HIRDA-A Anode furnace infrared thermal imaging online temperature detection and analysis system

Technical Solution

Wuhan Huajingkang Optoelectronics Technology Co., Ltd.

January 2024

Contents

HIRDA-A Anode furnace infrared thermal imaging Online temperature detection and analysis system Technical solution

1 Overview

Anode furnace is a production equipment that needs auxiliary heating. Compared with traditional combustion air combustion, oxygen combustion technology has obvious environmental protection and economic advantages. However, the main problem of traditional oxygen combustion is the uneven temperature distribution. The high temperature oxygen combustion flame will have an adverse effect on the heating process and the refractory materials of the furnace body, reducing the life of the furnace lining.

During the operation of the anode furnace, in order to control the smelting quality of copper, it is necessary to monitor the temperature of the molten copper in the furnace before adding materials and tapping the copper to obtain the temperature of the molten copper; at the same time, in order to ensure production safety, it is necessary to monitor the temperature of the end walls on both sides, the tuyere area, and the furnace shell, so as to promptly detect abnormal temperature changes of the equipment and avoid safety accidents in time.

2 System Introduction

2.1 Product Description

The infrared thermal imaging temperature monitoring system for anode furnace is a system specially used for monitoring the temperature of the furnace wall and the solution in the high-temperature smelting furnace. The furnace wall uses a long-wave infrared sensor, and the solution in the furnace uses a short-wave infrared sensor. They are respectively equipped with high-performance lenses and excellent imaging processing circuits, and are embedded with advanced image processing algorithms. It

has low noise, high protection level, strong environmental adaptability, low power consumption, fast startup, excellent imaging quality, wide temperature measurement range, and accurate temperature measurement. It is very suitable for high-temperature temperature measurement on-site applications.

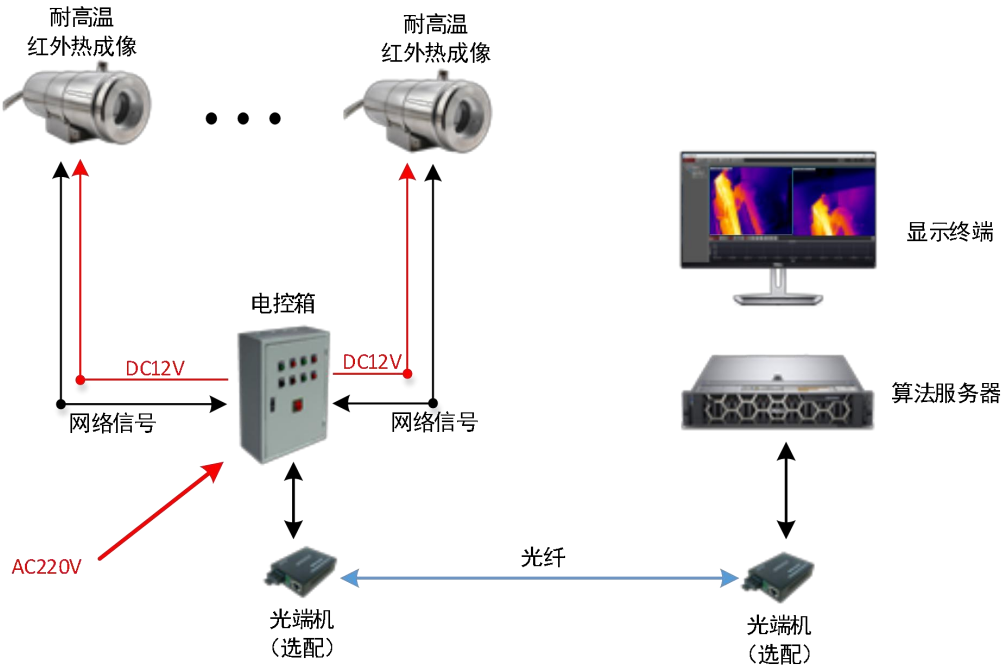


Figure 1. Block diagram of the H IRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system

