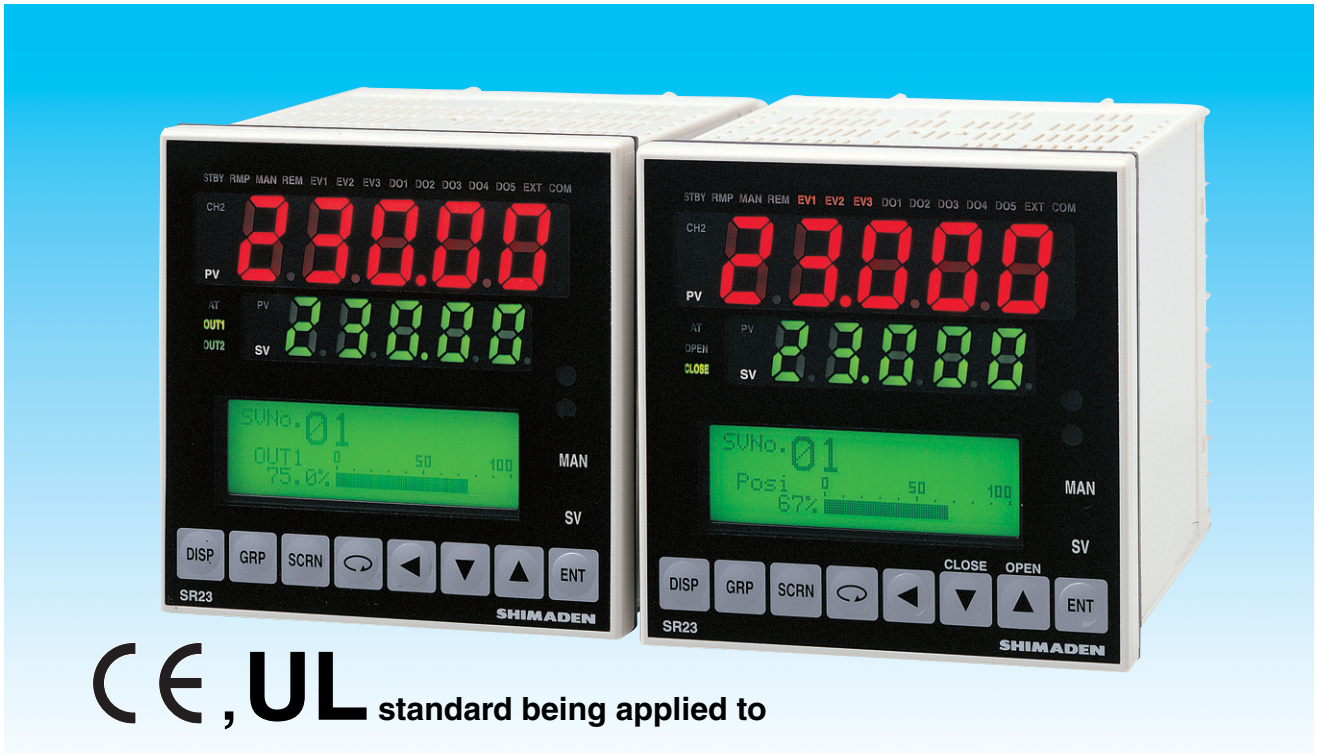
°C
%RH
SHIMADEN

Series SR23

SHIMADEN DIGITAL CONTROLLER



CE, UL standard being applied to

BASIC FEATURES

- ☐ *2-channel controller (Basic type: 1-channel controller)*
- ☐ *Independent 2-loop / Internal Cascade / 2-input operation control*
- ☐ *High accuracy ± (0.1% FS + 1 digit)*
- ☐ *High Sampling Cycle 0.1 sec.*
- ☐ *High resolution 1/1000 °C display achieved*
  **Only for R.T.D. input (scale: 0.000~30.000 °C)*
- ☐ *Auto-Tuning PID / Expert PID / Self-Tuning PID*
- ☐ *Multi-Setting of 10 Set Values*
- ☐ *Independent Universal-Input*
- ☐ *User Friendly Operation (Menu Driven: 4 Lines LCD Display)*
- ☐ *Easy Setting & Maintenance via Infrared COM port on the front panel*
- ☐ *Interface RS-232C/RS-485 (MODBUS / Shimaden)*
- ☐ *The front dust/splash-proof IP66*
- ☐ *Universal Power Supply (100~240V AC ±10%)*
- ☐ *Sensor power supply*

