SPA1□□□-MC DC Voltage Acquisition Module

User Manual

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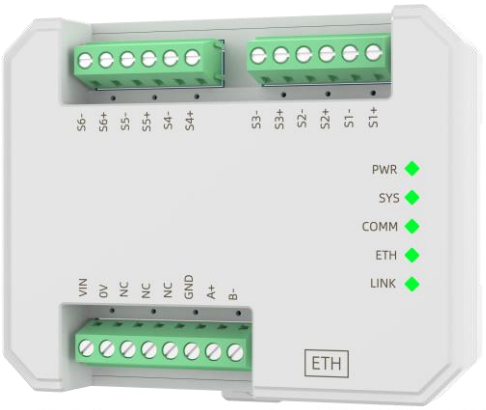
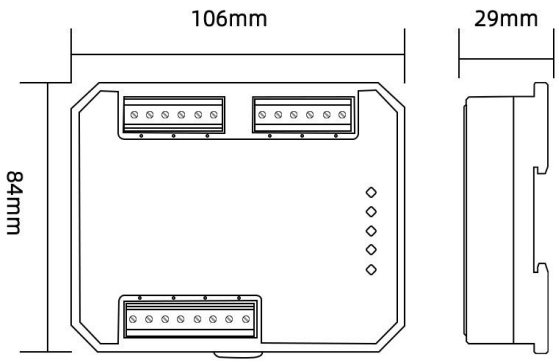
I. Precautions



- Do not operate this product beyond its design limits under any circumstances.
- The power supply for this product is 24V DC. Strictly prohibit the use of 220V AC power.
- This product should be installed in a safe location. The shell's maximum withstand temperature is +85°C.
- When used in environments with strong magnetic interference, Shielded cable is recommended for signal lines.
- Strictly prohibit unauthorized disassembly, modification, or repair of this product.
- Pay attention to the wiring method of this product to ensure correct Wiring and avoid damaging the product.
- Read this manual carefully before installation and use. If you have Any questions, please contact our technical support personnel or refer to relevant technical guidance videos.
- Our company is not responsible for damage to components other than this product during use.
- Please download the latest electronic version of the documentation. The content of this manual is for reference only. We continuously improve the user experience, and technical parameters are subject to change without notice.



II. Product Dimensions

- Product dimensions: **106mm (L) X 84mm (W) X 29mm (H)**
- Industrial-grade flame-retardant plastic shell, standard DIN35 rail mounting.

III. Operating Environment

- Do not expose this product to excessively high or low temperatures.
- The surrounding environment must be free from strong vibration, impact, and electromagnetic interference such as large currents and sparks.
- The operating environment must not contain harmful substances that cause severe corrosion to metal or plastic components. Do not use or store the product in harsh environments, otherwise it will affect the electrical performance of the product.
- Operating Temperature: -40℃～+80℃ Relative Humidity: 10% ～ 90%RH (non-condensing)

IV. After-Sales Service

We are committed to providing you with comprehensive after-sales service and warranty policy. The product warranty period is three years. During the warranty period, if the product fails due to non-human factors, we will provide free repair or replacement service. Damage caused by violation of operating regulations and requirements will require payment of parts cost and repair fee. After the warranty period expires, we continue to provide technical support and assistance. During this period, replacement parts are provided at cost price.

