Integrated multi-function meter

User's manual

1. General

Thank you for using the integrated multi-function combined meter.

This User's Manual provides the user with useful information regarding the instrument's installing, operating procedures and parameters setting as well as failure diagnosis. To ensure proper use of the instrument, please read this manual thoroughly before operating it. Keep the manual in a safe place.

2. Technical specifications

2.1. Input

2 analog input channels support various types of signal. The following options can be selected to input through meter configuration.

Voltage signal:	0-5/l-5VDC/0-20/0~100m VDC
Current signal:	0-20/4~20mADC
Thermal resistance:	Pt-100, Cu50
Thermocouple:	B, E, J, K, S, T

2.2. Output

1 analog output channel(4~20mA)can drive a maximum load of 750 Ω.

1 isolated 24VDC feedback output can supply a current as much as 50mA.

2.3. Accuracy

Rea-time display: ± 0.2% F.S.

Recall accuracy: ± 0.2% F.S.

Cold junction tolerance: ±2^{o}C

Clock accuracy: ± 2S/Day

Notes: Reject cold junction tolerance of thermocouples.

2.4. Record Interval

8 record interval selection: 1/2/5/20/40/60/120/240 second(s).

2.5. Record Capacity

4MB it.

The user can allocate it to two input channels through instrument configuration (0.5MBit per unit).

2.6. Record Time

If the power is ON, the total record time T of every channel can be calculated by the Record Interval T and Record Capacity n. See the formula as follows:

$$T=0.74 \text{ X } n \text{ X } t;$$

Where:

T:	day;
t:	S;
n:	M, the value can be 0.0, 0.5, 1.0, 1.5,2.0,2.5,3.0,3.5 or 4.0.

For example: In case n=4.0, t=240S, this channel can record for T=71 0.4 days.

2.7. Alarm Output

2 passive Contact Outputs. Contact Capacity: 1A 30VDC. Default: normal open.

2.8. Communication

RS485 mode: Complying with open MODBUS RTU slave protocol, and the baud rate can be set: 1200/4800/9600/19200/38400/57600 bps.

2.9. Screen

Display Resolution:	192 X 64
Scan frequency:	1Hz

2.10. Power Supply

Rated AC supply voltage: 0.2A @ 90-260VAC, 45-55Hz.

2.11. Size

Outline size: 160mm(Width) X 80mm(Height) X 48mm(Depth)
Hole size: 152mmX 76mm.

2.12. Net weight

<= 1.0kg.

2.13. Storage condition

Temperature: -20~60^{o}C. Avoid direct exposure to violent sunlight
Humidity: <85%RH (no coagulation).

2.14. Operating condition

Temperature: 0~55^{o}C
Humidity: 10-85%RH (no coagulation).
Notes: Do not operate in an erosive atmosphere. Do not bring liquid or conductive substance into the instrument. Keep airiness near the intake in a good condition.

3. Installing and Wiring

3.1. Outline Dimension

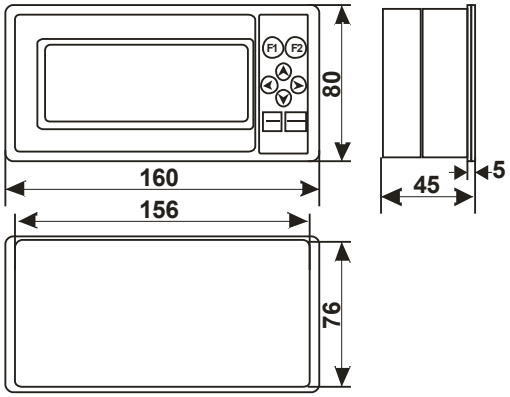


Figure 3.2-1 Outline Dimension Diagram of the Instrument

3.3. Connecting Terminals

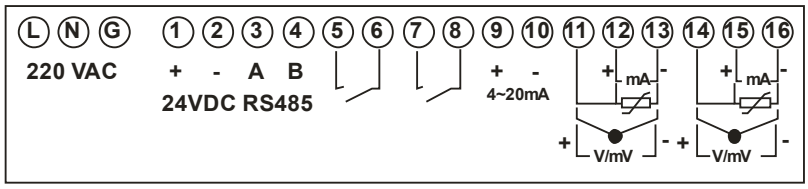


Figure 3.3-1 Distribution Diagram of Terminals

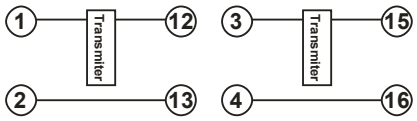


Figure 3.3-2 Wiring Diagram for 2-wire Transmitter

Notes: Section area of power cord: 0.5~2,5mm^2.Torque: 50Nm.

