INSTALLATION MANUAL
FOR
THE NTG-420 SOLID STATE TRANSMITTER-RECEIVER

Document No. 7ZPRR0001

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- Preface -

This instruction manual describes installation method of the NTG-420 Transmitter-Receiver. This manual describes radar system configuration with X-band Radar Antenna and NCD-2247-1B PC type radar monitor display as an example.

1. Selecting the installation position

1) Physical selection criteria

- Install the antenna at the center of the mast on the keel line.
- If the antenna cannot be installed at the above position for some reason, the amount of deviation must be minimized. And, reinforce the mount base and the platform and take precautions to protect the antenna from vibration and impact at the installation position.
- To avoid the radiating section coming in contact with other installed objects while it is rotating, ensure that there is at least 200 millimeters from the swing circle (turning radius) to other installed objects (Fig.1-1). The swing circle of the X-band Radar Antenna is as shown in Table 1-1.

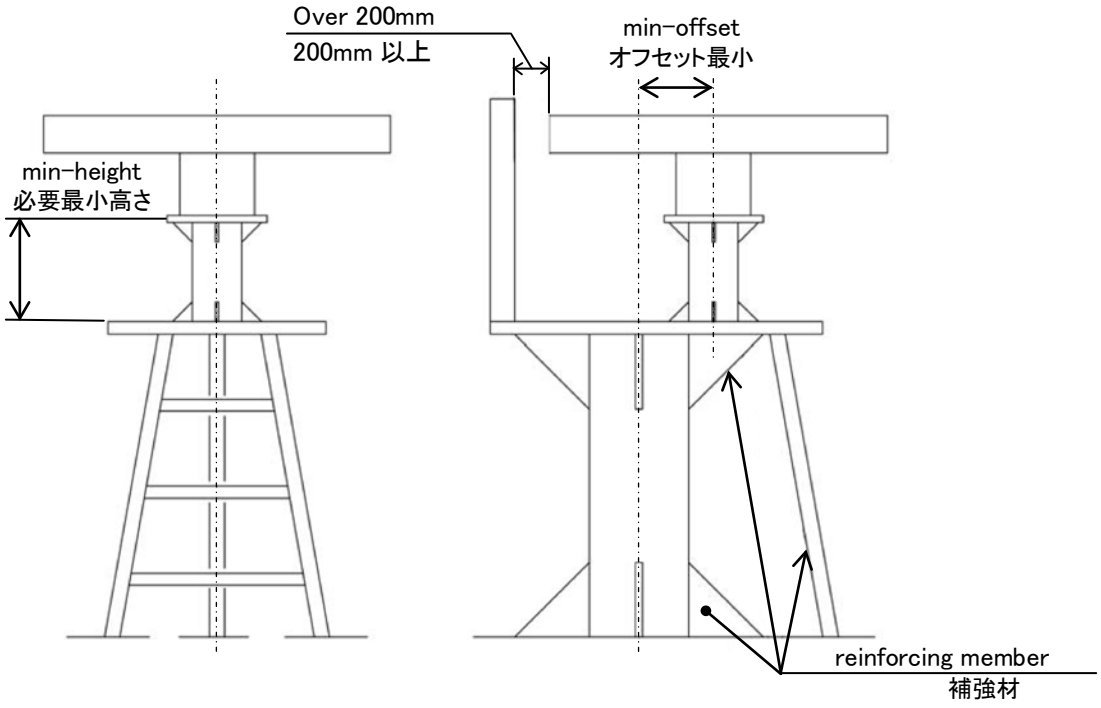


Fig.1-1 Installation of antenna

Table 1-1 Swing circle

Antenna	Swing circle
X-band Radar Antenna	2825mm

- Avoid having a rope or signal flag from winding around the radiating section thereby preventing it from rotating.

- Avoid the effects of dust and heat caused by smoke from a chimney.

- When determining the appropriate antenna height and installation location, take into consideration the reduction of vibration, the strength of the hull and the antenna mount base, and maintenance properties.

- Provide for maintenance space: platform, safety link, hand rail, steps, etc. The lower edge of a radar antenna should be a minimum of 500 mm above any safety rail.

- When installing the antenna, select a location where there are the fewest structural objects in the surrounding area so that the capability to drive the motor will not be depressed by the non-equability wind which is likely to rotate the antenna.

2) Electrical selection criteria

- The installation height of the antenna relates to the maximum detection distance. The higher is the better. (However, if it is too high, radio wave energy greatly attenuates above the antenna's vertical beam width (the point -3dB from the peak of the main lobe). As a result, it is difficult to detect a close-in target. Sea clutter also increases. Determine the installation height by taking into consideration the weight, maximum length of the cable, and maintenance after installation.

- If the installation height of the antenna is low, it is difficult to detect a long distance target. The ship's mast, derrick, and construction objects interfere with radiating beam causing the range that cannot be viewed on the radar display to increase.

  Generally, the lowest antenna installation position is supposed to be on the A-B line shown in Fig.1-2. In the case of the radar antenna, 2θ equals 20°. Specifically, the antenna position is normally elevated so that the building etc do not interfere with radiating beam. The inside of A point might be blind area due to antenna beam does not propagation. So, if near distance should be covered, antenna installation position must be considered carefully.

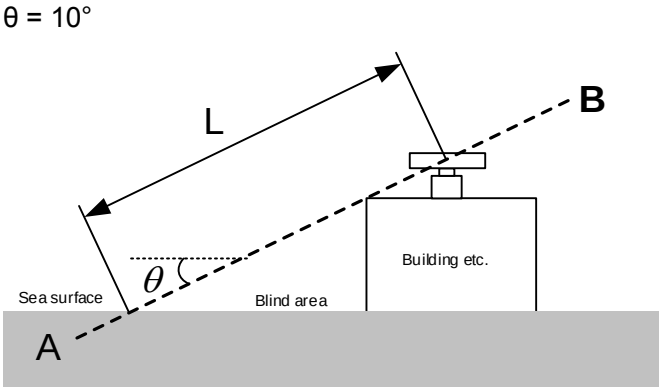


Fig.1-2 Antenna installation height vs Vertical beam width

- If it is considered that sufficient installation height cannot be provided when the antenna is installed directly on the roof of the building, use a mounting rack or radar mast (Fig.1-3). Normally, when the antenna installation height is less than 2 meters from the roof of the building, provide a mounting rack assembled at an angle frame to install the antenna. When the antenna installation height is 2 meters or higher from the roof of the building, provide a cylindrical radar mast to install the antenna. Consider the convenience of the service staff who take care of installation, maintenance, adjustment, and repair of the antenna by providing adequate footholds to the mounting rack and the radar mast.

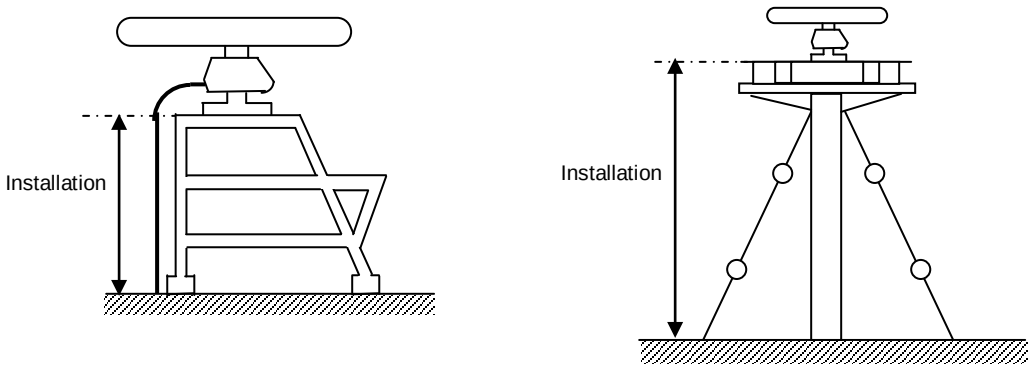


Fig.1-3 Mounting rack and mast for the antenna

- When installing the antenna, select a location where there are the fewest structural objects in the surrounding area so that false images which interfere with target detection will not be generated by signal reflection from other antennas, equipments, and cargos. Only as a guide, note that structural objects should not exist within the range of the vertical beam width (Fig.1-4).

  Vertical beam width of X-band Radar Antenna: Approx. 20° (±10.0° when the height of the radiating section is 0°).

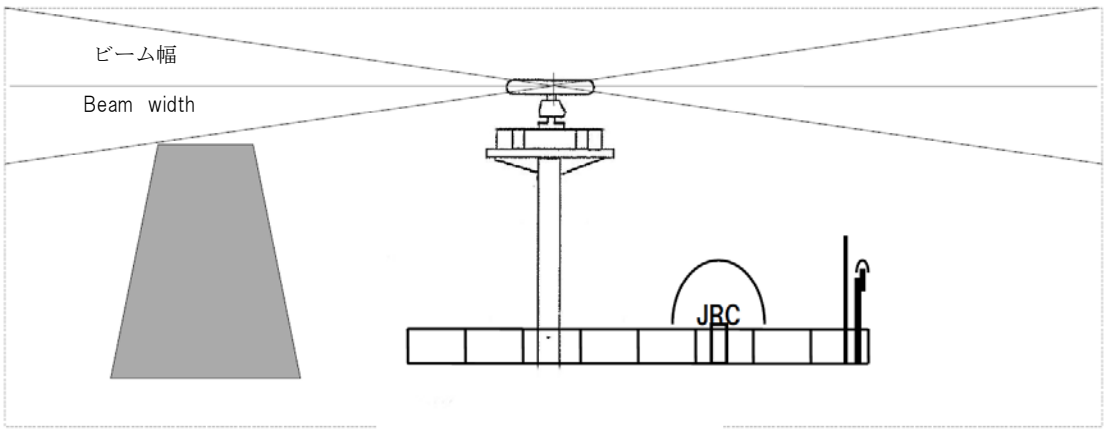


Fig.1-4 Antenna and the surrounding structural objects

- When installing two or more antennas, antennas in close proximity should have a minimum vertical elevation separation angle of 20 and a minimum vertical separation of 1m where possible, so that those antennas do not enter each other's vertical beam width range.

