Operating Instructions for **MT-CRC-8850** Conductivity / Resistivity Controller

Warning!

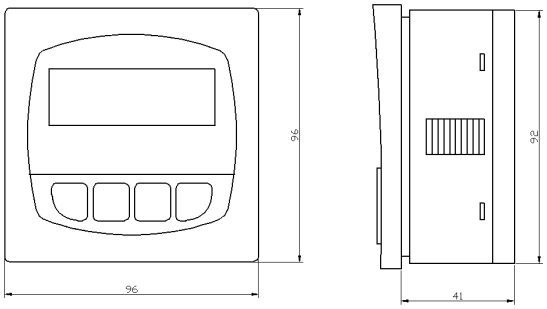
1. Cut off the power supply when connecting the input and output terminals.
2. Read the following instructions carefully and take precautions to prevent any possible personal injury.

Contents

1. Installation

1.1 Installation of the instrument panel.

1. This instrument needs a hole of **92 x 92mm**.
2. Press the back of the instrument with the mounting bracket until the quick-fixed card lock the grooves on the two sides of the instrument.
3. When removing the instrument, it is necessary to fix the instrument temporarily with adhesive tapes or hold the back of the instrument firmly in order to prevent the instrument from falling down. Pull the quick-fixed cards outwardly and draw out the instrument.



2. Product Specifications

General introduction

Compatible sensor: Standard type of conductivity / resistivity detector

Accuracy: reading**±2%**

The housing box for packing

- Protection grade: **IP65**, front
- Material of the shell: **ABS**
- Screen: synthetic polyester
- Keys: **4** encapsulated silicone keys
- Weight: about **225g**

Display:

- LCD display with backlight, **LCD 2x16** bit
- Contrast: defined by users, **5** levels
- Refresh rate: **3s**

Electrical performance

- Power: **18-36V DC**

Input range of the sensor

- Conductivity: **0.055-400,000uS**
- Resistivity: **10kΩ-18.25MΩ**

(The temperature of the test medium should be kept within the range of 0-100℃ when testing the resistivity.)

- TDS: **0.023-200,000ppm**
- Temperature: **PT1000, -25-125℃**

Current Output Signal

- **4-20mA**, isolated, transportable
  Maximum impedance of the loop: **600Ω MAX@24V**
- Refresh rate: **3S**
- Accuracy: **±0.03mA@25℃, 24V**

Control output signals

- Operating mode: **Hi/Lo/off** (normally open contact)
- Capacity of the relay contact:
  2A/250V AC (resistive load);
  2A/28V DC (resistive load)

Pulse Output Signal

- Output signal of the open collector, optical isolation
- The maximum pull-down current is **50mA** and the maximum pull-up voltage is **30VDC.**
- Pulse modes (maximum pulse rate: **400p/m**)

485 communication output signal

- Optional baud rate: **2400, 4800, 9600**

Specifications and dimension

- Overall dimension: **96x96x46mm** (height x width x depth)
- The dimension of the hole: **92x92mm** (height x width)

Environmental conditions

- Working temperature: **-10~70℃**
- Storage temperature: **-15~80℃**
- Relative humidity: **0~95%**, no dew point
- Insulation grade: **II**

3. Electrical connection

Caution: The instrument would be permanently damaged if the terminal sockets were not fully open before removal of wiring.

Wiring Procedures

1. Strip 13-16mm of insulating layer at one end of the conductive wire.
2. Press the orange terminal rod with a small screwdriver in order to open the terminal socket.

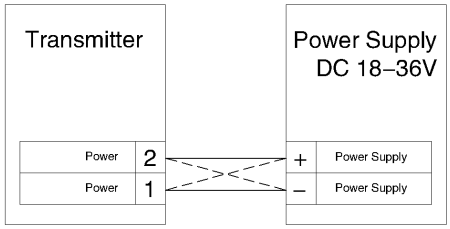
3. Insert the bare conductor (without insulating layer) into the terminal socket until the conductor reaches the bottom of the socket.
4. 4. Release the orange terminal rod and then fix the conductor with clips. Draw the conductor gently so as to ensure that the conductor is well–connected.

