speed is used to reject fixed clutter.
FastScan	Non-Doppler scanning mode featuring a fast update rate
FCC	Federal Communications Commission (usually refers to the US agency)
FMCW	Frequency Modulated Continuous Wave
GPS	Global Positioning System
GUI	Graphical User Interface
IP	Internet Protocol
KBPS	KiloBits Per Second
LAN	Local Area Network
MBPS	MegaBits Per Second
PPI	Plan Position Indicator
PPS	Pulse Per Second
PSR	Perimeter Surveillance Radar
RCS	Radar Cross Section
RF	Radio Frequency
TCP	Transmission Control Protocol
VDC	Volts of Direct Current
XML	EXtensible Markup Language

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1 INTRODUCTION

This manual describes the R20SS Perimeter Surveillance Radar (PSR) installation and maintenance procedures. Complete electrical, mechanical and physical interfaces of the system are also provided. The Installation Manual is intended for an audience of technically qualified personnel.

Note
This manual provides information on installing R20SS and a general description of its operational modes. For detailed instructions on how to use the different modes of the R20SS, please refer to the Operator Manual for Mid-Range Perimeter Surveillance Radars.

1.1 EQUIPMENT FEATURES AND SPECIFICATIONS

1.1.1 R20SS Radar Assembly

The R20SS provides detection capability for moving objects on the ground out to an instrumented range of up to 30 km over an area of up to 90° (360° when used with a pan/tilt positioner), and presents detection data to the operator through a Graphical User Interface (GUI). The data may also be transmitted via a third-party software application using an Extensible Markup Language (XML) Client responsible for implementing security policies.

R20SS Specifications	
Weight	45 lbs (20.4 kg) (921-0041-00-R0X) 42 lbs (19.1 kg) (921-0041-2X-R0X) 40 lbs (18.2 kg) (921-0041-3X-R0X)
Cooling	No forced cooling required
Operating Temperature Range	-30ºC to +60ºC
Storage Temperature Range	-54ºC to +71ºC
Operating Altitude Range	Up to 15,000 ft. / 4,572 m.
Power Input (nominal)	24 - 48 VDC (Nominal 28 VDC), 275 W (921-0041-00-R0X) 24 - 48 VDC (Nominal 28 VDC), 240 W (921-0041-2X-R0X) 24 - 48 VDC (Nominal 28 VDC), 170 W (921-0041-3X-R0X)
Frequency Band	X Band
Detection Range	10 - 15,000 m (medium range mode) 10 - 30,000 m (long range mode)
Warm-up time	Ready to operate less than 2 minutes after power-up
Scan rate	2 Hz
Compliance	FCC Part 90 FCC Part 15, class A MIL-STD-461 (Army ground):
	CE-102, CE-106, CS-101, CS-114, RE-102

Table 1 – R20SS Radar Assembly Specifications

Disclaimer!
The R20SS is designed for operation while in a fixed location and is not intended for use on moving platforms. Failing to adhere to this recommendation could compromise detection capability of the unit.

Disclaimer!
Due to the inherent nature of radar detection, the R20SS may present “nuisance” alarms triggered by animals, moving tree branches, ocean surf or waves moving within the radar field of detection.

Disclaimer!
Due to the inherent nature of radar detection, small and/or very slow moving objects may not be detected by the R20SS.

Disclaimer!
Under heavy rainfall conditions (> 10 mm/hr), the R20SS performance can be reduced, typically for targets furthest away. Under such conditions, the unit may not detect some moving objects and may result in increased nuisance alarms.

WARNING!

This equipment has been designed to comply with the limits for a Class A digital device, pursuant to part 15 of the Federal Communications Commission (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 this instruction manual, may cause harmful interference to radio communications. Contact local authorities for frequency authorization prior to installing and operating this equipment.

1.1.2 Pan/Tilt Positioner Assembly

The pan/tilt positioner allows the R20SS to be scanned in the azimuth and elevation axis. This allows a coverage of up to 360°. Please refer to the operator manual for configuring the pan/tilt positioner to cover a particular area.

Pan/Tilt Positioner Specifications	
Weight	< 15 kg (33 lbs)
Cooling	No forced cooling required
Operating Temperature Range	-40ºC to +60ºC
Power Input	24 - 42 VDC (Nominal 28 VDC), 100 W Max
Coverage	Pan: 360° continuous Tilt: ±20°
Speed	Pan: up to 30°/s Tilt: up to 5°/s
Accuracy	Pan: ±0.1° Tilt: ±0.5°
Compliance	MIL-STD-461
	MIL-STD-810

Table 2 - Pan/Tilt Positioner Specifications

1.2 SAFETY ISSUES

This equipment generates Radio Frequency energy and is intended for outdoor installations only. Based on limits specified by the Federal Communication Commission (FCC) on Radio Frequency (RF) Emissions, findings from tests conducted conclude that the R20SS do not represent any safety hazards and is therefore safe for human exposure, provided the following conditions are met:

Caution!
The installation must provide a separation distance from all persons and must not be co-located or operating in conjunction with any other antennas or transmitters. This safety distance complies with the FCC Limits for Maximum Permissible Exposure (MPE) for general population / uncontrolled exposure.

Safety Distances				
	Output Power	Frequency Band	FCC MPE distance (cm)	
			Controlled Exposure	General Population
R20SS-0041-00	25 Watts	X	170	400
R20SS-0041-2X	25 Watts	X	170	400
R20SS-0041-3X	8 Watts	X	85	190

1.3 UNPACKING THE R20SS RADAR ASSEMBLY

Following verification of the shipping documents, move the case to a clean area. Open the case and follow these steps:

Step 1 Inspect packing for any damage. If damage is noted, take photos and contact shipper.
Step 2 Remove packing material and retain for future use.
Step 3 Remove unit carefully.
Step 4 Place the unit on a flat clean surface, being careful not to damage the connector on the back of the unit.
Step 5 Compare the part and serial numbers appearing on the shipping invoice with the part and serial numbers appearing on each unit.
Step 6 If they do not match, contact your distributor/retailer with details.
Step 7 Make a list of items received versus items ordered and note each item's condition upon receipt.
Step 8 If they do not match, contact your distributor/retailer with details.
Step 9 Make a visual inspection of each unit to ensure it was not damaged during shipment.
Step 10 Keep this report. If there is damage, it is best to make digital photographs to aid with the claims process with the carrier.

1.4 INSTALLING THE TX ANTENNA ASSEMBLY (P/N 921-0041-00-R0X only)

To install the TX antenna assembly on the main radar assembly, follow these steps:

Step 1 Make sure the gasket is properly seated in the slot
Step 2 Connect the DB-25 connector and lock it by sliding the latch from right to left
Step 3 Torque the SMA connectors to 1 N·m (9 lb·in)

Caution!
Be sure to connect the SMA cable with the proper mating connector (the cable with the red ring mates with the connector surrounded by the red circle, the cable with the blue ring mates with the connector surrounded by the blue circle).

