Maintenance Manual

for

THE NTG-560 SOLID STATE TRANSMITTER / RECEIVER

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JRC Japan Radio Co., Ltd.

Revision Hsitory

Revision	Description	Issued

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CAUTION FOR HIGH VOLTAGE

High voltage of hundreds up to thousands volt are used in radio and radar devices. Although prudent measures for safety have been adopted, sufficient cares should be taken on operation, maintenance and adjustment of the device.

Electric shock by thousands volt leads to an instantaneous death for certain, and even electric shock by hundreds volt leads to an instantaneous death occasionally. To prevent such as accident, turn off the power source, discharge capacitors by a wire surely earthed at one end, and check that any charge is no longer inside the device, before you put your hand into the inside. It is still better to wear dry wool gloves. It is also necessary caution not to use both hands simultaneously, by putting the one hand into your pocket.

The selection of a stable foothold is essential to prevent more extensive or additional injuries.
When injured by electric shock, disinfect the burn perfectly and give first aid as soon as possible.

WHAT TO DO IN CASE OF ELECTRIC SHOCK

When a victim of electric shock is found, turn off the power source and earth the circuit immediately. If this is impossible, move the victim away from it without touching him with bare hands as quick as possible. He can safety be moved if an insulating material such as dry wood plate or cloth is used.

Breathing may stop if current flows through the respiration center of brain due to electric shock. If the electric shock is not large, breathing can be restored by artificial respiration. A victim of electric shock looks pale and his pulse becomes very weak or stops, resulting in unconsciousness and rigidity.

FIRST – AID TREATMENTS

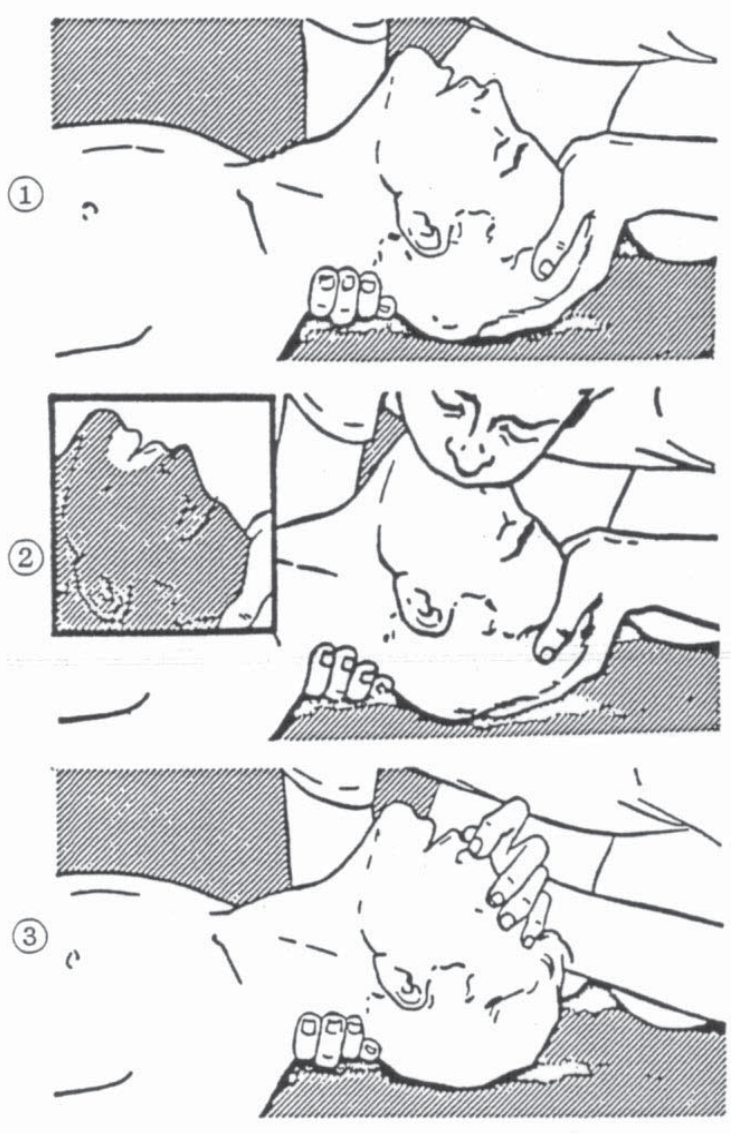
As far as the victim of electric shock is not in dangerous condition, artificial respiration should be started at once at the site. Once started it should be continued rhythmically.

(1) Do not touch the victim confusedly or rescuer may also receive an electric shock.
(2) Turn off the power source and move the victim from the electric line calmly.
(3) Call a physician or ambulance immediately, or instruct someone else to call.
(4) Place the victim on his back and loose his necktie, clothes, belt, etc.
(5) a. Examine the victim's pulse
    b. Examine the heartbeat by laying your ear on his heart.
    c. Examine breathing by breathing your face or back of hand close to his face.
    d. Examine the victim's pulse.
(6) Open the victim's mouth and remove the artificial teeth, cigarette or chewing gum, if any. Keeping the mouth open, stretch the tongue and insert a towel or the like to prevent the tongue from suffocating. (If it is hard to open the mouth with set teeth, open it by a screw-driver and insert a towel.)
(7) Wipe the mouth to prevent foam mucus and saliva from accumulating.

IN CASE PULSE CAN BE DETECTED BUT BREATHING STOPS (MOUTH TO MOUTH ARTIFICIAL RESPIRATION)

(1) Tilt the victim's head back as far as his face looks back.
(A pillow may be inserted under the neck)
(2) Pull the jaw into jutting position to open the throat.
(3) Pinch the victim's nostrils shut and place your mouth tightly over his after drawing your breath long. Then blow into mouth strongly. Continue blowing at a rate of 10 -15 breaths a minute.
(4) Watch carefully and continue artificial respiration till natural respiration is restored.
(5) If the opening of mouth is difficult, insert a vinyl pipe or the like into a nostril and blow into it by shutting the other nostril and mouth perfectly.
(6) Victim may stand up suddenly when he becomes aware. He should lie quickly and kept warm and calm.
Save him with hot coffee or tea (but never alcoholic drinks).

Fig 1 Method of mouth to mouth artificial respiration



Tilting back of Victim's head

Put one of your hands on the victim's forehead and the other under the neck①. In general his mouth opens when the head is tilted back, making easy mouth to mouth artificial respiration.

Place your mouth tightly over his and press your cheek against his nose② or pinch his nostrils by your fingers③ to prevent air leakage.

Blowing into Lungs

Blow into the mouth till the chest rises. The first 10 breaths should be performed as fast as possible.

IN CASE OF CARDIAC ARREST AND CESSATION OF BREATHING

(Cardiac massage and mouth to mouth artificial respiration)

(1) When no pulse can be detected, the pupils are open and no heartbeat is heard, cardiac arrest is considerable.
Therefore, artificial respiration should be started at once.

(2) Put the heel of one hand over the lower 1/3 of his breastbone and other hand on the back of the first. Apply your weight so that the breastbone is compressed by about 2 cm.
(Repeat it at a rate of about 50 times a minute.)
(Cardiac massage)

(3) In case of one rescuers
After about 15 times cardiac massages, give mouth to mouth artificial respiration 2 times, and repeat them in this manner.

