GME1F14 10KW

FM Transmitter Manual

System Introduction

GME1F14 10KW all solid state stereo FM radio transmitter is a new product. The transmitter performance is stable and reliable, with advanced technology, simple operation and easy maintenance.

System Features

- Advanced technology and design concept
  - LDMOS all solid state technology, the whole machine all solid state
  - National patent distribution and synthesis technology
  - Modular design concept
- Parallel redundant design, reducing off the air rate
  - Parallel redundant design of power amplifier: the transmitter has six identical 2000W power amplifiers, which can be backed up and replaced with each other.
  - Backup redundancy design of power supply: ten switching power supplies which are connected in parallel, supply power with average current. and the computer monitors the working status of the power supply.
  - Design of backup redundant exciter: the main exciter and the standby exciter are in mutual backup and automatic switchover. (The backup exciter is optional.)
- Intelligent and networked monitoring system
  - ARM processor control technology has a strong self-diagnostic function.
  - Touch screen design with simple and practical operation.
  - Perfect data detection technology and monitoring system; perfect function of computer control software.
  - CAN bus control system is fast and reliable, easy for using computer management and monitoring.
- Perfect protection measures, ensuring the safe operation of equipment
  - High performance and high power amplifier tube with anti VSWR 40:1.
  - The power amplifier is equipped with protections of VSWR, temperature, over excitation, etc.
  - Switching mode power supply has protections of over-voltage, over current, under voltage, temperature, etc.
  - The whole machine is equipped with VSWR, lightning protection, lack of phase etc.

protection.

- Hot swap technology, convenient for maintenance and operation
  - Amplifier hot swap
  - Switch power supply hot swap

System Composition

GME1F14 all solid state FM transmitter is mainly composed of five parts: the exciter, the RF system (including power amplifier, splitter, combiner, directional coupler, filter, etc.), control system, air cooling system and power supply; please refer to figure 2-1: outline drawing of GME1F14D FM10KW transmitter, and figure 2-2: block diagram of GME1F14D FM10KW transmitter.

Figure 2-1:

Outline drawing of GME1F14 FM10KW transmitter

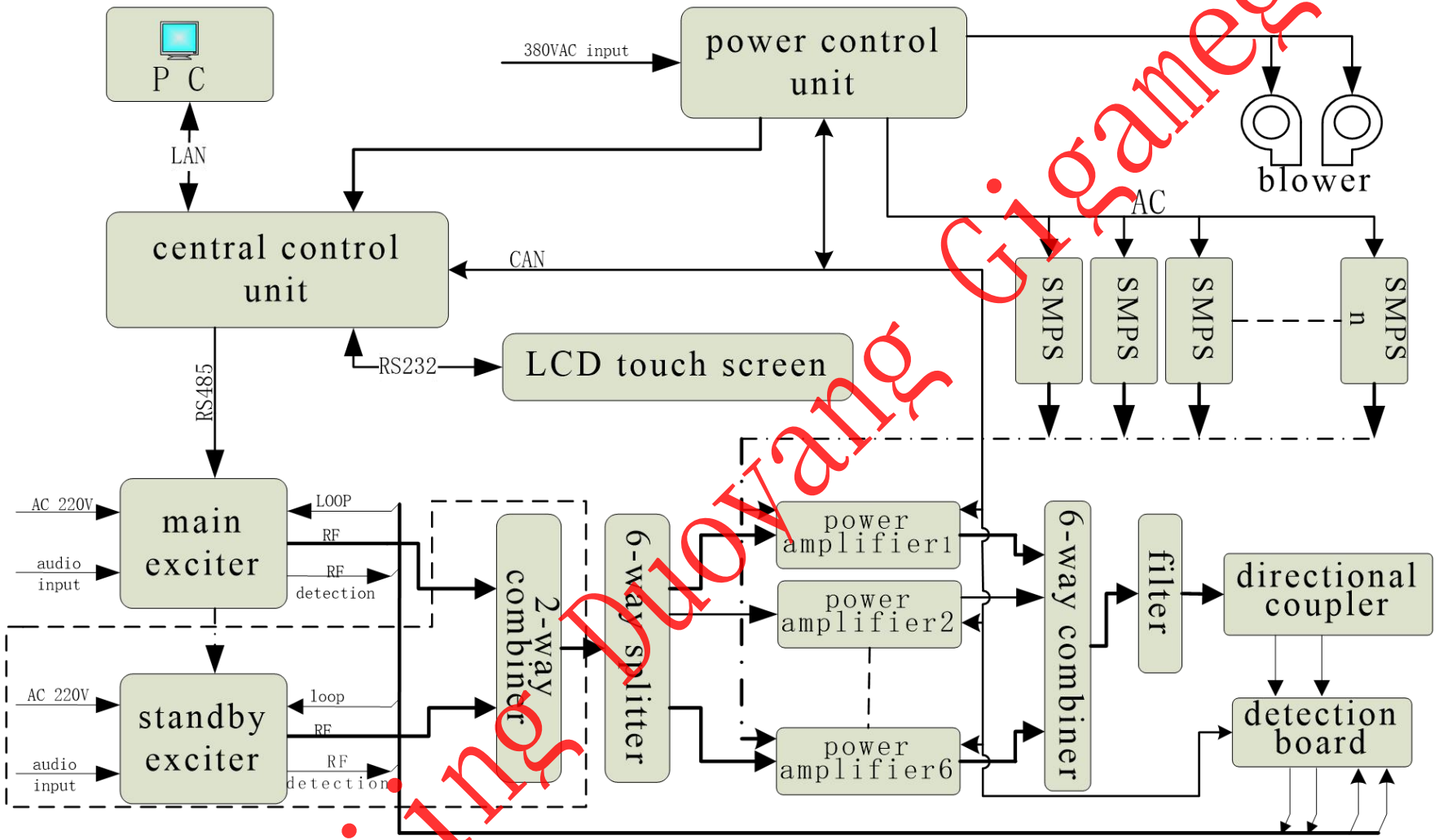


Figure 2-2: Block diagram of FM10KW transmitter

Note: in Figure 2- 2, the dashed box part is the user options, not standard configuration.

Configuration of GME1F14 Transmitter

Configuration of GME1F14 10KW FM transmitter includes standard configuration and user selection configuration.

