Installation Guide

for

Navtech Radar

I Series Radar Sensors

Document No: **MAINT0111**

Date: **September 2012**

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Document History

Issue	Date	Description
1.0	19/09/2012	First Draft
1.1	14/03/2013	Update for FCC statement
1.2	20/03/2013	Updated the FCC statement

List of figures

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Referenced Documents

Ref	Title	Supplier	Doc Ref No
1	RadarView-Lite for Windows User Manual	Cambridge Pixel	CP-25-127-03
2	SafeGuard witness Commissioning Guide	Navtech	
3	Navtech Service & Maintenance Manual I-TS Series Radar	Navtech	MAINT 0010
4	SafeGuard witness Operating Guide	Navtech	
5	Entry and User Level Firmware Commands for all W, I and AGS Series	Navtech	RND – S0069
6	I 200 Datasheet	Navtech	
7	Power Supply unit datasheet	Siemens	https://support.automation.siemens.com 6EP1332-1SH52 Data sheet
8	Local Processing Unit Datasheet	Navtech	ANC-0015
9	6 Channel Relay Module	Navtech	ANC-0024
10	Radar power cable assembly	Navtech	SUB-0022

Drawings List

Ref	Drawing No	Title
D1	ASM 0031	Radar Housing
D2	SUB 0119	Inline Power and Serial Cable
D3	MBP 0260	Steel bracket

1. Introduction

1.1 Scope

The Navtech *SafeGuard* Detection system provides an automatic monitoring solution for open areas such as airports, outdoor industrial machines and vehicles that commonly operate in ports, mines or other industrial areas. The *SafeGuard* system comprises a high frequency radar sensor, linked to a software system, *witness*. This guide provides instruction for the radar sensor installation ONLY. The installation of the witness application is covered separately in [2]. Service and Maintenance procedures are also covered separately in [3].

The instructions in this guide are applicable to the following Navtech radar sensors:

- I 200
- I 500

Details are provided for all the hardware components required for the installation.

1.2 Essential Items

The following are **essential** additional items that you need to install a radar sensor:

(i) Electrical Power

Electrical power (110 to 230vAC) sourced from, for example, local mains.

110 to 230vAC power is required for the Radar's 24vDC PSU.

- 110 to 230vAC power is also required for the Laptop Computer used during the commissioning process.

Note: Radars are network intensive. Some laptops reduce the performance of their network connection when only running on their internal battery.

(ii) A way of working safely at height

Most Container Cranes and Bulks Loader have walkways with hand rails - keeping to within the confines of these hand rails, will keep you relatively safe. However this does depend on the specific machine or site you are working on. If required to do wear a harness and fall arrestor – Make sure you clip on to a secure structure or on to a dedicated cable/SWR rope.

Make sure any equipment used conforms to:

- Shock Absorbing Lanyards – EN354/355
- Harnesses – EN361/prEN1496/1497/1498/020895
- Retractable Type Fall Arrester - EN360

(iii) Laptop computer

The laptop should have:

- RJ45 Ethernet connection.
- 9 pin Com port or USB to RS232 adapter [Optional]
- Software – SPxRadarViewLite-V1.47.1 or higher
- Serial communication software – e.g. HyperTerminal, TeraTerm, Putty.

(iv) Cat5E shielded patch lead (or Cross over cable, if laptop doesn't have Auto-MDIX)

(v) M10 nuts and bolts for mounting radar

The minimum for **one** radar, in A4 Stainless Steel.

- x4 off M10x80 HEX Set Screw
- x4 off M10 spring washers
- x4 off M10 plain washers
- x4 off Nyloc Nuts
- x12 off M10 Full plain nuts
- x2 off 17mm Spanner for the M10 nuts and bolts above.

(vi) 5m tape measure

(vii) Digital Level[1]

(viii) 25m² Trihedral Radar Target

(ix) Pair of 2 way radios

(x) An assistant

(xi) Power Supply cable (Minimum Requirement) - see 0Table 2 for specification, or Inline Radar Power, Serial and Current Cable (Optional) - see [3].

1.3 Pre requisites to working on a Container Crane & Bulk Loaders

Follow local Health and Safety guidelines, as determined by local safety management procedures. Navtech training courses are available, offering practical advice and recommendations on how to successfully install and commission the SafeGuard products

[1] Recommended Fisco Solatronic EN17

1.4 Radar sensor

The Navtech radar sensor will detect both small and large objects, moving or stationary, within its line of sight. It is designed to cover 360 degrees, and samples data at an angular resolution of approximately 0.4 degrees. The radar antenna is designed to have a narrow beamwidth in azimuth and elevation – typically 1.8 degrees; in this way objects within the radar field of view can be accurately located on the road surface.

The standard update rate for radar sensors is 120 rpm with a maximum detection distance of 200 meters radius. A signal return is produced and sent to the processing system every 0.25 meters from the sensor itself up to the maximum sensor range of 200 meters radius. This is repeated at each new azimuth angle as the antenna rotates. The system employs a frequency modulated sensor and so unlike Doppler systems, no movement is necessary to measure a vehicle, person or similar object within the radar line of sight.