2.2 System Features

- Real-time display: The full radiation thermal map is displayed in real time. The on-duty personnel can view the temperature at any location, record, take photos, analyze abnormal situations, and issue professional inspection reports;
- Temperature tracking: Automatically analyze the temperature rise trend of the entire screen or specific areas of the thermal image to find potential danger areas early;
- Data capture: Thermal imaging image data can be collected regularly for later analysis;
- High temperature trigger shooting and alarm: When temperature abnormalities occur, the monitoring background can be discovered in time, triggering the alarm, the sound and light alarm module will sound an alarm, and the software background will take pictures of the incident;
- Fault self-diagnosis: When the terminal device fails, the system can remind the on-duty personnel;
- Custom alarm thresholds and levels: The system can define 4 different alarm thresholds and levels to assist staff in evaluating the urgency and development trend of potential dangers;

- Automatic classification storage: Monitoring data, abnormal data and alarm information will be automatically stored in the corresponding equipment data column, which can be quickly and accurately called for analysis;

- Report function: Various reports can be customized according to customer requirements and exported to Word format;

- Temperature curve: The software can observe the real-time temperature curve of the temperature measurement object and make trend judgment.

2.3 System Features

- With all-weather passive thermal imaging function;
- Adopt self-developed temperature measurement and correction algorithm to achieve accurate temperature measurement;
- Strong environmental adaptability, can be used in harsh environments such as high temperature and high dust;
- High temperature solution temperature monitoring in the furnace;
- 360° all-round temperature detection of the furnace wall;
- Automatic positioning and early warning in high temperature areas;
- Open interface, providing SDK development kit, can be connected with DCS, PLC and other systems.

2.4 System Utility Requirements

2.3.1 power supply

Field probe power supply: 220VAC 50/60HZ power 50W/set

Control room power supply: 220VAC 50/60HZ power 100W

3 Application Scenario

Metal smelting furnace outer wall temperature monitoring, high temperature metal solution temperature monitoring

4 System composition

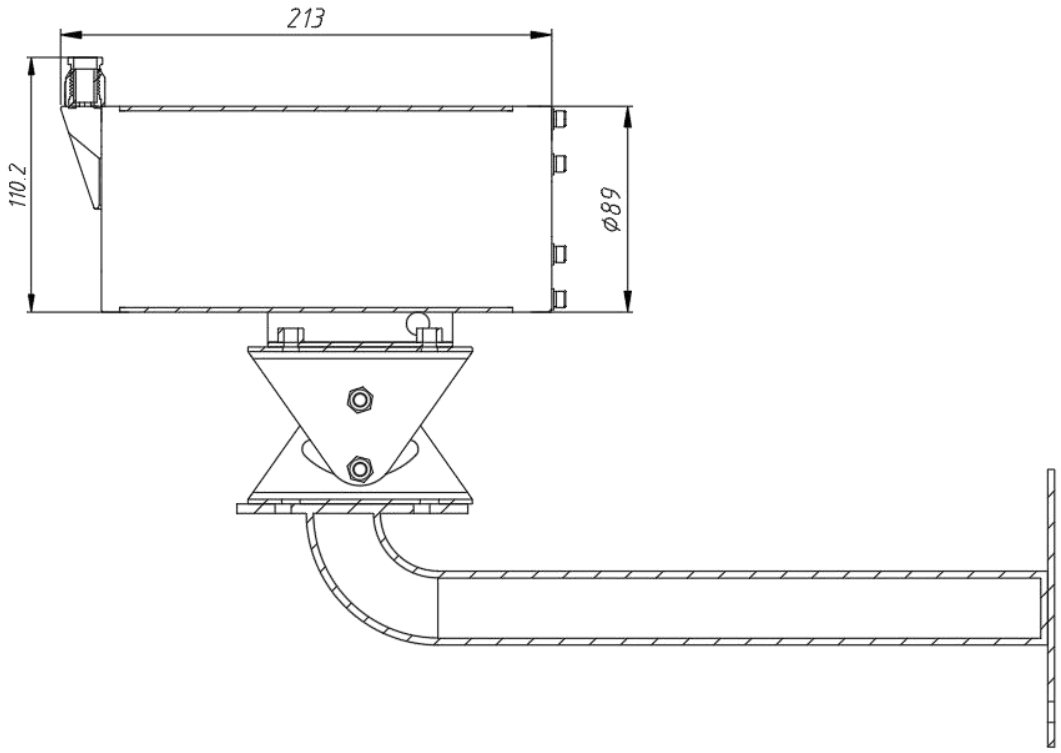
4.1 High temperature infrared thermal imaging thermometer

