DITEL

**SW series**
**Digital Temperature Controller**

# MICRO-CONTROLLER (96 × 96 mm)

## MICRO-CONTROLLER SW96

DATA SHEET

SW96

**SW96** is an extremely compact temperature controller which has 96 x 96 mm front panel with a large, white LCD and 58-mm depth behind panel.
Developed as a successor to the standard model SY, **SW96** features fast sampling speed (50 ms), highly accurate input indication, and universal input, in addition to various functions of SZ, while achieving a competitive price.
Equipped with multiple input/output and sophisticated control functions, **SW96** serves as a suitable temperature controller for a wide range of use.


## FEATURES

1. Enhanced control performance which makes **SW96** suitable for a wide range of application
   - Fast sampling speed of 50 ms (SY: 500 ms)
   - Improved input indication accuracy
     For example: indication accuracy when measuring around 0.0°C by using type K thermocouple of which measuring range 0.0 to 400.0°C: ±1.1°C (cf. SY96: ±3.1°C)
   - Freely configurable control cycle (100 ms to 99 s)
   - Control method selectable among 7 types
     (ON/OFF control, PID control, fuzzy PID control, self-tuning control, PID2 control, 2-degrees-of-freedom PID control, motorized valve control (with position feedback input))
2. Any type of input can be accepted
   - Universal input is supported (thermocouple, RTD, voltage, current)
   - Control output is selectable among 4 types (Relay contact, SSR drive, current linear, voltage linear)

   The following optional functions can be incorporated:
   - Up to 3 digital inputs and 5 digital outputs
   - Remote SV input, analog re-transmission output
   - Motorized valve control output (with position feedback input)
   - Current monitoring using CT
3. Easy-to-see clear display and user-friendly interface
   - Wide viewing angle, high luminance white LED backlit LCD
   - Large PV display (with character height of 26 mm which is the highest in the market)
   - Easy-to-distinguish parameter display with screen numbers
   - Easy-to-identify 11 segment alphanumeric display
   - Digit select key for easier value-setting (5 keys)
4. Most compact design in the market
   - Approx. 30% reduction in size compared to conventional models.
     (58 mm depth behind panel)
5. A variety of functions extending the possibility of temperature controller
   - 64 steps ramp/soak function
   - 8 PID setting pallets, 8 SV pallets, zone PID facilitate frequent change of control conditions
   - Loader interface provided as standard (Power can be supplied via loader cable. Loader software is available from our web site)
   - RS485 communication (optional) capable of cooperative operation, programless communication

## SPECIFICATIONS

**1. General specifications**

**Power supply:**
100 V (-15%) to 240 V (+10%) AC, 50/60 Hz;
24 V (±10%) DC/AC

**Power consumption:**
13 VA MAX. (100 to 240 V AC), 8 VA MAX. (24 V DC/AC)

**Insulation resistance:**
20 MΩ or more (at 500 V DC)

**Withstand voltage:**
Power source ↔ all terminals: 1500 V AC for 1 min
Relay contact output ↔ all terminals: 1500 V AC for 1 min
Between others 500 V AC for 1 min

**2. Input section**

**2.1 Process value input**

**Number of input:** 1

**Input setting:**
Programmable scale

**Input signal:** See Table 1
(Universal input: thermocouple, RTD, voltage, current)

**Standard measurement range and input type:**
See Table 1

**Indication accuracy (at Ta = 23°C):**
- Thermocouple input: either ±1°C ±1 digit or ±0.3% ±1

digit of indicated value, whichever is larger
*except:
Thermocouple B: 0 to 400°C: no accuracy assurance
Thermocouple R: 0 to 500°C: ±3°C ±1 digit
Thermocouples K, T, E, U, or N: -200 to -100°C: ±2°C ±1 digit
- RTD input: ±0.8°C ±1 digit or ±0.2% ±1 digit of indicated value, whichever is larger
- mV input, voltage input, current input: ±0.3%FS ±1 digit

**Temperature effect on sensitivity:**
±0.3%FS/10°C
**Indication resolution:**
See Table 1
**Input sampling rate:**
50 ms
**Input impedance:**
- Thermocouple, mV input: 1 MΩ or more
- Current input: 150 Ω or less (built-in diode)
- Voltage input: About 1 MΩ

**Variation by signal source resistance:**
- Thermocouple, mV input: ±0.3%FS ±1 digit per 100 Ω
- Voltage input: ±0.3%FS ±1 digit per 500 Ω

**Allowable wiring resistance:**
RTD: 10 Ω or less (per wire)
**Allowable input voltage:**
- DC voltage input: within ±35V
- Current input: within ±25 mA
- Thermocouple, RTD, mV input: within ±5 V

**Noise reduction ratio:**
- Normal mode: 40 dB (50/60 Hz)
- Common mode: 120 dB (50/60 Hz)
- Between input and power supply: ±1°C, at 220 V AC, 50/60 Hz

**Input correction:**
(a) User adjustment: ±50%FS for each of zero and span point
(b) Process value shift: ±10%FS
(c) Input filter: 0.0 to 120.0 sec (filter OFF if set at 0.0)
(d) Square root extraction: -0.1 to 105% (OFF if set to -0.1%)

