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**User's  
Manual**

**SL1000  
Input Module**

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Thank you for purchasing the SL1000 High-Speed Data Acquisition Unit. This user's manual explains the functions and operating procedures of the SL1000 Acquisition Software. To ensure correct use, please read this manual thoroughly before beginning operation.

Keep this manual in a safe place for quick reference in the event a question arises. This manual will come in handy when you are unsure of how to operate the product.

## List of Manuals

The following manuals, including this one, are provided as manuals for the SL1000. Please read all of them.

Manual Title	Manual No.	Description
SL1000 High-Speed Data Acquisition Unit User's Manual	IM 720120-01E	Explains all functions and procedures of the SL1000 excluding the communication functions.
SL1000 Acquisition Software User's Manual	IM 720120-61E	Explains all functions and procedures of the Acquisition Software used to configure and control the SL1000.
SL1000 Input Module User's Manual	IM 720120-51E	This manual. Explains the specifications of the input modules that can be installed in the SL1000.
Precautions Concerning the Modules	IM 701250-04E	The manual explains the precautions concerning the modules.
701992 Xviewer Install Manual	IM 701992-02E	This manual explains how to install the Xviewer* setup software.
SL1000 High-Speed Data Acquisition Unit	IM 720120-92	Document for China

The "E" in the manual numbers are the language codes.

\* The Xviewer user's manual is included in the Xviewer help.

Contact information of Yokogawa offices worldwide is provided on the following sheet.

Document No.	Description
PIM 113-01Z2	List of worldwide contacts

## Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
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## Revisions

- 1st Edition: December 2007
- 2nd Edition: September 2013
- 3rd Edition: June 2014
- 4th Edition: October 2015
- 5th Edition: March 2016
- 6th Edition: July 2017
- 7th Edition: October 2017

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# Conventions Used in This Manual

## Unit

k: Denotes 1000.

Example: 100 kS/s (sample rate)

K: Denotes 1024.

Example: 720 KB (file size)

## Notes and Cautions

The notes and cautions in this manual are categorized using the following symbols.



*Improper handling or use can lead to injury to the user or damage to the instrument.* This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

### **WARNING**

Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

### **CAUTION**

Calls attentions to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

## French

### **AVERTISSEMENT**

Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures graves (voire mortelles), et sur les précautions de sécurité pouvant prévenir de tels accidents.

### **ATTENTION**

Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures légères ou d'endommager l'instrument ou les données de l'utilisateur, et sur les précautions de sécurité susceptibles de prévenir de tels accidents.

### **Note**

Calls attention to information that is important for proper operation of the instrument.

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# 1 High-Speed 10 MS/s, 12-Bit Isolation Module (701250) Specifications

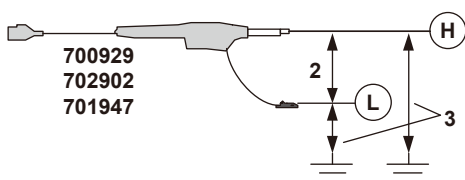
Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	10 MS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when sine wave of amplitude 60 % of range is input)	DC to 3 MHz
Voltage-axis range setting	50 mV range to 200 V range (1-2-5 steps) (when using 1:1 probe attenuation)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929(10:1), 702902(10:1), or 701947(100:1): <sup>2</sup> 600 V (DC+ACpeak) Combined with the 701901+701954 (1:1): <sup>4</sup> 200 V (DC+ACpeak) (as a value that meets the safety standard) 250 V (DC+ACpeak) (maximum allowable voltage, as a value that does not damage the instrument when applied) Direct input (cable that does not comply with the safety standards): <sup>6</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth Between input and case Between each input (at a frequency of 1 kHz or less)	Working voltage of safety standard In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1), <sup>3</sup> or in combination with 701901+701954 (1:1): <sup>5</sup> 400 Vrms (measurement category Other (O)), 300 Vrms (CAT II) Direct input (cable that does not comply with the safety standards): <sup>7</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	50 mV range to 200 V range: ±(0.5% of range)
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 700929 or 702902, 0.1 Hz or less when using the 701947)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>8</sup> )
Residual noise level (Input section shorted)	±400 μV or ±0.6% of range whichever is greater (typical value <sup>8</sup> )
Withstand voltage	2300 Vrms for 2 seconds (across each terminal and earth) (60 Hz)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	12 bit (1500 LSB/range)
Temperature coefficient	Zero point: 50 mV range to 200 V range: ±(0.05% of range)/°C (typical value <sup>8</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>8</sup> )
Bandwidth limit	Select from Full, 500 kHz, 50 kHz, 5 kHz, and 500 Hz Cut-off characteristics: -18 dB/OCT (typical value <sup>8</sup> )
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A: 1 V (for the 701930/701931) Clamp-on probe: 1 A:10 mV (for the 720930), 1 A: 2.5 mV (for the 720931)

# 1 High-Speed 10 MS/s, 12-Bit Isolation Module (701250) Specifications

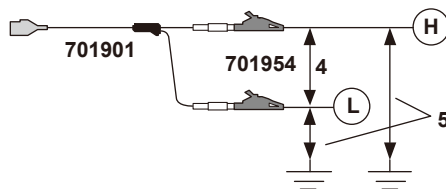
Item	Specifications
Compatible probes/cables	<p>Voltage probe: Recommended</p> <p>700929 (10:1 safety probe), 20 to 45 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>702902 (10:1 safety probe), 25 to 40 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>701947 (100:1 safety probe), 15 to 45 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>Current probe (power can be supplied from the SL1000 Unit, Option)</p> <p>701930 (150 A), 701931 (500 A), 701932 (30 A), 701933 (30 A)</p> <p>Clamp-on probe</p> <p>720930 (50 A), 720931 (200 A)</p> <p>High voltage differential probe (connect the GND cable provided with the probe to the SL1000 Unit case)</p> <p>700924 (1000:1, 100:1/1400 V (DC+ACpeak)): For measuring 1400 V (DC+ACpeak) or less</p> <p>Connection cable (for high voltage 1:1)</p> <p>701901 (isolated type BNC-safety alligator clip adapter ×2: For measuring 200 V (DC+ACpeak) or less), 701954 (alligator clip (dolphin type) red/black 2-piece set) is required separately</p> <p>Connection cable (for low voltage 1:1)</p> <p>366926 (non-isolated type BNC-alligator clip ×2: For measuring low voltage less than or equal to 42 V (DC+ACpeak))</p>

1 Value measured under standard operating conditions.

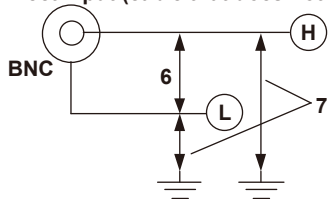
Combined with the 700929, 702902, or 701947



Combined with the 701901+701954



Direct input (cable that does not comply with the safety standards)