Procedures for removal of wiring

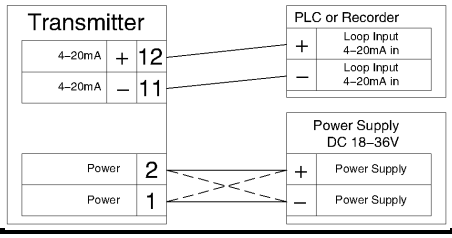
1. Press the orange terminal rod with a small screwdriver in order to open the terminal socket.
2. 2. Pull out the conductor from the fully open terminal socket.

3.1 System power supply / current circuit wiring

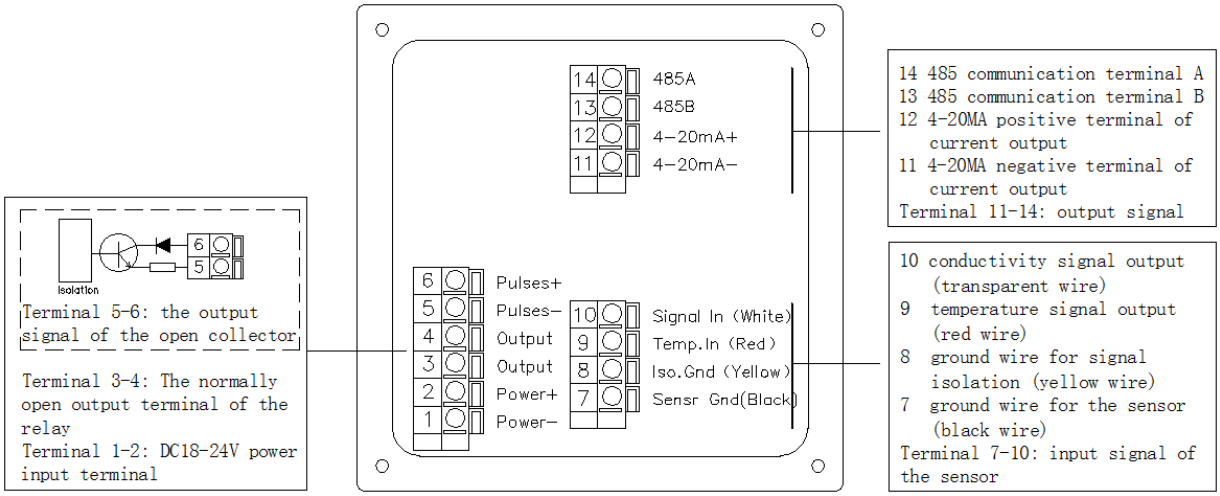
Application of a single standard function, without current signal output.



Connected with PLC/recorder with built-in power supply, independent power supply



3.2 Sensor input connection



Wiring instructions:

- The cables for the sensor and the AC cables cannot be laid in the same cable conduit as electronic noise can disturb the signals of the sensor.
- To lay the cables in the grounded metallic cable conduit is conductive to prevent electronic noise and mechanical damage.
- Seal the entrances of the cables in order to protect the cables from being damaged by humidity.
- Insert one conductor into each terminal socket. If two conductors need to be inserted in the same terminal socket, it is necessary to connect the two conductors and the terminal outside the terminal socket.

Choose the sensor with a proper measuring range according to the maximum and minimum values in the process flow:

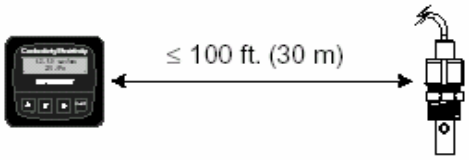
0.01-0.05 cell：0.055~100uS（10kΩ~18MΩ) 0.01-0.05 cell sensor is applicable for all kinds of resistivity test.

