

## 3-phase 4-wire AC multi-parameter digital transducer manual

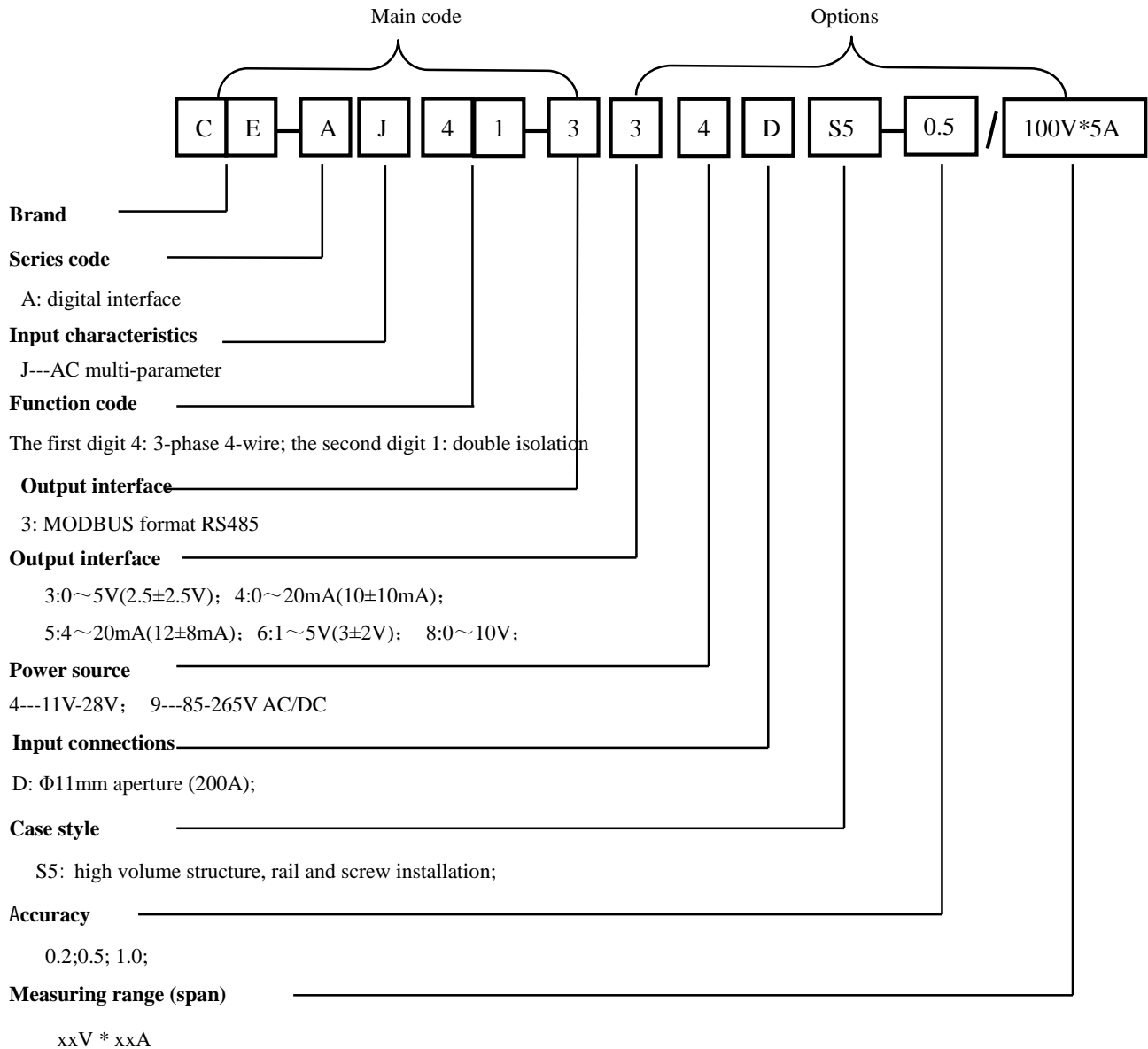
### CE-AJ41-3\*\*DS5-0.5

#### 1 Overview

This product is an intelligent isolation transducer of electrical parameter acquisition and transmission. It can measure the full-parameter of three-phase four-wire AC loop. Using high-precision 24-bit dedicated AD chip, the ratio dynamic range can be up to 5000: 1, the measurement parameters are voltage, current, frequency, active power, reactive power, power factor, total accumulative energy and other electrical parameters with high accuracy, good stability and high communication speed. The completely isolated processing technology is with anti-interference ability. Measurement of electrical parameters through the RS-485 digital interface output to achieve long-distance transmission, the product MODBUS protocol is complete compatible with a variety of configuration software or PLC equipment MODBUS (RTU) protocol. It can be applied to power, room monitoring, industrial measurement and other fields

#### 2 Part Number

CE-A product selection is as follows, in order to make your selected products accurate application, please read carefully.



#### 3 Product Features

2 Available with wide power supply: DC: 11-28V, AC/DC: 85-265V.

- 2 Digital and analog output at the same time, digital is communication output and analog output is programmable.
- 2 The analog output can be freely programmed to set the positive and negative power measurement or the inductive and capacitive polarity measurement of the power factor.
- 2 Analog output can be a 1-way current and a 1-way voltage signal at the same time, eight output functions of 0-5V/0-20mA or 1-5V /4-20mA or 2.5±2.5V/10±10mA or 3±2V /12±8mA, can be set freely.
- 2 Communication output can be freely set the communication rate and parity, the maximum communication speed is up to 115200 bps.
- 2 With the open-phase, voltage and current phase sequence error detection function. To provide voltage , current vector and the RMS output.