Technical Index

Ⅰ. General characteristics

Output power	10KW
RF output impedance	50Ω
Output interface	EIA 3-1/8, no flanges (with other interface optional)
Frequency range	87 -108MHz
Frequency stability	+/-1ppm (-10~50°C)
Residual wave radiation	Less than carrier 60dB
Supply voltage	380V/50Hz, three-phase four wire
Power consumption	≤20KVA
Outline dimension	800*996*1800(mm)
Ambient temperature	5-40°C
Altitude	≤2000m
Relative humidity	≤95%
Remote interface	LAN

Ⅱ. Audio index

1. L/R input stereo radio

Audio input interface	XLR balanced or unbalanced
Audio input impedance	600Ω (balanced) or10KΩ
Audio input level	-13dBm~+14dBm
Pre-emphasis time constant	0、50、75us (opitional)
Frequency response	±0.5dB (30Hz~15KHz)
Harmonic distortion	≤0.5%，(30Hz~15KHz)
FM signal to noise ratio	≥65dB
Left and right channel separation	≥45dB, 100% modulation (30Hz~15KHz)
Left and right channel level difference	≤0.4dB

Pilot signal frequency deviation	±1Hz

2. MPX input stereo radio

Audio input interface	BNC unbalanced
Audio input impedance	10KΩ
Audio input level	-13dBm~ +14dBm
Frequency response	±0.2dB (30Hz~100KHz)
Harmonic distortion	≤0.1%，(30Hz~100KHz)
FM signal to noise ratio	≥65dB
Left and right channel separation	≥50dB, 100% modulation

3. Single channel broadcasting

Audio input interface	XLR balanced or unbalanced
Audio input impedance	600Ω (balanced) or10KΩ
Audio input level	-13dBm~+14dBm
FM signal to noise ratio	≥65dB
Frequency response	±0.5dB (30Hz~15KHz)
Harmonic distortion	≤0.3%，(30Hz~15KHz)

4. SCA/RDS characteristics (options, decided by the exciter type)

SCA input interface	BNC unbalanced
SCA input impedance	10 KΩ
SCA input level	-20dBm~+10dBm
Frequency response	±0.2dB (40KHz~100KHz)

exciter

GME1F14 10kW transmitter gives full consideration of different types of user needs in the design; the exciter configuration is flexible and can be equipped with any panel height less than or equal to “2U”, with exciter of output power equal to or greater than 30W.

The standard equipment of GME1F14 exciter is GME3F31, but the user can choose to use double exciter configuration. In addition, the user can also choose other types of exciters according to their needs, such as RVR PTX-LCD type exciter and user-owned of other types of exciters. However, if the user chooses the other types of exciter (not the types mentioned above), control system will not be able to do exciter monitoring, including the loop regulation.

Control System

This chapter briefly introduces the composition, function, principle and operation method of the GME1F14D transmitter control system.

Control System Overview

GME1F** series FM transmitter control system is based on CAN and RS485 Protocol "classification" monitoring system, and its structure is shown in figure 4-1. It is composed of:

- “First level subsystem”: the central control unit (CCU), the subordinate units CAN, RS485 and RS232 interface;
- “Second level subsystem”: amplifier unit, CAN bus;

  Power control unit unit PCU, CAN bus, and its subordinate subsystem the power management board;

  The output power detection board, CAN bus;

  The exciter (considering the general configuration of different exciter, use RS485 interface, a total of two exciters);
- “Third level subsystem”: switching power management board PSC, with the higher level of the Power control unit board.

The GME1F14 control system is the "command" center of the transmitter. Its functions include:

- Transmitter logic control: including open, shut down operation, etc.
- Equipment fault protection and alarm: VSWR, temperature, etc.
- Running status indicator.
- The main work parameters measurement instructions: such as the output power, voltage, current, etc.
- Equipment working parameter setting.
- Remote control equipment (PC) communication: receiving remote control PC instructions, reporting equipment operating status and parameters.

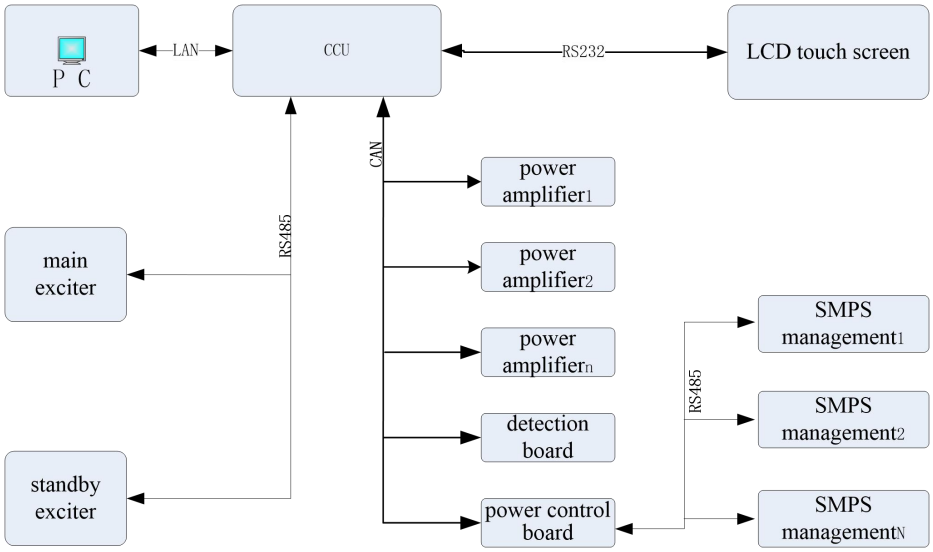


Figure 4-1: GME1FXX series FM transmitter monitoring system structure

Central Control Unit

The central control unit is the center of the whole transmitter control system. It is responsible for the external communication and the data collection and control of the other sub units in the transmitter. The central control unit uses ARM9 as the core processor. In structure, it adopts the method of the core board plus bottom interface, which is convenient for system maintenance. The central control unit is equipped with LINUX operating system, so the power on initialization time may be longer than the starting time of the system using CCU as the core processing system. But in the operation process, it adopts multi threading work, by which the problem are treated with more efficiency than single thread work.

The central control unit is composed of two parts: the control board of the ARM chip and the switch power supply; for principle block diagram, please refer to Figure 4-2.