8 The typical value is a representative or standard value. It is not strictly warranted.

## 2

# High-Speed 10 MS/s, 12-Bit Isolation Module (720250) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	10 MS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when sine wave of amplitude 60 % of range is applied)	DC to 3 MHz
Voltage-axis range setting	50 mV range to 200 V range (1-2-5 steps) (when using 1:1 probe attenuation)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929(10:1), 702902(10:1), or 701947(100:1): <sup>2</sup> 800 V (DC+ACpeak) Combined with the 701901+701954 (1:1): <sup>4</sup> 200 V (DC+ACpeak) (as a value that meets the safety standard) 250 V (DC+ACpeak) (maximum allowable voltage, as a value that does not damage the instrument when applied) Direct input (cable that does not comply with the safety standards): <sup>6</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth Between input and case Between each input(at a frequency of 1 kHz or less)	Working voltage of safety standard In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1), <sup>3</sup> or in combination with 701901+701954 (1:1): <sup>5</sup> 400 Vrms (CAT II) Direct input (cable that does not comply with the safety standards): <sup>7</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	±0.5 % of range
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 700929 or 702902, 0.1 Hz or less when using the 701947)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>8</sup> )
Residual noise level (Input section shorted)	±400 μV or ±0.06 div whichever is greater (typical value <sup>8</sup> )
Withstand voltage	2300 Vrms for 2 seconds (across each terminal and earth)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	12 bit (150 LSB/div)
Temperature coefficient	Zero point: ±(0.05% of range)/°C (typical value <sup>8</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>8</sup> )
Bandwidth limit	Select from Full, 500 kHz, 50 kHz, 5 kHz, and 500 Hz Cut-off characteristics: -18 dB/OCT (typical value <sup>8</sup> )
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A: 1 V (for the 701930/701931) Clamp-on probe: 1 A:10 mV (for the 720930), 1 A: 2.5 mV (for the 720931)

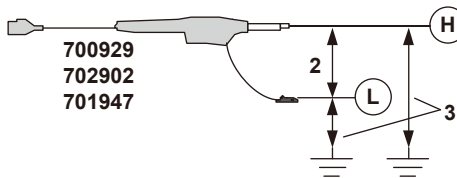


## 2 High-Speed 10 MS/s, 12-Bit Isolation Module (720250) Specifications

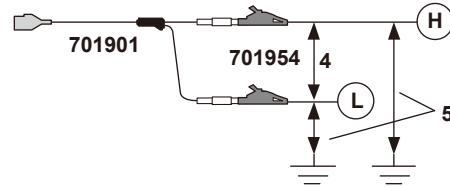
Item	Specifications
Compatible probes/cables	<p>Voltage probe: Recommended</p> <p>700929 (10:1 safety probe), 20 to 45 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>702902 (10:1 safety probe), 25 to 40 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>701947 (100:1 safety probe), 15 to 45 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>Current probe (power can be supplied from the SL1000 unit, Option)</p> <p>701930 (150 A), 701931 (500 A), 701932 (30 A), 701933 (30 A), 701917(5A), 701918(5A)</p> <p>Clamp-on probe</p> <p>720930 (50 A), 720931 (200 A)</p> <p>High voltage differential probe (connect the GND cable provided with the probe to the SL1000 unit case)</p> <p>700924 (1000:1, 100:1/1400 V (DC+ACpeak)): For measuring 1400 V (DC+ACpeak) or less</p> <p>Connection cable (for high voltage 1:1)</p> <p>701901 (isolated type BNC-safety alligator clip adapter ×2: For measuring 200 V (DC+ACpeak) or less), 701954 (alligator clip (dolphin type) red/black 2-piece set) is required separately</p> <p>Connection cable (for low voltage 1:1)</p> <p>366926 (non-isolated type BNC-alligator clip ×2: For measuring low voltage less than or equal to 42 V (DC+ACpeak))</p>

1 Value measured under standard operating conditions.

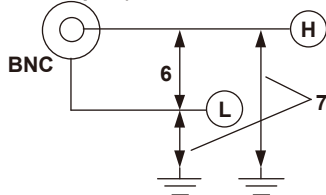
Combined with the 700929, 702902, or 701947



Combined with the 701901+701954



Direct input (cable that does not comply with the safety standards)



8 The typical value is a representative or standard value. It is not strictly warranted.

### 3 High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module (701251) Specifications

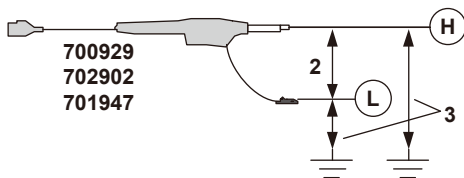
Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	1 MS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	50 mV range to 200 V range: DC to 300 kHz 20 mV range and 10mV range: DC to 200 kHz
Voltage-axis range setting	1 mV range to 20 V range (1-2-5 steps) (when using 1:1 probe attenuation)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>2</sup> 600 V (DC+ACpeak) Combined with the 701901+701954 (1:1): <sup>4</sup> 140 V (DC+ACpeak) Direct input (cable that does not comply with the safety standards): <sup>6</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth Between input and case Between each input(at a frequency of 1 kHz or less)	Working voltage of safety standard In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1), <sup>3</sup> or in combination with 701901+701954 (1:1): <sup>5</sup> 400 Vrms (measurement category Other (O)), 300 Vrms (CAT II) Direct input (cable that does not comply with the safety standards): <sup>7</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	50 mV range to 200 V range: ±(0.25% of range) 20 mV range: ±(0.3% of range) 10 mV range: ±(0.5% of range)
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	1 Hz or less (0.1 Hz or less when using the 700929 or 702902, 0.01 Hz or less when using the 701947)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>8</sup> )
Residual noise level (Input section shorted)	±100 μV or ±0.1% of range whichever is greater (typical value <sup>8</sup> )
Withstand voltage	2300 Vrms for 2 seconds (across each terminal and earth) (60 Hz)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	16 bit (24000 LSB/range)
Temperature coefficient	Zero point: 50 mV range to 200 V range: ±(0.02% of range)/°C (typical value <sup>8</sup> ) 20 mV range: ±(0.05% of range)/°C (typical value <sup>8</sup> ) 10 mV range: ±(0.10% of range)/°C (typical value <sup>8</sup> ) Gain: 10 mV range to 200 V range: ±(0.02% of range)/°C (typical value <sup>8</sup> )
Bandwidth limit	Select from Full, 40 kHz, 4 kHz, and 400 Hz Cut-off characteristics: -12 dB/OCT (typical value <sup>8</sup> )
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A: 1 V (for the 701930/701931) Clamp-on probe: 1 A:10 mV (for the 720930), 1 A: 2.5 mV (for the 720931)

### 3 High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module (701251) Specifications

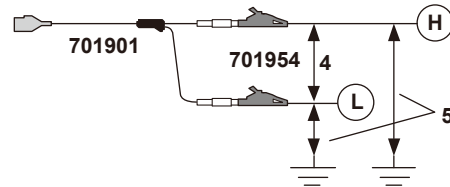
Item	Specifications
Compatible probes/cables	<p>Voltage probe: Recommended</p> <p>700929 (10:1 safety probe), 20 to 45 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>702902 (10:1 safety probe), 25 to 40 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>701947 (100:1 safety probe), 15 to 45 pF: For measuring 600 V (DC+ACpeak) or less</p> <p>Current probe (power can be supplied from the SL1000 Unit. Option)</p> <p>701930 (150 A), 701931 (500 A), 701932 (30 A), 701933 (30 A)</p> <p>Clamp-on probe</p> <p>720930 (50 A), 720931 (200 A)</p> <p>High voltage differential probe (connect the GND cable provided with the probe to the SL1000 Unit case)</p> <p>700924 (1000:1, 100:1/1400 V (DC+ACpeak)): For measuring 1400 V (DC+ACpeak) or less</p> <p>Connection cable (for high voltage 1:1)</p> <p>701901 (isolated type BNC-safety alligator clip adapter ×2: For measuring 200 V (DC+ACpeak) or less), 701954 (alligator clip (dolphin type) red/black 2-piece set) is required separately</p> <p>Connection cable (for low voltage 1:1)</p> <p>366926 (non-isolated type BNC-alligator clip ×2: For measuring low voltage less than or equal to 42 V (DC+ACpeak))</p>

