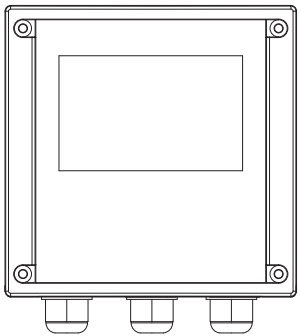
Version: 2024-03

ECS-7301 Conductivity / Resistivity / TDS Controller



144 Series

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Safe Operation

Read these safety instructions before use.
1. Inspect the instrument for shipping damage.
2. Operation is limited to trained technical personnel.
3. Read this manual before use; incorrect wiring may cause hazards or damage.
4. Check all wiring before energizing the instrument and verify all connected devices.
5. Avoid high temperature, high humidity, corrosive environments and direct sunlight.
6. Avoid surge-interference power supplies. If interference occurs, separate the instrument supply from other interfering equipment.

Intended Use

For industrial measurement of conductivity, resistivity, salinity, total dissolved solids (TDS) and temperature, including purified water, high-purity water, environmental monitoring and food production.

Mounting: panel, wall or pipe. Two current outputs; maximum load 500 ohm. Three control relays, rated up to 5 A at 250 VAC or 5 A at 30 VDC.

Package Contents and Warranty

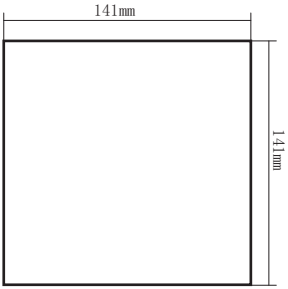
144 Series package: one instrument and four mounting-bracket sets (screws, retaining blocks and rods).

Specifications

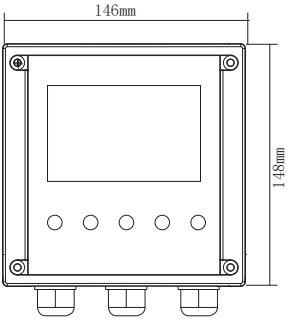
Function	Conductivity	Resistivity	TDS
Measurement range	K=0.01: 0.000-20.00 uS/cm K=0.10: 0.00-200.0 uS/cm K=1.0: 0.00-2000 uS/cm K=10.0: 0-20000 uS/cm	0.00-20.00 Mohm.cm	0-20000 ppm
Resolution	0.01 / 0.1 / 1	0.01	1
Accuracy	+/-1% F.S.	+/-1% F.S.	+/-1% F.S.
Electrode constant	0.001 to 20.000		
Temperature compensation	PT1000		
Temperature range	PT1000: -10.0 to +150.0 deg C		
Temperature resolution	0.1 deg C		
Temperature accuracy	+/-1% F.S.		
Operating temperature	0 to +70 deg C		
Storage temperature	-20 to +70 deg C		
Display	Large backlit color LCD		
Current output 1	Isolated 4-20 mA; max. load 500 ohm		
Temp. current output 2	Isolated 4-20 mA; max. load 500 ohm		
Current output accuracy	+/-0.05 mA		
RS485	Modbus RTU standard protocol		
Communication rate	9600 / 19200 / 38400		
Relay contact rating	5 A / 250 VAC; 5 A / 30 VDC		
Cleaning	ON: 1-1000 s; OFF: 0.1-1000.0 h		
Multifunction relay	Cleaning / periodic alarm / error alarm		
Relay delay	0-120 s		
Data logging	500,000 records		
Language	Simplified Chinese / English		
USB (optional)	Download records and update software; USB drive up to 32 GB		
Protection rating	IP65		
Power	90-260 VAC; <7 W		
Installation	Panel / wall / pipe		
Weight	144 Series: 0.85 kg; 96 Series: 0.70 kg		

Instrument Installation

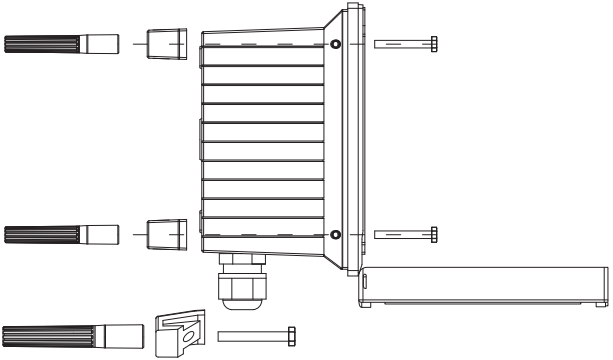
144 Series supports panel, pipe and wall mounting. For panel mounting, cut a 141 mm x 141 mm square opening, insert the instrument from the front, and secure the supplied brackets from behind the panel.



