MARINE RADAR

T-180/T-280

OPERATION MANUAL

SI-TEX®

DOC NO. T-180/T-280 8-94

PRECAUTIONS

High Voltage Warning

At several points in the antenna unit and display of this radar, there are high voltages dangerous to a person coming into direct contact with them. Although the equipment is designed to avoid danger in ordinary operation, care should be taken during the maintenance inside the units. Turn off the ship's main switch when checking the circuits or replacing components. Even after switching off the radar, some capacitors may take several minutes to discharge. Before touching the magnetron and/or CRT HV circuits, make sure to ground the capacitors with a clip lead or the like.

Microwave Hazard

Take care to avoid the possible harmful effects of microwave radiation from the radar. The eyes are particularly vulnerable to microwave. Never look directly into an open waveguide radiating power. Radar and other R. F. radiations can upset some cardiac pacemakers. If a user with a cardiac pacemaker suspects a malfunction, turn off the equipment and leave the vicinity of the antenna immediately. Whenever it is necessary to work on the antenna unit, always turn the power OFF.

Fuses

Before starting the operation of radar, confirm that properly rated fuses with the ship's main voltage are used.

Mains		T-180	T-280
12 VDC		5 A	5 A
24 VDC		3 A	3 A
32 VDC		3 A	3 A
Motor	12 VDC		10 A
	24/32 VDC		5 A

Magnetron Preheating

Before starting the operation for the first time after installation or more than 2 months without operation, preheat the magnetron more than 30 minutes by keeping the radar in TX SAVE (STANDBY) condition.

Welcome to SI-TEX Radar

The 7-inch high resoultion marine radar SI-TEX T-180/T-280 is a "state of the art" navigational aid. It gives much information such as distance and bearing to other boats, and other boat's movements.
Read this manual carefully before turning on the power.

Table of Contents

GENERAL DESCRIPTION

SI-Tex T-180 series (T-180 or T-280) has been designed as a compact and highly reliable radar system. This series is classified into two types according to the antenna unit.

T-180: **4 kW, Radome type**
T-280: **4 kW, Open scanner type**

The radar system is composed of two units; the display unit and antenna unit. The circuits except for magnetron and CRT employ solid-state components providing compactness and high reliability.

Antenna unit (aerial and transceiver)

The antenna unit consists of a microstrip array (T-180) or a slotted array (T-280), antenna drive unit, and transceiver unit. The antenna unit has been designed as water-tight, vibration-proof, and weather-resistant construction. The transceiver unit is of a module type which enables speedy and easy maintenance alongside the display unit by using an antenna testing cable.

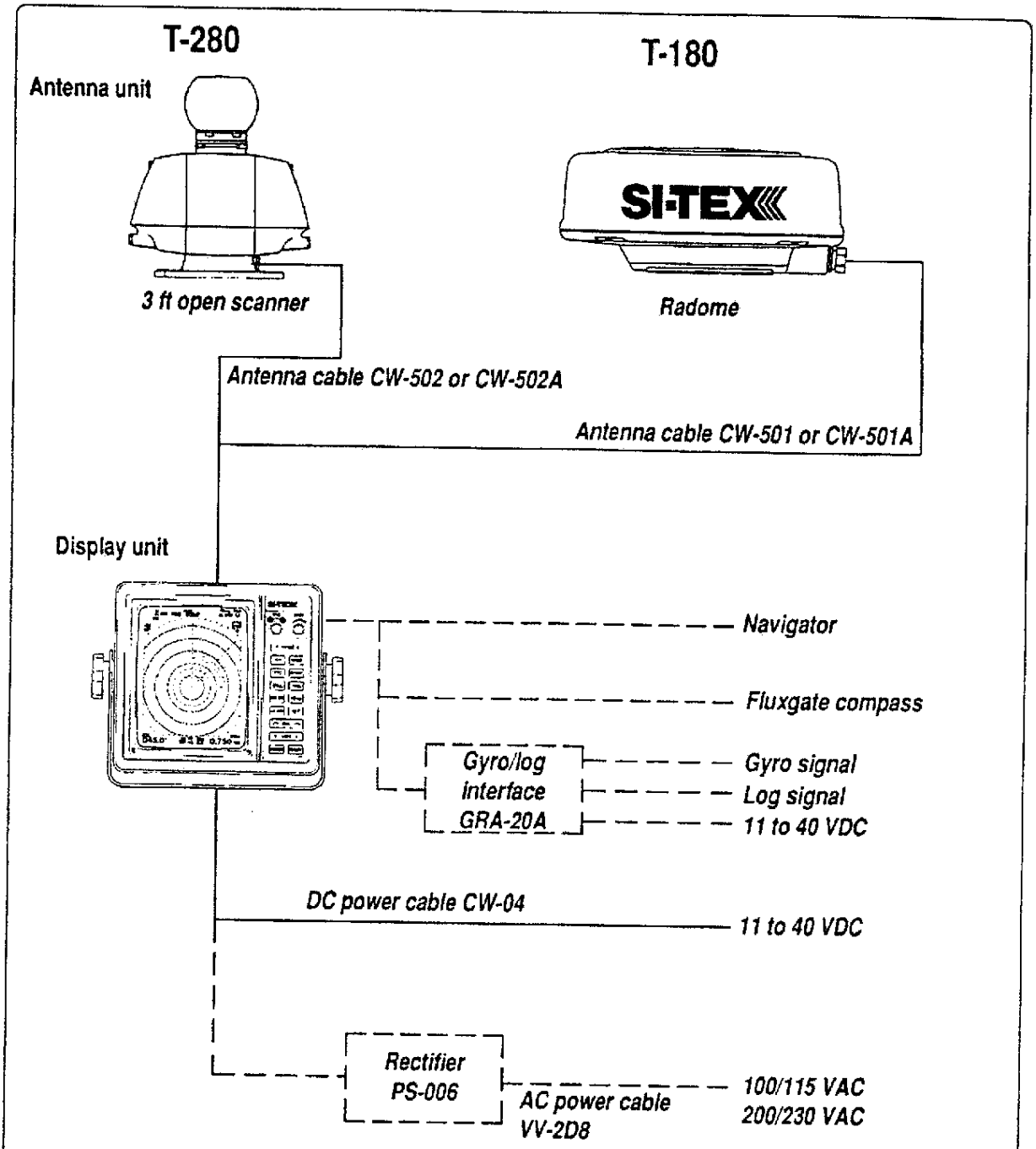
Radome type (T-180): The aerial, drive unit, and transceiver units are encapsulated in a reinforced plastic radome and operate under a wind load up to 100 knots.

Open scanner type (T-280): The antenna drive unit and transceiver unit are mounted in a rigid aluminum cast water-resistant antenna base. The slotted array antenna is contained in a reinforced plastic cylinder aerial case, providing smooth antenna rotation in a wind load of 70 knots.

Display unit

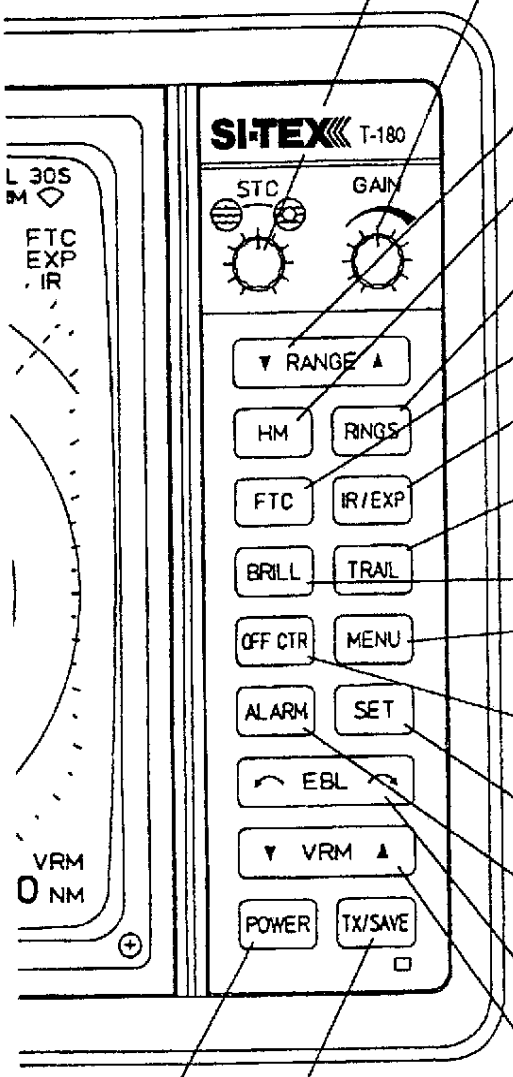
The radar picture is displayed on a 7-inch diagonal high-resolution CRT with the effective diameter of 97 mm (3.8 inches). The raster scan presentation provides clear images under bright daylight circumstances. The display unit mainly consists of CRT, logic circuit section, control section, and power circuit section assembled together in a drip-proof plastic case. Each section is of a module type providing easy maintenance. The logic circuit section performing major radar functions is mounted on one board. The power circuit is assembled on one board and mounted on the rear panel of the display unit. In addition to the radar presentation, positioning data from an on-board navigational equipment such as GPS, Decca, and Loran C navigator can be digitally displayed on the screen.
By interfacing a gyro compass, fluxgate compass, or equivalent bearing data, North-up or Course-up operation is available in addition to Head-up operation.

System Cofiguration



Model	Display unit	Antenna unit
T-180	MRD-66	MRT-141
T-280	MRD-69	MRT-143

Control Panel



STC control: Reduces sea clutter to clarify close-range targets.

GAIN control: Adjusts the receiving sensitivity.

RANGE key: Selects a range scale.

HM key: Turns off the heading marker (HM) while being pressed.

RINGS key: Turns the range rings on and off.

FTC key: Improves the target visibility in the rain, snow, or fog.

IR/EXP key: Rejects the interference caused by other radars and/or expands the target size.

TRAIL key: Activates the target trail function. The interval is 15, 30 seconds, 1, 3 minutes, or continuous.

BRILL key: Adjusts the overall picture brightness.

MENU key: Opens the menu display for specifying the interfacing format, presentation mode and tuning mode.

OFF CTR key: Shifts own boat position downward to extend the forward range by 1.5 times the screen range in use.

SET key: Turns the VRM/EBL and the alarm function on and off, or enters the menu selected.

ALARM key: Selects an alarm zone pattern of 90°, 180°, or 360°.

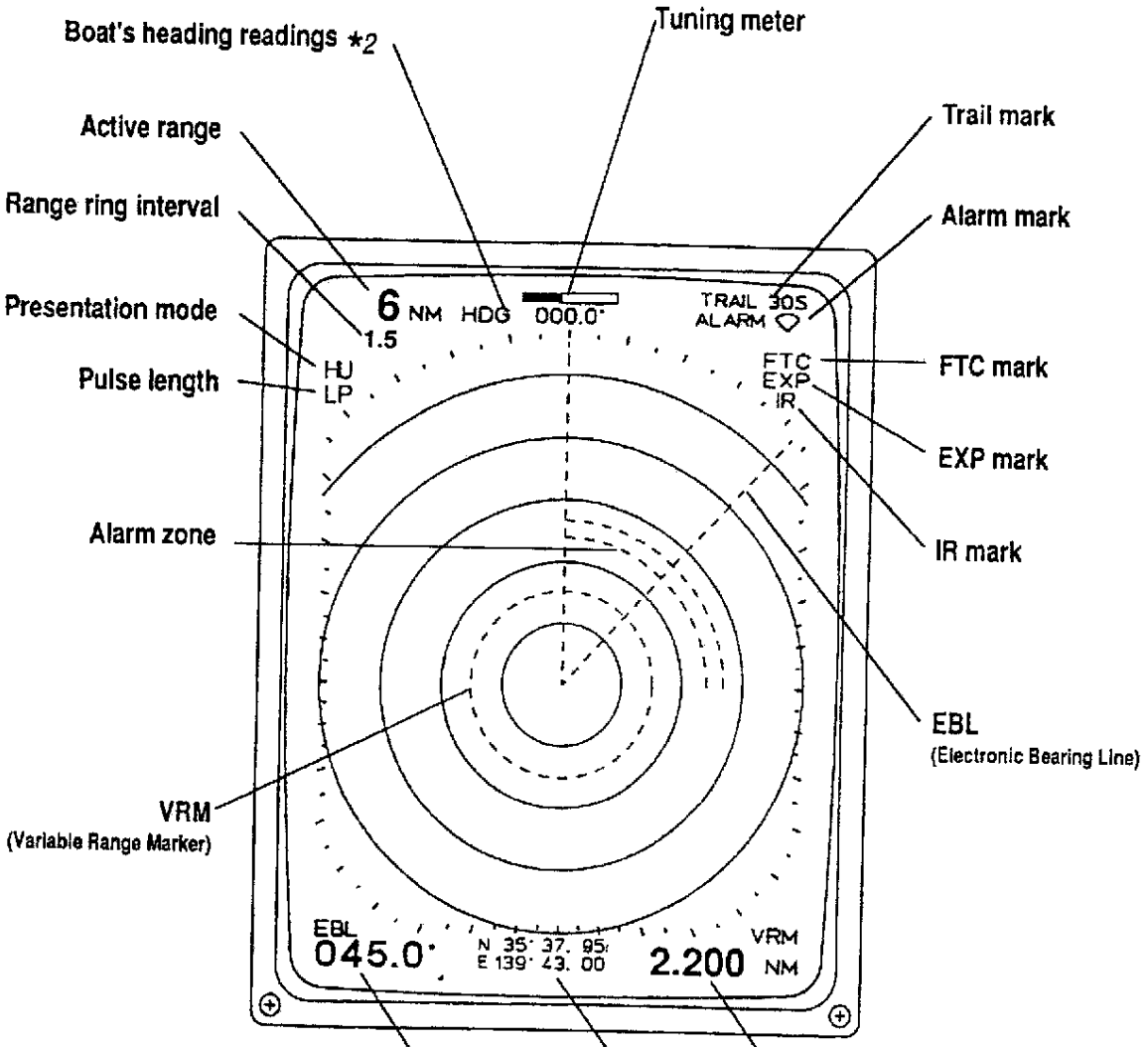
EBL key: Moves the EBL, specifies the alarm zone bearing, or performing manual fine tuning.

VRM key: Moves the VRM, specifies the alarm zone range, or performing manual coarse tuning.

TX/SAVE key: Alternates transmitting (TX) or standby (SAVE) mode. In standby mode, display is turned off with SAVE LED lit for reducing power consumption.

POWER key: Turns the power on and off.

Readouts and Marks on the Screen

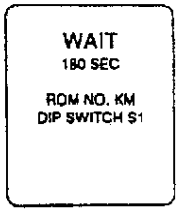
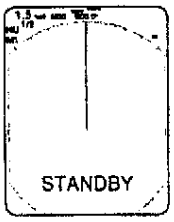
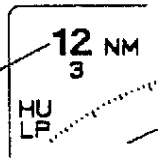
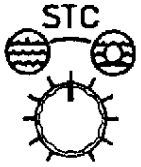


*1 *Requires navigator*

*2 *Requires navigator, fluxgate compass, or gyro compass and speed log with the gyro/log interface GRA-20A*

OPERATING INSTRUCTIONS

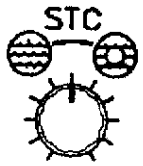
Getting Started

POWER	Press **POWER** key. • The display unit turns on, and a buzzer sounds momentaly. • The letters **WAIT** and the internal switch setting status appear on the screen. • The **180-sec.** magnetron pre-heating timer starts counting down.  **Note** ■ Pressing **POWER** key more than one second turns off the power.
TX/SAVE ○	When the magnetron pre-heating is completed, the letters **STANDBY** appears on the screen. Press **TX/SAVE** key to start transmission of the radar power. 
▼ RANGE ▲	Press either the arrow of **RANGE** key to select your desired detection range depending on the targets around your boat. *Range selected* 
BRILL	Press **BRILL** key to adjust the screen for a comfortable brightness. Every press of the key changes the screen brightness in four stages.
GAIN 	Turn **GAIN** control clockwise or counterclockwise so that noise speckles begin to appear on the screen.
STC 	Turn **STC** control slowly to reduce seaclutter affecting the target visibility if necessary. For more information about STC, see ***Reducing Sea Clutter*** on page 6.
FTC	Press **FTC** key to reduce rain, snow, fog clutter or cloud affecting the target visibility. For more information about FTC, see ***Reducing Image of Rain or Snow*** on page 6.

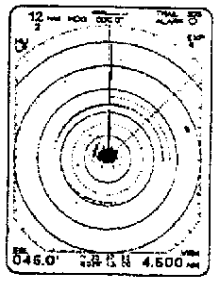
Stopping Transmission

Save (Stand by)	Full Stop
TX/SAVE ○	Press **TX/SAVE** key to set the radar to Save (Standby) condition. The screen is turned off with LED lamp on. By pressing the same key again, the transmission starts immediately without 180-sec. pre-heating.
Green light: STANDBY condition Red light: Power save condition when alarm is turned on. For more information about alarm, see Setting Proximity Alarm on Page 15.	
	POWER Press **POWER** key for about five seconds to turn the power off.

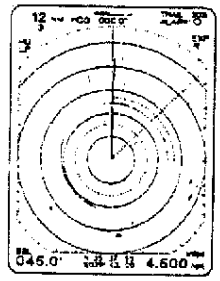
Reducing Sea Clutter



Sea clutter appears as many small dots near the center of the screen when the sea is rough. The clutter image usually stretches windwards and it can be reduced or eliminated by adjusting **STC** control. Remember excessive STC eliminates small target images.



STC function is not applied.

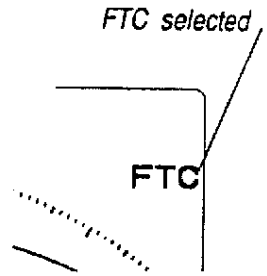


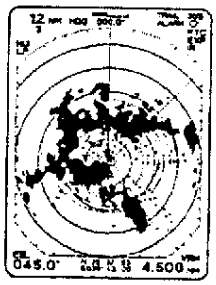
STC function is applied.

Reducing Image of Rain or Snow

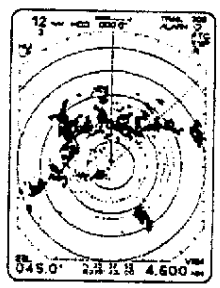
FTC

Rain or snow is usually displayed as obscure image. Such an image can be reduced by pressing **FTC** key. Every press of **FTC** key alternates the FTC on and off. Remember excessive **FTC** eliminates small target images.





FTC function is not applied.



FTC function is applied.

MENU

The following parameters can be changed through **MENU** screen.

a. **DATA** (Navigational data) - Displayed only when the input signal format (NMEA-0183, KODEN-717, or NMEA-0182) is selected according to ***Setting Dip Switches*** on page 37 of this operation manual.

