CE 0191

KODEN

# INSTALLATION MANUAL

## RADAR*pc*

# MDS-1R/8R/9R/10R

This product is specifically designed to be installed on boats and other means of maritime transport. If your country forms part to the EU, please contact your dealer for advice before attempting to install elsewhere.

***SAFETY PRECAUTIONS***

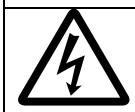
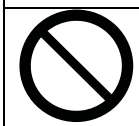
**High Voltage Warning** 

Dangerously high voltages are present within the RADAR*pc* scanner unit. There are no internal connections or adjustments necessary for installation. The cover should be removed only by a qualified radar service technician. Technicians must exercise extreme care when working inside the unit. Always remove power before removing the cover. Some capacitors may take several minutes to discharge, even after switching off the radar. Before touching the magnetron or any high voltage components, ground them with a clip lead.

**Microwave Radiation Hazard** 

The microwave energy radiated by a radar antenna is harmful to humans, especially to one's eyes. Never look directly into an open waveguide or into the path of radiation from an enclosed antenna. Radar and other radio frequency radiation can upset cardiac pacemakers. If someone with a cardiac pacemaker suspects abnormal operation, immediately turn off the equipment and move the person away from the antenna. Turn off the radar whenever it is necessary to work on the antenna unit or on other equipment in the beam of the radar.

**About this Operation manual**

| Symbol | Meaning |
|---|---|
|  Warning | **Mark for warning**<br>This symbol denotes that there is a risk of death or seriously injury when not dealing with it correctly. |
|  Caution | **Mark for caution**<br>This symbol denotes that there is a risk of slight injury or damage of device when not dealing with it correctly. |
|  | **Mark for danger high voltage**<br>This symbol denotes that there is a risk of death or seriously injury caused by electric shock when not dealing with it correctly. |
|  | **Mark for prohibition**<br>This symbol denotes prohibition of the specified conduct. Description of the prohibition is displayed near the mark. |

# MDS-1R/8R/9R/10R Installation Manual

## Contents

## *1 General Description*

The RADAR*pc* scanner unit includes the radar antenna, transmitter, receiver and necessary electronics. Also included with the RADAR*pc* scanner are the mounting hardware kit, interconnecting cable. Antenna control and radar image data are available by Ethernet(100base-TX/10base-T) to be connected to a PC or host display unit.

**General Description**

**MDS-1R / MDS-8R**

MDS-1R

| | |
|---|---|
| Diameter | 12 2/5 in., (315 mm) |
| Height | 8 1/10 in., (205 mm) |
| Weight | 9.9lb.,( 4.5kg) |
| Cable Length | 33 ft., (10 meters) |

MDS-8R

| | |
|---|---|
| Diameter | 19 15/16 in., (507 mm) |
| Height | 8 3/4 in., (222 mm) |
| Weight | 15.4 lb.,( 7 kg) |
| Cable Length | 33 ft., (10 meters) |

MDS-1R / MDS-8R

Electrical characteristics:

| | |
|---|---|
| Voltage | 10.8 to 41.6 Vdc |
| Power | 30 Watts or less |

Equipment Supplied

Scanner Unit, MRT-152R for MDS-1R/MRT-152SR for MDS-8R with cable
Fasteners, stainless steel:

- 4 Bolts, hex metric M10 x 25U
- 4 Flat washer
- 4 Lock washer
- 1 Template, for locating mounting holes
- 2 Fuses, 5A (spare)

### *Optional Parts*

15 or 20 meter cable

**MDS-9R**

| | |
|---|---|
| Diameter | 23 1/2 in., (597 mm) |
| Height | 8 15/16 in., (227 mm) |
| Weight | 17.5 lb.,( 7.8 kg) |
| Cable Length | 33 ft., (10 meters) |

Electrical characteristics:

| | |
|---|---|
| Voltage | 10.8 to 41.6 Vdc |
| Power | 45 Watts or less |

Equipment Supplied

Scanner Unit, MRT-150R for MDS-9R with cable
Installation material:

- 4 Bolts, hex metric M10 x 25U
- 4 Flat washer
- 4 Lock washer
- 1 Template, for locating mounting holes
- 2 Fuses, 8A (spare)

***Optional Parts***

15 or 20 meter cable

**MDS-10R**

3.5 ft

| | |
|---|---|
| Width | 47 1/4 in., (1200 mm) |
| Weight | 9.3 lb.,( 4.2 kg) |

4.5 ft

| | |
|---|---|
| Width | 59 1/16 in., (1500 mm) |
| Weight | 11 lb.,( 4.9 kg) |

Transceiver:

| | |
|---|---|
| Depth | 16 1/8 in., (410 mm) |
| Width | 10 5/8 in., (270 mm) |
| Height | 12 3/16 in., (310 mm) |
| Weight | 38 lb.,( 17 kg) |
| Cable Length | 66 ft., (20 meters) |

Electrical characteristics:

| | |
|---|---|
| Voltage | 10.8 to 41.6 Vdc |
| Power | 80 Watts or less |

Equipment Supplied

Scanner Unit, MRT-147R for MDS-10R with cable
Fasteners, stainless steel:

- 4 Bolts, hex metric M12 x 60U
- 4 Flat washer
- 4 Lock washer
- 1 Template, for locating mounting holes
- 2 Fuses, 8A (spare)

***Optional Parts***

15 or 20 meter cable

## 2 What is radar?

### *2.1 General*

The word "radar" is an acronym for "Radio Detecting And Ranging." In very simple terms, this is how it works. A radio transmitter sends a quick microwave pulse, and then a receiver listens for that signal's echo when it is bounced back from something in its path. The returning signal is processed by a computer to determine its relative distance, position and bearing. This information is graphically displayed on a screen for you to see. Other boats or ships, navigational markers, landmasses and such are referred to as targets.

By knowing how long it takes for a signal to return, the distance to a target can be determined. As the radar antenna scans through a 360-degree rotation, it can show where the target is relative to your position. By repeated scans, you can see which direction another vessel is moving.

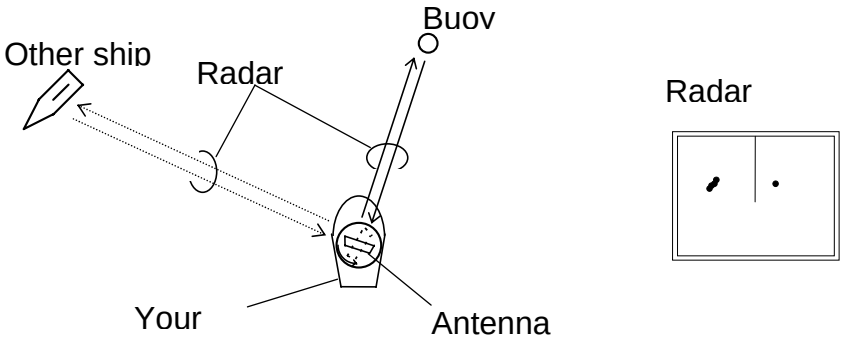



**Fig.2-1 What is radar?**

**Antenna**

How radar will perform is largely determined by its antenna or scanner. Increasing the size of the antenna improves long-range performance and target discrimination, or the ability to distinguish two separate targets at a distance. The critical factors are the antenna's beam width and side lobe level. Typically, a radar antenna will radiate a tightly focused beam from the front of the array. The longer the antenna array is, the narrower the beam width will be. Additionally, it will also emit smaller amounts of energy to each side. The lower the side lobe level, the less the effect of a false echo.

