ATSC3.0

Operating & Troubleshooting Manual

2024. 8

JM BROADCAST

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The comparisons and other information provided in this document have been prepared in good faith based on publicly available information. The reader is encouraged to consult the respective manufacturer's most recent published data for verification.

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Operator's Responsibilities

Copyright and Disclaimer Notice

Failure to comply with the instructions contained in this manual may result in personal injury and property damage and may result in invalidation of the warranty.

Keep this manual for future reference and place it next to the device for immediate use. For instructions, situations or incidents that are not specified in this manual, please contact JM Broadcast manager. When requesting technical information and spare parts, please provide exact model name and serial number.

Safety Considerations

Potential safety hazards exist unless proper precautions are observed when working with this unit. To ensure safe operation, the user must follow the information, cautions and warnings provided in this manual as well as the warning labels placed on the unit itself.

The installation location of these devices should be marked as a hazardous area.

High Voltage Hazards

High Voltage for the purpose of this manual, is any voltage more than 240V. Voltages. Above this value can be hazardous and even lethal under certain circumstances. Care should be taken when working with devices that operate at high voltage.

1) *Only authorized persons should operate switches on electrical devices.*
2) *Do not contact circuit with wet hands or tools.*
3) *Use non-conducting handles on tools that contact with the equipment.*
4) *Turn off the circuit switch before checking the equipment.*
5) *Do not arbitrarily change the circuit wiring connected to the power source.*
6) *The work area should be secure and free from nonessential items.*
7) *Operators should never work alone on high voltage devices. There should always be another person present in the same work area to assist in the event of an emergency.*
8) *Operators should be familiar with procedures for cutting off power supply in case of the emergency.*
9) *Operators should be familiar with CPR procedures etc. in case of the emergency.*

High Current Hazards

High power output devices can generate high levels of current surges. This applies to all voltages, but it needs to be emphasized, especially for lower voltages. Lower voltage devices provide safety from voltage, but require higher currents to provide the same power, which can cause serious injury from burns and explosions. Therefore, the following

precautions are required in high-current discharge devices:

1) *Remove all conductive personal items. (Rings, watches, necklaces etc.)*
2) *The work area should be secure and free from nonessential items.*
3) *Operators should never work alone on high-risk devices. There should always be another person present in the same work area to assist in the event of an emergency.*
4) *The RF High Power Amplifier Module inside the equipment generates high DC current during operation, so the operator's particular attention is required during operation. Never touch the connection area of the RF module when the amplifier is operating. The connector may have a current that excesses 480V/13A.*

RF Transmission Hazards

High power RF transmission can cause vision damage and skin burns. Long-term exposure to high RF energy leads to a variety of health problems. Take notes of the followings:

1) *Transmitter should be turned off before applying AC input power.*
2) *Do not look directly into the RF output waveguide.*
3) *Maintain an appropriate distance from the transmitting source so that the power density is below the guidelines recommended by ANSI/IEEE C95.1.*
4) *There may be leakage current in the equipment. Ensure ground connection before applying main power and after removing main power.*

Other Precautions

The RF High Power Amplifier Unit (HPA Module) weighs approximately 40kg (around 88.18lbs). So, it must be lifted by two or more people.

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A Digital device, pursuant to part 15 of the FCC Rules. 1. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The antenna(s) used for this transmitter must be fixed-mounted on outdoor permanent structures. RF exposure compliance is addressed at the time of licensing, as required by the responsible FCC Bureau(s), including antenna co-location requirements of §1.1307(b)(3). It should only be installed by personnel skilled in the art and trained in RF exposure limitations.

Changes or modifications not expressly approved by JM Broadcast could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

Antenna Radiation Hazard Notification

The antenna used with this product must be carefully designed and installed to reduce the chance of RF exposure to the user. Note that for the full power output of this transmitter of 1500 Watts with a 0 dBi antenna a minimum separation distance of 7.75m is recommended.

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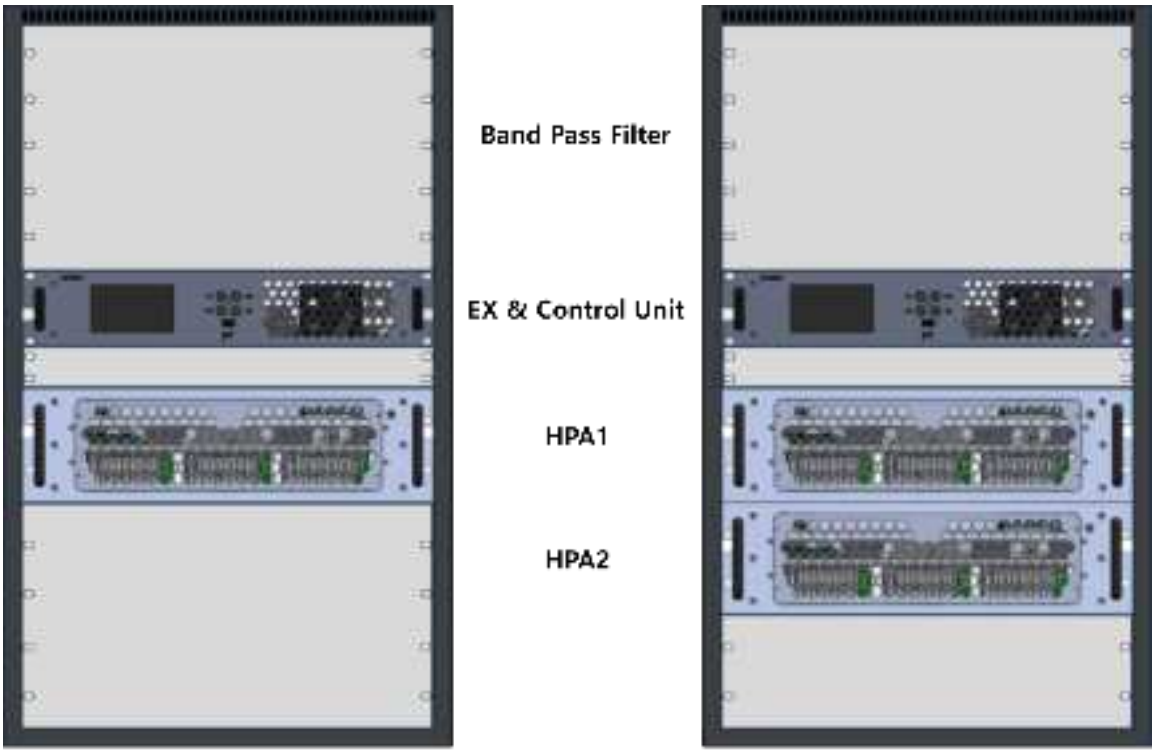
1. System Configuration

1.1 Diagram

1.1.1. Transmitter



1.2. Main Components

1.2.1. Modulator

- ✓ Exciter can be easily changed between ATSC3.0 and ATSC1.0 by changing only the software on the same hardware. In addition, DVB-T, DVB-T2, ISDB-T, and ISDB-Tb are also applicable.

- ✓ The exciter's own Auto Level Control function is included, allowing response to level abnormalities during operation.

- ✓ The Auto Adaptive Correction function allows the characteristics to be maintained without user intervention.

- ✓ Auto Adaptive Correction Operating Mode also has four functions, so the user can select and use the Mode appropriate for field conditions.

Combine to improve efficiency with minimal coupling loss, and mutual isolation is formed over 30dB to minimize mutual interference.
Combiner combines PA with 3dB Type.

1.2.2. EX & Control Unit

It is Button and LCD Touch Method that is convenient to operate. Even if additional functional improvements are required in the future, it is possible to respond, and stability is ensured by designing a dual structure of Button type and Touch type.

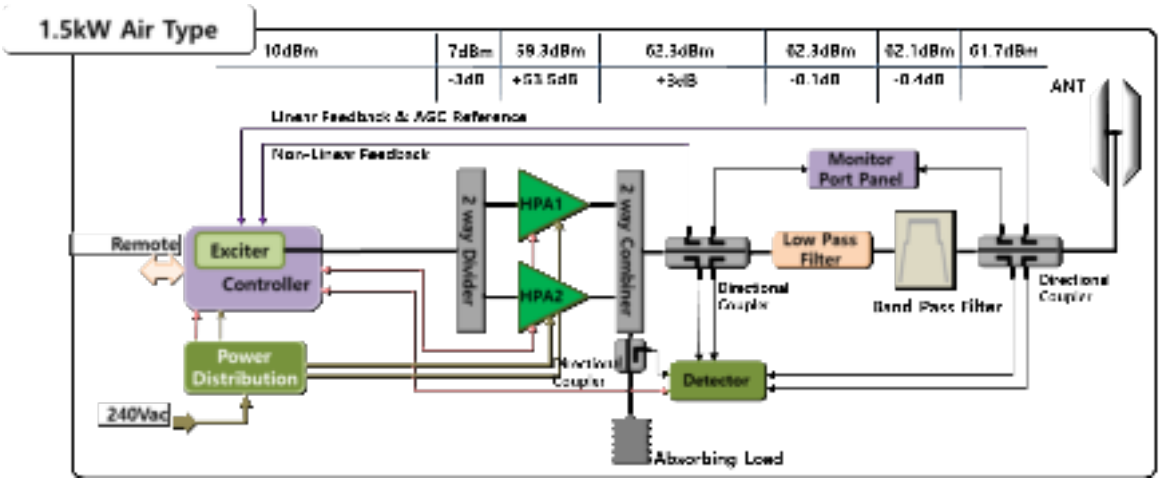
1. **Web GUI**

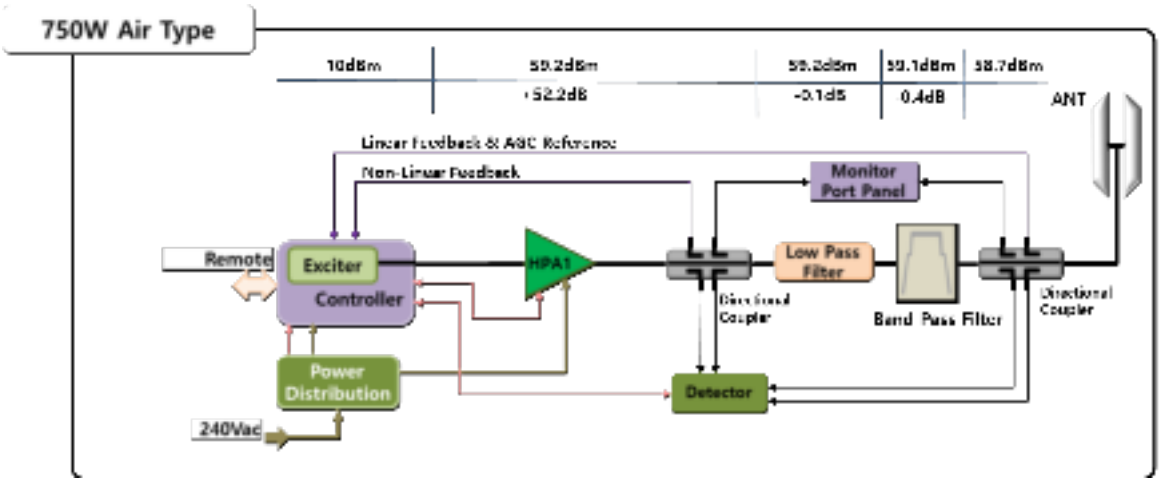
   The system can be controlled through a browser-based GUI through an Ethernet connection. Web GUI provides the same screen as TCU.
   It also provides RS-232/485 and Open Collector contacts to support various remote controls for operators.

