100W UHF
Terrestrial Digital Television Broadcasting Transmitter

Techinical Manual

V1.0

1. Overall Unit

1.1. Overall unit structure

100W air cooled UHF DTV transmitter is composed of 1 or 2 exciters, a power amplifier (PA) unit and passive components (divider, combiner, filter, directional coupler, etc.). It's usually installed in a 1.3 meter high standard 19 inch rack.

PA unit is a 5U chasis, integrated with power amplifier module, central control unit (CCU) and monitoring screen, switching mode power supply (SMPS), air cooling fan and so on, with high integration degrees level.

This transmitter has small volume and compact structure. Multiple transmitters can be installed in single cabinet, convenient installation and operation.

Fig. 1 Front view of the overall unit

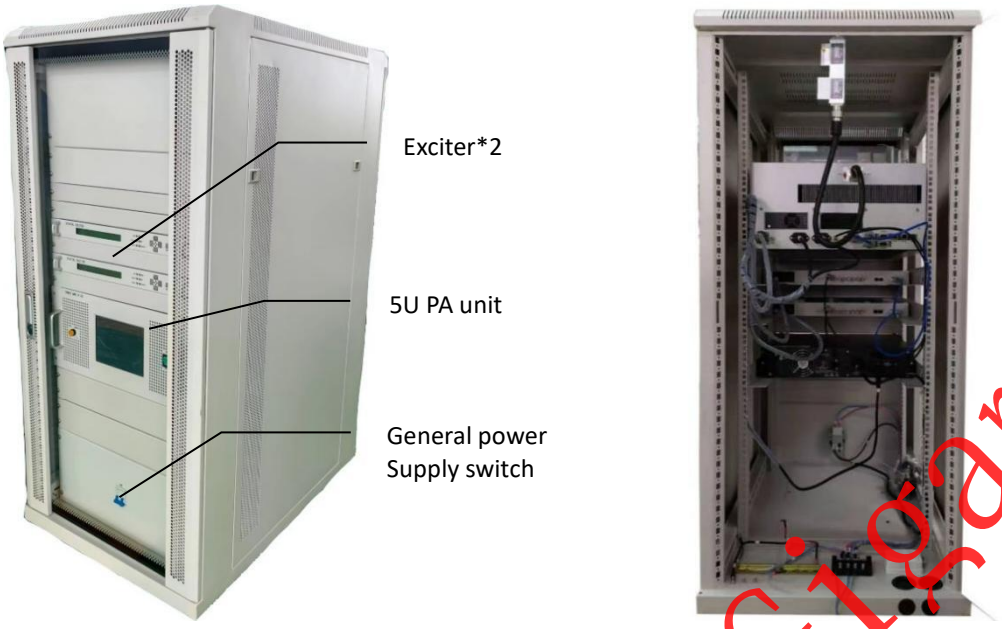


Fig.2 Front and rear view of the cabinet

1.2. Principle of the overall unit

Principle block diagram of the overall unit is shown as figure 3.

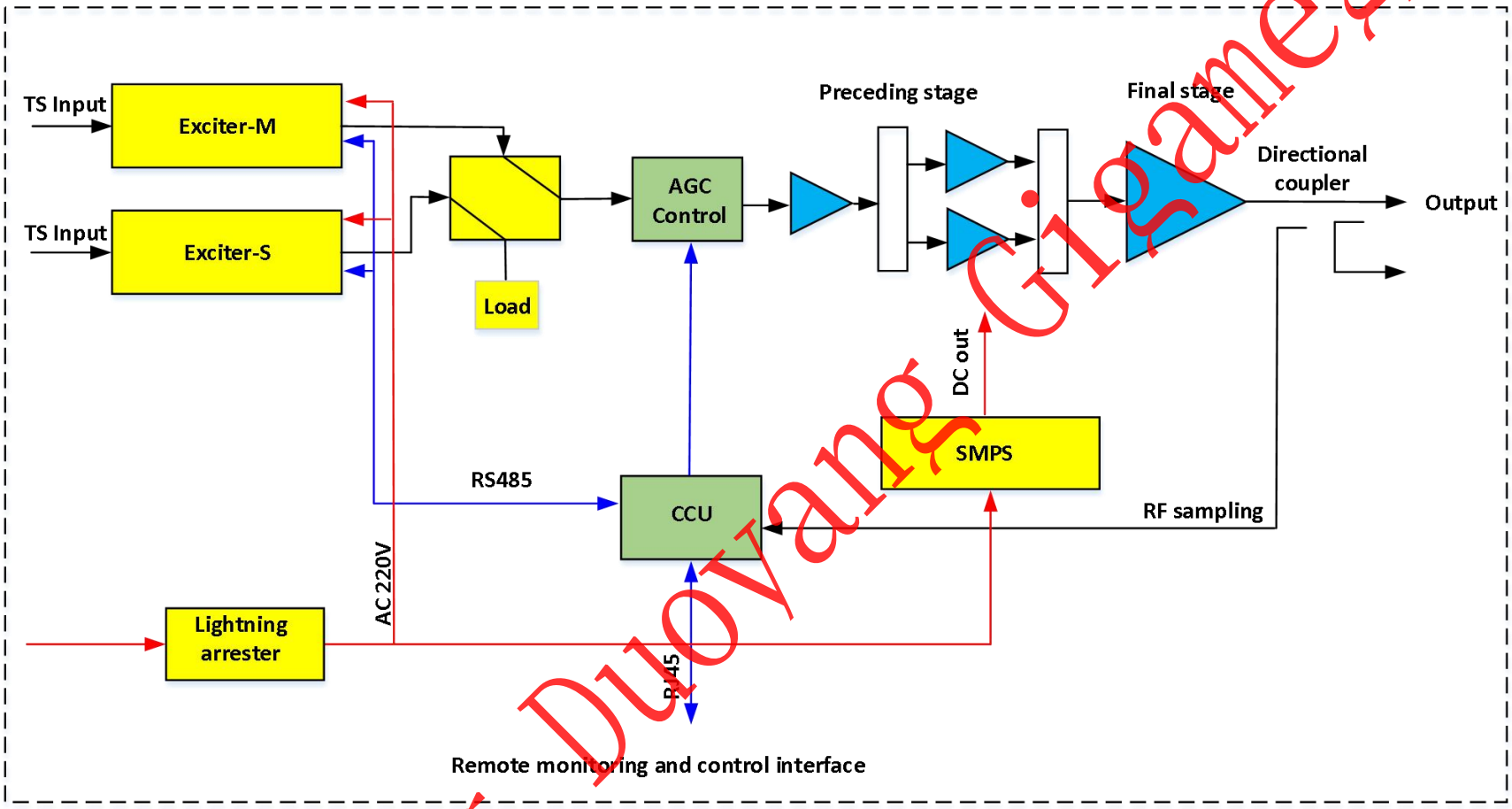


Fig. 3 Schematic diagram of the overall unit

1.3. SPECIFICATIONS

No.	Item	Measurement result
1	Frequency step size for SFN	1Hz
2	Frequency accuracy	MFN mode: ≤±100Hz SFN mode: ≤±1Hz
3	Phase noise	Refer to the below "Phase noise of the transmitter"
4	RF output power stability	±0.5dB
5	Spectrum mask	Meet specification of GB20600-2006
6	Shoulder attenuation (±3.2MHz, measured before filter）	≤-36dB
7	Inband inflatness (fc±2.591MHz)	±0.5dB （non dual-pilot mode）
8	Unwanted emission inside the adjacent channel	45dB lower than inband useful emission
9	Unwanted emission outside the adjacent channel	60dB lower than inband useful emission
10	MER	≥32dB
Note：measured after filter except specify		