- 2 High anti-interference ability, the input, output and power port to resist the surge voltage up to 2KV or more.

#### 4 Specifications

NO.	Item	Name of items	Date	Unite	Remarks
1	Accuracy	Accuracy	0.5	%	
		Temperature drift	<300	ppm/ °C	-20°C~70°C
2		Input range	Voltage:AC:0~500V, currentAC:0~200A;		
3		Operating temperature	-20°C~70°C	°C	
4	Digital output	Baud rate	4800,9600(default),19200,38400,57600,115200	bps	
		Parity	None, Even, Odd		The default data format: N, 8,1
		Communication distance	1200(RS-485)	m	RS485 repeater can extend the communication distance
		Max. number of nodes	64	Node	
		Bus protection	400W transient voltage		ESD protection and thermosnap
		A/D SPEED	200	ms	
5	Analog output	Output	Output a 1-way voltage and current signal 0-5V/0-20mA or 1-5V/4-20mA or 2.5±2.5V/10±10mA or 3±2V/12±8mA are free to choose		
		Output ripple	<10	mV	
		Overload capacity	Voltage output ≥ 500Ω, current output ≤ 300Ω (24V DC power supply can be 800Ω)	Ω	
		Response time	<200	ms	
6	Power source	Power supply	DC:11~28V; AC/DC:85~265V;	V	Wide power supply
		Power consumption	<1W(24V);	W	Different Auxiliary power, different power consumption
7	Reliability	MTBF	>30000	hour	
		Isolation voltage	Input/output: 2500V DC for 1 min Input/power supply: 2500V for 1 min Output/power supply: 2500V for 1 min	V	he double isolation part numbers, their output and power supply are grounded together, there is only between the input and output isolation voltage

	Overload	2 x voltage span 1 sec. 10 for times with interval of 10 sec. 10 x current span for 1 sec. 5 times with an interval of 300 sec (only for hole thru. parts)	The input outside the linear range will result in poor accuracy
	Electromagnetic Compatibility	Anti-lightning surge: input $\pm 4KV$ ; power supply side, digital port, analog output port: $\pm 2KV$ ; Anti-group pulse: $\pm 2KV$ input; power supply side, digital port, analog output port: $\pm 2KV$ ;	

