SENSOR CONTROLLERS

NPS
ON / OFF Input

CA
Analog Input

CA2
Analog Input

PS-18V
Power Supply

CA SERIES
Digital Panel Controller

Best Partner for Analog Sensors

Versatile Control with Analog Sensors

Bornier : IP 20

Applicable SUNX's analog sensors

- Laser collimated beam sensor
- LED collimated beam sensor
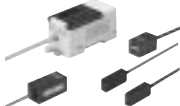- LED displacement sensor
- Analog fiber sensor
- High accuracy eddy current type displacement sensor
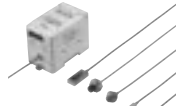- Analog inductive proximity sensor
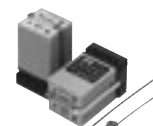- Super analog sensor

LA-510, LA-511 **LA-300** series **DSA-L100** **FX-11A** **GP-A** series **GSA** series **RS/RT-SAS** series

- Pressure sensors

DP2-2☐ **DP2-80** **DP2-4☐** **DP2-6☐** **DP-M2A** **DP-Y** series

High-speed Sampling: 1ms

With a fast sampling rate of 1,000 times/sec., it detects even momentary changes.

Two Input Channels with Various Calculations

The **CA** controller accepts two analog inputs and incorporates five arithmetic functions.
Thickness or width measurement is possible using one controller.

① $A + B$
② $A - B$
③ $L - (A + B)$
④ $\{(A/B) - 1\} \times 100$
⑤ $(A/B) \times 100$

A: Input 1
B: Input 2
L: Constant (arbitrary)

Flexible Scaling

The conversion of input values to a different scale can be simply done by key operation.
Since the need to convert the displayed value is eliminated, the required information can be confirmed immediately. In addition, convenient unit labels (V, A, J, kPa...) are also provided.

✕SUNX

APPLICATIONS

Measuring steel pole eccentricity

Analog inductive proximity sensors
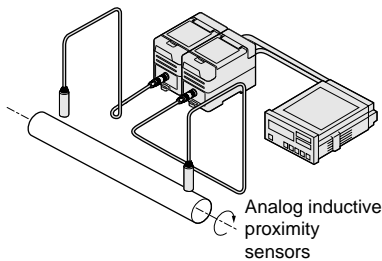
Measuring turbidity in water tank

The turbidity in the water tank can be measured in an analog manner.

Super analog sensor
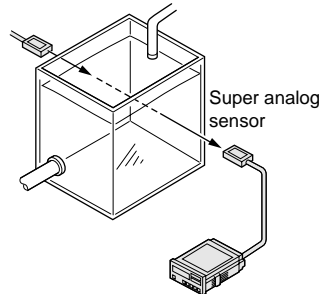
Measuring board thickness

LED displacement sensors
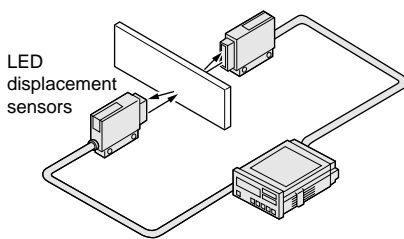
Measuring steel sheet width

Laser beam sensors
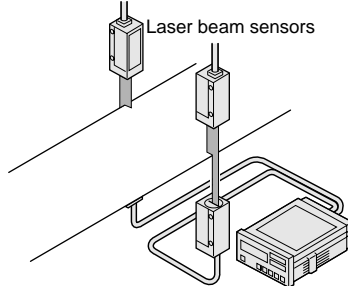
Five Separate Outputs

Four threshold levels can be set to obtain five separate comparative outputs.

This is convenient for a multi-level classification, such as, height judgment.

```
          HH  ┌──────── ON
              │         OFF
          HI  ┌────── ON
              │       OFF
Comparative   ┌──── ON
outputs   GO  │     OFF
          LO  ┌── ON
              │   OFF
          LL  ┌ ON
              │ OFF
              ▲▲  ▲▲
              LLLO HI HH
            Threshold values
```
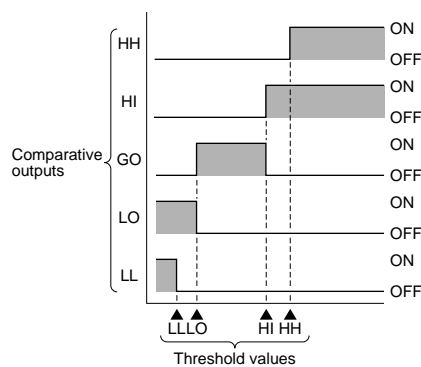
Versatile Input/Output

There are five types of input ranges and three types of output modes to choose from; total fifteen models are available.

