SKY3000L Transmitter
and
SKY1500L Transmitter

Operating & Troubleshooting Manual

JM BROADCAST

Revision C 7 2024

Jimyung Communications Co.,Ltd.(JM broadcast)
A-907 Technopark, 697 Pangyo-ro, Bundang-gu, Seongnam-si, 13511, Korea
Tel. +82-31-706-0150
Fax. +82-31-707-6382
Email : jmcom@jmbroadcast.com
Web : www.jmbroadcast.com

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.

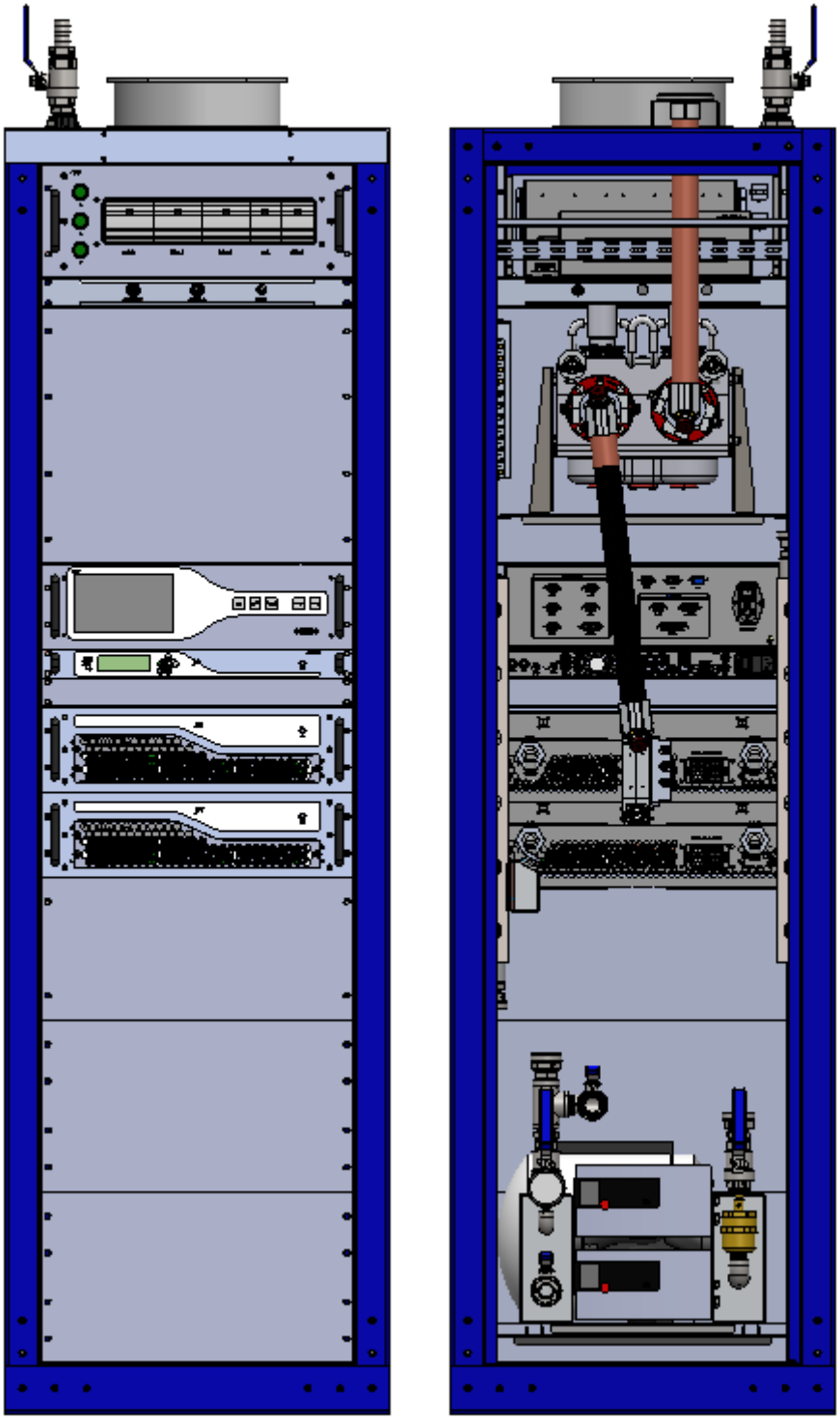
Antenna Radiation Hazard Notification

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 3000 Watts with a 0 dBi antenna a minimum separation distance of 7.75m is recommended.

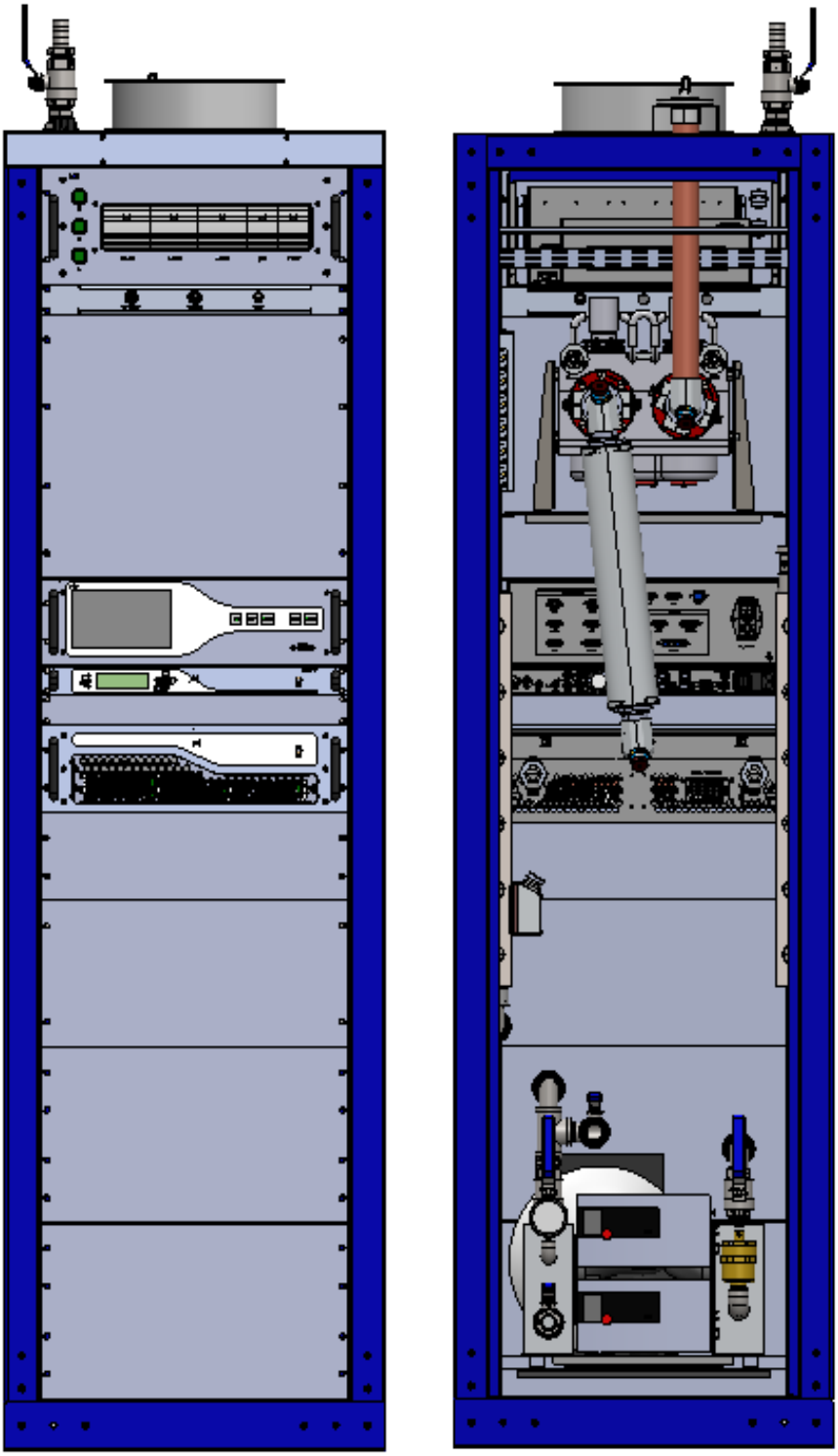
1. System Configuration

1.1 Diagram

1.1.1. 3kW Transmitter



1.1.2. 1.5kW Transmitter



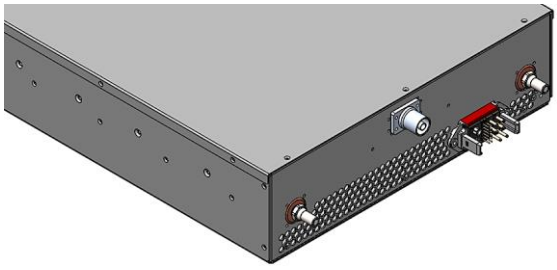
1.2. Main Components

1.2.1. Exciter

- ✓ Exciter is software enabled to operate using ATSC1.0 8 VSB modulation.
- ✓ The exciter includes an Auto Level Control function allowing response to level abnormalities during operation.
- ✓ The Auto Adaptive Correction function allows the characteristics to be maintained without user intervention if optionally chosen.
- ✓ The Adaptive Correction function has four operating modes and the user can select the appropriate mode for their conditions.

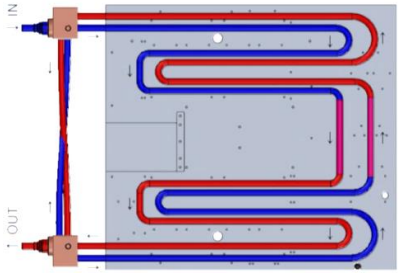
1.2.2. HPA

1. Hot Plug Method Application



The **HPA1600L** was designed with a modular structure that is convenient for maintenance using **the Hot Plug** method.

2. Reverse coolant flow design in Heat Sink



The heat sink is designed to maximize heat dissipation efficiency and consists of two circuits in which the coolant flows through the heat sink in opposite directions thereby maintaining a constant temperature throughout the heat sink.

3. HPA Combiners

The HPA1600L's internal pallet combiner and HPA output combiner use progressive combining with varying coupling ratios to improve efficiency with minimal coupling loss. High port to port isolation (over 30dB) results in minimized intermodulation products. The final amplifier module output combiner utilizes a 3dB hybrid and

associated reject load.

1.2.3. TCU(Transmitter Control Unit)

The TCU uses both buttons and LCD touch screen for operational convenience. It also provides RS-232/485 interfaces and open collector contacts to support various remote controls for operators.

1. **Web GUI**

   The system can also be controlled through a browser-based GUI with an Ethernet connection. The web GUI provides the same screen as the TCU..

1.2.4. Cooling System

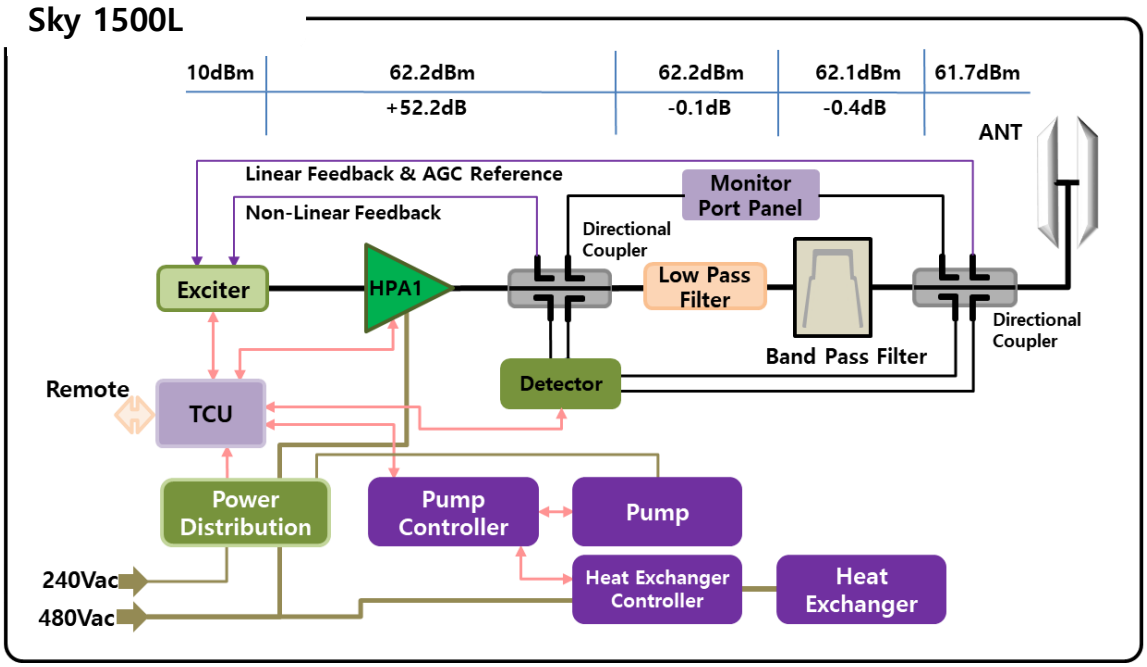
The cooling system is designed with dual redundant pumps which can be set to automatically switch on failure or switched manually via operator inputs on the TCU LCD screen.

2. System Description

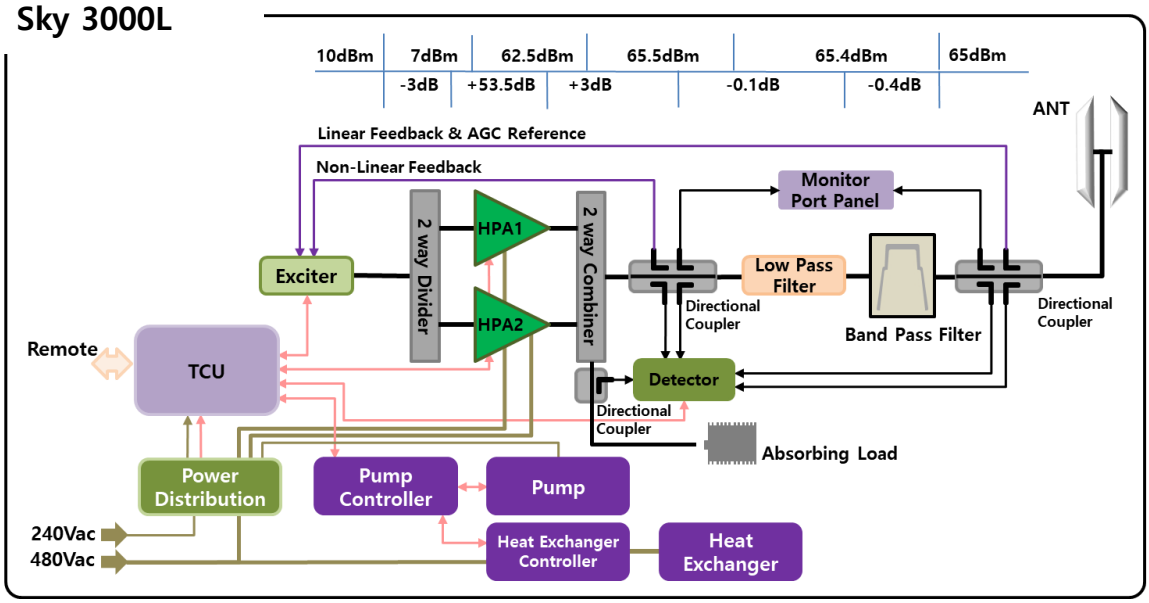
2.1. Description

2.1.1. System Diagram

Sky 1500L



Sky 3000L



2.1.2. System Configuration

1) Single or Multiple Transmitters

An overall broadcast transmission system can be configured to provide redundancy through the use of one or more transmitters in active or passive standby. Most systems will be configured to utilize a single transmitter and that is what is covered in this manual.

2.1.3 Cooling Methods

Cooling refers to removing the heat generated while operating the transmitter. The main components that generate heat include the high power amps, reject loads, and Band Pass Filter. Removing the heat generated in these areas has a significant impact on the reliability and lifespan of the equipment. There are two types of cooling generally used for TV transmitters:

1) Air Cooling

A fan is used to remove the heat from the heat producers. This method requires less design and simpler facilities than liquid cooling. It's disadvantages are; it's limited ability to remove heat in high-output equipment, noise, many failure points from the large numbers of fans, and the heat must ultimately be removed from the room by other means. Therefore, it is mainly used in low power output (less than 2KW) situations.

2) Liquid Cooling

This method of cooling uses flowing coolant to remove heat from the heat producers. It has a much higher cooling efficiency, lower maximum component temperatures, lower indoor-noise, and smaller thermal variations than air cooling. It's disadvantage is more complicated facilities design and installation due to the addition of a heat exchanger. This transmitter utilizes liquid cooling for these reasons.

2.1.4. Features

- ✓ **ATSC 1.0 8VSB Modulation Standard**

  The transmitter can optionally support other modulation formats such as: ATSC 3.0, DVB-T2 Standard, and ISDB-T Standard, and can be changed by 'Firmware Upgrade'.

- ✓ **STL IP Data Input Ports Qty 2**

  The transmitter includes two Ethernet ports on the top of the cabinet for input of IP data should that option be used for an STLIP. These ports are designed to autoswitch on failure.

- ✓ **Exciter ASI Input Ports Qty 2**

  The transmitter includes two ASI ports on the back of the exciter for input of ASI data. These ports are designed to autoswitch on failure.

- ✓ **Auto or Manual, Non-Linear and Linear Digital 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 occurs primarily in the high power amplifiers as a result of the amplification process. Linear distortion occurs primarily in the bandpass mask filter as a result of its shaped response. Therefore, we sample in front of the bandpass filter to compensate for non-linear distortion and after the bandpass filter to compensate for linear distortion. Our two measurement point method provides higher performance than the typical single post filter method since the nonlinear distortion components have passed through the filter which makes it more difficult to make accurate corrections.

  Application of our adaptive auto correction makes it very convenient for operators to use. We provide four settings for the correction; Idle, Run to Target, Auto Run, and Continuous, allowing tailoring to a particular field situation.

- ✓ **Doherty LDMOS Transistor**

  We achieve maximum reliability through the use of high stability LDMOS transistors and extremely high-efficiency by using the Doherty amplification method.

  Through years of in-house research we have widened the Doherty method bandwidth so that only two versions cover the entire UHF Band using the same transmitter hardware.

- ✓ **HPA Heat Sink**

  Our high power amplifier heat sinks were designed using a double water pipe type arrangement to maintain equal heat distribution throughout the heat sink. This prevents heat from being concentrated in one area, promotes continuous

cooling, and increases the efficiency of heat dissipation.

- ✓ **Controller**
  Our graphic LCD controller screen maximizes operator convenience and is designed so that on-site and remote screens are identical.
  Our LCD touch panel screen and separate ON/OFF control switch 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 Band 100W to 3kW average power adjustability**
  The transmittter's output power setting can be changed with one touch on the TCU over a wide range of output.