1 Value measured under standard operating conditions.

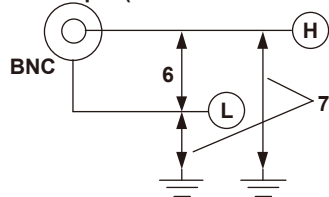
Combined with the 700929, 702902, or 701947



Combined with the 701901+701954



Direct input (cable that does not comply with the safety standards)



8 The typical value is a representative or standard value. It is not strictly warranted.

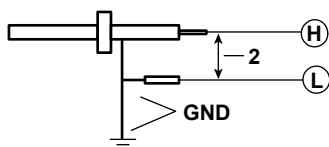
## 4 High-Speed 10 MS/s, 12-Bit Non-Isolation Module (701255) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	10 MS/s
Input format	Non-isolated, unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when sine wave of amplitude 60 % of range is input)	DC to 3 MHz
Voltage-axis range setting	50 mV range to 200 V range (1-2-5 steps) (when using 1:1 probe attenuation)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 701940 (10:1): <sup>2</sup> 600 V (DC+ACpeak) Direct input (cable that does not comply with the safety standards): <sup>3</sup> 200 V (DC+ACpeak) (as a value that meets the safety standard) 250 V (DC+ACpeak) (maximum allowable voltage, as a value that does not damage the instrument when applied)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	50 mV range to 200 V range: ±(0.5% of range)
Input connector	BNC connector (metallic type)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 701940)
Residual noise level (Input section shorted)	±400 μV or ±0.6% of range whichever is greater (typical value <sup>4</sup> )
A/D conversion resolution	12 bit (1500 LSB/range)
Temperature coefficient	Zero point: 50 mV range to 200 V range: ±(0.05% of range)/°C (typical value <sup>4</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>4</sup> )
Bandwidth limit	Select from Full, 500 kHz, 50 kHz, 5 kHz, and 5400 Hz Cut-off characteristics: -18 dB/OCT (typical value <sup>4</sup> )
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A: 1 V (for the 701930/701931) Clamp-on probe: 1 A:10 mV (for the 720930), 1 A: 2.5 mV (for the 720931)
Compatible probes/cables	Voltage probe (10:1 passive probe): Recommended 701940, 17 to 46 pF: For measuring 600 V (DC+ACpeak) or less Current probe (power can be supplied from the SL1000 Unit. Option) 701930 (150 A), 701931 (500 A), 701932 (30 A), 701933 (30 A) Clamp-on probe 720930 (50 A), 720931 (200 A) High voltage differential probe (connect the GND cable provided with the probe to the SL1000 Unit case) 700924 (1000:1, 100:1/1400 V (DC+ACpeak)): For measuring 1400 V (DC+ACpeak) or less Connection cable (for low voltage 1:1) 366926 (non-isolated type BNC-alligator clip ×2: For measuring low voltage less than or equal to 42 V (DC+ACpeak))

<sup>1</sup> Value measured under standard operating conditions.

### Recommended:

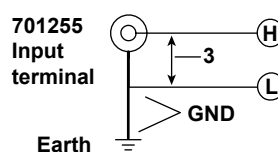
Combined with the 10:1 passive probe (701940)



**GND is connected to the case potential.**

### Direct input

(cable that does not comply with the safety standards)



**GND is connected to the case potential.**

<sup>4</sup> The typical value is a representative or standard value. It is not strictly warranted.

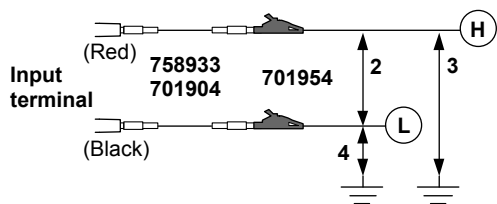
## 5 High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701267) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, GND, AC-RMS, and DC-RMS
Maximum sample rate	100 kS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	Waveform observation mode: DC to 40 kHz RMS observation mode: DC, 40 Hz to 10 kHz
Voltage-axis range setting	200 mV range to 2 kV range (1-2-5 steps)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 758933+701954 or 701904+701954: <sup>2</sup> 850 V (DC+ACpeak) Direct input (cable that does not comply with the safety standards): <sup>5</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth	Working voltage of safety standard Combined with the 758933+701954 or 701904+701954
Between input and case	Across probe tip H and earth: <sup>3</sup> 700 Vrms (CAT II)
Between each input (at a frequency of 1 kHz or less)	Across probe tip L and earth: <sup>4</sup> 400 Vrms (CAT II) Direct input (cable that does not comply with the safety standards) Across the input terminal, H or L, and earth: <sup>6</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	Waveform observation mode DC accuracy ±(0.25% of range) RMS observation mode DC accuracy ±(1.0% of range) AC accuracy (when a sine wave is input) ±(1.5% of range) At frequency of 40 Hz to 1 kHz AC accuracy (when the crest factor is 2 or less) ±(2.0% of range) At frequency of 40 Hz to 1 kHz AC accuracy (when the crest factor is 3 or less) ±(3.0% of range) At frequency of 40 Hz to 1 kHz
Input connector	Plug-in terminal (safety terminal)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	1 Hz or less
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>7</sup> )
Residual noise level (Input section shorted)	±1 mV or ±0.2% of range whichever is greater (typical value <sup>7</sup> )
Withstand voltage	3510 Vrms for 2 seconds (across each terminal and earth) (60 Hz)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	16 bit (24000 LSB/range)
Temperature coefficient	Zero point: ±(0.02% of range)/°C (typical value <sup>7</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>7</sup> )
Response time (only when observing RMS)	Rising (0 to 90% of range): 100 ms (typical value <sup>7</sup> ) Falling (100 to 10% of range): 250 ms (typical value <sup>7</sup> )
Bandwidth limit	Select from Full, 10 kHz, 1 kHz, and 100 Hz Cut-off characteristics: -12 dB/OCT (typical value <sup>7</sup> )
Connection cable	Measurement lead 758933 and alligator clip for measuring 850 V (DC+ACpeak) or less 1:1 safety cables 701904 and alligator clip for measuring 850 V (DC+ACpeak) or less (the alligator clip (dolphin type) 701954 is recommended)

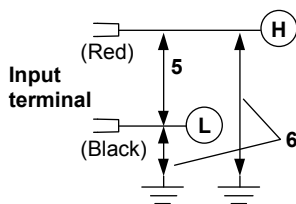
1. Value measured under standard operating conditions.