**Overrange, underrange:**
Beyond range of -5 to 105% (accuracy not guaranteed between -5 and 0, and between 100 and 105%FS)
*Pt (-200 to 850°C) input: out of the range between -2 to 105%
0 to 10 V DC input: out of the range between -2 to 105%
Thermocouple E input: out of the range between -5 to 102%

### 2.2 Remote SV input (optional)

**Number of inputs:**
1
**Input signal:**
Voltage: 0 to 5 V DC /1 to 5 V DC/0 to 10 V DC,
Current: 0 to 20 mA DC/4 to 20 mA DC (a 250Ω resistor is required for current input)
**Input impedance:**
About 1 MΩ
**Sampling rate:**
50 ms

### 2.3 Current transformer (CT) input (optional)

**Input type:**
Single phase CT, 1 point
For 1 A to 30 A: 40800018
For 20 A to 100 A: 40800019F
**Range of detected current:**
1 A to 100 A
**Detected current accuracy:**
Setpoint ±5% FS
**Detected current resolution:**
0.1 A
**ON time necessary for detection:**
300 ms MIN.

### 2.4 Digital input (DI) (optional)

**Number of points:**
Up to 3
**Specifications:**
No-voltage contact or transistor input
**Contact capacity:**
5 V DC, about 2 mA (per point)
**Input judgment:**
ON voltage: 2 V DC or lower
OFF voltage: 3 V DC or higher
**Sampling pulse width:**
50 ms MIN.
**Functions:**
Remote mode selection, SV changeover, control standby, AT startup, timer startup, alarm unlatch, program selection, start/stop/reset, PID switching (normal/reverse), etc.

### 2.5 Valve position feedback signal (potentiometer) input (optional)

**Resistance range:**
100 Ω to 2.5 kΩ (three-wire)
**Resolution:**
0.5%FS
**Input accuracy:**
±1.0%FS
**Temperature effect on sensitivity:**
±0.5%FS/10°C
**Burnout function:**
Not provided

## 3. Output section

### 3.1 Control output

**Number of points:**
Up to 2 (2 points: Heating/cooling control)
**Type:**
selected among (1) to (6) below
(1) Relay contact output (SPST)
- Proportional cycle: 1 to 150 sec
- Contact structure: SPST (single pole single throw)
- Contact capacity: 250 V AC/30 V DC, 3 A (resistive load)
- Minimum ON/OFF current: 10 mA (5 V DC)
- Mechanical life: 20 million operations MIN. (100 operations/min)
- Electrical life: 100,000 operations MIN. (rated load)

(2) Relay contact output (SPDT)
- Proportional cycle: 1 to 150 seconds
- Contact structure: SPDT (single pole double throw)
- Contact capacity: 250 V AC/30 V DC, 5 A (resistive load)
- Mechanial life: 50 million operations MIN. (100 operations/min)
- Electrical life: 100,000 operations MIN. (rated load)

(3) SSR/SSC drive output
- Proportional cycle: 1 to 150 sec
- ON voltage: 12 V DC (between 10.7 and 13.2V DC)
- OFF voltage: 0.5 V DC or lower
- Maximum current: 20 mA DC
- Load resistance: 600 Ω MIN.

(4) Current output (0 to 20 mA DC/4 to 20 mA DC)
- Accuracy: ±5%FS
- Load resistance: 500 Ω MAX.

(5) Voltage output (0 to 5 V DC/1 to 5 V DC/0 to 10 V DC/2 to 10 V DC)
- Accuracy: ±5%FS
- Load resistance: 10 kΩ MIN.

(6) Motorized valve control output
- Contact structure: 2 SPST contacts without interlock circuit
  *SPST: Single Pole Single Throw
- Contact capacity: 250 V AC/30 V DC, 3A (resistive load)
- Minimum ON/OFF current: 100 mA (24 V DC)
- Mechanical life: 20 million operations MIN. (100 operations/min)
- Electrical life: 100,000 operations MIN. (rated load)

### 3.2 Alarm output (optional)

**Number of outputs:**
Relay contact output: up to 5 (shared common)
up to 3 (independent common)

**Output specifications:**
Relay contact output
Contact structure: SPST (single pole single throw)
Contact capacity: 250 V AC/30 V DC, 1 A (resistive load)
Minimum ON/OFF current: 10 mA (5 V DC)
Mechanical life: 20 million operations MIN.
(100 operations/min)
Electrical life: 100,000 operations MIN. (rated load)

**Output functions:**
Alarm output (see "Alarm function"), main unit control mode output, program status output, control output 1 and 2, etc.

