

# NRB-2J

## DGPS BEACON RECEIVER

### INSTRUCTION MANUAL

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**JRC** *Japan Radio Co., Ltd.*

## ***INTRODUCTION***

Congratulation on your purchase of the NRB-2J DGPS Beacon receiver. This manual contains very important information on the installation, operation, and maintenance of your new equipment. In order to get the best results in operation and performance, please take the time to read this manual thoroughly.

## ***PRECAUTIONS***

In this manual, graphic symbols are employed to ensure its proper use and to prevent personal injury or damage to property. Read the following descriptions on the graphic symbols before using the manual.



**CAUTION**

*Denotes a danger that can cause personal injury or physical damages if this sign is ignored whilst system is in operation.*



## CAUTION

- Use the NRB-2J DGPS Beacon Receiver according to this instruction manual. Improper operation will not provide full performance.
- In case of failure, turn off the power and disconnect the connection cables.
- DO NOT open the upper housing. Refer servicing to a nearest JRC branch office or JRC agent. The servicing by unqualified personnel can result in failure or malfunction.
- This device is only an aid to navigation. Its accuracy can be affected by many factors including equipment failure or defects, environmental conditions, and improper handling or use. It is the user's responsibility to exercise common prudence and navigational judgment, and this device should not be relied upon as a substitute for such prudent and judgment.
- DO NOT connect this device to other manufacturer's GPS sensor or GPS navigation equipment. Otherwise, failure or malfunction can result.

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## 1. GENERAL

### Abbreviations

DGPS = Differential Global Positioning System

RTCM = Radio Technical Commission for Maritime Services  
SC-104 = Special Committee No.104

DDS = Direct Digital Synthesizer

RSSI = Receiving Signal Strength Indicator

MSK = Minimum Shift Keying

TTL = Transistor Transistor Logic

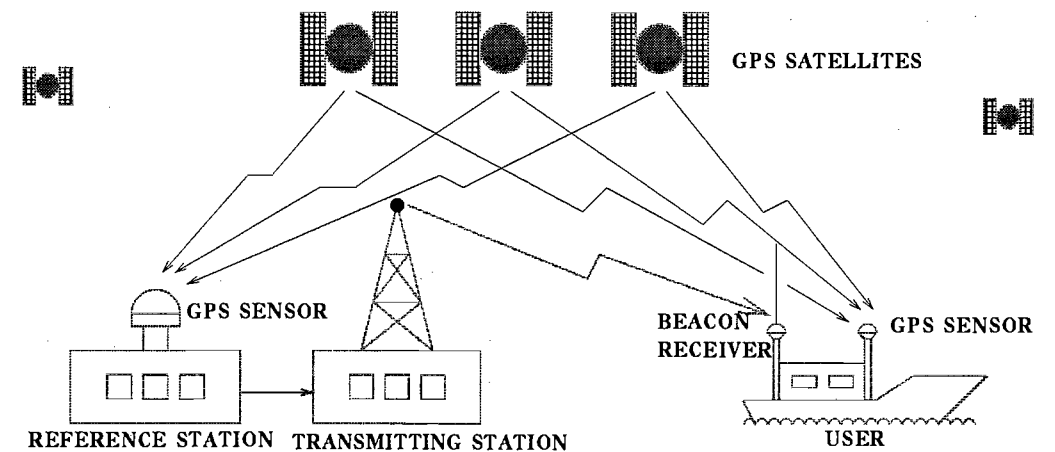
### 1.1 General Description on DGPS

The Differential Global Positioning System (DGPS) includes reference station, its positions (latitude and longitude) are accurately known, transmitting station that broadcasts GPS correction data by radio, and user's GPS sensor having DGPS mode and DGPS beacon receiver.

The reference station measures the position using a GPS receiver and compares the measured position with the actual position of the reference station to detect position errors.

The reference station transfers the detected errors as GPS correction data to the transmitting station.