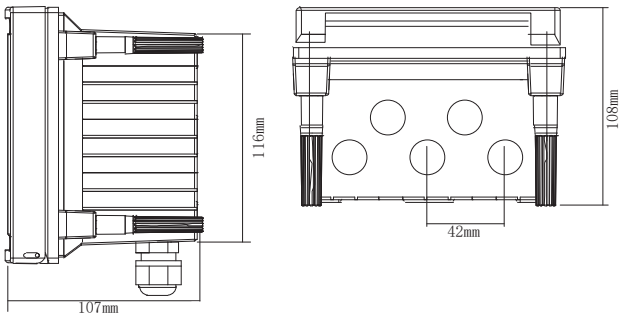
144 Series Opening Dimensions



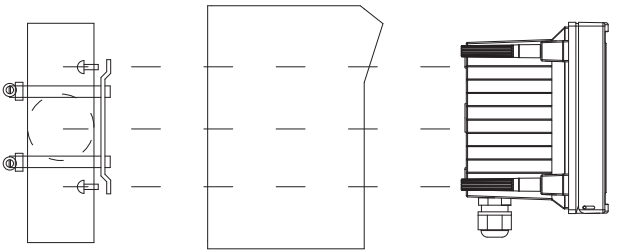
Panel Dimensions



144 Series Bracket Installation

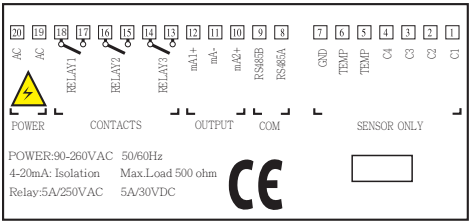


144 Series Dimensions

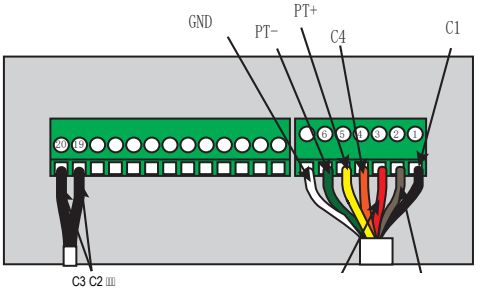


144 Series Wall and Pipe Mounting

144 Series

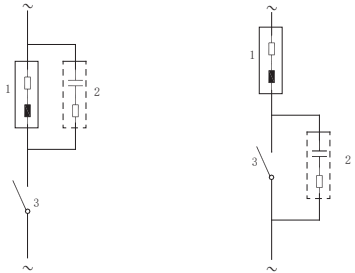


144 Series Electrode Wiring Diagram

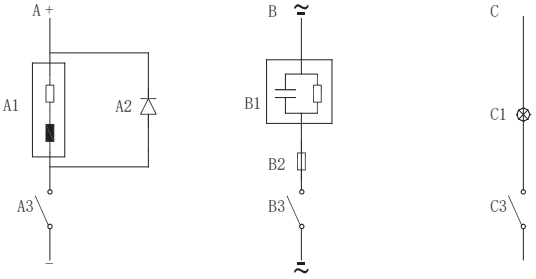


Relay Contact Protection Diagram

Sparking at relay contacts can shorten service life, especially with inductive or capacitive loads. Use an RC circuit to suppress sparks and arcing.



AC protection for inductive loads: 1. Load. 2. RC snubber for 220 VAC (R = 10 ohm, 1 W; C = 0.1 uF). 3. Relay contact.



A: DC protection: A1 inductive load, A2 1N4007, A3 relay contact. B: AC/DC protection: B1 capacitive load, B2 0.8 ohm / 1 W (at 24 VDC), B3 relay contact. C: Resistive load: C1 lamp, C3 relay contact.

Display Description

Display Example
NORMAL / ERROR
Main value = 0 uS
Unit = uS
Temperature = 25.0 deg C
Output A = 04.00 mA
Output B = 12.00 mA
Mode / date / time
R1 R2 R3

1. Status (NORMAL / ERROR). 2. Main display. 3. Unit. 4. Temperature and unit. 5-6. Current outputs 1 and 2. 7. Measurement mode, date and time. 8. Cycle/cleaning countdown; Delay appears when Relay 3 is delayed. 9. Temperature compensation. 10-12. Relay 1, 2 and 3 status.