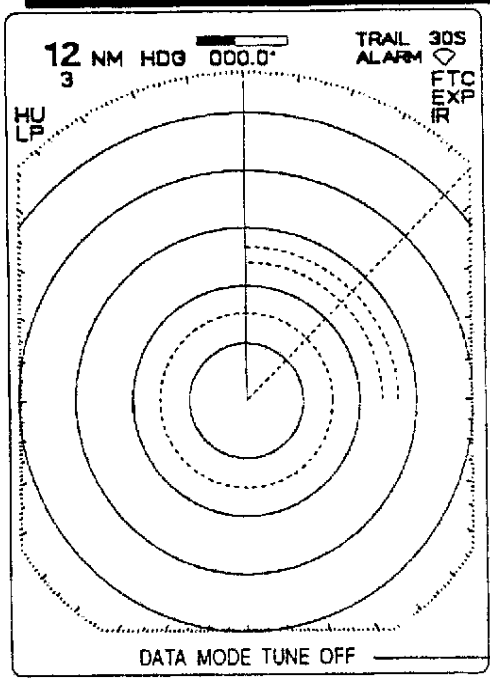
NMEA-0183 and KODEN-717	NMEA-0182
LL: Latitude/longitude LOP: Line of Position SPD: Speed and heading	LL: Latitude/longitude

b. **MODE** (Presentation mode)- Displayed only when the North-up or course-up mode is available according to ***Setting Dip Switches*** on page 37 of this operation manual.

NMEA-0183 and KODEN-717	NMEA-0182
Head-up mode North-up mode Course-up mode	Head-up mode

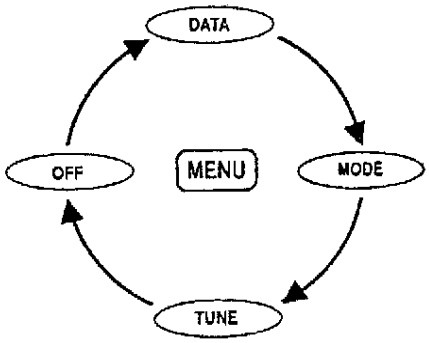
c. **TUNE** (Tuning system)
Automatic tuning
Manual tuning

Note
Some dip switch setting status (S1 on PCB E02-7000) does not allow **DATA** and **MODE** selection



Menu display

Every press of **MENU** key rotates the item to be selected in the direction of the arrow as shown below.



Displaying boat position or speed/heading

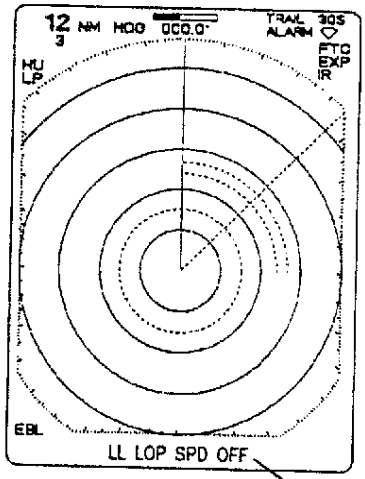
If you install a navigator, you can display ship's position data or speed and heading data; If you install a fluxgate compass or a gyro compass with gyro interface GRA-20A, you can display heading data. The position data is displayed in either latitude/longitude coordinates or Loran C LOP's coordinates. Prior to selecting the contents displayed, make sure to set the same signal format as the connecting device outputs. (For more information about signal format, see *Selecting Input Signal Format* on Page 37 of this operation mannul.)

Note

If you interface with a navigator or a fluxgate compass, the display response will be delayed because of slow data transmitting time from such an equipment. The position of fixed target on the display such as land or boat moored may fluctuate because bearing data from the navigator cannot follow the steering of boat. When your boat moves at a slow speed or stops, the bearing data from the navigator provides some errors. We, therefore, recommend you not to rely on that data in such a case.

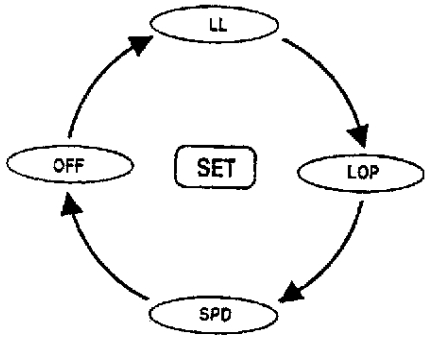
MENU ——— Press **MENU** key to highlight **DATA**, and DATA settings will be selected.

SET ——— Press **SET** key to highlight **LL**, **LOP**, or **SPD/HDG** for your desired display.



DATA display

Every press of **SET** key rotates the item to be selected in the direction of the arrow as shown below when **NMEA-0183** or **KODEN-717** format is selected.



MENU ——— Press **MENU** key to select other parameter, and the DATA contents specified above will be entered.

Note

If you want to cancel the menu function, press **MENU** key several times until **MENU** display is erased.

MENU

Displaying north-up or course-up mode

If you install a navigator, a fluxgate compass, or a gyro compass with gyro interface GRA-20A, you can select north-up or course-up mode besides head-up mode for your particular application. These modes are available only when:

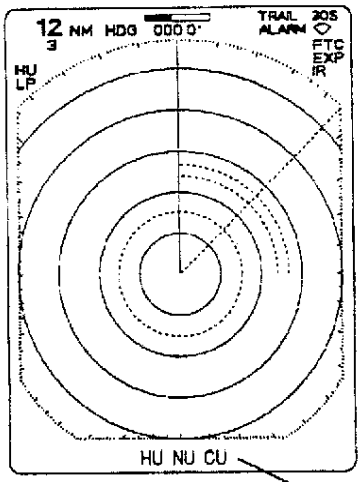
- Dip switch S1 #5 & #6 on PCB E02-7000: OFF
- NMEA-0183 format is selected. (For information about dip switch setting and signal format, see ***Setting Dip Switches*** on Page 37 of this operation manual.)

Note

If you interface with a navigator or a fluxgate compass, the display response will be delayed because of slow data transmitting time from such an equipment. The position of fixed target on the display such as land or boat moored may fluctuate because bearing data from the navigator cannot follow the steering of boat. When your boat moves at a slow speed or stops, the bearing data from the navigator provides some errors. We, therefore, recommend you not to rely on that data in such a case.

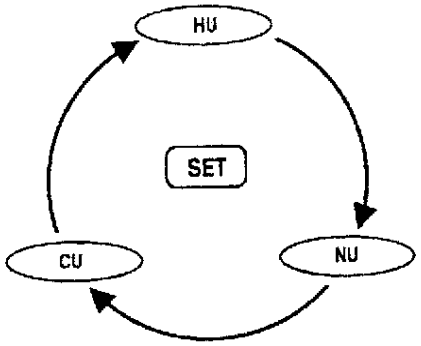
MENU ——— Press **MENU** key to highlight **MODE**, and MODE settings will be selected.

SET ——— Press **SET** key to highlight **NU** or **CU** for presentation mode.



MODE display

Every press of **SET** key rotates the item to be selected in the direction of the arrow as shown below.



MENU ——— Press **MENU** key to select other parameter, and the MODE contents specified above will be entered.

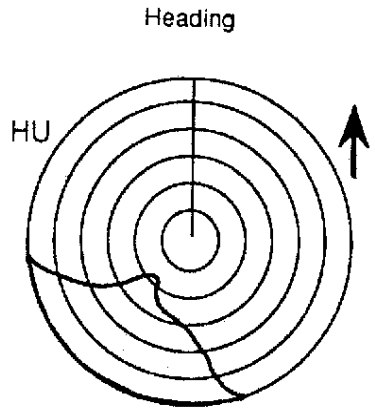
Note

If you want to cancel the menu function, press **MENU** key several times until **MENU** display is erased.

MENU

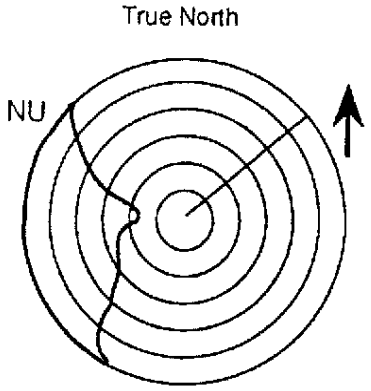
HU (Head Up)

Ship's heading comes to 0° of the radar scope. The relative bearing of other ships and land are obtained on the bearing scale.



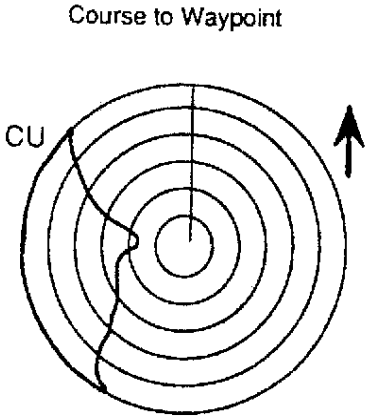
NU (North Up)

With the gyro-compass or fluxgate compass interfaced, the true north comes to 0° of the radar scope. The radar picture always corresponds to the navigation chart, and the bearing of target is referred to as true bearing.



CU (Course Up)

With the gyro-compass or fluxgate compass interfaced, the course to selected waypoint can be set on 0° of the radar scope. By steering to keep the ship's heading marker on 0°, the shortest course to the waypoint can be obtained.

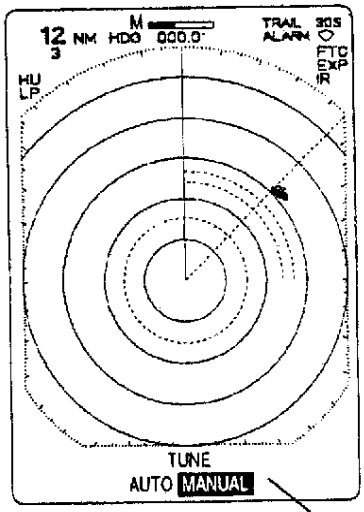


Selecting manual tuning capability

Your radar is provided with automatic tuning. However, if you want to operate tuning manually, manual tuning can be performed by the following operation.

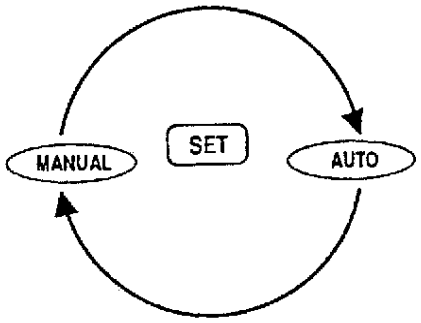
MENU ——— Press **MENU** key to highlight **TUNE**, and TUNE settings will be selected.

SET ——— Press **SET** key to highlight **MANUAL** for selecting manual tuning.



TUNEdisplay

Every press of **SET** key alternates the item to be selected in the direction of the arrow as shown below.



▼ VRM ▲ ——— In manual tuning mode, **VRM** key serves as coarse tuning adjustment key. Press **VRM** key to display the target as large as possible.

EBL ——— In manual tuning mode, **EBL** key serves as fine tuning adjustment key. Press **EBL** key to display the target as large as possible.

MENU ——— Press **MENU** key to select other parameter, and the MODE contents specified above will be entered.

Note

If you want to cancel the menu function, press **MENU** key several times until **MENU** display is erased. Depending on the dipswitch setting status on page 37, **DATA** or **MODE** display may be skipped.

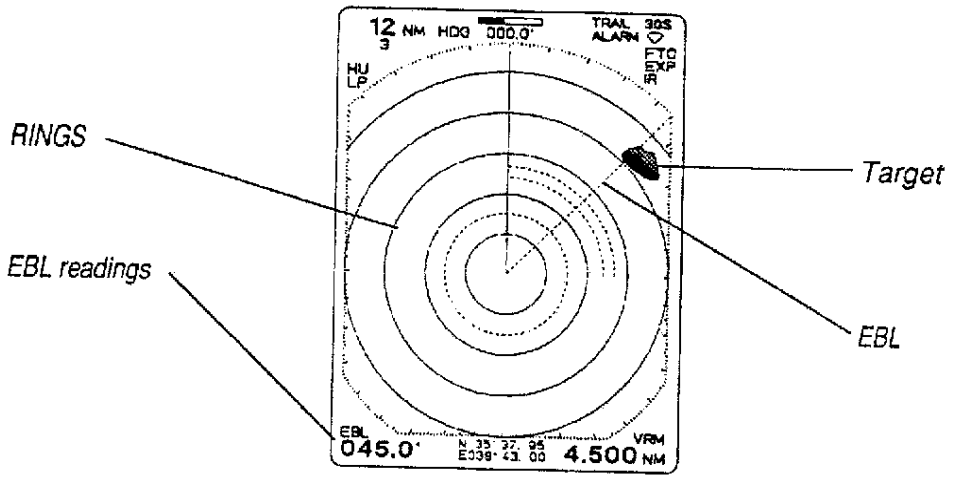
MENU

Measuring Bearing of Target by Using EBL

The bearing of target referring to the boat's heading or true north can be measured with the electronic bearing line (**EBL**).

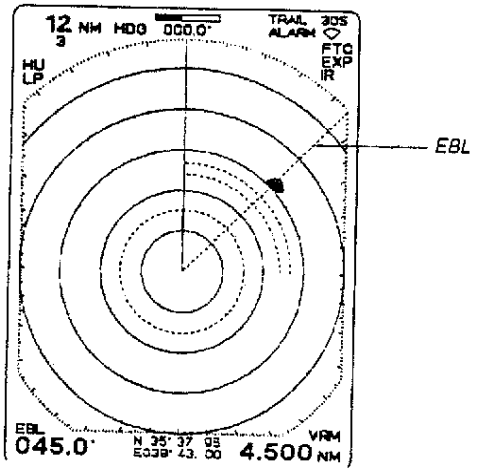
SET ——— Press **SET** key, and **EBL** will appear on the screen.

EBL ——— Rotate **EBL** to align with the target. The bearing readings are shown on lower-left corner of the screen.



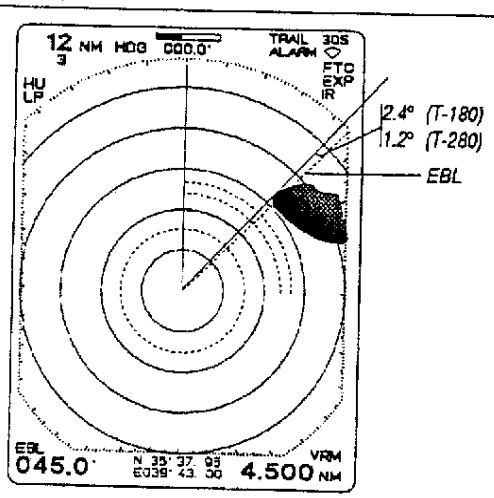
SET ——— Press **SET** key again, and **EBL** will turn off.

Small target



Align the EBL with the center of target.

Point of Island or land mass



Set the EBL:
2.4° inward the land from the measuring point for T-180
1.2° inward the land from the measuring point for T-280

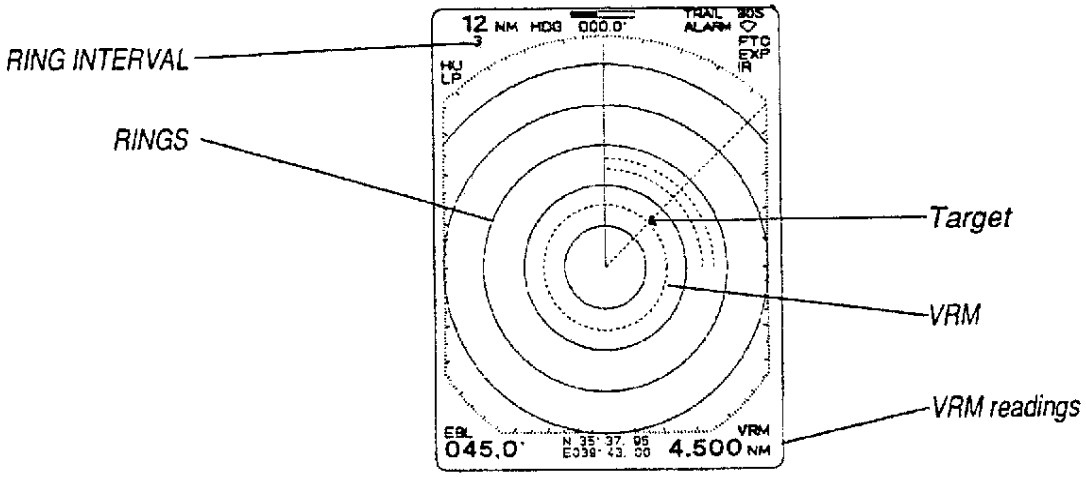
Measuring Range of Target by Using VRM or RINGS

Measuring with VRM

The distance to target can be measured with the variable range marker (**VRM**).

SET ——— Press **SET** key, and **VRM** will appear on the screen.

▼ VRM ▲ ——— Move **VRM** to align with the inner fringe of the target. The distance readings are shown on lower-right corner of the screen.



SET ——— Press **SET** key again, and **VRM** will turn off.

Measuring with RINGS

The distance of target from your boat can be roughly measured with the rings.

RINGS ——— Press **RINGS** key, and rings according to the active range scale will appear on the screen. The ring interval is displayed in the upper left-corner of the screen as shown in the above figure. The rings are erased by pressing **RINGS** key again.

T-180 *(Range and ring interval)*

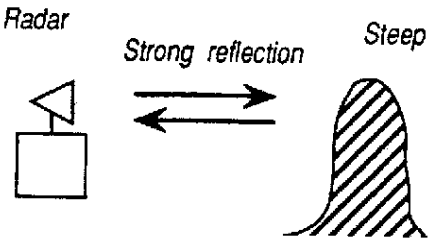
Range	1/8	1/4	1/2	1	2	4	8	16	24
Ring Interval	1/16	1/16	1/8	1/4	1/2	1	2	4	6

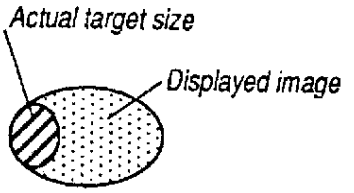
T-280 *(Range and ring interval)*

Range	1/8	1/4	1/2	3/4	1.5	3	6	12	24	48
Ring Interval	1/16	1/16	1/8	1/4	1/2	1	1.5	3	6	12

Reading Target Image Appearance

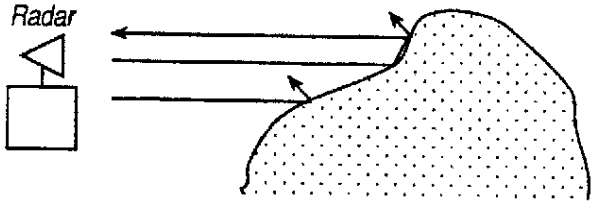
Image of strong reflection target

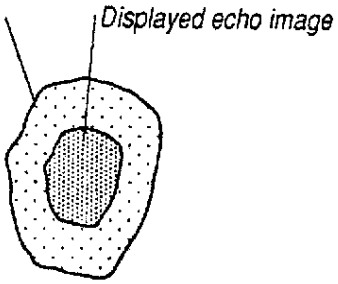




When target strongly reflects the radar waves, the trailing edge of echo image is expanded.

Image of weak reflection target





When the target reflection is weak and shows diffused reflection, the displayed echo image is contracted.