**5 Case Style and terminal definition**

1, product appearance diagram

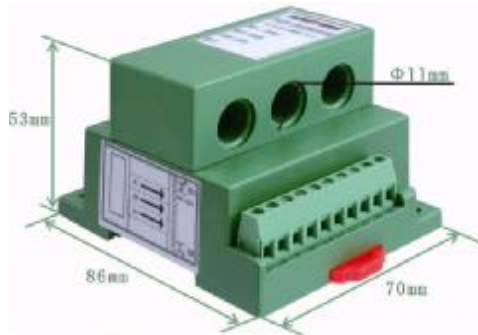


Figure 1, CE-AJ41-3\*\*DS5 type product shape

2, the product installation dimensions

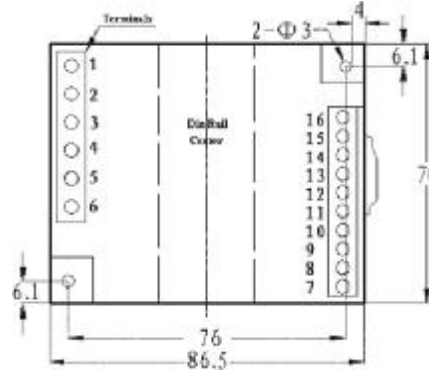


Figure 2, Guide rail mounting dimensions

3, the product installation dimensions

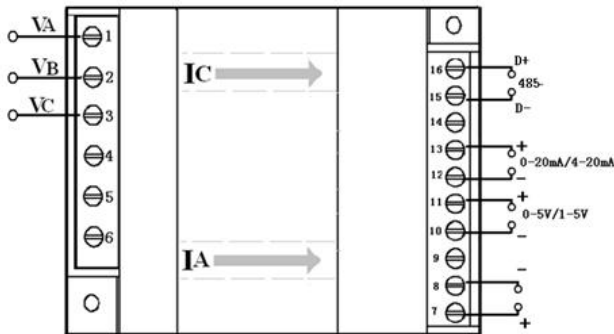


Figure 3, CE-AJ31-3\*\*DS5 3-phase 3-wire wiring diagram

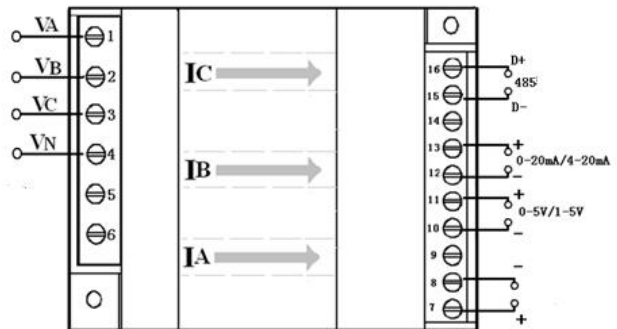


Figure 4, CE-AJ41-3\*\*DS5 3-phase 4-wire wiring diagram

Note of figure 4: When the three-phase four-wire product through the internal DIP switch set to three-phase three-wire measurement, the product wiring is required to connect B-phase voltage to the 4-pin terminal, 2-pin terminal and B-phase current is not connected.

**6 Analog output function settings**

Open the bottom of the product, the internal PCB board has a six-bit code switch, The first and second bits of the DIP switch are used to set active, reactive and power factor measurement (Note: This switch setting function is invalid when using the communication setting transmission output, see the 004EH register for details). The third bit sets the zero point to 0V (0mA) or 1V (4mA) output. The fourth bit is set to polarity measurement or to measure positive and negative power (inductive and capacitive measurement power factor). The bit 5 is set to negative power zero offset output, when the zero output is 4mA or 1V, non-polar measurement, when measured to have negative power, output will be less than 4mA or 1V, negative power maximum bias output to -20%, that is, the output is minimum to 0.8mA or 0.2V (Note: This bit setting is invalid when the 4-position switch is set to bipolar measurement); The switch status function is set as follows:

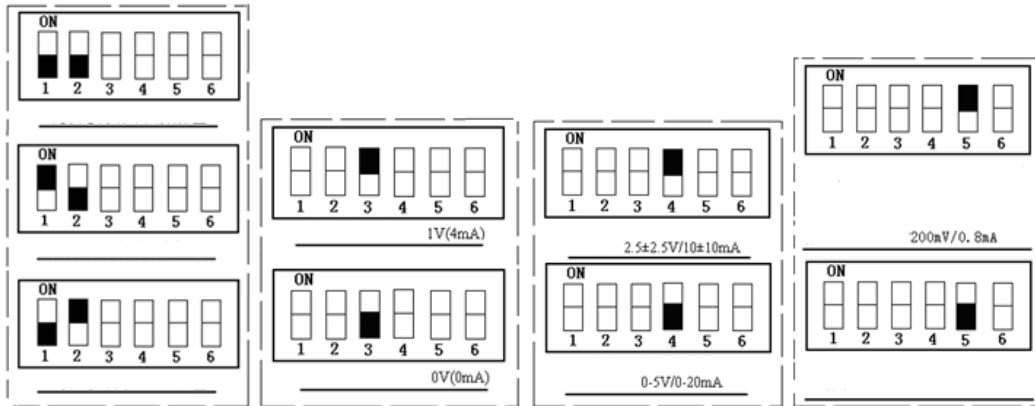


Figure 5 Measurement function settings; Figure 6 Zero output settings; Figure 7 Polarity measurement settings; Figure 8 Non-polar bias measurement

**7 MODBUS communication protocol**

**1 Format of message**

(1)Function code 03H--- to read the contents of registers from the slave equipment

The message from the master equipment:

Address of the slave equipment	(01H-FFH	1byte)
Function code	(03H	1byte)
Address of the first register		(2bytes)
Quantity of registers		(2bytes)
CRC code		(2bytes)

The correct responded message from the slave equipment

Address of the slave equipment	(01H-FFH	1byte)
Function code	(03H	1byte)
Byte count	(2xN*	1byte)
Data section		( N*x bytes)
CRC code		(2bytes)

(2) Function code 10H---to set data of registers of the slave equipment

The message from the master equipment

Address of the slave equipment	(01H-FFH	1byte)
Function code	(10H	1byte)
Address of the first register		2bytes)
Quantity of registers		(2bytes)
Byte count	(2xN*	1byte)
The data written to the register		(2x N*)
CRC code		(2bytes)

The correct responded message from the slave equipment

Address of the slave equipment	(01H-FFH	1byte)
Function code	(10H	1byte)
Address of the first register		(2bytes)
Quantity of registers		(2bytes)
CRC code		(2bytes)

Note: 1 For all address of registers, quantity of registers and contents of registers (data ), the high order byte is before their low order

byte. But the low order byte of CRC code is before its high order byte.

2 the length of the register is 16bits (2 bytes).

## 2Format of commands and explanation of the registers

(1)List of definitions of registers for electrical parameters data:

Address of register (Hex)	Contents of registers	Quantity of registers	Attribute if registers	Range of data	Analog output	note
0001H	A phase Voltage	1	Read only	0~12000	Exist	Unit: V, data need the restore calculation, see the 4 part of the formula
0002H	B phase Voltage	1	Read only	0~12000	Exist	
0003H	C phase Voltage	1	Read only	0~12000	Exist	
0004H	A phase current	1	Read only	0~12000	Exist	Unit: V, data need the restore calculation, see the 4 part of the formula
0005H	B phase current	1	Read only	0~12000	Exist	
0006H	C phase current	1	Read only	0~12000	Exist	
0007H	Total active power	1	Read only	-12000~+12000	Exist	Unit: W Note ①
0008H	Total reactive power	1	Read only	-12000~+12000	Exist	Unit: VAR
0009H	Total power factor	1	Read only	-10000~+10000	Exist	
000AH	Frequency of voltage	1	Read only	0~60000	None	A phase voltage frequency is up to 600HZ;
000BH	Active power of phase A	1	Read only	-12000~+12000	Exist	
000CH	Active power of phase B	1	Read only	-12000~+12000	Exist	
000DH	Active power of phase C	1	Read only	-12000~+12000	Exist	
000EH	Power factor of phase A	1	Read only	-12000~+12000	Exist	
000FH	Power factor of phase B	1	Read only	-12000~+12000	Exist	
0010H	Power factor of phase C	1	Read only	-12000~+12000	Exist	
0011H-12H	Positive active energy	2	Read/write	0~7FFFFFFFH	None	Hex
0013H-14H	Positive reactive energy	2	Read/write	0~7FFFFFFFH	None	Hex
0015H-16H	Negative active energy	2	Read/write	0~7FFFFFFFH	None	Hex
0017H-18H	Negative active energy	2	Read/write	0~7FFFFFFFH	None	Hex
0019H	Total apparent power	2	Read only	-12000~+12000	Exist	
001AH	Total fundamental active	1	Read only	-12000~+12000	Exist	
001BH	Reactive power of phase A	1	Read only	-12000~+12000	Exist	
001CH	Reactive power of phase B	1	Read only	-12000~+12000	Exist	
001DH	Reactive power of phase C	1	Read only	-12000~+12000	Exist	
001EH	Apparent power of phase A	1	Read only	-12000~+12000	Exist	
001FH	Apparent power of phase B	1	Read only	-12000~+12000	Exist	
0020H	Apparent power of phase C	1	Read only	-12000~+12000	Exist	
0021H	Fundamental power of phase A	1	Read only	-12000~+12000	Exist	
0022H	Fundamental power of	1	Read only	-12000~+12000	Exist	

	phase B					
0023H	Fundamental power of phase C	1	Read only	-12000~+12000	Exist	
0024H	Power angle of phase A	1	Read only	-1800~+1800	None	Unit: °, with one decimal
0025H	Power angle of phase B	1	Read only	-1800~+1800	None	
0026H	Power angle of phase C	1	Read only	-1800~+1800	None	
0027H	Voltage angle of phase A and B	1	Read only	-1800~+1800	None	
0028H	Voltage angle of phase A and C	1	Read only	-1800~+1800	None	
0029H	Voltage angle of phase B and C	1	Read only	-1800~+1800	None	
002AH	Voltage vector sum	1	Read only	-12000~+12000	Exist	
002BH	Current vector sum	1	Read only	-12000~+12000	Exist	
002CH	Bit status flag	1	Read only		None	See below for explanation
002DH	The internal temperature of the product	1	Read only	-30~80	None	Unit: °C
.....	.....	.....	.....	.....	...	
004EH	Analog output type	1	Read/write	0~5		0-DIP switch hardware control, see Section VII-0 ~ 5V/0 ~ 20mA 2-1~5V/4~20mA 3-2.5±2.5V/10±10mA 4-3±2V/12±8mA 5-0.2~1~5V/0.8~4~20mA
004FH	Electrical parameters of analog output	1	Read/write	1~45		Address range of valid register
0050H	Address	1	Read/write	Address (0~256)		
0051H	Baudrate	1	Read/write	Baudrate (5~10)		5-4800bps;6-9600bps; 7-19200bps;8-38400bps 9-57600bps;10-115200bps
0052H	Parity check	1	Read/write	Parity (0~4)		00 - no parity; 1 - odd parity; 2-even check; 3-mark check; 4-blank check (9 data bits, low level)
0053H	Voltage range	1	Read/write	0~60000		Only for identification, do not participate in operations
0054H	Current range	1	Read/write	0~60000		Only for identification, do not participate in operations
0055H-57H	Model name	3	Read/write	“AJ42-3”		6 bytes data, can be customized
.....	.....	.....	.....	.....	...	
00A8H	Broadcast reset address	1	Read/write	0~256		Use the broadcast address FA command, see Example 3 for

						details
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Note: ① The negative value of the output data range is expressed in hexadecimal complement, the expression method of all negative data is same.

