

Operation Manual

for Elite GC2010 Gas Chromatograph

V1.0.0

Statement

The manual is intended to help users to understand, use and maintain Elite GC2010. Our company does not assume the responsibility caused by business or special purpose use of the manual.

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Please read the document carefully before using Elite GC2010.

Foreword

Thank you for purchasing our equipment. To ensure correct and safe use of the instrument, please read it carefully before using.

The details of the equipment's composition, installation, method of using, maintenance, parts selection and other points are described in the manual. After reading, please keep it carefully. Please delivery the manual with the instrument.

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1 Instrument Introduction

1.1 Working Principle of Gas Chromatograph

Gas chromatography (GC) is a technique for separating and analyzing multi-component mixtures. It primarily utilizes differences in boiling points, polarity, and adsorption coefficients among sample components to achieve separation within a chromatographic column, followed by qualitative and quantitative analysis of the separated components.

The gas chromatograph employs a gas as the mobile phase (carrier gas). After a sample is introduced into the injector and vaporized, it is carried by the carrier gas into a packed or capillary column. Due to variations in boiling points, polarity, and adsorption coefficients, the components separate within the column. A detector connected downstream then sequentially identifies each component based on its physicochemical properties. The resulting data is transmitted to a chromatography workstation via a network, which records the chromatogram and generates an analytical report. A simplified schematic of the working principle is shown below:

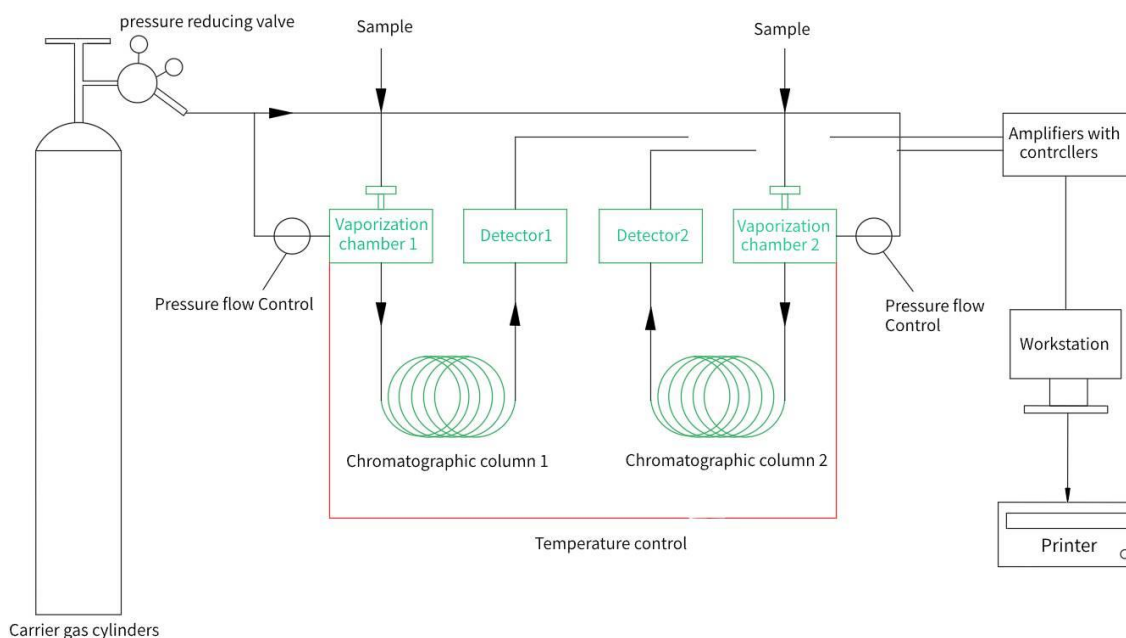


Figure 1.01 Simplified Schematic of Gas Chromatograph Working Principle

This method is widely applied in petrochemical, biochemical, pharmaceutical, sanitary inspection, food testing, environmental protection, and clinical sectors due to its high separation efficiency,

rapid analysis, and minimal sample consumption. It addresses challenges in quality control, scientific research, pollution monitoring, and process optimization across industrial and scientific domains.

1.2 Features of ELITE GC2010 Gas Chromatograph

Leveraging decades of R&D experience, our company has integrated advanced network communication technologies into the ELITE GC2010, resulting in a state-of-the-art gas chromatograph.

Key features:

- **Advanced Connectivity:** Equipped with 10/100/1000 Mbps Ethernet interfaces and built-in IP protocols, enabling remote data transmission via LAN/WAN for simplified laboratory setup and data management.
- **Intuitive Interface:** Features a 7-inch HD capacitive touchscreen with a user-friendly UI design.
- **Modular Design:** Supports parallel multi-processor operation for enhanced stability. Optional detectors include FID and TCD, with up to four detectors installable simultaneously for complex sample analysis.
- **High Reliability:** Utilizes industrial-grade chips, bus technology, and micro-flow gas control systems. Optimized temperature and gas flow precision ensure exceptional reliability.
- **Precision Temperature Control:** Eight-channel independent temperature control with $\pm 0.01^{\circ}\text{C}$ accuracy. Supports 20-stage programmable heating (expandable to 99 stages) and rapid cooling via an automatic rear-door system.
- **Signal Processing:** Integrates a 24-bit low-noise AD circuit with baseline storage and subtraction capabilities.
- **Workstation Compatibility:** Compatible with Windows XP/2000/7/8/10 operating systems.
- **Interoperability:** MODBUS/TCP protocol support enables integration with DCS systems.

1.3 Overview and Technical Specifications of ELITE GC2010

The ELITE GC2010 comprises an injector, detector, column oven, gas flow control system, temperature control system, signal detection module, and network-enabled workstation.

1.3.1 ELITE GC2010 Overview

The ELITE GC2010 features a 7-inch LCD touchscreen for intuitive operation. It is highly integrated, automated, and stable, making it ideal for prolonged use. Suitable for analyzing trace to macro amounts of organic/inorganic compounds and permanent gases, it offers excellent cost-performance for applications in petroleum, chemical, environmental, food safety, and research sectors.

1.3.2 ELITE GC2010 Technical Specifications

1.3.2.1 Main Specifications:

- Display: 7-inch HD capacitive touchscreen
- Temperature Zones: 8 independent channels
- Temperature Range: Ambient +5°C to 450°C ($\pm 0.01^\circ\text{C}$ accuracy)
- Programmable Heating: 20 stages (expandable to 99)
- Max Heating Rate: 80°C/min
- Gas Control: Precision mechanical valves for pressure/flow regulation
- I/O Ports: 8 external events, 2 auxiliary outputs
- Injectors: Packed column, capillary, 6-port valve, autosampler
- Detectors: Up to 4 (FID/TCD configurable)
- Startup Modes: Manual/automatic injection
- Communication: Ethernet IEEE802.3

1.3.2.2 Detector Specifications

- (1) Flame Ionization Detector (FID)
- Detection Limit: $\leq 3.0 \times 10^{-12}$ g/s (hexadecane/isooctane)
- Baseline Noise: $\leq 2 \times 10^{-14}$ A
- Baseline Drift: $\leq 1 \times 10^{-13}$ A/30 min
- Linear Range: $\geq 10^7$
- (2) Thermal Conductivity Detector (TCD)
- Sensitivity: $S \geq 10,000$ mV·ml/mg (benzene/toluene)
- Baseline Noise: ≤ 20 μV
- Baseline Drift: ≤ 30 $\mu\text{V}/30$ min
- Linear Range: $\geq 10^5$

1.4 ELITE GC2010 Key Configurations

1.4.1 Gas Flow Control System

ELITE GC2010 Gas Chromatograph Gas Circuit Control System Configuration:

Carrier Gas Circuit:

The carrier gas passes through a pipeline filter and receives stable input pressure (preset to approximately 0.3MPa at factory) via a primary pressure regulator valve. A tee connector divides the gas into two paths: one supplies a pressure protection controller for system protection upon gas interruption, while the other path feeds carrier gas to injectors I and II after flow regulation through pressure/flow control valves.

Hydrogen Gas Circuit:

Hydrogen gas passes through a pipeline filter and is divided into two paths via a tee connector. Each path undergoes flow regulation through pressure regulators and gas resistors. For capillary column applications, make-up gas (carrier gas) is merged before entering respective detectors.

Air Circuit:

Compressed air passes through a pipeline filter and is divided into two paths via a tee connector. Each path undergoes flow regulation through pressure regulators and gas resistors before entering corresponding detectors.

Refer to Figure 1.03 for the gas circuit flow diagram:

