HIRDA-MI
Molten iron temperature continuous detection system
Technical solution

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1 Overview

Iron temperature measurement, as an important link of metallurgical industry, artificial observation, with thermocouple, temperature measuring gun to complete, harsh working environment, need to measure the iron temperature, high labor intensity, less temperature measurement, every time the iron measure only 1~3 times, cannot achieve continuous temperature measurement, and thermocouple is consumables, high cost, operation is relatively backward. The normative fluctuation of workers' operation makes the monitoring of molten iron temperature not accurate enough to reflect the temperature situation and change trend of the whole iron out process. Especially in front of the blast furnace furnace environment is harsh, high temperature, dust, has a very high risk. Because the ironmaking process in the blast furnace is completely closed, it is difficult to measure the temperature directly in the furnace. We need to understand and control the temperature status of molten iron through external temperature measurement.

The low temperature of molten iron will affect the progress of the blast furnace, and the long time will lead to the furnace body, such as bonding, abnormal furnace type, abnormal furnace condition and endanger the safety production and other serious consequences. In addition, the molten iron temperature detection provides the most direct access to low silicon smelting
Effective detection means, under the premise of ensuring sufficient physical temperature, as far as possible to reduce the silicon content, and then reduce the coke ratio, is conducive to the steelmaking process. Iron iron temperature is of great significance to the operation of blast furnace, so it is necessary to establish a safe and intelligent continuous temperature measuring system.

I unit developed a new type of molten iron continuous temperature measurement system, the system can directly measure the iron when the iron flow temperature, eliminate the main ditch and slag skimming temperature and mean temperature influence, more direct and more accurate represents the furnace, cylinder physical thermal state and change process, with the dust interference resistance ability, measuring distance, flexible alignment target and accurate measurement and other outstanding characteristics.

The measurement results of the molten iron temperature are transmitted to the upper computer in the main control room through the signal line, and the special program is used to collect, process, display and store the data.

2 System introduction

2.1 Product Description

HIRDA-MI molten iron temperature continuous detection system is a high-tech system specially used to detect the molten iron temperature and conduct intelligent analysis. The system consists of high-temperature infrared thermal imaging thermometer, on-site equipment box, image algorithm server and client management software. Each iron port is equipped with a continuous temperature measuring device in the iron field. The continuous temperature measuring device of the iron field is installed in a suitable position near the iron mouth for cooling and dust prevention by compressed air. When the iron is out, the continuous temperature measuring device of the iron field can obtain the image and temperature of the iron flow at the same time.

It can capture clear images of molten iron flow, measure accurate temperature field distribution of molten iron flow at the taphole (including taphole molten iron temperature and slag temperature), and display real-time infrared video of molten iron flow.

The data obtained by the molten iron continuous temperature measurement system is transmitted to the industrial control machine of the main control room of the blast furnace through optical fiber for real-time display of the molten iron temperature screen and data storage. It can automatically detect the status of each outlet in real time and record the start time, end time and length of each outlet.