**Output cycle:**
100 ms

### 3.3 Re-transmission output (optional)

**Number of points:**
1

**Type:**
Current/voltage output (0 to 20 mA DC/4 to 20 mA DC/0 to 5 V DC/1 to 5 V DC/ 0 to 10 V DC/2 to 10 V DC)
- Guaranteed output range: 0 to 21 mA DC/0 to 10.5 V DC
- Accuracy: ±0.2%FS (±5%FS at 1 mA or smaller)
- Resolution: 10,000 MIN.
- Load resistance: 500 Ω MAX. (current), 10 kΩ MIN. (voltage)

**Output cycle:**
100 ms

**Output contents:**
PV, SV, DV, MV

**Additional function:**
Scaling function

## 4. Indication/setting section

### 4.1 Display unit

**Type:**
LCD (with backlight)

**Indication contents:**
Process value indication: 11-segment, 4-digit [white]
Setpoint indication: 11-segment, 4-digit [green]
Screen No. indication: 7-segment, 4-digit [orange]
Indication status: 42 indicator lamps

**Luminance setting:**
possible (4 steps)

### 4.2 Setting section

**Type:**
Sheet type keys (with emboss)

**Number of keys:**
5 keys

## 5. Control functions

### 5.1 Control types

**ON/OFF control**

**PID control**
- Dual control (heating/cooling)
- PID parameters determination: Auto tuning

**Fuzzy PID control**
- Dual control (heating/cooling)
- PID parameters determination: Auto tuning

**Self tuning control**

**PID2 control**
- Dual control (heating/cooling)
- PID parameters determination: Auto tuning

**2-degrees-of-freedom PID**
- PID parameters determination: Auto tuning

**Position proportional PID (servo) control with position feedback**
- Full stroke time: 30 seconds MIN.

### 5.2 Control parameters

- Proportional band (P): 0.1 to 999.9%
- Integral time (I): 0 to 3200 sec.
  Integral time control invalidated when I = 0.
- Differential time (D): 0.0 to 999.9 sec.
  Differential time control invalidated when D = 0.
- Control cycle: 100 to 900 ms (in 100 ms), 1 to 99 s (in seconds)
- Anti-reset windup:
  0 to 100% of measurement range
- Hysteresis band: 50% of measurement range
  (at 2-position control only)
- Number of SV and PID combinations: 8 combinations. Changed by any of parameter setting, digital input, communication, user function keying, zone change.

### 5.3 Control mode

**Mode type:**
Auto, Manual, Remote
* During 2-position control in Manual mode, 2-position manual operation with MV = 100% or 0% is operated.

**Mode switching:**
- Auto↔Manual: Balanceless·bumpless
- Auto/Manual → Remote: Balance·bumpless
- Auto/Manual ← Remote: Balance·bumpless

## 6. Alarm function

### 6.1 Number of alarm setting points

Up to 5 points (according to the number of DOs)

### 6.2 Alarm type

Process value (upper limit/lower limit, absolute/deviation, range), main unit error, etc.
(non-excitation, delay, latch, timer function option provided)

### 6.3 Heater current alarm function (optional)

*Current detector (CT) is to be prepared separately
(see page 7.)

**Detectable range:**
1 A to 100 A

**Detected current resolution:**

0.1 A

**Setting resolution:**
0.1 A

**Hysteresis:**
0.0 A to 100.0 A

## 7. Communication function

### 7.1 RS-485 interface (optional)

**Number of points:**
1 point

**Physical specifications:**
EIA-485

**Protocol:**
Modbus-RTU

**Communication method:**
Half duplex bit serial, Asynchronous communication

**Code type:**
Data length: 8 data bits. Parity: Odd, even, none.

**Communication rate:**
9600 bps, 19200 bps, 38.4 kbps, 115.2 kbps

**Connection status:**
Up to 32 units connectable including multidrop master function

**Communication distance:**
Up to 500 m (total connect extension)

**Additional functions:**
- Cooperative operation
  The function in which several temperature controllers (as slave devices) can be operated by a master temperature controller.
- Programless communication
  The function in which a temperature controller can communicate with a PLC without program.
  Supported PLCs: Mitsubishi PLC Q series
  Siemens PLC S7 series

## 8. Processing at power failure

Memory protection: Protect by non-volatile memory

## 9. Self-diagnosis

Method: Program error supervision by watchdog timer

## 10. Operation and storage conditions

**Operating ambient temperature:**
-10 to 50°C

**Storage temperature:**
-20 to 60°C

**Operating/storage ambient humidity:**
90%RH MAX. (no condensing)

**Warm-up time:**
30 min MIN

**Vibration:**
During transportation 9.8 m/s$^2$ (1G) or less

**Impact:**
During transportation: 294 m/s$^2$ (30G) or less

## 11. Structure

**Mounting method:**
Panel mount

**External terminals:**
Screw terminals, M3

**Case: material:**
- ABS, PPO
- Non-combustibility grade: UL94V-0 equivalent
- Color: Black

**Protection structure:**
- Panel front side: IP66, NEMA-4X equivalent
  (When the panel is mounted using our genuine packing. Not water-proof if mounted closely together.)
- Body: IP20 equivalent (slits on top and bottom)
- Terminals: IP00 equivalent. Terminal cover can be mounted optionally.

**Dimensions:**
96 (W) × 96 (H) × 58 (D) mm

**Weight:**
approx. 220g

## 12. User customize function

### 12.1 Program (ramp/soak) function

**Number of program steps:**
64 steps x 1 pattern,
32 steps x 2 pattern,
16 steps x 4 pattern
8 steps x 8 pattern
(1 step = 2 segments)

**Control option:**
Operation control by digital input
Status output by digital output

**Basic functions:**
(1) Segment time can be set in “Hour, Minutes” or “Minutes, Seconds”
(2) Guarantee soak
(3) Repeat action
(4) PV start
(5) Delay start
(6) Power restoring function

**Memory backup:**
EEPROM

### 12.2 User functions

Pressing the user key can perform Auto/Manual change, Standby ON/OFF change, local SV/remote SV change, ramp/soak change or other functions as assigned.

