LED Loop Powered Display for HiQDTmA Loop Powered Sensors

Complete field assembly is shown above including the HiQDTmA loop powered dual analog/digital mode sensor (on left) connected to LED loop powered display (in center) and Handheld Communicator (HHC, on right) which is used to perform configuration and calibration functions in the field. The required bridging adapter accessory to use the HHC is shown connected to the right port.

- *The gray cable shown to center is the 24VDC power from PLC that energizes both the loop powered LED display and sensor.*
- ***LED display assembly includes integral passive isolation for current loop so that no external isolator is required even if the loop powered sensor employed is non-isolated.***
- *See wiring schematic for LED loop powered display installation type on subsequent pages for further details.*
- ***Please refer to separate handheld communicator for use with HiQDTmA loop powered sensor documentation for details on how to use that device to implement various tasks described throughout this document.***

Typical Workflow

1. HiQDTmA sensors come factory precalibrated with pH buffers & 4-20mA output default scaled to 0-14 pH. The sensors can be re-calibrated prior to installation and/or the scaling can be modified, if desired.
2. Install the sensor in the field and connect to the facility's PLC, DCS, or SCADA system. Connecting to the loop powered display completes the circuit and powers the sensor. If readings on connected PLC do not match expected values, perform analog trim adjustments on PLC using HHC to simulate 4mA and 20mA states. If analog input trim adjustments are not supported on connected PLC, the analog trim adjustments can instead be performed on mA output signal from sensor using HHC. **Instructions provided on pages 7 & 8 on how to scale and simulate 4/20mA output as well as to perform analog trim output adjustments. Analog output mode is accessed from 'Special' LED while holding down both 'Up' & 'Down' buttons.**
3. If the reading on the loop powered display does not agree with values on PLC and HHC, the analog trim adjustment feature on the display may be used to create agreement between all devices on current loop.
4. For offset adjustments, connect the HHC to adjust readings as needed based on grab sample analysis from the installation. The analog output hold feature does not need to be enabled for in-situ calibrations.
5. When performing pH buffer calibrations or cleaning with sensor connected to PLC, **the analog output can be placed on hold prior to removing the sensor from process directly from 'Sensor Type' LED mode.**
6. Best workflow can be achieved with plug and play hot-swap of previously cleaned and calibrated HiQDTmA sensors, avoiding the need to clean and re-calibrate sensors in the field.

Typical HiQDTmA Installation Scheme with LED Loop Powered Display

Complete field assembly is shown including an HiQDTmA loop powered dual analog/digital mode sensor (on left) connected to an LED loop powered display with optional programmable relays (center) and Handheld Communicator (HHC, on right) to perform configuration and calibration.