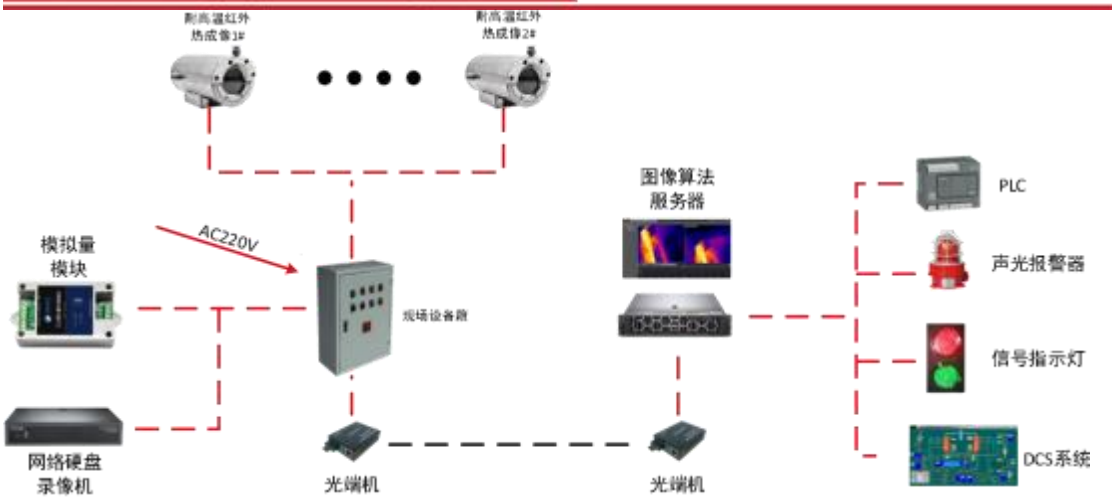


Figure 1. Block diagram of the HIRDA-MI system

2.2 System characteristics

- High temperature resistant design, withstand the highest ambient temperature of 200℃;
- High protection level, protection level up to IP66;
- Window automatic purge, no manual regular cleaning of the window;
- Full-screen real-time temperature measurement, wide coverage range;
- Not only rely on the system platform, can directly login to the ip to access the image and configuration, can directly output the alarm signal to the PLC or alarm;
- Support GB28181, onvif protocol, can be connected to the mainstream NVR;
- Temperature data can be connected to the LED screen and the PLC;
- Electric / autofocus, focus through the software at any time;
- Temperature measurement range is 800℃ to 1800℃;
- Temperature measurement accuracy of 1%;
- Support the modbus protocol and can dock with the DCS system for temperature data transmission.

2.3 System utility works requirements

2.3.1 Power supply

Field probe power supply: 220VAC 50/60HZ, power 150W/set

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

2.3.2 Compressed air or nitrogen gas

Compressed air temperature: 35℃

Compressed air pressure: 0.4 Mpa

Compressed air flow rate: 0.1-0.2m/MinF

3 System composition

HIRDA-MI molten iron temperature continuous detection system consists of high -temperature short-wave infrared thermal imaging thermometer, field equipment box, image data server, etc.

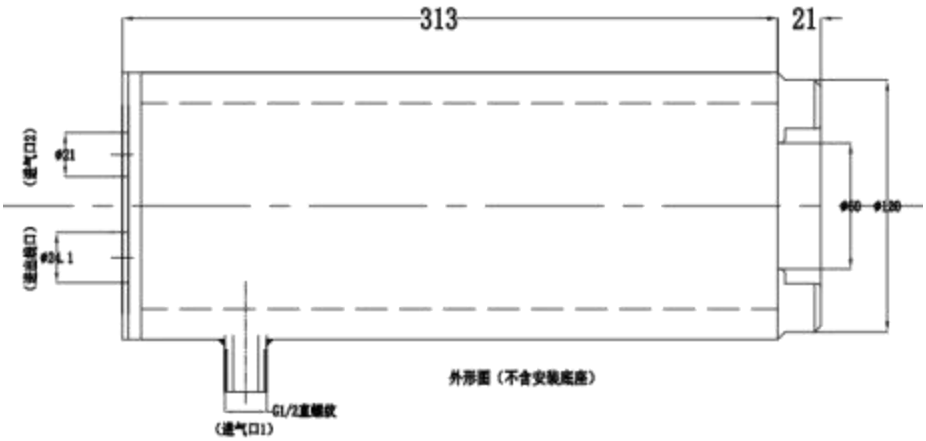
3.1 High-temperature type short-wave infrared thermal imaging thermometer

model	PFCDG320-G	
product picture		
image resolution ratio	384×288	640×480
Lens matching	25mm ,35mm ,50mm	
temperature resolution	0.5℃	
frame frequency	25Hz	
Image algorithm	Gamma correction, enhancement algorithm	
temperature measurement accuracy	≤1%	
Temperature measurement range	800℃~1800℃	
Network video compression format	H.264/ H.265	
data type	H264, H265, and 16 Bit, and the raw temperature data	
Network standards	Gigabit net / adaptive 10M / 100M / 1000M	
Protocol support	IPv4/ IPv6,TCP,UDP,NTP,HTTP,RTSP,RTP,ICMP,WebSocket,	

	ONVIF
Temperature output	Support the simulation amount of 4- -20ma, RS485
levels of protection	IP66
size	Φ126mm×351mm
way to install	Equipped with a cloud stand
weight	≤8Kg
working temperature	-20～200℃

