

Digital Controller-Version II

ES100X/P

Intelligent Digital Controller and Programmer

- Programmed with easy-to-use support software (ES Tools) or use front panel
- Use fuzzy fine-tuning to easily accomplish precise adjustment of PID parameters
- Programmable front panel function keys and five levels of security enhance operator interface without compromising system integrity
- A hybrid control function (advanced PID and fuzzy logic) is incorporated for high-precision control
- A single controller performs cascade, feed forward, ratio, valve control, heat/cool control (ES100 Models with secondary inputs are also available)
- A maximum of 400 steps are possible (99 program patterns, 99 steps)

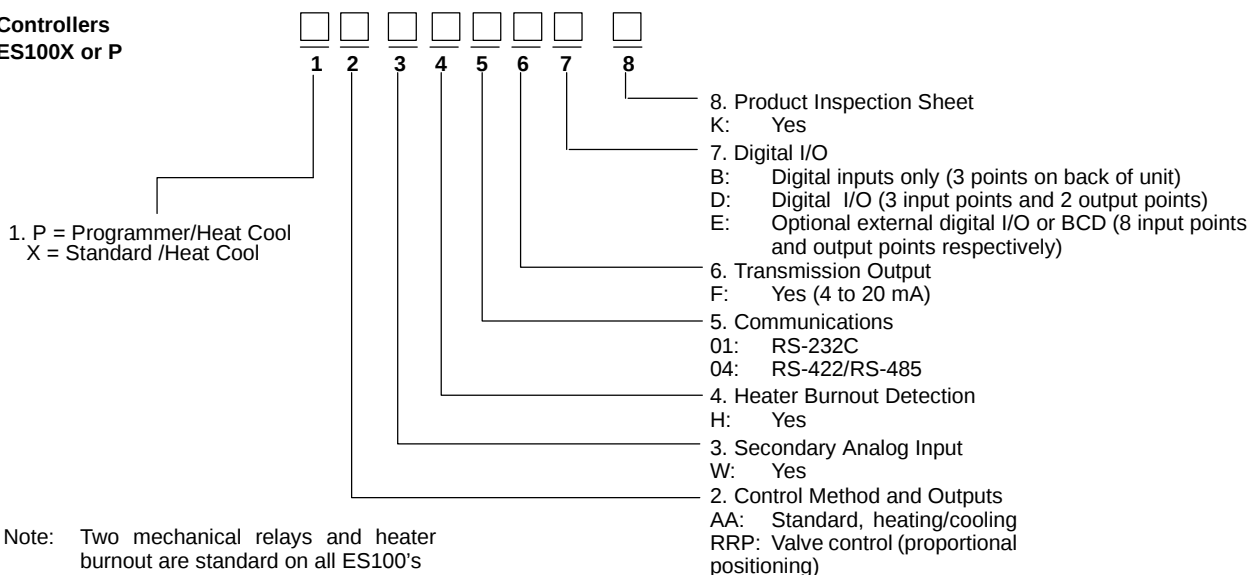


Ordering Information

The Controller part number does not include an output module. Order one or two Output Module(s) separately for each Controller.

MODEL NUMBER LEGEND

Controllers
ES100X or P



■ PROCESS CONTROLLERS

All ES 100's come standard with two control outputs and two relay outputs.

