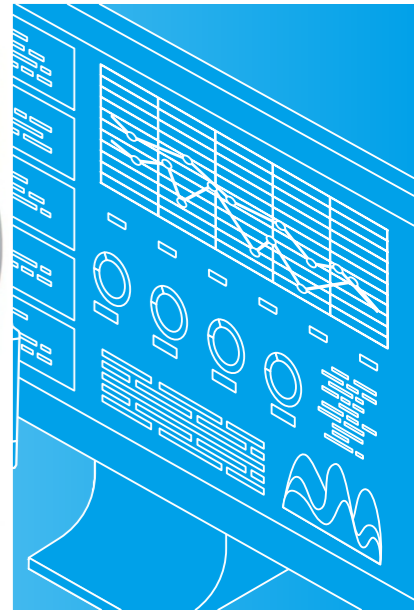




SUNLIGHTWELD



Intelligent Grounding On-Line Monitoring System



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2023 v1.1

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1 Summarize

Buildings, tank farms, substations, production automation equipment and other grounding is to prevent electronic instruments and other important equipment from lightning current damage, or due to other reasons caused by equipment leakage, interference and so on to take protective measures, the purpose is to lightning current, interference signals and other grounding system into the earth. This protects the stable operation of the device and the safety of the operator.

Because the grounding grid is buried underground for a long time, the maintenance and detection period of the underground grounding grid is long. After long-term acid-base corrosion, natural dissolution or man-made damage, the grounding resistance of the system is easily increased, resulting in poor grounding of the grounding grid, which will block the release channel of lightning current or interference signals, and weaken the protection function.

When the ground grid is required to discharge current, it cannot be discharged in time, which will generally make the ground potential rebound and lead to the unstable work of instruments and other automation equipment. Therefore, it is the basis for the stable and safe production of enterprises to grasp the status of the ground grid in real time and ensure the stability and reliability of the ground grid.

1.1 Corrosion of ground network

The buried grid will slowly corrode over time. There are many reasons for the corrosion, such as chemical corrosion, metal oxidation, galvanic corrosion, lightning impact, natural dissolution and so on. Because of the variety of materials and moisture in the soil, metals tend to corrode much faster underground than when exposed to air. The following figure is the data of natural corrosion and galvanic corrosion of metal materials of GB50650 grounding grid. The actual situation is that multiple states will occur superimposed, and the corrosion will exceed our imagination.

material	(%) Percentage of weightlessness (%)	
	1 year	3 year
Mild steel catalpa	2.6	6.11
Galvanized steel rod	1.5	2.4
Electroplated copper steel rod	0.52	0.93
Zinc bar	1.2	1.2

Table 3 Natural corrosion of single metal

material	Grounding body composition (I is mild steel)	Weight loss percentage of mild steel (%)	
		1 year	3 year
Galvanized steel rod (G)	G-1	1.2	2.85
Electroplated copper steel rod (C)	C-1	4.85	14.0

Table 4 Corrosion test data of different metal combinations (galvanic corrosion)



Site diagram of excavation of ground grid after corrosion

1.2 The importance of the grounding resistance online detection system

Whether the channel of lightning current discharge is smooth is often the top priority of lightning protection investigation. Generally, the conducting resistance of the connection between the grounding lead and the ground grid can be detected. The reliability of the ground grid can be predicted based on the conducting resistance, and the running status of the ground grid can be predicted through the accumulation of data.

The online grounding resistance monitoring system can not only monitor the on-going resistance of the underground lead and the ground network online, but also predict the status of the ground network through the on-going resistance. When enough data points are detected, the integrity of the ground network can also be calculated, so as to ensure that the lightning current can have a sound discharge channel when lightning strikes.

The online monitoring can not only reduce the workload of inspection and improve the work efficiency, but also describe the change curve of the ground network through the accumulation of data. The running state of the ground network can be predicted and analyzed through the curve, thus providing scientific data and judgment basis for operation and maintenance personnel.

1.3 Applicability of on-line monitoring of grounding resistance

The system developed by our company does not change any design structure of the original grounding system, and adopts non-contact measurement and other online monitoring technology, which will not affect the grounding effect and the normal operation of facilities. There is no need for self-test and real-time detection, and the product can be installed individually

Installation and use, can also be built into a wired network system or wireless network component system for use, when the system support, you can store the data, through the accumulation of data curve display, you can intuitively see the change trend of the ground network, to the health of the ground network pulse.

The product is divided into wired and wireless transmission modes:

1. wired network system: through RS485 communication protocol data transmission, by the main communicator (concentrator), monitoring software, power adapter, computer and other components, suitable for close distance, convenient construction wiring grounding resistance monitoring system.

2. Wireless network system: Data transmission through Lora wireless communication, by the main communicator (concentrator), GSM/GPRS/4G transceiver module, monitoring software, power adapter, computer, etc., suitable for remote or construction wiring is not convenient real-time monitoring of the grounding resistance, wireless transmission distance can cover 5 kilometers under barrier-free conditions, the factory can meet 1 km of stable communication.

S-CR-01 is suitable for tower grounding of transmission lines. Grounding of underground mine equipment; Meteorological lightning protection grounding; Petrochemical grounding; Grounding of communication; Grounding of transformer distribution station; Grounding of railway facilities; Grounding of building warehouse; Electrical equipment grounding. Especially suitable for such as petroleum, petrochemical, explosion-proof industry and other large complex devices, need to carry out protective grounding, lightning protection grounding, anti-static grounding and cathodic protection grounding system.