5 High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701267) Specifications

Combined with the 758933+701954 or 701904+701954



Direct input (cable that does not comply with the safety standards)



7 The typical value is a representative or standard value. It is not strictly warranted.

## 6 High-Voltage 1 MS/s, 16-Bit Isolation Module (with AAF, RMS) (720268) Specifications

Item	Specifications								
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration								
Number of input channels	2								
Input coupling	AC, DC, GND, AC-RMS, and DC-RMS								
Maximum sample rate	1 MS/s								
Input format	Isolated unbalanced								
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude ±60% of range is applied)	Waveform observation mode: DC to 300 kHz RMS observation mode: DC, 40 Hz to 100 kHz								
Voltage-axis range setting	200 mV range to 2 kV range (1-2-5 steps)								
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 758933+701954 or 701904+701954: <sup>2, 7</sup> 850 V (DC+ACpeak) Direct input (cable that does not comply with the safety standards): <sup>4</sup> 42 V (DC+ACpeak)								
Maximum rated voltage to earth Between input and case Between each input (at a frequency of 1 kHz or less)	Combined with the 758933+701954 or 701904+701954: <sup>3</sup> 1000 Vrms (CAT II), 600 Vrms (CAT III) Direct input (cable that does not comply with the safety standards): <sup>5</sup> 42 V (DC+ACpeak) (CAT II)								
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	Waveform observation mode DC accuracy ±(0.25% of 10 range) RMS observation mode DC accuracy ±(1.0% of range) AC accuracy (when a sine wave is input) ±(1.5% of range) At frequency of 40 Hz to 1 kHz AC accuracy (when the crest factor is 2 or less) ±(2.0% of range) At frequency of 40 Hz to 1 kHz AC accuracy (when the crest factor is 3 or less) ±(3.0% of range) At frequency of 40 Hz to 1 kHz 1 kHz to 10 kHz: Add 1.0% to the above AC accuracy.								
Input connector	Plug-in terminal (safety terminal)								
Input impedance	2 MΩ ± 1%, approx. 12 pF								
-3 dB point when AC coupled low frequency attenuation point	1 Hz or less								
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>6</sup> )								
Residual noise level (Input section shorted)	±2 mV or ±0.4% of range whichever is greater (typical value <sup>6</sup> )								
Withstand voltage	5400 VACrms for 2 seconds (across each terminal and earth) (60 Hz)								
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)								
A/D conversion resolution	16 bit (2400 LSB/div)								
Temperature coefficient	Zero point: ±(0.02% of range)/°C (typical value <sup>6</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>6</sup> )								
Response time (only when observing RMS)	Rising (0 to 90% of range): 120 ms (typical value <sup>6</sup> ) Falling (100 to 10% of range): 280 ms (typical value <sup>6</sup> )								
Bandwidth limit	Select from Full, 40 kHz, 4 kHz, 400 Hz, and AUTO Cut-off characteristics: Setting other than AUTO: -18 dB/OCT (typical value <sup>6</sup> ) AUTO: Digital filter Cutoff frequency (fc) when set to AUTO								
	<table border="1"> <thead> <tr> <th>Sample Rate</th> <th>Cutoff Frequency (fc)</th> </tr> </thead> <tbody> <tr> <td>100 kS/s or higher</td> <td>40 kHz</td> </tr> <tr> <td>100 S/s to 50 kS/s</td> <td>40% of the sample rate</td> </tr> <tr> <td>50 S/s or less</td> <td>40 Hz</td> </tr> </tbody> </table>	Sample Rate	Cutoff Frequency (fc)	100 kS/s or higher	40 kHz	100 S/s to 50 kS/s	40% of the sample rate	50 S/s or less	40 Hz
Sample Rate	Cutoff Frequency (fc)								
100 kS/s or higher	40 kHz								
100 S/s to 50 kS/s	40% of the sample rate								
50 S/s or less	40 Hz								
Connection cable	Measurement lead 758933 and alligator clip for measuring 1000 V (DC+ACpeak) or less 1:1 safety cables 701904 and alligator clip for measuring 1000 V (DC+ACpeak) or less (the alligator clip (dolphin type) 701954 is recommended)								
Crest factor (only when observing RMS)	3 or less								
Maximum setting range of DC offset	±1/2 of range								
Input bias current	2 nA or less								

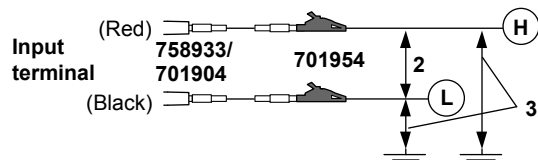
## 6 High-Voltage 1 MS/s, 16-Bit Isolation Module (AAF, RMS) (720268) Specifications

Item	Specifications
Table of cutoff frequency characteristics of the anti-aliasing filter (AAF)	When the filter is set to Auto, the anti-aliasing filter and low-pass filter are automatically set according to the sample rate.

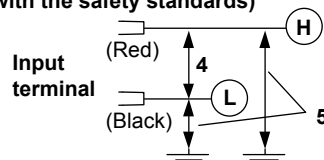
Sample Rate	AAF	Low-Pass Filter
1 MS/s	40 kHz	40 kHz
500 kS/s	40 kHz	40 kHz
200 kS/s	40 kHz	40 kHz
100 kS/s	40 kHz	40 kHz
50 kS/s	20 kHz	40 kHz
20 kS/s	8 kHz	40 kHz
10 kS/s	4 kHz	4 kHz
5 kS/s	2 kHz	4 kHz
2 kS/s	800 Hz	4 kHz
1 kS/s	400 Hz	400 Hz
500 S/s	200 Hz	400 Hz
200 S/s	80 Hz	400 Hz
100 S/s	40 Hz	400 Hz
50 S/s	40 Hz	400 Hz
Ext sample	OFF	OFF

1. Value measured under standard operating conditions.

### Combined with the 758933+701954 or 701904+701954



### Direct input (cable that does not comply with the safety standards)



6 The typical value is a representative or standard value. It is not strictly warranted.

7 When using this module other than SL 1000, DL 850, DL 850 V, DL 850 E, or DL 850 EV, the maximum input voltage is 1000 Vrms (1000 VDC or 1414 Vpeak max.)