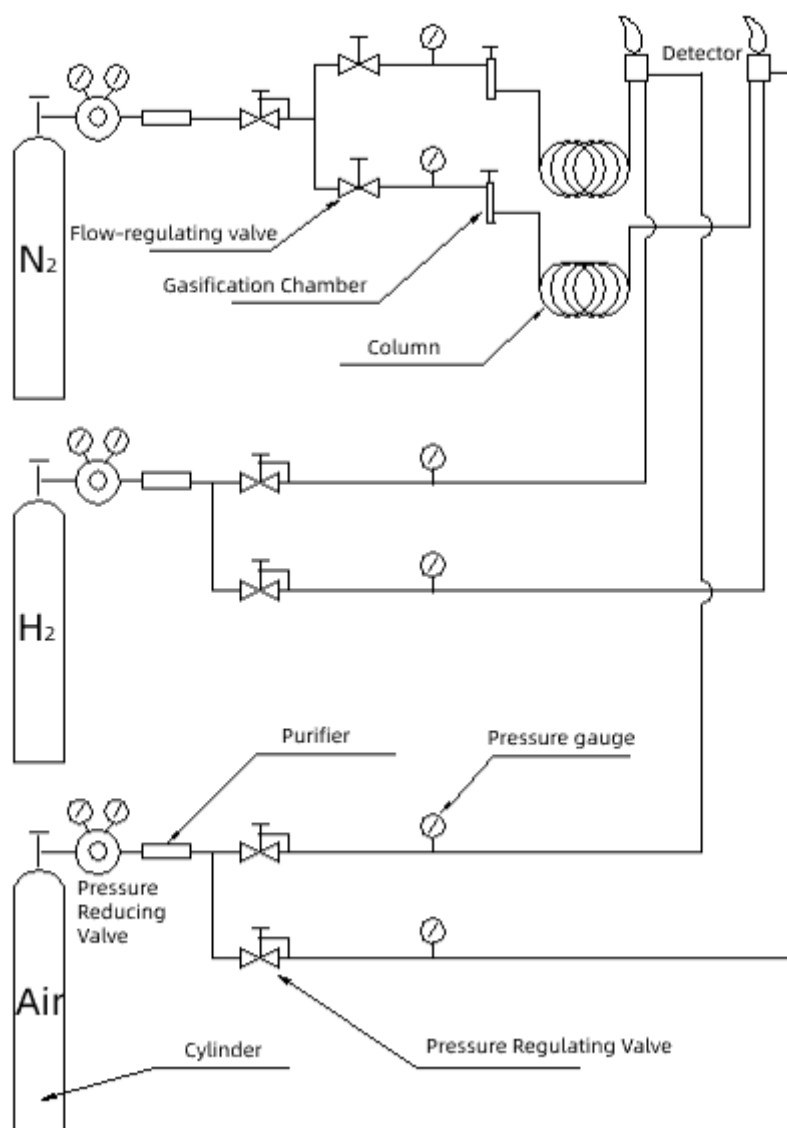


Figure 1.03 Gas Circuit Flow Diagram

Warnings:

The factory-set carrier gas pressure regulator (inside main unit) has been precisely calibrated. Do not adjust the regulator output pressure to maintain control accuracy.

When closing gas circuit regulators (pressure regulators, flow regulators, needle valves), avoid over-tightening to prevent valve damage.

1.4.2 Column Oven System

The ELITE GC2010 series features a spacious column oven (328×340×340mm) accommodating packed or capillary columns. It incorporates high-power heating elements and an intelligent rear ventilation system with dedicated fans for rapid heating/cooling. Dual software protection ensures

column safety during temperature control. Low-noise motors and stainless steel blades provide stable operation with minimal vibration.

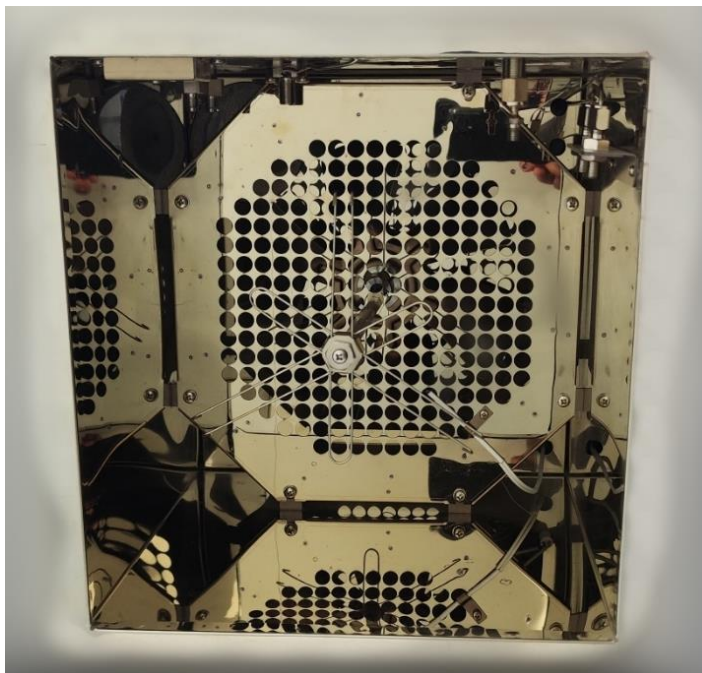


Figure 1.04 ELITE GC2010 Internal Oven Structure Diagram

1.4.3 Packed Column & Capillary Vaporizers

The packed column vaporizer is mounted on the front-left top of the oven (see Figure 1.05), while the capillary vaporizer structure is shown in Figure 1.06.

Vaporizer temperature control is managed by the microcomputer system. A heat sink cap with embedded Viton® injection septum is located at the top. The carrier gas inlet connects to the gas circuit control system outlet.

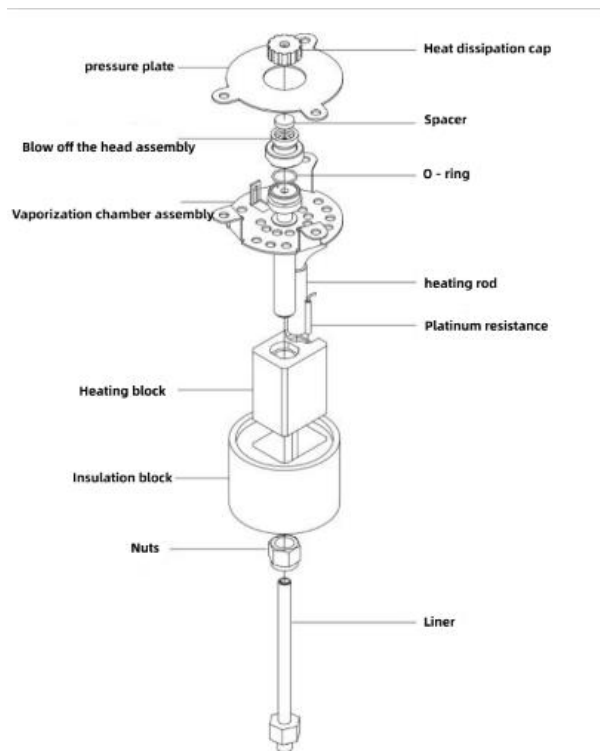


Figure 1.05 Packed Injector Structure Diagram

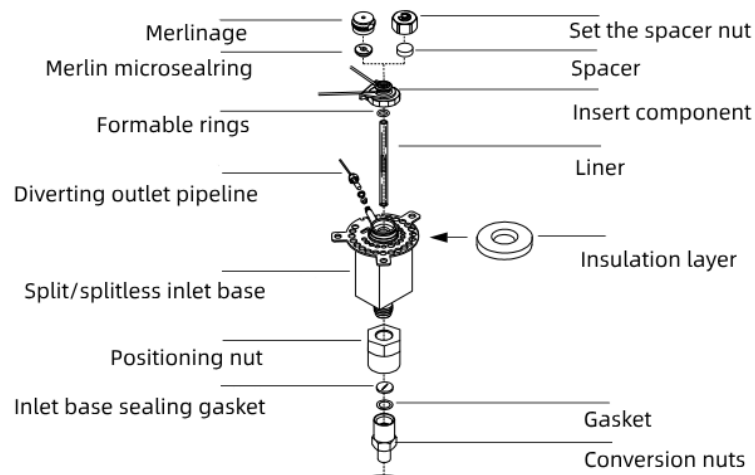


Figure 1.06 Diaphragm Purge Split Injector Structure Diagram

Notes:

The ELITE GC2010 supports multiple injector configurations (up to 3 packed columns simultaneously).

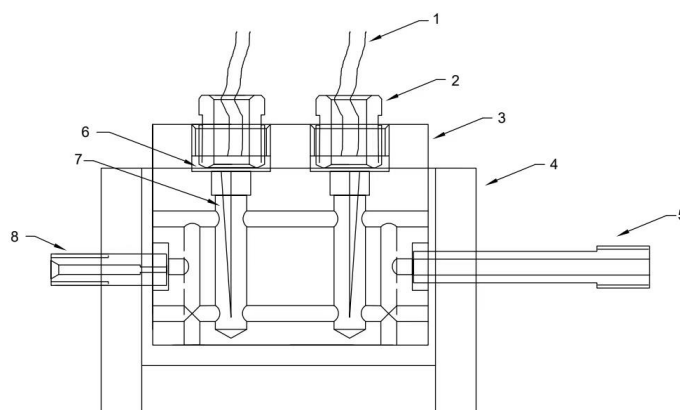
Standard configuration accepts Φ 4mm OD packed columns; Φ 3mm columns can be

accommodated with adapter liners.

Dedicated capillary split/splitless injectors with diaphragm purge function are available (up to 2 simultaneous installations).

1.4.4 Thermal Conductivity Detector (TCD)

The ELITE GC2010 can be equipped with a TCD detector (structure shown in Figure 1.07).



1. Tungsten Wire Leads 2. Compression Nut 3. Detector Body 4. Heating Block 5. Outlet Fitting 6. Copper Gasket 7. Tungsten Filament 8. Inlet Fitting

Figure 1.07 TCD Detector Structure Diagram

TCD Structure & Operating Principle:

Four symmetrical chambers are machined into a thermally conductive body, each containing a thermistor element. Two chambers serve as measurement cells while the other two act as reference cells. These form a Wheatstone bridge circuit connected to the TCD signal processing board. An integrated heater and temperature sensor maintain precise operating temperature through the temperature control system.

The reference cell receives only carrier gas, while the measurement cell receives carrier gas mixed with eluted components. When only carrier gas flows through both cells, the bridge remains balanced (baseline output). During sample elution, thermal conductivity differences between components and carrier gas disrupt bridge balance, generating chromatographic peaks.

Notes:

TCD operation must follow "Gas First, Heat Next, Current Last" protocol. Never apply bridge

current without carrier gas flow to prevent filament damage.

For shutdown: Turn off bridge current → Cool down → Shut off carrier gas after TCD temperature drops below 50°C above ambient.

Avoid excessive bridge currents as this accelerates tungsten oxidation and shortens detector life.

Refer to Figure 1.08 for recommended carrier gas/bridge current relationships.

