

INSTRUCTION MANUAL WAVEGUIDE TYPE MICRO MASTER MBX-301CA-NA

Be sure to read this instruction manual carefully before using to make correct operation of this device.

Be sure to read this instruction manual and keep properly.

Symbol	Amended reason			Pages	Date	Corrector
Approved by	Checked by	Drawn by	Designed by	Title	Waveguide Type Micro Master MBX-301CA-NA Instruction Manual	
YUTANI	YUTANI	HOSHINO	HOSHINO			
				Drawing No.	C-91-315	1/24

- NOTICE -

- Please keep this instruction manual on the side of operator and maintenance person. For the detailed warranty and contact items, refer to 「AGREEMENT」 of this product.
- Only properly trained & educated person for operation and maintenance of this device and also bearer of qualifications specified in the law shall operate this device.
- Be sure to read this instruction manual & relative documents before installation, operation and maintenance operate correctly in accordance with the directions on the knowledge of the device, information for safety, operation & handling method of this device.
- Keep always the scope of this various specification described on the instruction manual and execute correct maintenance to prevent possible malfunction.
- Please prohibit the operation and handling which aren't described on the instruction manual, using of the spare parts out of our supplies, remodeling, improper usage and operation not pursuant to the instruction of instruction manual. It may cause malfunction or personal injury. We shall not fully responsible for accident it may occur by such breaches.
- When you have incomprehensible item, question and unclear point, please contact to our branch office referred the last page.
- On the contents of this instruction manual we have intellectual property right. The contents may not, in whole or part be revealed to any third party without prior written consent from us.
- The contents in this instruction manual is subject to change without pre-notice for the purpose of improvement of the device.
- If in case of happening inactivity or malfunction, please contact to our referred branch office with the following information.
 - The contents of relative name plate or specifications(model name, production No., type, production date etc.)
 - Abnormal condition(more in detail including condition before & after)
 - Contact our offices which are mentioned in last page.
- FCC statement
 CAUTION USER : Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The antenna must be located greater than 20cm from the user.

Notice of safety

Be sure to read carefully this instruction manual and relative documents before installation, operation and maintenance of this device to operate correctly. Operate this device only after acquainting yourself all with knowledge of device, safety notice & caution items. This instruction manual classifies caution items rank as 「Danger」 「Caution」 「Prohibition」 and 「Enforcement」.



DANGER

Possible to cause a danger situation if misused and might be dead or critical injury



CAUTION

Possible to cause a danger situation if misused and might be harmed middle injury or slight injury or caused only physical damage



PROHIBITION

Supposed to cause a possible danger if misused and inform an action prohibited.



ENFORCEMENT

Supposed to cause a possible danger if misused and inform an action enforced.

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Notice of safety(to be continued)

About statement of above **⚠CAUTION** however, it is possible to cause more serious result according to situation. keep the above mentioned notice without fail since these are very important.


* The critical injury stated above means causing after effect by loss of eyesight, injury, burn(high temperature, low temperature), electric shock, fracture, poisoning etc., and necessity of hospitalization or long time attending to hospital for care. The middle injury or slight injury means injury, burn, electric shock etc. which are not necessary of hospitalization or long time attending to hospital for care. The physical damage means damage of property and equipment and enlarged damage relevant to damage of equipment.

These notice for safety informs more important supplementary contents regarding to safety of Hokuyo Waveguide Type Micro Master. The customers should establish the safety measure according to various standards and criteria for the sake of safety operation and maintenance of equipment and device.

The following danger mark is for Hokuyo Waveguide Type Micro Master. If this danger instruction may not be kept, it is possible to cause an accident resulting injury or death. Please note that the order of this instruction is never adopted order in important level and all instructions stated here are important.

 DANGER	Pages
* Take caution to handle the device and don't hit against or drop off the control box. There is some possibilities to cause an accident resulting injury and cause any malfunctions.	14
* Don't hit against or drop off the antenna. There is some possibilities to cause an accident resulting injury and cause any malfunctions.	15
* In order to avoid danger of electric shock, ensure the power source is off when installation, maintenance and inspection.	19
* In order to avoid danger of electric shock, don't touch with exposed charging part.	22


The following caution mark is for Hokuyo Waveguide Type Micro Master. If this caution instruction may not be kept, it is possible to cause an accident resulting injury or death. Please note that the order of this instruction is never adopted order in important level and all instructions stated here are important.

 CAUTION	Pages
* Read this instruction manual carefully to operate safely.	6
* Be sure to reach the instruction manual to final user.	6
* Be sure to keep the instruction manual by final user.	6
* If lifting magnet or crane hook etc. comes near above antenna, it may cause any malfunctions.	13
* It may cause chattering around operating point of detecting object. Take measures to work in normal application or on system.	13
* When reflecting surface of detecting object isn't flat and peculiar, It may not detect correctly. Please ask us beforehand.	14
* Don't stamp on antenna during installation. Don't use for scaffolding.	16
* If the surface of antenna is dirty, wipe off. It may cause any malfunctions.	16
* When setting side by side or reflecting object exists, take note on direction of projector and receiver of antenna.	16
* When installation, don't stamp on waveguide and joint. Don't use for scaffolding. It may cause deformation of waveguide ad loosening of joint and it may cause any malfunctions because of microwave attenuation.	16


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Notice of safety(to be continued)

The following prohibition mark is for Hokuyo Waveguide Type Micro Master. If this prohibition instruction may not be kept, it is possible to cause an accident resulting injury or death. Please note that the order of this instruction is never adopted order in important level and all instructions stated here are important.

 CAUTION	Pages
* When installation, take off the protection lid from dust attached on waveguide inlet on waveguide, antenna and control box.	17
* Keep waveguide, elbow and antenna inside in order to avoid wetting. If water invaded into the waveguide, it may cause malfunction because of microwave attenuation.	17
* Keep off any foreign substances inside waveguide.	18
* Wipe off any stain inside and outside waveguide. If there are some foreign substance or dirt, it may cause malfunction because of microwave attenuation.	18
* When using socket and elbow, cut the waveguide 2mm or 14mm shorter than setting length because there is a gap.	18
* If you don't connect joint correctly, it can't get sufficient performance. Also, it is necessary to keep proper procedure and work correctly because it is difficult to find out wrong piping after completing piping.	19
* Device and below contact shows Power-OFF state.	19
* Put power source in after checking wiring. If wiring isn't correct, it may cause any troubles.	21
* Don't loose fitting screw for plane polarization one revolution or more. Adjuster for plane polarization turns too much or comes off.	21
* Adjust with detecting object or the same shape dummy. The different shape may cause incorrect adjustment.	21
* Change hysteresis and Off-delay in accordance with detecting condition. It is not necessary to make the following setting.	21
* Make sure to adjust in accordance with the following procedure.	21
* If water curtain, water or oil scale exist on whole antenna surface, it may cause unstable operation. If such condition is expected, make a maintenance/inspection and improve such environment.	22


The following prohibition mark is for Hokuyo Waveguide Type Micro Master. If this prohibition instruction may not be kept, it is possible to cause an accident resulting injury or death. Please note that the order of this instruction is never adopted order in important level and all instructions stated here are important.