If conductivity exceeds the positive/negative display range, the display shows 99.99 / 999.9 / 9999. If temperature exceeds its positive/negative range, it shows -99.9 / 999.9.

Key Description

Key	Measurement	Settings	Calibration	Records
MODE	Enter password	Exit	Exit	Exit
CAL	Enter calibration	Move digit	Move digit	Move digit
UP	View records	Increase value	Increase value	Increase value
DOWN	None	Decrease value	Decrease value	Decrease value
ENTER	Backlight on/off	Confirm	Confirm	Confirm

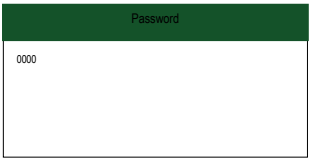
Hold Mode

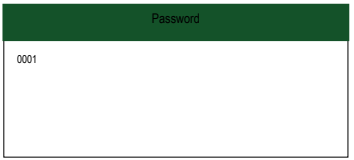
Hold mode is active during calibration, settings, record viewing and relay cleaning. All relays are open (inactive); current output follows the selected Fixed Current or Last Current setting; the displayed measurement is held.

After leaving these modes, hold mode remains active for about 10 seconds. It is also active for about 10 seconds after power-up. Fixed Current can be set from 4.00 to 20.00 mA. Last Current retains the last measured output current.

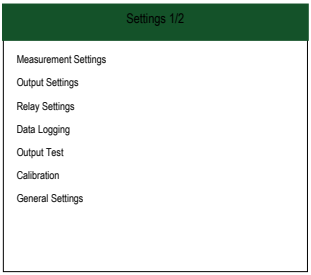
Settings

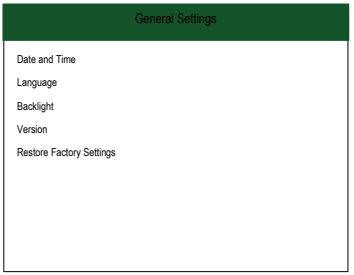
Press MODE, use UP/DOWN and SHIFT to enter password 0001, then press ENTER. MODE exits. After 10 minutes without a key press, the instrument returns to measurement mode.





Main Screen





Use UP/DOWN to select and ENTER to open a function. ENTER saves values. MODE exits. Out-of-range values show Error. After 10 minutes without a key press, the instrument returns to measurement mode.

Measurement Settings

Measurement Settings

Parameter Settings

Temperature Settings

Parameter Settings

Mode = Conductivity

Range = 2000 uS

Offset = +000 uS

Filter = 01

Select measurement mode with UP/DOWN, then press ENTER. Only conductivity has a range selection. Offset ranges: conductivity +/-1.000 uS / +/-10.0 uS / +/-100 uS / +/-1.00 mS / +/-10.00 mS / +/-100.0 mS / +/-100 mS; resistivity +/-1.00 Mohm; TDS +/-100 ppm. Filter range: 0-10. Increase filtering to stabilize readings, noting that response becomes slower.

Measurement Settings

Parameter Settings

Temperature Settings

Temperature Settings

Compensation = Manual

Probe = Pt1000

Offset = +0.0 deg C

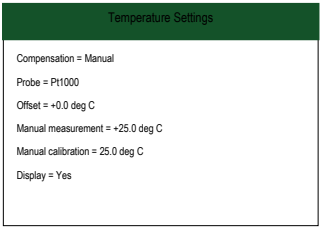
Manual measurement = +25.0 deg C

Manual calibration = 25.0 deg C

Display = Yes

Temperature Settings

1. Select automatic or manual temperature compensation.
2. Select the temperature probe type.
3. Temperature offset range: +/-5.00 deg C (automatic mode only).
4. Enter manual measurement temperature.
5. Enter manual calibration temperature.
6. Select whether temperature is displayed on the measurement screen.
7. In automatic mode, connect a functioning probe; otherwise temperature output may be incorrect.
8. Confirm that the connected probe type matches the selected type.
9. Manual measurement temperature is used for measurement compensation in manual mode.
10. Manual calibration temperature is used for calibration compensation in manual mode.



