GME1F13 Integrated FM Transmitter User Manual

1 Overview

1.1 Product introduction

1) The case include all from stereo input to FM 1KW output.

2) With brand-new direct RF output architecture, the mainboard features excellent performance and simple and fast frequency regulating, and has good frequency uniformity in the entire FM frequency band.

3) With brand-new full broadband loop plan, the entire unit has functions of accurate power test (power test deviation: ±10%; typical value: ±5%) and loop control in the entire FM frequency band.

1.2 Description of entire unit functions

1) Maximum output power of entire unit: 1100W;

2) Support the following work modes of FM radio:

a) Single channel radio;

b) Stereo radio;

c) Stereo radio with additional programs;

d) FM data radio or additional information channel.

3) Support 87MHz to 108MHz work frequency range;

4) Support functions of synchronous FM network;

5) Support manual and automatic switching between internal and external 10M reference clocks;

6) Support analog L/R input, 2 AES/EBU input and manual and automatic switching;

7) Support AES/EBU monitor output;

8) Support SCA/RDS input and 19 kHz pilot frequency output;

9) Monitor, alarm and automatic protection functions are shown as follows:

Table 1 Monitor and Alarm Functions

Monitor Contents	Alarm Condition	Automatic Protection disposal
AES/EBU input	Interception	--
Reference clock	Invalid	Close RF
Temperature	Over-heating	Close RF
Loop control-Automatic (ALC)	Overload, exceeding manual set threshold or other abnormities during automatic control mode of electrical level	Lower power

10) Support front panel touch screen and RS232/485 control;

11) Support automatic/manual switching between main and standby units.

1.3 System block diagram of entire transmitter unit

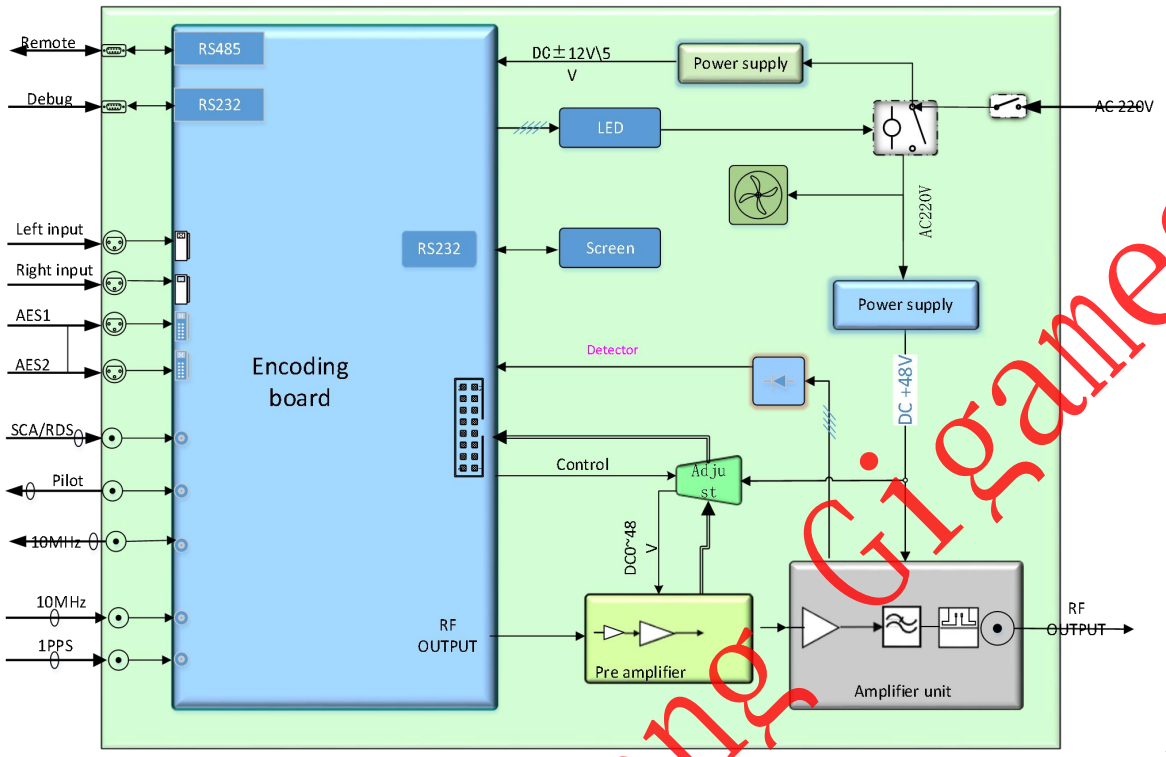


Figure 1-1 Function Module Block Diagram of Integrated Synchronous FM Radio

1.4 Technical indexes

Rated output power:	1KW
Work voltage:	AC220V±15%
Work current:	≤10A
Frequency range:	87.00MHz to 108.00MHz, stepping 10kHz
Frequency stability:	Synchronous work $< 10^{-8}$ (lock GPS) Independent work $< 10^{-6}$ (internal temperature compensate crystal oscillator)
Frequency offset:	0 to 100kHz adjustable, stepping 1KHz
Audio frequency response:	Superior to 0.05dB, 30Hz to 15KHz
FM noise-signal ratio:	Above 70dB
Audio frequency distortion:	< 0.03%, 30Hz to 15KHz