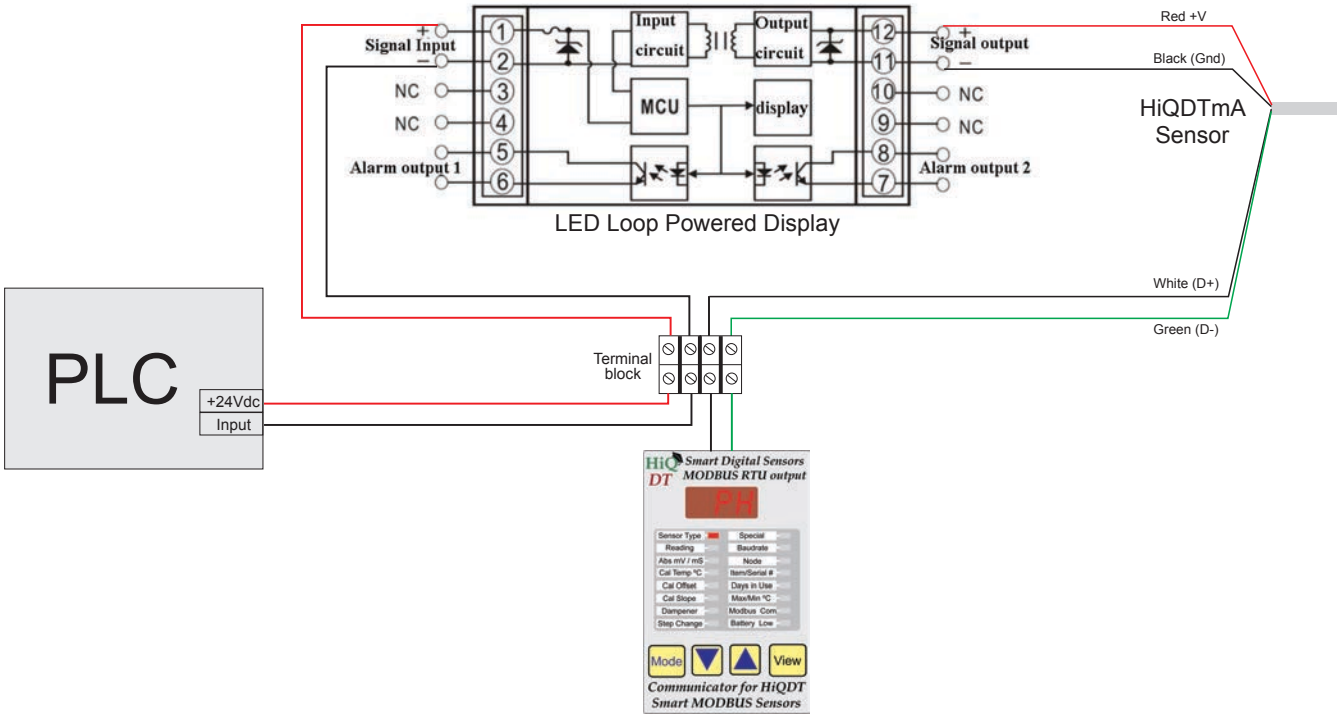
The gray cable (not included) is the 24VDC power from the PLC to energize both loop powered LED display and loop powered sensor. See the wiring schematic on next page for further details.

There are 4 access points on the bottom of assembly:

1. *Port on top row left accepts loop powered sensor*
2. *Port on top row right is used for the HHC.*
3. *Port on bottom row left cable gland is used for 24VDC loop power from the connected PLC.*
4. *Bottom row right cable gland only used when relay are employed; otherwise, a sealing boot must be affixed to keep NEMA 4X rating.*

Bridging adapter for handheld communicator is shown connected to top right port. When top left or right port are not in use the sealing caps are affixed. Assembly is NEMA 4X rated when fully installed. All connectors are NEMA 6P rated when interfaced. Assembly includes mounting hardware for wall, plate or pipe installation. The wall mounting style hardware is shown in the picture above.

Typical HiQDTmA Wiring Schematic with LED Loop Powered Display



- **All connections prewired at the factory and internal to loop powered display assy. Wiring schematic is reference only in case of accidental disconnection of leads. Power cable from PLC is not included.**

- When the dual analog/ digital mode HiQDTmA sensor is connected, it completes the current loop and the LED loop powered display is energized, showing the current process value based upon scaling set and present sensor reading.

- The HHC can perform changes such as scaling the current loop or performing an in-situ offset calibration. If the sensor is removed from process for calibrations with pH buffers, the analog output may be placed on hold with the HHC to avoid disruptions to any connected closed loop control systems.

- Scaling of analog output can be as little as 1pH unit between 4mA & 20mA set-points. Output is reversible, so it can be non-inverted (standard) or inverted (optional).

- For best agreement on the data acquisition device, reduce scaling to the narrowest possible range and perform an in-situ 4mA trim offset and 20mA trim span calibration at the process temp.

- The HiQDTmA sensor will operate in 1 of 3 modes, determined by operating voltage at startup:
  - Loop powered pH sensor with no digital communications (analog only mode)
  - Both a loop powered pH sensor and smart digital sensor (dual analog and digital mode)
  - A smart digital sensor only (digital only mode).