1-input Specification

- **1-output control**

Ordering Information

ITEM	CODE			SPECIFICATIONS	
SERIES	SR23-			96 × 96 DIN size, high-performance digital controller	
BASIC FUNCTIONS	SS			Universal-input, 1-input/1-output control, 3 event outputs	
CONTROL OUTPUT 1	Y			Contact 1c, contact rating: 240V AC 2.5A/resistive load, 1A/inductive load	
	I			Current 4 ~ 20mA DC, Load resistance: max. 600Ω	
	P			SSR drive voltage output 12V±1.5V DC, Load current: max. 30mA	
	V			Voltage 0 ~ 10V DC, Load current: max. 2mA	
CONTROL OUTPUT 2	N-			None	
REMOTE SETTING INPUT /HEATER BREAK ALARM (FOR SINGLE-PHASE)	standard	06		0 ~ 10V DC, Input resistance: approx. 500kΩ	Non-insulated input
		04		4 ~ 20mA DC, Input resistance: 250Ω	
		05		1 ~ 5V DC, Input resistance: approx. 500kΩ	
		14		4 ~ 20mA DC, Input resistance: 250Ω	Insulated input
		15		1 ~ 5V DC, Input resistance: approx. 500kΩ	
		16		0 ~ 10V DC, Input resistance: approx. 500kΩ	
		31		Heater break alarm* (heater current 30A with CT)	* Selectable only when Control Output 1 is Y or P
		32		Heater break alarm* (heater current 50A with CT)	
ANALOG OUTPUT 1		0		None	
		3		0 ~ 10mV DC, Output resistance: 10Ω	
		4		4 ~ 20mA DC, Load resistance: max. 300Ω	
		6		0 ~ 10V DC, Load current: max. 2mA	
ANALOG OUTPUT 2/ SENSOR POWER SUPPLY		0		None	
		3		0 ~ 10mV DC, Output resistance: 10Ω	
		4		4 ~ 20mA DC, Load resistance: max. 300Ω	
		6		0 ~ 10V DC, Load current: max. 2mA	
		8		Sensor power supply 24V DC 25mA	
EXTERNAL INPUT/ OUTPUT CONTROL SIGNAL (DI/DO) *1	standard	0		DI 4 points, DO 5 points (SV No. switching not available)	
		1		DI 10 points, DO 9 points (SV No. switching available)	
		2		DI 10 points, DO 13 points (SV No. switching available)	
COMMUNICATION FUNCTION			0	None	
			5	RS-485	Shimaden standard protocol / MODBUS (RTU/ASCII) communication protocol
			7	RS-232C	
REMARKS				0 Without	
				9 With	

*1 When switching the SV No. by DI, 10 points of DI (CODE 1 or 2) are required.
*2 Ten DI points (code 1 or 2) are required for switching the SV No. by DI.

Optional Accessories

Name	Model	Description
Infra-red Communication Adapter	S5004	USB connector cable (2m), Setup Software (CD-ROM)
Shunt Resistor	QCS002	250Ω ±0.1%, external input resistance at current input
Relay Unit	AP2MC	Converts open collector output to contact output. 2 circuits built-in
SV No. Selector	KA251	BIN code. SV1 ~ SV10 can be switched and selected.

Relay Unit Model AP2MC
(Converts open collector output to contact output. 2 circuits built-in)

SV No. Selector Model KA251
(BIN code. SV1 ~ SV10 can be switched and selected.)