1.4 Product advantages

S-CR-01 series online grounding resistance monitoring system has passed the test of various detection institutions, and the product has passed the 100KA lightning surge test. That is to say, when the lightning protection grounding passes the 100KA lightning current during the actual operation of the product, the online detector works normally. Below is an excerpt from the test report.

See Table 1 for the waveforms and severity levels of the lightning test of the power cord. The preferred waveforms and options are selected in general cases or without any provisions.	Severity level: X Test 10/350us as required by customer Test current: 100kA	Meet the requirements
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EMI part through the "GB/T 9254-2008 information technology equipment radio harassment limits and measurement methods" level A requirements, that is to say, can work in most places, other equipment will not produce interference.

EMS part through the "electromagnetic compatibility test and measurement technology GB/T 17626" stipulated surge, static electricity, pulse group, radiation disturbance resistance, power frequency magnetic field disturbance resistance, voltage drop, RF magnetic field conduction harassment of the highest strict grade requirements. That is to say the online detector can work in a stable strong interference environment. Below is an excerpt from the test report.

Summary of Test Results

Test Items	Examination Requirement	Method of detection	Level of detection	Test Results
Power terminal disturbance voltage	Q/2W 1-2021	GB/T 9254 2008	A grade	qualified
Disturbance of radiation(below 1GHz)	Q/2W 1-2021	GB/T 9254 2008	A grade	qualified
Radiofrequency electromagnetic field immunity	Q/2W 1-2021	GBT 17626.2 2018	Air discharge: And 15 kv Contact discharge: Soil 8 kV	qualified
Electrostatic discharge immunity	Q/2W 1-2021	GB/T 17626.3 2016	10V/m 80 MHz~ 12.0 GHz 80% AM	qualified
Power frequency magnetic field immunity	Q/2W 1-2021	GB/T 17616.8 2006	100 A/m 50hz	qualified
Immunity to voltage dips, short interruptions and voltage changes	Q/2W 1-2021	GBT17626.29 2006	Dc power input wall port: 0%C. Run 100ms The well waiting time is 30ms 40%T. lasts 300m 70% of U. It lasts for 300m	qualified
Disturbance immunity of electrical fast transient pulse groups	Q/2W 1-2021	GB/T17616.4 2018	Dc power input G port: Soil 4 kw Control port; Soil 2 kv 485 Communication port: Sh 2 kw	qualified
Radiated disturbance immunity of RF field induction	Q/2W 1-2021	GB/T 17626.6 2017	Dc power input drink: 10 Vrn) 150kHr -80	qualified

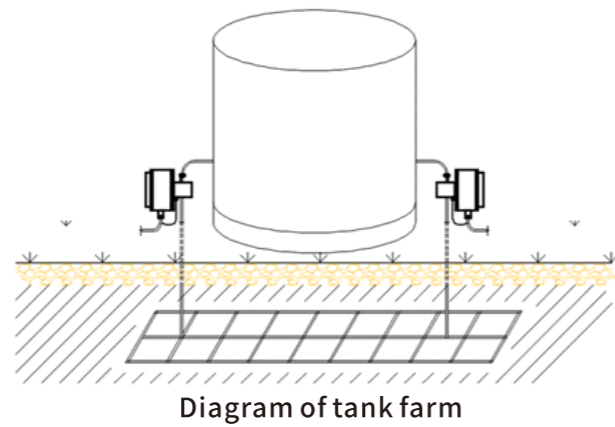
1.5 Installation position of the grounding resistance detector

The grounding resistance detector of T-CR-01 series online grounding resistance monitoring system adopts the loop measurement method to measure the grounding resistance and is installed at the connection between the underground lead and the vertical grounding body. Through online monitoring, the connection condition of the grounding lead can be monitored, or the equivalent grounding resistance of the whole grounding network can be calculated from the grounding resistance value of these devices. To determine the running status of the local grounding network.

1.5.1 Installation position of the grounding resistance detector

The following figure is a schematic diagram of storage tank monitoring. Based on the metal conductive characteristics of the tank, both the ground lead line and the ground grid are metal materials constituting the loop. On that side, we can monitor the resistance data of the metal loop and judge the loop resistance

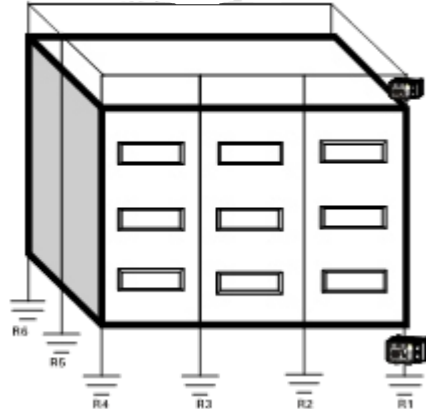
Whether the connection between the offline line and the ground network meets requirements. If there are more monitoring data of ground lead down, and the computer records the data, a trend analysis of the data, when the data has a certain number of years, it can be seen that the data of the ground network changes.