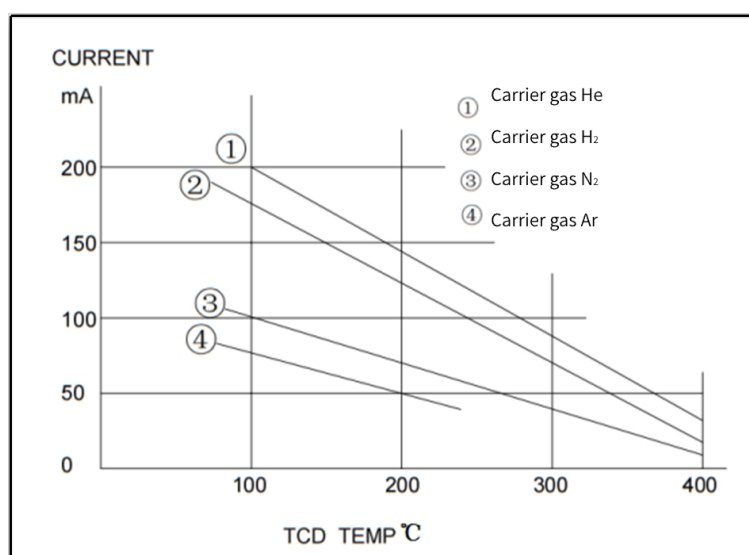


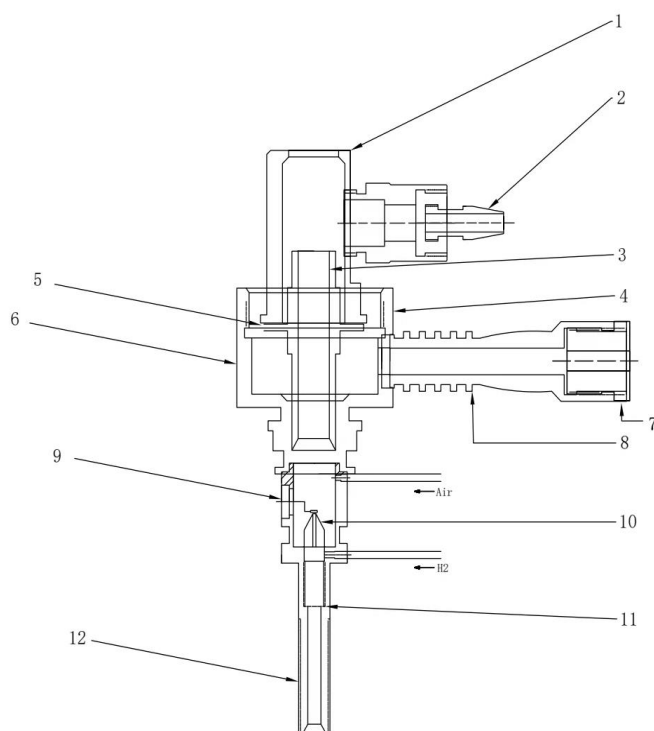
Figure 1.08 TCD Carrier Gas vs. Bridge Current Reference Chart

Safety Note: Bridge current settings are not retained after power-off. The system defaults to 0mA upon startup.

Warning: Oxygen contamination significantly reduces TCD filament life. Ensure thorough carrier gas deoxygenation!

1.4.5 Flame Ionization Detector (FID)

The FID is a universal detector offering high sensitivity, wide linear range, and excellent stability. It responds rapidly to analyte changes, making it ideal for trace analysis with capillary columns. The ELITE GC2010 supports two independent FID detectors.



1. Dust Cap 2. Ignition Wire 3. Collection Cylinder 4. Ion Chamber Cap 5. Insulating PTFE Gasket 6. Ion Chamber 7. Signal Cable
 Compression Nut 8. Signal Connector 9. Polarization Electrode 10. Ceramic Nozzle 11. Nozzle Base 12. FID Base

Figure 1.09 FID Detector Structure Diagram

The FID is mounted on the front-top of the main unit within a thermally conductive block containing heating elements and temperature sensor connected to the control system. The polarization ring is grounded, creating an electric field with the collector electrode. The collector output connects to the FID micro-current amplifier via low-noise cable. Hydrogen and air are supplied through stainless steel tubing from the gas control system.

FID Operating Principle:

Sample combustion in the hydrogen flame generates ions. The electric field between polarization and collector electrodes drives ions to the collector, producing a measurable current signal. This signal is amplified and processed by the micro-current amplifier before being sent to the chromatographic data system.

Instructions:

Do not activate FID hydrogen flow without a column installed to prevent hydrogen accumulation in the oven. Always shut off hydrogen and air first during shutdown, extinguish the flame, then turn off carrier gas after cooling.

FID requires high-purity gases. Use only properly filtered carrier gas, hydrogen, and air.

To prevent contamination, avoid connecting aging columns directly to the detector. Seal unused detector ports with blanking nuts. When aging with hydrogen, ensure proper ventilation.

Verify electrical connections and gas types before power-up.

Warning: High voltage (200V) present at collector electrode during operation - electrical shock hazard!

1.4.6 Display Screen

The ELITE GC2010 series features a 7-inch capacitive touchscreen display providing clear visual status monitoring.

The intuitive interface offers comprehensive functionality with simple operation and easy learning curve.

Refer to Chapter 3 for detailed operating instructions.

1.4.7 External Event Control & Communication Output

External event control is integrated within the instrument. The IO board provides 8 event outputs (2 terminals per event, labeled Event 1-8).

Communication uses a 10/100/1000Mbps adaptive Ethernet interface connected via network cable to the workstation computer.

Note: For optimal performance, the instrument integrates 24-bit AD circuitry and does not provide conventional analog outputs. It is only compatible with our proprietary workstation software.

1.4.8 Power Switch

The power switch controls main unit power supply.

Warning: When accessing electrical components, disconnect the power plug from the outlet! High voltages may remain present in the chromatograph even after power-off.

1.5 Instrument Operating Environment

1.5.1 Installation Environment

The ELITE GC2010 Gas Chromatograph should be operated in an environment with temperature ranging from 5°C to 35°C and relative humidity between 0% and 85%. For optimal performance and maximum service life, we recommend operating the instrument in a comfortable environment

with stable temperature and humidity control.

Exposure to corrosive substances (gases, liquids, or solids) can damage the instrument's materials and components and must be avoided.

The instrument must be installed on a stable workbench. Vibrations from the workbench can affect instrument stability. To ensure proper ventilation of the column oven's heated air, maintain a minimum clearance of 30 cm behind the instrument (do not place flammable materials in this area!) and provide a 30-40 cm access space for installation and maintenance.

The ELITE GC2010 requires a 10/100 Mbps or Gigabit Ethernet network. Ethernet connectivity can be established using a HUB, switch, or similar networking device.

1.5.2 Power Supply Environment

Detector	Gas Application	Gas Name	Purity Requirement
FID	Carrier Gas	N ₂ or He	≥ 99.999%
TCD	Carrier Gas	He, H ₂ , or N ₂	≥ 99.999%
ECD	Carrier Gas	N ₂ (optimized with oxygen removal)	≥ 99.999%
NPD	Carrier Gas	N ₂ or He	≥ 99.999%
FPD	Carrier Gas	N ₂ or He	≥ 99.999%
	Make-up Gas	N ₂	≥ 99.99%
	Fuel Gas	H ₂	≥ 99.99%

Detector	Gas Application	Gas Name	Purity Requirement
	Assist Gas	Air	Clean and dry

The ELITE GC2010 operates on a 220V $\pm 10\%$ (50Hz ± 0.5 Hz) power supply with a minimum power capacity of 2500W. For user safety, the instrument's panel and enclosure are grounded using a three-core power cord in compliance with International Electrotechnical Commission (IEC) standards.

Note: Proper grounding is essential to minimize electrical noise.

Warning: Never use water pipes, gas pipes, or neutral lines as substitutes for grounding conductors!

1.5.3 Gas Supply Environment

To achieve optimal performance, the ELITE GC2010 requires gases meeting specified purity levels. Recommended gas purities are listed below:

We recommend installing gas purifiers in the gas lines. After extended use, regenerate the molecular sieve and silica gel within the gas purifiers.

2 Instrument Installation

2.1 Unpacking Inspection

Upon receipt, inspect the instrument packaging for damage. If any damage is observed, immediately contact the manufacturer or supplier. After unpacking, verify all included components against the packing list. Report any discrepancies or physical damage to the instrument to the manufacturer or supplier promptly to avoid potential losses or delays.

2.2 Instrument Placement

After confirming the instrument is in good condition, place it on a stable workbench. Ensure the workbench is stable and vibration-free. Maintain a clear space behind the instrument for ventilation and future maintenance, and avoid storing flammable materials in this area.

2.2.1 Gas Supply Installation

Before using the ELITE GC2010, configure the gas supply according to Section 1.5.3 based on the detectors you intend to use.

Install gas supplies in a safe location. If using gas cylinders, secure them to prevent tipping. Regardless of the gas source type (gas generator, cylinder, or compressor), verify that the gas quality meets the ELITE GC2010's requirements to prevent analysis errors, contamination, or instrument damage.

2.2.2 Pressure Regulator Installation

Follow these steps for pressure regulator installation:

Remove the low-pressure outlet nuts from two oxygen regulators and one hydrogen regulator. Attach the regulator connectors and loosely screw on the low-pressure output adjustment screws. Install the regulators onto the gas cylinders. After hand-tightening the cylinder nuts, open the cylinder high-pressure valve. The regulator high-pressure gauge should indicate cylinder pressure. Close the cylinder high-pressure valve. The regulator high-pressure gauge indication should remain stable. If the pressure drops, check for gas leaks before proceeding.