 PROHIBITION	Pages
* Don't install at the places where water always splashes on the antenna surface. If water splashes on the antenna surface, it may not detect correctly.	15
* Don't use the other waveguide, joint and elbow than Hokuyo brand. We can't guarantee the performance.	16
* Don't use waveguide as an earth of the other device. It may cause corrosion by electricity.	16
* Don't make a piping at the places where waveguide is always soaking. If water invaded into the waveguide, it may cause malfunction because of microwave attenuation.	17
* Don't use a deformed sleeve or a used sleeve.	18
* Don't use pipe wrench. It may cause any deformation of elbow, joint and waveguide or it may cause the attenuation of microwave.	18

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Notice of safety(to be continued)

The following enforcement mark is for Hokuyo Waveguide Type Micro Master. If this enforcement instruction may not be kept, it is possible to cause an accident resulting injury or death. Please note that the order of this instruction is never adopted order in important level and all instructions stated here are important.

 ENFORCEMENT	Pages
* Max. piping length should be within 25m. It may cause any malfunctions.	13
* Install control box at the places with ambient temperature, -10 degrees to +60 degrees C. It may cause any troubles or malfunctions.	13
* Install control box at the places without excessive vibration or impact. Over specifications cause any troubles or malfunctions.	13
* Install control box at the places where it is easy for maintenance.	13
* Install antenna stand at the places with ambient temperature, -20 degrees to +600 degrees C. It may cause any troubles or malfunctions.	13
* Don't install antenna stand at the places where water always splashes on the antenna surface. If water splashes on the antenna surface, it may cause malfunctions.	13
* Don't soak piping line of waveguide in water always. It may cause any malfunctions.	13
* No other than detecting objects must be existed in the detecting area. It may cause any malfunctions.	13
* Use clean air(Dry type) as air for air-purge. Water may accumulate and foreign substances invade in waveguide and it may cause malfunctions.	14
* When it installs control box in vertical position, make connecting part of waveguide downward. In case of air-purge system, water may invade into control box by accumulating water in the air and it may cause any troubles.	14
* If ambient temperature rises over 60 degrees C because of radiant heat from detecting objects, take measures such as heat shield plate etc. It may cause any troubles.	14
* Install antenna stand in horizontal with passing line. It may cause any malfunctions.	15
* Be 300mm(Distance H) between antenna surface and passing line. It may cause any malfunctions.	15
* If there is any possibility that detecting object hits antenna stand, install protective frame. Antenna stand may be broken.	15
* Install protective frame at the out of detecting area.	15
* If there is the other reflecting objects than detecting objects in detection area over antenna, remove it. It may cause any malfunctions.	15
* If there is a apron between rollers in detection area over antenna, remove it. It may cause any malfunctions.	15
* If cooling water from roller splashes to antenna surface, install water-protecting cover.	16
* If waveguide soaks in water always, make a high piping with supporting stand.	17
* If there are some places to be stamped or to be hit by heavy materials on the piping line, protect waveguide with cover etc. It may cause deformation of waveguide ad loosening of joint and it may cause any malfunctions because of microwave attenuation.	17
* Fix the support of waveguide from the top of tube etc. Don't fix tube itself directly. Don't deform waveguide. it may cause any malfunctions because of microwave attenuation.	17
* Be 1.5m or less for support interval.	17
* Cut off the cross section at right angle against axis of waveguide. It may cause the attenuation of microwave because of insufficient connection.	17
* Remove the inside and outside burrs with file or reamer. Outside burrs may injury the sleeve or joint and inside burrs may cause the attenuation of microwave.	18

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Introduction



CAUTION GENERAL ITEMS

- * Read this instruction manual carefully to operate safely.
- * Be sure to reach this instruction manual to final user.
- * Be sure to keep this instruction manual by final user.

- * This instruction manual describes the necessary procedures and handling information of waveguide type micro master.
- * For the safe and correct use of this device, keep this instruction manual and read them carefully before operation, maintenance and inspection
- * The figures and diagrams etc. in this instruction manual are showing basic operation handling so it may not correspond to the delivered device.

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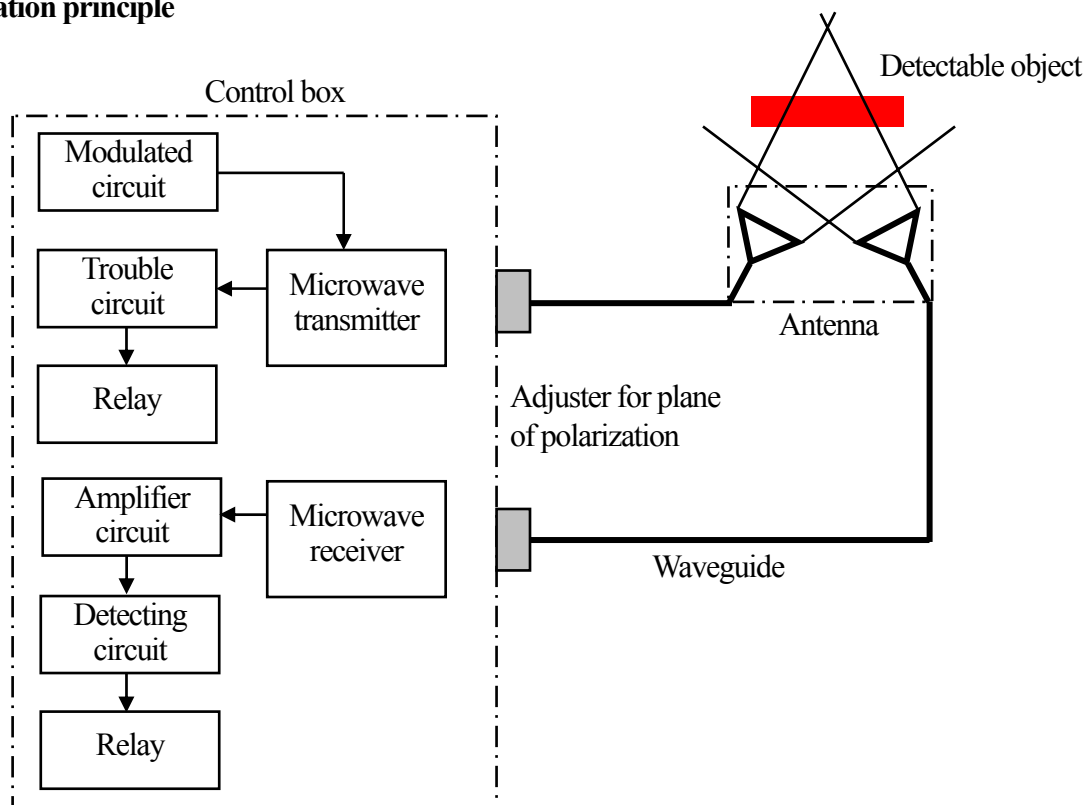
1. General

- * This unit is a non-contact detection switch with microwave which had been developed for iron and steel making industry and is a suitable for detection of metal under severe condition with normal to extreme high (red heat) temperature.
- * Microwave from transmission antenna is reflected by detectable objects and detection signal is executed by incidence to reception antenna.
- * This unit consists of an antenna (detecting part), control box (transmitter, receiver and amplifier) and waveguide which is connected to both sections.
- * Microwave is a kind of electromagnetic wave and generally electromagnetic wave with 1 to 30GHz is called microwave. This device is using microwave with 10.525GHz.

2. Feature

- * No influence by disturbance light
There is no influence by sun light or illumination because it is using microwave.
- * Withstanding steam, dust or smoke
Microwave is a higher permeability than light and permeates without attenuation even opaque object which can't permeate light, steam or smoke.
- * Withstanding heat
This unit can be used for detection of high temperature objects without water or air-cooling because electronic circuit which is very sensitive to heat is isolated from antenna section as detection part.
- * High linearity
Microwave provides high linearity because character is similar to light.