# 7 Universal (Voltage/Temp.) Module (701261) / Universal (Voltage/Temp.) Module (with AAF) (701262) Specifications

Item	Specifications																																							
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration																																							
Function	Temperature (thermocouple) or voltage measurement (switchable)																																							
Number of input channels	2																																							
Input coupling	TC, DC, AC, and GND TC: Temperature (thermocouple) measurement DC: Voltage measurement (DC coupling) AC: Voltage measurement (AC coupling)																																							
Voltage measurement maximum sample rate	100 kS/s																																							
Temperature measurement data update rate	500 Hz																																							
Input format	Isolated unbalanced																																							
Measurement range/accuracy <sup>1</sup>	[Voltage measurement] Voltage range: 50 mV range to 200 V range (1-2-5 steps) Voltage accuracy: ±(0.25% of range) [Temperature measurement] <sup>2</sup>																																							
Thermocouple standards • K, E, J, T, N, R, S, B: IEC 60584-1 DIN IEC 60584-1 JIS C1602 • W: W-5%/Re/W-26%/Re (Hoskins Mfg. Co.) ASTM E988 • L: Fe-CuNi, DIN43710 • U: Cu-CuNi, DIN43710	<table border="1"> <thead> <tr> <th>Type</th> <th>Measurement Range</th> <th>Accuracy</th> </tr> </thead> <tbody> <tr> <td>K</td> <td>-200 to 1300°C</td> <td></td> </tr> <tr> <td>E</td> <td>-200 to 800°C</td> <td></td> </tr> <tr> <td>J</td> <td>-200 to 1100°C</td> <td></td> </tr> <tr> <td>T</td> <td>-200 to 400°C</td> <td>±(0.1% of reading + 1.5°C)</td> </tr> <tr> <td>L</td> <td>-200 to 900°C</td> <td>Except ±(0.2% of reading + 1.5°C) for -200°C to 0°C</td> </tr> <tr> <td>U</td> <td>-200 to 400°C</td> <td></td> </tr> <tr> <td>N</td> <td>0 to 1300°C</td> <td></td> </tr> <tr> <td>R</td> <td>0 to 1700°C</td> <td>±(0.1% of reading + 3°C)</td> </tr> <tr> <td>S</td> <td>0 to 1700°C</td> <td>Except, 0 to 200°C: ±8°C 200 to 800°C: ±5°C</td> </tr> <tr> <td>B</td> <td>0 to 1800°C</td> <td>±(0.1% of reading + 2°C) Except, 400 to 700°C: ±8°C Effective range is 400 to 1800°C</td> </tr> <tr> <td>W</td> <td>0 to 2300°C</td> <td>±(0.1% of reading + 3°C)</td> </tr> <tr> <td>Au7Fe<sup>3</sup></td> <td>0 to 300 K</td> <td>0 to 50 K: ±4 K 50 to 300 K: ±2.5 K</td> </tr> </tbody> </table>	Type	Measurement Range	Accuracy	K	-200 to 1300°C		E	-200 to 800°C		J	-200 to 1100°C		T	-200 to 400°C	±(0.1% of reading + 1.5°C)	L	-200 to 900°C	Except ±(0.2% of reading + 1.5°C) for -200°C to 0°C	U	-200 to 400°C		N	0 to 1300°C		R	0 to 1700°C	±(0.1% of reading + 3°C)	S	0 to 1700°C	Except, 0 to 200°C: ±8°C 200 to 800°C: ±5°C	B	0 to 1800°C	±(0.1% of reading + 2°C) Except, 400 to 700°C: ±8°C Effective range is 400 to 1800°C	W	0 to 2300°C	±(0.1% of reading + 3°C)	Au7Fe <sup>3</sup>	0 to 300 K	0 to 50 K: ±4 K 50 to 300 K: ±2.5 K
Type	Measurement Range	Accuracy																																						
K	-200 to 1300°C																																							
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T	-200 to 400°C	±(0.1% of reading + 1.5°C)																																						
L	-200 to 900°C	Except ±(0.2% of reading + 1.5°C) for -200°C to 0°C																																						
U	-200 to 400°C																																							
N	0 to 1300°C																																							
R	0 to 1700°C	±(0.1% of reading + 3°C)																																						
S	0 to 1700°C	Except, 0 to 200°C: ±8°C 200 to 800°C: ±5°C																																						
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Au7Fe <sup>3</sup>	0 to 300 K	0 to 50 K: ±4 K 50 to 300 K: ±2.5 K																																						
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	[Voltage measurement] DC to 40 kHz [Temperature measurement] DC to 100 Hz																																							
Maximum input voltage <sup>4</sup> (at a frequency of 1 kHz or less)	Both temperature and voltage input: 42 V (DC + ACpeak) (as a value that meets the safety standard) 150 V (DC + ACpeak) (maximum allowable voltage, as a value that does not damage the instrument when applied)																																							
Maximum rated voltage to earth <sup>5</sup> Between input and case Between each input (at a frequency of 1 kHz or less)	Both temperature and voltage input: 42 V (DC+ACpeak) (CAT II, 30 Vrms)																																							
Vertical resolution	[Voltage measurement] During voltage input: 24000 LSB/range [Temperature measurement] When measuring temperature: 0.1°C																																							
-3 dB point when AC coupled low frequency attenuation point	[Voltage measurement] 0.5 Hz or less																																							
Input connector	Binding post																																							
Input impedance	Approx. 1 MΩ																																							
Common mode rejection ratio	[Voltage measurement] 80 dB (50/60 Hz) or more (typical value <sup>6</sup> ) [Temperature measurement] 120 dB or more (50/60 Hz, with 2-Hz filter ON, signal source resistance of 500 Ω or less) (typical value <sup>6</sup> )																																							
Residual noise level (Input section shorted)	[Voltage measurement] ±100 μV or ±0.1% of range, whichever is greater (typical value <sup>6</sup> )																																							
A/D conversion resolution	[Voltage measurement] 16 bits (24000 LSB/range)																																							

**7 Universal (Voltage/Temp.) Module (701261) /Universal (Voltage/Temp.) Module (with AAF) (701262) Specifications**

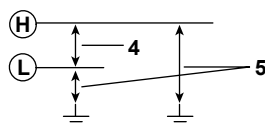
Item	Specifications	
Temperature coefficient	[Voltage measurement]	Zero point: $\pm(0.01\% \text{ of range})/^{\circ}\text{C}$ (typical value <sup>6</sup> ) Gain: $\pm(0.02\% \text{ of range})/^{\circ}\text{C}$ (typical value <sup>6</sup> )
Reference junction compensation accuracy (when the input terminal temperature is balanced)	K, E, J, T, L, U, N: R, S, B, W: Au7Fe:	$\pm 1^{\circ}\text{C}$ $\pm 1.5^{\circ}\text{C}$ $\pm 1 \text{ K}$
Bandwidth limit	[Temperature measurement]	(Digital filter + analog filter) Select from Full, 30 Hz, 8 Hz, and 2 Hz + 150 Hz secondary analog filter
	[Voltage measurement]	Select from Full, AUTO, 4 kHz, 400 Hz, or 40 Hz. Cutoff characteristics: $-12 \text{ dB/OCT}$ (typical value, <sup>6</sup> setting other than AUTO)
Cutoff frequency (fc) when set to AUTO (701262 only)		
	<b>Sample Rate</b>	<b>Cutoff Frequency (fc)</b>
	100 kS/s or higher	40 kHz
	100 S/s to 50 kS/s	40% of the sample rate
	50 S/s or less	20 Hz
Cutoff characteristics for AUTO: $-65 \text{ dB at } 2 \times \text{fc}$ (typical value <sup>6</sup> )		

Table of cutoff frequency characteristics of the anti-aliasing filter (AAF)

When the filter is set to Auto, the anti-aliasing filter and low-pass filter are automatically set according to the sample rate.