2. System Description

2.1. Description

2.1.1. System Diagram





2.1.2. System Configuration

1) Passive Reserve Type

Consists of two complete transmitters and an ACU, it implements an automatic switching function when a problem occurs with the operating equipment. There is almost no downtime since problematic equipment can be maintained while broadcasting. So, this is the most advantageous method for maintaining continuous broadcasting.

Most broadcasting systems choose this method.

2) Active Reserve Type

To the exciter or HPA, it is manufactured using the passive reserve method, and thereafter it consists of only one unit. This method is designed to reduce costs compared to the Passive Reserve method and to compensate for situations where emergency response is not possible in the Single Type. It has the disadvantage of being vulnerable to emergency response for a part consisting of only one unit, but it is sometimes selected to reduce production costs.

3) Single Type

It is operated with only one device. When a problem occurs, the solution is to repair or replace the problematic part. It is vulnerable to maintain continuous broadcasting since the downtime is longer than other methods when a problem occurs.

Advantages are good space efficiency and low production costs.

This is the system selected for this equipment.

2.1.3 Cooling Methods

Cooling refers to cooling down the heat generated while operating the transmitter. The main parts that generate heat in the transmitter include HPA, Dummy Load, and Band Pass Filter. How to efficiently cool the heat generated in these areas can have a significant impact on the stability and lifespan of the equipment.

1) Air Cooling

This is a method of cooling the generated heat using a fan.

The design and facilities are simpler than water cooling. For disadvantages, it has limitation in cooling down heat in high-output equipment, noise, and many failure factors due to installation of large numbers of fans. Therefore, it is mainly used in low power output (less than 2KW).

2) Liquid Cooling

This is a method of cooling by flowing coolant to the heat generating area. It has the disadvantage of being more complicated in design and facilities compared to air cooling, but it has a much higher cooling efficiency than air cooling. Compared to the air-cooling type, it has lower maximum temperature, lower indoor-noise, and smaller thermal change in the transmitter.

2.1.4. Feature

- ✓ **ATSC3.0 Standard Modulation**

  For Option, it supports DVB-T2 Standard, ATSC 1.0 Standard & ISDB-T Standard, and can be changed by 'Firmware Upgrade'. If a Modulation Type change condition occurs, agile response is possible.

- ✓ **STL 2 Port (Max 4Port)**

  A port that can receive STL signals through Ethernet.

- ✓ **Auto / Manual Digital Non-Linear/ Linear Correction**

  Correction is a function that corrects the distortion of the RF originating from the exciter as it passes through the system. Non-Linear Distortion mostly occurs in HPA, Linear Distortion occurs in Band Pass Filter. Therefore, we do "Sampling" in front of Band Pass Filter to compensate Non-Linear Distortion and do "Sampling" at Band Pass Filter Out to compensate Linear Distortion. Sometimes, there is equipment designed to proceed one sampling from Filter Out, but it has lower performance than the 2 Point method, Nonlinear distortion components that have passed through the filter become unclear due to the filter, making it difficult to perform accurate correction.

  In addition, Adaptive Auto Correction is applied, making it very convenient for operators to use, and the operation method can be set to four types (Idle, Run to Target, Auto Run, and Continuous), making it easy to respond to field situations.

- ✓ **Doherty LDMOS Transistor**

  We achieved Maximum reliability by applying the stability of the LDMOS Transistor and the high-efficiency, low-power technology of the Doherty method. Through years of in-house research, the narrow bandwidth of the Doherty

method was reduced to two sections within the UHF Band.
This means that the frequency variable range has been expanded without changing the transmitter hardware.

- ✓ **Controller**
  We adopted Graphic LCD to maximize operator convenience and designed the on-site and remote screens to be identical to minimize sense of difference.
  Touch Panel is applied to LCD and separating ON/OFF Control Switch into two makes transmitter control possible even if a problem occurs with the LCD.

- ✓ **Remote Control & Monitoring**
  Supporting both Web GUI (Ethernet) and Open Collector contact methods simultaneously, enables multiple connections from remote locations.

- ✓ **UHF Bands' 100W ~ 1.5kW average Power**
  Output settings can be changed with One Touch on the TCU.

- ✓ **Independent power supply method for each unit**
  Each unit includes an AC/DC converter, allowing simple Test in any place where AC power is supplied by using the provided cable.

2.1.5. System Specifications

GENERAL

Description	Specifications
TX Frequency Band	Designated channel in 470 ~ 810MHz
AC Input	480V_{AC} 3phase 4wire ± 10%, 50/60Hz
Operating Temp.	0 ℃ ~ +45℃
Permissible relative air humidity	≤ 85%
Dimension(Transmitter Rack)	19" Standard Rack type (W 600 x D 1000 x H 1065mm)
Cooling System	Forced Air Cooling
Data Input	TS 2 Ethernet Port(RJ45) or ASI/SMPET-310 2port
GPS Antenna Input Connector	TNC-female
RF Output Impedance	50Ω
RF Output Connector	Transmitter :1 5/8" EIA Flange Type
Remote	Ethernet(RJ-45) / Open Collect(D-Sub) /

PERFORMANCE

Description	Specifications
Output Power(Average)	100W ~ 750W Average(after Mask Filter) 500W ~ 1.5kW Average(after Mask Filter)
Frequency Stability	GPS, 10MHz, 1pps
Spurious & Harmonics	≤ -60dBc
Power Stability	≤ ±5%
MER	≥ 27dB
Frequency Response	≤ ±1dB
Output VSWR	≤ 2.0

2.1.6. Specifications of Unit

2.1.6.1. EX & Control Unit (Exciter Part)

Item	Specifications	
Modulation	ATSC3.0 Standard	
	Modulation Schemes	: QPSK, 16QAM, 64QAM, 256QAM
	Guard Interval	: 1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
	Discrete Fourier Transform(DFT) size	: 1k, 2k, 8k, 16k, 32k
	Forward Error Correction(FEC)	: LDPC +BCH 1/2, 3/5, 2/3, 4/5, 5/6, 6/7, 8/9
	Modulation	: OFDM
	Multi PLPs	: Yes
Data Input	Main Ethernet 2 Port	
Pre-correction	Nonlinear(Pre-distortion) Linear(Pre-equalizer) Adaptive Auto Pre-correction	
Output Frequency	Designated Channel Frequency (30~1000MHz, 1Hz step)	
Output Connector	BNC Female	
RF Power Output	Max +18dBm(Avg)	
Frequency Stability	Within ± 1Hz (with GPS)	
GPS Antenna Input	TNC Female	

2.1.6.2. HPA800

Item	Specifications
Output Stage Technology	850W : BLF888E x 8ea (LDMOS) / Doherty
RF Power Output	Max 850W Average Power
Power Output Stability	Within 5%
Input Connector	BNC Female
Output Connector	7/8" Quick Socket
Cooling System	Liquid Cooling
Temperature Protection	Thermistor Control
Output Match	VSWR ≤ 1.5
Gain Stability	Less than ± 0.5dB (In band)

2.1.6.3. HPA800 Power Supply

Item	Specifications
AC Input Voltage	AC240V / 1phase / 3wire / 50~60Hz
DC Output Voltage	$50V_{DC}$
DC Output Maximum Current	Max 110A (55A x 2ea)
Output Voltage Stability	Within ± 0.5V

2.1.6.4. Band Pass Filter

Item	Specifications
Output Stage Technology	3.5kW
Center Frequency	Designated Frequency
Bandwidth	6MHz
Insertion Loss	≤ 0.5dB
Pass Band Ripple	≤ 1dB
Return Loss	≥ 25dB
Impedance	50Ω

2.1.6.5. Main Power Distribution

Item	Specifications
AC Input	AC240V, 1phase, 3wire
AC Output	AC240V, 1phase, 3 wire

2.2. System Installation

When installing the system, the following must be observed.

The transmitter must be installed on a stand to prevent flooding.

To properly connect the Rigid Line, it must be aligned vertically and horizontally.

The rigid line must be installed according to the specifications, the cut surface must be finished, and the installed rigid line must be fixed using a hanger.

All AC Cable, Data Cable, RF Cable (Except Rigid Line) should be installed on the tray to prevent any damage.

2.2.1 Transmitter Installation

2.2.1.1. Transmitter RF Connection

1. Stream Input

Connect broadcast streams to the transmitter using one or two ASI ports on the back of the exciter.

2. GPS Input (optional)

Optionally, connect a GPS Antenna to serve as a reference for a transmission network. You may also optionally supply this timing via a 10MHz or NTP input.

3. Fil FB (Post Filter Feedback)

Ensure that a post filter sample from the Band Pass Filter Output Directional Coupler is placed on the exciter feedback port.

This is used as a source of reference for AGC(Auto Gain Control) and linear Correction.

4. RF Output

Connect to the antenna through the 1-5/8" EIA port on the top of the transmitter where the amplified RF power is output.

2.2.1.2 Transmitter AC Connection

Install the optional Surge Protector at the Site Main distribution board if selected and then connect it to the transmitter Top Cover Terminal. Surge Protector should be firmly mounted on existing facilities and connected to a ground wire. By using an 6sq/3-wire type, the AC cable should be connected to the AC Main Terminal Block at the rear of

in the rack. When connecting the AC cable, be sure to use an 'O' type lug, and to prevent electric leakage, you should minimize the exposed area of the wire by closing it with tube, heat shrink tube, insulating tape, etc., and by covering it with a terminal block.

3. First Time On-Air.

3.1. AC Power Supply

3.1.1. AC Power Check

Turn "OFF" all connected Breaker Switch.

Check whether the supply is normally below 240Vac specified in the installed AC line.

1) Check the Main Distribution Board input voltage.
2) Main Distribution Main Switch ON
3) Check Transmitter of Main Distribution Unit Breaker Switch Output Impedance.
4) Transmitter Breaker Switch ON of Main Distribution Unit
5) Move to Transmitter and Check Transmitter Main Breaker Switch Input Voltage.
6) Transmitter Main Breaker Switch ON
7) Check Power Distribution Unit Output Voltage on the back of the Transmitter.
8) Unit Breaker Switch ON
9) AC Switch ON installed on the back of EX & Control Unit

3.2. Change Frequency.

Warning:

This equipment is only allowed to operate on frequencies authorized by both the grant of FCC equipment authorization and the FCC broadcast license.

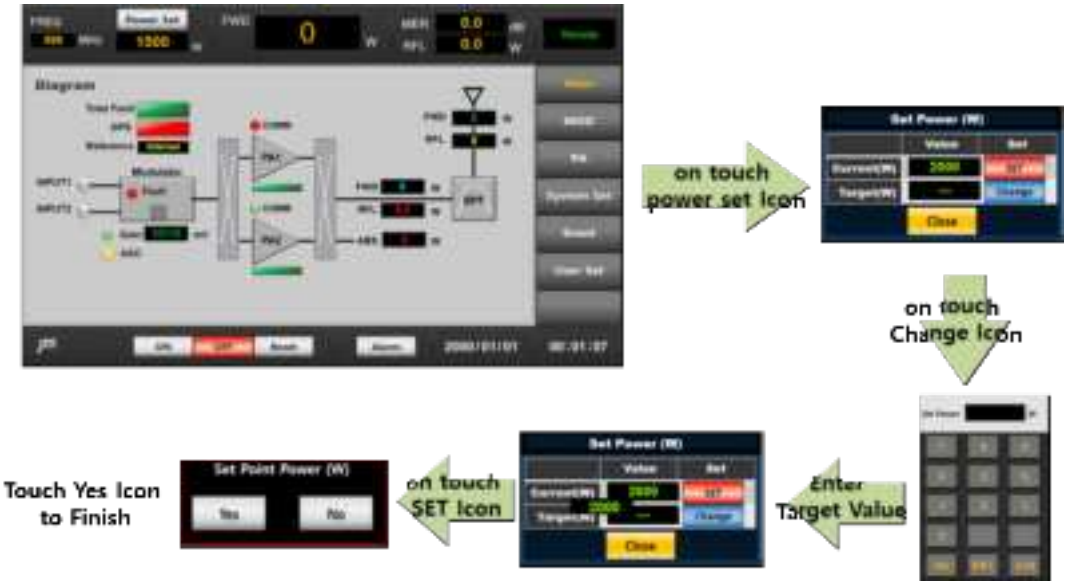
- Make sure the frequency is set to the specified frequency.
- The confirmation method is to check on the Main Page or MOD Exciter page of EX & Control Unit.
- You can change the frequency on the EX & Control Unit System Set page or Modulator Web.

