

# General Specifications

## Analog I/O Modules (for FIO)



### GS 32Q06K30-31E

#### ■ GENERAL

This GS describes the hardware specifications of the analog I/O modules that can be mounted on the safety node unit and the safety control unit.

#### ■ STANDARD SPECIFICATIONS

##### ● Current Input Module

This module inputs 4 to 20 mA signals from the field.

The SAI143 can be made dual redundant.

Item	Specifications
Model	SAI143 (*1)
Number of input channels	16 channels, module isolation (*5)
Rated input range	4 to 20 mA
Permissible input range	0 to 25 mA
Input impedance during Power-ON	250 Ω + $\frac{\text{Voltage drop in the input protection circuit inside the module}}{\text{Current value}}$ (*6)
Input impedance during Power-OFF	500 kΩ minimum
Rated accuracy	SAI143-S : ±16 μA (Input range 1 to 23 mA) SAI143-H : ±16 μA (Input range 0.05 to 23 mA) (*3) (*4)
Data update frequency	40 ms
Temperature drift	±16 μA/10 °C
Transmitter power supply	16.15 V minimum (at 20 mA) 26.4 V maximum (at 0 mA) (Output current limit: 25 mA)
2/4-wire setting	Individual channel setting Changed by setting pins
Withstand voltage	1.5 kV AC between input signal and system for 1 minute (*2)
Maximum current consumption	5 V system: 320 mA, 24 V system: 550 mA
Weight	Approx. 0.34 kg (For pressure clamp terminal block or MIL cable) Approx. 0.39 kg (With signal cable interface adapter)
External connection	Pressure clamp terminal MIL cable Dedicated signal cable
Support PRM	Available (SAI143-H)
Transmitter power supply ON/OFF function (*7)	Available in 2-wire setting, for all 16 channels at the same time.

- \*1: No Zener barriers can be connected to this module. An isolation barrier should be used when an intrinsic safety instrumented system is used.
- \*2: 500 V AC when dedicated signal cable is used.
- \*3: ±32 μA (input range under 0.05 mA) (Style code S3 or later)
- \*4: Rated accuracy of style code S3 or later is ±16 μA (Input range 0.05 to 23 mA).  
Rated accuracy of style code S2 or earlier is ±16 μA (Input range 1 to 23 mA).
- \*5: When SAI143-S□3 or SAI143-H□C is used in the ambient temperature more than 60°C, number of input channels which a user can use is restricted. Refer to "ProSafe-RS Outline of I/O Modules (for FIO)" (GS 32P06K60-01EN).
- \*6: The maximum voltage drop in the input protection circuit is 0.45 V. The module input impedance varies from 272.5 Ω (20 mA) to 362.5 Ω (4 mA).
- \*7: This function enables to reset the alarm state of Fire and Gas devices by turning off the transmitter power supplied from this module in 2-wire setting.  
Supported by R4.03.00 or later and style code S4 or later.

## ● Voltage Input Module

This module inputs 1 to 5 V/1 to 10 V signals from the field.

The SAV144 can be made dual redundant.

Item	Specifications
<b>Model</b>	SAV144
<b>Number of input channels</b>	16 channels, module isolation
<b>Rated input range</b>	1 to 5 V/1 to 10 V
<b>Permissible input range</b>	±30 V
<b>Input impedance during Power-ON</b>	1 MΩ
<b>Input impedance during Power-OFF</b>	100 kΩ
<b>Rated accuracy</b>	1 to 5 V: ±4 mV 1 to 10 V: ±9 mV
<b>Data update frequency</b>	40 ms
<b>Temperature drift</b>	1 to 5 V: ±4 mV/10 °C 1 to 10 V: ±9 mV/10 °C
<b>Withstand voltage</b>	1.5 kV AC between input signal and system for 1 minute (*1)
<b>Maximum current consumption</b>	5 V system: 300 mA 24 V system: 140 mA
<b>Weight</b>	Approx. 0.24 kg (For pressure clamp terminal block or MIL cable) Approx. 0.29 kg (With signal cable interface adapter)
<b>External connection</b>	Pressure clamp terminal MIL cable Dedicated signal cable (KS1)

\*1: 500 V AC when dedicated signal cable is used.

## ● TC/mV Input Module

This module receives signals from mV and thermocouple (TC). The SAT145 can be made dual redundant.