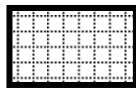
3. Operation principle



- * Operation principle of waveguide type Micro Master is as follows:-
- * Microwave is generated by modulated signal from modulated circuit through microwave transmitter.

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- * Microwave which was generated by microwave transmitter is radiated from transmission antenna through waveguide.
- * In case that there are any detectable objects in detection area which consists of installation angle between transmission and reception antenna, installation dimension and antenna directional angle, microwave from transmission antenna is incident to reception antenna by reflecting detection objects.
- * Microwave which is incident from reception antenna is reached to microwave receiver through waveguide. The signal from microwave receiver is executed as contact signal through amplifier circuit and detection circuit.
- * In case that microwave transmitter was broken, contact signal is executed through trouble circuit.
- * Adjuster for plane of polarization
Microwave can't communicated if microwave transmitter can't be coincided with electric/magnetic field direction of receiver. Cross section for microwave transmitter and input/output waveguide of receiver can distinguish electric and magnetic field direction because of rectangle but cross section of propagation waveguide is round and it may make a gap to electric and magnetic field direction in accordance with piping route and so electric and magnetic field direction are coincided with adjuster for plane of polarization.



Cross section of waveguide for transmitter and receiver



Cross section of propagation waveguide



Electric field direction

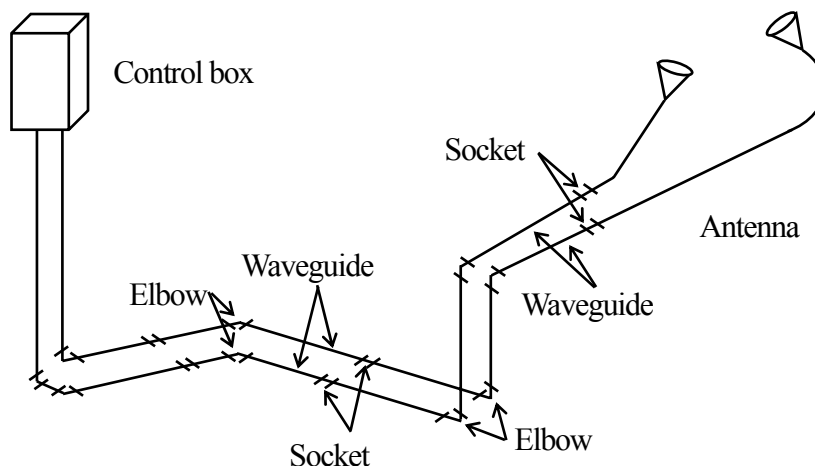


Magnetic field direction

4. Structure and model No.

Waveguide type micro master consists of the following part.

- (1) Control box : MBX-301CA-NA
 - (2) Antenna : MAR-201 or MAR-251
 - (3) Waveguide : MWG-20
 - (4) Joint : Socket MSJ-20, Elbow MBJ-20
 - (5) Support stand for waveguide
- } Specify necessary quantities in accordance with piping route.



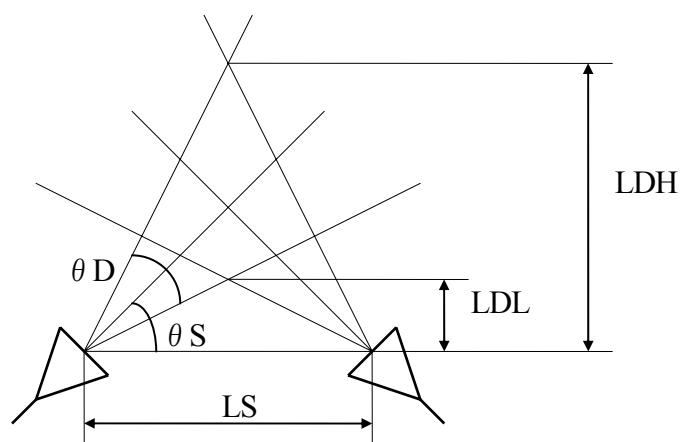
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5. Specifications

Radio wave	A2N 10.525GHz(Model No. in accordance with Japanese radio wave regulation)		
Power source	115VAC(97 to 130VAC)		
Current consumption	4.5VA or less		
Control output	1C relay 250VAC 3A COS ϕ =1, 30VDC 5A Photo-coupler open-collector $V_{ce} \leq 75V$, $I_c \leq 100mA$		
Trouble output	1C relay 250VAC 3A COS ϕ =1, 30VDC 5A		
Min. detectable objects	Steel material with 50mm×50mm, reflecting surface(In case that detecting object is in the center of detecting area and reflecting surface is flat.)		
Distance between antenna surface and passing line	300mm(Between the center of antenna face and passing line)		
Response time		Operating time	Returning time
	Relay	10msec or less	20msec to 10sec(Adjustable)
	Photo-coupler	3msec or less	10msec to 10sec(Adjustable)
Sensitivity adjuster	5 steps per 5dB(3.16 times)		
Hysteresis	1mm to 30mm Adjustable(2 to 10dB)		
LED lamps	Power lamp	Green	Light up when Power-ON
	Operation lamp	Red	Lights up when detecting
	Trouble lamp	Red	Lights up when transmission trouble
	Receiving level lamp	Red 5 points	Lights up in accordance with receiving level
Ambient temperature	Control box	-10 to +60 degrees C	
	Waveguide, joint	-20 to +600 degrees C	
	Antenna	-20 to +600 degrees C	
Ambient humidity	45 to 95%RH(Not icing)		
Insulation resistance	20Mohm or more(Between power/output relay and case)		
Withstand voltage	1500VAC/min(Between power/output relay and case)		
Noise resistance	Pulse with 100nsec and 1500V by noise simulator		
Vibration resistance	10 to 55Hz and double amplitude 1.5mm		
Impact resistance	490m/S ² (Approx. 50G) or more		
Protective structure	IP64		
Materials	Control box	AC2B	
	Waveguide	SUS304	
	Joint	BC-6	
	Antenna	SPCC, BC-6, Vycor glass	
External connection	M4 screw terminal		
Weight	Control box	Approx. 10Kg	
	Waveguide	Approx. 1Kg	
	Joint	Approx. 150g	
	Antenna	MAR-201 : Approx. 11Kg, MAR-251 : Approx. 12Kg,	
Painted color	Control box	Munsell 7.5BG6/1.5	
Air blow in waveguide (When using antenna with air-purge)	Quality	Industrial clean air	
	Quantity	20lit./min	
	Pressure	10Kg/cm ²	
Antenna specifications	Antenna interval LS	MAR-201, MAR-251 : 250mm	
	Setting angle	MAR-201, MAR-251 : 65 degrees	
	Directional angle θ D	25 degrees	