1.5.2 Building or substation

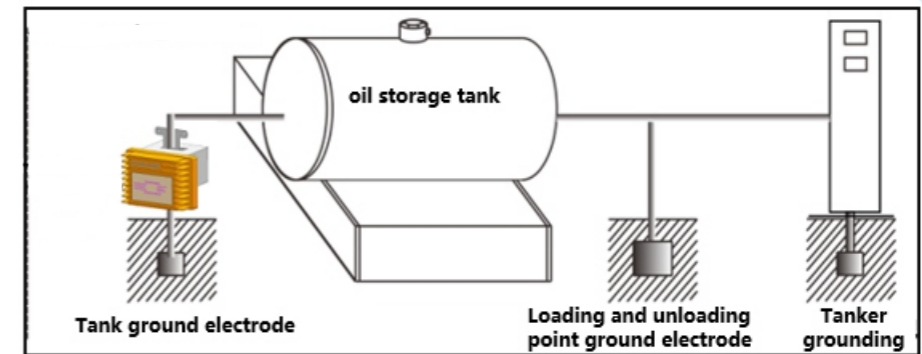
The following is a schematic diagram of the building. The schematic diagram of the substation is the same as the building. The lightning protection overhead line and ground lead line at the top of the building are connected to the ground grounding network as a whole. By monitoring the resistance data of this loop, it is possible to determine whether the lead line and the ground grid can be connected.

Lightning protection overhead line



1.5.3 Gas Station

The following is an example of a gas station. The ground resistance detector can be installed at any ground point in the oil tank, the refueling machine, or the ground lead in the control room.



1.5.4 Oil-gas booster station

The following is an example of a booster station. The in-line earthing resistance detector can be installed with a selection of contacts.



2 System Functions

2.1. Product functions

2.1.1 Grounding Resistance Detector (Can be divided into explosion-proof type, non-explosion-proof type and micro type those three types)

The ground resistance detector has the function of displaying the current ground resistance value and dry contact alarm output, so the product can be installed and used independently, or it can transmit data through RS485 communication protocol to form a network system.



Micro Type



Explosion proof type



Non explosion proof type

Parameter Name	Parameter Index	
Explosion proof standard	Ex d IIC T6 Gb explosion-proof type	
Class of protection	IP65 and WF2 can be used outdoors	
Plant power supply	18~36VDC	
	85~265VAC/DC	
	Battery powered, wireless communication (no wiring, 10 years battery life, wireless communication distance of 1000 meters)	
Range of resistance	0.01Ω~200Ω	
Rate of differentiation	0.001Ω	
Precision	≤1Ω: Error ≤10mΩ, 20°C±5°C, 70%RH below	
	≤100Ω: Error ≤±1%	
Working Environment	-40°C~85°C, Humidity ≤95%RH (no condensation)	
Overflow indication	If the value is larger than 10Ω, the -- symbol is displayed	
Signal Transfer Output	Panel alarm indicator with simultaneous output	Battery power is not available
	Dry contact (with 5A/220VAC)	
Communication interface	RS485 (ModBUS RTU protocol), photoelectric isolation, 1200 m /9600bps	
	Wireless communication (433M), communication distance of 1000 meters	
Size of product	200mm×200mm×206mm Explosion proof type	
	200mm×280mm×112mm Non explosion proof type	
	169mm×142mm×150mm Mini type	
Ground wire perforation dimensions	54mm×21mm Closed mouth type (can pass through 54mmX10mm flat bar or diameter 20mm cable)	
The installation	The ground cable is fixed on the grounding flat steel through the center of the detector	

2.1.2 Intelligent Terminal

Non-explosion-proof intelligent display terminal is a 10.1" color display, internal integration of data acquisition and storage, data

Transmission, event record alarm, curve data, data Kanban and other functions. The product has two alarm dry contact output, can expand the alarm indicator light, alarm bell, etc. It can collect 4 channels (32 devices per channel), 2 uploading serial ports, 1 network port, 2 alarm outputs and 4 IO status inputs. It can process data from 1000 collection points.