Item	Specifications
<b>Model</b>	SAT145
<b>Number of input channels</b>	16 channels, Isolated Channels
<b>Input signal</b>	TC: JIS C 1602, IEC 60584-1 (ITS-90) J: -210 to 1200 °C    K: -270 to 1372 °C E: -270 to 1000 °C    T: -270 to 400 °C S: -50 to 1767 °C    R: -50 to 1767 °C N: -270 to 1300 °C    B: 42 to 1820 °C
	mV -100 to 150 mV, -20 to 80 mV, -5 to 25 mV
<b>Switching input signals</b>	TC/mV can be set individually for CH1 to CH16.
<b>Permissible input range</b>	± 5 V
<b>Withstand voltage (*1)</b>	Between input and system: 1500 V AC for 1 minute Between channels: 200 V AC for 1 minute
<b>Input impedance</b>	At least 1 MΩ during Power-ON At least 1 MΩ during Power-OFF
<b>Accuracy</b>	TC    ± 40 μV mV    ± 40 μV
<b>Allowable total resistance of signal source plus wiring</b>	1000 Ω or less
<b>Effect of allowable signal source resistance (1000 Ω)</b>	± 20 μV (*2)
<b>Reference junction compensation accuracy (*3) (*4)</b>	-20 to 0 °C    ± 1.5 °C 0 to 30 °C    ± 1.0 °C 30 to 70 °C    ± 1.5 °C
<b>Temperature drift</b>	± 40 μV / 10 °C
<b>Data update period</b>	150 ms
<b>Burn-out</b>	Individual channel setting Setting: Burnout upscale/Burnout downscale Detection time: 1.5 s
<b>Ambient temperature (during operation)</b>	-20 to 70 °C
<b>Maximum current consumption</b>	5 V system: 400 mA 24 V system: 200 mA
<b>Weight</b>	Approx. 0.47 kg
<b>External connection</b>	Dedicated signal cable (AKB331)

\*1: Use AKB331 of style code S3 or later.

\*2: In dual redundant configuration, this effect is ± 40 μV.

\*3: Reference junction compensation accuracy is specified on combination with SBT4D.

It varies depending on the temperature environment of SBT4D.

These values indicate Reference junction compensation accuracy against the ambient temperature of terminal board.

\*4: This accuracy changes due to the installation condition.

If measured temperature is lower than 0 °C, multiply the above value by the following coefficient (K):

$$K = \frac{\text{Thermoelectromotive force per degree at 0 °C}}{\text{Thermoelectromotive force per degree at measured temperature}}$$

## ● RTD Input Module

This module inputs RTD signals from the field. The SAR145 can be made dual redundant.

Item	Specifications
<b>Model</b>	SAR145
<b>Number of input channels</b>	16 channels, Isolated Channels
<b>Input signal (*5)</b>	RTD (3 wires) JIS C 1604, IEC 60751 (ITS-90) (*3): Pt100, Pt50, Pt200, Pt500, Pt1000 DIN 43760-1987: Ni100 Minco: Ni120
<b>Withstand voltage</b>	Between input and system: 1500 V AC for 1 minute Between channels: 200 V AC for 1 minute
<b>Accuracy (*1) (*2)</b>	800 $\Omega$ range to 400 $\Omega$ : $\pm 160$ m $\Omega$ to 800 $\Omega$ : $\pm 180$ m $\Omega$ 4000 $\Omega$ range to 2000 $\Omega$ : $\pm 900$ m $\Omega$ to 4000 $\Omega$ : $\pm 1700$ m $\Omega$
<b>Allowable resistance of wiring</b>	150 $\Omega$ or less (wiring resistance per wire) (*4)
<b>Measurement current</b>	800 $\Omega$ range: 0.5 mA 4000 $\Omega$ range: 0.1 mA
<b>Temperature drift</b>	800 $\Omega$ range to 400 $\Omega$ : $\pm 150$ m $\Omega$ / 10 $^{\circ}$ C to 800 $\Omega$ : $\pm 300$ m $\Omega$ / 10 $^{\circ}$ C 4000 $\Omega$ range to 2000 $\Omega$ : $\pm 750$ m $\Omega$ / 10 $^{\circ}$ C to 4000 $\Omega$ : $\pm 1500$ m $\Omega$ / 10 $^{\circ}$ C
<b>Data update period</b>	150 ms
<b>Burn-out</b>	Individual channel setting Setting: Burnout upscale/Burnout downscale Detection time: 1.5 s
<b>Ambient temperature (during operation)</b>	-20 to + 70 $^{\circ}$ C
<b>Maximum current consumption</b>	5 V system: 500 mA 24 V system: 200 mA
<b>Weight</b>	Approx. 0.47 kg
<b>External connection</b>	Dedicated signal cable (AKB611)