- ✓ **Independent HPA power supplies provide operational redundancy**
- ✓ Each high power amplifier assembly includes a separate AC/DC converter/power supply thereby providing redundancy and easy return to full power. A side benefit is the ability to bench test any individual amplifier assembly utilizing a separate AC power cord.

2.1.5. System Specifications

GENERAL

Description	Specifications
TX Frequency Band	Designated 6 MHz channel in 470 – 608 MHz
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 (600 x 1300 x 2000mm)
Cooling System	Liquid Cooling
Data Input	Dual ASI (ATSC 1.0)
RF Output Impedance	50Ω
RF Output Connector	Transmitter :1 5/8″ EIA Flange Type
Remote Connections (Optional)	Ethernet (RJ-45) / Open Collect (D-Sub)

PERFORMANCE

Description	Specifications
Output Power(Average)	100W ~ 1.5kW Average (after Mask Filter) Sky1500L 500W ~ 3kW Average (after Mask Filter) Sky3000L
Spurious & Harmonics	≤ -75dBc per FCC specifications
Power Stability	≤ ±5% per FCC specifications
MER	≥ 27dB
Frequency Response	≤ ±1dB
Output VSWR before shutdown	≤ 1.5

2.1.6. Specifications of Unit

2.1.6.1. Exciter

Item	Specifications
Modulation	8 VSB (ATSC 1.0 Standard)
Stream Inputs	ASI connectors (qty 2)
Pre-correction	Nonlinear(Pre-distortion), Linear(Pre-equalizer), Adaptive Auto Pre-correction (4 modes)
Output Frequency	Designated Channel Frequency (470 to 608MHz, 1Hz step)
Output Connector	BNC Female
RF Power Output	Max +18dBm(Avg)
Frequency Stability	Within ± 100 Hz over 24 hours
AC Input Voltage	$240V_{AC}$ / 1phase / 50~60Hz

2.1.6.2. HPA1600L

Item	Specifications
Output Stage Technology	BLF888E x 16ea (LDMOS) / Doherty
RF Power Output	Max 1600 Watts (Avg)
Power Output Stability	Within 5%
Input Connector	CombiTac 34.83108 / COAX58
Output Connector	7/8" Quick Socket
Cooling System	Liquid Cooling
Temperature Protection	Thermistor Control
VSWR before shutdown	VSWR ≤ 2.0
Gain Stability	Less than ± 0.5dB (In band)

2.1.6.3. HPA1600L Power Supply

Item	Specifications
AC Input Voltage	AC480V / 3phase / 4wire / 50~60Hz
DC Output Voltage	$50V_{DC}$
DC Output Maximum Current	Max 120A (40A x 3ea)
Output Voltage Stability	Within ± 0.5V

2.1.6.4. Band Pass Filter

Item	Specifications
Input Power Max.	4.2kW
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	AC480V, 3phase, 4wire AC240V, 1phase, 3 wire (Pump & Others)

2.1.6.6. Liquid Cooling System

Item	Specifications
Coolant	Ethylene Glycol 50% Pure Water 50% (Recommended) (May change depending on site conditions, any changes must be discussed with the manufacturer.)
Pressure	In Operation 1~2bar/In Standby under 1bar
Shutdown for Over temperature	>= 60˚C (140˚F)
Pump	Dual pumps with automatic transfer in case of pump failure.
Heat Exchanger	8Kcal/h, Single fan fixed speed

2.2. System Installation

When installing the system, the following must be observed.

The transmitter is a water-cooled device and should be installed on a stand to prevent water leakage and flooding.

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

Rigid line must be installed according to the manufacturers specifications, the cut surface must be finished, and the installed rigid line must be supported with hangers.

All external AC cables, data cables, and RF cables (except rigid line) should be installed in a tray to prevent damage.

After completing the liquid cooling system installation, circulate coolant for at least 30 minutes using an external injection pump to filter out air and foreign objects introduced during construction.
Then, clean and reinstall the strainer attached to the outdoor unit.

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 8sq/4-wire type, the AC cable should be connected to the AC Main Terminal Block at the top of 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.

Fix Heat Exchanger Controller on an indoor wall, connect the outdoor fan power to the Heat Exchanger Controller at the Site Main distribution board. Connect the power controlled by the TCU in the Heat Exchanger Controller to the Heat Exchanger. When connected in reverse, the wind direction is reversed, and cooling capacity is reduced. Therefore, you must check the wind direction.

2.2.1.3. Transmitter Data Cable Connection

Check the connector name on the transmitter top cover and connect to the designated connector.

Ethernet cable uses Category 5 or higher.

2.2.1.4. Transmitter Water Hose Connection

Inlet

This is the port through which coolant flows from the outdoor unit through the heat exchanger.

Outlet

This is the port through which the coolant that absorbs heat from the transmitter flows to the heat exchanger.

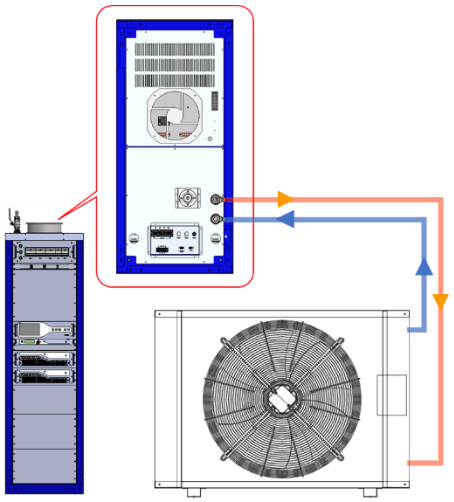
Connection

The cutting edge of the hose should be cut close to vertical.

The Hose Clamp must be firmly installed and be sure to check it once more before supplying water, and just before the end of the installation work.

Since the hose is under pressure, you must check the tightness condition every six months for the first year and at least once a year thereafter.

2.2.3. Liquid Cooling System Installation



Connection

The cut edge of the hose should be cut close to vertical.

Connect the inlet and outlet locations so that they match the blueprint.

The Hose Clamp must be firmly installed and be sure to check it once more before supplying water, and just before the end of the installation work.

2.2.3.1. Heat Exchanger

2.2.3.1.1. Heat Exchanger AC Connection

Consists of one heat exchanger and is equipped with one Fan.

Fan is 480Vac/ 3phase / 3wire / 60Hz.

This Fan is controlled from Pump Control Board of Transmitter.

AC power is connected from the Site Main distribution box.

Connect to the terminal block inside the water-proof distribution box of the heat exchanger.

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, shrink tube, insulating tape, etc., and by covering it with a terminal block.

2.2.3.1.2. Heat Exchanger Controller Data Cable Connection

Connect to control the operation of the fan and receive status information.

Cable of 6C x 24AWG is provided. Only 4line is used.

2.2.3.1.3. Water Hose Outdoor Installation

The durability of the hose provided is suitable for 95% of all chemical substances.

It can be used up to 16bar internal pressure.

When installed outside a building, it must be installed away from direct sunlight.

The coating reacts to strong ultraviolet rays.

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 480Vac (Transmitter)/240Vac (Pump) 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 Board/Pump Breaker Switch Output Impedance.
4) Transmitter of Main Distribution Board /Pump Breaker Switch ON
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 installed on the back of TCU and Exciter ON

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 TCU Exciter Page or the initial screen of the Exciter Front LCD.
- Changes can be made in User Setting → Frequency on the TCU Exciter Page or Exciter Front LCD.

3.3. Change RF Set Power.

Touch Set Power on the TCU 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 is done as follows in Exciter LCD.

When you select AGC Disable, the MGC Menu appears.

Since the system facilities have not been completely verified, you should select a method of gradually increasing the output from 0W. Adjust the power using the Up and Down keys.

Gain CNTR V value changes are immediately reflected in Power, so caution is required.

3.4. TX-ON.

Check if the Input Data status is Normal on the TCU Exciter screen.

Check if the Gain CNTR V value of MGC is 0.

Press the ON button on the TCU to activate the transmitter.

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

Press the OFF button on the TCU to stop the transmitter.

Change AGC setting to Enable.

Press the ON button on the TCU to activate the transmitter.

Power gradually increases and reaches Set Power.

3.5. TUNE UP.

No particular tune-ups are required for the transmitter to operate as designed other than the items in 3.1 to 3.4 above, however the FCC recommends and requires periodic confirmation of the transmitters output power with a calibrated power meter through the output directional coupler and measurement of the transmitters output frequency and spectrum with a spectrum analyzer per IEEE STD 1631 – 2008.

4. Alarm Manual.

4.1. VSWR

Detection of VSWR is performed at the 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 to check for this failure mode..
VSWR above 1.5 :1 is considered a Fault.
Depending on the origin/location of the VSWR, confirmation details are as follows:

4.1.1. HPA VSWR Fault.

It is very likely that a problem occurred between the 2Way Combiner, 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 TCU 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 15kW Reflector Power in the TCU and checking the Channel Mask by the Spectrum.

4.1.3. BPF Output VSWR Fault.

You can suspect the binding condition of the Rigid Liner and Main Feeder connected to the antenna in the Band Pass Filter and the Antenna damage. First, check the temperature of each part and the binding status of the Rigid Line connected to the antenna and the Main Feeder.
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 TX-A Directional Coupler installed in the ACU.

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

Operates when the HPA heat sink temperature is 80℃ or higher, the pump temperature is 10℃ higher than the coolant temperature, or the pump temperature is 90℃, and it means that a problem has occurred in the cooling system.

Check the operating status of the Pump and Flow Meter, and the open status of the valve.

If the problem is with one specific HPA, separate the HPA and check the condition of the water connector and replace the thermistor.

4.4. Low power

Occurs when the current output 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.

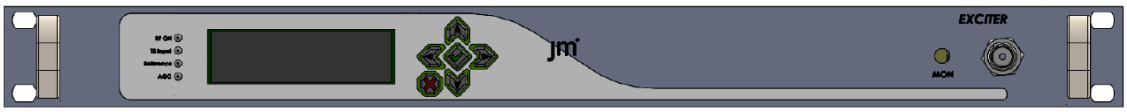
5. Detail of Unit.

5.1. Exciter

5.1.1. Specifications

Item	Specifications
Input 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) $\pm 2X10^{-8}$ 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	AC 240V, 60Hz, 1A
Dimension(mm)	483 × 44 × 550

5.1.2. Front



5.1.2.1. LEDs

LED Name	Color	Contents
RF ON	Off	Exciter RF Out Off
	Green	Exciter RF Out Normal
TS Input	Off	No Input & Test Mode Off
	Green	Primary or Secondary Normal & Test Mode Off
	Orange	Test Mode On
Reference	Green	GNSS or External
	Orange	Internal
AGC	Green	AGC Enable
	Orange	AGC Disable
	Orange Ember	AGC Over Range (When the AGC value is more than 1V higher than the set and memorized MGC value)

5.1.2.2. Screen Conversion

Up and down button

Used to move Menu items up and down or to raise or lower setting values.

Left button

Used to move the cursor to the left within the Page.

Right

Used to move to a lower Menu or move the cursor to the right within the Page.

√ Checkmark

Used to confirm selected details.

X

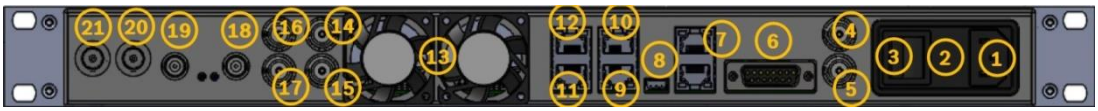
Used to move to the Upper Menu or cancel the setting step.

5.1.2.3. Front Monitor Port

Monitor Port is about 17dB lower than Exciter Output.

The monitor port includes a 50Ω pad to minimize changes in output due to changes in the impedance of the monitor port.

5.1.3. Exciter Rear



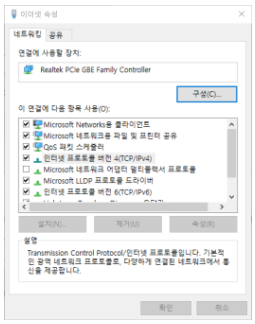
No	Name	Detailed Description
1		AC Power Connect
2		Fuse Box (220V/2A)
3		AC Power ON/OFF Switch
4	DATA 2	ASI or SMPET-310M Input Port (for ATSC1.0)
5	DATA 1	ASI or SMPET-310M Input Port (for ATSC1.0)
6	RS485 & Control	connect to TCU
7	CAN Control	not Use (CAN Control System)
8	Debug	Exciter Firmware Upgrade Port
9	PHY2	Exciter Web Port
10	PHY3	Exciter Web Port
11	PHY1	TS Port
12	PHY0	TS Port
13		FAN _ 5 Volts / Size 40X40
14	1pps In	1pps Reference Input Port
15	1pps Out	1pps Reference Output Port
16	10MHz In	10MHz Reference Input Port
17	10MHz Out	10MHz Reference Output Port

18	GPS In	Connect to GPS Antenna (DC Volts 5V or 3.3V)
19	RF Out	Exciter RF Output
20	FB FIL IN	Sampling at After Filter Point (Linear Correction source: Fit level ±9dBm)
21	FB AMP IN	Sampling at Before Filter Point (Non Linear Correction source: Fit level ±9dBm)

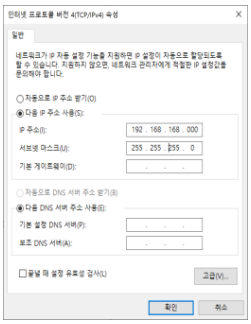
5.1.4. Web GUI

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

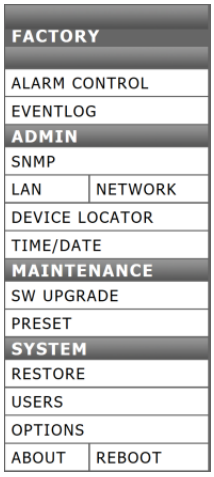
5.1.4.2.1. Web GUI Direction

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.

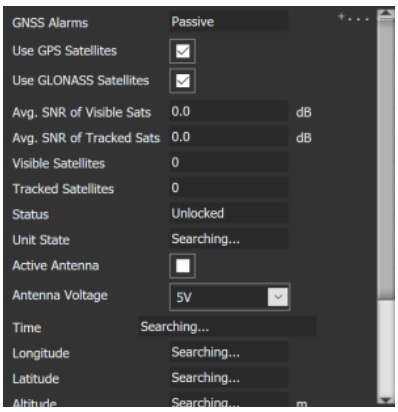
Reboot : You can reboot the Modulator.

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 optionally 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.

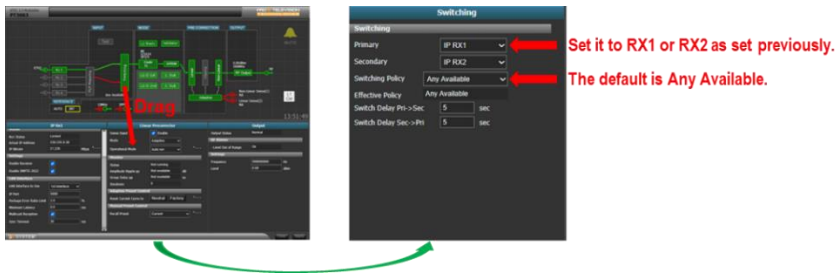
5.1.4.2.4. ATSC3.0 TS Network Setting

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.

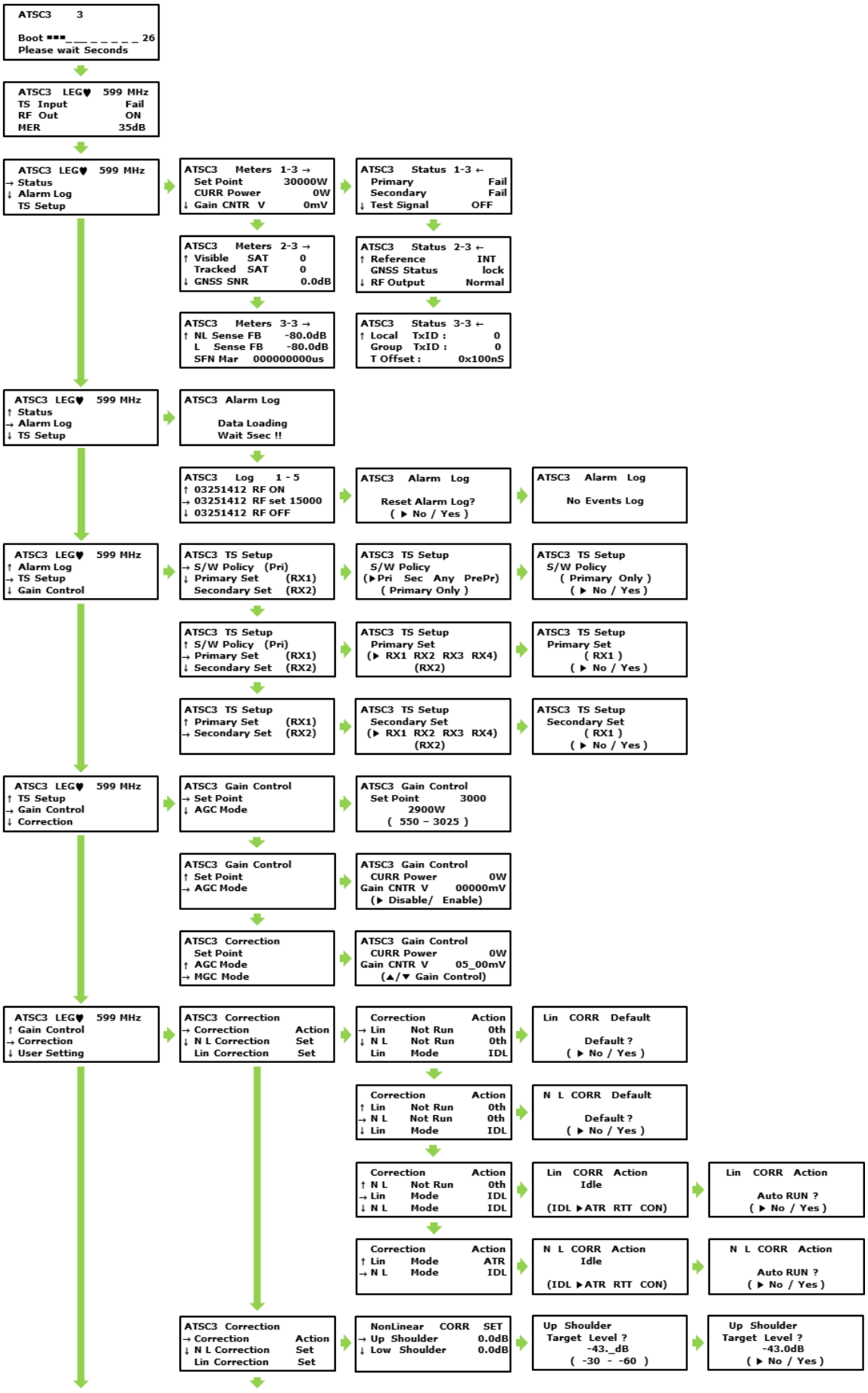
Lower the switching block and set it as shown below.