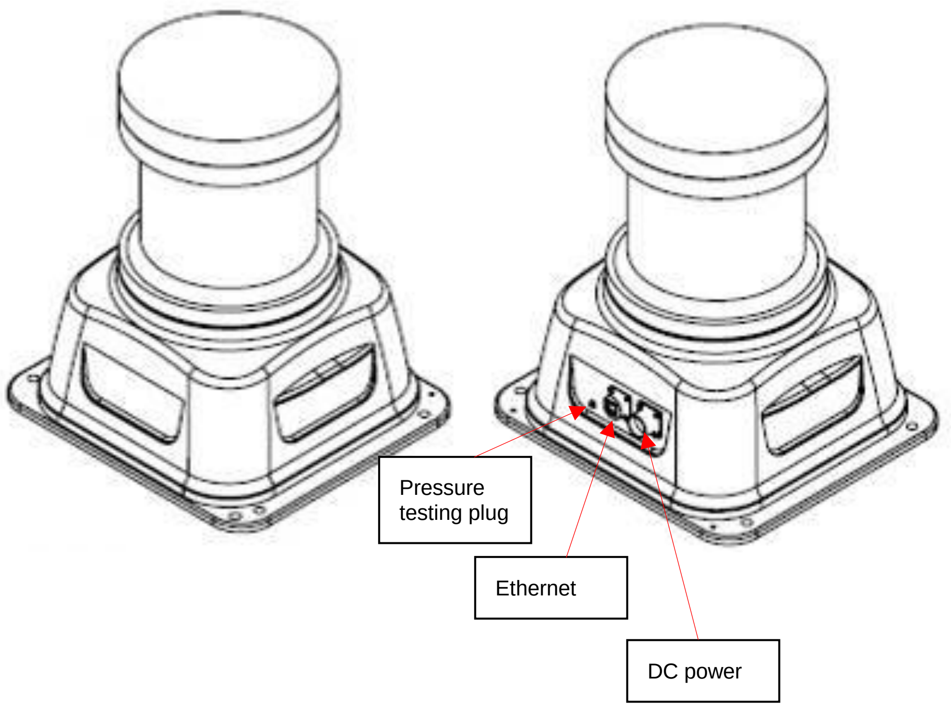


Figure 1 Radar sensor - isometric views

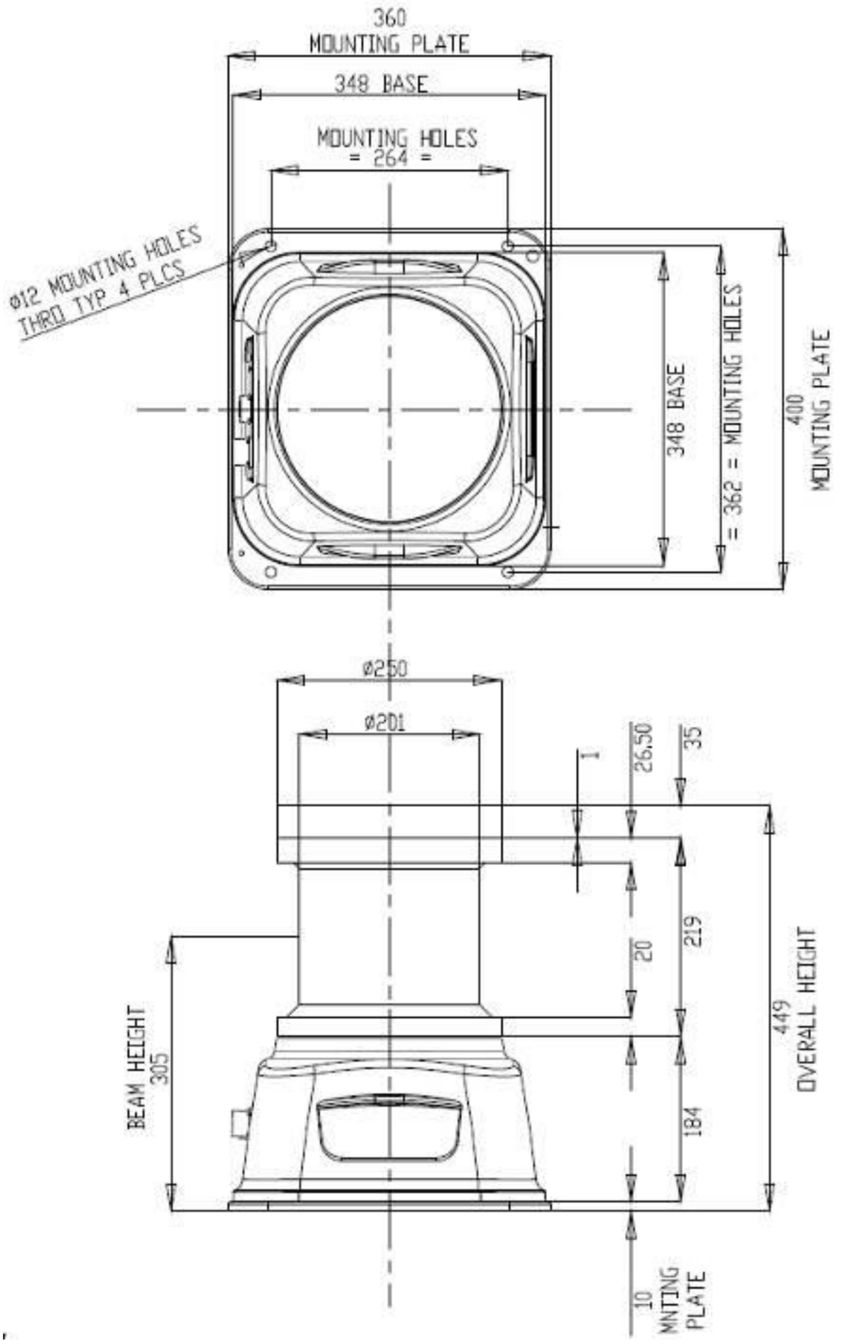


Figure 2 Radar sensor - dimensions

See [D1] for further details on the radar housing. Each radar is supplied with a Power cable assembly[10] and an Ethernet environmental shell (which fits over a standard RJ45 to provide an IP67 seal). Further connector detail in Annex C

2. Installing the Radar hardware

2.1 Overview

This section details the installation process, which comprises the following steps:

1. Determine radar sensor locations
2. Mount radar
3. Connect radar sensor
4. Prepare laptop
5. Connect laptop
6. Level radar sensor
7. Install Navtech *witness* software
8. Confirm sensor coverage

Note: **The installation and configuration of the** *witness* **software is covered separately in [2].**

CAUTION Before performing any installation task ensure you are aware of Health & Safety procedures. (See Section 0)

2.2 Radar sensor locations

2.2.1 Location

Radar sensors must be positioned in such a location that they have optimum 'line of sight'. To the objects they are to detect. Both I-200 and I-500 radar sensors scan in a horizontal beam. The witness processing software is designed to generate an alarm signal, should an object appear within a detection zone, software configured to lie within the scan area. Other factors to consider when choosing a mounting location include how close the radar is to a power source on the machine. Also accessibility, both for installation and on-going maintenance.

Example 1 – Radar installed centrally on the underside of a boom

Below are two diagrams of a radar centrally mounted on the underside of a bulk loader boom. This mounting location is only suitable if there is no trolley, or loading chute that travels along the underside of the boom. In this case the installed radar would obstruct the free movement of the chute

The reason for placing a radar in this location is to detect objects to the side of the boom, which could be struck if the bulk loaded slewed or long travelled in that direction. A single radar offers protection on both side of the boom

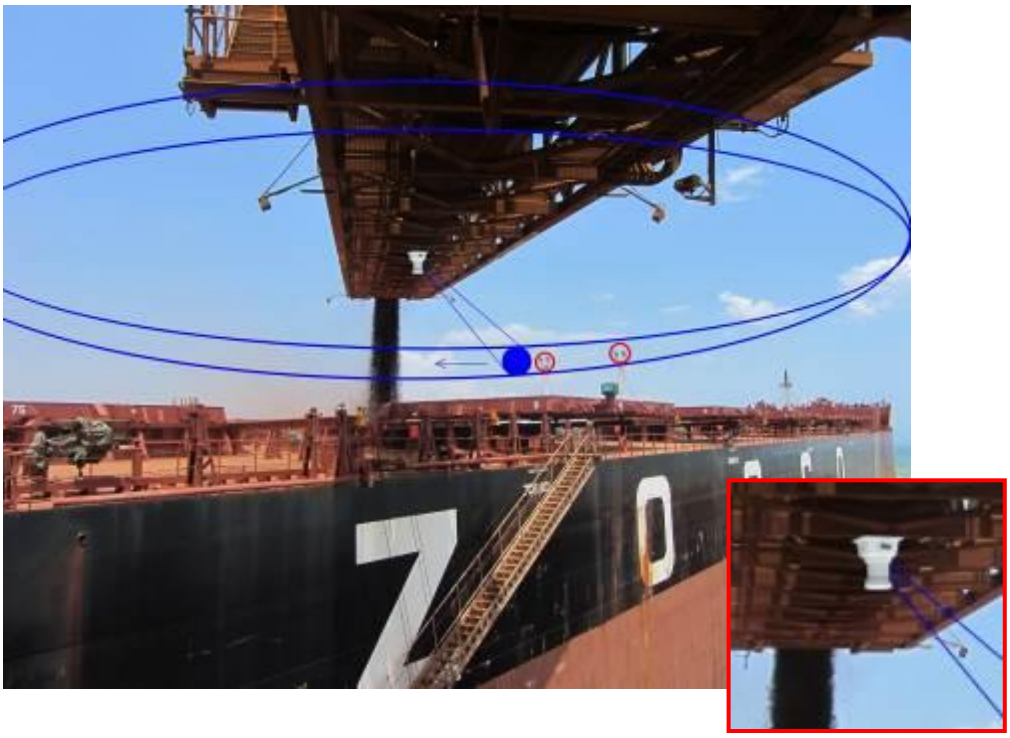


Figure 3 Single radar mounted on the underside of a bulk loader

The primary use of the single radar scanning a horizontal plane is to protect slew and long travel. A secondary benefit though, is to stop the boom being lowered/luffed down on to an object that is raised above the deck level of a vessel. Although, this radar will not detect objects that are beneath the pane of the horizontal scan, as the boom luffs down these objects should be detected. Care should be taken to ensure the radar is mounted at a sufficient distance from the underside of the boom, so the luff motion can be stopped in time to prevent a collision.

By considering the rate of luff of the boom; the scan rate of the radar (typically 2 rps); and the number of required detections configured in the witness processing software to generate a stop alarm; the ideal separation between radar and boom can be calculated.

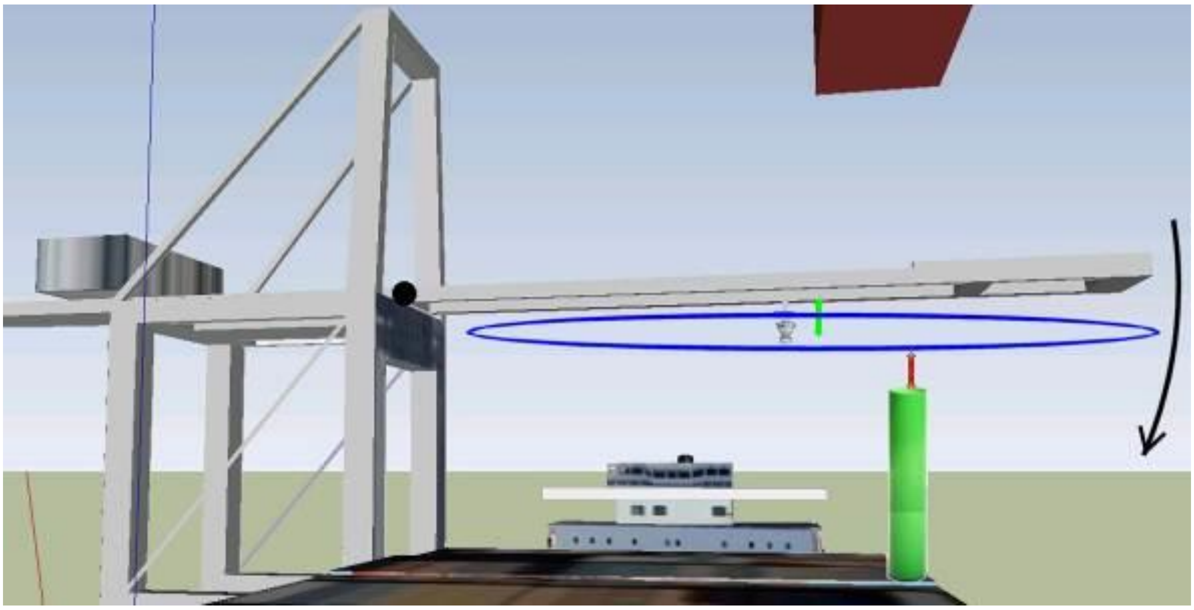


Figure 4 **A single radar detects objects as the boom luffs**

Luff Operation - Vertical Radar		
Boom length	52	meters
rate of turn on boom Luff	0.15	deg/sec
velocity at the tip of the boom	0.14	meters/sec
Radar detections configured in software processing, to raise a stop alarm	4	
Time to detect, for a 2 Hz radar [4Hz option available]	2.0	Sec
Luff meters moved at the boom tip, before full detection	0.27	meters
Safety Margin, to accommodates the boom stopping distance	1.5	meters

Configured Min working distance Vertical	1.77	meters
Expected radar mounting distance, offset from the boom (note the beam to mounting base distance is approx. 300mm)	1.47	meters

Table 1 **Calculating the installation distance of radar from boom *to detect a raised spar whilst the boom Luffs***

Example 2 – Radar installed on each side, on the underside of a boom

The example below shows how two can be used to detect on either side of the boom. In this case it's not possible to use a single radar on the underside, this would impeded the free movement of the loading chute. See also example 4.