V. Application Fields

Automation Equipment

Medical Electronics

Remote Monitoring

Process Control

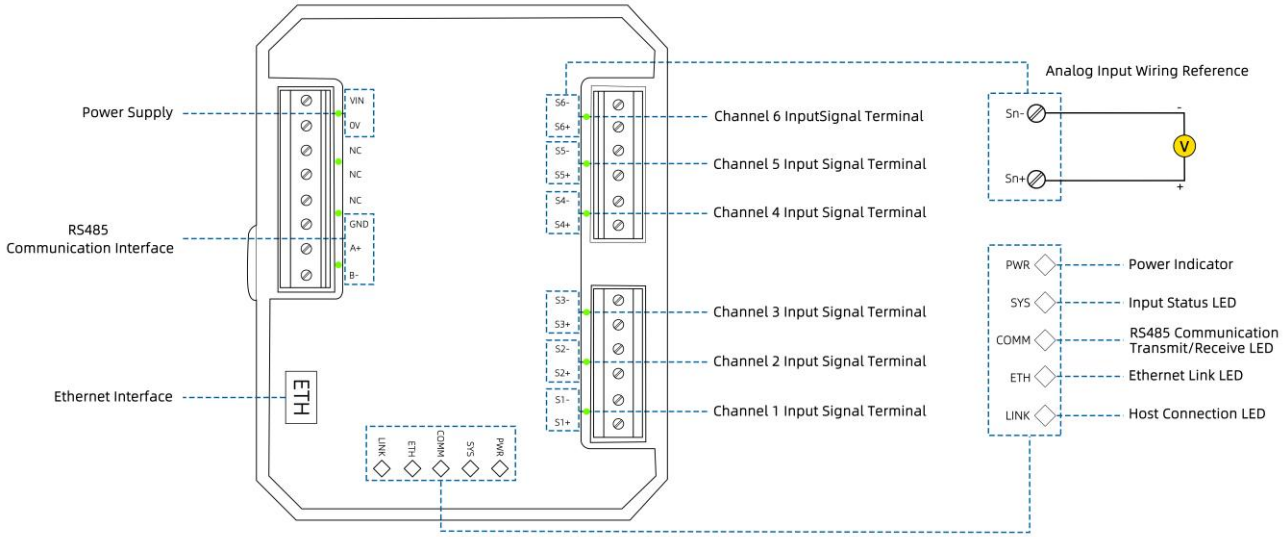
· Product Introduction

The SPA analog data acquisition module is meticulously designed based on a new generation embedded system. The module is equipped with an isolated communication interface, which can communicate separately with a PC or PLC, or be networked with multiple communication modules. Simultaneously, the module is equipped with a transient suppression circuit, which can effectively suppress various surge pulses and protect the module for reliable operation in harsh environments.

The SPA1□□□-MC series DC voltage acquisition module acquires 4/6 channels of voltage signals and is equipped with an RS485 communication interface. The module uses an advanced Δ-Σ high-precision analog-to-digital converter with a resolution of up to 24 bits and a measurement accuracy better than 0.05%. Power supply, input, and communication output are isolated from each other. It is suitable for acquiring various analog signals in industrial sites and can meet the requirements of industrial sites with high measurement demands, medical electronics, security monitoring, smart buildings, smart homes, power monitoring, process control, and other occasions.

This product requires independent power supply and uses a DIN35mm standard rail mounting method. Field installation is simple, usage is flexible, and it can handle various field applications.

· Wiring and indication



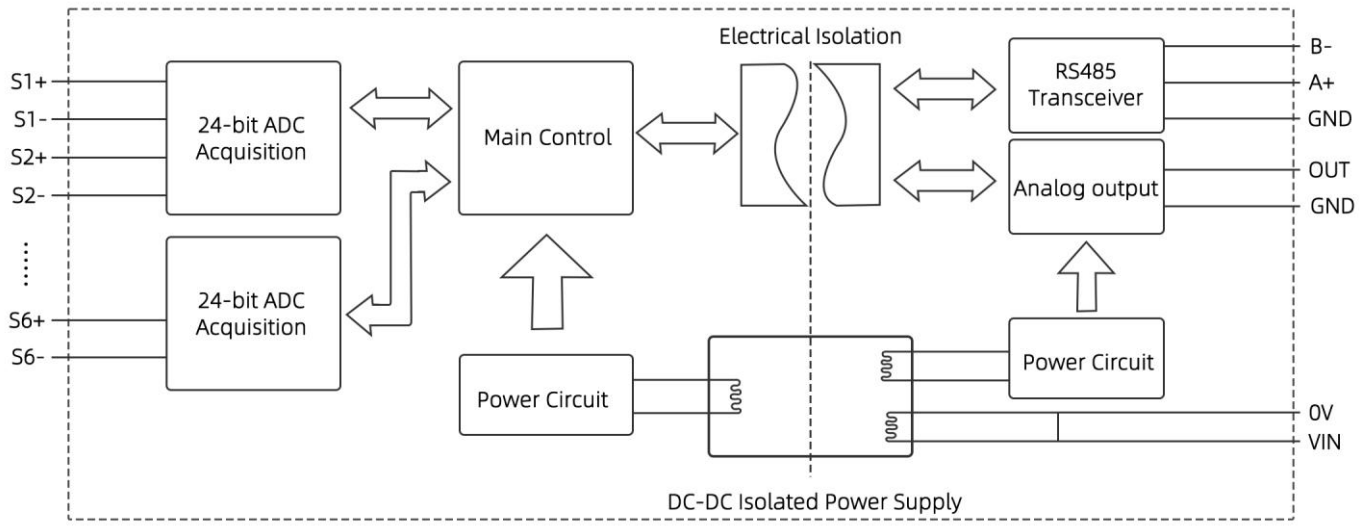
Note:

1. This module is available in three communication versions: RS485/Ethernet (ETH)/ RS485 + Ethernet.

2. The Ethernet port is active only in versions equipped with Ethernet functionality.

3. For specific Ethernet features and operation, please refer to the Serial Server Manual.

· Module working principle



· Technical Parameters

Basic Parameters	
Power Supply	DC12～36V(DC24V recommended)
Power Consumption	＜1.5W
Measurement Accuracy	±0.05%F.S（+25℃）
Temperature Drift	≤200ppm/℃
Sampling Frequency	≤8Hz
ESD Protection	±15KV
Isolation Voltage	3000VDC
Power Protection	Reverse connection voltage< -40V
Dielectric Strength	1500 VAC / 1 minute (Power, Input, Output)
Insulation Resistance	≥100MΩ (Power, Input, Output)
EMC Compatibility	Complies with GB/T18268.1 (IEC61326-1)
Applicable Field Devices	Devices supporting MODBUS-RTU protocol: Configuration software, PLC, HMI, PC, etc.
Input Terminal	
Number of Channels	4/6 channels
Input Range	The input range is referred to in the product name
Input Impedance	≥10MΩ
Sampling Resolution	24-bit ADC
Input Overload Capacity	1.2 times the nominal value of the measured voltage
Output Terminal	
Output Signal	RS-485/ Ethernet
Communication Protocol	Standard MODBUS-RTU protocol
Communication Distance	1200m (RS485 typical)
Environmental Conditions	
Operating Temperature	-40℃～+80℃
Storage Temperature	-40℃～+85℃
Relative Humidity	10%～90%RH (non-condensing)
Atmospheric Pressure	80kPa～106kPa

· Terminal Description

Terminal Mark	Function Description
VIN	Power supply positive terminal, DC12-36V input
OV	Power supply negative terminal
NC	No Connection (Empty pin)
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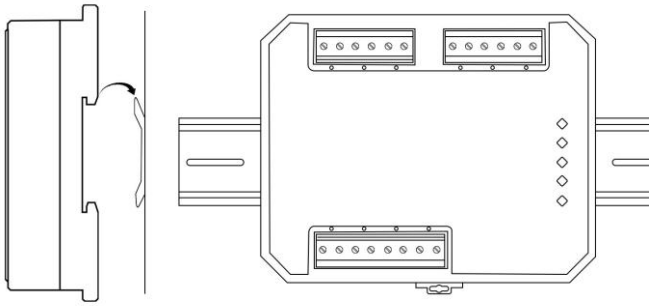
GND	RS-485 communication signal ground
A+	RS-485 communication signal positive
B-	RS-485 communication signal negative
S1+	Channel 1 input signal positive terminal
S1-	Channel 1 input signal negative terminal
S2+	Channel 2 input signal positive terminal
S2-	Channel 2 input signal negative terminal
S3+	Channel 3 input signal positive terminal
S3-	Channel 3 input signal negative terminal
S4+	Channel 4 input signal positive terminal
S4-	Channel 4 input signal negative terminal
S5+	Channel 5 input signal positive terminal
S5-	Channel 5 input signal negative terminal
S6+	Channel 6 input signal positive terminal
S6-	Channel 6 input signal negative terminal
ETH	Ethernet port（optional）

· Indicator Description

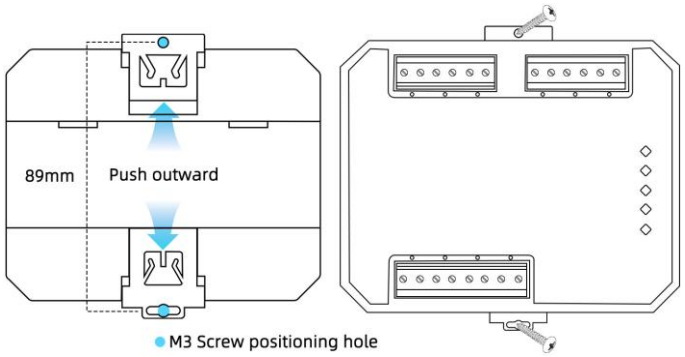
Indicator Mark	Function Description
PWR	Power indicator
SYS	Input Signal Status Indicator, flashes when no signal is present
COMM	RS485 Communication Indicator, flashes when transmitting/receiving signals
ETH	Ethernet Port Connection Indicator
LINK	Terminal Connection Indicator