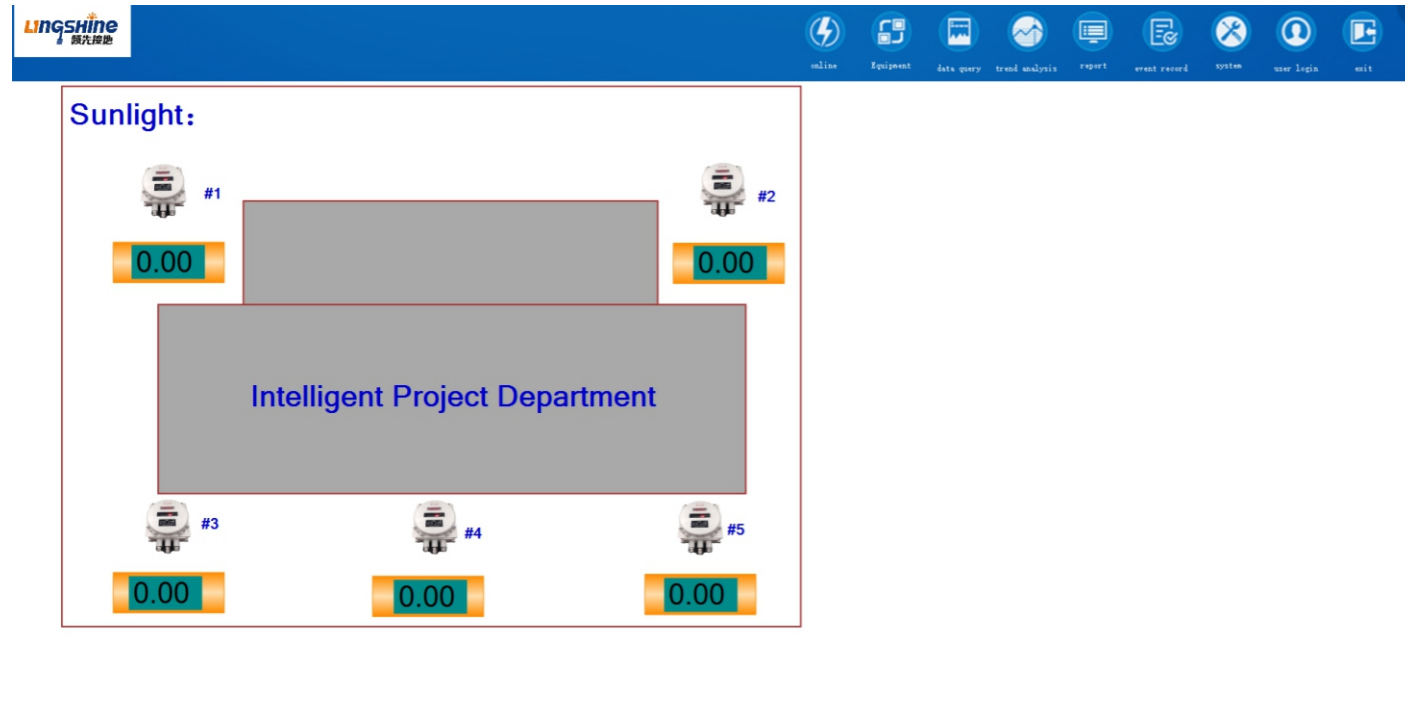
Explosion-proof intelligent terminal can collect data of 2 channels (32 sets per channel) ground resistance detector system, 2 uploading serial ports, 1 road network port, 1 alarm output, 1 IO status collection. The product has data collection, data storage, event record, alarm output and other functions. When more than two channels or 64 devices need to be collected, connect a ground resistance detector to the current intelligent terminal, that is, add a level-1 intelligent terminal unit to manage 64 level-2 intelligent terminal units.

Parameter Name	Parameter indicators	Description
Explosionproof standard	Ex d IIC T6 Gb	Explosionproof products
Protection level	IP65、WF2	Can be used outdoors
Working power supply	AC/DC 8~265V Power consumption ≤5W DC24V (18-36V) Power consumption ≤3W	Ordering instructions, choose one from two choices
Working conditions	Environmental temperature -30~75°C Relative Humidity 5%~95% No condensation	Beyond the temperature range, the LCD display will be blurred or black, does not affect other functions, after the temperature recovery, the display will return to normal
Dimension, weight	230×230×150mm, 5kg, Four corner fixed installation	Explosionproof type
	276×192×55mm 1.5Kg	Embedded installation
	322×418×100mm 7Kg	Non-explosion-proof, wall mounted
Display size	10.1 inches	Capacitive touch screen (non-explosionproof type)
Data Upload Channel	Number of channels: 2 channels RS485 Communication rate: 1200~115200bps	Opto-isolation
Network port upload channel	1-channel 100M network card	
Data acquisition channel	Number of channels: 2 channels RS485	Explosionproof type
	Number of channels: 4 channel RS485 Communication rate: 1200/2400/4800/9600	Non-explosion-proof type, optoisolated
Maximum access devices	4×32 units of equipment	Non-explosion-proof type
	2×32 units of equipment	Explosionproof type
Data Point Capacity	1000点 1000 points	
Historical data storage	Store 1 month of data / hourly	
Trend Data Storage	Annual data storage / once a day storage	
Event Recording Capacity	292 Articles	
Data update time	< 3s	

2.1.3 Monitoring the Background

Monitoring background system, can be equipped with a standard control screen cabinet, the size of 800 (width) *600 (depth) *2200mm (height), the background computer for industrial control machine, placed in the control screen, the field collection of ground resistance real-time data, can be transmitted to the monitoring background through RS-485 or Ethernet port communication.

The monitoring background is based on configuration design, which is a software system written in C# based on windows system. It adopts modular structure design and uses MySQL database for data storage. It can collect and process the data of all ground resistance detectors. System data are all saved to the database, data storage time, size according to the size of the hard disk to determine their own (because the amount of system data is not large, according to the current mainstream computer configuration, its data storage time is almost unlimited). In addition, the system reserves external device ports to connect to products of other manufacturers and provide grounding resistance system data to other systems.



The main interface of the system, that is, the online monitoring function, can overlay the position of the grounding resistance detector in the geographical diagram of the actual device distribution or various renderings, and intuitively display the monitoring value of each grounding resistance detector on the map.

parameter name	Parameter index
Protection class	IP40
Industrial computer	21-inch monitor, industrial control computer (memory 8G, hard disk 500G)
Data Display	<ol style="list-style-type: none"> 1. Logic of grounding resistance detector/intelligent terminal 2. Connect the graphical display overlaid on the geographic infographic 3. Communication status display
Alarm display	<ol style="list-style-type: none"> 1. Graphical interface alarm prompt 2. Voice synthesis output alarm 3. Automatically push the map to the independent interface the monitoring point where the alarm occurs 4. The data is sent to the upper level system for alarm
Curvedisplay	Real-time curve, historical curve, column chart, pie chart, trend curve
data analysis	<ol style="list-style-type: none"> 1. Data comparative analysis of the same equipment at different times 2. Data comparative analysis of different devices at the same time
Report function	<ol style="list-style-type: none"> 1. Report format customization, data content Customization 2. Generate reports automatically
cloud service	Support Alibaba Cloud, own cloud platform and other platforms
Web publishing	support
Mobile App	support
Collection point capacity	Not less than 10000 points, general industrial computer
Data acquisition channel	Depending on the external communication server, the acquisition channel is not limited. Support serial port, network port And other communication methods, a variety of communication protocols.
data storage time	Not less than 3 years depending on hard disk and data storage density