Input range	Output mode
① 4 to 20mA	① Relay output
② 1 to 5V	② Transistor output
③ ± 1V	③ Transistor output with BCD output
④ ± 5V	
⑤ ± 10V	

Power Supply for Sensors

An additional power supply is not necessary for sensors because the **CA** controller incorporates a 12V DC 150mA power supply.

Three Types of Hold Functions

Peak hold, bottom hold and peak-to-peak hold functions are available. Eccentricity or amplitude is easily measured.

Peak-to-Peak

Peak

Bottom
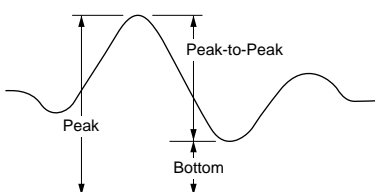
Storage of Eight Preset Values

The **CA** series stores eight patterns of threshold values, scaling values, etc. Further, since they can be selected by an external input, a change in manufacturing plan can be implemented smoothly.

Various Functions
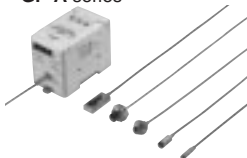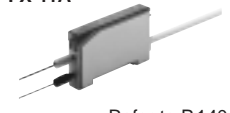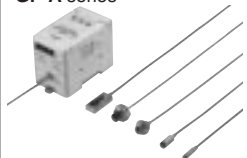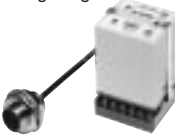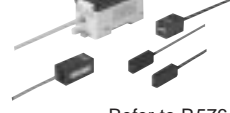
Various functions, such as, power supply ON-delay function, measurement start delay function, hysteresis setting function, etc., which allow versatile control have been incorporated.

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767

SENSOR CONTROLLERS

NPS
ON / OFF Input

CA
Analog Input

CA2

PS-18V
Power Supply

CA

ORDER GUIDE

Type		Appearance	Input range	Model No.	Output
Relay output			4 to 20mA	**CA-R1**	Relay contact 1a (HH, HI, LO and LL) Relay contact 1c (GO)
			1 to 5V	**CA-R2**	
			± 1V	**CA-R3**	
			± 5V	**CA-R4**	
			± 10V	**CA-R5**	
Transistor output			4 to 20mA	**CA-T1**	NPN open-collector transistor (HH, HI, GO, LO and LL)
			1 to 5V	**CA-T2**	
			± 1V	**CA-T3**	
			± 5V	**CA-T4**	
			± 10V	**CA-T5**	
	With BCD output		4 to 20mA	**CA-B1**	NPN open-collector transistor (HH, HI, GO, LO, LL and BCD output)
			1 to 5V	**CA-B2**	
			± 1V	**CA-B3**	
			± 5V	**CA-B4**	
			± 10V	**CA-B5**	

Note: With effect from January, 1977, the input range of CA-□3/□4/□5 has been increased to include models which can be used for the negative side of the range, too.

Applicable SUNX sensors

Input range	4 to 20mA	1 to 5V	± 1V	± 5V	± 10V
Model No.	**CA-□1**	**CA-□2**	**CA-□3**	**CA-□4**	**CA-□5**
Applicable models	High accuracy eddy current type displacement sensor **GP-A** series Refer to P.608 Differential pressure sensor with analog current output **DP-M2A** Refer to P.734	Analog fiber sensor **FX-11A** Refer to P.140 Laser collimated beam sensor **LA-510**, **LA-511** Refer to P.564 LED collimated beam sensor **LA-300** series Refer to P.576 LED display digital pressure sensor **DP2** series Refer to P.696 LED display anti-corrosive digital pressure sensor **DP-Y** series Refer to P.724	Analog-output inductive proximity sensor **GSA** series of 1mm sensing range Refer to P.806	High accuracy eddy current type displacement sensor **GP-A** series Refer to P.608 Analog-output inductive proximity sensor **GSA** series of 2mm sensing range Refer to P.806	Super analog sensor **RS/RT-SAS** series Refer to P.804 Infrared displacement sensor **DSA-L100** Refer to P.805