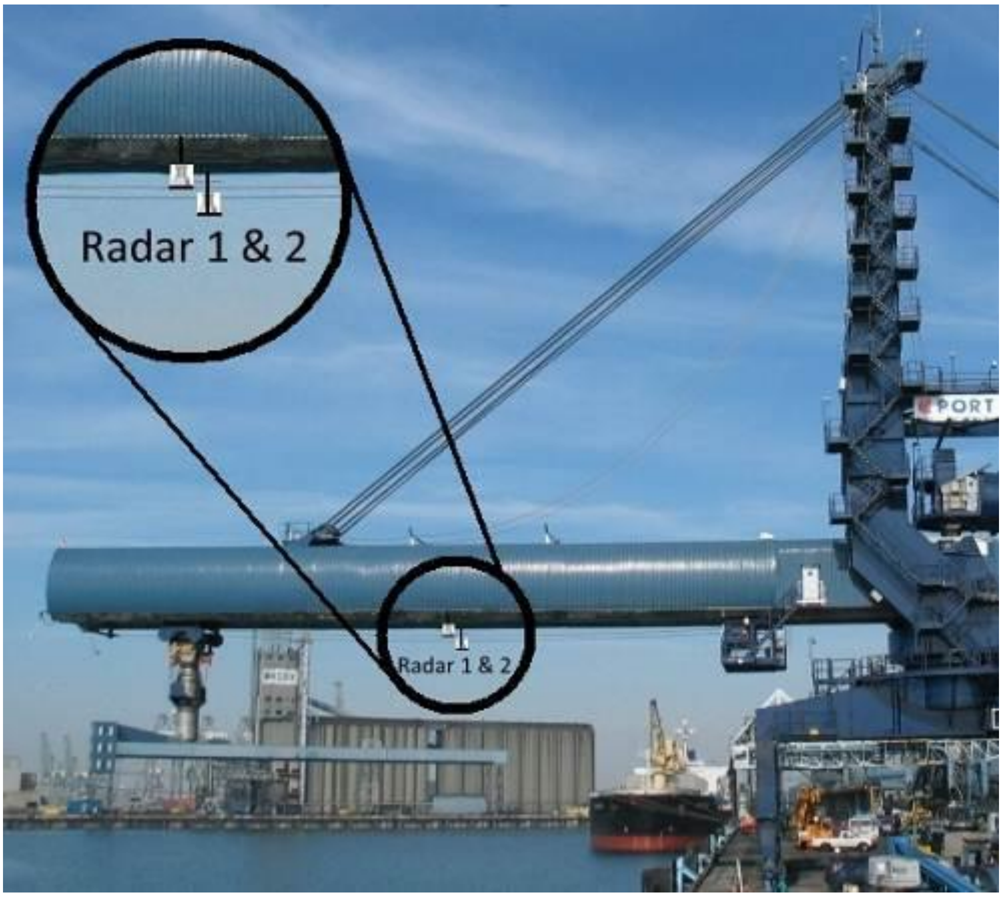


Figure 5 **Detection on either side of a boom with a moveable loading chute, with 2 radar**

Example 3 – Radar installed on each side of the boom and scanning vertically

For extra protection of bulk loader boom, it is also possible to mount radar that scan through a vertical plane. These provide protection in the following cases:

- The distance between the underside of the boom, and the deck of a vessel it is handling will be continually measured. If the boom luffs towards the ship, the crane motion can be stopped. Although the horizontally scanning radar in Figure 4 will protect a luff motion onto a vertical spar, it won't be adequate to stop luffing onto the deck or a hatch cover.
- As well as during a luff movement, the distance between boom underside and loader may become too close as the boom long travels or slews along the vessel. This is particularly the case if the vessel bow is raised in relation to the stern, as the stern is loaded with heavy bulk first (or vice versa)
- The distance between boom underside and vessel can reduce to an unsafe separation in the event that the tide changes, or the vessel is unloading and it raises on the waterline

Figure 6 This loader is shown with combined horizontal and vertical scanning radar

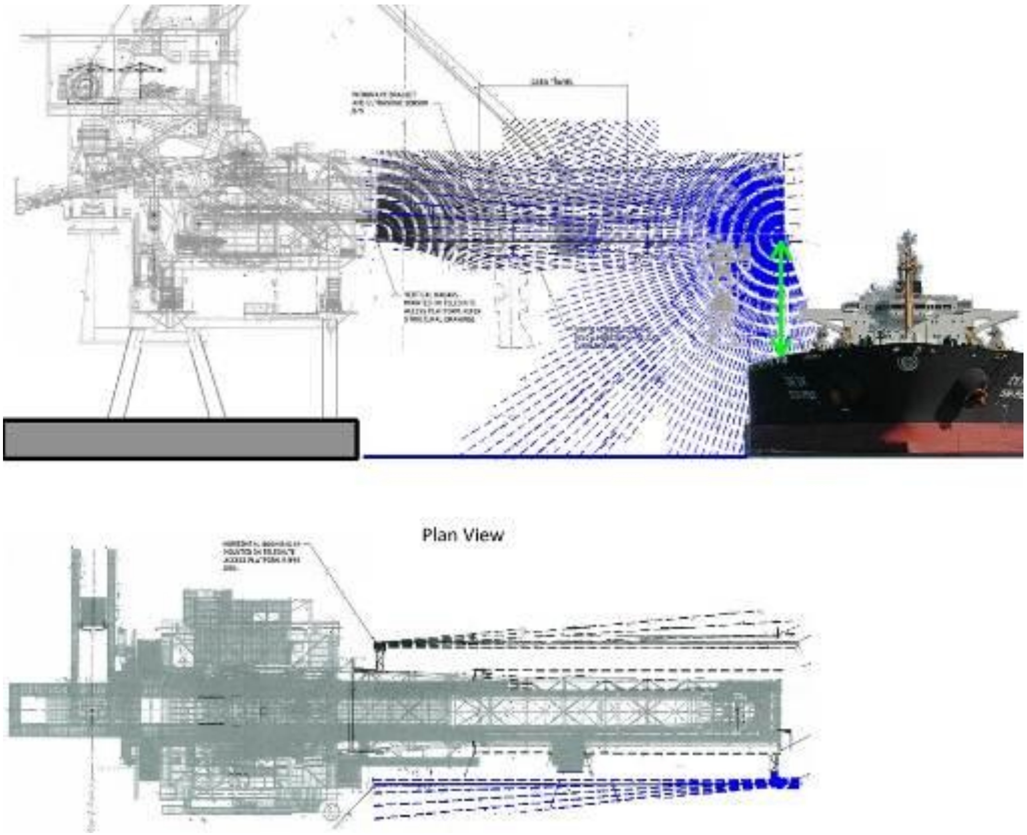


Figure 7 **The scan plane of vertically scanning radar sensors**

Example 4 – A single radar at the end of a boom structure

A single radar mounted on the underside of the boom, scanning a horizontal plane. This configuration is usually used on Ship to Shore container handling cranes. These cranes do not luff, or slew, but it is the long travel movement that needs protecting, since the crane may long travel into the ship structures in extreme conditions.

It is necessary to mount the radar at the end of the boom, to avoid obstructing the free movement of the trolley on the underside of the boom. However in this configuration, as the trolley approaches the end of the boom, the radar is obscured and then offers little protection. Many operators are of the opinion that the driver is well place in this location to have a good field of view of the vessel. As the trolley moves off the boom, the driver is further form the objects he needs good sight of, but the radar then has a completely clear view of the vessel, offering comprehensive detection. The alternative to having the trolley obscure the single radar at the boom tip, would be to use 2 radar as shown in Figure 5

Figure 8 Single Radar on an STS, container handling crane

2.2.2 Orientation

The I-series scanning radar sensors, cover 360 degrees whilst rotating. The zero point or 0 degree point is set, at factory, to lie on the opposite side of the radar to the connectors. See Figure 9. All I-Series radar rotate in a clockwise direction, whether orientated as shown in Figure 1 or inverted as shown in Figure 3.

It is always helpful when commissioning the radar if the encoder zero is aligned with the boom or structure it's to protect. For example, in Figure 3 the zero point should be directed towards the end of the boom (with the connectors on the quay side of the radar). In this orientation, objects on the left of the boom will appear on the left hand side of the commissioning interface, and those physically on the right hand side of the boom will appear on the right of the interface.

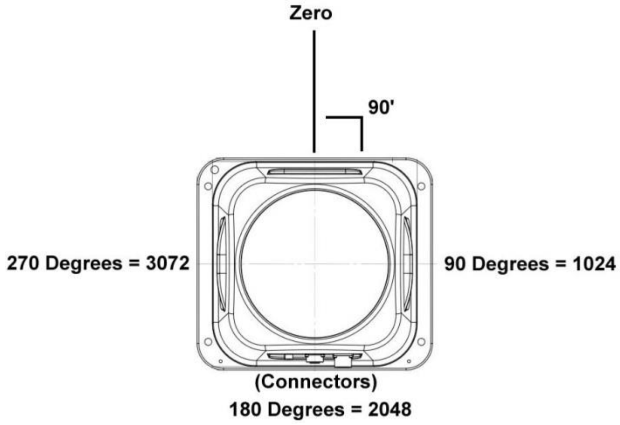


Figure 9 Plan view of a radar, showing the encoder zero angle

2.3 Mounting radar sensor

Radar sensors may be mounted on various structures (e.g walls, roofs, gantries) using brackets. Sample posts and brackets are shown in Annex B.

Radar sensors are fitted to a plate on top of the post, or on the bracket, using nuts and bolts, which allows you to adjust the tilt [See Figure 11]. Adjusting the tilt (levelling the sensor) ensures optimum detection performance and is detailed in Section 2.7.