Stereo resolution:	> 65dB, 30Hz to 15KHz
Frequency of pilot frequency:	19kHz ±0.5Hz
Attenuation of audio frequency input:	-10.5dB to +10.5dB
Interface of audio frequency input:	L, R analog audio frequency interface AES/EBU,
Attenuation of RDS input:	-2dB to +16dB
Attenuation of SCA1 input:	-2dB to +16dB
Attenuation of SCA2 input:	-2dB to + 16dB
Pre-emphasis of audio frequency:	0us, 50us,75us

1.5 Front panel

Control panel includes case handle, vent, power switch, local/remote control transfer switch, one LCD, fault indicator lamp, DEBUG interface, etc.

The front panel is shown in Figure 1-2.

Figure 1-2 Front Panel

1.5.1Definition of LED indicator lamps of integrated synchronous FM radio transmitter

No.	Marks of Front Panel Interfaces	Function Instruction
1	Power	Status of encoding board power
2	RF	RF status is on when indicator lamp is on and it is off when indicator lamp is off; Work status of power amplifier at remote control; power amplifier works when RF is on at remote control.
3	Interlock	Indicator lamp of interlock status. Equipment is locked when red lamp is on.
4	Loss of lock	Indicator lamp of loss of lock. System clock is loss of lock when red lamp is on.
5	Alarm	Transmit alarm indication; review specific fault type on touch screen for detail status.

1.6 Introduction of rear panel

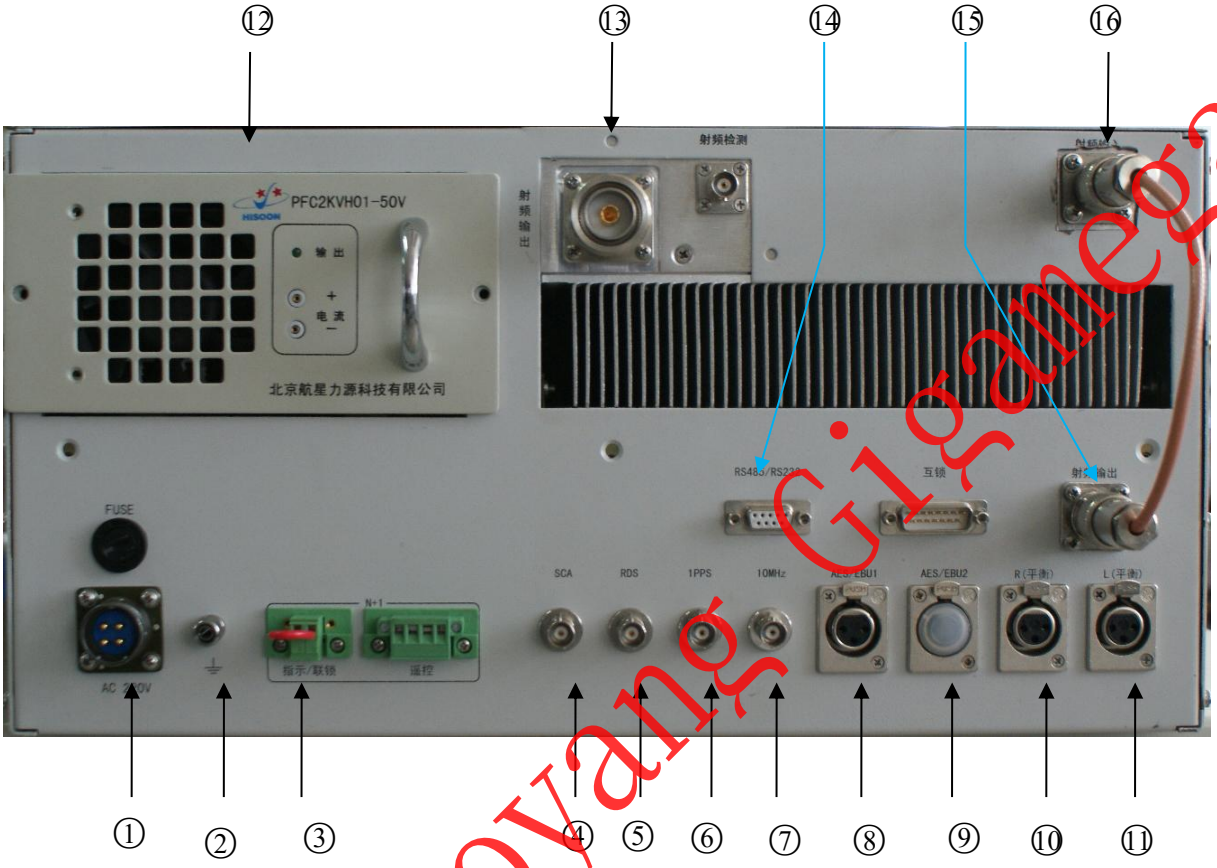


Figure 1-3 Rear Panel

① AC220V input interface

② Grounding

③ Interlock

④ SCA input

⑤ RDS input

⑥ GPS_1PPS input interface;

⑦ GPS_10MHz input interface;