LED Loop Powered Display and Isolator for HiQDTmA Sensors

Features	Applications
• Local display of HiQDTmA sensor value from current loop • 3½ bit LED digital display, high precision, display ±2 bytes • Programmable upper and lower isolated alarm relays • 4-20mA isolated detection with high precision grade • High linearity in full measuring range, nonlinearity < 0.2% • High 3KVDC isolation between signal input and output • Voltage drop <6.5V excluding external power consumption. • 35mm DIN-RAIL mountable form factor, factory pre-installed into NEMA 4X assembly ready for immediate field mounting • Operating temperature range: - 25 ℃ to + 70 ℃	• **Galvanic isolation makes this device ideal for use with non-isolated type HiQDTmA loop powered sensors.** • Connection ports for HiQDTmA loop powered sensors, handheld communicator (HHC), loop powered from facility and (optional) programmable dry contact relays • Channel to channel isolation among signal input channels to connected PLC, DCS, etc. • Ground loop interference suppression in control loop • Stable transmission between instrument signal and sensor • Display for industrial measurement & control application with loop powered device in a safe non-hazardous location

Introduction

Current Loop Signal Intelligent LED Digital Meter adopts low power consumption current loop circuits and electricity stealing technology, which has the following functions: display, alarm, isolated transmission. The product consists of current signal modulation and demodulation circuits, signal coupling isolated conversion circuits, display and alarm controlling circuits. The small input equivalent resistance used achieves the voltage input range which meets the various user various requirements in signal isolation, display, alarm, long-distance transmission without distortion in passive mode. Internal integration and new isolation technologies enable the device to reach 3KVDC insulation voltage and meet industrial grade temperature, humidity, shake harsh environmental requirements. LED loop powered display series are easy to use, standard DIN35 rail mounting design, convenient for users to install and use. **The product achieves 4-20mA current loop signal isolation, display and control functions without external power supply and other components.**

LED loop powered display assembly has a variety of functions which are different from that of the traditional products by adopting intelligent design. It is a kind of passive products which can transmit and isolate the 4-20mA signal in the current loop, and display it correspondingly in decimal figures based on the set range. Two-wire passive operating mode, without external power supply, so it is easy to do wiring and has small size, high precision, low cost. Traditional digital meter adopts potentiometer adjustment technology, it is not flexible in adjustment and easy to be influenced by temperature. That intelligent digital meter has two adjusting buttons, which controlled by the central processor CPU, can be used to set zero, span, a decimal point, alarm, time delay and other parameters, so it has strong flexibility in application. The digital panel meter adopts LED display panel, constant current drive, it has good performance in display and has anti-reverse, over-current protection function. The digital meter is widely used in industry control, petroleum chemical industry, environmental protection, mining and other controlling devices on electrochemical liquid measurements.

LED Loop Powered Display assembly is mainly used for signal isolation and display on 4-20mA current loop signal from sensors, PLC, DCS. The embedded digital meter is used to measure 4-20mA signal by taking power directly from 4-20mA current loop without external power supply. The figure displayed is not the current value measured, but the 4mA, 20mA pre-configured value which display in linearity accordingly. For example: 4mA is default set to 0.00 and 20mA is default set to 14.00. When the input is 8mA, the meter displays 3.50; when the input is 12mA, the meter displays 7.00; when the input is 16mA, the meter displays 10.50. The maximum display range is -1,999 to +1,999 as defined by 3½ bit limit or any decimal point shifted equivalent thereof (i.e. -1.999 to +1.999 and so forth). The digital meter also has alarm function and two-channel switch signal output which can display, control signals and alarm simultaneously. The digital meter has two alarm points, and there are positive and negative alarm setting. Alarm point is for the figure displayed in the meter, when there is alarm, the last decimal point in LED panel meter will flash, and alarm information is transferred into alarm signal through digital optical coupling isolation. For the digital meters with alarm function, the alarm upper limit and lower limit, alarming methods can be set through programmer, refer to *Calibration Instructions* for meters below.