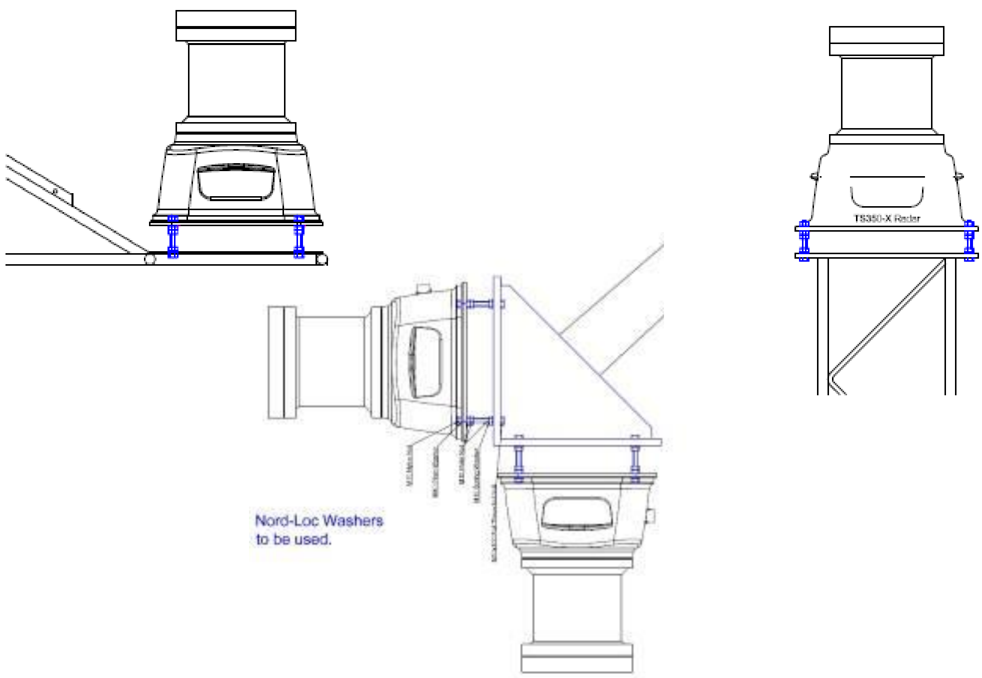


Figure 10 Mounting radar on posts/brackets, for both vertical and horizontally scanning radar

The sensor mounting plate (or bracket) design allows for a simple yet effective method to fine tune the incline of the sensor. For each of the mounting holes, the bolt is fed from underneath and locked onto the mounting plate with a nut. Two more nuts are used below the radar base plate and another is used above so that the sensor can be positioned anywhere up or down the bolt thread, as necessary.

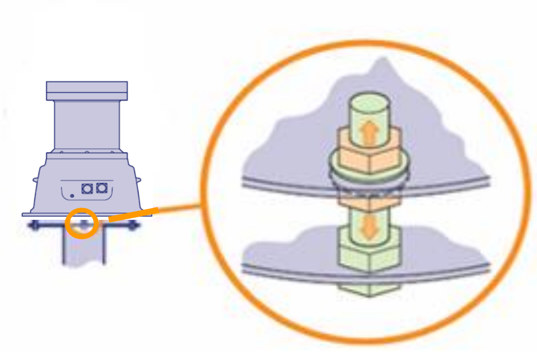


Figure 11 Levelling adjustment

2.4 Connecting radar sensor

Each radar sensor requires a power and a data connection. Both are made using military specification connectors to ensure link integrity in the harshest environmental conditions. The power and data connections run from the sensor to a conveniently placed junction box (e.g.at the base of the post) where the power supply is situated. See Figure 12.

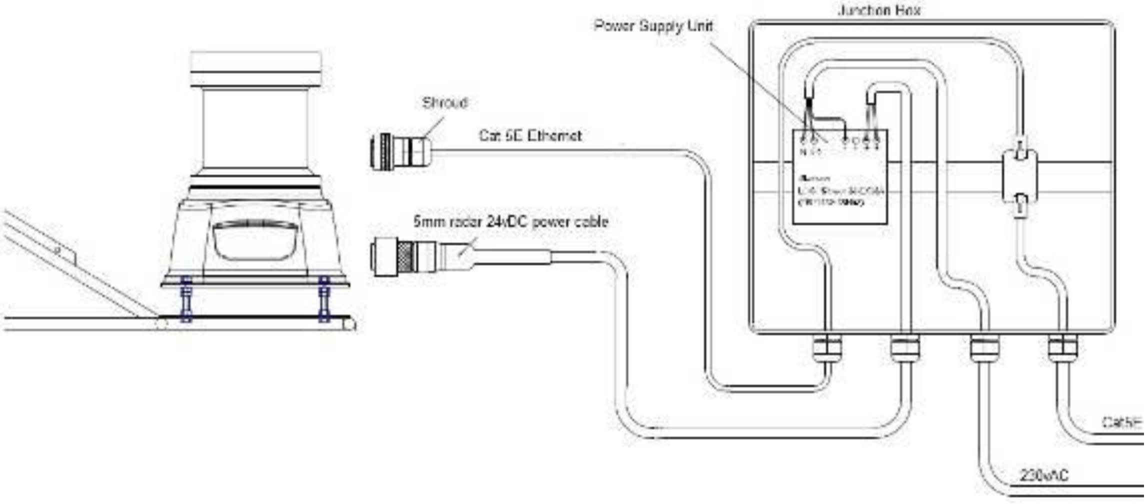


Figure 12 Connections to radar sensor

Supplied with each radar sensor are a power cable with a mil-spec connector for the sensor connection and a bare end at the junction box connection. A mil spec shroud is also supplied for use with a suitable environmentally protected Ethernet network connection. It is essential that the supplied shroud is correctly used to ensure that the data connection is water tight.

IMPORTANT: Failure to correctly fit the shroud can invalidate the warranty on sensors that have been caused to fail through water ingress.

1. Attach 24vDC connection to the radar.

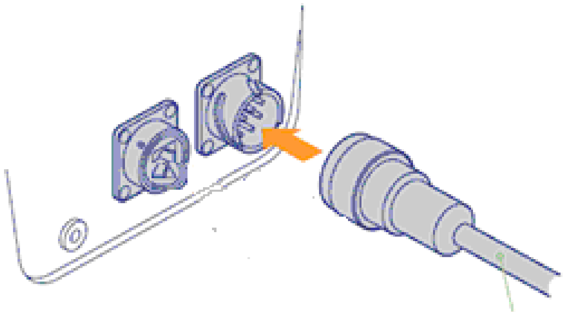


Figure 13 Connecting radar sensor

2. Ensure the Power and Ethernet cables are securely connected into junction box.
3. Ensure the junction box has the Navtech supplied 24vDC power supply installed. (The power supply unit has a peak current capacity of 4 Amps, though typically the radar draws a continuous 1 Amp). See.[8].
4. Ensure that the Power supply cabling is correctly terminated at the radar end with a secure Amphenol MIL spec connector. Pin D (Red or Brown) is 24vDC, Pin J (Blue or Black) is 0V.

IMPORTANT: To prevent floating voltage levels on the low output of the radar sensor power supply unit, link the 0v output to earth.

5. Ensure the junction box has an Ethernet cable running to the infrastructure network switch.

2.5 Preparing the laptop

> **IMPORTANT:** Ensure that your laptop has its IP address set to operate within the same subnet as the radar sensor

2.5.1 Factory settings

The IP address (e.g. 192.168.0.1) of the radar sensor is preset before leaving Navtech Radar Limited according to client specifications and will be declared on a label attached to the outer casing.

The subnet mask of the radar sensor is often preset to 255.255.255.0 but could also be set wider (such as 255.255.0.0) if requested. Therefore, if the sensor IP address is 192.168.0.1 and the mask is 255.255.255.0, then your computer must use an IP address in the range:
192.168.0.2 to 192.168.0.254.

2.5.2 Changing factory settings

The IP address and subnet mask can be changed using firmware commands sent to the radar either via Telnet (see [5]), or using a serial connection (see [D3]).

2.6 Connecting your laptop

1. At the radar, connect the laptop via CAT5 cable to the radar.
2. Ensure that the radar sensor is powered on and is rotating - you can faintly hear the rotor when it is running.
3. Use SPx Radar View application [1] to display the radar data. (See Annex A)

2.7 Levelling radar sensor

For optimum detection performance it is important that each sensor is level in relation to the area that it surveys. Level in this sense may not mean absolutely horizontal, generally the radar will be levelled so as to scan parallel to the boom they are to protect.

