4 Theory

4.1 Principle of Operation

The principle of this product is basically the same as for general radars widely used at present.

Electromagnetic waves are transmitted from the antenna toward the concrete as shown in Figure 4-1. The electromagnetic waves are reflected by an interface with the reflecting objects (e.g., reinforcing steel bars or cavities) whose electrical property is different from that of concrete. The waves are reflected back onto the surface of concrete and received by the receiving antenna placed near the concrete surface. The distance to the reflecting objects can be calculated from the time the reflected waves need to reach the receiving antenna. The horizontal locations of the objects can be detected by moving the main unit on the surface of concrete.

Since this product is designed to probe objects with high resolution that are near from the surface of concrete, it transmits pulse waves having a width of only about one nanosecond (one-billionth of a second) or less.

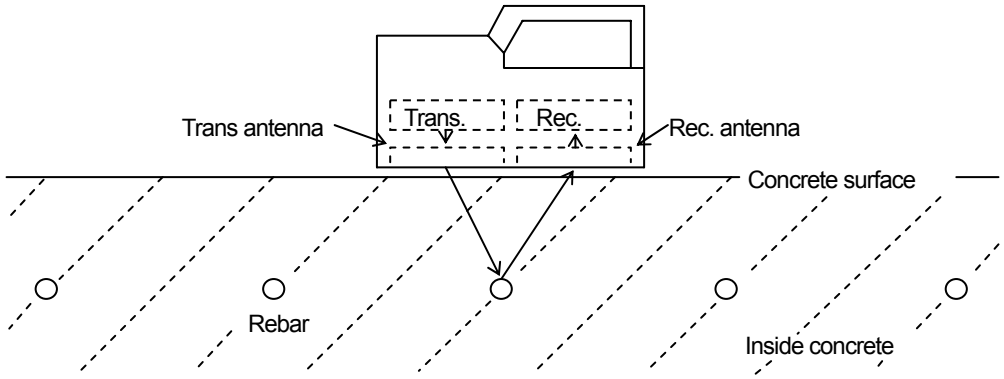


Figure 4-1 Diagram of Principle

Figure 4-2 shows a wave reflected by a reinforcing steel bar or the like in a concrete structure, which is obtained by this product.

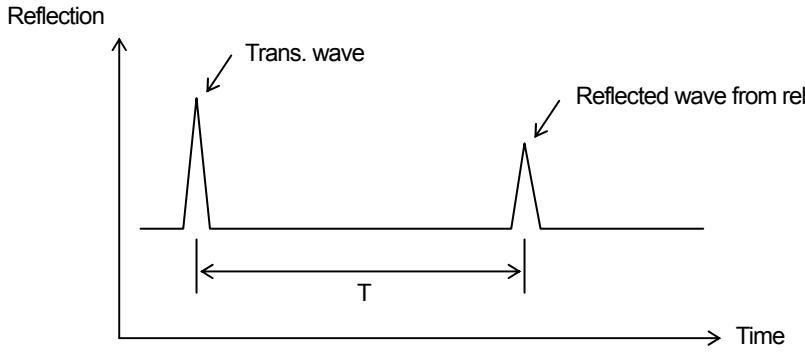


Figure 4-2 Sample of Reflected Waveform

Velocity V of electromagnetic waves in concrete is obtained from the following formula:

$$V = \frac{C}{\sqrt{\varepsilon_r}} \quad (m/s)$$

C: Velocity of electromagnetic waves in vacuum (in air) (3×10^8 m/s)

ε_r: Relative dielectric constant of concrete (6 to 11 in the example)

Distance D to the reflecting object is obtained from the following formula:

$$D = \frac{1}{2} V T \quad (m)$$

4.2 Applicable Conditions

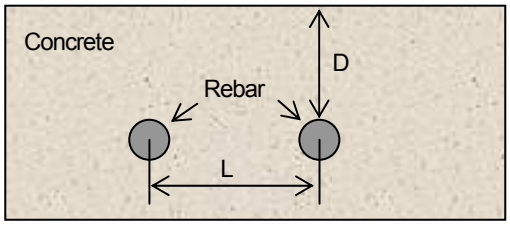
(1) Applicable measuring conditions

(Waves reflected by objects to be scaned in reinforced concrete structures must be received adequately, so the applicable measuring conditions vary slightly depending on the on-site condition.)

○ Search depth (covering depth) within 0.5 ~ 30 cm (for concrete with a relative dielectric constant ＝ 6.2 everywhere and the top rebar of diameter ≧ 6mm)
○ Objects to be probed that are at a depth of less than 75 mm have an interval spacing of at least 75 mm and where the depth of the object to be probed is greater than 75 mm, the interval spacing of the objects is more than the depth
○ Quality of concrete: Uniform
○ Direction of reinforcing steel: Orthogonal to this product's traveling direction

(2) Inapplicable measuring conditions

○ Scan of reinforcing steel or the like in concrete whose surface contains objects such as metal that reflect radio waves
○ Presence of reinforcing steel bars that are parallel to this product's traveling direction
○ Concrete that has a narrow (pitch) arrangement for the interval of rebar in the horizontal direction
(Target: depth less than 75 mm → interval between rebar, less than 75 mm
Depth of greater than 75 mm → interval of rebar less than depth)



D<75mm → L>75mm
D≧75mm →L≦D×0.23
} Difficult to implement

5 Maintenance Inspection

WARNING

Do not attempt to disassemble, modify, or repair this product.
Doing so could cause fire, electric shock, or breakdown.