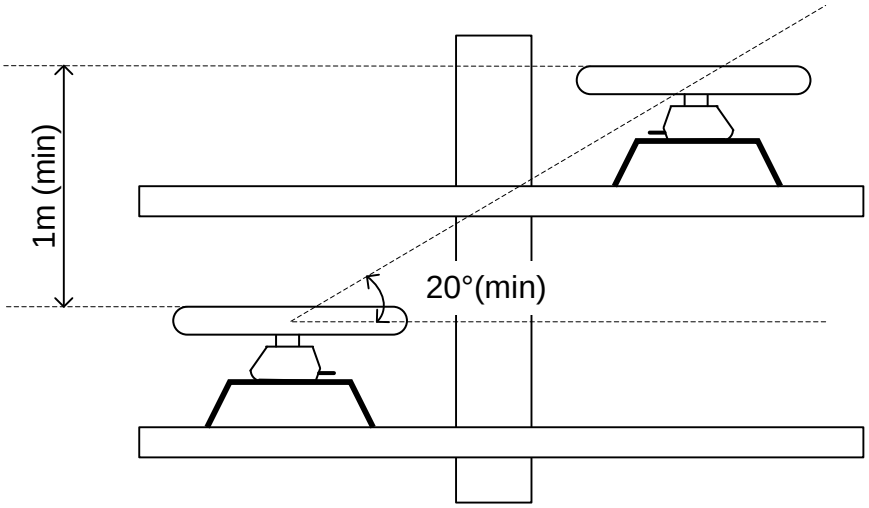


Fig.1-5 Installing two or more antennas

- To avoid interference with other equipment and to prevent radio noise from generating, do not place the VHF antenna, AIS/GPS antenna, and VSAT/INMARSAT's dome within the range of the vertical beam width.

* If there is a concern that structural objects existing within the vertical beam width may generate false images, equip the structural objects with a radio wave absorber. (There are two types of absorbers: broadband type having no specific resonant frequency and narrowband type which can absorb a band with a specific frequency. Use those where applicable.) Furthermore, it is effective to install a metal reflector, which reflects radio waves upwardly, between the antenna and a structural object so that the radar's radio wave will not directly come in contact with the structural object.
When the structural objects exist in the surrounding area of Antenna unit, the false echo may appear. The sector blank function is effective to reduce the signal reflection from the structural objects. Because of it can stop transmission. Therefore, it may reduce the false echo appearance.

Note: Because most radio wave absorbers have poor durability, some must be replaced every year. When installing a reflector, the area to the rear of the reflector becomes a blind sector. Therefore, minimize the size of the reflector.
When the sector blank function set to on, ensure a sufficient view field in the surveillance area.

* The above procedures for selecting an antenna installation position are described based on the radar's antenna. Comprehensively select the antenna position by considering other antennas' installation procedure manual, building tower mast structure, strength of the selected position, and vibration.

3) Confirmation during test run

If the antenna vibrates a lot during test run, try to reduce or prevent vibration by reinforcing the antenna mount base or using wire stays attached to the radar mast.

4) Others
   - The design of the mounting platform for the antenna should take into account the vibration requirements defined by IEC 60945.

Vibration

Frequency	2 to 13.2Hz 13.2 to 100Hz
Amplitude	+/-1mm +/-10%
Acceleration	7m/s^2 constant

   - All installations should facilitate protection of equipment, including cabling, from damage.
     The cables should be kept as short as possible to minimize attenuation of the signal.

   - Crossing of cables should be done at right angles(90°) to minimize magnetic field coupling.

   - Eliminating the interference on frequencies used for marine communications due to operation of the radar. All cables of the radar are to be run away from the cables of radio equipment. (ex. Radiotelephone. Communications receiver and direction finder, etc.) Especially inter-wiring cables between antenna unit and display unit of the radar should not be run parallel with the cables of radio equipment.

   - Cable should not be exposed sharp bends.

   - The grounding of equipment units should be carried out according to this manual.

5) After installation
   After you have completed the installation work, check and test the installation work with customer(s) and confirm with each other.

2. Installation procedure

1) Precautions for transporting and storing the antenna

- An antenna is a heavy load. Be very careful about handling it.
- Do not allow the antenna fall on its side while it is stored or being installed.
- Do not apply rope to the antenna in the way that squeezes or deforms the radiating section.
- When hoisting the antenna by a crane, do not hoist it by attaching a belt or a rope only to the antenna's radiating section as shown in Fig.2-1.
- When lifting the antenna（Fig.2-2）:
  Wrap a cloth around the antenna's support section located at the bottom of the radiator, and then attach a belt to it to lift the antenna.

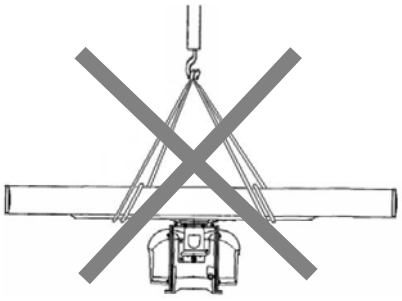


Fig.2-1 Improper way to hoist

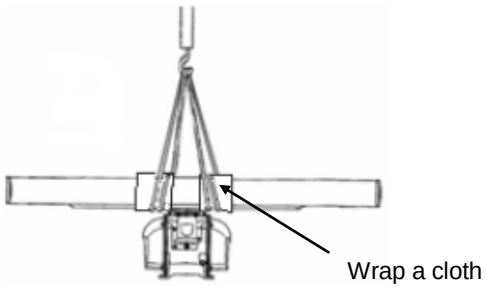


Fig.2-2 Lifting the Antenna

2) Installation procedures

a) Maintain a flat level surface on which to install the antenna.

- Use sufficiently thick steel material and reinforcement material for the antenna's installation surface (mount base) to reduce vibration and impact. Keep the mount base flat and smooth.

- If there is a partial gap between the mount base and the antenna chassis's legs, work on the installation surface so that it becomes flat and smooth. If a gap exists and the antenna is tightly clamped, the chassis will distort and become damaged by vibration.

b) Avoid using vibration-proof rubber and resin

- Do not insert an elastic body, such as vibration-proof rubber or resin, between the mount base and the antenna chassis' legs. If rubber or resin is inserted, the amplitude of vibration increases, resulting in the possibility of damage to the antenna. Furthermore, if installation bolts become loose due to deterioration of rubber or resin, the antenna may be damaged or fall from its mount.

3) Installation and clamping method

a) Installation direction

- Installation should be done so that the cable gland side is oriented accessibility by maintenance staffs.

b) Bolts, nuts and tightening torque to be used

- Use stainless steel bolts for the antenna and uniformly tighten all of the bolts using double nuts for each bolt so that the antenna will not become loose (Table 2-1).

- Although the length of the bolt will differ according to the thickness of the mount base, use a bolt long enough so that more than 4 millimeters of thread protrudes beyond the double nuts after the double nuts have been tightened.

Table 2-1 Length of antenna mounting bolts and tightening torque

Antenna Unit	Thickness of Mount Base (mm)	Bolt	Torque (N-m)
	12	M10×55(mm) SUS304	40

c) Use of washer and corrosion-resistant measures

- At the location where a bolt's head or nut comes in contact with the antenna chassis' legs and the mount base, insert a plain washer which fits the bolt; and, at the location where the nut comes in contact with the plain washer, insert a spring washer, and then securely tighten the nuts (Fig.2-3).

- To prevent corrosion due to the contacts between different metals, such as the antenna chassis' legs, installation surface, bolts, nuts, etc., cover the bolt's head and nuts with sealant (Fig.2-3).

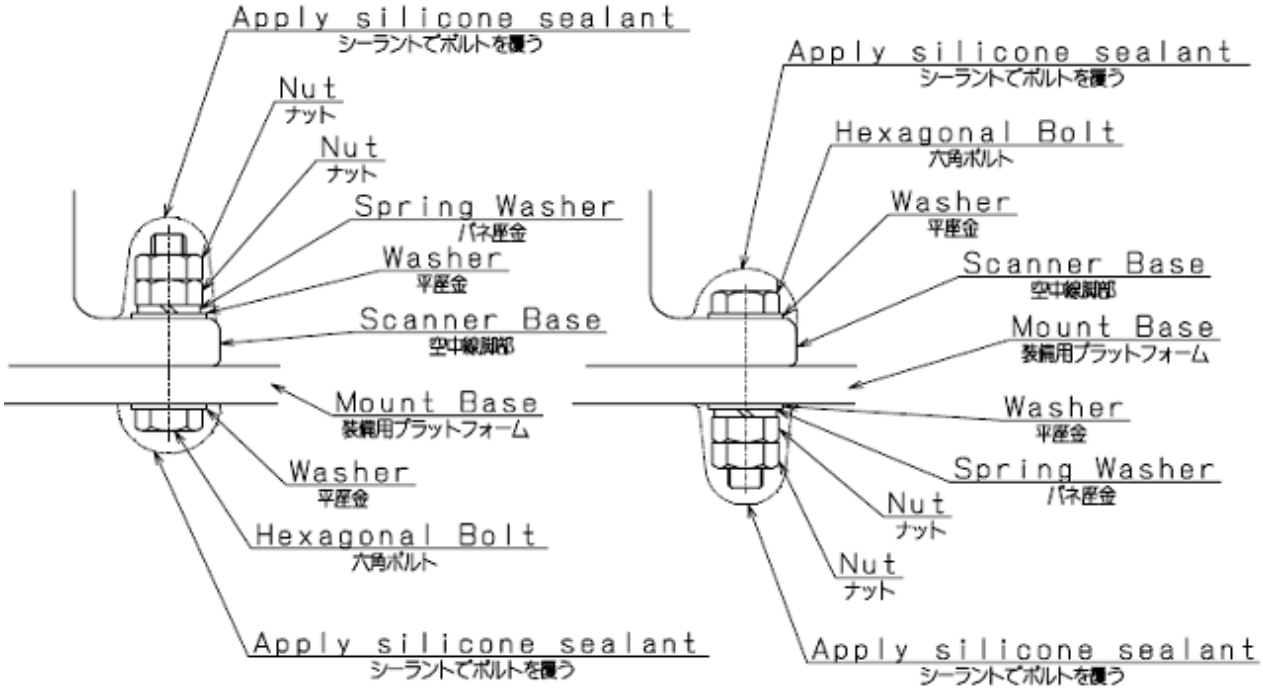


Fig.2-3 Use of washer and corrosion-resistant measures

d) Grounding and corrosion-resistant measures

- Ground the antenna chassis and the installation surface (hull) by using an earth line. Apply sealant to the connection portion of the earth line to prevent corrosion and damage by vibration (Fig.2-4).