3.3. Change RF Power Set.

Touch Set Power on the EX & Control Unit screen to change it to target power.

Although MGC does not actually operate according to Set Power, it operates as a reference point for Fault (Low Power, Over Power, VSWR). Therefore, it must be set to the target power level.

Initial operations begin with MGC. Change to MGC are as follows.



3.4. TX-ON.

1). Check if the Input status is Normal on the screen of EX & Control Unit.

2). Enter the Mod Gain Control Page of the EX & Control Unit.
Check if the Gain CNTR V value of MGC is under 1000mV.

3). Press the ON button on the EX & Control Unit to activate the transmitter.

4). Gradually increase the Gain CNTR V value of MGC so that the Power Meter reaches the specified power.

5). Press the OFF button on the EX & Control to stop the transmitter.

6). Change to AGC.

7). Press the ON button on the EX & Control Unit to activate the transmitter.

8). Power gradually increases and reaches Set Power.

4. Alarm Manual.

4.1. VSWR

Detection of VSWR is performed by HPA, Band Pass Filter (BPF), and Antenna.

Although it is very rare, when a surge flows into the exciter, the frequency may change to 474. Take Caution.

VSWR is considered as Fault above 1.5.

Depending on the origin location of VSWR, confirmation details are as follows:

4.1.1. HPA VSWR Fault.

It is very likely that a problem occurred between the 2Way Combiner(2 HPA), Low Pass Filter, and Band Pass Filter in the HPA Output. This can be determined by lowering the Set Power to 200W and checking the status of the Absorbing Power of the EX & Control Unit and the HPA Reflector Power.

4.1.2. Transmitter VSWR Fault.

The binding condition of the rigid line connected to the Band Pass Filter Output (BPF) and damage of the BPF can be suspected.

It can be judged by checking the Reflector Power in the EX & Control Unit and checking the Channel Mask by the Spectrum.

4.1.3. BPF Output VSWR Fault.

You can suspect the binding condition of the Rigid Line and Main Feeder connected to the antenna in the Band Pass Filter and the Antenna damage.

First, check the temperature of each part, and check the connection between the main feeder and the antenna, and the main feeder and the rigid line.

There may also be a possibility of moisture entering the antenna area.

If possible, it is recommended to TX-OFF for suspicious parts and then check with Network Analyzer.

4.2. Over Power

Occurs when the current power increases by more than 110~120% (configurable) of the Set Power.

Check the FIL FB Cable connection status connected to the exciter and check the L Sense FB Level on the exciter LCD screen. It is recommended to manage and record the L Sense FB Level usually.

As the L Sense FB Level decreases, the actual power increases.

If the level is lower than usual, you should check the characteristics of the Directional Coupler installed in the BPF output.

Otherwise, there may be a metering error. If a metering error is suspected, use a standard

Meter to check and correct it at the Band Pass Filter Output Directional Coupler.

4.3. Over Temperature

It operates when the temperature of the HPA heat sink is above 80 degrees.
The cause may be a damaged HPA fan or a damaged temperature sensor.
Replace the fan or replace the temperature sensor.

4.4. Low power

Occurs when the current output power drops to 10%~80% (configurable) of Set Power.
The biggest cause is damage to the HPA transistor.
The inspection is to check the current value of the HPA's FPA (Final Pallet Amp).
The FPA that is relatively below 50% can be judged as transistor damage.
The transistor should be replaced.

5. Detail of Unit.

5.1. EX & Control Unit

5.1.1. Exciter Specifications

Item	Specifications
Data	STL (TS)
Frequency Band	30-1000MHz (Spacing 1Hz)
Sense1 (Non-Linear)	-9dBm ~9dBm
Sense2 (Linear)	-9dBm ~9dBm
Auto Correction Mode	Idle, Auto Run, Run to Target, Continuous 4Mode
Frequency Stability	±0.001 ppm(with GPS) ±5 ppm(without external reference)
MER	≥40dB at Exciter output
IMD	≤-50dBc at Exciter output
Display & Control	Front LCD & Button
Ext Reference	10MHz (0 ~ 10dBm), 1pps, GPS
Input Connector	RJ45 Ethernet
Output Connector	BNC-Type Female
Output Level	18dBm Max.
Remote/Alarm	15 PIN D-SUB Female
AC Power	AC85~305V (±10%), 60Hz, 1A
Dimension(mm)	483 × 44 × 550

5.1.2. Front

All operations are possible on the screen with the 5" Touch Screen LCD.
You can display the information collected by each part of the transmitter and control the transmitter.

5.1.2.1. Front Switch

ON

This is the button to start the transmitter. It operates the same as the ON button on the LCD. It is configured to control the transmitter even when the LCD can't be used.
Operated only in LOCAL Mode.
Can't control in REMOTE Mode.
In addition, the ON command is in the interlock open state and does not operate when Main or Spare Transmitter is ON state. Only one transmitter can be turned on in the entire System.

OFF

This is the button to stop the transmitter. It operates the same as the OFF button on the LCD. It is configured to control the transmitter even when the LCD can't be used.
Operated only in LOCAL Mode.
Can't control in REMOTE Mode.

REM

A Local/Remote Conversion Switch.
In Local Mode, it is possible to control from TCU & Exciter.
Remote Mode transfers control to the ACU.
In Remote Mode, it is not possible to control from TCU & Exciter.

RES

When a fault occurs, it continues to be displayed even if the cause is resolved. Reset is the function that clears this.

Reset only resets the status display, so if a fault actually occurs, the Fault displays again after reset.

USB Port

You can control the LCD by connecting a Mouse or Keyboard.

Can be used if a problem occurs with the LCD Touch.

5.1.3. Rear

No	Name	Detailed Description
1	RF Out	The Port where the Exciter RF is output. It is connected to HPA Input.
2	Gain	A Variable Resistor that can adjust the Exciter Output Level. Caution is required as the Actual Power changes.
3	GPS	The Port where GPS Ant is connected. DC5V is output.
4	ETI IN 1	NC
5	ETI IN 2	NC
6	10MHz IN / OUT	You can connect External 10 MHz or use 10 MHz of the Exciter as a reference for other equipment.
7	HPA FWD	It is connected to the Directional Coupler installed in the Filter Input and receives this signal to detect HPA Output Forward Power.

		Based on this value, it determines the Over Power and Low Power of the HPA and monitors the VSWR by comparing it with the 8th Reflector Power.
8	HPA RFL	It is connected to the Directional Coupler installed in the Filter Input and receives this signal to detect HPA Output Reflector Power. Monitors VSWR by comparing with 7th Forward Power.
9	1pps IN / OUT	The 1pps IN / OUT Port that is not used in current equipment.
10	FIL FB IN	It is connected to the Directional Coupler installed in the Filter Output and receives this signal to detect the Output Forward Power of the transmitter. It drives AGC based on this signal. Therefore, if the cable is disconnected during operation, an HPA Over Power Fault occurs and transmission is stopped.
11	VSWR, H/R, H/F, F/F	VSWR : A Variable Resistor that can change the VSWR Trip Point. Can be turned off faster than the CPU's judgment. Not used in low output.
		H/R : A Variable Resistor that sets the value of HPA Reflector Power. The actual value does not change, only the Metering value changes. But if you set H/R incorrectly, the Transmitter turns OFF due to the VSWR Fault, or it may not respond to actual problems.
		H/F: A Variable Resistor that sets the value of HPA Forward Power. The actual value does not change, only the Metering value changes.

		But if you set H/F incorrectly, the Transmitter turns OFF due to Over Power.
		F/F: A Variable Resistor that sets the value of Filter Output Power. In MGC Mode, only the Metering value is changed, not the Actual value, but in AGC Mode, changes must be made carefully as it affects the Actual Power.
12	PHY0,1,2,3	PHY0 and PHY1 can be used as EDI Input. Modulator Web can be used in 0, 1, 2, and 3, but must follow the internal settings. PHY1 is a default Port, and it is recommended to use a fixed IP of 192.168.168.168. If you want to use it for remote control, it is recommended to use PHY 2 and 3.
13	Data1,2	A terminal that can connect ASI or SMPT-310 Data. It is used to connect to other Type Transmitter.
14	Remote Control / Remote Status	It is connected to ACU and transmits ON / OFF / Reset command and Status information in Dry Contact method.

Remote Status Pin Map

D25-1	TX RF On status
D25-2	TX Remote status
D25-3	Summary Alarm
D25-4	Interlock Open Alarm
D25-5	Demod Signal Normal
D25-6	High Temperature Alarm
D25-7	TS#1 Input Normal
D25-8	Low power Alarm
D25-9	High Reflected Power Alarm
D25-10	GND
D25-11	PA Fault Alarm
D25-12	Power Supply Fault Alarm
D25-13	HPA Fan Alarm

D25-14	Preset 1 Status
D25-15	GND
D25-16	Preset 2 Status
D25-17	TS 1 Selected (Preset 3 Status)
D25-18	TS 2 Selected (Preset 4 Status)
D25-19	Factory Preset Status
D25-20	TS#2 Input Normal
D25-21	Forward power (Analog)
D25-22	Reflected power (Analog)
D25-23	DC Votage (Analog)
D25-24	DC Current (Analog)
D25-25	GND

Remote Control Pin Map

D25-1	TX reset Command
D25-2	Power Decrease
D25-3	GND
D25-4	Preset 2 Control
D25-5	TS 2 Select Command (Preset 4)
D25-6	GND
D25-7	TX ON Command
D25-8	TX OFF Command
D25-9	EXT + 12V in
D25-10	+12V Out
D25-11	GND
D25-12	
D25-13	
D25-14	Power Increase
D25-15	Preset 1 Control
D25-16	GND
D25-17	TS 1 Select Command (Preset 3)
D25-18	Factory Reset
D25-19	GND
D25-20	Interlock In
D25-21	EXT + 12V in
D25-22	+12v Out

		D25-23	GND
		D25-24	NC
		D25-25	GND
15	HPA Control	Transmits ON / OFF / Reset commands in dry contact method and collects detailed information through 485 communication with HPA CPU.	
16	Debug	It is connected to the ACU and transmits all information collected from the TCU through RS-232 communication. In addition, commands made through Remote Terminal 14 can also be received. If necessary, it can use TCU Firmware for Upgrade purposes.	
17	WEB	A Port that is connected to the Hub and sends the TCU screen to the ACU. This allows you to view the same TCU screen as the transmitter at a remote location, and control is also possible.	
18	AC IN	The AC In Port that includes Noise Filter and Fuse in inside. The standard of Fuse is 220V/2A.	
19	Absorbing (No Marking)	A Port that connects the Power by coupling the Power applied to the Absorbing Load of the 2Way Combiner. It is connected to a Detector that converts the coupled RF signal into DC. The Detector converts the signal to DC and transmits DC to the Controller, and the Controller calculates the Absorbing Power by using its value.	