8 Digital input _AES1 signal interface;

9 Digital input _AES2 signal interface;

10 Analog input _R channel signal interface;

11 Analog input _L channel signal interface;

12 Switch power

13 RF output interface;

14 Communication interface RS485 interface

15 Excitation signal output

16 Excitation signal input

2 Introduction of Power Amplification Module

2.1 System block diagram of power amplifier

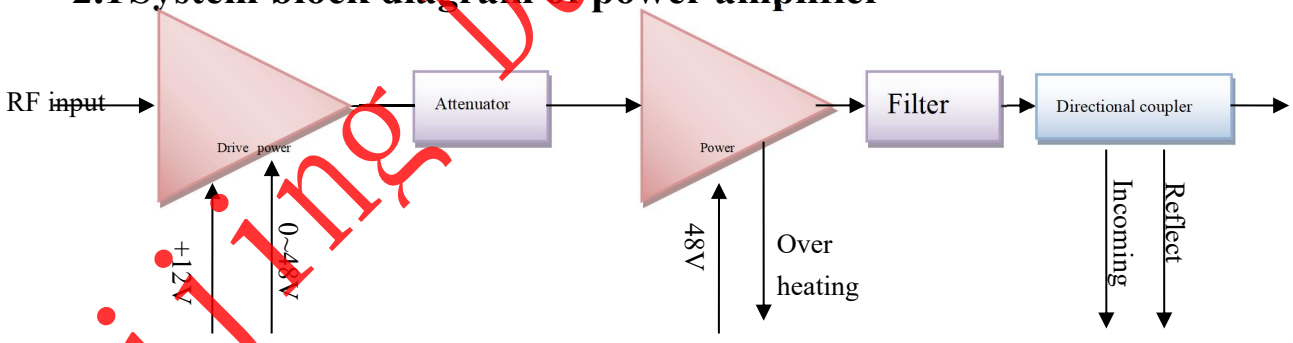


Figure 3-1 System Block Diagram of Power Amplifier

As shown in the figure above, the transmitter has the two-stage power amplification modules which are all broadband amplifiers and change work frequency between 87 and 108MHz, requiring no adjustment to the amplifier. The preceding stage amplifier has such two types of power supplies as +12V and 0 to 50V variable voltage power; gain of the preceding stage varies with the voltage. The attenuator is added between two-stage

(preceding and final stages) amplifiers to increase the isolation of two-stage amplifiers. The output end of the final stage power amplifier has the low pass filter to eliminate the power amplifier harmonic wave generated by the nonlinearity. At last, a part of RF signals is taken out via the directional coupler and sent to the detection for sampling. Besides, the power amplifier is equipped with temperature relay and sensor to provide two temperature protection sampling signals.

2.2 Performance indexes

- **RF part**
  - ✧ Frequency range: 87 ~ 108MHz
  - ✧ Input power: ≤4mW(6dBm)
  - ✧ Output power Pout: ≤1100W
  - ✧ Gain G: 60～65dB
  - ✧ Gain flatness: ±0.5dB
  - ✧ Efficiency: ≥60%
- **Power part**
  - ✧ Power supply voltage: +50V ≤40A (MAX)
  - ✧ Power supply voltage: +12V ≤1A（MAX）

2.3 Preceding stage power amplifier

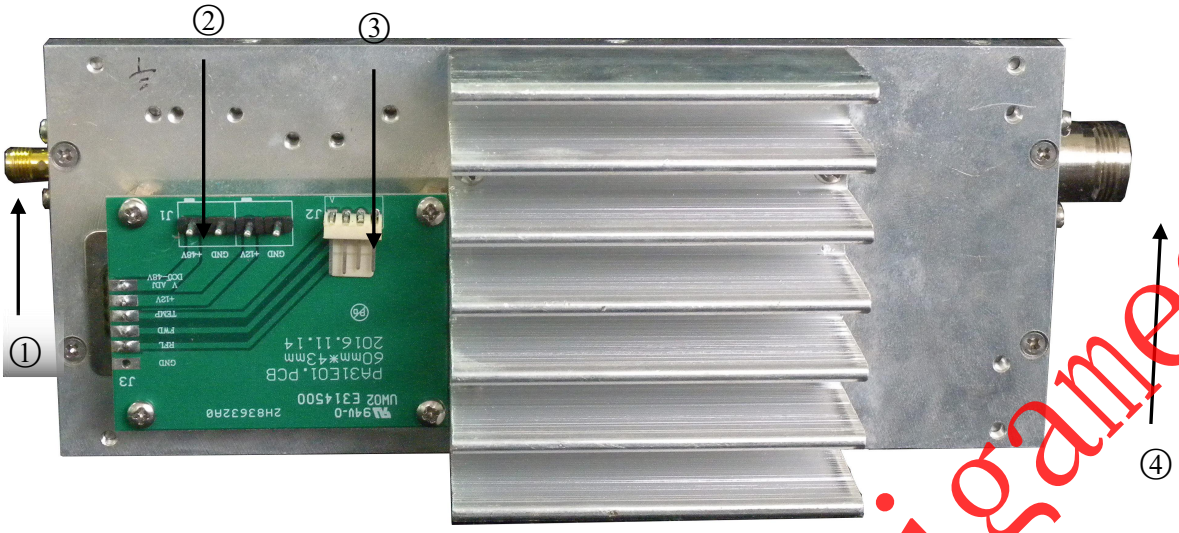


Figure 3-2 Physical Object Photo of Power Amplifier

2.3.1 Basic performance indexes of excitation power amplifier

- **RF part**
  - ✧ Frequency range: 87～108MHz
  - ✧ Input power: ≤4mW(6dBm)
  - ✧ Output power Pout: ≤30W
  - ✧ Gain: ≥40dB
  - ✧ Gain flatness: ±0.5dB
- **Power part**
  - ✧ Power supply voltage: 0 to +50V ≤2A (MAX)
  - ✧ Power supply voltage: +12V ≤0.5A (MAX)