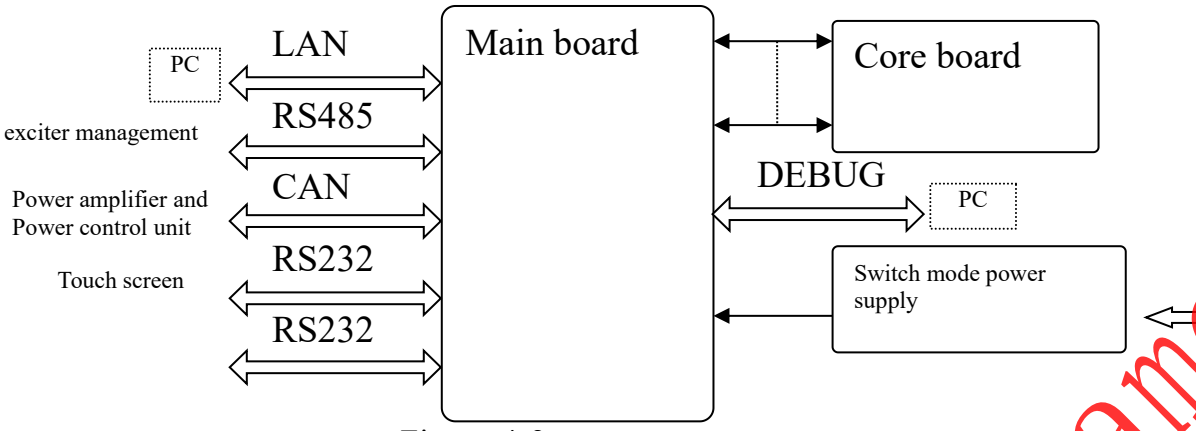


Figure 4-2: Block diagram of central control unit

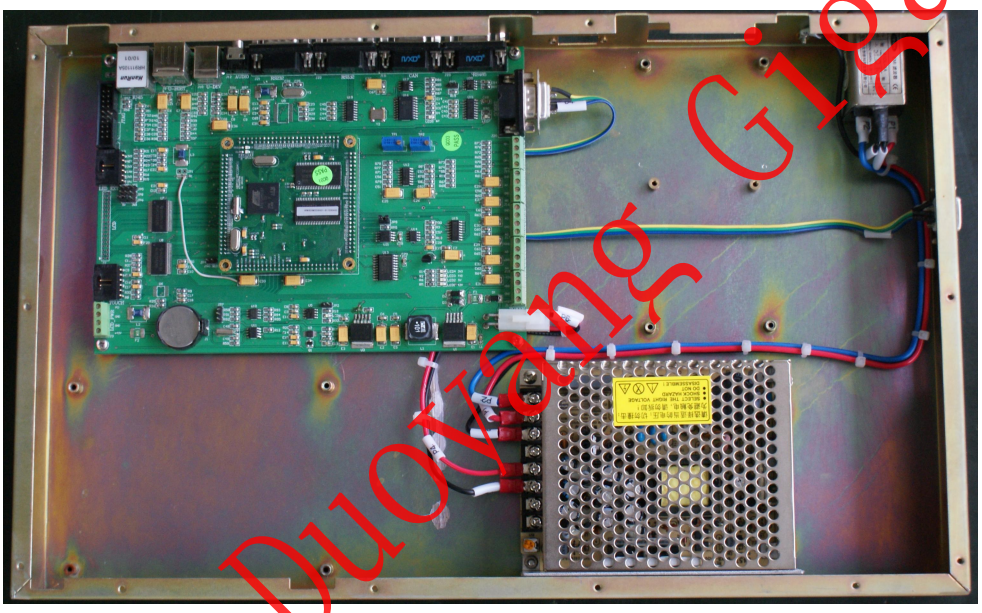


Figure 4-3: central control unit

➢ External interface

The external interface of the central control unit includes the following types (please refer to the block diagram of the central control unit):

- An LAN port: interface for the transmitter and external monitoring device, in accordance with the Ethernet standard.
- Three USB port: mainly used for downloading software.
- A CAN bus interface: for internal power amplifier unit and detection unit to control the communication between Power control unit units.
- Data communication interface (RS485): mainly to communicate with the exciter.
- Data communication (RS232) interface: the central control unit has three foreign RS232, among which one is for the touch screen communication, one is the main

control of the DEBUG port, as well as the RS232 standard, and the last one is a reserved interface.

➢ Introduction to the function of central control unit

The central control unit is the core of the transmitter, which has the following functions:

1. Human computer interaction function: the central control unit achieves human-computer interaction through the plug-in touch screen. Operation on the touch screen can observe the operating parameters of the main parts of the system or set the parameters of the system, etc.
2. Transmitter data collection: collecting whole machine data and unit data for main components such as exciter, power amplifier, power supply unit, etc., recording fault information, occurrence time and fault point of the transmitter; the operator can access the data from the LCD touch screen.
3. Control over the open, shutdown mode of the transmitter: GME1F14 transmitter provides two kinds of open, shutdown mode, that is, manual/automatic mode, the central control unit in automatic mode provides four kinds of open, shutdown mode:
   a) Button switch open, shutdown mode KEY: open, shutdown button control on the touch screen;
   b) Remote control switch mode REM: control over the open, shut down mode in the monitoring PC machine;
   c) Timing switch mode TIME: the open and shutdown settings can be carried out regularly in both central control unit and PC machine;
   d) Coexisting mode ALL: the coexistence of “button switch open, shutdown mode KEY”, “remote control switch mode” and “timing switch mode”.

   Switch priority: Key, Time and Rem, from high to low.
4. User settings
   a) The system time, cumulative work time, the transmitter local address, transmitter type, exciter type etc.; the exciter type requires manual setting if the setting error may cause the transmitter being not able to read the exciter parameters.
   b) Automatic switch mode: key KEY, timing TIME, remote control REN and coexistence model ALL;
   c) Timing on and off schedule.
5. Data display: display through the front door on the touch screen.

a) Time information: system time, timing on and off time, equipment cumulative working hours, etc.

b) Whole machine information: on and off state, incident power, reflected power, VSWR, fault information of the whole machine, etc.

c) exciter information: main state quantity of the exciter.

d) Amplifier information: the number of amplifiers, and the power, voltage, current, fault information (temperature, over actuation, VSWR) of the amplifier.

e) Power information: the number of switch mode power supply and the parameters of each switch mode power supply .