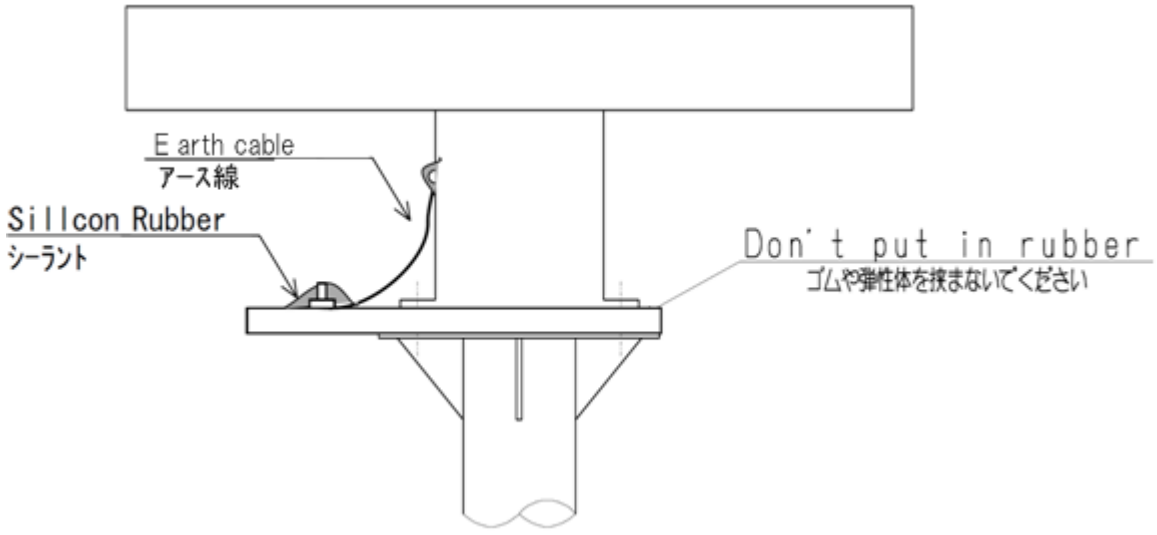
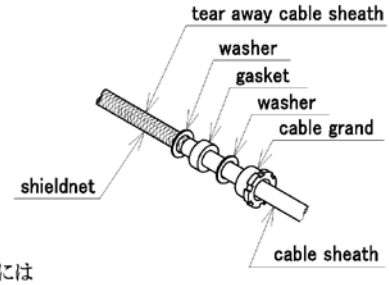


Fig.2-4 Grounding and corrosion-resistant measures

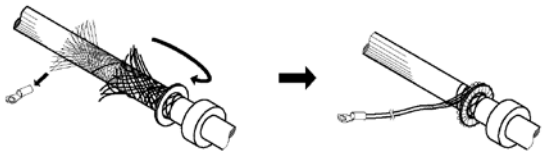
3. Connecting the installation cable

Instruction for Equipment
装備要領

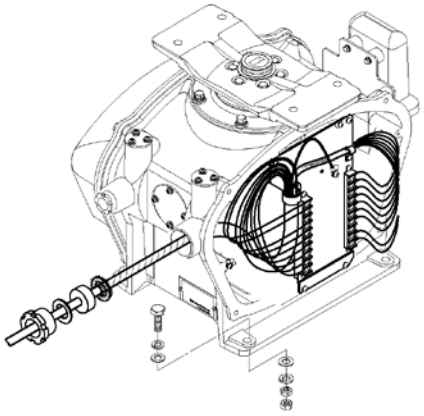
1. Put the cable into cablegrand, washers and gasket.
   Tear away the cable sheath.
   ケーブルをワッシャ、ガスケット、グランドに通し、
   被覆を剥がす。



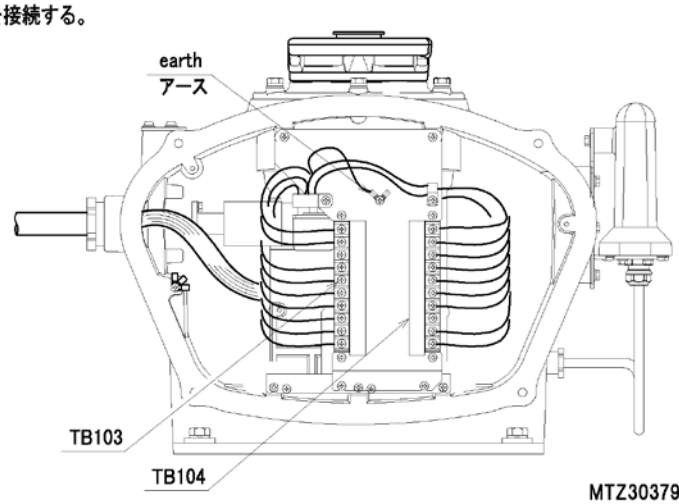
2. Unknit outer shieldnet and wrap it around a washer.
   Connect a solderless terminal (for a ground) to a inner shildnet.
   外側のシールドネットをほどき、座金に巻きつけ、内側のシールドネットには
   丸型圧着端子(アース)を取付ける。



3. Equip the scannerunit with bolts and washers.
   ボルト、ワッシャを用いて、空中線を装備する。

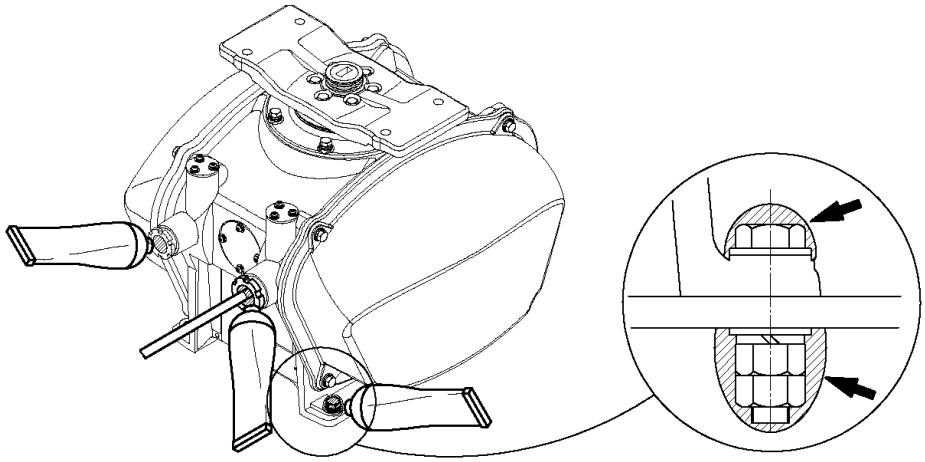


4. Clump the cable, connect terminals .
   ケーブルを各部でクランプし、端子を接続する。

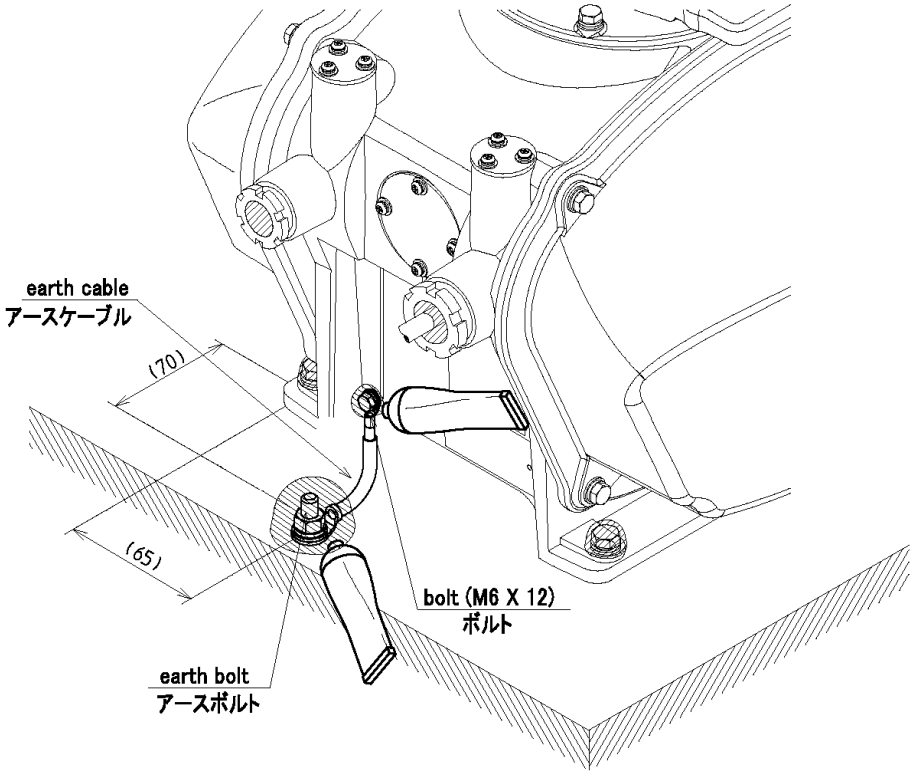


MTZ303797-1/2

5. Apply silicone sealant around the bolts and into the cable inlet.
ボルトの周辺部とケーブルグランド部をシールする。

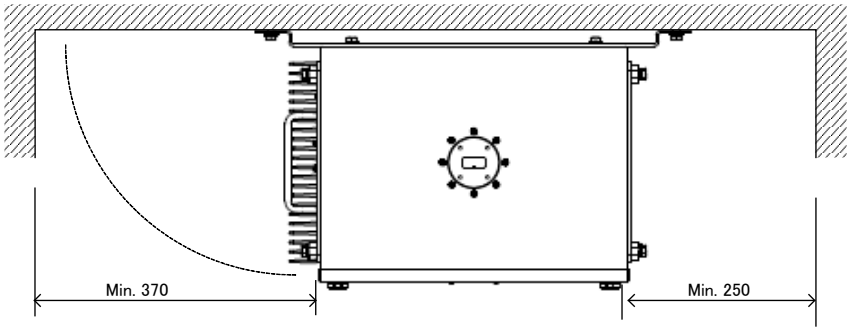


6. Bolt the earth cable to mountbase and scanner.
Apply silicone sealant around the bolts.
アースケーブルをボルトで締結後、締結部分を全てシールすること。



4. Installation of Solid State Transmitter-Receiver (NTG-420)

The mounting place of NTG-420 Solid State Transmitter-Receiver is shown below. It is required to secure a space for equipment and maintenance.