0.1 cell：1~1000uS

1.0 cell：10~10,000uS

10.0 cell：100~200,000uS

20.0 cell：200~400,000uS



3.3 Relay output signal

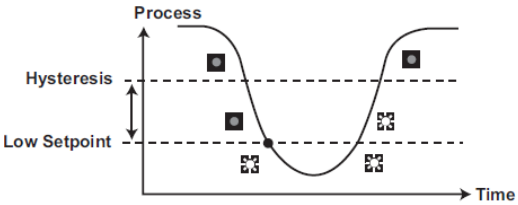
Caution: The control of external equipments must be connected to intermediate relays.

- Low

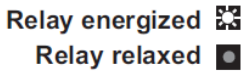
When the process variable is lower than the set value, the output switch of the relay should be closed. When the process variable is higher than the set value plus the return difference, the output switch of the relay should be open.

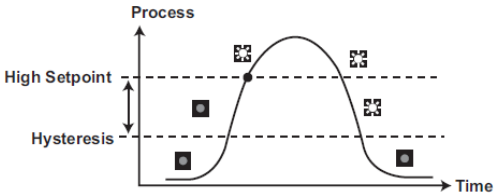
- High

When the process variable is higher than the set value, the output switch of the relay should be closed. When the process variable is lower than the set value plus the return difference, the output switch of the relay should be open.



The lower limit





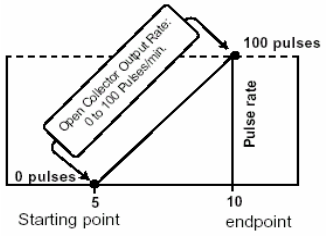
The higher limit

3.3 Proportional pulse output signal of the open collector.

- Proportional pulse

The open collector will send out proportional pulse signals with a width of 100ms according to the pulse rate set in the CALIBRATE menu.

See the following examples:



- When the measured value is below 5.0, the output signal is 0p/m.
- When the measured value is 7.5, the output signal is 50p/m.
- When the measured value reaches 10 or above, the output signal is 100p/m.

Set the maximum pulse rate and the starting and end points in the CALIBRATE menu.

The VIEW Menu

- During normal operation, the instrument displays VIEW menu.
- When using CALIBRATE menu or OPTIONS menu, if no key is pressed for over ten minutes, the instrument will automatically return to VIEW menu.
- Press the Up and Down arrow keys to have different contents displayed. The display options are continuous and can be repeatedly displayed.
- Changing the display options will not interrupt the normal operation of the system.
- No password is needed to change the display options.
- Output settings cannot be edited in the VIEW menu.

The VIEW menu

Displayed content	Description
123.45uS/cm +67.89 ℃	Display the conductivity and temperature values input by the sensor. This is a permanent display format.

The following items are displayed temporarily and the system will return to the permanent display items 10 minutes later.

Loop Output 13.75 mA	Display a current output value of 4-20mA.

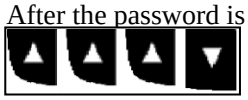
Procedures for editing the instrument

Step 1: keep pressing the **ENTER** key:

- Keep pressing the **ENTER** key for 2 seconds, and the system will enter into **CALIBRATE menu**.
- Keep pressing the **ENTER** key for 5 seconds, and the system will enter into **OPTIONS menu**.

Step 2: Press the Up-Up-Up-Down arrow keys according to the sequence of the password.

- After the password is typed in, the first item of the selected menu option will be Displayed.



Step 3: Drag the menu by pressing the Up or Down key.

- Press the Up or Down arrow key to exit the menu and return to measurement status.

Step 4: Choose the menu option to be edited by pressing the Right arrow key.

- The first bit of the displayed content starts to flicker.

Step 5: Press the Up or Down arrow key to edit at the flicker bit.

- Press the Right arrow key to move the flicker bit forward.
- Press the Up or Down arrow key to return to the previous menu.

Step 6: Press the **ENTER** key to save the new settings and then return to Step **3**.