**Side lobe**

The beam in which the strongest radio signal is radiated from the antenna is called the “main lobe”. Those beams that are radiated in other directions are referred to as the “side lobes”. The side lobe level refers to the difference in level (signal strength) between the largest side lobe and the main lobe.

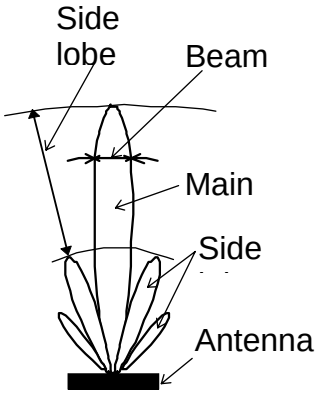



**Fig.2-2 Antenna pattern**

### *2.2 Characteristics of Radar Wave*

Radio waves travel out from the antenna while bending slightly along the earth's surface. The amount they bend depends on atmospheric conditions. The sight distance of a radar generally is about 6% longer than the optical sight distance and is calculated using this equation:

Radar sight distance (NM) = 2.22 ($\sqrt{}$ antenna height (m) + $\sqrt{}$ target height (m))

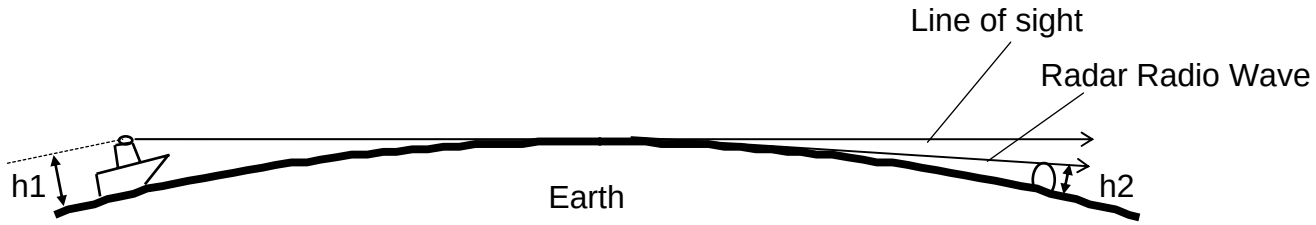



**Fig.2-3 Radar wave**

**Targets difficult to display on screen**

The intensity of the reflected radio signal from a target depends on the distance, height, and size of the target, as well as its material and shape, along with the radar's transmitter power output and antenna size. Targets made of fiberglass, wood, or other low-reflectance materials or those that have a small incident angle are difficult to display on a screen. Sandy beaches, and sandy or muddy shallows can be difficult to catch. Because there's not much to reflect a signal back to you, a coastline can actually be closer to your boat than it appears on the screen.

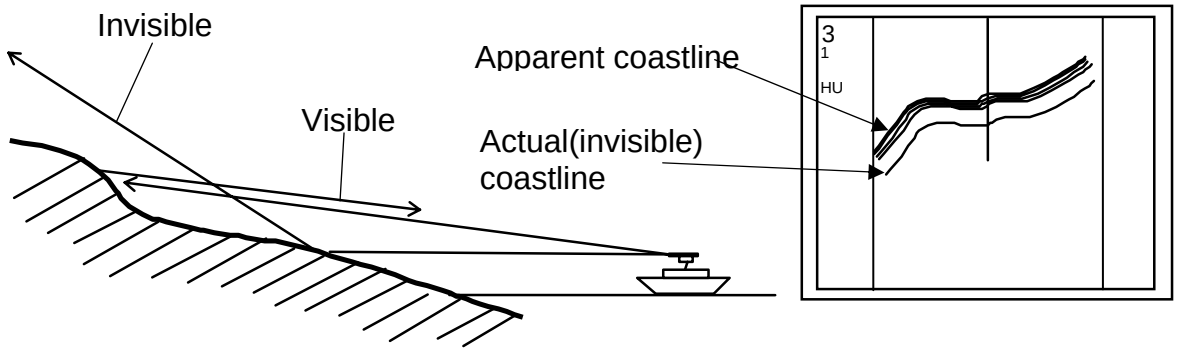



**Fig.2-4 Targets difficult to display on screen**

**Shadow zones of radar**

Radar waves propagate in a straight line. A high outcropping of land or a large ship will create a shadow zone behind it and prevent you from seeing targets on the other side. More importantly, if a mast or some part of the boat's superstructure is in the path of the antenna's sweep, this will also create a shadow zone. No targets will be recognized behind it and it could create a dangerous situation.

**False echoes**

Sometimes radar will display targets on screen that do not exist in the real world. You should be aware of how and why this happens.

A. Ghost echoes

Sometimes one large object very near your boat will appear as two different targets onscreen. One is the actual radar echo. The other is a ghost echo generated by a re-reflection of the original signal. It comes back to your own boat, bounces back to the target, and then is picked up by the antenna on the second bounce. The actual echo appears at the correct distance and bearing on the screen. The ghost echo appears somewhere behind your boat. This type of false echo is also generated by re-reflection of waves from bridges, quay walls or building along shore.

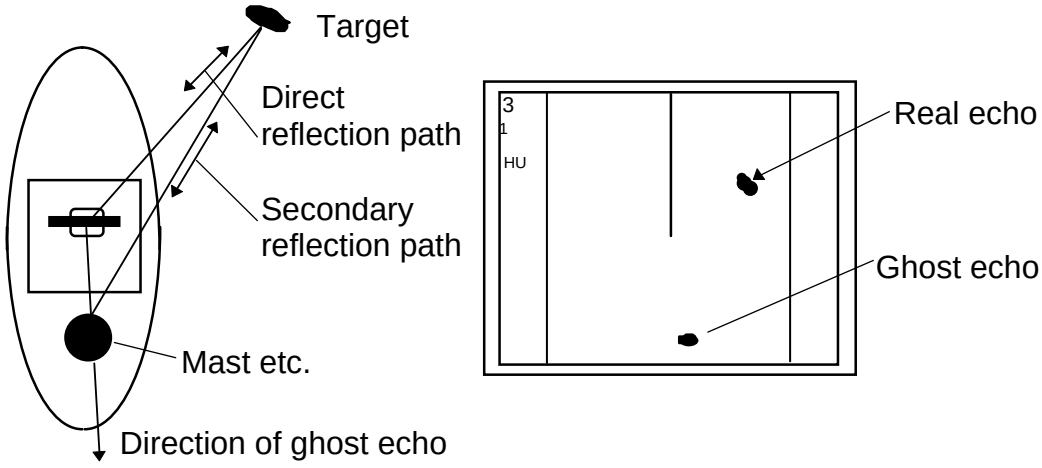



**Fig.2-5 False echoes of radar (Ghost echoes)**

B. Multiple echoes

If there is a large vertical reflecting surface near your boat, as in the case when you pass alongside a large ship, radar signals are repeatedly bounced back and forth between your boat and the other object. Two to four images appear on the screen at equal intervals in the same bearing. This is called a multiple echo. The image appearing closest to you is the real echo. Multiple echoes will disappear as you move away from the reflecting object or its bearing changes.