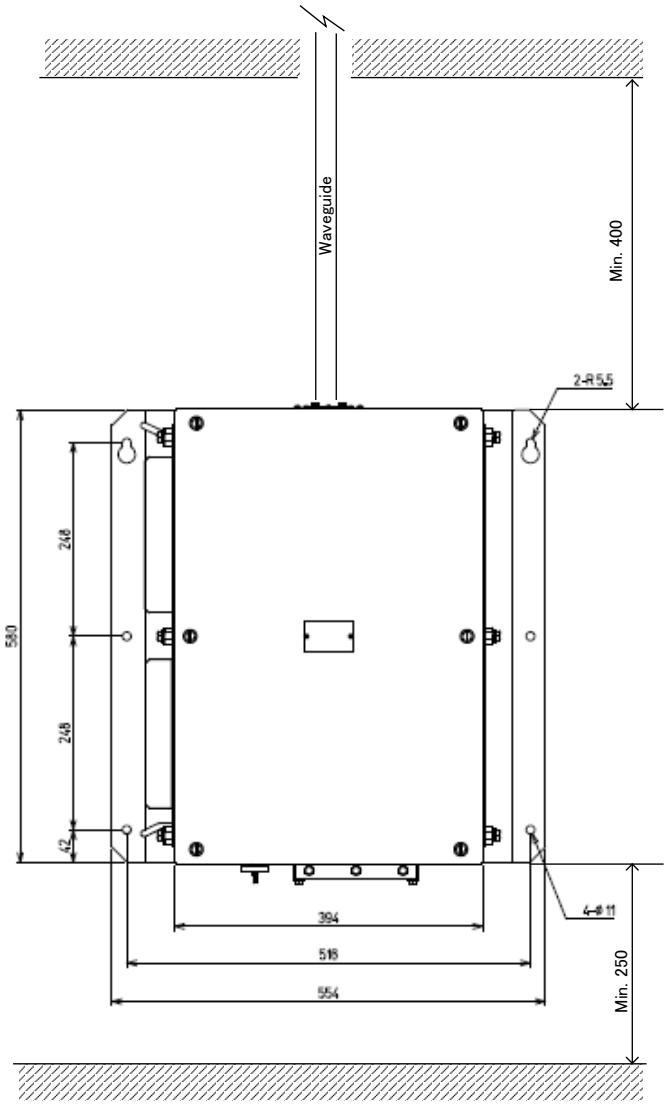


Fig.4-1 NTG-420 Installation (Space for Mounting Place)

5. Solid State Transmitter-Receiver(NTG-420) Wiring

Table 5-1 Connect Terminal of NTG-420

Terminal No.	Connect	Cable
Waveguide flange(UG-51/U)	X-band 9ft Antenna	WRJ-9 Waveguide)
P1	DC Power Supply (DC 48V)	Power Cable
P2 Not Used for this System	External Equipment (ex. Radar Data Processor)	RE-422 cable or equivalent
P3 Not Used for this System	External Equipment (ex. Radar Data Processor)	14-core shield composite cable(2695110056).
P4	X-band Radar Antenna	14-core shield composite cable(2695110056) or equivalent
RJ-45JJ	NCD-2247—1B Radar Control/Monitoring PC	LAN cable Cat.6a
Optical Communication Board (AGM-741 daughter board)	NCE-5584-1B IQ Data Recording PC	Optical Cable 2C
Earth Point	Earth line	IV-5.5 or equivalent

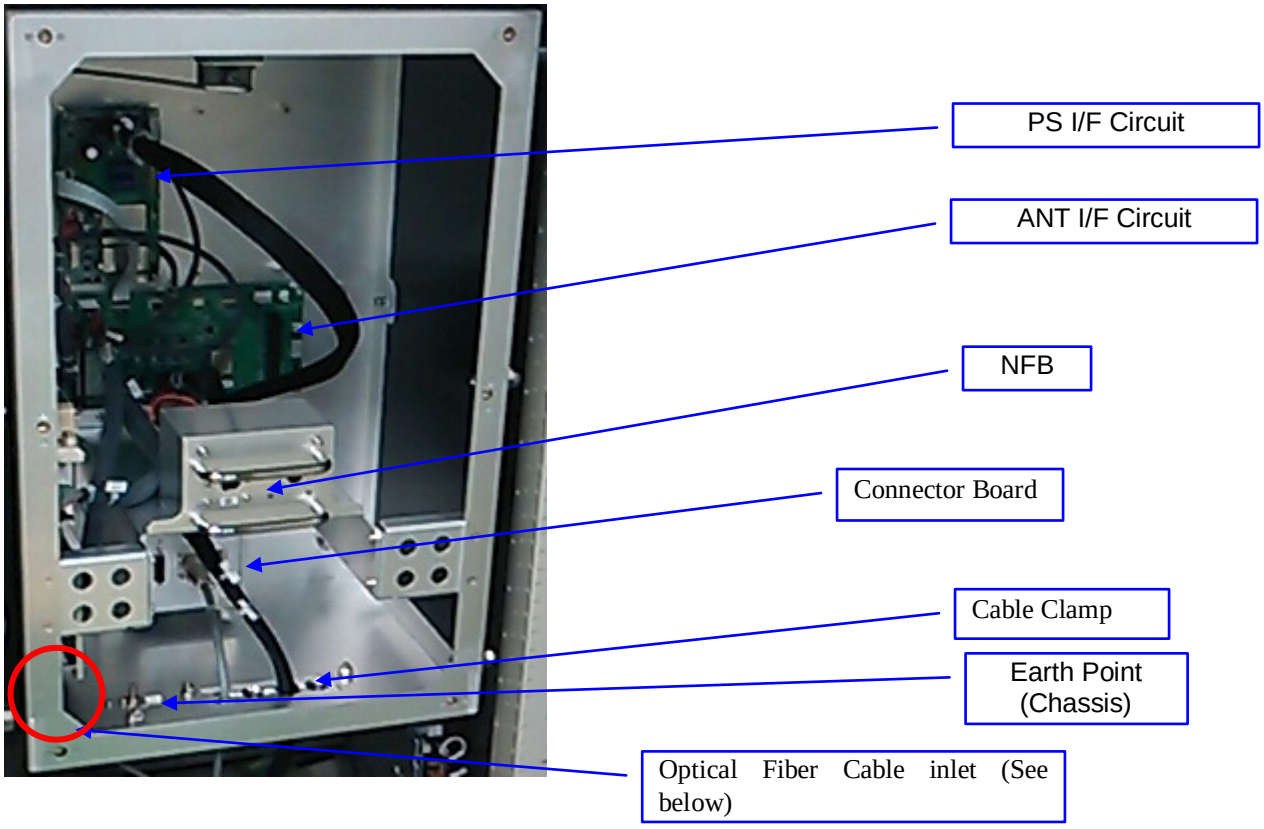


Fig.5-1 Inside View of NTG-420

Table 5-1 Signal Layout of each Terminal

Table 5-1 (1) P1

Pin No.	Pin Name	In/Out	Description
1	+48V	In	+48V
2	+48V RTN	In	+48V Return
3	GND		Ground

Table 5-1 (2) P2

Pin No.	Pin Name	In/Out	Description
1	MNT-TX-P	Out	Maintenance Port RS-422 output-P
2	MNT-TX-N	Out	Maintenance Port RS-422 output-N
3	MNT-RX-P	In	Maintenance Port RS-422 input-P
4	MNT-RX-N	In	Maintenance Port RS-422 input-N
5	MNT E	In/Out	Shield (Ground)
6	NC	-	Reserved
7	NC	-	Reserved
8	NC	-	Reserved
9	NC	-	

Table 5-1 (3) P3

Pin No.	Pin Name	In/Out	Description
1	VD	Out	Radar Video Signal
2	VD_E	Out	Radar Video Signal Return
3	TRIG	Out	Radar Trigger Signal
4	TRIG_E	Out	Radar Trigger Signal Return
5	BP	Out	Antenna Bearing Pulse Signal
6	BPE	Out	Antenna Bearing Pulse Signal
7	BZ	Out	Bearing Reference Signal
8	BZE	Out	Bearing Reference Signal Return
9	NMEA_P	In/Out	Control/Monitoring Signal(RS-485)-P
10	NMEA_N	In/Out	Control/Monitoring Signal(RS-485)-N
11	NMEA_E	In/Out	Return
12	NC	-	Reserved
13	NC	-	Reserved
14	NC	-	Reserved
15	SHIELD	-	

Table 5-1 (4) P4

Pin No.	Pin Name	In/Out	Description
1	SAF SW-	In	Antenna Safety Switch Return
2	SAF SW+	In	Antenna Safety Switch Signal
3	ΦZ	In	Antenna Bearing Pulse (ΦZ-Phase)
4	ΦZE	In	Return
5	ΦA	In	Antenna Bearing Pulse (ΦA-Phase)
6	ΦAE	In	Return
7	ΦB	In	Antenna Bearing Pulse (ΦB-Phase)
8	ΦAE	In	Return
9	NC	-	Reserved
10	NC	-	Reserved
11	NC	-	Reserved

12	+12V ISO	Out	+12V Antenna Encoder Power
13	+12V RET	Out	Return
14	NC	-	Reserved
15	SHIELD		

Fig. 5-2 Waveguide Flange (UG-51U) of NTG-420

6. Installation Cable and Waveguide

6.1 CM14CXVBTBTV(2695110056)

This is composite cable of 14 wires with shielded coaxial cable. This cable is using between Antenna and TRX. Also, equivalent cable can be used which is provided by customer.