### 12.3 Password function

3-level password function

## 13. Simple power-monitoring function and operating days alarm

### 13.1 Simple power-monitoring function

- By connecting a current transformer (to be prepared separately), electric power consumption of a heater can be displayed.
  (Electric power is calculated with the fixed voltage value.)
- Current detector (CT) is to be prepared separately (see page 7.)
- Current detection range: 1 A to 100 A

### 13.2 Operating days alarm

- Displays the operating days and activates alarm output (optional) when it exceeds the setpoint.
- This function is useful for preventive maintenance because it let you know the appropriate time for maintenance work.

**Table 1 Measurement range**

| Input type | | Code (PvT) | Measurement range [°C] | Minimum input increment [°C] |
|---|---|---|---|---|
| | Pt100 | PT1 | 0.0 to 150.0 | 0.1 |
| | | PT2 | 0.0 to 300.0 | 0.1 |
| | | PT3 | 0.0 to 500.0 | 0.1 |
| | | PT4 | 0.0 to 600.0 | 0.1 |
| | | PT5 | -50.0 to 100.0 | 0.1 |
| | | PT6 | -100.0 to 200.0 | 0.1 |
| | | PT7 | -199.9 to 600.0 | 0.1 |
| | | PT8 | -200 to 850 | 1 |
| Thermocouple | J | J1 | 0.0 to 400.0 | 0.1 |
| | | J2 | -20.0 to 400.0 | 0.1 |
| | | J3 | 0.0 to 800.0 | 0.1 |
| | | J4 | -100 to 1000 | 1 |
| | K | K1 | 0 to 400 | 0.1 |
| | | K2 | -20.0 to 500.0 | 0.1 |
| | | K3 | 0.0 to 800.0 | 0.1 |
| | | K4 | -200 to 1300 | 1 |
| | R | R | 0 to 1700 | 1 |
| | B | B | 0 to 1800 | 1 |
| | S | S | 0 to 1700 | 1 |
| | T | T1 | -199.9 to 200.0 | 0.1 |
| | | T2 | -199.9 to 400.0 | 0.1 |
| | E | E1 | 0.0 to 800.0 | 0.1 |
| | | E2 | -150.0 to 800.0 | 0.1 |
| | | E3 | -200 to 800 | 1 |
| | L | L | -100 to 850 | 1 |
| | U | U1 | -199.9 to 400.0 | 0.1 |
| | | U2 | -200 to 400 | 1 |
| | N | N | -200 to 1300 | 1 |
| | W | W | 0 to 2300 | 1 |
| | PL-II | PL-2 | 0 to 1300 | 1 |
| DC voltage | 0 to 5 V | 0-5V | "-1999 to 9999 (Scaling range)" | - |
| | 1 to 5 V | 1-5V | | |
| | 0 to 10 V | 0-10 | | |
| | 2 to 10 V | 2-10 | | |
| | 0 to 100 mV | MV | | |
| DC current | 0 to 20 mA | 0-20 | | |
| | 4 to 20 mA | 4-20 | | |

* Input signal, measurement range, and set value at the time of delivery are as follows:

Thermocouple K, Measurement range from 0 through 400C, Set value 0 C.
Switching the input signal among thermocouple, RTD, current, and voltage is available by key operation on the front panel.

# CODE SYMBOLS

**Model Specifications**

| | TYPE | SYROS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Front panel size W x H 48 x 96 mm | SW96 | | | | A | B | C | D | E | F | G |
| **A** | **CONTROL OUTPUT 1** | | | | | | | | | | | |
| | Relay contact SPST | | | | | 1 | | | | | | |
| | Relay contact SPDT | | | | | 2 | | | | | | |
| | SSR drive control | | | | | 3 | | | | | | |
| | Current output (0-20 mADC / 4-20 mADC) | | | | | 4 | | | | | | |
| | Voltage output (0-5 VDC / 1-5 VDC/ 0-10 VDC / 2-10 VDC | | | | | 5 | | | | | | |
| **B** | **CONTROL OUTPUT 2** | | | | | | | | | | | |
| | None | | | | | | 0 | | | | | |
| | Relay contact SPST | | | | | | 1 | | | | | |
| | SSR drive control | | | | | | 2 | | | | | |
| | Current output (0-20 mADC / 4-20 mADC) | | | | | | 3 | | | | | |
| | Voltage output (0-5 VDC / 1-5 VDC/ 0-10 VDC / 2-10 VDC) | | | | | | 4 | | | | | |
| | Re-transmission output (0-20 mADC / 4-20 mADC) | | | | | | 5 | | | | | |
| | Re-transmission output (0-5 VDC / 1-5 VDC/ 0-10 VDC / 2-10 VDC) | | | | | | 6 | | | | | |
| **C** | **ALARM OUTPUT** | | | | | | | | | | | |
| | None | | | | | | | 0 | | | | |
| | 1 point | | | | | | | 1 | | | | |
| | 2 points | | | | | | | 2 | | | | |
| | 3 points | | | | | | | 3 | | | | |
| | 2 points (independent common) | | | | | | | 4 | | | | |
| **D** | **POWER SUPPLY** | | | | | | | | | | | |
| | 100-240 VAC | | | | | | | | 1 | | | |
| | 24 VDC / 24 VAC | | | | | | | | 2 | | | |
| **E** | **OPTIONS** | | | | | | | | | | | |
| | None | | | | | | | | | 0 | | |
| | RS485 Communication | | | | | | | | | 1 | | |
| | Digital input (DI1, DI2) | | | | | | | | | 2 | | |
| | Remote SV input + Digital input (DI3) - Note 2 | | | | | | | | | 3 | | |
| | CT input + Digital input (DI1) - Note 1 | | | | | | | | | 4 | | |
| | RS485 Communication + Digital input (DI1) | | | | | | | | | 5 | | |
| | RS485 Communication + Digital input (DI3,4,5) + Alarm (AL4,5) | | | | | | | | | 6 | | |
| **F** | **SPECIAL VERSION** | | | | | | | | | | 0 | |
| **G** | **SPECIAL VERSION** | | | | | | | | | | | 0 |
| | | | | | | | | | | | | |