6. PC communication with monitoring: through the special monitoring software, monitor PC can communicate with the central control unit.

a) Receive the PC inquiry instruction, and report the machine state;

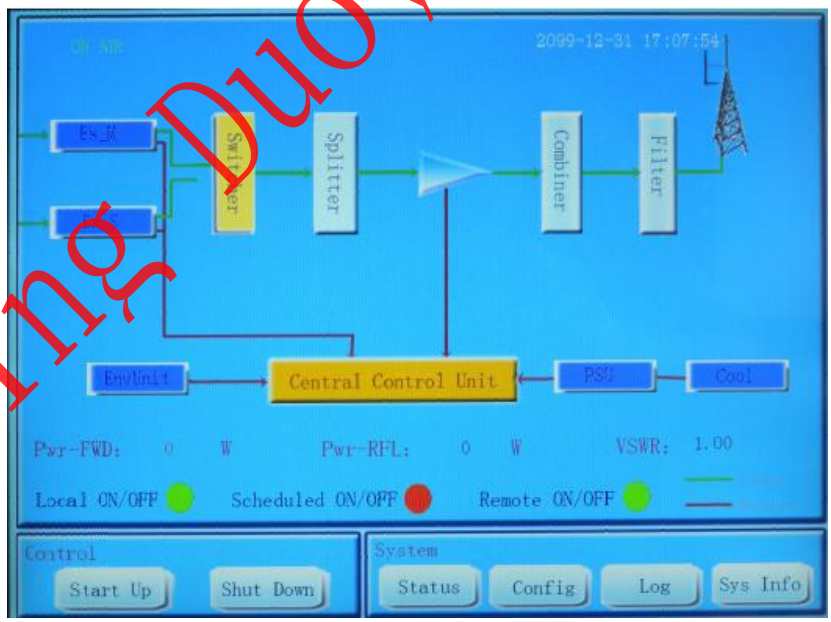
b) Accept the PC machine settings: switch mode, control parameters, etc.;

c) Receive PC machine control instructions, such as open, shutdown operations, etc.

d) Operate the exciter, such as changing the operating frequency and output power.

Display and Operation of Touch Screen

1. Default interface



The upper left corner of this interface is the working status indication; when the main control is in normal standby, the touch screen displays as is shown above, displaying words “BY STAND” in the upper left corner of the screen. The “ON AIR” message on the transmitter means that the transmitter has a radio frequency output.

The middle part is the system block diagram of the transmitter; by clicking icons of “exciter”, “Y (PA)” and “control unit” in the diagram, one can directly enter the corresponding parameter display interface.

At the bottom of the system diagram, it is the indicating positions for output power, reflected power and the location of the VSWR. If the display value background becomes red, it indicates that the current number is out of the system. Please pay attention to finding out the reasons.

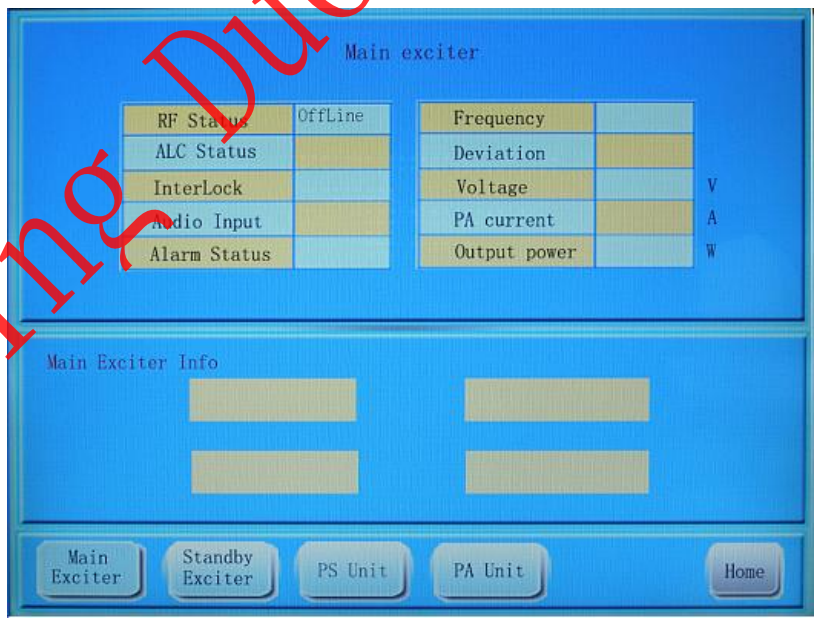
Then the following is the control mode display area, there are three modes: local automatic, time switch, and remote control switch. When the character behind the circle is green, it means the current control mode is valid; if it is gray, it means this mode is disabled.

2. System initialization

In the system, as long as the main switch of the transmitter is closed, the touch screen will be in constant brightness; if the transmitter, after the results work, does not need remote control switch, it is best to cut off the transmitter power to ensure the safety of the whole transmitter.

Note: in the transmitter, since the closed circuit breaker, for about 1min is the time for power initialization of the central control unit, at which time, the screen may display all and all operation is invalid wait. In the initialization process, the working status character, the power value, the number of the power amplifier, etc of the transmitter will not be displayed.

3. exciter interface parameters



exciter parameters is divided into two pages of main exciter and standby exciter; when the exciter is not open or do not exist, the display parameters in the working state column will be

offline. Other parameters can be displayed when they are working online.

Loop state: manual, inner and outer rings, three kinds in total. The inner loop is formed inside the exciter itself, and the outer ring is a large loop formed by the exciter with the last stage power amplifier module.

Interlock condition: when the exciter is locked by other devices (main exciter locked by exciter, or standby exciter locked by main exciter), it shows “Locked”. For RF output, it shows “Normal”.

Audio mode: displays the current driver audio signal source type, including AES (digital audio) and analog audio.

Alarm state: refers to general alarm state of the exciter; as long as the exciter has a warning, it displays “ON”.

