AI-85X Series Temperature Limiter
User Manual
(V2.0)

Table of Contents

1 Overview

1.1 Main Features

● Strong anti-interference design, passes 4KV pulse group anti-interference test. The anti-interference performance meets the requirements of electromagnetic compatibility (EMC) under harsh industrial conditions.

● Segment display upgraded to new-generation self-luminous LED technology: no light leakage or viewing angle issues, higher luminous efficiency, more vivid colors, greatly reduced power consumption, and selectable LED color combinations.

● Designed for a wide operating temperature range of 0~+50°C, uses a high-precision crystal oscillator, and has undergone aging tests at temperatures up to 100°C.

● Device is SIL1 certified, ensuring reliability and stability.

● When measured temperature reaches the upper limit, the device enters a safe state to protect rear-end equipment.

● Self-diagnosis function: in case of failure, the device enters a safe state to protect rear-end equipment.

● The device is designed to protect rear-end equipment from damage caused by high temperatures. When an over-temperature or fault condition occurs, it cuts off power to the rear-end side. It is mainly used in industries such as semiconductors, photovoltaics, and lithium electronics.

⚠Precautions

This manual introduces the AI-85X Temperature Limiter, V2.0. Some of the features mentioned in this manual may not be applicable to other versions of the instrument. The model and software version number of the instrument will be shown on the display during startup. Users should be aware of the differences between different models and versions when operating the device. Please read this manual carefully to ensure the proper use of the instrument and fully utilize its functionalities. Before use, the AI instrument must be configured correctly according to their input/output specifications and functional requirements. The instrument can only be put into operation after the parameters have been properly set.

1.2 Model Definition

AI－85X	D61	X3	L3	S	－	24VDC
①	②	③	④	⑤		⑥

This refers to an instrument with the following specifications: ① Basic model: AI-85X; ② Panel size: D61 (48×48mm); ③ Linear current output; ④ Dual relay contact outputs; ⑤ Optically isolated RS485 communication interface with built-in isolated power supply; ⑥ Instrument power supply: 24VDC.

① indicates basic instrument model

AI-859 (0.2-Class accuracy, with a 5-year free warranty)
AI-858 (0.2-Class accuracy, with a 5-year free warranty)
AI-857 (0.2-Class accuracy, with a 5-year free warranty)
AI-856 (0.2-Class accuracy, with a 5-year free warranty)
AI-855 (0.2-Class accuracy, with a 3-year free warranty)
AI-854 (0.2-Class accuracy, with a 3-year free warranty)
AI-853 (0.2-Class accuracy, with a 3-year free warranty)
AI-852 (0.2-Class accuracy, with a 2-year free warranty)
AI-851 (0.2-Class accuracy, with a 2-year free warranty)
AI-850 (0.2-Class accuracy, with a 2-year free warranty)

1.3 Technical Specifications

- **Input specification:** Pt100、Pt1000
- **Measurement range:** Pt100 (-200~+600°C)、Pt1000(-200~+800℃)
- **Measurement accuracy:** 0.2 class
- **Measurement Temperature Drift:** ≤100PPm/℃
- **Safety functions:** temperature limiting, response time ≤2 seconds when fault or over-temperature detected
- **Output Specifications (**Fixed**):**
  Relay Contact Switch Output: 30VDC/2A
  Linear current output: 0~20mA、4~20mA
- **Alarm function:** Over-limit alarm, over-temperature alarm, poor contact alarm, inaccurate detection alarm, ROM check error alarm, RAM check error alarm, CPU check error alarm, CLOCK check error alarm
- **Electromagnetic Compatibility:** IEC61000-4-4 (Electrical Fast Transient) ±4KV/5KHz, IEC61000-4-5 (Surge) 4KV, and the instrument operates without freezing or malfunctioning of I/O ports under 10V/m high-frequency electromagnetic interference, with measurement value fluctuation not exceeding ±5% of the full scale
- **Isolation withstand voltage:** ≥500V between the power supply, relay contacts, and signal terminals; ≥ 500V between isolated low-voltage signal terminals
- **Power Supply:** 24VDC, -15%, +10%
- **Power consumption:** ≤1W (including CPU, measurement, relay, display, and communication)
- **Operating Environment:** Temperature 0~50℃; Humidity ≤90%RH, non-condensing;
- **Altitude:** ≤2000m
- **Overvoltage category:** Class II
- **Pollution Level:** 2
- **Weight:** 106g
- **Noise level:** ≤60 dBA
- **IP Rating:** IP40
- **Storage temperature and humidity:** -10~70℃; humidity ≤90%RH, non-condensing;
- **Product:** Built-in product,except the user operation interface
- **SIL Level:** SIL1
- **Probability of Failure per Hour(PFH):** ≤3.5084E-07
- **Safe Failure Fraction(SFF):** ≥60%
- **Performance Level(PL):** b
- **Category:** B
- **Mean Time To Failure Dangerous(MTTFd):** 91 years
- **Average Diagnostic Coverage(DCavg):** ≥72%
- **Hardware Fault Tolerance(HFT):** 0
- **Systematic Capability(SC):** 1
- **Operation mode:** High Demand or Continuous Mode
- **Response time:** ＜2 second
- **Classification:** Type B

