



User Manual

Electromagnetic Conductivity Sensor

DEC-220



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General Introduction

DEC-220 is based on electrode-less inductive conductivity measurement. It utilizes a generator to create an alternating magnetic field in the primary coil, inducing an electric current in the medium. The strength of the induced current depends on the conductivity, i.e., the ion concentration in the medium. The induced current generates another magnetic field in the secondary coil. The receiver measures the induced current on the coil to determine the conductivity of the medium. It also features a built-in temperature sensor for automatic temperature compensation, making it suitable for long-term online monitoring applications.

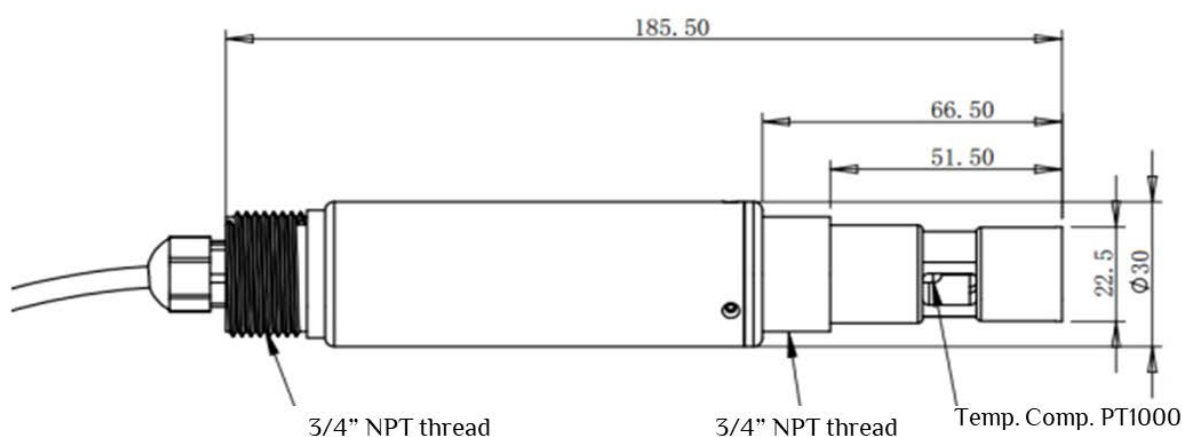
Features:

- Digital sensors, directly outputting RS-485 digital signals and supporting MODBUS/RTU.
- Built-in temperature sensor, can automatically compensate for temperature changes
- No electrodes, therefore no polarization reaction
- Measurement and medium are completely electrically isolated, allowing for high-precision measurement of heavy or easily sedimenting media or solutions with low maintenance costs.
- Low power consumption of sensors, and internal circuit design to resist interference

Application:

Online continuous monitoring of ocean, industrial wastewater, pharmaceuticals, biotechnology and industrial manufacturing.