Phase noise of the transmitter

Offset from center frequency (Hz)	LO phase noise (dBc/Hz)
10	< -60
100	< -75
1k	< -85
10k	< -95
100k	< -110
1M	< -115

Operation condition & Dimension

1	Ambient temperature	Normal operation: 5-45℃ Permitted operation: 0~50℃
2	Relative humidity	Normal operation: ≤90% (20℃) Permitted operation: ≤95% (Non condensation)
3	Atmospheric pressure	86kPa-106kPa
4	Power supply	2-phase, 220V AC, 50Hz
5	Dimension	900mm (D) *600mm (W) *1300mm (H)

Interface

- TS input：ASI，BNC , female, 75Ω.
- 10MHz input: BNC, female, 50Ω, AC coupling, V_{P-P}≥600mV (10MHz reference signal: sinusoid wave, peak-to-peak value range: -5dBm ~ 12dBm).
- 1PPS input：BNC, female, TTL, 50Ω.
- Detection output: SMA, female, 50Ω.
- M&C interface: RJ45 LAN
- RF output: L29(K), 50Ω.

2. Exciter

The transmitter is equipped with corresponding model of exciter according to the user's operating requirements, its technical details please refer to the technical specifications of the exciter.

3. Power amplifier (PA) unit

3.1. Structure introduction

PA unit is a 5U chasis, integrated with power amplifier module, central control unit (CCU) and monitoring screen, switching mode power supply (SMPS), air cooling fan and so on, with high integration degrees level.

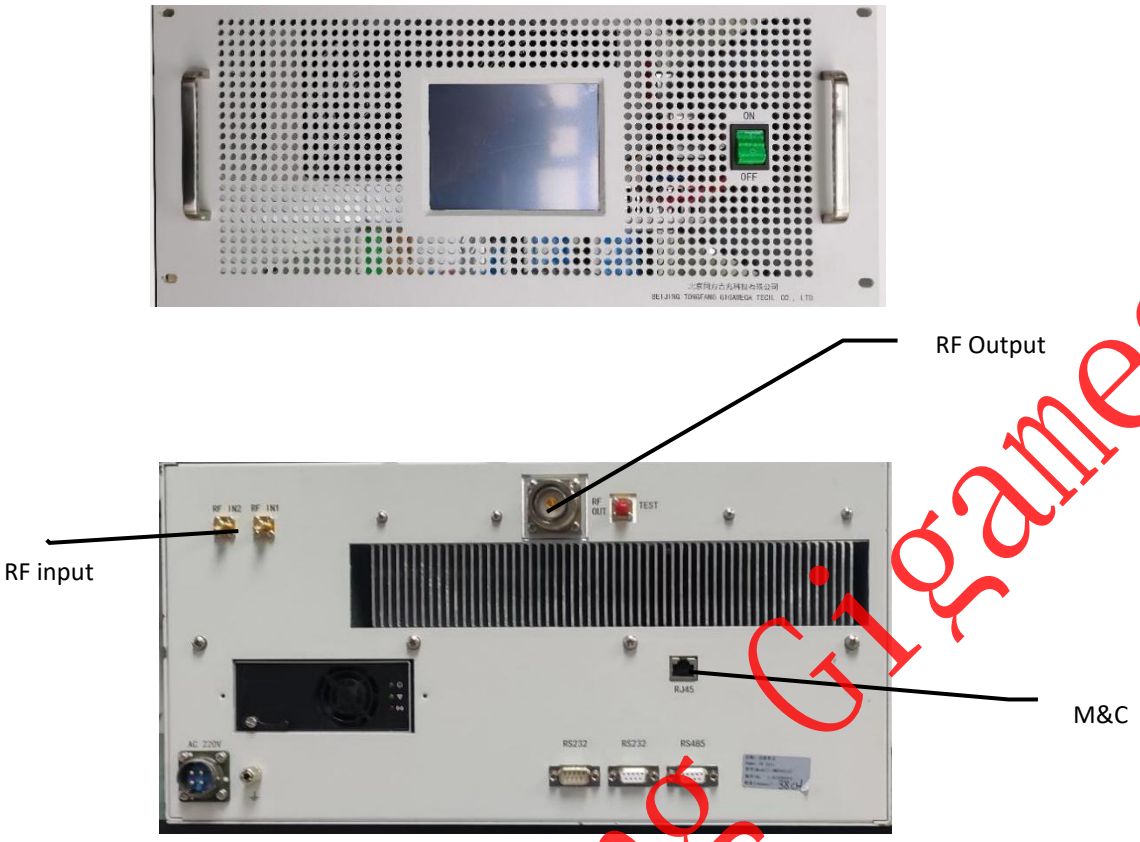


Fig. 4 Front panel and Rear panel of PA unit

3.2. Schematic diagram

The schematic diagram of the PA unit is shown in figure 6.