2.3.2 Definitions of interfaces

Interface	Function Description	Connector
1	RF signal input	SMA-K4Y
2	Power input	EK508-2P
3	Signal test and output	S2541-5P
4	RF signal output	N-50KF wiring terminal

2.4 Final stage power amplifier module

Besides amplifying the input signal power, the power amplifier module, which is fixed to the radiator, also has output filter and directional coupler. The output filter filters the harmonic wave signal of the output signal of the power amplifier to prevent the harmonic wave from interfering with the equipment. The directional coupler samples output and reflection signals; some power is taken out by the coupling and sent to the detection circuit; some are output to RF test port. Besides the temperature sensor to output the temperature sampling signal, the power amplifier module is also equipped with the temperature relay to form dual over-heating protection with the temperature sensor. The RF output and monitor ports stretch out to the rear panel directly.

The final stage adopts two import 600W LDMOS power devices MRFE6VP5600H to constitute the balance amplifier which features good mutual isolation, large margin and high reliability. Interior of the amplifier includes the temperature compensation circuit to ensure its stable output power and low temperature drift.

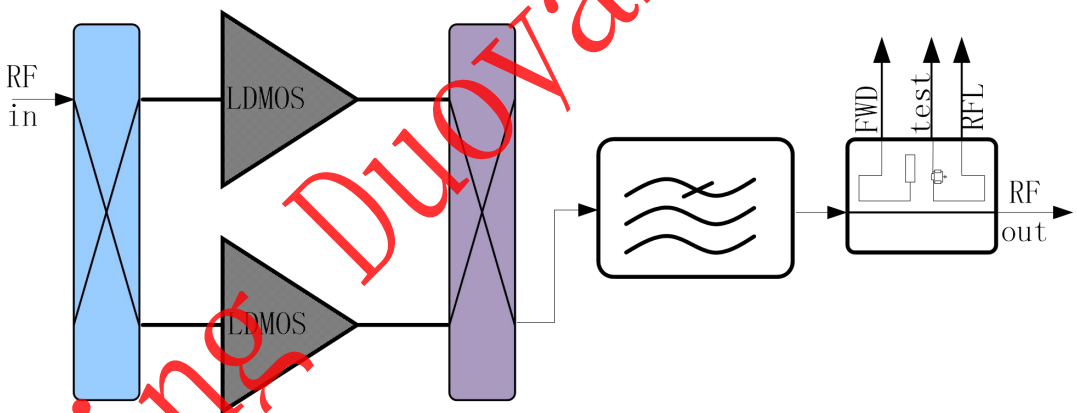


Figure 3-3 Principle Diagram of Power Amplifier Module

2.4.1 Basic performance indexes of final stage power amplifier

➢ **RF part**

- ✧ Frequency range: 87 to 108MHz
- ✧ Input power: ≤20W
- ✧ Maximum output power: 1100W
- ✧ Gain: ≥22dB

- ✧ Gain flatness: ±0.5Db
- ✧ Output harmonic wave <1mW& -60dBc
- ✧ Power supply voltage: DC +50V ≤30A（MAX）

3 Power System

The integrated synchronous FM radio adopts two power modules, with power efficiency equaling to or bigger than 70%.

3.1 +50V/40A switch power

- Input voltage: AC176V to 264V 47 to 63HZ
- Output voltage: DC: +50V
- Ripple wave: 480mV
- Possess functions of output over-voltage and over-current protection
- Power output indication signal includes:
  - Current: output signal voltage value ×25 equals to current
  - Three fault alarm signals are over-voltage, over-current and over-heating respectively. Entire unit displays as one power fault

3.2 ±12V, +5V switch power

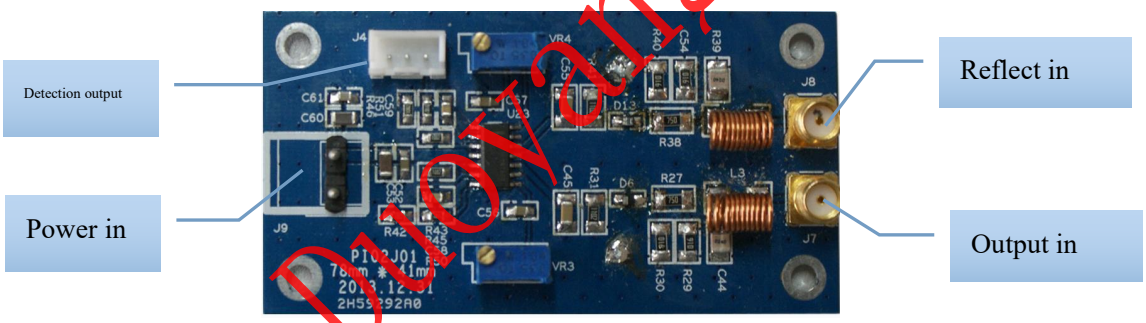
- Input voltage: AC176V to 264V
- Output voltage: DC:
  - ◆ +12V 2A
  - ◆ -12V0.5A
  - ◆ +5V2A
- Power efficiency: 70%
- Ripple wave: 120mV

➢ The power supplies power for the main control panel, modulator, detection board and control panel.