Table 3.3-1 gives a list of definitions for each connecting terminal.

Table 3.3-1 Terminal Definition

Item	Tag	Remark
Power supply	L, N, G	90~260VAC
24V output	1, 2	Capacity: 50 mA isolated from other power supply
RS485 interface	3, 4	Connect to A (+) and B(-) for RS485 communication respectively
No. 1 alarm relay output K1	5, 6	DC30V 1A
No. 2 alarm relay output K2	7, 8	DC30V 1A
4~20mADC analog output	9, 10	Maximum load is 750 Ω
Analog input chanel 1	11, 12, 13	Wiring as Fig. 3.3.-1
Analog input chanel 2	14, 15, 16	Wiring as Fig. 3.3.-1

Notes: Any analog input channel of the meter can work together with an analog output channel to form a PID control loop.

3.4. Communication Wiring

This instrument is equipped with RS485 interface. Please use Shielded Twisted Pair as communication cable for RS485 communication (provided by user). If the cable is longer than 100 meters, a termination resistor of 120 ohm is required (provided by user). The termination resistor should be connected between two remote ends. When using the RS485RS232 adapter from our company, connect the instrument to PC as Fig.3.4-1.

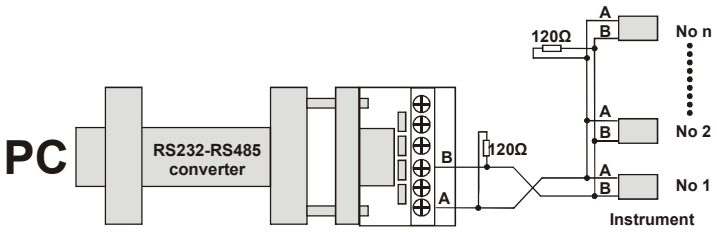


Figure 3.4-1 Sketch map of communication connection

4. Operation and Configuration Manipulation

4.1. Keyboard

This integrated multi-function combined meter contains 8 keys in total, see Fig 4.1-1. Each key has different function in operating state and configuration state. For details, refer to Table 4.1-1.

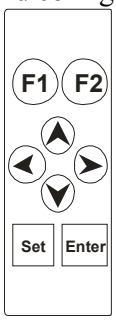


Figure 4.1-1 Operation Keyboard

Table 4.1-1 Function for each key

Description	Function	
Symbol	**Operating**	**Configurating**
F1	Enter configuration panel	
F2	1. Switch time-base at Curve-Panel 2. Speed search and location of history record data during alarm period of time on Alarm Overview Panel	
Set	3. Activate the time of fixed search in history trend panel 4. Activate SV setting value on Adjustment panel	
Enter	1. Switch between operating panel in non-actvated state 2. confirm the moment when time is activated on history trend panel 3. Activate SV setting value on Adjustment panel	Enter, Quit sub-panel
▲	1. Switch between display chanel upwards in cursor-free state 2. Select previous option or increase value 3. Confirm alarm records on Alarm overview panel	
▼	1. Switch between display chanel dowards in cursor-free state 2. Select next option or decrease value	
◀	1. Move the cursor forward 2. recall history data on history trend panel 3. Manual/Automatic switch	
▶	1. Move the cursor backrward 2. recall historical data at historical curve display	

Notes: Press on direction key without release will accelerate alternation

4.2. Operating Panel

When powered on, the instrument enters Operating Panel, including Customize Panel, Digital Display Panel, Adjustment Panel, Real-time Curve Panel, History Trend Panel, and Alarm Overview Panel etc.

Notes: If the control function of configuration is disabled, the Adjusting Panel will not appear. If the Record Capacity Share for each input channel is 0, the History trend Panel will not appear. If there is no alarm record, the Alarm Overview Panel will not appear.

4.2.1. Customize Panels

Customize Panel is used to configure different display panel in different application. There can be one or more Customize Panel, but not always. (See Panel Edit Handbook)

4.2.2 Digital Display Panel

Two-channel digital display panel is shown as FigA.2.2-1 .