When the power cord is damaged (exposed core wire, open circuit failure, or broken sheath), please contact our headquarters on Page **81** or our nearest branch office (See Section 9), sales outlet, or service station for a replacement power cord. Use of a damaged power cord could cause fire or electric shock.

Stop using this product immediately when a sign of malfunctioning is detected, and follow only the detailed procedure in this instruction manual. If it cannot be restored to normal operation, contact our nearest branch office (See Section 9), sales outlet, or service station. Use of this product in abnormal state could cause fire or breakdown.

Should this product emit an abnormal sound, odor, or smoke, immediately turn off the power switch, remove the battery pack, disconnect the power plug from the socket outlet, and contact our nearest branch office (See Section 9), sales outlet, or service station.
Use of this product in abnormal state could cause fire, electric shock, or breakdown.

5.1 Daily Inspection

Before attempting to operate this product, confirm that the battery pack, optional equipment cables, and the like are connected correctly and there is no abnormality in appearance.

5.2 Daily Maintenance

Users are not to carry out any maintenance except for cleaning of this product's external surfaces.

Wipe out stains with a soft damp cloth (which was squeezed of any excess water after being soaked in cold or warm water), and then wipe this product with a dry cloth again. Do not use solvents such as thinner, benzine, and alcohol because they may damage the top finish of this product.

5.3 Troubleshooting

This product's states listed below are not always a sign of trouble.

Check for this product again before asking for repair.

Main unit state	Check Items and Response
The main unit cannot be turned on. Nothing is displayed.	• Check if the battery pack is mounted. →Mount a fully charged battery pack according to Section 3.1 Scan preparation. • Check if the battery pack is exhausted. →Mount a fully charged battery pack according to Section 3.1 Scan preparation. • Check if the power plug of the AC adapter is connected. →Connect the AC adapter correctly according to Section 3.1 Scan preparation. • Check if the battery pack is mounted while the output plug of the AC adapter is connected to the AC input connector on this product. →Disconnect the AC adapter according to according to Section 3.1 Scan preparation, and operate this product with the battery pack.
The battery pack is exhausted rapidly.	• Check if the battery pack is charged sufficiently. →Charge the battery pack fully according to Section 3.10.2 Charging Device BC-3008 series. • Has the battery pack itself reached the end of its life? → Exchange it for a new battery pack that is fully charged.
Scanning does not start when the **START** key is pressed.	• Are you at the parameter setting screen? →Return to the scan screen following Section 2.3 Parameter setting screen. • Do you continuously press the **START** key? → Press the **START** key for more than one second. Without pressing the key, continuously, the detection stops automatically..
The B-mode display is advanced when the **START** key is simply pressed.	• Check if time is set to the X-axis parameter (the scan mode). →Set Distance according to Section 2.3.5 X-axis.
The detection is automatically finished during detection .	• Do you continuously press the **START** key? →When you release the **START** key during detection, the detection comes to an end after 8 seconds. (If the **START** key is pressed again within 8 seconds, the detection continues.)

Main unit state	Check Items and Response
No print out when pressing the **OUTPUT** key	•Check if the parameter setting for the external data output is correct. →Set the external data output setting in accordance with Section 3.6 External output methods. •Check if the software DIP switch of the printer is correctly set to **IrDA**. →Set the DIP switch setting to **IrDA** in accordance with the document **Note: Operation of Handy Search NJJ-105 Option Printer DPU-445**.
The message "Turn OFF/ON the printer" is displayed when the **OUTPUT** key is pressed.	• Check if the printer settings have been initialized. →Turn OFF/ON the printer, and press the **OUTPUT** key again to start printing. →Refer to the printer's operation manual for the procedure to initialize the printer.
The message "Charge the printer's battery" is displayed when the **OUTPUT** key is pressed.	• Check if the battery pack is exhausted. →Mount a fully charged battery pack, and press the **OUTPUT** key again to start printing.
The message "No printing paper" is displayed when the **OUTPUT** key is pressed.	• Is the printer out of paper? →Load a new paper roll, and press the **OUTPUT** key again to start printing.
The message "Printer error" is displayed when the **OUTPUT** key is pressed.	• Check if the printer displays an error message. →Eliminate the cause of the printer error according to the printer instruction manual.
"CF Not Available" message appears if the **CF** key is pushed	• Has the CF memory been removed? • Was the CF memory inserted after turning the power on? →Whether or not CF is inserted is checked when the power is turned on. Insert a CF memory following section Section 3.1 Scan preparation.
Data from the CF memory can not be read	• Has the CF memory been removed? →Insert a CF memory following section 3.1 Scan preparation. • Is the file attempting to be read data from this product? →This product can not open data from the NJJ-95 series. Please check the data
The date/time indication has been changed to "0s."	No trouble The voltage of the internal button-type lithium battery has dropped. The battery is rechargeable and is charged automatically when this product is used.Set the date and time according to Section 2.3.7 date/time.
Continuous use warms the casing.	This is a normal phenomenom.