(4) In case of two rescuers
While the victim is be massaging, another person should give mouth to mouth artificial respiration.
A breath is interposed after 5 cardiac massages.
(Cardiac massage and mouth to mouth artificial respiration)

(5) Examine the pupils and pulse often. When they become normal stop the first aid treatments, serve the victim with coffee or tae and keep him warm and calm, while watching him carefully.

(6) Commit the victim to a medical specialist, according to the situation. For earlier recovery of the victim from the mental shock, the understanding of bystanders is essential.

SAFETY INFORMATION

To prevent harm to those who use this product or other people and damages to property, safety precautions to be followed are described as follows.

★ The degrees of harm and damages caused by misuse with neglecting indications are classified and described as follows.

DANGER	This indication means "Hazard can cause severe injury or
WARNING	This indication means "Hazard can cause injury or only physical damages."

★ Kinds of precautions to be followed are classified and described with the following icons. (A few examples of icons are as follows.)

This icon is to call attentions.

This icon is to prohibit some actions

This icon is to force some actions.

DANGER

Plug in completely

Incomplete plugging may generate heat to cause a shock or a fire.

In case of malfunctions or abnormal conditions (smoke, foul odor, sound, etc.), turn the power off and turn off the breaker of the power distributor.

Unplug

Turn the power off and consult with our company. Do not repair the device by yourself because it is dangerous.

Do not put the device on unstable places(a shaky stand, tilted place, etc.).

Prohibition

Dropping or falling down of the device may cause injury.

Do not wet or water the device.

Do not wet

Wetting the device may cause a shock or a fire.

Do not put things (containers with liquid, flower pots, etc.) or creatures on the device.

Prohibition

Entering of liquid or excrement may cause a shock or a fire.

★ In case of entering, unplug from the outlet and consult with our company.

Do not put liquid such as water, metals or inflammable objects inside the device.

Prohibition

Entering may cause a shock or a fire.

In case of entering, unplug from the outlet and consult with our company.

DANGER

Do not drop or bump the device.

Physical shock may cause a s hock or a fire.

Prohibition

Do not use the device under a voltage other than the indicated power-supply voltage.

Malfunction may occur to cause a shock or a fire.

Prohibition

Do not remove the back lid, the cabinet or the cover, or do not modify the device.

Consult with our company for internal inspection and repair.

Do not decompose

When thunder has started, do not touch the power cables, the signal cables and the device.

Touching will cause a shock

Do not touch

Do not damage the power cord or the plug.

Damaging, processing, loading, heating, bending and twisting forcedly or pulling may deteriorate insulation of coating, expose cores or break the cord to cause a shock or a fire.

Prohibition

★ In the case of damages, unplug from the outlet and ask our company

WARNINGS

Carry the CRT monitor by more than one people since the monitor is heavy.

Stumbling, etc. may cause injury.

Disconnect the plug and the connection lines when moving the device.

Damage of cords may cause a shock or a fire.

Unplug

Unplug with holding the plug.

Damage of cords may cause a shock or a fire.

Unplug

Unplug from the outlet for safety when maintaining

A shock may be caused.

Unplug

WARNINGS

Do not unplug with wet hands

A shock may be caused.

Prohibition

Do not block the ventilation holes of the cabinet.

Heating up internally may cause malfunction or a fire. Pay attention to the following:

Prohibition

★Do not turn over, lay down or

Do not put the device where much moisture or dust exists, and greasy fumes or steam is generated.

Prohibition

Putting the device on a cooking table or near a heater may cause a shock or a fire.

Ask our company for internal inspection and cleaning periodically.

Without cleaning for a long time, dust gathered inside the device may cause malfunction or a fire.

Unplug from the outlet when not using for a long time.

Dust gathered on the plug may cause a fire or a shock.

Unplug

CAUTIONS

Do not put other devices (a TV, a display device, etc.) or magnetized objects near the CRT monitor. Installing the CRT monitor near those may have an effect on the screen (disturbing colors or swaying the screen).

★Move the device seemed to effect away as possible. In case the phenomenon does not stop even so, consult with our company.

Ground the earth wire of the plug.

A shock may be caused without grounding the earth wire.

Furthermore, poor reception for TV's, radios, etc. may

Do not put the device in direct sunshine or in the heat of heating apparatus.

Heat may cause deformation of the cabinet or malfunction of parts.

Do not use the device in a dark place at close range for a long time. Using the device in a dark place at close range for long time may weary eyes or weaken eyesight.

★Use the device at a distance of 40 or 50 cm in a bright place where newspaper can read easily. Take a rest for eyes every 30 minutes.

Do not contact the cabinet with rubber or plastic products for a long time.

The quality of the cabinet may alter or the coating may come off.

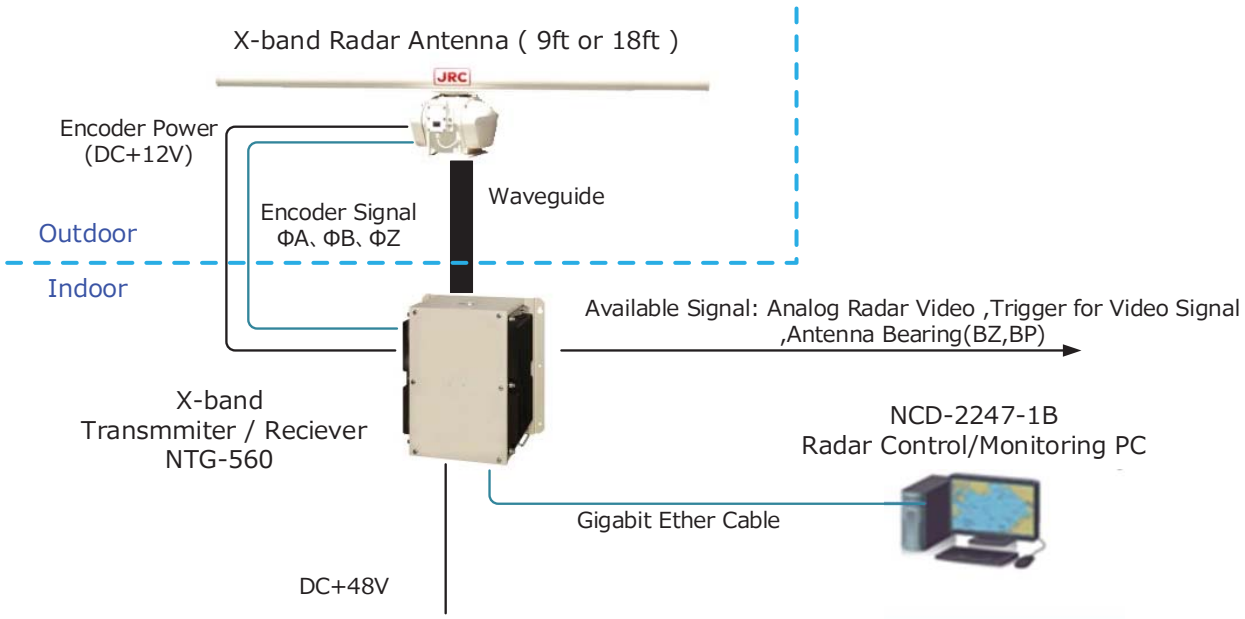
1. General

The JRC Model NTG-560 Solid State Transmitter-Receiver is ideal radar designed to be high performance, high quality and high reliability. The transmitting output power is 240W. This radar has been full semi-conductorized, so superior reliability have been expected.

The following picture shows NTG-560 Solid State Transmitter-Receiver.