Output Settings

Output Settings

Current Output A

Current Output B

Communication

Current Output A - Conductivity

Mode = Conductivity

Output = 4-20 mA

4.00 mA = 0000 uS

20.00 mA = 2000 uS

Offset = +0.00 mA

Filter = 01 s

Hold = Fixed

Fixed current = 04.00 mA

Output Settings

Current Output A

Current Output B

Communication

Current Output A - Temperature

Mode = Temperature

4.00 mA = +000.0 deg C

20.00 mA = +100.0 deg C

Offset = +0.00 mA

Filter = 01 s

Hold = Fixed

Fixed current = 04.00 mA

For conductivity / resistivity / salinity / TDS, set the values at 4.00 and 20.00 mA. Minimum span: conductivity 1.00 / 10.0 / 100 (uS/mS), resistivity 1.00 Mohm, salinity 1.00 g/kg, TDS 100 ppm. Offset +/-1.00 mA; filter 0-120 s; hold Fixed or Last. Output after offset is limited to 3.50-22.00 mA.

Temperature output minimum span is 10 deg C; offset +/-1.00 mA; filter 0-120 s.

Output Settings

Output Settings

Current Output A

Current Output B

Communication

Current Output B - Temperature

Mode = Temperature

Output = 4-20 mA

4.00 mA = +000.0 deg C

20.00 mA = +100.0 deg C

Offset = +0.00 mA

Filter = 01 s

Hold = Fixed

Fixed current = 04.00 mA

Output Settings

Current Output A

Current Output B

Communication

Current Output B - Conductivity

4.00 mA = 0000 uS

20.00 mA = 2000 uS

Offset = +0.00 mA

Filter = 01 s

Hold = Fixed

Fixed current = 04.00 mA

Current Output B can be configured for temperature or conductivity-family measurement. Temperature minimum span: 10 deg C. For conductivity / resistivity / salinity / TDS, see the corresponding scale requirements. Offset +/-1.00 mA; filter 0-120 s; hold Fixed or Last. Output after offset: 3.50-22.00 mA.

Communication and Relay Settings

Communication Settings

Address = 001

Baud rate = 9600

Communication address: 1-255. Select the communication rate with UP/DOWN.

Relay A Settings

Status = Enabled

Action point = 1000 uS

Release point = 0010 uS

Delay = 000 s

Select Enabled/Disabled. Set the action and release points for conductivity / resistivity / salinity / TDS. Delay: 0-120 s after the action point is reached.

Relay Settings

Relay A

Relay B

Multifunction Relay

Relay 3 Settings

Status = Disabled

Cycle = 0001.0 h

Cleaning = 0010 s

Delay = 000 s

Function = Error Alarm

Relay Settings

Relay B Settings
Status = Enabled
Action point = 0010 uS
Release point = 1000 uS
Delay = 000 s

Set Enable/Disable, action point, release point and delay (0-120 s). Example: action at 10 uS/cm and release at 1000 uS/cm.

Multifunction Relay
Status = Disabled
Cycle = 0001.0 h
Cleaning = 0010 s
Delay = 000 s
Function = Error Alarm

Relay 3 functions: Cleaning, Periodic Alarm or Error Alarm. Cycle time: 0.1-1000.0 h; cleaning time: 1-1000 s; delay: 0-120 s.

Relay A/B action and release points may be configured for conductivity, resistivity, salinity or TDS. In the source examples, Relay A acts at 1000 uS/cm and releases at 10 uS/cm; Relay B acts at 10 uS/cm and releases at 1000 uS/cm.

Data Logging Settings

Data Logging Settings

Settings

View Records

Download Records

Parameters

Status = Off

Display = Record

Clear = No

Interval = 01 min

View Records

Enter starting record

Starting Record

000000

Press ENTER to view

Download Records

Insert USB drive

Download Records

Press ENTER to read data

Use UP/DOWN to select and ENTER to confirm. Logging interval: 1-60 minutes. Records can be displayed as a list (5 records per page) or graph (150 records per page). Insert a USB drive to download. 500,000 records take about 10 minutes; 50,000 take about 1 minute. Clearing all records takes about 10 seconds.

Recorded Data

Conductivity Records

24-01-14 1200 uS

25.0 deg C

21:20:49

...

Conductivity Graph

2000

1000

0000

150 records/page

Records are stored at the selected interval. Record view shows 5 entries per page; graph view shows 150 entries per page. Use UP/DOWN to select a starting record.