Caution!
Be careful not to damage the SMA cables, as since they operate at microwave frequencies they are fragile.

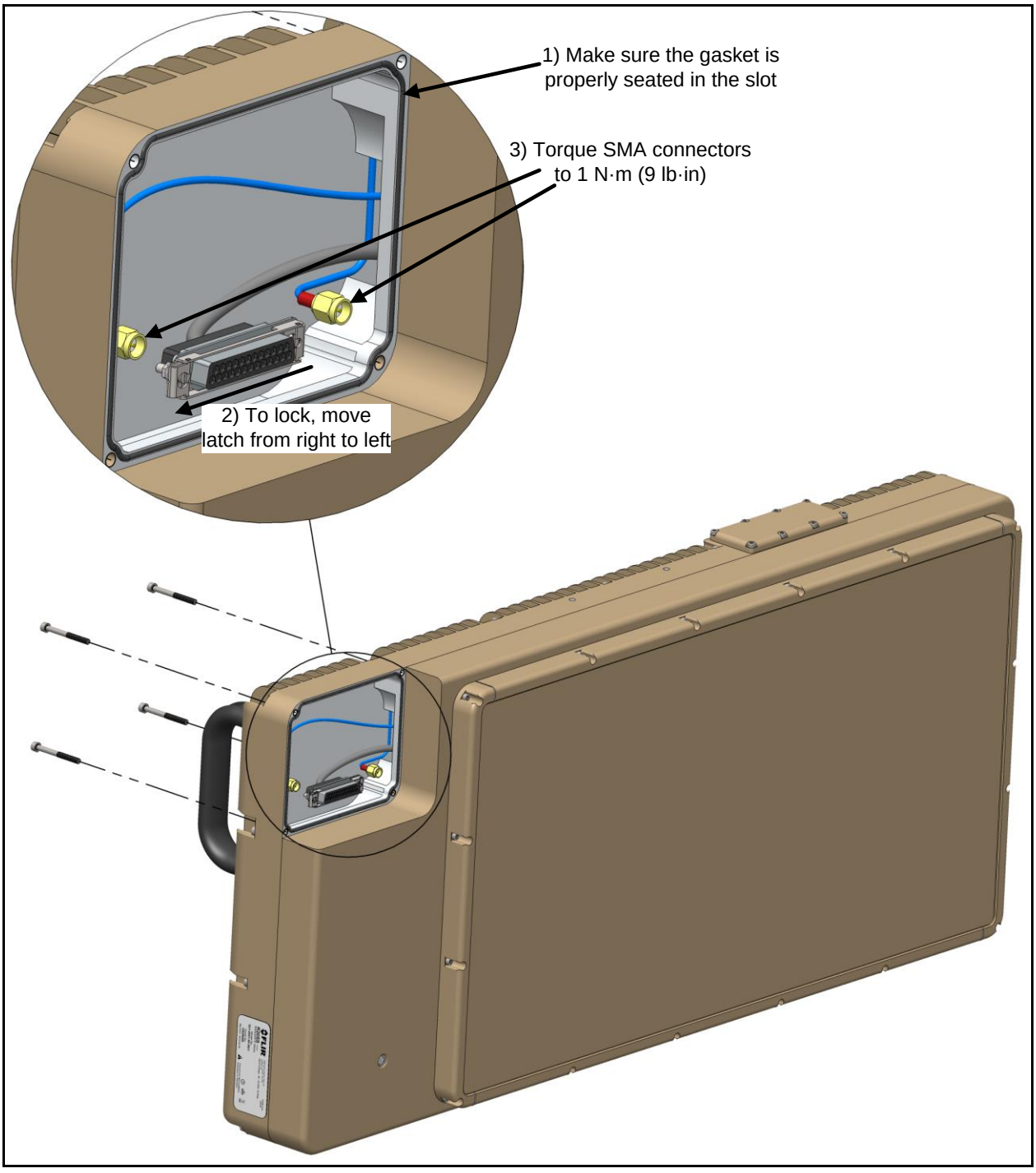

Figure 1 - Installing TX Antenna Assembly (1/2)

Step 4 Apply medium strength threadlocker on the four (4) M4 screws

Step 5 Torque M4 socket head cap screws to 2.5 N·m (22 lb·in)