The transmitting station broadcasts the GPS correction data to the users around it. The broadcasted GPS correction data are received by the user's beacon receiver, and send it to the GPS sensor. The GPS sensor corrects the positions measured by itself on the basis of GPS correction data. The DGPS system that has introduced the above procedure is a new GPS system that can measure position by an error of 1/10 or less as slight as the position accuracy of the current GPS system.



DIFFERENTIAL GPS SYSTEM

## 1.2 Features of the NRB-2J

When the NRB-2J Beacon receiver is connected with the GPS sensor having the DGPS mode, the position accuracy of GPS sensor will be improved from approximately 100 m or less to 10 m or less. The NRB-2J Beacon receiver has major features listed below :

### (1) Compact size with antenna combined

The Beacon receiver is installed outside together with whip antenna. The power consumption is less than 3.2W.

### (2) RTCM SC-104 compatibility

The output data of the receiver conforms to the RTCM SC-104 format widely used in the world. The Beacon receiver can be connected with the GPS navigation unit having the DGPS mode, however the interface level and transmission rate of the GPS navigation unit must conform to those of the Beacon receiver.

### (3) DDS (Direct Digital Synthesizer)

The local signals applied to the receiver circuit are generated by DDS ICs for excellent response time and C/N (carrier to noise ratio).

### (4) Tuning operation in automatic and manual operation modes

The Beacon receiver tunes to the optimum transmitting station only by connecting with the optional DGPS interface and turning on the power. When the Beacon receiver is connected with the JRC's NWZ-4550 GPS display, the automatic operation mode or manual operation mode is selectable and the RSSI is displayed.

- Automatic operation mode: Automatically tunes to the transmitting station.
- Manual operation mode: Speedily selects a desired transmitting station by entering frequency and baud rate.

### (5) Automatic memory function for almanac message

When the DGPS system is operated formally, the transmitting stations will broadcast the almanac messages, such as their frequencies, baud rates and station health (operation states of the transmitting stations). The beacon receiver automatically registers the almanac message to select the optimum transmitting station in the automatic operation mode.

## 1.3 Specifications

### 1.3.1 Signal Processing

- (1) Frequency range: 283.5 to 325.0 kHz in automatic operation mode  
275.0 to 335.0 kHz in manual operation mode
- (2) Frequency resolution: 100 Hz
- (3) Local oscillation: DDS
- (4) Minimum signal strength:  $5 \mu$  V/m
- (5) Dynamic range: > 90 dB
- (6) Minimum SNR (signal-to-noise ratio): 12 dB
- (7) Adjacent channel rejection: > 26 dB at 500 Hz offset
- (8) Acquisition time: < 30 sec. at 12 dB SNR

### 1.3.2 Data Processing

- (1) Demodulation: MSK
- (2) Data decoding: Differential detector
- (3) Rf bit rate: 50, 100 and 200 baud in automatic operation mode  
25, 50, 100, 110, 150, 200, 250, and 300 baud in manual operation mode.
- (4) Error detection: Parity error check

### 1.3.3 Power Requirements

- (1) Input voltage  
Rated +12 Vdc (input voltage ranges from + 10.8 to +16 Vdc), negative grounded
- (2) Power consumption: 3.2 W max

### 1.3.4 Equipment Interface

- (1) Output data format: RTCM SC-104 format
- (2) Interface levels: 0 V (Mark) and +5 V (Space), TTL level
- (3) Transmission rate: 4,800 baud (both transmission and reception)
- (4) Transmission format: Asynchronous serial data transmission, with 1 start bit, 8 data bits, 0 parity bit and 1 stop bit
- (5) Command data protocol: 6-of-8 format

1.3.5 Operating Temperature Range: -15 to +55 °C

### 1.3.6 Mechanical Specifications

- (1) Antenna: 4 foot whip antenna (stainless steel)
- (2) Connection cable: 5-core shielded cable (attached to receiver), measuring  $6.0 \pm 0.2$  mm outside diameter and  $15\text{m} \pm 0.5$  m long
- (3) Dimensions: 110 (Dia) × 129 (H) mm (without antenna)
- (4) Weight: Approx. 1.3 kg (including connection cable, excluding antenna)