1.4 Energy-saving and Environmental Protection Design

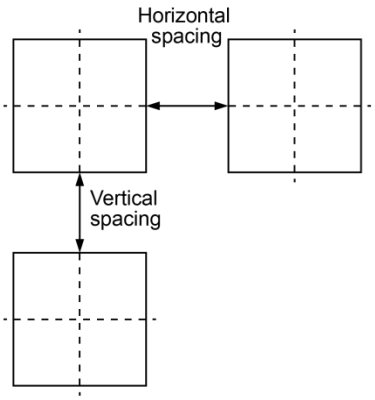
The AI-8 series adopts energy-saving and environmentally friendly design, featuring extremely low temperature drift and very low power consumption. High-quality components are used, with key parts selected for low temperature drift and matched by testing, ensuring optimal energy-saving performance in various applications. Yudian also pays attention

to the instrument's own power consumption, for example, using LED displays with higher luminous efficiency than ordinary products, which reduces drive current for the same brightness, lowering power consumption and improving product reliability and performance.

2. Installation and Wiring

2.1 Installation

2.1.1 Panel Mounting Method



① Leave appropriate spacing between instrument mounting holes according to different sizes and bracket types; tight side-by-side mounting is allowed if necessary. Recommended horizontal spacing ≥8mm, vertical spacing ≥30mm.

② Insert the instrument into the panel cutout, press the mounting bracket into the opening on the case to temporarily fix the unit.

③ When tightening the mounting bracket and terminal wiring, set the tightening torque to 0.39~0.58N·m.

2.2 Wiring

2.2.1 Wiring Precautions

④ To avoid interference, route signal wires separately from power wires.

⑤ Use shielded cables (cross-sectional area 0.5mm^2 ~ 1.25mm^2), with the shield grounded at one end. Wire stripping length should be 6~8mm.

⑥ Use crimp terminals for terminal wiring, with suitable wire and crimping tools. Use M3.0 terminals for crimp connections.

2.2.2 Panel-Mounted Instrument Wiring Diagram

■ **The wiring diagram for the** D61 **panel instrument** (48X48mm) **is as follows:**

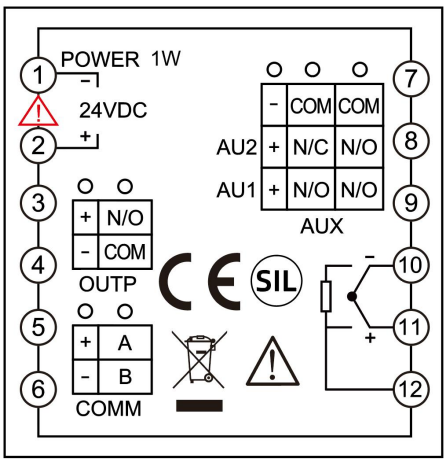
① 24VDC/1W power supply input: connect to 2+ and 1-.

② 4~20mA output: connect to 3+ and 4-.

③ RS485 communication: connect to 5A and 6B.

④ 30VDC/2A Relay interface: connect to 7 (common), 8 (AU2), 9 (AU1).

⑤ Sensor interface: 10, 11, 12.



3 Display and Operation

3.1 Panel-mounted Instrument Front Description

① Upper display window: Display measured values PV, parameter names, etc.

② Middle display window: Display the set value SV, alarm code, parameter values, etc.