**NOTES;**

1- When using the CT input as a heather burnout alarm, add one alarm output in the (C) code.

2- When using the current input for the remote SV input, add a 250 Ohm resistor to the input terminal

# SCOPE OF DELIVERY

- Controller × 1
- Instruction manual × 1
- Panel mounting adapter × 2
- Watertight packing × 1

| | TYPE (MOTORIZED VALVE CONTROL) | SYROS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Front panel size W x H 48 x 96 mm | SW96 | | | | A | B | C | D | E | F | G |
| A | **CONTROL OUTPUT 1** | | | | | | | | | | | |
| | Motorized valve control output (without PFB input) | | | | | S | | | | | | |
| | Motorized valve control output (with PFB input) | | | | | V | | | | | | |
| B | **CONTROL OUTPUT 2** | | | | | | | | | | | |
| | None | | | | | | 0 | | | | | |
| C | **ALARM OUTPUT** | | | | | | | | | | | |
| | None | | | | | | | 0 | | | | |
| | 1 point | | | | | | | 1 | | | | |
| | 2 points | | | | | | | 2 | | | | |
| | 2 points (independent common) | | | | | | | 3 | | | | |
| D | **POWER SUPPLY** | | | | | | | | | | | |
| | 100 - 240 VAC | | | | | | | | 1 | | | |
| | 24 VDC / 24 VAC | | | | | | | | 2 | | | |
| E | **OPTIONS** | | | | | | | | | | | |
| | None | | | | | | | | | 0 | | |
| | RS485 Communication + Digital input (DI1, 2, 3) | | | | | | | | | 1 | | |
| F | **SPECIAL VERSION** | | | | | | | | | | 0 | |
| G | **SPECIAL VERSION** | | | | | | | | | | | 0 |

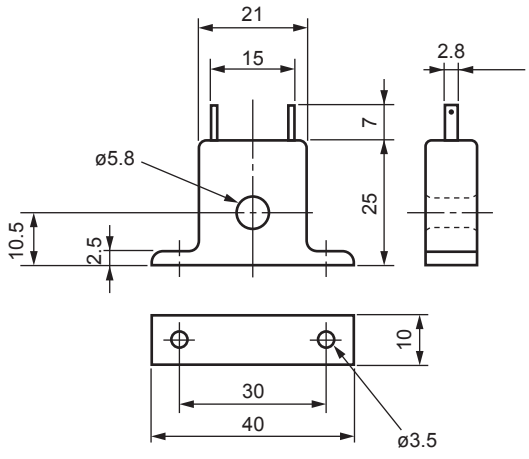
## OPTIONAL ITEMS

| | |
|---|---|
| Current detector (CT) 1 to 30 A | Type: 40800018 |
| 20 to 100 A | Type: 40800019 |
| Terminal cover | Type: 14000216 (2 pieces) |
| Shunt resistor (250Ω ± 0.1%) | Type: 40800032 |

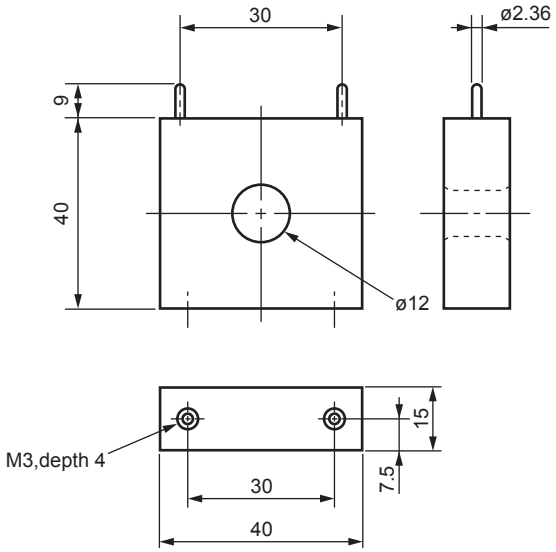
Note) Two terminal covers are necessary.