The CALIBRATE Menu

Displayed content (the content are the factory settings)	Description
Cell: Custom 1.0000 >	For a sensor, it is necessary to check the quality certificate or the labels attached to the sensor; Type in the correct cell constant.
Cond Units: uS >	Choose correct units for the measured values: uS, mS, ppm, kΩ, MΩ.
Set: Temperature >	Adjust the measured temperature values of the system according to the accurate external reference values.
Set: Conductivity >	For a sensor, completion of this single-point wet calibration will lead to the most accurate measurement result. When all the input values are “zero”, the “TEMP” value and the “COND” value will be restored to factory settings.
Loop Source: Cond >	Choose the source signal that is corresponding to the current output signal: conductivity value and temperature value.
Loop Range: uS 0.0000→100.000 >	Set the minimum and the maximum physical values (4mA and 20mA respectively) that are corresponding to the current output signal. When changing the unit of the conductivity, it is necessary to make sure that settings in this item are modified accordingly.
Output Source: Cond >	Choose the source signal that is corresponding to the relay output signal: conductivity value or temperature value.
Output Mode: Off >	Choose either a “High” or “Low” working model for the relay. If the above “High” and “Low” functions are not needed, the working model can be turned to “Off”.
Output Setpnt: 10.0000 uS >	Under “Low” or "High” model, if the process variable reaches the set value, the output signal of the relay will be excited. When changing the unit for the conductivity value, it is necessary to make sure that settings in this item are modified accordingly.
Output Hys: 0.5000 uS >	When the measured value reaches the set value ± the return difference value, the output signal of the relay will be reset. Choosing“+” or “-” depends on whether the relay is under “High” or "Low” working models. (See page 3 for more details.)
Pules Source: Cond >	Choose the source signal that is corresponding to the proportional pulse output signal: conductivity value or temperature value.
Pules Range: uS 0.0000→100.000 >	Under the “Pulse” working model, it is necessary to set the starting point, end point and the maximum pulse rate that are corresponding to the pulse signals. When the unit of the conductivity value is changed, it is necessary to make sure that settings in this item are modified accordingly.
Output PlsRate: 120 Pulses/Min >	Under the “Pulse” working model, it is necessary to set the maximum pulse rate of the proportional pulse signal. MT-CRC-8850 can accept the values within the range of 0~400.
RS485 Source: Cond >	Choose the source signal that is corresponding to the RS485 communication output signals: conductivity value or temperature value.
RS485 Baud Rate: 4800 >	Choose RS485 communication baud rate: 2400, 4800, or 9600.

The OPTIONS Menu

Displayed content (the content are the factory settings)	Description
Contrast: 3 >	Adjust the display contrast of the LCD in order to get the best visual effects. Level 1 is the relatively lower contrast while Level 5 is the relatively higher contrast. In relatively hot environment, it is better to choose the relatively lower contrast level.
Cond Decimal: * * * *. * >	Set the optimal output resolution according to the specific application. The display value will be displayed automatically according to the above setting. The resolution should be *****; ****.*; ***.**; **.*** or *.****.
Temperature Comp %: 2.00 >	Each 1℃ of temperature change will lead to conductivity change. The percentage of the conductivity change should be within the range of 0.00~10.00%.
PPM Factor: 2.00 >	If the unit of the measured values is PPM, it is necessary to set the proportion between the total amount of dissolved solid and "uS". (See page 7 for more details.) TDS parameters can only adopt PPM as the unit.
Comeback Factory Set: >	Use this function with caution. If you choose "yes", the instrument will resume its initial data, so that you need to re-calibrate the instrument. Therefore, we do not recommend the users to use this function.
Averaging: Off >	"OFF" is most responsive to the changes of the process variables. If there are frequent or large fluctuations, you may choose the deferred response time of 3s, 6s, 9s,…, 30s. The longest deferred response time is 30s.

Calibration Procedures

Electrical calibration for an instrument should be done in the factory.