5.1.4. Modulator Web GUI

5.1.4.1. Computer Network Setting Initial Stage (Based on Window 10)

Open Computer Network Settings.

Properties of TCP/IPv4

IP:192.168.168.***
Mask:255.255.255.0

1) Connect Lan Cable to Exciter Rear Panel PHY1.

2) Exciter Basic IP is 192.168.168.168.
Therefore, Set the Computer's IP to one of the IPs between 192.168.168.2 and 192.168.168.255, excluding 192.168.168.168.

3) Open the Internet Browser window and enter 192.168.168.168 in the address bar.

Observer Mode ID: admin PW: (leave blank)
Manager Mode ID: PW:

4) Ethernet Port Setting

Select System's LAN at the bottom left of the screen.

LAN settings consist of 5 interfaces.
You can consider Interface as an Ethernet Group to be used internally.
Each IP and Physical Ethernet can be set in this interface.
Required settings are made based on the following:

Physical Ethernet	: It sets the Physical Port. This number is matched with the Exciter Rear PHY number.
Static IP Address	: This is the Web GUI IP address that connects to the outside.
IP Netmask	: It is a netmask that connects to the outside.
Multicast IP Address	: Destination IP Address of STL Network when receiving TS Data. In other words, enter the Multicast IP set in the gateway.
DHCP Mode	: When checked, the Static IP Address settings will follow the settings of the Ethernet Switch or Ethernet Hub. If this happens, you may not be able to use the user-assigned IP.

5.1.4.2. ATSC3.0 Setting

5.1.4.2.1. Web GUI Direction

Click the desired item in the diagram as shown in the picture. If you click and drag, a box will follow you, and if you release the click while the box is in one of the three parts at the bottom, the details of the item will appear.

*. Detailed information for some items is not supported.

5.1.4.2.2. Detail of System Menu

Items related to the Modulator System can be found in System at the bottom left.

ALARM CONTROL : Alarm application items can be selected.

EVENTLOG : You can check the alarm that occurred in the modulator.

SNMP : You can configure SNMP communication settings.

Among the internal items, characters can be entered in SysLocation, and the entered characters are displayed at the top of the main screen.

LAN : You can set Exciter Ethernet Network.

NETWORK : When connecting the exciter to an external Internet network, it sets the gateway, DNS, port, etc.

DEVICE LOCATOR : -

TIME/DATE : It can change Modulator time and includes setting items when using NTP.

SW UPGRADE : This is a window to update modulator firmware. Be careful not to disconnect the power during update.

Preset : You can save the current Modulator Setting information and load and apply the saved information.

Restore : You can reset all settings of the modulator to the factory default state. All settings will be changed, so be very cautious.

USERS : You can change Login Password.
Changes are not recommended.

OPTIONS : You can check the Option items applied to the Modulator.

ABOUT : You can check the Status Report and version Report of the Modulator.

Reboot : You can reboot the Modulator.

5.1.4.2.3. Reference Setting

ATSC3.0 can configure SFN (Single Frequency Network).
If the reference is incorrect when configuring SFN, the receiving points overlapping with the two transmitting points become unable to receive broadcasts. For this reason. Reference is very important.

ATSC3.0 Reference can be divided into two parts:
Synchronization part with input data and the frequency synchronization part between each transmitter.
GPS provides both Syncs. If GPS is not used, 10MHz and NTP Server synchronized with the gateway must be provided.

GPS (Optional)

GPS is a system that provides information such as location, altitude, and speed using satellites.
When GPS is connected, you can obtain all information such as 10MHz, 1pps, Date, Time, etc.
The ATSC Exciter provided by JM Broadcast is equipped with a GPS reception module as standard.
When you open the GNSS information window, it appears as follows:

**. The Active Antenna's Check Box must be checked to operate.*

Visible Satellites

Refers to a satellite contacted by an antenna.

Tracked Satellites

Refers to Visible Satellites that are receiving meaningful information from the receiver.

Tracked Satellites must always be maintained at least 4 for accurate data extraction.

Antenna Voltage

Antenna Voltage is changed according to the operating voltage of the antenna.

The voltage can be set to 3.3V or 5V. When purchasing an antenna, you must check this first.

5.1.4.2.4. ATSC3.0 TS Network Setting

Connect TS Stream Line (Ethernet) to Exciter Rear Side PHY0.

Connect Computer and Exciter Rear Side PHY1.

Connect to Exciter Web and set as shown below.

Lower the switching block and set it as shown below.

When setup is completed normally, the RF Output Block in the Web Diagram will change to a green line. If it does not change, there is a problem with TS Data or an error in settings.

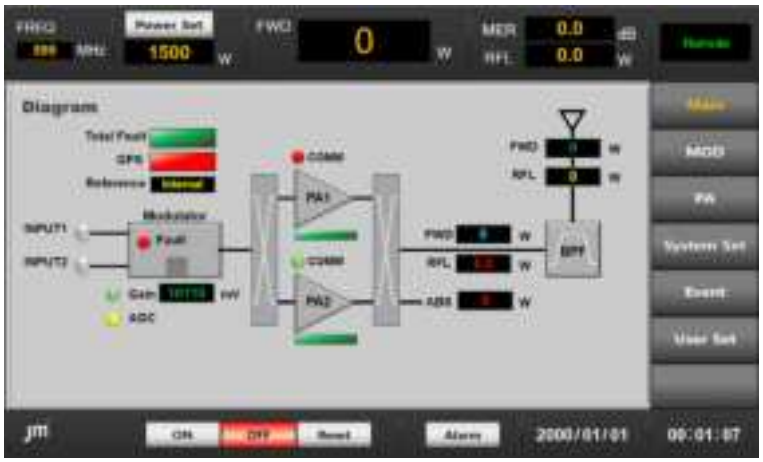
If everything is normal, it will definitely change to green.

5.1.5. Front LCD

The Touch Panel Type was applied for user-friendly operation, and it was organized around each unit for convenient access.

This screen is displayed the same way in the remote Web GUI.

5.1.5.1. Main



Displays information of each Transmitter's Path on one screen.

5.1.5.1.1. Top Fixed Bar

599MHz :

Displays the Frequency set in the Modulator.

Changes are possible on the System Set screen and Modulator Web.

Power Set :

Displays the AGC Target Power of the transmitter set by the User.

The prerequisite is that the exciter's Gain Control Mode must be set to AGC state.

If it is Local, it can be set, but the actual application is applied when changing to AGC Mode.

This part is displayed in all windows as a fixed screen.

Change Power Set

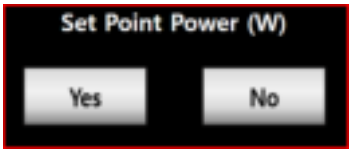
1) When you touch the 

Button, a Pop-up window appears.

2) When you press the Change Button in the Set Power window, an input window appears.

3) Enter the desired Power and press the ENT Button to display the value entered in the Target value. In this status, changes have not yet been applied to the system. It makes one more confirmation to prevent unintended changes.

4) Press the Current's Set Button to apply it to the System. When applied to the system, Exciter Set Power is changed, and the value set in Current is displayed.



FWD :

Band Pass Filter Output Forward Power is displayed.

AGC controls this value to reach Set Power and becomes a reference for Over Power and Low Power.

This part is displayed in all windows as a fixed screen.

MER :

Receives Band Pass Filter Input/Output Feedback from the Exciter and displays the analyzed MER value.

This part is displayed in all windows as a fixed screen.

RFL :

Band Pass Filter Output Reflector Power is displayed.

It compares this value with the FWD value and calculate the VSWR to determine the Fault.

Remote :

Changes can be made by selecting the Key on the TCU & Interface Board and selecting the Button on the screen.

5.1.5.1.2. Diagram

Total Fault :

If one or more faults are detected in the corresponding Path, it changes from green to red.

GPS :

Displays the GPS status. When an error occurs, it changes from green to red. When it turns red, connect to the Modulator via Web connection, and check the settings. If there are no problems with the settings, check the cable connection status and whether there is a short circuit. If everything is normal, you should check the GPS ANT.

Reference :

Displays the reference currently being applied to the Modulator.

Reference types include GPS, 10MHz, 1pps, and Internal.

It can be set to Auto, GPS, External, or Internal in Modulator Web, and the default is Auto.

In Auto Mode, if a problem occurs with each Reference, it is set in the following order: GPS, 10MHz or 1pps, and Internal.

In Manual Mode, you can set GPS, External, Internal, etc. directly.

INPUT1,2 :

Displays the status of the TS signal. If it is normal, it will be green. If it is abnormal, it will be off.

Modulator Fault:

If TS is normal and Modulator Output is Mute when TX ON status, it turns red. If this situation occurs, you should access the modulator and analyze the cause. It is recommended to contact the manufacturer.

Modulator Fault may occur about 1~2 seconds when Transmitter turns ON. If it continues, inspection is required.

GAIN :

Displays the current voltage that controls System Power in the Exciter's MGC or AGC Mode. This is one of the factors that should be checked on a daily basis.

AGC :

Displays the System Gain Control Mode.

In MGC Mode, it is yellow, and in AGC Mode, it turns into green.

PA COMM :

Displays the communication status between PA (Power Amplifier) and TCU.

If the communication status is normal, it is green, if abnormal, it turns red.

If there is an abnormal situation, check the rear HPA Control Line first.

If there is no problem with connection, there may be a problem with the PA or TCU RS485 parts, so contact the manufacturer.

Voltage :

Displays the PA DC Voltage. 50V (±1.5V) is the setting value.

Current :

Displays the total current value consumed in PA.

For more detailed information, you can check on the PA screen.

FWD :

Displays the Forward value of each Point.

This is one of the factors that should be checked on a daily basis.

RFL :

Displays the Reflector value of each Point.

This is one of the factors that should be checked on a daily basis.

5.1.5.1.3. Bottom fixed bar

ON :

This is the button to start the Transmitter.

It operates the same as the ON switch of TCU Front.

Operated only in LOCAL Mode.

Can't control in REMOTE Mode.

This part is displayed in all windows as a fixed screen.

OFF :

This is the button to stop the Transmitter.

It operates the same as the OFF switch of TCU Front.

Operated only in LOCAL Mode.

Can't control in REMOTE Mode.

This part is displayed in all windows as a fixed screen.

Reset :

Reset Alarm and Fault status.

Reset the Alarm and Fault status and switches the transmitter to a status

where it can be restarted.

Does not resolve actual Alarms and Faults.

This is a function that allows you to reset the status and check the status again. The user must identify the cause and resolve it directly.

Operates the same as the RES Switch on the front.

Alarm :

If any of the following occurs in the transmitter, the 

Button turns red.

When you Touch the 

Button that turns red, the following screen appears.

Check the status of the Unit and take action.

This part is displayed in all windows as a fixed screen.

- **Input**

  A problem occurred with TS Data Input.

  Check the Exciter Page and if it is difficult to determine the cause, access the Modulator Web GUI and check the status.

  Check the connection status of the TS Cable and the 10 MHz or GPS. If all connections are normal, you should check the data status supplied by the scheduler.

- **Low Power**

  Check the Analog value of HPA Page.

  Compare the HPA Forward value with the Pallet Current value to see if there is anything relatively low. If there is a relatively low Pallet, replace the Transistor of the Pallet or check the PCB status to proceed. Please refer to HPA1600L RF Part Transistor Test & Replace Capture.