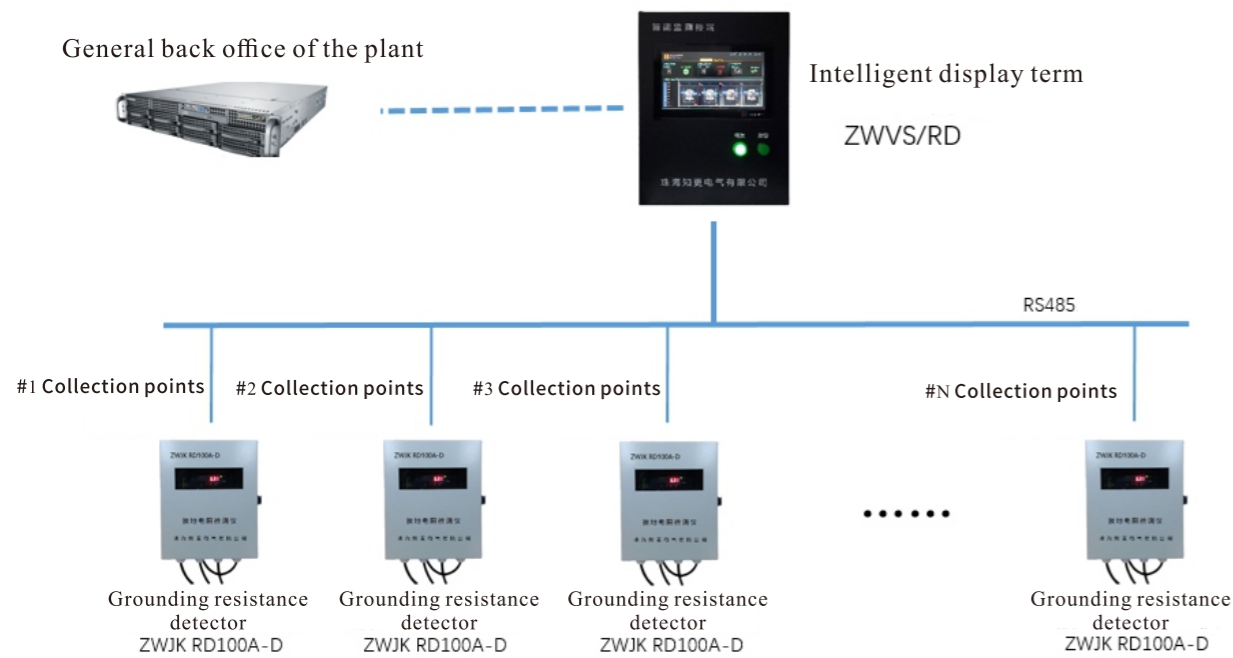
3 System structure

ZWJK RD100 series grounding resistance online monitoring system adopts three-layer structure design:
 System management: mainly composed of background computer system, set in the comprehensive management center, with the whole system all data comprehensive analysis management function, to provide us with effective data information support for production safety management.

Application layer: It consists of intelligent display terminals, etc., which are generally installed in appropriate positions in the equipment area with wall-mounted installation. It mainly provides on-site workers with real-time monitoring data of relevant equipment in a centralized manner.

Equipment layer: It is composed of ground resistance monitoring instrument, etc., divided into explosion-proof and non-explosion-proof products according to application layer occasions. It mainly monitors the ground resistance value of the measured point and transmits it to the application layer in real time.