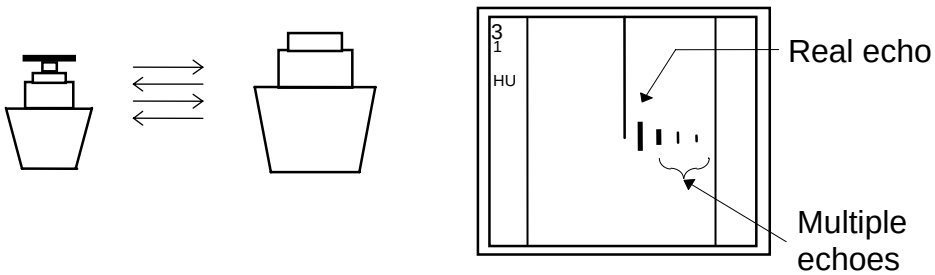



**Fig.2-6 False echoes of radar (Multiple echoes)**

C. False echoes caused by side lobe

An antenna's side lobe emissions are low power, and will not register distant targets. However, if there is a strong reflecting target near your boat, it sometimes may appear as a circular-arc false echo on the screen.

**⚠ CAUTION**

**When near large targets or land, your boat's mast may sometimes appear as a circular-arc shaped false echo.**

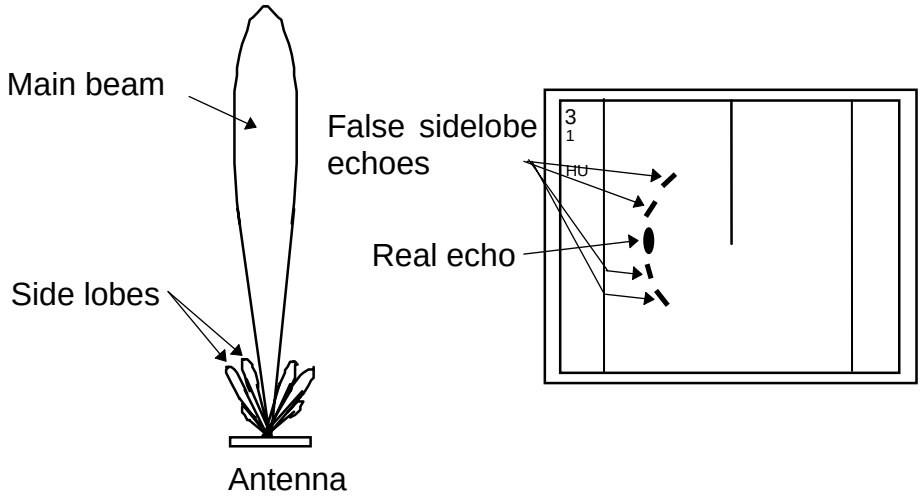



**Fig.2-7 False echoes of radar (Caused by side lobe)**

D. Distant false echoes caused by duct phenomenon

The duct phenomenon sometimes occurs when meteorological conditions create a temperature inversion between layers of air. When this happens, radar waves propagate erratically and can reach a location considerably farther away from your boat than the radar's maximum distance range. What appears onscreen is a false echo that looks to be nearer than the actual target. Since the true echo from the distant target is outside the measurement capabilities of the radar, its apparent distance will change when you change ranges, and you can conclude that it's a false echo.

**Radar interference**

If another boat's radar is operating on the same frequency as yours, it can create interference on your display. The interference usually appears as spiral or radial patterns. This radar has an interference rejection control to eliminate interference. Turn it on to reduce or eliminate the interference.

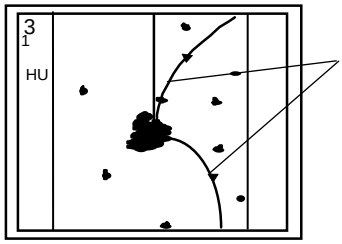



**Fig.2-8 Radar interference**

# *3 Installation*

## *3.1 Installation Considerations*

Prior to actual installation of the RADAR*pc* scanner unit, several factors must be considered to assure maximum performance. The scanner must be located so that passengers and crew are not exposed to the direct radar beam. To comply with FCC RF exposure requirements, the radar antenna for this scanner must be installed to provide a separation distance of 0.5 m or more from all persons. The scanner unit should be mounted on the center line of your vessel in a location that has an unobstructed view forward and is as clear as possible the rest of the way around the unit. A location as high as practical to improve maximum range is desirable, keeping in mind that minimum range objects may be overlooked if mounted too high. Position the unit forward of large structure and exhaust stacks. Large structure or stacks cause blind spots. Contamination from engine exhaust on the scanner housing reduces radar performance.

Antennas for GPS, radio communication or other equipment should not be in the radar beam. Use non-metallic extension poles to move the active area of antennas above the radar beam.

In selecting a location, consider the suitability of the mounting surface. It must be flat and approximately level with the vessel's water line. The surface must support the weight of the scanner and have access to the under side for installation of the four mounting bolts.

① **Shifting from keel line**

By shifting the scanner position from the keel line to the starboard side of the boat, it is possible to move shadow zones to the port side. This makes it possible to keep a clear view to the bow. The distance to be shifted can calculated using the following equation:

Ls=0.4R+D/2 [m] (when R<15m)

Ls=0.025R+D/2 [m] (when R>=15m)

where Ls = distance to be shifted from keel line

D = diameter of obstacle on keel line

R = distance from scanner to obstacle

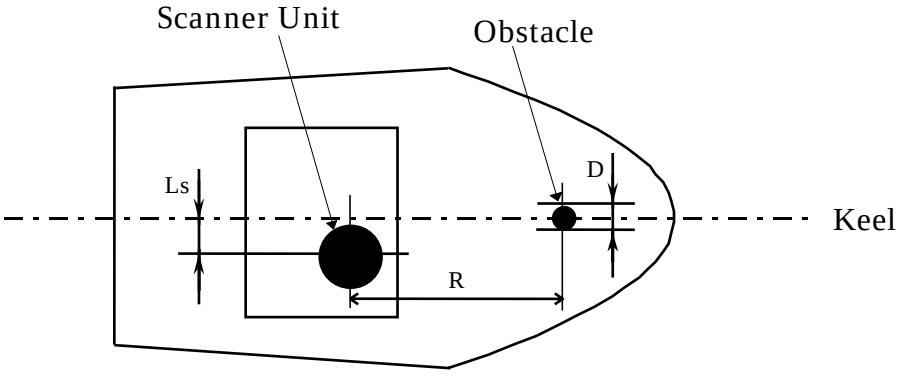



**Fig.3-1 Shifting from keel line**

**② Obtaining sufficient dip angle**

Raise the scanner position so that there is a sufficient dip angle θ available between the line of sight from the scanner to the obstacle and the horizontal line. By raising the dip angle above 5°, it is possible to prevent mid- and long-distance shadow zones. The radar cannot detect objects below the line of sight.