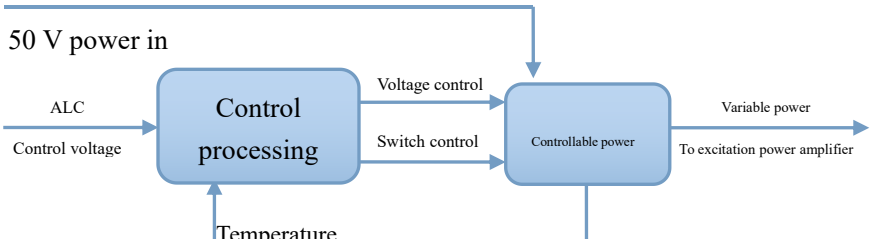
4 Power Test and Control System

The transmitter can work at any designated frequency in the FM frequency band. Interior of the transmitter has the power test and control system which are prepared especially for the broadband transmitter.

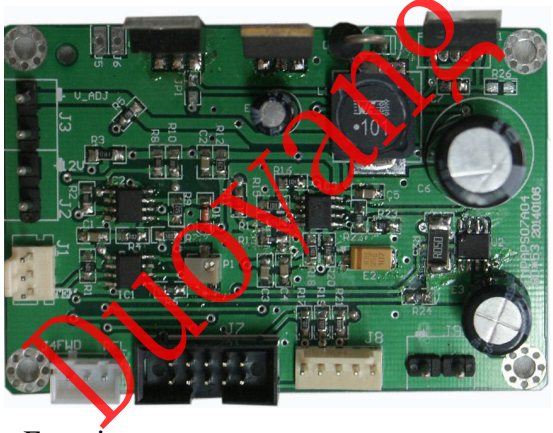
The power detection consists of three small parts including directional coupling, frequency compensation and detection amplification. The frequency compensation and detection amplification are on one circuit board which is known as the detection board as shown in the following figure. The directional coupler takes out the signal output of certain power from the output RF signal and sends it to the frequency compensation circuit. The work feature of the directional coupler itself leads to different coupling output powers; the frequency compensation circuit makes the output RF signal almost identical. In this case, the detection voltage of the detection output meets the requirement of ±10% in the full frequency band.



As the circuit for power control, FMPAPS07A05 has variable power and test signal regulation, processing and combined output, with the principle block diagram shown as follows:



Analog output signals here include detection voltage of output power, detection voltage of reflection, work voltage of final stage power amplifier, final stage work current, work voltage of excitation power amplifier, work current of excitation power amplifier, work temperature of transmitter, etc. When temperature of the temperature sensor exceeds 70°C, output of the variable power is shut off; it can recover its normal work after temperature is normal, with physical object shown as follows:



Definitions of Interface Functions:

Interface Code	Function Description	To
J1	Temperature sampling	Temperature sensor
J2	+12 power	Excitation power amplifier
J3	Variable voltage power out	Excitation power amplifier
J4	Detection voltage input	Detection board
J5	Power grounding	Reserve
J6	12V	Reserve
J7	ALC and analog signal interface	Control panel

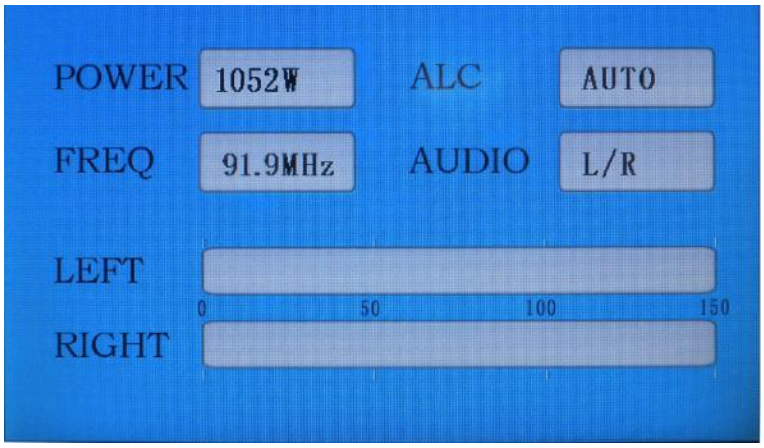
J8	Switch power test	Large switch power
J9	48 to 50V power input	Large switch power

Definition of Interface J7 with Control Panel (ALC)