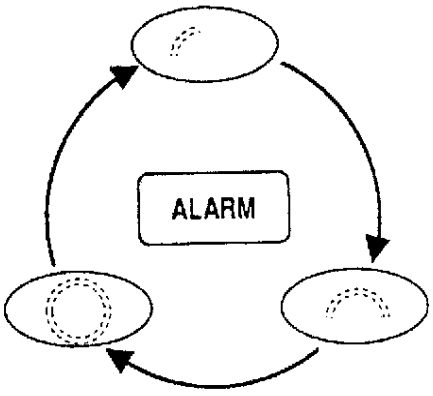
Setting Proximity Alarm

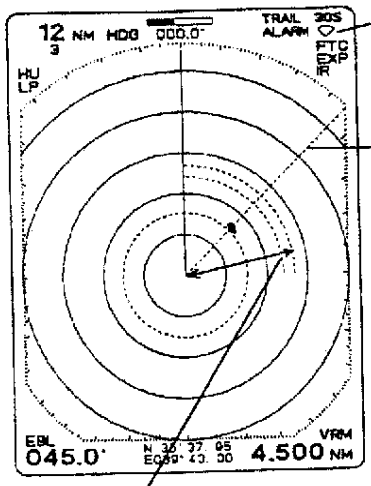
The proximity alarm is provided to warn the operator that another boat is approaching yours, or yours is approaching a dangerous area. The function is effective to avoid collision, or for anchor watch alarm.

ALARM ——— Press **ALARM** key, and a circle alarm zone pattern will appear on the screen.

ALARM ——— Press **ALARM** key until the pattern turns to your desired one. The selected alarm zone is displayed on the screen.

Every press of **ALARM** key rotates the item to be selected in the direction of the arrow as shown below.





Alarm pattern

EBL

Alarm zone range specified by VRM

EBL ——— Press either arrow of **EBL** key to rotate the pattern until zone center reaches your desired point.

▼ VRM ▲ ——— Press either arrow of **VRM** key to move zone pattern outward or inwards until the outer fringe of the pattern reaches your desired alarm range.

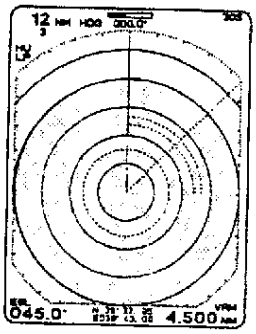
SET ——— Press **SET** key to enter the alarm zone pattern specified. The audible alarm turns on when the target stays in the alarm zone for eight seconds or more.

Notes

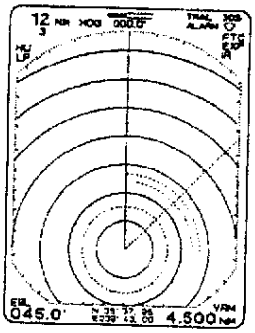
- When the alarm function is set, radar continues to transmit in SAVE mode to warn you of intrusion of other boats.
- Alarm zone width is 1/15 of the active range.
- When SET key is pressed, EBL and VRM return to the ordinary operation. If the alarm range is set too close to the center of radar screen, the alarm function cannot be actuated and the letters ALARM flickers.

Available alarm range

The available alarm range are shown below.



On-centering:
Same range as the active range.



Off-centering:
Half of the active range.

Notes

Alarm function will be turned off when:

- Alarm range is set near the center of screen.
- The alarm zone exceeds the range shown in the left figure of on-centering mode by decreasing the range.
- The alarm zone exceeds the range shown in the left figure by selecting off-centering mode.

Turning off the alarm

■ Turning off the alarm function when audible alarm is sounding

ALARM ——— Press **ALARM** key, and the alarm function will be turned off and the highlighted letters **ALARM** will be erased on the upper right-hand corner of the screen.

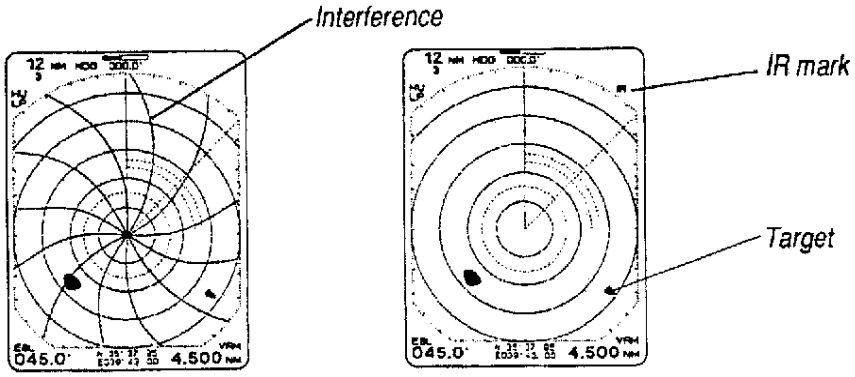
■ Turning off the alarm function when audible alarm is not sounding

ALARM ——— Press **ALARM** key , and highlighted letters **ALARM** appears on the upper right-hand corner of the screen. Hold down **ALARM** key until the highlighted letters **ALARM** are erased, and the alarm function will be turned off.

Rejecting Interference

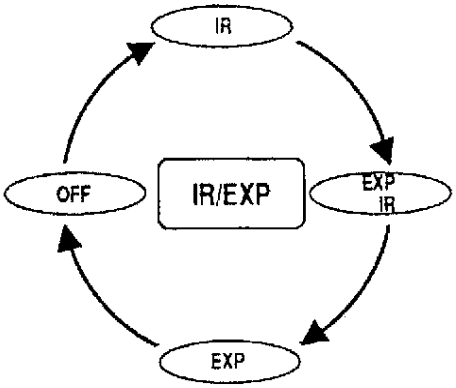
When there are boats using radar around you, your radar screen picture is affected by interference caused by other radars. In such a case, you can reduce or eliminate this interference by applying IR function. **IR** mark is indicated on upper-right corner of the screen. This interference rejection function is automatically set to **ON** when the power is turned on.

IR/EXP ——— Press **IR/EXP** key until **IR** mark is displayed in the upper right hand-corner of the screen, and interference rejection function will be applied.



IR: OFF IR: ON

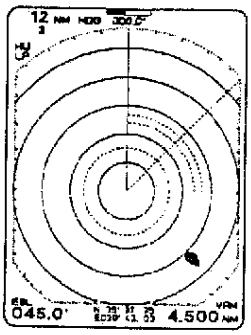
Every press of **IR/EXP** key rotates the item to be selected in the direction of the arrow as shown below. For information about **EXP**, see ***Expanding Image*** on Page 18.



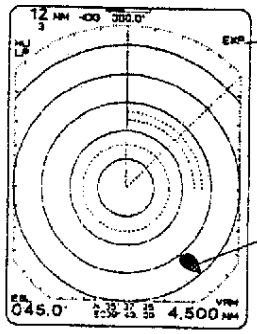
Expanding Image

When your target is very small, such a target size can be expanded in rangewise to give you close view by applying EXP function. **EXP** mark is indicated on upper-right corner of the screen.

IR/EXP ——— Press **IR/EXP** key until **EXP** mark is displayed in the upper right-hand corner of the screen, and expansion function will be applied and the target size will be expanded rangewise.

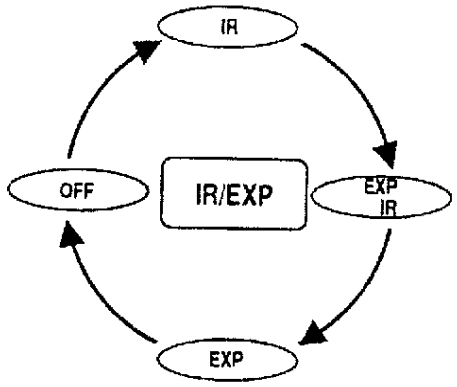


EXP: OFF



EXP: ON

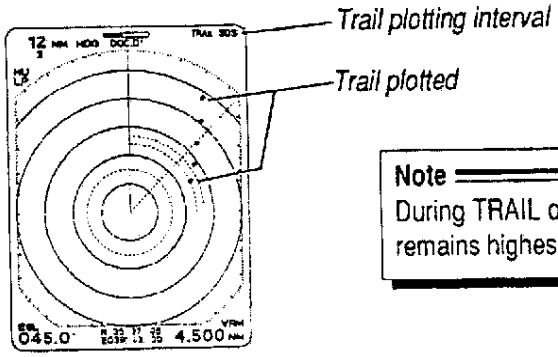
Every press of **IR/EXP** key rotates the item to be selected in the direction of the arrow as shown below. For information about IR, see ***Rejecting Interference*** on Page 17.



Displaying Other Boat's Trail

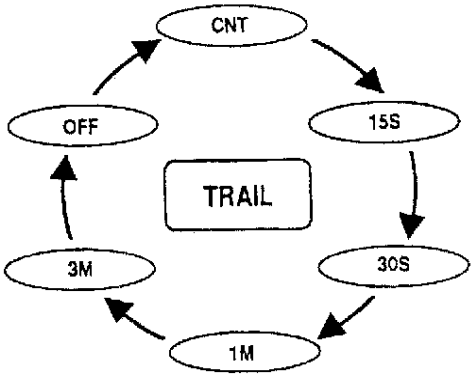
The movements of other boats can be displayed as plotted trails on the screen. The plotting interval is selectable as shown below.

TRAIL ——— Press **TRAIL** key until **TRAIL** mark and trail plotting interval readings are displayed in the upper right-hand corner of the screen. The trail is displayed in the lowest brightness level on the screen.



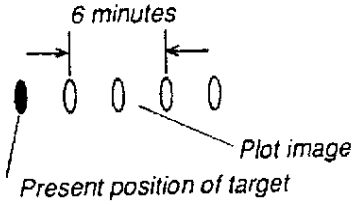
Note
During TRAIL operation, the image brightness remains highest (level 1).

Every press of **TRAIL** key rotates the trail plotting interval in the direction of the arrow as shown below. **CNT**: Continuous plotting



Measuring relative speed of other ship

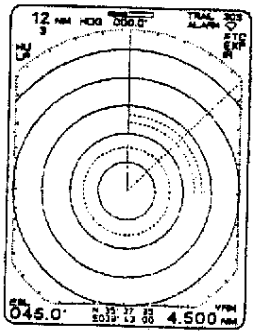
(1) Turn on the plotting function in 3-minute intervals.
(2) Measure the distance between two points in 6-minute intervals.
(3) Multiply the measured distance by ten which gives the relative speed of the target to own ship.



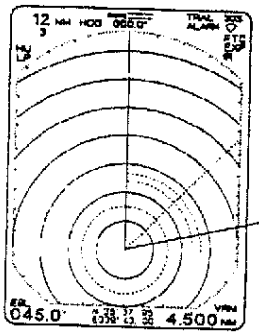
Off-centering

Your boat position on the screen will shift downward by half the active range so that you may view long distance forward without changing the range scale.

OFF CTR ——— Press **OFF CTR** key, and your boat position on the screen will shift downward by half the active range so that you may view long distance forward without changing the range scale.

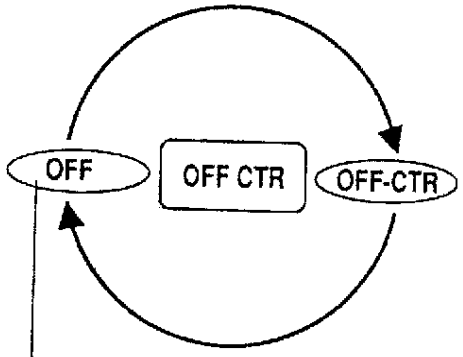


Normal screen



Off-centered screen

Every press of **OFF CTR** key turns on or off alternately as shown below.



OFF: On-centering

Notes

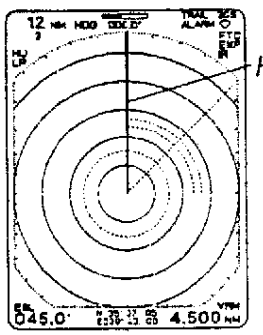
Off-centering is not applicable in the following ranges:

- T-180: **24 NM** range
- T-280: **48 NM** range

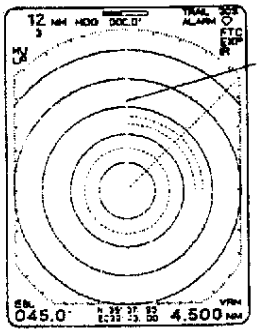
Hiding Heading Marker from Screen

Heading marker (HM) can be erased from the screen if desired.

HM ——— Press down **HM** key, and heading marker will be erased from the screen. Releasing the key redisplays the heading marker.



Normal screen



HM key is being pressed.

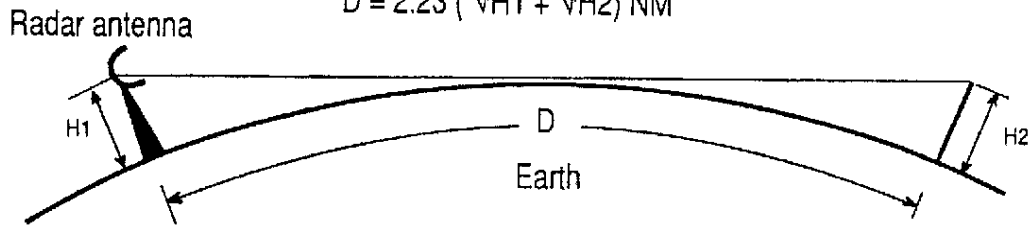
PICTURE INTERPRETATION

Capability of radar varies depending on the situation where a radar is sited, specified radar performance, climate condition, and skill of the operator. The following paragraphs describe these conditions that affect the capability of radar and finally, the correct interpretation of the radar picture.

Radar Horizon

The radio waves used for the radar are called microwaves, which travel straight like light. Light is generally refracted toward the ground surface due to the temperature, humidity, the atmospheric pressure change in the air and other reasons, so that we can obtain the visual range more than the physical visibility. This is called optical horizon as compared with the physical horizon. On the other hand, microwaves have a similar characteristic, and this is called radar horizon. Since microwaves are longer than light in terms of wavelength, the radar horizon is positioned farther than the optical horizon by about 6% and the physical horizon by about 15%. A target farther from the radar horizon is not detectable theoretically. The radar horizon changes according to the radar antenna height and target height. Assume that H1(m) is the radar antenna height and H2(m) is the target height. The distance D (NM) to the target is obtainable by the following equation.

$$D = 2.23 (\sqrt{H1} + \sqrt{H2}) \text{ NM}$$



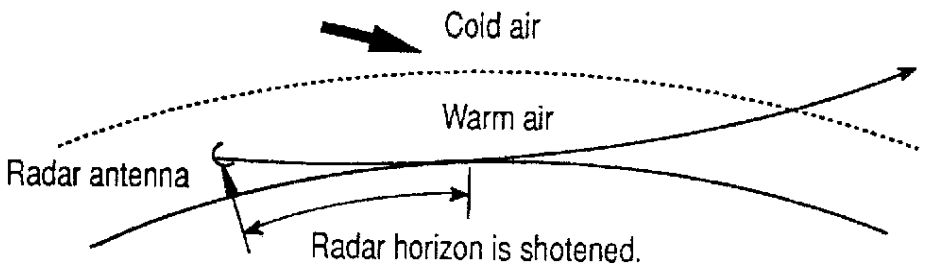
Radar Horizon False echoes

Variation of Detectable Range Due to a Change of Ambient Conditions

As the temperature distribution and humidity change in the air, the refractive index of radar radio waves change, consequently causing the detectable range of the radar to vary somewhat.

Sub-refraction

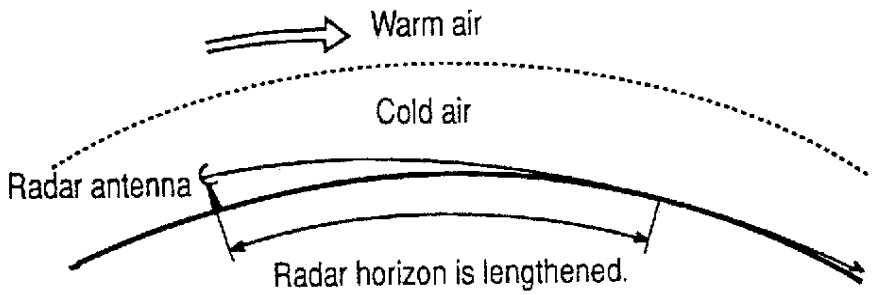
When cold air flows over the warm surface, the radar radio waves are curved upward as shown in the figure. This phenomenon is called sub-refraction. As a result, the detectable range of the radar is reduced. This phenomenon is likely to occur in the polar regions, or a warm current sea area where cold air from the polar regions flow into the sea.



Sub-refraction

Super-refraction

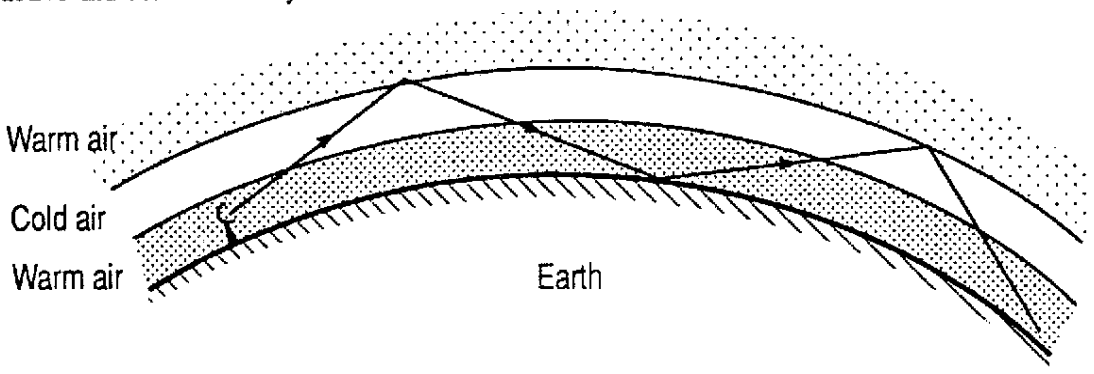
On the contrary, when the air being warmed up in internal land regions flows into the cold sea, radio waves are curved downward. This phenomenon is called super-refraction. In this case, the detectable range of the radar increases from normal condition. This phenomenon is apt to be produced in the warm coastal regions, and it becomes noticeable as the temperature difference becomes larger.



Super-refraction

Ducting

If air layers having a different temperature or a different atmospheric pressure are produced alternately in the altitudes, a distant target exceeding the visible range of the radar is detectable. This phenomenon is caused by the following property. When air layers having a different temperature contact each other, radio waves are not refracted, but reflected on the boundary where the refractive indices of two layers differ.



Ducting

As a result, radio waves can be propagated farther along the curvature of the earth. The passage where the radio waves travel is called Duct. The abnormal propagation of radio waves through this duct is called ducting.