Dimensional drawing

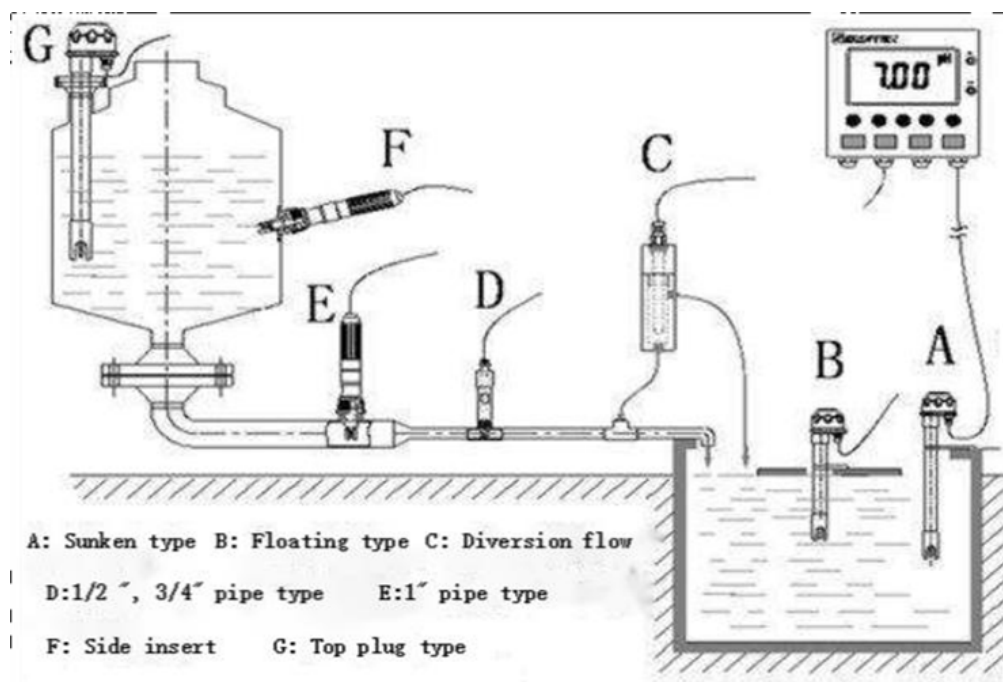


Technical parameters

Name	Parameters
Output Signal	Support RS-485, MODBUS/RTU protocol
Measurement Method	Non-contact electromagnetic principle
Range	0 ~ 200 mS/cm; Customizable within a range of 600 mS/cm
Accuracy	±1.5% F.S.
Resolution	0.1 mS/cm
Working Conditions	0 ~ 65°C; <0.6 Mpa; High temperature conductivity customization
Calibration Mode	Two-point calibration
Response Time	10 seconds T90
Temperature Compensation	Automatic temperature compensation (PT1000)
Power Supply	12 or 24 VDC ±10%, 10 mA;
Dimensions	Diameter 30 mm; Length 185.5 mm;
Protection Grade	IP68; Water depth up to 20 meters; Other customizations available
Service Life	over 36mths
Cable Length	Default is 5 meters; Customization available
Sensor Housing Material	PVC; PEEK; Customizable

Installation Notes and Wire Connection

1. Installation



Note: The sensor should be installed at least 2 cm away from the bottom and side wall of the container during installation testing.

2. Electrical connection

- Brown wire - power supply (12 or 24 VDC)
- Black wire - Ground
- Blue wire - 485A.
- White wire - 485B.
- Bare wire - shielding layer

Sensor cable: 4-wire AWG-24 or AWG-26 shielded wire.

Outer diameter: 6.0-6.2 mm;

Flexible twisted pair shielded cable.

Calibration

1. Zero calibration

Distilled water is used to rinse the sensor measurement probe plane, and a filter paper is used to absorb the liquid. The sensor is placed in air for stabilization before sending zero-point calibration instructions; it takes about 3 minutes for the values to stabilize.

2. Slope calibration

Insert the sensor into a slope standard buffer solution (such as 100 mS/cm), wait for the value to stabilize, and then send out calibration instructions. It takes about three minutes for the value to stabilize.

Note that during calibration, the sensor measurement probe should be kept at least 2 cm away from the bottom of the container.

Please refer to the Modbus RTU communication protocol operation manual for calibration instructions.

Note: The sensor has been calibrated before leaving the factory. It is not advisable to calibrate it arbitrarily unless there are errors beyond measurement error.

Maintenance and precautions

1. Maintenance

- Inductive electrode is basically maintenance-free. It is recommended to clean the attachment of sensor measuring probe every 30 days; Avoid using hard objects to scratch the light guide part of the measuring probe during cleaning; Please wipe it with a soft damp cloth
- It is recommended to clean the sensor measurement probe attachment every 30 days; avoid using hard objects that may scratch the light guiding part of the measurement probe during cleaning; please use a soft wet cloth for wiping.

2. Precautions

- The conductivity must be cleaned with distilled water before installation, and pay attention not to scratch the graphite surface.
- Installation measurement: Avoid installation measurements in areas with turbulent water flow, reducing the impact of air bubbles on the measurement. Keep the measuring probe at a distance of 2 cm from the bottom.
- Suggestion: Select and equip our protective cover to prevent microbial attachment from affecting measurement results.

Common Issue and Solutions

Problem	Possible Cause	Solution
The operation interface cannot connect or display measurement results.	Wrong wiring method of cables.	Check the wiring method.
	Incorrect sensor address.	Check if the address is correct.
Measurement values are too high, low, or the value is continuously unstable.	Foreign objects attached to the probe head of the sensor.	Clean the surface of the sensor probe head.
	Bubbles at the measuring point.	Remove bubbles.

Quality and Service

Thank you for choosing our product.

Shanghai ChiMay provides after-sales service of the machine within one year from the date of sale but does not include the damage caused by improper use. If you need repair or adjustment, please send it back, but the freight must be paid for by yourself.