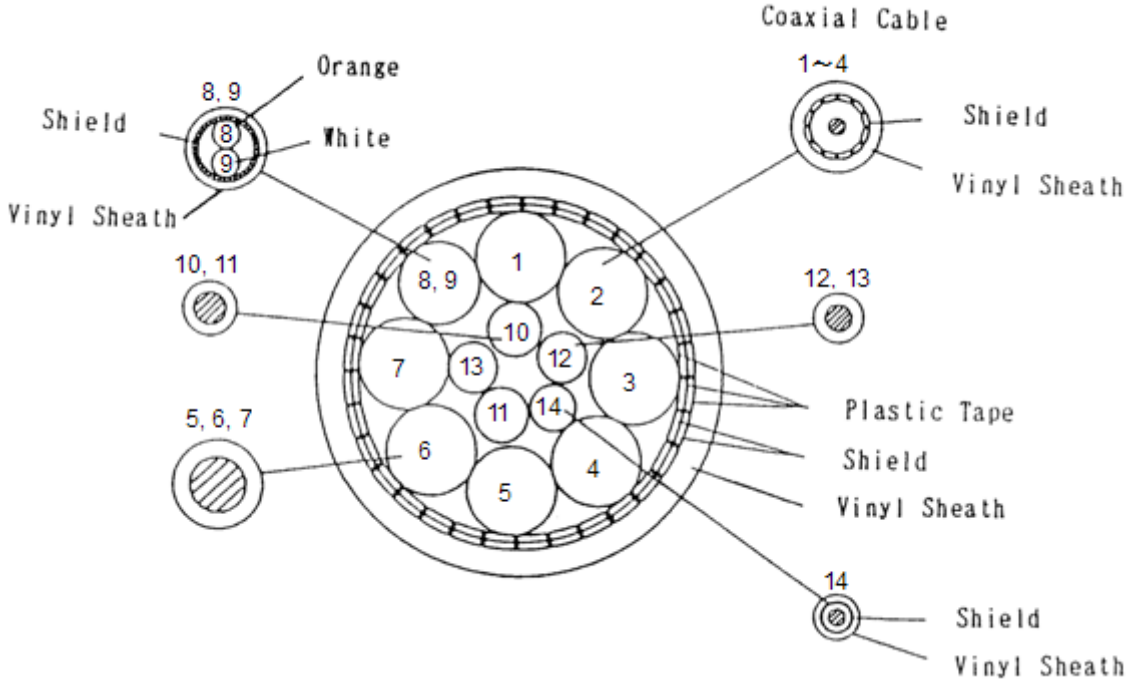


Fig.6-1 CM14CXVBTBTV(2695110056) Component

Table 6-1 CM14CXVBTBTV(2695110056) material

Core (No.)	Cross Section (m2)	No. of wire / φ	Color	Remarks
1	0.5	19 / 0.18	Black 1	Coaxial Cable
2	0.5	19 / 0.18	Black 2	Coaxial Cable
3	0.5	19 / 0.18	Black 3	Coaxial Cable
4	0.5	19 / 0.18	Black 4	Coaxial Cable
5	5.5	35 / 0.45	Yellow	
6	5.5	35 / 0.45	Green	
7	5.5	35 / 0.45	Brown	
8	0.3	12 / 0.18	White	Twisted pair cable with Shield sheath white
9	0.3	12 / 0.18	Orange	
10	2	37 / 0.26	Red	
11	2	37 / 0.26	Blue	
12	1.25	50 / 0.18	Black	
13	1.25	50 / 0.18	Purple	
14	0.5	1 / 0.18	Gray	Shield wire

Max. diameter: 23.0mm

6.2 Waveguide and Cable Installation

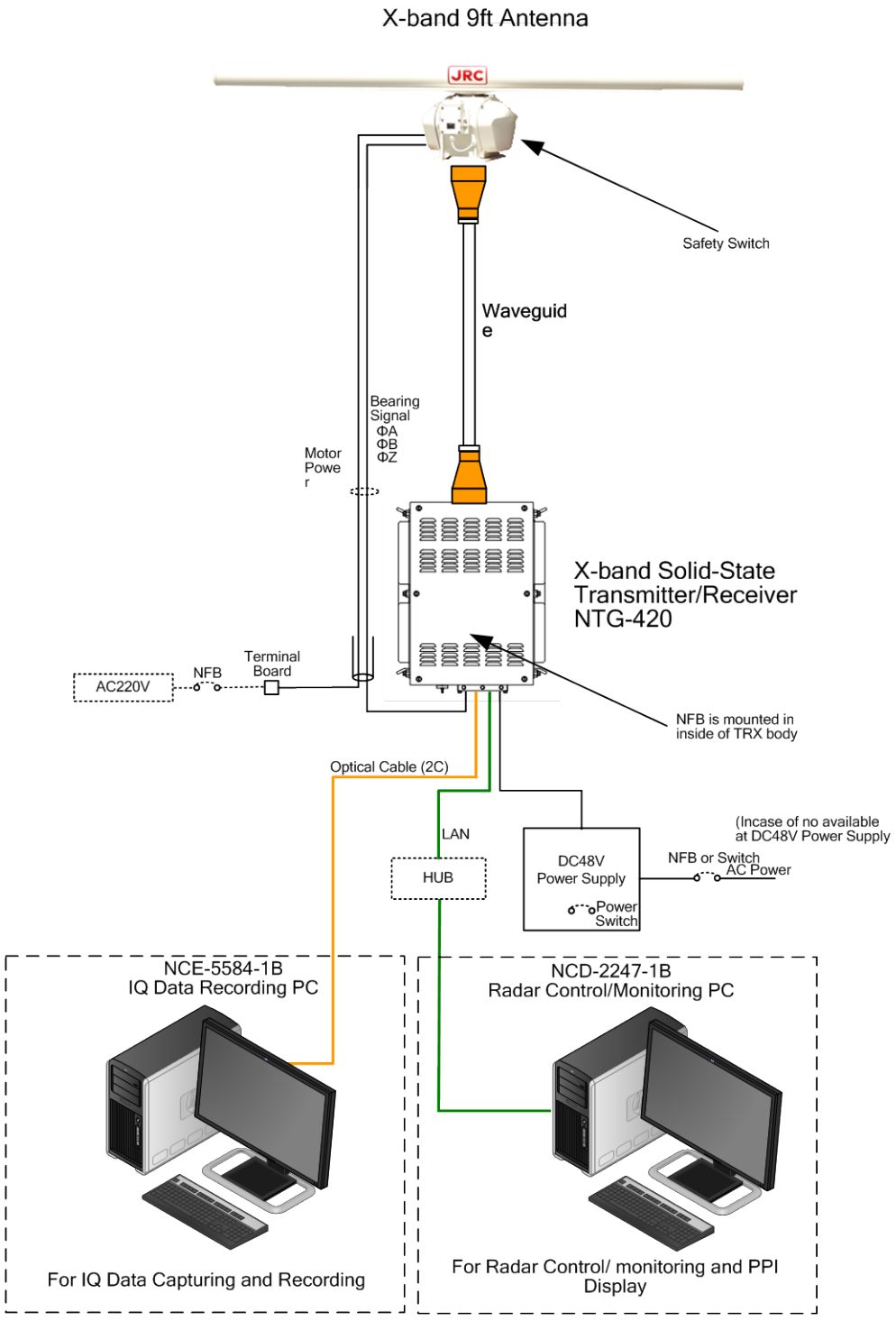


Fig.6-2 Waveguide and Cable Installation Diagram for NTG-420 with peripheral equipment

Table 6-2 Waveguide Materials List (for Example)

(No.)	WAVEGUIDE	Flange A	Flange B	Remarks
①	Tapered Transit Waveguide	(Flat): UG-51/U	(Flat) : UG-39/U	
②	Flexible Waveguide ANDREW Model :Elliptical Waveguide Type : EW85 Frequency Range : 7.7-9.8GHz	(Choke) : No.185BC	(Choke) : No.185BC	
③	Tapered Transit Waveguide	(Flat): UG-39/U	(Choke) : UG-52B/U	

Notes:

For detailed assembling method, please contact waveguide manufacturer(s) including required special tools and materials