  If the HPA Forward and Pallet Current values are constant but overall lower than before, check the status of the Exciter, Divider, and cables between them.

For Exciter, check Exciter Explain of Display of Main Capture.

- **Over Power**

  If it occurs in **AGC mode,** it is necessary to check the connection status and level of the FIL FB in the Exciter Rear**.** When this level is lowered, the Output Forward Power is raised by the AGC, resulting in an Over Power Alarm.

  If it occurs in **MGC Mode,** set MGC Power below Set Power.

- **VSWR:**

  Check the VSWR Capture described above to deal with the alarm.

- **ABS Fault**

  Absorbing occurs when the Power Balance between HPA1600L goes wrong.

  If the value of Absorbing Power is 300W or higher due to incorrect Power Balance between HPA1600L, a Fault occurs. In this state, it becomes OFF.

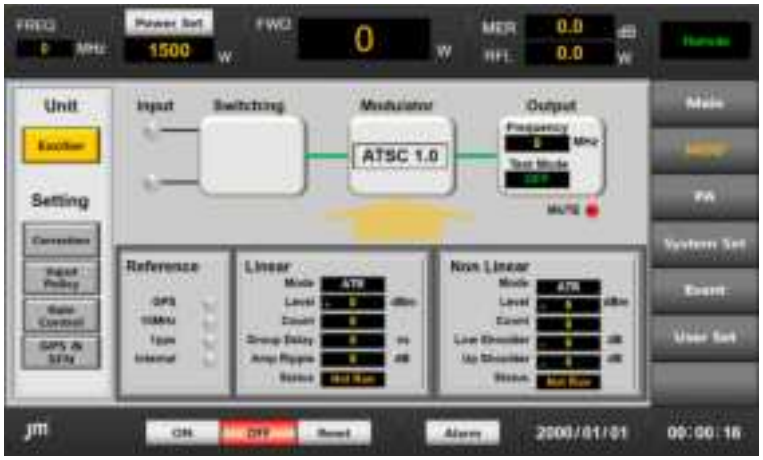
  Afterwards, the Transmitter remains in the OFF state until reset by the User.

  The cause of the occurrence is a change in the Phase and Gain Balance between HPAs. Check the current of the HPA and check the status of the Transistor. Changes in phase are extremely rare, but if in doubt, open the HPA front cover and adjust Phase VR.

5.1.5.2. MOD

5.1.5.2.1. Exciter

The Screen related to Modulator (Exciter).



Input :

Displays the status of the TS signal.

Switching :

Displays which TS signal is currently being used.

Details are explained in the Input Policy screen.

Modulator :

Displays the Modulation Type.

Output :

Frequency

Displays the Output Frequency.

You can change it on the System Set screen.

Test Mode indicates the status of the Modulator's internal settings.

Test Mode

PRBS

When TS Stream is not supported, System Test can be performed by supporting the same ATSC1.0 Modulation. In ATSC3.0, it is not activated without TS Data.

Since the data is not included, the TV screen cannot be confirmed, but all characteristics can be measured under the same conditions as when the stream is present.

When Test Mode On, the Exciter Output is always RF ON regardless of the presence or absence of TS Input. However, TS Stream transmission is not possible in PRBS_ON state.

Therefore, for normal broadcast transmission, Test Mode must be Off.
Condition: A Mode Option must be installed and set to A Mode.
Normal operation is B Mode.

CW (single Carrier)

This mode changes the center frequency of the designated channel to single tone and outputs it. The purpose is to measure frequency deviation.

Mute :

Displays the Modulator Output status.
If status is normal, it is green; if status is abnormal, it turns red.
Red color occurs when Modulator Output is not transmitted in RF ON, Data IN Normal state. To determine the cause, access the Modulator Web, check the Mute Reason, and take measures.
If action is difficult, contact the manufacturer.

Reference :

Indicates what reference has been contacted.
Default Reference is GPS.
Changes are possible in the Modulator Web GUI.

Linear

Picks up from the Band Pass Filter Output and compensates mainly for Group Delay and Frequency Response characteristics that are distorted (AM, PM) by the filter.

Mode:	There are Auto Run, Continue, Run to Target, Monitoring, and single Mode.
Level:	Displays the level of the Feedback Signal. Correction operates normally only when the Level is within ±9dBm.
Count:	Indicates the number of correction operations.
Group Delay:	Displays Group Delay value measured from the Modulator. It is one of the reference points for

	Correction Operation.
AMP Ripple:	Displays Amplitude Ripple value measured from the Modulator. It is one of the reference points for Correction Operation.
Status:	Indicates the status of current Correction Operation.

Non Linear

Picks up from HPA Output or Band Pass Filter Input and compensates mainly for Amplitude Error and Phase Error characteristics that are distorted (AM, PM) by HPA.

Mode:	There are Auto Run, Continue, Run to Target, Monitoring, and single Mode.
Level:	Displays the level of the Feedback Signal. Correction operates normally only when the Level is within ±9dBm.
Count:	Indicates the number of correction operations.
Low Shoulder:	Displays Low Shoulder value measured from the Modulator. It is one of the reference points for Correction Operation.
Up Shoulder:	Displays UP Shoulder value measured from the Modulator. It is one of the reference points for Correction Operation.
Status:	Indicates the status of current Correction Operation.

Details related to settings are explained in the Correction Screen below.

5.1.5.2.2. Correction

Displays the operation status and setting values of Auto Adaptive Correction.

For settings, Touch  Button to move to the enable screen.

5.1.5.2.2.1. Correction 의 정의

Distortion occurs when the RF signal modulated and channel converted from the exciter passes through a system including HPA and filter. This distortion causes a deviation from specifications. Correction is what compensates for this.

There are two Correction methods, the 1 Point Pick Up method and the 2 Point Pick Up method, but recently the 2 Point Pick Up method is mostly used.

The 1 Point Pick Up method is very disadvantageous in terms of accuracy and stability because the non-linear data collection width is significantly reduced due to the influence of the Final Filter. The data collection width of Non Linear Correction is about Fc±12MHz. Data must be analyzed with this bandwidth to confirm the characteristics of HPA and add appropriate ingredients, but from the Fc ± 3.2 MHz point, you will receive and analyze completely different data that has been forcibly cut by the filter, so accurate Correction cannot be achieved. The distortion caused by Band Pass Filter gets worse by HPA for Non Linear, and by Band Pass Filter for Linear. Therefore, the 2 Point Pick Up method is used to pick up and correct each Band Pass Filter In and Out.

Default Reset

Reset Linear Correction Data that has operated up to the current point.

Correction Count is also reset and goes to '0'.

It operates the same as 'Natural' on the Web GUI. For user's convenience, it is changed to commonly used words.

Operation Mode

Idle:

If correction was not started, it is left as it was, and if it was operated, the last data operated is maintained until the conditions are changed by the user.

Auto(Auto Run)**:**

Determines on its own whether it is satisfied with the set Target Point and repeats Apply / Monitoring. This is the manufacturer shipping mode.

RTT(Run to Target)**:**

Operates without limit until the set Target Point is satisfied.
Once satisfied, subsequent operations operate as Idle.

Conti(Continuous)**:**

Continues to operate until changed to another mode.

Group Delay & AMP Ripple

Current is displayed by the exciter analyzing the Filter Output Feedback signal and is a characteristic of the actual System.
Group Delay & AMP Ripple Target sets the value desired by the User.
Correction operates so that the Current value is below the Target value.

Target Level settings change depending on system performance and environment.

If the Target Point is set too low in Auto Run or Run to Target Mode, it may operate like Continuous mode, and if set too high, it may operate like Idle.

The Linear Target Level setting can be used without changing the value set by the manufacturer. Because the distortion caused by the Band Pass Filter is large, this characteristic does not change significantly.

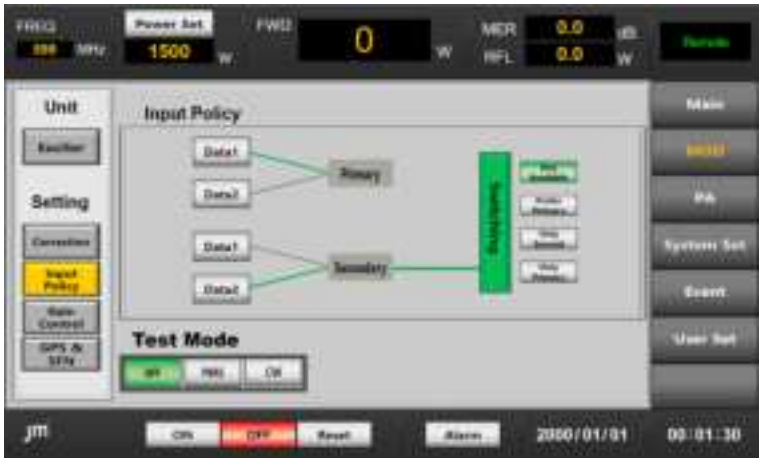
Shoulder

The Up & Down Shoulder value is the value displayed by the exciter by analyzing the HPA Rack Output Feedback signal.

Target sets the value desired by the User.
Correction operates so that the Shoulder value is below the Target value.
The Target Level sets an appropriate value according to the system performance and environment.
If the Target Point is set too low in Auto Run or Run to Target Mode, it may operate like Continuous mode, and if set too high, it may operate like Idle.
Therefore, the target should be set to an appropriate value in the field over a long period of time.

5.1.5.2.3. Input Policy

Access by Touching the Input Policy Button.
You can determine the operation method of the patch between TS 1, 2 and Primary, Secondary Matching and Primary, Secondary.



This is a screen where you can set the switching function for two TS signals.
Depending on the transfer method, it is defined as follows:

Pri (Primary Only)
Transmits using only TS Stream connected to the Primary Line.
If there is a problem with the primary line, it will be canceled.
This mode is applied when TS1 is selected in TCU.

Sec (Secondary Only)
Transmits using only TS Stream connected to the Secondary Line
If there is a problem with the secondary line, it will be canceled.
This mode is applied when TS2 is selected in TCU.

Any (Any available)

Priority is not given to either Primary or Secondary, and changes are made automatically if a problem occurs in the selected TS Line.

Change Time can be set in the Web GUI, and the default setting is 5 seconds.

PrePr (Prefer Primary):

A Primary priority mode.

If Primary Line is normal, Primary is being selected. If the Primary Line is abnormal and the Secondary Line is normal, it goes to Secondary, and when the Primary Line becomes normal, it unconditionally goes back to Primary.

This function is not applied to the TS Select window.

5.1.5.2.4. Gain Control

This is a screen related to System Gain operation type and MGC Power settings.

Gain ***mV :

Displays the Gain Control Voltage currently applied to the System.

AGC :

This is a mode in which the System controls the Current Power by adjusting the System Gain Control to the Set Power.

In AGC Mode, you can change the output by changing the Power Set at the top.

MGC :

This is a Mode that User can change the System Gain Control directly. You can adjust it by Touching the Power Increase/Decrease. When you touch the Power Increase/Decrease, it is immediately applied to the Power, so take caution when you change it.

5.1.5.2.5. GPS & SFN

This is a screen related to SFN settings.

GNSS :

Indicates satellite reception status. Satellites receive both GPS and GLONASS systems simultaneously.

SNR : Indicates the satellite reception SNR value.

Visible : Indicates the number of satellites that can be received by the antenna.

Tracked : Indicates the number of satellites with which the modulator has contacted the visible satellite. Information is received from tracked satellites and applied to the modulator.

At least 4 satellites must be in contact.

SFN ID :

You can set the transmitter's transmission ID.

Delay Value :

Indicates the Delay value applied in the transmitter.