Sample Rate	AAF	Low-Pass Filter
100 kS/s	40 kHz	OFF
50 kS/s	20 kHz	OFF
20 kS/s	8 kHz	OFF
10 kS/s	4 kHz	4 kHz
5 kS/s	2 kHz	4 kHz
2 kS/s	800 Hz	4 kHz
1 kS/s	400 Hz	400 Hz
500 S/s	200 Hz	400 Hz
200 S/s	80 Hz	400 Hz
100 S/s	40 Hz	40 Hz
50 S/s	20 Hz	40 Hz
20 S/s to 5 S/s	20 Hz	40 Hz
2 S/s or less	20 Hz	40 Hz
Ext sample	40 kHz	OFF

- Value measured under standard operating conditions.
- Does not include the reference junction temperature compensation accuracy.
- This module supports Au7Fe with 0.07% metal content with respect to gold.



- Typical value represents a typical or average value. It is not strictly warranted.

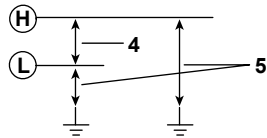
## 8 Temperature, High Precision Voltage Isolation Module (701265) Specifications

Item	Specifications			
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration			
Function	Temperature (thermocouple) or voltage measurement (switchable)			
Number of input channels	2			
Input coupling	TC, DC, and GND TC: Temperature (thermocouple) measurement DC: Voltage measurement (DC coupling)			
Data update rate	500 Hz			
Input format	Isolated unbalanced			
Measurement range/accuracy <sup>1</sup>	[Voltage measurement]	Voltage range: 1 mV range to 100 V range (1-2-5 steps) Voltage accuracy: ±(0.08% of range + 2 µV)		
For the thermocouple standards, see the 701261 specifications.	[Temperature measurement] <sup>2</sup>			
		<b>Type</b>	<b>Measurement Range</b>	<b>Accuracy</b>
		K	-200 to 1300°C	
		E	-200 to 800°C	
		J	-200 to 1100°C	
		T	-200 to 400°C	±(0.1% of reading + 1.5°C)
		L	-200 to 900°C	Except ±(0.2% of reading + 1.5°C) for -200°C to 0°C
		U	-200 to 400°C	
		N	0 to 1300°C	
		R	0 to 1700°C	±(0.1% of reading + 3°C)
		S	0 to 1700°C	Except, 0 to 200°C: ±8°C 200 to 800°C: ±5°C
		B	0 to 1800°C	±(0.1% of reading + 2°C) Except, 400 to 700°C: ±8°C Effective range is 400 to 1800°C
		W	0 to 2300°C	±(0.1% of reading + 3°C)
	Au7Fe <sup>3</sup>	0 to 300 K	0 to 50 K: ±4 K 50 to 300 K: ±2.5 K	
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	[Voltage measurement]	DC to 100 Hz		
	[Temperature measurement]	DC to 100 Hz		
Maximum input voltage <sup>4</sup> (at a frequency of 1 kHz or less)	Both temperature and voltage input: 42 V (DC+ACpeak)			
Maximum rated voltage to earth <sup>5</sup> Between input and case Between each input (at a frequency of 1 kHz or less)	Both temperature and voltage input: 42 V (DC+ACpeak) (CAT II, 30 Vrms)			
Vertical resolution	[Voltage measurement]	During voltage input: 24000 LSB/range		
	[Temperature measurement]	When measuring temperature: 0.1°C		
-3 dB point when AC coupled low frequency attenuation point	[Voltage measurement]	0.5 Hz or less		
Input connector	Binding post			
Input impedance	Approx. 1 MΩ			
Common mode rejection ratio	[Voltage measurement]	80 dB (50/60 Hz) or more (typical value <sup>6</sup> )		
	[Temperature measurement]	120 dB or more (50/60 Hz, with 2-Hz filter ON, signal source resistance of 500 Ω or less) (typical value <sup>6</sup> )		
Residual noise level (Input section shorted)	[Voltage measurement]	±4 µV or ±0.1% of range, whichever is greater (typical value <sup>6</sup> )		
A/D conversion resolution	[Voltage measurement]	16 bits (24000 LSB/range)		
Temperature coefficient	[Voltage measurement]	Zero point: ±(0.01% of range)/°C + 0.05µV/°C (typical value <sup>6</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>6</sup> )		
Reference junction compensation accuracy (when the input terminal temperature is balanced)	K, E, J, T, L, U, N: R, S, B, W: Au7Fe:	±1°C ±1.5°C ±1 K		
Bandwidth limit (digital filter)	Select from Full, 30 Hz, 8 Hz, and 2 Hz			

## 8 Temperature, High Precision Voltage Isolation Module (701265) Specifications

Item	Specifications
Input bias current	20 nA or less The zero point appears to be offset when the input is open due to the effects of bias current on this module. However, this is not a malfunction. Connect the input to the object to be measured.

- 1 Value measured under standard operating conditions.
- 2 Does not include the reference junction temperature compensation accuracy.
- 3 This module supports Au7Fe with 0.07% metal content with respect to gold.



- 6 The typical value is a representative or standard value. It is not strictly warranted.

# 9

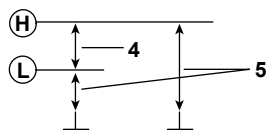
## Temperature, High Precision Voltage Isolation Module (low noise) (720266) Specifications

Item	Specifications			
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration			
Function	Temperature (thermocouple) or voltage measurement (switchable)			
Number of input channels	2			
Input coupling	TC, DC, and GND TC: Temperature (thermocouple) measurement DC: Voltage measurement (DC coupling)			
Data update rate	125 Hz			
Input format	Isolated unbalanced			
Measurement range/accuracy <sup>1</sup>	[Voltage measurement]	Voltage range: 1 mV range to 200 V range(1-2-5 steps) Voltage accuracy: ±(0.08% of range + 2 µV)		
For the thermocouple standards, see the 701261 specifications.	[Temperature measurement] <sup>2</sup>			
		<b>Type</b>	<b>Measurement Range</b>	<b>Accuracy</b>
		K	-200 to 1300°C	
		E	-200 to 800°C	
		J	-200 to 1100°C	
		T	-200 to 400°C	±(0.1% of reading + 1.5°C)
		L	-200 to 900°C	Except ±(0.2% of reading + 1.5°C) for -200°C to 0°C
		U	-200 to 400°C	
		N	0 to 1300°C	
		R	0 to 1700°C	±(0.1% of reading + 3°C)
		S	0 to 1700°C	Except, 0 to 200°C: ±8°C 200 to 800°C: ±5°C
		B	0 to 1800°C	±(0.1% of reading + 2°C) Except, 400 to 700°C: ±8°C Effective range is 400 to 1800°C
		W	0 to 2300°C	±(0.1% of reading + 3°C)
		Au7Fe <sup>3</sup>	0 to 300 K	0 to 50 K: ±4 K 50 to 300 K: ±2.5 K
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60% of range is applied)	[Voltage measurement]	DC to 15 Hz		
	[Temperature measurement]	DC to 15 Hz		
Maximum input voltage <sup>4</sup> (at a frequency of 1 kHz or less)	Both temperature and voltage input:	42 V (DC+ACpeak)		
Maximum rated voltage to earth <sup>5</sup> Between input and case Between each input (at a frequency of 1 kHz or less)	Both temperature and voltage input:	42 V (DC+ACpeak) (CAT II, 30 Vrms)		
Vertical resolution	[Voltage measurement]	During voltage input: 2400 LSB/div		
	[Temperature measurement]	When measuring temperature: 0.1°C		
DC offset setting range	±50% of range			
Input connector	Binding post			
Input impedance	Approx. 1 MΩ			
Common mode rejection ratio	[Voltage measurement]	80 dB (50/60 Hz) or more (typical value <sup>6</sup> )		
	[Temperature measurement]	120 dB or more (50/60 Hz, with 2-Hz filter ON, signal source resistance of 500 Ω or less) (typical value <sup>6</sup> )		
Residual noise level (Input section shorted)	[Voltage measurement]	±4 µV or ±0.1% of range, whichever is greater (typical value <sup>6</sup> )		
A/D conversion resolution	[Voltage measurement]	16 bits (2400 LSB/div)		
Temperature coefficient	[Voltage measurement]	Zero point: ±(0.01% of range)/°C + 0.05µV/°C (typical value <sup>6</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>6</sup> )		
Reference junction compensation accuracy (when the input terminal temperature is balanced)	K, E, J, T, L, U, N: R, S, B, W: Au7Fe:	±1°C ±1.5°C ±1 K		