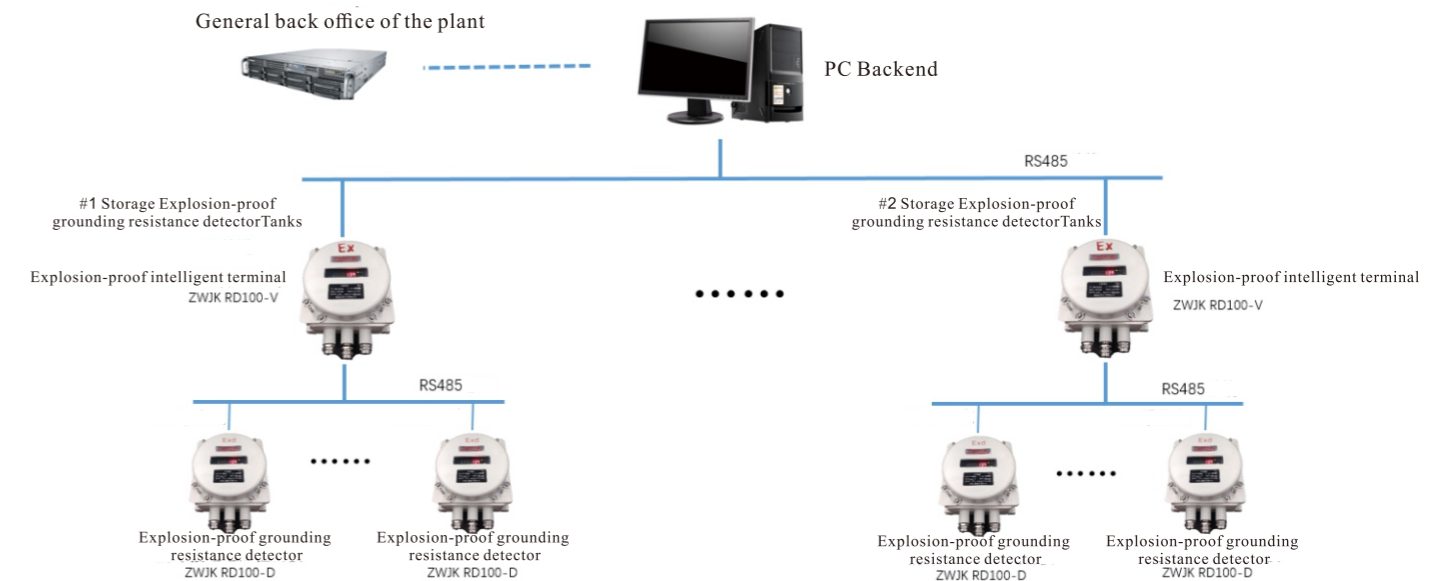
Ground monitoring system topology of non-explosion-proof area in the factory



Tank area grounding monitoring system topology

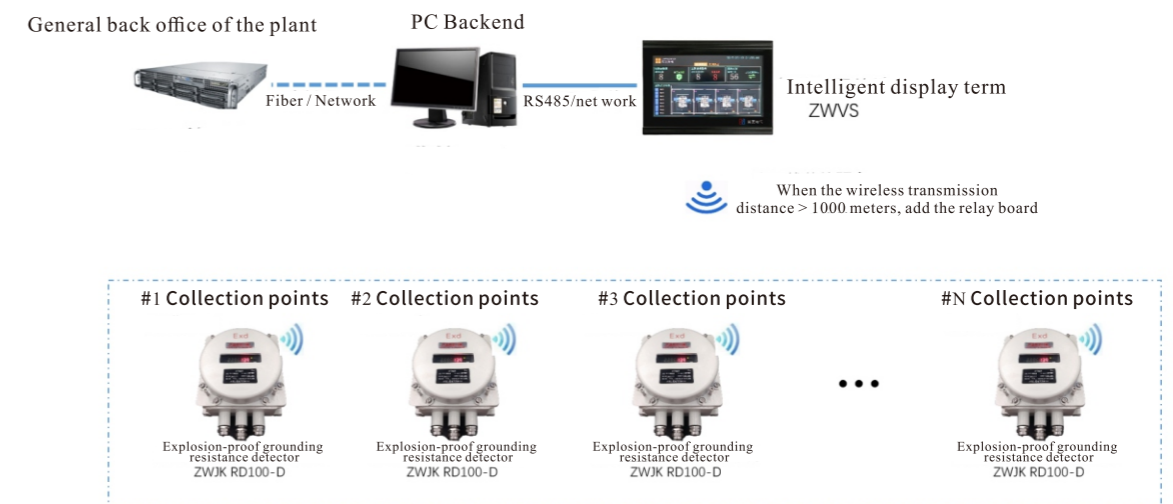
The main feature of the tank area grounding resistance system is explosion-proof, wide area, using explosion-proof grounding resistance detector for data acquisition, data concentration of data terminal unit, in a unified sent to the monitoring background (tank area is not large or data points can choose non-explosion-proof data display terminal unit). After data collection, the monitoring background can forward the data to the grounding resistance monitoring center of the whole plant.

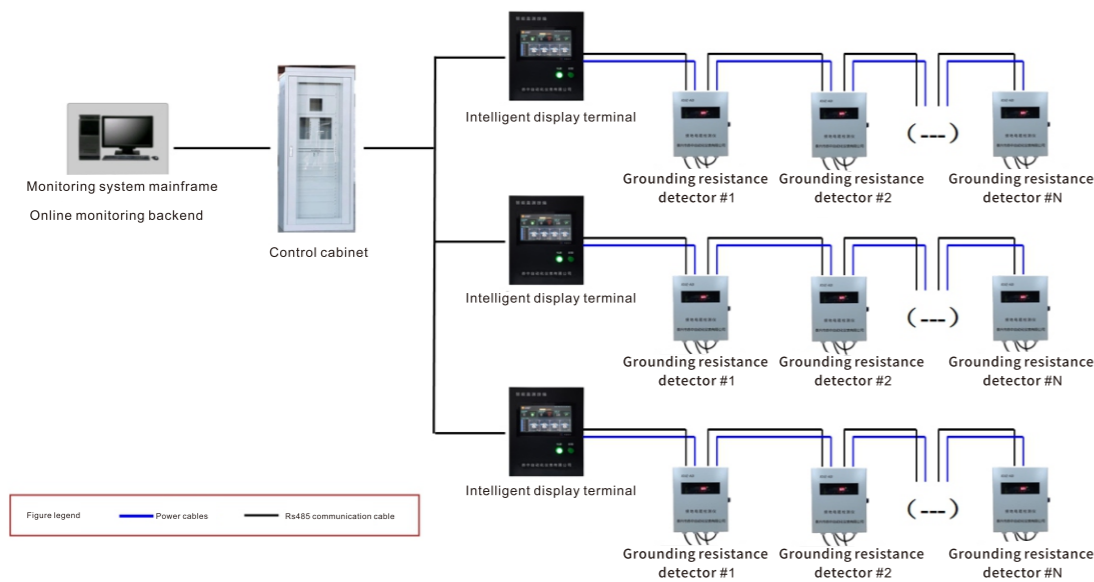
For large distribution area, communication distance is long, it is possible to exceed the longest communication distance of RS485 1200 meters.