Interface Code	English Indication	Function Description	I/O Type
01	V10	Voltage sampling	Output
02	GND	Analog grounding	Grounding
03	V20	Voltage sampling	Output
04	REFDET	Monitor voltage of reflection power	Output
05	I10	Current sampling of preceding stage power amplifier	Output
06	FWDDET	Test voltage of output power	Output
07	I20	Current sampling of final stage power amplifier	Output
08	GND	Analog grounding	Grounding
09	TEMP	Temperature test	Output
10	V-ADJ	Control voltage of microcontroller	Input

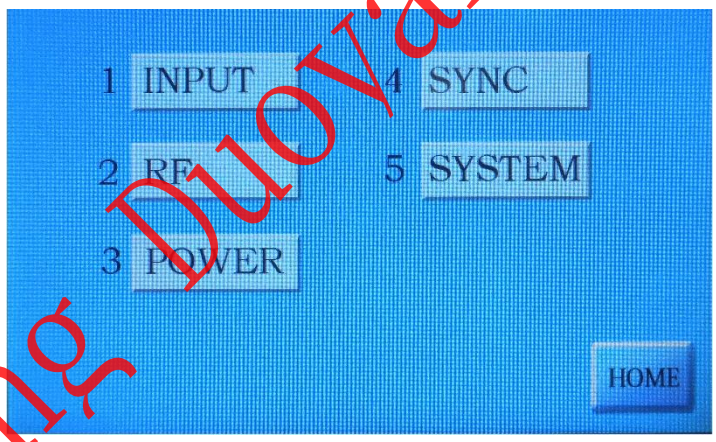
5 Operation and Instruction of Display Screen and Keyboard

5.1 Menu homepage



Enter the default page after powering on the transmitter and turning on the main switch. The default interface mainly displays current output power, loop mode, RF frequency, audio frequency source as well as electrical level statuses of left and right sound channels. Besides, there are two touch buttons Menu and Status. Click them to enter the next menu.

5.2 Set option menu:

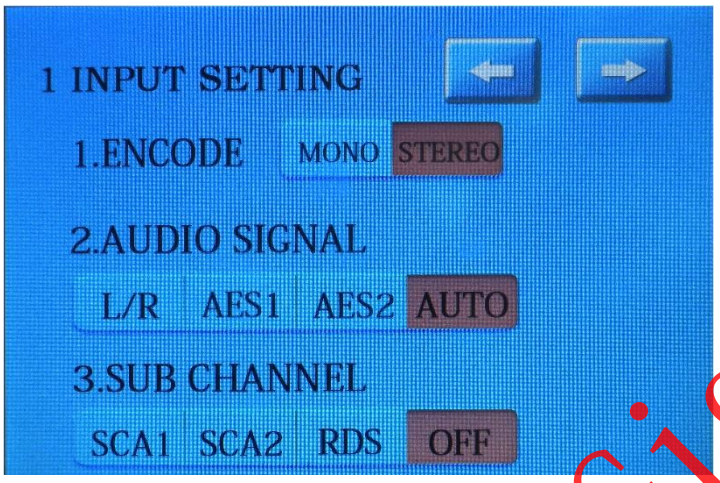


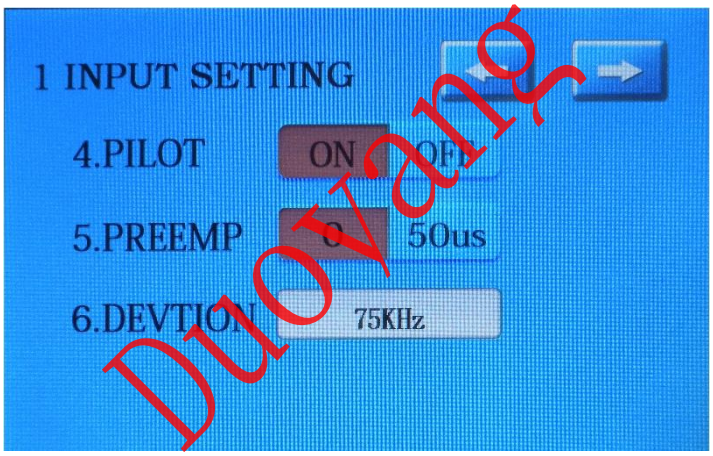
In the default interface, click the menu button to enter the set option menu page which has five options as shown in the figure above. The synchronous set function is not available and is invalid.

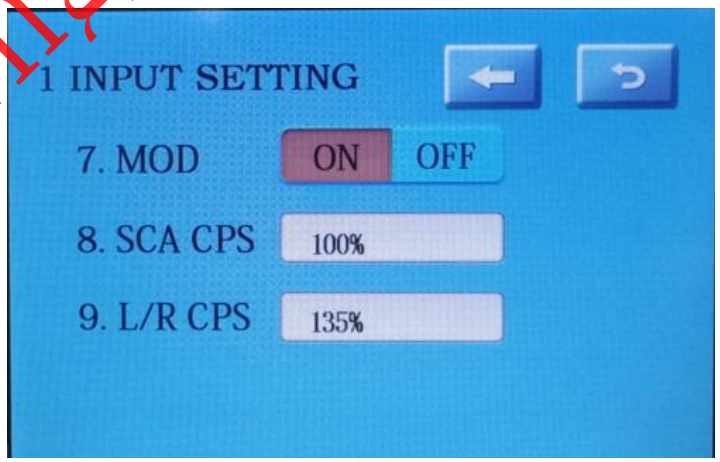
5.3 Input set:

As shown in the figure above, the input set page has three pages, 9 options in total. The first five and the 7th items just require clicking corresponding buttons directly; the other three items require clicking white dialog boxes and entering the specific value set page for setting.