- Procedure A: Verify the accuracy and linearity of an instrument with accurate (±0.1%) fixed-resistor-simulated temperature and conductivity values.
- Procedure B: Wet calibration process. This procedure needs the sensor input signals and NIST traceable test liquid. Correct operation will result in the most accurate system calibration.

A) Conduct precision calibration with an accurate resistor. (Electronic calibration).

1. Simulated temperature value

The temperature input signal of Model 8850 is the thermal resistance value of PT-1000. The temperature of ℃ is corresponding to the resistance of 1000Ω. Each ℃ of temperature change will lead to 3.84Ω of resistance change. (1000Ω＝0℃, 1003.84Ω=1.0℃, 1007.68Ω＝2.0℃ ····· 1096Ω=25℃)

- A resistor should be arranged between the "Temp" and the "Iso. Gnd" terminals. (1000~1096Ω)
- In the "Set Temp" item under the CALIBRATION menu: Adjust the accurate temperature values according to the measured resistance values. (See the editing procedure in the CALIBRATION menu.)
- Another different resistor should be arranged between the above two terminals in order to calibrate the linearity of the temperature measurement.
- If the instrument displays incorrect values, it is necessary to be repaired. (±1℃).

2. Simulated conductivity value

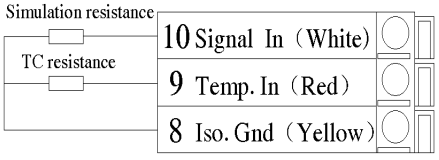
Accurate resistance value that is used for simulating a specific conductivity value can be worked out. Conductivity value can be calculated according to a specific resistance value.

$$\text{Resistance value} = \frac{\text{Conductance constant}}{\text{Conductivity value (Siemens*)}} \qquad \text{Example: } \frac{0.1\text{Cell}}{0.000020\text{ (Siemens*)}} = 5{,}000\Omega \text{ or } 5\text{k}\Omega$$

$$\text{Conductivity value} = \frac{\text{Conductance constant}}{\text{Simulated resistance value } (\Omega)} \qquad \text{Example: } \frac{0.1\text{Cell}}{100{,}000(\Omega)} = 0.000001\text{Siemens*or } 1\text{uS/cm}$$

(*1uS=1x10^{-6} Siemens or 0.000001Siemens)

- A resistor for simulating the conductivity value should be arranged between the "Signal IN" and "Iso Gnd" terminals.
- In the "Set Cond" option under the CALIBRATE menu: Adjust the accurate conductivity values according to the resistance values. (See the editing procedure in the CALIBRATE menu.)
- Arrange another resistor with different values for verifying the linearity of the conductivity measurement of the instrument.
- If the instrument displays incorrect values (reading±2%), it needs to be repaired.



B) Conduct wet calibration with **NIST** traceable test liquid.
When conducting wet calibration with NIST traceable test liquid, it is necessary to check the temperature information of the test liquid. Do not contaminate the test liquid. The sensor must be in the temperature conditions indicated on the test liquid labels.

- Remove the sensor from the system and then wash the sensor with a small amount of test liquid.
- Put the sensor into the test liquid.
- Put the reference thermometer in the same test liquid in which the sensor is put.
- Wait for a certain period of time to let the temperature signal become stable.
- In the "Set Temp" option under the CALIBRATE menu: adjust the displayed temperature value according to the value of the reference thermometer. (See the editing procedure for more details.)
- In the "Set Cond" option under the CALIBRATE menu: Adjust the displayed conductivity value according to the conductivity value of the test liquid. (See the editing procedure for more details.)
- Put the sensor into another kind of test liquid with a different conductivity value in order to verify the linearity.
- If the instrument displays the incorrect values (For temperature: ±1℃; and for conductivity value: ±2%), it should be repaired.