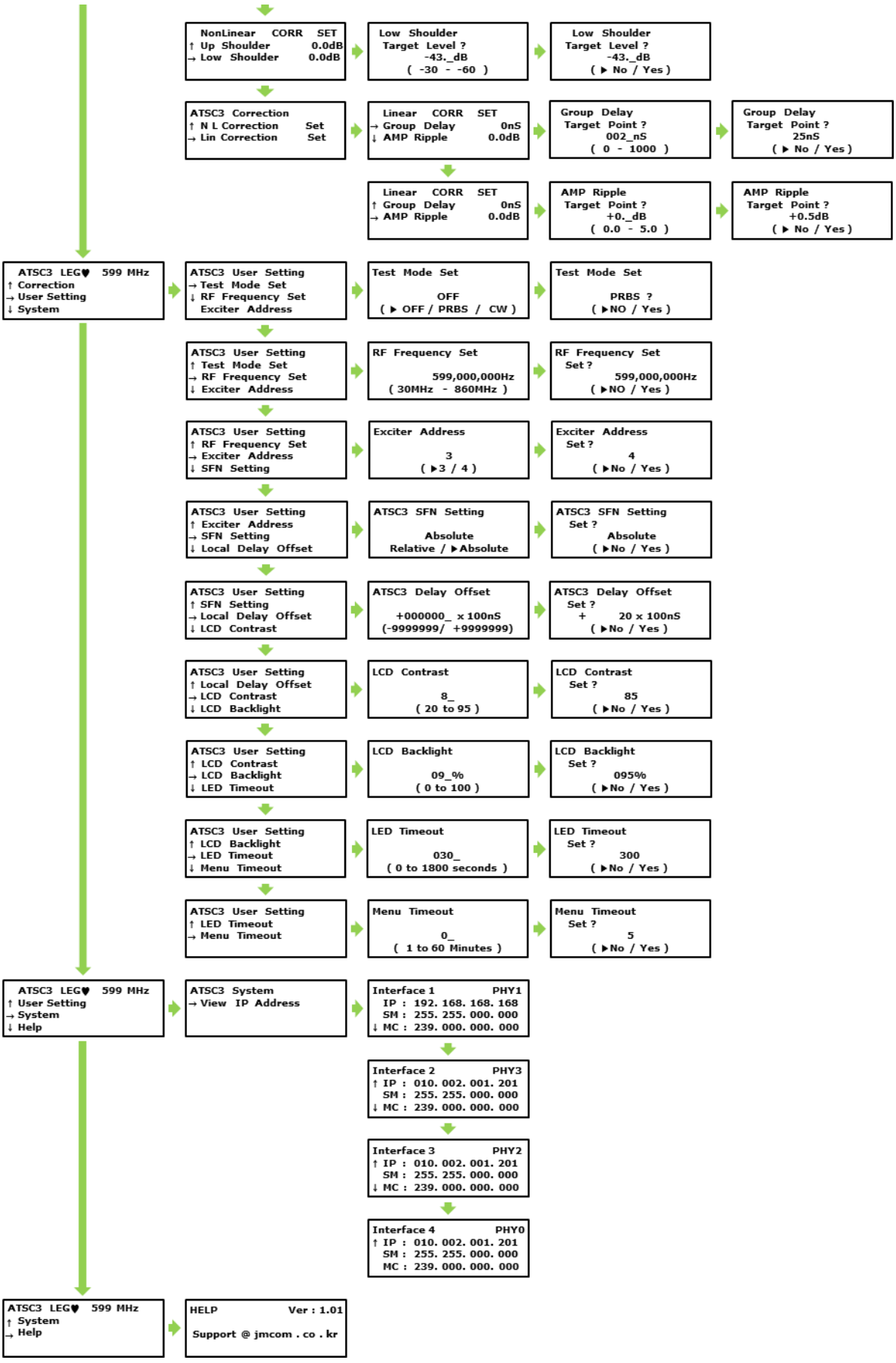


When setup is completed normally, the RF Output Block in the Web Diagram will change to a green line. If it does not change, there is a problem with TS Data or an error in settings.

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

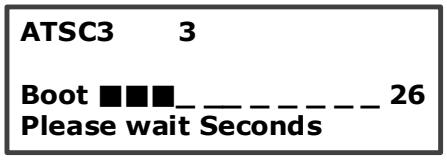
5.1.5 Menu Tree




NonLinear CORR SET
↑ Up Shoulder 0.0dB
→ Low Shoulder 0.0dB
Low Shoulder
Target Level ?
-43._dB
(-30 - -60)
Low Shoulder
Target Level ?
-43._dB
(▶ No / Yes)
ATSC3 Correction
↑ N L Correction Set
→ Lin Correction Set
Linear CORR SET
→ Group Delay 0nS
↓ AMP Ripple 0.0dB
Group Delay
Target Point ?
002_nS
(0 - 1000)
Group Delay
Target Point ?
25nS
(▶ No / Yes)
Linear CORR SET
↑ Group Delay 0nS
→ AMP Ripple 0.0dB
AMP Ripple
Target Point ?
+0._dB
(0.0 - 5.0)
AMP Ripple
Target Point ?
+0.5dB
(▶ No / Yes)
ATSC3 LEG♥ 599 MHz
↑ Correction
→ User Setting
↓ System
ATSC3 User Setting
→ Test Mode Set
↓ RF Frequency Set
Exciter Address
Test Mode Set
OFF
(▶ OFF / PRBS / CW)
Test Mode Set
PRBS ?
(▶NO / Yes)
ATSC3 User Setting
↑ Test Mode Set
→ RF Frequency Set
↓ Exciter Address
RF Frequency Set
599,000,000Hz
(30MHz - 860MHz)
RF Frequency Set
Set ?
599,000,000Hz
(▶NO / Yes)
ATSC3 User Setting
↑ RF Frequency Set
→ Exciter Address
↓ SFN Setting
Exciter Address
3
(▶3 / 4)
Exciter Address
Set ?
4
(▶No / Yes)
ATSC3 User Setting
↑ Exciter Address
→ SFN Setting
↓ Local Delay Offset
ATSC3 SFN Setting
Absolute
Relative / ▶Absolute
ATSC3 SFN Setting
Set ?
Absolute
(▶No / Yes)
ATSC3 User Setting
↑ SFN Setting
→ Local Delay Offset
↓ LCD Contrast
ATSC3 Delay Offset
+000000_ x 100nS
(-9999999/ +9999999)
ATSC3 Delay Offset
Set ?
+ 20 x 100nS
(▶No / Yes)
ATSC3 User Setting
↑ Local Delay Offset
→ LCD Contrast
↓ LCD Backlight
LCD Contrast
8_
(20 to 95)
LCD Contrast
Set ?
85
(▶No / Yes)
ATSC3 User Setting
↑ LCD Contrast
→ LCD Backlight
↓ LED Timeout
LCD Backlight
09_%
(0 to 100)
LCD Backlight
Set ?
095%
(▶No / Yes)
ATSC3 User Setting
↑ LCD Backlight
→ LED Timeout
↓ Menu Timeout
LED Timeout
030_
(0 to 1800 seconds)
LED Timeout
Set ?
300
(▶No / Yes)
ATSC3 User Setting
↑ LED Timeout
→ Menu Timeout
Menu Timeout
0_
(1 to 60 Minutes)
Menu Timeout
Set ?
5
(▶No / Yes)
ATSC3 LEG♥ 599 MHz
↑ User Setting
→ System
↓ Help
ATSC3 System
→ View IP Address
Interface 1 PHY1
IP : 192. 168. 168. 168
SM : 255. 255. 000. 000
↓ MC : 239. 000. 000. 000
Interface 2 PHY3
↑ IP : 010. 002. 001. 201
SM : 255. 255. 000. 000
↓ MC : 239. 000. 000. 000
Interface 3 PHY2
↑ IP : 010. 002. 001. 201
SM : 255. 255. 000. 000
↓ MC : 239. 000. 000. 000
Interface 4 PHY0
↑ IP : 010. 002. 001. 201
SM : 255. 255. 000. 000
MC : 239. 000. 000. 000
ATSC3 LEG♥ 599 MHz
↑ System
→ Help
HELP Ver : 1.01
Support @ jmcom . co . kr

5.1.6 Explanation of Display Menu

5.1.6.1. Booting

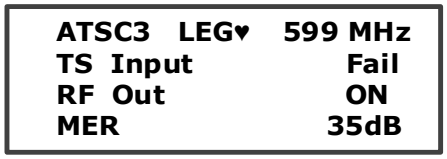


This is the first screen that appears on the LCD when power is supplied to the Exciter.

Booting time is 60 seconds.

ATSC3: Modulation type **3**: Exciter RS485 Address

5.1.6.2. Main



When Booting is completed, it switches to the main screen.

ATSC3 Modulation type

LEG Exciter can be controlled in Local mode.

Other Display : REG – Some items become unchangeable in Remote mode.
(MGC/AGC, Frequency, Set Power etc.)

♥ This is a sign indicating that the exciter is applied to the system in the Dual Exciter Type Transmitter.

599MHz Displays the center frequency of the channel set in the Exciter.

TS Input Displays the status of TS Input.

Normal Status is displayed as Normal/Fail.

RF Out ON This means that the exciter RF Output is being output normally after receiving the ON command from SCU, TCU or Emergency Switch.
OFF is displayed when receiving OFF command, or the RF Output fails after receiving an ON command.
There are many conditions that can cause RF Output Fail.
If the ASI is abnormal, several problems may occur, such as reference problems, ASI protocol problems, exciter hardware or software problems, exciter setting errors, etc.
The way to analyze this is to check the Event log page in the Exciter

Web GUI. By analyzing the log, you may find the cause and take action. If it is still difficult to analyze the cause, there is a way to reset it by executing Restore in the Exciter Web GUI and returning to the initial mode. If the software gets tangled inside the Exciter, it is often resolved this way.

Restore changes all settings to factory reset. Therefore, sufficient knowledge of the method and a very careful approach are required before implementation.
To prevent mistakes, detailed records of the method are not written. Contact the manufacturer if needed.

MER 35dB Analyzes the Band Pass Filter Input and Output Feedback signals and displays the MER (Modulation Error Ratio) value measured by the exciter. The initial value displayed after TX ON is an imaginary number. The analysis value of the feedback signal is displayed a few minutes after the transmitter starts normal transmission.

5.1.6.2.1. Exciter booting Error

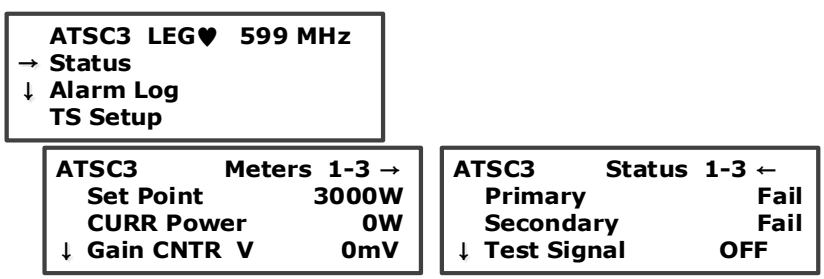
If Frequency is displayed as 000MHz after Exciter Booting is completed:

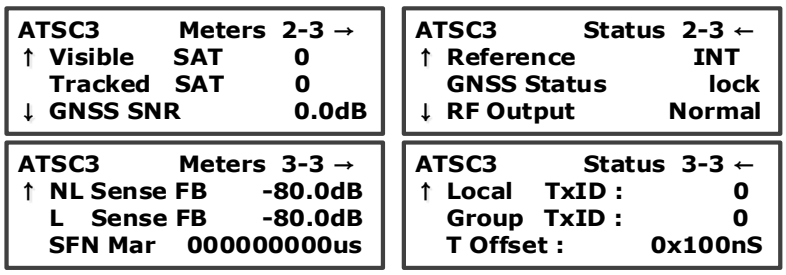
1. Turn off the AC power switch on the Exciter rear panel, wait for 10 seconds, and then turn it on.
2. When booting is complete after 1 minute, check the frequency.
3. If the same symptoms appear, repeat steps 1 and 2 up to 3 times.
4. If the problem remains the same after 3 attempts, contact the manufacturer.

5.1.6.2.2. Exciter Interlock

When testing the Exciter alone, you must Short Pin 1 and Pin 9 of the RS485 Control Connector (D-sub 15 pin) of the Exciter Rear Panel in order to turn RF On in Test Mode On or TS Input Normal.

5.1.6.3. Status





5.1.6.3.1. Meters

Set Point

The Target Point of System RF Output Power.

Setting is done in TCU, and the range is 550W~3025W.

CURR RF Power

Displays the Current RF Output Power analyzed by the exciter's own detector circuit from the feedback signal received by coupling from the Filter Output.

AGC operates so that the value is the same as the Set Point.

Therefore, it is a very important element in AGC operation.

If AGC mode is operated with the cable disconnected, it may cause HPA damage.

Gain CNTR V

Displays the Gain Control Voltage value currently controlled by the AGC circuit.

Max. 9000mV

Visible SAT

Number of Visible Satellites (GPS)

Tracked SAT

Number of Tracked Satellites among Visible SATs above.

GPS SNR

The Signal to Noise Ratio of GPS Signal.

N L Sense FB

Non-Linear Sense Level

Refers to the Feedback Signal Level coupled between HPA and Filter Input and connected to the Exciter. (Normal correction operates only when maintained within ±9dBm.)

Lin(Linear) **Sense FB**

Refers to the Feedback Signal Level coupled from the Filter Output and connected to the Exciter. (Normal correction operates only when maintained within ±9dBm.)

SFN Mar(Single Frequency Network Margin)

When operating SFN (Single Frequency Network), the spare time excluding Network and System Delay Time is displayed.

5.1.6.3.2. Status

Primary

Displays the status of ASI Data connected to Primary. This status becomes the TS1 LED information of TCU and SCU. Status is Normal or Fail.

Secondary

Displays the status of ASI Data connected to Secondary. This status becomes the TS2 LED information of TCU and SCU. Status is Normal or Fail.

Teat Signal: Indicates the operation status of Test Mode.

Reference: Currently selected Reference Source

GPS Status: Displays Satellite Lock and Unlock status.

RF Output

Displays the Exciter RF Output status. TCU and SCU receive this status and display the Exciter status. Status is Normal or Fail.

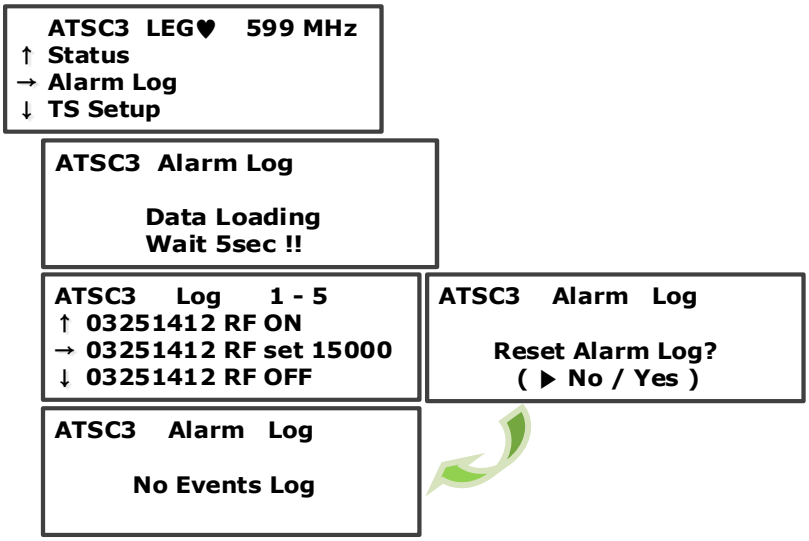
Local TxID

Displays the transmitter ID. When there are multiple signals at the receiving point, it is used to determine the transmission location of each signal.

Group TxID

Groups Broadcasting stations or identical transmitting stations and assigns IDs to facilitate information confirmation at the receiving point.

5.1.6.4. Alarm Log



The composition of the Alarm Log is recorded in the order of Date, Time, and Item. The order of logs that occurred at the same time is meaningless. Thus, user analysis is required.

Only TCU control contents are recorded in the log. It is stored in-house and can only be checked on site through the Exciter Front LCD.

Modulator Issue is not included in this log.

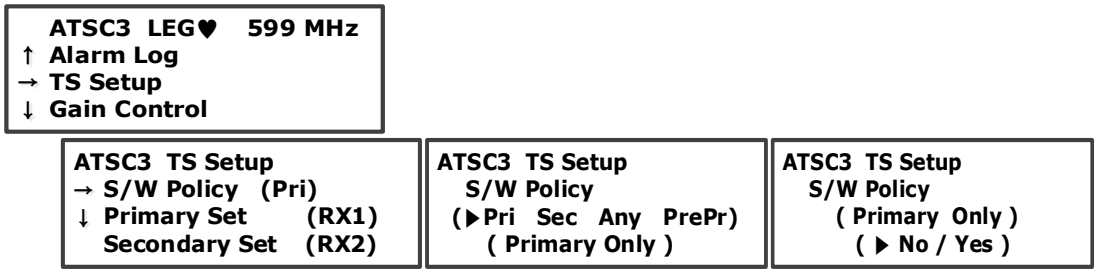
The modulator's log is recorded in detail in the modulator itself and can be checked through Exciter Web.

5.1.6.4.1. Event Log Item

1. RF OUT ON
2. RF OUT OFF
3. AGC Enable
4. AGC Disable
5. GPS Lock
6. GPS Unlock
7. Set Point Change

5.1.6.5. TS Setup

5.1.6.5.1. Switching Policy



S/W Policy

This is the Menu that determines Primary and Secondary Selection.

The following four conditions are supported:

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.

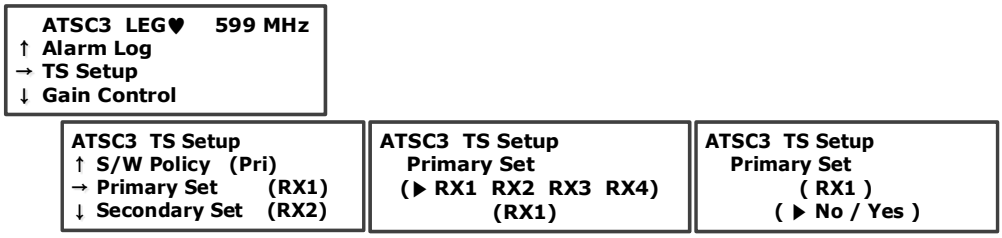
Change Time can be set in the Web GUI, and the default setting is 5 seconds.

PrePr (Prefer Primary):

A Primary priority mode.