The exaggerated examples below show how a sensor with an incorrect incline could miss targets which are lower down the slope:

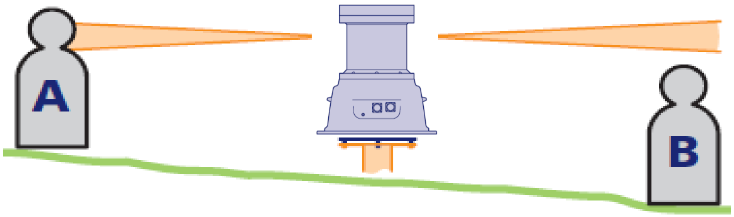


Figure 14 Horizontal radar sensor misses target B

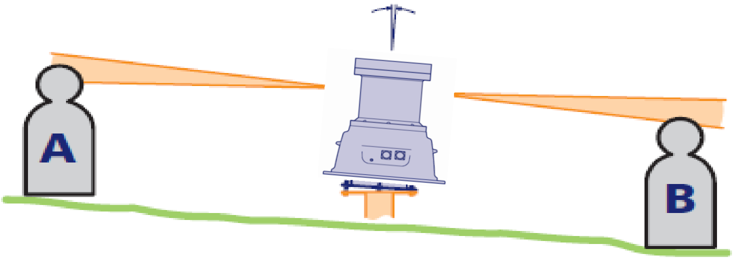


Figure 15 Inclined radar sensor locates both targets

A Digital Level as indicated in Figure 16, can be used to ensure the radar is installed level. This should be checked in two axes, on the radar lid, as shown below. The objective is to install the radar so that it scans in a plane which is parallel to the boom or structure which is being protected

Figure 16 Digital Inclinometer mounted on radar sensor

2.7.1 Adjusting radar

Once installed on the machine, fine adjustments of the radar level may be needed. These are best made with reference to the actual radar image, as viewed in RadaView test software

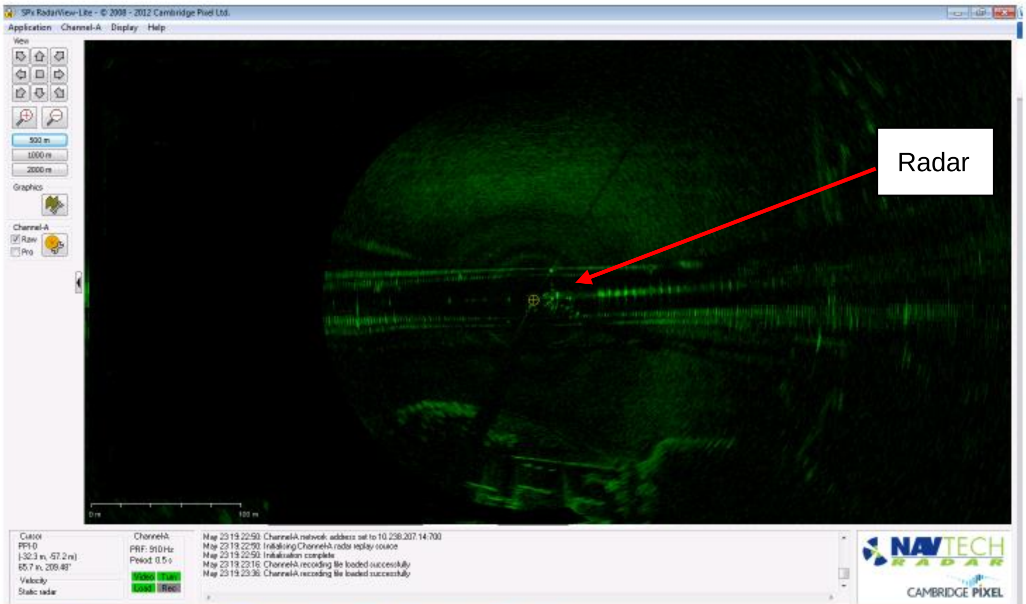


Figure 17 SPx RadarView display (A)

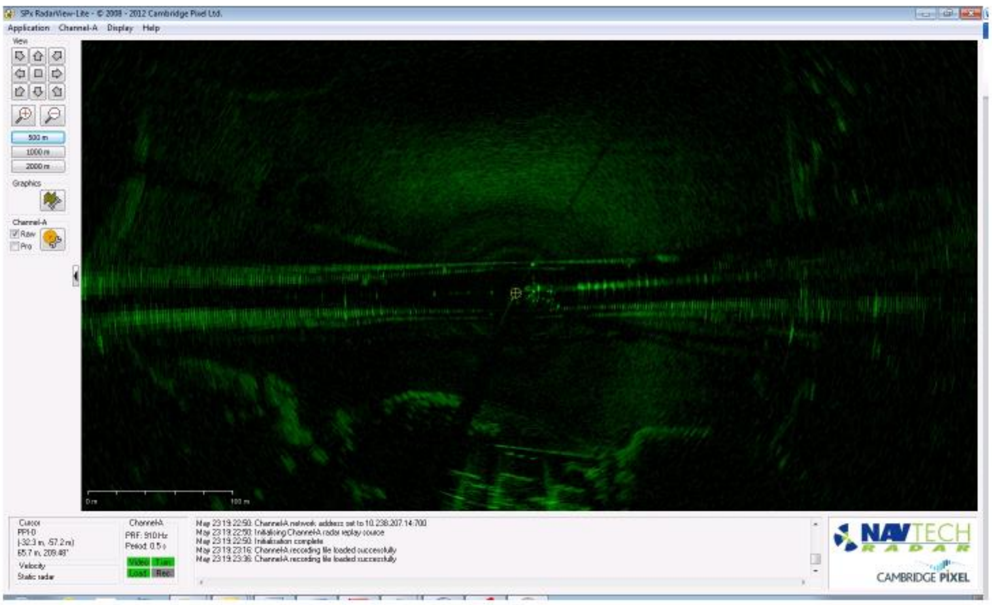


Figure 18 SPx RadarView display (B)

Using the RadarView application to view the radar data (see Annex A), you are aiming to have an equal amount of data either side of the radar.

1. If there is more radar data one side than the other, as shown in Figure 17, change the angle of the radar until you have an equal amount of data either side of the radar, as shown in Figure 18. Radar targets can be used as the test object.

2. If there is not enough radar image to view from objects/structures already within the radar line of sight, test targets can be used instead. Adjust the radar tilt of the radar on the threaded studs, to maximise the signal level on the 2 targets are determined from the RadarVew software (See Annex A for detailed instruction).

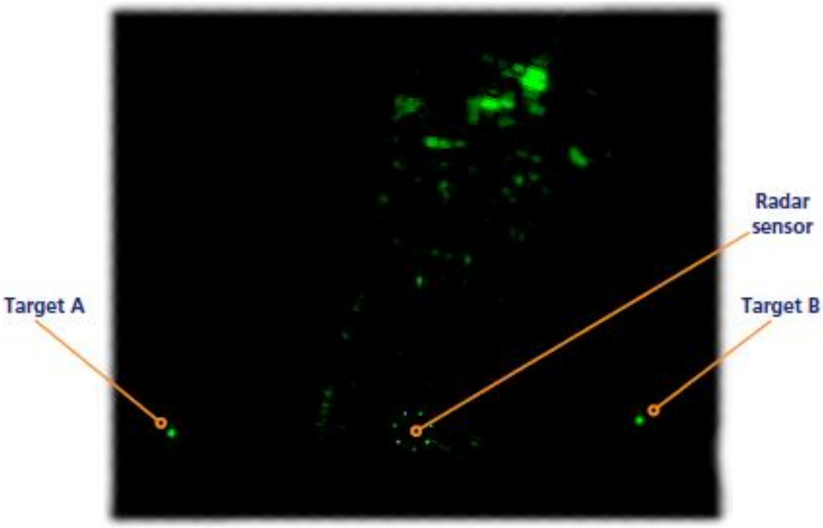


Figure 19 Radar view to locate target

2.8 Securing the radar

1. Secure the radar on the mounting bracket, or post plate. To do this: lock off the two lower nuts on each stud by tightening one against the other. (This is to ensure that, if the radar is removed, the tilt angle is not changed)

2. Record the tilt angle from the digital inclinometer. See Annex E for a sample table.

2.9 Confirming sensor coverage

1. Install and configure the witness software as described in [2].

2. Enter basic detection areas into the witness interface. (See [2]).

3. Where possible, place test objects into the radar detection zone. Monitor these on the interface and confirm that detection alarms are raised

4. Refine the radar detection zones, based on the tests and save the settings.
5. Disconnect the laptop from the radar and connect the radar to the infrastructure network switch.
6. Repeat for each radar

3. Health & Safety

3.1.1 General

1. A first aid kit should be available at all times.
2. In addition to the conditions detailed in this section the Site Safety Procedures for the location where the equipment is being installed must be complied with at all times.

3.1.2 Design

The design and manufacture of all equipment supplied as part of the Navtech radar tracking and monitoring system for permanent installation is CE accredited:

- European Electromagnetic Compatibility Directive 89/336/EEC
- ETSI EN301 091-1 Electromagnetic compatibility and Radio Spectrum Matters Short Range devices

3.1.3 Maintenance

1. Make sure that electrical supplies are properly isolated before removing any covers. The supply should be disconnected by the operation of the main isolating switch, removal of fuses or other acceptable method. A notice should be placed at the point of isolation showing:-

   DANGER - WORK IN PROGRESS

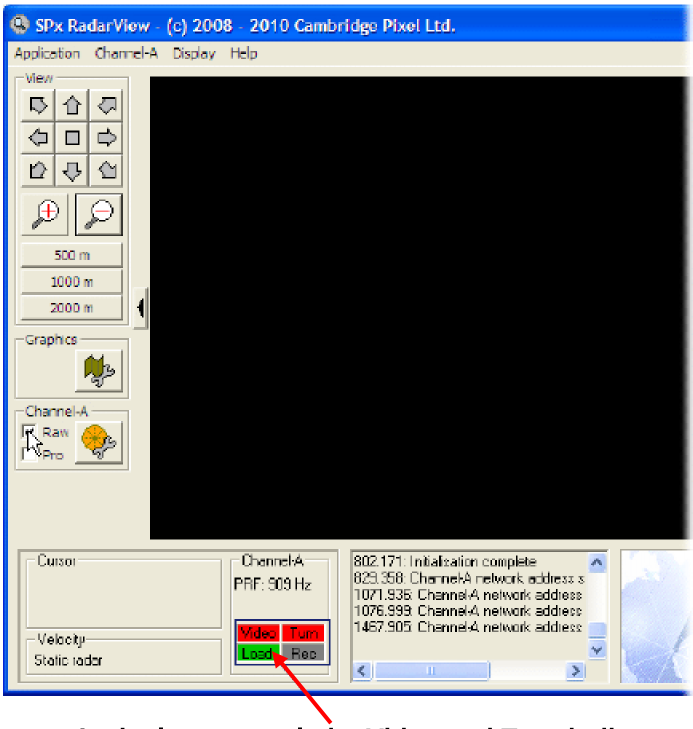
2. Place a barrier or guard rail round the work area.
3. When working on elevated equipment, make sure that all ladders and staging are secure. If necessary, wear a safety harness.
4. Be aware of any special hazards specific to the site or location where equipment is located. Take all necessary precautions.