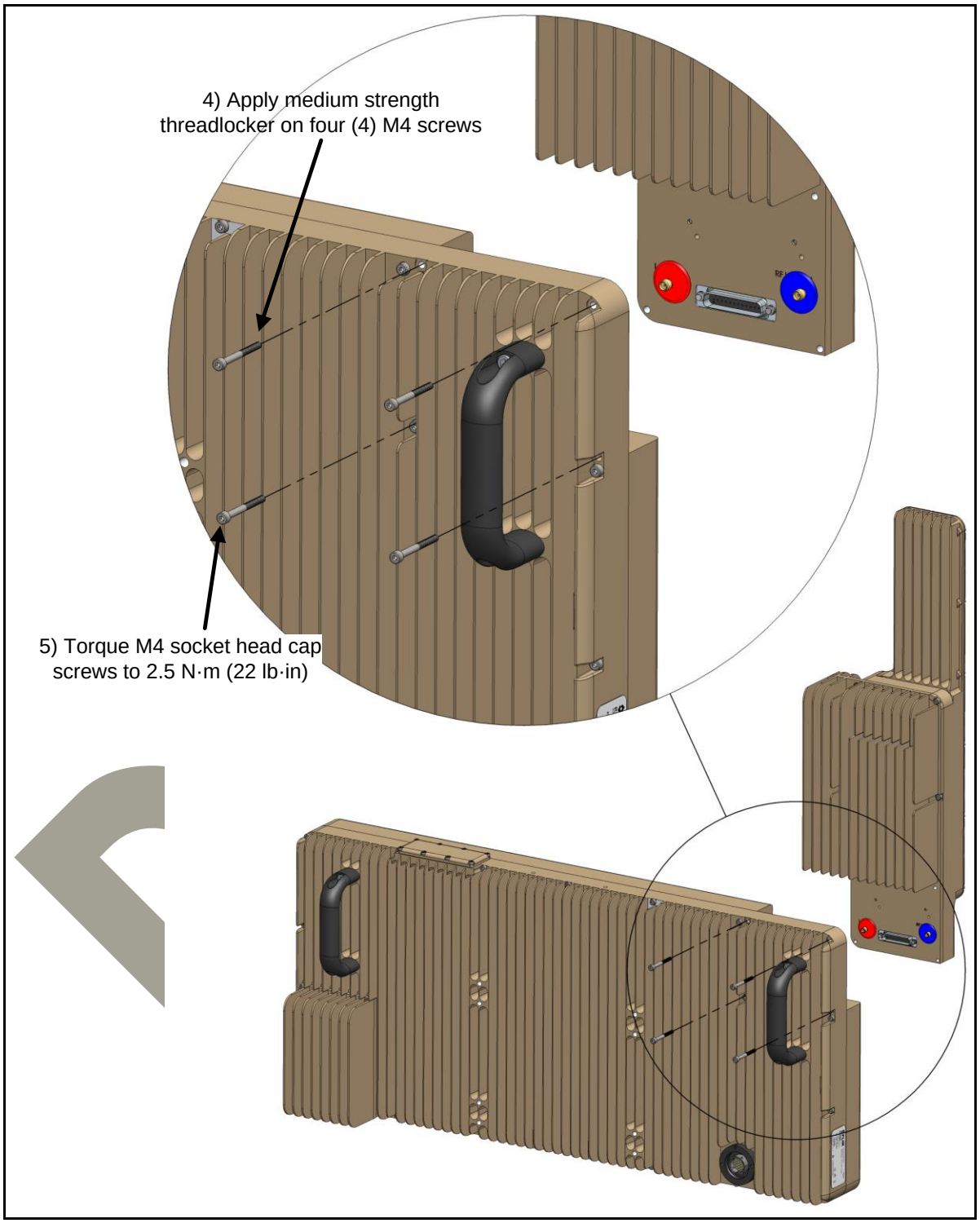

Figure 2 - Installing TX Antenna Assembly (2/2)

2 HARDWARE SYSTEM DESCRIPTION

2.1 HARDWARE COMPONENT DESCRIPTION

The R20SS Radar System comprises the following components. Some of these components may not be needed, depending on the specific installation.

1. R20SS Radar Assembly
2. Pan/Tilt Positioner (optional)
3. Radar Server computer
4. Client computer
5. Breakout box
6. Radar power supply
7. Network infrastructure
8. Cabling

2.2 PHYSICAL SYSTEM OVERVIEW

Figure 3 shows a typical hardware configuration of a R20SS Radar System.

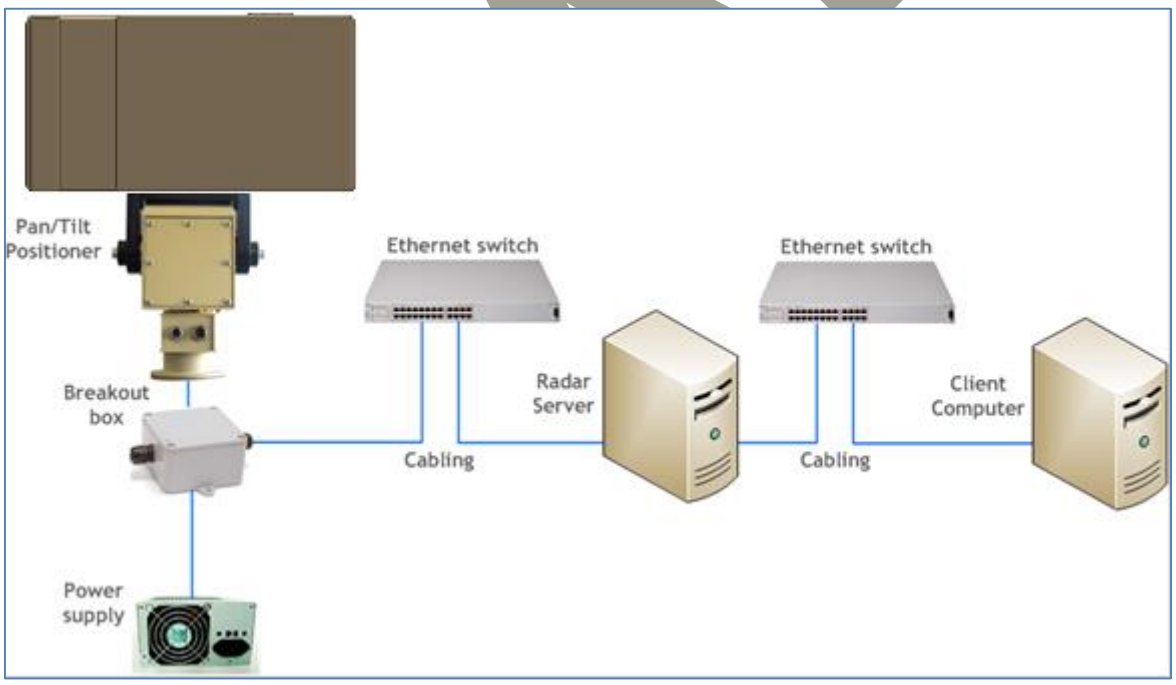

Figure 3 - R20SS Radar System Physical Overview

2.2.1 R20SS Radar Assembly

The R20SS Radar Assembly consists of the main assembly and the TX antenna assembly.

Figure 4 - R20SS Radar Assembly (V2)

2.2.2 Pan/Tilt Positioner (optional)

The Pan/Tilt Positioner consists of a single assembly. It is used to rotate the radar in azimuth and elevation to increase its coverage and adapt to the terrain around the radar.

Figure 5 - Pan/Tilt Positioner

2.2.3 Radar Server Computer

The Radar Server computer hosts the following applications:

- Radar Application Manager
- Radar Server Application
- Radar Terminal Application
- Radar Console Application (configuration and diagnostics only)

Depending on the installation, the Radar Server computer may also host the client applications and function as the Client Computer.

2.2.4 Client Computer

The Client computer hosts the client applications (Cameleon Tactical, Control Station, XML third-party application). You can also use the Radar Console for remote diagnostics.

2.2.5 Breakout Box

In some installations a breakout box may be installed in close proximity of the radar to incorporate the radar power supply and/or an Ethernet fiber-optic media converter.

2.2.6 Radar Power Supply

The radar power supply supplies power to the R20SS Radar Assembly and optionally to the pan/tilt positioner. Refer to Section 3.5 for determining the appropriate power supply capacity required.

2.2.7 Network Infrastructure

The network infrastructure consists of Ethernet switches, Ethernet media converters, wireless Ethernet transceivers, etc. The network infrastructure provides the physical support for the Device and the Client networks. Refer to the Configuration Manual for a description of these networks.

2.2.8 Cabling

FLIR Radar Systems provide connectorized cables for sale in standard lengths. Pre-cut cable lengths vary. You can order cables with connectors at both ends. Please contact your FLIR Sales Representative for assistance.