Current detector (CT)

• Specification : 1 to 30 A

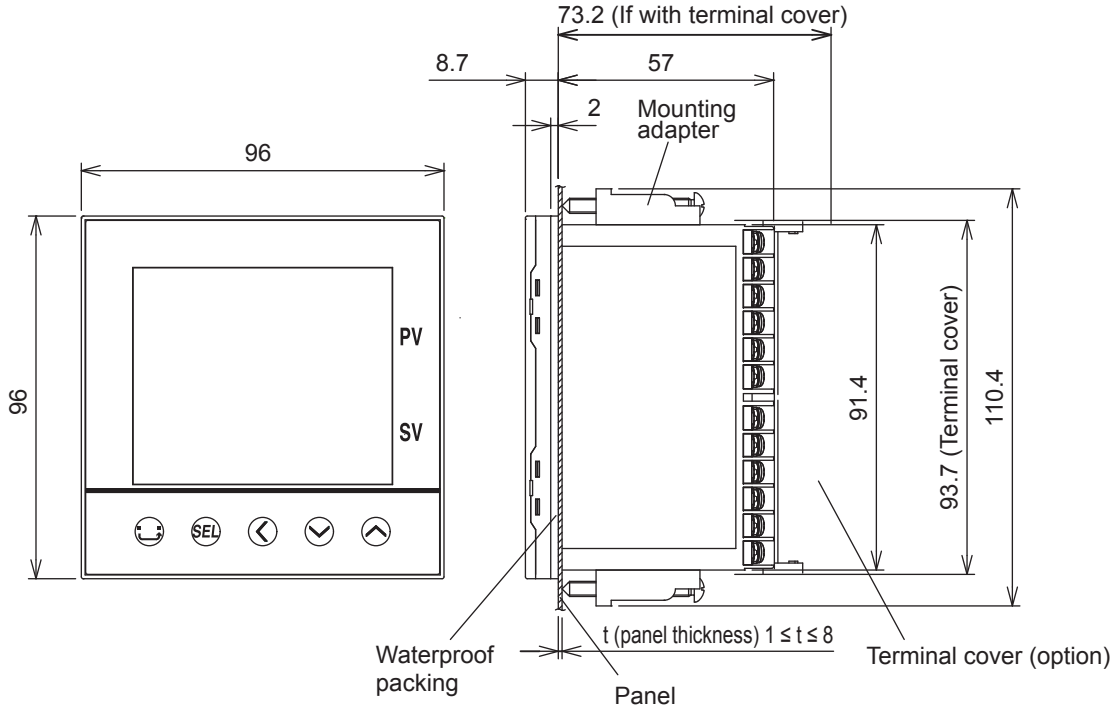



• Specification : 20 to 100 A

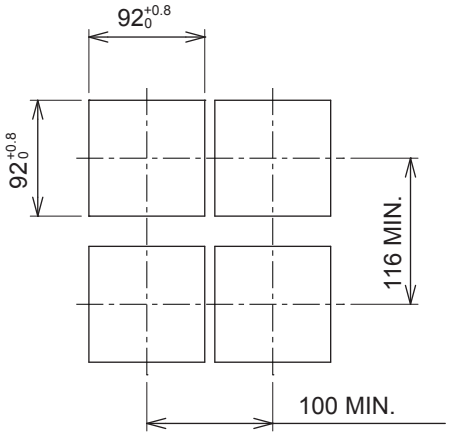


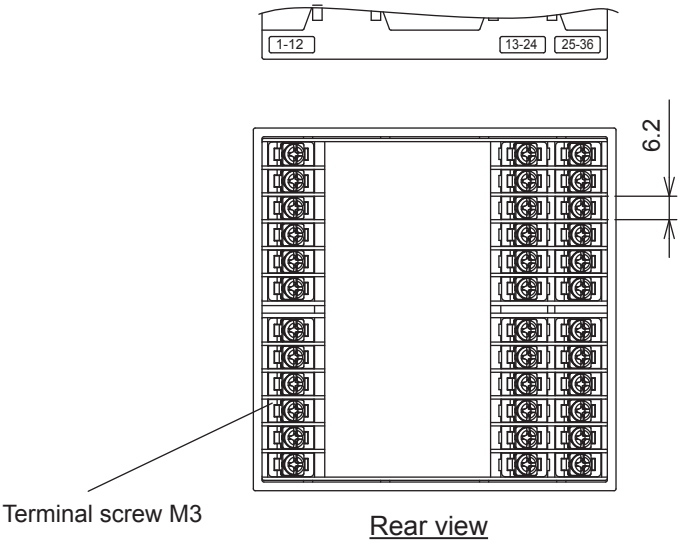

Note 1) Detection is available only for single phase heater.
Note 2) Unusable for heater control by thyristor phase angle control.