· Installation Instructions

This module uses the DIN35mm rail mounting method. The rail should comply with the installation dimension specifications for the TH35-7.5 type rail according to the national standard GB/T19334-2003. Users can easily install or remove the module on the rail. Installation must be stable and secure. This module also supports screw mounting without a rail.



– Installation method of guide rail –



– Screw installation method –

· Product Naming Rules

Taking SPA1040-MC01L as an example: Four-channel DC voltage acquisition module, 24-bit ADC acquisition accuracy, no analog output, RS485 communication function, module DC12-36V power supply, likely refers to form factor M								
SPA	1	04	0	M	C	0	1	L
Product Type	Sensor Type	Number of Channels	Input Range	Product Form Factor	Acquisition Resolution	Analog Output	Communication Method	Power Supply
Analog Acquisition Module	1 DC Voltage 2 DC Current 3 AC Voltage 4 AC Current 5 Resistance 9 Custom	1-32	0 0-5V 1 0-10V 2 0-50V 3 0-100V 4 0-250V 5 0-500V 6 0-750V 7 0-1000V 9 Other Voltage	N Form Factor K Form Factor M Form Factor W Form Factor F Form Factor R Form Factor Y Form Factor Q Form Factor	A 12-bit ADC B 16-bit ADC C 24-bit ADC D 32-bit ADC	0 No Output 1 0-5V 2 0-10V 3 4-20mA 4 0-20mA	0 No Comm 1 RS485 2 ETH 3 RS485+ETH 4 CAN 9 Other Comm	L DC12-36V H AC220V C +12V D +24V

· Product Model Selection Guide

SPA1040-MC01L-BLE: Module with built-in Bluetooth function for terminal connection (default version)

SPA1040-MC01L-4G: Module with 4G function for terminal connection

SPA1040-MC01L-WIFI: Module with Wi-Fi function for terminal connection

SPA1040-MC01L: Basic version, without terminal connection function

· MODBUS-RTU Communication Protocol

The MODBUS-RTU protocol defines multiple function codes to achieve different functions. This manual explains the message format for commonly used function codes. This module only supports some of these function codes: 0X03, 0X04, 0X06, 0X10.

Function Code	Register add	Function Description
0X01	0XXXX	Read Coil Status (bit operation), e.g., read relay or digital output current state (ON/OFF)
0X02	0XXXX	Read Input Status (bit operation), e.g., read one or more groups of digital input states (ON/OFF)
0X05	0XXXX	Write Single Coil (bit operation), e.g., force a relay or digital output ON/OFF
0X03	4XXXX	Read Holding Registers
0X04	4XXXX	Read Input Registers (can be replaced by 0X03)
0X06	4XXXX	Write Single Holding Register
0X10	4XXXX	Write Multiple Holding Registers

· Communication Parameter Settings

Parameter	Setting Range	Default Value
Address	1～247	1
Baud Rate	1200、2400、4800、9600、14400、19200、38400、56000、57600、115200	9600
Parity	None, Even, Odd	None
Stop Bits	1, 2, 0.5, 1.5	1

· Communication Protocol Description

This communication board complies with the MODBUS RTU bus protocol, RS485 interface. The communication format is 11 bits:

1 start bit

8 data bits

1 parity bit (if used)

1 stop bit (with parity), 2 stop bits (without parity)

Data type: Unsigned int

With Parity

Start Bit	1	2	3	4	5	6	7	8	Parity Bit	Stop Bit

Without Parity

Start Bit	1	2	3	4	5	6	7	8	Stop Bit	Stop Bit

The message frame starts with a silence interval of more than 3.5 character times. The first field transmitted is the module add, followed by the function code, then the register add then the data, followed by the CRC16 check. It ends with a silence interval of more than 3.5 character times. The frame format is as follows:

Start Bit	Module add	Function Code	Register add High Byte	Register add Low Byte	Register Data High Byte	Register Data Low Byte	CRC16 calibration	End
>3.5 Chars	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte	2 Byte	>3.5 Chars
	1–247	0X03 0X06	0X00	0X01	0X00	0X01	CRC	

Function Code: 0X01

1.Host Request Frame:

1 Byte	2 Byte	3 Byte	4 Byte	5 Byte	6 Byte	7 Byte	8 Byte
ADR	0X01	Start address Hi	Start address Lo	Qty Hi	Qty Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	coil start address to be read		number of coils to be read		CRC16 checksum from bytes1 to 6	

2.Slave Response Frame (Correct) : Coil status 0 = OFF and 1 = ON

1	2	3	4、5	6、7	……	N−1、N	N+1	N+2
ADR	0X01	Coil status Byte Count	Coil Status 1 Data	Coil Status 1 Data	……	Coil Status N Data	CRC16 Lo	CRC16 Hi
Module address (1~247)	Function code	Returns the number of bytes in coil status	Returns the wire net status data (one coil status is two bytes)				CRC16 checksum from bytes 1 to N	

Function Code: 0X02

1.Host Request Frame:

1	2	3	4	5	6	7	8
ADR	0X02	Start address Hi	Start address Lo	Qty Hi	Qty Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	The coil input start address to be read		number of coils to be read		CRC16 checksum from bytes1 to 6	

2.Slave Response Frame (Correct) : Coil status 0 = OFF and 1 = ON

1	2	3	4、5	6、7	……	N−1、N	N+1	N+2
ADR	0X02	Coil status Byte Count	Coil Status 1 Data	Coil Status 1 Data	……	Coil Status N Data	CRC16 Lo	CRC16 Hi
Module address (1~247)	Function code	Returns the number of bytes in coil status	Returns multiple coil input status data				CRC16 checksum from bytes1 to N	

Function Code: 0X05

1.Host Request Frame: Coil status 0 = OFF and 1 = ON

1	2	3	4	5	6	7	8
ADR	0X05	Coil address Hi	Coil address Lo	Force Data Hi	Force Data Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	Written coil address		Number of coils written		CRC16 checksum from bytes1 to 6	

2.Slave Response Frame (Correct) :

1	2	3	4	5	6	7	8
ADR	0X05	Coil address Hi	Coil address Lo	Force Data Hi	Force Data Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	Written coil address		Returns coil status data		CRC16 checksum from bytes1 to 6	

Function Code: 0X03

1.Host Request Frame:

1 Byte	2 Byte	3 Byte	4 Byte	5 Byte	6 Byte	7 Byte	8 Byte
ADR	0X03	Start address Hi	Start address Lo	Reg Qty Hi	Reg Qty Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	The register starting address to read is		Number of registers read		CRC16 checksum of bytes 1 to 6	

2.Slave Response Frame (Correct) :

1	2	3	4、5	6、7	……	N−1、N	N+1	N+2
ADR	0X03	Byte Count	Reg 1 Data Hi	Reg 1 Data Lo	……	Reg N Data Hi, Reg N Data Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	Returns the effect of reading register bytes	Returns multiple register data (one register data is two bytes)				CRC16 checksum of bytes 1 to N	

Function Code: 0X06

1.Host Request Frame:

1	2	3	4	5	6	7	8
ADR	0X06	Reg address Hi	Reg address Lo	Reg Data Hi	Reg Data Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	Register address to be written		Register data to be written		CRC16 checksum of bytes 1 to 6	

2.Slave Response Frame (Correct) :

1	2	3	4	5	6	7	8
ADR	0X06	Reg address Hi	Reg address Lo	Reg Data Hi	Reg Data Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	Returns the register address written		Returns the written register data		CRC16 checksum of bytes 1 to 6	

Function Code: 0X10

1.Host Request Frame:

1	2	3、4	5、6	7	8、9	10、11	……	N−1、N	N+1	N+2
ADR	0X10	Start Add	Reg Qty	Byte Count	Reg 1 Data	Reg 2 Data	……	Reg N Data	CRC Check	CRC Check
Module address (1~247)	Function code	The starting address of the register to be written	Validity of register written	Number of register data bytes written	Multiple register data written (One register data is two bytes)				CRC16 checksum of bytes 1 to N	

2.Slave Response Frame (Correct) :