Detector type	Short-wave area array detector	Long-wave uncooled focal plane detector
Image resolution	640×480	640×512
Lens selection	12mm 、25mm 、35mm	4mm、8mm 、13mm 、19mm
Wavelength range	1～2μm	8～14μm
Frame rate	125Hz	25Hz
focusing	Electric/Automatic	
Image Algorithms	Gamma correction, enhancement algorithm	
Temperature measurement accuracy	±2℃ or ±2%	
Temperature measurement range	800℃~2000℃	-20℃~550℃
Data Types	H264 、H265 、16Bit Raw temperature data	
Web Standards	Gigabit Ethernet/Adaptive 10M/ 100M/ 1000M	
Protocol support	IPv4/ IPv6、TCP、UDP、NTP、HTTP、RTSP、RTP、ICMP、WebSocket、 ONVIF	
Temperature output	Support analog quantity 4--20ma 、RS485	
Protection level	IP66	
size	≤。110×213mm	
Installation	Equipped with PTZ bracket	
weight	≤8Kg	
Operating temperature	-20℃~+60℃	

Storage temperature	-40℃~+70℃
Temperature shock resistance	5℃/min（-40℃~60℃)
Vibration resistance	4.3g, 2 hours for each of x, y and z axes
Shock resistance	Acceleration 30g, half sine wave, pulse width 6ms, impact 3 times in the installation direction
humidity	≤95%(non-condensing)

4.2 Overall size

The overall structure dimensions are shown in the figure below.

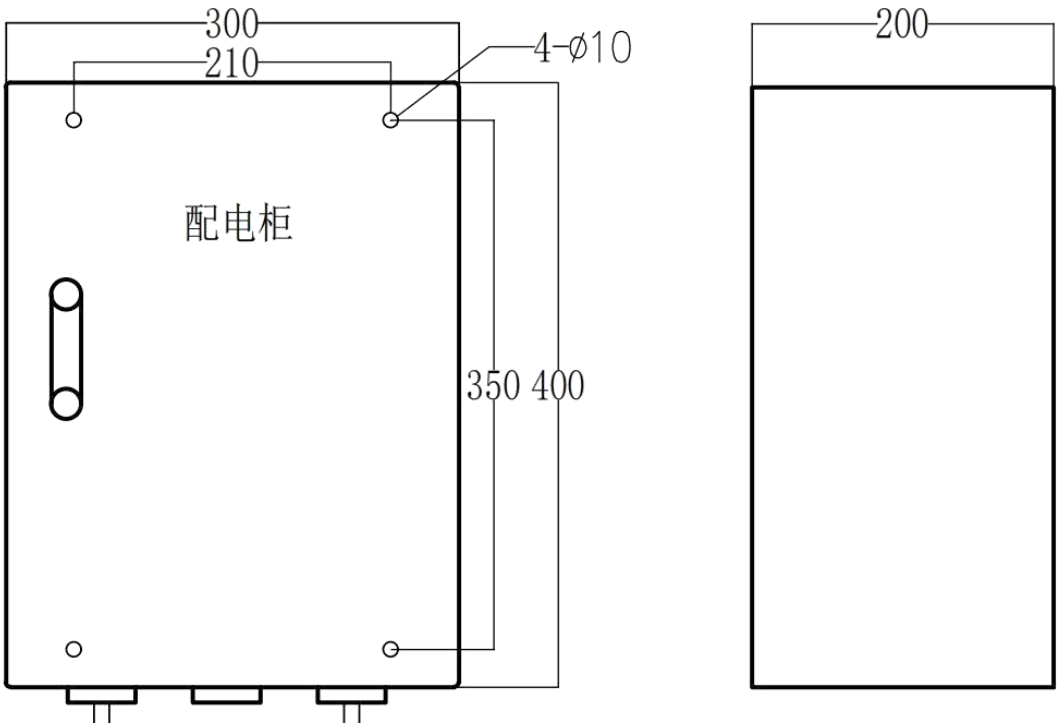


4.3 Multifunctional power control box

The electric control cabinet contains an industrial Ethernet switch (photoelectric conversion) and a power adapter. Its main function is to provide a stable power supply, network exchange (photoelectric conversion), and data conversion for the infrared thermal imager.