Output Test

Output Test

Current output A = 04.00 mA

Current output B = 04.00 mA

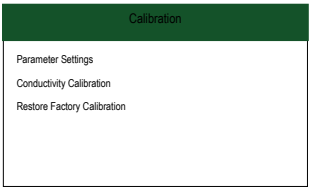
Relay A = Release

Relay B = Release

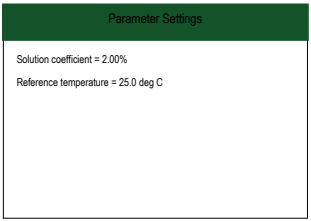
Multifunction relay = Release

1. Current output A: 4.00-20.00 mA. 2. Current output B: 4.00-20.00 mA. 3-4. Select Relay A/B with UP/DOWN. Use this function to test outputs and relays.

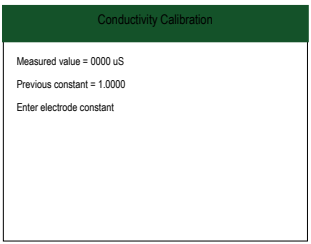
Calibration



Select a function with UP/DOWN and press ENTER. If the calculated cell constant differs from the electrode constant by more than 30%, replace the electrode.

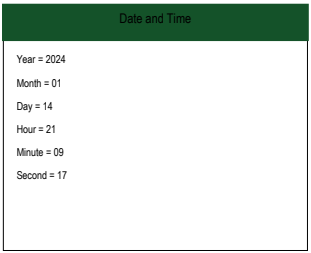


Enter solution temperature coefficient (0.01%-40.00%) and reference temperature (15-35 deg C). Conductivity is normally compensated to 25.0 deg C; change the reference temperature if required.



Place the electrode in a known standard solution. The measured conductivity is displayed. When stable, use UP/DOWN to enter the cell constant until the displayed conductivity matches the standard, then press ENTER to save. An error appears if the measured value exceeds the selected range or temperature is outside 0.0-60.0 deg C.

General Settings - Date and Time



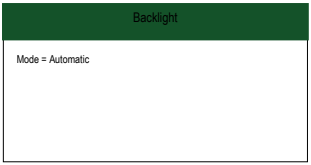
Set date and time with UP/DOWN. The clock is retained for about two days after power loss.

General Settings - Language



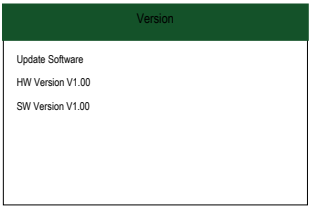
Sets the display language to Simplified Chinese.

General Settings - Backlight



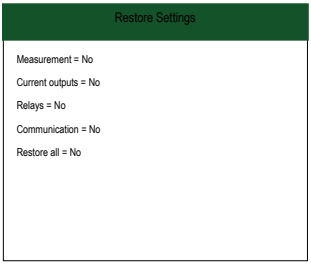
Select automatic backlight-off after 60 seconds or manual backlight.

Version



Displays current hardware/software versions. Insert a USB drive containing the update file and select Update Software; update takes about 30 seconds.

Restore Factory Settings



Select individual groups or Restore All. Language, backlight contrast, communication settings and measurement mode are not affected. Conductivity, resistivity, salinity and TDS calibration values are not affected.

Factory Default Values

Parameter	Default	Range / Options
EC 20 mA value	2000 uS/cm	100-2000
EC 4 mA value	0 uS/cm	0-1900; min span 100
RES 20 mA value	20.00 Mohm	1.00-20.00
RES 4 mA value	19.00 Mohm	0.00-19.00; min span 1.00
TDS 20 mA value	2000 ppm	100-133000
TDS 4 mA value	0 ppm	0-132900; min span 100
Temperature 20 mA value	100.0 deg C	0.0-130
Temperature 4 mA value	0.0 deg C	-10.0-120.0; min span 10.0
Current output 1 offset	0.00 mA	+/-1.00
Current output 2 offset	0.00 mA	+/-1.00
Current output 1 filter	1 s	0-120
Current output 2 filter	1 s	0-120
Current output 1 fixed current	4.00 mA	4.00-20.00
Current output 2 fixed current	4.00 mA	4.00-20.00
Current output 1 hold mode	Last	Fixed / Last
Current output 2 hold mode	Last	Fixed / Last
Relay 1 EC action / release	1000 / 10 uS/cm	0-2000; min gap 1
Relay 1 RES action / release	10.00 / 0.1 Mohm	0.00-20.00; min gap 0.01
Relay 1 TDS action / release	1000 / 10 ppm	0-133000; min gap 1
Relay 1 delay	0 s	0-120
Relay 2 EC action / release	10 / 1000 uS/cm	0-2000; min gap 1
Relay 2 RES action / release	0.1 / 10.00 Mohm	0.00-20.00; min gap 0.01
Relay 2 TDS action point	10 ppm	0-133000
Relay 1 TDS release point (as printed)	1000 ppm	0-133000
Relay 2 delay	0 s	0-120