APPENDIX

Drawing

OUTLINE DRAWING

X-BAND RADAR ANTENNA

NTG-420 X-BAND SOLID STATE TRANSMITTER-RECEIVER

BLOCK DIAGRAM

X-BAND RADAR ANTENNA

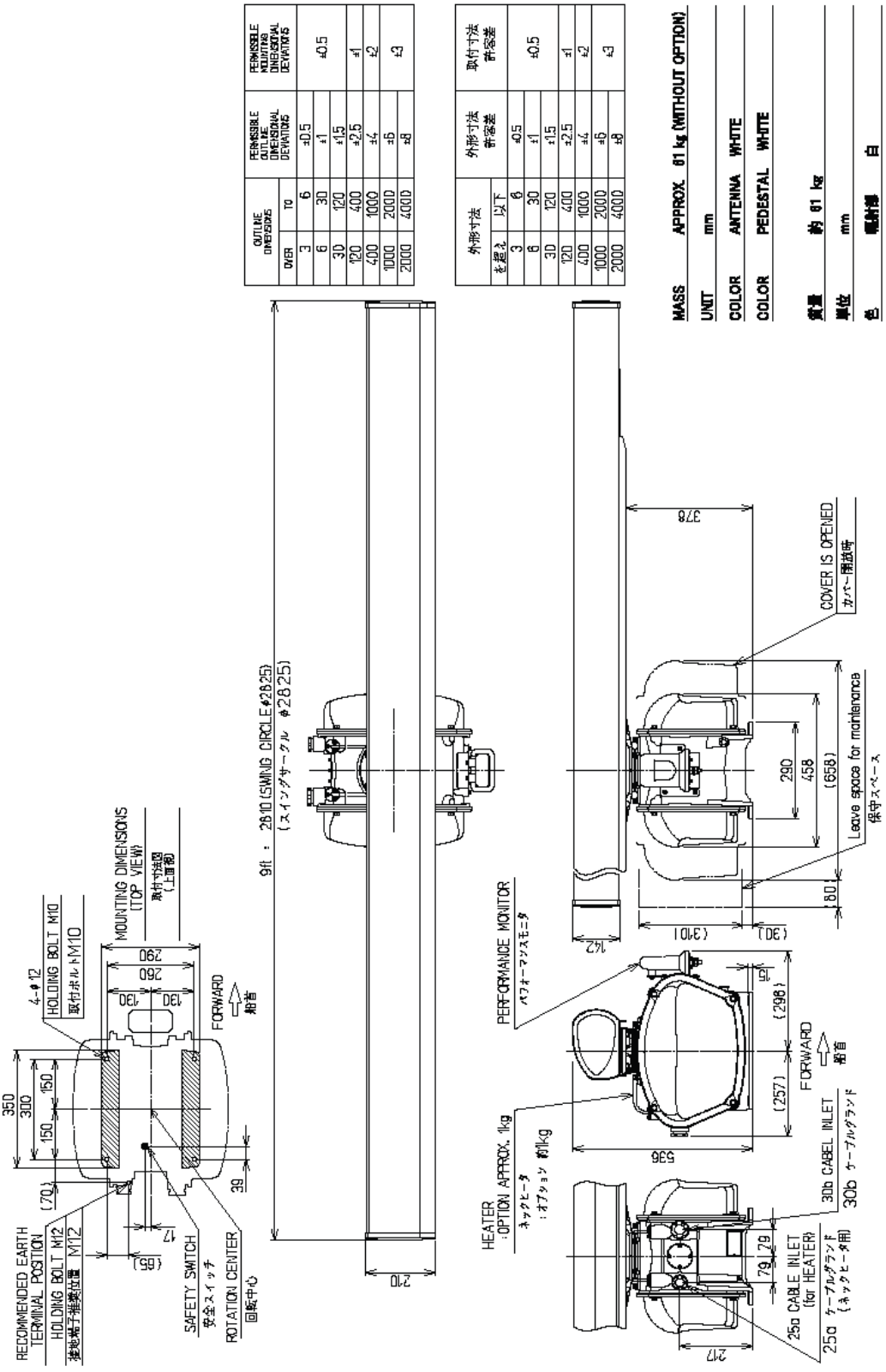
NTG-420 X-BAND SOLID STATE TRANSMITTER-RECEIVER

WIRING DIAGRAM

INTERCONNECTION FOR NTG-420 X-BAND SOLID STATE TRANSMITTER-RECEIVER (REFERENCE)

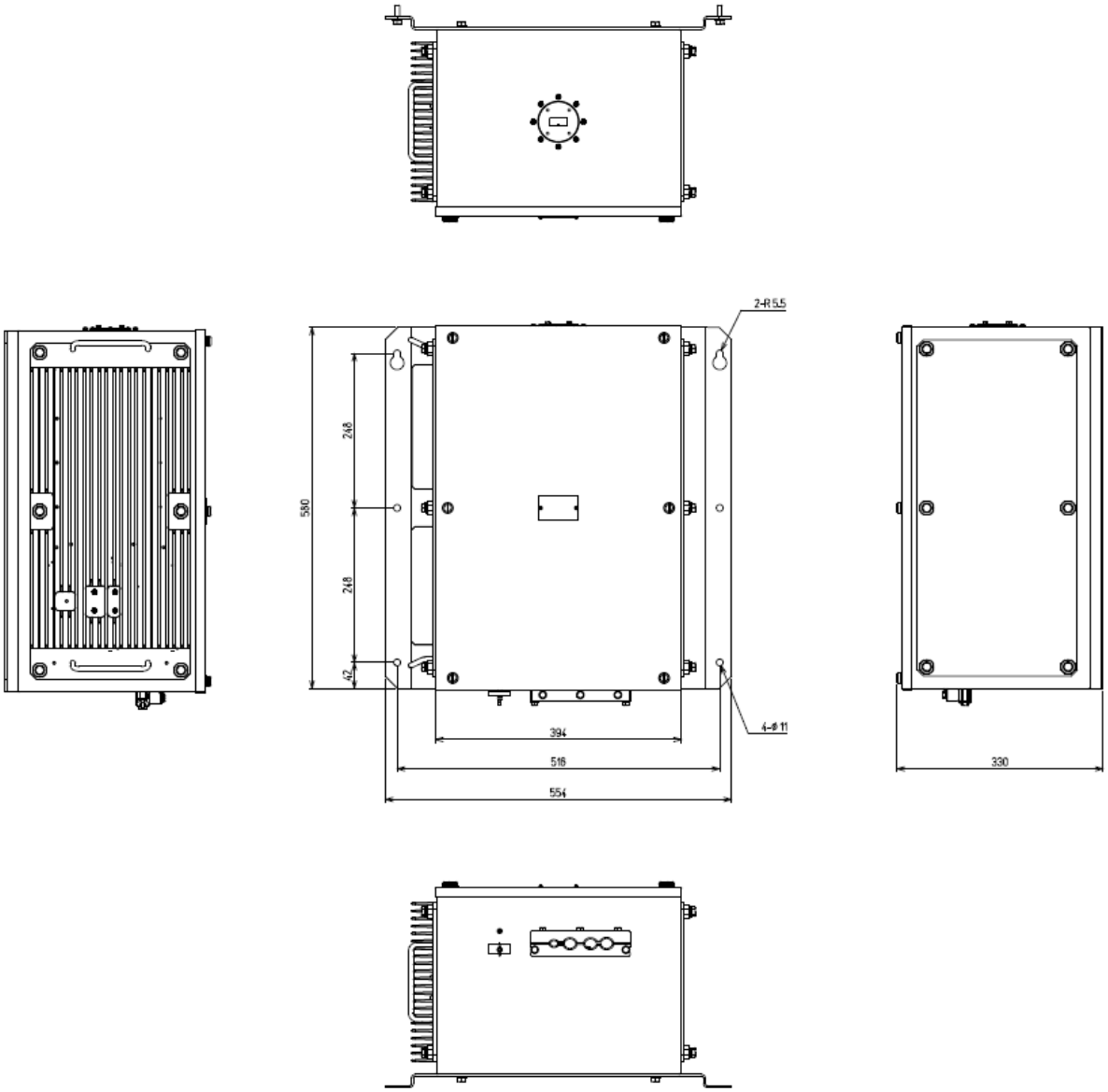
WAVEGUIDE CATALOGUE

Outline Drawing of X-band Radar Antenna

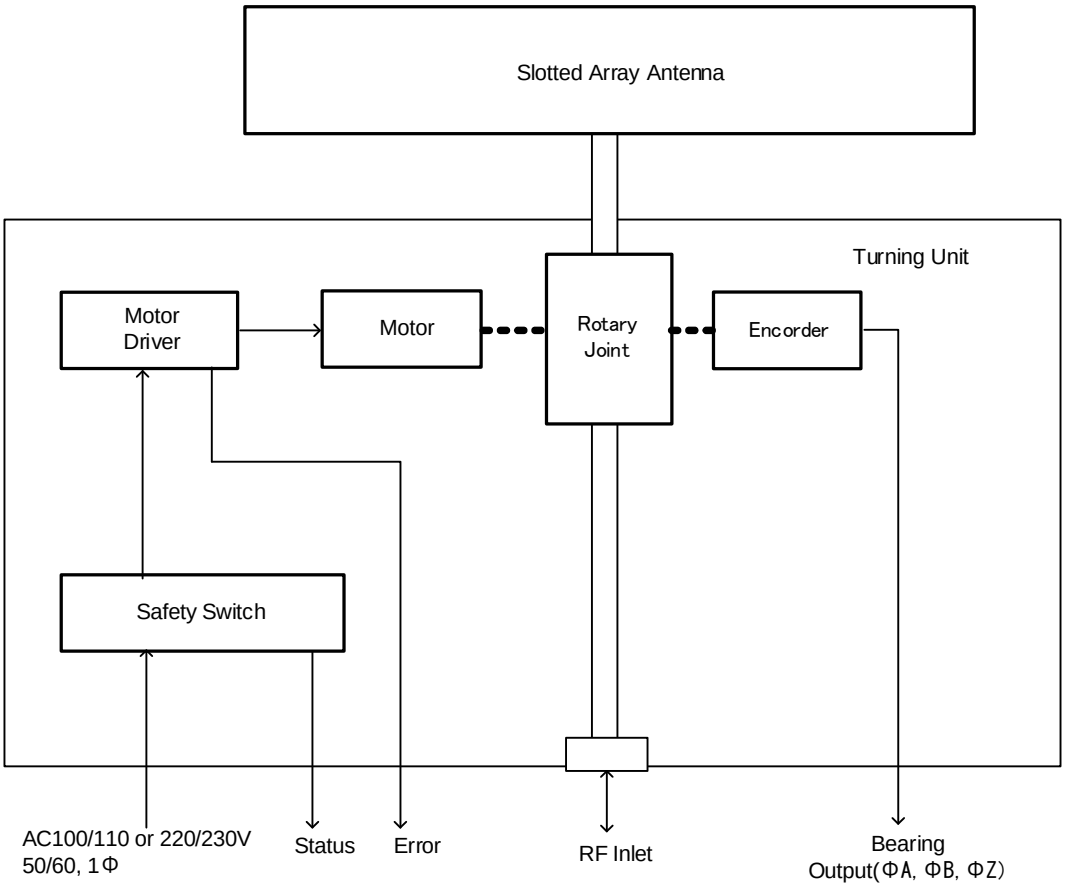


Note: Performance Monitor does not included in this system.