Temperature Coefficient

The measurement of conductivity is in close relation with temperature. The effects of the temperature can be presented by the conductivity variation with each℃ of temperature change. Generally, 25℃ is regarded as the reference temperature. The changes of conductivity values caused by each℃ of temperature change should be represented by percentage or the changes in slope.
According to the types of the process solutions, slop will change dramatically. The default value of the temperature compensation is 2.00%/℃. Some process flows require necessary adjustment in order to acquire the optimal accuracy. The procedure for determining the optimal temperature compensation coefficient is as follows:

1. Change all the input values into "Zero" in order to invalidate the temperature compensation coefficient in 8850 factory settings.
2. Heat the sample of the solution until its temperature is close to the maximum value of the process temperature. Put the sensor into the solution sample and then wait for several minutes in order to make the temperature signal become stable. Fill in the following blanks with the displayed temperature and conductivity values in the VIEW menu:
   The displayed temperature: T1=_____℃; the displayed conductivity value: C1=_____uS
   (When the conductivity value of the solution is within the range of 0.055uS~0.1uS (the resistivity is within 10 MΩ~18MΩ), this process is not applicable. In this case the internal pure water curve is applicable and 2.00%/℃ can be regarded as the default value.)
3. Cool the solution until its temperature is close to the minimum value of the process temperature. Put the sensor into the solution sample and wait for several minutes to allow the temperature signal become stable. Fill in the following blanks with the displayed temperature and conductivity values:
   The displayed temperature: T2=_____℃; the displayed conductivity value: C2=_____uS
   (It is recommended that the conductivity values in Steps 2 and 3 should have a variation of 10%.)
4. Substitute the values recorded in Steps 2 and 3 into the following formula:

$$\text{TC Slope} = \frac{100 \times (C1 - C2)}{(C2 \times (T1 - 25)) - (C1 \times (T2 - 25))}$$

Example: if the conductivity of the solution sample is 205uS@48℃, when it is cooled, its conductivity will be reduced to 150uS@23℃. (C1=205, T1=48, C2=150, T2=23)
TC can be calculated according to the following formula:

$$\text{TC Slope} = \frac{100 \times (205 - 150)}{(150 \times (48 - 25)) - (205 \times (23 - 25))} = \frac{5500}{3860} = 1.42\%\ /℃$$

PPM (Parts Per Million) Coefficient

This coefficient is only required when the PPM display unit is chosen. The PPM coefficient is programmable within the range of 0.01~3.00. (The default value set in the factory = 2.00)
The optimal PPM coefficient can be determined by calculating the conductivity value of the solution and the total amount of the dissolved solid.

$$\text{PPM Coefficient} = \frac{\text{Conductivity of the solution (uS/cm)}}{\text{Total amount of dissolved solid}} \qquad \text{TDS (PPM)} = \frac{\text{PPM Coefficient}}{\text{Conductivity of the solution (uS/cm)}}$$

Example: The conductivity of the solution = 400uS/cm; TDS=200PPM (mg/L);

PPM Coefficient = 400uS/200PPM = 2.00

Troubleshooting

Displayed content	The possible causes	The recommended solutions
————	It displays the over range. When the process variation is close to or equal to the limit value of the sensor range, this shows that the instrument is in normal condition.	■ Check the CALIBRATE menu to see whether the cell constant is correct. ■ Check the CALIBRATE menu to see whether the unit setting is correct.
Value must be less than 3	PPM Coefficient must be within the range of 0.00~3.00.	Set a PPM coefficient below 3.
Value must be 400 or less	The pulse rate should not exceed 400.	Set a pulse rate below 400.
Too much Error CHECK SENSOR	■ The sensor is damaged or dirty. ■ Wiring error. ■ The temperature elements are damaged.	■ Clean or replace the damaged sensor. ■ Check whether wiring is correct. ■ Replace the sensor.

Technical instructions:

A： If the current output signal is locked at 0mA, please check the “Loop Range” option under the **CALIBRATE** menu so as to check whether the display value of the instrument exceeds the corresponding option.

B： If the pulse output signal is always locked at 0Pulse, please check the “Pulse Range” option under the **CALIBRATE** menu to see whether the display value of the instrument exceeds the corresponding option.