Minimum Detectable Range

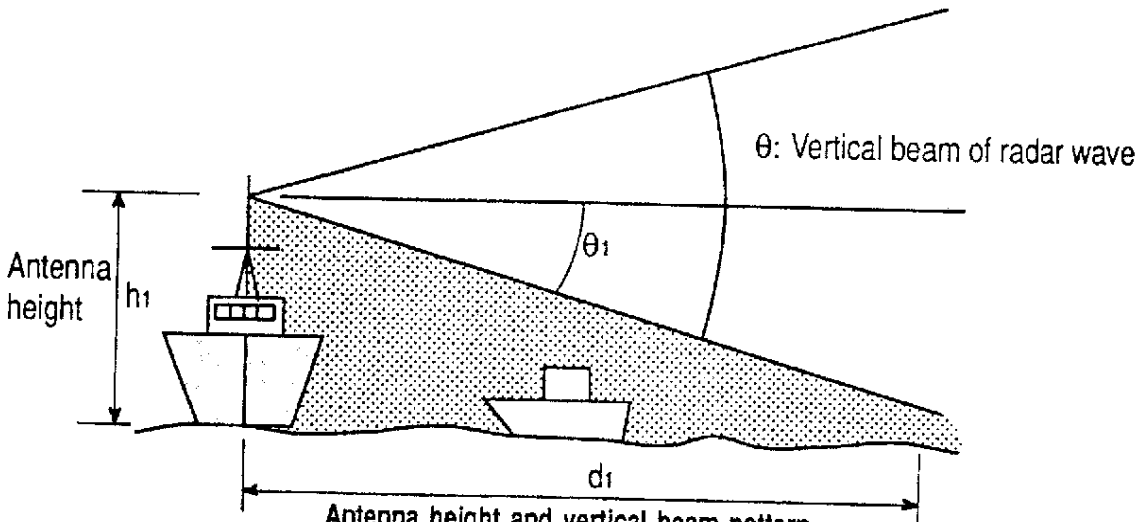
The minimum distance the radar can detect a target is called "Minimum Detectable Range". This minimum range varies depending on the following major factors as transmission pulse width, RF leakage time, and height of antenna. The following paragraphs describe these factors that affect the Minimum Detectable Range.

Transmission pulse width

In most radar systems, the radar transmission pulse width is switched to short or long depending on the range scale. In short range, a short pulse width is used to improve the nearby target detection as well as picture definition. In long range, long pulse width is used to achieve good long range performance.

Height of antenna

Height of antenna also affects the short range target detection. If the antenna is sited at a relatively higher level from the sea surface, the radar wave may skip the closer range causing the radar to fail in detection of the closer target. Vertical beam width of the antenna pattern is also involved as shown in Figure below. Wider beam results in the better short range detection, shortening the detectable range d1 as shown in Figure below.

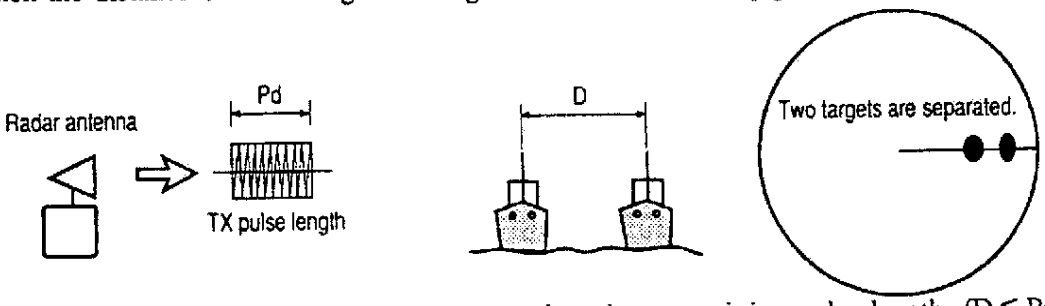


Antenna height and vertical beam pattern affecting detection of short range target.

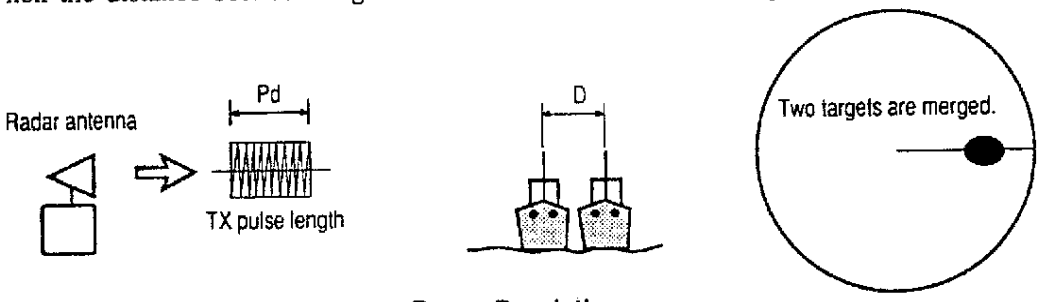
Range resolution

The range resolution is defined as the minimum distance between two targets in the same bearing which are discriminated as two images on the CRT screen.

a. When the distance between targets is longer than the transmitting pulse length; (D > Pd)



b. When the distance between targets is shorter than the transmitting pulse length; (D ≦ Pd)

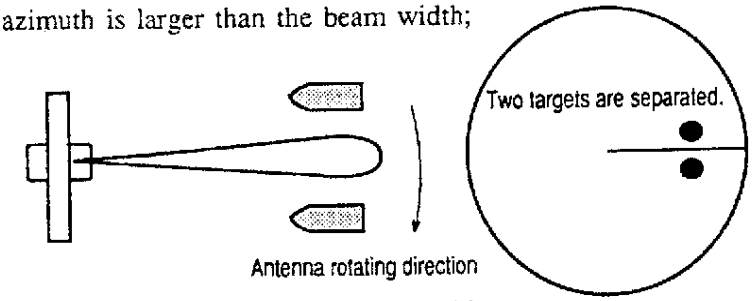


Range Resolution

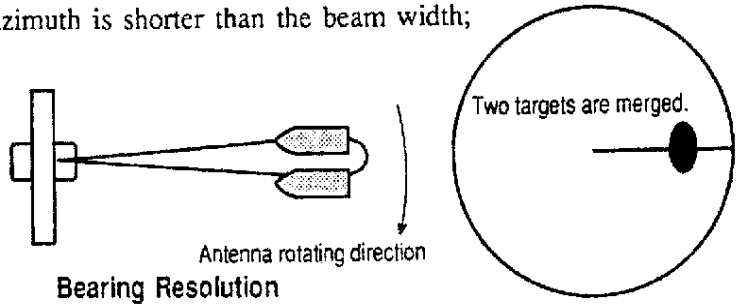
Bearing resolution

The bearing resolution is defined as the minimum bearing where the two targets of the same distance are displayed separately as two independent images on the screen, and it is determined by the antenna horizontal beam width.

a. When the targets distance in azimuth is larger than the beam width;



b. When the targets distance in azimuth is shorter than the beam width;

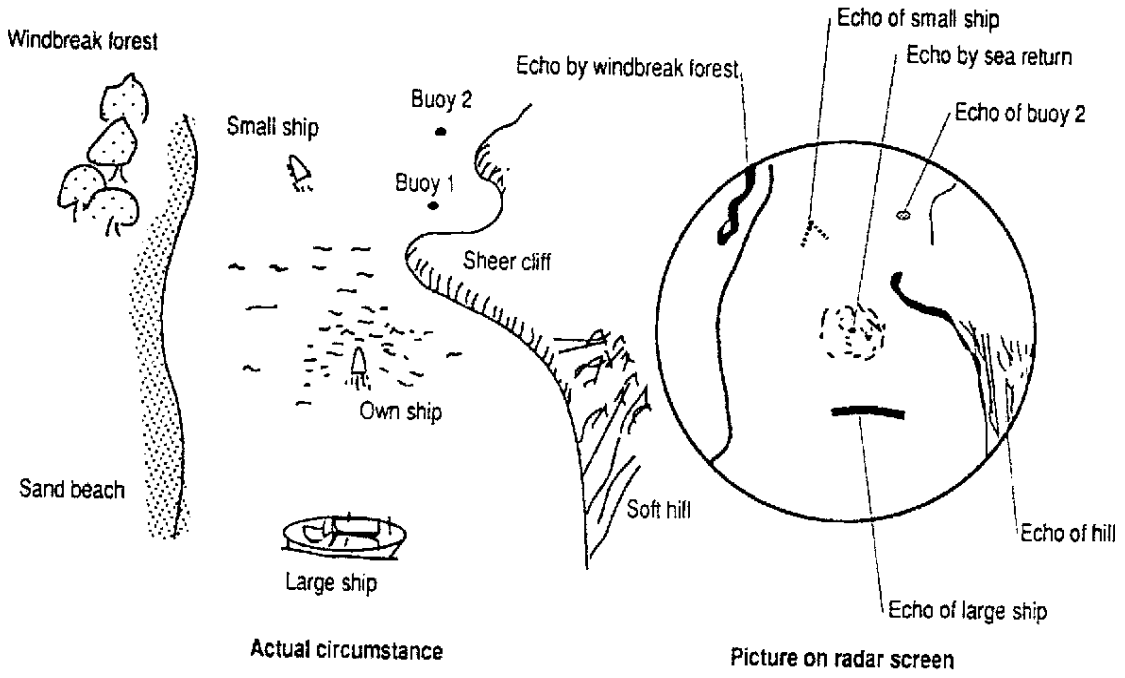


Bearing Resolution

How to Interpret the Radar Picture

In order to interpret the radar picture, an operator should be familiar with peculiarity of the radar video presentation caused by the wanted and unwanted effects. For instance, those echoes produced from the structure of bridge, sand beach, waves, and ship's wake may be shown in a different presentation from those viewed by the operator. For correct interpretation of the radar picture, it is highly recommended that the operator gets used to image presentation of the radar in fine weather condition.

Normal echoes



How to Interpret the Picture

Figure above shows an example of typical radar pictures. As shown in this figure, the portions being radiated by radar waves are painted on the radar screen. No.1 buoy blocked by the cape is not detected.

The echo of the large ship having a large echoing area is painted similar to its original profile because of short distance. On the other hand, the echo of the small ship is represented as a spot, because its reflection area is small.

The hill in the 90° ~ 130° direction on the starboard side is a deep forest zone, and its echoing area is large. Thus, it is represented as wide spreading echoes on the screen. On the other hand, since the sand beach being located on the port side is deep, but is not topographic, powerful reflection echoes are not obtainable, thus, it is shown as a weak echo.

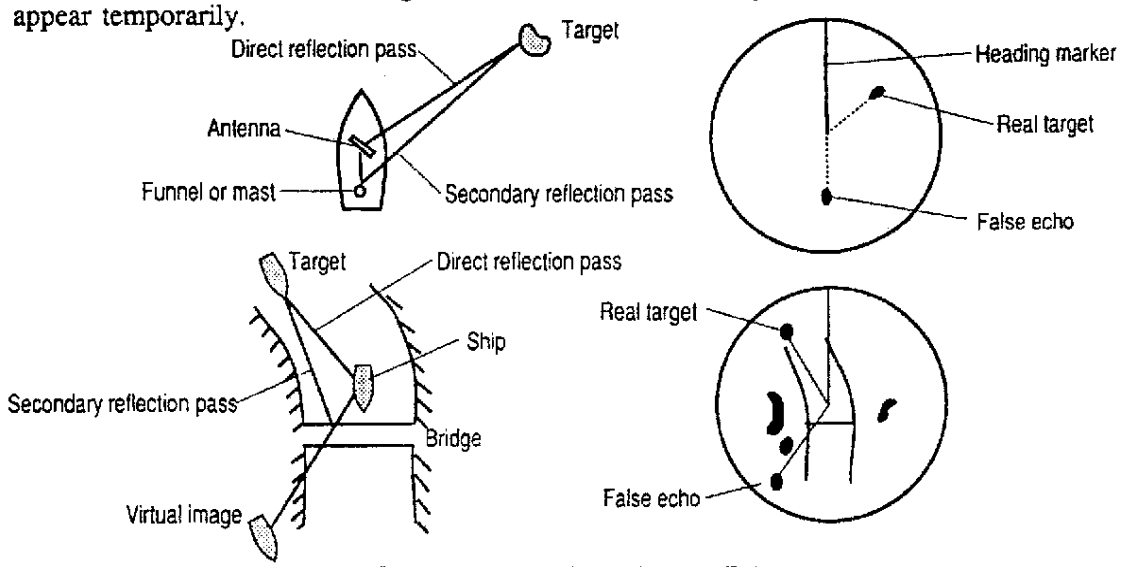
On the other hand, the windbreak forest produces strong echoes, and it is shown on the screen as massive echoes with high contrast. The reflection intensity of the waves differ according to their profiles. They are represented as a collective group of spot echoes in general. The ship's wake is represented stronger than that viewed by human eyes.

False echoes

False echoes may appear according to the surrounding circumstances. The kinds of false echoes and generating mechanisms of these echoes will be described.

a. False echoes caused by reflection

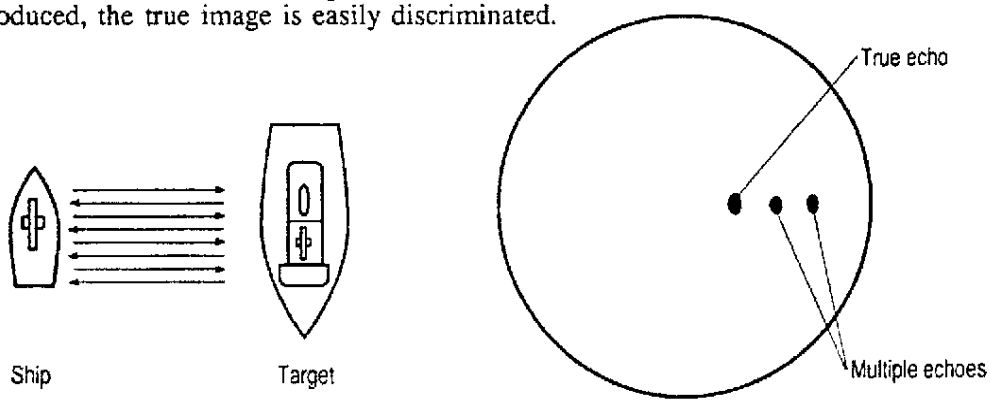
A near distance target may appear in two different directions. One is a real echo, while the other is a false one produced by the reflected waves from the structures near the radar antenna, such as a funnel, a mast, etc. If a large structure, like an iron bridge exists nearby, a false echo may appear temporarily.



Generation Principle of False Echoes

b. False echoes caused by multiple echoes

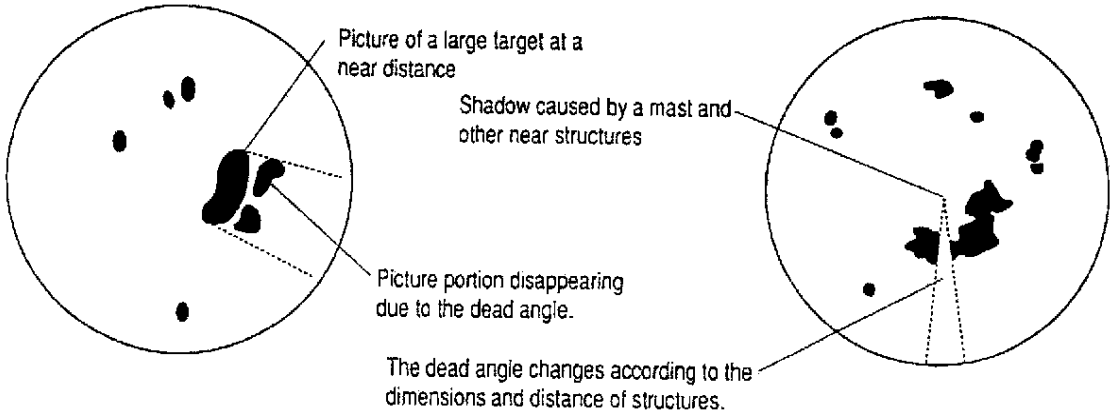
When the ship passes near a large ship, radio waves are repeatedly reflected between own ship and a nearby ship, causing several echoes at regular distances to appear in the same bearing. These false echoes produced by multiple reflection are called multiple echoes. In this case, the real target is located at the nearest distance. Since multiple echoes soon disappear when own ship has been separated from the reflection target or the direction has changed, even if these multiple images are produced, the true image is easily discriminated.



False Echoes by Multiple Reflection (Multiple echoes)

c. Shadow and dead angle

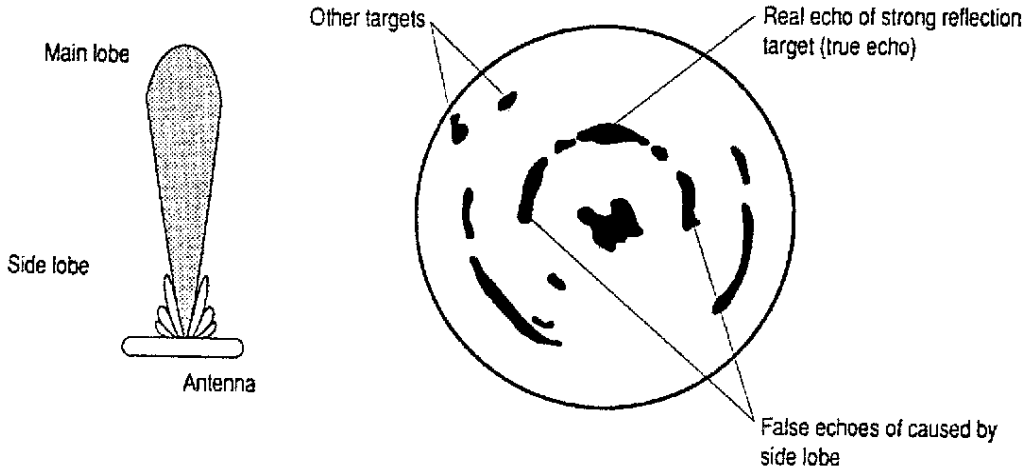
If the funnel, mast, post, and other structures are located near the antenna or if a tall obstacle is present in a near distance, a shadow is produced at the rear of these structures or the target. No picture may appear due to the shadow up to a far distance in an extreme case. This range is called dead range, and the shadow may be produced entirely or partially. Since the dead angle due to the funnel, mast, etc. is detectable during the installation of the antenna, it can be eliminated by changing their installation sites.



Shadow and Dead Angle

d. False echoes caused by side lobes

The radiation beams emitted from the antenna comprise side lobes in addition to the main lobe. Since the sidelobe energy is very low, it does not affect any distant target at all. A false echo due to the sidelobes is produced from a very near target with strong reflection target. A false echo caused by the side lobes appears as an arc. It is eliminated by slightly reducing the gain or by changing the FTC level with FTC key.