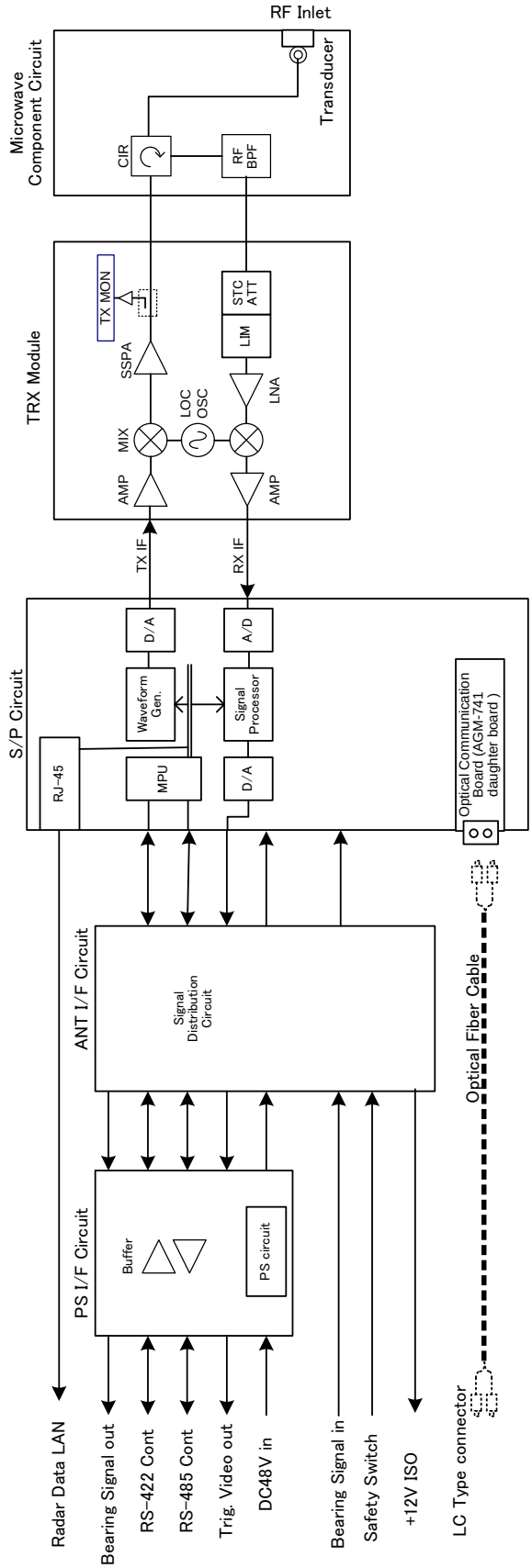
Outline Drawing of NTG-420 X-Band Solid State Transmitter-Receiver



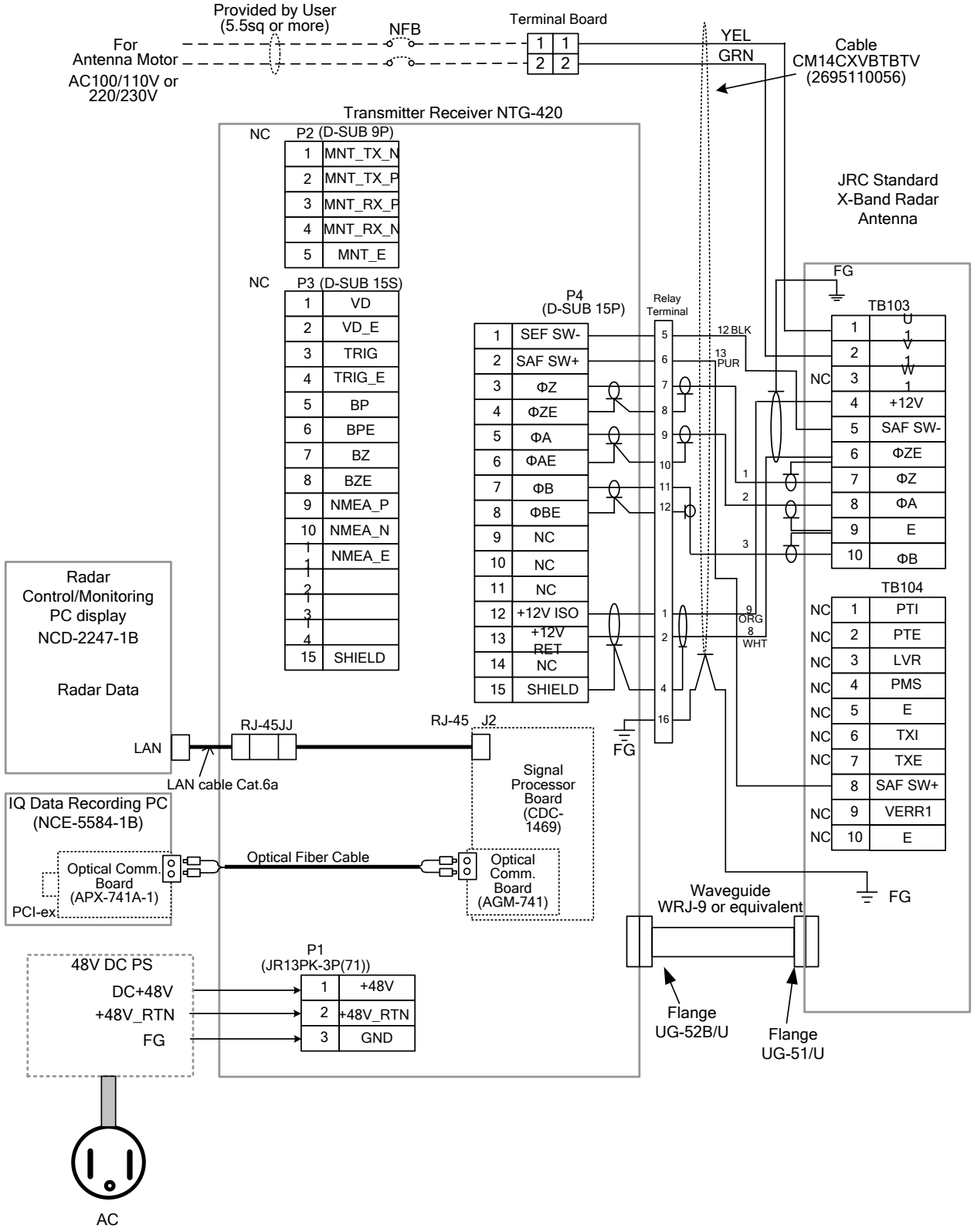
Block Diagram of X-band Radar Antenna



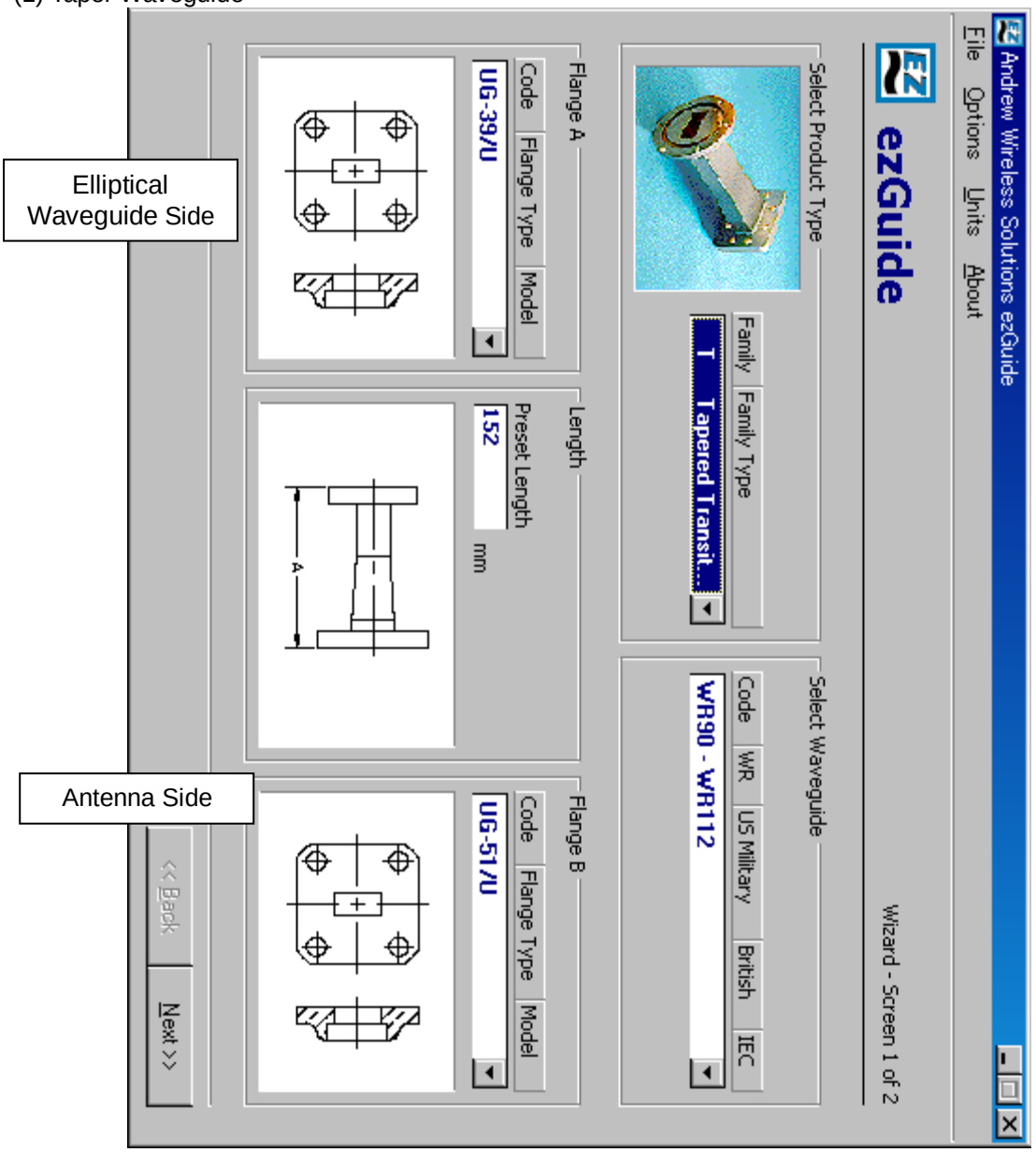
Block Diagram of NTG-420 X-Band Solid State Transmitter-Receiver



Interconnection for NTG-420 X-Band Solid State Transmitter-Receiver (Reference)
(Confirm the antenna motor power before installation)



Waveguide Catalogue
(1) Taper Waveguide



(2) Elliptical Waveguide

Elliptical Waveguide
Types EW85

Characteristics

Type Numbers	
Premium Waveguide, Standard Jacket	EW85
Standard Waveguide, Fire Retardant Non-Halogenated Jacket	35409-17**
Electrical	
Max. Frequency Range, GHz*	7.7-9.8
•TEm Mode Cutoff Frequency, GHz	6.46
Group Delay at 9.2 GHz, ns/100 ft (ns/100 m)	142 (465)
Peak Power Rating at 9.2 GHz, kW	38.9
Mechanical	
Minimum Bending Radii, without rebending, inches (mm)	
E Plane	8 (200)
H Plane	19 (480)
Minimum Bending Radii, with rebending, inches (mm)	
E Plane	8 (200)
H Plane	19 (480)
Maximum Twist, degrees/foot (m)	1 (3)
Dimensions over Jacket, in (mm)	1.29 x 0.88 (32.8 x 22.4)
Weight, pounds per foot (kg/m)	0.33 (0.50)

* Actual usable range is limited by the connecting rectangular waveguide.
** UL® listed Type CATVR.