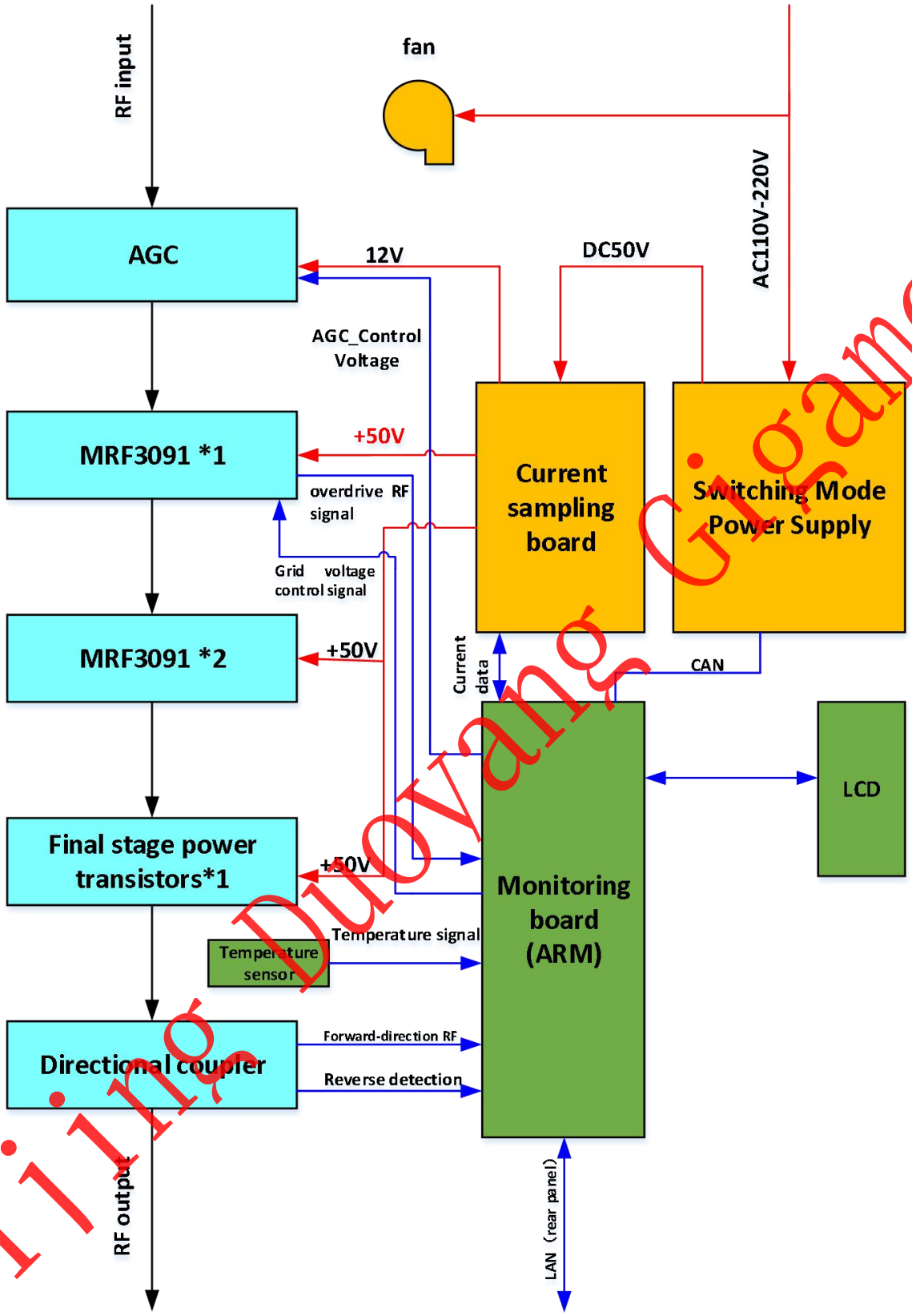


Fig. 5: PA unit schematic diagram

3.3. Specifications of PA unit

Frequency range	Working channel center frequency ±16MHz
Output power	100±10W rms
Input/output impedance	50Ω/50Ω
Input reflection loss	≤—20 dB
Output reflection loss	≤—20 dB (static)
Gain	≥50dB
Working state (final stage)	Doherty
Operating voltage	50V
Efficiency	≥25%。
Over temperature protection point (light on as the criterion)	70±5ºC
Overload protection point (light on as the criterion)	VSWR≥2
Over drive protection point (light on as the criterion)	Excitation power increases by 0.8dB
Phase difference of the same batch of power amplifier	≤5°
Cooling requirement	Forced air cooling
Outline dimension	620mm(D)*482mm(W)*200mm(H)
External interface	Input: SMA, Output: L29-K

3.4. PA module

The PA unit has 1 final stage power amplifier boards and each board is composed of 1 LDMOS field effect tube, with each field effect tube and its input and output matching circuit constituting a single tube amplifier.

The PA unit has good linearity and strong consistency, and is interchangeable.

The FET adopts a voltage bias method, and its grid bias voltage is formed by drain voltage through secondary voltage stabilization treatment. That is, the +50VDC drain voltage of the FET is reduced by a 2kΩ resistor and adjusted through 78L12 voltage stabilization and potentionmeters of RW1 and RW2, it can reach a static grid bias value.

A monitoring board of PA unit is used for sending operation parameters of the PA units to central

control unit (CCU) through CAN bus interface after sampling, storage, A/D conversion and microprocessor based processing, realizing PA unit's monitoring by CCU. The main monitoring parameters include each power tube's current, power amplifier temperature, output power, switching mode power supply current and so on. PA unit is provided with the functions of self-protection control for overdrive, overload and over-temperature as well as state indication.

3.5. Central control unit

The central control unit is the core module of the transmitter monitoring system, which is responsible for coordinating the whole monitoring system and providing the external communication interface. Its main functions are as the follows.

- Collect running data of the transmitter.
- Transmitter switch on/off control and parameter setting.
- Provide transmitter external M&C interface.
- Transmitter important parameter display.
- Fault alarm and fault protection.
- Provie human computer interaction interface.

The details of each function are as follows:

Collect transmitter running data

Collect running data of overall unit and its main components (exciter, power amplifier, switching mode power supply etc.) and record transmitter fault information (occurrence time, the fault point). The transmitter operaion data collected by CCU can be viewed from the touch screen.

Control transmitter switch on/off

The transmitter provides the following control methods for switch on/off.

a) Touch screen button switch on/off: Startup and shutdown on the touch screen of the transmitter is controlled by soft keys. Double confirmation is needed.

b) Remote control switch on/off: start up and shut down control on the monitoring PC.

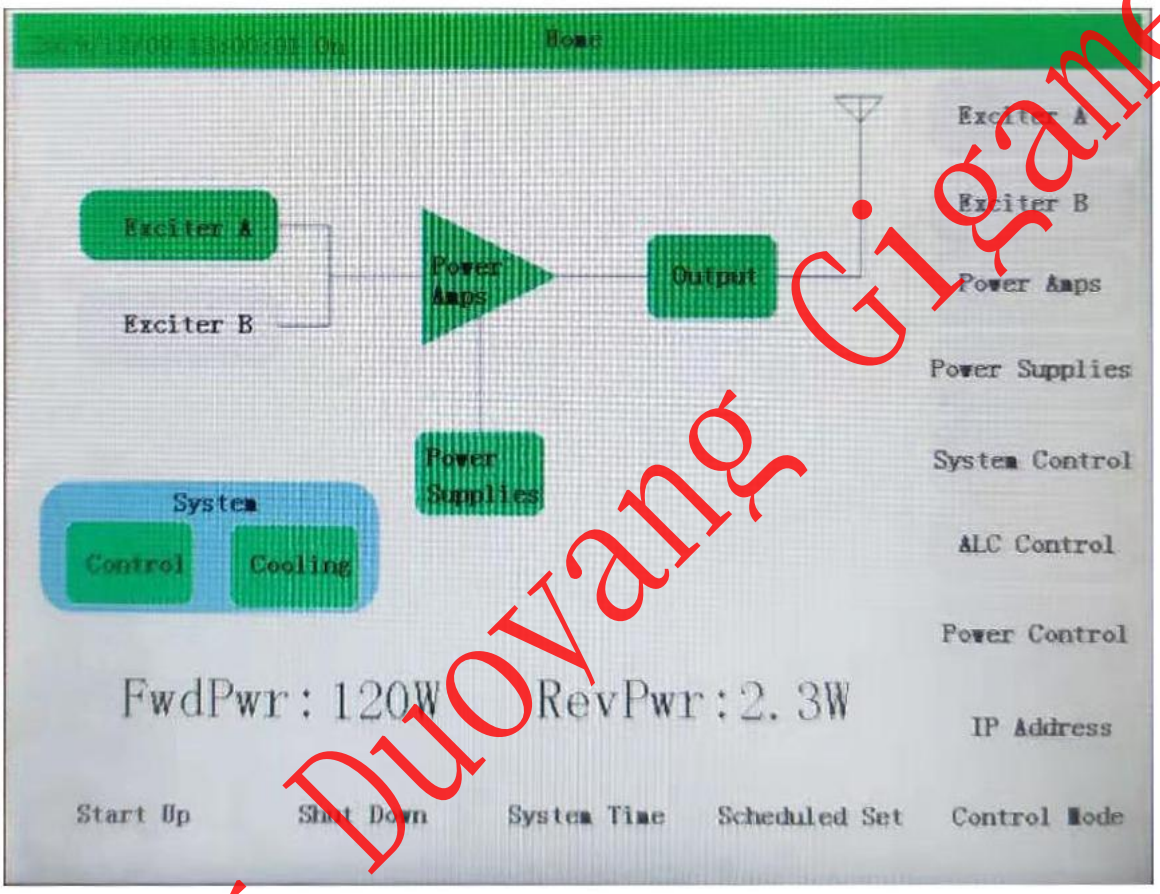
c) Scheduled switch on/off: the use M&C software, according to 7 days a week, 4 periods a day to set up the startup and shutdown schedule. It can choose to execute in the computer, or download the timing schedule to the transmitter to execute.

d) Automatic control function priority: "button"> "remote control">"scheduled".