## 2. COMPONENTS

### 2.1 Standard Components

Item	Model or Code	Q'ty	Remark
Beacon receiver	NRB-2J	1	With connection cable
Whip antenna	CODE 314	1	4 feet
Antenna mounting adapter	MPBP30376	1 set	Fixture for fixing the Beacon Receiver (Adapter, Spacer, Belt for clamp)
Instruction manual	H-6ZPJD00193	1	in English

### 2.2 Options

Item	Model or Code	Application & Components
DGPS interface	NQA-1481D	For setting manually around Japan only ( With Instruction manual, Connection cable, etc.)
DGPS interface	NQA-1572	For setting manually and automatically throughout the world ( With Instruction manual, Connection cable, etc.)

### 3. INSTALLATION

To afford full performance of the JRC's NRB-2J Beacon receiver, it has to be mounted in a proper manner. This section explains how to install the NRB-2J on a ship.

#### 3.1 Selecting the Location

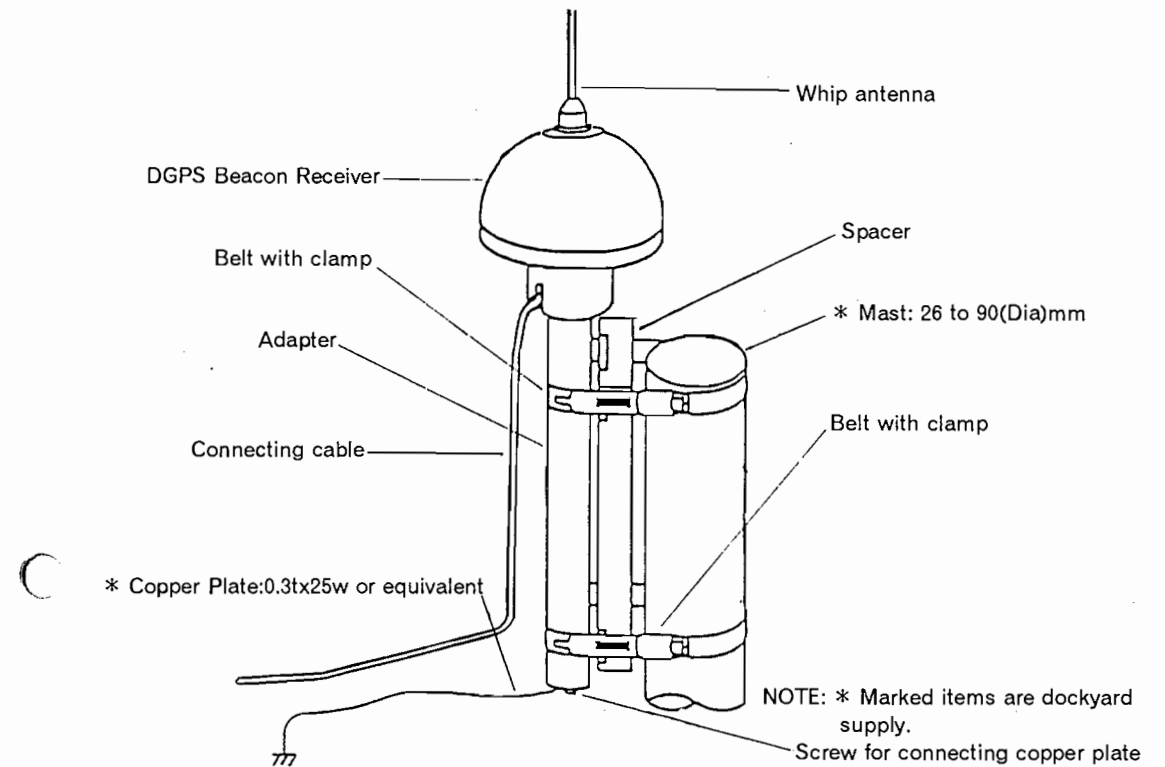
The GPS correction signal broadcasted by the transmitting station propagates along the earth's surface. For this reason, if there exist antennas of other equipment and metallic articles between the transmitting station and the Beacon receiver, this can cause the Beacon receiver not to receive the GPS correction data at any location capable of receiving. A preferred mounting location for the Beacon receiver on the ship is in an area that is relatively free of obstructions and separated from other antennas. For example, the top of the mast of the ship becomes the most preferable mounting location. Selecting this kind of location will enable the Beacon receiver to receive the GPS correction data as long as the ship is in the receivable area.