3 SYSTEM INSTALLATION

Before installing the R20SS Radar System, the following installation parameters must be determined:

- Final location
- Height above ground
- Power requirements
- System network topology, and network components needed to support this topology

3.1 GENERAL CONSIDERATIONS

The optimal R20SS Radar Assembly location is determined based on the following factors:

- Unobstructed line of sight to the area under surveillance
- Radar height above ground
- Proximity to large radar reflectors such as buildings, trucks, aircraft and other large metallic objects
- Power and connectivity availability

The radar assembly should be installed in a location where it has an unobstructed view of the area to be monitored. Since it is not always possible to get an unobstructed line of sight out to the instrumented range, the installation point should be selected so as to maximize the area the radar can monitor. One must consider terrain contour, seasonal vegetation changes, and potential obstruction from ground vehicles such as cars, trucks and trains, as well as aircraft and ships, since it may change over time.

In addition to the line of sight considerations, there shouldn't be any large metallic object or structure in front of the radar within the first 100 meters (330 ft), over a 180° azimuth sector if the radar is fixed, or over 360° if the radar is operated with a pan/tilt positioner.

3.2 RADAR HEIGHT

The radar height above ground must be carefully determined based on the line of sight and on the operating range desired. Longer detection ranges require a greater mounting height to maintain the desired sensitivity. Typical radar mounting heights are given in Table 3. The radar can still be mounted lower than recommended, but the sensitivity could be reduced at long range.

Range of interest	Optimal radar height above ground
0 - 5 km	15 m (50 ft)
0 - 10 km	30 m (100 ft)
0 - 20 km	60 m (200 ft)

Table 3 - Installation Height Considerations

Note
FLIR Radars recommends asking your Sales Representative about site surveys prior installation, to ensure proper site selection and ideal system installation for optimal functioning of the R20SS to your specific requirements.

It can be advantageous to install the radar on a natural hill to benefit from the added height (refer to Figure 6 and Figure 7).

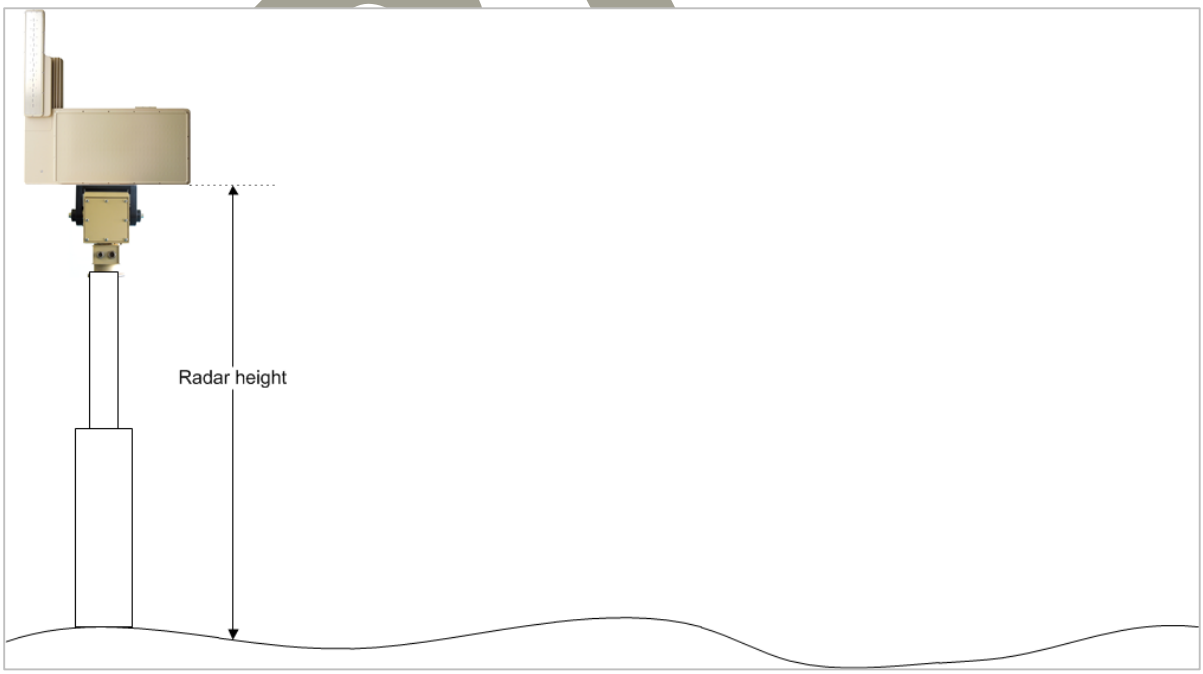

Figure 6 - Radar Height Above Ground (flat terrain)

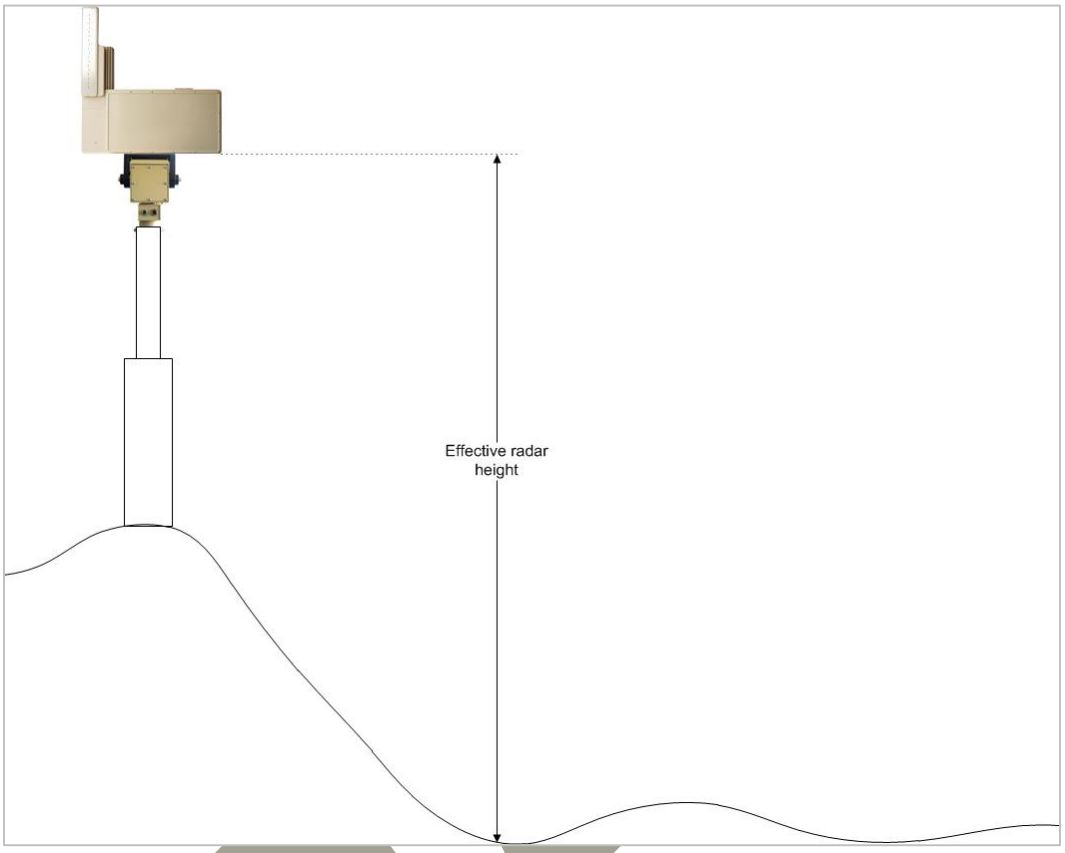

Figure 7 - Radar Height Above Ground (hilly terrain)