768

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SPECIFICATIONS

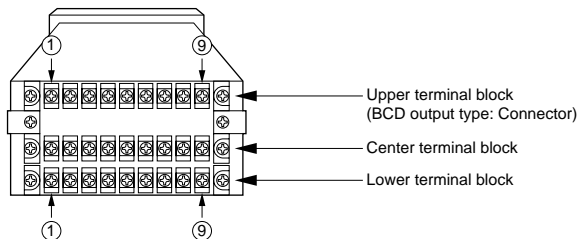| Type	Relay output	Transistor output	
			With BCD output
Item / Basic model No.	**CA-R☐**	**CA-T☐**	**CA-B☐**
Supply voltage	100 to 240V AC ± 10%		
Power consumption	17VA or less		
Power supply for sensor	12V DC $^{+10}_{0}$ %, 150mA		
Analog input — Input range	**CA-☐1**: 4 to 20mA, **CA-☐2**: 1 to 5V, **CA-☐3**: ± 1V, **CA-☐4**: ± 5V, **CA-☐5**: ± 10V		
Analog input — Input impedance	Current input: 20Ω, Voltage input: 1MΩ (**CA-☐3**: 100kΩ)		
Analog input — No. of inputs	2 Nos.		
Analog input — Input method	Single end		Floating
Analog input — A/D conversion method	Successive approximation method		
Analog input — Sampling period	1ms or more (1,000 times/sec. max.)		
Switching inputs (Process number selection / External synchronization / Zero-adjustment / Reset / Auto-reference / Hold)	Operation: Negative logic Signal condition: 5V-CMOS · LSTTL compatible		

Comparative outputs (HH, HI, GO, LO and LL)	Relay contact 1a (HH, HI, LO and LL)
	Relay contact 1c (GO)
	• Switching capacity: 250V 1A AC (resistive load)
	  30V 1A DC (resistive load)
	• Electrical life: 200,000 times or more
	• Mechanical life: 20 million times or more
		NPN open-collector transistor
		• Maximum sink current: 100mA
		• Applied voltage: 35V DC or less (between comparative output and COM.)
		• Residual voltage: 1V or less (at 100mA sink current)
		  0.4V or less (at 16mA sink current)	

Response time	10ms or less	1ms or less	
Data outputs (A0 to D3, POL, DTV, OR)	——————	——————	BCD 4 digits negative logic NPN open-collector transistor • Maximum sink current: 70mA • Applied voltage: 35V DC or less (between data output and GND) • Residual voltage: 1V or less (at 70mA sink current) 0.4V or less (at 16mA sink current)
Outcome value display	3 5/6 digit LED display (letter height: 14.2mm)		
Display refresh rate	Selectable from 0.2, 0.5, 1, 2.5, 10 or 20 times/sec.		
Display range	− 5999 to + 5999 (' + ' is not displayed)		
Display accuracy	± (0.1% F.S. + 2 digits) at 23 ± 5°C		
Temperature characteristics	± 100ppm F.S./°C		
Threshold value display	3 5/6 digit LED display (letter height: 8mm)		
Display range	− 5999 to + 5999 (' + ' is not displayed)		
Process number display	1 digit LED display (letter height: 8mm)		
Display range	0 to 7		
Function display	HLD (threshold value hold), AG (previous average comparison), 0-ADJ. (zero-adjustment) AR (auto-reference), PH (peak hold), BH (bottom hold) Each abbreviation lights up when the respective function is effective.		
Indicators — Comparative output	HH, HI: Red LEDs (light up when the respective output is ON) GO: Green LED (lights up when the GO output is ON) LO, LL: Orange LEDs (light up when the respective output is ON)		
Indicators — External synchronization input	Orange LED (lights up when the external synchronization input is ON)		
Indicators — LL-HH value display	Orange LED (lights up when LL and HH values are shown on the lower and upper threshold value displays)		
Main functions	Process number selection, arithmetic functions, hold, scaling, auto-reference, power supply ON-delay, start delay, hysteresis setting, etc.		
Environmental resistance — Ambient temperature	0 to + 50°C (No dew condensation), Storage: − 20 to + 70°C		
Environmental resistance — Ambient humidity	20 to 85% RH, Storage: 20 to 95% RH		
Environmental resistance — Noise immunity	Power line: 1,500Vp, 10ms cycle, 0.5 μs pulse width; Radiation: 300Vp, 10ms cycle, 0.5 μs pulse width (with noise simulator)		
Environmental resistance — Voltage withstandability	2,000V AC for one min. between the input, the power and F.G., and between all terminals connected together and enclosure		
Environmental resistance — Insulation resistance	100MΩ, or more, with 500V DC megger between the input, the power and F.G., and between all terminals connected together and enclosure		
Environmental resistance — Vibration resistance	10 to 55Hz frequency, 1.5mm amplitude in X, Y and Z directions for two hours each		
Environmental resistance — Shock resistance	981m/s^2 acceleration (100G approx.) in X, Y and Z directions for three times each		
Memory protection	Non-volatile memory (EEPROM)		
Material	Enclosure: ABS		
Connecting method	Screw-on terminal block [BCD output type: Screw-on terminal block and connector (Note)]		
Weight	500g approx.		
Accessory	Unit seal: 1 set		