In addition, consideration must be given for running the connection cable. The cable should be connected in a direct path to an external device such as the DGPS interface and run in a manner so as to keep the cable separated from other shipboard cables as much as possible to prevent the connection cable from being interfered by the signals from these cables. If the connection cable does not keep apart from the other shipboard cables, this can cause the DGPS system not to make DGPS operation even if the Beacon receiver receives the GPS correction data.

#### 3.2 Installation Procedures

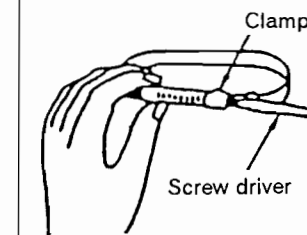
##### 3.2.1 Installing the Beacon Receiver

Beacon receiver should be installed using the supplied antenna mounting adapter. For installation, see Figure 3.1.

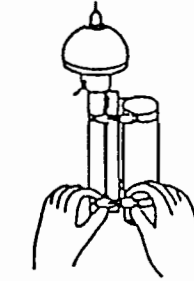


#### INSTALLATION PROCEDURE

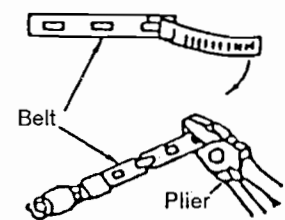
1. Loosen the screw of the belt with a screw driver and remove the clamp.



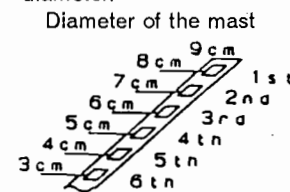
2. Wind the belt around the mast as show.



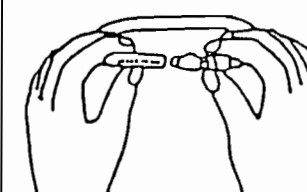
3. Cut out the extra part of the belt with a plier.



4. The maximum diameter of the mast is 9cm. Cut the belt at the square hole corresponding to the mast diameter.



5. After cutting the belt, wind the belt around the adapter and the mast.



6. Tighten the screw of the clamp by using a screw driver.

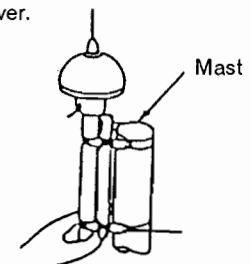



Figure 3.1 Installation of the NRB-2J DGPS Beacon receiver



### 3.2.2 Mounting the Whip Antenna


Screw the supplied whip antenna into the top of the proper Beacon receiver by hand. Then, tighten the whip antenna with a proper sized wrench.



**CAUTION** *If the whip antenna is not securely mounted, the Beacon receiver may not receive the GPS correction data at any location capable of receiving.*

### 3.2.3 RF-grounding

Because the Beacon receiver uses the whip antenna, it must be RF-grounded. Screw for RF-grounding is provided at the bottom of the adapter of the supplied antenna mounting adapter set. Though the grounding method is different depending on ships, direct connection should be made between the grounding screw on the adapter and the object grounding such as sea water grounding plate, using a grounding material (copper plate of 0.3 mm thick by 25 mm wide).