- Input interface: 100M/1000M Ethernet, RJ45 interface
- Output interface: 1000M optical port
- Transmission rate: up to 1000M
- Standard：IEEE802.3、IEEE802.3u、IEEE802.3x

- Power Supply：AC 220V±10% 50W
- Ambient temperature：-20℃~65℃
- Ambient humidity：≤90%
- Dimensions： 400（W） ×300（H） ×200（D）mm
- Dimensional drawings



4.4 Stainless steel hose

Stainless steel hoses are resistant to high temperatures, high pressures and corrosion. To facilitate the movement of the camera probe, the cables and compressed air connected to the camera probe use stainless steel hoses as the connecting medium.

- Path:：Φ12、Φ10、Φ8、Φ6
- Interface：ZG1/2″
- Material：Heat resistant stainless steel

4.5 High temperature resistant cables

As the ambient temperature at the work site is generally high, in order to ensure stable and reliable communication and video transmission, cables are selected that are high temperature resistant, fire resistant, and have shielded mesh.

The main technical parameters are as follows:

- Rated temperature: -65℃~+250℃ (maximum ambient temperature: 250℃, minimum ambient temperature: -65℃)
- Rated voltage：600V
- Implementation Standards：GJB773A-2000
- Conductor: multi-strand tinned copper wire
- Color: red, black DC12V 0.5m2; orange and white, orange, green and white, green, blue and white, blue, gray and white, gray network cable.
- Insulator: Polytetrafluoroethylene (PTFE)
- Performance: corrosion resistance, strong acid resistance, strong alkali resistance, oxidation resistance; high voltage resistance, non-flammable, non-aging
- Test voltage: 7000V without breakdown

4.6 Optical cable and interface (on demand)

The control signals and video signals for long-distance transmission are all transmitted using single-mode optical fiber. Optical fiber transmission has the characteristics of high signal quality and anti-interference, and the signal transmission distance can reach more than 20km. In addition, the system is equipped with SC type optical cable interface to facilitate optical cable connection.

The technical parameters are as follows:

- Fiber type: Single mode
- Working wavelength：13l0nm and 1550nm
- Attenuation characteristics: 1310nm wavelength is 0.36dB/km; 1550nm wavelength is 0.21dB/km
- Bending loss: Φ75×100 turns, additional bending loss ≤0.5dB
- Fiber optic interface: single mode SC

4.7 Multi-function server

- Intel® Core™ i7-11700 processor (quad-core, 8MB, 3.60GHz)
- Memory 16GB 1600MHz DDR3 Non-ECC
- Hard Drive 256G SSD + 1TB 3.5-inch SATA (7,200 Rpm) Hard Drive
- Monitor 23.8 inches
- Windows 10 Pro, 64-bit operating system

5 System Software

5.1 Software interface

The system client software interface is shown in the figure below.