General Parameters

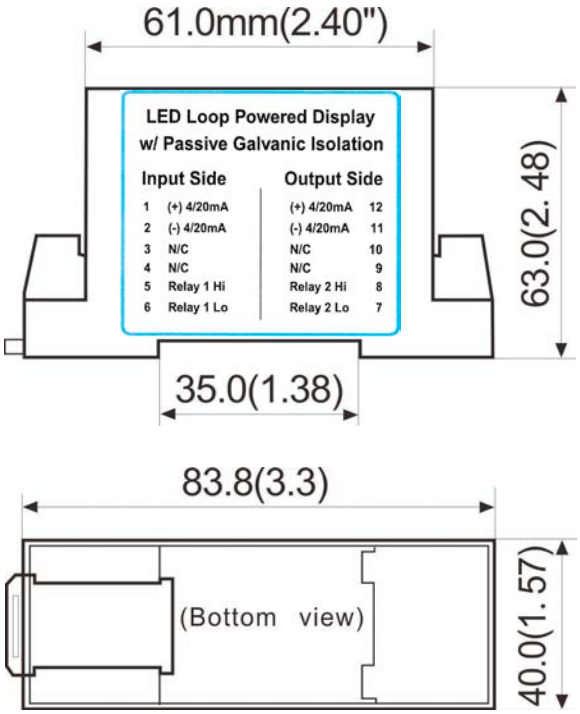
Precision, linearity error grade ------- - 0.1, 0.2	Backlash ---------- < 0.5%
Auxiliary power---------No	Isolation---------- Signal input and output
Operating temp---------- -25 to +75 ℃	Insulation resistance ---------- ≥20MΩ
Operating humidity ------10 ~ 90% (no condensation)	Withstanding volt ----------3KV (60HZ / S), Leakage current 1mA
Storage Temp---------- -25 to +75 ℃	Anti-impulse voltage --------- 3KV,1.2/50us (peak value)
Storage humidity----------10 ~ 95% (no condensation)	

Technical Parameters

Parameters	Testing Conditions	Min.	Typical Value	Max.	Unit
Isolation Volt. DC, 50Hz	10S	3000			VDC
Insulation Resistance			10^{12}‖1		Ω‖Pf
Leakage Current	240Vrms, 60Hz		0.5		uA
Temp.drift			±50	±100	PPm/℃
Non-linearity			±0.2	±0.5	%FSK
Input Signal Voltage Range		12		36	V
Input Impedance	20mA		330R+RL		Ω
Input Overload Capacity			22	24	mA
Output Overload Capacity			300	500	Ω
Output Linearity Range		0.05	4	20	mA
Output Current Io			20	40	mA
Output Voltage Drop Voh	Io=20mA			6.5	V
Output Ripple				5	mV
Response Time			20	50	mS
Frequency Response (small signal bandwidth)	Io=20mA		100		Hz

Dimension & Terminal Definitions for LED Loop Powered Display Module (35mm DIN-RAIL)

Terminal	Label	Description
1	(+) 4/20mA	+24VDC power from PLC
2	(-) 4/20mA	DC Gnd from PLC
3	N/C	No Connection
4	N/C	No Connection
5	Relay 1 Hi	Alarm output #1 (high level)
6	Relay 1 Lo	Alarm output #1 (low level)
7	Relay 2 Lo	Alarm output #2 (low level)
8	Relay 2 Hi	Alarm output #2 (high level)
9	N/C	No Connection
10	N/C	No Connection
11	(-) 4/20mA	Loop Sensor Gnd (Black)
12	(+) 4/20mA	Loop Sensor +24VDC (Red)