(2) Description of PFlag status flag

The 16-bit data is read out from this register and each bit represents the specific meaning of the following

Bit15	Bit14=1	Bit13=1	Bit12=1	Bit11=1	Bit10=1	Bit9=1	Bit8=1
Invalid	At least one reactive is negative	At least one active is negative	Current misorder	Voltage misorder	C phase loss of pressure	B phase loss of pressure	A phase loss of pressure
Bit7=1	Bit6=1	Bit5=1	Bit4=1	Bit3=1	Bit2=1	Bit1=1	Bit0=1
Reverse reactive of combined	Reverse reactive of phase C	Reverse reactive of phase B	Reverse reactive of phase C	Reverse active of combined	Reverse active of phase C	Reverse active of phase B	Reverse active of phase A

### 3Example:

Example 1: To read the data of voltage and current

Send command:

Address of the slave equipment	Function code	Address of the first register		Quantity of registers		CRC-L	CRC-H
01H	03H	00H	01H	00H	06H	94H	08H

Return data:

Address of the slave equipment	Function code	Data bytes count	Register contents	CRC-L	CRC-H
01H	03H	0BH	Outputs 12 data in register definition table	XX	XX

Example 2: (Change the address from 01 to 02, set new baudrate to 9600pbs <code 06>)

Send command:

Address of the slave equipment	Function code	Address of the first register	Quantity of registers	Data bytes count	Data written to register				CRC-L	CRC-H		
					Address		Address					
01H	10H	00H	50H	00H	02H	04H	00H	02H	00H	06H	D7H	51H

Note: Code for baudrate 05H---4800bps; 06H---9600bps;07H---19200bps;08H---38400bps;09---57600bps;0AH---115200bps

Return data:

Address of the slave equipment	Function code	Address of the first register		Quantity of registers		CRC-L	CRC-H
01H	10H	00H	50H	00H	02H	41H	D9H

Example 3 for the command “to search address of broadcast” (Also available 10H function to modify the address)

Broadcast address	Function code	Broadcast address		Quantity of registers		CRC-L	CRC-H
FAH	03H	00H	A8H	00H	01H	10H	61H

Send command:

Address of the slave equipment	Function code	Data bytes count	Return data		CRC-L	CRC-H
FAH	03H	02H	00H	01H	C9H	85H

Example 4: configuration of analog output

Send command:

Address of the slave equipment	Function code	Address of the first register		Quantity of registers		Data bytes count	Data written to register				CRC-L	CRC-H
							Output type		Output electrical parameters			
01H	10H	00H	4EH	00H	02H	04H	00H	02H	00H	04H	D6H	10H

Description: The data 0002H is written as analog output type 1-5V / 4-20mA, and 0004H is the reactive power register address, the analog port outputs reactive power transmission value.

Return data:

Address of the slave equipment	Function code	Address of the first register		Quantity of registers		CRC-L	CRC-H
01H	10H	00H	4EH	00H	02H	21H	DFH

## 4 Data

(1): data format conversion

Complement: If data > 32768, then data = 65536-data; otherwise data = data;

Original: data = data;

Thereinto: Data - The decimal number is conversion read from hexadecimal of the data register

Meaning of the data: 10000 correspond to the rated value. For example, when the maximum value of input current is 5.000A, the expected output value is 10000D or 2710H and 25.000A correspond to 5000D or 1388H of the expected output value.

(2) Calculation of power:

$$P = n * X_p * \text{current range} * \text{voltage range} / 10000 \quad (\text{W})$$

$$Q = n * X_q * \text{current range} * \text{voltage range} / 10000 \quad (\text{Var})$$

Thereinto:  $X_p$ ---the data of active power received by the master equipment,

$X_q$ ---the data of reactive power received by the master equipment. (2 bytes, high order byte ahead, the MSB is sign bit)

(3) Calculation of energy

$$N = X_w * \text{current range} * \text{voltage range} / (1000 * 3600) \quad (\text{KWh})$$

Thereinto:  $X_w$ --- the data of energy received by the master equipment. (4 bytes, high order byte ahead, the MSB is sign bit)

