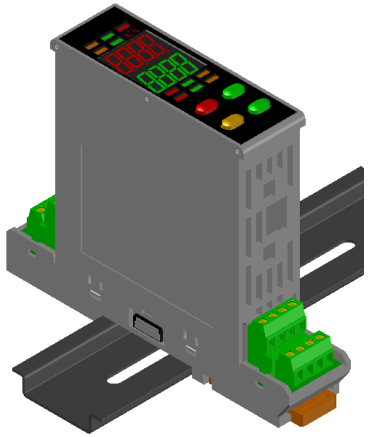
DMC Temperature Controller

Installation and Operation Guide



1. Introduction

The DMC is a DIN-rail mounted controller, its slim size makes it ideal for in-panel application.

1.1 Highlight Features

- Slim size 24 x 75 x 87 (W x H x D)
- Removable terminal block, easy for replacement and maintenance
- No power supply and communication wiring required between the DMC unit's connection (Max. connected units : 32)
- Ramp to Set-point or soft start function available.
- One optional DI (digital input) or AI (analog input) available
- Adjustable brightness of LED display
- 2-degree PID algorithm
- Easy to set up without power supply wiring by connecting to PC with the URC-1020 cable

1.2 Specification

Input signal : User programmable. refer to table 1.

- Thermocouple (T/C) : industry standard thermocouple types, J, K, T, E, B, R, S, N, C (ITS-90).
- Pt100 : Excitation 180uA. 2 or 3 wire connection (ITS-90 α=0.00385).
- Voltage : -60mVdc to 60mVdc or -10Vdc to 10Vdc.
- Current : -24mA to 24mA

Measuring range : User programmable. Maximum range refer to table 1.

Measuring accuracy : refer to Table 1. the accuracy is tested under the operating condition of 24°C±3°C.

Input signal	Maximum Range	Accuracy
Thermocouple J	-50 to 1000°C (-58 to 1832°F)	±1°C
Thermocouple K	-50 to 1370°C (-58 to 2498°F)	±1°C
Thermocouple T	-270 to 400°C (-454 to 752°F)	±1°C
Thermocouple E	-50 to 750°C (-58 to 1382°F)	±1°C
Thermocouple B	0 to 1800°C (32 to 3272°F)	±2°C(Note1)
Thermocouple R	-50 to 1750°C (-58 to 3182°F)	±2°C
Thermocouple S	-50 to 1750°C (-58 to 3182°F)	±2°C
Thermocouple N	-50 to 1300°C (-58 to 2372°F)	±2°C
Thermocouple C	-50 to 1800°C (-58 to 3272°F)	±2°C
Pt100 (DIN)	-200 to 850°C (-328 to 1562°F)	±0.2°C
Pt100 (JIS)	-200 to 600°C (-328 to 1112°F)	±0.2°C
mA	-24mA~24mA	±4μA
mV	-60mV~60mV	±0.01mV
Voltage	-10V~10V	±2mV

***Factory Setting**

Note 1: Accuracy is not guaranteed between 0 and 400°C (0 and 752°F) for type B.

Table 1 Input Signal

Sampling rate : 100mS

Control Output :

- Relay output : 3A/240Vac (Resistive load)
- SSR output : 24Vdc pulsed voltage for driving SSR (Max. load current 20 mA)
- Current output : 4~20mA (Resistive load 600 ohms Max.)
- Voltage output : 0~10V (Resistive load 500 ohms Min.)

Control Mode : PID with auto-tune, P with manual reset or On/Off with hysteresis available.

- Proportional Band : 0.0~300.0% (0.0 % = On/Off mode)
- Integral Time : 0.0~3000 sec.
- Derivative Time : 0.0~1000 sec.
- Cycle Time : 0~60 sec.
- Hysteresis : 0~9999

Ramp Function :

- Ramp rate : 0~9999 unit/minute or unit/second (0 = disable the ramp function)

Alarm Output : 5A/240Vac (Resistive load)

Alarm Function : Energized / De-energized with 0~30000 Sec. / Min. delay

- Alarm function disable
- Process high alarm
- Process low alarm
- Deviation high alarm
- Deviation low alarm
- Inside deviation band alarm
- Outside deviation band alarm

Alarm Mode :

- Normal mode
- Standby mode
- Latch mode
- Standby and Latch mode

Option :

■ DI (digital input) – Contact input

■ AI (analog input) – 4~20mA, 0 ~10V

Communication :

■ Interface : Half duplex based on EIA RS-485

■ Protocol : Modbus RTU mode

■ Data format :

Start bit : 1

Data bit : 8

Parity : None, even, odd

Stop bit : 1 or 2

■ Baud Rate : 9600, 19200, 38400, 57600, 115200 bps

Power supply : 24Vdc (19 ~ 32 Vdc)

Power consumption : 4.8VA Max.