NTG-560 External View

The example of radar system application of this equipment is shown in the following figures.



Application Example

2. Specification

Transmitting frequency : Non-chirp pulse 9,410MHz(P0N)
Chirp pulse 9,440 ± 15MHz(Q0N)
CW-pulse / Chirp pulse (P0N/Q0N) *1
Frequency Accuracy : +/- 300ppm
Transmitting power : 240W +1dB, -3dB (120W~300W)*2
Transmitter Type : Solid State Power Amplifier(SSPA)
Transmission pulse width : Refer to Transmission Table(1)
Pulse repetition frequency(PRF) : Refer to Transmission Table(1)

Transmission Table(1)

No.	Pulse width			PRF
	CW pulse	Chirp pulse	CW pulse /Chirp pulse	
0	0.07us	2.8us	0.07us/2.8us	2280Hz
1	0.15us	4.6us	0.15us/4.6us	2280Hz
2	0.3us	9.1us	0.3us/9.1us	2280Hz
3	0.15us	18.3us	0.15/18.3us	1280Hz
4	0.15us	28.0us	0.15us/28.0us	640Hz
5	0.3us	9.1us	0.3us/9.1us	1864Hz
6	0.6us	9.1us	0.6us/9.1us	1280Hz
7	0.07us	2.8us	0.07us/2.8us	4100Hz

Minimum Detection Signal(MDS) : -93dBm or less
A/D Sampling rate : 16bit / 84MHz
Pulse compression : Provided
Video Processing function : Interference rejection, CFAR and Coherent integration
Output signal : Radar video and Trigger
Radar control/monitoring : TCP/IP communication
Power supply : DC48V ± 10%
Power consumption : Less than 130W
Dimensions : 554mm(W) x 330mm(D) x 580mm(H) (Including Mounting Plate)
Operation temperature range : -15 ~ +50ºC, Non-condensing
Relative humidity : 93% @+40ºC
Storage temperature range : -25 ~ +60ºC

*1: Transmits both P0N and Q0N at simultaneously
*2: Transmitting power is fixed.

3. Theory of Operation

The NTG-560 Solid State Transmitter-Receiver(SSTRX) is consist of following blocks. Refer to Fig. 2

A0: SS TRX (NTG-560)

A1: TRX Unit (NMA-581A)

A1A1: TRX Module (CMN-821H)

A1A2: 1st Local OSC (CGH-450)

A1A3: S/P(Siganl Processing) Circuit (CDC-1469A)

A1A4: 2nd Local OSC (CGH-382A)

A1A5: Circulator (GAB1543-0280)

A1A6: 50ohm LOAD (PE6095)

A1A7: Circulator (GAB1543-0280)

A1A8: Optical Interface Board (AGM-741A)

A1FL11:Tx RF BPF(CFL-517F8)

A1FL12:Rx RF BPF(CFL-537)

A3: Transducer (112WCAS)

A4: ANT I/F Circuit (CHM-400)

A5: PS I/F Circuit (CBD-2027)

The transmitting waveform is created at the waveform generator in the block of S/P circuit based on waveform information selected by display system.

The transmitting waveform consists of two pulses, one for the short pulse covering in short range (CW modulated pulse) and another long pulse covering in long range(FM modulated pulse). The modulated CW and FM pulse are converted into 9GHz band frequency in the TRX Module by using the local oscillator. The transmitting signal of 9GHz band frequency is amplified by the SSPA(Solid State Power Amplifier) and outputs to the antenna passing through the circulator. The SSPA can be drastically improved a power consumption efficiency by way of switching function to cut power consumption during stopping transmitting period.

The radar echo which was received on antenna inputs receiver circuit passing through the circulator. The limiter is inserted at the receiver terminal for protection the high input RF power caused by a leak power from the transmitter and unexpected input spectrum.

The received signal is amplified by the LNA (Low Noise Amplifier) and converted into the IF band by local oscillator. The converted IF signal is also converted to digital signal by the ADC(Analog Digital Converter) at the S/P circuit, and then the received digital signal inputs to the signal processing circuit.

The signal processing circuit performs the signal demodulation, especially pulse compression process of the FM modulated pulse and also clutter suppression process (interference, rain/snow reflection etc.) and then outputs to the DAC(Digital Analog Converter) circuit. DAC converts from digital radar video to analog video then output to the display system through the PS I/F circuit.