Dimensional Details for NEMA 4X Field Assembly

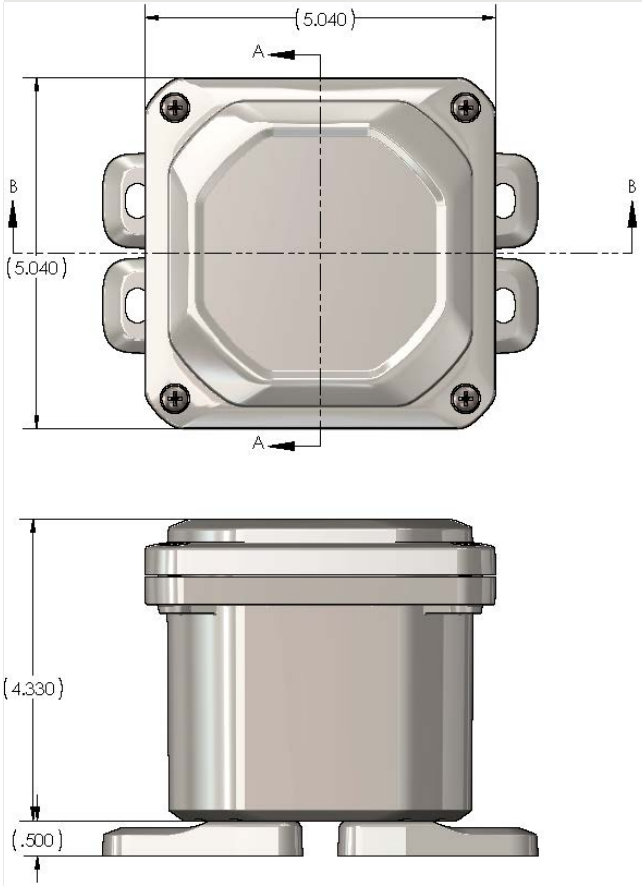


Photo of 35mm DIN-RAIL mountable module only

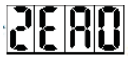
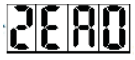
To the left are the relevant major external dimensions for the complete LED loop powered display assembly. The various details such as the input ports as well as the LED display itself are not shown for simplicity but rather just the dimensions from the NEMA 4X enclosure are provided.

To the top is shown just the 35mm DIN-RAIL mountable LED loop powered module only. For simplicity this does not show the wiring schematic label or any connected wiring.

LED Display Meter Calibration Instructions

Input signal to the meter, the meter is in power-on self-test state and displays the mark  , then turn into the measuring display state.

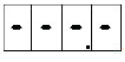
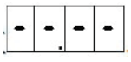
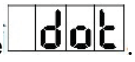
① **Zero setting** (when it is 4-20mA current loop input)

Press button **A**+**B**, it shows the zero setting interface  , then press **A**+**B** again, turn into zero setting, the interface shows the current setting value  , at this time the last digit is flickering, press button **A,** four digital tube are flickering alternately, flickering digit is the bit to be adjusted, press button **B,** the digit of flashing bit changes from 0 to 9 in turn. The first digit of left side changes from the "**–**; **-1**; **0** to **9** in turn)," users set them according to the values displayed (Note: 4mA display value range of 4mA is: -1999 ~ 9999, the default value is "0.0"). Complete the setup, press button **A**+**B** to confirm and return the interface  .

② **Full scale/Span setting** (when it is 4-20mA current loop input)

Continue to press button **A** to go to span setting interface  , then press button **A** + **B**, turn into span settings, the interface shows the current setting value  . (Note: For 20mA, the display range is from -1999 to 9999, the default value "200.0"). The rest of the operation is the same as that in ①. Complete the setup, press button **A**+**B** to confirm and return the interface  .

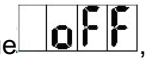
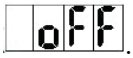
③ **Decimal point setting**

Continue to press button **A** to go to the decimal point setting interface  , then press button **A** + **B**, turn into current value setting interface  , press button **B**, the decimal point is shifted one bit to the left  . Press button **B** in continuous, the decimal point shifts to the left in turn. Complete the setup, press button **A**+**B** to confirm and return the interface  .