8-Bank Process Controller					
Control System	Analog Inputs	Digital on-board/external inputs and outputs	Serial communications	Transfer Output	Part number
Standard and Heating/Cooling (see note 1)	1	None	None	None	ES100X-AAH
	1	3 inputs	None	4 to 20 mA	ES100X-AAHFB
	1	8 external inputs and outputs	None	4 to 20 mA	ES100X-AAHFE
	1	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100X-AAH01FE
	1	8 external inputs and outputs	RS-422/485 (see note 2)	4 to 20 mA	ES100X-AAH04FE
	2	3 inputs	None	4 to 20 mA	ES100X-AAWHFB
	2	8 external inputs and outputs	None	4 to 20 mA	ES100X-AAWHFE
	2	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100X-AAWH01FE
	2	8 external inputs and outputs	RS-422/485 (see note 2)	4 to 20 mA	ES100X-AAWH04FE
Valve Positioning (see note 3)	1	3 inputs	None	4 to 20 mA	ES100X-RRPFB
	1	8 external inputs and outputs	None	4 to 20 mA	ES100X-RRPFE
	1	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100X-RRP01FE
	1	8 external inputs and outputs	RS-422/485 (see note 2)	4 to 20 mA	ES100X-RRP04FE
	2	3 inputs	None	4 to 20 mA	ES100X-RRPWHFB
	2	8 external inputs and outputs	None	4 to 20 mA	ES100X-RRPWHFE
	2	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100X-RRPWH01FE
	2	8 external inputs and outputs	RS-422/485 (see note 2)	4 to 20 mA	ES100X-RRPWH04FE
8-Bank Programmable Ramp/Soak Process Controller					
Control System	Analog Inputs	Digital on-board/external inputs and outputs	Serial communications	Transfer Output	Part number
Standard and heating/cooling (note 1)	1	None	None	4 to 20 mA	ES100P-AAH
	1	3 inputs, 2 outputs	None	4 to 20 mA	ES100P-AAHFD
	1	8 external inputs and outputs	None	4 to 20 mA	ES100P-AAHFE
	2	8 external inputs and outputs	None	4 to 20 mA	ES100P-AAWHFE
	1	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100P-AAH01FE
	2	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100P-AAWH01FE
	1	8 external inputs and outputs	RS-422/485 (note 2)	4 to 20 mA	ES100P-AAH04FE
	2	8 external inputs and outputs	RS-422/485 (note 2)	4 to 20 mA	ES100P-AAWH04FE
Valve Positioning (note 3)	1	3 inputs, 2 outputs	None	4 to 20 mA	ES100P-RRPFD
	1	8 external inputs and outputs	None	4 to 20 mA	ES100P-RRPFE
	2	8 external inputs and outputs	None	4 to 20 mA	ES100P-RRPWFE
	1	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100P-RRP01FE
	2	8 external inputs and outputs	RS-232C	4 to 20 mA	ES100P-RRPW01FE
	1	8 external inputs and outputs	RS-422/485 (note 2)	4 to 20 mA	ES100P-RRP04FE
	2	8 external inputs and outputs	RS-422/485 (note 2)	4 to 20 mA	ES100P-RRPW04FE

- Note:
1. Standard setting is factory default.
 2. Factory default is RS-422.
 3. Only relay control outputs are available.

Temperature Inputs (Selections Available within the ES100X/P Controller)

Input type (switch selectable)		Thermocouples					Platinum RTD
		Type R/S	Type K1	Type K2	Types J1/L1	Types J2/L2	Types JPt/Pt
Temperature range	°C	0 to 1,700	-200 to 1,300	0.0 to 600.0	-100 to 850	0.0 to 400.0	-199.9 to 600.0
	°F	0 to 3,000	-300 to 2,300	0.0 to 999.9	-100 to 1,600	0.0 to 750.0	-199.9 to 999.9
Unit of measure		1°C or F, main setting and alarm					

Input type (switch selectable)		Thermocouples					
		Types T/U	Type E	Type B	Type N	Type W	Type PLII
Temperature range	°C	-199.9 to 400	0 to 600	100 to 1,800	0 to 1,300	0 to 2,300	0 to 1,300
	°F	-199.9 to 700	0 to 1,100	300 to 3,000	0 to 2,300	0 to 3,000	0 to 2,300
Unit of measure		1°C or F, main setting and alarm					

Current/Voltage Inputs (Selections Available within the ES100X/P controller)

Input	Current		Voltage						
Range	4 to 20 mA	0 to 20 mA	0 to 10 mV	0 to 100 mV	-10 to 10 mV	1 to 5 V	0 to 1 V	0 to 5 V	0 to 10 V

■ OUTPUT MODULE - ORDER SEPARATELY

Output	Relay output	SSR output	Voltage output (for driving SSR)			Linear voltage output	Linear current output
			12 VDC, NPN	24 VDC, NPN	24 VDC, PNP		
Part number	E53-R	E53-S	E53-Q	E53-Q3	E53-Q4	E53-V34, 0-10 VDC, E53-V35, 0-5 VDC	E53-C3, 4-20 mA E53-C3D, 0-20 mA

Note: The E53-C cannot be used.