Common mode rejection ratio : >90dB.

Operating temperature : 0 to 55°C

Humidity : 0 to 85% RH (Non-Condensing)

Electromagnetic compatibility (EMC) :

■ EMS : EN 61000-6-2

EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-6

■ EMI : EN61000-6-4

Dimension : 24 x 75 x 87.5 mm (W x H x D).

Housing material : ABS/PC plastic. UL 94V0

Weight : 100g

1.3 Ordering information

DMC – D – [1] [2] [3]

[1] Input Type :

Code	Input Type
T	Thermocouple
D	PT100
L	0~50 mV
V	0~10 V
M	4~ 20 mA

[2] Output 1 :

Code	Output
R	Relay
P	Pulse Voltage to drive SSR
M	4 ~ 20 mA
V	0 ~ 10 V
O	Other specified by customer

[3] Aux Input :

Code	Input Type
A	Analog input
D	Digit input

2. Installation and wiring

2.1 Mounting a unit

1. Hook the upper side of DMC controller on the DIN rail
2. Press the Bottom side of DMC controller toward the DIN rail to lock the clip into DIN rail.

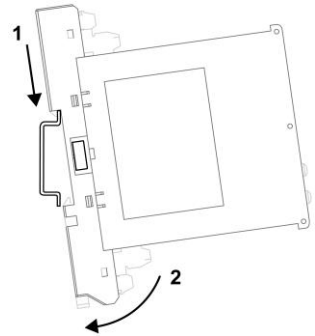


Figure 1. Mounting

2.2 Removing a unit

Insert a flathead screwdriver into the clip and pull it upward to release the hook as shown in Figure 2, the unit will pop-up from DIN rail by itself.

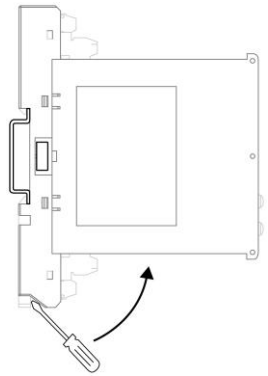


Figure 2. Removing

2.3 Connections and wiring

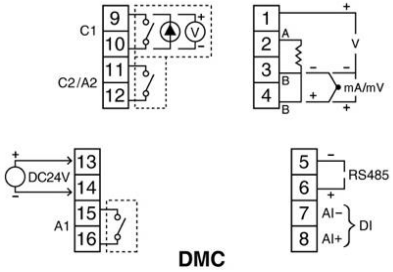


Figure 3. Terminal connections

Wiring precaution : Inverter, mechanical contact relays, arc welders, and ignition transformers are all common sources of electrical noise in an industrial environment, so always keep input signal and communication wires away from those noise-generating devices.