**CAUTION** *If the RF-grounding is not made or made in an improper manner, the Beacon receiver may not receive the GPS correction data at any location capable of receiving.*

### 3.3 External Connection

Connection of the NRB-2J Beacon receiver with an external device should be made with the connection cable already connected to the Beacon receiver. Figure 3.2 shows an example of connection of the Beacon receiver with the optional GPS display. Figure 3.3 shows another example of the Beacon receiver with DGPS interface. Figure 3.4 shows the pin arrangement of the connector equipped at the connection cable. The DGPS interface and connection cable are different depending on the GPS navigation unit that accepts the GPS correction data received by the Beacon receiver. However, the +12 Vdc power for the Beacon receiver is supplied from the DGPS interface or GPS navigation unit irrespective of the GPS navigation unit connected. The GPS correction data received by the Beacon receiver are fed to the external GPS receiver through pin 4 of the connector. For the connection with the external units, see the instruction manual for the DGPS interface or GPS navigation unit.

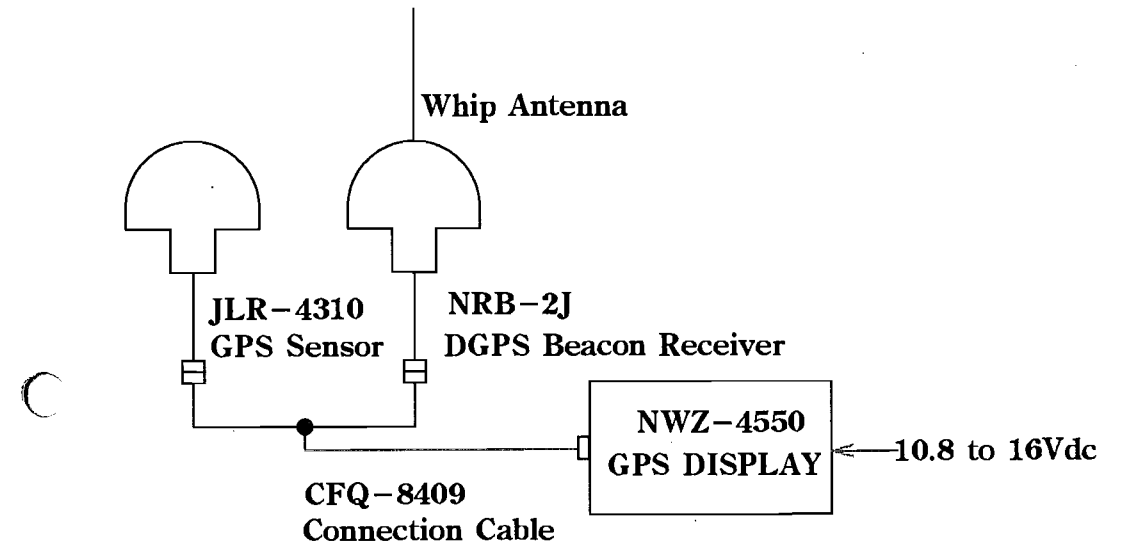


Figure 3.2 Example 1 of connection with external unit

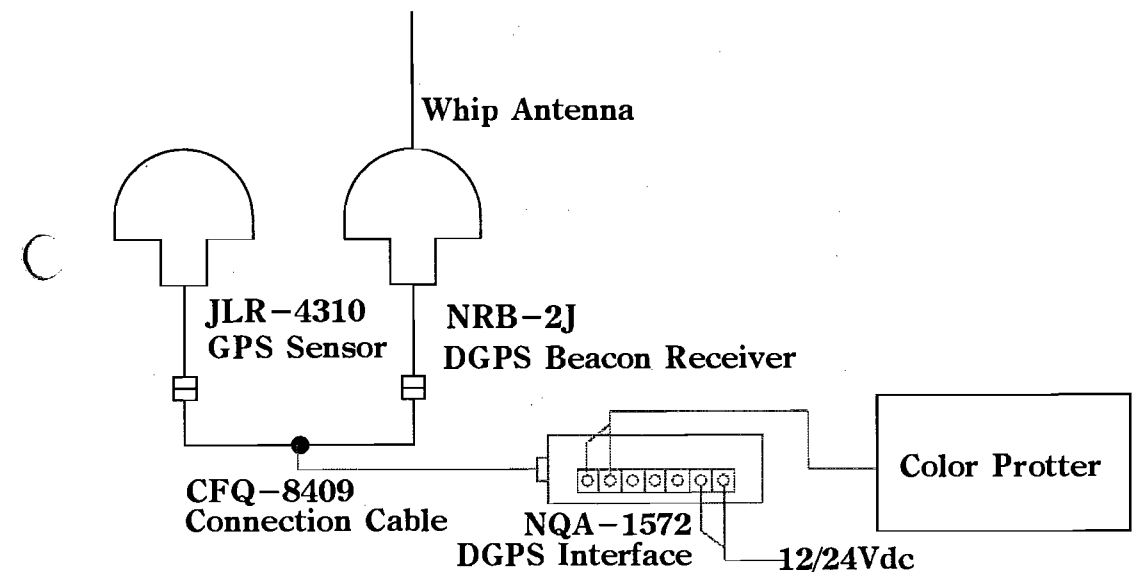


Figure 3.3 Example 2 of connection with external unit

## 4. OPERATING INSTRUCTION

### 4.1 Automatic Operation Mode

The NRB-2J Beacon receiver is normally started in the automatic operation mode by turning on the power. The automatic operation mode continues until the command for switching to the manual operation mode is input to the Beacon receiver from an external unit. In sequence of automatic operation, the Beacon receiver searches the beacon frequency band in which the GPS correction signals are broadcasted to