3.6 Operation interface of transmitter

The local control of transmitter serves as the control interface of human-computer interaction (HCI) via color touch screen, including transmitter's local operation, real-time query of working parameters, general parameter setting and log query. The details of menu are as follows:

1) Main Interface



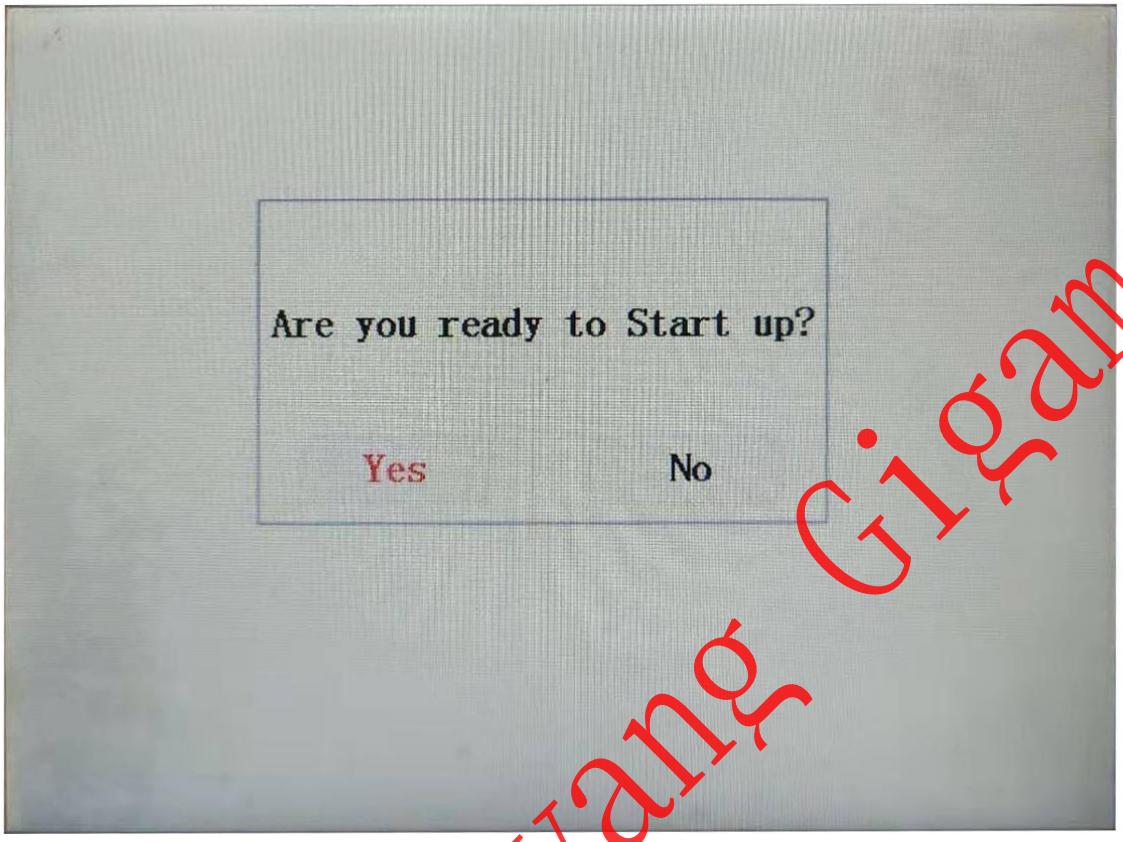
[Description]

The main interface of the whole machine mainly includes the display of the system diagram of the whole machine, the composition of the transmitter is shown in detail by the block diagram, and the direction of the signal flow is shown by the connection between each other. Display the corresponding part's working state on the basis of box's color. For example, Ex A and Ex B refer to the master exciter A and the standby energizer B. Below is a menu of functions, including switch on, switch off, system time settings, timer switch settings, control mode.

The right column is the component menu and system settings, including the main exciter, power amplifier unit, switching power supply, system settings, ALC control, power control, IP address

settings, the details on each function key how to operate and how to set will be separately described below.

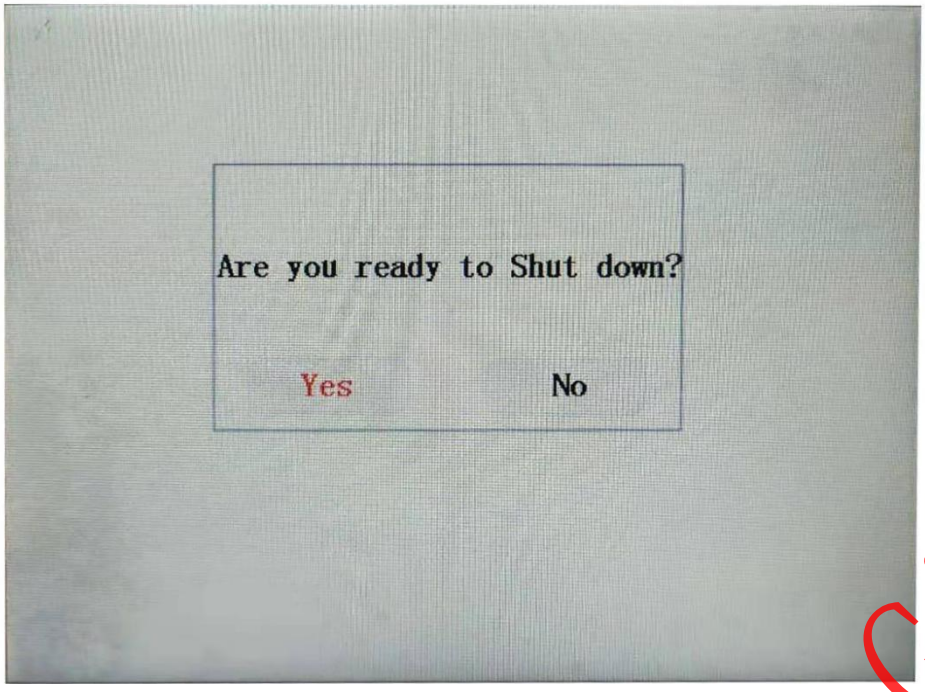
2) Welcome screen



[Description]

The foregoing figure is the example of welcome screen, and the user can log into this screen after pressing down the “On” button on the main interface. For security reason, second confirmation is needed for start-up. The user shall click “Yes” for confirming the start-up operation, and click “No” to cancel in case of any misoperation. After clicking “No”, the user can return to the main interface to carry out other operation.