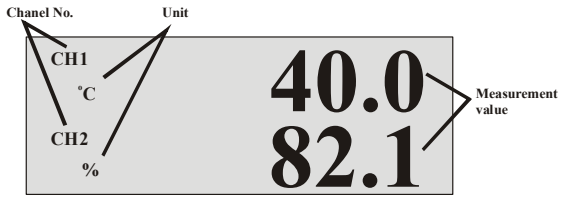


Figure 4.2.2-1 Two-channel Digital Display Panel

Single-channel digital display panel is shown as FigA.2.2-2.

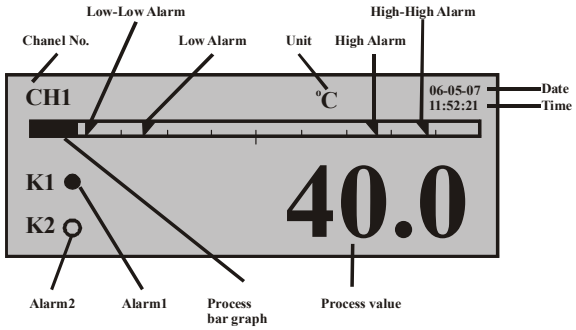


Figure 4.2.2-2 Single-channel Digital Display Panel

Kl: Disc means No.1 relay contacts are closed while circle represents open.
K2: Disc means No.2 relay contacts are closed while circle represents open.

4.2.3 Adjustment Panel

Adjustment Panel is shown as Fig4.2.3-1

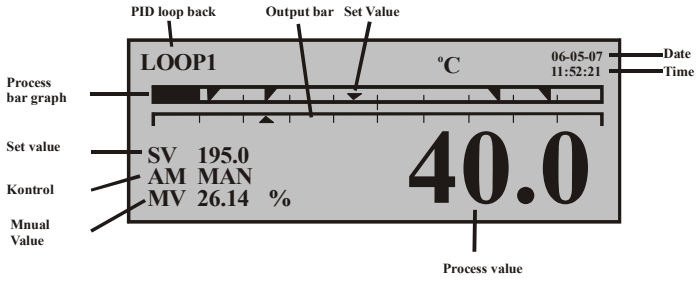


Figure 4.2.3-1 Adjustment Panel

Notes: This panel will be displayed only when PID control is activated at Configuration Panel.

- Modify set value
  On Adjustment Panel, press "Set" to activate cursor and this value can be set within the range of corresponding sampling channel. After setting, press "Enter" to confirm.
- Modify output value
  On Adjustment Panel, press "Left" key to switch into manual mode and activate the cursor at MV. The value can be modified within the range 0.00%-100.00%.
- Manually/Automatically Switch
  On Adjusting Panel, press "Left" key to select the manual or automatic switch of Adjustment Panel. 4.2.4 Real-time Curve Panel

Real-time Curve Panel is shown as Fig4.2.4-1

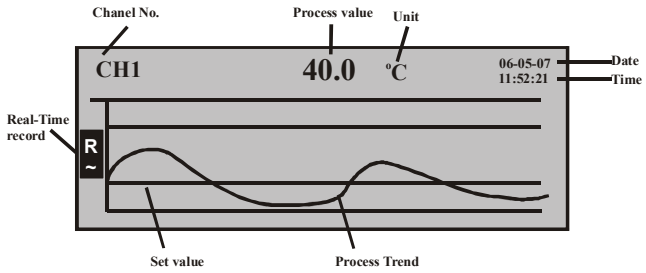


Figure 4.2.4-1 Real-time Curve Panel

Time rod can be changed through F2. In the figure above, 3m means that it takes 3 minutes to record this curve. Current measured value is displayed at the end of the curve. From this Figure, we know that the measured value for channel i at the time of 11 :05:28 on the day of August 7th in 2006 is 40.0 ^{o}C. This curve records the trend from 3 minutes before to present. Vertical coordinate can be scaled automatically to fully display the curve on the panel.

4.2.5 History Trend Panel

History trend Panel is shown as FigA.2.5-1. Date and time at the top of screen mark up the time at the right hand of the trend.