tune to the optimum transmitting station. When tuning the transmitting station that is broadcasting the GPS correction signal, the Beacon receiver analyzes the received GPS correction data. When having received an almanac message during the analysis, the Beacon receiver judges whether the near transmitting station should be registered or not depending on the operation state of the beacon station that is contained in the message. When it is registered, the Beacon receiver decides the transmitting station to be tuned depending on a result of comparison of the RSSI of transmitting station in tuning with the RSSI of the near transmitting station. If having judged that the GPS correction signal cannot be received as the RSSI is lower than a certain level, the Beacon receiver deletes the registration of the transmitting station. Since the transmitting station is registered as long as the RSSI is not lower than a certain level or the power is not turned off. When the operation is switched to the manual mode before being set to the automatic operation mode again, the Beacon receiver judges whether the GPS correction signal from the registered transmitting station can be received or not. If the GPS correction signal from the registered transmitting station cannot be received, the Beacon receiver performs the same operation as the power is turned on to tune the transmitting station.

- NOTE 1 :** *As for the period of time until the Beacon receiver tunes to the transmitting station in automatic operation mode, it is affected by the atmospheric noises and the interference signals in the beacon frequency band.*
- NOTE 2 :** *When connected with the DGPS interface, the Beacon receiver tunes to the transmitting station only by turning on the power, but the Beacon receiver does not always operate in automatic operation mode.*