■ CURRENT TRANSFORMERS (CT) - ORDER SEPARATELY

Hole diameter	Part number
5.8 mm (0.23 inch)	E54-CT1
12.0 mm (0.47 inch)	E54-CT3

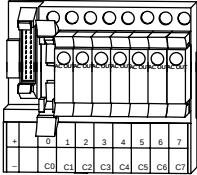
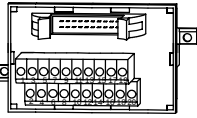
Note: The E54-CT2 cannot be used.

■ ES TOOLS SUPPORT SOFTWARE (IBM PC/AT PS/2) - ORDER SEPARATELY

Item		Part number
Support Software		ES100-YA904-EV2
Cable for Support Software	25-pin	ES100-CT022-202
	9-pin	ES100-CT023-202

Note: Cables for front jacks are sold separately.

■ CABLES - ORDER SEPARATELY

Description		Part Number
Connecting cables	For one G7TC-OC08 output block and XW2B-20G4/5 input block	G79-200C-175-ES1
	For G7TC-OC08 output block only	G79-200C-ES1
	For XW2B-34G4/5 BCD input block only	XW2Z-200C
Relay output blocks 	8 inputs, 12 VDC	G7TC-OC08-DC12
	8 inputs, 24 VDC	G7TC-OC08-DC24
Input terminal blocks  XW2B-20G4	8 inputs, DC	XW2B-20G4/5
	8 inputs, BCD	XW2B-34G4/5

■ ACCESSORIES - ORDER SEPARATELY

Item	Part number
Watertight Cover NEMA 4X	Y92A-96N
Terminal Cover (conforms to VDE0106)	E53-COV01

■ ES100 DOCUMENTATION

Manual	Catalog number
ES100P Digital Controller User's Manual	H69
ES100X Digital Controller User's Manual	H70
ES100 Support Software ES/TOOLS Support Software User's Manual	H71
ES100 Digital Controller User's Manual (Communications Guide)	H72
ES100 Digital Road Map Programming Manual	H03OAA1

Specifications

■ RATINGS

Supply voltage		100 to 240 VAC, 50/60 Hz
Operating voltage range		85% to 110% of rated supply voltage
Power consumption		Approx. 20 VA (at 100 VAC) to 25 VA (at 240 VAC)
Analog input 1 (main input)	Current input	4 to 20 mA, 0 to 20 mA (impedance: 150Ω±10%)
	Voltage input	1 to 5 V, 0 to 5 V, 0 to 1 V, 0 to 10 V, 0 to 10 mV, 0 to 100 mV, -10 to 10 mV (impedance: 1 MΩ min.)
	Thermocouple	R, S, K, J, T, E, B, N, L, U, PLII, W
	Platinum resistance thermometer	Pt100, JPt100
Analog input 2 (aux. input, ES100X only)	Current input	4 to 20 mA (impedance: 150Ω±10%)
	Voltage input	1 to 5 V (impedance: approx. 1 MΩ)
CT input (see note 1)		Connect the dedicated CT (E54-CT1 or E54-CT3).
Potentiometer input (see note 1)		100 Ω to 2.5 kΩ
Control output (see note 2)		Output Unit (sold separately) (use the Output Unit to obtain a control output. The position proportional output type, however, has Relay Output Units only.)
Control mode		Hybrid of fuzzy logic and advanced PID control with auto-tuning and fine-tuning or ON/OFF.
On board digital output	Relay output	Two Independent outputs (SPDT and SPST-NO), 250 VAC, 3 A
	Open collector output	Common outputs, 24 VDC ^{+10%/-15%} , max. load current: 100 mA
Transmission output		1 output, 4 to 20 mA with a load of 600 Ω max.
External signal input	Power supply	24 VDC ^{+10%/-15%} , (the model with expansion I/O needs an external power supply) Current when the signal is ON: 3 mA max. Leakage current when the signal is OFF: 0.3 mA max.
Setting method		Digital setting with Up and Down Keys or ES TOOLS Support Software (via RS-232C terminal on the front panel or remotely through back terminals)
Indication method		Digital indications (character height: PV: 14.2 mm, SV: 10.2 mm, BANK, STEP, PTN: 7.6 mm) (color PV: red, SV: green, BANK, STEP, PTN: yellow) Bar graph indication (resolution: 10; color: green) Status of ramp and soak (displayed by three green LEDs (ES100P only))
Other functions		Manual output. Communications: RS-232C, RS-422/RS-485, BCD. Assignments: front keys, setting/display items, digital I/O, and analog I/O. Processing: ×, −, +, ÷, primary time-lag filters, linear approximation, broken line approximation, extraction of a square root, Boolean operators, average addition, average movement. Four internal ON/OFF timers; four internal counters. Heating/cool control (except the Proportional Positioning Model) SP setting limiter, SP rise/fall rate limiter, MV (output) change rate limiter, multi-level key protect selection etc. 8 bank: set value, event output, PID parameter MV, (output) limiter; program bank (ES100X only); Cascade control (possible with a single model with secondary input); Fixed SP; time signal; step output (ES100P only) 99 patterns with 400 steps.