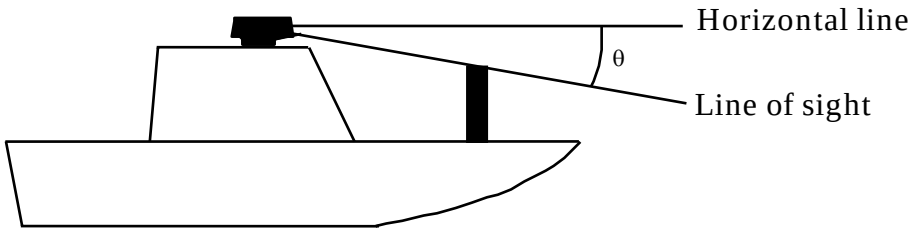



**Fig.3-2 Obtaining sufficient dip angle**

### *3.2 Installing Scanner Unit*

Use a mounting base such as the ones shown in Fig. 3.3, or you can install the scanner directly to a roof or other flat surface. Be certain you keep the water drain tube clear. It's located at the bottom of the scanner unit.

Note : If the mounting bracket or surface has a curvature of more than 2mm, use spacers with the mounting bolts to prevent stress on the scanner housing.

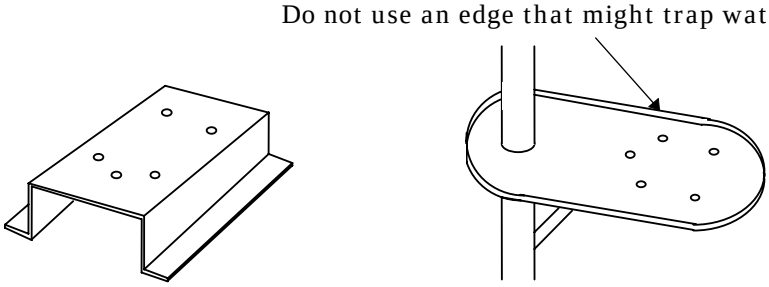



**Fig.3-3 Mount base**

## Note

The recommended mounting surface thickness is 3/8 to 1/2 in. (9 mm to 13 mm). If the mounting surface is thin, a doubler should be added. If it is thicker, longer bolts must be purchased. **The scanner will be damaged if bolts penetrate more than 9/16 in. (15 mm).**

Also, consider the cable route from the scanner to the operator's location. Avoid routing the interconnecting cable through areas of possible damage from moving objects, machinery, exposure to chemicals or high temperature.

### *Prepare RADAR**pc** For Installation*

Unpack your new RADAR*pc* and check the contents against the packing list. Do not remove the cover from the unit. There are no connections or adjustments inside the unit that are needed for installation or operation. The cable must remain attached. For ease of handling, coil the cable and place it on top of the scanner. Then secure it with tape. Invert the scanner and make sure the four mounting holes are clear to accept bolts.

Working at higher elevations may become necessary while installing the scanner unit. Observe safety measures and take sufficient precaution to avoid personal injury or damage to the equipment.

### *3.3 Installation Procedure*

- Prepare the mounting surface by making sure it is clean and flat.

**Note(MDS-1R/8R/9R)**

A template is provided for making fixing holes at installation site.

However it is recommended to check if the template matches with actual unit just in case the template has dimensional change by reproduction or swelling by moisture.

- Use the template provided to mark the location of four mounting holes. Align the template squarely with the center line of the vessel and with the arrow pointing forward.
- Drill four 1/2 in. (13 mm) diameter holes through the mounting surface.
- Check that each bolt (with lock washer and flat washer) protrude through the mounting surface at least 5/16 in. (8 mm) but less than 9/16 in. (15 mm). The scanner will be damaged if bolts protrude more than 9/16 in. (15 mm).
- Apply sealant around each mounting hole.
- Place the RADAR*pc* scanner unit on the mounting surface. Orient the scanner with the index mark on the housing facing forward (cable gland facing aft).
- Install and tighten four M10 x 25U (M10 x 1 in.) mounting bolts.
- Uncoil the scanner cable.
- Secure the cable near the scanner to support the weight of the cable and prevent strain on the watertight cable seal. If the cable is to pass through tubing or a bulkhead, protect the unfinished end. Do not use the unfinished wires or fabric braid to pull the cable. • Route the cable to the operator's location, securing it at appropriate points along the way. Make a drip loop and apply sealant at the entry point of an exterior bulkhead.