Accessories and spare parts

Item	QTY (pcs)
Sensor	1
User Manual	1
Certificate of Conformity	1
Protective Cover	1(optional)

Data Communication

1. Modbus

Modbus protocol is a general communication protocol which has been widely used in today's industrial control field. Through this protocol, controllers can communicate with each other or with other devices via a network (such as Ethernet). Modbus protocol uses master-slave communication technology, that is, the master device actively queries and operates the slave device.

- A) The master sends a request to the slave
- B) The request from the master device is analyzed and processed by the slave device, and the result is sent to the master device
- C) If anything goes wrong, an exception function code is returned from the device

Modbus RTU Communication mode frame format

Device Address	Function Code	Data	CRC Byte	CRC Byte
8 bit	8 bit	8 bit	8 bit	8 bit

- Use RTU mode, the message is sent at least to begin with a pause interval of 3.5 characters time transmission equipment is the first domain address bus network equipment continuously detect network, including pause when the first interval time domain (domain) to receive, every device decodes to determine whether to own after the last transmission character, a pause at least 3.5 characters time calibration for the end of the message of a new message can be started after the pause.
- The entire message frame must flow as a continuous stream. If there is a pause of more than 1.5 characters before the frame completes, the receiving device refreshes the incomplete message and assumes that the next byte is the address field of a new message.

2. Information frame format

The default data format of Modbus communication for this sensor is:

MODBUS-RTU	
Baud	9600 (Default)
Device Address	1 (Default)
data bits	8bits
Parity	nothing
stop bits	1bit

a) Function Code 03H: Read register value

The host sends

1	2	3	4	5	6	7	8
ADR	03H	Start register high byte	Start register low byte	High register number in bytes	Low register count	CRC low byte	CRC high type

Byte 1: ADR: Slave address code (=001~254)

Byte 2: Function code for reading register values

Bytes 3 and 4: Starting address of the register to be read

(For reading instruments connected under the FCC)

Bytes 5 and 6: Number of registers to be read

Bytes 7 and 8: The CRC16 checksum from Byte 1 to Byte 6

The host sends:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total bytes	data register 1	data register 2	...	data register M	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 03H: Read register value function code

Byte 3 : The total number of bytes from 4 to M(including 4 and M)

Bytes 4 to M: data registers

Bytes M+1、M+2 : CRC16 checksum from byte 1 to M

When an error is received from the slave, send it back from the slave:

1	2	3	4	5
ADR	83H	information code	CRC low byte	CRC high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 83H: Error reading register value

Byte 3 information code: 01 - Function code wrong

03 - SET DATA ERR

Bytes 4、5: CRC16 checksums from bytes 1 through 3

b) Function Code 06H: Write a single register value

The host sends:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	High byte of data	Low byte of data	CRC code the low byte	CRC code the high byte

When the slave receives correctly, the slave sends back:

1	2	3	4	5	6	7	8
ADR	06	Register high byte address	Register low byte address	High byte of data	Low byte of data	CRC code the low byte	CRC code the high byte

When the slave receives an error, the slave sends back:

1	2	3	4	5
ADR	86H	Error code information code	CRC Code the low byte	CRC Code the high byte

Byte 1 ADR: Address code of the slave machine (=001~254)

Byte 2 86H: Write register value error function code

Byte 3 Error code information code: 01 – Function code wrong

03 – SET DATA ERR

Bytes 4、5 : CRC checksums from bytes 1 to 3

3) Data structure types

Integer

unsigned short

The data consists of two integers

XXXX XXXX	XXXX XXXX
Byte1	Byte0

Float

Float, IEEE 754 (single precision);

The data consists of 1 symbol bit, 8-bit exponent, and a 23-bit mantissa

XXXX XXXX	XXXX XXXX	XXXX XXXX	XXXX XXXX
Byte3	Byte2	Byte1	Byte0
sign bit	Exp Index place	F decimal place	