Note: 1. Either a CT input or a potentiometer input is available (both of them cannot be used at the same time).

2. All control outputs are electrically insulated from the internal circuitry (except transfer output and auxiliary terminal output).

■ OUTPUT MODULE RATINGS

Relay Output Module	E53-R (see note 1)	SPDT; 5 A, 250 VAC (resistive load)
SSR Output Module	E53-S	SPST-NO; 1 A, 75 to 250 VAC; leakage current: 1.5 mA max. (at 200 VAC)
Voltage Output Module (see note 2)	E53-Q	40 mA max., 12 VDC; NPN (with short-circuit protection)
	E53-Q3	20 mA max., 24 VDC; NPN (with short-circuit protection)
	E53-Q4	20 mA max., 24 VDC; PNP (with short-circuit protection)
Linear Output Modules	E53-C3	4 to 20 mA, DC: 600 Ω max.; resolution: approx. 2,600
	E53-C3D	0-to 20 mA, DC: 600 Ω max.; resolution: approx. 2,600
	E53-V34	0-10 VDC, Linear voltage output
	E53-V35	0-5 VDC, Linear voltage output

Note: 1. If control period is less than 5 seconds, a solid state relay (E53-S) should be used instead of the E53-R.

2. For driving external G3PA/G3NA SSR

■ CURRENT TRANSFORMER RATINGS

Max. continuous heater current	50 A
Dielectric strength	1,000 VAC (for 1 min)
Vibration resistance	50 Hz (approx. 10G)
Weight	E54-CT1: Approx. 11.5 g; E54-CT3: Approx. 50 g
Accessories (E54-CT3 only)	Contact: 2; Plug: 2

■ CONTROLLER CHARACTERISTICS

Item		ES100X	ES100P
Indication accuracy (see note)	Thermocouple	(±0.1% of indication value or ±1°C, whichever greater) ±1 digit max.	
	Platinum resistance thermometer	(±0.1% of indication value or ±0.5°C, whichever greater) ±1 digit max.	
	Voltage/current input	(±0.1% FS, ±1 digit max.)	
Display range		-9999 to 9999 (limited by input type)	
ON/OFF control hysteresis		0.01% to 99.99% FS (in units of 0.01%)	
Proportional band		0.0% to 999.9% FS (ON/OFF control when 0.0%) 0.1% to 999.9% FS (proportional position model) (in units of 0.1%)	
Integral (reset) time		0 to 9,999 s (PD control when 0 s) (in units of 1 s)	
Derivative (rate) time		0 to 9,999 s (PI control when 0 s) (in units of 1 s)	
Fuzzy intensity		0.0% to 100.0% (Advanced PID control (2-PID) when 0.0%) (in units of 0.1%)	
Event set value		Equivalent to -200.0% to 200.0% FS of industrial value or unit	
Control period		1 to 120 s (in units of 1 s)	
Sampling period		0.1 s min. type 0.2 s (in units of 1 s)	
Display refresh period		1x, 2x, 5x, or 10x sampling period	
PV compensation		Equivalent to -100.0% to 100.0% FS of industrial value or unit	
Manual manipulated value		-5.0% to 105.0%	
Manipulated value limit	Lower limit	-5.0% to -0.1% max.	
	Upper limit	+0.1% min. to 105.0%	
Setting time (1 step)		---	0 to 99 hours 59 minutes or 0 to 99 minutes 59 seconds
Program capacity		---	Total steps 400 max. (99 patterns, 99 steps)
Programming method		---	Break point method (patterns can be decided by the user)
Insulation resistance		20 MΩ min.	
Dielectric strength		2,000 VAC, 50/60 Hz for 1 min between terminals of different polarities	
Vibration resistance	Malfunction	10 to 150 Hz, 0.5-mm single amplitude each in X, Y, and Z directions	
	Mechanical	10 to 150 Hz, 0.75-mm single amplitude each in X, Y, and Z directions	
Shock resistance	Malfunction	20G max., 3 times each in 6 directions	
	Mechanical	30G max., 3 times each in 6 directions (20G's in the forward direction)	
Ambient temperature	Operating	-10° to 55°C (14° to 131°F) with no icing	
	Storage	-25° to 65°C (-13° to 149°F) with no icing	
Ambient humidity	Operating	35% to 85%	
Memory protection		Lithium cell backup (10 years at normal room temperature)	
Enclosure ratings	Front panel	IEC standard IP50 (with water proof cover: IP66, NEMA4)	
	Rear case	IEC standard IP20	
	Terminals	IEC standard IP00 (with terminal cover: VDE 0106/P100)	
Standards/Approvals		UL1092, CSA22.2 No. 14, CSA22.2 No. 1010-1	
Weight		Approx. 800 g	