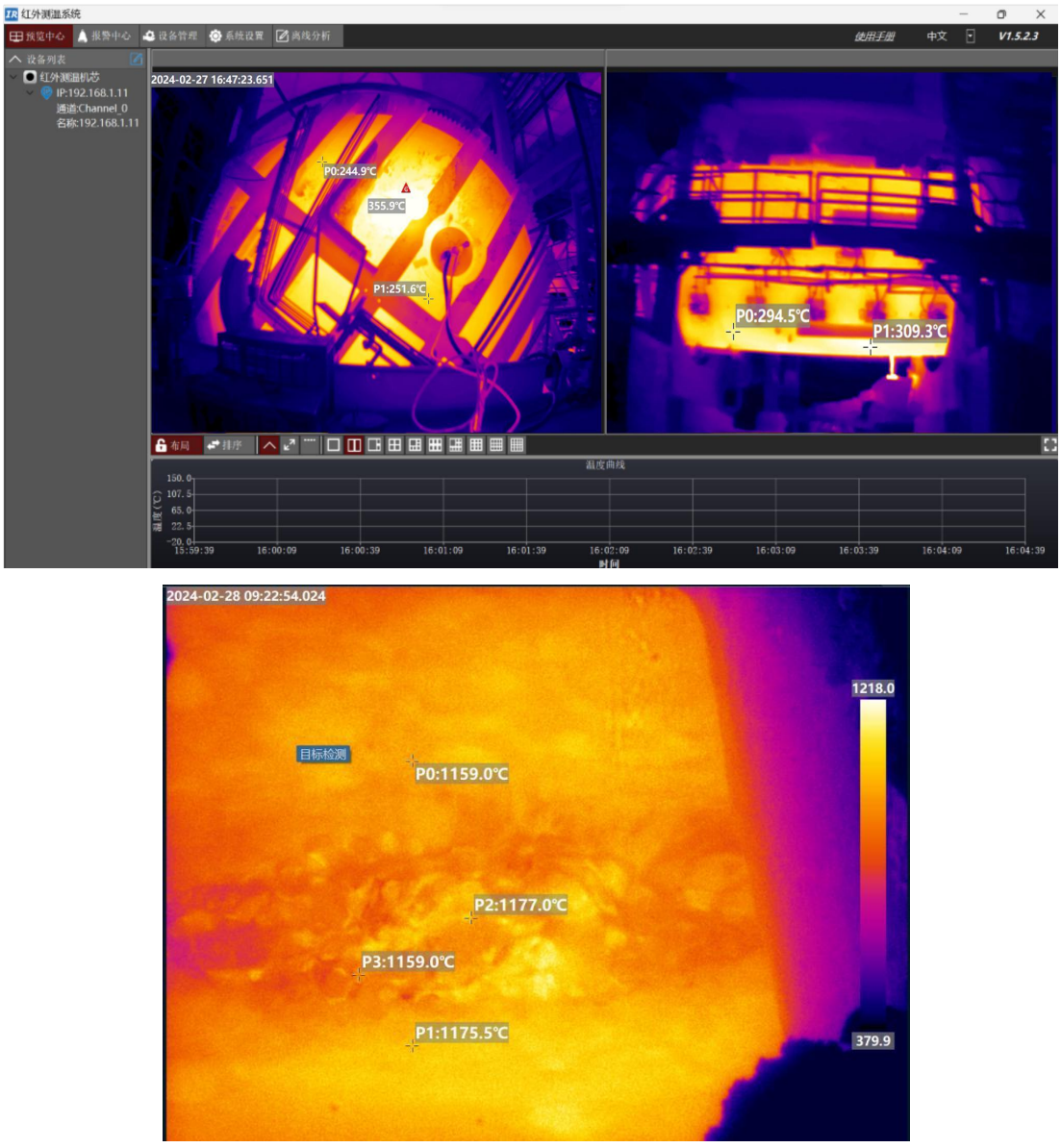


Figure 2 System software interface

The basic functions of the software are as follows:

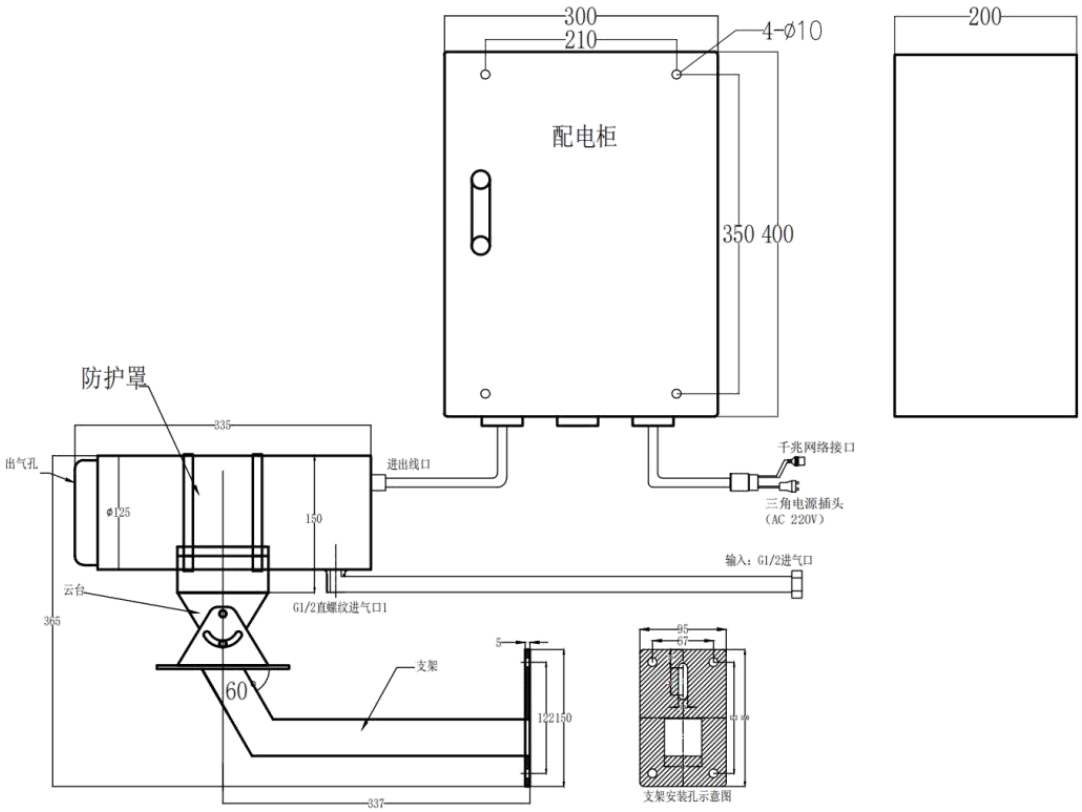
- Real-time video display: Real-time display of full radiation thermal images and high-definition visible light videos. The temperature at any location in the infrared thermal image can be checked, and abnormal situations can be recorded, photographed, and analyzed.
- Temperature tracking: Automatically analyze the temperature rise trend of the entire infrared thermal image or a specific area to detect potential dangers early.
- Data capture: Thermal imaging image data can be collected regularly for later analysis.