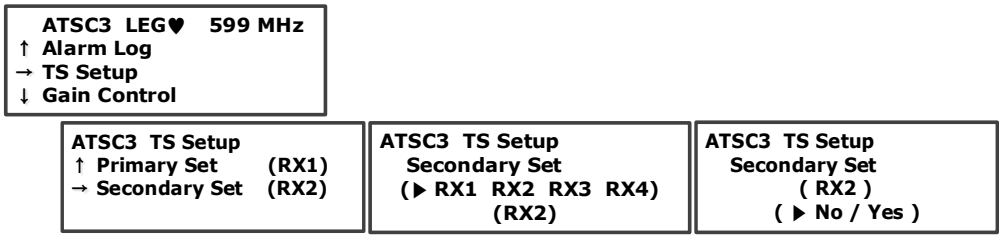
If Primary Line is normal, Primary is being selected. If the Primary Line is abnormal and the Secondary Line is normal, it goes to Secondary, and when the Primary Line becomes normal, it unconditionally goes back to Primary. This function is not applied to the TS Select window.

5.1.6.5.2. Primary Set



You can select Primary Data Source. It connects to Exciter Rear PHY0(Data1), PHY1(Data2), PHY2(Web Control), PHY3(Web Control).
You can choose between PHY0 or PHY1.

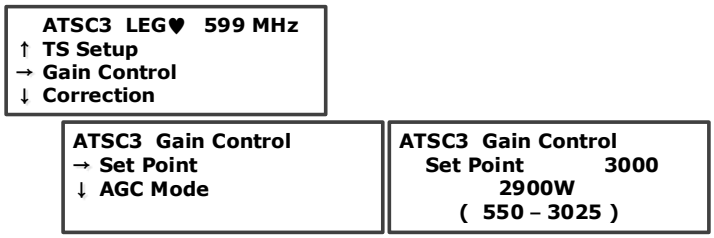
5.1.6.5.3. Secondary Set



You can select Secondary Data Source. It connects to Exciter Rear PHY0(Data1), PHY1(Data2), PHY2(Web Control), PHY3(Web Control).
You can choose between PHY0 or PHY1.

Both Primary and Secondary can select the same PHY. But in this case, the switch policy becomes meaningless.

5.1.6.6. Gain Control

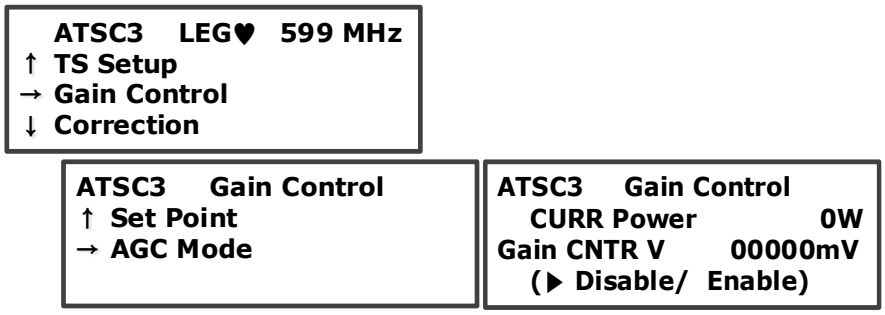


5.1.6.6.1. Set Point

You can set Set Power when operating without TCU.
After setting the target value, press the √ switch to apply it.
However, actual power is applied only when the Gain Control Mode is AGC.

If the Gain Control Mode is MGC, it only sets and the power is not changed.

5.1.6.6.2. AGC Mode



CURR Power

Feedback signal received from Band Pass Filter Output is converted to Power in Detector circuit and displayed. This value becomes the reference for Set Power. AGC adjusts the Gain so that CURR Power reaches Set Power.

Gain CNTR V

Displays the AGC Voltage controlling the System Gain. The Maximum is 9000mV. If this voltage rises more than 1V above the MGC voltage, the AGC LED on the front of the exciter lights up. This phenomenon means that the system gain is lower than when initially set.

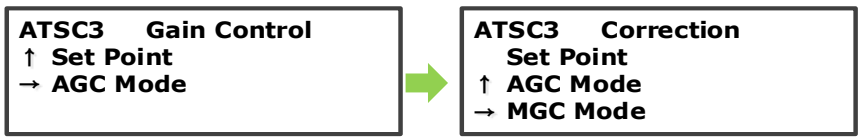
The verification process is as follows:

- ✓ Check FPA Current on TCU's HPA screen. Check if there is an FPA that is lower than 50% through relative comparison. For FPA that display current below 50%, the transistor must be replaced after additional inspection. (See the HPA Chapter)
- ✓ Check MGC voltage. If there is no problem with HPA, increase the MGC CNTR V value. (See the MGC Chapter)

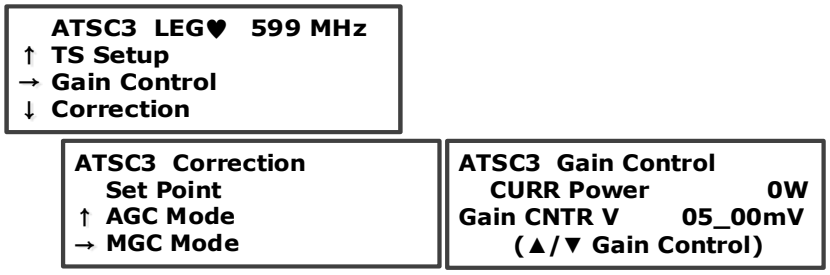
(▶Disable/Enable)

You can change AGC, MGC settings.

If you select Disable, MGC Mode is selected, and if you select Enable, AGC Mode is selected. If you select Disable, the MGC Menu appears as follows. When set to MGC Mode, Set Power changes in TCU are not applied.



5.1.6.6.3. MGC Mode



Gain CNTR V

Displays the MGC Voltage controlling the System Gain. The Maximum is 12000mV. Above 9000mV, the voltage increases, but the actual power does not increase. To change Gain CNTR V, select the digit using the left and right buttons and change the value by pressing the up and down buttons. When the bottom digit exceeds 9, the front digit goes up. Therefore, the change is made from the lowest digit.

Changed values are applied to the system immediately without additional settings. Therefore, if the range of change is large, it may put strains on the HPA and Filter, so be careful.

5.1.6.7. Correction

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 ± 4.2 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.

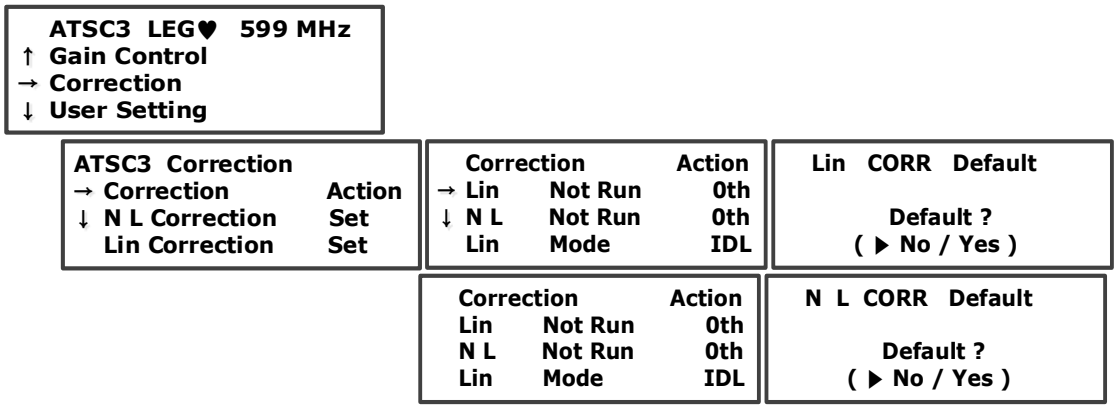
Linear

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.

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.

5.1.6.7.1. Correction Action



Correction Action

Displays information such as status of correction currently in progress and selected Correction Operating Mode etc.

- **Linear Correction Action**

Lin Initial 0th

Displays the Operating Status and the Correction Count of Linear Correction.

Operating status

Moni (Monitor)

When Correction has completed operation and switched to standby mode or Correction Operating Mode is monitoring.

Apply(Applying)

Correction is in operation.

Init (Initializing)

Collecting and analyzing initial data.

This state occurs when the exciter is rebooted, or enters Correction Defaults, or the sense level goes out of the acceptable range and then comes back in. It is displayed as 10~90%.

Not Run

In this state, Correction does not work because the Sense Level has never been normalized because the Exciter has never been transmitted to this Path after Booting.

Default

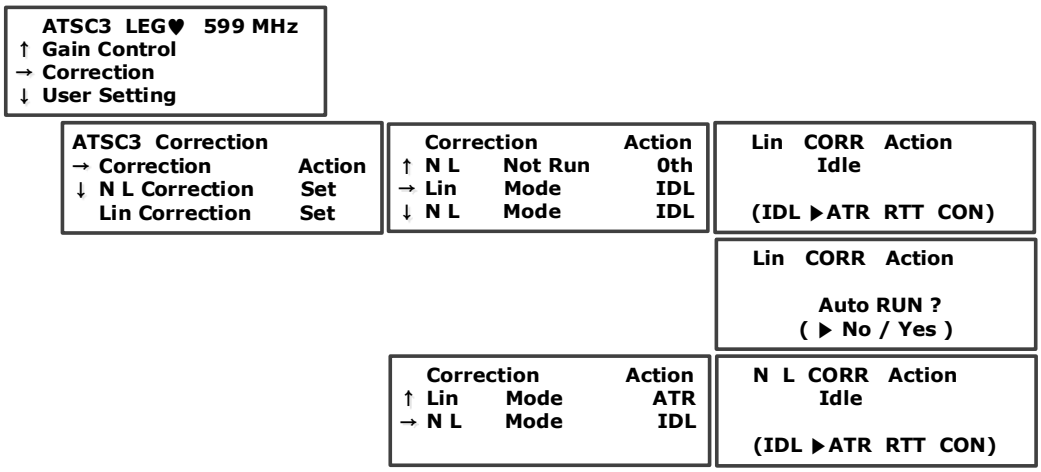
Reset the Linear Correction Data that has operated up to the current point. Correction Count is also reset and goes to 0.

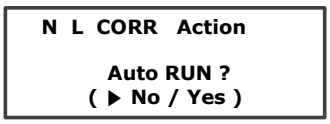
It operates the same as 'Natural' on the Web GUI. For user's convenience, it is changed to commonly used words.

- **Non Linear Correction Action**

  Same as Linear Correction.

5.1.6.7.2. Linear & Non Linear Correction Mode





N Lin Mode IDL: Indicates that Non Linear Correction Operating Mode is in Idle state.

Auto Adaptive Correction Operating Mode

IDL(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.

ATR(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.

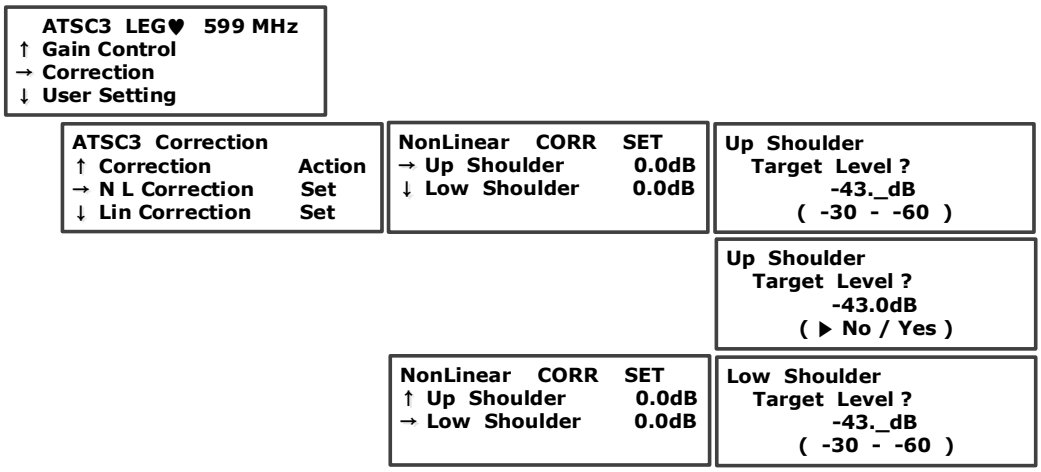
RTT(Run to Target)**:**

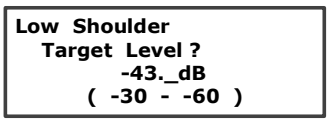
Operates without limit until the set Target Point is satisfied.
Once satisfied, subsequent operations operate as Idle.

CON(Continuous)**:**

Continues to operate until changed to another mode.

5.1.6.7.3. Non Linear Correction Set





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

Up & Down Shoulder Target Level is to set the value desired by the user. Correction operates with the goal of being below this value.

Setting the target level sets an appropriate value according to the system performance and environment.

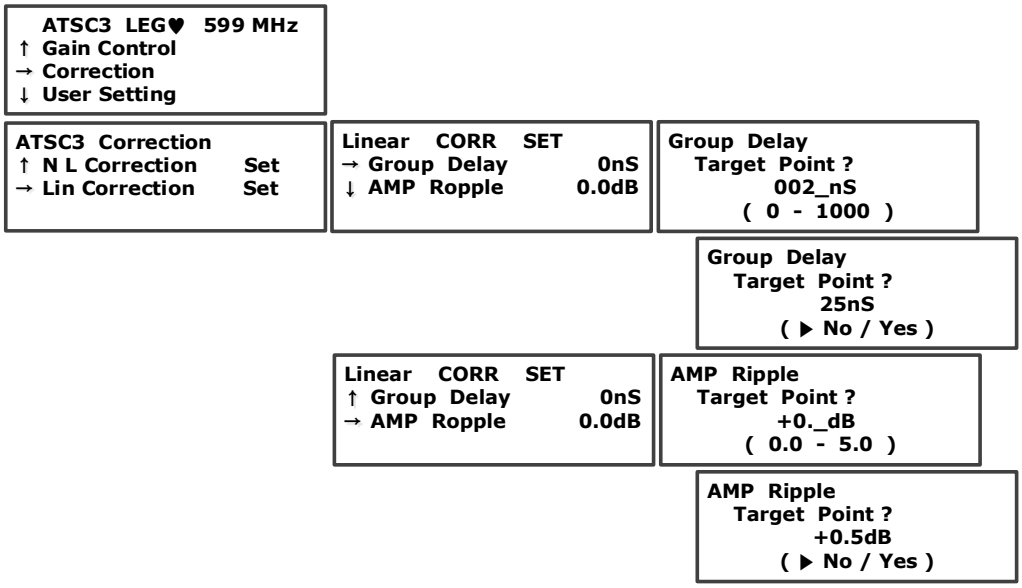
If the Target Point is set too low in Auto Run or Run to Target Mode, it may operate like Continuous mode, and if set too high, it may operate like Idle. Therefore, it is recommended that the target level be set to an appropriate value in the field over a long period of time.

The data collection range of Non Linear Correction is approximately Fc ±12MHz.

Sensing point is HPA Output and operating level is ±9dBm.

The displayed Shoulder value is the value read at FC±3.1MHz point.

5.1.6.7.4. Linear Correction Set



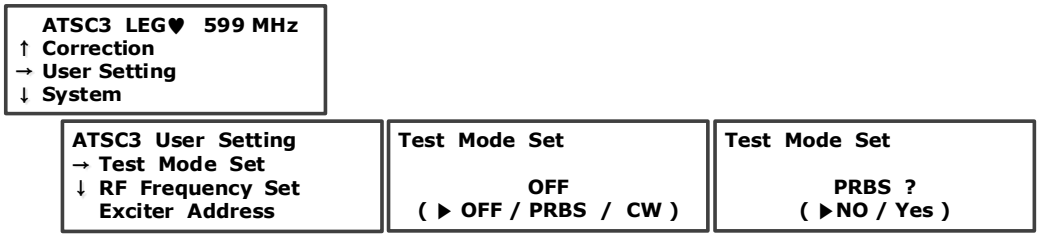
Group Delay & AMP Ripple value is the value displayed by the exciter by analyzing the Filter Output Feedback signal.

Group Delay & AMP Ripple Target Level is to set the value desired by the user. Correction operates with the goal of being below this value.

Setting 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.
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.
Sensing point is After Filter and operating Level is ±9dBm.

5.1.6.8. User Setting

5.1.6.8.1. Test Mode Set



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.

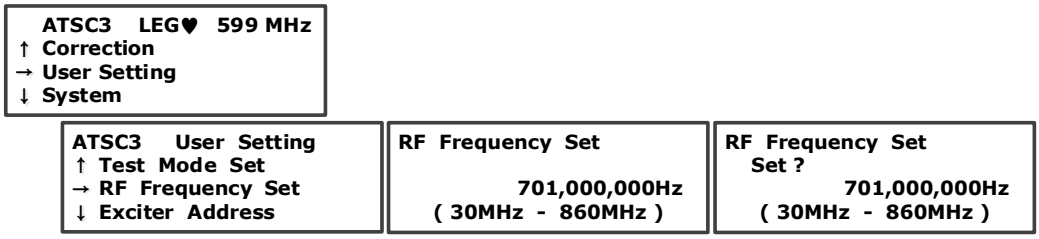
Condition: A Mode Option must be installed and set to A Mode.

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.

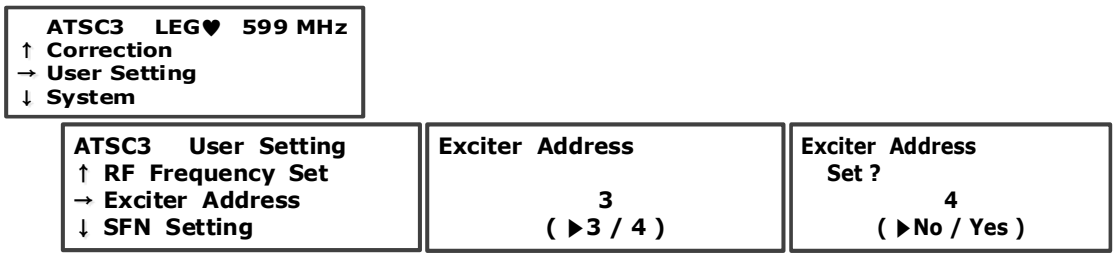
5.1.6.8.2. RF Frequency Set



You can change the center frequency of the desired channel. Unit of change is 1Hz.