Note: Indication accuracy varies with the type of sensor and the sensing temperature as follows:

K and T sensor (-100°C max.), R, S, and W sensor (200°C max.), and U sensor: ±2°C±1 digit; B sensor (400°C max.): ±6°C±1 digit indication accuracy without using the built-in cold contact compensation circuit is ±0.1% FS or ±1°C whichever is smaller except for the following sensors: R and S sensor (200°C max.): ±1.5±1 digit; L2 and U sensor: ±1°C±1 digit

■ OUTPUT MODULE CHARACTERISTICS

Relay unit life expectancy	Mechanical	10,000,000 operations min.
	Electrical (max. load)	100,000 operations min.

■ HEATER BURNOUT DETECTION CHARACTERISTICS

Max. heater current	50 A, single-phase
Monitor accuracy of input current	±5% FS ±1 digit max.
Heater burnout detection setting range	0.0 to 50.0 A (see note 1)
Heater current monitor range	0.0 to 55.0 A
Min. detectable ON time	200 ms (see note 2)

Note: 1. Heater burnout is not detected when current is set to 0.0 A; the burnout alarm will be automatically turned ON when current is set to 50.0 A.

2. When the control output is ON for less than 200 ms, heater burnout is not detected and heater current is not measured.

■ SUPPORT SOFTWARE CHARACTERISTICS (ES TOOLS)

Personal computer	IBM PC/AT, IBM PS/2
Display	EGA (VRAM 256 K-byte), VGA
Main memory	640 K-byte
Communications method	RS-232C; half-duplex
Transmission speed	9,600 bps
PC-DOS version	V3.20/V3.30/V4.00/V5.0
Printer	EPSON FX-80 series, HP Laser Jet IIP (PCL4 min.), HP Laser Jet IV

■ COMMUNICATIONS

Communications	RS-232C	RS-422	RS-485	BCD	Transmission output
Transmission method	None, half-duplex	4-wire, half-duplex	2-wire, half-duplex	Data select code method	4 to 20 mA Load: 600 Ω max. resolution: 12-bit
Synchronization method	Start-stop synchronization			---	
Baud rate	1,200/2,400/4,800/9,600/19,200 bps			---	
Transmission code	ASCII (7-bit) (see note 3)			---	

Note: 1. The maximum total cable length must not exceed the following limits.

RS-422: 500 m, RS-232C: 15 m, RS-485: 500 m

2. A maximum of 32 Temperature Controllers can be connected to one host computer using serial communications (RS-422 or RS-485).

3. 8-digit ASCII codes can be also used.

4. Front panel communications port at 9600 BPS, 8 data bits, even parity, two stop bits, accessible only with Omron 9/25 pin serial cable.

Operation

■ SAMPLING PERIOD

The sampling period of the ES100-series Digital Temperature Controller is factory-set to 200 ms. If only the advanced PID control is used, the sampling period will vary with the Model as follows (with a baud rate of 9,600 bps for the Models incorporating a communications function):