Note: Purchase the mating connector for the BCD output type separately.
Recommended mating connector: HIF3BA-34D-2.54R (Manufactured by Hirose Electric Ltd.)
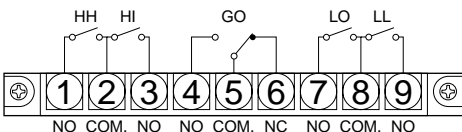AXM134415A (Manufactured by Matsushita Electric Works Ltd.)

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769

CA

I/O CIRCUIT AND WIRING DIAGRAMS

Terminal arrangement

Upper terminal block (BCD output type: Connector)

Center terminal block

Lower terminal block

• Upper terminal block

Relay output type

1	2	3	4	5	6	7	8	9
NO	COM.	NO	NO	COM.	NC	NO	COM.	NO

HH HI   GO   LO LL

Transistor output type

HH HI   GO   LO LL

NC

1	2	3	4	5	6	7	8	9
COM.			COM.			COM.		

Transistor output with BCD output

BCD data output

10^0 digit 10^1 digit

A-REF./RESET HOLD

B0 D0 B1 D1 REQ PT2

A0 C0 A1 C1 DVS PT1 PT4 0-ADJ. GND

(2)(4)(6)(8)(10)(12)(14)(16)(18)(20)(22)(24)(26)(28)(30)(32)(34)

(1)(3)(5)(7)(9)(11)(13)(15)(17)(19)(21)(23)(25)(27)(29)(31)(33)

A2 C2 A3 C3 POL DTV HI LO GND

B2 D2 B3 D3 OR HH GO LL

(1)(2)(4)(8) 10^3 digit   NPN open-collector
10^2 digit   transistor output
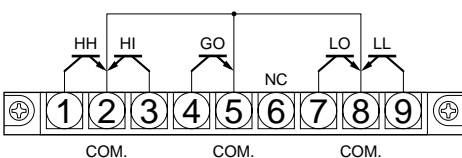
BCD data output

<Signal designation>
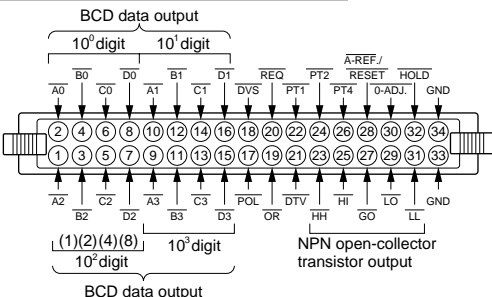
$\overline{A0}$ to $\overline{D3}$: BCD data output
$\overline{POL}$: Polarity signal output
     '+' when Low, '−' when High
$\overline{DVS}$: Device select input
     Input signal to enable BCD data output
     BCD output is enabled when it is Low.
$\overline{OR}$: Over-range output
     Low signal is output when input value exceeds input range
$\overline{REQ}$: Request input
     Data request input in PLC (programmable logic controller) mode
$\overline{DTV}$: Data valid output
     Low signal is output when BCD data is established
$\overline{PT1}$ to $\overline{PT4}$: Process number selection inputs
$\overline{A\text{-}REF}/RESET$: Auto-reference/Reset input
$\overline{0\text{-}ADJ.}$: Zero-adjustment input
$\overline{HOLD}$: Hold input
HH, HI, GO, LO, LL: Comparative outputs
GND: Ground

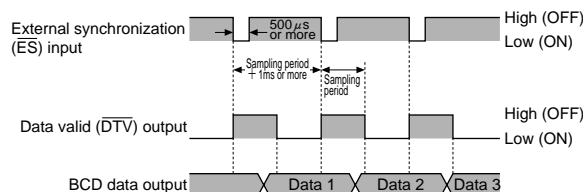### • Center terminal block and lower terminal block

A-REF./   Process number
HOLD 0-ADJ. RESET selection inputs

NC	NC	HOLD	0-ADJ.	RESET	PT1	PT2	PT4	GND
1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9
A	COM.	B	+	COM.	$\overline{ES}$	F.G.		