3.2.1 Minimum Detection Range

The radar height has an effect on the minimum detection range. Typically, higher radar installations have longer minimum detection ranges. Table 4 shows typical minimum detection ranges as a function of radar height.

Radar height	Minimum detection range
0 m	10 m
5 m	50 m
10 m	100 m
15 m	140 m
20 m	185 m
30 m	275 m

Table 4 - Minimum Detection Range vs Radar Height

3.3 RADAR ASSEMBLY INSTALLATION

3.3.1 Radar Range

The R20SS supports two different ranges: medium range (15 km) and long range (30 km). While both modes provide the same detection performance, the medium range provides a better range resolution which provides better detection performance on very slow or tangentially moving targets. If the chosen installation site does not provide line-of-sight beyond 15 km, or if optimal detection performance for tangential targets is desired, it is recommended to configure the radar in medium range mode. If detection of vehicles beyond 15 km is desired, and if the line-of-sight on the regions of interest goes beyond 15 km, it is recommended to configure the radar in long range mode.

3.3.2 Tilt Angle

The R20SS should normally be used with a tilt angle of 0°. Other values may be used to follow a particular terrain contour, as shown in Figure 8.

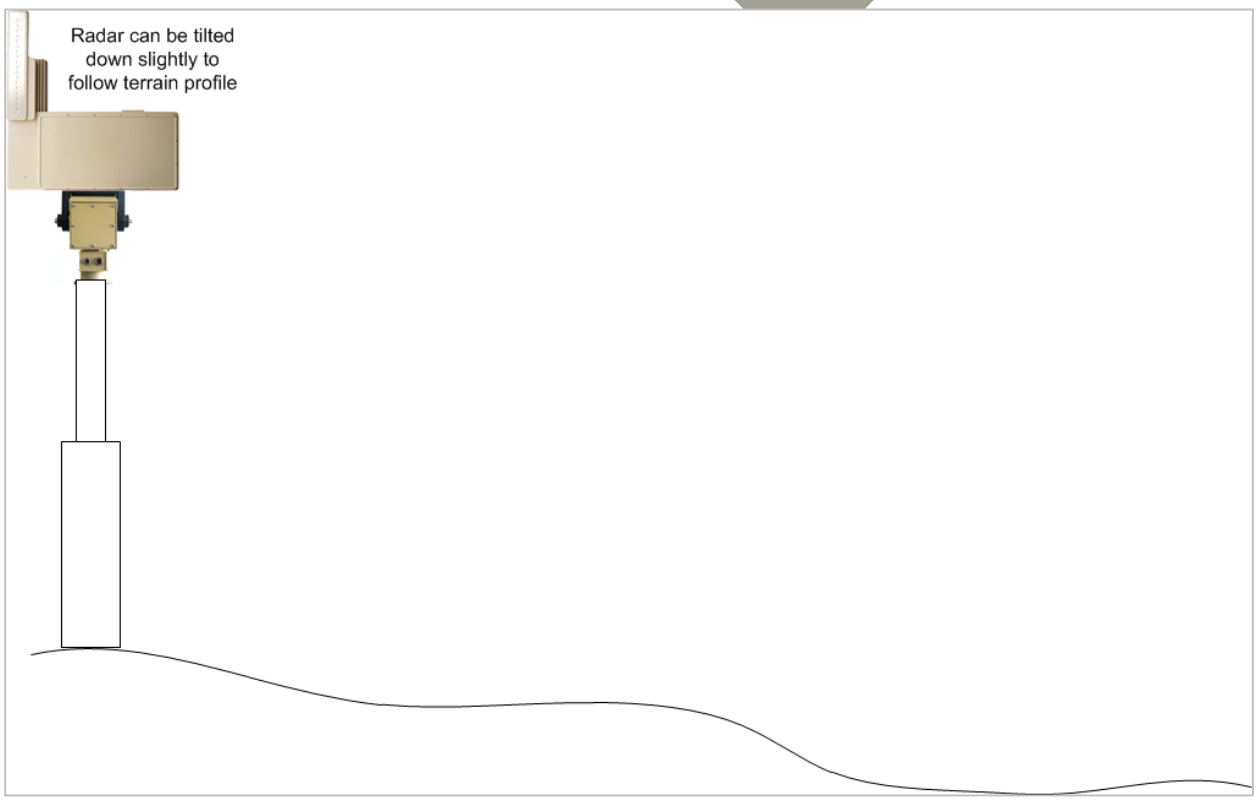

Figure 8 - Optimizing Radar Tilt Angle to Follow Terrain Profile

Note
FLIR Radars recommends asking your Sales Representative about site surveys prior to installation in order to ensure proper site selection and ideal system installation for optimal functioning of the R20SS to your specific requirements.

3.4 RADAR MOUNTING

Figure 9 show the R20SS V1 radar assembly outline, while Figure 10 shows the rear mounting plate outline. Figure 11 shows V2 radar assembly outline.