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Detecting area



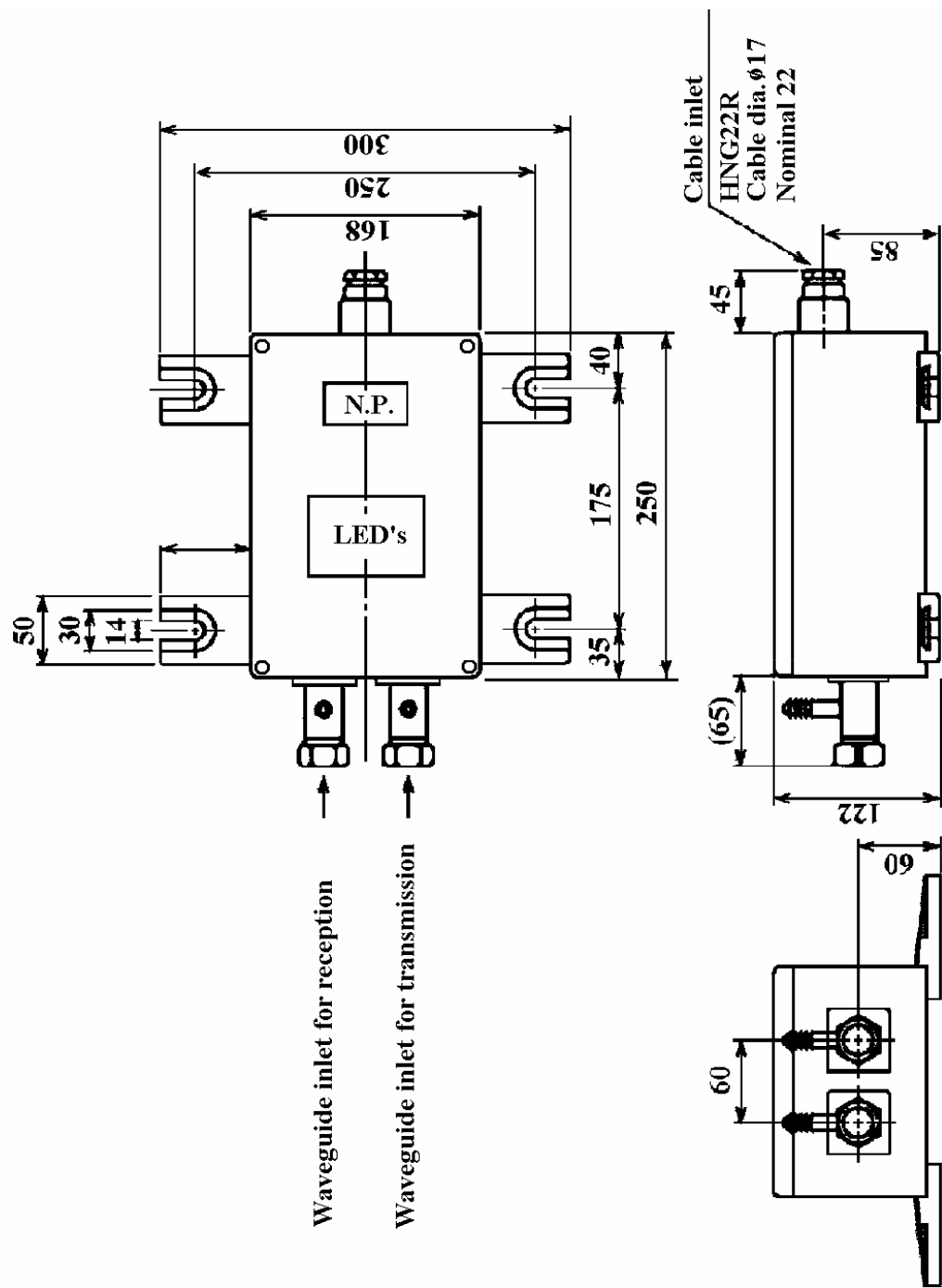
$$LDH = LS / 2 \tan(\theta S - \theta D/2)$$

$$LDL = LS / 2 \tan(\theta S - \theta D/2)$$

MAR-201, MAR-251 LDH approx. 560mm

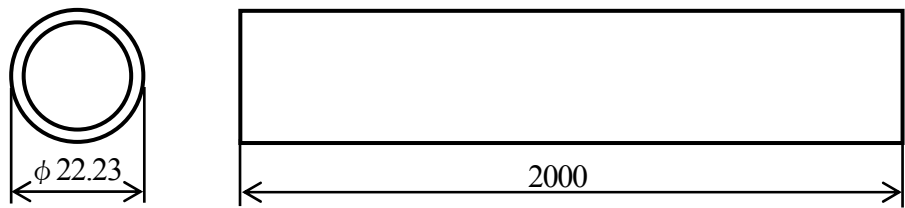
LDL approx. 160mm

6. External dimension
6-1. Control box



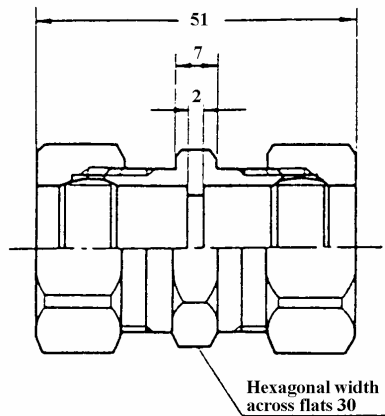
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6-2. Waveguide
MWG-20

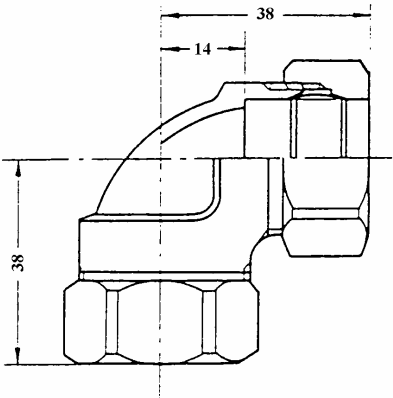


6-3. Joint

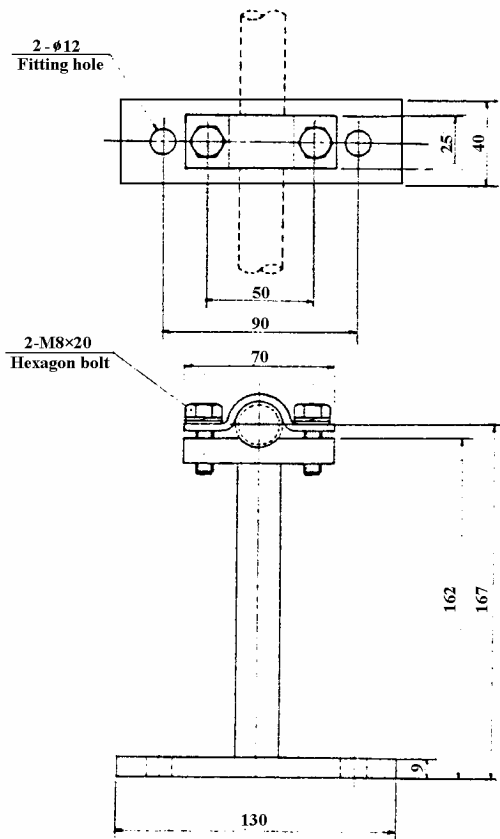
(1) Socket, MSJ-20



(2) Elbow, MBJ-20



6-4. Support stand for waveguide



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7. Considerable item before installation

Consider about installing place of control box, antenna stand and piping route and length of waveguide before installation.



ENFORCEMENT

PIPING LENGTH WITHIN 25m

- * Max. piping length should be within 25m. It may cause any malfunctions.

Piping length is limited because of attenuation of radio wave through waveguide. Piping length should be within 25m because if it is 25m or more, amplifier margin of control box is getting short and it can't operate correctly.



ENFORCEMENT

INSTALLATION PLACE OF CONTROL BOX

- * Install control box at the places with ambient temperature, -10 degrees to +60 degrees C. It may cause any troubles or malfunctions.
- * Install control box at the places without excessive vibration or impact. Over specifications cause any troubles or malfunctions.
- * Install control box at the places where it is easy for maintenance.

Take counter-measures with shield plate etc. if ambient temperature is +60 degrees C or more by radiant heat.
Vibration resistance : vibration 10 to 55Hz, double amplitude 1.5mm
Impact resistance : 490m/S²(approx. 50G)



ENFORCEMENT

INSTALLATION PLACE OF ANTENNA

- * Install antenna stand at the places with ambient temperature, -20 degrees to +60 degrees C. It may cause any troubles or malfunctions.