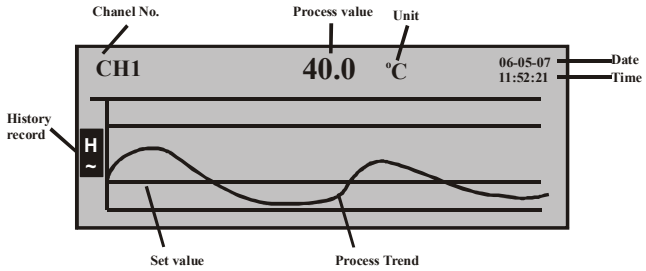


Figure 4.2.5-1 History Trend Panel

Timeline can be changed through F2. In the figure above, 3m shows that it takes 3 minutes to record this trend. When inquiring history trend, press "Set" first to activate cursor and set date and time. Then press "Enter" to inquire. Pressing left key or right key is another way to inquire. From the Figure above, we can get that the measuring value for channell at the time of 11 :05 :28 on the day of August 7th in 2006 is 40.0℃. This trend records the curve from 3 minutes before to current time.Vertical coordinate can be scaled automatically to fully display the treqd in the panel.

4.2.6 Alarm Overview Panel

Alarm Overview Panel is shown as FigA.2.6-1. Alarm Overview Panel gives detailed description of recent sixteen alarms for current channel in terms of date, time and type etc. It aids the operator to take measures to prevent accidents. "*****" shows alarm is not end, "√" shows alarm has been acknowledged by the operator.

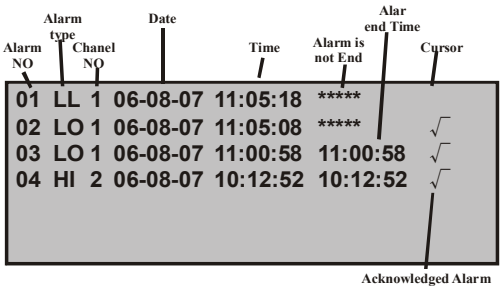


Figure 4.2.6-1 Alarm overview Panel

- Alarm Types
  There are five types of Alarm:
  HH: High-High alarm
  HI: High alarm
  LO: Low alarm
  LL: Low-Low alarm
  AV: varied alarm
- Speed search and analysis alarm data

  Move cursor by left and right key and press F2 to enter history recall panel for time when current alarm occurs. If the record capacity of certain channel is 0.0M, this function is unusable. If new data has overwritten history data at the alarm moment, the history panel displays history data as early as possible .
- Alarm Acknowledgement

  Alarm Acknowledgement is defined as when the operator finds the alarm and takes effective measures to prevent danger. Unacknowledged alarm can be changed to acknowledged alann through the operations as follows: *Move cursor to desired alarm field, press "Up" key to display "√" as an alarm acknowledgement symbol.*
- Page

  Integrated multi-function combined meter is able to record the latest 16 alarm records. But one panel can display only 8 records. Press Left or Right key to move cursor repeatedly to page to watch other alarm records. Notes: Alarm records will be lost if the instrument is power off. If no alarm occurs, this panel will be skipped when switching between panels.

4.3. Configuration Panel

4.3.1. Configuration Code Input Panel

If the user need configuration, press "Fl" on any operating panel to enter Input Code Panel. See FigA.3.1-1.

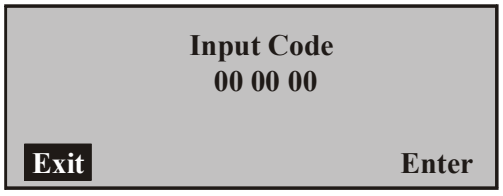


Figure 4.3.1-1 Configuration Code Panel

If correct code is input, the instrument enters configuration main panel. Otherwise, the operator has no right to change configuration information.

Notes: six-digit code should be input at three times and each time two digits. Factory default value of the code is "000000".

4.3.2 Configuration Main Panel

Configuration adopts cascade panel. FigA.3.2-1 is Configuration Main Panel.

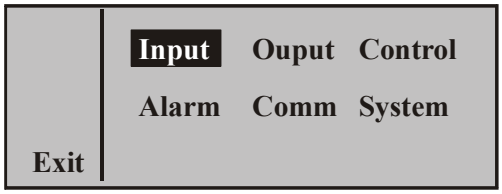


Figure 4.3 .2-1 Configuration Main Panel

Input: As for analog input configuration, the user is able to configure two analog input channels through this menu

Output: namely transmitter output. Users can set output signal as a transmitter parameter of 4-20mADC.

Control: PID control information. The user can set PID parameters via this menu.

Alarm: Set alarm parameters for analog input.Communication: Set local address and baud rate.

System: Set system information.