Model	Sampling period	Model	Sampling period
ES100X-AAH	100 ms	ES100X-AAHFB	100 ms
ES100X-AAHFD	100 ms	ES100X-AAHFE	100 ms
ES100X-AAWHFB	100 ms	ES100X-AAWHFE	100 ms
ES100X-AAH01FE	100 ms	ES100X-AAH04FE	100 ms
ES100X-AAWH01FE	200 ms	ES100X-AAWH04FE	200 ms
ES100X-RRPFB	100 ms	ES100X-RRPFD	100 ms
ES100X-RRPFE	100 ms	ES100X-RRPWFB	100 ms
ES100X-RRPWFE	100 ms	ES100X-RRP01FE	100 ms
ES100X-RRP04FE	100 ms	ES100X-RRPW01FE	200 ms
ES100X-RRPW04FE	200 ms	ES100P-AAH	100 ms
ES100P-AAHFD	100 ms	ES100P-AAHFE	100 ms
ES100P-AAWHFE	200 ms	ES100P-AAH01FE	200 ms
ES100P-AAH04FE	200 ms	ES100P-AAWH01FE	200 ms
ES100P-AAWH04FE	200 ms	ES100P-RRPFD	200 ms
ES100P-RRPFE	200 ms	ES100P-RRPWFE	200 ms
ES100P-RRP01FE	200 ms	ES100P-RRP04FE	200 ms
ES100P-RRPW01FE	200 ms	ES100P-RRPW04FE	200 ms

Control Operation Period

The control operation period is an important factor for the following control operations:

- Heating/cooling control
- Cascade control
- Fuzzy control
- Analog I/O assignment
- Digital I/O assignment
- No. of events used
- No. of times that ON/OFF timer used
- Input type selector (linearization required or not)
- Terminal communications baud rate
- Use of digital I/O (BCD communication)

Note: Refer to ES100X/ES100P Operation Manual for details.

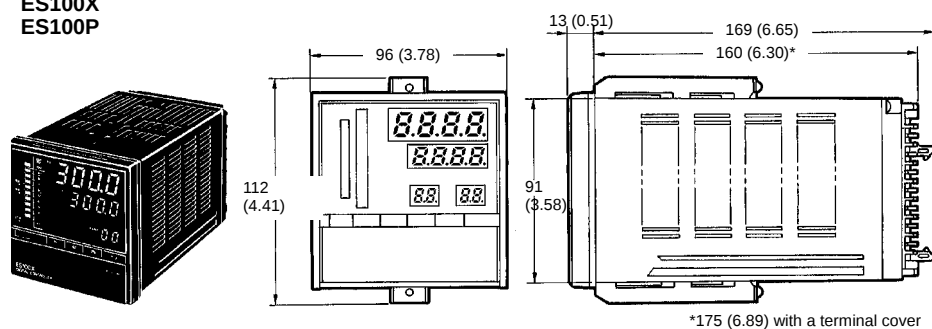
The control operation period can be checked with the monitor (character P229) in the check mode.

Dimensions

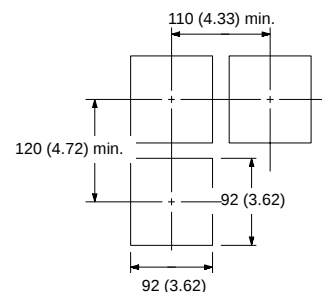
Unit: mm (inch)

■ PROCESS CONTROLLERS

ES100X
ES100P



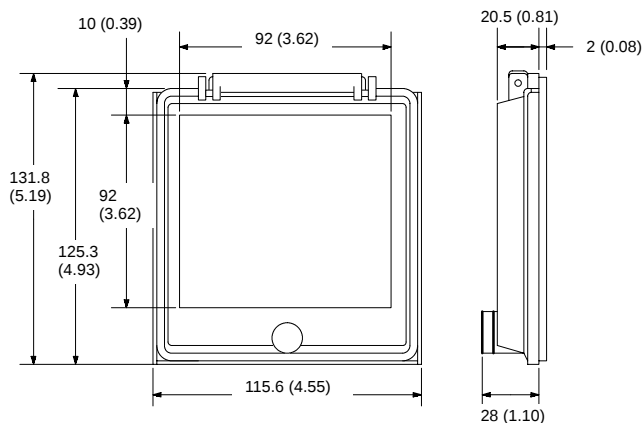
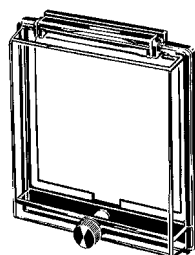
Panel Cutouts