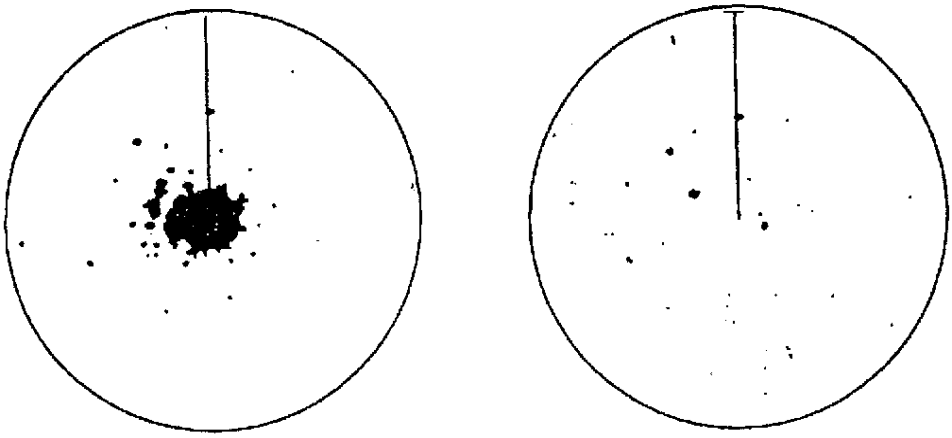


False Echo Caused by Side Lobe

False Echo Caused by Side Lobe

e. Effect of sea clutter

Sea clutter presentation is displayed when sea surface becomes rough. This is originated from the wave which changes its position from time to time causing random displays on the screen. To reduce this effect, STC control is used. The target detection becomes difficult when applied too short or too much.

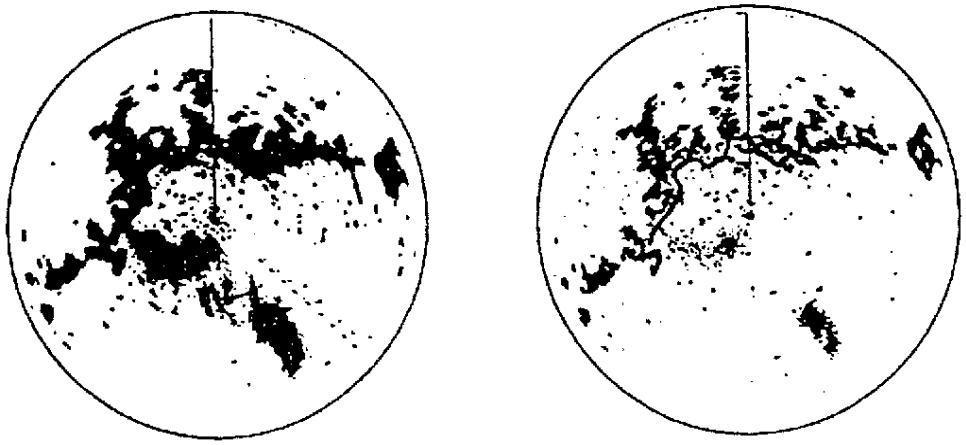


STC: TOO LOW STC: NORMAL

STC Control Settings

f. Effect of rain and snow

The radio waves used for radar are easily attenuated by rain and snow. Radar range performance is therefore closely related to these unwanted echoes, called weather clutter. In most cases, these clutter components are shown on radar screen as drifting small particle echoes like cotton, spreading over the wide area on the screen. Suppression can be made by activating the STC circuit. Reducing receiver gain by GAIN control is also effective to assist suppressing the weather clutters.



FTC: TOO LOW FTC : NORMAL

FTC Settings

MAINTENANCE

Routine Maintenance

Monthly check

1. Check the surface of radome (T-180) or scanner radiator cover (T-280) for filth, paint, caked salt, or scratches.
2. Clean the surface with a clean soft cloth soaked with fresh water or neutral cleanser.
3. If the display screen is dirty losing the contrast, clean the screen with a cloth soaked with anti-static agent. **Do not use dry cloth as it causes static charging which accumulates dusts.**

Semiannual check (T-280)

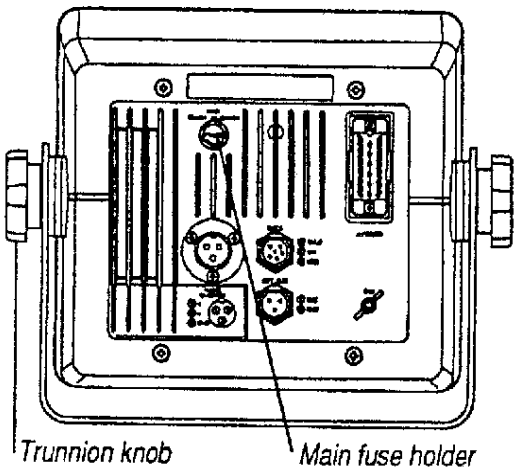
Check the motor brushes of the antenna unit every six months. If the contact surfaces become less than 6 mm, replace them. Spare motor brushes are attached to the body of the motor.

Replacing Fuse

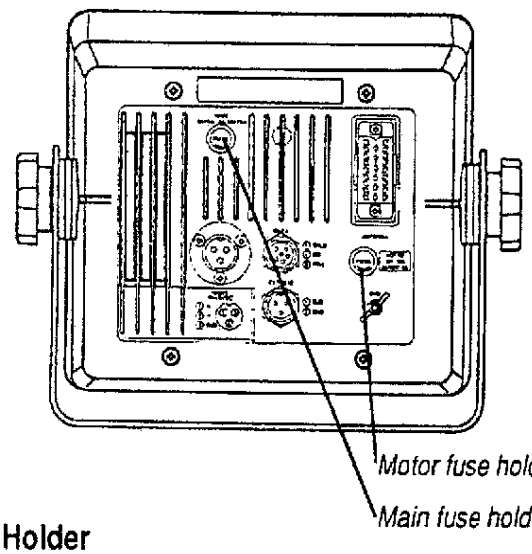
Fuse holder(s) is(are) located on the rear panel of the display unit.

1. If it is difficult to access the fuse holder caused by narrow space installation, loosen two trunnion knobs and draw the display unit toward you.
2. Turn the fuse holder cap counterclockwise all the way and take out the blown fuse.
3. Insert a new one.
4. Fit the fuse holder cap by the reverse procedure to fix the fuse.
5. Restore the display unit with fixing screws.

T-180



T-280

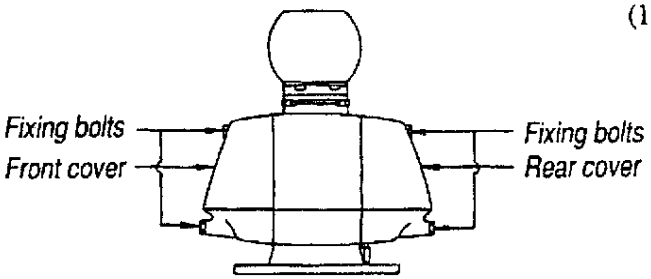


Location of Fuse Holder

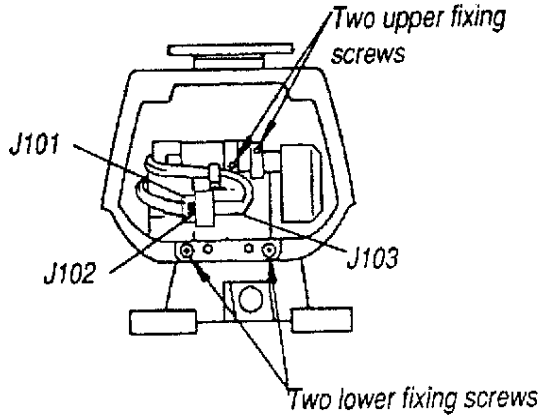
Fuse rate

Type		T-180	T-280
Main	12 VDC	5A	5A
	24/32 VDC	3A	3A
Motor	12 VDC		10A
	24/32 VDC		5A

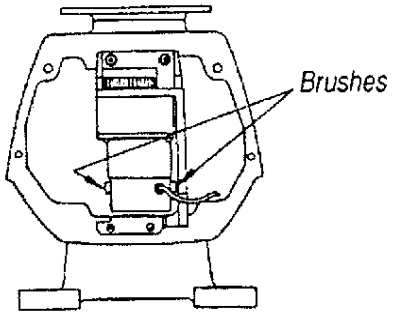
Replacing Motor Brush (T-280 only)



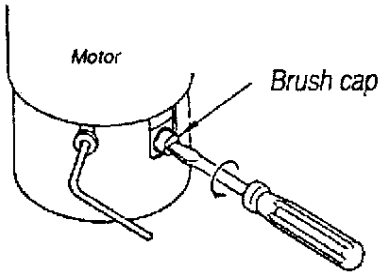
(1) Remove the front and rear covers by loosening the four fixing bolts.



(2) Undo upper two and lower two fixing screws. Unplug J101, J102 and J103, and then remove the transceiver unit from the antenna unit.



(3) Find the motor brushes attached to both sides of the motor.



(4) Turn the brush cap counterclockwise with a flat screw driver until it comes off.
(5) Replace the worn brushes with new ones and fix them by the reverse procedure.

Adjusting TUNE Meter

Your radar is provided with automatic tuning; therefore, you do not usually have to adjust the tune. We, however, recommend you readjust the tune whenever the MIC (Microwave Integrated Circuit), IF (Intermediate Frequency) unit, or Magnetron is replaced with new one. For more information about adjusting TUNE meter, see ***Checking and Adjusting Tune*** on page 35 of this operation manual.

ADJUSTMENT AFTER INSTALLATION

After installation, be sure to adjust the internal controls as mentioned below.

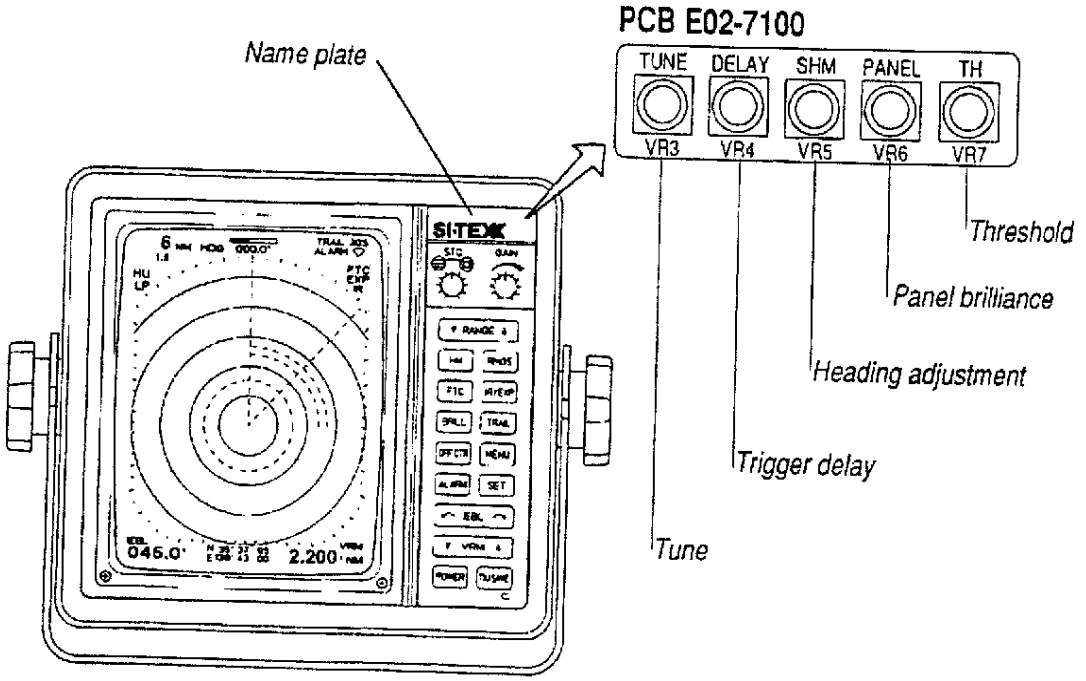
CAUTION

- High voltages are applied to the antenna and display units.
- Ship's main is applied to the internal unit even when power is turned off.
- Confirm that correctly rated fuse is used for the ship's mains.
- Preheat the magnetron at least 30 minutes keeping standby condition when first turning the power on after the installation, or replacement of the magnetron.

Locations of Potentiometers for Adjustment

The potentiometers for adjustment are located behind the SI-TEX name plate on the upper part of the control panel as shown in the drawings below. The name plate can be easily removed by inserting a slotted screwdriver.

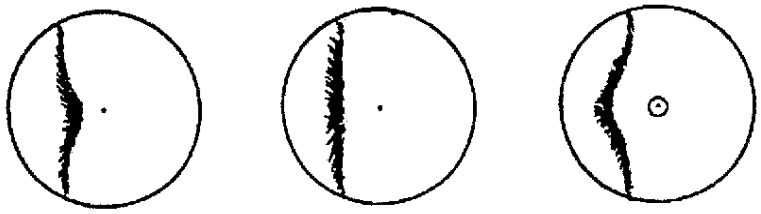
Be sure to stay on the transmitting (TX) condition at least 30 minutes before starting adjustment.



Adjusting Trigger Delay

According to the length of antenna cable connecting the antenna unit and display, the image of the straight object, such as breakwater and riverfront may be deformed as shown below caused by short or excessive trigger delay.
Adjust the **VR4** to obtain normal trigger delay by the following procedure:

(1) Press **RANGE** key to select **1/8NM** range.
(2) Adjust **VR6 (DELAY)** so that the image on the scope may become normal.
- The straight targets such as bank or bridge are correctly presented.
- A target with known distance is presented at correct position. We recommend you use **VRM** for range measurement.

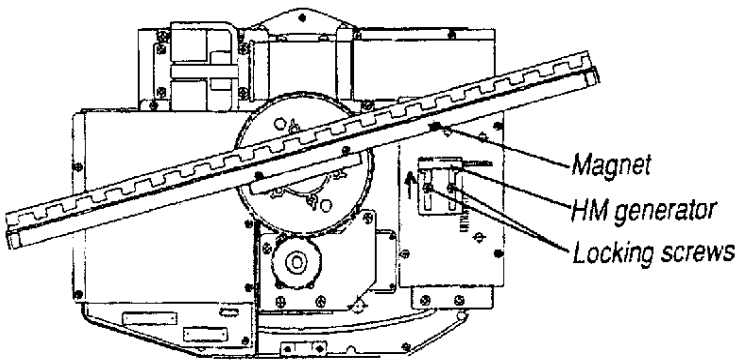


Short delay *Normal* *Excessive delay*

Adjusting Bearing of Heading Marker (T-180 only)

(1) When the ship is mooring, or calmly anchored, find some stationary visible targets in the range of **2 to 4 NM**.
(2) Measure the target bearing on the compass as well as on the radar screen. If the radar bearing deviates more than ±1° from the actual bearing, correct the bearing by the following procedure:
(3) Rotate potentiometer VR5 (SHM) on PCB E02-7100 clockwise or counterclockwise so that the error becomes less than ±1°. If the error cannot be corrected by this switch, further adjustment is necessary.
(4) Turn off the power by pressing **POWER** key.
(5) Open the radome cover by removing four antenna fixing bolts.
(6) Find the heading marker generator (HM generator) board as shown in the drawings below.
(7) Loosen the locking screws as shown in the drawings below.
(8) Move the generator slowly. If you move the generator in the direction of the arrow, the target will rotate counterclockwise.
(9) Rotate potentiometer VR5 (SHM) clockwise or counterclockwise again so that the error becomes less than ±1°.
(10) Reassemble the antenna unit by the reverse procedure.

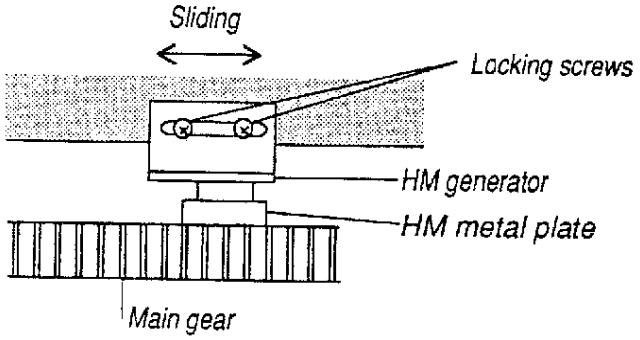
Note
If the bearing error is more than +16° and cannot be compensated by above mentioned measure, check if the antenna unit is correctly installed.

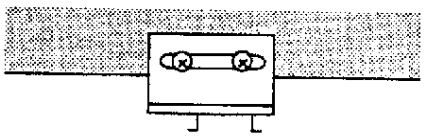
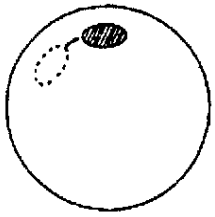
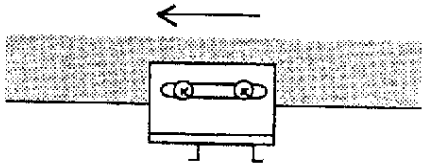
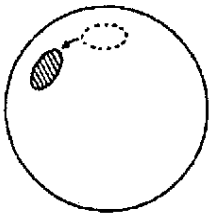


Adjusting Bearing of Heading Marker (T-280 only)

(1) When the ship is mooring, or calmly anchoring, find some stationary visible targets in the range of **3 to 6 NM.**
(2) Measure the target bearing on the compass as well as on the radar screen. If the radar bearing deviates more than ±1° from the actual bearing, correct the bearing by the following procedure:
(3) Rotate potentiometer **VR5 (SHM)** on **PCB E02-7100** clockwise or counterclockwise so that the error becomes less than ±1°. If the error cannot be corrected by this switch, further adjustment is necessary.
(4) Turn off the power by pressing **POWER** key.
(5) Open the radome cover by removing four antenna fixing bolts.
(6) Find the heading marker generator (HM generator) board as shown in the drawings below.
(7) Loosen the locking screws as shown in the drawings below.
(8) Move the generator slowly. If you move the generator in the direction of the arrow, the target will rotate clockwise.
(9) Rotate potentiometer **VR5 (SHM)** clockwise or counterclockwise again so that the error becomes less than ±1°.
(10) Reassemble the antenna unit by the reverse procedure.

Note
If the bearing error is more than +16° and cannot be compensated by above mentioned measure, check if the antenna unit is correctly installed.



HM generator sliding	Target movement
Rightward slide 	*Clockwise* 
Leftwards slide 	*Counterclockwise* 

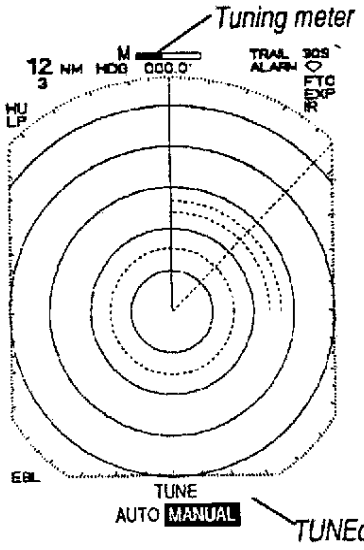
Checking and Adjusting Tune

TUNE has been factory-set; however, make sure to readjust the tune when you replace the MIC, IF unit, or magnetron with new one for repair.

▼ RANGE ▲ ——— Press either arrow of **RANGE** key to select **6 NM** or a longer range.

MENU ——— Press **MENU** key to highlight **TUNE**, and **TUNE** will be effective.