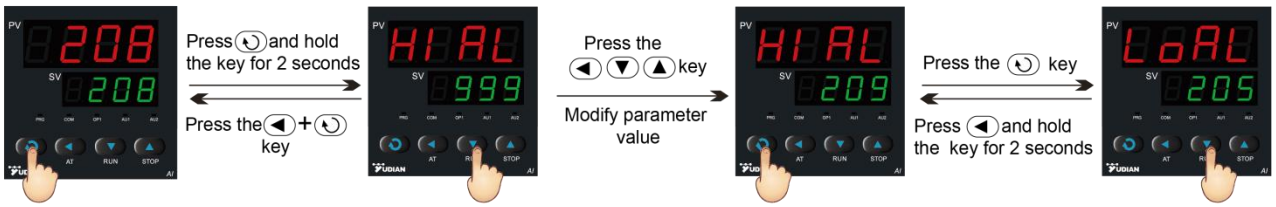
③ Set key: Used to enter the parameter setting mode and confirm parameter modifications

④ Data Shift

⑤ Data Decrease Key

⑥ Data Increase Key

⑦ 4 LED indicators: OP1 indicates current transmission output; AU1 and AU2 correspond to relays AU1 and AU2 (lit means relay is closed, off means open); COM flashing indicates communication with the host computer; ALM lit indicates alarm; RUN flashing indicates device running.



3.3 Operation Methods

3.3.1 Setting Parameters

Press the key in the basic display state and hold it for about 2 seconds to enter the customized field parameter setting state. Parameter values can be modified directly by pressing the keys such as , , and . Press the key to decrease the value and the key to increase the value. The decimal point of the modified value will flash (acting as a cursor). Press and hold the key to quickly increase/decrease the value, with the speed increasing automatically as the decimal point shifts to the right. The users can also press the key to directly move the position (cursor) and modify the data, making the operation faster. Press the key to save the modified parameter value and display the next parameter. Hold the key to go down quickly. Press the key and hold it for more than 2 seconds to return to display the previous parameter. First press and hold key, then press the key again to directly exit the parameter setting mode. If no key is pressed, the instrument will automatically return to the basic display mode after approximately 25 seconds.

4 Parameter Function

4.1 Parameter Lock and Custom Parameter Table

4.1.1 Parameter Lock (Loc)

The parameter lock Loc provides various levels of operation permissions and password input for accessing the complete parameter table. Its functions are as follows:

Loc = A x 1 + B x 2;

A = 0: allows modification of field parameters; A = 1: prohibits modification of field parameters;

B = 0: allows modification of field parameters via 485; B = 1: prohibits modification via 485;

Set Loc=808 password (password can be any number between 256~9999, default is 808) and press  to confirm, the users can enter the display and modify the complete parameter table. Once the complete parameter table is accessed, all parameters except for read-only ones can be modified.

4.1.2 Custom Parameter Table

The AI-8's parameter table programmable definition function allows users to define custom parameters for the instrument. To protect important parameters from unauthorized modification, the parameters that need to be displayed or modified on-site are called on-site parameters. The on-site parameter table is a subset of the complete parameter table and can be defined by the user. These parameters can be directly accessed for modification, while the complete parameter table can only be accessed by entering a password.

Parameters EP1~EP8 allow users to define 1~8 on-site parameters. If fewer than 8 on-site parameters are needed, the first unused parameter should be defined as nonE. For example, if the required parameter table includes HIAL, dPt, and Scb, the EP parameters can be set as follows: EP1=HIAL, EP2=dPt, EP3=Scb, EP4=nonE.

4.2 Complete Parameter Table

The full parameter table includes six sections: alarm, input, output, communication, system functions, and field parameter definition. Parameters include:

Parameter	Parameter Meaning	Description	Setting Range (default)
Addr Rddr	Communication Address	The Addr parameter is used to define the instrument communication address, and the valid range is 0~99. Instruments on the same communication line should have different Addr values to distinguish them from each other.	0~99 (1)
bAud bRud	Baud Rate	The bAud parameter defines the communication baud rate, which can be set within the range of 1200~19200bit/s (19.2K). When the baud rate exceeds 9600 bit/s and a 4-digit LED display is used, values like 19.20 represent 19200 bit/s.	1200~ 19.2K (9600)
AFC RFC	Communication Mode	The AFC parameter is used to select the communication mode, calculated as follows: AFC=A×1+D×8+F×32+G×64; D = 0: No parity check. D = 1: Even parity check.	0~255 (0)
InP InP	Input specification code	InP = 21 for Pt100 input InP = 23 for Pt1000 input Note: If InP is not 21 or 23, the device enters safe state.	0~44 (21)
OPt OPt	Output Type	0-20，0-20mA Linear Current Output 4-20，4-20mA Linear Current Output	(4-20mA)