2.2.3 External Gas Line Connection

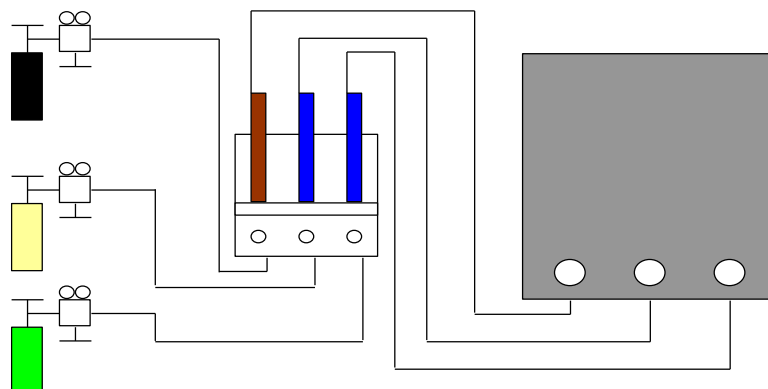


Figure 2.01 External Gas Line Connection Diagram

The ELITE GC2010 uses $\Phi 3 \times 0.5$ mm outer diameter polyethylene, PTFE, stainless steel, or copper tubing for external gas connections.

Refer to Figure 2.01 for connection details.

Important Notes:

Vent gas(split) and detector exhaust ports to the exterior to prevent indoor air contamination when analyzing toxic substances.

Regularly perform leak checks during operation. Gas leaks can disrupt instrument operation or cause accidents (e.g., hydrogen leaks can lead to explosions).

Recommended gas inlet pressures to the chromatograph:

Carrier gas: 0.5 MPa

Air: 0.5 MPa

Hydrogen: 0.4 MPa

2.2.4 .System Leak Check

Power off the instrument.

Ensure cylinder pressure regulators are fully relaxed. Open the cylinder high-pressure valves, then gradually adjust the low-pressure regulators to achieve:

Carrier gas cylinder: 0.5 MPa

Hydrogen cylinder: 0.4 MPa

Air cylinder: 0.5 MPa

(If using a gas generator, follow the manufacturer's pressure specifications for idle operation.)

Close the cylinder high-pressure valves and all chromatograph gas valves (carrier, hydrogen, air, make-up, split, and purge). Fully relax the cylinder pressure regulators. Monitor the pressure gauges for 10 minutes. A stable pressure reading indicates a leak-free system. If pressure drops, systematically inspect and repair leaks.

3 Instrument Operation

The ELITE GC2010 features a 7-inch color LCD display with a modern, flat UI design. It provides a comprehensive overview of the entire instrument status while also allowing detailed parameter settings. The interface is user-friendly and highly functional, enabling operators to fully understand and control the instrument.

The ELITE GC2010 Gas Chromatograph incorporates an 8-channel temperature control algorithm, allowing independent temperature setting and control for eight distinct zones. The column oven supports 20-stage temperature programming (expandable to 99 stages), and its rear door automatically opens and closes based on the oven's temperature control algorithm. Additionally, the instrument is equipped with 8 event outputs that can be programmed with time parameters to control external devices such as valves and pumps. It also features an automatic ignition function, enabling one-touch startup preparation.

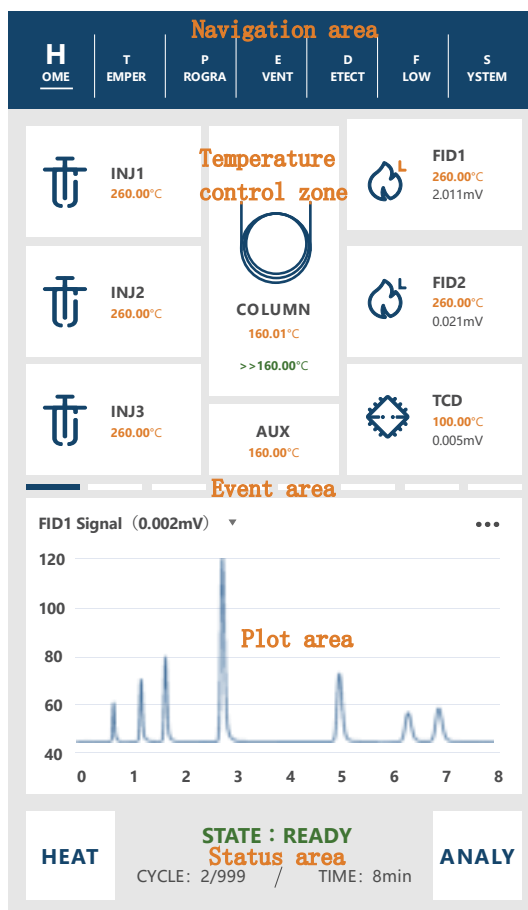
3.1 Startup Interface



Upon powering on the instrument, the display shows the startup interface (as illustrated above).

3.2 Main Interface

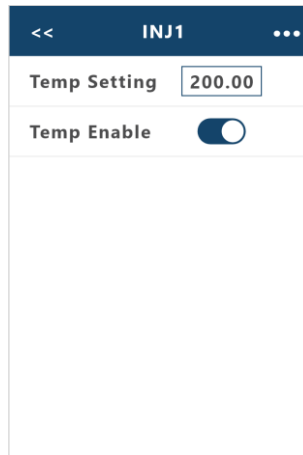
Tap anywhere on the startup interface to access the main interface, which provides an overview of the instrument's operational status (refer to the figure below):



Navigation Area: Facilitates switching between seven primary pages: Home, Temperature, Program, Events, Detection, Flow, and System.

Temperature Control Area: Displays temperature values for key zones, detector types, and signal values. In a standard configuration, the left section corresponds to the injector, the center to the column oven and auxiliary zones, and the right to the detector, mirroring the physical layout of the instrument.

Tap any temperature zone to access its settings window for convenient parameter configuration:
Injector and Auxiliary Zones:



Set Temperature: Enter the target temperature for the zone.

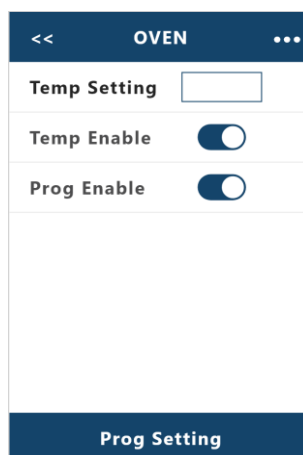
Input Method: Tap the temperature field to activate the numeric keypad (shown below).



Enter the value and click "Enter".

On/Off: Toggle heating for the zone.

Column Oven:



Temperature settings and on/off functions are identical to other zones.

Program: Enable or disable temperature programming.

Program Settings: Navigate to the temperature programming configuration interface (see Section

3.4).

FID Detector:

<< LFID1 ...	<< SFID2
Temp Setting <input type="text" value="200.00"/>	Temp Setting <input type="text" value="200.00"/>
Temp Enable <input checked="" type="checkbox"/>	Temp Enable <input checked="" type="checkbox"/>
Threshold(mV) <input type="text" value="0.500"/>	Threshold(mV) <input type="text" value="0.500"/>
Ignition(s) <input type="text" value="5"/>	Ignition(s) <input type="text" value="5"/>
Gain 1 >	
Fire	Fire

FID detection offers two operational modes: Linear Amplifier (LFID) and Logarithmic Amplifier (SFID). Temperature settings and on/off functionality are consistent with other instrument zones. Gain Selection (LFID only): Tap to choose amplifier gain levels, enabling sensitivity adjustments as depicted in the figure:

<< Gain
1
2
3
4

Ignition Duration: Duration of igniter power-on, typically set between 1-10 seconds.

Ignition Threshold: Signal value used to determine successful ignition. If the detected signal exceeds this threshold and remains stable for a set period, ignition is confirmed.

Ignition: Manual ignition activation button.

Automatic Ignition Sequence:

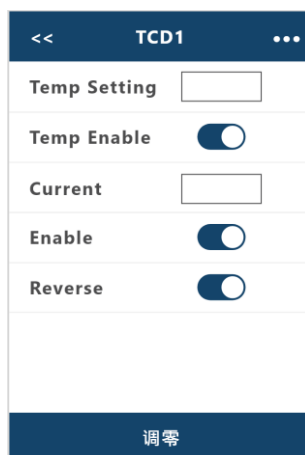
After power-on, initiate heating by pressing the "Heat" button.

Once all activated temperature zones reach and stabilize at their target temperatures, the instrument enters "Ready" status.

The system then attempts automatic ignition in sequence based on ignition detection status.

If ignition fails, it will retry automatically after 1 minute. This cycle repeats up to five attempts.

TCD Detector:









Temperature settings and on/off functions are identical to previously described zones.

Bridge Current: Enter the desired bridge current value. Note that changes will not take effect until the Bridge Current switch (below) is activated.

Polarity: Inverts the positive/negative polarity of the TCD signal output.

Zero Adjust: Forces the current signal value to be recognized as the zero baseline.

Detector icons in this area indicate detector type and status:

-  LFID (Inactive/Active)
-  SFID (Inactive/Active)
-  TCD (Bridge Current Off/On)
-  FPD (High Voltage Off/On)
-  NPD (Inactive/Active)
-  ECD (Base Current Off/On)

Event Area: Displays the status of eight event inputs (Events 1-8). Inputs are visually represented as white (inactive) or blue (active). On instruments equipped with automatic ignition, Events 7 and 8 control air purge valves for Ignition Sequence 1 and 2 respectively.

Plotting Area: This section displays chromatographic signal curves. Users can select which signals to display by tapping the "☰" icon in the top-left corner, which opens a signal selection menu:

<< Signal item >	<< Signal item >	<< Signal item >
Detector signal	ovenTemp	dec1Signal
Temperature	inj1Temp	dec2Signal
Flow&Press	inj2Temp	dec3Signal
Event output	inj3Temp	dec4Signal
	dec1Temp	
	dec2Temp	
	dec3Temp	
	auxTemp	

<< Signal item >	<< Signal item >	<< Signal item >
inj1	CarryGas	Hydrogen
inj2	Split	Air
inj3	Purge	Make-up
dec1		
dec2		
dec3		
aux1		
aux2		

Tap the "... " icon in the top-right corner to access display range settings, as shown in Figure below:

<<
Range Setting

Upper Range

Lower Range

Input the desired upper and lower limits to adjust the plotting area's display range.