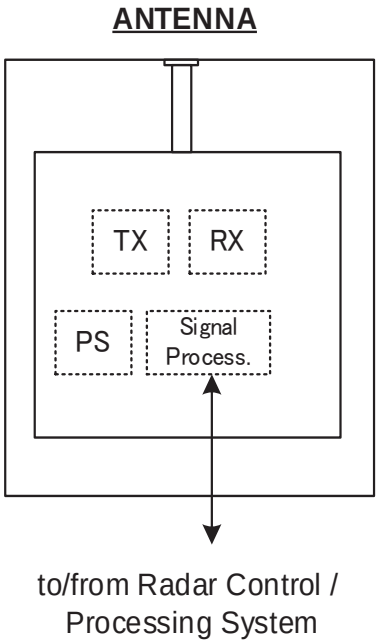


Fig.2 (1) NTG-560 Configuration Diagram

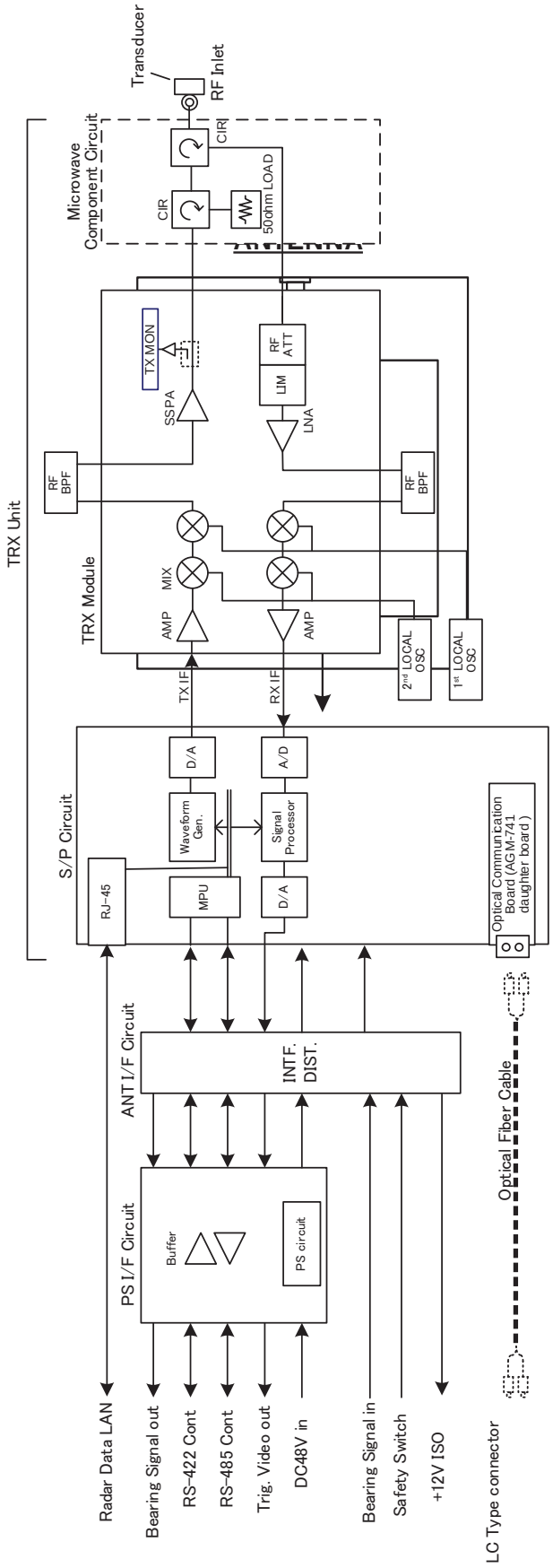


Fig.2 (2)　NTG-560 Configuration Diagram

3.1 Principle of Each Circuit

3.1.1 TRX Unit (NMA-581A)

3.1.1.1 TRX Module (CMN-821H)

The TRX (transmitter/receiver) module has the function of converting the frequency of the IF signal generated by the waveform generator in the signal processing circuit up to the 9 GHz frequency band using a local oscillator, and outputting the RF transmit signal.Then amplify 300W power by SSPA circuit. And this circuit has the function to receive the reflected power by objects through the antenna which are converted into IF signal by demodulator. Then the IF signal output to Signal Processing circuit for digital signal processing such as ADC, pulse compression, video processing.

TRX Module consists of following bolcks. Refer to 3.1.1-1

- ·Transmitter (with Frequency Convertor)
- ·Power AMP
- ·Receiver (with Demodulator)
- ·IF AMP
- ·without Local OSC (LOCAL OSC module is CGH-450 and CGH-382A)

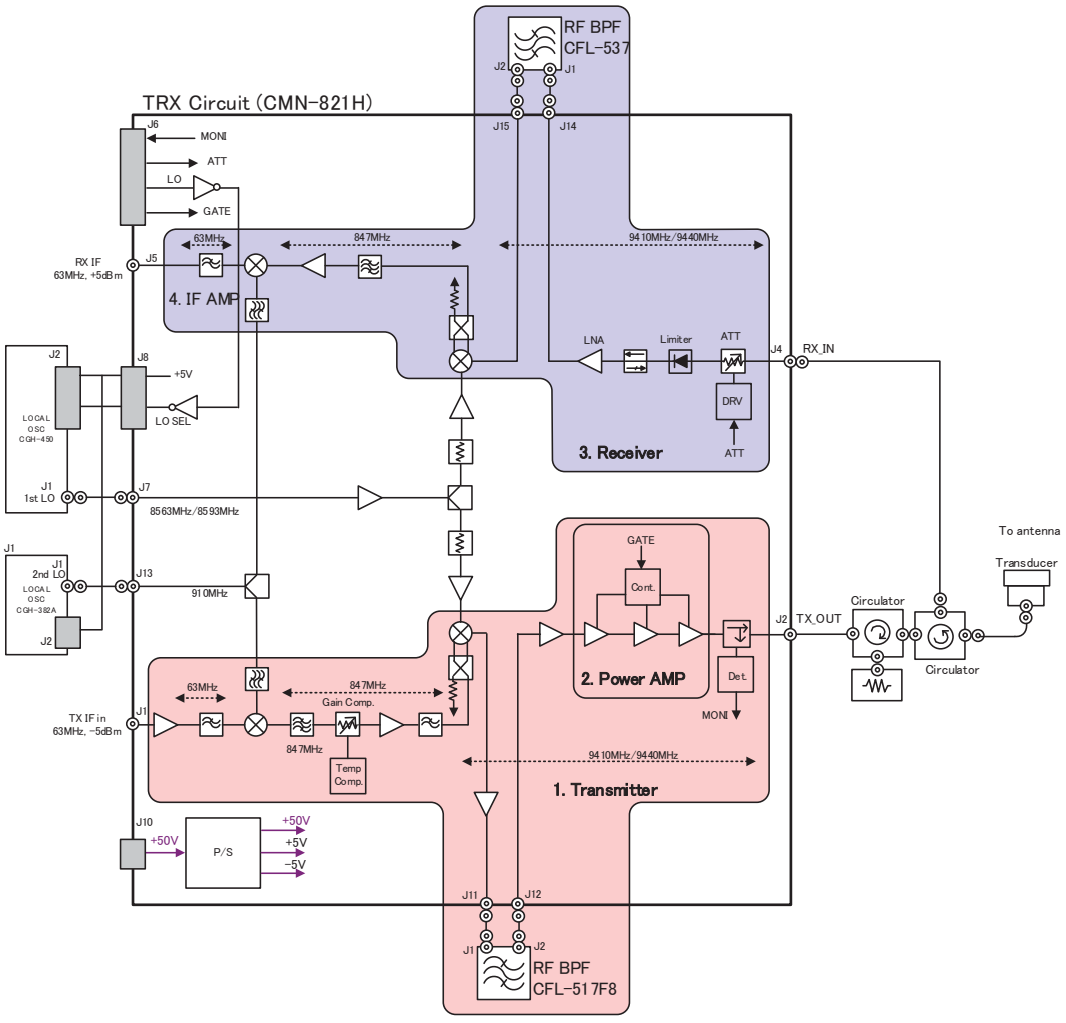


Fig. 3.1.1-1 TRX Unit Block Diagram

1) Frequency Converter curcuit and Locl OSC circuit

This block is to up-convert a chirp wave from Signal Processing circuit to X-band transmitting frequency. IF signal with chirp wave converts 847MHz to mix 910MHz of 2nd Local oscilator. After this signal tunes a gain along temperature, this signal is mixed with 2 kinds of frequencies inputted from 1st Local OSC. This signal becomes 9GHz signal then it send to RF BPF(band Pass Filter) for filtering the un-necessary frequency. Output of BPF outputs to PA(Power Amplifier) circuit.

2)Power AMP circuit (SSPA)

Power AMP circuit output to 300W from Frequency Converter amplifies. RF signal output to Antenna Port at 240W, through two Circulator. Power Amp circuit Gain is approximately 54dB and power supplies at 50V,used GaN device.

Power supplies timing on Input signal, this reason is reductance of power comsumption and to avoid over heat of circuit. Power Amp circuit outputs to through the circulator then convert to coaxial cable to waveguide by transducer. RF power applies Antenna and radiates into air.

3)Receiver circuit and IF AMP circuit

Received signal from Antenna through circulator inputs the receiver circuit. The first step applies a RF ATT(RF Attenuator) circuit. A RF ATT circuit is to avoid Received signal with saturation. The next step applies a limitter circuit. A limitter circuit protect the receiver device to burn out by a received high power signal. The next step applies input LNA(Low Noise AMP.) device. Output signal of LNA circuit is through BPF(Band Pass Filter) and converted into the IF signal through the 2setps mixing circuit. IF signal is amplified by IF AMP circuit and output to the signal processing circuit.

3.1.1.2 Signal Processing Circuit (CDC-1469A)

This circuit is mainly composed of signal processor, controller and waveform generator, which are composed MPU and large scale FPGA integrated circuit. Signal processor performs radar trigger/processing timing generator, A/D converter, signal processing circuit such as pulse compression, interference rejection, sweep averaging, CFAR and near/far video multiplex circuit.

The controller performs data communication processing between this equipment and radar controller such as display equipment. This equipment is adopted RS-485 serial communication line.

Waveform generator performs to generate the FM modulated transmitting waveform signal. This signal is applied to TRX circuit, and then amplifies to 240W transmit peak power.