Infra-red Communication Adapter Model S5004 with USB connector cable

19 SPECIFICATIONS

19-1 Display

- **LED display**
  Measured value (PV) :7-segment red LED 5 digits, height of characters 16 mm
  Set value (SV) :7-segment green LED 5 digits, height of characters 11 mm
- **LCD display**
  SV No., OUT% graph, control output value, various parameter displays
  128 x 32 dot matrix liquid crystal display with yellow-green LED backlight
- **Action display lamps**
  17 action statuses display. Light on or blinking when status is enabled

STBY	Green	Blinks when control output is set to standby (STBY=ON)
RMP	Green	Blinks during execution of ramp control, and lights during ramp control is paused
MAN	Green	Blinks when control output is set to manual operation
REM	Green	Lights when remote setting (REM) is set in SV No. selection
EV1 to EV3	Orange	Lights when each EV acts
DO1 to DO5	Orange	Lights when each DO acts
EXT	Green	Lights when SV No. can be selected by external switch
COM	Green	Lights when communication mode is ON
AT	Green	Blinks during execution of auto tuning or lights during holding of auto tuning
OUT1	Green	Control output (1-output side)
OUT2	Green	Control output (2-output side)

- **Display accuracy**
  ± (0.1% + 1digit) of measuring range (See Measuring Range Code Table for individual ranges.)

TC input	± (0.1% FS + 1°C)
Pt input	± (0.1% FS + 0.1°C)
mV, V input	± (0.1% FS + 1 digit)
mA input	Depends on accuracy of externally attached resistor (When ±0.1%FS accuracy is required, specify when ordering)

- **Temperature range for maintaining display accuracy**
  23°C±5°C
- **Display resolution**
  0.0001, 0.001, 0.01, 0.1, 1 (differs depending on measuring range)
- **Sampling cycle**
  0.1 seconds (100 msec)

19-2 Setting

- **Local setting** By 10 front panel key switches
  - Setting range: Same as the measuring range
  - Multi-SV value setting: Up to 10 points (SV1 to SV10) settable
  - Multi-SV value selection: Front panel key switches or external control input (binary code)
    10 external control inputs (DI) (optional) can be selected
- **Remote setting** By external analog signals, not insulated (standard)/insulated (option)
  Remote setting is alternative of heater break alarm
  - Setting accuracy: ±(0.1% FS + 1 digit)
  - Setting signal: 0 to 10V, 1 to 5V, 4 to 20 mA DC (selectable from code selection table)
  - Sampling cycle: 0.2 seconds (200 msec)
  - Remote scaling: Possible within measuring range (reverse scaling possible)
  - Remote bias: ±10000 Unit
  - Remote filter: OFF, 1 to 300 seconds
  - Remote square root: Low cut range 0.0 to 5.0% FS (at mV, V)
  - Remote ratio: 0.001 to 30.000
  - Local/remote switching: Front panel key switches or external control input
  - Direct tracking function: Remote set value switchable to local set value by bumpless transfers
- **Ramp control** Increment/decrement ramp control
  - Ramp value setting range: Ascending/descending individual setting
    OFF, 1 to 10000 Unit/minutes or seconds (when multiplier = 1)
    OFF, 0.1 to 1000.0 Unit/minutes or seconds (when multiplier = 0.1)
  - Ramp unit time: Unit/seconds, unit/minutes
  - Ramp unit multiplier: x 1, x 0.1
- **Higher/lower limit setting limiter**
  Any value set within measuring range (lower limit < higher limit)