Status Area: Displays real-time instrument status and analytical progression.

Start/Stop Analysis: Initiates chromatogram recording in the workstation. Activates temperature programming (if configured) and executes event sequences (if defined).



Start/Stop Temperature Control: Activates heating/cooling for enabled temperature channels to reach setpoint temperatures. For instruments with EPC (Electronic Pressure Control) circuitry, gas flow control is automatically engaged.



When the temperature reaches the constant temperature zone (the column temperature is generally $\pm 1^{\circ}\text{C}$, and the other channels are $\pm 5^{\circ}\text{C}$), the status bar will display "ready".

Note: When the status is not ready, the analysis button fails to start the analysis.

3.3 Temperature parameters

Click the navigation key "Temperature" at the top to enter the temperature parameter interface of the instrument, and you can view the parameters of each temperature control area, as shown in the following figure:

Name	Temp $^{\circ}\text{C}$	Set $^{\circ}\text{C}$	Protect $^{\circ}\text{C}$	Enable
OVEN	120.0	120.0	140.0	<input checked="" type="checkbox"/>
INJ1	160.1	160.0	180.0	<input checked="" type="checkbox"/>
INJ2	260.1	260.0	280.0	<input checked="" type="checkbox"/>
INJ3	160.0	160.0	180.0	<input checked="" type="checkbox"/>
FID1	260.0	260.00	280.0	<input checked="" type="checkbox"/>
FID2	100.1	100.00	120.0	<input checked="" type="checkbox"/>
TCD	380.4	380.0	400.0	<input checked="" type="checkbox"/>
AUX	0	60.00	80.0	<input type="checkbox"/>

HEAT STATE : READY ANALY
CYCLE: 2/999 / TIME: 8min

Temperature: Name of temperature control area, which can be entered by clicking, as follows:



You can use English input method and Chinese Pinyin input method (click "Chinese" or "English" to switch), backspace is used to delete the previous Chinese character, and click "ENTER" after input.

Measured: shows the measured temperature of 8 control temperature;

Setting: the corresponding temperature can be input according to the needs of the sample.

Protection: display the protection temperature of 8 temperature control channels. This temperature is automatically calculated by the instrument according to the users set temperature, without modification;

Enable: Click the temperature control to control whether to heat the temperature zone;

3.4 Program heating parameters

Click the navigation key "PROGRA" at the top to enter the Programming parameter interface, and you can view the Programming parameter setting, as shown in the following figure:

Step	Rate°C/min	Target°C	Hold min	Total min
1	10.0	200.0	2.0	11.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0

1~6 7-12 13-18 19-24

HEAT STATE : READY ANALY

CYCLE: 2/999 / TIME: 8min

Program temperature increase refers to the process in which the temperature of the column box needs to be gradually increased according to the set value during the sample analysis, for example, the temperature of the column box is 60°C for 5 minutes, and then it is raised to 200°C at a rate of 5°C for 10 minutes. It can be set as shown in the image above, after entering the parameters, the time column will automatically calculate the total time and each time period. If the total program ramp time is longer than the analysis time (see 3.8), the system will change the analysis time to the ascending ramp time. The temperature of the column box is set in the temperature interface, and cannot be set in this interface; Analogy of second-order programmed heating. Enable: Used to turn the program on and off.

Note: When the heating rate of a certain stage is 0, the heating of that stage and subsequent stages will be invalid; when the heating rate of the first stage is 0, the heating content of the whole program will be invalid.

temperature programmed work:

When the instrument is on, press the "heat" key to make the instrument enter the temperature control state. When the instrument is in the "ready" state, press the "analysis" key to start the program heating control.

When the instrument completes a full program heating cycle, the timer in the status display area will stop and reset; the instrument will automatically open the oven door to quickly reduce the temperature inside the oven to the initial temperature, shortening the cooling time of the instrument. When the temperature inside the oven drops to the initial temperature ($\pm 1^\circ\text{C}$), it displays "Ready," awaiting the next program heating start. This process repeats.

When the instrument performs the program heating, under the temperature control system, press the "end" key to interrupt the program heating state, and the instrument will return to the constant temperature state.

3.5 Event parameters

Click the navigation key "Event" at the top to enter the event parameter interface of the instrument:

Event	Manual	On1	Off1	On2	Off2	Enable
NO.1	<input type="radio"/>	0.0	1.0	0.0	0.0	<input checked="" type="checkbox"/>
NO.2	<input type="radio"/>	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>
NO.3	<input type="radio"/>	0.0	0.0	0.0	0.0	<input checked="" type="checkbox"/>
NO.4	<input type="radio"/>	160.0	160.0	160.0	160.0	<input checked="" type="checkbox"/>
NO.5	<input type="radio"/>	260.00	260.00	260.00	260.00	<input checked="" type="checkbox"/>
NO.6	<input type="radio"/>	100.00	100.00	100.00	100.00	<input checked="" type="checkbox"/>
NO.7	<input checked="" type="radio"/>	380.0	380.0	380.0	380.0	<input checked="" type="checkbox"/>
NO.8	<input type="radio"/>	60.00	60.00	60.00	60.00	<input type="checkbox"/>

HEAT STATE : READY ANALY
CYCLE: 2/999 / TIME: 8min

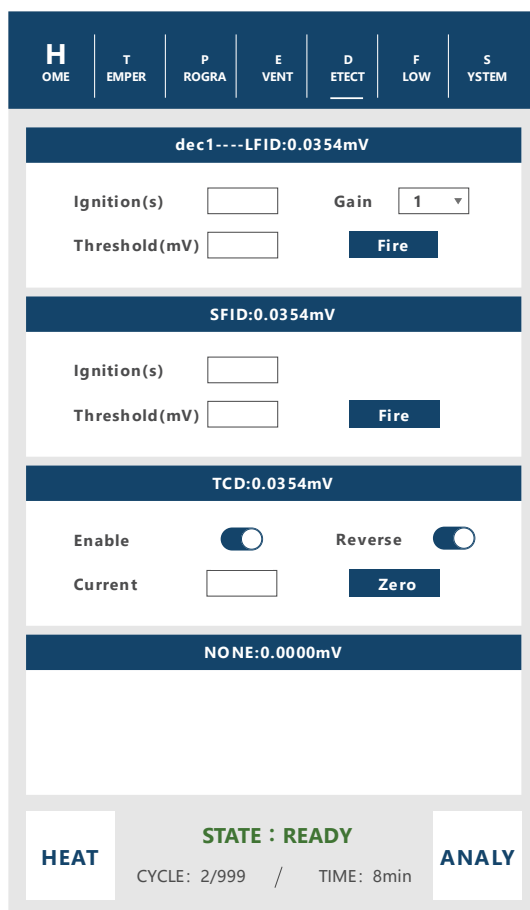
This interface has a total of 8 event channels. If you need external events, set them in this interface.

Manual: When not in the analysis state, you can manually click to control event output.

Enable: Enable and disable the output function of the event.

3.6 Detector parameters

Click the navigation key "detector" at the top to enter the detector parameter interface of the instrument, and you can view the detector parameters of each channel, as shown in the following figure:



The interface is set up in the same way as the 3.2 detector Settings section.

3.7 Flow parameters

Click the navigation key "flow" at the top to enter the EPC flow parameter interface, where you can view the flow or pressure parameters of each channel.

The interface has not yet been developed and enabled.

3.8 System parameters

Click the navigation key "System" at the top to enter the system parameter interface:

H OME	T EMPER	P ROGRA	E VENT	D ETECT	F LOW	S YSTEM
Analy						
Continue(min):		<input type="text" value="10.0"/>				
Count:		<input type="text" value="999"/>				
System						
Sleep(min) :		<input type="text" value="10.0"/>				
Language:		<input type="text" value="English"/> ▾				
Mute:		<input checked="" type="checkbox"/>				
Theme:		<input type="text" value="Sea"/> ▾				
Factory ▾						
Power:		<input type="text"/>				
About						
HEAT	STATE : READY					ANALY
CYCLE: 2/999 / TIME: 8min						

analysis procedure:

Continue: The time of a single analysis cycle.

Count: When set to 9999, it is an infinite loop.

system:

Sleep time: If the display is not used for more than the sleep time, the backlight of the display will be turned off. When the sleep time is 0, the display will not sleep.

Language: Switch between Chinese and English.

Silent: Whether to enable the click sound on the display screen.

Manufacturer configuration: To enter the manufacturer configuration, you need to contact the after-sales engineer.

Ignition power: the power output of automatic ignition, which is set when the instrument leaves the factory.

About: Click the About dialog box to view the circuit board versions, as shown in the figure:

<< About	
Main Board	V2.9
IO Board	V1.0
Heat Board	V1.0
Detector Board 1	V1.0
Detector Board 2	V1.0
Detector Board 3	V1.0
Detector Board 4	V1.0

4 Maintenance and maintenance of instruments

4.1 Cleaning of the injector

The injector is relatively easy to be polluted, especially the vaporization tube is easy to be polluted, so it is important to clean the injector:

- (1) Cleaning of the injector: solvent cotton balls can be directly washed, and then blow with air (mainly to blow off the cotton fiber and dry the solvent);
- (2) Cleaning of the liner tube: after removing the liner tube, it can be soaked in acetone for 1-2h, and then ultrasonic treatment for more than 30min. If there are still stubborn pollutants, $\phi 1.6$ stainless steel wire and cotton swabs can be used to remove acetone and then ultrasonic treatment;
- (3) The new sample pad needs to be processed before replacement; then install the vaporization tube liner and sealing nut.

The cleaned injector must be strictly tested before the instrument can be used!

4.2 Cleaning of hydrogen flame ionization detector

- 1、 Remove the FID cover, remove the collection cylinder and insulating washer, clean the cover, collection cylinder and insulating washer with acetone or alcohol and then dry;
- 2、 If the pollution is serious, the parts to be cleaned can be put into the ultrasonic cleaning liquid, after ultrasonic, wash with clear water and then clean with alcohol and dry;
- 3、 If the chromatographic stationary liquid is contaminated with the detector, select a solvent that can dissolve the stationary liquid;
- 4、 If the nozzle is contaminated, clean it as above

4.3 Installation of chromatographic column

4.3.1 Installation of filling column

The installation of the packed column at both the injector and the detector is similar. The injector end of the packed column should be pushed to the top; at the detector end, it should also be pushed to the top.