## OUTLINE DIAGRAM (Unit : mm)




## PANEL CUTOUT SIZE (Unit : mm)

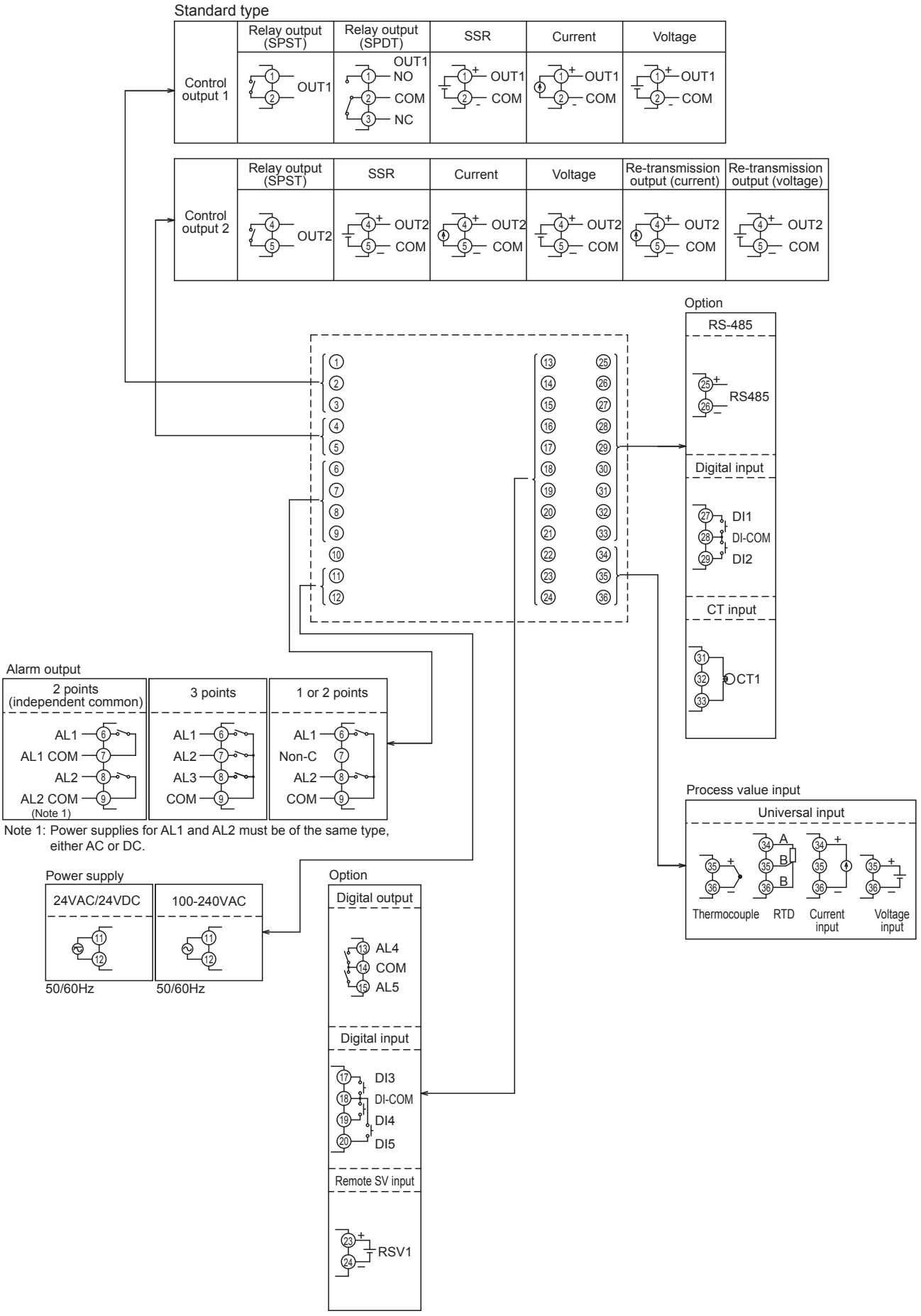


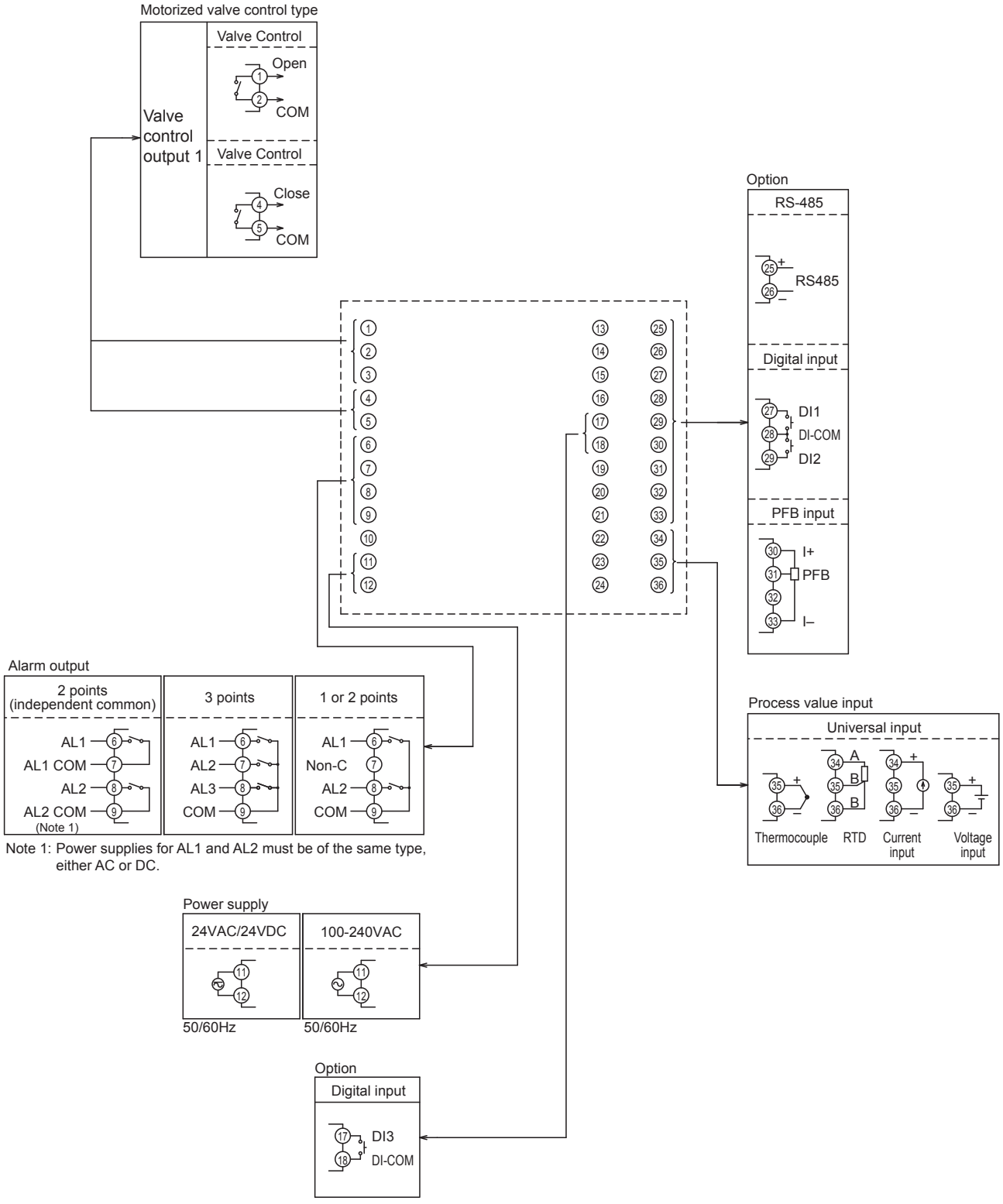

Terminal block is not attached to unused terminals (terminal 13 to 24) according to the model.

# TERMINAL ALLOCATION

**Standard type**

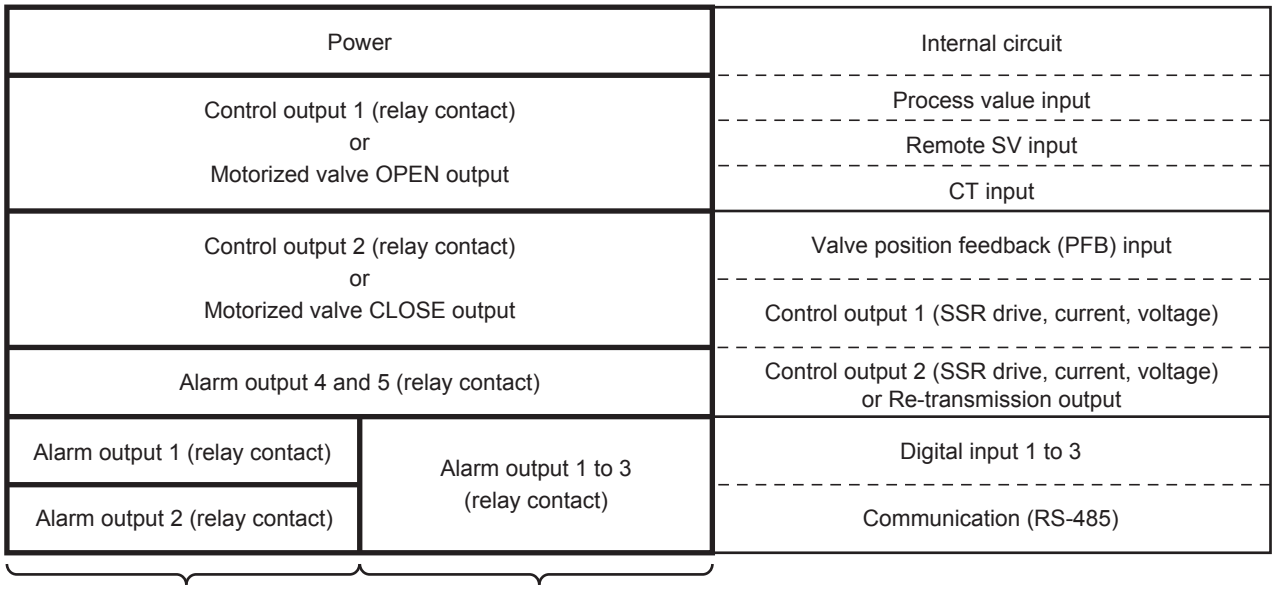


**Motorized valve control type**




Note 1: Power supplies for AL1 and AL2 must be of the same type, either AC or DC.

## INSULATION BLOCK DIAGRAM




- When the C code is "4"
  AL 1 and 2:
  independent common
- When the C code is other than "4"
  AL 1 to 3: shared common

: Basic insulation
: Functional insulation
: No insulation

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