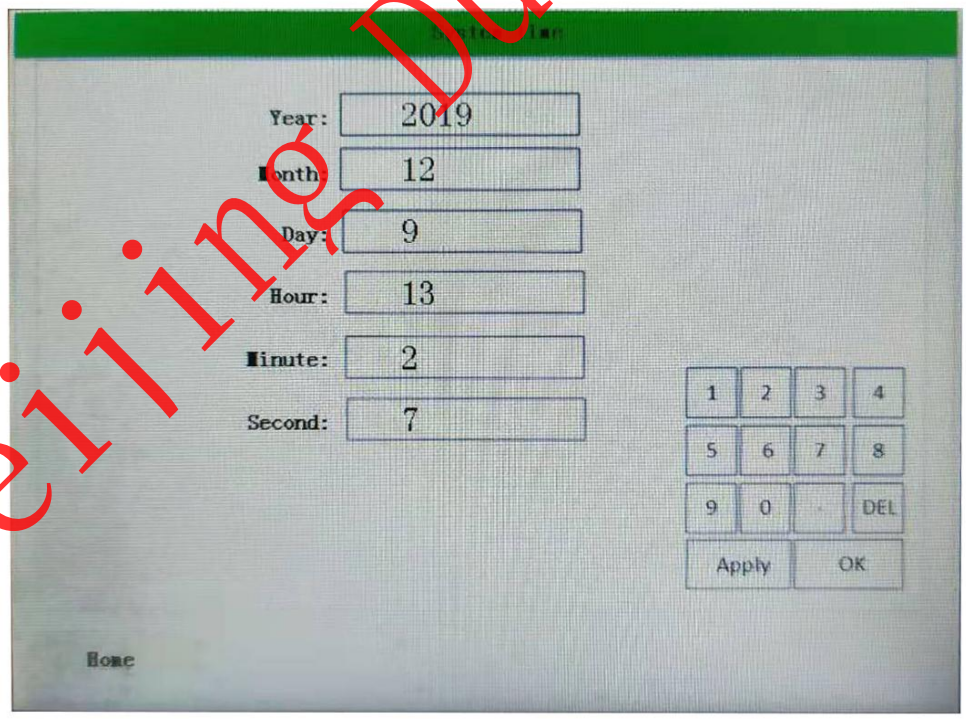
3) Shut-down screen



[Description]

The foregoing figure is an example of shut-down screen, and the user can enter into this screen after pressing down the “Off” button on the main interface. For security reason, second confirmation is needed for shutting down the machine. The user shall click “Yes” for confirming the shut-down operation, and click “No” to cancel in case of any misoperation.

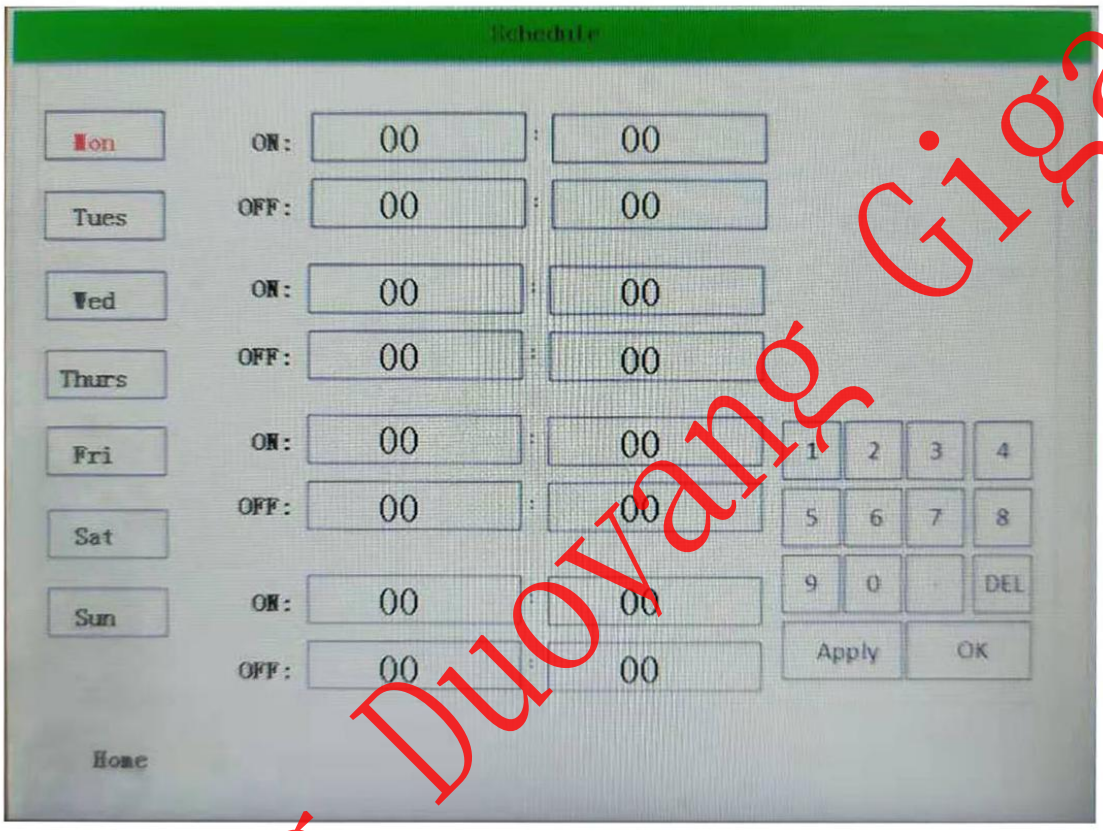
4) Setting interface for system time



[Description]

The image above is the System Time Settings interface, which goes into the Settings interface when you touch the System Time key on the main interface. The date is year, month and day in sequence, and the time is hour, minute and second in sequence. On the right is the input keypad, you can enter the specific number, press Apply and OK to confirm, after setting, click Home to return to the main menu.

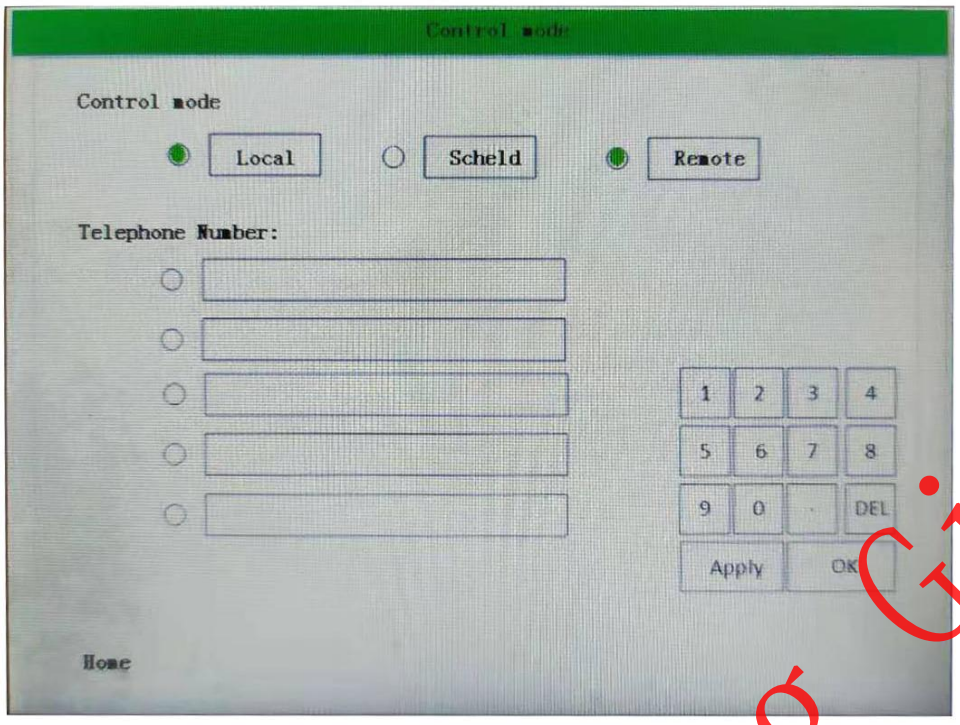
5) Setting interface for timing on/off



[Description]

The image above is the setting interface of the timer switch. When you touch the Schedule key of the main interface, enter the setting interface. The left column shows the day of a week. First of all, the user can click and choose the day at the left column for time switch setting. The middle column consists of four different periods of the day, and the user can select the specific time for turn it on and turn it off. The right-most is the input keypad, you can input the specific value, press Apply and OK to confirm, after setting, click Home to return to the main menu.