Due to the rigidity of glass, the glass filling column must be installed at both ends of the injector and detector. The installation procedure is the same at each end, and the column installation at the detector end should be referred to the corresponding section according to the detector used.

ELITE GC2010 gas chromatograph $\Phi 3$, $\Phi 4$ mm packed column is connected to the injector.

The installation steps are as follows:

- 1) The M10 x 1 $\Phi 3$ mm nut is first fitted into the ends of the chromatographic column;
- 2) Install $\Phi 3$ mm graphite rings at both ends of the chromatographic column, and then install the corresponding inner diameter liner tube. Push into the bottom of the detector (to the bottom), and tighten the nut;
- 3) The height of the chromatographic column should be adjusted according to specific requirements at the injection port, and the nut should be tightened;
- 4) Use neutral soap to detect the leak, there should be no leakage;

5) Wipe off the soap;

6) Φ The installation steps of 4mm chromatographic column are the same as above;

Note: The inlet end of the packed column should be left with an empty tube of about 50mm in length to avoid difficulties during injection. The inlet end of the chromatographic column must not be confused with the detector end; it should be marked when filling the packed column. At the detector end, a sufficient section of empty column (at least 40 mm) should also be left to prevent the nozzle bottom from touching the glass fiber or packing material at the column end.

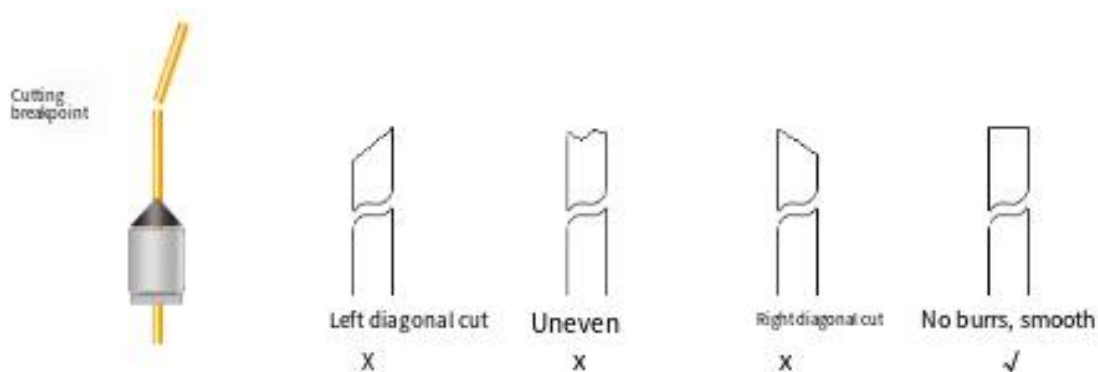
4.3.2 Installation of capillary column

The molten silica capillary column is very regular and does not need to be sorted. However, the column end should be newly cut, free of hair, and the edge should be neat. It is important to remove the particulate matter from the column, the stationary phase, and the sealing ring. To do this, the end of the column should be cut anew, using a suitable special cutting tool to scratch the desired cut. Usually, the column nut and washer are installed before cutting.



Figure 4.01

Note: Wear protective glasses to prevent potential eye injuries from flying particles when handling cut glass or molten silicon capillary columns. Be cautious to avoid punctures on the skin while handling the capillary column. Since the column is quite rigid, it is crucial to pay attention to these precautions before handling the capillary column.



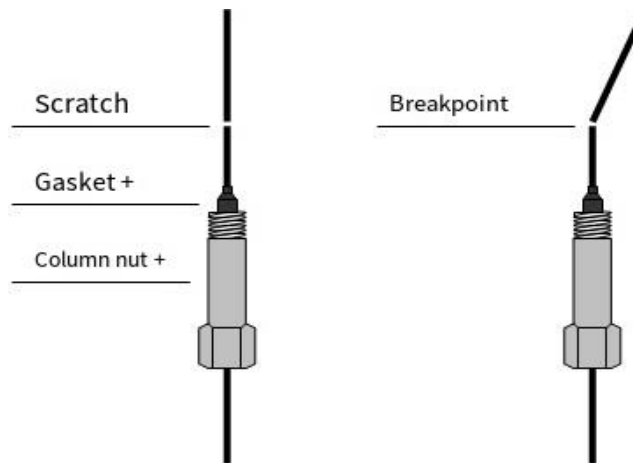


Figure 4.02 Melt quartz capillary column

The capillary column is wound around a metal frame, which is suspended on the capillary column holder inside the column oven. The ends of the column extend from the bottom of the frame, smoothly bending towards the sample inlet and detector interface, ensuring that no part of the column touches the inner walls of the column oven. A graphite washer may contaminate the column when passing through it; follow the instructions in "Preparing Fused Quartz Capillary Columns" to cut the ends of the column. The following figure shows the length to be reserved at the vaporization chamber end and FID end when installing the elastic quartz capillary column. The vaporization chamber end should be 4-6mm longer than the graphite pad, Leave 86mm at the FID end. As shown in Figure 4.03:

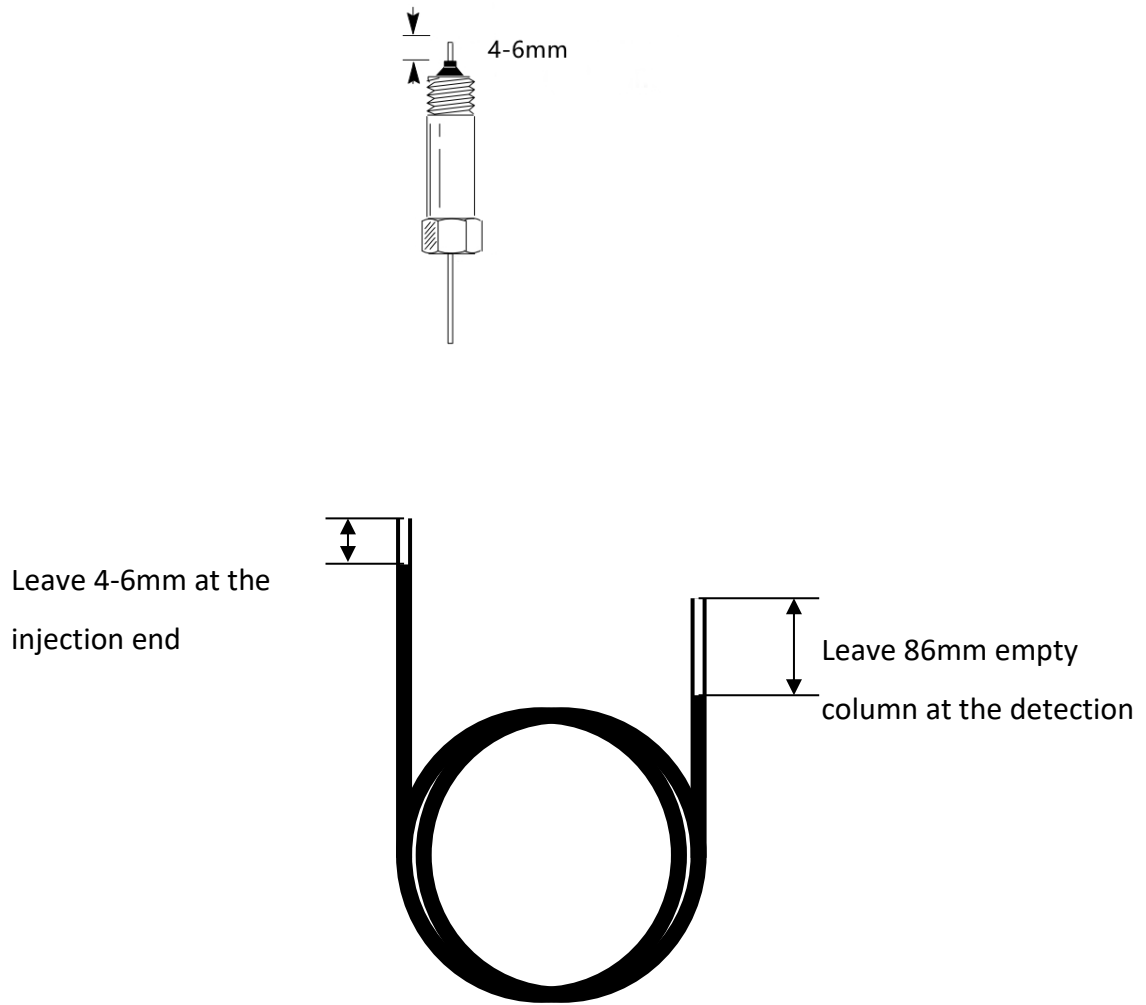


Figure 4.03, Capillary installation

5. Faults and troubleshooting of instruments

5.1 Boot problems

5.1.1, no response when starting up

Fault diagnosis	Check methods and repair
The problem with mains electricity	Check the mains power
blown fuse	Check the fuse and replace it
The display is not bright	Check the display screen

5.1.2 No offline

Fault diagnosis	Check method and repair
Network cable problem	Check the network cable and PING this GC on the PC
The IP address is set incorrectly	Check the IP address and set it correctly
The computer operating system firewall blocks it	Remove the firewall barrier
Computer anti-virus software prevents it	Remove the blocking of anti-virus software
The computer or chromatograph network indicator light is not on	Check the network cable, switch, chromatograph or computer
Online but intermittently	Check for network and IP address conflicts

5.2 Chromatographic peak problem

5.2.1 No baseline

Fault diagnosis	Check method and repair
The detection board is not installed	Check whether the inspection board is installed
The amplifier is faulty	Replace the amplifier
The baseline and background colors are set to the same color	Change the color