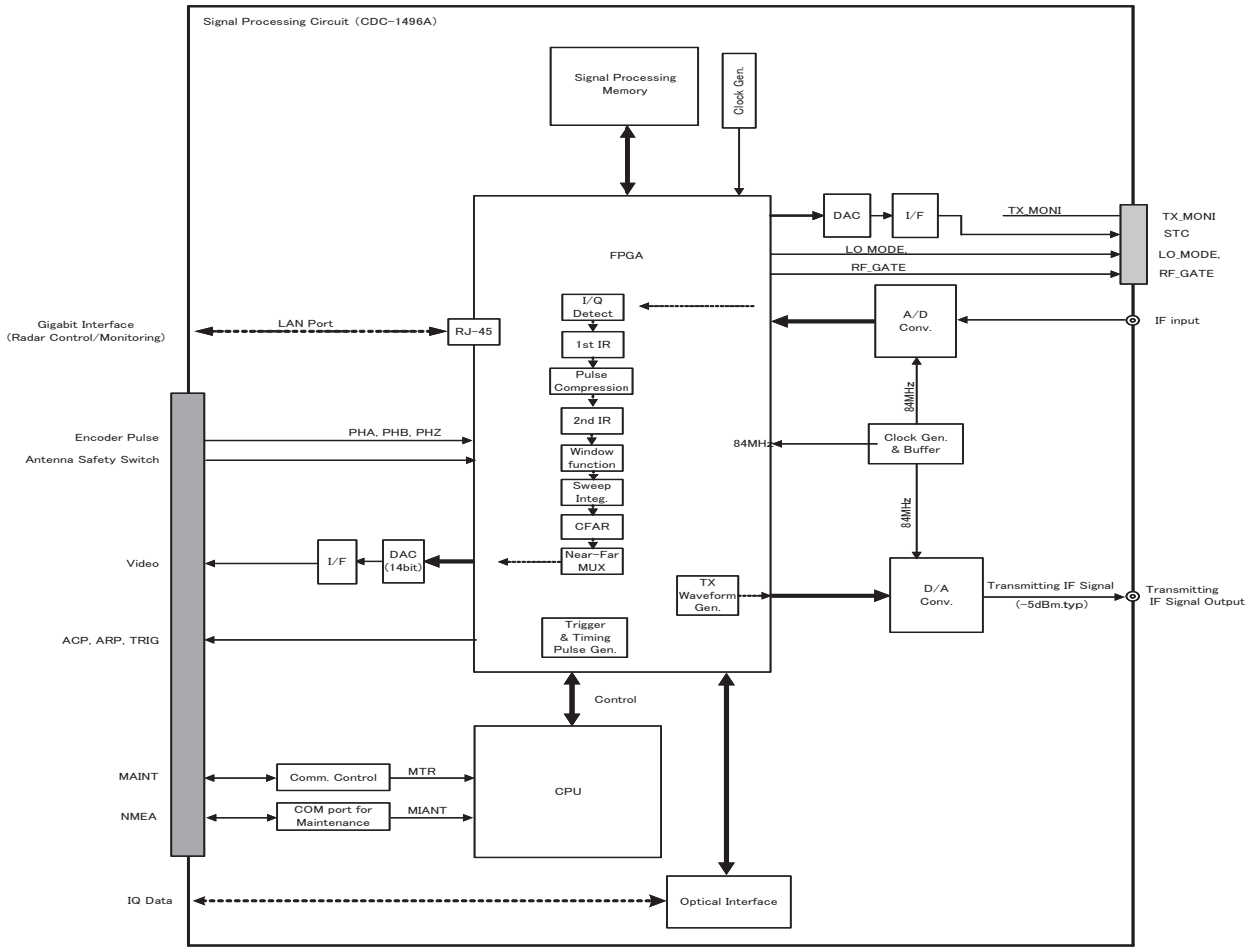


Fig. 3.1-1 Signal Processing Circuit Block Diagram

3.1.2 ANT I/F Circuit (CHM-400)

ANT I/F circuit receives antenna bearing signals and safety switch information. These data send to S/P circuit and PS I/F circuit. Also, this circuit has various signal interfacing functions between PS I/F and S/P Circuit.

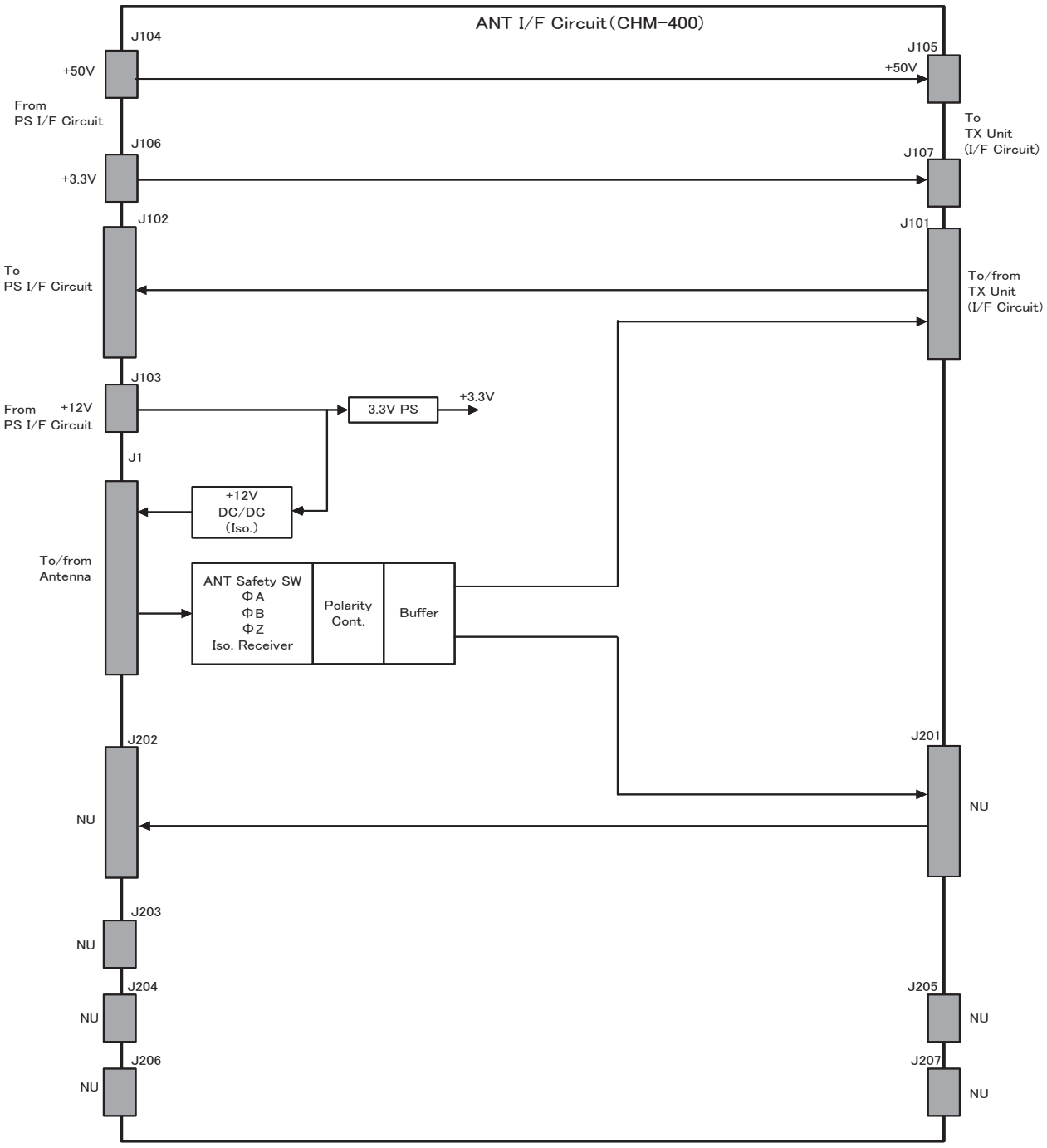


Fig. 3.1.2-1 ANT I/F Circuit Block Diagram

3.1.3 PS I/F circuit (Power Supply Interface) (CBD-2027)

The Block diagram of PS I/F Circuit showa fig. 3.1.3-1.