④ **Damping time setting**

Continue to press button **A** to go to damping time setting interface  , then press button **A** + **B**, go to the current value setting interface  , the damping time range can be set from 0 seconds to 20 seconds, press button **A**, the time value is down ↓, press button **B**, the time value is up ↑, the setting value changes based on 0.5s multiplied. Complete the setup, press button **A**+**B** to confirm and return the interface  .

⑤ **Alarm switch setting**

Continue to press button **A** to go to the alarm switch settings interface  , then press button **A** + **B**, go to the alarm switch setting, the meter displays the current setting value  , indicating the following alarm settings do not come into effect. Press button **A** or **B** to switched it into  , indicating the following alarm parameters come into effect. All the alarming indicates through the last flashing point. Complete the setting, press button **A** + **B** to confirm and return to the menu. The factory default setting is  .

⑥ **The first alarm point setting**

Continue to press button **A** to go to the first alarm setting interface  , then press button **A** + **B**, go to the first alarm current value setting  , the first digit in the left is flickering, press button **A,** two digital tubes are flickering alternately, flickering bit is the bit to be adjusted. Press button **B**, the flickering digits change from 0 to 9 in turn, set the limit or boundary point based on the value displayed. (Note: The alarm setting value represents the percentage of the current signal input, such as the setting is  , means that alarm limit point is (20mA-4mA) * 50% +4 mA = **12mA,** when the input current is greater or less than 12mA (it's up to alarm direction setting), the micro-controller outputs alarm signal to drive the optical-coupler, then it gives an alarm through external alarm equipments connected to the meters (the alarm function is designed according to users' requirements). Complete the setting, press button **A** + **B** to confirm and return to the main menu.

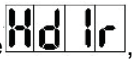
⑦ **The second alarm point setting**

Continue to press button **A** to go to the second alarm point setting interface  , the setting method is the same as that in ⑥. Complete the setup, press **A+B** button to confirm and return to main menu.

⑧ **The first alarm point direction setting**

Continue to press button **A** to go to the first alarm point direction setting interface  , then press button **A** + **B**, go to the current value setting interface  , indicating it gives an alarm when the value varies from low to high, e.g., set the limit point to 12mA, it give an alarm when the input current is increased from 4mA to the value which is higher than 12mA, no alarm when the current is decreased from 20mA to the value which is lower than 12mA. Press button **B**, shift to  , indicating it gives an alarm when the value varies from high to low, e.g., set the limit point to 12mA, no alarm when the current is increased from 4mA to the value which is higher than 12mA, it gives an alarm when the input current is decreased from 20mA to the value which is lower than 12mA. When the input current is restored to the previous current value (before the state of alarm), the state of alarm is canceled. Complete the setup, press **A** + **B** button to confirm and return to the main menu. (Note: In the state of alarm, the last decimal point in the LED display panel is flashing which indicates the current state is in alarm conditions.)

⑨ **The second alarm point direction setting**

Continue to press button **A** to go to the second alarm point direction setting interface  , the setting method is the same as that in ⑧. Complete the setup, press **A+B** button to confirm and return to menu.

⑩ **Alarm delay time setting**

Continue to press button **A** to go to alarm delay time setting interface  , press button **A+B** to go to current value setting interface  ; the alarm delay time can be set to the value from 0 seconds to 30 seconds, press button **A**, the time value is up ↑, press button **B**, the time value is down ↓, the setting value changes based on 1.0s multiplied. Complete the setup, press button **A+B** to confirm and return the interface. (Note: 0 means no delay, it will not give the alarm immediately when it meets the alarm condition, but go to the alarm state after the value displayed meets the alarm condition for several seconds, when the value restored to that in normal safe (no alarm), state of alarm is released without delay.)

Continue to press button **A** to return to the measuring display interface, the end of all settings.