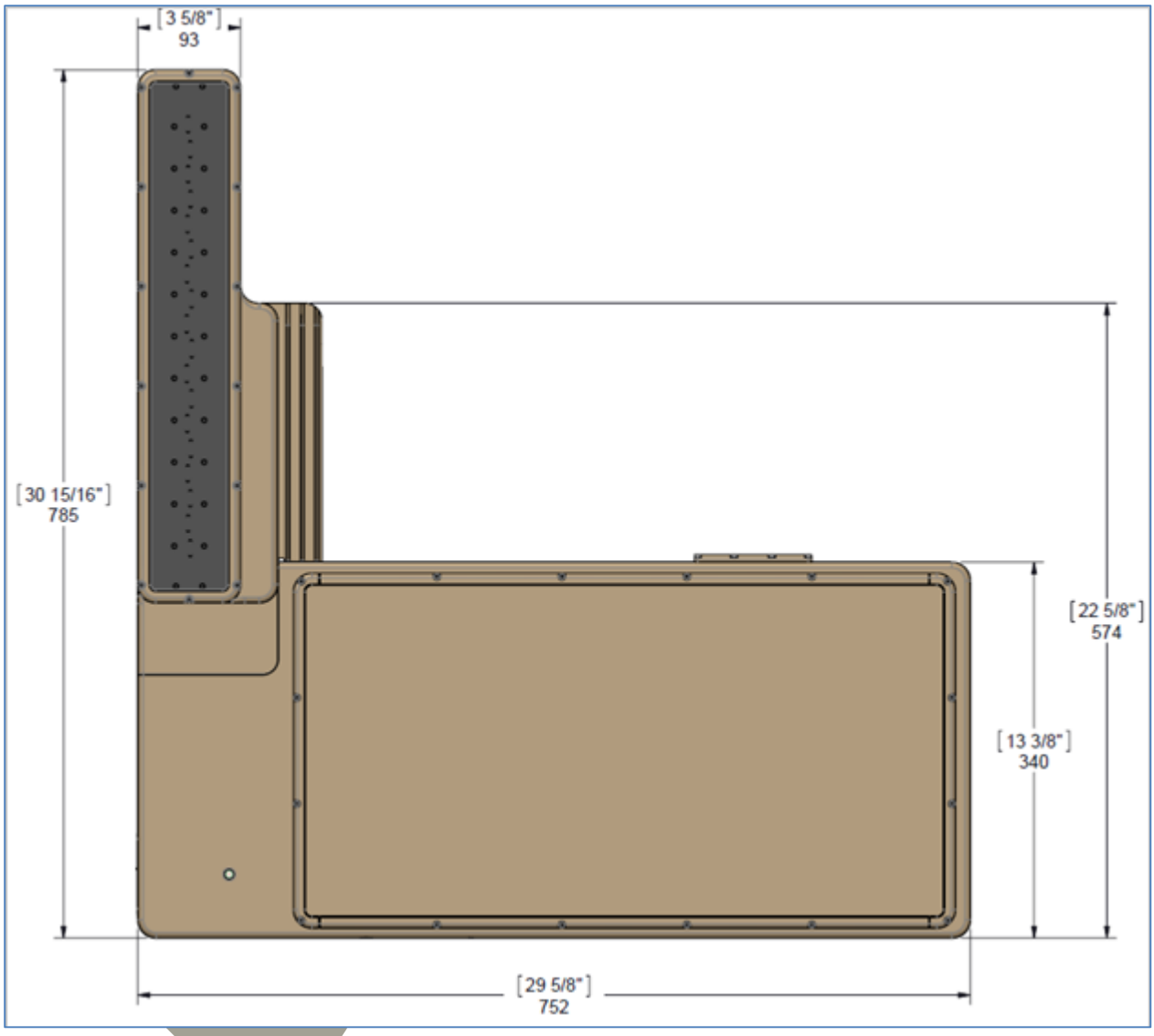

Figure 9 - V1 Radar Assembly Outline

Figure 10 - V1 Rear Mounting Plate Outline (dimensions in mm)

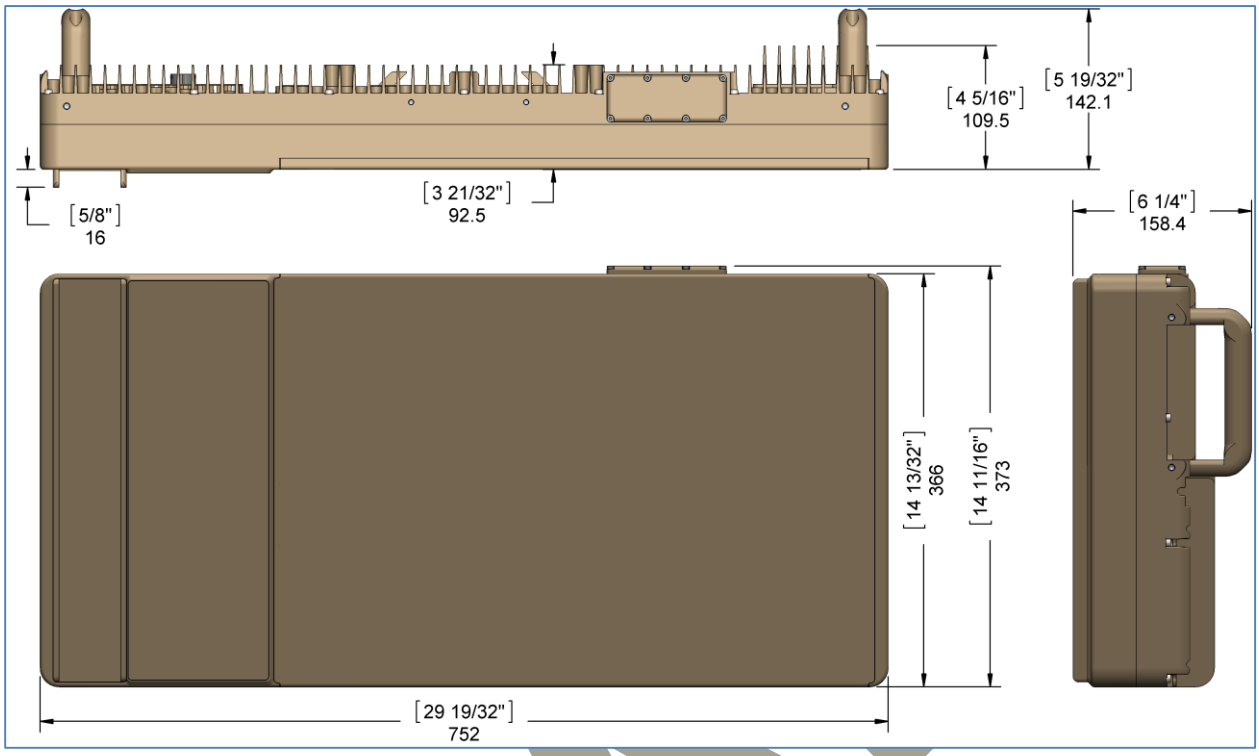

Figure 11 - V2 Radar Assembly Outline

When the radar is mounted on a pan/tilt positioner, the pan/tilt mounting plate outline must be used, as shown in Figure 12.