19-3 Input

- **Universal-input, multi-range**
  Thermocouple input, RTD input, voltage input (mV, V), current input (mA),
- **Thermocouple (TC) input type**
  B, R, S, K, E, J, T, N, PLII, PR40-20, WRe5-26, {L, U (DIN43710) }
  AuFe-Cr (Kelvin scale).
  For details, see Measuring Range Code Table
  Display range ±10% of measuring range
  Allowable range of external resistance
  100Ω max.
  Input resistance Approx. 500 kΩ
  Cold junction compensation
  Selectable between internal and external cold junction compensation
  Internal cold junction compensation accuracy
  ±1°C (in range of 18 to 28°C)
  Burnout functions Standard feature (up scale)
- **RTD input type** JIS Pt100 /JPt100 3-wire type. For details, see Measuring Range Code Table
  Display range ±10% of measuring range (not lower than -273.15°C)
  Lead wire tolerance 10Ω max. per wire
  Amperage Approx. 1.1mA
- **Voltage (mV, V)**
  input type -10 to 10, 0 to 10, 0 to 20, 0 to 50, 10 to 50, 0 to 100, -100 to 100 mV
  -1 to 1, 0 to 1, 0 to 2, 0 to 5, 1 to 5, 0 to 10, -10 to 10 V
  Universal-input, programmable scaling
  For details, see Measuring Range Code Table
  Input resistance Approx. 500 kΩ.
- **Current (mA)**
  Input type 4 to 20, 0 to 20 mA: Universal-input and programmable scaling by receiving resistance to 0 to 5, 1 to 5 V inputs
  Receiving resistance
  250Ω by external resistance
- **Common functions**
  Sampling cycle 0.1 seconds (100 msec)
  PV bias ±10000 Units
  PV slope Input value x 0.500 to 1.500
  PV filter OFF, 1 to 100 seconds
- **Input operation** Possible with voltage or current input
  Square root extraction operation
  Low cut range 0.0 to 5.0% FS
  Linearizer approximation
  Number of input points: 11
- **Isolation** Insulated between input and DI input, or input and various outputs
  Not insulated between input and the system, input and remote input, or input and CT input

19-4 Control

- **Control output** 1-output specification, 2-output specification

- **Control system (common to Control Output 1 and 2)**
  W/ auto tuning function, Expert PID control
  Multi-PID: By PID Nos.01 to 10 (10 types)
  Individual PID set on each SV No. (and remote SV)
  Zone PID: Selectable between individual PID and zone PID (max. 10 zones)
  Proportional band (P): OFF, 0.1 to 999.9% (OFF: ON-OFF action)
  Integral time (I): OFF, 1 to 6000 seconds (OFF: P or PD control)
  Derivative time (D): OFF, 1 to 3600 seconds (OFF: P or PI control)
  Manual reset (MR): -50.0 to 50.0% (Control Output 1, available when I = OFF)
  Dead band (DB): -19999 to 20000 Unit (Control Output 2 in 2-output specification)
  Hysteresis (DF): 1 to 9999 Unit (Effective when P=OFF)
  Proportional cycle: 1 to 120 seconds (at contact or SSR drive voltage output)
- **Control output type/rating (common to Control Outputs 1 and 2)**
  Y: Contact 1c, Contact rating: 240 V AC, 2.5 A/resistive load, 1A/ inductive load
  I: Current 4 to 20 mA DC, Load resistance: 600Ω max.
  P: SSR drive voltage 12 V±1.5 V DC, Load current: 30 mA max.
  V: Voltage 0 to 10 V DC, Load current: 2 mA max.
  Output accuracy: ±0.5% FS (5 to 100% output/within accuracy maintaining temperature range)
  Resolution: Approx. 1/14000 (during current or voltage output)
- **Operation/output update cycle**
  0.1 seconds (100 msec)
- **Control output characteristics**
  Reverse (for heating)/Direct (for cooling), Control Outputs 1 and 2 set individually (heating/cooling, 2-stage heating/2-stage cooling selectable in 2-output specification)
- **Higher/lower output limiter setting range**
  Higher limit/lower limit (set individually for each PID No.)
  Setting range: 0.0 to 100.0% (lower limit < higher limit)
- **Output rate-of-change limiter**
  OFF, 0.1 to 100.0%/seconds (set individually for Control Outputs 1 and 2)
- **Control output at error**
  0.0 to 100.0% (set individually for Control Outputs 1 and 2)
- **Control output at standby**
  0.0 to 100.0% (set individually for Control Outputs 1 and 2)
- **Manual control**
  Auto/manual switching
  Balanceless/bumpless transfers (simultaneous for Control Outputs 1 and 2)
  Output setting range: 0.0 to 100.0% set individually for Control Outputs 1 and 2
  Setting resolution: 0.1%
- **Isolation** Insulated between Control Output and the system
  Not insulated between Control Outputs

19-5 Event Output

- **Number of outputs** Total 3: EV1 to EV3
- **Output rating** 240 V AC/1.0A resistive load common to contact outputs (normally open contacts)
- **Output update cycle** 0.1 seconds (100 msec)
- **Setting/selection** Individual setting (individual output), selectable from 20 types (to designate output)