- Enter next submenu
  1. Press "Left" or "Right" key to move cursor to a corresponding position on the menu
  2. Press "Enter" key to confirm.
  3. The instrument enters next submenu automatically.

- Quit configuration
  1. Press "Left" or "Right" to move cursor and stop it at "Exit"
  2. Press "Enter" key to confirm.
  3. The instrument enters next submenu automatically.

4.3.3 Input Configuration

Input Configuration Panel is shown as FigA.3.3-1.

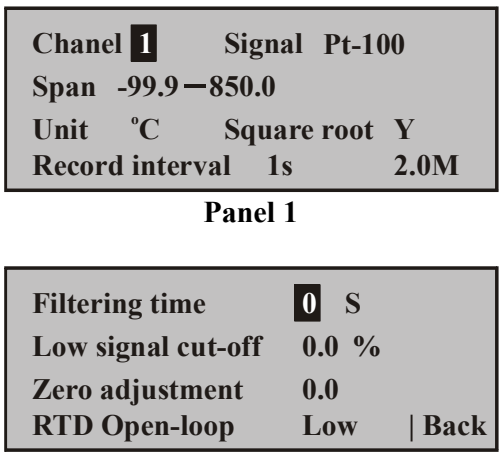


Figure 4.3.3-1 Input Configuration Panel

Notes: Input Configuration contains Panel I and Panel 2. Use "Left" and "Right" key to switch between them. When the type of signal is thermal resistance, Resistance broken will be displayed. When the type of signal is thermocouple, thermocouple broken will be displayed. If other type of signal is input, none will be displayed in this field.

- Channel
  2 selectable channels
- Signal
  Types of signal:
  TC: B, E, J, K, S, T
  RTD: PtIOO, Cu50
  Voltage: 0-20mVDC, 0-100mVDC, 0-5VDC, 1-5VDC
  Current: 0-20mADC, 4-20mADC
- Measuring Range
  Here is the range for engineering value.
- Units
  Engineering units: Nm^3/h, m^3/h, m^3/min, m^3/s, L/h, L/min, L/s, t/h, t/min, t/s, kg/h, kg/min, kg/s, ^oC , Pa, kPa, MPa, kgf/cm^2, bar, mmH20, mmHg, %, ppm, pH, r/min, mm, Hz, kHz, mA, A, kA, mV, V, kV, VA, kVA, W, kW, MW, Var, kVar, MVar, J, kJ, uS/m, uS/cm, kg,J/kg^oC , kWh,ug/L
- Square Root
  When Square root is needed, please press "Yes".
- Record interval
  Record interval can be set as 1/2/5/20/40/60/]20/240 second(s). The bigger record interval is, the longer record time is. Vise versa. Usually, if the signal varies swiftly, choose a small value for record interval; if the signal varies slowly, choose a big value for record interval. The field of "2.0M" in the figure above shows the record capacity of this channel is 2.0MBit. If the value of this field is "0.0M", it means there is no record memory allocated to this channel, namely this channel doesn't record. After record capacity is changed, all data recorded previously will be clear and the instrument allocates new record capacity for each channel again. Be cautions to change this value.
- Filtering time
  One-order lag Filtering can help smooth the signal. The range is 0-99.

- Low signal cutting
  If signal to be measured is relatively small, measuring error will be big, especially when the signal is below 1% and thus the precision goes even lower enormously. In that case, low signal cutting takes the result as zero. The value should be within the range of 0.0-25.5%.
- Zero Adjustment
  Within the measuring range, if there is a deviation between displayed value and actual value, the user can use Zero Shift to modify and improve display precision. If the displayed value is 0.5 while the actual value is 0.2, the user can set Zero Shift as -0.5 to display 0.0.
- RTD Open-loop
  On control adjustment state, set safety value for "Resistance broken" or "Thermocouple broken". The user can select Starting Point, Hold and End Point.
- After finished setting, return.

4.3.4 Output Configuration

Output Configuration Panel is shown as Fig.4.3.4-l.