## 9 Temperature, High Precision Voltage Isolation Module (low noise type) (720266) Specifications

Item	Specifications
Bandwidth limit	Line filter: 15 Hz Cutoff characteristic: -6 dB/OCT(typical value <sup>6</sup> ) Digital filter: Select from Full, 8 Hz, 1 HZ, and 0.1 Hz Cutoff characteristic: -24 dB/OCT
Input bias current	20 nA or less The zero point appears to be offset when the input is open due to the effects of bias current on this module. However, this is not a malfunction. Connect the input to the object to be measured.

- 1 Value measured under standard operating conditions.
- 2 Does not include the reference junction temperature compensation accuracy.
- 3 This module supports Au7Fe with 0.07% metal content with respect to gold.



- 6 The typical value is a representative or standard value. It is not strictly warranted.

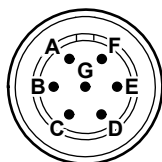
# 10 Strain Module (NDIS) (701270) Specifications

Item	Specifications																												
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration and auto balance																												
Number of input channels	2																												
Maximum sample rate	100 kS/s																												
Input format	DC bridge (auto balancing), balanced differential input, and isolated																												
Auto balance type	Electronic auto balance																												
Auto balance range	±10000 μSTR (1 gauge method)																												
Bridge voltage	Select from 2 V, 5 V, and 10 V.																												
Gauge resistance	120 Ω to 1000 Ω (bridge voltage: 2 V) 350 Ω to 1000 Ω (bridge voltage: 2 V, 5 V, and 10 V)																												
Gauge factor	1.90 to 2.20 (set in 0.01 steps)																												
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	DC to 20 kHz																												
mV/V range support	Supports the strain gauge transducer unit system. mV/V range = 0.5×(μSTR range/1000)																												
Measurement range (FS) and measurement range	When using STR range <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Measurement Range (FS)</th> <th>Measurement Range</th> </tr> </thead> <tbody> <tr> <td>500 μSTR</td> <td>-500 μSTR to +500 μSTR</td> </tr> <tr> <td>1000 μSTR</td> <td>-1000 μSTR to +1000 μSTR</td> </tr> <tr> <td>2000 μSTR</td> <td>-2000 μSTR to +2000 μSTR</td> </tr> <tr> <td>5000 μSTR</td> <td>-5000 μSTR to +5000 μSTR</td> </tr> <tr> <td>10000 μSTR</td> <td>-10000 μSTR to +10000 μSTR</td> </tr> <tr> <td>20000 μSTR</td> <td>-20000 μSTR to +20000 μSTR</td> </tr> </tbody> </table> When using mV/V range <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Measurement Range (FS)</th> <th>Measurement Range</th> </tr> </thead> <tbody> <tr> <td>0.25 mV/V</td> <td>-0.25 mV/V to +0.25 mV/V</td> </tr> <tr> <td>0.5 mV/V</td> <td>-0.5 mV/V to +0.5 mV/V</td> </tr> <tr> <td>1 mV/V</td> <td>-1 mV/V to +1 mV/V</td> </tr> <tr> <td>2.5 mV/V</td> <td>-2.5 mV/V to +2.5 mV/V</td> </tr> <tr> <td>5 mV/V</td> <td>-5 mV/V to +5 mV/V</td> </tr> <tr> <td>10 mV/V</td> <td>-10 mV/V to +10 mV/V</td> </tr> </tbody> </table>	Measurement Range (FS)	Measurement Range	500 μSTR	-500 μSTR to +500 μSTR	1000 μSTR	-1000 μSTR to +1000 μSTR	2000 μSTR	-2000 μSTR to +2000 μSTR	5000 μSTR	-5000 μSTR to +5000 μSTR	10000 μSTR	-10000 μSTR to +10000 μSTR	20000 μSTR	-20000 μSTR to +20000 μSTR	Measurement Range (FS)	Measurement Range	0.25 mV/V	-0.25 mV/V to +0.25 mV/V	0.5 mV/V	-0.5 mV/V to +0.5 mV/V	1 mV/V	-1 mV/V to +1 mV/V	2.5 mV/V	-2.5 mV/V to +2.5 mV/V	5 mV/V	-5 mV/V to +5 mV/V	10 mV/V	-10 mV/V to +10 mV/V
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5 mV/V	-5 mV/V to +5 mV/V																												
10 mV/V	-10 mV/V to +10 mV/V																												
DC accuracy <sup>1</sup>	±(0.5% of FS + 5 μSTR)																												
Maximum input voltage (at a frequency of 1 kHz or less)	Between Input+ and Input-: 10 V (DC+ACpeak)																												
Maximum rated voltage to earth Between input and case Between each input (at a frequency of 1 kHz or less)	Between each terminal and earth ground: 42 V (DC+ACpeak) (CAT II, 30 Vrms)																												
Input connector	NDIS connector (Recommended by JSNDI (The Japanese Society for Non-destructive Inspection))																												
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>2</sup> )																												
A/D conversion resolution	16 bit (48000 LSB/range: Upper = +FS, Lower = -FS)																												
Temperature coefficient	Zero point: ±5 μSTR/°C (typical value <sup>2</sup> ) Gain: ±(0.02% of FS)/°C (typical value <sup>2</sup> )																												
Bandwidth limit	Select from Full, 1 kHz, 100 Hz, and 10 Hz Cutoff characteristics: -12 dB/OCT (typical value <sup>2</sup> )																												
Function	mV/V support. Supports the strain gauge transducer unit system.																												
Standard accessories	NDIS connector (for external connection: PRC03-12A10-7M10.5 by Tajimi) A1002JC: 2 pieces																												
Compatible accessories (sold separately)	Recommended bridge head 701955 (NDIS 120 Ω, enhanced shield version, comes with a 5-m cable) Recommended bridge head 701956 (NDIS 350 Ω, enhanced shield version, comes with a 5-m cable)																												