Annex A Using SPx RadarView

The SPx RadarView application consists of two files which must be located in the same folder (any folder) on your laptop:

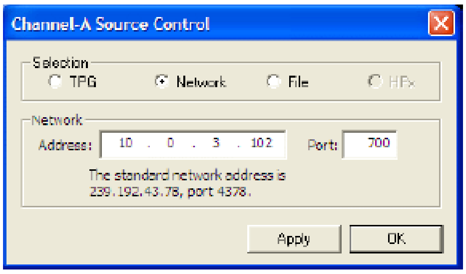
- SPXRadarView.exe
- SPXRadarView.rpi

1. Run **SPXRadarView.exe**. You should see a blank main screen:



Note: In the lower panel, the Video and Turn indicators will be red indicating that there is no communication with the sensor.

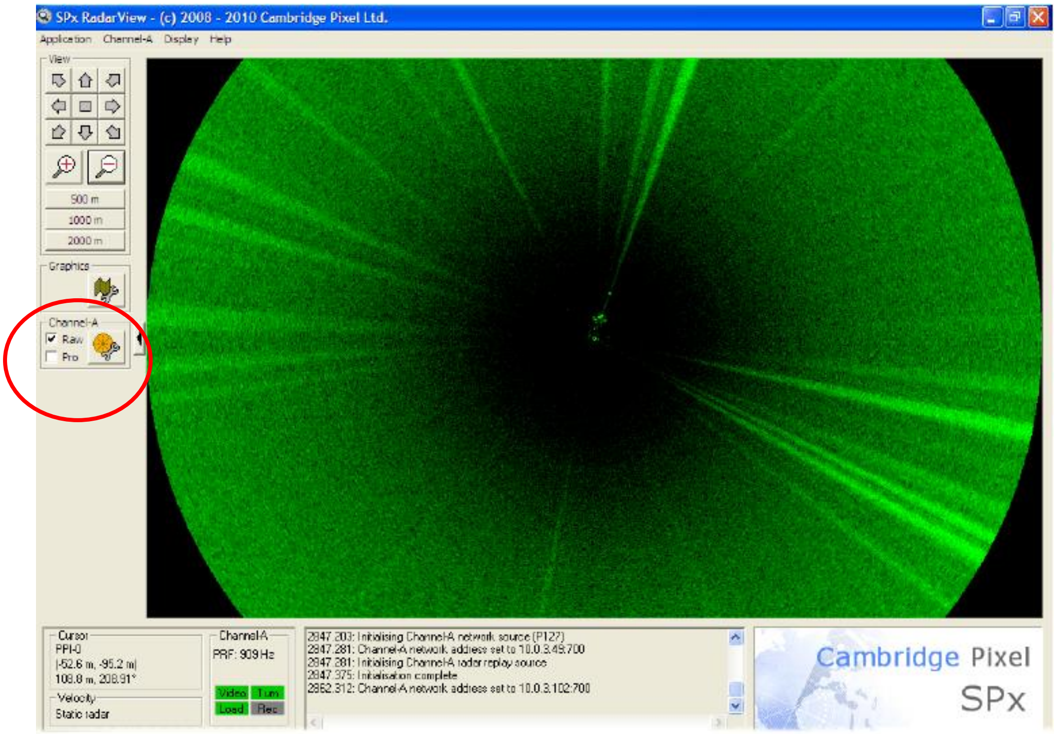
2. Click the Channel-A menu on the toolbar, and select the **Source...** option.



Ensure that the Selection option is set to **Network** and in the Address field, enter the IP Address of the sensor. The **Port** must be set to **700**.

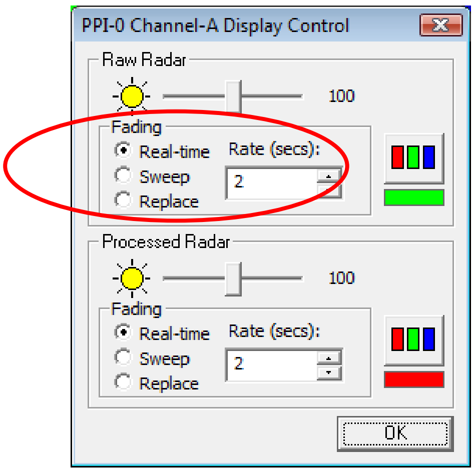
Click **OK**.

Once the IP address and port are correctly set and the application makes contact with the sensor, the **Video and Turn** indicators should turn green. Shortly afterwards, you should begin to see radar scan information within the main window.



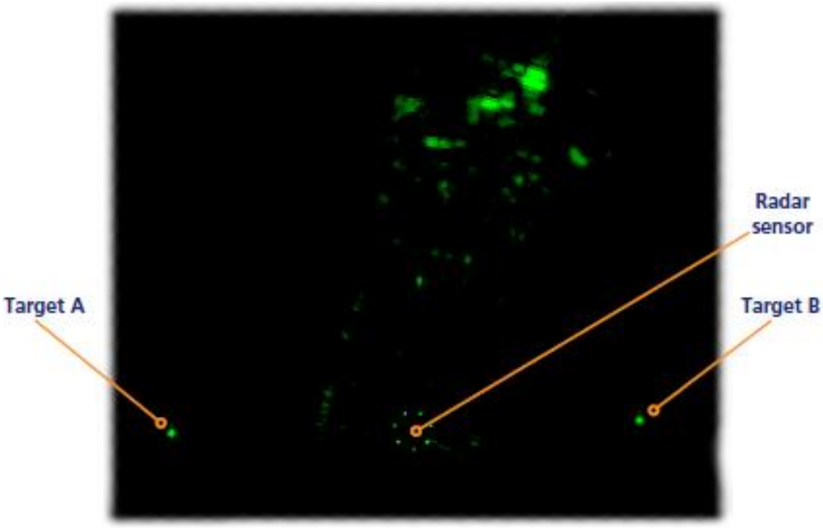
On the left side of the screen, ensure that the **Raw** option is ticked.

3. Click the  button to show the Display Control dialog box:

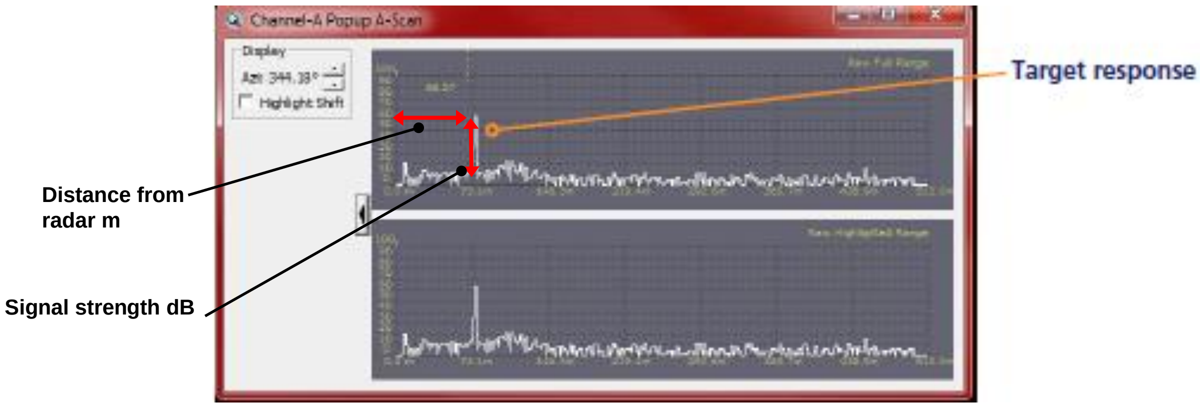


Ensure that in the Raw Radar section, the Fading option is set to **Sweep** and the Rate (sweeps) is set to **5**. Click **OK**.

4. Click the  button to zoom into the radar view so that you can clearly see the both of your test targets:

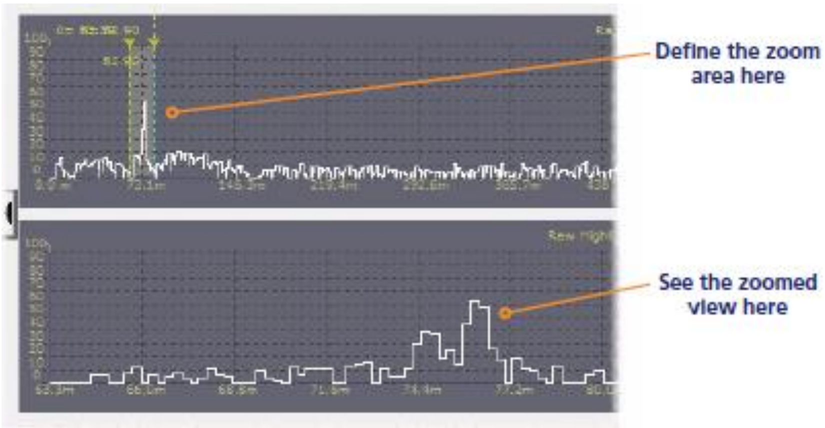


5. Right click the mouse pointer on the exact middle point of one of the targets to display a popup options box. Click the option **Popup Channel-A AScan….** to display a scan window.