3. Operation

3.1 Front panel description

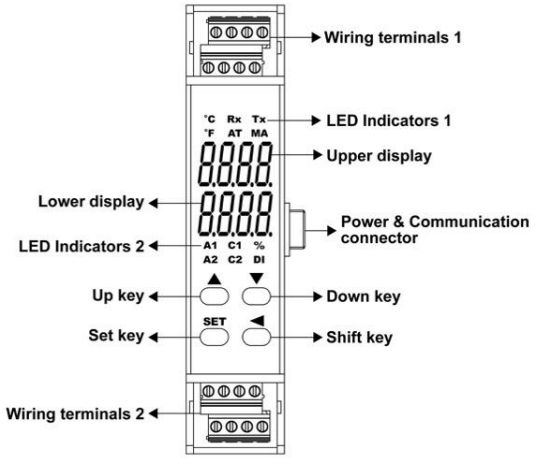


Figure 4. Front panel description

- Upper display : Display the Process Value(PV), parameter index code or error code
- Lower display : Display the Set-point Value(SV) or parameter setting value
- °C : Celsius indicator
- °F : Fahrenheit indicator
- Rx : Receive indicator
- Tx : Transmit indicator
- AT : Auto-tuning indicator
- MA : Manual mode indicator
- C1 : Control output 1 indicator
- C2 : Control output 2 indicator
- A1 : Alarm 1 indicator
- A2 : Alarm 2 indicator
- % : Lower display showing output percentage indicator
- DI : Digital input indicator
- SET key : Use to menus navigation and set value registration
- Shift key : Shift the digit of numeral
- Down key : Decreases the parameter value
- Up key : Increases the parameter value
- SET + Shift key for 2 sec. : Enter set up mode
- SET + up key : Return to PV/SV display
- Shift + Down key on powering up : Reset all parameters to default setting

3.2 Powering up procedure

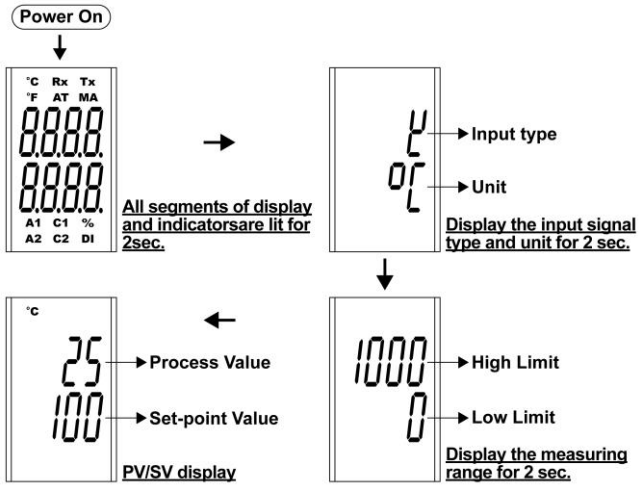


Figure 5. Powering up procedure

3.3 Configuration

3.3.1 Menu Flowchart

After powering up procedure, the controller stays in PV/SV display. The upper display shows the process value (measuring value) and the lower display shows the set-point value (target value). All the configurable parameters are located in different levels and can be accessed by keypad operation as shown in figure 6.

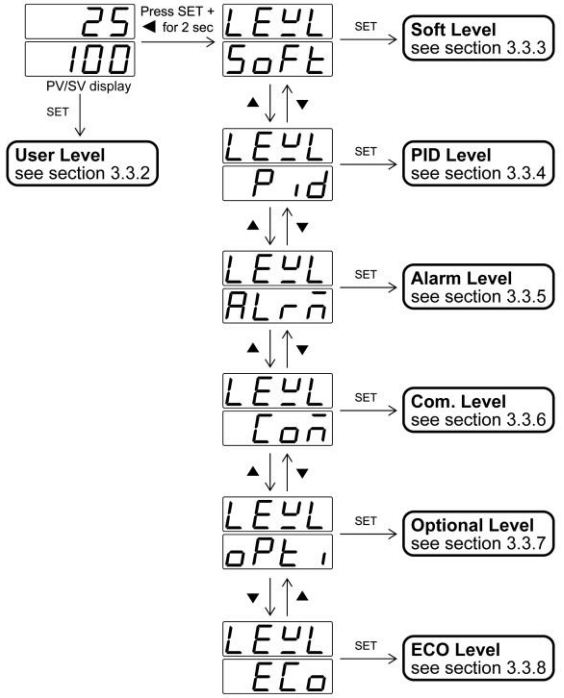


Figure 6. Menu flowchart

3.3.2 User Level

Display	Description	Range	Default	Unit
%	"%" indicator lit, Lower display showing output percentage	0.0~100.0%	N/A	%
rUn	Control mode	oFF : Off on : On At 1 : AT1 At2 : AT2 nAn : Man	On	N/A
br it	Display Brightness	3~10	5	N/A

Control output percentage

In Auto mode (rUn = on), it shows the percentage of output power applied to the control output.

In Manual mode (rUn = nAn), the "MA" indicator is lit. The percentage of output power can be set manually.

Control mode

Select the control mode to be

Off – Standby mode. Both control output and alarm are turned off.