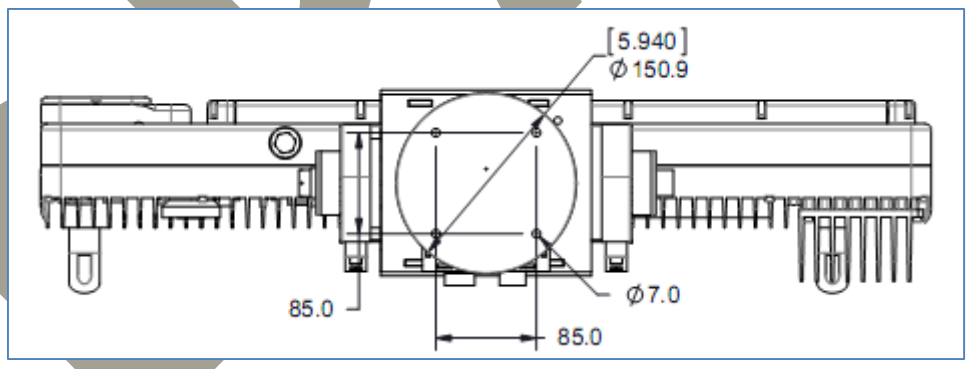

Figure 12 - Pan/Tilt Mounting Plate Outline

Figure 13 shows the camera mounting outline, on top of the radar assembly.

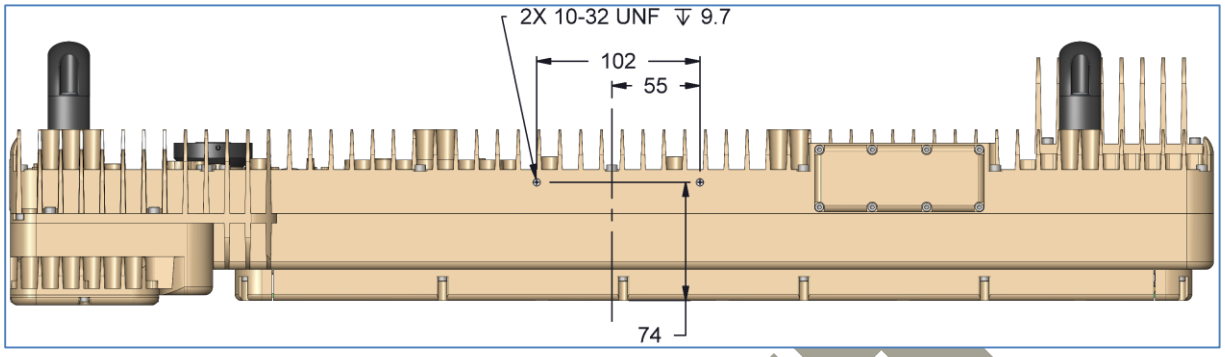

Figure 13 - Camera Mounting Outline

3.4.1 Mounting Considerations

The mount must provide stability and rigidity in order to support the weight of the R20SS radar (and optionally the pan/tilt positioner), and prevent vibrations. This is necessary for the unit to maintain optimal detection performance. The presence of vibrations or oscillations could compromise the detection of low-speed targets and cause false alarms.

The radar mounting plate interface must normally be level. Failure to do so will result in the radar operating at sub-optimal tilt or roll angle and could reduce the detection performance.

There is a GPS antenna at the top of the radar assembly. This GPS antenna should have a clear view of the sky for optimal radar performance, so no metallic structure must be installed on top of the radar.

3.5 POWER DISTRIBUTION NETWORK

The R20SS radar requires a nominal 28 VDC (accepting from 24 to 48 VDC) at its input and consumes less than 275 W in operation (less than 175 W for the low-power version).

The pan/tilt positioner requires a nominal 28 VDC (accepting 24 to 42 VDC) at its input and consumes less than 100 W in operation. When the temperature drops below freezing, a built-in heater will activate and add up to 100 W of power consumption.

There can be a single power supply for both the radar and the pan/tilt positioner (if so equipped), or they can each have their own power supply. If a single power supply is used for both, it is important that the input voltage meets the requirements of both equipments (24 to 42 VDC).

You should select a power supply capable of its nominal voltage consistently through a range of expected temperatures.

The power supply must deliver the required amount of power on a continuous basis. Allowance for a power-on surge should be provided, therefore, a minimum of 25 % power margin is recommended for trouble-free operation in all conditions.

If using long supply wires, a proper wire gauge must be used to ensure that the resulting voltage drop along the supply wires meets the radar minimum operating voltage. In some cases, the power supply may be incorporated into a breakout box located next to the radar assembly, to ensure a low voltage drop.

Note
The system is reverse-polarity protected

Electrical power is delivered to the radar through the power/data connector. A single weatherproof connector is used to provide all external connections to the radar assembly. The connector is a "bayonet"- type connector. The pin assignments are indicated in the figures and tables below:

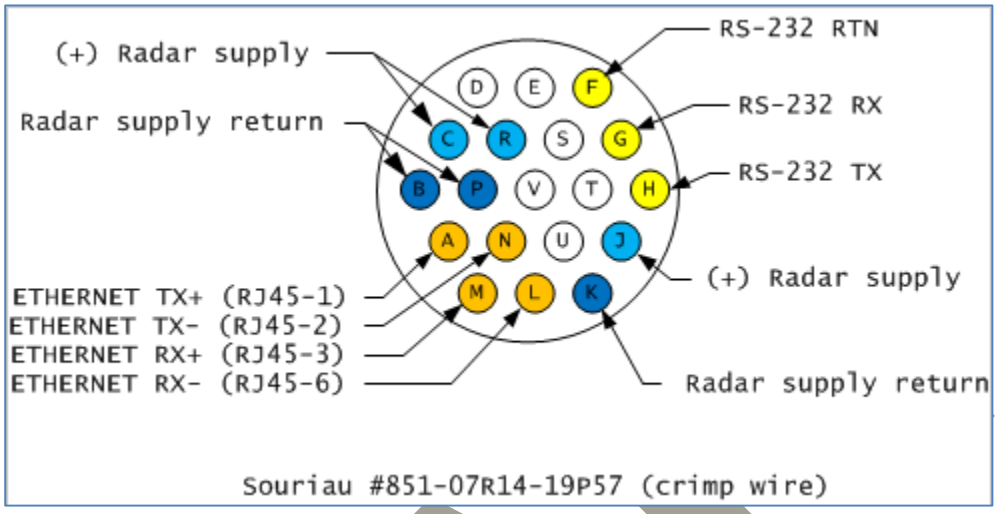

Figure 14 - Radar Power/Data Connector Pin Out

Pin	Function	Pin	Function
A	ETHERNET TX + (RJ45-1)	L	ETHERNET RX - (RJ45-6)
B	Radar power supply return	M	ETHERNET RX + (RJ45-3)
C	(+) Radar power supply	N	ETHERNET TX - (RJ45-2)
D	Reserved	P	Radar power supply return
E	Reserved	R	(+) Radar power supply
F	RS-232 return	S	Reserved
G	RS-232 RX	T	Reserved
H	RS-232 TX	U	Reserved
J	(+) Radar power supply	V	Reserved
K	Radar supply return		