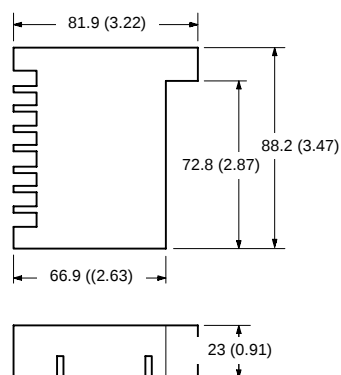
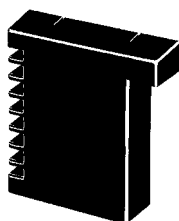
When mounting more than one Unit

■ ACCESSORIES

Y92A-96N Watertight Cover-NEMA4X



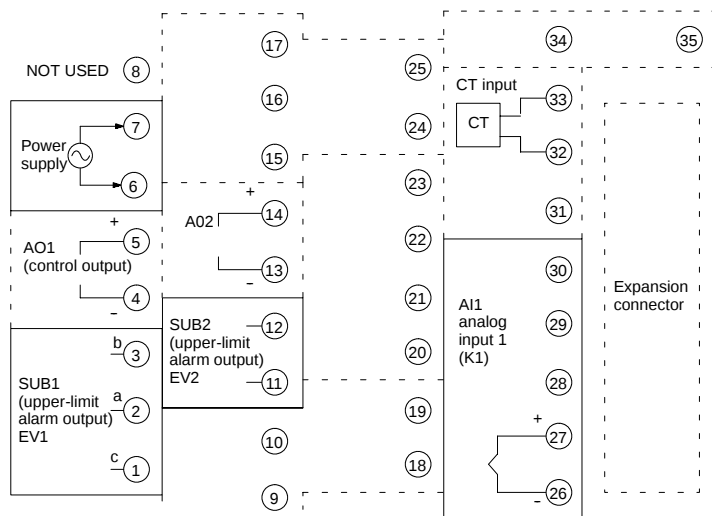
E53-COV01 Terminal Cover



Installation

■ FACTORY-SET TERMINAL CONFIGURATION

Basic Model ES100□-AAH



The allocation shown in the diagrams is applicable to all Basic Models.

Input K₁: -200 to 1,300°C (-328 to 2372°F)

Control output: Heating control

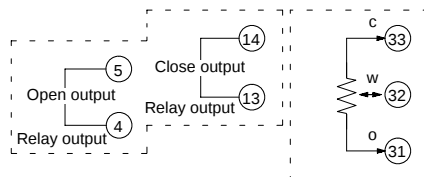
Auxiliary output: Upper-limit deviation alarm (to be set with EV1 and EV2)

If the heating/cooling control mode is selected, AO1 is used for heating and AO2 is for cooling control output. To use AO1 and AO2, purchase Output Units.

■ TERMINAL FUNCTIONS (FIXED) OF MODELS OTHER THAN BASIC MODELS

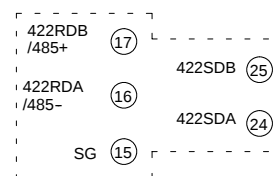
Proportional Positioning Control

ES100□-RRP□□□□□



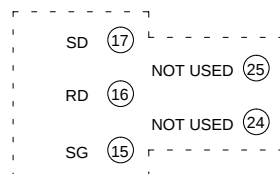
Upper Link RS422/485

ES100□-□□□□04□□



Upper Link RS-232C

ES100□-□□□□01□□

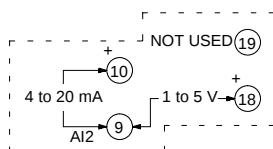


■ TERMINAL FUNCTIONS (POSSIBLE TO RELOCATE) OF MODELS OTHER THAN BASIC MODELS

Input 2 (4 to 20 mA Remote Setting)

ES100□-□□W□□□□□

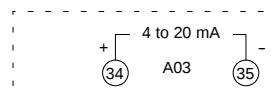
Initial setting: Use an input of 4 to 20 mA for remote setting. The setting will be effective in the SP mode.



Transmission Output (AI1 Process Value)

ES100□-□□□□□□F□

Initial setting: The value measured by analog input 1 will be output in a range of 4 to 20 mA.