On – Auto mode (closed loop control). In this mode, the control output percentage is determined by PID algorithm or ON/OFF action.

AT1 – Auto-tuning mode 1. In this mode, the controller will tune the PID parameters automatically at SV. The process will oscillate around the SV during AT1 process (Figure 7). Use AT2 mode if overshooting beyond the normal process is likely to cause damage.

AT2 – Auto-tuning mode 2. In this mode, the controller will tune the PID parameters automatically at (SV-10%). The process will oscillate around (SV-10%) during AT2 process (Figure 7).

Man – Manual mode (open loop control). In this mode, the control output can be set manually.

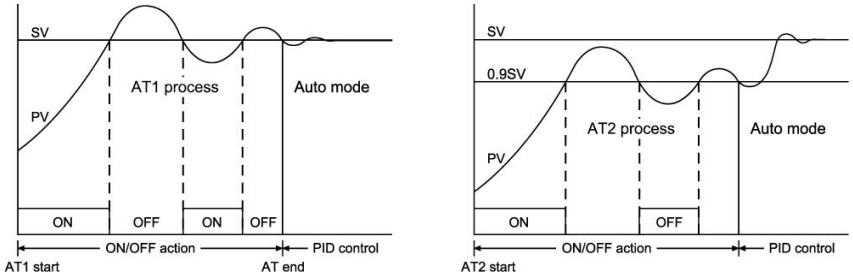


Figure 7. Auto-tuning Process

Display Brightness

Set the brightness of LED display.

3.3.3 Soft Level

Display	Description	Range	Default	Unit
rAnP	Ramp rate	oFF, 1~9999 (0.1~999.9)	oFF	Unit / sec.(min)
SSt	Soft start time	oFF, 00.01~99.59	oFF	Minutes : Seconds
SSo	Soft start output	0.0~50.0 %	0.0	%

Ramp rate

The controller can act as either a fixed setpoint controller or as a single ramp controller. If the ramp rate is set to a value other than "oFF", the process will increase or decrease at the setting rate during initial power up or with setpoint change. The ramp rate is in degree per min. or sec. depends on the time scale set (PTME) setting.

Soft start time

Soft start function is a feature that gradually heats up a hot runner system to avoid damaging the heater and ensure proper operation. This process involves applying reduced power (set by soft start output) to the heaters for a specific duration (set by soft start time). Typical soft start times range from 30 to 60 minutes. Please note that soft start function is activated when the DMC starting up. If the PV is higher than 120°C at the start or the PV reaches 120°C during soft start time, the soft start function will be ignored and the DMC will go to auto mode. the auto-tuning is prohibited during soft start duration.

Soft start output

Set the output during soft start time.

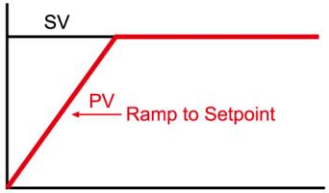


Figure 8. Ramp Function

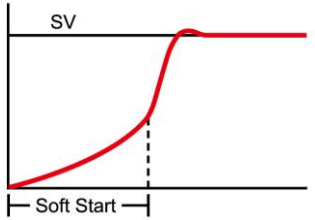


Figure 9. Soft Start

3.3.4 PID Leve

Display	Description	Range	Default	Unit
Pb	Proportional band	0.0~300.0	5.0	%
t i	Integral time	oFF,1~3000	240	Sec.
td	Derivative time	oFF,1~1000	60	Sec.
nr	Manual reset	0.0~51.0	0.0	%
HYS	Hysteresis of control output 1 (available only when Pb=0)	0~1000 (0.0~100.0)	0	unit
Ct	Cycle time	0~60	15	Sec.
CPb	Cooling proportional band	0.0~300.0	5	%
db	Dead band	-1000~1000 (-100.0~100.0)	0	°C,°F or Engineering Unit
CCt	Cooling cycle time	1~60	15	Sec.
CHYS	Hysteresis of cooling output	0~1000 (0.0~100.0)	0	unit

Proportional band

Set the proportional band in percentage of SPAN (High limit - Low limit). It can be set automatically by auto-tuning process.

Integral time

Set the integral time constant in repetitions per second. It can be set automatically by auto-tuning process.

Derivative time

Set the derivative time constant in second. It can be set automatically by auto-tuning process.