Wireless ground resistance monitoring topology

It is suitable for real-time monitoring of grounding resistance at long distance or inconvenient construction wiring. The wireless transmission distance can cover 5 kilometers under barrier-free condition, and the factory can meet the stable communication of 1 kilometer.





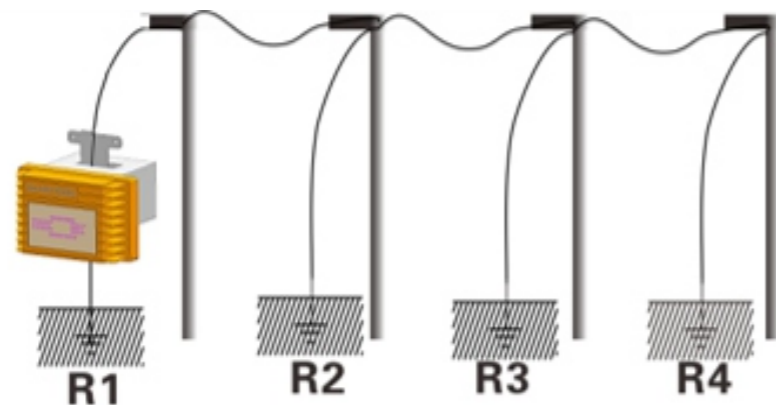
4 All kinds of Applications

4.1.1 Grounding pylons of transmission systems

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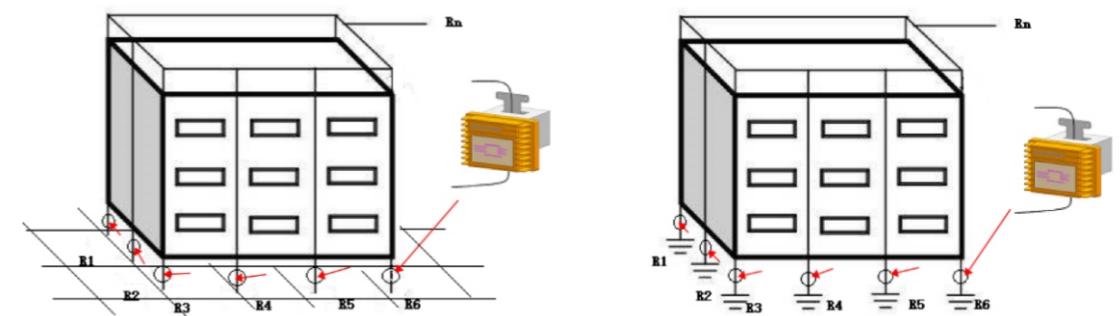
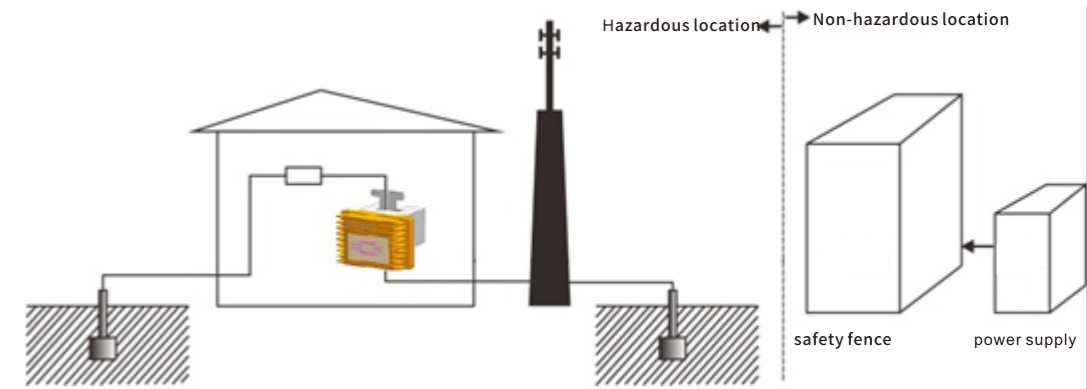
Application layer: It consists of intelligent display terminals, etc., which are generally installed in appropriate positions in the equipment area with wall-mounted installation. It mainly provides on-site workers with real-time monitoring data of relevant equipment in a centralized manner.

Equipment layer: It is composed of ground resistance monitoring instrument, etc., divided into explosion-proof and non-explosion-proof products according to application occasions. It mainly monitors the ground resistance value of the measured point and transmits it to the application layer in real time.