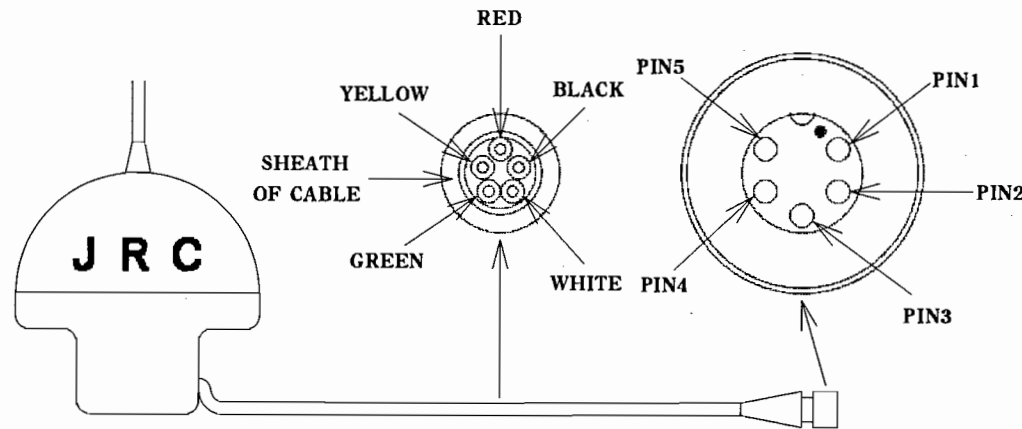


Figure 3.4 Pin arrangement of the connector

Pin No.	Wire Color	Application & Description	Suitable External unit & Connection cables
1	Red	+12 Vdc Positive input of dc power	DGPS interface • NQA-1481D • NQA-1572
2	Black Sheath	Negative (ground) input of dc power	
3	White	Common for signals	
4	Green	TTL output of GPS correction data 0 V (Mark) and +5 V (Space)	Connection cable • CFQ-8409 • CFQ-8411 • CFQ-2676
5	Yellow	TTL input of receiver control signal	

## 4.2 Manual Operation Mode

When the manual operation mode switching command is input to the NRB-2J Beacon receiver from an external unit, the Beacon receiver keeps a certain frequency and baud rate. The set frequency and baud rate are contained in the manual operation mode switching command. Since the Beacon receiver does not analyze the received GPS correction data in the manual operation mode, it does not register the near transmitting station even if having received an almanac message. However, the Beacon receiver will securely receive the GPS correction data as long as it is set at the frequency and baud rate of the transmitting station that is receivable in the manual operation mode.

## 5. OPERATION

The NRB-2J Beacon receiver has no switches and controls that you have to handle directly. Operation of the Beacon receiver is different depending on the external unit connected. The Beacon receiver can be ordinarily operated only by turning on the power, but does not need any handling for tuning in optimum transmitting station. When the Beacon receiver is connected with the NWZ-4550 GPS display, you can select two mode: automatic operation mode that the Beacon receiver automatically tunes to the optimum transmitting station; and manual operation mode that the Beacon receiver tunes a specific transmitting station with the frequency and baud rate selected by user. You also can display the RSSI specific to the Beacon receiver on the edisplay of the NWZ-4550. Details of the operating procedures are different depending on the external unit connected. See the instruction manual for the DGPS interface or GPS display.

## 6. TROUBLESHOOTING

The NRB-2J Beacon receiver undergoes a comprehensive test before being packed and shipped. Should the Beacon receiver fail to function normally, check the following points.

- The power switch of the external unit is turned on.
- There are no obstacles around the Beacon receiver and whip antenna, and the whip antenna is connected vertically.
- The connection cable is securely connected with the external unit.
- The RF-grounding is securely made.

If the Beacon receiver fails to function even after the above checking, immediately disconnect the connection cable of the Beacon receiver from the external unit to stop operation of the Beacon receiver.