Manual reset

For PID control, this value is set automatically after auto-tuning process. For P control, it is used to compensate the deviation between process value and setpoint.

Hysteresis for ON/OFF control

In ON/OFF control (Proportional band set to 0.0%), the control output turns On/Off with respect to the setpoint. Therefore, the control output would change frequently in response to a slight change in process value. This might shorten the service life of the output device. To prevent this, a hysteresis is provided in the ON/OFF control.

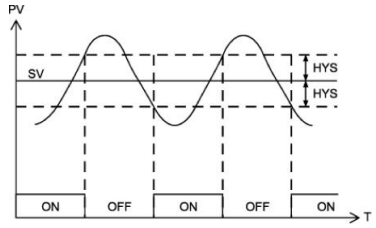


Figure 10. ON/OFF Control Action

Cycle time
Set the control output cycle time. It is recommended to set to 15 sec. for Relay output and set to 1 sec. for pulsed voltage output.

Cooling proportional band
Set the cooling proportional band in percentage of SPAN (High limit – Low limit). It can be set automatically by auto-tuning process. Set to 0.0 for ON/OFF control mode.

Dead band
This setting defines the area in which both heating and cooling outputs are inactive, known as dead band, or the area in which they are both active, known as overlap. A positive value results in a dead band, while a negative value results in an overlap.

Cooling cycle time
Set the cooling output cycle time. It is recommended to set to 15 sec. for Relay output.

Hysteresis of cooling output
Available when cooling proportional band set to 0%.

3.3.5 Alarm Level

Display	Description	Range	Default	Unit
A 1SP	Alarm 1 set-point	-1999~9999 (dP=0000) -199.9~999.9 (dP=000.0) -19.99~99.99 (dP=00.00) -1.999~9.999 (dP=0.000)	10	unit
A 1HY	Alarm 1 hysteresis	0~9999 (dP=0000) 0~999.9 (dP=000.0) 0~99.99 (dP=00.00) 0~9.999 (dP=0.000)	0	unit
A 1FU	Alarm 1 function	AoFF : A.oFF A.H i : A.Hi A.Lo : A.Lo A.d iH : A.diH A.d iL : A.diL A.bdH : A.bdH A.bdL : A.bdL b.oFF : b.oFF b.H i : b.Hi b.Lo : b.Lo b.d iH : b.diH b.d iL : b.diL b.bdH : b.bdH b.bdL : b.bdL	A.diH	N/A

A 1nd	Alarm 1 mode	nonE : None Stdy : Stdy LAtH : LAtH StLA : StLA	None	N/A
A 1dt	Alarm 1 delay time	oFF, 00.01~99.59	oFF	HH.MM/MM.SS
A2SP	Alarm 2 set-point*	Same as Alarm1 set-point	10	Unit
A2HY	Alarm 2 set hysteresis*	Same as Alarm1 set hysteresis	0	Unit
A2FU	Alarm 2 function	Same as Alarm1 function	A.diL	N/A
A2nd	Alarm 2 mode*	Same as Alarm1 mode	None	N/A
A2dt	Alarm 2 delay time*	Same as Alarm1 delay time	oFF	HH.MM/MM.SS

Alarm 1 set-point, Alarm 2 set-point
The setpoint of alarm event

Alarm 1 hysteresis, Alarm 2 hysteresis
The hysteresis of alarm action

Alarm 1 function, Alarm 2 function
Select the alarm function

A.oFF – Alarm function disable.