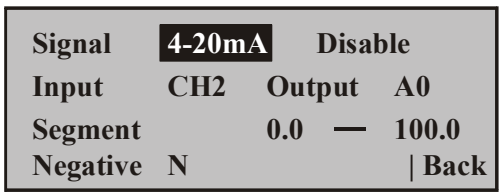
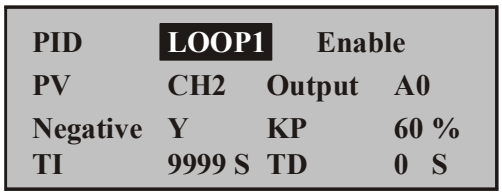


Figure 4.3.4-1 Output Configuration Panel

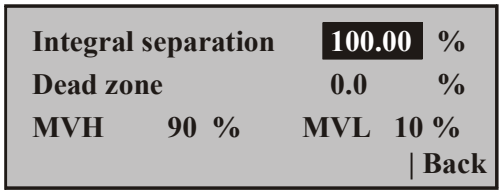
- Output Signal
  Enable and Disable means the transmitting function is valid or invalid.
- Sampling
  It means channel needing transmitter. The user can select sampling channel number.
  OutputIt supports transmitter output for AO point.
- Transmitter Range
  Get upper limit and lower limit as limits for transmitter output respectively according to the range of sampling channel.
- Function
  If this Function is positive, the upper limit of Transmitter Range is 20mA and the lower limit is 4mA. If this Function is negative, the upper limit of Transmitter Range is 4mA and the lower limit is 20mA.
- Return after setting is finished
  If Transmitter Range is enabled, PID control should be disabled.

4.3.5 Control Configuration

Control Configuration is shown as Fig.4.3.5;1 .



Panel 1



Panel 2

Figure 4.3.5-1 Output configuration Panel

Notes: Control Configuration contains Panels I and Panel 2. Switch between them by moving cursor.

- PID
  LOOPl is the identifier for PID loop. "On" means the control is enabled while "Off' means the control is disabled.
- Sampling
  It means input signal channel of PID control loop. The user can select sampling channel.
- Output
  It supports transmitter output for AO point.
- Negative
  If output increases as input increases, the control function is positive; If output increase as input decreases, the control function is negative. If PID output increases, relative sampling value inclines to increase, select Negative. Otherwise, select Positive. Make the PID loop as a negative feedback.
- KP
  It is the proportional coefficient of PID control loop. Its range is 0.1-999.9%. The bigger KP is, the stronger control response is. Large Kp not only makes the system more sensitive but also accelerates it. Per contra, the control response is weaker and the system tends to be unstable.
- TI
  It is integral time of PID control loop. Its range is 1-9999. The littler TI is, the stronger control response is and thus the system tends to be unstable. But littler TI helps to eliminate steady error and improve control precision. Per contra, bigger TI weakens the function. If the TI value is 9999s, it takes no action.
- TD
  It is differential time ofPID control loop. Its range is within 0-9999.
  TD helps to improve the dynamic property of system. If TD is bigger, differential function is stronger and the overshoot is also bigger, but adjustment time is shorter. If TD is smaller, the overshoot is bigger and adjustment time is longer.
  So a suitable differential time is important.
  Set proportional coefficient, integration time and differential time as follows:
  First according to Table 4.3.5-1 to get an approximate range for the three parameters and then follow the steps below to get the value:

Proportional coefficient setting:

First set the integral time as 9999s and the differential time as 0 to disable integral function as well as differential function. In this way, pure proportional control is adopted. Increase proportional parameters slowly and watch the response of system. When the response rate is rast and a certain overshoot appears, stop it. If the stable error of system is acceptable and response curve satisfies the design, use proportional control only. Integral time setting: If the stable error of proportional control system fails to meet the design, it is necessary to add integral function. Reduce the integral time gradually from a big value to a small one (integral function is enhanced) and observe the output until the stable error of system decreases to zero (meet the specifications). Try and trail for several times until the speed of steady-state error eliminating is acceptable. Care should be taken that the overshoot will be larger and the user need to reduce the proportional coefficient properly. Differential time setting: If proportional and integral (PI) controller fails to satisfy the design after reiterative adjustment, differential function should be taken into account. When setting, increase the differential time from zero slowly (differential function is enhanced), observe the overshoot and stability. At the same time, make a fine adjustment for proportional coefficient and integral time until a satisfied result is got.