- **MDS-1R**

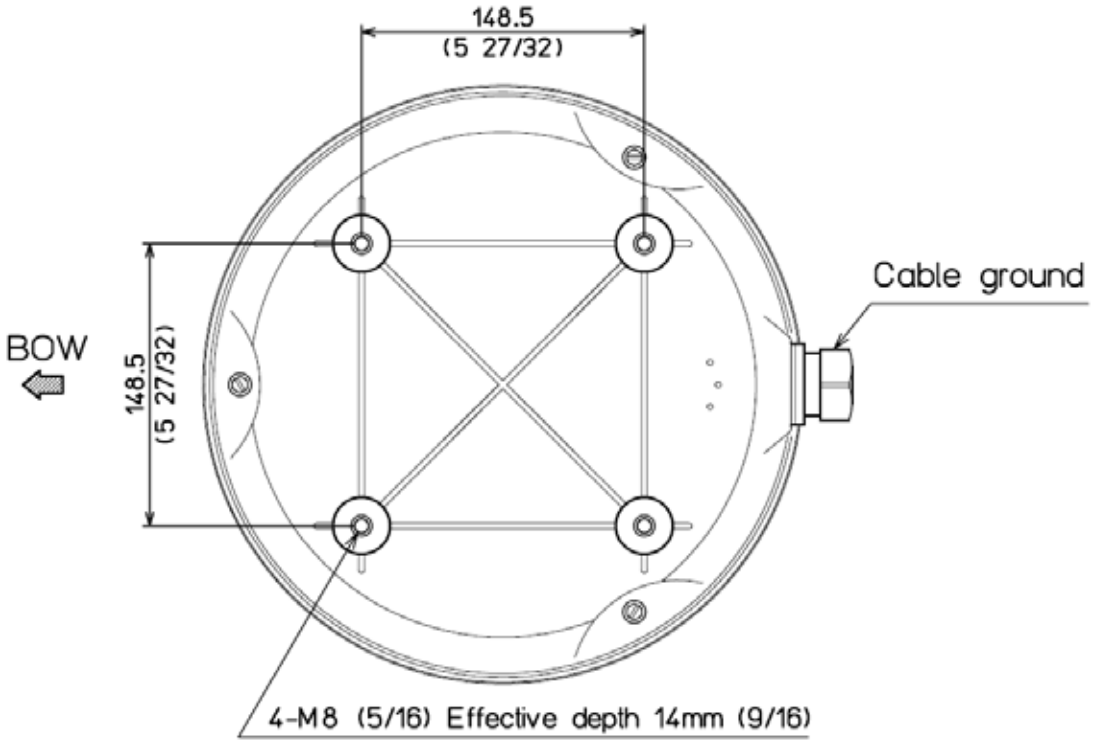



**Fig.3-4 Hole positions for mounting Scanner Unit(MDS-1R)**

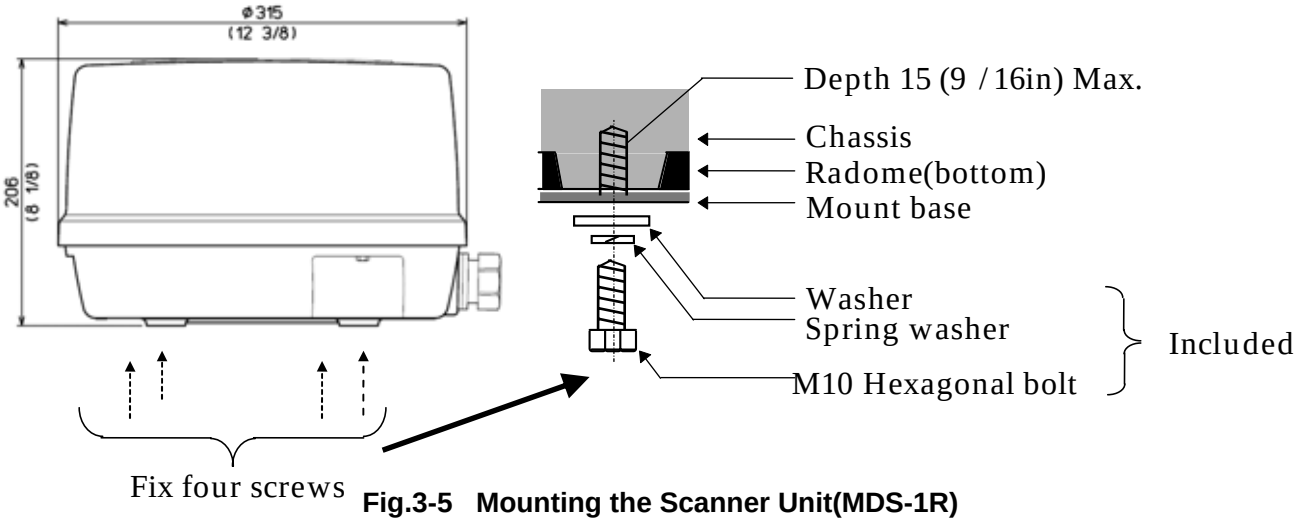



**Fig.3-5 Mounting the Scanner Unit(MDS-1R)**

**MDS-8R**

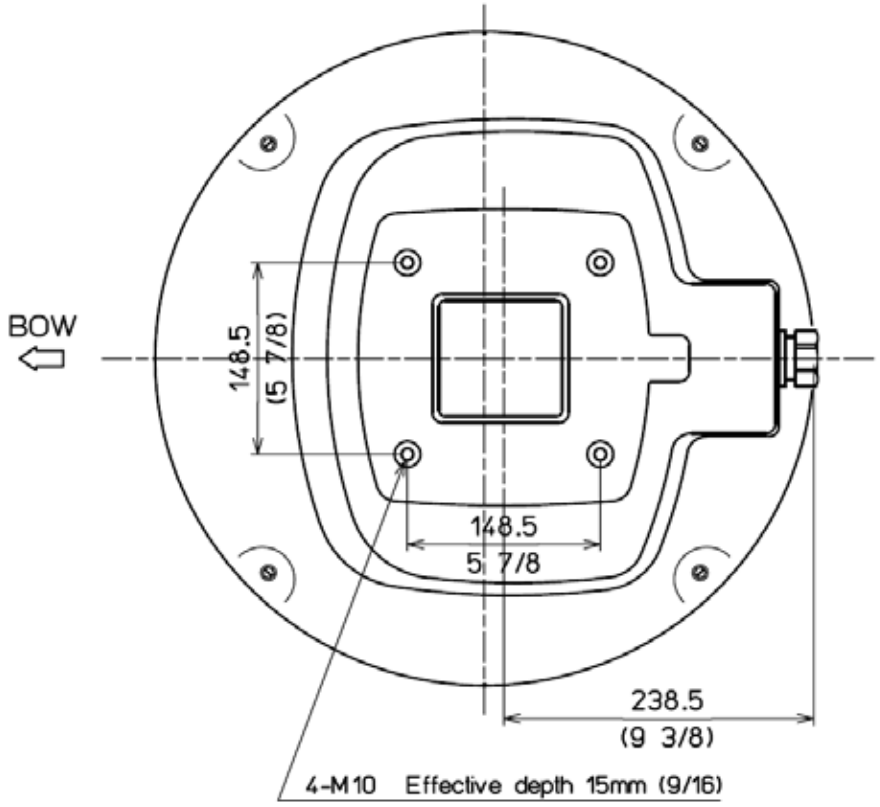



**Fig.3-6 Hole positions for mounting Scanner Unit(MDS-8R)**

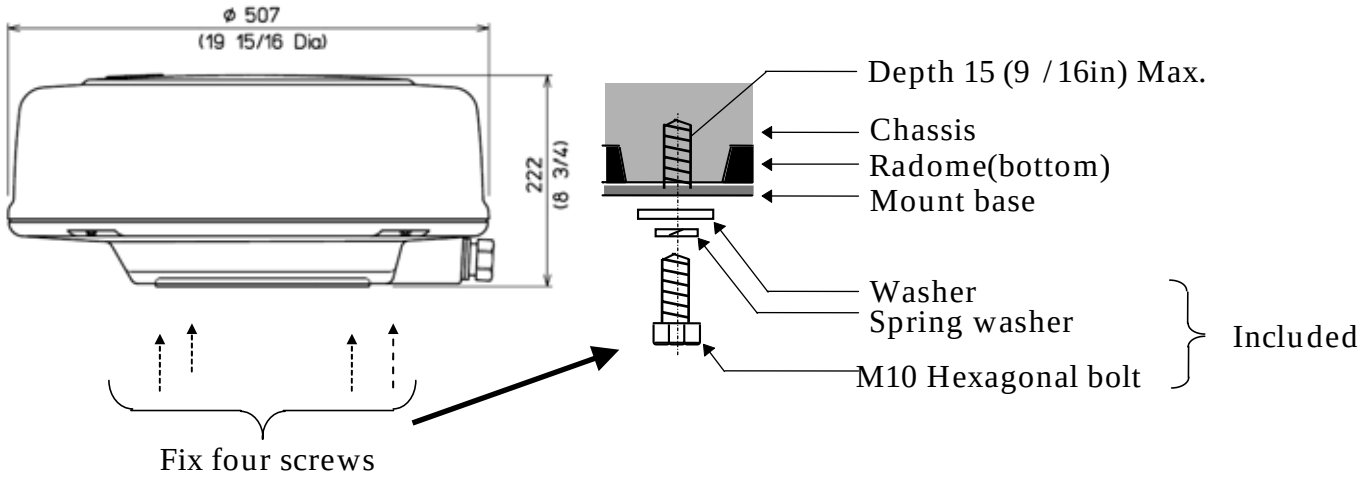



**Fig.3-7 Mounting the Scanner Unit(MDS-8R)**

**MDS-9R**

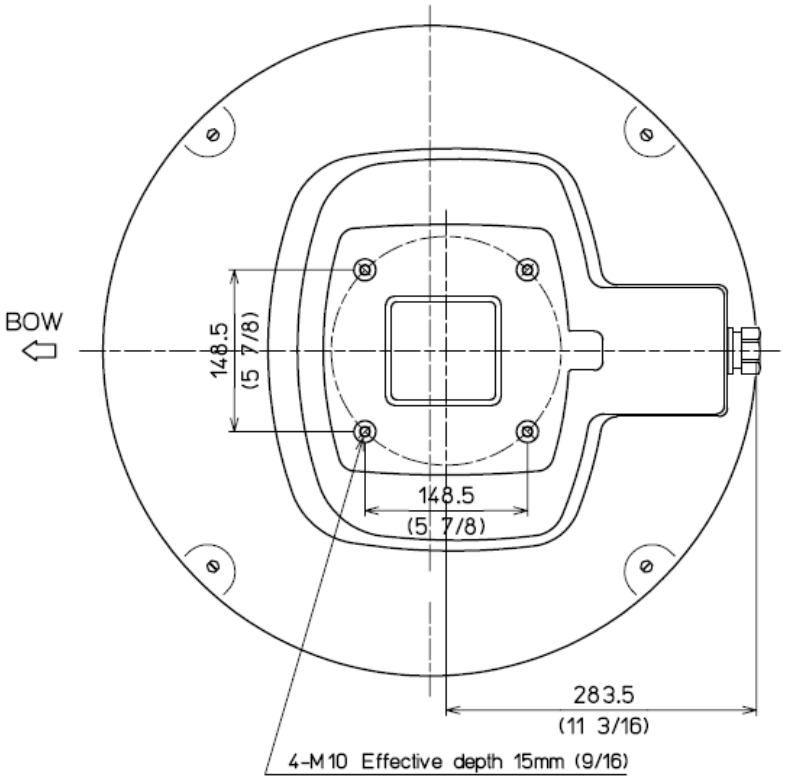



**Fig.3-8 Hole positions for mounting Scanner Unit(MDS-9R)**

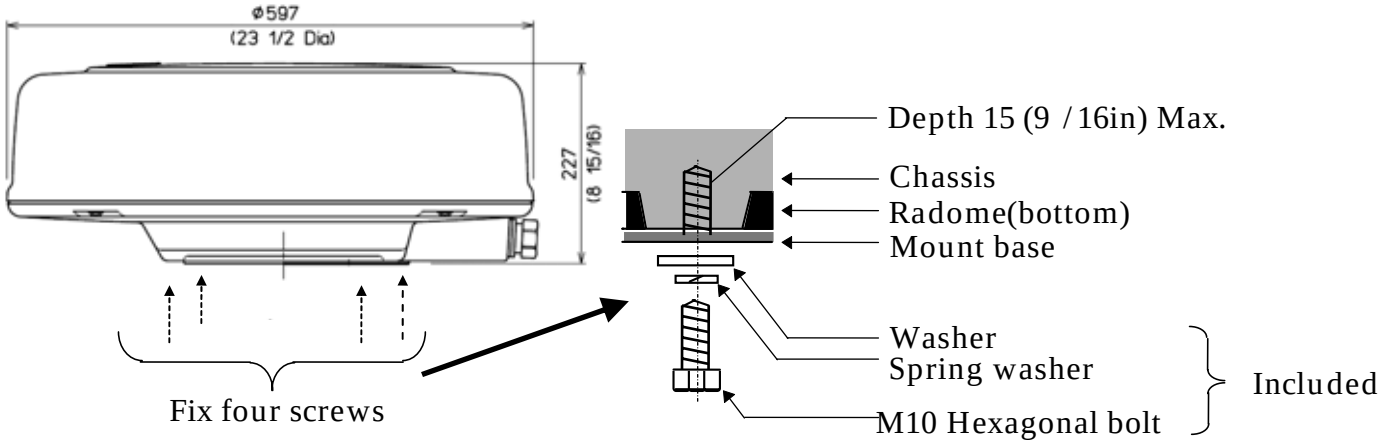



**Fig.3-9 Mounting the Scanner Unit(MDS-9R)**

**Note(MDS-10R)**

A template is provided for making fixing holes at installation site.

However it is recommended to check if the template matches with actual unit just in case the template has dimensional change by reproduction or swelling by moisture.

- Use the template provided to mark the location of four mounting holes. Align the template squarely with the center line of the vessel and with the arrow pointing forward.
- Drill four 9/16 in. (14 mm) diameter holes through the mounting surface.
- Apply sealant around each mounting hole.
- Place the RADAR*pc* scanner unit on the mounting surface. Orient the scanner housing facing forward (cable gland facing aft).
- Install and tighten four M12 x 60U (M12 x 2 1/2 in.) mounting bolts.
- Uncoil the scanner cable.
- Secure the cable near the scanner to support the weight of the cable and prevent strain on the watertight cable seal. If the cable is to pass through tubing or a bulkhead, protect the unfinished end. Do not use the unfinished wires or fabric braid to pull the cable.
- Route the cable to the operator's location, securing it at appropriate points along the way. Make a drip loop and apply sealant at the entry point of an exterior bulkhead.