The sampling rate is incorrect	Change the sampling rate (20 times per second)
The chromatograph is not connected to the computer	Check the network and network parameters

5.2.2, no chromatographic peak

Fault diagnosis	Check method and repair
The injector temperature is too low	Increase the injector temperature
The syringe is clogged	Replace the syringe
The amplifier power supply is disconnected	Check the amplifier,
No carrier gas passed through	Check whether the carrier gas flow path is blocked and the gas in the cylinder is used up
Silicone rubber leaks	Replace silicone rubber
No flames	stir up trouble
There is no FID polarization voltage	The polarization voltage is poorly grounded

5.2.3 Normal retention time with decreased sensitivity

Fault diagnosis	Check method and repair
The syringe is leaking	Replace the syringe
Improper selection of sensitivity	Choose the appropriate sensitivity
The carrier gas leaks	Detect the leak and do the corresponding treatment
Improper selection of hydrogen and air flow (FID)	Adjust the corresponding flow

5.2.4 Drag tail peak

Fault diagnosis	Check method and repair
Injection tube contamination	Clean the sample tube
The temperature of the chromatography column furnace is too low	Increase the column temperature
The injection temperature is too low	Raise the temperature of the injector

Improper selection of chromatographic column	Select the appropriate chromatographic column
--	---

5.2.5 Tongue protrusion

Fault diagnosis	Check method and repair
The sample size is too large	Reduce the sample size
The sample agglutinates in the system	First, the column temperature should be increased, and then the temperature of the appropriate injector, chromatographic column and detector should be selected

5.2.6 Chromatographic peak separation is not good

Fault diagnosis	Check method and repair
The columns are too short	Choose a longer chromatographic column
Loss of fixed fluid	Change the chromatographic column or age the chromatographic column
The column temperature is too high	Lower the column temperature
The choice of fixed liquid is incorrect	Select the appropriate chromatographic column
The carrier gas flow rate is too high or too low	Adjust the carrier gas flow

5.2.7 Baseline mutation

Fault diagnosis	Check method and treatment
External electrical field interference	Eliminate the interference of external electric field that affects the normal operation of the instrument
The power plug is not in good contact	Install the power outlet firmly
Improper selection of hydrogen and air flow	Re-adjust the flow of hydrogen and air

5.2.8 Irregular baseline fluctuation during constant temperature operation

Fault diagnosis	Check method and repair
The instrument is not installed in a good	Install the instrument in a place without

position	strong vibration, preferably on a vibration-free cement table.
The instrument is not well grounded	Check and make good grounding accordingly
The fixative is not appropriate	The choice of fixed liquid is appropriate
Improper selection of carrier gas flow	Adjust the carrier gas flow appropriately
The carrier gas is leaking	leak detection
Detector contamination	Clean the detector
Improper selection of hydrogen and air (FID)	Adjust the flow of hydrogen and air appropriately

5.2.9 The sensitivity of the retention time extension is low

Fault diagnosis	Check method and repair
The carrier gas flow rate is too slow	Increase the gas flow rate
Change of carrier gas flow after injection	Replace the sample syringe with silicone rubber
The silicone rubber of the injector leaks	Replace the sample syringe with silicone rubber

5.2.10 When the peak occurs, the signal suddenly returns below the baseline and extinguishes

Fault diagnosis	Check method and repair
The sample size is too large	Reduce the sample size
The carrier gas flow rate is too high	Select the appropriate carrier gas flow rate
The flow of hydrogen or air is too low	Regulate the flow rate of hydrogen and air
Flame nozzle contamination	Clean the flame nozzle
The stationary liquid in the chromatography column is lost	Re-age the chromatographic column

5.2.11 The baseline does not return to zero

Fault diagnosis	Check method and repair
Detector contamination	Clean the detector

The amplifier is faulty	Check the amplifier
-------------------------	---------------------

5.2.12 There are spikes in the irregular distance

Fault diagnosis	Check method and repair
Insulator leakage	Detect the leak and deal with it accordingly
The amplifier is faulty	Replace the amplifier
The flames were flickering	Adjust the appropriate hydrogen and air flow
High frequency signal line fault	Check the high frequency signal line
The detector has dust	Ear balls are blown away

5.2.13 There is a certain amount of burr in equal intervals

Fault diagnosis	Check method and repair
The water condenses in the hydrogen line	Remove water from the pipe and replace or activate the desiccant
There is a blockage in the flow	Impurities are removed from the flow path
blow-by	Detect the leak and deal with it accordingly
The flames were flickering	Adjust the appropriate hydrogen and air flow

5.2.14 Dome Peak

Fault diagnosis	Check method and repair
Exceeds the linear range of the detector	Reduce sample size
The amplifier was not properly selected	Re-select the appropriate amplifier

5.2.15 Baseline noise is large

Fault diagnosis	Check method and repair
Chromatographic column contamination	Change the chromatographic column
Carrier gas pollution	Replace or regenerate the carrier gas filter
The carrier gas flow rate is too high	Regulate the carrier gas flow rate again
bad earth	Check and make good grounding
Injection port contamination	Clean the sample tube in the injector
Air or hydrogen flow rate is too high or too low	Regulate the flow of air or hydrogen

(FID)	
Air or hydrogen pollution	Replace the hydrogen or air filter
The water condenses in the FID	Increase FID temperature to remove moisture
High frequency signal line fault	Check high frequency signal lines

5.2.16 Additional peaks

Fault diagnosis	Check method and repair
High impedance peaks for the same sample as before	Wait until all the previous samples have slipped out before taking a sample
The water condensed in the chromatography column is then eluted	The operating conditions of the installation or regeneration purifier should be properly selected
Sample decomposition	Lower the injector temperature
Samples were contaminated	Ensure that the sample is clean

5.2.17 Sawtooth baseline

Fault diagnosis	Check method and repair
Steady flow valve diaphragm fatigue	Replace the diaphragm or repair the valve
The flow of air is not right	Reset the flow rate of the air stream

5.2.18 Counter-peak

Fault diagnosis	Check method and repair
Excessive hydrogen flow (FID)	Adjust the hydrogen flow
The positive and negative switches are wrong	Move the positive and negative switches to the correct position
Error in the tungsten wire lead between the reference cell and the measurement cell (TCD)	Check the lead wires of the reference pool and measurement pool tungsten wire.

5.2.19 Baseline shift in one direction without injection (FID)

Fault diagnosis	Check method and repair
The detector temperature is too low	Increase detector temperature
The column temperature stops heating or is out	Overhaul the temperature control system and

of control	heating wire platinum resistance
blow-by	leak detection

5.2.20 Unidirectional baseline drift

Fault diagnosis	Check method and repair
The detector temperature changes greatly	Stable detector temperature
Amplifier zero drift	Overhaul the components of the amplifier
The column temperature increases or decreases substantially	Stabilize the column temperature
blow-by	leak detection

5.2.21 Irregular baseline changes during temperature rise

Fault diagnosis	Check method and repair
The column lost too much	Select an appropriate chromatographic column, use the column temperature should be far below the maximum use temperature of the stationary liquid, and age the column
No suitable operating conditions were selected	Select appropriate operating conditions
The chromatographic column is contaminated	Change the chromatographic column

5.2.22 Periodic baseline fluctuations

Fault diagnosis	Check method and repair
The detector temperature control is not good	Check that the contact is good
The carrier gas flow pressure is too low	Change the carrier cylinder
The temperature of the chromatographic column furnace is not properly adjusted	Check whether the platinum resistance contact is good
Improper adjustment of carrier gas flow	Regulate the carrier gas flow rate again
Improper air and hydrogen regulation (FID)	Regulate the flow of hydrogen and air

5.2.23 Baseline change after program heating

Fault diagnosis	Check method and repair
As the temperature rises, column loss increases	Select the appropriate chromatographic

	column or aged chromatographic column
The column flow rate has not been corrected	Correct the column flow rate
The chromatographic column is contaminated	Change the chromatography column

5.3 Precautions for thermal conductivity detector

During the use of TCD detector, you must pay attention to and comply with the following contents

- When no carrier gas is introduced, bridge current should not be set to avoid the accident of tungsten wire burning.
- When aging the column for the first time, do not connect the carrier gas to the thermal conductivity cell after the column, but leave it empty in the column box; do not use hydrogen during aging (remember)!!! Generally, nitrogen is used. Bridge flow should not be set during aging.
- The thermal conductivity cell detector is a precision component. Do not disassemble the tungsten wire inside the cell by yourself to avoid unnecessary losses.

5.4 Analysis and troubleshooting of common faults of thermal conductivity detector

5.4.1, the sample does not peak

Fault diagnosis	Check method and repair
No set current	First set the current
The tungsten wire broke	Replace the tungsten wire
The internal connectors and connecting wires of the TCD thermal conductivity power supply components are not properly inserted	Reinsert the relevant plug and socket
The syringe is leaking or blocked	Replace the syringe
Silicone rubber leaks	Replace silicone rubber

5.4.2 The signal output amplitude is too large (when no sample is injected)

Fault diagnosis	Check method and repair
The tungsten wire in the cavity touches the pool wall	Contact the factory for maintenance
The resistance of tungsten wire is not matched	Contact the factory for maintenance
The internal connectors and connecting wires of the	Reinsert the relevant plug and socket

TCD thermal conductivity power supply components are not properly inserted	
--	--

5.4.3, the baseline noise is large

Fault diagnosis	Check method and repair
The carrier gas is not pure (the purity of the carrier gas is very important)	The carrier gas should be purified before being deoxygenated and dried
The heat conduction pool is contaminated	Clean the tank and the injector
The chromatographic column is not aged	Re-age the chromatographic column.
Silicone rubber leaks	Replace silicone rubber
The gas line system and the connection with the chromatographic column leak	Detect the leak and deal with the leak accordingly.
The TCD operating current is set too high	Reduce the set value of working current to an appropriate value.
The thermal conductivity power supply is unstable	Contact the factory for maintenance

Appendix A Electrical Conditions

A qualified electrical technician should be able to supply the system with the right power. This is required whether it is retrofitting existing electrical equipment or installing new equipment.