Offset is a value that can be changed when setting SFN with another transmitter.

If the reception at the overlapping point is abnormal, you can change this value to make the reception normal.

Process is Modulator Processing Time and cannot be changed.

5.1.5.3. PA

This is a screen where you can check the PA status.


HPA1


HPA2

It includes detailed information about the PA and fault-related items, allowing you to check the status of the PA on one screen.

5.1.5.4. System Set

This is a screen where you can change system-related items.

Low Power Alarm Set

Calculate the Threshold Power by applying the Percent set based on the set power and determine whether the Main FWD Power is outside the threshold.

1) When you Touch the Change Button, a Pop-up window appears.

2) Enter the desired numbers and press ENT Button to display the value entered in the Target value. In this status, changes have not yet been applied to the system. It makes one more confirmation to prevent unintended changes.

3) Press the Current Set Button to apply it to the System. When the Current value changes and the Main Power falls below the set standard, a Low Power Alarm is generated. In this state, if the ACU is in Manual Mode, the current state is maintained, and if it is in Auto Mode, it becomes a Transfer Condition and is transferred to the opposite Transmitter.

Over Power Alarm Set

Calculate the threshold power by applying the Percent set based on the set power and determine whether the Main FWD Power is outside the threshold.

1) When you touch the Change Button, a Pop-up window appears.

2) Enter the desired numbers and press ENT Button to display the value entered in the Target value. In this status, changes have not yet been applied to the

system. It makes one more confirmation to prevent unintended changes.

3) Press the Current Sent Button to apply it to the System. When the Current value changes and the Main Power exceeds the set standard, an Over Power Alarm is generated. In this state, if the ACU is in Manual Mode, it is turned OFF, and if it is Auto Mode, it becomes a transfer condition and is transferred to the transmitter on the other side.

The operation is turned off from the TCU as soon as it is recognized without waiting time.

TX Frequency Set

This is a screen where you can change TX Frequency of the Transmitter.

1) When you touch the Change Button, a Pop-up window appears.

2) When you touch the ENT Button after entering the Frequency value, the Frequency changes accordingly.
You can only change the MHz unit. For Hz unit, you can change it by accessing the Modulator Web.

The final operating point is executed in the Modulator, and since the BPF is located behind the HPA, frequency changes must be made with caution.

Address :

TCU communicates with ACU (System Controller) through RS-485. You can select the TCU Address for this communication. Changes must be made after getting the consent of the manufacturing company.

5.1.5.5. Event

This is a screen where you can check the logging data of each path.

Record all changes that occur on the transmitter.

Through this, the cause of the Fault can be analyzed.

The recording method is divided into time and content, and it is possible to check whether it was done in the system itself, changed by the user, or performed remotely.

5.1.5.6. User Set

The screen where you can check the logging data of each path.

Network :

TCU provides the same screen to ACU and Remote Web.

Screen sharing is done through LAN, and this is the screen where you can check LAN information.

Filter & PA Unit :

This is the window where you can select the presence or absence of a Filter and the number of PAs.

Filter

The current AGC (with a filter) receives feedback from the Filter Output, but when used without a filter, it operates by changing the Feedback Point of the AGC to HPA Output.

Number of PAs.

You can select the number of PAs.

If there is one PA, it will be 750W, and if there are two, it will be 1500W.

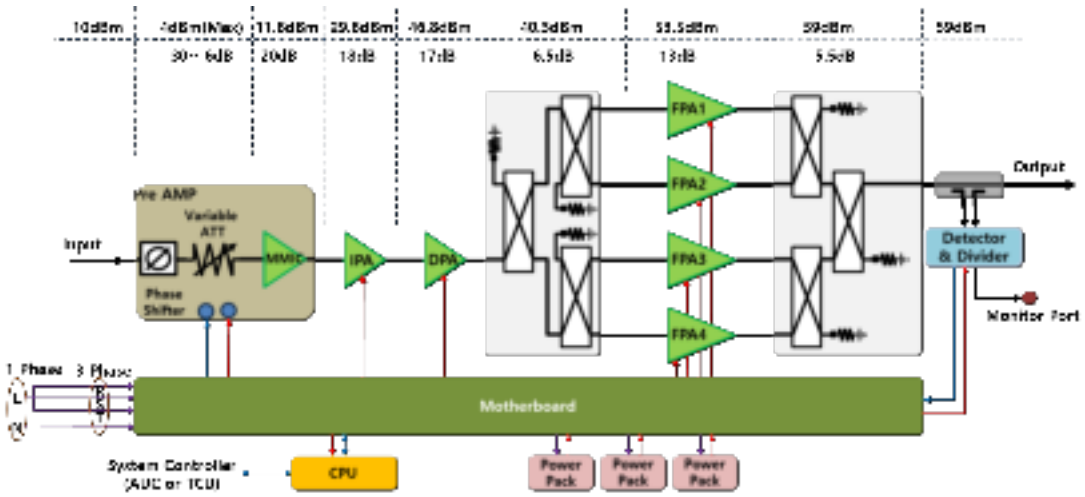
User:

5.2. Transmitter Configuration

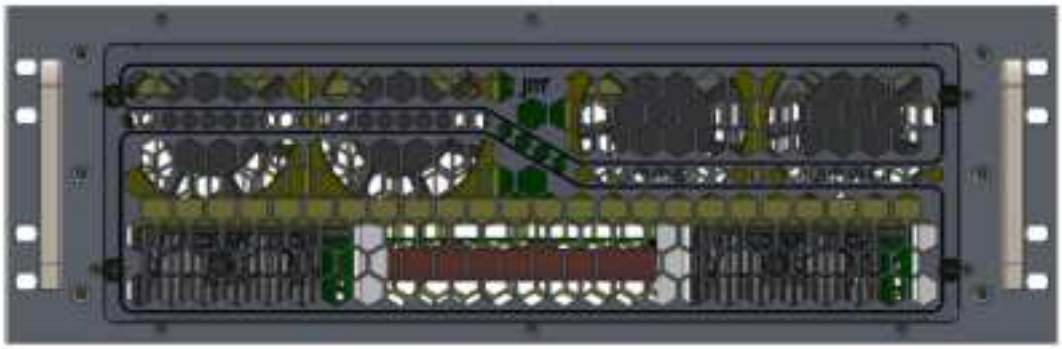
HPA is a UDTV transmitter terminal amplifier that amplifies the exciter output signal to a specified high output and radiates it to the Antennas. This equipment consists of two or one HPA800L Units, Divider, and Combiner.

5.2.1. HPA800

HPA1600L consists of RF at the top and Power and Control parts at the bottom.
Designed to actively respond to VSWR, Over Power, Over Temperature, Over Voltage, and Over Current.
Designed to be easy to attach and detach using the Hot Plug method.
The heat sink is designed with a double cooling pipe structure to increase efficiency.
Considering AC Phase Balance, the Power Pack is composed of 3 pieces, and secures a 30% Margin of the used power.



5.2.1.1. Front



On the Front, there is an HPA Output Monitor terminal SMA Female Connector, so you can check the HPA RF characteristics.

When you open the Front cover, you can easily attach and detach the internal Power Pack.

Power pack Separation is possible during operation.
For complete safety, it is recommended to proceed after turning off the Breaker Switch of the HPA800.

On the left, there is the Front Board for LED display and setting, and its functions are as follows.

DC ON LED : Turns on when the AC voltage of the power supply is connected properly.

Control LED : Turns on when received the RF ON command.

Address SW : Rotary SW to set RS485 Address.

Phase Adj. : Adjust Phase. For balance tuning when two or more HPA1800Ls are installed.
Adjusting the manufacturer's shipping status of Transmitters with two or more HPAs combined is prohibited, and when adjustment is necessary, adjust it after familiarizing yourself with the contents while equipped with the relevant measuring instrument.

Gain Adj. : Adjust the Gain of AMP.
Adjusting the manufacturer's shipping status of Transmitters with two or more HPAs combined is prohibited, and when adjustment is necessary, adjust it after familiarizing yourself with the contents while equipped with the relevant measuring instrument.

Forward Adj. : Adjust Output Forward Reading Power.
It is set and shipped by the manufacturer, and **modification is prohibited**.

Reflect Adj. : Adjust Output Reflect Reading Power.
It is set and shipped by the manufacturer, and **modification is prohibited.**

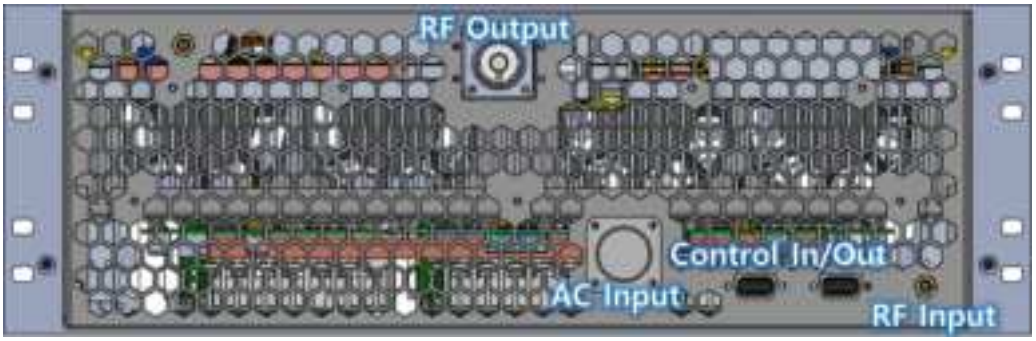
Debug Port : Connects Firmware Update and Monitor GUI to RS232.
Connector Type 5046-3P(Pin1-TXD, Pin2-RXD, Pin3-GND)

Changes on the HPA Front Board must be made after sufficient prior review. Tuning Points included here have a direct effect on

the System.

You have to be very careful.

5.2.1.2. Rear



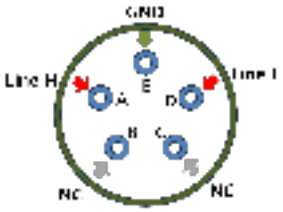
5.2.1.2.1. RF Output

A 7/8" Quick Insert Male Type Output Port of RF amplified by HPA and connected to the Combiner.

5.2.1.2.2. AC Input

It is 240V 1Ø(Single-Phase). Only 3 pins out of 5 pins are in use.

This is the place where the high voltage flows, so it requires special attention when handling.



It can be separated without any special measures during operation, but it is recommended to disconnect after turning OFF the relevant Breaker Switch on the PDU.

RF Input

Where Drive RF Output is divided and connected in Divider.

This connection has a phase. It is linked to Divider Port and Combiner Port.

When connected to a divider port other than the designated port, the balance in the Combiner is distorted, and the RF output flows to the Combiner Absorbing

Dummy, and only a very small amount flows to the RF Output Port.

Control & Communication

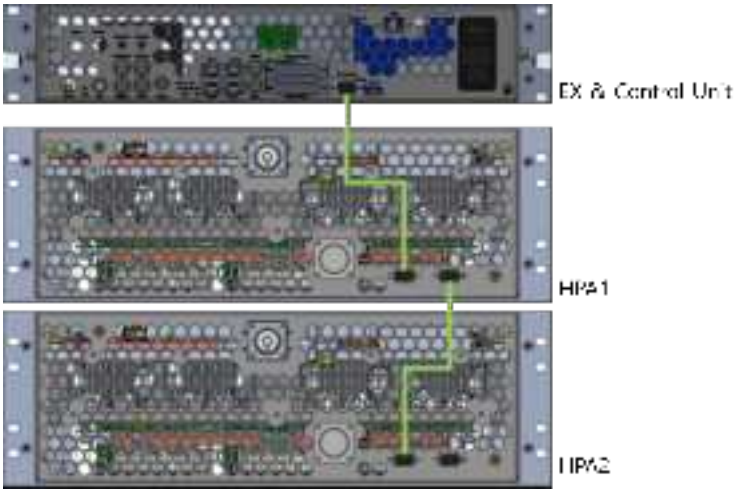
Contact Type is TX On, Off, Reset, and RF On Answer.