INPUT   12V DC 150mA OUTPUT   100 to 240V AC (Power input)

Analog signal input A channel   Analog signal input B channel   Power supply for sensor   External sync. input

Note: 'COM.' and 'GND' are common in the relay output type and the transistor output type.
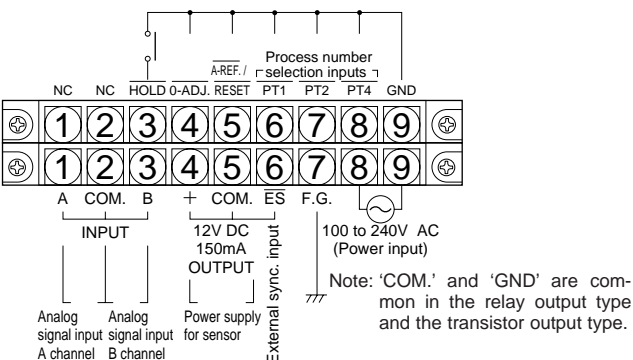
BCD output time chart
• PC (personal computer) mode

External synchronization input operation

① Without function

External synchronization ($\overline{ES}$) input   500 μs or more   High (OFF) Low (ON)

Sampling period + 1ms or more   Sampling period

Data valid ($\overline{DTV}$) output   High (OFF) Low (ON)

BCD data output   Data 1 Data 2 Data 3

Measurement is done when $\overline{ES}$ input falls and measured data is established when $\overline{DTV}$ output becomes low.

② With function

External synchronization ($\overline{ES}$) input

Sample A mode   High (OFF) Low (ON)

Sample B mode   High (OFF) Low (ON)

Data valid ($\overline{DTV}$) output   1ms or less   Sampling period or less   High (OFF) Low (ON)
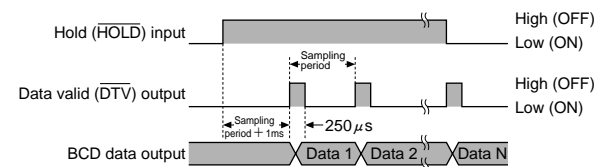
BCD data output   Data 1 Data 2
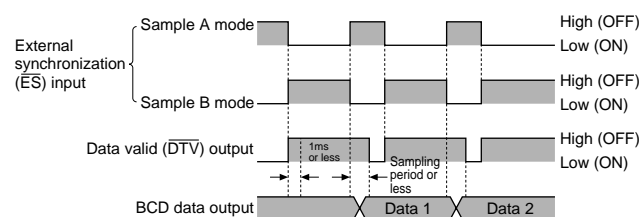
In the Sample A mode, continuous measurement starts at the fall of the $\overline{ES}$ signal and ends when the $\overline{ES}$ signal is detected as High.
In the Sample B mode, continuous measurement starts on detecting the $\overline{ES}$ signal as High (within 1ms after its rise) and ends on detecting it as Low (within one sampling period after its fall).
The $\overline{DTV}$ output becomes Low within one sampling period after the end of measurement, and the measurement data is established.

run mode

Hold ($\overline{HOLD}$) input   High (OFF) Low (ON)

Sampling period

Data valid ($\overline{DTV}$) output   High (OFF) Low (ON)

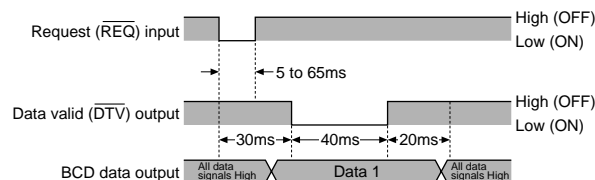Sampling period + 1ms   250 μs

BCD data output   Data 1 Data 2 Data N

If the $\overline{HOLD}$ input is held High, the measurement data is output every sampling cycle.

• PLC (programmable logic controller) mode

Single sampling

Request ($\overline{REQ}$) input   High (OFF) Low (ON)

5 to 65ms

Data valid ($\overline{DTV}$) output   High (OFF) Low (ON)

30ms 40ms 20ms

BCD data output   All data signals High   Data 1   All data signals High

The $\overline{DTV}$ output becomes Low 30ms approx. after the fall of the $\overline{REQ}$ input, and the measurement data is established. Read the measurement data at the time the $\overline{DTV}$ output becomes Low. The $\overline{DTV}$ output becomes High after remaining Low for 40ms, and after another 20ms, all data becomes High.