4mA and 20mA Calibration (that settings should be done cautiously)

Input 4mA signal to the meter, press and hold the **A** button until the digital meter displays  . Stop to press button for 3Seconds, then press button **A** again, the meter shows  , now the 4mA current input signal sampling has been saved as the standard. Change the input signal into 20mA, press button **A**, the meter displays  , press button **A** after 3 Seconds, the meter displays  . 20mA current input signal sampling has been saved as the standard. Press button **A** again, return to the state of measurement.

Model selection examples

When the signals measured is beyond the limits of AD bit of the IC measuring range, or the display value is greater than 9999 or less than -1999 without decimal points, do the over-range display.

Beyond the measuring limit AD bit of the IC (4-20mA calibration)

4mA : display **0**, 20mA: display **2000**, input 3.01mA, display **oLL**, input 26.01mA, display **oHH**.
4mA : display **2000**, 20mA: display **0**, input 3.01mA, display **oLL**, input 26.01mA, display **oHH**.

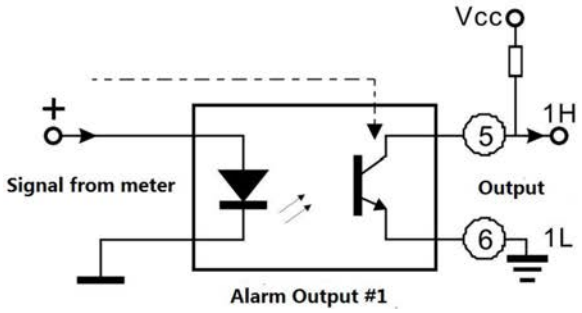
The digit displayed is greater than 9999, less than -1999 without decimal point:

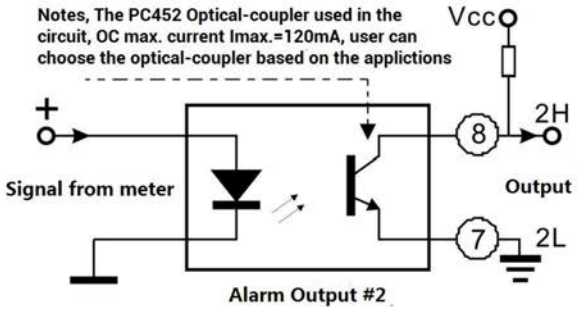
4mA: display **0**, 20mA: display **9999**, 20.01mA : display **oHH**, because the input has no decimal point, it can be shifted.
4mA: display **-1999**, 20mA: display **5000**, 3.99mA: display **oLL**, because the input has no decimal point, it can be shifted.

Alarm Output and Applications

1. In main CPU chip, there is DC current level signal output which generates from two-channel alarm signal, the low level output indicates the alarm state, high level output indicates non-alarm state.

2. The display digital meter operates in 2-wire passive mode, the min. operating current is 3mA, so the alarm signal is also very weak, the min. current is 0.5mA. The meter isolates the signal through photosensitive triode type optical-coupler, and adopts open-collector (OC) output. The output is connected to pull-in voltage, the current can be amplified to 120mA. The functional block of photosensitive triode type optical-coupler below: in the diagram, the signal from meter is isolated by optical-coupler.⑤,⑥ "1H /1L", ⑦、⑧"2L/2H" wiring terminals are the output terminals of open-collector of optical-coupler, the terminals are to be connected to external power supply circuits of the meter to do further amplification and strengthen on alarm signal, and to drive the required components like sound, light, power, cool, heat, motor, etc. ⑤,⑥"1H /1L": the first alarm output,⑦,⑧"2L /2H": the second alarm output, "1H", "2H": connect to photosensitive triode collector, "1L", "2L": connect to emitter.





Due to the max. current limit of photosensitive triode IC, the capability of the meter in current amplification and drive load is limited. If the greater drive current is required to propel inverters, magnetic valves, stepper motor or other devices, user can add power expansion circuit (power amplifier tube or servo circuit) to amplify current or order it from us specially.

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