Output types

1) None	No action (no assignment)
2) DEV Hi	Higher limit deviation alarm
3) DEV Low	Lower limit deviation alarm
4) DEV Out	Outside higher/lower limit deviation alarm
5) DEV In	Inside higher/lower limit deviation alarm
6) PV Hi	PV higher limit alarm
7) PV Low	PV lower limit alarm
8) SV Hi	SV higher limit alarm
9) SV Low	SV lower limit alarm
10) AT	ON during execution of auto tuning
11) MAN	ON during manual control operation
12) REM	ON while remote SV is in action
13) RMP	ON while ramp control is in action
14) STBY	ON while control is out of action
15) SO	ON when PV and REM scale over error occurs
16) PV SO	ON when PV scale over error occurs
17) REM SO	ON when REM scale over error occurs
18) LOGIC	ON during logic operation output by DI or communication
19) Direct	ON during Direct output by communication
20) HBA	ON during heater break alarm action
21) HLA	ON during heater loop alarm action

Direct cannot be set for events, but for DOs.

- **Setting range**

DEV Hi, Low	-25000 to 25000 Unit
DEV Out, In	0 to 25000 Unit
PV Hi, Low	Within measuring range
SV Hi, Low	Within SV setting range

Hysteresis 1 to 9999 Unit (when DEV, PV or SV is selected)

Action delay time OFF, 1 to 9999 seconds (when DEV, PV or SV is selected)

Standby action Selectable from 3 types (when DEV, PV or SV is selected)

OFF, no standby action

1) At power ON, or at STBY ON→ OFF

2) At power ON, at STBY ON→ OFF, or at execution SV is changed

3) At input error (SO), when action is OFF

Output characteristics switching

Selectable between normally open and normally closed

- **Isolation** Insulated between alarm output and various I/O, or alarm output and the system

19-6 External Control Output (DO)

- **Number of outputs** 13, 9, or 5 points in total: standard 5 and 8 or 4 can be added optionally
  DO1 to DO3 Darlington output 3 points
  DO4 to DO5 Open collector output 2 points
  DO6 to DO9 Open collector output 4 points (optional)
  DO10 to DO13 Open collector output 4 points (optional)
- **Output rating** Open collector output 24 V DC/8 mA max., ON voltage 0.8 V or lower
  Darlington output 24 V DC/50mA max., ON voltage 1.5 V or lower
- **Output update cycle** 0.1 seconds (100 msec)
- **Setting/selection** Individual setting (individual output), selectable from 21 types
  Details are the same as those for event outputs.
  (However, LOGIC can be assigned to only DO1 to DO5. Direct can be assigned to only DO6 to DO13 with communication option.)
  Details of setting range, hysteresis, action delay time and standby action are the same as those for event outputs.
- **Output characteristics switching**
  Normal open and normal close selectable
- **Isolation** Insulated between DO and various I/O, or DO and the system
  Not insulated between DOs

19-7 External Control Input (DI)

- **Number of inputs** 10 points in total: standard 4 and 6 optional
  DI1 to DI4 4 points
  DI5 to DI10 6 points (optional)
- **Input rating** Non-voltage contact or open collector

  Input specifications

  Photocoupler input

  5 V DC, 2.5mA max. voltage application per 1 input

  Input holding time

  0.1 seconds (100 msec)
- **Setting/selection** Individual setting (individual input), selectable from 10 types

  Input types

  1) None — No action (no assignment)
  2) MAN — Switching of control output between auto/manual (when ON: manual)
  3) REM — Switching of REM SV/LOCAL SV setting (when ON: REM SV setting)
  4) AT — Switching of AT execution/stop (at ON "edge": AT execution)
  5) STBY — Switching of control execution/standby (when ON: standby)
  6) ACT — Switching of direct/reverse action on Output 1 characteristics (when ON: direct action)
  7) ACT2 — Switching of direct/reverse action on Output 2 characteristics (when ON: direct action)
  8) Pause — Switching of pause/resume of ramp control (when ON: ramp pause)
  9) LOGIC — Logic operation (when ON: execution of logic operation and output to EV or DO)
  10) EXT_SV — Multi-SV switching by DI7 to DI10 (only when DI option is selected)
- **Isolation** Insulated between DI and various I/O, or DI and the system
  Not insulated between DIs.