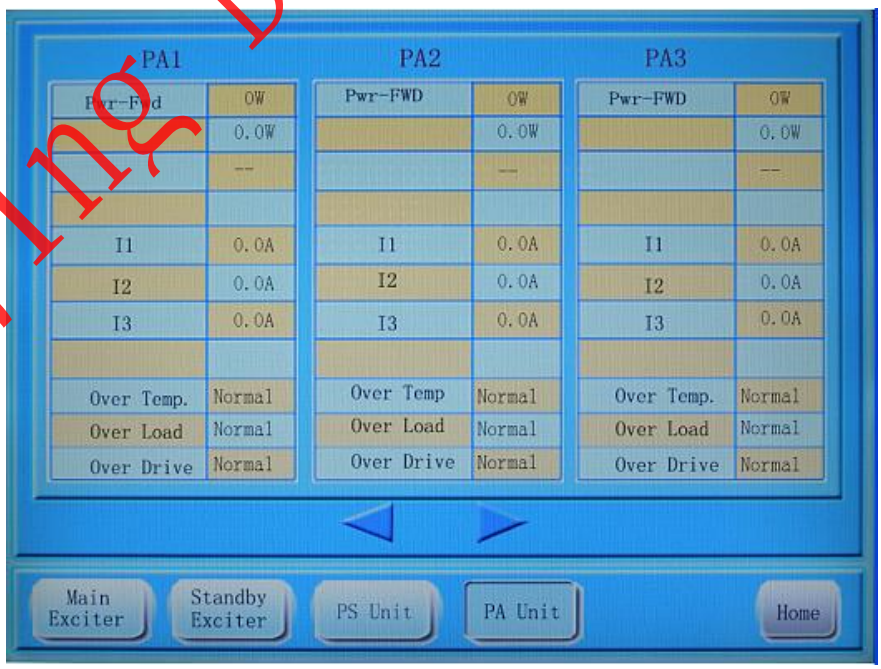
Working frequency: displays the working frequency of the exciter, with the unit of MHz and the display precision 0.1MHz.

Frequency offset: display unit of KHz and display precision of 0.1 KHz.

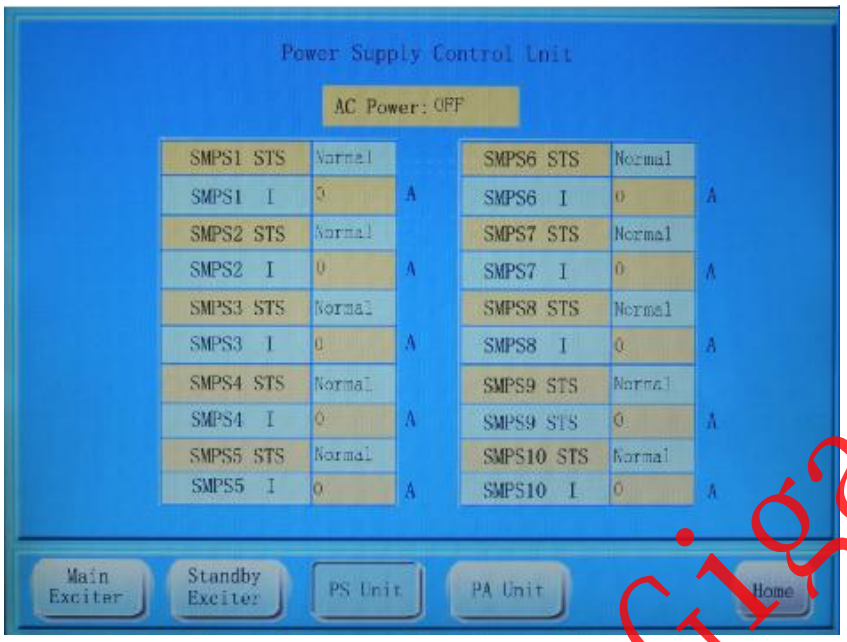
ALC voltage: exciter ALC loop control voltage; the voltage can only be displayed when using the exciter produced by our company. For instance, RVR exciter does not belong to this type.

Small power amplifier current: refers to the working current of the incentive final stage power transistor, with display precision of 0.1A; in the lower part of the exciter information bar, it displays detailed fault names.

4. Power amplifier parameter interface



5. Electric control parameter interface



In this system, the current parameter of the switch mode power supply is collected from the power management board, to the electric control board, and to the central control unit. The machine has ten of switch mode power supply status in total, displaying on the screen.

Power state: if the display is normal, the switch power supply has no alarm information.

Power X current: the user can judge whether the switch mode power supply is under mean flow work according to the three current instructions on this surface.

6. System settings

The system is set with the system time, IP address, timer switch, control mode, and other settings. At the bottom of each page, there are several page switch buttons for the above parameter settings. Each part is shown as follows.

1. Time setting:

2. IP address setting:

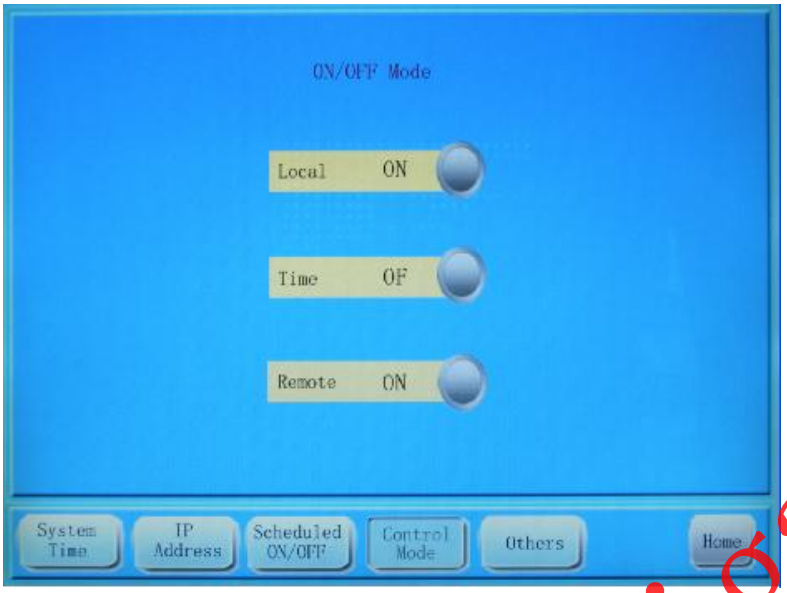
The transmitter adopts the TCP/IP protocol, and the related IP address setting should be done by the user according to the actual network environment.

3. Timing switch setting

As is shown in the figure, the timer switch function is designed for seven days a week, four open shutdown time a day. The transmitter, under the timing switch mode operation, works in the manner of a seven day cycle.