Continuous sampling

Request ($\overline{REQ}$) input   High (OFF) Low (ON)

Data valid ($\overline{DTV}$) output   High (OFF) Low (ON)

30ms 40ms 30ms 40ms 30ms

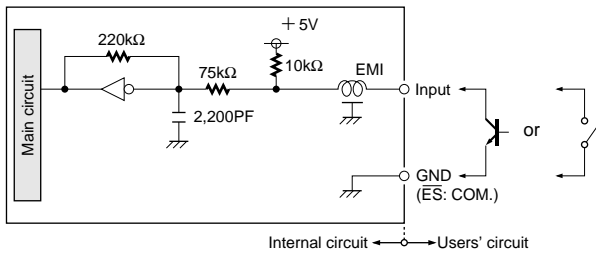BCD data output   All data signals High.   Data 1   Data 2   Data 3
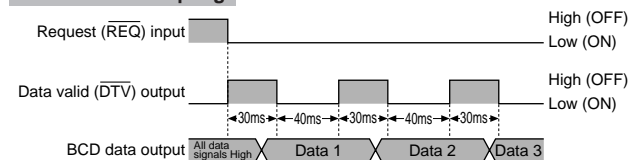
If the $\overline{REQ}$ input is held Low, the measurement data is updated every 70ms.
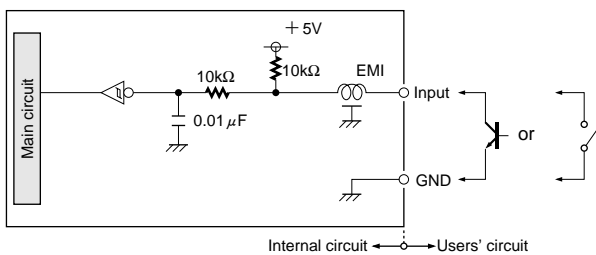
I/O CIRCUIT AND WIRING DIAGRAMS

Input circuit diagram
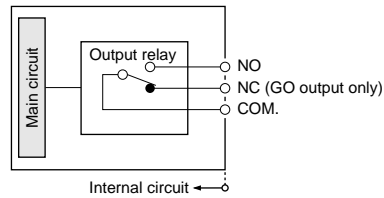
ES, REQ, DVS

A-REF., RESET, 0-ADJ., PT1 to PT4, HOLD

Output circuit diagram

Relay output

Transistor output
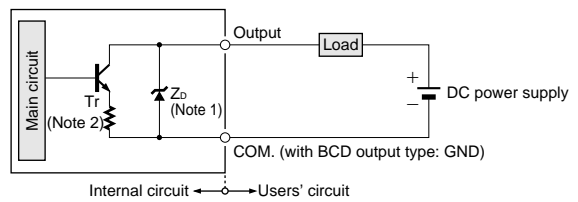
Notes: 1) The zener diode is incorporated only for the comparative output.
2) The resistance is incorporated only in the transistor output type **CA-T□**.

Symbols ... Z_D: Surge absorption zener diode
Tr : NPN output transistor

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771

SENSOR CONTROLLERS

NPS
ON / OFF Input

CA
Analog Input
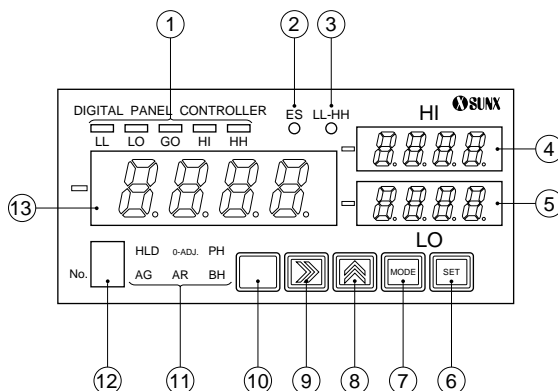
CA2

PS-18V
Power Supply

CA

PRECAUTIONS FOR PROPER USE

⚠️ This product is not a safety controller. It does not possess control functions needed for accident prevention or safety maintenance.

Functional description

	Description	Function
①	Comparative output indicators	Light up, respectively, when LL, LO, GO, HI and HH comparative outputs are ON.
②	External synchronization input indicator	Lights up when the external synchronization input is ON.
③	LL-HH value display indicator	Lights up when LL-HH value display is selected with ⊠ key in the RUN mode. ⸍ The upper threshold value display shows the 'HH' value and the lower threshold value display shows the 'LL' value. ⸌
④	Upper threshold value display	'HI' or 'HH' value is displayed in the RUN mode. In the SET mode, the set values and contents are displayed.
⑤	Lower threshold value display	'LO' or 'LL' value is displayed in the RUN mode. In the SET mode, the set values and contents are displayed.
⑥	SET key	Each set value is entered.
⑦	MODE key	Pressing the key changes the mode.
⑧	Increment key	At each press, it increments each digit of the set value by one.
⑨	Shift key	It shifts the settable digit.