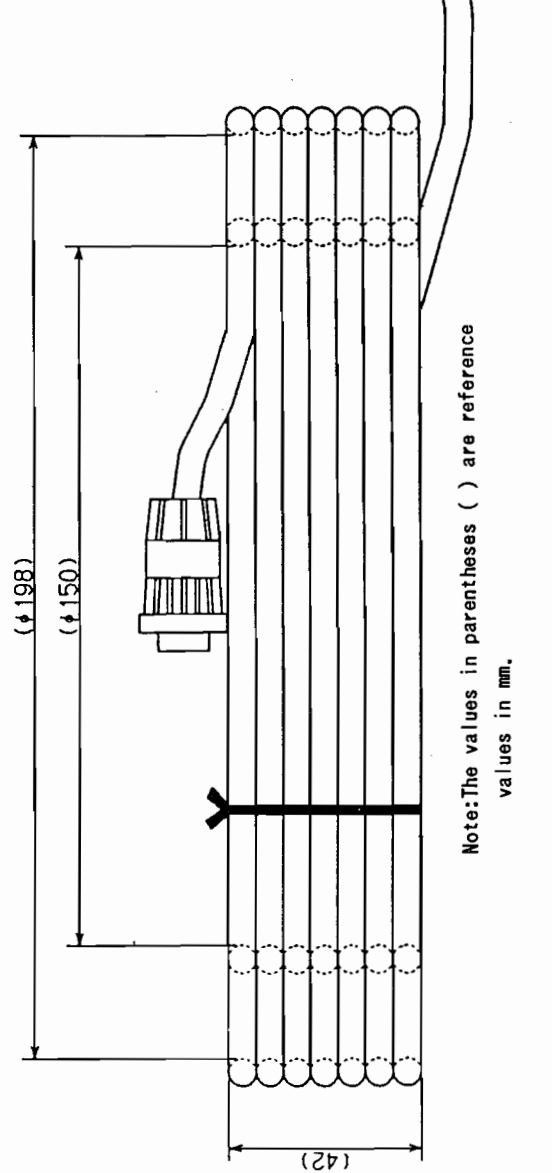
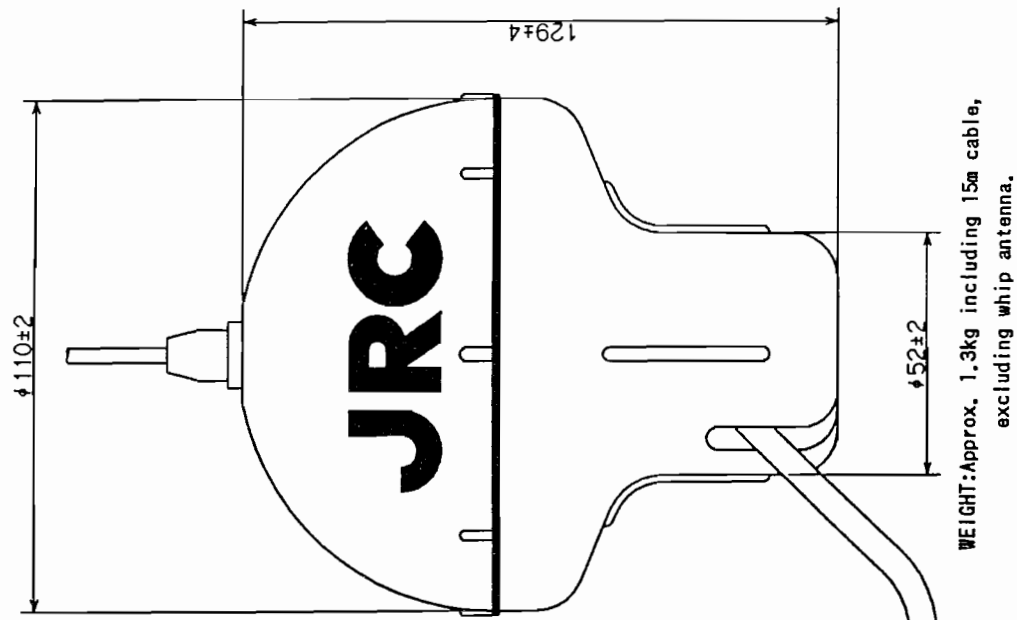
If you order repair of the Beacon receiver, please inform the details of the trouble to JRC or qualified JRC agent.

## 7. MAINTENANCE AND INSPECTION

Operational state of the NRB-2J Beacon receiver depends on the degree of the maintenance and inspection you perform. You should proceed periodically with the simple maintenance and inspection steps listed below.

- Screws of the Beacon receiver for looseness
- Upper housing of the Beacon receiver for damage
- Connection cable for mark of scratch and crack
- Connection cable for secure connection

If the Beacon receiver or connection cable is damaged, this allows adverse effect of sea water to shorten service life of the unit to a great extent. Replace it immediately.



Note: The values in parentheses ( ) are reference values in mm.

NRB-2J DGPS BEACON RECEIVER OUTLINE DRAWING

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