SET ——— Press **SET** key to highlight **MANUAL** for selecting manual tuning.



▼ VRM ▲ ——— In manual tuning mode, **VRM** key serves as coarse tuning adjustment key. Press **VRM** key to display the target as large as possible.

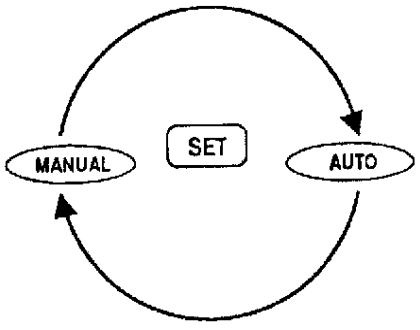
◠ EBL ◡ ——— In manual tuning mode, **EBL** key serves as fine tuning adjustment key. Press **EBL** key to display the target as large as possible.

TUNE

VR3 ——— Slowly rotate the potentiometer **TUNE (VR 3)** until the tuning meter bar becomes the longest.

SET ——— Press **SET** key to highlight **AUTO** for selecting automatic tuning.

Every press of **SET** key rotates the item to be selected in the direction of the arrow as shown below.

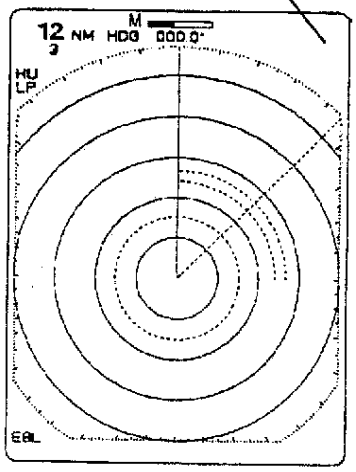


Adjusting Noise Level

Noise level has been factory-set; however, make sure to readjust the noise level when you replace the MIC, IF unit, or magnetron with new one for repair.

▼ RANGE ▲ —— Press up arrow of **RANGE** key to select **24 NM** for T-180 or **48 NM** for T-280.

FTC, IR, EXP: OFF



FTC —— Press **FTC** key until **FTC** letters in the upper right-hand corner of the screen turn off to set **FTC** OFF.

IR/EXP —— Press **IR/EXP** key until **IR** and **EXP** letters in the upper right-hand corner of the screen turn off to set **IR/EXP** OFF.

STC

—— Turn **STC** control completely counterclockwise.

GAIN

—— Turn **GAIN** control completely clockwise.

TH

VR7

—— Slowly rotate the potentiometer **TH (VR 7)** on **PCB E02-7100** until noise speckles slightly appear on the screen.

Adjusting Control Panel Illumination

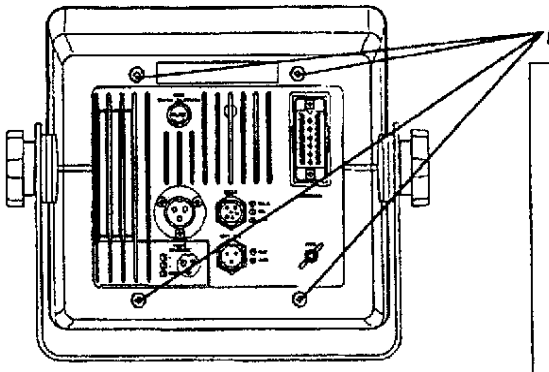
PANEL

VR6

—— Slowly rotate the potentiometer **PANEL (VR 6)** on **PCB E02-7100** until the control panel gives comfortable brightness during night operation.

Setting Dip Switches

The dip switches are located on the internal printed circuit board E02-7000.

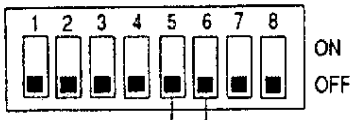


How to find the dip switches:

(1) Remove two trunnions from the display unit.
(2) Remove four fixing screws.
(3) Detach the case from the unit.
(4) Place the display unit on the table with bottom side upwards, and you will find the dip switches on the printed circuit board E02-7000.
(5) After setting the dip switches, reassemble by the reverse procedure.

Selecting input signal format

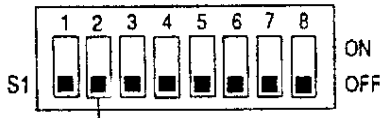
When you connect your navigator, fluxgate compass, or gyro compass with gyro interface GRA-20A (option), make sure to set the same signal format as that of connecting device by referring to the table below.



NMEA-0183	KODEN-717	NMEA-0182	NO INPUT
OFF	ON	OFF	ON
OFF	OFF	ON	ON

Changing the unit of measure for VRM

The unit of measure for VRM (Variable Range Marker) is selectable. It is factory-set to NM; therefore, if you want to use the unit of measure of kilometer (km), set the dip switch by referring to the table below.



ON	km (kilometer) is selected.
OFF	NM (nautical mile) is selected.

SPECIFICATIONS

Major Performance - *T-180*

Note: Specifications subject to change without notice.

Antenna unit

(1)	Antenna system	Micro-strip antenna, radome type
(2)	Antenna rotation	24 rpm
(3)	Antenna beamwidth	Horizontal: 4.7° Vertical: 25°
(4)	Sidelobe level	-20 dB or less from the main beam
(5)	Transmitting frequency	9410 ±30 MHz
(6)	Peak power output	4 kW
(7)	Type of emission	P0N
(8)	Pulse width (μsec)/PRF(Hz)	S: 0.08/1640 M1: 0.25/1640 M2: 0.5/820 L: 1.0/546
(9)	Center frequency	60 MHz
(10)	IF band width	6 MHz/3 MHz
(11)	Receiver	Linear amplifier with MIC
(12)	Modulator	FET drive
(13)	Duplexer	Ferrite circulator
(14)	Receiver protector	Solid-state limiter (part of MIC assembly)
(15)	Overall noise figure	6 dB
(16)	Environmental condition	Ambient temperature: -15°C to 50 °C (5°F to 122°F) Humidity: 95% at 35°C (95°F) Wind Velocity: 100 knots (51.5 m/sec)

Display unit

(1)	Picture tube	7-inch diagonal green monochrome high resolution CRT
(2)	Resolution	480 x 640
(3)	Video level	4 levels
(4)	Presentation modes	Head-up (course-up and north-up available by interfacing navigator with NMEA-0183 format, or fluxgate compass)
(5)	Range scale (n.m.)	1/8 1/4 1/2 1 2 4 8 16 24
(6)	Rings interval (n.m.)	1/16 1/16 1/8 1/4 1/2 1 2 4 6
(7)	Off-centering	50% of radius
(8)	Minimum range	Better than 25 m on 1/8 n.m. range
(9)	Range discrimination	Better than 30 m
(10)	Range accuracy	70 m or 0.8% of the range, which ever is the greater.
(11)	Bearing accuracy	Better than ±1%
(12)	Tuning	Automatic or manual
(13)	Echo trail interval	15, 30 seconds, 1, 3 minutes, continuous
(14)	Alarm	90°, 180°, 360°
(15)	Navigation data display	Boat position (Latitude/Longitude or loran C LOP coordinates) or speed/heading
(16)	Functions	Gain, STC, FTC (on/off), tune (auto/manual), heading marker, interference rejection, target expansion, VRM, EBL, KM/NM selection
(17)	Power supply	11 to 40 VDC
(18)	Power consumption	Approx. 50 W (at power save mode: 35 W) at 12 VDC
(19)	Environmental condition	Temperature: -10°C to 50 °C (14°F to 122°F) Humidity: 95% at 35°C (95°F)

Major Performance - *T-280*

Note: Specifications subject to change without notice.

Antenna unit

(1)	Antenna system	Slotted array antenna, open scanner type
(2)	Antenna rotation	24 rpm
(3)	Antenna beamwidth	Horizontal: 2.5° Vertical: 25°
(4)	Sidelobe level	Less than -20 dB inside ±10° from the main beam Less than -27 dB outside ±10° from the main beam
(5)	Transmitting frequency	9410 ±30 MHz
(6)	Peak power output	4 kW
(7)	Type of emission	P0N
(8)	Pulse width (μsec)/PRF(Hz)	S: 0.08/1640 M1: 0.25/1640 M2: 0.5/820 L:1.0/546
(9)	Center frequency:	60 MHz
(10)	IF band width:	6 MHz/3 MHz
(11)	Receiver	Linear amplifier with MIC
(12)	Modulator	FET drive
(13)	Duplexer	Ferrite Circulator
(14)	Receiver protector	Solid-state limiter
(15)	Overall noise figure	6 dB
(16)	Environmental condition	Ambient temperature: -15°C to 50 °C (5°F to 122°F) Humidity: 95% at 35°C (95°F) Wind Velocity: 70 knots (36 m/sec)

Display unit

(1)	Picture tube	7-inch diagonal green monochrome high resolution CRT
(2)	Resolution	480 x 640
(3)	Video level	4 levels
(4)	Presentation modes	Head-up (course-up and north-up available by interfacing navigator with NMEA-0183 format. or fluxgate compass)
(5)	Range scale (n.m.)	1/8 1/4 1/2 3/4 1.5 3 6 12 24 48
(6)	Rings interval (n.m.)	1/16 1/16 1/8 1/4 1/2 1 1.5 3 6 12
(7)	Off-centering	50% of radius
(8)	Minimum range	Better than 20 m on 1/8 n.m. range
(9)	Range discrimination	Better than 30 m
(10)	Range accuracy	70 m or 0.8% of the range, which ever is the greater.
(11)	Bearing accuracy	Better than ±1%
(12)	Tuning	Automatic or manual
(13)	Echo trail interval	15, 30 seconds, 1, 3 minutes, continuous
(14)	Alarm	90°, 180°, 360°
(15)	Navigation data display	Boat position (Latitude/Longitude or loran C LOP coordinates) or speed/ heading
(16)	Functions	Gain, STC, FTC (on/off), tune (auto/manual), heading marker, interference rejection, target expansion, VRM, EBL, KM/NM selection
(17)	Power supply	11 to 40 VDC
(18)	Power consumption	Approx. 55 W (at power save mode: 45 W) at 12 VDC
(19)	Environmental condition	Temperature: -10°C to 50 °C (14°F to 122°F) Humidity: 95% at 35°C (95°F)

Equipment List - *T-180*

Standard equipment list

No.	Description	Rating	Remarks	Quantity
1	Antenna unit	MRT-141	5 kg (11.0 lb)	1
2	Display unit	MRD-66	4.7 kg (10.4 lb)	1
3	Hood	MRH-100		1
4	Magnifying lens	MRL-100		
5	EMI filter	MRF-100		
6	Antenna cable	CW-501 or -501A	10 m (33 ft)	1
7	DC power cable	CW-04	3 m (9.9 ft)	1
8	Spare parts		Refer to spare parts list	1 set
9	Installation materials		Refer to installation materials list	1 set
10	Operation manual			1

Spare parts list

No.	Description	Rating	Use	Quantity
1	Fuse	3 A (F-7142)	24 VDC, 32 VDC	2
2	Fuse	5 A (F-7142)	12 VDC	2

Installation materials list

No.	Description	Rating	Use	Quantity
1	Truss tapping screw	TPT5 x 20U	For display unit	4
2	Hexagonal bolt	SUS B10 x 25U	For antenna unit	4
3	Plain washer	2W 10U	For antenna unit	4
4	Spring washer	SW 10U	For antenna unit	4

Option

No.	Description	Rating	Remarks	Weight/length
1	Navigator connecting cable	CW-153A	With 6-pin connectors	5 m (16.5 ft)
		CW-155	With BNC and 6-pin connectors	5 m (16.5 ft)
2	AC power cable	VV-2D8		
3	Gyro interface unit	GRA-20A		1.7 kg (3.75 lb)
4	Rectifier	PS-006		8 kg (17.6 lb)

Equipment List - *T-280*

Standard equipment list

No.	Description	Rating	Remarks	Quantity
1	Transceiver	MRT-143	17 kg (37.5 lb)	1
2	Aerial	MRA-32	4 kg (8.8 lb)	1
3	Display unit	MRD-69	4.7 kg (10.4 lb)	1
4	Hood	MRH-100		1
5	Magnifying lens	MRL-100		
6	EMI filter	MRF-100		
7	Antenna cable	CW-502 or -502A	10 m (33 ft)	1
8	DC power cable	CW-04	3 m (9.9 ft)	1
9	Spare parts		Refer to spare parts list	1 set
10	Installation materials		Refer to installation materials list	1 set
11	Operation manual			1

Spare parts list

No.	Description	Rating	Use	Quantity
1	Fuse	3 A (F-7142)	24 or 32 VDC	2
2	Fuse	5 A (F-7142)	12 VDC	2
3	Fuse	5 A (F-7142)	For antenna drive motor (24/32 VDC)	2
4	Fuse	10 A (F-7142)	For antenna drive motor (12 VDC)	2
5	Motor brush	GM-5120-1	For antenna drive motor	1 set

Installation materials list

No.	Description	Rating	Use	Quantity
1	Truss tapping screw	TPT5 x 20U	For display unit	4
2	Hexagonal bolt	SUS B12 x 60U	For antenna unit	4
3	Plain washer	2W 12U	For antenna unit	8
4	Spring washer	SW 12U	For antenna unit	4
5	Nut	N12U	For antenna unit	4
6	Anti-corrosion washer	30 ø	For antenna unit	4
7	Anti-corrosion washer	50 ø	For antenna unit	4
8	Neo seal putty	B-70-3	For cable gland of antenna unit	100g (0.22 lb)

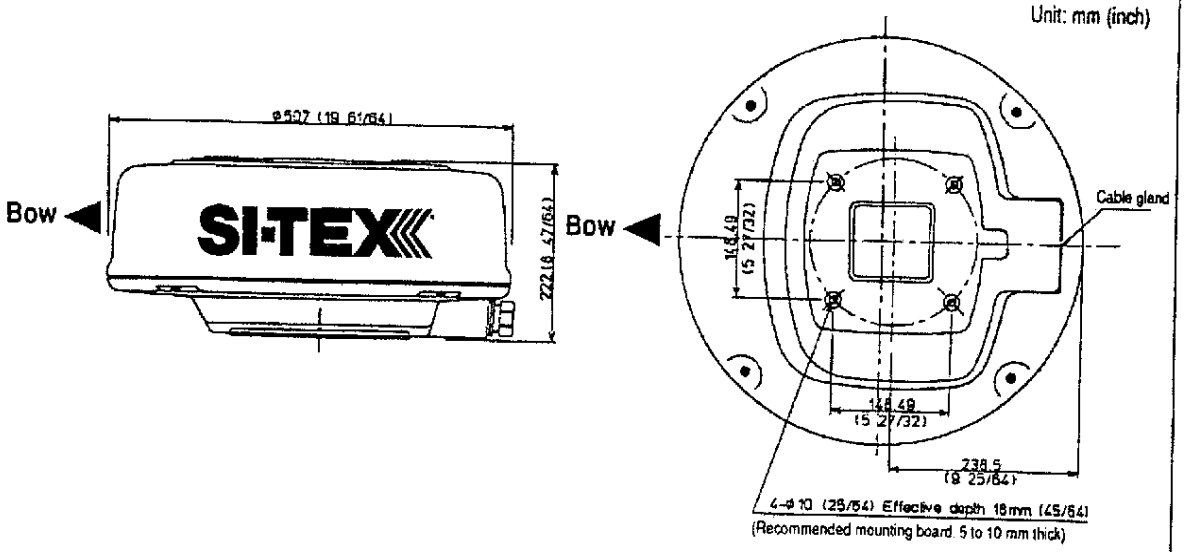
Option

No.	Description	Rating	Remarks	Weight/length
1	Navigator connecting cable	CW-153A	With 6-pin connectors	5 m (16.5 ft)
		CW-155	With BNC and 6-pin connectors	5 m (16.5 ft)
2	AC power cable	VV-2D8		
3	Gyro interface unit	GRA-20A		1.7 kg (3.75 lb)
4	Rectifier	PS-006		8 kg (17.6 lb)

Outline and Dimensions - *T-180*

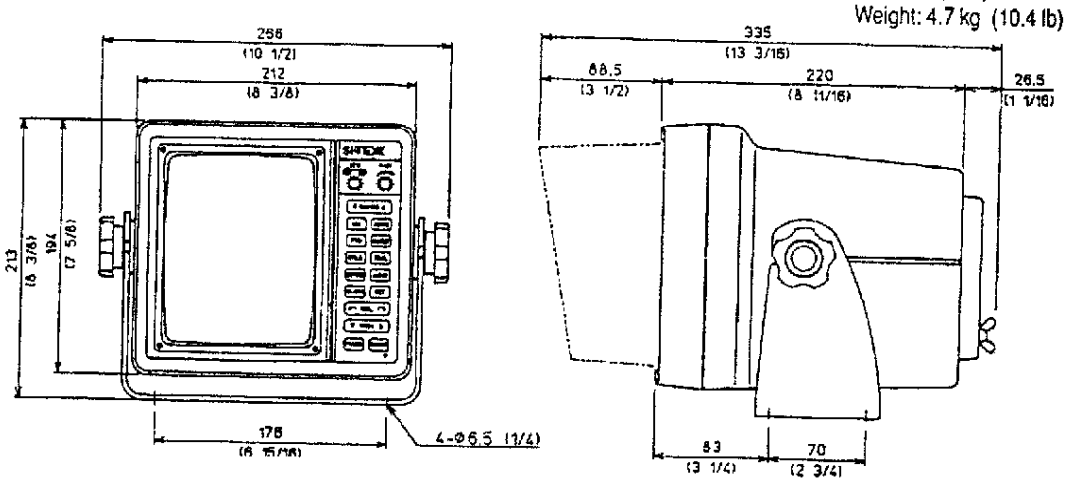
Antenna unit

Unit: mm (inch)

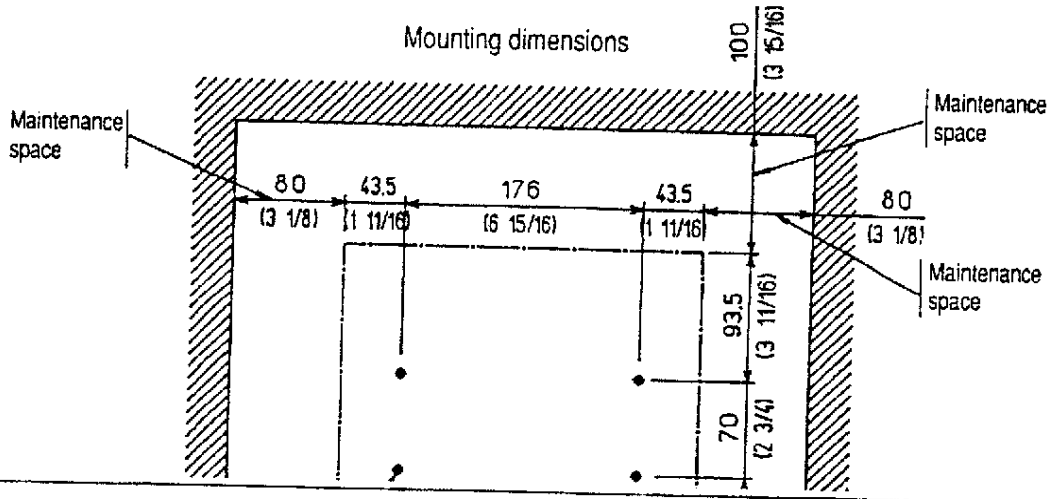


Display unit

Unit: mm (inch)
Weight: 4.7 kg (10.4 lb)