	Description	Function
⑩	SECRET key	It is an auxiliary key to move from the RUN mode to the SET mode. Pressing the MODE key while pressing the SECRET key changes the mode to the SET mode.
⑪	Function display	HLD (Threshold value hold) AG (Previous average comparison) 0-ADJ. (Zero-adjustment) AR (Auto-reference) PH (Peak hold) BH (Bottom hold) Each abbreviation lights up when the respective function is effective.
⑫	Process number display	The process number which is selected from eight patterns of storage is displayed.
⑬	Measurement value display	The measurement value is displayed in the RUN mode. (Except when different functions are used.) The menu or the error message is displayed in the SET mode.

Function at a glance

Function	Details
Arithmetic operations	This function computes data from Channel A and Channel B inputs. CH-A: Channel A data. CH-B: Channel B data. A + B: Addition of Channel A data and Channel B data. A − B: Subtraction of Channel B data from Channel A data. L − (A + B): Subtraction of A + B from constant L. (A/B − 1) × 100: Computes the difference between Channel A data and Channel B data as a percentage of Channel B data. A/B × 100: Computes the ratio (%) of Channel A data to Channel B data.
Hysteresis setting	This function determines the hysteresis (difference between ON and OFF points) of the comparative outputs.
LSD (least significant digit) fixed '0' display	This function fixes the least significant digit display at '0'. It does not affect the comparison operation.

Function	Details
Auto-reference	This function automatically corrects the threshold values according to a change in the reference value. When the auto-reference ($\overline{\text{A-REF.}}$) input is made Low, the measured value at that instant is added to each threshold value (HH, HI, LO and LL).

772

⊗SUNX

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PRECAUTIONS FOR PROPER USE

Functions at a glance

Function	Details
Sampling period selection	This function selects the sampling period from 1 to 5,000ms.
Decimal point position setting	This function sets the place of the decimal point on the display.
Scaling	This function converts the input value range to an arbitrary output value range.
Threshold value display alternation	This function changes the threshold values displayed on the upper and lower value displays during operation. LO, HI ◁Alternation▷ LL, HH
Zero-adjustment (0-ADJ.)	By making the zero-adjust (0-ADJ.) input Low, the measured pressure is forcibly set to '0' and measurement is done by taking this input value as the reference ('0').
Zero-adjustment (0-ADJ.) clear	The input value which was forcibly set to '0' by the zero-adjust (0-ADJ.) function is restored to the original value.
Zero suppression	This function removes unnecessary zeros in upper digits. (e.g.) 0460 → 460
Previous average comparison	This function neglects slow changes, such as drift, and captures only sudden changes.
Operation delay	This function sets the delay time between the actual start of A/D conversion and the input of the start signal (HOLD or ES).
Timer	ON-delay: Neglects short period signals. OFF-delay: Prolongs output signals by a fixed time interval. **Time chart** Timer period: T = 0 to 1,000ms
Trigger mode set	It selects the function (peak hold, bottom hold, peak to peak hold) operation timing. run (Run) mode: Normal processing Sample A (SPLA) mode: Operation when external synchronization signal (ES) input is Low (when function is used) Sample B (SPLb) mode: Operation when external synchronization (ES) input is High (when function is used)
Power-up delay	This function starts measurement after the set delay time after switching on the power supply.
Comparison value selection	This function sets the operation of the comparative outputs when a function (peak hold, bottom hold, peak-to-peak hold) is used. CInP : The comparative output is obtained by comparison between the input value and the threshold value. CdSP : The comparative output is obtained by comparison between the display value and the threshold value.
Analog input monitor	This function displays the analog input data directly on the display without scaling.

Function	Details
Process number selection	① Threshold values (HH, HI, LO and LL) ② Scaling values (Zero point, Span point) ③ Hysteresis ④ 0-ADJ.(Zero-adjustment) ⑤ Decimal point position ⑥ Comparison method A total of eight combinations of the above set values are stored in the memory and can be selected by key operation or by external inputs.
Process number selection control	This function determines whether the selection of the process number is by key operation at the front panel or by the logic combination of the external inputs at the rear.
Threshold value hold	The measurement is stopped and the display value is held at the instant the display value exceeds the threshold value.
Comparison method setting	This function determines how to activate the comparative outputs by comparison of the display value with the threshold values. • **High-GO-Low comparison (HGL)** The threshold values must fulfill the following conditions. ① LL<LO ② LO<HI − Hysteresis ③ HI<HH • **Independent High-ON comparison (HIon)** Each comparative output is independent. GO output is turned ON only when all other comparative outputs are OFF. • **Independent High-Low-ON comparison (HLon)** Each comparative output is independent. GO output is turned ON only when all other comparative outputs are OFF.