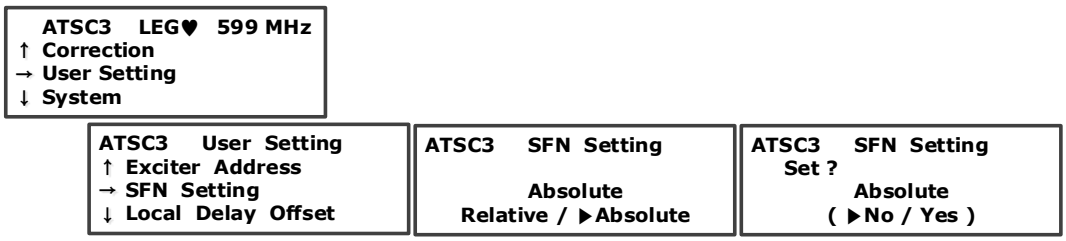
If the system has a Band Pass Filter connected, you must be careful when making changes. You must check the center frequency and bandwidth of the Band Pass Filter first.
Different frequencies may cause HPA damage.
Damage resulting from this is not the fault of the manufacturer.

5.1.6.8.3. Exciter RS485 Address



Decides the RS485 Address of the Exciter.
When using two exciters, their addresses must be selected differently.
If the same address is selected, the exciter information on the TCU screen overlaps and accurate information is not displayed.
Therefore, it is recommended to use the RS485 Address as initially set.

5.1.6.8.4. SFN Setting



You can decide how to set SFN Time.

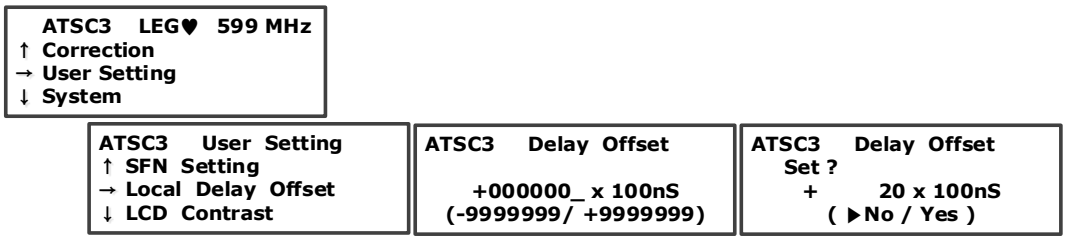
Relative

A method of transmitting data in a relative concept. This method transmits data sequentially in the order in which it was received, 1 second after receiving the data.

Absolute

A method of transmitting data in an absolute concept. This method analyzes the time information given to each data in the gateway and transmits it accurately at the given time.

5.1.6.8.5. Local Delay Offset



You can set the Local SFN Delay value.

The biggest purpose of SFN (Single Frequency Network) System is to increase frequency efficiency by covering an entire area with one frequency.

If the entire metropolitan area were considered a broadcasting area, there would be about 10 transmitting and relaying stations.

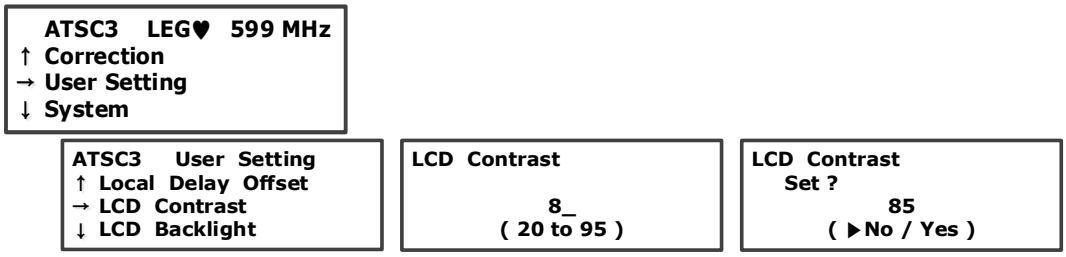
In this situation, RF overlaps in many areas. SFN technology allows broadcast reception even when RF overlaps.

At this point, the most important factor in overlapping signals is Time. Even if each transmitting station transmits at the same time, the distance between transmitting stations A and B is different when viewed from the receiving point. This distance becomes a variable of time that takes for radio waves to arrive. SFN Delay is what resolves these time variables.

If you provide an appropriate delay to a transmitting station that is close in distance, you can enable reception by matching the arrival time with a transmitting station that is relatively far away.

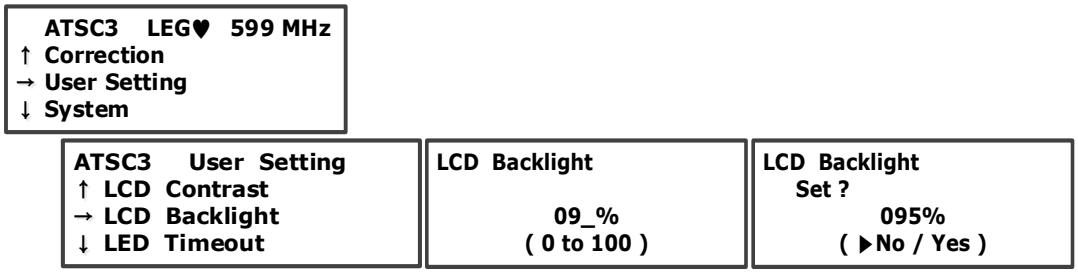
The Delay Time value is determined by checking at the receiving point.

5.1.6.8.6. LCD Contrast



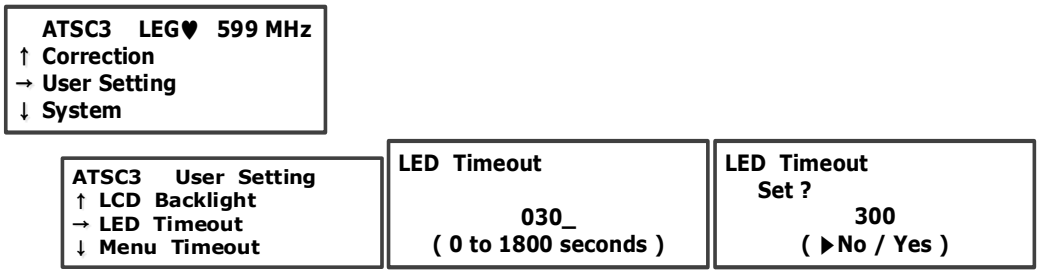
You can change LCD text clarity.

5.1.6.8.7. LCD Backlight



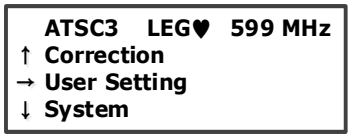
You can change the brightness of the LCD Back Light.

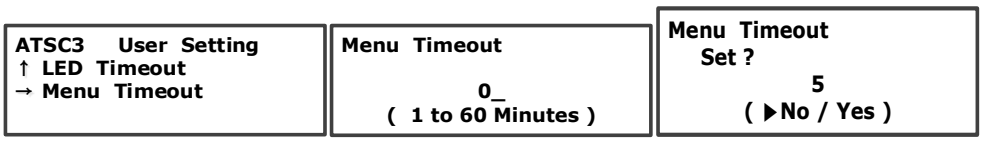
5.1.6.8.8. LED Timeout



You can set the time to turn off the LCD Back Light.

5.1.6.8.9. Menu Timeout

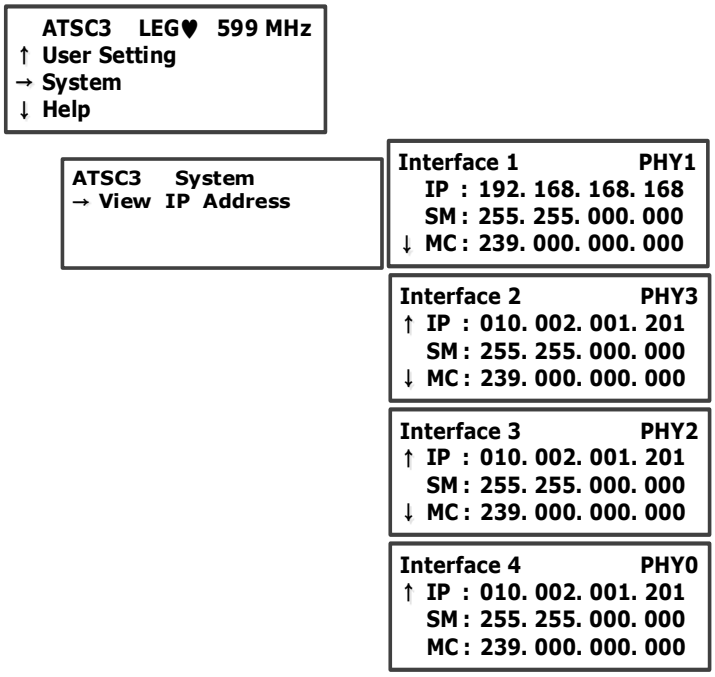




You can set the time to automatically return to the Main screen from the sub-Menu.

5.1.6.9. System

5.1.6.9.1. View IP Address



Displays IP information of Exciter Ethernet Port.

PHY Number is linked to Exciter Rear Side PHY Number.

This information can only be checked and cannot be changed.

5.1.6.9.2. Exciter Network setting

1) Network Set Approach

2) Setting Modulator LAN Port

The default IP Address of **PHY1** is 192.168.168.168.

The port becomes active after Network Reset.

For this reason, it is used for manufacturer management.

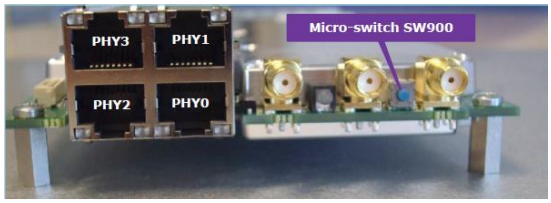
Changes are prohibited except in unavoidable cases.

For **TSoIP** Setting, select an unused one among the 2nd~5th Interface, select Physical Eth 0 for Physical Ethernet, and set the IP.

The Physical Ethernet Number matches the Ethernet connector PHY0~3 port number of the Rear Panel.

3) IP Address Preset

If you press the SW900 Switch between Sense 1 and 2 SMA Connectors for 10 seconds with power supplied, the IP will be changed to the initial state. However, Multicast IP does not change.

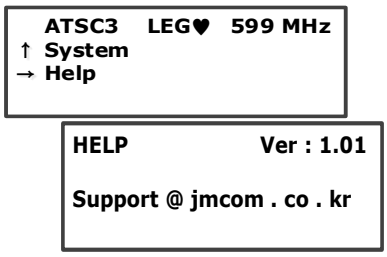


LAN Interface	Status	PHY	IP / Mask	VLAN(status and ID
1st Interface (FLAN)	Enabled	ETH1	192.168.168.168 255.255.0.0	Status: Disabled ID: 10
2nd Interface (FLAN)	Disabled	ETH1	10.2.1.250 255.255.0.0	Status: Disabled ID: 11

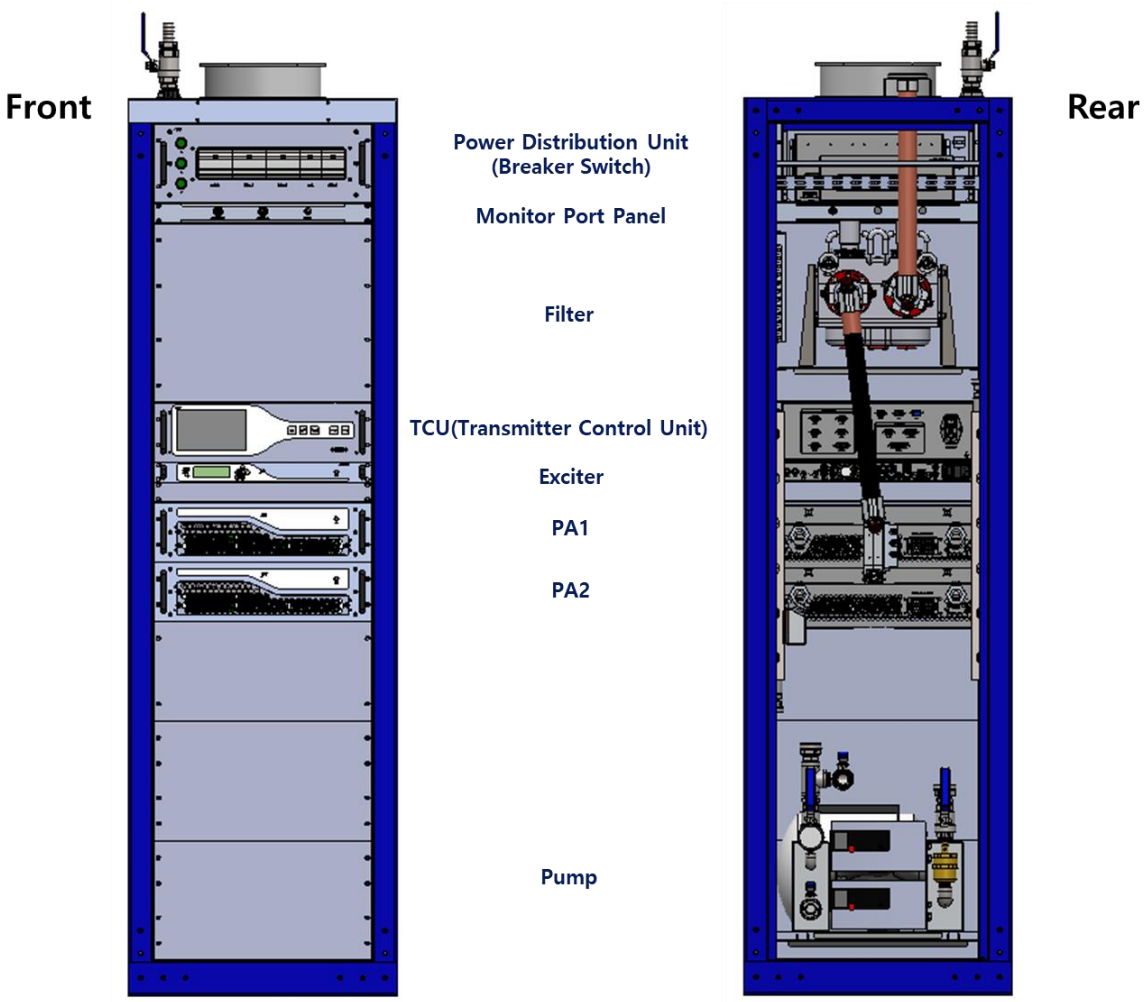
3rd Interface (FLAN)	Disabled	ETH2	10.3.1.250 255.255.0.0	Status: Disabled ID: 12
4th Interface (FLAN)	Disabled	ETH3	10.4.1.250 255.255.0.0	Status: Disabled ID: 13
5th Interface (FLAN)	Disabled	ETH3	10.5.1.250 255.255.0.0	Status: Disabled ID: 14

When Preset is completed, only the 1st Interface is enabled, and the rest are set to disabled. To use an additional interface, connect to the web through Port PHY 1, enable the interface, then change the IP settings, and use it.

5.1.6.10. Help

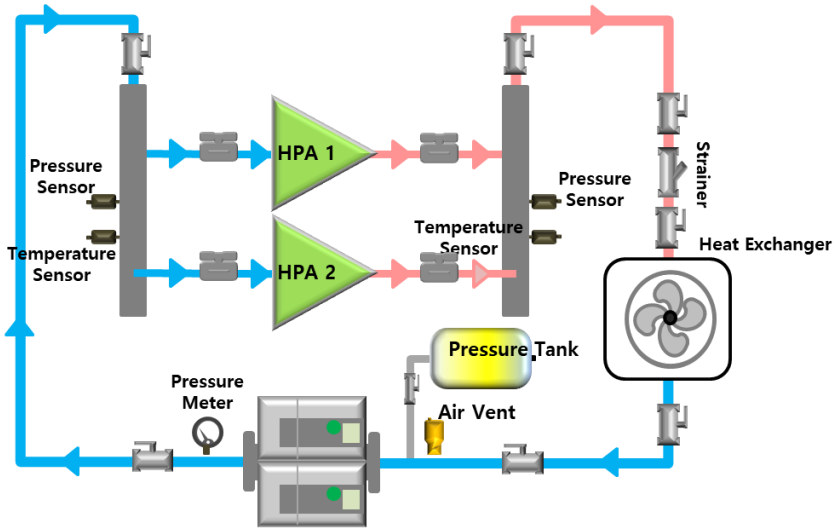


5.2. Transmitter Configuration



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 one or two HPA1600L Units, Divider, and Combiner.

Liquid Cooling System Diagram



5.2.1. HPA1600L

HPA1600L consists of RF at the top and Power and Control parts at the bottom.

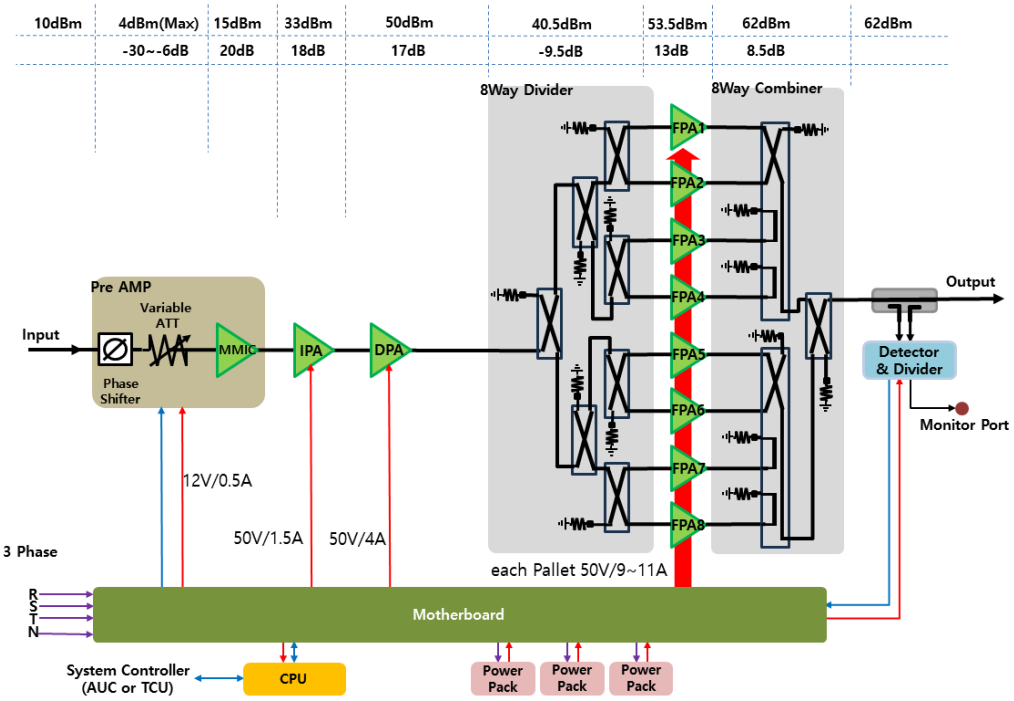
Designed to actively respond to VSWR, Over Power, Over Temperature, Over Voltage, and Over Current.

Designed to be easy to attach and detach using the Hot Plug method.