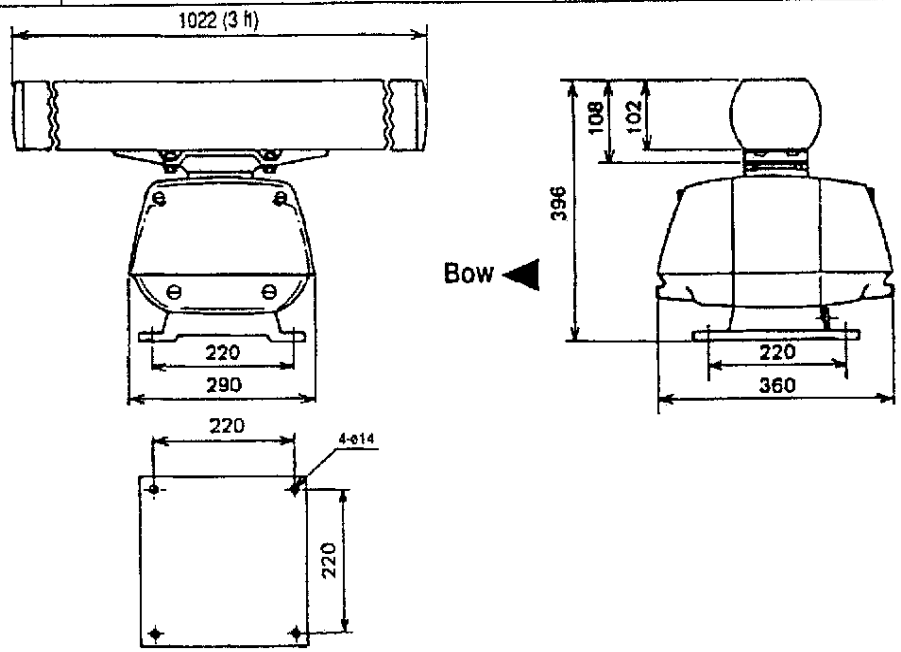
Mounting dimensions



Outline and Dimensions - *T-280*

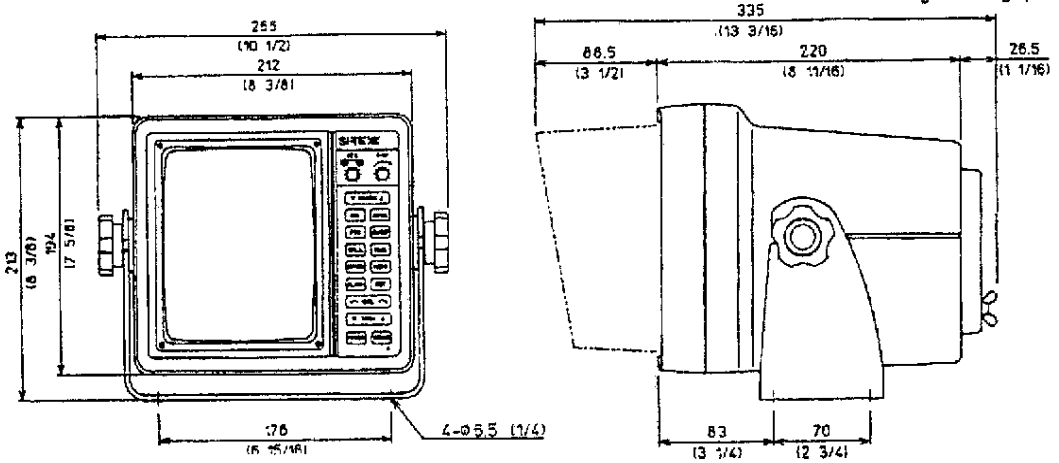
Antenna unit

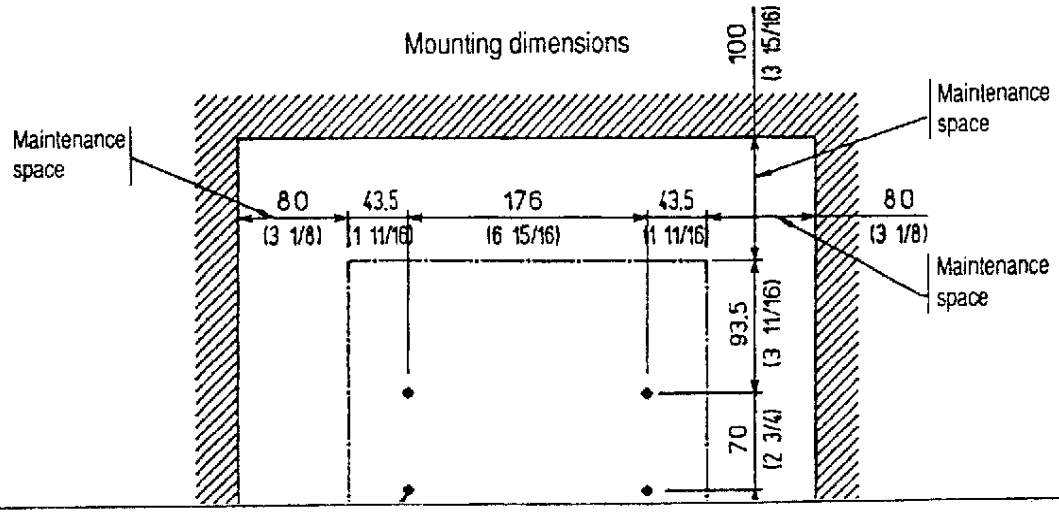
Unit: mm (inch)



Display unit

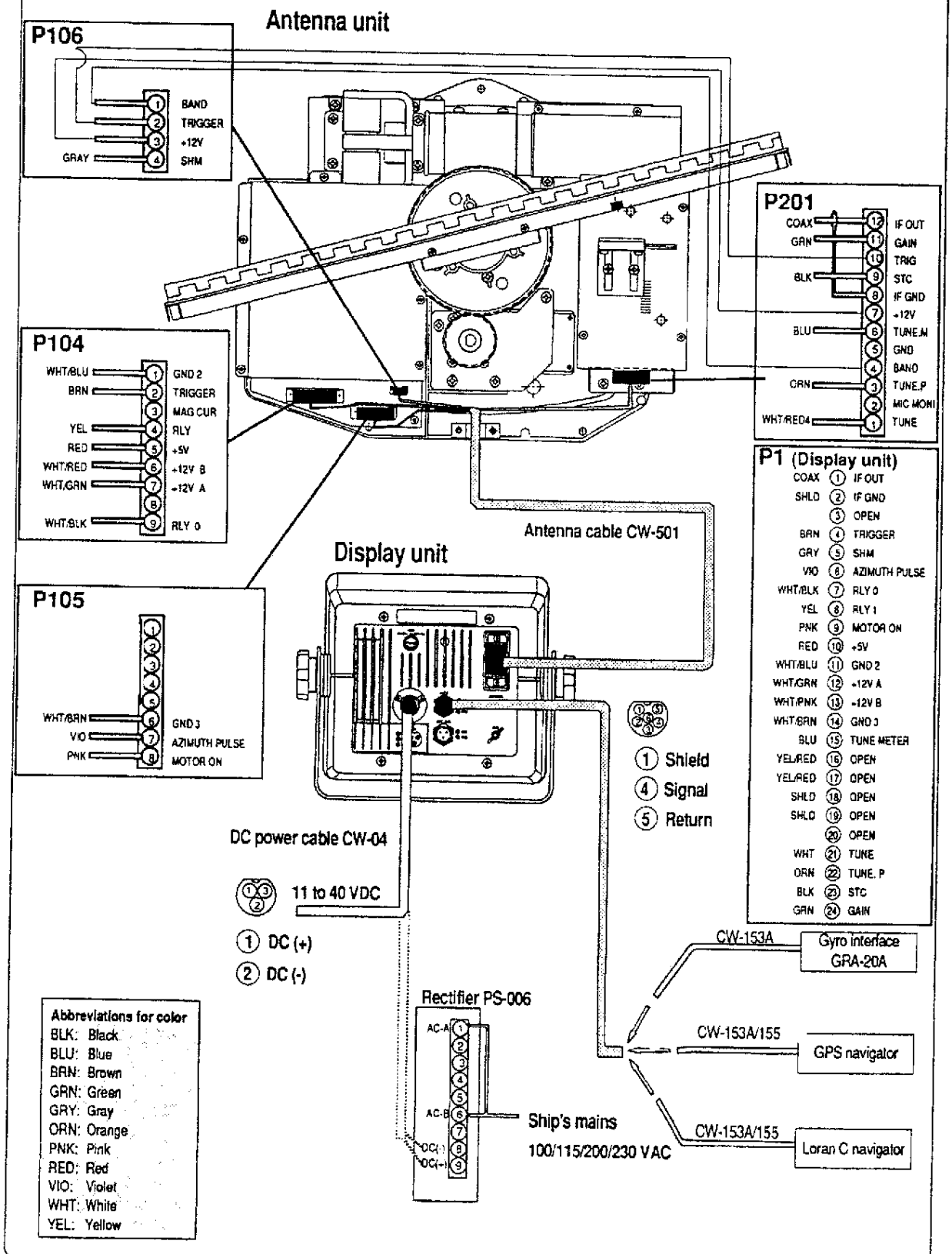
Unit: mm (inch)
Weight: 4.7 kg (10.4 lb)



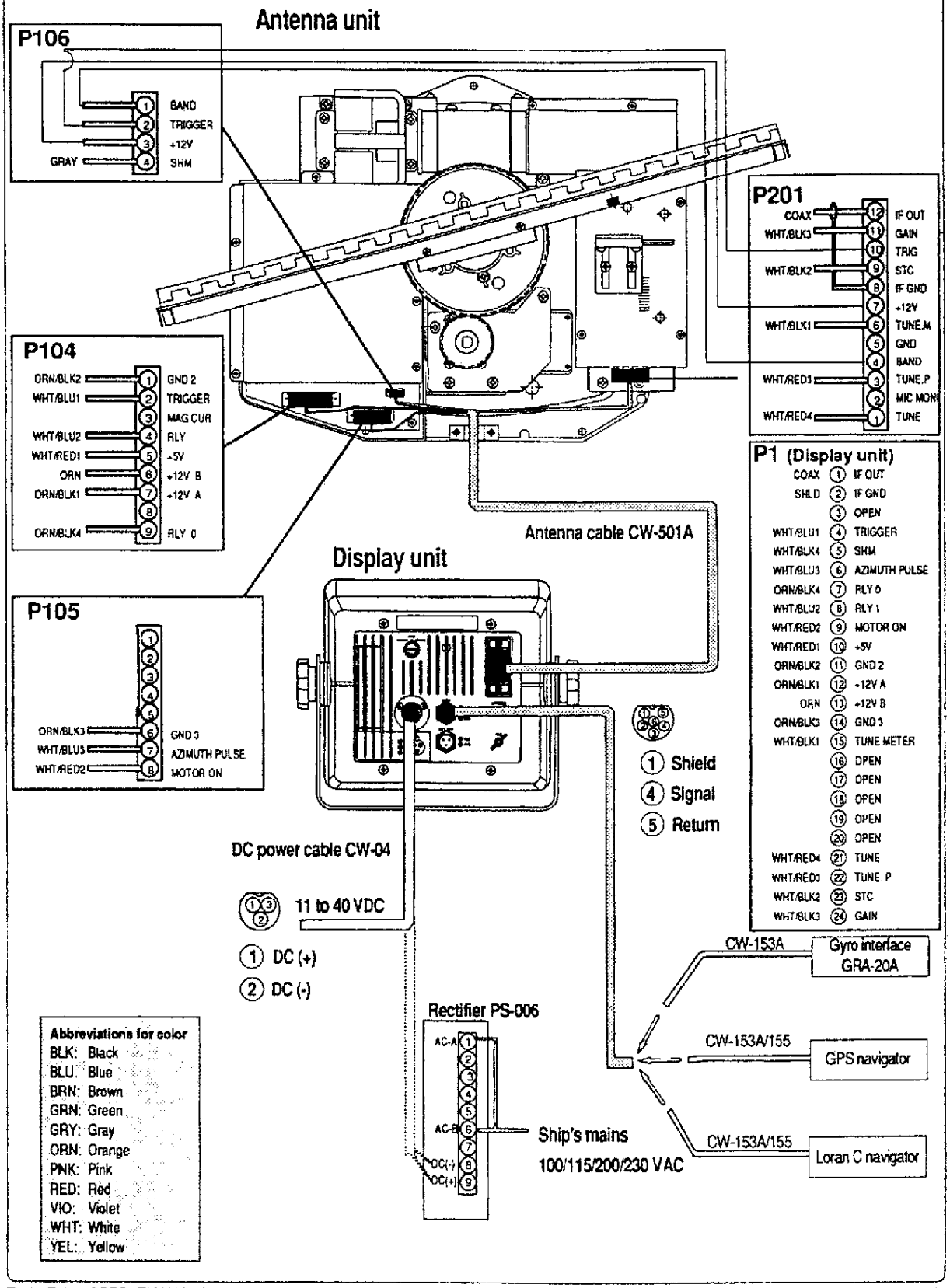


Interconnection Diagram - *T-180*

For antenna cable CW-501 (coating color: white)

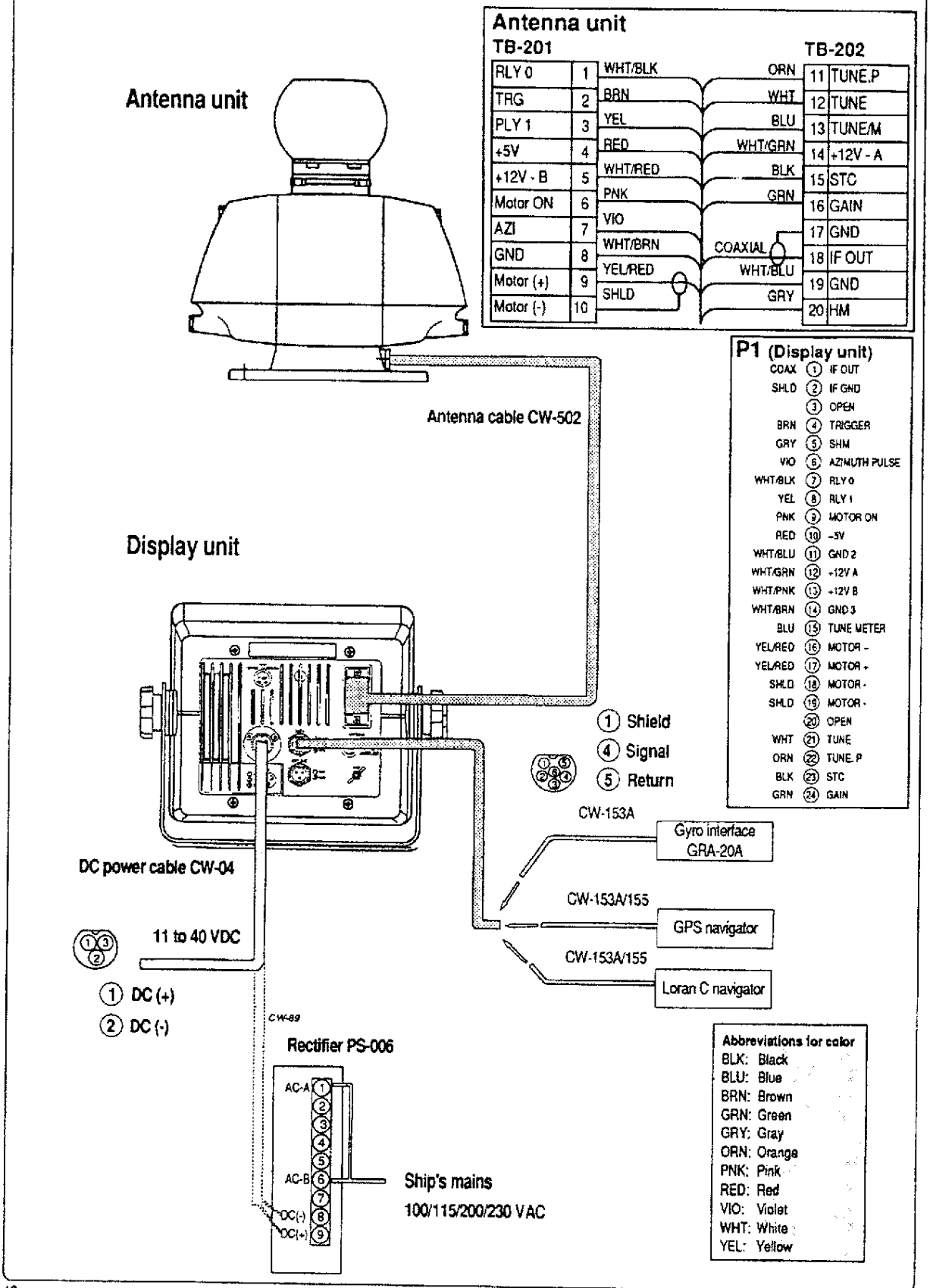


For antenna cable CW-501A (coating color: gray)

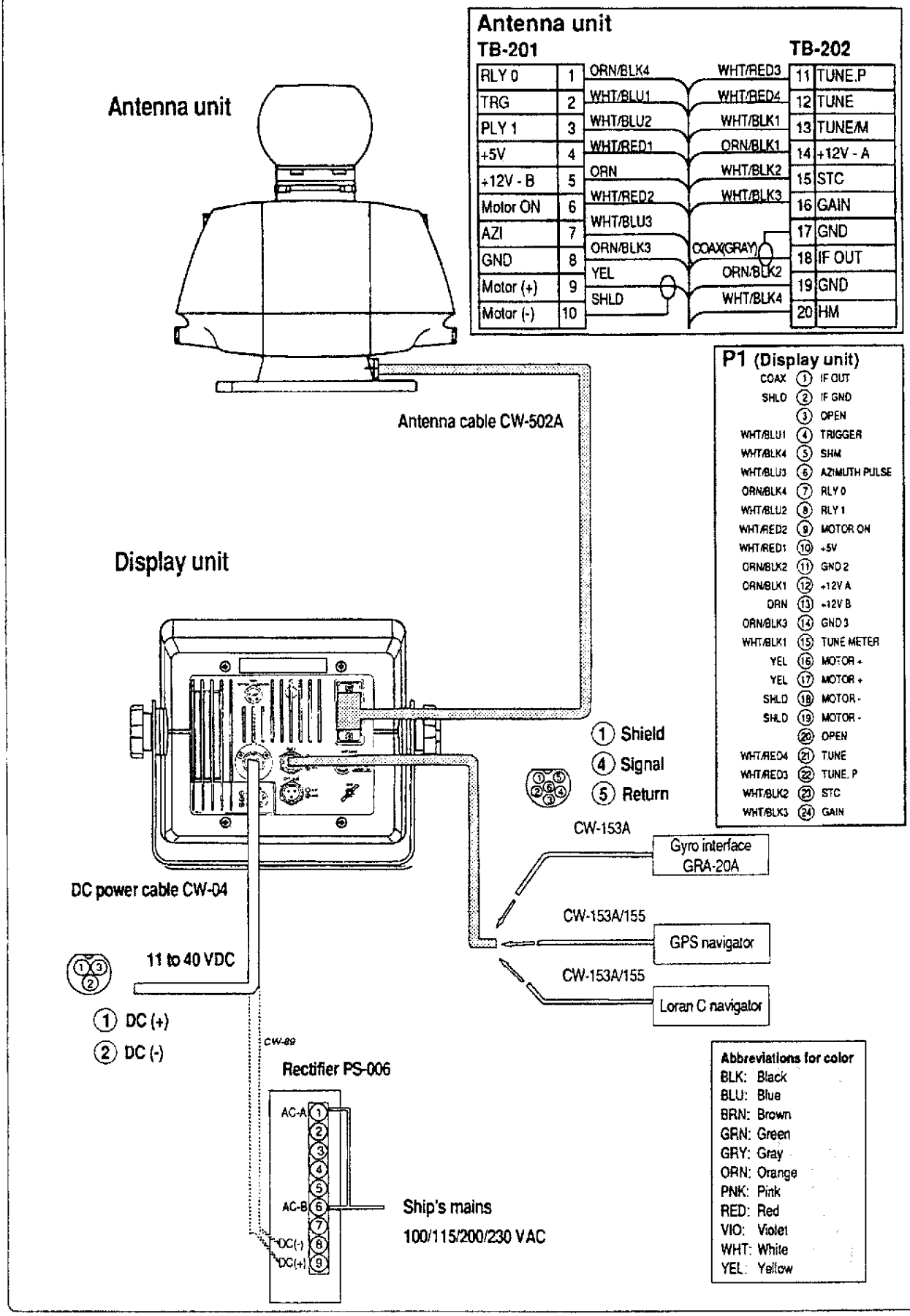


Interconnection Diagram - *T-280*

For antenna cable CW-502 (coating color: white)



For antenna cable CW-502A (coating color: gray)



Installing Antenna Unit - *T-180*

Install the antenna unit at a place where:

- Neither funnel nor mast exists in the direction of the bow.
- Neither funnel nor ventilator exists around the antenna unit.