A.Hi – Process high alarm with Form A contact

A.Lo – Process low alarm with Form A contact

A.diH – Deviation high alarm with Form A contact

A.diL – Deviation low alarm with Form A contact

A.bdH – Deviation band high alarm with Form A contact

A.bdL – Deviation band low alarm with Form A contact

b.oFF – Alarm function disablef

b.Hi – Process high alarm with Form B contact

b.Lo – Process low alarm with Form B contact

b.diH – Deviation high alarm with Form B contact

b.diL – Deviation low alarm with Form B contact

b.bdH – Deviation band high alarm with Form B contact

b.bdL – Deviation band low alarm with Form B contact

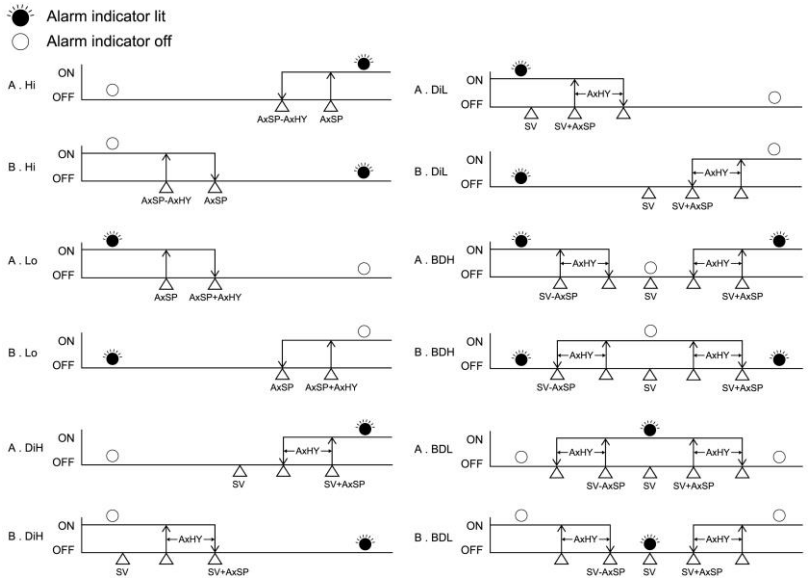


Figure 11. Alarm function

Alarm 1 mode, Alarm 2 mode
Select the alarm mode as
None – Disable the alarm mode
Stdy – Standby mode prevents an alarm event while powering up. The alarm is active only after alarm event has been cleared and then occurs again.
LAtH – Latch mode. the alarm output and indicator will be latched as the alarm event occurs. The alarm output and indicator will not change its state even if the alarm event has been cleared unless the power is off.
StLA – Both standby and Latch mode are applied. Figure 12 shows the result of different alarm modes applied on Deviation Band High Alarm with alarm hysteresis set to 0.

Alarm 1 delay time, Alarm 2 delay time
Alarm delay time is set to postpone the alarm action by the setting time.

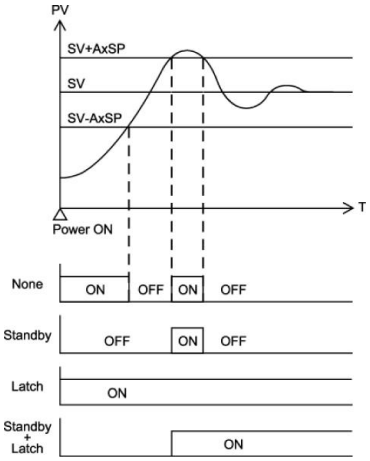


Figure 12. Alarm Mode

3.3.6 Communication Level

Display	Description	Range	Default	Unit
id	Communication ID	1~247	247	N/A
bAUd	Baud rate	9.6K : 9.6K 19.2K : 19.2K 38.4K : 38.4K 57.6K : 57.6K 115K : 115.2K	19.2K	bps
rtU	Parity and Stop bit	n81 : None, 1 stop bit n82 : None, 2 stop bit o81 : Odd, 1 stop bit E81 : Even, 1 stop bit		

Communication ID
Set the ID number in the communication network.

Baud rate
Set the communication baud rate.

Parity and Stop bit
Select the parity and stop bit combination.

3.3.7 Option Level

Display	Description	Range	Default	Unit
tYPE	Input signal type	J : J type K : K type t : T type E : E type b : B type r : R type S : S type n : N type C : C type d-Pt : PT100 (DIN) J-Pt : PT100 (JIS) -nA : mA -nU : mV -U : V rSP : External	K type	N/A
SCAL	Low scale for linear input	-1999~9999	0	Unit
SCAH	High scale for linear input	-1999~9999	1000	Unit
CUt	Cut-off function	none : None Lo : Low Hi : High HiLo : High/Low	None	N/A