ENFORCEMENT

NO WATER ON ANTENNA SURFACE

- * Don't install antenna stand at the places where water always splashes on the antenna surface. If water splashes on the antenna surface, it may cause malfunctions.



ENFORCEMENT

NO SOAKING ON WAVEGUIDE

- * Don't soak piping line of waveguide in water always. It may cause any malfunctions.



ENFORCEMENT

NO OTHER REFLECTING OBJECT THAN DETECTABLE OBJECT

- * No other than detecting objects must be existed in the detecting area. It may cause any malfunctions.



CAUTION

LIFTING MAGNET AND CRANE

- * If lifting magnet or crane hook etc. comes near above antenna, it may cause any malfunctions.



CAUTION

CHATTERING

- * It may cause chattering around operating point of detecting object. Take measures to work in normal application or on system.

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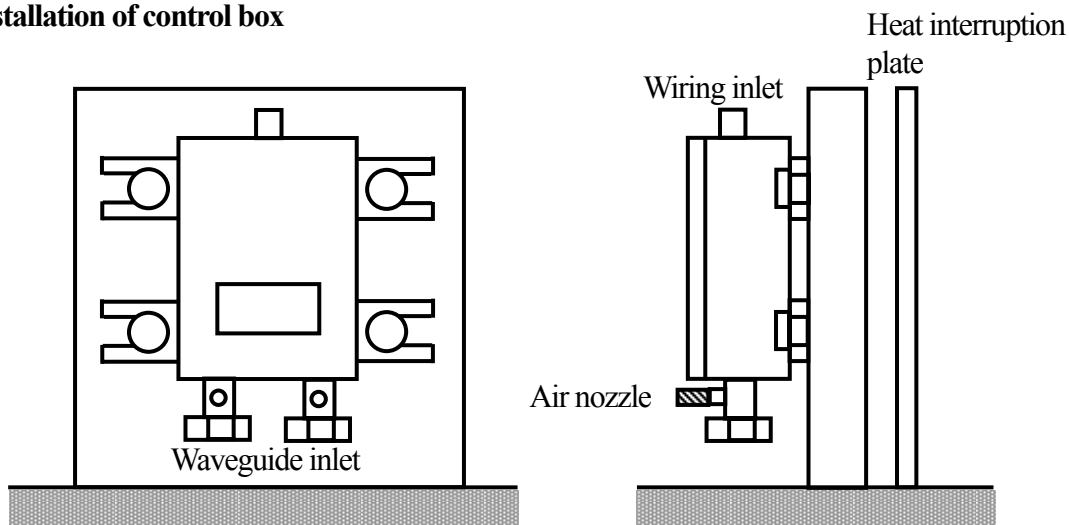
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**CAUTION****REFLECTING SURFACE**

* When reflecting surface of detecting object isn't flat and peculiar, It may not detect correctly. Please ask us beforehand.

8. Installation**8-1. Installation of control box**

- * Refer to item 6-1 about installation dimensions. Install it with plain washer and spring washer and tighten with 4 pcs of M12 bolt.
- * Wiring inlet is HNG22R, cable diameter 17mm and steel electric conduit nominal diameter 22.

**ENFORCEMENT****USE CLEAN AIR**

* Use clean air(Dry type) as air for air-purge. Water may accumulate and foreign substances invade in waveguide and it may cause malfunctions.

Air amount should be 20 liter/min. and air pressure should be 10Kg/cm². Air nozzle is 11mm for outer diameter and 6mm for inner diameter(hose nipple 11-1/4 or 11-3/8). Use hose with 11mm in diameter.

**ENFORCEMENT****DOWNWARD INSTALLATION FOR
CONNECTING PART OF WAVEGUIDE**

* When it installs control box in vertical position, make connecting part of waveguide downward. In case of air-purge system, water may invade into control box by accumulating water in the air and it may cause any troubles.

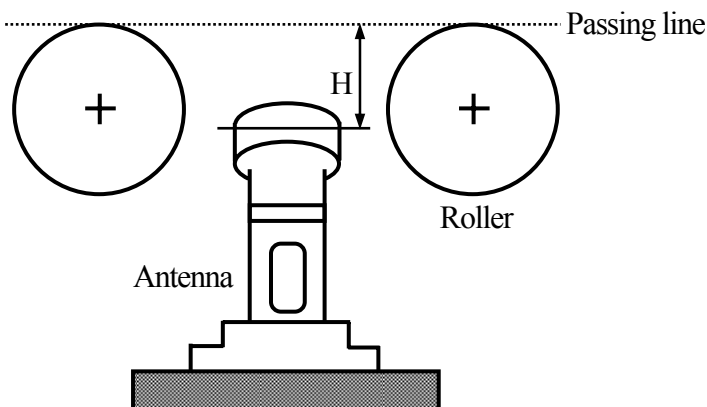
**ENFORCEMENT****HEAT SHIELD PLATE IS NECESSARY**

* If ambient temperature rises over 60 degrees C because of radiant heat from detecting objects, take measures such as heat shield plate etc. It may cause any troubles.

**DANGER****DROPPING**

* Take caution to handle the device and don't hit against or drop off the control box. There is some possibilities to cause an accident resulting injury and cause any malfunctions.

8-2. Installation of antenna



- * Refer to external dimension of antenna about installation dimension. Install it with plain washer and spring washer and tighten with 4 pcs of M12 bolt.



ENFORCEMENT HORIZONTAL INSTALLATION

- * Install antenna stand in horizontal with passing line. It may cause any malfunctions.



ENFORCEMENT HEIGHT OF ANTENNA

- * Be 300mm(Distance H) between antenna surface and passing line. It may cause any malfunctions.



ENFORCEMENT PROTECTIVE FRAME IS NECESSARY

- * If there is any possibility that detecting object hits antenna stand, install protective frame. Antenna stand may be broken.
- * Install protective frame at the out of detecting area.



ENFORCEMENT REMOVING OTHER REFLECTING OBJECTS THAN DETECTING OBJECTS

- * If there is the other reflecting objects than detecting objects in detection area over antenna, remove it. It may cause any malfunctions.



ENFORCEMENT REMOVING APRON BETWEEN ROLLERS

- * If there is a apron between rollers in detection area over antenna, remove it. It may cause any malfunctions.



DANGER DROPPING

- * Don't hit against or drop off the antenna. There is some possibilities to cause an accident resulting injury and cause any malfunctions.



PROHIBITION NO WATER ON ANTENNA SURFACE

- * Don't install at the places where water always splashes on the antenna surface. If water splashes on the antenna surface, it may not detect correctly.

**ENFORCEMENT****WATER PROTECTING COVER IS NECESSARY**

* If cooling water from roller splashes to antenna surface, install water-protecting cover.

**CAUTION****DON'T STAMP**

* Don't stamp on antenna during installation. Don't use for scaffolding.

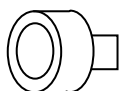
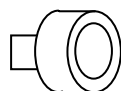
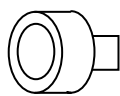
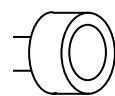
**CAUTION****DIRT**

* If the surface of antenna is dirty, wipe off. It may cause any malfunctions.

**CAUTION****DIRECTION OF ANTENNA**

* When setting side by side or reflecting object exists, take note on direction of projector and receiver of antenna.