- \*1: Include the tolerance which is caused by dedicated signal cable AKB611(up to 5 m).  
In case of the cable length of AKB611 is more than 5 m, 15 m $\Omega$  shall be added to the accuracy per each 5 m.
- \*2: These values apply for the case when the resistance of field wiring line A and line B are the same value.  
If the difference of resistance between line A and line B happens, the different value among them needs to be added.
- \*3: SAR145 also supports JIS C 1604: 1989 JPt100.
- \*4: Wiring resistance for signal cable of INnA, INnB and INnC must be identical.
- \*5: When connecting the RTD modules, use the resistors composed of the passive parts. If an instrument that simulates resistance electronically is connected, it may cause error between reading and actual values. Do not connect voltage signal to the modules.

### ● Current Output Module

This module outputs 4 to 20 mA signals to the field.

The SAI533 can be made dual redundant.

Item	Specifications
<b>Model</b>	SAI533
<b>Number of output channels</b>	8 channels, module isolation (*3)
<b>Rated output range</b>	4 to 20 mA
<b>Maximum range of guaranteed precision</b>	1.25 to 23 mA
<b>Output range</b>	1.25 to 23 mA
<b>Allowable load resistance @ rated range</b>	230 to 600 $\Omega$
<b>Accuracy</b>	$\pm 48 \mu\text{A}$
<b>Data update frequency</b>	40 ms
<b>Temperature drift</b>	$\pm 16 \mu\text{A}/10^\circ\text{C}$
<b>Withstand voltage</b>	1.5 kV AC between output signal and system for 1 minute (*1)
<b>Maximum current consumption</b>	5 V system: 320 mA 24 V system: 300 mA
<b>Weight</b>	Approx. 0.26 kg (For pressure clamp terminal block or MIL cable) Approx. 0.33 kg (With signal cable interface adapter)
<b>External connection</b>	Pressure clamp terminal MIL cable Dedicated signal cable
<b>Support PST(*2)</b>	Available (KS1)

\*1: 500 V AC when dedicated signal cable is used.

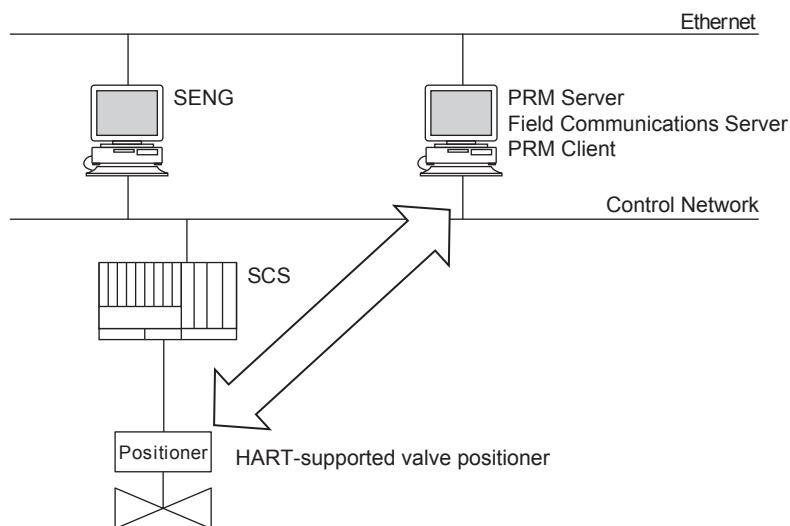
\*2: Diagnosis in operation of PST(Partial Stroke Test)

\*3: When SAI533-H□3 is used in the ambient temperature more than 60°C, number of output channels which a user can use is restricted. Refer to "ProSafe-RS Outline of I/O Modules (for FIO)" (GS 32P06K60-01EN).

### ■ HART COMMUNICATION

Analog I/O module with HART communication on ProSafe-RS allows Plant Resource Manager (PRM) to manage the HART communication devices connected to input and output modules on SCS. Also, the analog output module allows PRM client to conduct Partial Stroke Test (PST) on HART-supported valve positioner equipped with the PST function.

The HART communication functions on ProSafe-RS are interference-free and have no impact on the safety functions on SCS.



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**Figure Example of the HART Communication Function System Configuration**

## ● Analog I/O Modules for HART Communication Function

The following table shows analog I/O modules for HART communication function available to ProSafe-RS.