This circuit has power suppy and interface function.

1) Power Supply Function;

Various DC power supplies used for this equipment are generated such as +5V, +12V, +50V and +3.3V.

2) IInterface function

This block is a buffer to output TI(Trigger), BP(Bearing Pulse), BZ(Beraing reference) for the analog display system if necessary.

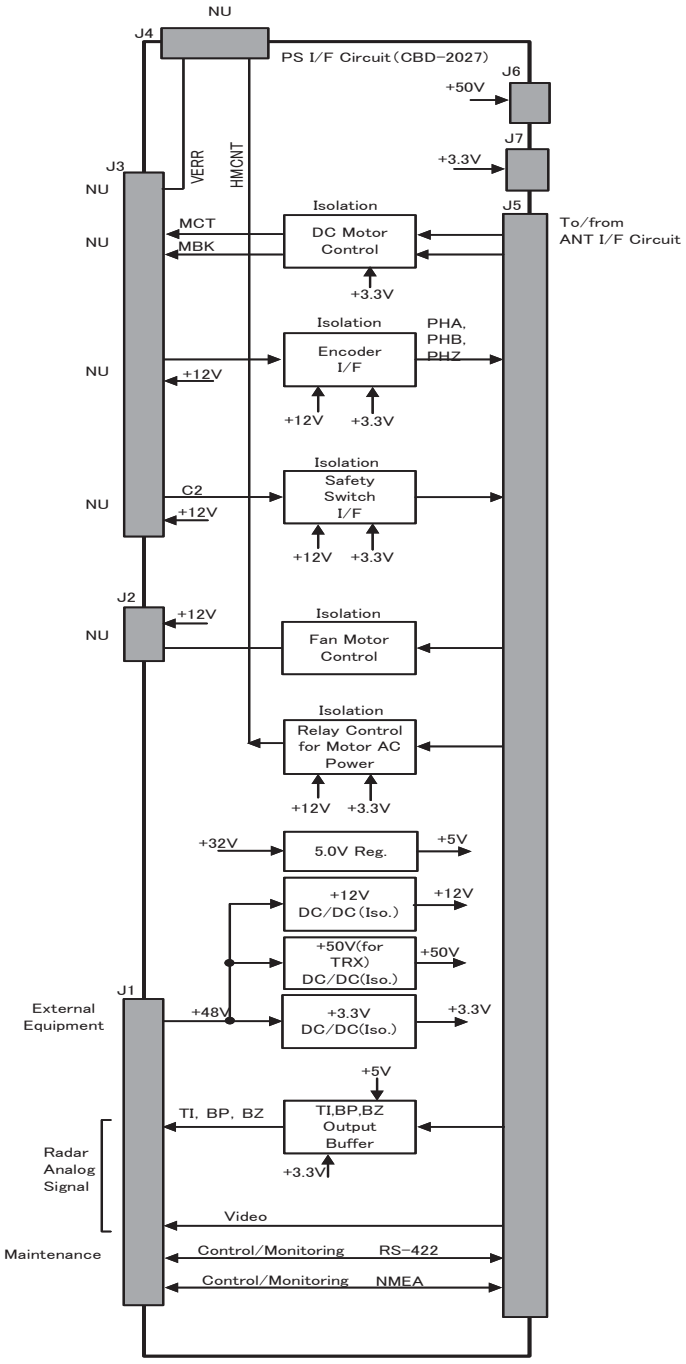


Fig. 3.3-1 PS I/F circuit Block Diagram

4. Check and Troubleshooting

In case check and troubleshooting are performed, it carries out by being careful an electric shock and an injury enough.

Moreover, the engineer who received a sufficient experience and sufficient training needs to carry out.

4.1 Check by LED Indication

The following Light Emitting Diodes are attached in each unit of this equipment, and a state of operation can be checked.

4.1.1 S/P Circuit

Table 4-1 S/P Circuit LED conditon

NO.	Item	Condition	Color	Remarks
1	Power ON(POW)	Normal	Green	-
		Abnormal	Off	External 3.3V is Low or internal DC-DC converter voltages are higher than specified value.
2	Alarm(ALM)	Normal	Off	-
		Abnormal	Red	When the items of one of the followings are abnormalities; Trigger, Antenna Rotation Direction, ACP, ARP, DC Power, DAC PLL lock, ADC, DAC, Internal PLL, DDR-SRAM condition, Video Signal
3	Transmit ON(TX)	Normal	Green	-
		Abnormal	Off	Not received Transmit ON command.
4	IF Data(IF)	Normal	Green	IF Optical Interface operating normal
		Abnormal	Off	DIP SW does not set to upmast mode. Or optical fiber cable is disconnected.
5	High Speed Optical Comm. Data(GIGA)	Normal	Green	Success polling normal
		Abnormal	Off	Optical Cable Disconnected or The power supply of the polling PC is not on.
6	LAN Connection((LAN)	Normal	Green	Success LAN connection
		Abnormal	Off	Not Connected
7	Video Output(VD)	Normal	Green	Normal level
		Abnormal	Off	Video(main-bank) output level is less than specified level.
8	Trigger Output(TRG)	Normal	Green	Trigger output normal
		Abnormal	Off	Trigger does not output or disconnected the cable.
9	TX monitor(RF)	Not used	Green	-
		-	-	-