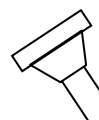
Transmission
side



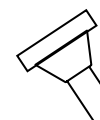
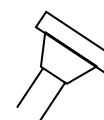
Transmission
side

Neighboring in before and behind

Transmission
side



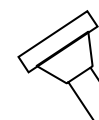
Transmission
side



Neighboring in right and left

Reflecting
object

Transmission
side



Near reflecting object

9. Piping of waveguide**PROHIBITION****DO NOT USE OTHER BRAND**

* Don't use the other waveguide, joint and elbow than Hokuyo brand. We can't guarantee the performance.

**PROHIBITION****DO NOT USE WAVEGUIDE AS AN EARTH OF OTHER EQUIPMENT**

* Don't use waveguide as an earth of the other device. It may cause corrosion by electricity.

**CAUTION****DO NOT STAMP**

* When installation, don't stamp on waveguide and joint. Don't use for scaffolding. It may cause deformation of waveguide and loosening of joint and it may cause any malfunctions because of microwave attenuation.

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**CAUTION****TAKING OFF PROTECTION LID FROM DUST ATTACHED**

* When installation, take off the protection lid from dust attached on waveguide inlet on waveguide, antenna and control box.

**CAUTION****STORING INDOORS**

* Keep waveguide, elbow and antenna indoors in order to avoid wetting. If water invaded into the waveguide, it may cause malfunction because of microwave attenuation.

9-1. Piping route**PROHIBITION****DO NOT SOAK**

* Don't make a piping at the places where waveguide is always soaking. If water invaded into the waveguide, it may cause malfunction because of microwave attenuation.

**ENFORCEMENT****SUPPORTING STAND IS NECESSARY**

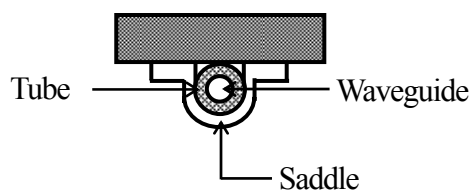
* If waveguide soaks in water always, make a high piping with supporting stand.

**ENFORCEMENT****PROTECTIVE COVER IS NECESSARY**

* If there are some places to be stamped or to be hit by heavy materials on the piping line, protect waveguide with cover etc. It may cause deformation of waveguide and loosening of joint and it may cause any malfunctions because of microwave attenuation.

**ENFORCEMENT****SUPPORTING FROM TOP OF TUBE**

* Fix the support of waveguide from the top of tube etc. Don't fix tube itself directly. Don't deform waveguide. It may cause any malfunctions because of microwave attenuation.

**ENFORCEMENT****SUPPORT INTERVAL WITHIN 1.5M**

* Be 1.5m or less for support interval.

9-2. Cutting of waveguide**ENFORCEMENT****CUTTING AT RIGHT ANGLE**

* Cut off the cross section at right angle against axis of waveguide. It may cause the attenuation of microwave because of insufficient connection.

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ENFORCEMENT

REMOVING BURRS

- * Remove the inside and outside burrs with file or reamer. Outside burrs may injury the sleeve or joint and inside burrs may cause the attenuation of microwave.



CAUTION

ANY FOREIGN SUBSTANCES INSIDE WAVEGUIDE

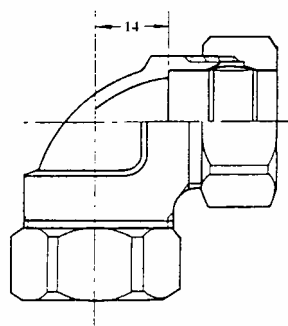
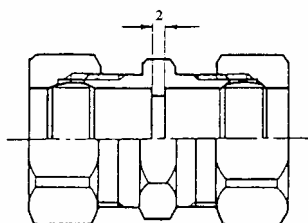
- * Keep off any foreign substances inside waveguide.
- * Wipe off any stain inside and outside waveguide. If there are some foreign substance or dirt, it may cause malfunction because of microwave attenuation.



CAUTION

CUTTING LENGTH

- * When using socket and elbow, cut the waveguide 2mm or 14mm shorter than setting length because there is a gap.



9-3. Connection of joint

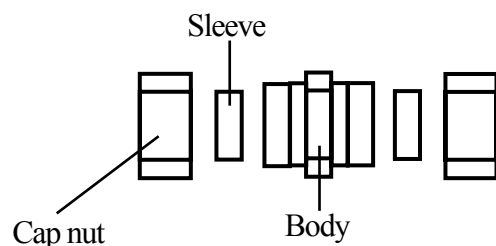


PROHIBITION

DO NOT USE USED SLEEVE

- * Don't use a deformed sleeve or a used sleeve.

* Decomposed diagram



PROHIBITION

DO NOT USE PIPE WRENCH

- * Don't use pipe wrench. It may cause any deformation of elbow, joint and waveguide or it may cause the attenuation of microwave.

* Use monkey wrench.

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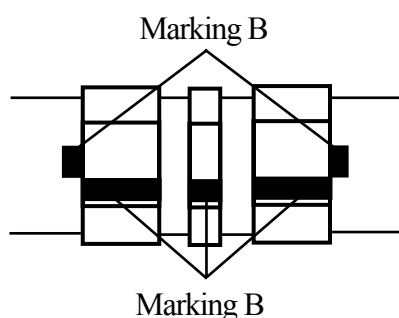
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**CAUTION****CONNECTION OF JOINT**

* If you don't connect joint correctly, it can't get sufficient performance. Also, it is necessary to keep proper procedure and work correctly because it is difficult to find out wrong piping after completing piping.

* Procedure

- (1) **Check to set sleeve to joint correctly.** If incorrect, set it correctly after loosening cap nut.
- (2) **Check there is no burrs, flaw or transformation at insertion point of waveguide.** If there are any burrs, flaw or transformation, cut down them because of attenuation.
- (3) **Check there is no dust in waveguide and oil etc. isn't adhere inside.** If there are any dust or dirty, clean up because of attenuation.
- (4) **Insert cap nut and sleeve fully without removal.**
- (5) Tighten cap nut fully with hand.
- (6) Make a marking of "A" and "B" at joint, cap nut and waveguide with marker pen etc. This marking is to check revolving and tightening amount.



- (7) Tighten approx. 1.15 revolution with spanner or adjustable wrench, seeing marking "A". Don't use pipe wrench because of attenuation by transforming.
- (8) If marking "B" is 7mm or more away from the end of cap nut after tightening, replace sleeve with new one and make it again from first.

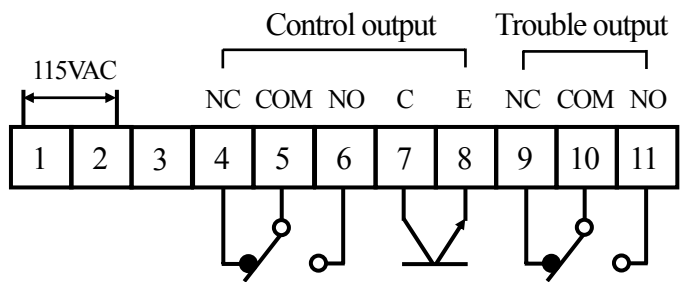
10. Wiring of control box**DANGER****ELECTRIC SHOCK**

* In order to avoid danger of electric shock, ensure the power source is off when installation, maintenance and inspection.

**CAUTION****CONTACT INDICATION**

* Device and below contact shows Power-OFF state.