Model	Module	Description
SAI143-H	Analog Input module (Current input)	4 to 20 mA, 16 channels, module isolation
SAI533-H	Analog Output module (Current output)	4 to 20 mA, 8 channels, module isolation

One HART device is connectable for each channel. Each channel is equipped with a power supply function to the HART device.

Each module has only one HART modem and is communicable concurrently with only one HART device.

## ● HART Communication Specifications

**Table HART Communication Specifications**

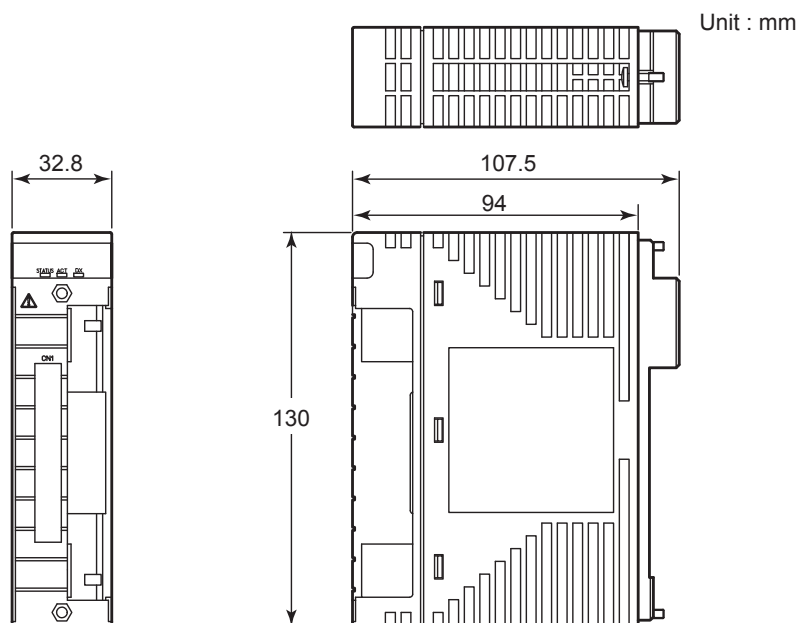
Function	Description
Communication mode	Serial half duplex, start-stop synchronization, 1 start/ 8 bit/ odd parity/ 1 stop
Applicable standard	HART Protocol Revision 5.7 (*1)
Transmission speed	1200 ±2 bps
Modulation technique	Binary phase-continuous FSK 1: 1200 Hz ±1 %, 0: 2200 Hz ±1%
Frame length	5 to 267 bytes Contents of max. 267 bytes: Delimiter: 1 Address: 5 Command: 1 Byte count: 1 Data: 255 (includes two bytes of response code) Check byte: 1
Frame detection	3 byte header byte-count carrier (ON/OFF) Preamble: 5 to 20 bytes
Error detection coding	Longitudinal/vertical parity
Response time	Max. 28 characters (256.7 ms)
No response timer	33 characters (305 ms) for primary, 41 characters (380 ms) for secondary
Bus monitor	8 characters (75 ms)
Response window	20 ms

\*1: The HART 5, 6, and 7 devices can be connected but applying the HART protocol 5.7 function.

## EXTERNAL DIMENSIONS

### ● SAI143, SAV144 and SAI533 Analog Input/Output Modules

For pressure clamp and MIL cable



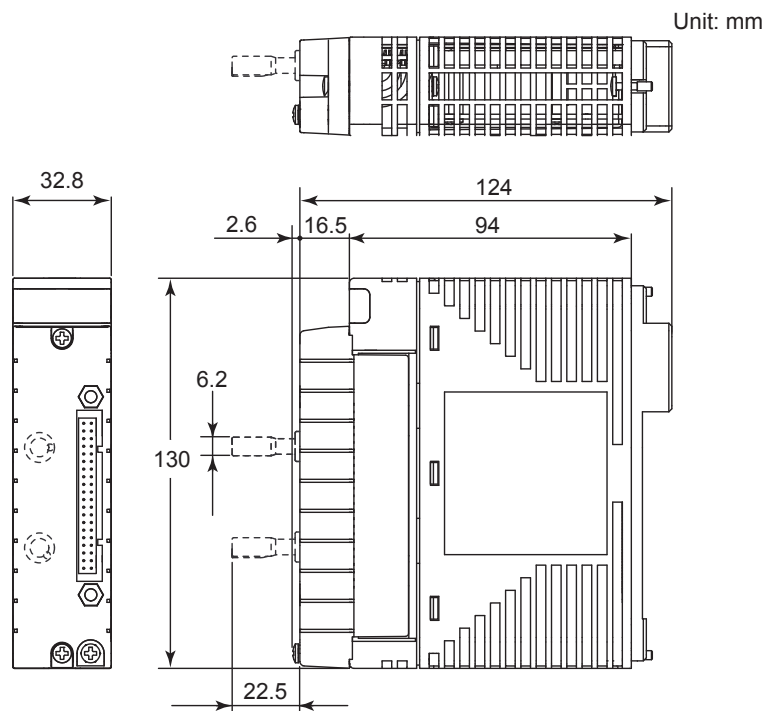
Nominal tolerance:

Nominal tolerance is  $\pm 0.8$  mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is  $\pm 1.5$  mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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### With signal cable interface adapter



Nominal tolerance:

Nominal tolerance is  $\pm 0.8$  mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is  $\pm 1.5$  mm.

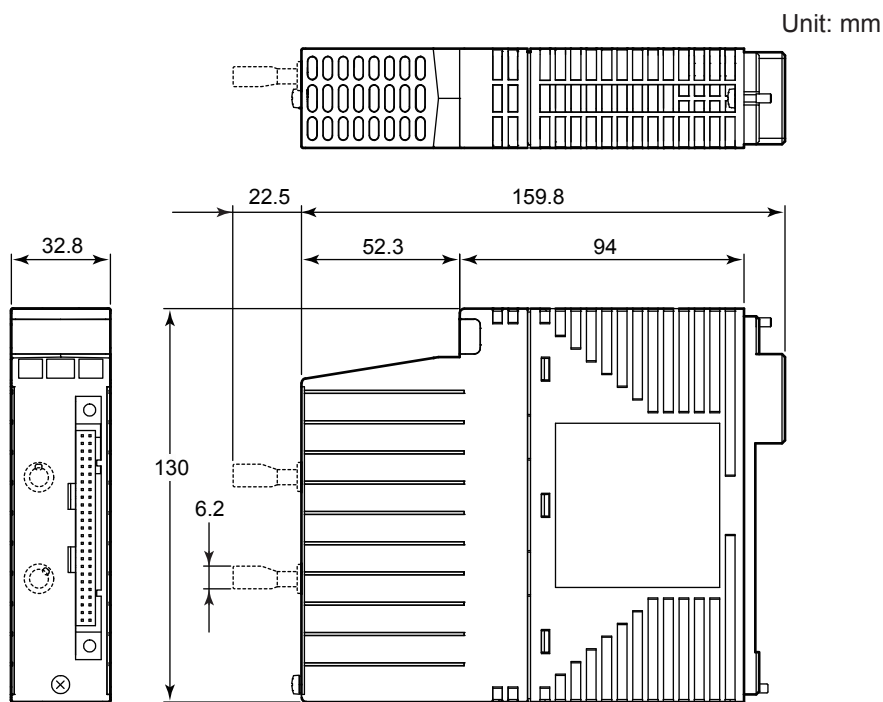
The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

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Note: Dash line expresses prevention pin of false insertion. This pin is added if option code /PRP is specified.

## ● SAT145, SAR145 Analog Input Modules

With signal cable interface adapter



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### Nominal tolerance:

Nominal tolerance is  $\pm 0.8$  mm for the dimensions of 0.5 mm or more and 120 mm or less, and the combined nominal tolerance is  $\pm 1.5$  mm.

The nominal tolerance is in accordance with JEM 1459 for the dimensions over 120 mm.

Note: Dash line expresses prevention pin of false insertion. This pin is added if option code /PRP is specified.



## ■ MODEL AND SUFFIX CODES

		Description
<b>Model</b>	SAI143	Analog Input Module (4 to 20 mA, 16 channels, module isolation)
<b>Suffix Codes</b>	-S	Standard type
	-H	With HART communication [Release: R1.02.00] (*1)
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*2)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*2)
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
<b>Option Codes</b>	C	With ISA Standard G3 and high-density installation (-20 to 70 °C) (*5)
	/A4S00	With pressure clamp terminal block for analog [Model: STA4S-00]
	/A4S10	With pressure clamp terminal block for analog (with surge absorber) [Model: STA4S-10]
	/A4D00	With dual-redundant pressure clamp terminal block for analog (*3) [Model: STA4D-00]
	/A4D10	With dual-redundant pressure clamp terminal block for analog (with surge absorber) (*3) [Part name: STA4D-10]
	/PRP	With prevention pin of false insertion (*4)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]

\*1: For dual-redundant pressure clamp terminal block, please do not use STA4D-□0 S1.