19-8 Logic Operation Functions

- **Number of logic operation outputs**
  Assignable to 8 points in total: EV1 to EV3 3 points, DO1 to DO5 5 points
  DO4 and DO5 are exclusively for timer and counter operation.
- **Number of logic operation inputs**
  10 external control input points, DI1 to DI10, can be assigned individually to source 1 and source 2
- **Input logic conversion** Input logic conversion possible individually on source 1 and source2 (EV1 to EV3, DO1 to DO3 output)
  1) BUF By external control input logic
  2) INV Inversion of external control input logic
  3) FF Flip-flop logic operation of external control input
- **Logic operation (1)** Logic operation output by source 1 and source 2 (EV1 to EV3, DO1 to DO3 output)
  1) AND Output by logical product
  2) OR Output by logical sum
  3) XOR Output by exclusive OR
- **Logic operation (2)** Logic operation output by cause 1 (DO4, DO5 output)
  1) Timer operation OFF, 1 to 5000 seconds
  2) Counter operation OFF, 1 to 5000 counts

19-9 Heater Break Alarm (option)

- **Alarm action** HBA alarm ON when control output is ON and heater break is detected
  HLA alarm ON when control output is OFF and heater loop error is detected
  Alarm detection HBA is detected at heater current ≤ setting current value, when control output is ON
  HLA is detected at heater current ≥ setting current value, when control output is OFF
  Hysteresis at heater break or loop error detection 0.2 A
  Remote input cannot be used when heater break alarm is selected.
- **Current detection** Heater current detection by external CT (supplied CT for exclusive use/single phase)
  Current detection selection
  Selectable from Control Output 1 or Control Output 2 only when control output is Y or P
  Sampling cycle 0.2 seconds (200 ms)
  Minimum action confirmation time
  0.2 seconds (200 msec) or longer (regardless of whether control output is ON or OFF)
- **Current setting** Heater break, heater loop alarm set individually
  Setting range OFF, 0.1 to 50.0 A (OFF=suspension of alarm action)
  Setting resolution 0.1 A
- **Current display** 0.0 to 55.0 A
  Display accuracy 3% FS (sine wave 50 Hz)
  Sampling cycle 0.2 seconds (200 ms)
  Minimum action confirmation time
  0.2 seconds (200 msec) or longer (regardless of whether control output is ON or OFF)
- **Output** Assigned to EVENT, DO output
  Output hold Selectable between Lock mode and Real mode
- **Isolation** Insulated between CT input and DI input, or CT input and various outputs
  Not insulated between CT input and sensor input, or CT input and the system

19-10 Analog Output (option)

- **Number of outputs** Maximum 2, Ao1, Ao2 individual setting, individual output
  Only Ao1 when sensor power supply (optional) is selected

- **Output types (assignments)**
  Selectable from 5 types
  1) PV Measured value (measured value in execution)
  2) SV Set value (set value in execution)
  3) DEV Deviation value (measured value in execution - set value in execution)
  4) OUT1 Control Output 1
  5) OUT2 Control Output 2 (in 2-output specification)
- **Output rating** Individual selection (individual output)
  0 to 10 mV DC/output resistance 10Ω
  0 to 10 V DC/load current 2 mA max.
  4 to 20mA DC/load resistance 300Ω max.
- **Output accuracy** ±0.1% FS (of indicated value)
- **Output resolution** Approx. 1/14000
- **Output update cycle** 0.1 second (100 msec)
- **Output scaling** PV, SV within measuring range: DEV within -100.0 to 100.0%;
  OUT1 and OUT2 within 0.0 to 100.0%; reverse scaling possible
- **Isolation** Insulated between analog outputs and various I/O, or analog outputs and the system
  Not insulated between analog outputs (Ao1 and Ao2)

19-11 Sensor Power Supply (option)