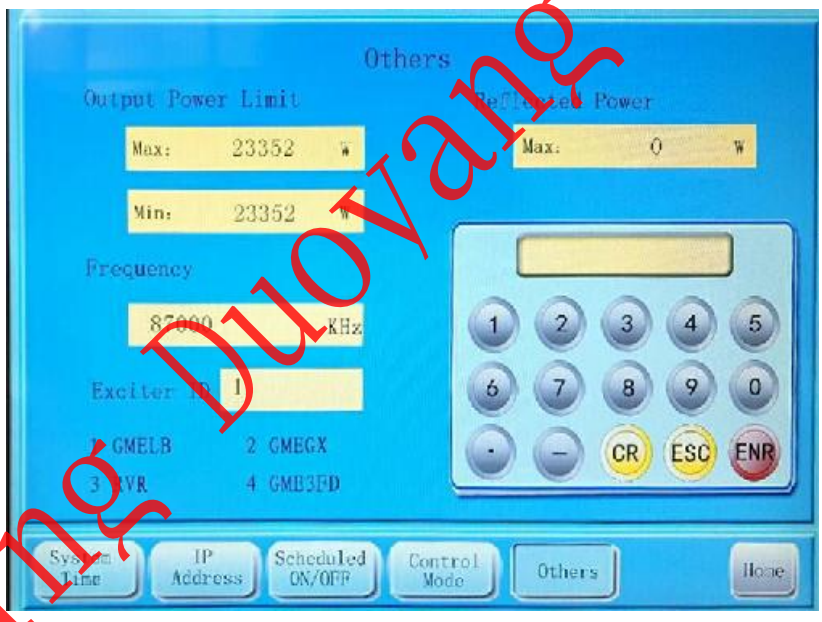
Setting: first selected on the day, the selected button of the day will be different from others. Then point the cursor to the corresponding time period of the boot or shutdown time bar, and click on the right side of the keyboard to input the set time, and to click “ENR” after the setting. Note: the boot time should be shorter than the shutdown time; otherwise it may cause errors, resulting in failure hindering normal time set for automatic switch operation.

Control model



The current display is entering the control mode settings page. Clicking the circular button can start the corresponding control mode, in which the sign “On” means that this function is valid.

4. Other settings:



The upper and lower bounds on output power, the upper limit of the reflected power alarm should be set here, and the most importantly, the type of exciter. If the exciter type is not set here, the exciter parameters may not be correctly read. The “GME DEX” of the exciter type refers to GME3FN31B, GME3FN31E series FM exciter, adopting digital processing technology, produced by our company. GEE refers to the GME3FN31A exciter produced by our company. RVR refers to the PTX-LCD series exciter produced by Italian RVR Company.

Switch Mode Power Supply Management Unit (SMPS)

switch mode power supply management board, in the equipment control system, is the lower unit of the Power control unit unit, responsible for collecting the information of the switch power supply, and sending the data to the host computer. A switch mode power supply management board can manage as many as 8 SPS series switch mode power supply , which can meet the needs of FM 1~10KW transmitter. Its block diagram is shown in Figure -X.

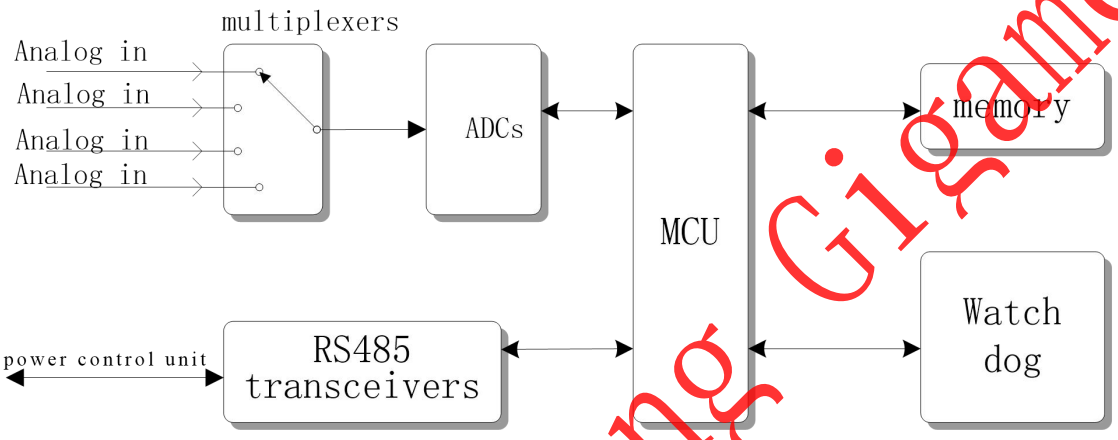


Figure 4-8: Block diagram for switch power management board

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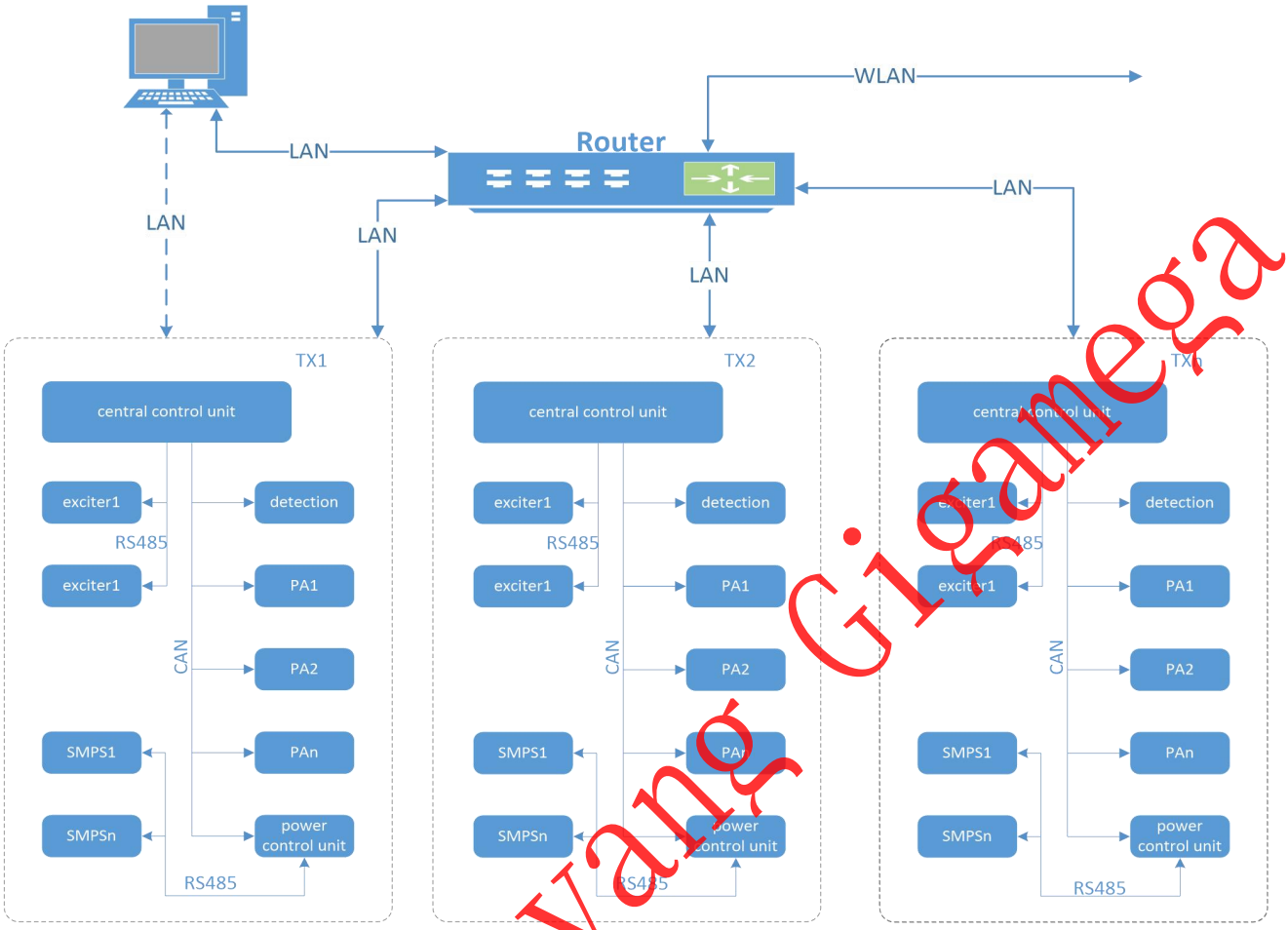