After inputting values in corresponding range, click the confirm button to confirm value inputting.

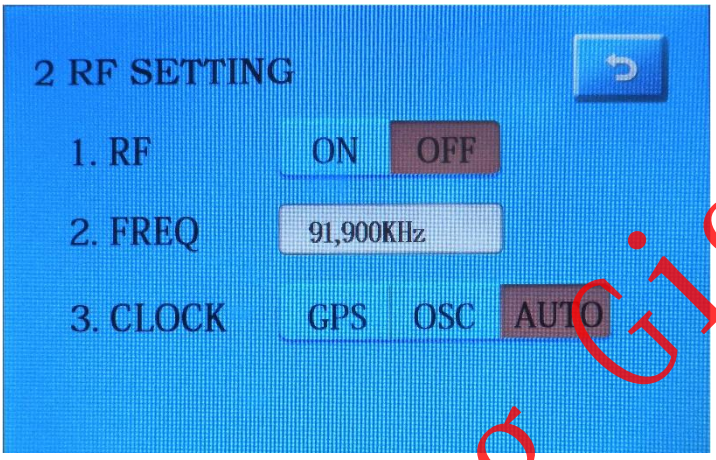






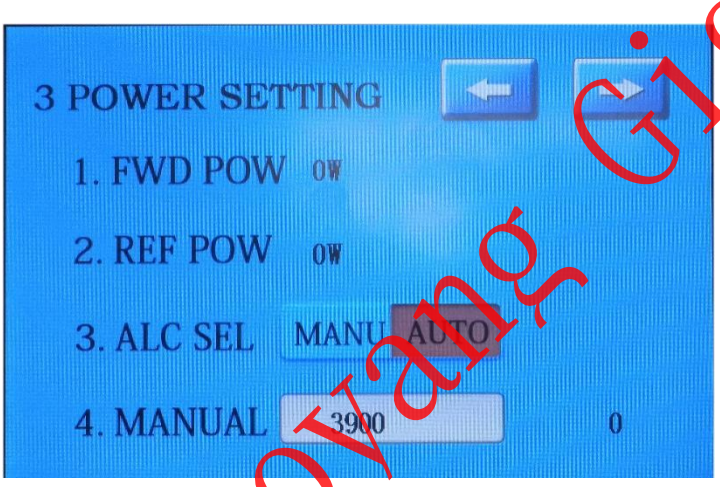
5.4 RF set:

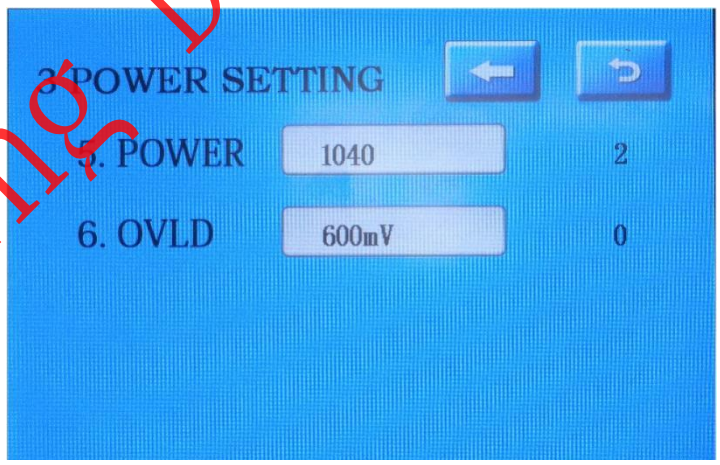
RF set menu has three options. Status of the RF switch decides whether the transmitter has RF power output. And the minimum stepping of the frequency set is 1 KHz; therefore the range of the input frequency is between 87, 000 KHz and 108000 KHz.



5.5 Power set:

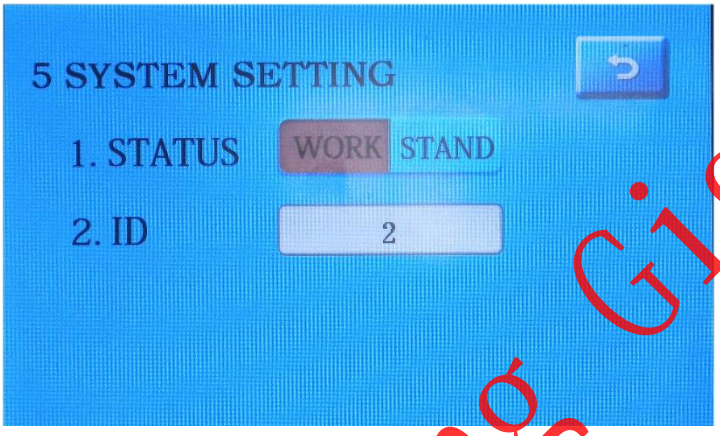
The power set mainly include set output power, control and protection functions. Item 1 forward power and Item 2 backward power only display and have no operation. Item 3, 4, 5 and 6 can be set. There are two values behind Item 4 manual set: the value on the left is the set value and the value outside the box is the current DAC control value (max.: 4095). Click the value in Item 5 forward power set box to enter the set page. Item 6 overload set is to set overload protection point.