Unit	Unit	°C : °C °F : °F EnG : Engineer	˚C	N/A
dP	Decimal point	0000 000.0 00.00 (for linear input signal only) 0.000 (for linear input signal only)	0000	N/A
ACt	Control action	dir : Dir rEv : Rev	Rev	N/A
LoLt	Low limit	Refer to table 1.	0	Unit
HiLt	High limit	Refer to table 1.	1000	Unit
FiLt	Digit filter	0.0~99.9	0.0	Sec.
PtmE	Time scale	HH.mm : HH.MM mm.SS : MM.SS	HH.MM	N/A
EroP	Error protection	0000 0001 0010 0011 0100 0101 0110 0111	0000	N/A
SHoF	Setpoint offset	-1999~9999 (dP=0000) -199.9~999.9 (dP =000.0) -19.99~99.99 (dP=00.00) -1.999~9.999 (dP=0.000)	0	Unit
PVoF	Process value offset correction	-1000~1000 (dP=0000) -100.0~100.0 (dP=000.0) -10.00~10.00 (dP=00.00) -1.000~1.000 (dP=0.000)	0	Unit
LoCK	Security lock	0000 0001 0010 0011 0100 0101 0110	0110	N/A

Input signal type

Select the input signal type. The available input signal types are :
Thermocouple : J K T E B R S N C
RTD : PT100 (JIS standard) or PT100 (DIN standard)
Linear : 4~20mA, 0~60 mV or 0~10 V
Please note that the DIP switch on the terminal block of DMC controller should be configured in accordance with input signal.

	1	2
Thermocouple/PT100/0mV~50mV	Off	Off
4 ~ 20 mA	On	Off
0 ~ 10 V	Off	On

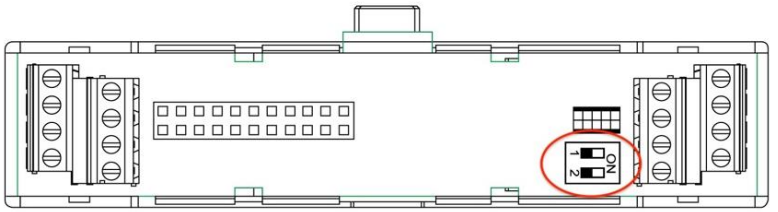


Figure 13. Input signal hardware setting

Low scale for linear input

Select the low scale corresponding to low linear input signal (INL). The default low linear input signal for mA, mV and V is 4.00mA, 0.00mV and 0.00V separately. This parameter is only showed when the input signal type is set to mA, mV or V. (See also the cut-off function for further detail)

High scale for linear input

Select the high scale corresponding to high linear input signal (INH). The default low linear input signal for mA, mV and V is 20.00mA, 50.00mV and 10.00V separately. This parameter is only showed when the input signal type is set to mA, mV or V. (See also the cut-off function for further detail)

Cut-off function

The Cut-off function is used to limit the process value of linear input signal (mA, mV or V) within the boundary whenever the input signal is out of the high/low limit range (set by Hilt and LoLt). The cut-off function can be set to “Low”, “High” or “High/Low”, set to “None” disables the cut-off function. The cut-off function has no effect for input signal other than linear input.

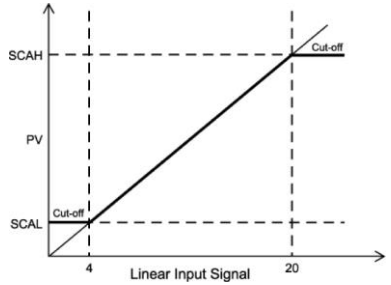


Figure 14. Scale and Cut-off Function

PV scale calculation : $$PV = \frac{IN-INL}{INH-INL}(SCAH - SCAL) + SCAL$$

where
IN: the linear input signal.
INH: the high calibration of linear input signal. It is set in calibration parameters (the factory default is mAH=20.00, mVH=50.00 and VH=10.00).
INL: the low calibration of linear input signal. It is set in calibration parameters (the factory default is mAL=4.00, mVL=0.00 and VL=0.00).
Example :
For a 4~20mA input signal, the INL is set by mAL=4.00mA and the INH is set by mAH=20.00mA. Set SCAL=0.0 SCAH=100.0 (Of course, you may select other scale value and decimal point to alter the resolution) and LoLt=0.0 HiLt=100.0.
For a 12mA input, the PV will be 50.0.
For a 22mA input, the PV will be 112.5 with cut-off function set to “None” or 100.0 with cut-off function set to “High” or “High/Low”.
For a 0mA input, the PV will be -25.0 with cut-off function set to “None” or 0.0 with cut-off function set to “Low” or “High/Low”.