・**MDS-10R**

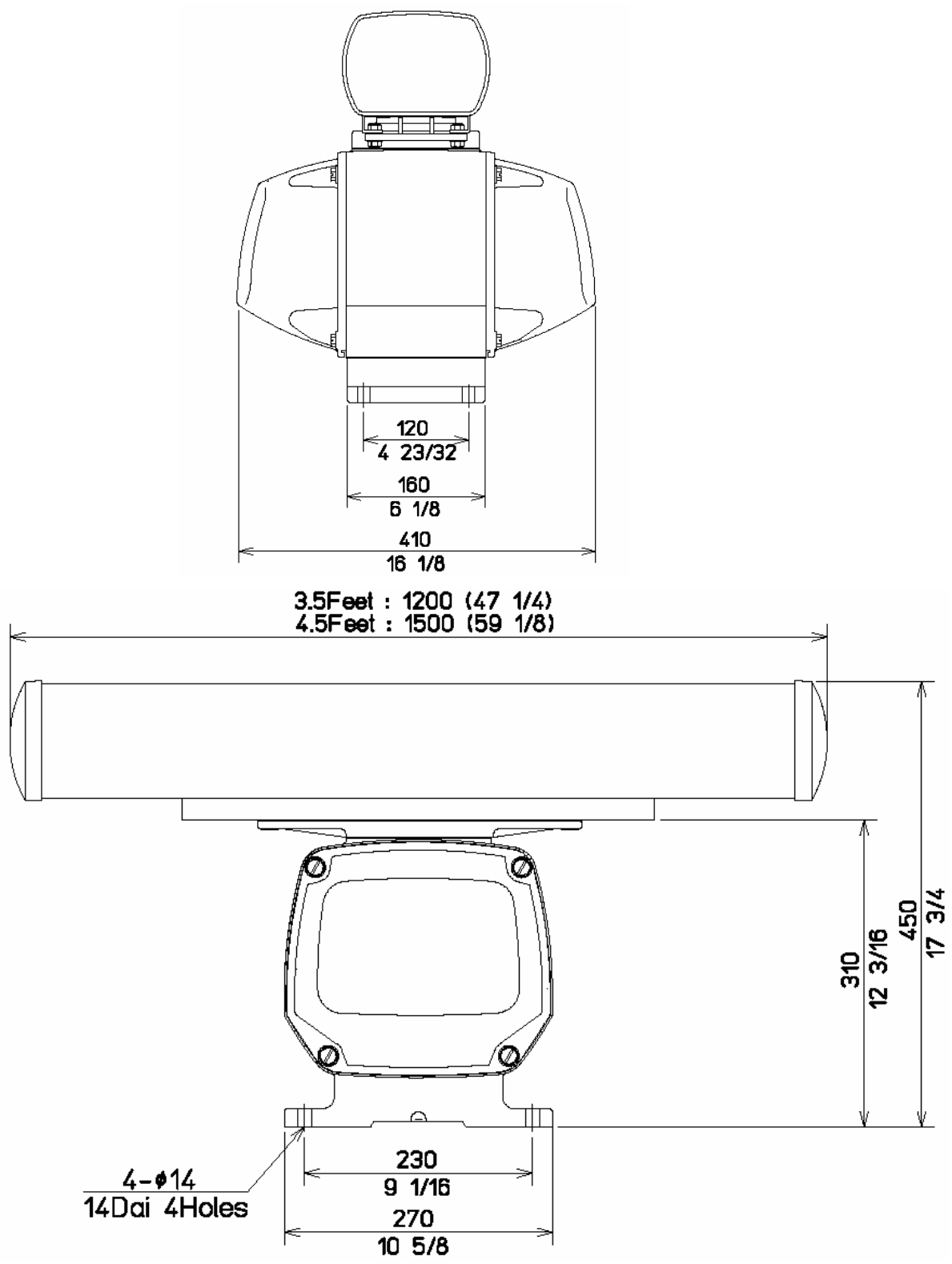



**Fig.3-10 Hole positions for mounting Scanner Unit**

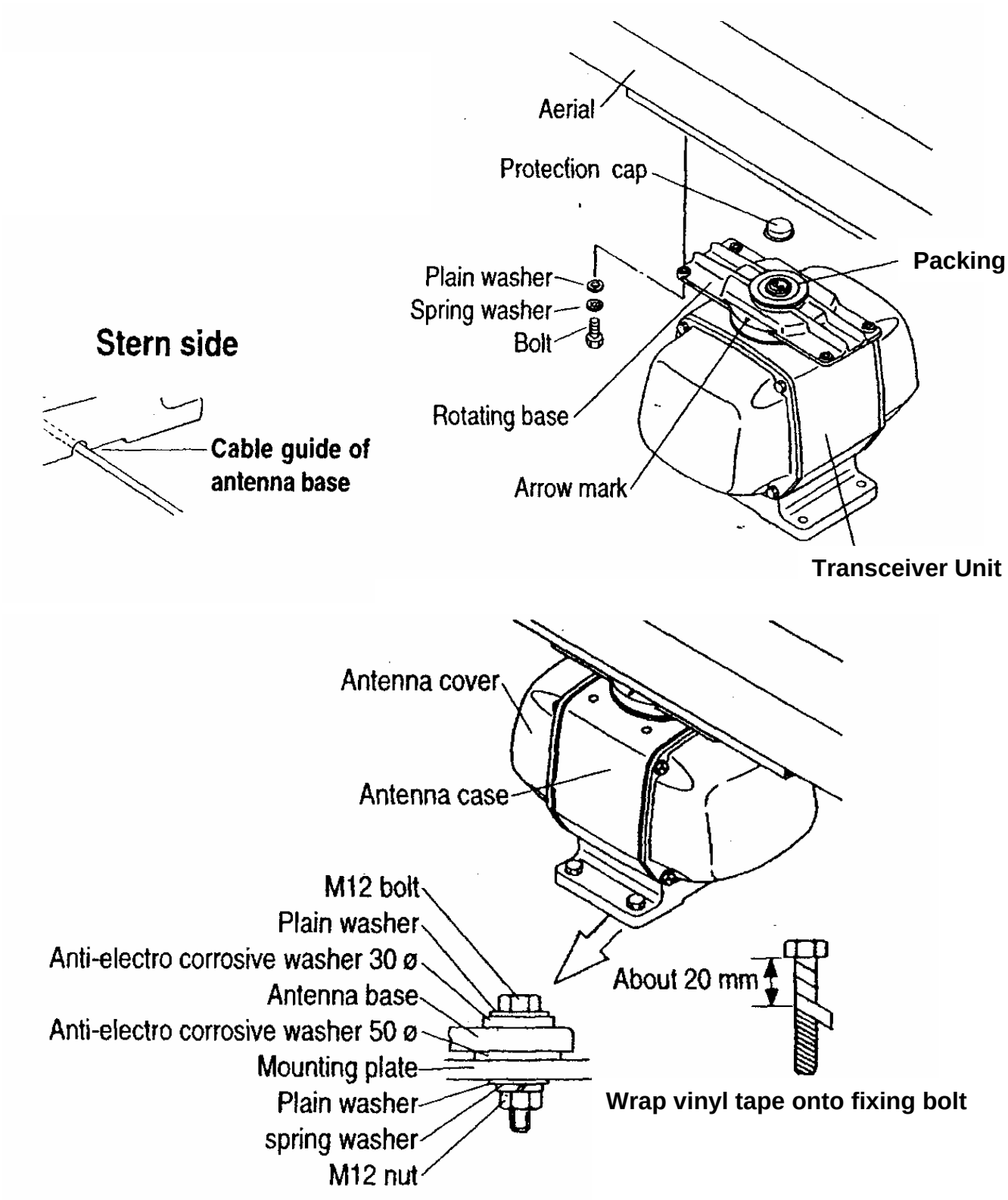



**Fig.3-11 Scanner Unit Installation (MDS-10R)**

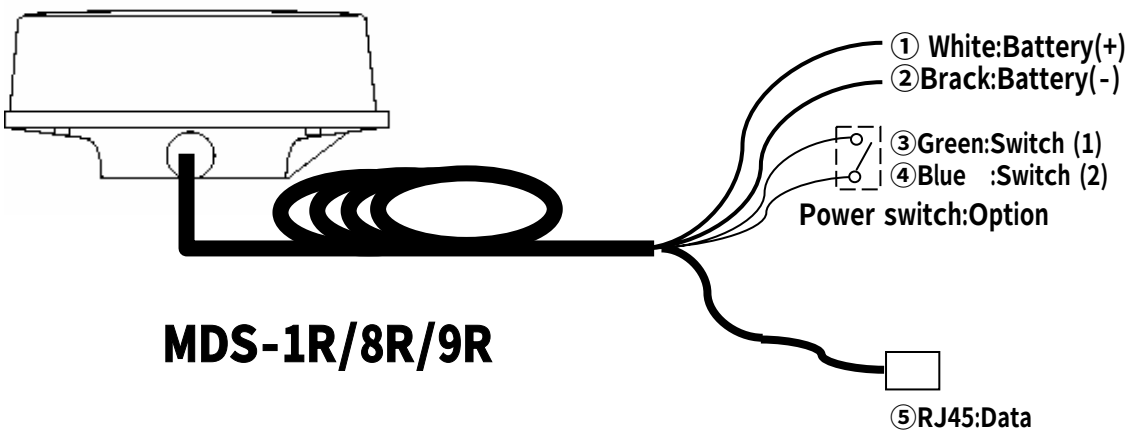
## *4. Specifications*

### Scanner Unit

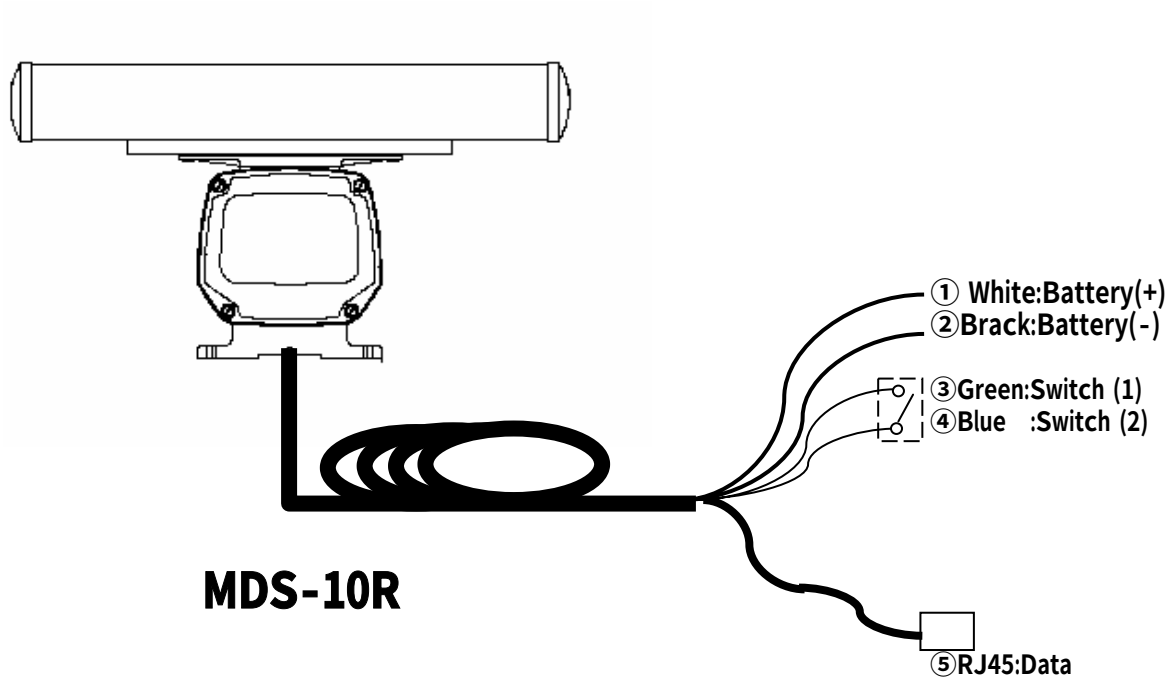
| | | MDS-1R | MDS-8R | MDS-9R | MDS-10R |
|---|---|---|---|---|---|
| Antenna | | 0.9feet, enclosed radome | 1.5 feet, enclosed radome | 1.8 feet, enclosed radome | 3.5/4.5 feet, Open Antenna |
| Peak power output | | 2 kWatts | 2 kWatts | 4 kWatts | 4 kWatts |
| Transmit frequency | | 9445 +/– 30 MHz | 9445 +/– 30 MHz | 9410 +/– 30 MHz | 9410 +/– 30 MHz |
| Beam width | Horizontal | 7° | 4.7° | 4.0° | 2.4°/1.7° |
| | Vertical | 25° | 25° | 25° | 25° |
| Sidelobes | | Better than –20 dB | Better than –20 dB | Better than –20 dB | Better than –23 dB |
| Rotation | | 30 rpm | 30 rpm | 24 rpm | 24 rpm |
| Pulse length/PRF | Short | 0.1 uSec/2200 Hz | 0.1 uSec/2200 Hz | 0.1 uSec/2000 Hz | 0.06 uSec/4000 Hz |
| | Medium1 | 0.3 uSec/1100 Hz | 0.3 uSec/1100 Hz | 0.25 uSec/2000 Hz | 0.15 uSec/2000 Hz |
| | Medium2 | - | - | 0.5 uSec/1000 Hz | 0.4 uSec/1000 Hz |
| | Long | 0.8 uSec/550 Hz | 0.8 uSec/550 Hz | 1.0 uSec/500 Hz | 1.0 uSec/500 Hz |
| IF center frequency | | 60 MHz | 60 MHz | 60 MHz | 60 MHz |
| IF bandwidth | Short and Medium1 | 6 MHz | 6 MHz | 6 MHz | 20 MHz |
| | Medium2 and Long | 3 MHz | 3 MHz | 3 MHz | 5 MHz |
| Noise figure | | 10 dB nominal | 10 dB nominal | 6.0 dB or less | 5.0 dB or less |
| Operating temperature | | –13 to 131 °F (–25 to +55 °C) | –13 to 131 °F (–25 to +55 °C) | –13 to 131 °F (–25 to +55 °C) | –13 to 131 °F (–25 to +55 °C) |
| Wind force | | 100 knots relative | 100 knots relative | 100 knots relative | 70 knots relative |
| Water resistance | | IPX6 (IEC529) | IPX6 (IEC529) | IPX6 (IEC529) | IPX6 (IEC529) |
| Presentation Modes | | Heading up, North up, Course up | Heading up, North up, Course up | Heading up, North up, Course up | Heading up, North up, Course up |