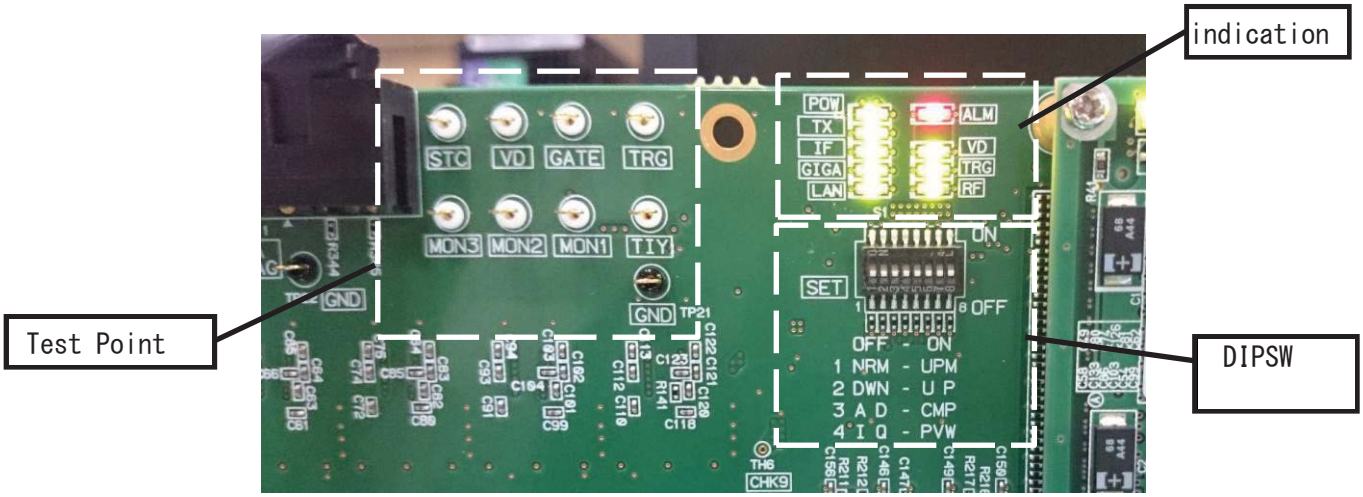


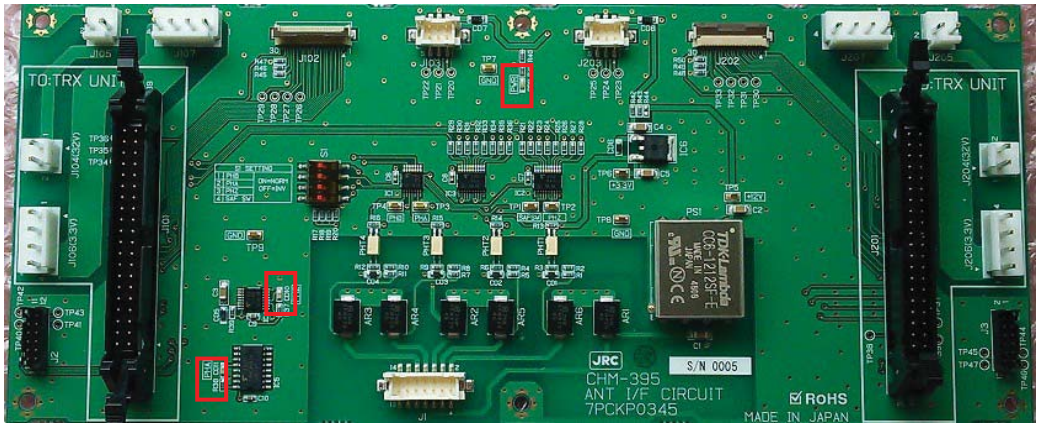
Fig. 4-1 S/P Circuit LED Location

4.1.2 ANT I/F Circuit

Table 4-2 ANT I/F Circuit LED conditon

NO.	Item	Condition	Color	Remarks
1	Power(PWR)	Normal	Green	-
		Abnormal	Off	External DC12V is not supplied.
2	Bearing signal phase-A(PHZ)	Normal	Flickering at every scan	-
		Abnormal	Keeping On or OFF	Antenna does not rotating or encoder was malfunction.
3	Bearing signal phase-A(PHA)	Normal	Flickering	-
		Abnormal	Keeping On or OFF	Antenna does not rotating or encoder was malfunction.

LED Location



4.2 Troubleshooting

No.	Trouble	Countermeasure of Trouble
1	No Power appied to J1 (J1-1: -48V, J1-2: 48VE) Check the Peripheral Equipment.	DC Power supply of Peripheral equipment.
2	Power is applied but no transmission 1)Remote control ine is Operationg ? 2)Antenna safety switch line is disabled?	 1) Check the “Communication State” on CDC-1469A Control module by LAN (NMEA) window of the NCD-2247-1B Radar Control / Monitoring PC. 2) Check the antenna safety switch at antenna pedestal. Check the “Antenna Switch Failure” by above window.
3	Poor sensitivity 1)Water leeakage in the Waveguide? 2)Antenna Radiation surface stained? 3)Is monitor of PA output power normal? (Measure the output power by Power Meter according to Inspection Procedur.	 1)Remove water and repair the waveguide at leekage portion. 2)Clean it. 3)TRX circuit may be failure, replacement of TRX unit(NMA-581A).such as TRX module(CMN-821H), RF BPF(CFL-517FB), 1st LOCAL OSC(CGH-450), 2nd LOCAL OSC(CGH-382), S/P Circuit(CDC-1469)
4	Failure State lit. 1)Intialization Failure 2)PLL Lock Failure 3)Antenna Switch Failure 4)ARP Signal Failure 5)ACP Signal Failure 6)Direction of Rotation Failure 7)Trigger Signal Failure 8)Video Signal Failure	 1) Replace the S/P Circuit(CDC-1469A) 2) Replace the S/P Circuit(CDC-1469A) 3) Check the Antenna Saffty switch 4) Check the encoder in Antenna 5) Check the encoder in Antenna 6) (Not used in this system) 7) Replace the S/P Circuit(CDC-1469A) 8) Replace the TRX Unit(NMA-581A)

	9)Internal Power Supply Failure	9) Replace the PS I/F Circuit (CBD-2027)
	10)IF Light Signal Failure	10) (Not used in this system)
	11)High-speed Optical IF(Interface) Board Failure	11) Replace the Optical Interface board (AGM-741A)
	12)FPGA Temperature	12) Check the FPGA actual temperature, and replace if temperature is higher than 85degree.
	13)SP- Board Temperature	13) Check the actual board temperature, and replace if temperature is higher than 85degree.

5. Replacement of Major Parts

Replacement of major parts are shown in table below

Table 5-1 Replacement of major parts list

No.	Parts Name	Model	Remarks
1	TRX Unit	NMA-581A	Composed TRX Module (CMN-821H), 1st Local OSC (CGH-450), 2nd LOCAL OSC(CGH-382), S/P(Siganl Processing) Circuit (CDC-1469A)
2	ANT I/F Circuit	CHM-400	
3	PS I/F Circuit	CBD-2027	

5.1 Replacement of the TRX Unit (NMA-581A)

The TRX module consists of three units and in order to carry out performance satisfaction, it is adjusted in combination. When a unit breaks down, it is necessary to exchange three units simultaneously.

1) Stop the operation by NCD-2247-1B Radar Control/Monitoring PC
2) Turn off CB1(NFB)
3) Disconnect the J1 (DC48V Power Input line)
4) All the connectors to case harness are removed.
5) The 6 screws which is fixing TRX Unit is removed.
6) It removes carefully so that wiring etc. may not be damaged.
7) Attach new TRX Module in a procedure contrary to the above.