All other information is via RS232.

If there is one PA, connect one of the 2 connectors to the HPA Port of the EX & Control Unit.

If there are two PAs, connect one part of HPA1 to the HPA Port of the EX & Control Unit, and connect the other to HPA2.

Example Control Column Plot Between Units.



5.2.1.3. RF Part

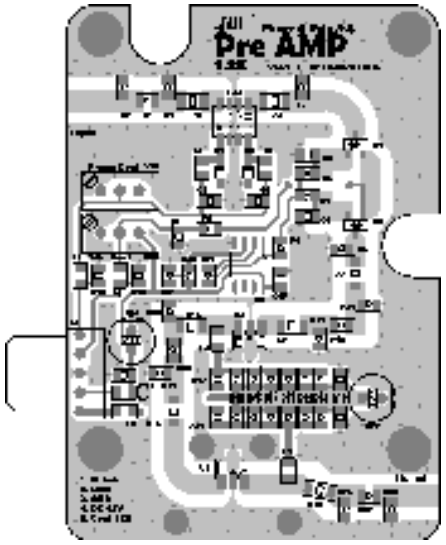
5.2.1.3.1. Composition

The RF Part is located at the top of the HPA800 and consists of Pre AMP, IPA, DPA, FPA, Divider, Combiner, and Detector.

Each part is designed in an independent form and is easy to repair.

5.2.1.3.2. Pre AMP

Consisted of a circuit that amplifies the RF received from the Divider, Phase Shift, and Gain Adjuster.



Amp

The power amplifier using MMIC for HPA Gain compensation.

Phase Shift

It is Phase Adjust using Hybrid Coupler, Capacitor, and Tuning Diode, and can be set in the 'Phase' Variable Register on the Front Panel.

Gain Adjust

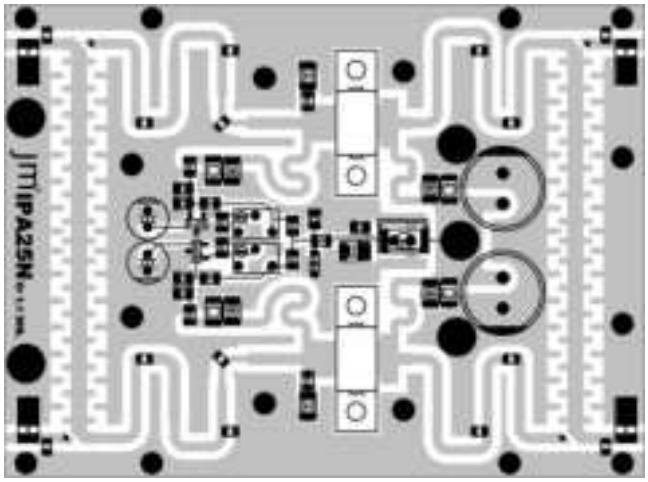
By implementing a π-type Attenuator using a PIN Diode, it can be set in the 'Gain'

Variable Register of the Front Panel.

5.2.1.3.3. Intermediate Power AMP(IPA)

A Pre-Drive amplifier using a P1dB 25W class FET (MRFE6VS25N) combines two amplifiers with a 3dB coupler to linearly amplify the power required to drive the Drive AMP.

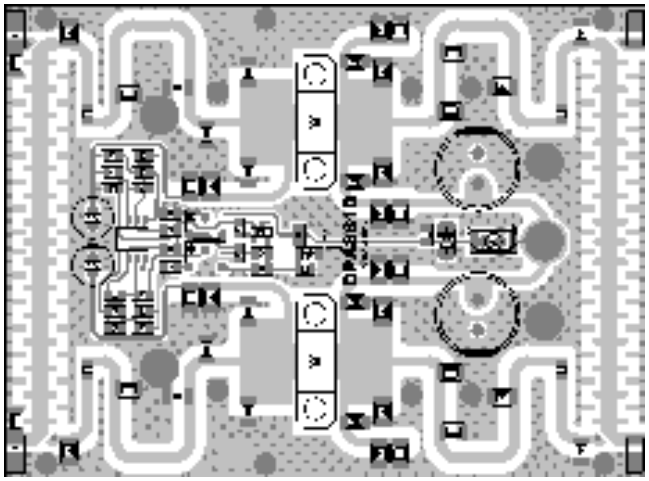
Adjust Gate Bias with the Variable Register.



5.2.1.3.4. Drive Power AMP (DPA)

OFDM 30W class push-pull type LDMOS (BLF881) combines two amplifiers with a 3dB coupler to linearly amplify the power required to drive the Final Power AMP (FPA).

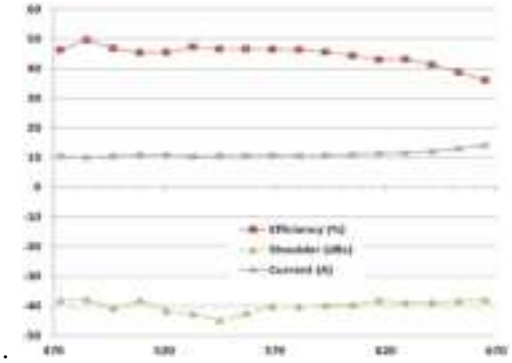
Adjust Gate Bias with Variable Register.



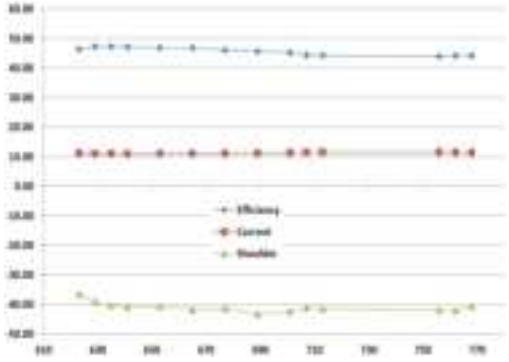
5.2.1.3.5. Final Power AMP

OFDM 150W class push-pull type LDMOS (BLF888E) combines two amplifiers with a 3dB coupler to linearly amplify the power required to drive the Regulation power.
BLF888E Transistor independently implements Doherty.
The manufacturer produces 2 bands within UHF Broadband (470~810MHz).
Adjust Gate Bias with Variable Register.
The FPA in HPA800 consists of 4 pallets and generates an output of OFDM 900W (Max).
The following are the characteristics of each Pallet 250W frequency.

Low Band Pallet



High Band Pallet



We use Low Band Pallet.

5.2.1.3.6. Transistor Test & Replace

To determine whether there is a problem with the transistor, measure the resistance value between the transistor input (Gate) and GND with a multi tester with the power turned off.
Normal values are 1.3kΩ for IPA25D & DPA and 100Ω(Peak)/300 Ω(Normal) for FPA.
If it is more than 50% lower than the value shown here and the current value is relatively lower than 50%, it can be judged as transistor damage.

Transistor Replacement Method

1. Completely separate the lead of the transistor, which is considered to be damaged, from the PCB.
   When separating the leads, be careful not to damage the PCB Lead. Since it is attached to a heat sink, heat conduction is very high. Therefore, a high-frequency soldering-iron should be used rather than a regular soldering-iron.

2. Remove the fixing bolts (M3) on both sides of the transistor using a +-shaped screwdriver.

3. If there is a Transistor Guide, separate it first and then remove the Transistor.

4. Clean the area where the Transistor was removed to ensure that no foreign substances remain.
   If a transistor is attached with foreign substances remaining, the attachment surface is lifted, causing a rapid decrease in thermal conductivity, which causes the transistor to be damaged again within a very short period of time.
   Lead (Pb) from the PCB where the Transistor Lead was attached should also be removed cleanly.
   If it is installed without being removed, force is applied to the Lead, which may cause the transistor's ceramic case to break and the Lead to fall.

5. Apply Thermal Grease to the bottom side of the new Transistor appropriately, check the direction, and then insert it.
   It is recommended to use non-conductive Thermal Grease.
   In the case of using conductive Thermal Grease, unwanted electrical short may be caused by sticking to parts other than necessary application.
   If you apply too little Thermal Grease, the thermal conductivity will decrease, and if you apply too much, it will overflow after attachment. The overflow problem is that in the case of nonconductive grease, if left for a long time, dust will sit down, and if the dust becomes conductive, its properties will be affected.
   Therefore, if grease overflows, it must be removed.

6. Secure the fixing bolt with sufficient force using a +-shaped screwdriver.

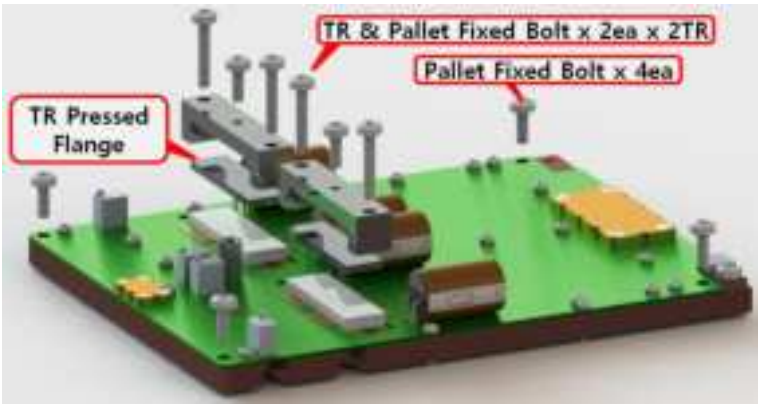
7. Using a soldering iron, solder with sufficient heat and lead so that the Transistor Lead is perfectly attached to the PCB.

8. Check again for abnormalities by checking the resistance value with the Multi Tester.

9. After installing in the Exciter RF Mute state, turn it on for final confirmation.

10. If there is an error in the final confirmation result, that is, if the current is

displayed relatively high by more than 1A, contact the manufacturer.



*. The purpose of using TR Pressed Flange used to fix the transistor is to strengthen the contact between TR and Pallet by pressing it when the TR is fixed only on both sides, which causes the center to lift.

5.2.1.3.7. HPA800 Divider

Divider consists of two types: 2Way Divider and 2Way Divider x 2ea.
Coupler is composed of 3dB Type.

5.2.1.3.8. HPA800 4 Way Combiner & Detector

A 2-Stage Combiner that combines two FPA each in the first 2Way combiner, and finally combines again in the second 2Way combiner.
The combined power is transmitted to the 2Way Combiner (2 HPA type) through the Direct Coupler, and the forward and reflector signals sampled from the Coupler are converted into DC in the Detector circuit and transmitted to the lower controller to be converted into Power.
It determines Low Power, Over Power, and VSWR, based on this Power,

5.2.1.4. AC/DC Power Part

The AC/DC Power Part is located at the bottom of the HPA1800L and is consisted of Power Pack, Power Pack Mother Board, and Control Board.

5.2.1.4.1. Power Pack

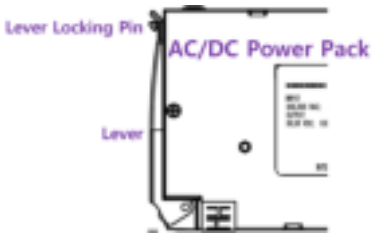
A power supply that changes AC220V(Max AC260V) single-phase input power to DC 50V output. The manufacturer is GE (General Electronic), and this product is used in the most equipment in the world and guarantees reliability and stability.