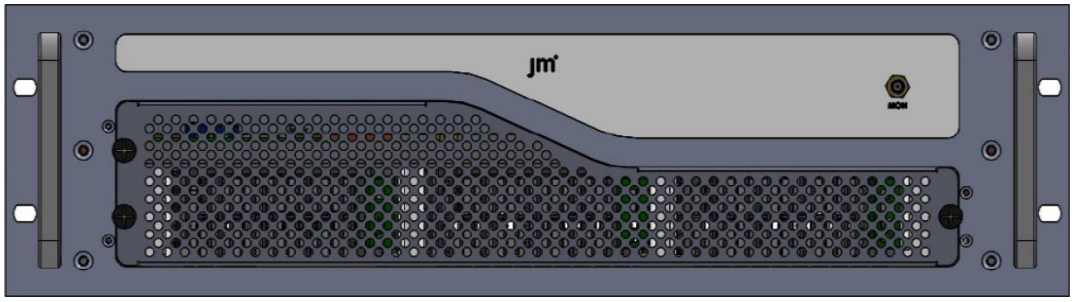
The heat sink is designed with a double cooling pipe structure to increase efficiency.

Considering AC Phase Balance, the Power Pack is composed of 3 pieces, and secures a 30% Margin of the used power.

Diagram



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 HPA1600L.

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 HPA1600Ls 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.

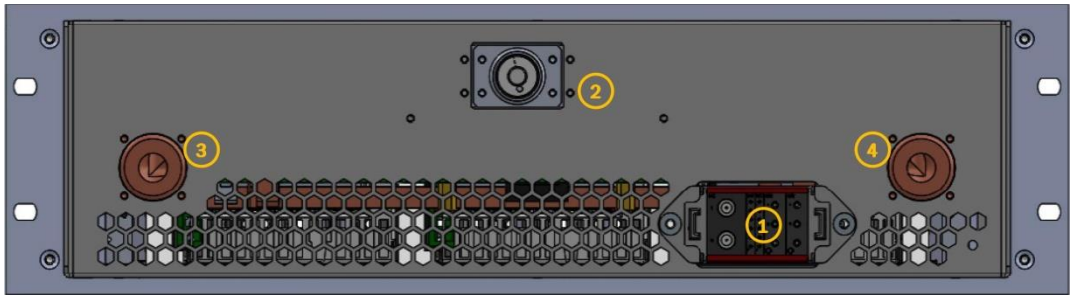
Forward Adj. : Adjust Output Forward Reading Power.
It is set and shipped by the manufacturer, and modification is prohibited.

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. Main Connector(Data/Control) ①

Features such as RF Input, AC Input, Control, and Communication are integrated into one Connector. When detaching, the order of removal is RF Input, Control, Communication, AC Input, and GND.

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.

BNC Female Trumpet Connector

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.

AC Input Pin

It is 220V 1Ø(Single-Phase). Only 3 pins out of 6 pins are in use.

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

Control & Communication

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

All other information is via RS232.

5.2.1.2.2. RF Output Connector ②

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

5.2.1.2.3. Liquid Inlet Connector ③

A Liquid Inlet Connector that supplies water to HPA.

Connected to the Transmitter Water Inlet Pipe and an intermediate valve is installed.

☑ Liquid Inlet Connector is Auto Stop, but it is recommended to lock the intermediate valve and disconnect the HPA in case of foreign objects or weaker tension.

5.2.1.2.4. Liquid Outlet Connector ④

A Liquid Outlet Connector where water that absorbs heat from HPA flows out.

It is the connector marked in red that is connected to the Transmitter Water Outlet Pie and an intermediate valve is installed.

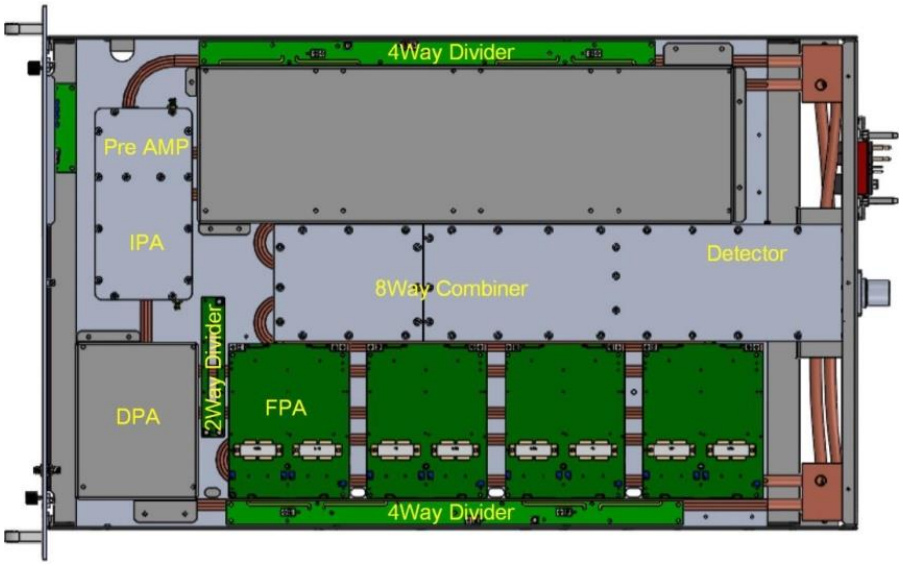
☑ Liquid Outlet Connector is Auto Stop, but it is recommended to lock the intermediate valve and disconnect the HPA in case of foreign objects or weaker tension.

5.2.1.3. RF Part

5.2.1.3.1. Composition

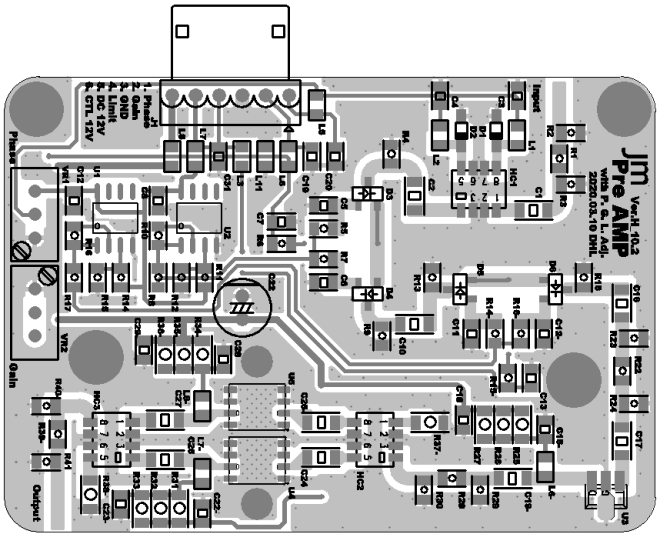
The RF Part is located at the top of the HPA1600L and consists of Pre AMP, IPA, DPA, FPA, Divider, Combiner, and Detector.

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

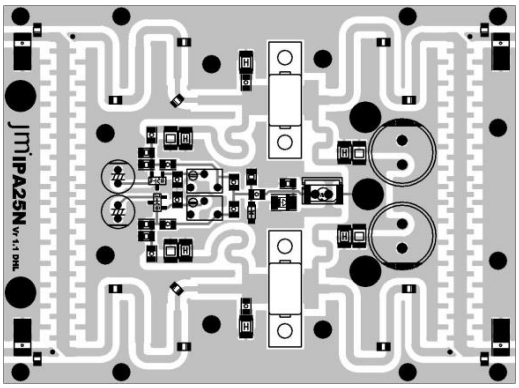
It is Phase Adjust using Hybrid Coupler, Capacitor, and Tuning Diode, and can be set in the 'Phase' Variable Register on the Front Panel.

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.

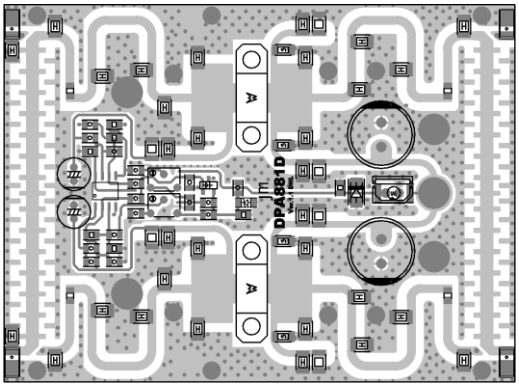
5.2.1.3.3. Intermediate Power AMP(IPA)

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 150W class push-pull type LDMOS (BLF888E) combines two amplifiers with a 3dB coupler to linearly amplify the power required to drive the Final Power AMP (FPA). BLF888E Transistor independently implements Doherty.
The manufacturer produces 2 bands within UHF Broadband (470~810MHz).
Adjust Gate Bias with Variable Register.
Uses the same pallet as FPA.



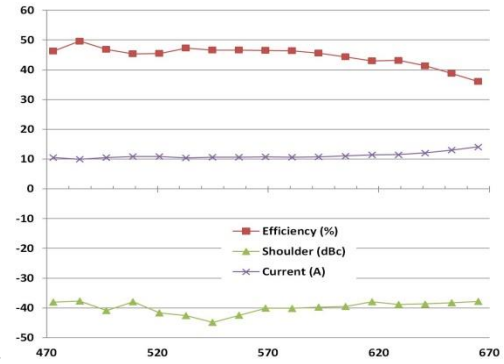
5.2.1.3.5. Final Power AMP

Pallet has the same configuration as DPA.

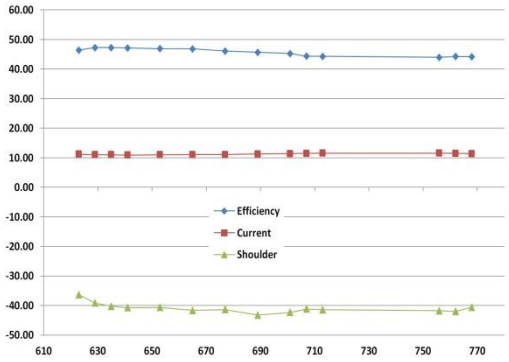
The FPA in HPA1600L consists of 8 pallets and generates an output of OFDM 2000W (Max).

The following are the characteristics of each Pallet 250W frequency.

Low Band Pallet



High Band Pallet



We use Low Band Pallet.

BLF888E; BLF888ES

UHF power LDMOS transistor

Rev. 2 — 30 August 2016

AMPLEON

Product data sheet

1.1 General description

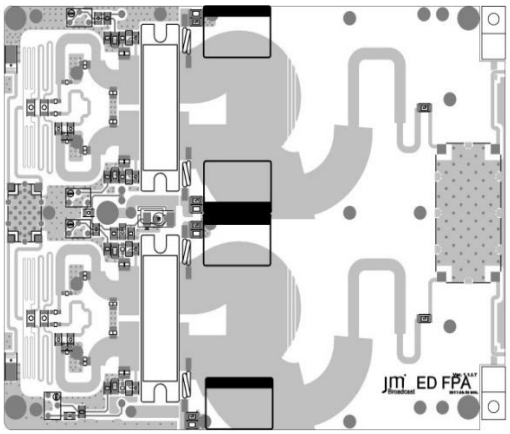
A 750 W LDMOS RF power transistor for asymmetrical broadcast Doherty transmitter applications which operates at 150 W DVB-T average power. The excellent ruggedness of this device makes it ideal for digital and analog transmitter applications.

Table 1. Application information

RF performance at V_{DS} = 50 V in an asymmetrical Doherty application.

Test signal	f	$P_{L(AV)}$	G_p	η_D	IMD_{shidr}	PAR
	(MHz)	(W)	(dB)	(%)	(dBc)	(dB)
DVB-T (8k OFDM)	470 to 608	150	17	52	−38	8 [1]
	600 to 700	150	17	50	−38	8 [1]
	650 to 790	150	15	49	−38	8 [1]

[1] PAR (of output signal) at 0.01 % probability on CCDF; PAR of input signal = 9.5 dB at 0.01 % probability on CCDF.



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 and 100Ω for DPA&FPA 888E. 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.

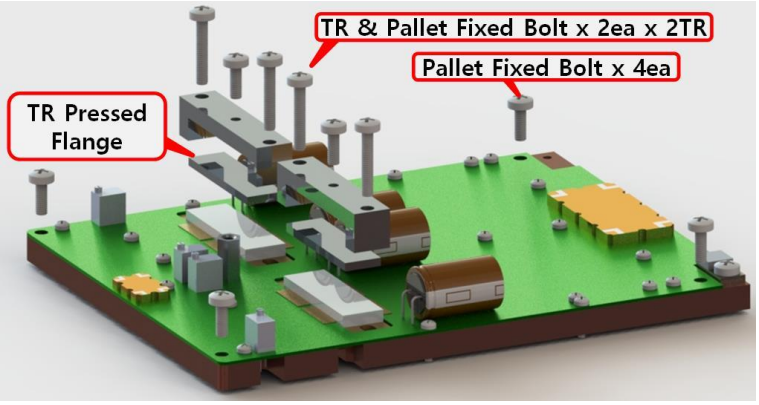
6. Secure the fixing bolt with sufficient force using a +-shaped screwdriver.

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. HPA1600L Divider

Divider consists of two types: 2Way Divider and 4Way Divider.
Coupler is composed of 3dB Type. To match the Phase with the combiner, a Phase Pattern for each port was additionally designed.

5.2.1.3.8. HPA1600L 8 Way Combiner & Detector

A method of combining two 4Way combiners into a 2Way combiner.
4Way is a progressive type and is combined in the following order: 3dB, 4.77dB, and 6dB.
The RF combined in this way is finally combined by a 2Way Combiner.
The combined power is transmitted to the 10Way Combiner 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 HPA1600L 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 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.

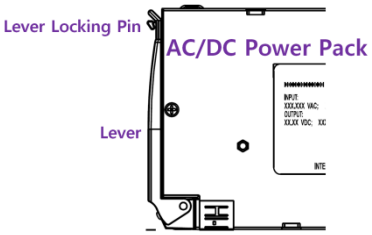
It can supply a current of up to 160A by parallel running up to 3 Power Packs in module form.

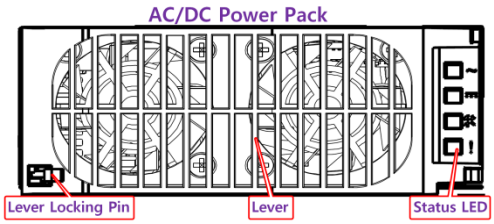
The Power Pack adjusts the current consumed between packs through Mutual Current Sharing so that the current is evenly distributed.

Output Power : 50V @ 2000W, 5V @ 4W
Universal AC input : 90 ~ 300V
Programmable output voltage : 44 ~ 58 Vdc
Output Current : 40Adc @ 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	

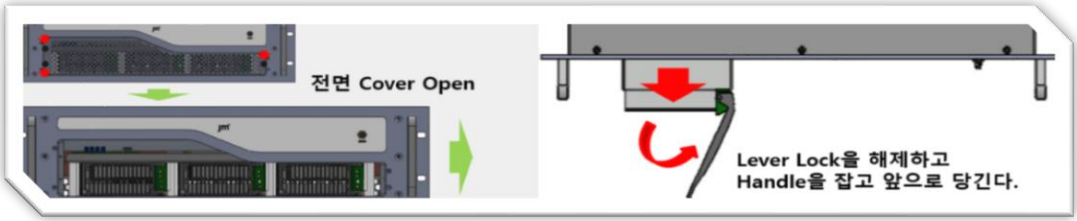




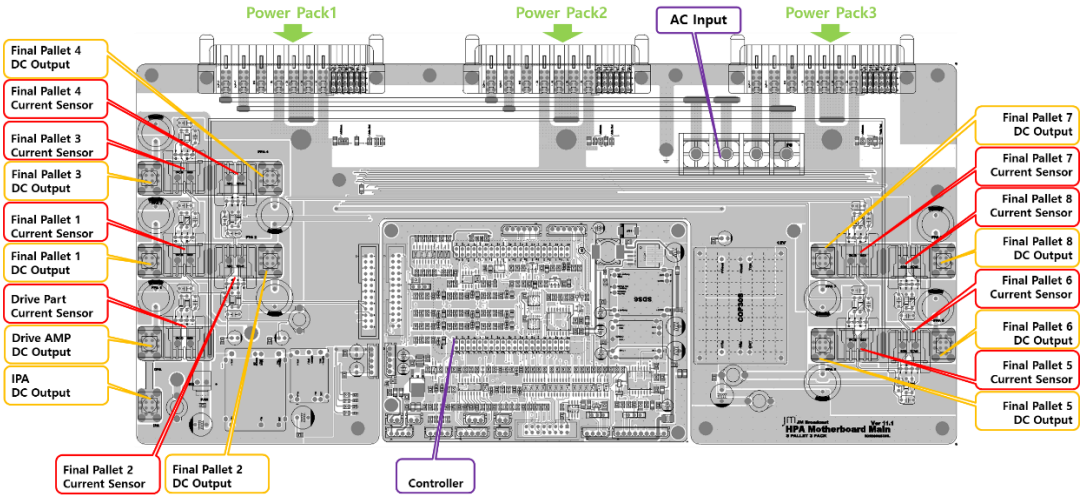
Replace

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. HPA1600L Motherboard



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

Interface & Current Sensing Function

Separate 480Vac into 277Vac and connect to Power Pack.
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 HPA1600L Controller

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

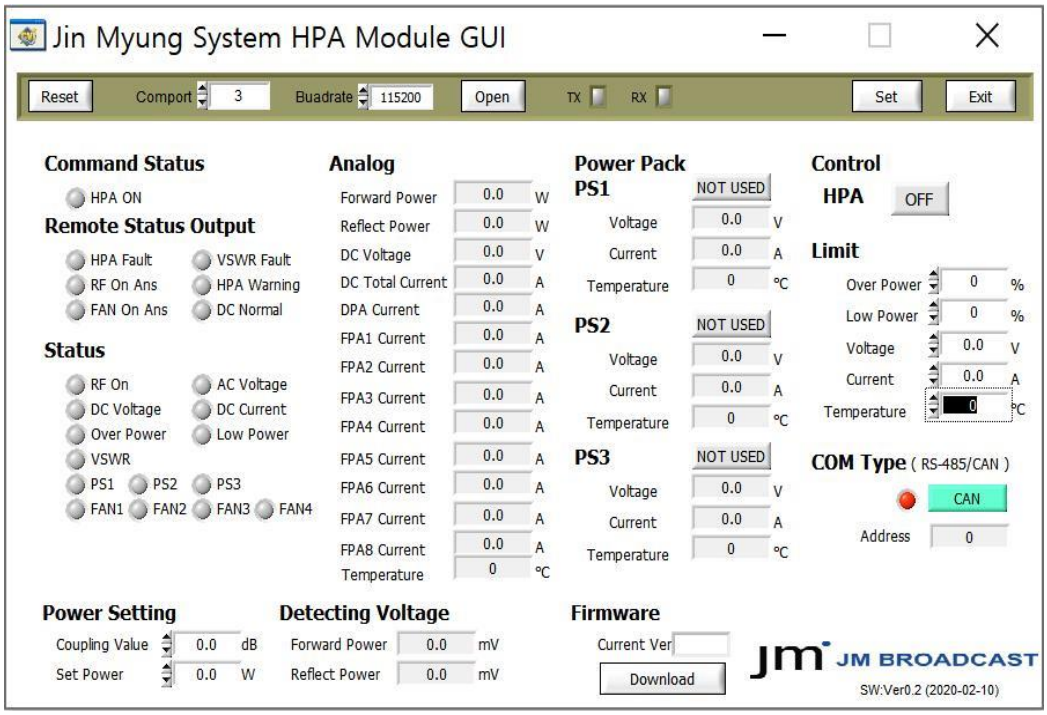
Install the CPU Board on top of the Interface Board.