1	2	3	4	5	6	7	8
ADR	0X10	Start Add Hi	Start Add Lo	Reg Qty Hi	Reg Qty Lo	CRC Lo	CRC Hi
Module address (1~247)	Function code	Returns the starting address of the register written		Returns the number of registers written		CRC16 checksum of bytes 1 to 6	

· Register Definition Table

PLC add	Register add (HEX)	Function Definition	R/W Attribute	Value Range and Description
40002	1	Channel 1 Output Signal Value	Read Only	1–65536, corresponding to the actual output signal value. For a 0-5V output signal, a reading of 2500 corresponds to 2.500V
40003	2	Channel 2 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40004	3	Channel 3 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40005	4	Channel 4 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40006	5	Channel 5 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40007	6	Channel 6 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40008	7	Channel 7 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40009	8	Channel 8 Output Signal Value	Read Only	Same value range and interpretation as Channel 1
40010	9	Channel 1 Measured Engineering Value	Read Only	1–65536, corresponding to the actual range value. For example, if the engineering range is 0–5000V, a reading of 110 corresponds to an actual value of 110V
40011	A	Channel 2 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40012	B	Channel 3 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40013	C	Channel 4 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40014	D	Channel 5 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40015	E	Channel 6 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40016	F	Channel 7 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40017	10	Channel 8 Measured Engineering Value	Read Only	Same value range and interpretation as Channel 1
40018	11	Channel 1 Measured AD Value	Read Only	0–65535, corresponding to the acquired AD value. For example, with an engineering range of 0–5000V, 0 corresponds to 0V and 65535 corresponds to an input of 5000V
40019	12	Channel 2 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40020	13	Channel 3 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40021	14	Channel 4 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40022	15	Channel 5 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40023	16	Channel 6 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40024	17	Channel 7 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40025	18	Channel 8 Measured AD Value	Read Only	Same value range and interpretation as Channel 1
40051	32	Channel 1 Engineering Upper Limit	Read/Write	0–65535. For example, if the actual voltage full scale is 5000V, set the upper limit to 5000
40052	33	Channel 1 Engineering Lower Limit	Read/Write	0–65535. The default lower voltage limit is set to 0
40053	34	Channel 2 Engineering Upper Limit	Read/Write	0–65535
40054	35	Channel 2 Engineering Lower Limit	Read/Write	0–65535
40055	36	Channel 3 Engineering Upper Limit	Read/Write	0–65535
40056	37	Channel 3 Engineering Lower Limit	Read/Write	0–65535
40057	38	Channel 4 Engineering Upper Limit	Read/Write	0–65535
40058	39	Channel 4 Engineering Lower Limit	Read/Write	0–65535

40059	3A	Channel 5 Engineering Upper Limit	Read/Write	0–65535
40060	3B	Channel 5 Engineering Lower Limit	Read/Write	0–65535
40061	3C	Channel 6Engineering Upper Limit	Read/Write	0–65535
40062	3D	Channel 6 Engineering Lower Limit	Read/Write	0–65535
40063	3E	Channel 7 Engineering Upper Limit	Read/Write	0–65535
40064	3F	Channel 7 Engineering Lower Limit	Read/Write	0–65535
40065	40	Channel 8 Engineering Upper Limit	Read/Write	0–65535
40066	41	Channel 8 Engineering Lower Limit	Read/Write	0–65535
40067	42	Channel 1 Input Signal Type	Read/Write	0: 0-5V 1: 0-10V 2: 0-20mA 3: 4-20mA
40068	43	Channel 2 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40069	44	Channel 3 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40070	45	Channel 4 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40071	46	Channel 5 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40072	47	Channel 6 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40073	48	Channel 7 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40074	49	Channel 8 Input Signal Type	Read/Write	Same value options and interpretation as Channel 1
40083	52	Communication add	Read/Write	1～247
40084	53	Baud Rate	Read/Write	0：1200bps 1：2400bps 2：4800bps 3：9600bps 4：14400bps 5：19200bps 6：38400bps 7：56000bps 8：57600bps 9：115200bps
40085	54	Parity Bits	Read/Write	0：None 1：Even 2：Odd
40086	55	Stop Bits	Read/Write	0：1 Stop Bit 1：0.5 Stop Bits 2：2 Stop Bits
40087	56	Device Number 1	Read Only	0～65536
40088	57	Device Number 2	Read Only	0～65536
40089	58	Firmware Version	Read Only	0～65536
40090	59	Device Category	Read Only	0～65536