- High temperature triggers shooting and alarm: When abnormal temperature occurs, the background can detect it in time and trigger an alarm. The software background will take infrared and visible light pictures of the incident.
- Fault self-diagnosis: When a terminal device fails, the system automatically alarms.
- Customizable alarm thresholds and levels: The system can define multiple alarm thresholds and levels to assist staff in assessing the urgency and development trend of hidden dangers.

6 Configuration List

No.	Name	Model	Unit	Quantity	Remarks
1	High temperature resistant infrared thermal imaging thermometer	PSCDG220-NX46	set		Furnace wall temperature monitoring
2	High temperature resistant short wave infrared thermal imager	PSCDG220-G46	set		Furnace solution temperature monitoring
3	Electric control cabinet	SEB432	set		
4	Image algorithm server	IDS	set		Including hardware and software, display
5	High temperature metal hose	φ 12mm	set		
6	Matching cable	/	set		
7	Installation accessories	HIRDA-FJ	set		Including mounting bracket and adjustable pan/tilt
8	4-20mA conversion module	HIRDA-DA	set		

7 On-site installation diagram



8 Division of labor between the two parties

Supplier：

1) Provide HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system manufacturing, transportation,

2) Responsible for selecting the installation location of the HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system equipment, and providing the equipment installation location map before construction.

3) Responsible for training the purchaser's personnel on the commissioning, use, maintenance and overhaul of the HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system, so that the purchaser's personnel can master the operating skills independently.

4) Provide relevant technical information such as product certificates, inspection reports, operating and maintenance instructions, etc.

Buyer:

1) Provide the relevant on-site data and design drawings required for the installation and commissioning of the HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system equipment.

2) Responsible for the piping, wiring and optical fiber melting of cooling air (cooling water), optical fibers and cables required for the HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system equipment.

3) Make sure the site has the installation conditions required by the supplier, and notify the supplier's technical staff in advance to participate in guiding the installation and commissioning.

4) The purchaser shall assist in providing working conditions for the supplier's on -site service personnel.

9 Acceptance Criteria

1) The infrared thermal image of the anode furnace wall and the solution in the furnace can be displayed on the software interface of the HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system. When the cooling gas meets the use requirements, the equipment maintains a good working effect;

2) Can display the current monitored anode furnace usage status and check historical maintenance data;

3) Display the abnormal temperature area on the surface of the anode furnace and prompt an alarm;

4) The supplier shall provide professional training to the personnel designated by the purchaser.

10 After-sales commitment

1) The warranty period of HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system is 12 months from the date of acceptance or 18 months after the equipment arrives (the warranty period of purchased products, servers including internal hardware is 12 months from the date of equipment arrival).

2) If the thermal imager is damaged due to improper use, the purchaser shall order spare parts in a timely manner and the supplier shall provide maintenance services.。

3) The HIRDA-A anode furnace infrared thermal imaging online temperature detection and analysis system software is used for a long time, and the software upgrade service is provided free of charge.

4) When receiving a call from the buyer, the supplier is responsible for guiding the buyer to handle the fault; if the buyer cannot solve the problem, the supplier promises to rush to the site to handle it within 48 hours. Company service phone: 400-080-4288.