Figure 4-11: Computer monitoring system of GME1F14 series transmitter

RF System

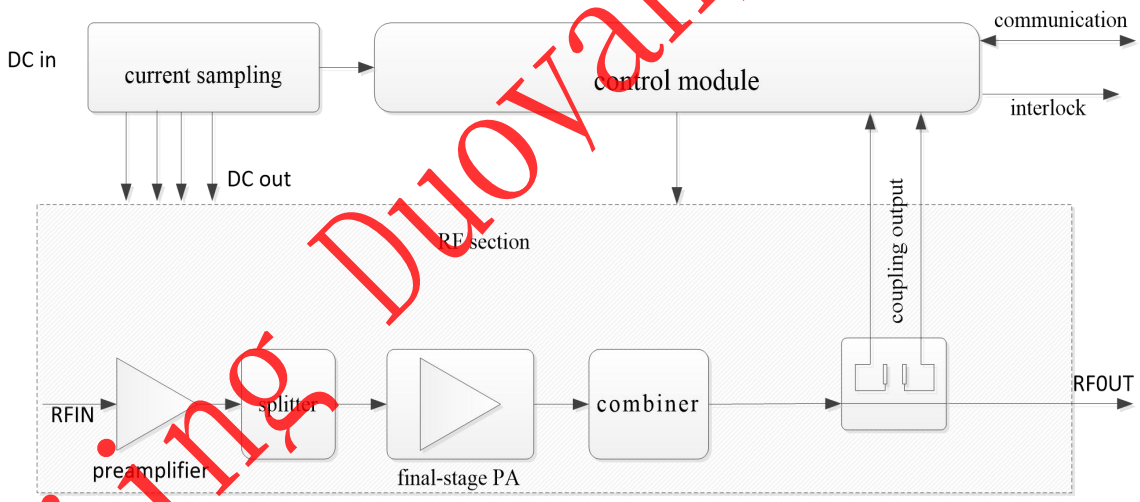
GME1F14 RF transmitter system can be divided into two parts: the active part and the passive part; the active part is mainly the power amplifier, and passive part comprises splitter, combiner, output filter, directional coupler, and double exciter switching unit in double exciter configuration.

Power Amplifier Unit

In Chapter Two Transmitter Configuration, we have introduced the GME1F14 transmitter with 6 GME0F23A03 2000W power amplifier units.

Ⅰ. 2KW power amplifier unit (PAU)

2KW power amplifier unit is mainly composed of RF power amplifier, passive power distribution, synthesis, filtering (optional), current distribution and sampling, signal detection and control (see instructions of amplifier measurement and control) and other parts. As is shown in the following figure:



2000W amplifier (PA), in the control board, has fault protection in temperature, over excitation, overload and others; when there is fault indication, it will turn off the gate voltage to actuate the power amplifier to protect the power amplifier. Because the single power amplifier output power is too large, the fault protection system also needs to cooperate with the exciter interlock. Coupled with fault protection, there is light emitting diode display in the amplifier panel.

Figure 5-7: Power amplifier

Table: Technical indicators for 2000W amplifier (PA)

Frequency range	87-108MHz
Power supply voltage	+48V
Input interface/impedance	C9-50J
Output interface/impedance	7/8"/50Ω
Output power	≥2000W
Gain	≥42 dB
Efficiency	≥75%
Temperature protection point	70±5℃
VSWR protection point	VSWR≥2
Over excitation protection point	Excitation power increased by 0.8dB
Cooling	Forced air cooling

Ⅱ. Current distribution and sampling

The main function of current distribution and sampling plate is divide the DL29 power supply and DC power supply with signal interface into the power amplifier into multiple DC output. After sampling circuit, give power supply to each final stage power transistor. The sampling circuit converts the DC current into a voltage signal, which is used to measure the working current of each power tube.

Ⅲ. GME0F23A03 power amplifier unit

GME0F23A03 power amplification unit is a 2000W power amplifier (please refer to Figure 5-2), composed of a maximum output of 30W pre amplifier with four 600W power amplifier module, by two distribution, synthesis and directional coupler, with 42db gain and the maximum output power of 2000W. Among them, the compound of two power amplifier tubes adopts the orthogonal bridge mode with better isolation characteristics, in order to reduce the interaction of two power amplifier modules.