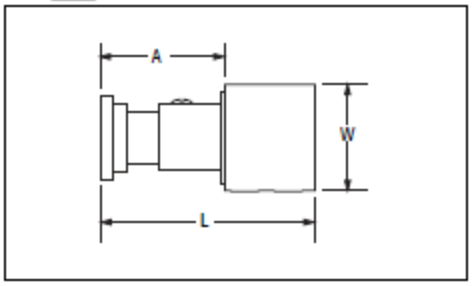
Attenuation, Average Power, Group Velocity

Frequency GHz	Attenuation dB/100 ft (dB/100 m)	Average Power Rating, kW	Group Velocity of Propagation,%
7.7	4.32 (14.20)	1.17	54.4
7.9	4.01 (13.10)	1.26	57.6
8.1	3.78 (12.40)	1.34	60.3
8.3	3.59 (11.80)	1.40	62.8
8.5	3.45 (11.31)	1.46	65.6
8.7	3.33 (10.92)	1.52	67.6
8.9	3.23 (10.59)	1.56	69.4
9.1	3.14 (10.31)	1.61	71.0
9.3	3.07 (10.07)	1.64	72.4
9.5	3.01 (9.86)	1.68	73.8
9.7	2.95 (9.68)	1.71	75.0
9.8	2.93 (9.60)	1.72	75.6

Attenuation values based on VSWR 1.0, ambient temperature 24°C (75°F) and are guaranteed within ±5%. Average power ratings based on VSWR 1.0 and 42°C (76°F) temperature rise over 40°C (104°F) ambient.

Connectors – Flange dimensions on pages 216-217

	L in (mm)	W in (mm)	A in (mm)	Weight lb (kg)
Type No. 185BC				
	4.75 (121)	2.1 (52)	3.5 (89)	2.0 (0.9)

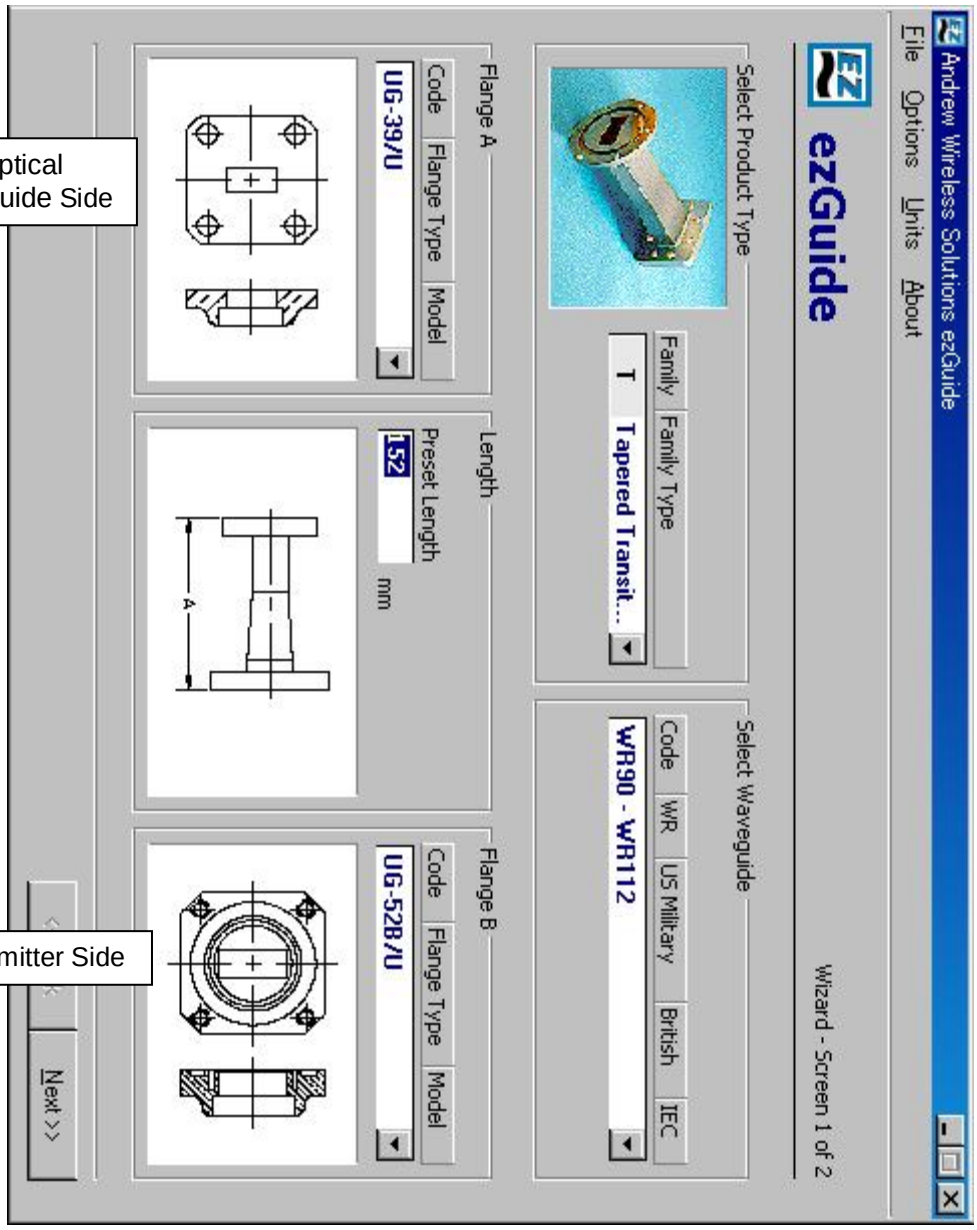


Connector Material: Brass

ANDREW.

Customer Service Center - Call toll-free from: • U.S.A., Canada and Mexico 1-800-255-1479

(3)Taper Waveguide



Elliptical Waveguide Side

Transmitter Side

Maximum Permissible Exposure(MPE) Calculation

The MPE was calculated with the antenna used as the highest antenna gain which may be used.

Radiofrequency radiation exposure limits.(Frequency: 10MHz to 300GHz)
Limits for Occupational/Controlled Exposure(mW/cm^2)=5.00
Limits for General Population/Uncontrolled Exposure(mW/cm^2)=1.00

NTG-420 Performance characteristics

Antenna gain(dB)=	38	Assumed 22feet Slotted Array Antenna	
Output Average Power(W)=	4.6	(dBm)=	36.628
Frequency(MHz) =	9410		
Cable Loss(dB) =	1	Assumed 10m Waveguide Lengh	
Calculated EIRP mW) =	23054613	73.628	(dBm)

Power Density(SmW/cm^2)=EIRP/4・π・r^2
(r=cm)

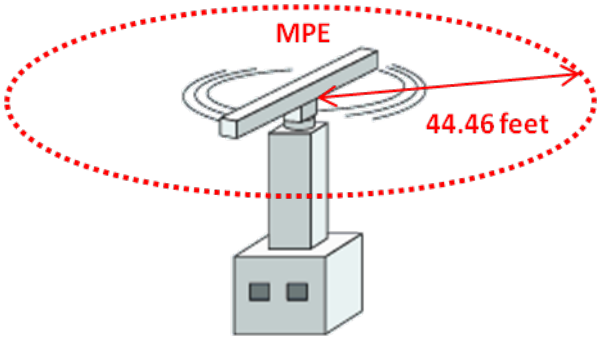
EIRP mW	Distance cm	Distance Feet	Power Density (S) mW/cm^2	
23054612.7	1500	49.21	0.81539	
23054612.7	1450	47.57	0.87259	
23054612.7	1355	44.46	0.99924	General population
23054612.7	1350	44.29	1.00665	
23054612.7	1300	42.65	1.08558	
23054612.7	1250	41.01	1.17416	
23054612.7	1200	39.37	1.27405	
23054612.7	1150	37.73	1.38724	
23054612.7	1100	36.09	1.51622	
23054612.7	1050	34.45	1.66406	
23054612.7	1000	32.81	1.83463	
23054612.7	950	31.17	2.03283	
23054612.7	900	29.53	2.26497	
23054612.7	850	27.89	2.53928	
23054612.7	800	26.25	2.86661	
23054612.7	750	24.61	3.26156	
23054612.7	700	22.97	3.74414	
23054612.7	650	21.33	4.34232	
23054612.7	610	20.01	4.93047	Occupational
23054612.7	550	18.04	6.06489	
23054612.7	500	16.40	7.33851	
23054612.7	450	14.76	9.05989	
23054612.7	400	13.12	11.46643	

23054612.7	350	11.48	14.97656
23054612.7	300	9.84	20.38476
23054612.7	250	8.20	29.35405
23054612.7	200	6.56	45.86570
23054612.7	150	4.92	81.53903
23054612.7	100	3.28	183.46282
23054612.7	50	1.64	733.85127

Conclusion:

Frequency	General population Limit Minimum Distance(feet)	Occupational Limit Minimum Distance(feet)
10MHz-300GHz	44.46	20.01

The NTG-420 is radar system for operating at the land based services.
The radiating structure for the radar is typically mounted as following diagram.
The radar system will satisfy the requirements of RF exposure per rule.



Typical Installation of radar system

FCC Caution

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1) Reorient or relocate the receiving antenna.
2) Increase the separation between the equipment and receiver.
3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4) Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 80 and Part 90 of the FCC rules.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

IC (Indutry Canada)

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : 1) l'appareil ne doit pas produire de brouillage; 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.