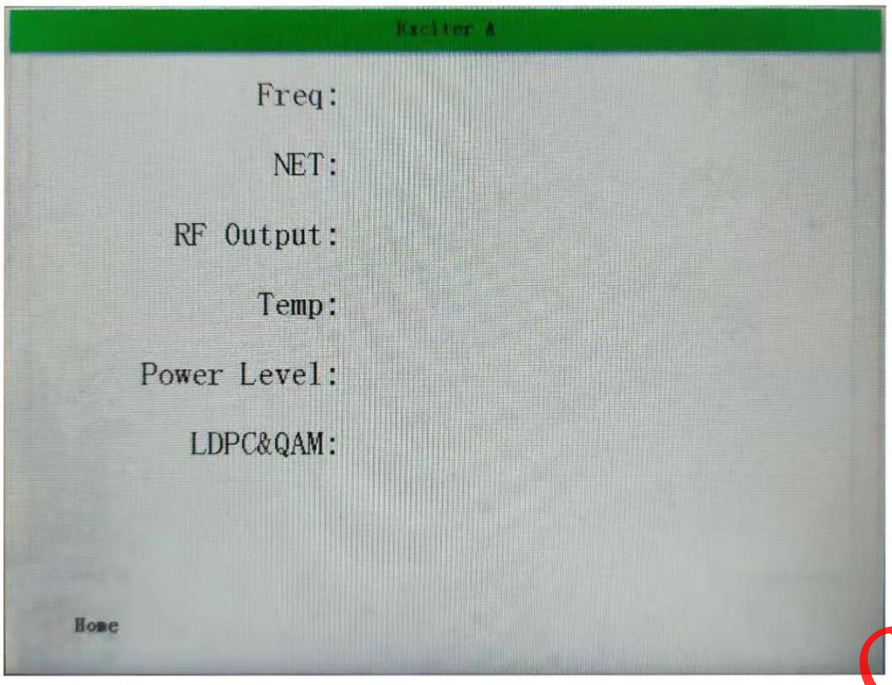
6) Setting interface in the on/off control mode

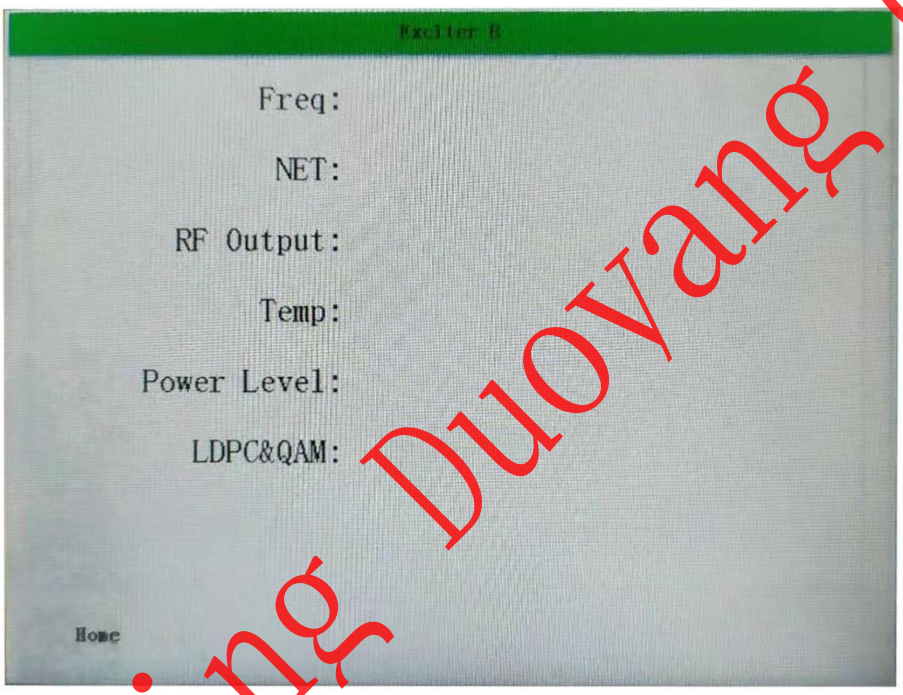


[Description]

The image above shows the switch control mode settings interface, when you touch the main interface control mode key, enter the sub-interface. There are three control switch mode options. Each mode ON and OFF status can be changed by clicking on the round button above the corresponding column. The phone setting is used when the SMS module monitor is applied (optional function). Click Home to return to the main menu after setting.

7) Exciter Parameter View

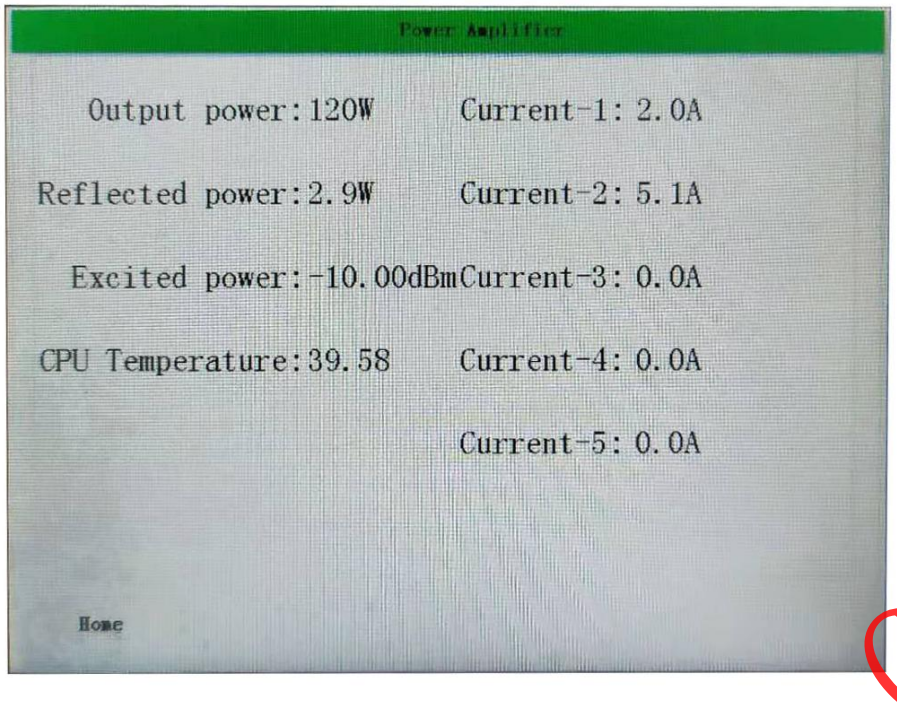




[Description]

The image above is the exciter working parameter query interface, which enters the sub-interface after you touch the main interface exciter A or B. Enter the main exciter or the standby exciter working parameters query interface. You can see the exciter's specific information or parameters, the exciter's working status, working mode, working frequency, temperature and so on. Click Home at the end to return to the main menu.