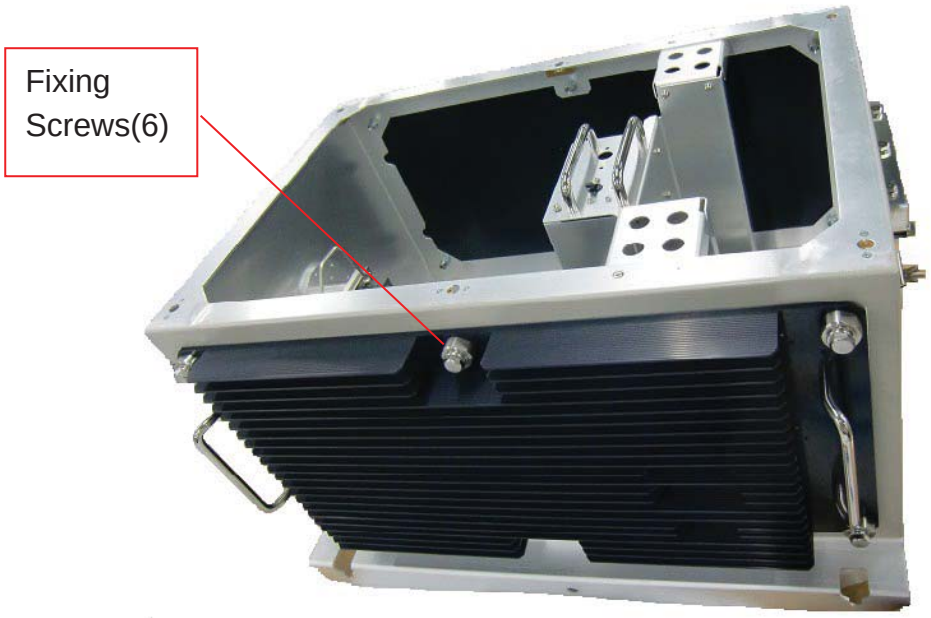


Fig. 5-1 NTG-560 X-band Solid State Transmitter-Receiver Internal View

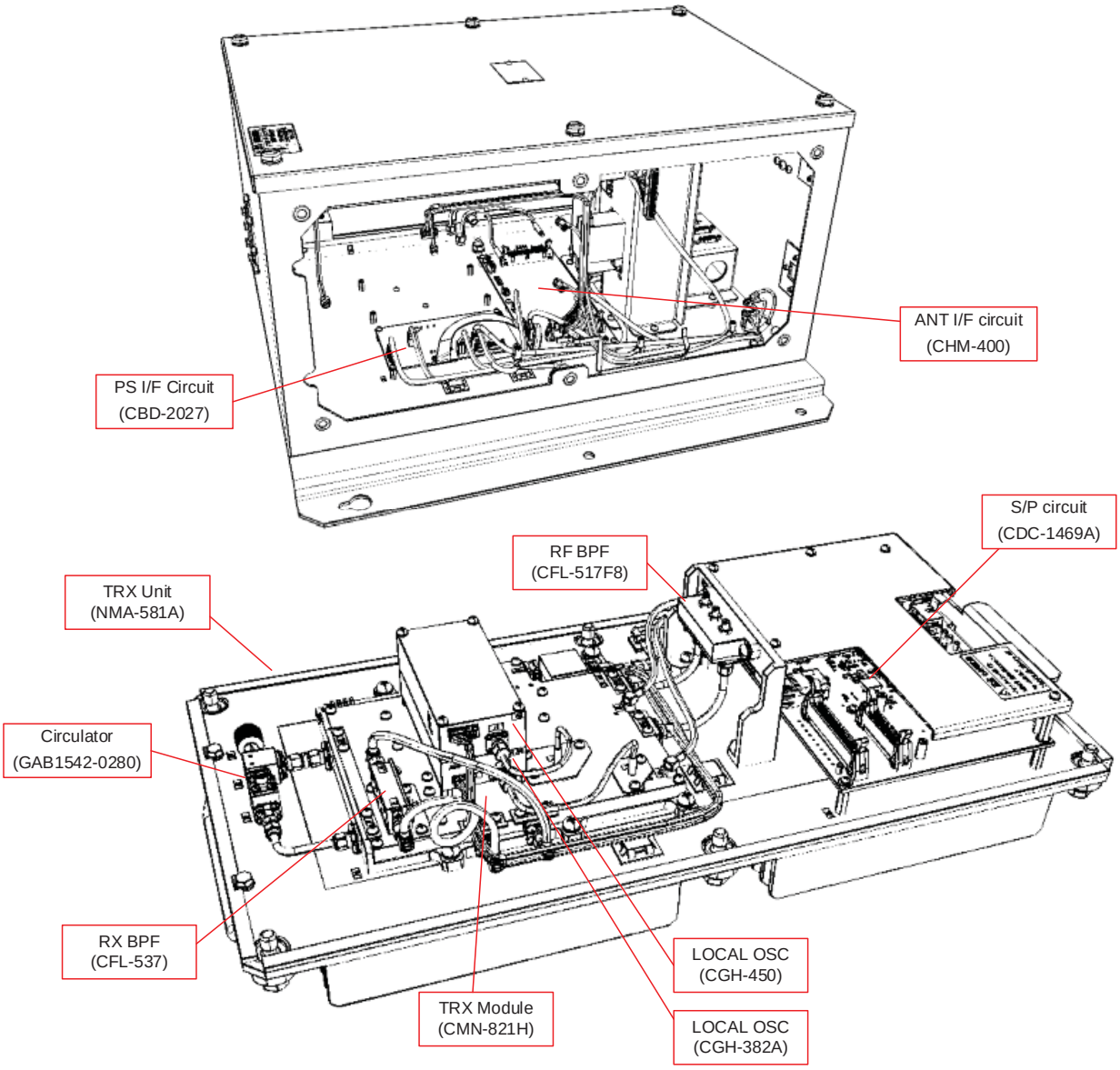


Fig. 5-2 Inside View of NTG-560 (Removed TRX Unit NMA-581A)

5.2 Replacement of ANT I/F Circuit (CHM-400)

After removing the whole connectors, remove the six screws that hold the PCB, and then after checking the wiring status, remove the PCB unit.

Reconnect the connectors into the same status as that which was checked before replacement.

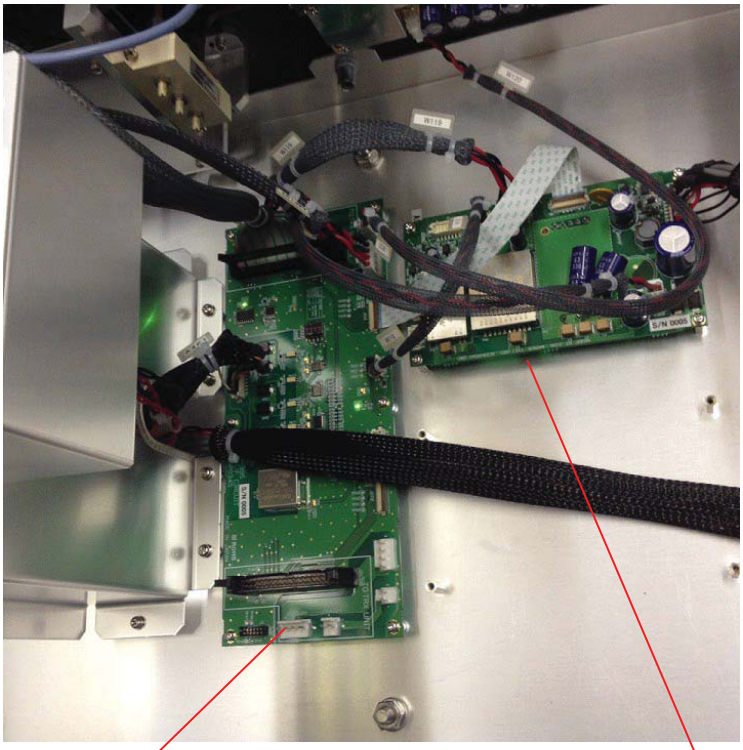


Fig. 5-3 Inside view of NTG-560

5.3 Replacement of PS I/F Circuit (CBD-2027)

After removing the whole connectors, remove the four screws that hold the PCB, and then after checking the wiring status, remove the PCB unit.

Reconnect the connectors into the same status as that which was checked before replacement.

6. Disposal of Equipments

When disposing of this unit, be sure to follow the local laws and regulations for the place of disposal.