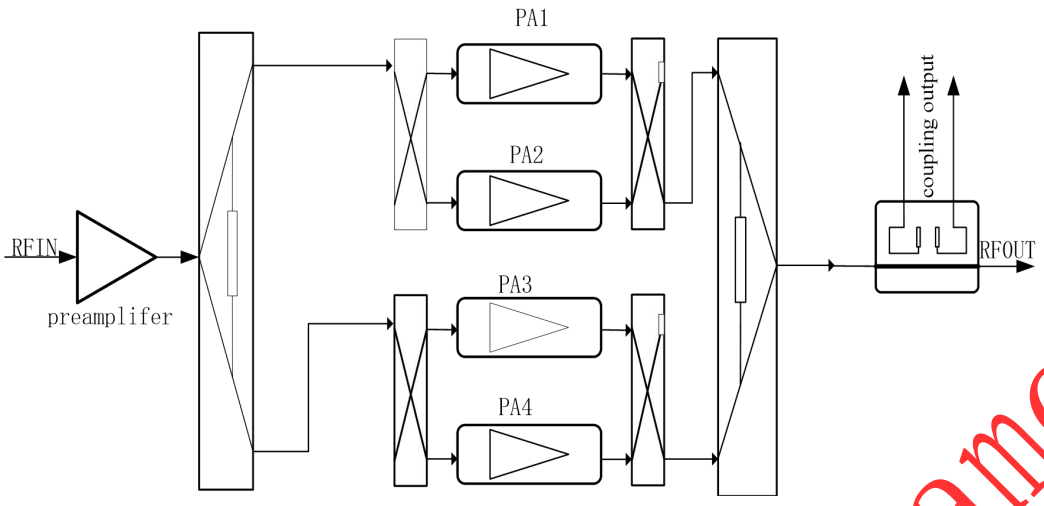


Figure 5-2: Block diagram for GME0F23A03 amplifier (PA) principle

600W single power amplifier module (PA)

The core component of GME0F23A03 power amplifier is the LDMOS tube MRFE6VP5600H with 600W output. The circuit is designed as "push-pull" mode (refer to Figure 5-1). Input uses a transmission line transformer, changes the single ended signal directly into a balanced way, at the same time, with the function of impedance transformation. Output also adopts the first coaxial wire to do the impedance transformation, and then through a balanced unbalanced conversion to realize output. The system is in broadband design, with working voltage of 48VDC, gain of about 26dB, and the maximum output power of about 600W.

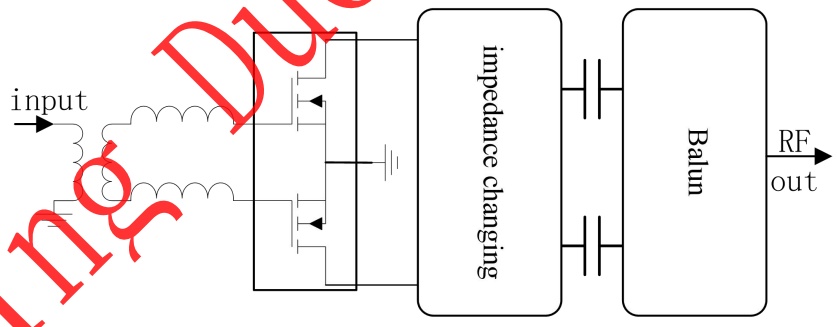


Figure 5-1: Block diagram for 650W power amplifier

Power Supply, Air Cooling System

Ⅰ. Alternating current (AC) power supply system

GME1F14 transmitter uses 3 phase 4 wire 380VAC power supply; AC power supply system includes the power distribution unit, switch control panel and equipment on the bottom of the lightning arrester. Please refer to schematic diagram of distribution unit GME7F14C.

AC power supply system completes the AC power distribution, control, protection, alarm and interlock of the whole machine.

- Power distribution: distribution unit provides power supply for all AC power supply unit in the equipment, including exciter, wind machine, switching mode supply, etc.
- Control: control unit CJ4 completes the control over fan opening and closing; CJ3 completes the control over the switch mode power supply and the exciter.
- Protection: a lightning arrester is installed on the bottom plate of the equipment to complete the three stage lightning protection; the power control unit is provided with short phase, wrong phase, AC power supply overvoltage, under voltage protection, over voltage, under voltage and fault;
- Alarm: when the AC power supply is in protections of missing phase, wrong phase, over-voltage and under voltage, the "phase indicator" light on the switch control panel emits sound and light alarm;
- Interlocking: Power control unit unit design ensures the safe operation of equipment (including the transmitter external coaxial switch, load work needs), and sets the chain contact. During boot time, the interlock point must be closed; otherwise the transmitter can not work, so as to protect the machine and other related equipment for safe operation.
- Switch machine: the switch machine of transmitter is divided into manual and automatic. In automatic way, according to the procedures set by the process, electric control board and corresponding relay controls the power supply of each corresponding component; in addition, the front panel of the cabinet is provided with a manual emergency switch machine button, and the button is provided with a light bulb.

Ⅱ. Switch mode power supply

The final amplifier of GME1F14 transmitter uses 10 switch power supply in 48V (HX2K5VH01-50V) for power supply, the switch mode power supply adopts three-phase three-wire input, with input AC power of 380V50Hz and rated output current of 50A. All the

switch mode power supply output are received together to form parallel current sharing power supply; these power supplies always have a power supply current greater than the other power supplies, with the maximum power supply output current difference about 2A; If the difference is too large, it is necessary to check whether the power of the output voltage is equal. Switch power supply has protection function in temperature, voltage, current, etc., and can be charged pressure hot swappable, convenient for online maintenance (note: to minimize the number of plug use in other normal work of the power supply, so as to avoid the large DC's burning the interface in instant access); for the external interface reference, please refer to Figure 6-1.

Figure 6-1: HX2K5VH01-50V external interface

Pin	Meaning	Pin	Meaning
1	AC380V input	11	grounding
2	AC380V input	12	hot-swap control
3	AC380V input	13	to cover
4	over temperature	14	DC output positive
5	current sharing	15	DC output positive
6	input under voltage	16	DC output positive
7	output over voltage	17	DC output negative
8	current output	18	DC output negative
9	hot-swap control	19	DC output negative
10	grounding		

Figure 6-1: Definition of HX2K5VH01-50V-48 external interface

switch mode power supply is a device to convert AC into DC, which can generate large heat in the conversion process. As the wind turbine is a vulnerable device, in the process of operation, attention should be paid to the working state of the fan; if there is a large abnormal sound, please timely replace the fan, so as not to affect the normal operation of the entire

power supply.

Air Cooling System

Transmitter GME1F14 adopts the forced air cooling method; the cooling components include exciter, power amplifier (PA) and +48V power switch. Exciter, switch mode power supply , etc. are equipped with internal fans, the amplifier cooling fan system is located in the middle part of the machine cabinet, using the method of following air in-taking and the cover air out-taking. The main fan adopts centrifugal fan, which has the advantages of large wind volume, high wind pressure, low noise, with consideration to the stability of the transmitter and redundancy; 10KW machine adopts four centrifugal fans, with mutual backup.