Table 5 - Radar Power / Data Connector Pin Assignent

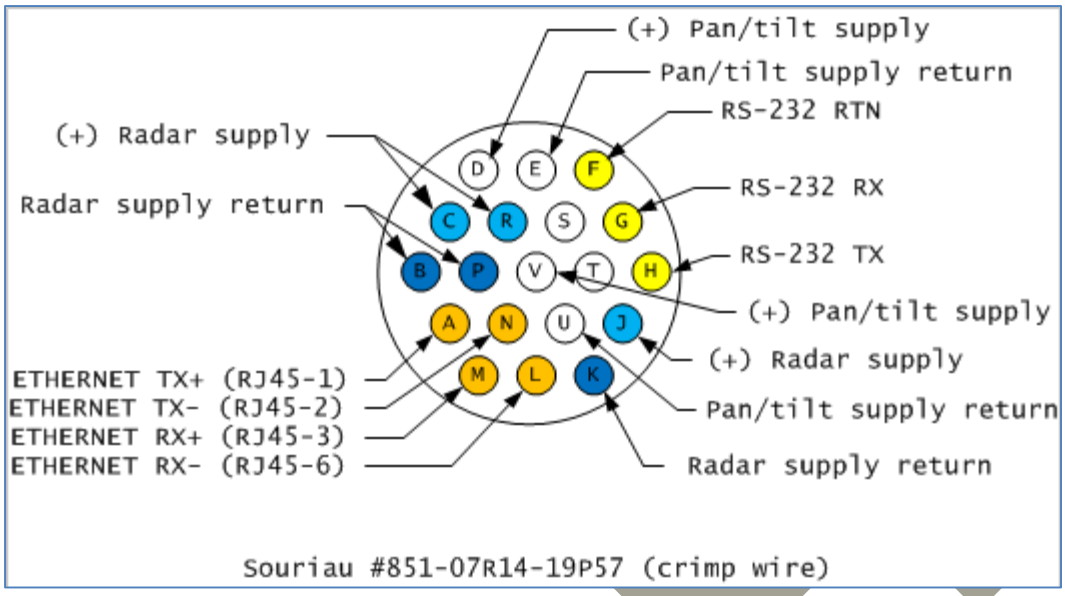

Figure 15 - Pan/Tilt Power/Data Connector Pin Out

Pin	Function	Pin	Function
A	ETHERNET TX + (RJ45-1)	L	ETHERNET RX - (RJ45-6)
B	Radar power supply return	M	ETHERNET RX + (RJ45-3)
C	(+) Radar power supply	N	ETHERNET TX - (RJ45-2)
D	(+) Pan/tilt power supply	P	Radar power supply return
E	Pan/tilt power supply return	R	(+) Radar power supply
F	RS-232 return	S	Reserved
G	RS-232 RX	T	Reserved
H	RS-232 TX	U	Pan/tilt power supply return
J	(+) Radar power supply	V	Pan/tilt power supply
K	Radar supply return		

Table 6 - Pan/Tilt Power / Data Connector Pin Assignent

Note
RETURN +28V has the same meaning as the – (minus) terminal on a battery. The cable to connect to the radar should use the appropriate mating connector (FLIR Radars Part # 401-1015).

Table 7 and Table 8 shows the pinout for the camera connectors.

Pin	Signal	Comment
A	+CAM_VID	Coax cable center
B	CAM_VID_RTN	Coax cable shield
C	+CAM_SUPL	Positive wire of camera supply
D	CAM_SUPL_RTN	Camera supply return wire
others	Unused	-

Table 7 - Base Camera Connector Pin Assignent

Pin	Signal	Comment
A	+CAM_VID	Coax cable center
B	CAM_VID_RTN	Coax cable shield
C	+CAM_SUPL	Positive wire of camera supply
D	CAM_SUPL_RTN	Camera supply return wire
others	Unused	-

Table 8 - Side Arm Egress Camera Connector Pin Assignent

3.6 COMMUNICATION NETWORK

The network should be configured as per the recommendations found in the Configuration Manual.

Ensure installing the network components per the manufacturer's recommendations.

The recommended Ethernet cabling for connecting network components is Cat 5e or Cat 6. The IEEE 802.3 standard specifies that the maximum cable length is to be 100 meters (328 feet) between two Ethernet devices for 10 and 100 Mbps links.

4 MAINTENANCE

4.1 RECOMMENDED MAINTENANCE SCHEDULE

Action	Frequency	Comments
RADOME CLEANING	Dependent on the environment	
MECHANICAL INSPECTION	Every year	To be done only by a trained technician or return to FLIR for inspection
GORE™ MEMBRANE VENTS	Dependent on the environment Recommended every 2 years	

Table 9 – Recommended Maintenance Schedule

4.2 RADOME CLEANING

The instructions for cleaning the radome are as follows:

- Keep the Radome clear from any obstruction such as trees or branches or any natural formation of dirt, grime or bird deposits. Such formations may attenuate radar signals.
- Use a moist cloth to clean the Radome at time intervals necessitated by environmental conditions.

4.3 REPLACING THE MEMBRANE GORE VENT

The Gore Membrane Vent is screwed in under the base plate assembly. The R20SS has a Gore Membrane Vent to even the pressure as well as to prevent insects and water from entering the radar. The instructions below are given for the replacement of the Gore Membrane Vent. Contact FLIR Radars' Customer Support for to help in ordering a new one.

NOTE: The estimated time to complete this procedure is from 2 minutes to 15 minutes.

Figure 16 - Gore Membrane Vent

Step 1 Remove the Gore Vent from the radar base plate using a 16mm hex socket.
Step 2 Clean and dry the plate surface in contact with the Gore Membrane Vent.
Step 3 Screw the new Gore Membrane Vent back in place and torque the parts at 8 lbs-in using a 16mm socket.

5 TROUBLESHOOTING

When a fault is detected by the radar, operation will be interrupted and the error code identification number will be displayed in Radar Console, in the center of the radar icon, in red. If the error code is not listed in Table 10, follow the steps below.

Error code	Description	Action
4.40	Moving base fault detected	Try cycling the power to the pan/tilt positioner
6.40	Moving base connection problem detected	Verify that the pan/tilt positioner is powered
6.41	Moving base initialization in progress	Wait until the pan/tilt positioner initialization is complete

Table 10 - Pan/Tilt Positioner Errors

Step 4 Try re-initializing the system.
Step 5 If the error persists, gather the following information:

- Physical installation
- Network topology
- Software version
- Radar serial number
- Error code number and conditions under which the error occurred
- Any relevant application/system logs

Step 6 Contact Customer Support.


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