* Make a wiring of M4 screw terminal as follows:-



Control output terminal

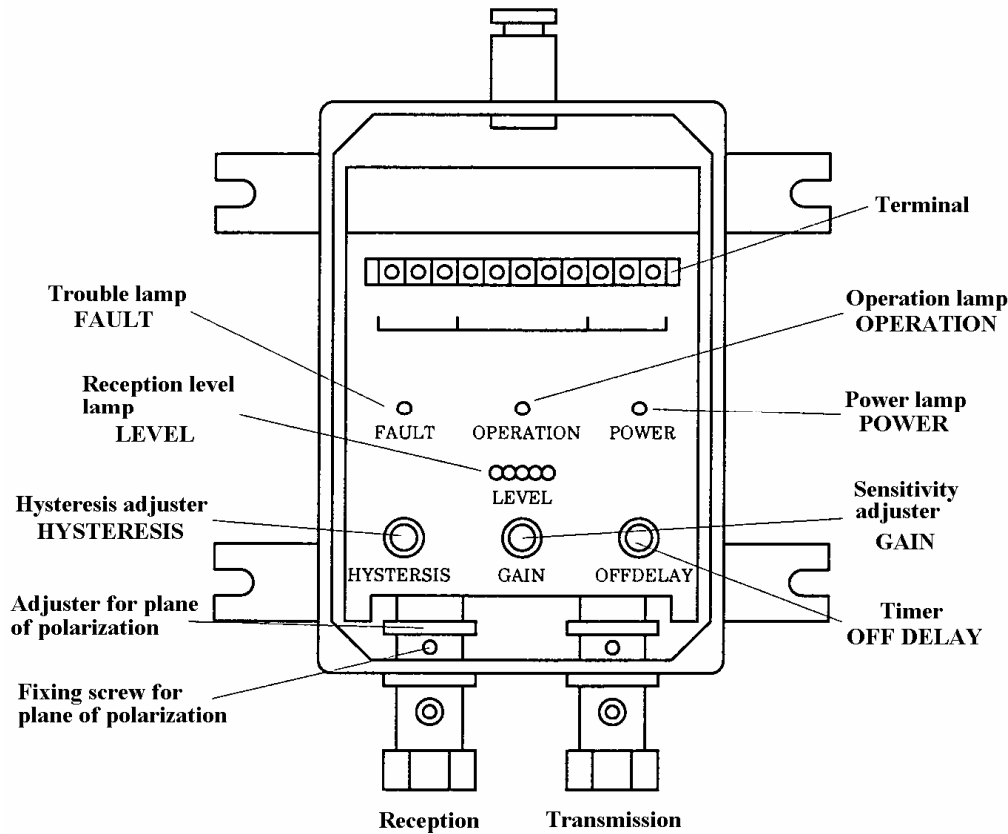
Terminal No.		4 - 5	5 - 6	7 - 8
Power-OFF state		CLOSE	OPEN	---
Power-ON state	When non-detection	OPEN	CLOSE	ON
	When detection	CLOSE	OPEN	OFF

Trouble output terminal


Terminal No.		9 - 10	10 - 11
Power-OFF state		CLOSE	OPEN
Power-ON state	When normal	OPEN	CLOSE
	When troubled	CLOSE	OPEN

11. Adjustment

11-1. Adjustment part



- * Power lamp(POWER) : Lit up when Power-ON
- * Operation lamp(OPERATION) : Lit up when detection
- * Trouble lamp(FAULT) : Lit up when transmission trouble
- * Reception level lamp(LEVEL) : Lit up in accordance with reception level


 Operation margin : -4 -2 0 2 4 dB

- * Hysteresis adjuster(HYSTERESIS) : 0 to 10dB(Adjustable)
- * Sensitivity adjuster(GAIN) : 5 steps(per 5dB), Possible to turn at 4 or more but 0 to 4 is available
- * Timer(OFF DELAY) : 0.2 to 10sec(Adjustable)
- * Adjust for plane of polarization : Adjustment for electric and magnetic field direction of microwave transmitter and receiver
- * Fixing screw for plane of polarization : Plane of polarization is fixed

11-2. Procedure



CAUTION

POWER ON AFTER CHECKING WIRING

- * Put power source in after checking wiring. If wiring isn't correct, it may cause any troubles.



CAUTION

FITTING SCREW FOR PLANE POLARIZATION

- * Don't loose fitting screw for plane polarization one revolution or more. Adjuster for plane polarization turns too much or comes off.



CAUTION

DUMMY IS NECESSARY

- * Adjust with detecting object or the same shape dummy. The different shape may cause incorrect adjustment.



CAUTION

SETTING OF SCALE

- * Change hysteresis and Off-delay in accordance with detecting condition. It is not necessary to make the following setting.



CAUTION

NECESSARY TO ADJUST

- * Make sure to adjust in accordance with the following procedure.

Procedure

- * **Put power source on after checking wiring.**
- * **Check the state that POWER lights up and FAULT goes off.**
- * Place detectable objects or dummies on passing line of upper antenna.
- * Loosen fixing screw for plane of polarization. **Don't loosen with 1 revolution or more** because it drops out.
- * Set HYSTERESIS and OFF DELAY to "0".
- * See so that 5 pcs of level lamp don't light up by turning GAIN. If all 5 pcs light up at "0", set to "0".
- * **Seeing LEVEL, adjust at the point where LEVEL lamp lights up exceedingly by turning adjuster for plane of polarization for both transmission and reception side and fix it with screw.** If all LEVEL lamp lights up, adjust not to light up by turning GAIN.(Adjust not to saturate)
- * **Set HYSTERESIS to "5".** Ordinarily it is set to "5" but raise up scale if there are any chattering.

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- * **Set GAIN at 1 step upper than all 5 pcs of LEVEL lamp.** If 1 step can't be up, margin is getting smaller but set at the point where 5 pcs of LEVEL lamp lights up. Don't be dirty at antenna surface.
- * **If all 5 pcs of LEVEL lamp don't light up, check piping procedure of waveguide.**
- * Remove detectable objects or dummies on passing line.
- * **Check LEVEL lamp doesn't light up.** If LEVEL lamp lights up, it seems to be any reflection except for detectable objects and so remove reflective part or replace with suitable antenna to detection area.
- * **Set OFF DELAY to "0".** Ordinarily it is set to "5" but raise up if it is necessary to take long output time.
- * **Check OPERATION lamp lights up and control output changes by placing detectable objects or dummies in detection area.**
- * **Remove OPERATION lamp goes off and control output changes by removing detectable objects or dummies from detection area.**

12. Maintenance/inspection



CAUTION

NECESSARY TO MAINTAIN AND INSPECT

- * If water curtain, water or oil scale exist on whole antenna surface, it may cause unstable operation. If such condition is expected, make a maintenance/inspection and improve such environment.



DANGER

ELECTRIC SHOCK

- * In order to avoid danger of electric shock, don't touch with exposed charging part.