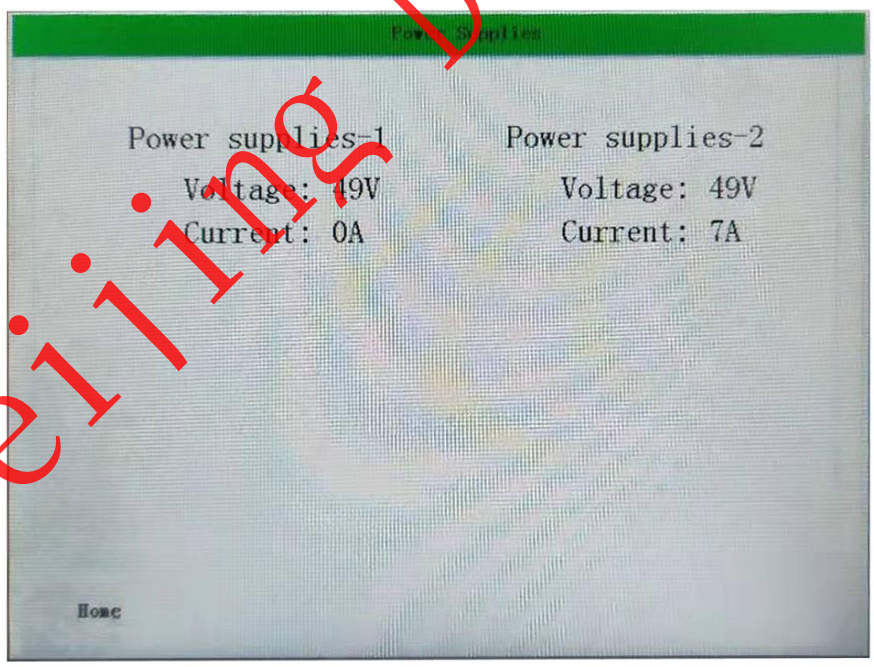
8) Power Amplifier Unit Parameter View



[Description]

The image above is the power amplifier unit working parameters query interface, when you touch the main interface power amplifier unit, enter the sub-interface. The main operating parameters of the power amplifier unit can be viewed, including the working current of the power amplifier unit, the input/output/emission power of the power amplifier unit, and the internal temperature of the power amplifier unit. The user can click "Home" to return to the main menu after finishing check.

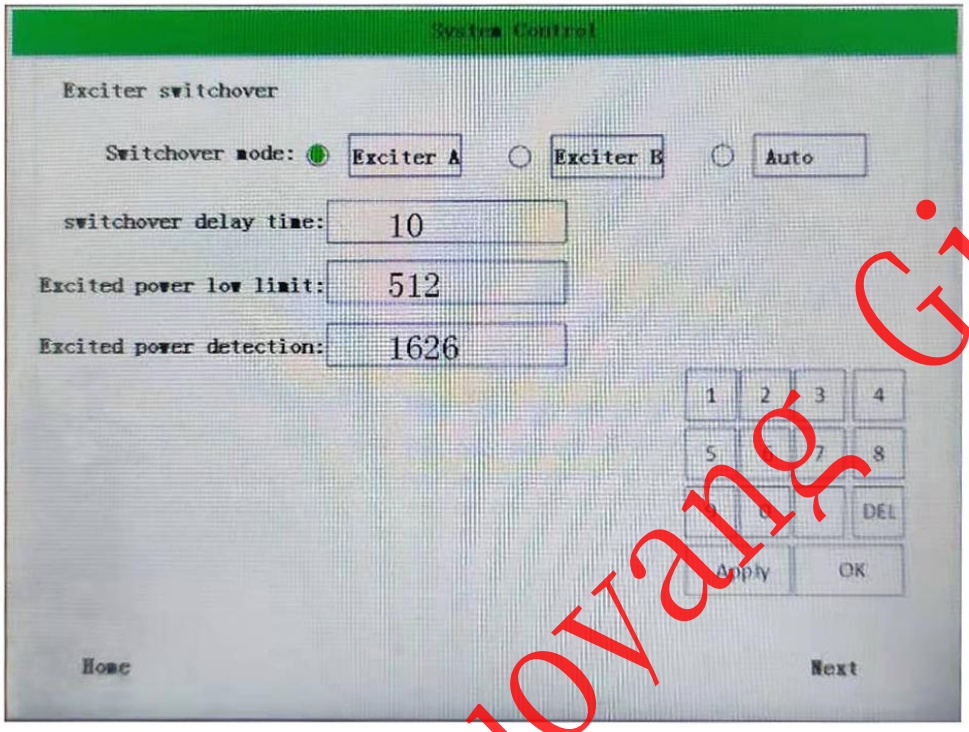
9) View of the parameters of the switching power supply



[Description]

The image above is the switching power supply working parameters query interface, when you touch the main interface switching power supply, enter the sub-interface. You can check the working voltage and working current of the switching power supply. The user can click “Home” to return to the main menu after finishing check.

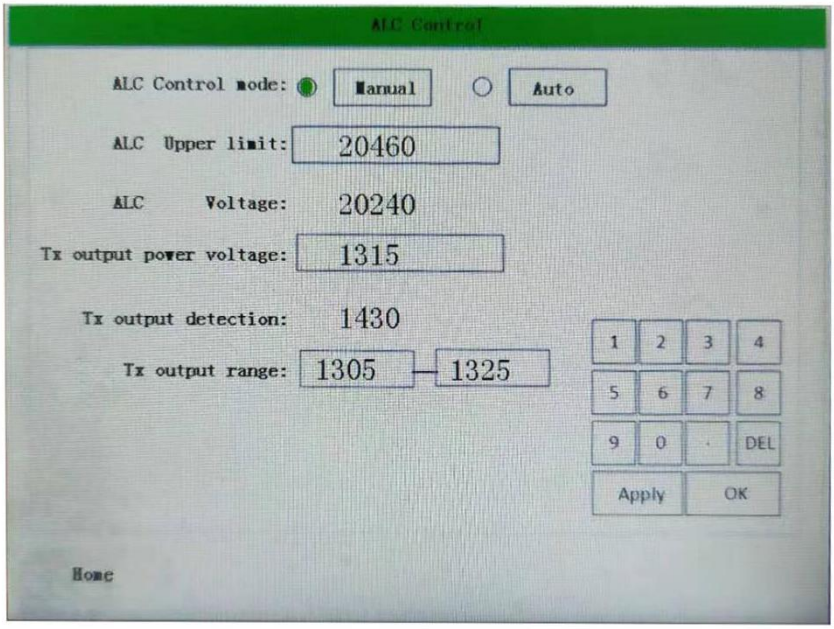
10) System control settings



[Description]

The image above is the system control settings interface, you can set the main exciter, exciter switch mode, exciter switch delay time, the minimum power output limit of the exciter, on the right is the numeric keypad, click Apply and OK to complete the settings, then, click Home to return to the main menu.