The scan window provides live signal strength data concentrating only on the angular direction of the chosen target from the radar sensor. In each of the two graph plots, the x-axis shows the distance from the sensor while the y-axis indicates the returned signal strength. You should see a spike representing your target at the relevant distance.

6. On the top graph, left click on either side of the spike to create a zoomed view on the lower graph.

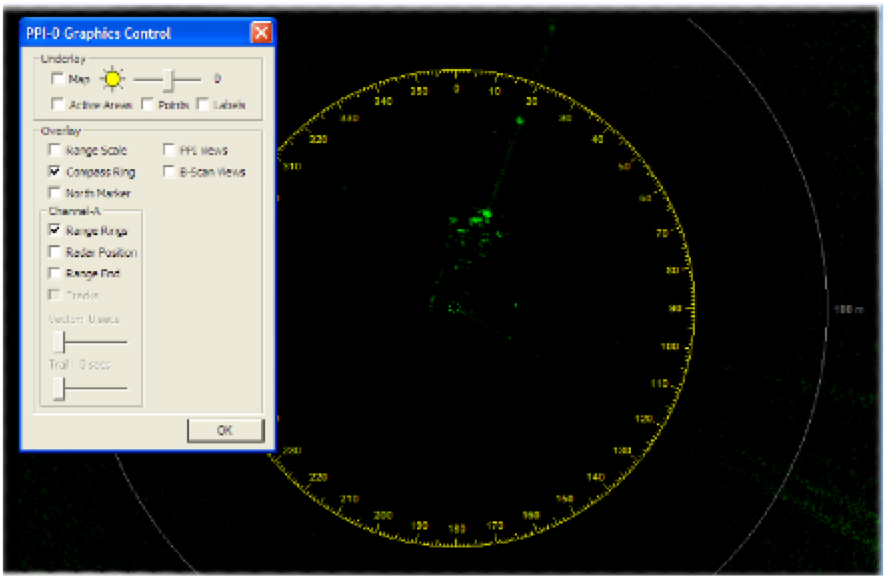


This will allow you to see small changes in the returned signal strength on the lower graph when levelling the sensor:

7. Repeat steps 5 and 6 for the other target so that you can view both on screen at the same time.

8. Adjust the radar sensor level (See Section 2.7) while checking the scan graphs to ensure the best response from both targets.

9. To assist with orientation, optionally click the  button to show the Graphics Control dialog box:



Two options within this dialog box are of particular use:

- Enable the Compass Ring option to superimpose compass graduation marks around the sensor view.

Note: North is aligned to the zero point of the radar sensor, not magnetic north.

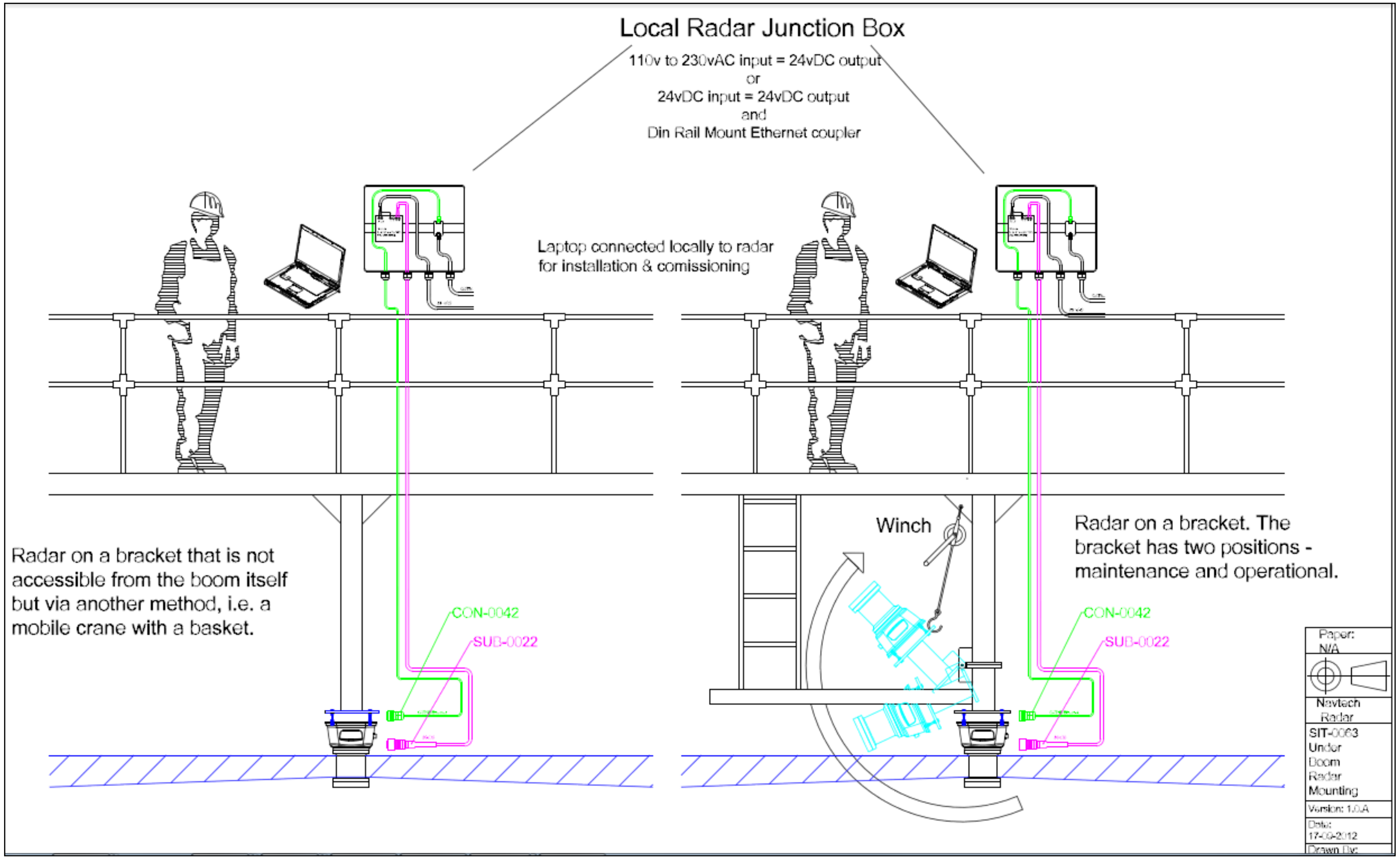
- Enable the Range Rings option to overlay range lines every 100m onto the sensor view

Annex B Sample Brackets

Figure 20 I-200 mounted on a ship to shore container crane.

Shown in the deployed position (above) on 2 different bracket arrangements and recovered for maintenance (below)

Figure 21 Mounting bracket, and installed on a wall



Local Radar Junction Box
110v to 230vAC input = 24vDC output
or
24vDC input = 24vDC output
and
Din Rail Mount Ethernet coupler
Laptop connected locally to radar
for installation & comissioning
Radar on a bracket that is not accessible from the boom itself but via another method, i.e. a mobile crane with a basket.
Winch
Radar on a bracket. The bracket has two positions - maintenance and operational.
CON-0042
SUB-0022
CON-0042
SUB-0022
Paper:
N/A
Navtech
Radar
SIT-0063
Under
Boom
Radar
Mounting

Figure 22 Two possible methods of mounting a radar centrally, under the boom

Annex C Specifications

This Annex contains the specifications for the cables and connectors supplied by Navtech, with the exception of the Ethernet connector which is a standard RJ45 connector.

C.1 Radar power cable

318-B LSZH cable	
Part no	Eland A5Z02015BK
No of Cores x Nominal Cross Sectional Area	2 x 1.5 mm^2
Core Identification	2 cores: Blue, Brown
Current carrying capacity	Single phase AC 16 amps
Insulation	LSZH (application dependent)
Sheath	LSZH (application dependent)
Standard	IEC 60092-353
Conductor	Class 5 flexible plain copper to BSN EN 60228:2005

Table 2 Radar power cable specification

C.2 Radar Cat 5E cable

Cat 5E cable	
Part no	Eland A8NCAT5EFTPGSWB
No of pairs	4
Core Identification	4 pairs: Blue + White/Blue, Orange + White/Orange, Green + White/Green, Brown + White/Brown
Standards	ISO/IEC 11801, TIA/EIA 568B
Braiding	GSWB (Galvanised Steel Wire Braid)
Sheath	LSZH (application dependent)
Sheath colour	Black

Table 3 Radar Cat 5E Ethernet cable specification

C.3 Radar power cable connector (radar end)

Amphenol 97 series	
MIL Spec	MIL-C-50152
Model	3106A
Operating temperatures	–55°C to +125°C
Power pins	Pin D (Red or Brown wire) & Pin J (Blue or Black wire)
Design Characteristics	10 socket plug, Single key/keyway polarization Threaded coupling, hard dielectric inserts

Table 4 Radar power cable (radar end) connector specification

C.4 Radar Cat 5E cable connector (radar end)