Table 4.3.5-1 KP, TI, TD experiential values (for indication only)

System	Proprotional coeficient KP	Integral time TI (s)	Diferential time TD (S)
Temp.	170 ~ 500 %	180 ~ 600	30 ~ 180
Flux	100 ~ 250 %	6 ~ 60	
Pressure	140 ~ 330 %	24 ~ 180	
Liquid level	130 ~ 500 %		

- Integral separation
  If (deviation/range) X 100%~Integral action separation coefficient (control variable near to set-value), integral action is effective. Contrarily, integral action is separated (integral action is disabled). Range of integralaction separation: 0 .00 ~ 1 00.00%.
- Dead zone
  When signal has a small vibration, dead zone can prevent the output varies continually which may ring the system to an unstable state. Range of dead zone is: 0-25.5%.
- MVH
  MVH is the upper limit of regulator. When the result of regulator is bigger than output upper limit, actual output is kept as the value specified by output upper limit. The range is MVL~100%.
- MVL
  MVL is the lower limit of regulator. When the result of regulator is smaller than output lower limit, actual output is kept as the value specified by output lower limit. The range is 0%~MVH.
- After finished setting, return
  Notes: When PID control is ON, transmitter output must be disabled.

4.3.6 Alarm Configuration

Alarm Configuration Panel is shown as Fig. 4.3.6-1.

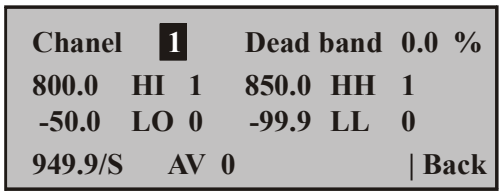


Figure 4.3.6-1. - Alarm Configuration Panel

- Channel
  Channel 1 and Channel 2 is selectable to set alann parameters.
- Dead band
  Dead band is used to prevent repeating alann around the alann point. For example, assumed the range of channel I is 0-100. The high alann point is 80 while the low alann point is set as 20. And dead band is set as 5.0%. If high alann occurs, the instrument will cancel this alann only when the measured value is smaller than 80-100*5%=75. In like manner, if low alann occurs, the instrument will cancel this alann only when the measured value is bigger than
  20 + 100 * 5% = 25.
- Alann setting
  HI, HH, La, LL in the figure above shows High alann, High-high alann, low alarm, low-low alarm respectively. The value before characters specifies alarm threshold while the value after characters specifies the connected relay number. When there comes an alarm, this relay will take actions. 0 means that there is no connected relay. 1 means that No.1 relay is connected. 2 means No.2 relay is connected. The same relay can be connected to different alarm. If any alarm occurs, this relay will be closed.
- Change rate (AV) alarm
  Change rate alann is used when the variation of measured value overflows and brings about an alarm. There are two values after the change rate. One is alarm threshold following the change rate. Another is connected relay number following the alarm threshold.
- After finished setting, return.

4.3.7 Communication Configuration

Communication Configuration Panel is shown as FigA.3.7-1 .

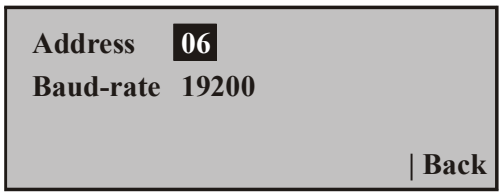


Figure 4.3.7-1 Communication Configuration Panel

MODBUS (RTU) communication protocol is used by default. Communication configuration is used to set local communication address and communication baud rate. Communication address can be set as a value within I ~63. When constitute a same communication network, it is not pennitted to assign a same communication to the instrument.(see attachment for MODBUS address mapping)

4.3.8 System Configuration

System Configuration Panel is shown as Fig.4.3.8-1.

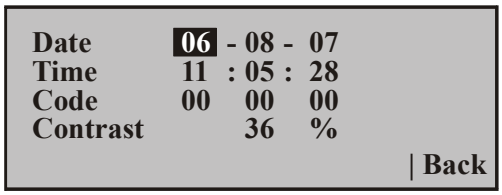


Figure 4.3.8-1 System Configuration Panel

- Date, Time
  Adjust system time to keep the accuracy of time. Generally, the adjustment is small. If system clock walks more slowly, the time will jump in the direction of future. In this way, this period of time becomes the range lower limit when on history inquire panel. If system timer walks more quickly, the time will overlap in the direction of past. In this way, the instrument will not record during this period oftime until present time is the same as than before adjustment.
  Notes: In case system clock walks more quickly and it is one hour later after the data and time has been modified in the direction of past, all history record data will be cleared. The instrument will record again by modified time. Be careful to modify.
- Code
  This code is also called configuration privilege code. Please keep this code in mind after setting.
- Contrast
  0~100% adjustable.