Unit
Select the process value indication in °C or °F when the input signal type is set to thermocouple or PT100. Select engineer unit for linear input (mA, mV or V).

Decimal point
Select the decimal point position. The setting 00.00 and 0.000 is available for linear input only.

Control action
Dir – Direct action used for cooling process
Rev – Reverse action used for heating process

Low limit
Set the low limit of measuring range. When the PV goes below the low limit, the PV display flashing indicates a low limit error. The control output and alarm will be set according to the Error Protection.

High limit
Set the high limit of measuring range. When the PV goes beyond the high limit, the PV display flashing indicates a high limit error. The control output and alarm will be set according to the Error Protection.

Digit filter
Set the time constant for digit filter (the first order filter). It is useful when the process value is too unstable to be read.

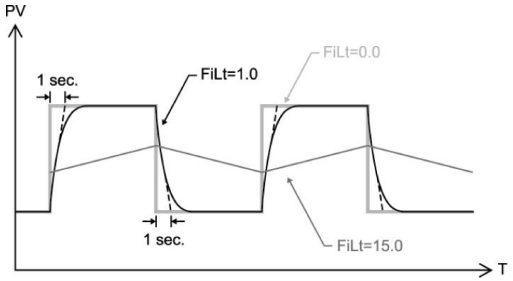


Figure 15. Digit Filter

Time scale
Set the time scale used for alarm delay time and ramp rate.
HH.MM – The alarm delay time is in hour and minute / The ramp rate is in per minute.
MM.SS – The alarm delay time is in minute and second / The ramp rate is in per second.

Error protection
Set the control output and alarm status whenever an error occurred. (refer to 4 Error Message)

Error protection	C1	A1	A2 / C2
0000	OFF	OFF	OFF
0001	OFF	OFF	ON
0010	OFF	ON	OFF
0011	OFF	ON	ON
0100	ON	OFF	OFF
0101	ON	OFF	ON
0110	ON	ON	OFF
0111	ON	ON	ON

Setpoint offset
Shift the setpoint value with an offset. The actual control target is shifted with this offset from setpoint value but not added to SV display.

Process value offset correction
A value to be added to PV to correct the sensor offset error

Security lock
The security lock is useful to lock out the parameters from unauthorized changed

Security lock	
0000	Only the security lock is open to change, all other parameters are locked
0001	Only the security lock and setpoint value is changeable. all the other parameters are locked
0010	The user level is open to change.
0011	The user and alarm levels are open to change.
0100	The user, alarm, and soft levels are open to change.
0101	The user, alarm soft and PID levels are open to change.
0110	All parameters are open to change.

3.3.8 ECO level

Display	Description	Range	Default	Unit
SEt	Turn On or Off ECO mode	On or Off	On	N/A
t inE	Time to enter ECO mode	10~60	30	Sec.
br i	Display brightness of ECO mode	0 ~ 2	2	N/A

Turn On or Off ECO mode
ECO mode is useful to saving power consumption by reducing the brightness of LED display.

Time to enter ECO mode
Set the time duration to enter ECO mode when there is no any key operation

Display brightness of ECO mode
Set the display brightness of ECO mode. Set to 0, the display will turn off and the LED indicators are lit with lowest brightness

4. Error Message

Display	Error Description	Correction
oPEn	Sensor break or open	1. Check the sensor is connected and input signal type is selected correctly. 2. Replace the sensor
AdEr	Input signal has out of A/D converter range	1. Check the sensor is connected and input signal type is selected correctly. 2. Replace the sensor. 3. Return to the supplier for repairing
EPEr	The content of EEPROM is corrupt	1. Return to default setting by pressing shift and down keys simultaneously while power on. And reconfigure the parameters 2. Return to the supplier for repairing
AtEr	Fail to complete the auto-tuning process within 2 hours	1. Retry the auto-tuning again. 2. Improve the control process to have fast response or use manual tuning instead of auto-tuning
Flashing	The PV is out of range	1. Check the sensor is connected and input signal type is selected correctly 2. Check the polarity of sensor is connected correctly 3. Check the high/low limit is set properly. 4. Replace the sensor