3.2 Structural size of the whole machine

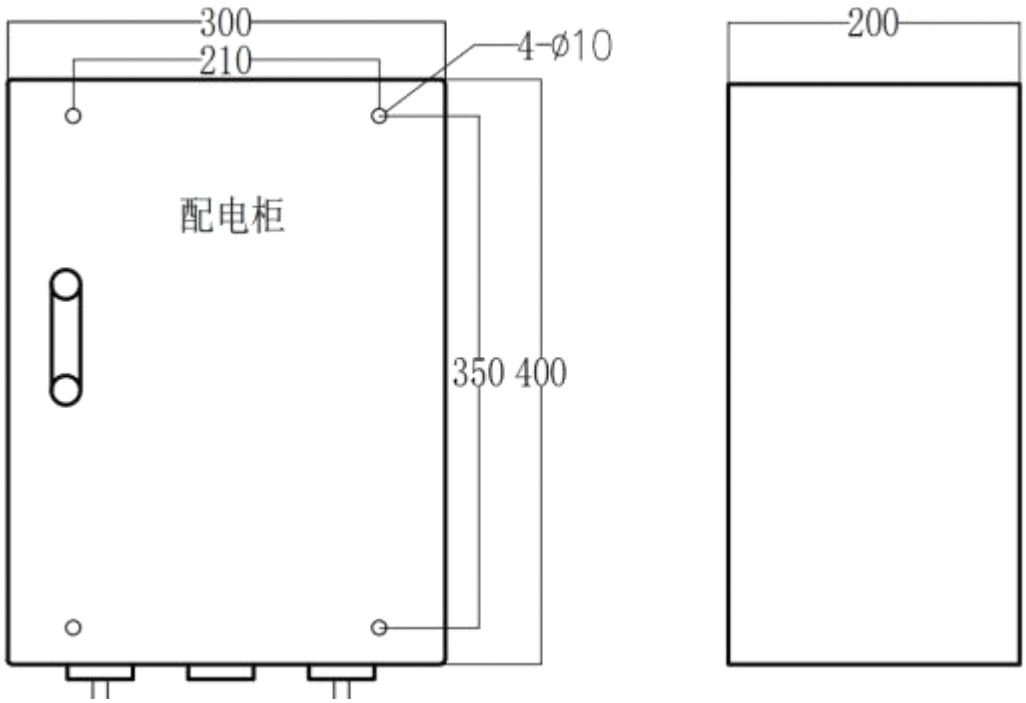
The structure size of the whole machine is shown in the following figure.



3.3 Site control box

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

- Input interface: 100M / 1000M Ethernet, RJ 45 interface
- Output interface: 1000M optical port
- Transmission rate: up to 1,000 M
- Standard: IEEE802.3, IEEE802.3u, IEEE802.3x
- Power supply: AC 220V± 10% 50W
- Ambient temperature: -20℃ ~65℃
- Ambient humidity: 90%
- External size: 400 (W) 300 (H) 200 (D) mm
- Irene size drawings



3.4 High-temperature resistant cable

Due to the ambient temperature of the work site is generally high, in order to ensure the stable and reliable transmission of communication and video transmission, the cables are comprehensive cables with high temperature resistance, fire resistance and shielding network.

The main technical parameters are listed as follows:

- Rated temperature: -65℃ ~ + 250℃ (maximum operating ambient temperature: 250℃, minimum operating ambient temperature: -65℃)
- Rated voltage: 600V
- Execution standard: GJB773A-2000
- Conductor: multiple-plated copper wire
- Color: red, black DC12V 0.5m2; orange white, orange, green white, green, blue white, blue, gray, gray network cable.
- Insulator: PTeflon (PTFE)
- Performance: corrosion resistance, strong acid resistance, strong alkali resistance, oxidation resistance; high voltage resistance, non-combustion, non-aging
- Test voltage: 7000V does not breakdown

3.5 Image algorithm server

- Intel ® Core ™ i7-11700 Processor (Quad-Core, 8MB,3.60GHz)
- Memory is 16GB 1600MHz DDR3 non-ECC
- Hard disk 256G solid-state + 1TB 3.5-inch SATA (7,200 Rpm) hard disk
- Display is 23.8 inches
- Windows 10 Professional version, a 64-bit operating system

3.6 Install the accessories

- Air filter
- 25 m stainless steel trachea
- 110 m high temperature resistant cable
- Adjustable cradle head holder
- Assembly and pre-commissioning before installation