The Control Board receives ON/OFF/RESET signals from the SCU and operates the HPA. It reads RF Power, Voltage, Current, and Heatsink Temperature, and issues an OFF command itself in case of an error.

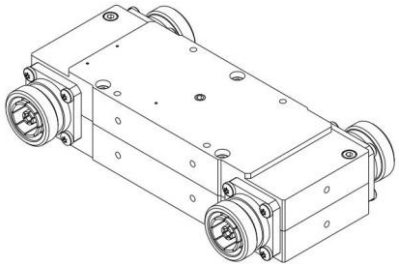
Transmits all read information to SCU (ACU).

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 3kW Transmitter)



Install one per Path.

It serves to combine the RF power amplified from two HPA1600Ls into one.

2Way Combiner is 3dB type.

The combined power is connected to the Low Pass Filter through a 1 5/8″ rigid Line.

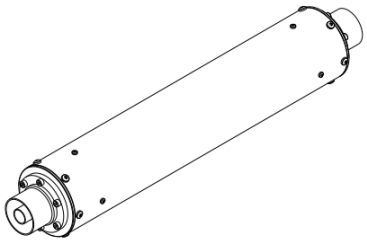
The combiner includes an Absorbing Dummy, and a Coupler is attached to check the RF Power applied to the Dummy.

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

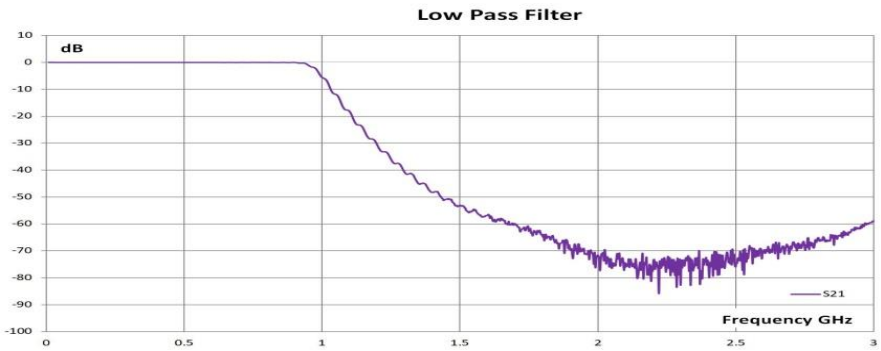
It is attached to the transmitter Inlet Water Divider to dissipate heat from the Absorbing Dummy.

5.4. Low Pass Filter

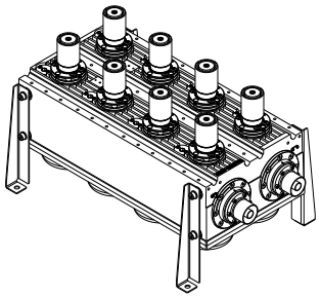
Used to remove Harmonics.



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	4.2kW
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	Liquid
Cooling Liquid Temperature	≤50℃
Liquid Temperature Rise @ 10kW	1.5℃

5.6. Liquid Cooling System

5.6.1. Summary

The Liquid Cooling System is responsible for cooling off the heat from the high-temperature amplifier and all other heating parts in the Liquid Type Transmitter.
The Liquid Cooling System consists of a pipe of each heating unit, a water pump for water circulation, an outdoor cooler, and a connection pipe, and has a Controller that controls and monitors them.
The Liquid Cooling System consists of individual Systems.
It is connected to the TCU and operates as a System.

The Liquid Cooling System is a closed-circuit system that always maintains a constant

pressure. Compared to the open circuit, a constant flow rate can be maintained, and the evaporation amount of coolant is very small, making it easy to manage.

The coolant used is Ethylene Glycol diluted with distilled water 1:1. The freezing point is -34℃. Increasing the concentration of Ethylene Glycol lowers the freezing point, but heat dissipation efficiency decreases, so it should be used in an appropriate ratio considering the usage environment. (Changes are possible depend on on-site circumstances. If changes are made, consult with the manufacturer.)

5.6.3. Liquid Controller

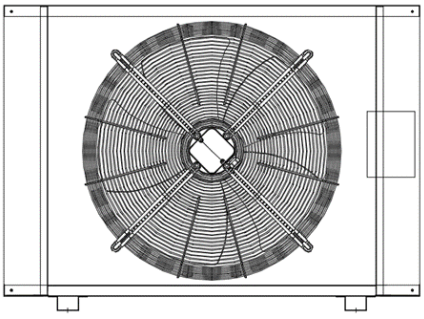
Control the water pump and the heat exchanger by receiving the TCU's command and check the status information of the pump and deliver it to the TCU.
It communicates with the pump through RS485. Therefore, pumps have different RS485 Addresses. When replacing the pump, it must be set to the same Address after replacement.
Heat Exchanger Fan Control is designed to control the SSR installed in the Heat Exchanger Controller.

5.6.4. Heat Exchanger

A device that cools the heat generated during the operation of the Transmitter to the atmosphere and consists of a Radiator and a fan equipped with a powerful Motor.

Consists of a Triple Fan and operates by stop, cross-operation, or simultaneous operation depending on the temperature. Control is executed in the Pump Controller, and only ON/OFF commands are received from the TCU.

Radiator



480Vac 3Ø 60Hz

Strainer

The Inlet of the Heat Exchanger is equipped with a Strainer to filter out foreign substances. It should be cleaned after operating dozens of minutes after the initial coolant injection, and at least once a year.

5.6.4. Fail Check & Replace

A system designed to always keep the pressure constant. If the pressure usually drops, the first thing to think about is a water leak. If you discover a leak, contact the manufacturer to take action.
If no leak is found, inject air into the pressure tank.
Set at 1.5 to 2.2 bar in operation and 0.7 to 1 bar in shutdown.

5.6.4.1. Heat Exchanger Fan

If the FAN does not operate even after the ON command is applied, check the input power. If power is not applied, check the SSR mounted on the Heat Exchanger Controller and if abnormal, turn off the Breaker Switch and replace it.

If the Fan does not operate even though the input voltage is normal, you should replace the damaged fan.
Fan replacement sequence:

1) TX OFF in TCU
2) Turn off the Heat Exchanger Breaker in Site Main AC Distribution
3) Disconnect the Fan AC line from the terminal block mounted on the Heat Exchanger enclosure and remove the binding of the line.
4) Remove the bolt securing the Fan and separate the Fan.
5) Install the new Fan in the reverse order above.
6) Turn on the Heat Exchanger Breaker and TX ON and check the Fan operation status.

5.6.4.2. Pump

The pump is a Dual Pump product. The two are comprised of one product. You can check any abnormalities on the TCU Pump screen.
If the pump in operation fails, it is automatically changed.
It was designed considering flow rate and flow velocity to sufficiently handle the heat

generation of the System. Considering Water Line installation, use products with a standing capacity of 6M or more.

Communication Error

TCU Alarm Screen comm

If there is a problem with the entire pump communication, you should check the Control Board. Ask this part to the manufacturer. (You can check from Event / Alarm Set → Alarm Set → Unit Communication)

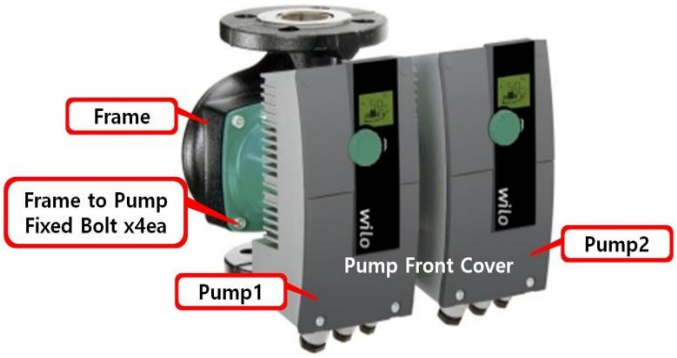
If communication with one Pump is not possible, check the corresponding Pump on the TCU screen, open the Pump Front Cover, check the connection status of the communication Module mounted on the right side. If there is no problem, separate the communication Cable with a small flathead screwdriver and replace it with a new one.

Pump Error

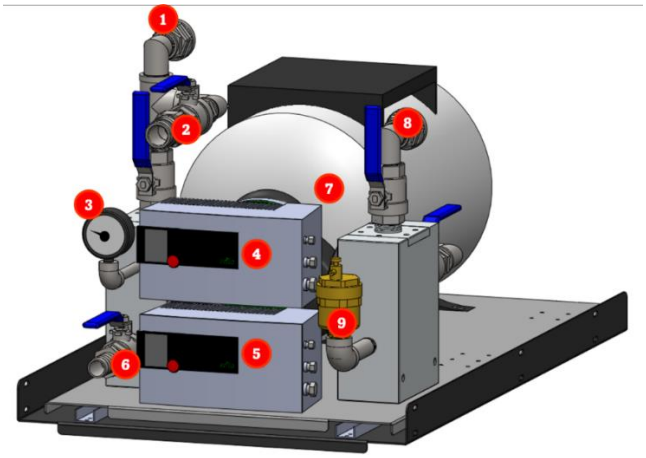
If communication is normal but the message "Error" is displayed on the pump's own LCD or the RPM does not increase, the Pump should be replaced. The pump is divided into a Frame and a Pump Body. Only the Pump Body can be replaced.

Pump replacement sequence:

1) Turn off the relevant Pump Breaker Switch.
2) Close the Valves attached to the Pump Inlet and Outlet.
3) Open the Pump Front Cover, disconnect all connected lines, and place them on top of the Pump to prevent from getting wet when disconnecting the Pump.
4) Remove the 4 bolts that secure the Pump and Frame. When removing, the valve is closed, but since the pressure in use is maintained inside the pump, remove it very slowly so that the pressure can be released little by little.
5) When attaching a new pump, check the location of the 'O' ring.
6) Secure it to the Frame.
7) Connect the AC cable disconnected from the Pump Front and the communication Cable.
8) Open the valve, operate the replaced pump in Manual mode on the TCU Pump screen, and check the operation status and leakage.
9) After final confirmation, determine and set the Pump Operating Mode in the TCU.



. 5.6.4.2.1. Water Pump Composition



No	Name	Detailed Description
1	Pump Outlet	This is the Pump Outlet Port connected to the Transmitter Inlet water Divider. It is equipped with a Valve that blocks the flow of water when the Pump Rack or Pump is separated. Must be open during operation.
2	Pump Water In Port	This is the coolant inlet. It is a Quick Insert Type and is connected to a pump for coolant injection. Must be closed during operation. When opened, a very large amount of coolant is instantly ejected due to the pressure inside the transmitter. It can result fatal accidents. Never open after cooling water is injected. When draining coolant, open number 10 and it will drain naturally due to internal pressure. To push out the remaining coolant with air, you can connect an

additional adapter and inject air by the compressor.

3	Pressure Meter	Indicates the pressure applied to the Liquid system. It has similar values to the TCU screen. When injecting Coolant, set Pressure based on this value.
4,5	Pump	This is Wilo's Stratos-D 32/1-12 Model and is a Dual Type, and includes a check valve to prevent backflow, allowing independent operation. This pump operates by Auto or Manual. **Pump Information** Temperature Range : -10~110℃ Max Operating Pressure : 10bar Max Delivery Head H : 8m Motor Power : 12~300W Speed : 1400~4800rpm Power Consumption : 12~300W Current Consumption : 0.22~1.37A Mains Connection : 230V±10%, 50/60Hz
6	Drain Port	This is a Coolant Outlet. It serves to discharge air when injecting Coolant and is used when removing Coolant. Must be closed during operation.
7	Pressure Tank	Maintain pressure during normal operation. The coolant pressure decreases over time, and this is a device that compensates for this and maintains the pressure. There is a rubber valve inside, so the tank is filled half with coolant and half with air. The Tank has an air inlet. This is a Connector that injects air into the Tank to maintain a constant pressure after injecting Coolant. The injection can be done by using a Compressor or a bicycle air injector. In addition, when the remaining Air escapes through the Air Vent and the cooling water evaporates, the pressure decreases little by little, and this part is also used to

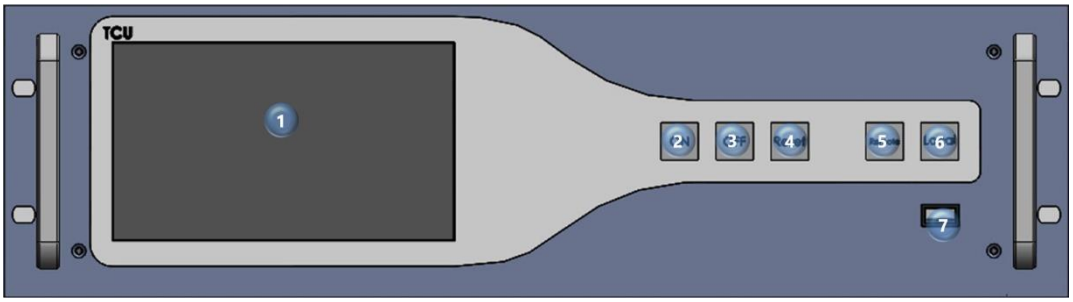
		supplement it. If the coolant pressure drops below 1 bar even when the pump is in operation, check for a coolant leak. If there is a leak, take action and inject coolant. If no leak is found, inject air into the Tank.
8	Pump Inlet	This is the inlet through which the cooled coolant from the heat exchanger flows. It is connected to Heat Exchanger Outlet. It is equipped with a flow meter with a transparent sight glass, allowing you to visually check the flow rate, flow velocity, and condition of the coolant. There is a Valve under the flow meter, which blocks the flow of water when the Pump Rack or Pump is separated. Must be open during operation.
9	Air Vent	A device that removes air remaining in the cooling System. Operate normally in an Open state.

5.7. PDU(Power Distribution Unit)

Receives Main 480Vac and distributes AC power to each Unit.
It consists of Main Breaker, Surge Protector, and Breaker for each Unit.

5.8. Transmitter Control Unit (TCU)

5.8.1. TCU Front



TCU stands for Transmitter Control Unit.
Turns the Transmitter ON/OFF according to the command sent from the Front Switch or Remote Location.

In addition, the TCU receives information through communication with Exciter, HPA1600L, Meter Detector, Pump, etc., displays it on the LCD, analyzes the information, detects faults, and alarms, and turns the equipment ON/OFF according to the set operation plan.
The collected information and status are transmitted to a remote location so that system status can be checked.

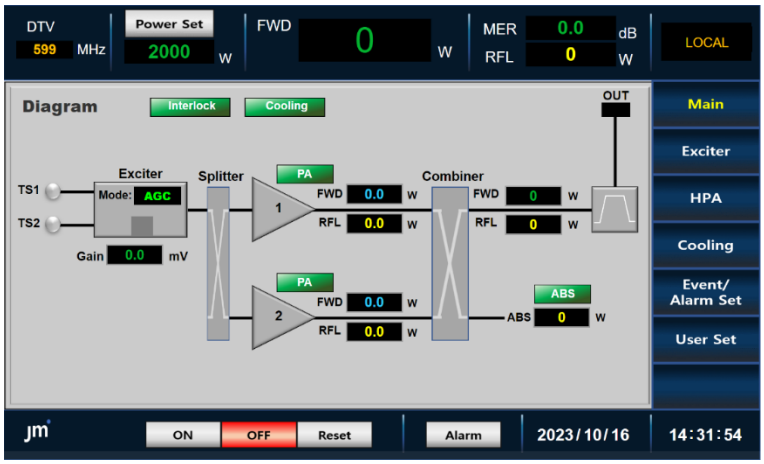
No	Name	Detail Description
1	**LCD**	All operations are possible on the screen with the 7" Touch Screen LCD. You can display the information collected by each part of the transmitter and control the transmitter.
2	**ON**	This is the button to start the transmitter. It operates the same as the ON button 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.
3	**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.
4	**RESET**	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.
5	**Remote**	Grants control authority for the transmitter to the SCU. Controls the transmitter by receiving commands from the SCU. This is the mode that normally used.
6	**Local**	Grants control authority for the Path Transmitter to TCU. Transmitter can be controlled directly from TCU.
7	**USB**	Port for administrator.

5.8.2. LCD Display

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.

5.8.2.1. Main (ex.3kW Transmitter)



Set Power

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

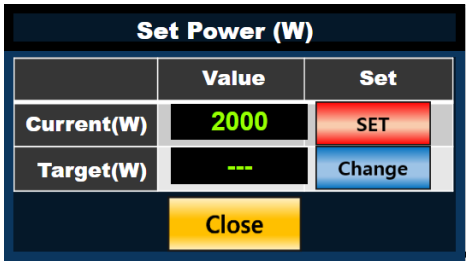
The prerequisite is that the exciter's Gain Control Mode must be set to AGC state.

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

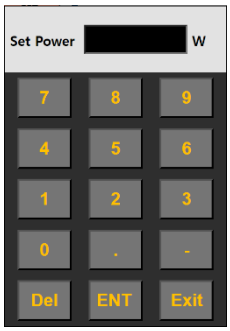
This part is displayed in all windows as a fixed screen.

Change Set Power

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

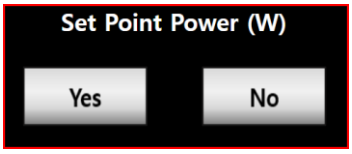


2) When you press the Change Button in the Set Power window, an input window appears.



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 (Forward)

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 (Modulation Error Ratio)

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 (Reflector)

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 / Local

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

Diagram

The status information of the RF system is organized on one screen to facilitate fault location identification. If a Fault occurs, you can go to the relevant Page to check detailed information.

FNC

This is an abbreviation for Function. After touching this Button in Local Mode, the ON/OFF/Reset Button can be applied only when the color changes to Green.

The FNC Button is automatically released after 50 seconds.

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

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.

Alarm

If any of the following occurs in the transmitter, the 

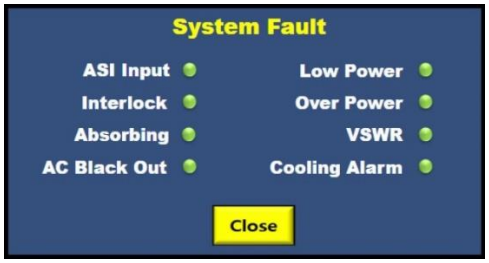
Button turns red.