- **Number of outputs** 1
  Output from Analog Output 2 (Ao2) terminal
  When the sensor power supply is selected, Analog Output 2 (Ao2) is unusable.
- **Output rating** 24 V DC/25 mA max.
- **Isolation** Sensor power supply insulated from various I/O and system, analog output 1 and system

19-12 Communication (option)

- **Communication type**
  RS-232C, RS-485
- **Communication system**
  RS-232C 3-line half-duplex system
  RS-485 2-line half-duplex multidrop (bus) system
- **Communication distance**
  RS-232C 15 m max.
  RS-485 500 m max. (depending on connection conditions)
- **Number of connectable devices**
  RS-232C 1
  RS-485 32 (differs depending on connection conditions including the host)
- **Synchronization system**
  Start-stop synchronization
- **Communication speed**
  2400, 4800, 9600, 19200 bps
- **Communication (device) address**
  1 to 98
- **Communication delay time**
  1 to 50 msec
- **Communication memory mode**
  EEP, RAM, r_E
- **Communication protocol (1)** SHIMADEN protocol
  Data length 7-bit, 8-bit
  Parity EVEN, ODD, NONE
  Stop bit 1-bit, 2-bit
  Control code STX_ETX_CR, STX_ETX_CRLF, @_: _CR
  Checksum (BCC) ADD, ADD_two's cmp, XOR, None
  Communication code
  ASCII
- **Communication protocol (2)** MODBUS ASCII mode
  Data length 7-bit (fixed)
  Parity EVEN, ODD, NONE
  Stop bit 1-bit, 2-bit
  Control code _CRLF
  Error check LRC check
  Function code 03H and 06H (Hex) supported
  1) 03H Read data
  2) 06H Write data
- **Communication protocol (3)** MODBUS RTU mode
  Data length 8-bit (fixed)
  Parity EVEN, ODD, NONE
  Stop bit 1-bit, 2-bit
  Control code None
  Error check CRC 16
  Function code 03H and 06H (Hex) supported for
  1) 03H Read data
  2) 06H Write data

19-13 Infrared Communication

- **Communication system** Direct communication is possible with a PC through the infrared USB conversion adapter (sold separately)
- **Number of connectable devices**
  1
- **Infrared communication specification**

Synchronization system	Start-stop synchronization
Communication speed	9600 bps
Data format	7E1 (7-bit, even parity, 1 stop bit)
Control code	STX_ETX_CR
Checksum (BCC)	ADD
Communication code	ASCII

- **Communication protocol** Shimaden standard (extended) protocol

19-14 General Specifications

- **Data storage** Non-volatile memory (EEPROM)
- **Operating environment conditions**

Temperature	-10 to 50°C
Humidity	90% RH max. (no dew condensation)
Elevation	2000 m above sea level or lower
Category	II
Pollution class	2

- **Storage temperature** -20 to 65°C
- **Power voltage** 100 to 240 V AC ±10% 50/60 Hz
- **Power consumption** Max. 22 VA
- **Input noise removal ratio**
  Normal mode 40 dB min. (50/60 Hz)
  Common mode 120 dB min. (50/60 Hz)
- **Applicable standards**
  Safety IEC61010-1:2001 and EN61010-1:2001
  EMC EN61326
- **Insulation resistance**
  Across I/O terminals and power terminal : 500 V DC 20MΩ min.
  Across power terminals and ground terminal : 500 V DC 20MΩ min.
- **Dielectric strength** Across I/O terminals and power terminal : 2300 V AC for 1 minute (faradic current 5mA)
  Across power terminals and ground terminal : 1500 V AC for 1 minute (faradic current 5mA)
- **Protective structure** Front operating panel only is dust-proof and drip-proof. (equivalent to IP66, NEMA4X)
- **Case material** PC resin molding (equivalent to UL94V-1)
- **External dimensions (H x W x D)**
  96 x 96 x 111 mm (panel depth:100 mm)
  Panel depth is 112 mm when terminal cover is installed.
- **Mounting** Imbedded in panel (using mounting fixtures)
- **Thickness of usable panel** 1.0 to 8.0 mm
- **Size of panel cutout** 92 (H) x 92 (W) mm
- **Weight** 600 g max.