dPt dPt	Decimal Point Position	Four display formats are available for selection: 0, 0.0, 0.00, and 0.000. Note: When the display value exceeds four digits, decimal places are truncated. For example, 1.234 displays as 1.234; 12.234 displays as 12.23.	(0.0)
Scb Scb	Input Offset Correction	The Scb parameter is used to apply a translation correction to the input, compensating for errors in the sensor and input signal. Note: Generally it should be set to 0. Incorrect settings can lead to measurement errors.	-999.0~ +400.0 (0.0)
FILt F ILt	Input Digital Filtering	The FILt determines the strength of the digital filtering. The higher the setting, the stronger the filtering, but the slower the response speed of the measurement data. When the measurement is subject to significant interference, gradually increase FILt to reduce the instantaneous fluctuations of the measurement value to less than 2~5 counts. When the instrument undergoes metrological verification, FILt should be set to 0 or 1 to improve the response speed. The unit of FILt is 0.5 seconds.	0~40 (0)
HIAL H IAL	Upper Limit Alarm	When the measured value PV > HIAL, AU1 and AU2 will disconnect, entering a safe state. When LoAL < PV < HIAL, set ALrE to 666 to reset.	-999.0~ +3200.0 (300.0)
LoAL LoAL	Low Limit Alarm	When the measured value PV < HIAL, AU1 and AU2 will disconnect, entering a safe state. When LoAL < PV < HIAL, set ALrE to 666 to reset.	-999.0~ +3200.0 (-200.0)
SPSL SPSL	Current output scalelower limit	Temperature scale corresponding to the minimum current transmitter output	-999.0~ +3200.0 (-200.0)
SPSH SPSH	Current output scale upper limit	Temperature scale corresponding to the maximum current transmitter output	-999.0~ +3200.0 (600.0)
AF AF	Advanced Function Code	The AF parameter is used to select the advanced function, and its calculation method is as follows: AF=A×1+B×2 +C×4 +D×8+E×16+F×32+G×64 +H×128 A=0: The alarm can only be cleared by entering the parameter table; A=1: Press and hold on the main interface to clear the current alarm. D=0: The password to access the parameter table is the public 808. D=1: The password is the value of the parameter PASd.	0~255 (1)
PASd PASd	Password	When PASd is set between 0-255 or AF.D=0, setting Loc=808 allows access to the complete parameter table. When PASd is set between 256-9999 and AF.D=1, Loc=PASd must be set to access the parameter table. Note: Only expert-level users are allowed to set PASd. It is recommended to use a unified password to avoid forgetting it.	0-999 (808)
ALrE ALrE	Over-limit Alarm Reset	When an over-temperature occurs, the display will flash HIAL or LoAL and enter a safe state. Relays AU1 and AU2 will disconnect. After confirming on-site safety, if the equipment needs to continue operation, you can reset the over-limit alarm by entering 666 in the ALrE parameter and pressing ⟲.	0~999 (0)

PArE PArE	Parameter Error Reset	When the display flashes PArE and enters a safe state, relays AU1 and AU2 will disconnect. Please check whether the on-site parameter settings are correct. After confirming they are correct, if the equipment needs to continue operation, you can reset the parameter error alarm by entering 666 in the PArE parameter and pressing .	0~999 (0)
EtrE EtrE	Measurement Error Alarm Reset	When the display flashes EtrE and enters a safe state, relays AU1 and AU2 will disconnect. Please check whether the measured value is normal. After confirming it is normal, if the equipment needs to continue operation, you can reset the measurement error alarm by entering 666 in the EtrE parameter and pressing .	0~999 (0)
orAL orAL	Over-temperature Alarm Reset	When the display flashes "orAL" (over-temperature) or "FErr" (disconnection or poor contact), and enters a safe state, relays AU1 and AU2 will disconnect. Please check whether the wiring and measured value are normal. After confirming they are normal, if the equipment needs to continue operation, you can reset the over-temperature alarm by entering 666 in the orAL parameter and pressing .	0~999 (0)
EP1-EP8 EP1- EP8	On-site Parameter Definitions	1~8 field parameters can be defined as commonly used parameters that require modification by the on-site operator after the Loc lock is applied. If there are fewer than 8 field parameters, their values can be set to nonE.	(EP1=HIAL EP2=LoAL EP3~EP8 =nonE)