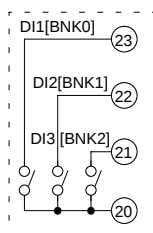
■ DIGITAL I/O (POSSIBLE TO RELOCATE) OF MODELS OTHER THAN BASIC MODELS

Digital Input (Bank selectable) for ES100X

ES100X-□□□□□□B

Initial setting: Used to select a bank. The terminals operate as follows:

BNK0: 2⁰
BNK1: 2¹
BNK2: 2²

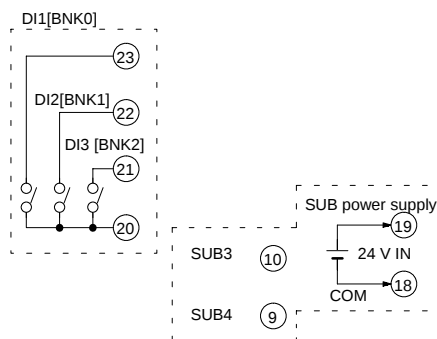


Digital I/O (Bank selectable) for ES100X

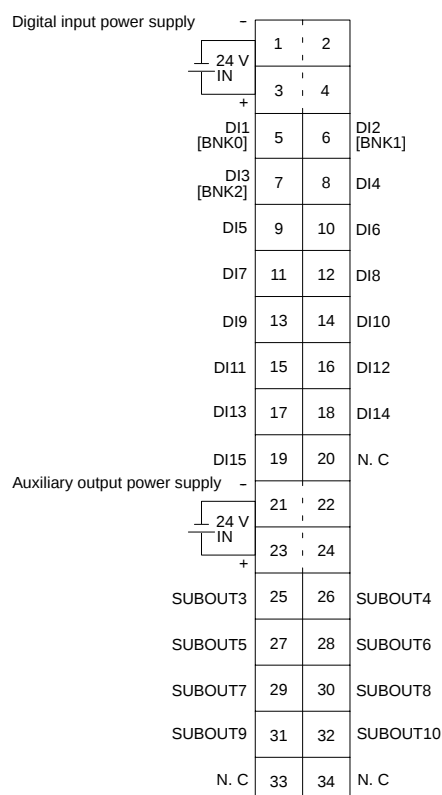
ES100X-□□□□□□D

Initial setting: Used to select a bank. The terminals operate as follows:

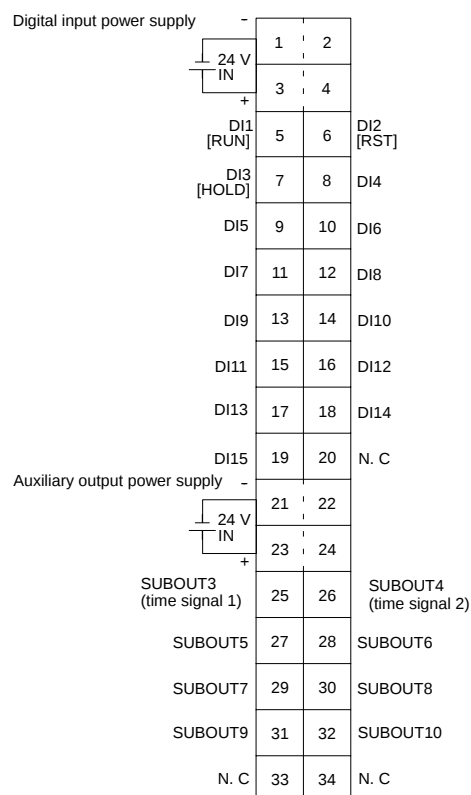
BNK0: 2⁰
BNK1: 2¹
BNK2: 2²



External Digital I/O for ES100X ES100X-□□□□□□E



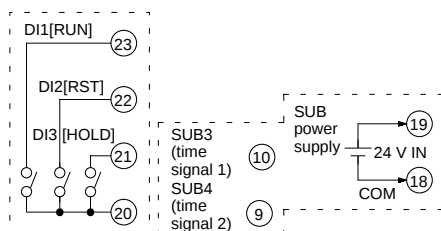
External Digital I/O for ES100P ES100P-□□□□□□E



Digital I/O (Operation Instruction and Time Signal) for ES100P

ES100P-□□□□□□D

Initial setting: The RUN, RST, and HOLD input are used to operate the program. Time signals set by programs are output from the terminals.



DI1 through DI8 are digital input terminals and SUBOUT3 through SUBOUT10 are digital auxiliary output terminals, both sets of which can be allocated as instructed by the user's software. The terminals without allocation prior to shipping can be freely allocated as required by the user.

DI9 through DI15 are special terminals for BCD communication.



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