Amphenol RJF series	
Part No	RJF6
MIL Spec	MIL-C-26482
Data Transmission	Category 5e per ISO/IEC 11801
Mechanical	Bayonet coupling (Audible & Visual coupling signal) 4 mechanical Coding / Polarization possibilities by the user (insert rotation) RJ45 cordset retention in the plug : 100 N in the axis Mating cycles : 500 min
Environmental Protection	Sealing: IP67 Salt Spray : 48 h with Nickel plating> 96 h with black coating> 500 h with hard anodic coating and Cadmium Fire /Low Smoke: UL94 V0 and NF F 16 101 & 16 102 Vibrations : 25 –250 Hz, 5 g, 3 axes : no discontinuity> 1µs Humidity: 21 days, 43°C, 98%humidity Rapid change of Temperature: 5 –20°C / +85°C cycles

Table 5 Radar Cat 5E cable connector (radar end) specification

Annex D Construction of test target

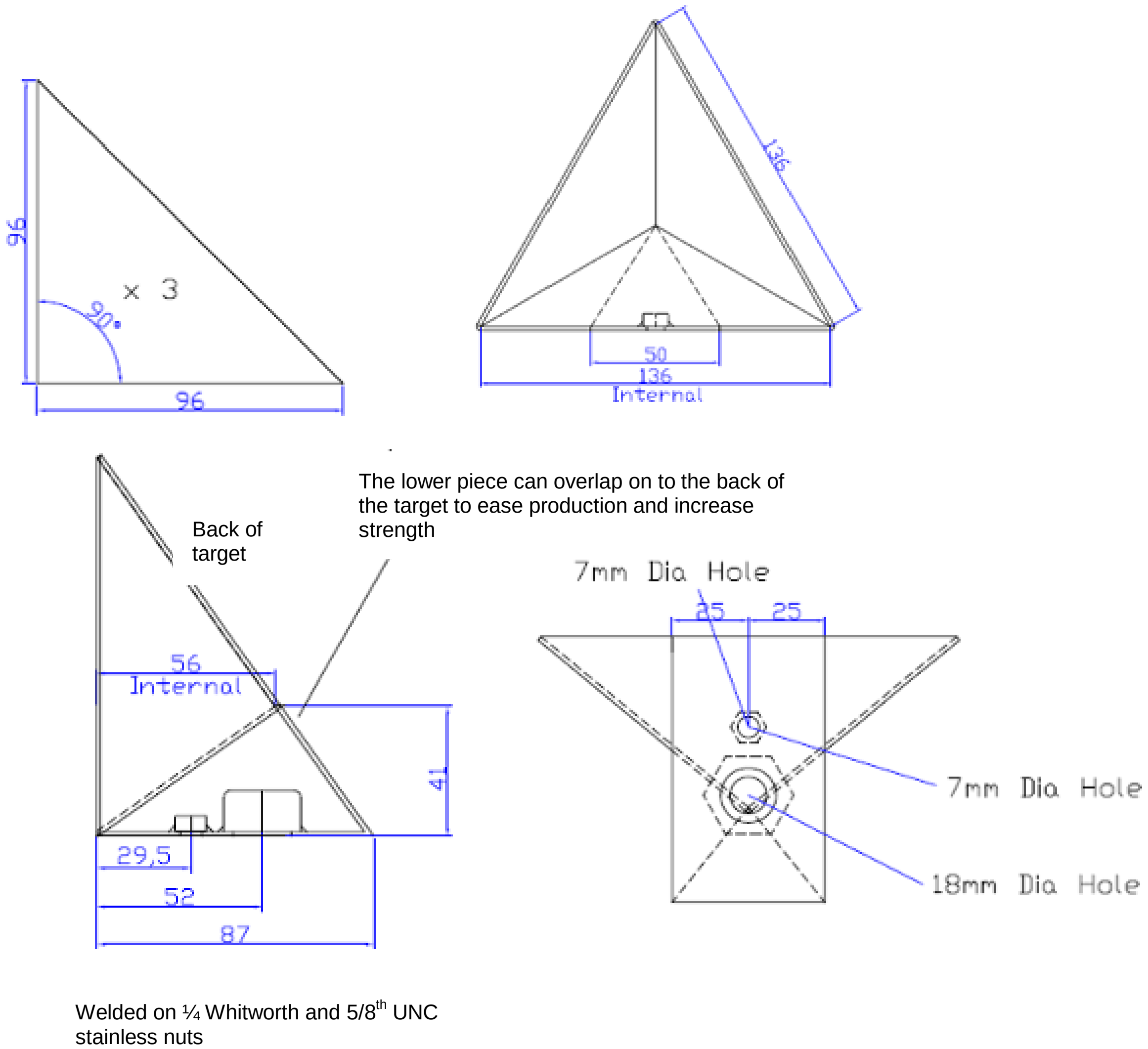
The following drawings show how to construct a test target.

Tolerance: +/- 1mm on linear dimensions

Material: 1.5 stainless

Finish: Bare metal

The target can be made by welding 3 flat triangles together, or by folding one piece and welding the meeting edges:

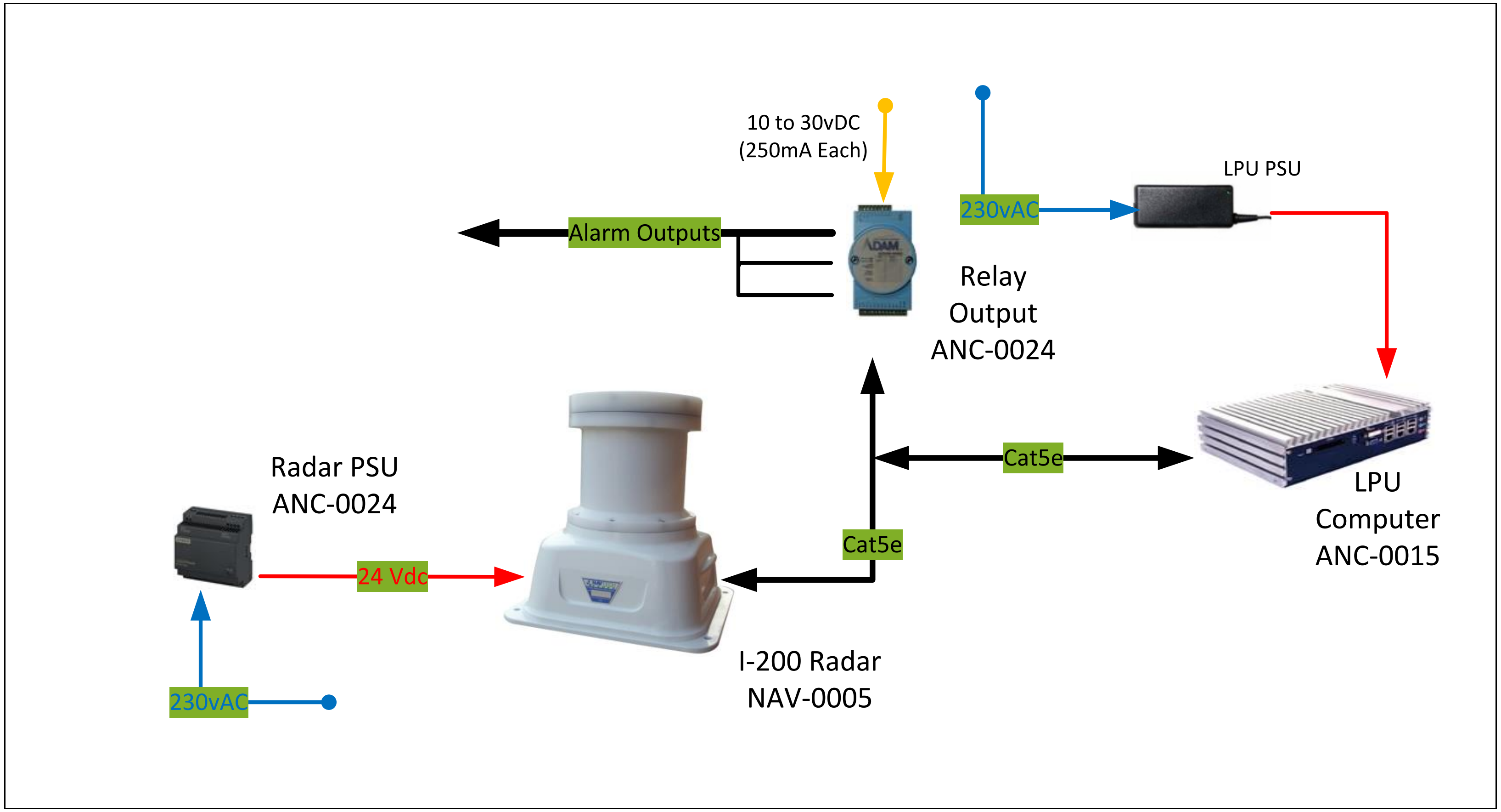


Annex E Radar sensor configurations

A sample table to record data for each radar.

Radar Sensor	Serial No	IP Address	Subnet Mask	Approximate Geographical position		Radar Base Plate Angle (deg)
				Lat(N)	Long (E)	
Example	*100*	*192.168.1.170*	*255.255.255.0*	*59.25023*	*17.85109*	*+1.5*
A1						
A2						
A3						
A4						

ANNEX – F   Outline System Diagram



ANNEX – G Radio Frequency Energy Compliance

FCC compliance statement (United States)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation.

The operation of this device is limited to a fixed position at airport locations for foreign object debris detection on runways and for monitoring aircraft as well as service vehicles on taxiways and other airport vehicle service areas that have no public vehicle access. This equipment must be mounted in a fixed location maintaining a minimum separation distance of 40cm from personnel when in general operation. This restriction of operation is specific for use in North America. For use in other regions aligned to the FCC regulations, specific country restrictions should be reviewed.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.