1. Make four bolts on the mounting plate using "Template for antenna unit mounting" attached.
2. When packing the antenna, four hexagonal bolts and washers are attached with spacers as shown in Fig. 1. When the bolts are released after unpacking, the spacers become useless. Place the antenna on the mounting plate and securely fix it with the bolts from the bottom as shown in Fig. 2.

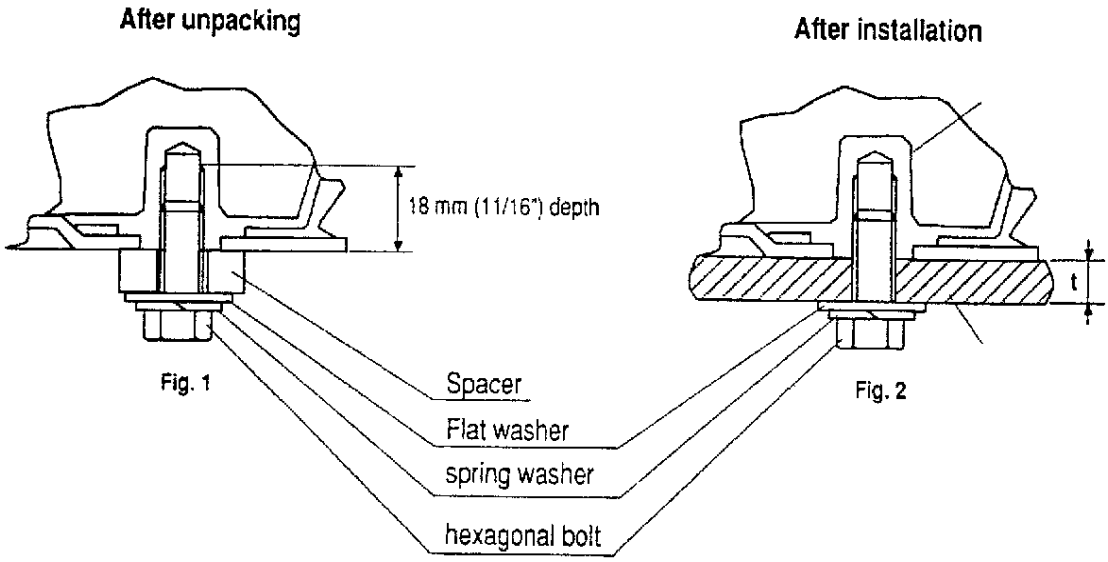


Fig. 1 Fig. 2

3. The bolt size vaies according to the thickness of mounting plate. (See Table 1) M10x25U bolts for 5 to 10 mm plate are supplied as the standard installation materials.
4. We recommend the mounting plate with a thickness to meet standard bolt.
   If thicker mounting plate is used, please otherwise procure corresponding longer bolts.

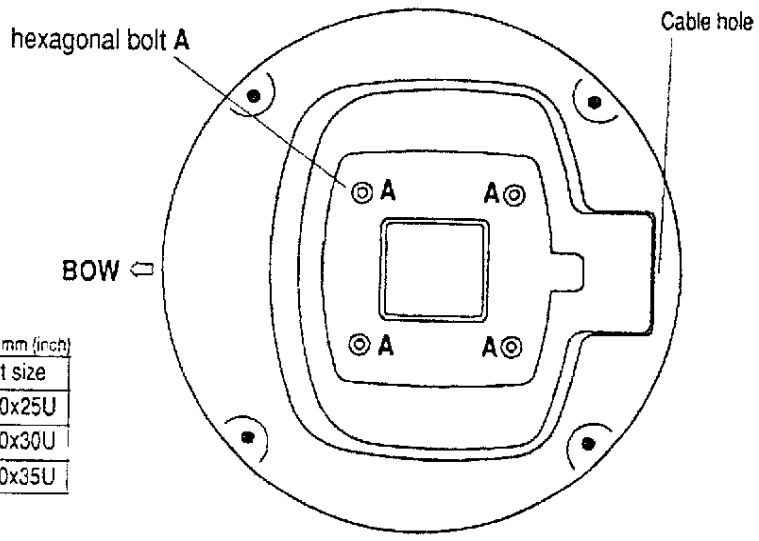


Table 1

Unit: mm (inch)

Thickness of mounting plate (t)	Bolt size
5 mm to 10 mm (3/16 to 3/8)	M10x25U
11 mm to 15 mm (7/16 to 9/16)	M10x30U
16 mm to 20 mm (5/8 to 3/4)	M10x35U

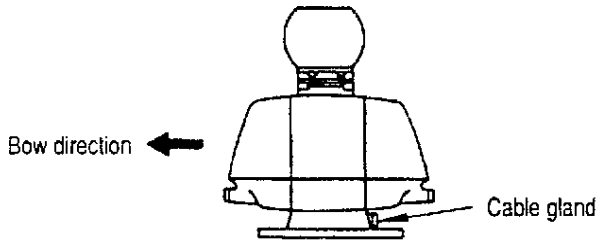
Installing Antenna Unit - *T-280*

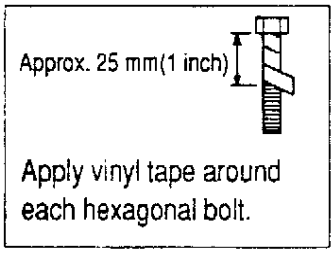
Install the antenna unit at a place where:

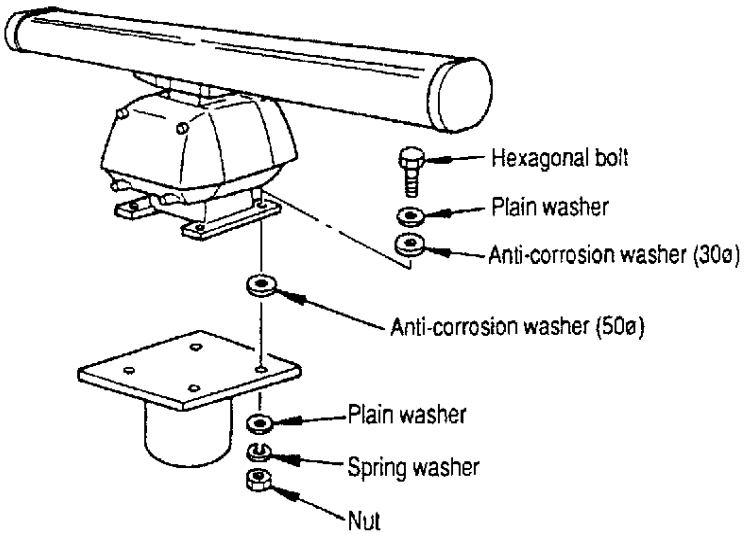
- Neither funnel nor mast exists in the direction of the bow.
- Neither funnel nor ventilator exists around the antenna unit.

1) Place antenna unit onto the mounting plate with arrow mark aligned with bow.
   Recommendable thickness of antenna mounting plate: 5 to 10 mm (1/4 to 3/8 inch)

2) Fix the antenna unit by using four sets of bolts (B12 x 60), spring washers, plain washers, anti-corrosion washers supplied as installation materials.







APPENDIX A: Antenna Height and Distance Table (unit: n.m.)

		Antenna Height (Meters)				
		5	10	15	20	25
Target Above Sea Level (meters)	0	4.96	7.02	8.59	9.93	11.10
	5	9.93	11.95	13.56	14.89	16.06
	10	11.98	14.04	15.62	16.95	18.12
	15	13.56	15.62	17.20	18.53	19.69
	20	14.89	16.95	18.53	19.86	21.03
	25	16.06	18.12	19.69	21.03	22.20
	30	17.12	19.17	20.75	22.09	23.26
	35	18.10	20.15	21.73	23.06	24.23
	40	19.00	21.06	22.64	23.97	25.14
	45	19.86	21.91	23.49	24.82	25.99
	50	20.66	22.72	24.29	25.62	26.80
	55	21.43	23.48	25.06	26.39	27.56
	60	22.16	24.22	25.79	27.12	28.30
	65	22.86	24.92	26.50	27.82	29.00
	70	23.54	25.59	27.17	28.50	29.67
	75	24.19	26.25	27.82	29.15	30.33
	80	24.82	26.88	28.45	29.78	30.96
	85	25.43	27.49	29.07	30.39	31.57
	90	26.03	28.08	29.66	30.98	32.16
	95	26.60	28.66	30.24	31.56	32.74
	100	27.16	29.22	30.80	32.13	33.30
	105	27.71	29.77	31.35	32.67	33.85
	110	28.25	30.30	31.88	33.21	34.38
	115	28.77	30.83	32.41	33.73	34.91
	120	29.28	31.34	32.92	34.25	35.42
	125	29.78	31.84	33.42	34.75	35.92
	130	30.28	32.33	33.91	35.24	36.41
	135	30.76	32.81	34.39	35.72	36.89
	140	31.23	33.29	34.87	36.20	37.37
	145	31.70	33.75	35.33	36.66	37.83
	150	31.15	34.21	35.79	37.12	38.29

APPENDIX B: NMEA-0183 Input Format

Input sentence descriptions

The following input formats are available for displaying own boat's position readings or presenting north-up or course-up mode.

Descriptions	Contents of data fields
GPGLL (LC)GLL	**Latitude, longitude** $GP GLL, XXXX.XX, N/S, XXXXX.XX, E/W CR LF (LC) Latitude (XX° XX.XX') Latitude (N) or Latitude (S) Longitude (XXX° XX.XX') Longitude (E) or Longitude (W)
GPGTD (LC)GTD	**LOP' TD's** $GP GTD, XXXXX.X, , XXXXX.X, , CR LF (LC) Time difference: µsec (LOP 1) Time difference: µsec (LOP 2)
GPVTG (LC)VTG	**Actual track and ground speed** $GP VTG, XXX, T, XXX, M, XX.X, N, XX.X, K CR LF (LC) Track degree True Track degree Magnetic Speed Knots Speed Kilometers/Hr

GPHDT (LC)	**True, Present** $GP HDT, XXX. , T CR LF (LC) Heading degree True
GPHDM (LC)	**Magnetic, Present** $GP HDM, XXX. , M CR LF (LC) Heading degree Magnetic
GPHSC (LC)	**Steering Heading** $GP HSC, XXX. , T, XXX. , M CR LF (LC) Heading degree True Heading degree Magnetic
GPHCC (LC)	**Compass Heading** $GP HCC, XXX. CR LF (LC) Heading degree
GPVHW (LC)	**Heading and water Speed** $GP VHW, XXX. , T, XXX. , M, XX.X, N, XX.XX, K CR LF (LC) Heading degree True Heading degree Magnetic Heading degree Speed Knots Speed Kilometer/Hr

APPENDIX C: Glossary

Bearing — The direction to a target, generally expressed in degrees. If expressed as relative bearing, the measurement would be in degrees with the vessel's bow as 0 degrees. The bearing given in degrees magnetic would be in reference to the direction measured by a compass. Bearing in degrees true measures direction to an object or target with reference to correct geographic North and South.

CRT — Cathode Ray Tube. Used to display radar images. Similar in theory and function to a television picture tube

EBL — Electronic Bearing Line. Used to measure relative bearing to a target on the radar CRT display.

FTC — Fast Time Constant. Refers to the FTC key which changes the time constant of the video input circuit in order to increase the visibility of a target in rain, fog, snow and clouds.

Gain — The level of amplification of a signal. In radar,the gain control controls the amount of amplification of the received, reflected signal.

HM — Heading Marker. Indicates to the radar operator the direction of the vessel's bow.

Interference – Signals produced by outside sources received by the radar that produces undesirable display images.

Microwave — R.F. (Radio Frequency) signals of very short wave length. Usually wave lengths between 1 meter and 1 millimeter.

Radar — An acronym that stands for Radio Detecting And Ranging.

Range — The distance to a target.

Refraction — The bending of microwave signals as they travel through the atmosphere.

Resolution — The measure of a radar transceiver's and display's ability to differentiate between two targets at a minimum separation.

Standby — Stand By. An operating mode that maintains power to the display and T/R unit, but there are no microwave transmissions.

STC — Sensitivity Time Constant. Abbreviation for the control used to reduce sea clutter. This control reduces sensitivity of the receiver for close-in returns.

Transceiver — A transmitter and receiver built into one package.

Antenna unit - Combination of the antenna, transmitter, and receiver which is the portion of the radar system mounted on the outside of the vessel (on a mast, top of wheel house, etc.)

VRM — Abbreviation for Variable Range Marker. An electronic circular cursor that aids in estimating the range to a specific target.

CERTIFICATE OF LIMITED WARRANTY

Providing you present a valid proof of purchase, SI-TEX Marine Electronics Inc. warrants all parts of each new product against defect in material and workmanship under normal use and will repair or exchange any parts proven to be defective at no charge for a period of two years for parts and one year for labor from the date of purchase, except as provided below under Limited Warranty Exceptions.

Defects will be corrected during normal working hours by an authorized SI-TEX Marine Electronics Inc. dealer, service center, or at the SI-TEX office in St. Petersburg, Florida. There will be no charge for labor for a period of one year from the date of purchase, except as provided below under Limited Warranty Exceptions.

This Warranty and Proof of Purchase must be made available to the authorized SI-TEX Marine Electronics Inc. service location or dealer at the time of service.

LIMITED WARRANTY EXCEPTIONS

SI-TEX Marine Electronics Inc. will not be responsible for equipment which has been subjected to water or lightning damage, accident, abuse, or misuse nor any equipment on which the serial number label has been removed, altered or mutilated.

SI-TEX Marine Electronics Inc. assumes no responsibility for damage incurred during installation.

This Limited Warranty is effective only with respect to the original purchaser.

Any cost associated with transducer replacement, other than the cost of the transducer itself, is specifically excluded from this Limited Warranty.

Travel cost incurred will not be accepted for SI-TEX Marine Electronics Inc. products.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION OF THE FACE HEREOF.

SPECIFIC EXCLUSIONS

Charges for overtime, stand-by, holiday, and per diem are specifically excluded from the Limited Warranty.

Chart paper, stylus, stylus belt, lamps, and fuses are consumable items and are not covered by this Limited Warranty.

Installation workmanship or materials except as provided directly by SI-TEX Marine Electronics Inc. are not covered by this Limited Warranty.

SI-TEX Marine Electronics Inc. equipment or parts thereof which have been repaired or altered except by an authorized SI-TEX Marine Electronics Inc. dealer or service center are not warranted in any respect.

Transducer, software update, battery, microphone, magnetron, and microwave components and water damage on water resistant VHF radio are items excluded from the two-year warranty and are covered by warranty for a period of one year for both parts and labor.

SI-TEX Marine Electronics Inc. will not, at any time, assume any costs or labor charges for checkout or external line fuse replacement or problems not found to be at fault in equipment itself.

THERE ARE NO WARRANTIES OR GUARANTEES EXPRESSED OR IMPLIED WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY. SI-TEX MARINE ELECTRONICS INC. HAS NO OTHER LIABILITY TO PURCHASE FOR DIRECT OR CONSEQUENTIAL DAMAGE OR ANY THEORY INCLUDING ABSOLUTE LIABILITY, TORT, OR CONTRACT. THIS LIMITED WARRANTY CANNOT BE ALTERED OR MODIFIED IN ANY WAY AND SHALL BE INTERPRETED IN ACCORDANCE WITH THE LAWS OF THE STATE OF FLORIDA. THIS WARRANTY IS LIMITED TO THE CONTINENTAL U.S.A., ALASKA, HAWAII, AND CANADA.

HOW TO OBTAIN SERVICE UNDER THIS WARRANTY

To provide better flexibility, SI-TEX Marine Electronics Inc. gives you the option of obtaining service under this warranty by either:

a) Contacting an authorized SI-TEX Marine Electronics Inc. service station (The closest service station may be found by contacting your dealer of purchase.)

or

b) Shipping your equipment prepaid via UPS or truck with insurance prepaid to SI-TEX Marine Electronics Inc. at the address provided below. SI-TEX Marine Electronics Inc. will, whenever possible, make all repairs covered by Limited Warranty within two weeks of receiving the equipment in Florida and return same to you, freight prepaid.

c) You must present a copy of your Purchase Sales Slip at the time you request warranty service.

Shipping/Mailing Address:

SI-TEX Marine Electronics Inc.
11001 Roosevelt Blvd., Suite 800
St. Petersburg, FL 33716
727-576-5734

SI-TEX Marine Electronics Inc. offers a complete line of quality marine electronics including fishfinders, electronic charting systems, radars, autopilots, GPS/WAAS/Loran receivers, SSB receivers, direction finders, VHF radios, VHF marine & TV antennas, and integrated systems. For more information, contact your SI-TEX dealer or the main office, located in St. Petersburg, Florida.