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.



- **TS 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.

- **Absorbing**

  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.

- **Cooling Alarm**

  This means that a problem has occurred in the Liquid Cooling System.

If the pressure falls below 0.5 bar during operation and lasts more than 20 seconds, or the coolant temperature rises above 60°C and lasts more than 30 seconds, the system recognizes it as a Fault and turns the equipment OFF. Afterwards, the Transmitter remains in the OFF state until reset by the User.

It is very likely that the cause is a leak in the Liquid Circuit.

If no leakage has been confirmed, the previously contained air may be removed over time, lowering the pressure. In this case, inject air into the pressure tank to achieve the appropriate pressure. The pressure tank can be found by removing the Blank Panel at the bottom of the Rack.

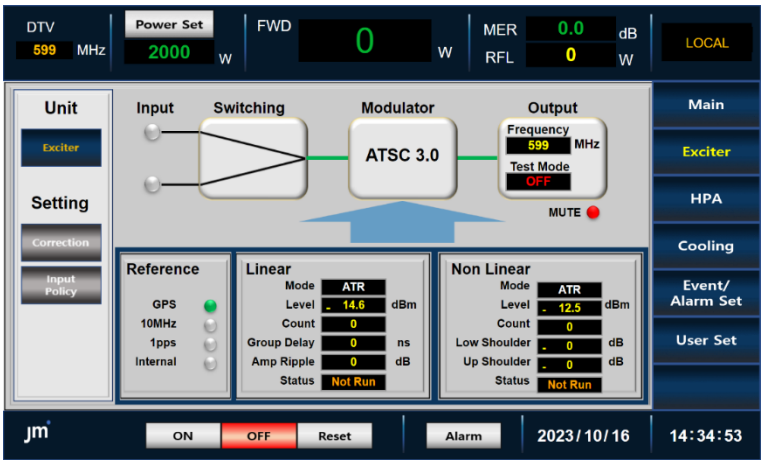
- **AC Black Out**

  It means a power outage has occurred.

Date & Time

Analyzes GPS signals from the Exciter to generate accurate date and time. It receives and displays the information and uses this time to generate Log Data.

5.8.2.2. Exciter



Displays Exciter's information.

You can check it more detailly in the Exciter web GUI, and only the parts deemed necessary by the User are selected and displayed.

Input

Displays the status of TS1 and TS2. Green in case of Normal, OFF in case of Failure.

Switching

Confirms which of TS1 and TS2 is selected and applied to the System.

The selected Line turns Green.

Modulation

Displays Modulation with ATSC3.0.

Output

Frequency is only displayed for the operator's convenience, and since changing frequency is an important matter, it is only available on the Exciter Front LCD for the purpose of making accessibility difficult.

Test Mode displays what the current Test Mode is. Test Mode should always be set to OFF. If other Mode (PRBS, CW) is selected, it would be Off-the-air. For this reason, changes are only possible in the Exciter Front LCD and TCU Input Policy.

Reference

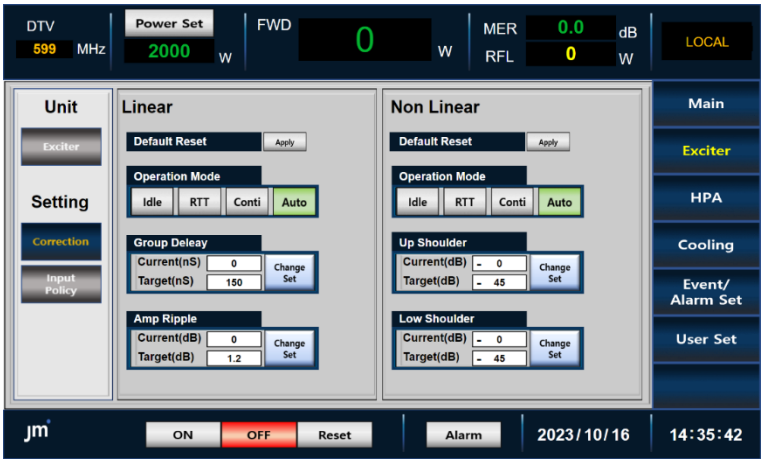
Displays the status of each reference. Indicates what Reference is currently being used for transmission.

5.8.2.2.1. Correction

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

For settings, Touch 

Button to move to the enable screen.



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.

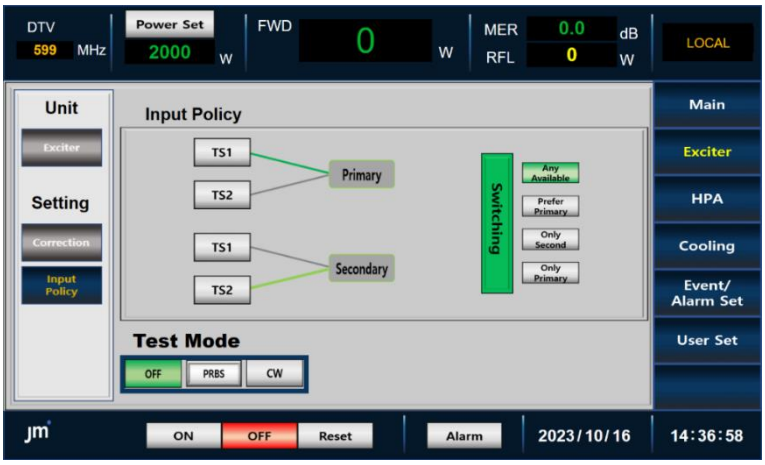
If the Target Point is set too low in Auto Run or Run to Target Mode, it may operate like Continuous mode, and if set too high, it may operate like Idle. Therefore, the target should be set to an appropriate value in the field over a long period of time.

5.8.2.2.2. Input Policy

Access by Touching the 

Button.

You can determine the operation method of the patch between TS 1, 2 and Primary, Secondary Matching and Primary, Secondary.



Button displays TS status. It only displays simple status.

Switching

This is the Menu that determines Primary and Secondary Selection.

The following 4 conditions are supported:

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.

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.

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.

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.

Test Mode

OFF

Test Mode is OFF. This is the mode that should be selected during regular operation.

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

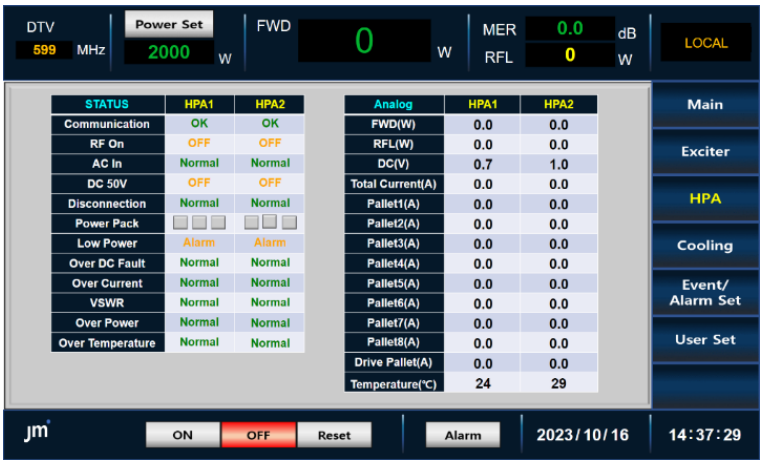
A single carrier is transmitted at Center Frequency.
Used when measuring frequency with a Spectrum Analyzer.

5.8.2.3. HPA

5.8.2.3.1. Status (ex. 3kW Transmitter)

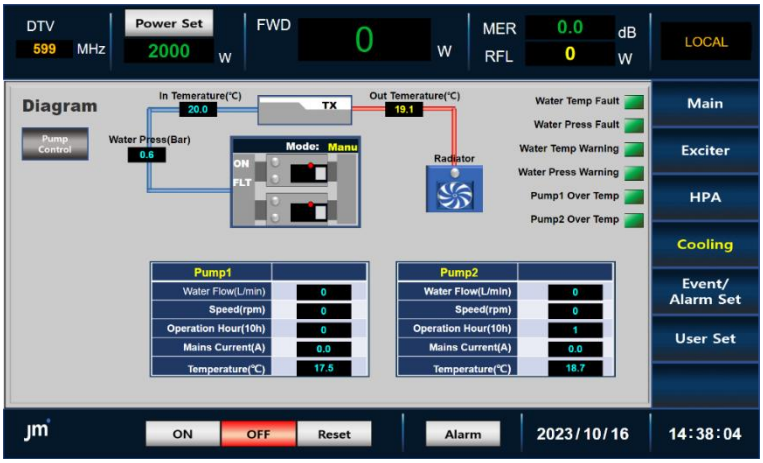
Displays Status information analyzed by HPA for each HPA1600L.

You can check the status of HPA1600L and Analog values on the current screen.



5.8.2.4. Cooling

5.8.2.4.1. Main



The Main screen displays the Status of the Pump and Heat Exchange Fan, as well as the Transmitter Inlet and Outlet temperatures and Inlet pressure.

The standard for **Water Temp** is 40℃. If it lasts over 40℃ for 3 seconds, it is considered a Fault.

If it is 10℃ higher than the coolant temperature of **Pump Over Temp,** or if the pump temperature is over 50℃ and lasts for more than 20 seconds, it is considered a Fault**.**

Water Flow: Displays the amount of water pumped per minute.

Speed: Displays the number of revolutions of the pump motor per minute.

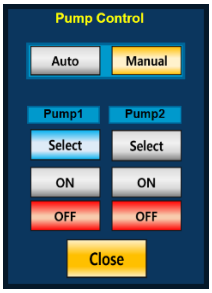
Operation Hour: The total time the pump has been operating is displayed in units of 10 hours.

Mains Current: Displays the current being applied to the Pump.

Temperature: When the pump motor operates, heat is generated. Display the temperature.

Pump Control

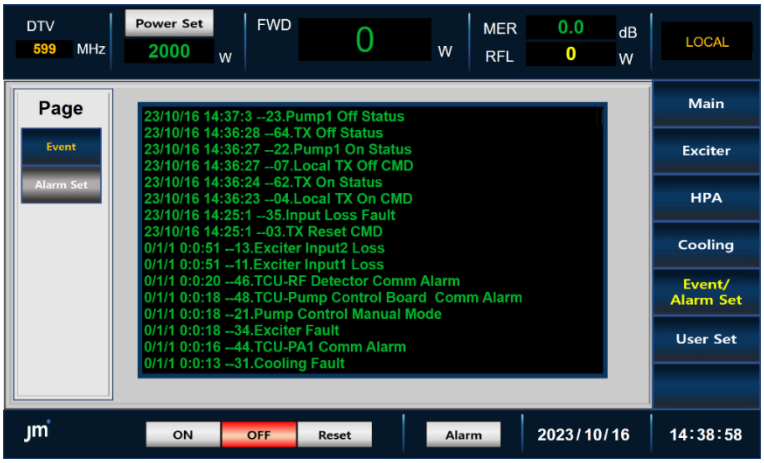
When you press the Pump Control Button, a Pop window appears.



Pump control mode can be selected, and in Manual Mode, the operator can perform Pump ON/OFF.

In Auto Mode, Pumps 1 and 2 are automatically switched every week.

5.8.2.5. Event / Alarm Set



5.8.2.5.1. Event

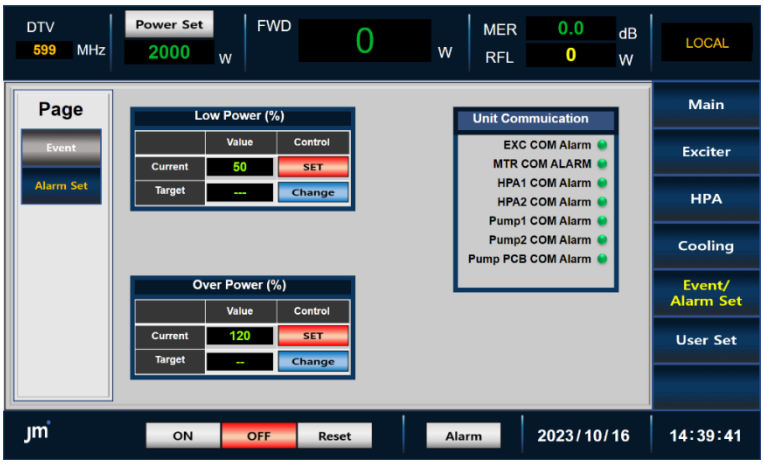
Record all changes that occur on the transmitter.

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.

5.8.2.5.2. Alarm Set

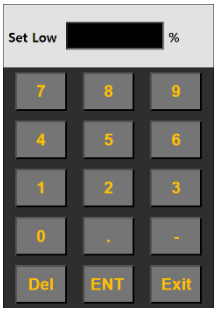
You can access by touching the Alarm Set Button.



Low Power Alarm Set

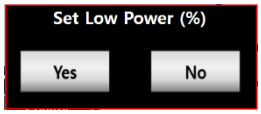
Calculate the Threshold Power by applying the Percent set based on the set power and determine whether the Main FWD Power is outside the threshold.

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.

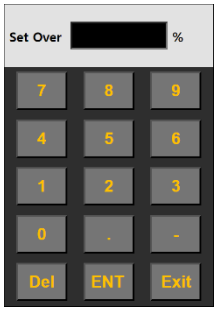
3) Press the Current Set Button to apply it to the System. When the Current value changes and the Main Power falls below the set standard, a Low Power Alarm is generated. In this state, if the ACU is in Manual Mode, the current state is maintained, and if it is in Auto Mode, it becomes a Transfer Condition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



Over Power Alarm Set

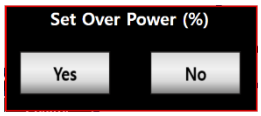
Calculate the threshold power by applying the Percent set based on the set power and determine whether the Main FWD Power is outside the threshold.

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 Set 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.

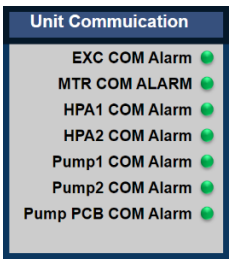


The operation is turned off from the TCU as soon as it is recognized without waiting time.

Unit Communication

You can check the operation status of RS 485 communication between each Unit. In case of Failure, check whether the power supply is normal and the cable connection between Units. If there is no problem but the Failure continues, contact

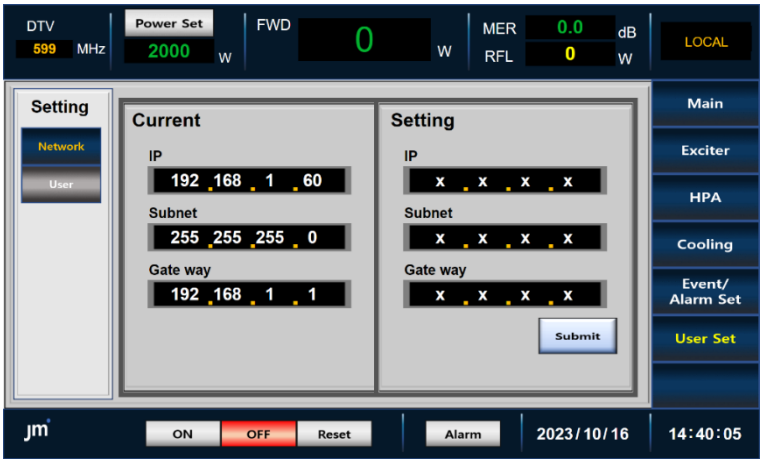
the manufacturer.



5.8.2.6. User Set

5.8.2.6.1. Network

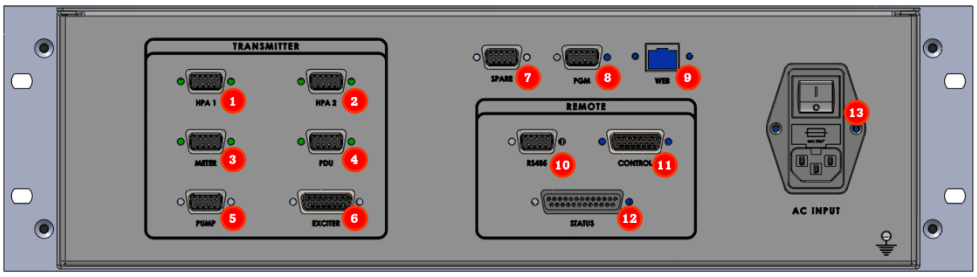
You can set the network environment for Remote Control connection.



5.8.2.6.2. User

You can change the Web access Password.

5.8.3. TCU Rear



No.	Name	Detail
1	HPA1	Connected to HPA1. Controls HPA1 and receives information collected from HPA Controller.
2	HPA2	Connected to HPA2. Controls HPA2 and receives information collected from HPA Controller.
3	Meter	Connected to the Detector module attached to the Rack Side. Receives information through RS-485 communication.
4	PDU	NC
5	PUMP	Connected to the Pump Controller attached to the Rack Side. Controls the pump and Heat Exchanger and receives information collected from the Pump Controller.
6	EXCITER	Connected to the Exciter. Controls exciter RF On/Off and receives Exciter information.
7	PGM2	A Port that can update the Firmware of the Remote CPU.
8	PGM1	A Port that can update the Firmware of the TCU CPU.
9	WEB	This is the Remote Web GUI connection port.
10	FAN SSR	Connected to the Transmitter Top Cover Fan. Controls FAN according to TX ON/OFF.
11	COMMAND	This is the Remote Control Command Input Port.

Ds15-1	Fault Reset Command in
Ds15-2	TX On Command in
Ds15-3	TX Off Command in
Ds15-4	Exciter RF Mute ON
Ds15-5	GND
Ds15-6	Exciter RF Mute OFF
Ds15-7	EXC Primary TS1 select
Ds15-8	EXC Primary TS2 select

Ds15-9	Pump 1 Select Command in
Ds15-10	GND
Ds15-11	Pump 2 Select Command in
Ds15-12	NC
Ds15-13	NC
Ds15-14	GND
Ds15-15	GND

12 STATUS This is the Remote Control Status Output Port.

Ds25-1	TX Remote mode
Ds25-2	TX Off status
Ds25-3	TX On status
Ds25-4	TX Total Fault
Ds25-5	GND
Ds25-6	Interlock Open Fault
Ds25-7	TX VSWR Fault
Ds25-8	TX Low power Alarm
Ds25-9	Cooling Water Fault
Ds25-10	GND
Ds25-11	Exciter Fault
Ds25-12	HPA1,2 Fault
Ds25-13	Pump 1 selected
Ds25-14	Pump 2 selected
Ds25-15	GND
Ds25-16	NC
Ds25-17	NC
Ds25-18	NC
Ds25-19	NC
Ds25-20	NC
Ds25-21	NC
Ds25-22	NC
Ds25-23	NC
Ds25-24	GND
Ds25-25	GND

13 AC INPUT This is 85~305Vac Input Port.
It has a built-in Fuse. Fuse is 2A.