:: Estimate the total electricity needs of the region.

* Easy to install output cable.

Develop plans for electrical safety.

:: Ensure that all wiring complies with local regulations.

Determine the power requirements of the power supply

Figure out how much electricity your area needs.

Note: The total power should include the original equipment plus the equipment to be added in future expansion plans.

voltage limit

At any location where the instrument is installed, when the system has been energized, the phase line-neutral line voltage should be maintained within the range of +10% to -10% of the rated voltage, and the voltage should be measured from the power input side of the system.

frequency limitation

The allowable line frequency limit depends on the narrowest device in the system (measured at the power line input of the instrument). The ELITE GC2010 network gas chromatograph has a wide limit and can operate in the range of 50Hz to 60Hz.

Number of harmonics

The maximum total harmonic of the instrument feeder shall not exceed 5% (measured at the power input of the instrument after the instrument is powered on).

Power supply glitches

In some areas, the power lines used by instrument systems may experience excessive voltage drops, or surge voltages, transient voltages, power outages, or other unexpected situations, making the operation of the instrument system unreliable. Therefore, the quality of power supply must be checked. If any items do not meet the system requirements during inspection, they should be corrected.

power supply noise

The structural design of the ELITE GC2010 network analyzer is capable of withstanding reasonable input line noise. However, many noises from other electrical utilities cannot be controlled by the

network analyzer. The primary sources of this electrical noise are other electrical equipment near the instrument, such as motors, solenoid valves, thyristor rectifiers, and X-ray machines.

In addition, there may be "midline-ground noise" caused by poor contact of the midline and "ground — ground" noise caused by poor floor grounding. The maximum allowable wire noise is 3V (rms) from 30Hz to 50Hz.

A small "ground — center line" voltage can be measured with an oscilloscope, because if there is a distortion deviation in the voltage, the reading on the analog meter will be distorted. Generally speaking, if the voltage is lower than the measured result, there is a problem.

Noise elimination

If noise from existing electrical equipment or future installations is to be eliminated, we recommend that a qualified feeder be installed between the main distribution panel and the instrument distribution panel. Check that the neutral contact and grounding are in good condition (see below under "Grounding").

If there are still bad transient phenomena after installing a qualified feeder, then a device that can reduce the input electrical noise should be installed.

power interference

Interference from input power noise that affects the power output or interferes with signal lines in the system can cause malfunctions in instrument systems. These input interferences can be categorized into surges, drops, and transients, which are described as follows: "Surge" and "drop" refer to sudden changes in the positive and negative values of input voltage, lasting between 5 milliseconds. Generally, "surge" and "drop" should not exceed about $\pm 15\%$ of the normal rated line voltage, and they should return to a stable state within 17 milliseconds (at 60Hz) and 20 milliseconds (at 50Hz).

"Power voltage transient" is a sudden change in the positive and negative values of the input voltage, lasting between 1 and 5 milliseconds. If this transient time is greater than 20% of the rated voltage (depending on its energy), the instrument will malfunction.

When monitoring the quality of input power and evaluating interference characteristics, a power input interference monitor is very useful. Since power line interference can occur hourly, daily, and weekly, this monitor should be connected for at least a week. Also, do not treat the measured results as absolute values, as interference levels can vary with seasonal changes.

The test method is to use a spike signal with a rise time of 0.5 microseconds and a pulse duration of 10 microseconds, with an amplitude twice the power supply voltage.

Power processing equipment

If there are still transient phenomena after installing dedicated feeders and grounding, then equipment that can reduce input power line interference should be installed. There are basically four kinds of devices that can accomplish this task:

1. Isolation transformer
2. Power voltage regulator
3. Motor-generator equipment
4. Uninterrupted power supply system

The power of the line regulation equipment must meet the current and future needs. The minimum rated value recommended by our factory is 5KVA, which can meet both the current requirements and the future expansion requirements.

Appendix B Grounding

In order to make the instrument run safely and reliably, it is very important that the instrument is well grounded. Generally speaking, most countries and regions require the installation of a ground wire for electrical equipment to ensure personal safety.

safety ground

Various standards generally require the installation of safety conductors for electrical equipment. The standards generally require that each live wire (neutral) be accompanied by a safety conductor. The size of the safety conductor must be the same as that of the live wire.

In general, safety standards require that the safety conductor be connected to the conductive surfaces of electrical equipment that operators may come into contact with, or to conductive surfaces that could be energized due to an electrical accident. Under normal operating conditions, this wire should not carry back AC current. If the instrument's frame is not grounded, or if the live wire accidentally touches the frame, the voltage on the frame can reach a hazardous level.

Connecting the safety ground wire to the chassis of the instrument can prevent the risk of electric shock, as this forms an extremely low impedance circuit that could cause the circuit breaker to trip or the fuse to blow. Each instrument comes with a safety grounding device; simply connect the instrument to a grounded terminal or install the grounding ring according to the specifications provided by the user, and the circuit is complete.

As described below, the safety ground in the instrument is usually connected to the conduit of the building through an insulated grounding device, which in turn grounds the distribution of the sub-circuit. Local and national safety codes must be complied with in all cases.

The safety ground must be properly connected to the terminal of the main distribution grounding busbar. It is generally understood that the impedance of the ground wire returning from any load to the main grounding busbar must be less than 11 ohms.

Noise-free grounding

To ensure the ELITE GC2010 network instrument operates well, we consistently recommend using a noise-free grounding device. This type of grounding is also known as "insulated grounding" because it is separate from the grounding devices of other electrical appliances in the building. When connecting the ELITE GC2010 network instrument to other instruments, using "insulated grounding" will help maintain system reliability.

In most cases, ordinary grounding is not sufficient because it is impossible for the grounding

device not to bring in some noise caused by poor grounding. Noise may also come from the RF broadcaster, and the ground wire may carry a generally stable current.

Typical grounding conditions that tend to generate noise are as follows:

1. Catheter
2. Roof and building beams
3. Sprinkler pipes (connecting the ground wire to these pipes is not allowed by most fire codes).
4. Improve the support structure of the floor.
5. Gas pipe

It is easy to be affected by the noise of the building caused by poor grounding when the ground wire is connected to these tubes. At the same time, they will also receive interference from the frequency of electricity due to the influence of the antenna.

The following items can be grounded (consult with the local electrical inspection department and select a grounding method acceptable to the local authorities):

1. Connect a wire of appropriate size to the main pipe of the building or to the entrance of the main conduit.
2. Drive a long nail into the wet soil and connect it to the ground.
3. It can also be connected to other reliable entry points.

The insulated ground wire must be securely connected to the device. Do not clamp the ground wire onto pipes or grounding posts with clips. Also, do not use any methods that may loosen the connections for attachment. The joints must be welded with copper or tin soldering, minimizing the reduction in insulation resistance at the grounding connection as much as possible. If installed improperly, resistance can be measured at the joint, and combined with the resistance of the ground wire, it will create an undesirable potential on the insulated grounding system. When installing the ground wire, prevent it from accidentally coming into contact with other ground wires, as this can adversely affect the insulation. The insulated wire must be connected to the insulating busbar of the distribution panel, then through joints, to each unit of the instrument system from the distribution panel. The insulating busbar can consist of the grounding floor on the distribution panel.

The size of the wire used should result in the lowest ground resistance from the farthest point to the main distribution panel junction. Consult your local electrical inspection department about the wire specifications used.

When a power grid processing device is installed in a multi-story building, the casing of the power

grid processing device should be connected to the reinforcing bars in the building structure. This reduces ground noise. One end of the ground wire should be connected to the casing of the line processing device, and the other end should be welded to the nearest vertical beam reinforcement bar. It is better to connect the ground wire to the buildings reinforcing bars rather than to a separate grounding post in the basement.

Measurement of the quality of the connection between the central line and the ground wire
Several devices specifically designed to measure the quality of grounding systems are available on the market. These include ground detectors, which guide the current in the ground wire for testing and indicate the quality of grounding (displayed as lights or in ohms). Another type is the ground resistance tester, used to measure the resistance of the grounding system.

If the grounding impedance is too high, several items should be checked. If there is no power grid treatment equipment installed and no designated grounding device, check whether the neutral-grounding (N-G) connection on the buildings main distribution panel is good. If line treatment equipment has been installed, also recheck the N-G connection points on the line treatment device. If the current N-G connection point is improperly installed, it should be moved to a suitable position, as an improper installation can cause unwanted currents in the grounding conductor. Check that the grounding wire is properly connected. If the size of the grounding wire is smaller than that of the circuit, or if the grounding wire is not insulated, we recommend replacing it with an insulated wire of the same size as the circuit.

Balance of electrical load

It is important to balance electrical loads using three-phase and split-phase systems because:

- It can reduce the adverse effects of external voltage drop and voltage change on the equipment driven by a single transformer.
- Can improve the performance of insulated transformers.
- Extend the service life of transformers.

Unbalanced loads can create a voltage difference between the neutral and ground lines.

Measuring this voltage can determine if the load is balanced. When balancing the load, use a clamp ammeter. First, measure the current in each phase, then disconnect the power line from the instrument system panel, rearrange the load, and measure again. Repeat this process until the neutral line current reaches its minimum value.

The voltage difference between the neutral and ground wires can also be used to verify if the load is balanced. After powering up the instrument, use an oscilloscope to measure the voltage

difference between the neutral and ground wires at the power input terminal of the instrument. The connection between the ground clip probe should be as short as possible. Remove the power cord from the system distribution panel, rearrange the load, and then repeat the measurement. Repeat this process until the voltage between the neutral and ground wires reaches its minimum value.

The neutral-ground voltage may be further reduced when balancing the load of other feeders, or it may be reduced when increasing the size of the feeder. If the neutral-ground voltage on the system distribution panel is too high, a dedicated feeder is hung from the main distribution panel.