4 System software

4.1 Software interface

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

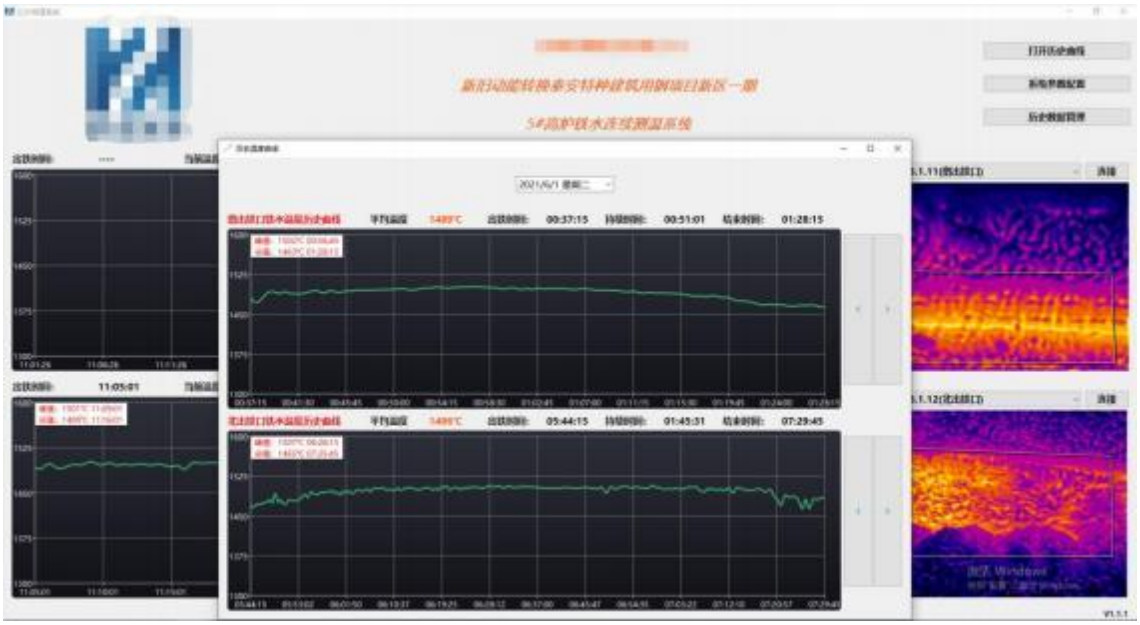


Figure 2. System software interface

The basic functions of the software are described as follows:

- The molten iron temperature is displayed in real time and is updated every second on the curve. Time is shown on the abscissa, continuously showing the temperature change curve of the whole iron process.

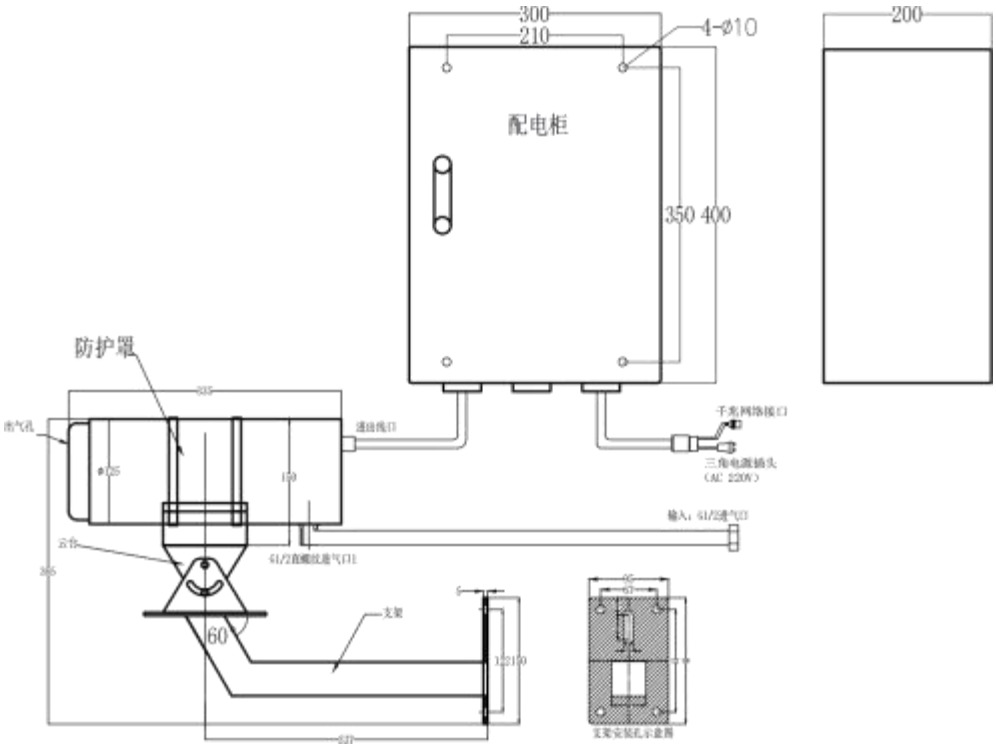
- The start time, end time and duration of the iron will be recorded automatically.
- The real-time video clearly shows the situation of iron outlet, and the brightness can be adjusted.
- Tip the measured abnormal temperature. When the temperature is outside the set range, display HIGH or LOW.
- Real-time automatic detection of the iron mouth out of the state, the main page automatically switch the iron mouth, to realize the automatic detection and judgment of the iron mouth.
- Automatically save the current temperature and average temperature, save the monitoring interface every 30min, and save the iron exit after the iron monitoring interface.
- The historical data and monitoring interface can be queried, and save the temperature value for 2 months, and the monitoring interface screenshot is saved for 6 months.
- It can overcome the interference of dust, high temperature and other factors, and accurately measure the temperature field distribution, including the outlet temperature and the outlet slag temperature.
- It can be connected with the LED screen through ModBus protocol and analog output to display the temperature.