\*2: When selecting SAI143-□6□ or -□F□, you can not choose the option code of pressure clamp terminal block and MIL cable connector.

\*3: When using this module in a dual-redundant configuration, order an additional module with the same specifications but without option codes.

\*4: When SAI143-□6□ or -□F□ is selected, you can choose the option code for prevention pin of false insertion.  
A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SAI143.

\*5: Suffix code for "With ISA Standard G3 and high-density installation" is available in case of SAI143-H□C. This is not available in case of SAI143-S.

		Description
<b>Model</b>	SAV144	Analog input module (1 to 5 V/1 to 10 V, 16 channels, module isolation)
<b>Suffix Codes</b>	-S	Standard type
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
<b>Option Codes</b>	3	With ISA Standard G3 and temperature (-20 to 70 °C)
	/A4S00	With pressure clamp terminal block for analog [Model: STA4S-00]
	/A4S10	With pressure clamp terminal block for analog (with surge absorber) [Model: STA4S-10]
	/A4D00	With dual-redundant pressure clamp terminal block for analog (*2) [Model: STA4D-00]
	/A4D10	With dual-redundant pressure clamp terminal block for analog (with surge absorber) (*2) [Part name: STA4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]

\*1: When selecting SAV144-S63 or -SF3, you can not choose the option code of pressure clamp terminal block and MIL cable connector.

\*2: When using this module in a dual-redundant configuration, order an additional module with the same specifications but without option codes.

\*3: When SAV144-S63 or -SF3 is selected, you can choose the option code for prevention pin of false insertion.  
A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SAV144.

		Description
<b>Model</b>	SAT145	TC/mV Input Module (16 channels, Isolated Channels)
<b>Suffix Codes</b>	-S	Standard type
	6	With signal cable interface adapter and no explosion protection
	F	With signal cable interface adapter and explosion protection
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
<b>Option Codes</b>	/PRP	With prevention pin of false insertion

		Description
<b>Model</b>	SAR145	RTD Input Module (16 channels, Isolated Channels)
<b>Suffix Codes</b>	-S	Standard type
	6	With signal cable interface adapter and no explosion protection
	F	With signal cable interface adapter and explosion protection
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
<b>Option Codes</b>	/PRP	With prevention pin of false insertion

		Description
<b>Model</b>	SAI533	Analog Output Module (4 to 20 mA, 8 channels, module isolation)
<b>Suffix Codes</b>	-H	With HART communication
	5	For pressure clamp terminal block or MIL cable with no explosion protection
	6	With signal cable interface adapter and no explosion protection (*1)
	E	For pressure clamp terminal block or MIL cable with explosion protection
	F	With signal cable interface adapter and explosion protection (*1)
	3	With ISA Standard G3 and temperature (-20 to 70 °C)
<b>Option Codes</b>	/A4S00	With pressure clamp terminal block for analog [Model: STA4S-00]
	/A4S10	With pressure clamp terminal block for analog (with surge absorber) [Model: STA4S-10]
	/A4D00	With dual-redundant pressure clamp terminal block for analog (*2) [Model: STA4D-00]
	/A4D10	With dual-redundant pressure clamp terminal block for analog (with surge absorber) (*2) [Model: STA4D-10]
	/PRP	With prevention pin of false insertion (*3)
	/CCC01	With connector cover for MIL cable (for flat ribbon cable) [Model: SCCC01]

\*1: When selecting SAI533-H63 or -HF3, you can not choose the option code of pressure clamp terminal block and MIL cable connector.

\*2: When using this module in a dual-redundant configuration, order an additional module with the same specifications but without option codes.

\*3: When SAI533-H63 or -HF3 is selected, you can choose the option code for prevention pin of false insertion.  
A mechanism to prevent wrong type I/O module insertion is supported with signal cable. The signal cable used with this I/O module must have option code /SAI533.

## ■ CONFORMITY STANDARDS

Refer to “ProSafe-RS Standards Compliant Models” (GS 32P01B60-01EN).

## ■ ORDERING INFORMATION

Specify the model and suffix codes.

For selecting the right products for explosion protection, please refer to TI 32S01J30-01E without fail.

## ■ TRADEMARKS

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