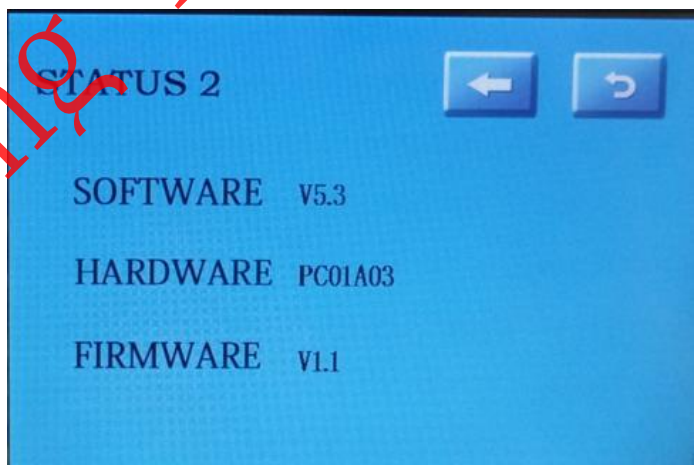
5.6 System set

System set is mainly to set communication address of main and standby units and RS485 equipment. When the button of the standby unit is in dark color, the current equipment is the standby unit and the transmit start has 30s of delay comparing with setting to the main unit.

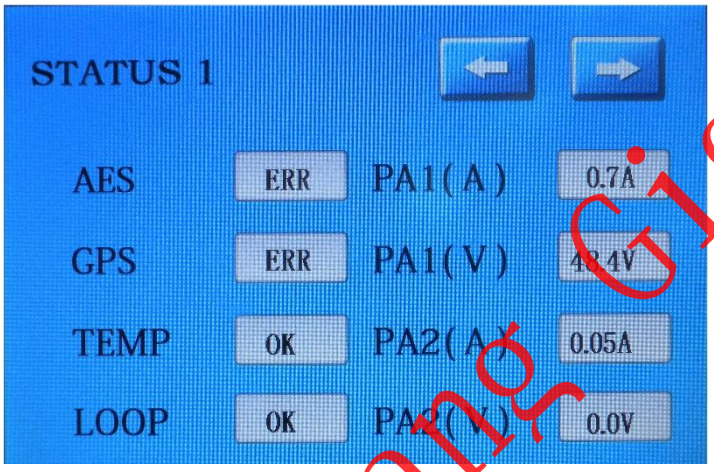


5.7 Status display:

Status display is divided into two pages as shown in the figure below. One page displays basic equipment information including software, hardware and firmware versions.



The second page displays alarm information and work parameters of power amplifier. Power amplifier current 1 is the total current of the final stage power amplifier unit, which shall be within 30A normally. Voltage 1 refers to the voltage of the final stage power amplifier, which is normal between 48 and 50V. Power amplifier current 2 and voltage 2 are the voltage and current of the excitation power amplifier, which are not fixed but vary with power and frequency.



6 Safety and Attentions

I. The transmitter shall be started and operated by professionals only.

II. Since the transmitter has the function of local and remote control switching, please pay attention to the work status before starting it. Before switching to the remote control, the transmitter shall be at the local control startup status; otherwise, the multiple-actuation may appear.

III. Please read the instructions carefully before operating the transmitter.

IV. Work voltage of the transmitter is 220V/50Hz AC power supply; the load capacity of the AC power distribution panel (cabinet) equipped for transmitting is bigger than 2 KVA.

1. Incoming wire section of AC power of the transmitter is bigger than or equals to 2.5mm2 (4mm2 is recommended)
2. Voltage fluctuation range is smaller than or equals to 15%

V. Safe grounding wire

The safe grounding of the transmitter and the machine room shall be connected reliably

VI. Antenna feeder system: to ensure long-term safe operation of the equipment, the antenna feeder requires that VSWR shall be smaller than or equals to 1.2

VII. To ensure safe equipment operation, its air inlet and outlet shall be free from obstructions and have dust removed regularly.

7 Switch-on and Switch-off Operation of Transmitter

Switch-on and switch-off from local control

Connect the transmitter to AC220V power and load (antenna or dummy load). With local and remote control buttons at the popup status, turn on the main switch button on the front panel and energize and start the transmitter to complete the startup operation. There may be seconds of system initialization processes from transmitter energizing to startup; it is the normal self-inspection process when the display screen and the indicator lamps of the front panel flash for several times.

Switch-on and switch-off from remote control

To realize switch-on and switch-off from remote control, first turn the transfer switch on the panel to the remote control status (the button is at the press-in status and the indicator lamp on the switch is on). According to the communication protocol, the remote main unit sends corresponding switch-on and switch-off instructions to the transmitter via the RS485 interface, and the control panel executes corresponding switch-on and switch-off actions based on the order. It is switch-on status at the default status (factory set). Switch-on from remote control can also be operated from the touch screen, i.e. when entering the RF set menu and setting RF status to switch-on, the transmitter powers on the power amplifier simultaneously and the RF indicator lamp on the front panel will be on.