5 Configuration list

No	name	model	unit	quantity	remarks
1	High-temperature type short-wave infrared thermal imaging thermometer	PFCDG320-G	short for Taizhou		resolution ratio: focal distance: Temperature measurement range:
2	Electric control cabinet	SEB432	individual		
3	Image algorithm server	IDS	cover		Including hardware and software, parts, display
4	air compressor	YBM-15A	short for Taizhou		apolegamy
5	Cold dry machine	S-100AFB	short for Taizhou		apolegamy
6	High temperature metal hose	φ 12mm	cover		
7	Supporting cable	/	cover		High temperature resistant cable

8	Install the attachment	HIRDA-FJ	cover		Including the mounting bracket and adjusting the cloud head
9	The 4-20mA conversion module	HIRDA-DA	individual		apolegamy

6 Schematic diagram of the site installation



7 Division of labor between the two parties

Supplier:

1) Provide the manufacturing, transportation, installation and commissioning services of HIRDA-MI molten iron temperature continuous detection system to ensure the normal operation of the system, ensure the integrity of the system and meet the requirements of site use.

2) Responsible for selecting the installation position of HIRDA-MI molten iron temperature continuous detection system, and provide the installation position map before construction.

3) Responsible for the debugging, use, maintenance and maintenance of the HIRDA-MI temperature continuous detection system for the personnel, so that the personnel can independently master the operation skills.

4) Provide product qualification certificate, inspection report, use and maintenance instructions and other relevant technical data.

Buyer:

1) Provide the relevant site data and design drawings required for the installation and debugging of HIRDA-MI molten iron temperature continuous detection system equipment.

2) Responsible the work of piping, wiring and melting optical fiber for cooling gas, optical fiber and cable required by HIRDA-MI molten iron temperature continuous detection system equipment.

3) Responsible for training the purchaser's personnel on the commissioning, use, maintenance and overhaul of the HIRDA-MI hot metal temperature continuous detection system, so that the purchaser's personnel can master the operating skills independently.

4) The demander shall assist in providing the working conditions for the factory service personnel of the supplier.

8 Acceptance criteria

1) Display the infrared heat map of molten hot metal on the software interface of HIRDA-MI molten iron temperature continuous detection system, and the equipment maintains a good working effect under the condition that the cooling gas meets the use requirements;

2) Display the area of abnormal molten iron temperature, and prompt the alarm;

3) The supplier shall provide professional training to the personnel designated by the demander.

9 After-sales commitment

1) The warranty period of HIRDA-MI molten iron temperature continuous detection system is 12 months from the date of acceptance, and 18 months after the arrival (the warranty period of purchased products and servers including internal hardware is 12 months from the arrival date of goods of the equipment).

2) If the thermal imager is damaged caused by improper use, the demander shall order spare parts in time, and the supplier shall provide maintenance services.

3) HIRDA-MI molten iron temperature continuous detection system software is used for a long time, and the software upgrade service is provided for free.

4) When receiving the call from the demander, the supplier is responsible for guiding the demander to handle the fault; if the demander cannot solve the problem, the supplier promises to come to the site within 48 hours. Company service telephone number: 400-080-4288.