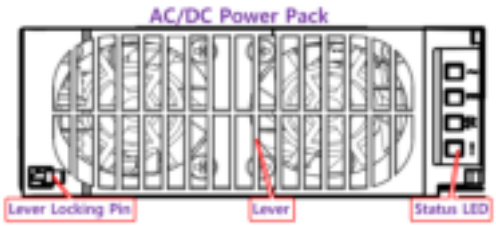
It can supply a current of up to 110A by parallel running up to 2 Power Packs in module form.
The Power Pack adjusts the current consumed between packs through Mutual Current Sharing so that the current is evenly distributed.

Output Power :	50V @ 2725W, 5V @ 4W
Universal AC input :	90 ~ 260V
Programmable output voltage :	44 ~ 58 Vdc
Output Current :	55Adc @ 50V
Operating Temperature :	-10°C to +75°C
High Efficiency :	96.2%

Status LED

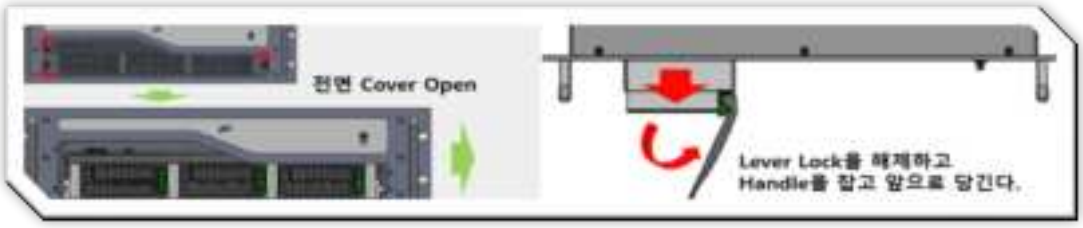
LED	On	Blinking
⏦	Input OK	Input Output of Limits
⎓	Output OK	Overload
🌡	Over Temperature Warning	
!	Fault	



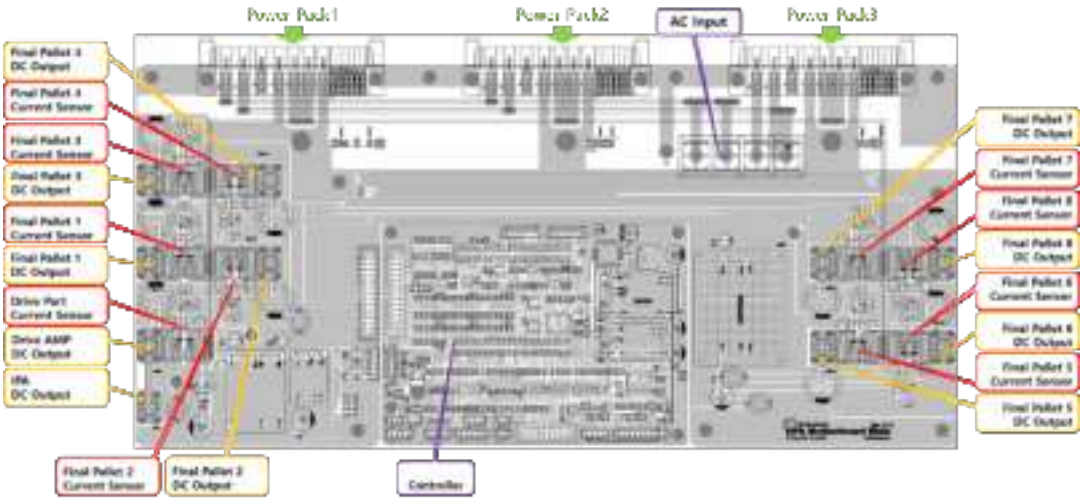


Replace

If you loosen and remove the three HPA front cover fixing bolts by hand, you can see the Power Pack installed inside. Press the Lever Locking Pin on the power pack itself to raise and pull the lever, and it will fall forward.
Installation can be done in reverse order.



5.2.1.4.2. HPA800 Motherboard (same as HPA1600L)



Motherboard includes Interface function, Current Sensing, and DC-DC Convertor function.

Interface & Current Sensing Function

Connects the power pack and control board.

The 50Vdc generated by the Power Pack is combined into one. This design ensures that 50Vdc is normally supplied to the entire AMP even if one Pack has a problem.

Separates 50Vdc into 9 lines and supplies to each pallet through the Current Sensor.

Data detected by the Current Sensor is delivered to the Controller.

DC-DC Convertor Function

Converts 50Vdc to 12Vdc, 5Vdc, -12Vdc and supplies driving voltage to Controller, Detector, Pre Amp, and Current Sensor.

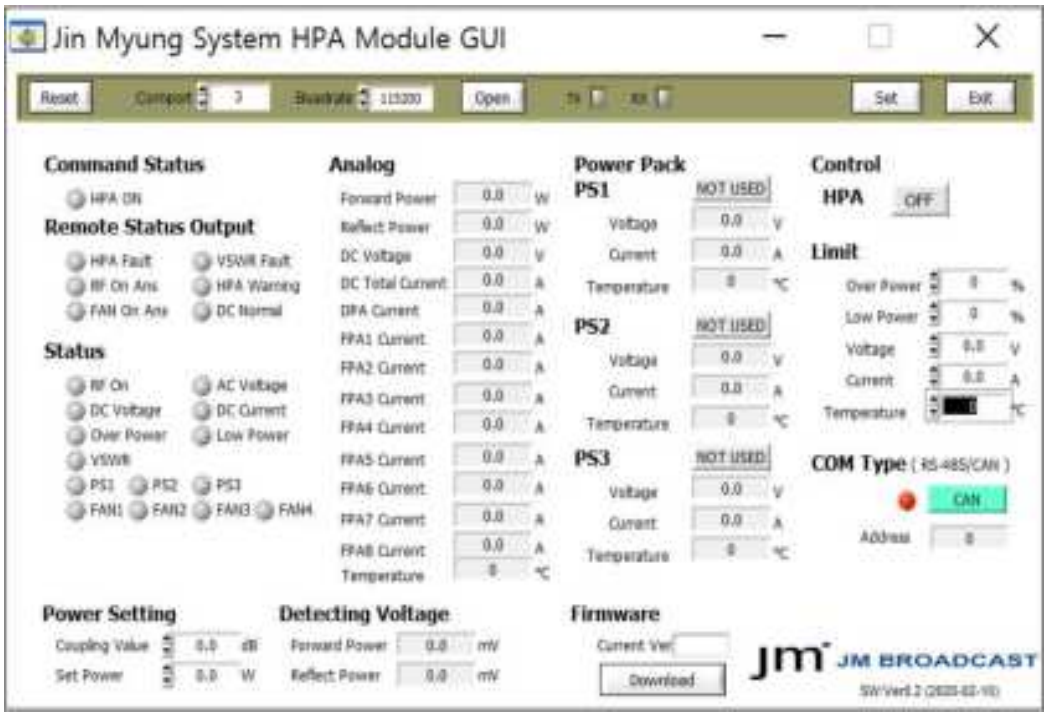
5.2.1.4.3 HPA800 Controller (same as HPA1600L)

The Control Board is divided into a CPU Board and an Interface Board.

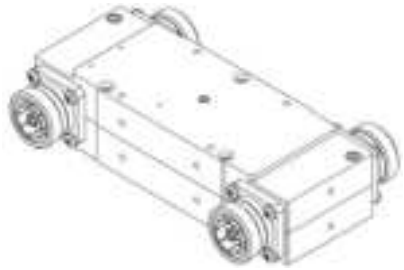
Install the CPU Board on top of the Interface Board.

The Control Board receives ON/OFF/RESET signals from the EX & Control Unit and operates the HPA. It reads RF Power, Voltage, Current, and Heatsink Temperature, and issues an OFF command itself in case of an error.
Transmits all read information to EX & Control Board.
Software updates are performed through a dedicated GUI Program on the Molex 5046 3pin Connector of the HPA Front Board.

GUI



5.3. 2 Way Combiner(Only 1.5kW Transmitter)



Install one per Path.
It serves to combine the RF power amplified from two HPA800s into one.
2Way Combiner is 3dB type.
The combined power is connected to the Low Pass Filter through a 1 5/8" rigid Line.
The combiner includes an Absorbing Dummy, and a Coupler is attached to check the RF Power applied to the Dummy.

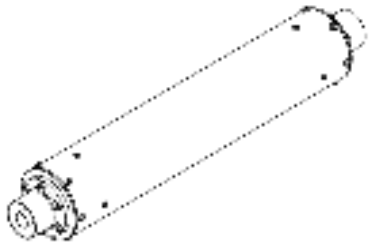
Here, the Sampled signal is delivered to the Meter Detect Unit, Powered, and delivered to the TCU.

The Absorbing Dummy Load is attached to the heat sink and is attached around the HPA Fan on

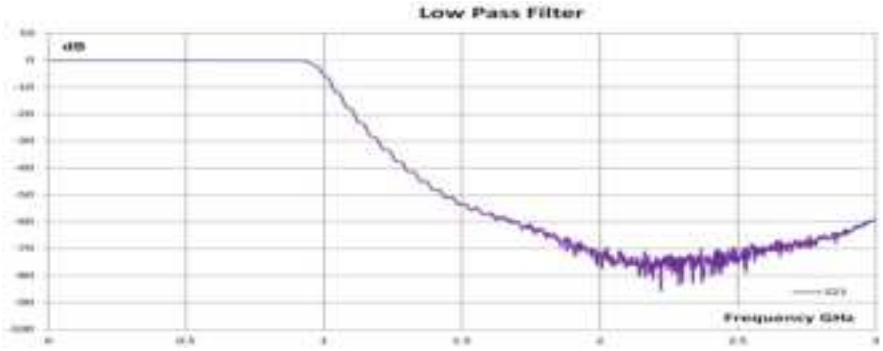
the rear side of the rack to dissipate heat through the HPA Fan.

5.4. Low Pass Filter

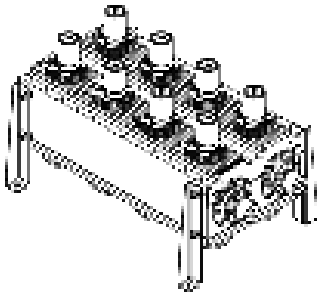
Used to remove Harmonics.



Max Input Power	: 7kW
Impedance	: 50Ω
VSWR	: <1.06
Insertion Loss	: 0.05dB
Harmonic Response	: 2nd -45dB , 3rd -50dB



5.5. Band Pass Filter



It serves to remove Spurious signals other than the designated channel.
It also serves to satisfy the Out-of-band Firing Power stipulated in the law.

5.5.1. Filter Specifications

Power Rating	3.5kW
Bandwidth	6MHz
Cavity	8poles
Mask	Critical Mask
Impedance	50Ω
VSWR	>25dB(<1.11)
Temperature Stability	<2kHz /℃

Max Operating Temperature	70℃
Input Connector	1 5/8" Un-flange
Output Connector	1 5/8" Un-flange
Cooling Type	Forced Air
Cooling Liquid Temperature	≤50℃
Liquid Temperature Rise @ 10kW	1.5℃

5.6. PDU(Power Distribution Unit)

Receives Main 240Vac and distributes AC power to each Unit.

It consists of Main Breaker, Surge Protector, and Breaker for each Unit.

6. Circuit Diagram