5 Communication Protocol

5.1 MODBUS-RTU Communication Protocol Command Description

The AI series instruments support the MODBUS protocol, with support for three commands: 03H (read parameters and data), 06H (write a single parameter), and 10H (write multiple parameters). They can communicate with other MODBUS devices. To ensure speed, the AI instruments use RTU (binary) mode, baud rate can be set from 4800~19200bps, 1 or 2 stop bits, no parity bit, and instrument address range 0~99.

For the 03H command, 1~ 20 piece(s) of data can be read at a time, with each data being 2 bytes. For example, to read 2 data, the command would be as follows:

Instrument address	Read command (function code)	Read parameter code address	Read register length	Check code
XXH	03H	00H XXH	00H 02H	CRC

Message Example:

A. Read HIAL at address 7 = -100.1, send 01 03 00 07 00 01 35 CB, return 01 03 02 FC 17 B9 4A

B. Read PV at address 19 = -100.1, send 01 03 00 15 00 01 95 CE, return 01 03 02 FC 17 B9 4A

06H Write Command Format: For example, to write SV value as 100.0 (parameter dPt=1), the command is:

Instrument address	Write command (function code)	Write parameter code address	Write data value	Check code
XXH	06H	00H 04H	00H 01H	CRC

Message Example:

A. Write HIAL at address 7 = -100.1, send 01 06 00 07 FC 17 39 05, return 01 06 00 07 FC 17 39 05

10H Write Multiple Parameters

Command Format: For example, to write SV value as 100.0 (parameter dPt=1), the command is:

Instrument address	Write command (function code)	Write parameter code address	Number of registers to write	Number of bytes to write	Write data value	Check code
XXH	10H	00H 04H	00H 01H	02H	00H 01H	CRC

Instrument return data format follows the standard MODBUS protocol, and most user configuration software can handle it automatically. Note: Write commands do not support returning measurement values, only the parameter value written. Due to MODBUS protocol limitations, write commands cannot return measurement values, so measurement values cannot be refreshed during writing. When writing parameters continuously, alternate write and read commands to avoid failure to refresh measurement values. If there is a bug in the program causing write commands to be mistakenly called, it may result in incorrect parameter writing. Therefore, minimize the use of write commands in your program to avoid abnormal instrument operation.

5.2 Parameter Codes (Register) Addresses and Meanings

Decimal Code	Hexadecimal Code	MODBUS Register	Parameter Name	Description
0	00H	40001	Addr Communication Address	
1	01H	40002	bAud Baud Rate	
2	02H	40003	AFC Communication Mode	
3	03H	40004	INP Input Specification	
4	04H	40005	OPt Output Type	
5	05H	40006	dPt Decimal Point Position	
6	06H	40007	Scb Measurement Offset Correction	
7	07H	40008	FILt Digital Filtering	
8	08H	40009	HIAL Upper Limit Alarm	
9	09H	40010	LoAL Lower Limit Alarm	
10	0AH	40011	SPSL Output Current Scale Lower Limit	
11	0BH	40012	SPSH Output Current Scale Upper Limit	
12	0CH	40013	AF Function Selection	
13	0DH	40014	EP1 On-site Parameter	Users can define 8 parameters for read/write as needed
14	0EH	40015	EP2 On-site Parameter	
15	0FH	40016	EP3 On-site Parameter	
16	10H	40017	EP4 On-site Parameter	
17	11H	40018	EP5 On-site Parameter	
18	12H	40019	EP6 On-site Parameter	
19	13H	40020	EP7 On-site Parameter	
20	14H	40021	EP8 On-site Parameter	