6 After-sales Service

If this product malfunctions, read Section 5.3 Troubleshooting carefully, and check this product again. If this product still malfunctions, stop using it, and contact our nearest branch office, sales outlet, or service station.

●Information to be reported

- Product name, model number, and serial number
- Detailed information about the abnormal state
- Company/organization name, address, and telephone number

For inquiries about after-sales service, contact our nearest branch office (See Section 9), sales outlet, or service station.

For the contact informationon, see Section 9 Where to contact.

7 Disposal

WARNING

Before disposing of the used lithium ion battery, insulate the charging terminals by taping or the like. Otherwise, the battery could cause fire or explosion if short-circuited.

7.1 Disposal of Used Battery Pack

- Discharge the used battery pack (lithium ion battery) completely, insulate the charging terminals by a non-conductive tape or the equivalence, and then dispose of it as nonflammable refuse. If the explanation here does not conform to local regulations, contact your local government for details.

7.2 Disposal of this product

- Dispose of this product as required by local regulations.

8 Specification

8.1 Handy Search NJJ-105

Table 8-1 Specification of NJJ-105

item	Functions and Performances
Search method	Electromagnetic wave radar method
Search object	Rebar (reinforcing steel bar), Polyvinyl-chloride pipe, Cavity, etc.
Search depth	5 to 300mm for the concrete with a relative dielectric constant ＝ 6.2 everywhere and the top rebar of diameter □ 6mm
Depth resolution	Approx. 1 mm at the display range setting of Shallow Approx. 2 mm at the display range setting of Deep
Horizontal discrimination resolution	≧ 75mm for the scanned object located at depth < 75mm ≧ Depth of the scanned object for the object located at depth ≧ 75mm ※Typical performance for the reference concrete: This product allows the user to discriminates between two rebars located respectively at depth 75mm and 175mm and at the interval of 40 mm.
Maximum search depth	2.5mm
Maximum scan distance	15m
Display mode	B-mode (Vertical Cross Section) and BA-mode(Vertical Cross Section and Reflection Waveform Graph)
Image processing	During scanning: Real time auto surface wave processing, Real time manual deduction processing, and Real time user surface wave processing During not scanning: Fixed surface wave processing, User surface wave processing, Deduction processing, Manual surface wave processing, Average wave processing, Peak processing, and Original image
Display	TFT Color LCD (640 x 480 dots)
Depth calibration	2.0 to 20.0, 0.1 step and time
Maximum scan speed	Approx. 40cm/s, Alarm capability furnished for the over speed scanning
Control functions	Display marker（Maximum 42 points), Battery capacity indicator, and Display inverse video
Data output functions	Data output function to the dedicated printer (IrDA)
Data save functions	CF Memory (Approx. 200 scan data of 15m distance and binary format can be stored in the 1GB CF memory)

Table 8-1 Specification of NJJ-105 (Continued)

Item	Specification
Temperature range	0 to ＋50℃
Power	Battery pack or AC adapter (option)
Continuous operation time	Approx. 1.5 hour when using the fully charged battery.
Structure	Light splash proof
Size	Approx. 149(W)×147(H)×216(D)mm
Weight	Approx. 1.2kg

8.2 Battery pack BP-3007 series

Table 8-2 Specification of battery pack BP-3007 series

Item	Specifications
Battery	Lithium ion battery
Nominal capacity	1500 mAh
Nominal voltage	7.2 V
Temperature range (when charging)	0 to ＋40℃
Temperature range (when discharging)	－10 to ＋60℃
Size	Approx. 38 x 70 x 20mm
Weight	Approx. 103g

8.3 Battery charger BC-3008 series

Table 8-3 Specification of battery charger BC-3008 series

Item	Specifications
Power supply	AC 100 to 240V, 50/60 Hz
Output voltage	DC 8.4 V
Output current	0.6A
Temperature range	0 to ＋35℃
Size	Approx. 56 x 107 x 44mm
Weight	Approx. 120g

9 Where to Contact

For inquiries and repair about this product, contact our main office below, the nearest branch office, sales outlet, or service station.

Japan Radio Co. Ltd.
Section-I, International Business Department. Sales and Marketing
Fjisawa bldg.
30-16,ogikubo 4-chome Suginami-ku, Tokyo 167-8540,Japan
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FAX:+81-3-6832-1844
Web site: http://www.jrc.co.jp