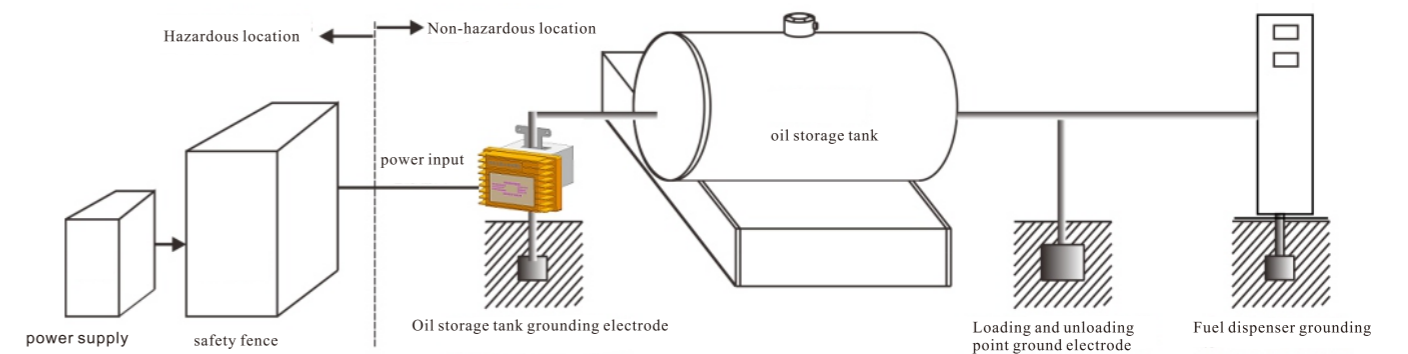


4.1.2 Grounding substation, equipment room and transmitter tower

Generally, the grounding of substation, equipment room and transmitter tower is independent in the field. The grounding resistance detector can be installed separately in the building. If connected, the grounding resistance detector can be installed as a loop, as shown in the following figure.



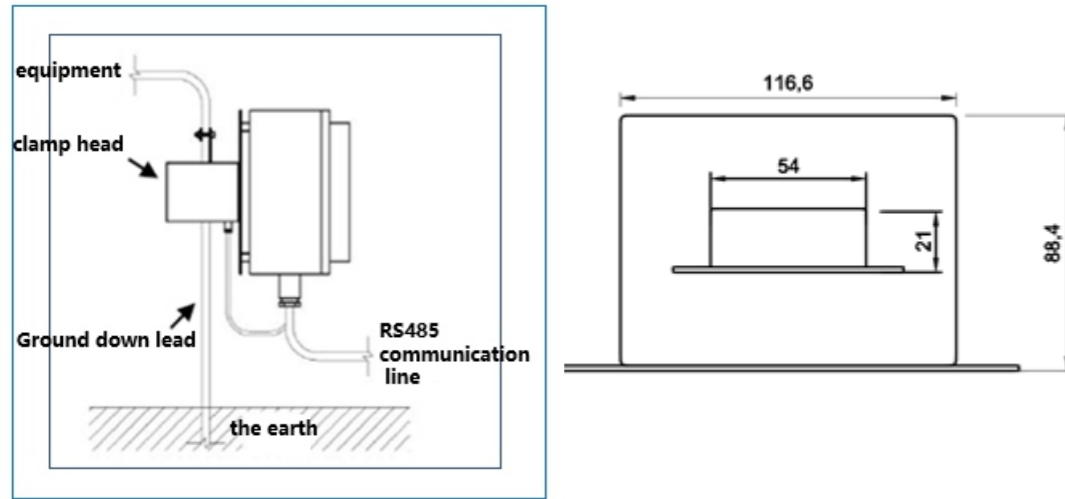
Grounding of buildings such as monitoring center and control room



Grounding of oil storage tank and loading and unloading point

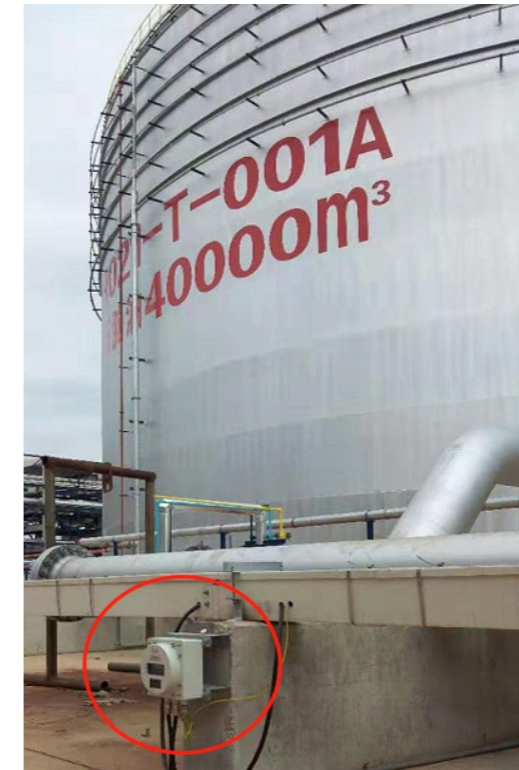
5 Installation Mode

After the grounding flat steel is disconnected, use bolts to secure the product pliers to the grounding flat steel. The hole size of the grounding flat steel is 54mm X 20mm.



6 Site installation Pictures

After the grounding flat steel is disconnected, use bolts to secure the product pliers to the grounding flat steel. The hole size of the grounding flat steel is 54mm X 20mm.



Site installation picture of explosion-proof intelligent terminal



Background system



Site installation picture of non-explosion-proof grounding resistance detector



Explosion-proof grounding resistance detector site



Substation installation site diagram



Substation installation site diagram



Installation site diagram of non-explosion-proof intelligent display terminal