21	15H	40022	Loc Parameter Lock	
22	16H	40023	Alarm Flag	Read Only, Bit9: ROM Check Alarm Bit8: RAM Check Alarm Bit7: CPU Check Alarm Bit6: CLOCK Check Alarm Bit5: Measurement Alarm Bit4: Parameter Alarm Bit3: Over-temperature Alarm Bit2: Poor Contact Alarm Bit1: Lower Limit Alarm Bit0: Upper Limit Alarm
23	17	40024	PV Temperature	Read Only
24	18	40025	Device Number High Byte	Read Only, high two bytes of device number
25	19	40026	Device Number Low Byte	Read Only, low two bytes of device number
26	1AH	40027	Instrument Model Characteristic Code	Read Only, instrument model

5.3 Communication Error Prompts

Instrument address	Command (Function Code)	Error Code	Check code
XXH	80H + XXH	XXH	CRC

Error Codes:
01H Function Code Error
02H Register Out of Range
03H Write Data Error

6 Display/Alarm Symbols and Common Q&A

6.1 Display/Alarm Symbols

After powering on, the instrument enters the basic display state. The upper and lower display windows show the measured value (PV) and set value (SV) respectively. The SV display window can also alternately display symbols or status indicators as shown below:

Parameter	Description	Response
HIAL H IAL	Indicates upper limit alarm occurred	Enter 666 in the ALrE parameter and press the ↺ key to reset, or set the A bit of parameter AF to 1 and press and hold △ on the main interface to reset.

LoAL LoAL	Indicates lower limit alarm occurred	Enter 666 in the ALrE parameter and press the key to reset, or set the A bit of parameter AF to 1 and press and hold on the main interface to reset.
E100 E 100	Indicates instrument program ROM check error	Return to factory for repair
E101 E 101	Indicates instrument program RAM check error	Return to factory for repair
E102 E 102	Indicates instrument program CPU check error	Return to factory for repair
E103 E 103	Indicates instrument program CLOCK check error	Return to factory for repair
PArE PArE	Indicates on-site parameter error	Enter 666 in the PArE parameter and press the key to reset, or set the A bit of parameter AF to 1 and press and hold on the main interface to reset.
EtrE EtrE	Indicates measurement IC may be faulty	Enter 666 in the EtrE parameter and press the key to reset, or set the A bit of parameter AF to 1 and press and hold on the main interface to reset.
orAL orAL	Indicates input measurement signal out of range	Check input specification parameter settings, input wiring, and signal; enter 666 in orAL parameter and press the key to reset, or set the A bit of parameter AF to 1 and press and hold on the main interface to reset.
FErr FErr	Indicates sensor disconnection or poor contact	Check sensor wiring; enter 666 in the orAL parameter and press the key to reset, or set the A bit of parameter AF to 1 and press and hold on the main interface to reset.

6.2 Frequently Asked Questions

6.2.1 How to enter the internal parameter list?

Press and hold for two seconds to enter the parameter list, then press briefly to find the next parameter. If the full parameters are locked, find the password lock parameter "Loc" and set it (the default is 808; if it has been changed, you need to enter the correct password). Then, press the key briefly to view all parameters.

6.2.2 How to determine whether the instrument has output?

First, check if the OP1, AU1, and AU2 indicator light on the instrument panel is on. If it is not lit, verify whether the instrument is operating properly and check if the instrument parameters are set correctly. If the indicator is on, it means the instrument output status is normal. A multimeter can then used to test whether the output terminal signal is normal. If the output signal is normal but the downstream actuator does not work, trace the output wiring to check for faults in other devices or wiring. If there is no output signal, it can be concluded that the instrument output module is faulty.

6.2.3 The instrument panel is flashing “orAL”?

This indicates that the instrument has not detected an input signal. First, check whether the sensor model corresponds to the input specification parameter Inp. Then, verify if the wiring to the instrument’s input terminal is correct. If no issues are found, measure whether the signal from the sensor is correct, as the sensor may be damaged.

6.2.4 How to set the alarm parameters?

First, set the alarm parameter to the required value (for example, if you need to set an upper limit alarm at 200°C, change the HIAL parameter to 200).

6.2.5 How to clear the alarm?

Check the current alarm code, and refer to the code description and troubleshooting methods in section 6.1 to clear the alarm.

6.2.6 How often is calibration performed? How to calibrate?

The instrument should be calibrated every two years, either by returning it to the factory for calibration or by technical personnel on-site.

This product is restriction of use in the industrial environment.

ADDRESS: No.6 Longku East Road, Xiang'an District, Xiamen, Fujian, 361101, China

Follow our official
WeChat account for
technical support