Factory Default Values (continued)

Parameter	Default	Range / Options
Relay 3 cycle time	1 h	0.1-1000.0
Relay 3 cleaning time	10 s	1-1000
Relay 3 delay	0 s	0-120
Relay 3 function	Error Alarm	Cleaning / Periodic Alarm / Error Alarm
Logging interval	1 min	1-60
Communication ID	1	1-255
Communication rate	9600	9600 / 19200 / 38400
EC offset	0.00 uS/cm	+/-100
RES offset	0.00 Mohm.cm	+/-1.00
TDS offset	0.00 ppm	+/-100
Measurement mode	0-2000 uS/cm	see mode/range list in source
Temperature offset	0.0 deg C	+/-5.0
Manual measurement temperature	25.0 deg C	-10.0-130.0
Manual calibration temperature	25.0 deg C	0.0-60.0
Filter	1	0-10
Temperature compensation	Automatic	Automatic / Manual
Temperature probe	NTC30K	Pt1000 / NTC30K
Record display mode	Record	Record / Graph

Password: press MODE. SHIFT: user electrode calibration. 0001: function settings. After 10 minutes without a key press, the instrument exits and saves changed parameters.

Error Codes

Error 01	Memory error
Error 02	Measured value above maximum
Error 03	Measured value below minimum
Error 04	Temperature above maximum
Error 05	Temperature below minimum
Error 06	Current output 1 above 20.5 mA; maximum 22.00 mA
Error 07	Current output 1 below 3.8 mA; minimum 3.5 mA
Error 08	Current output 2 above 20.5 mA; maximum 22.00 mA
Error 09	Current output 2 below 3.8 mA; minimum 3.5 mA
Error 10	Data logger fault
Error 11	ADC fault
Error 12	Factory data missing

RS485 Communication

Modbus RTU protocol. Measurement values are floating-point numbers; other data are signed two-byte parameters (-32767 to 32767) represented in hexadecimal. Baud rate 9600 (fixed), 8 data bits, no parity, 1 stop bit. Function 03 reads settings; Function 04 reads measurements. Exception 01: unrecognized function; 02: invalid address; 03: invalid data quantity.

RS485 Communication

Reading 04 - Measurement Registers

Modbus RTU protocol. Measurement values are floating-point numbers; other data are signed two-byte values (-32767 to 32767) represented in hexadecimal, with the most significant bit as the sign bit.

Master Request Frame

Device ID	Function	Start address	Quantity	CRC16
Length	1 byte	1 byte	2 bytes	2 bytes
Example	0x01	0x03	0x0001 / 0x0001	0xD5CA

This example reads the first data item; refer to the register map.

Slave Response Frame

Device ID	Function	Byte count	Data	CRC16
Length	1 byte	1 byte	N bytes	2 bytes
Example	0x01	0x03 / 0x02	0x02 0xBC	0xB895

Baud rate: 9600 (fixed), 8 data bits, no parity, 1 stop bit. Function 03 reads setting values; Function 04 reads measured values. Exception 01: unrecognized function code. Exception 02: invalid address. Exception 03: invalid data quantity.

Dec	Hex	Register / Definition	Format
00	0x00	Model	Fixed M
01	0x01	Model	Fixed 2
02	0x02/0x03	Measured value	Float
04	0x04/0x05	(blank in source)	
06	0x06	Temperature	X0.1
07	0x07	Measurement current 1	X0.01
08	0x08	Measurement current 2	X0.01
09	0x09	Unit	X1
10	0x0A	(blank in source)	
11	0x0B	Error code	X1
12	0x0C	Status	X1