SENSOR CONTROLLERS

NPS
ON / OFF Input

CA
Analog Input

CA2

PS-18V
Power Supply

CA

PRECAUTIONS FOR PROPER USE

### Functions at a glance

Function	Details
Comparison method setting	• **Independent Low-ON comparison ($Loon$)** Each comparative output is independent. GO output is turned ON only when all other comparative outputs are OFF.
Peak hold	• **Run (run) mode** In normal condition, the maximum measured value is displayed and the display is reset when reset (RESET) input falls Low. • **Sample A ($SPLA$) mode** **Sample B ($SPLb$) mode** The maximum value measured in the period the external synchronization (ES) input is Low (High in case of Sample B mode) is held and displayed.
Peak-to-Peak hold	• **Run (run) mode** In normal condition, the difference in the maximum and the minimum measured values is displayed, and the display is reset when reset (RESET) input falls Low. • **Sample A ($SPLA$) mode** **Sample B ($SPLb$) mode** The difference in the maximum and the minimum values measured in the period the external synchronization (ES) input is Low (High in case of Sample B mode) is held and displayed.

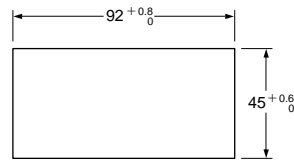| Function	Details
Bottom hold	• **Run (run) mode** In normal condition, the minimum measured value is displayed, and the display is reset when reset (RESET) input falls Low. • **Sample A ($SPLA$) mode** **Sample B ($SPLb$) mode** The minimum value measured while the external synchronization (ES) input is Low (High in case of Sample B mode) is held and displayed.
Hold	• **Run (run) mode** The display is held at the value at which the hold (HOLD) input falls Low and normal operation is restored when it rises to High. • **Sample A ($SPLA$) mode** **Sample B ($SPLb$) mode** The display is held at the value in which the external synchronization (ES) input falls Low for the first time after power-up and does not change till its next falling down.
Display OFF	This function turns off the measured value display.
Display refresh rate selection	This function selects the refresh rate of the measured value display from 0.2, 0.5, 1, 2.5, 10 or 20 times/sec. It does not affect the comparison operation.

DIMENSIONS (Unit: mm)

CA-□   Digital panel controller

91.8

96

48

9.2 ← 111 → (25) → (Note)

44.8
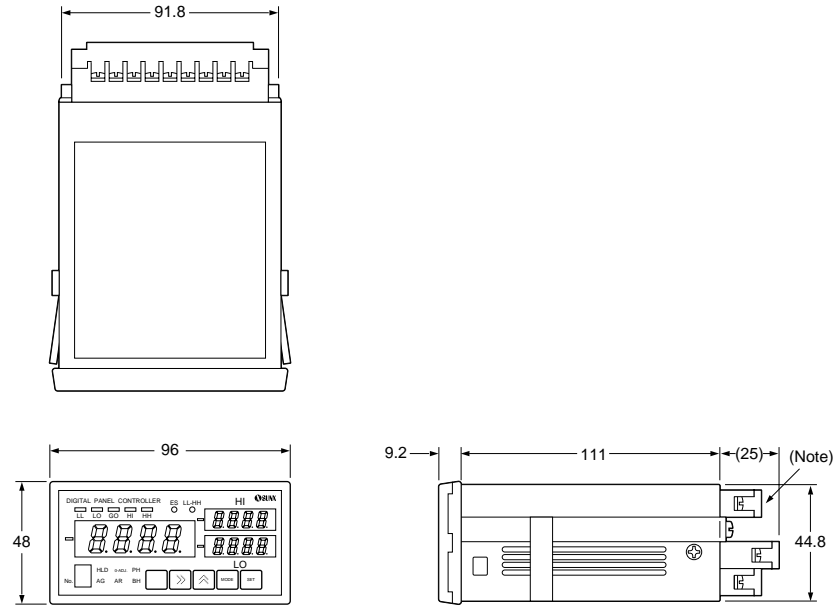
Note: Connector in case of **CA-B□**.
HIF3BA-34PA-2.54DS (Manufactured by Hirose Electric Ltd.)

Recommended mating connector
HIF3BA-34D-2.54R (Manufactured by Hirose Electric Ltd.),
AXM134415A (Manufactured by Matsushita Electric Works Ltd.)
or equivalent

Panel cut-out dimensions

$92^{+0.8}_{0}$

$45^{+0.6}_{0}$

Note: The panel thickness should be 0.5 to 5mm.

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775