12-1. Periodical maintenance

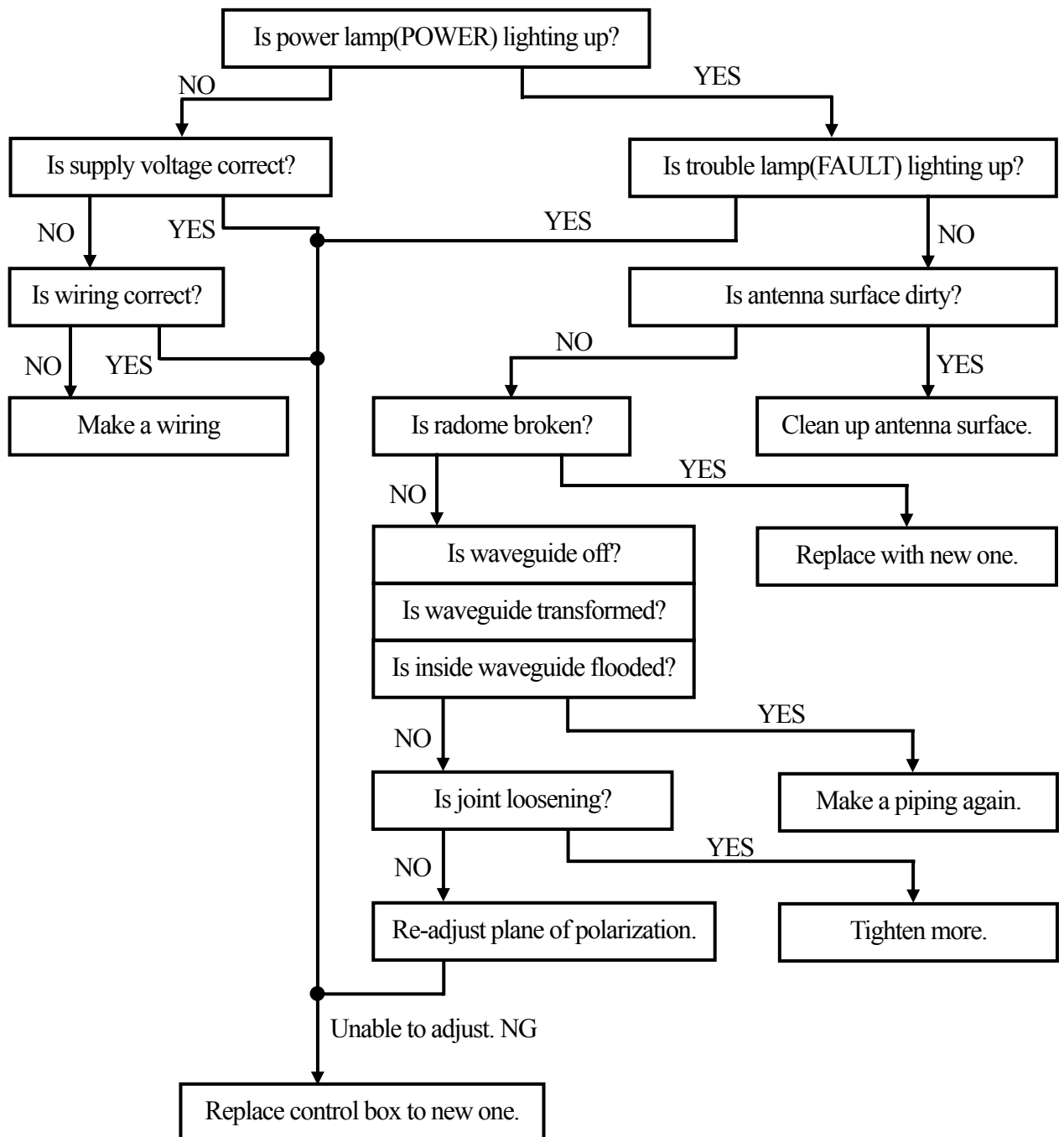
- * Make periodical maintenance as undermentioned standard. Period may be changed by circumstances.

Inspecting item	Period	Measures
Dirt on antenna	Once/month	Wipe up if dirty
Transformation of waveguide	Once/month	Replace it if transforming
Flood of waveguide	Once/month	Drain off if flooded and after that, take a measure not to flood.
Supporting of waveguide	Once/half year	Tighten if loosening
Loosening of joint	Once/half year	Tighten if loosening
Lighting Nos. of LEVEL	Once/half year	Adjust in accordance with item 11 if all LEVEL lamp don't light up

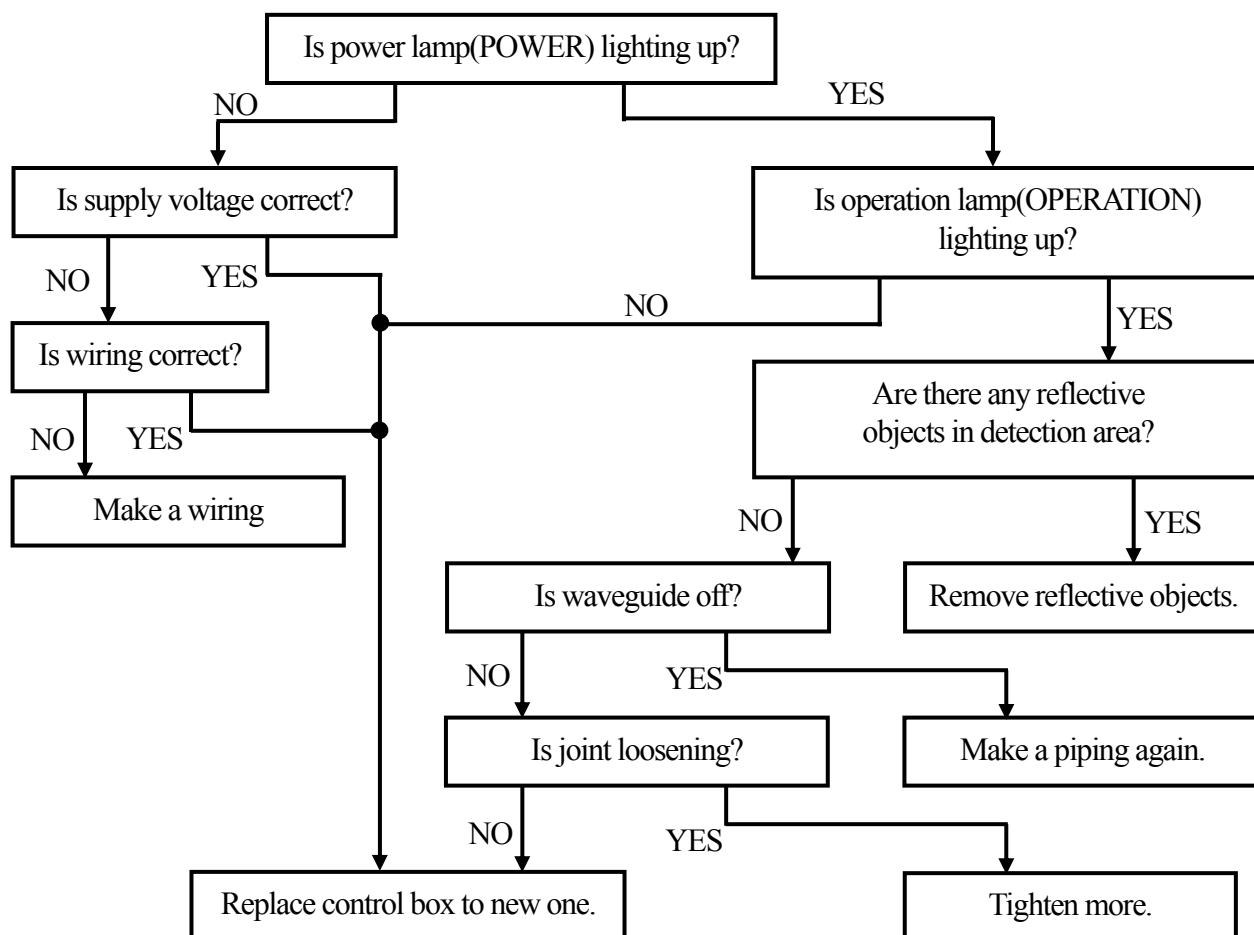
12-2. Trouble/inspection

Inspect with the following procedures if operation is unstable or unable.

(1) Phenomenon : Control output signal doesn't execute although there is a detectable objects in detection area.



(2) Phenomenon : Control output signal executes although there is no detectable objects in detection area.



13. Reference

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