Function 03 - Current Output and Relay Registers

Dec	Hex	Register / Definition	Format
00	0x00	EC current 1, 20.00 mA value	X0.001/0.01/0. 1/1
01	0x01	EC current 1, 4.00 mA value	X0.001/0.01/0. 1/1
02	0x02	RES current 1, 20.00 mA value	X0.01
03	0x03	RES current 1, 4.00 mA value	X0.01
04	0x04	SAL current 1, 20.00 mA value	X0.01
05	0x05	SAL current 1, 4.00 mA value	X0.01
06	0x06	TDS current 1, 20.00 mA value	X1
07	0x07	TDS current 1, 4.00 mA value	X1
08	0x08	Temperature current 1, 20.00 mA value	X0.01
09	0x09	Temperature current 1, 4.00 mA value	X0.01
10	0x0A	EC current 2, 20.00 mA value	X0.001/0.01/0. 1/1
11	0x0B	EC current 2, 4.00 mA value	X0.001/0.01/0. 1/1
12	0x0C	RES current 2, 20.00 mA value	X0.01
13	0x0D	RES current 2, 4.00 mA value	X0.01
14	0x0E	SAL current 2, 20.00 mA value	X0.01
15	0x0F	SAL current 2, 4.00 mA value	X0.01
16	0x10	TDS current 2, 20.00 mA value	X1
17	0x11	TDS current 2, 4.00 mA value	X1
18	0x12	Temperature current 2, 20.00 mA value	X0.01
19	0x13	Temperature current 2, 4.00 mA value	X0.01
20	0x14	Current output 1 offset	X0.01
21	0x15	Current output 2 offset	X0.01
22	0x16	Current output 1 filter time	X1
23	0x17	Current output 2 filter time	X1
24	0x18	Current output 1 fixed current	X0.01
25	0x19	Current output 2 fixed current	X0.01
26	0x1A	Current output 1 hold mode (0 Fixed; 1 Last)	X1
27	0x1B	Current output 2 hold mode (0 Fixed; 1 Last)	X1

Function 03 - Registers (continued)

Dec	Hex	Register / Definition	Format
28	0x1C	Relay 1 EC action point	X0.001/0.01/0.1/1
29	0x1D	Relay 1 EC release point	X0.001/0.01/0.1/1
30	0x1E	Relay 1 RES action point	X0.01
31	0x1F	Relay 1 RES release point	X0.01
32	0x20	Relay 1 SAL action point	X0.01
33	0x21	Relay 1 SAL release point	X0.01
34	0x22	Relay 1 TDS action point	X1
35	0x23	Relay 1 TDS action point (source wording)	X1
36	0x24	Relay 1 delay time	X1
37	0x25	Relay 2 EC action point	X0.001/0.01/0.1/1
38	0x26	Relay 2 EC release point	X0.001/0.01/0.1/1
39	0x27	Relay 2 RES action point	X0.01
40	0x28	Relay 2 RES release point	X0.01
41	0x29	Relay 2 SAL action point	X0.01
42	0x2A	Relay 2 SAL release point	X0.01
43	0x2B	Relay 2 TDS action point	X1
44	0x2C	Relay 2 TDS release point	X1
45	0x2D	Relay 2 delay time	X1
46	0x2E	Relay 3 cycle time	X0.1
47	0x2F	Relay 3 cleaning time	X1
48	0x30	Relay 3 delay time	X1
49	0x31	Relay 3 function (0 Cleaning; 1 Periodic Alarm; 2 Error Alarm)	X1
50	0x32	Record storage interval	X1
51	0x33	EC offset	X0.001/0.01/0.1/1
52	0x34	RES offset	X0.01
53	0x35	SAL offset	X0.01
54	0x36	TDS offset	X1
55	0x37	Temperature offset	X0.1
56	0x38	Language selection (0 Chinese)	X1
57	0x39	Filter	X1
58	0x3A	Solution temperature coefficient (0.01%-40.00%)	X0.01
59	0x3B	Reference temperature (15.0-35.0 deg C)	X0.1
60	0x3C	Measurement mode (0 EC; 1 RES; 2 SAL; 3 TDS)	X1
61	0x3D	EC measurement range: 0=20.000 uS; 1=20.00 uS; 2=200.0 uS; 3=2000 uS; 4=20.00 mS; 5=200.0 mS; 6=2000 mS	X1
62	0x3E	Manual measurement temperature	X0.1
63	0x3F	Manual calibration temperature	X0.1
64	0x40	Temperature compensation (0 Auto; 1 Manual)	X1
65	0x41	Probe type (0 Pt1000; 1 NTC30K)	X1