4) Register address

Register address	Name	Read/Write	Explanation	Number of registers (byte)	Data type
0x0100	Temperature value	R	°C value x10 (e.g.: 25.6 temperature display as 256, default 1 decimal)	1 (2 Bytes)	unsigned short
0x0101	Conductivity	R	When the measurement range is 0 to 200mS/cm, the corresponding value is x 10 (For example, the conductivity of 16.2mS/cm is displayed as 162, default 1 decimal.)	1 (2 Bytes)	unsigned short
0x0107	humidity measurement	R	%RH value x10 (For example: 11.3% relative humidity display is 113, default 1 decimal)	1 (2 Bytes)	unsigned short
0x1000	temperature correction	R/W	Temperature calibration: write the data as the actual temperature value x10; The readout data is the temperature calibration offset x10	1 (2 Bytes)	unsigned short
0x1001	zero calibration	R/W	Zero point calibration in the air when the written data is 0	1 (2 Bytes)	unsigned short
0x1003	The slope of calibration	R/W	Calibration in a known standard solution (reference slope point 50%-100% range) Range: 0 ~ 200mS/cm write data as the actual value of the standard solution x10;	1 (2 Bytes)	unsigned short
0x2000	address sensor	R/W	The default is 1, and the data range is 1-127	1 (2 Bytes)	unsigned short
0x2003	Baud rate setting	R/W	Default is 9600 write 0 is 4800; Write 1 as 9600; Write 2 as 19200	1 (2 Bytes)	unsigned short
0x2020	Factory Reset	W	The calibration value is restored to the default value and the written data is 0. Note that the sensor needs to be calibrated again before it can be used after reset	1 (2 Bytes)	unsigned short

5) Example command

Default register:

a) Change slave address:

Address: 0x2000

Number of registers: 1

Function Code: 0x06

Default sensor address: 01

Change the Modbus device address of the sensor and change the device address 01 to 06, as show below::

Send instructions: 01 06 20 00 00 06 02 08

Response: 01 06 20 00 00 06 02 08;

Note: Change the address to 06, save after power off.

b) Baud:

Address: 0x2003

Number of registers: 1

Function Code: 0x06

Default: 1 (9600bps)

Support value: 0-2 (4800-19200bps)

Baud rate can be changed by the upper computer setting. After the change, it can work. without restarting. After power down, baud rate of upper

computer setting can be saved:

Integer	Baud
0	4800 bps
1	9600 bps
2	19200 bps

Send instructions: 01 06 20 03 00 02 F3 CB

Response: 01 06 20 03 00 02 F3 CB

Note: Change the baud rate to 19200bps, save when power is lost.

FR Function Register: (0-200mS/cm) :

a) **Temperature instruction:**

Address: 0x0100

Number of registers: 1

Function Code: 0x03

Read sample values: 19.2°C

Send instructions: 01 03 01 00 00 01 85 F6

Response: 01 03 02 00 C0 B8 14

Returns hexadecimal unsigned integer data, Temperature value=Integer/10, keep 1 decimal place.

b) Instruction for measuring conductivity value:

Address: 0x0101

Number of registers: 1

Function Code: 0x03

Read sample values: 50mS/cm

Send instructions: 01 03 01 01 00 01 D4 36

Response: 01 03 02 01 F4 B8 53

Returns hexadecimal unsigned integer data, Conductivity=Integer/10, keep 1 decimal place.

c) Continuously read temperature and conductivity value instructions

Address: 0x0100

Number of registers: 2

Function Code: 0x03

Read sample values: 19.2°C and conductivity 50mS/cm

Send instructions: 01 03 01 00 00 02 C5 F7

Response: 01 03 04 00 C0 01 F4 FA 18

Register returns hexadecimal unsigned integer data, Temperature value=Integer/10, keep 1 decimal place.

Register returns hexadecimal unsigned integer data, Conductivity=Integer., keep 1 decimal place.

d) Humidity measurement instruction:

Address: 0x0107

Number of registers: 1

Function Code: 0x03

Read sample values: relative humidity 40%

Send instructions: 01 03 01 07 00 01 34 37

Response: 01 03 02 01 90 B9 B8

Register returns hexadecimal unsigned integer data, Humidity=Integer/10, keep 1 decimal place.

e) Calibration instructions:

temperature correction

Address: 0x1000

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration at 25.8°C

Send instructions: 01 06 10 00 01 02 0D 5B

Response: 01 06 10 00 01 02 0D 5B

The sensor needs to be calibrated in a constant temperature environment without temperature fluctuation.

Zero conductivity calibration

Address: 0x1001

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibrate in air

Send instructions: 01 06 10 01 00 00 DC CA

Response: 01 06 10 01 00 00 DC CA

Conductivity slope calibration

Address: 0x1003

Number of registers: 1

Function Code: 0x06

Calibration sample: Calibration in a conductivity solution of 100mS/cm

Send instructions: 01 06 10 03 03 E8 7D B4

Response: 01 06 10 03 03 E8 7D B4



For other question, feel free to contact us.
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