(4): Calculation of frequency

$$F = X_f / 100 \quad (\text{Hz})$$

Thereinto:  $F$ --- the data of frequency received by the master equipment. (2 bytes, high order byte ahead, the MSB is sign bit)

(5): Calculation of angle

$$\Phi = X_\phi / 10 \quad (^\circ)$$

Thereinto:  $X_\phi$ --- the data of angle received by the master equipment. (2 bytes, high order byte ahead, the MSB is sign bit)

(6): Calculation of current and voltage

$$U = X_u * \text{voltage range} / 10000; \quad I = X_i * \text{current range} / 10000;$$

Thereinto:  $X_u$ --- the data of voltage received by the master equipment.  $X_i$ --- the data of current received by the master equipment.

(7): Calculation of power factor

$$C = X_c / 10000;$$

Thereinto:  $X_c$ --- the data of power factor received by the master equipment.

## 8 Correct use of the transducer

1. installation

1.1 DIN rail installation method:

<http://www.ce-transducer.com>  
[sales@ce-transducer.com](mailto:sales@ce-transducer.com)

3rd Floor, building 1, Zaimao industrial park, Baoji road, Bantian, Longgang district, Shenzhen City, China Post code: 518049

- ① The transducer fixed on the side of the card slot and hook on the mounting rail;
- ② Pull down the spring pin;
- ③ Clip the transmitter mount on the mounting rail;
- ④ Release the spring pin and place the transmitter on the mounting rail.

#### 1.2 Screw mounting method:

- ① 4mm diameter hole in the fixed plate according to the screw hole position shown in Fig. 2;
  - ② Use the screw  $\Phi 3.5$  to insert into hole and secure it.
- 2 Products factory has been accurately set according to the "product standard". Apply power after determine the correct wiring.
  - 3 The maximum wire diameter of the terminal block is 2mm (16-26AWG). Remove the 4mm ~ 5mm insulation layer from the end of the mounting wire and insert it into the terminal block, then tighten the screw.
  - 4 Product supply power requires the isolation voltage  $\geq 2000\text{VAC}$ , AC ripple  $<10\text{mV}$ . Multiple transducers can share a common set of power supplies, but the power circuit can no longer be used to drive relays and other can produce spikes in the load, in order to avoid interference signal transmission to the transducer.
  - 5 The transducers output 0-20mA (or 4-20mA), the RL standard is  $\leq 250\Omega$ , and 0-5V voltage output RL standard is  $\geq 2\text{K}\Omega$ , can guarantee the output accuracy and linearity over the entire rated input range. current output can increase the load capacity to  $800\Omega$  when the power supply is +24V

## 9 Notes

- 1 Please pay attention to the power supply information on the product label, and the power supply used grade of the transducer, otherwise it will cause the product to be damaged.
- 2 Transducer for the integrated structure, not removable, and should avoid collision and fall.
- 3 The transducers are used in environments with strong electromagnetic interference. Standard precaution such as shielding the input and /or output lines should be observed. All lines should be as short as possible. If a group of transducers are mounted together, keep a space more than 10mm between adjacent units.
- 4 The input value given on the transducer label refers to the RMS value of the ac signal.
- 5 Only use the effective terminal of the transducer. The other terminals may be connected with the internal circuit of the transducer, and can't be used for other purposes.
- 6 Transducer has a certain anti-lightning ability, but when the transducer input and output feeders exposed to extreme bad environments, must be taken lightning protection measures.
- 7 Don't damage or modify the product label and logo. Don't disassemble or modify the transmitter, otherwise the company will no longer provide the product "three guarantees" (replacement, returns, repair) services.
- 8 The transducers use flame-retardant ABS plastic shell package. which limit temperature is  $+75\text{ }^{\circ}\text{C}$ . The shell will be deformed with high-temperature baking, and will affect product performance. Do not use or save the product near the heat source. Do not bake the product in a high-temperature oven.
- 9 When measuring the voltage or current with the multi meter pen, please screw the terminal screw in the end, otherwise it may not measure the voltage or current output value.

Note: There are unknown and the test methods of the technical indicators, please contact our company.