| Range scales (nm) | | 1/8, 1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 24 | 1/8, 1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 24 | 1/8, 1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 24, 36 | 1/8, 1/4, 1/2, 3/4, 1, 1.5, 2, 3, 4, 6, 8, 12, 24, 48 |
| Minimum range | | Better than 66 feet (20 m) on 1/8 nm range | Better than 66 feet (20 m) on 1/8 nm range | Better than 66 feet (20 m) on 1/8 nm range | Better than 66 feet (20 m) on 1/8 nm range |
| Range discrimination | | Better than 66 feet (20 m) | Better than 66 feet (20 m) | Better than 66 feet (20 m) | Better than 66 feet (20 m) |
| Range accuracy | | Better than 23 feet (7 m) or 0.8% of maximum range of the scale in use | Better than 23 feet (7 m) or 0.8% of maximum range of the scale in use | Better than 23 feet (7 m) or 0.8% of maximum range of the scale in use | Better than 23 feet (7 m) or 0.8% of maximum range of the scale in use |
| Bearing accuracy | | Better than 1° | Better than 1° | Better than 1° | Better than 1° |
| Other functions | | Gain, STC, FTC, interference rejection, target expansion | Gain, STC, FTC, interference rejection, target expansion | Gain, STC, FTC, interference rejection, target expansion | Gain, STC, FTC, interference rejection, target expansion |
| Interface | Mode of communication | Ethernet | Ethernet | Ethernet | Ethernet |
| | Transmission speed | 100base-TX/10base-T | 100base-TX/10base-T | 100base-TX/10base-T | 100base-TX/10base-T |
| Voltage supply | | 10.8 to 41.6 Vdc | 10.8 to 41.6 Vdc | 10.8 to 41.6 Vdc | 10.8 to 41.6 Vdc |
| Power consumption | | 30 Watts or less | 30Watts or less | 45 Watts or less | 80 Watts or less |
| Preheat time | | 90 seconds | 90 seconds | 120 seconds | 120 seconds |
| Cable length | | 33 feet (10 m) standard | 33 feet (10 m) standard | 33 feet (10 m) standard | 33 feet (10 m) standard |

## 5. Electrical and Data connction

| | Function | Wire Color | Remareks |
|---|---|---|---|
| ① | Battery (+) | Large White | DC12V to DC41.6V |
| ② | Battery (-) | Large Black | 0V |
| | | | |
| ③ | Switch (1) | Green | POWER ON: short circuit } (green - blue) |
| ④ | Switch (2) | Blue | POWER OFF: open circuit } |
| | | | |
| ⑤ | Data | - | LAN data to pc |




MDS-1R/8R/9R




MDS-10R

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