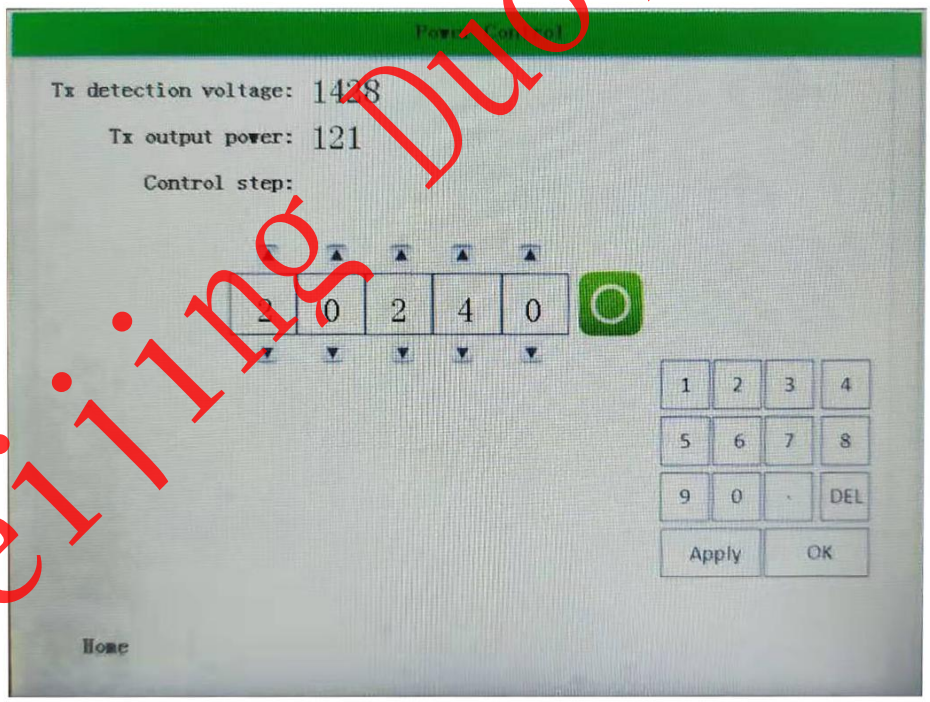
11) ALC control settings



[Description]

The image above is the ALC control setting interface, you can set the ALC control mode, ALC upper limit, transmitter output voltage, transmitter output voltage range, on the right is the numeric keypad, click Apply and OK to complete the settings, then click Home to return to the main menu.

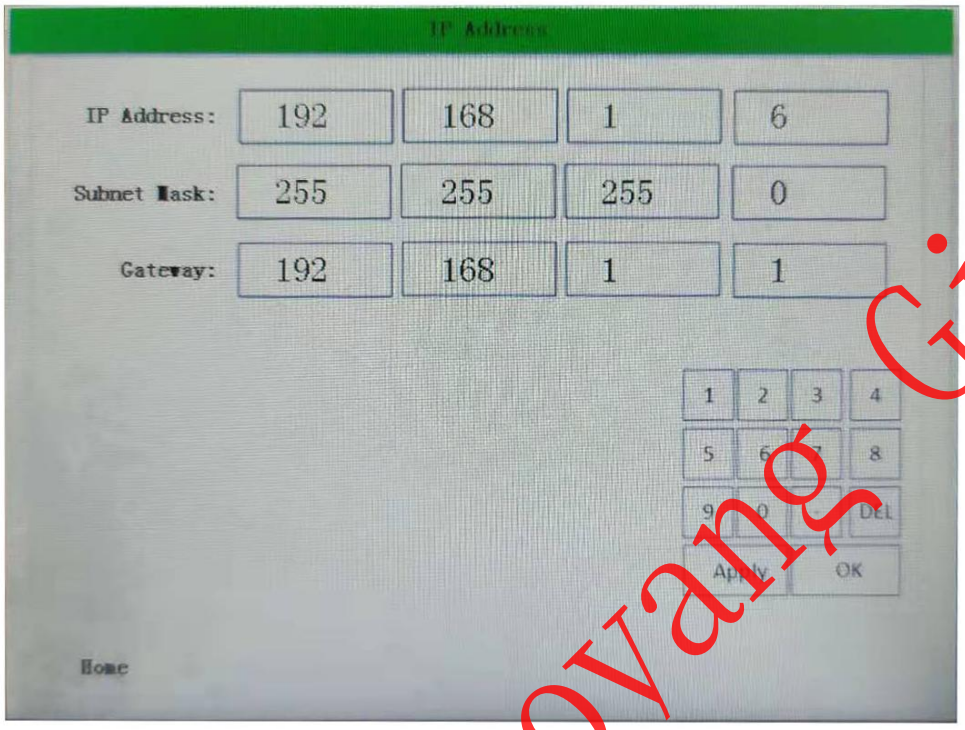
12) Power control settings



[Description]

The image above is the power control settings interface, you can set the output power control step, on the right is the numeric keypad, click Apply and OK to complete the settings, click Home to return to the main menu.

13) IP address settings



[Description]

The image above is the IP address setting interface. The transmitter's IP address can be set. If the computer communicates with the transmitter, the transmitter's IP address and the computer's IP address must be set in the same network segment. On the right is the numeric keypad, click Apply and OK to complete the settings, and click Home to return to the main menu.

3.8. Switching mode power supply

The transmitter adopts AC220V two-phase three wire balanced input to ensure he same power for each phase. The transmitter has 1 SMPS unit of 2kW, with large power capacity redundancy.

The front and rear panels of the SMPS unit are shown in figure 7and figure 8.

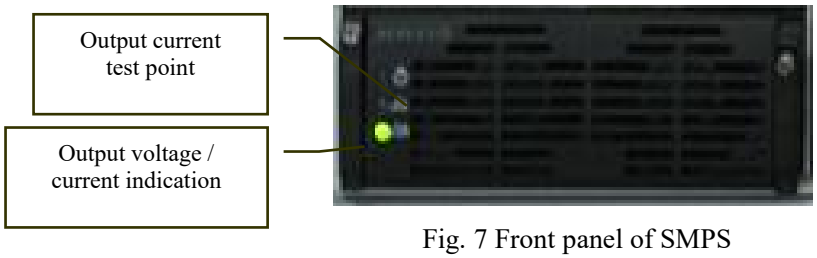


Fig. 7 Front panel of SMPS

Fig. 8 Rear panel of SMPS

SMPS specifications

Output rated voltage	50V
Output rated current	40A
Output voltage regulation	≤±0.5%
Output current regulation	≤±0.5%
Peak to peak ripple voltage	≤200mV (20MHz oscilloscope)
AC input voltage range	110V-220V
Output overvoltage protection point	53V±1V
Output overcurrent protection point	40A～42A
Power factor	≥0.92
Current sharing precision	≥±5%
Output short circuit protection	Yes
Lightning protection	Yes
Conversion efficiency	≥90%
Over temperature protection	80℃±3℃
Working temperature	0℃～45℃
Storage temperature	-30℃～60℃
Relative humidity	≤90%
Altitude	≤2000m
Insulation strength	input to casing and input to output: AC1500V output to casing: DC500V (This machine has lightning protection measures)

Dimension	70(W)mm x 265(H)mm x 380(D)mm

3.9. Cooling fan

The whole cooling system adopts 3 low noise fans, which can be used for cooling the power amplifier unit. The amplifier radiator adopts advanced heat dissipation aluminum shovel teeth technology, with high efficiency of heat dissipation.

The air outlet on the rear panel the PA unit chasis discharges hot wind and completes air cooling process of power amplifier.

4. Passive component

4.1. Directional coupler

The RF power of the transmission channel is coupled out, which is used as an indication and protection of transmitting power, or to monitor RF modulated waveform. It has a strong direction. The coupled power value is related to the transmission power of the transmission channel.

Technical specification

Frequency range	470-860MHz
Coupling factor	Meet the requirements of the transmitter (see the equipment identification)
Directional	≥24dB
main way VSWR	≤1.05

Two-port directional coupler has 1 output power detection ports and 1 reflected power detection port. Sampling signal of directional coupler is the DC voltage (related to output power or reflected power) amplified by detector and an RF monitoring signal.