Item	Specifications
Precautions	<ul style="list-style-type: none"> <li>• Highly sensitive measurements are made in the <math>\mu\text{V}</math> level in strain measurements. Therefore, take measures against noise at the strain sensor perimeter, bridge head, and cable wiring.</li> <li>• Depending on the noise environment, an error may result in the balance. Check the influence before making measurements.</li> <li>• The bridge head specified by YOKOGAWA has high noise resistance.</li> <li>• Some of the strain gauge sensors and bridge heads made by other manufacturers do not have sensing wires connected. (No such problems with bridge heads made by YOKOGAWA.) If such products are used, an error may result in the bridge voltage leading to measurement errors, because sensing does not work effectively. If possible, it is desirable that sensing be done very close to the bridge. However, if this is not possible, use the NDIS conversion cable (DV450-001) that is sold separately by YOKOGAWA.                      Outline specifications of the DV450-001: Sensing cable, NDIS male-female, 30 cm in length, insert it as close to the bridge as possible</li> <li>• The connector shell is connected to the case potential.</li> <li>• When a bridge head (701955 or 701956) is used, the connector shell, cable shield, and the bridge head case are all connected to the case potential of the SL1000 Unit.</li> <li>• When a bridge head (701955 or 701956) is used, the floating GND is connected to the bridge head case inside the bridge head.</li> <li>• Be sure to execute balancing again when you change the range or the bridge voltage.</li> </ul>

- 1 Value measured under standard operating conditions.
- 2 The typical value is a representative or standard value. It is not strictly warranted.

**Module front View**



- A: Bridge+ (positive bridge voltage)**
- B: Input- (negative measurement signal)**
- C: Bridge- (negative bridge voltage)**
- D: Input+ (positive measurement signal)**
- E: Floating common**
- F: Sense+ (positive bridge voltage sensing)**
- G: Sense- (positive bridge voltage sensing)**

The connector shell is connected to the case potential.



# 11 Strain Module (DSUB, Shunt-Cal) (701271) Specifications

Item	Specifications																												
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration and auto balance																												
Number of input channels	2																												
Maximum sample rate	100 kS/s																												
Input format	DC bridge (auto balancing), balanced differential input, and isolated																												
Auto balance type	Electronic auto balance																												
Auto balance range	±10000 µSTR (1 gauge method)																												
Bridge voltage	Select from 2 V, 5 V, and 10 V.																												
Gauge resistance	120 Ω to 1000 Ω (bridge voltage: 2 V) 350 Ω to 1000 Ω (bridge voltage: 2 V, 5 V, and 10 V)																												
Gauge factor	1.90 to 2.20 (set in 0.01 steps)																												
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	DC to 20 kHz																												
mV/V range support	Supports the strain gauge transducer unit system. mV/V range = 0.5×(µSTR range/1000)																												
Measurement range (FS) and measurement range	When using STR range <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Measurement Range (FS)</th> <th>Measurement Range</th> </tr> </thead> <tbody> <tr> <td>500 µSTR</td> <td>-500 µSTR to +500 µSTR</td> </tr> <tr> <td>1000 µSTR</td> <td>-1000 µSTR to +1000 µSTR</td> </tr> <tr> <td>2000 µSTR</td> <td>-2000 µSTR to +2000 µSTR</td> </tr> <tr> <td>5000 µSTR</td> <td>-5000 µSTR to +5000 µSTR</td> </tr> <tr> <td>10000 µSTR</td> <td>-10000 µSTR to +10000 µSTR</td> </tr> <tr> <td>20000 µSTR</td> <td>-20000 µSTR to +20000 µSTR</td> </tr> </tbody> </table> When using mV/V range <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Measurement Range (FS)</th> <th>Measurement Range</th> </tr> </thead> <tbody> <tr> <td>0.25 mV/V</td> <td>-0.25 mV/V to +0.25 mV/V</td> </tr> <tr> <td>0.5 mV/V</td> <td>-0.5 mV/V to +0.5 mV/V</td> </tr> <tr> <td>1 mV/V</td> <td>-1 mV/V to +1 mV/V</td> </tr> <tr> <td>2.5 mV/V</td> <td>-2.5 mV/V to +2.5 mV/V</td> </tr> <tr> <td>5 mV/V</td> <td>-5 mV/V to +5 mV/V</td> </tr> <tr> <td>10 mV/V</td> <td>-10 mV/V to +10 mV/V</td> </tr> </tbody> </table>	Measurement Range (FS)	Measurement Range	500 µSTR	-500 µSTR to +500 µSTR	1000 µSTR	-1000 µSTR to +1000 µSTR	2000 µSTR	-2000 µSTR to +2000 µSTR	5000 µSTR	-5000 µSTR to +5000 µSTR	10000 µSTR	-10000 µSTR to +10000 µSTR	20000 µSTR	-20000 µSTR to +20000 µSTR	Measurement Range (FS)	Measurement Range	0.25 mV/V	-0.25 mV/V to +0.25 mV/V	0.5 mV/V	-0.5 mV/V to +0.5 mV/V	1 mV/V	-1 mV/V to +1 mV/V	2.5 mV/V	-2.5 mV/V to +2.5 mV/V	5 mV/V	-5 mV/V to +5 mV/V	10 mV/V	-10 mV/V to +10 mV/V
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5 mV/V	-5 mV/V to +5 mV/V																												
10 mV/V	-10 mV/V to +10 mV/V																												
DC accuracy <sup>1</sup>	±(0.5% of FS+5 µSTR)																												
Maximum input voltage (at a frequency of 1 kHz or less)	Between Input+ and Input-: 10 V (DC+ACpeak)																												
Maximum rated voltage to earth Between input and case Between each input (at a frequency of 1 kHz or less)	Between each terminal and earth ground: 42 V (DC+ACpeak) (CAT II, 30 Vrms)																												
Input connector	9-pin D-Sub connector (female)																												
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>2</sup> )																												
A/D conversion resolution	16 bit (48000 LSB/range: Upper = +FS, Lower = -FS)																												
Temperature coefficient	Zero point: ±5 µSTR/°C (typical value <sup>2</sup> ) Gain: ±(0.02% of FS)/°C (typical value <sup>2</sup> )																												
Bandwidth limit	Select from Full, 1 kHz, 100 Hz, and 10 Hz Cutoff characteristics: -12 dB/OCT (typical value <sup>2</sup> )																												
Function	mV/V support. Supports the strain gauge transducer unit system. Shunt calibration support. Built-in shunt calibration relay (1 gauge method).																												
Standard accessories	Connector shell set for soldering A1520JD (9-pin D-Sub): 2 pieces, A1618JD (connector shell): 2 pieces																												
Compatible accessories (sold separately)	Recommended bridge head 701957 (D-Sub 120 Ω, shunt-Cal, enhanced shield version, comes with a 5-m cable) Recommended bridge head 701958 (D-Sub 350 Ω, shunt-Cal, enhanced shield version, comes with a 5-m cable)																												

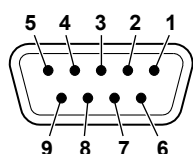
## 11 Strain Module (DSUB, Shunt-Cal) (701271) Specifications

Item	Specifications
Precautions	<ul style="list-style-type: none"> <li>Highly sensitive measurements are made in the <math>\mu\text{V}</math> level in strain measurements. Therefore, take measures against noise at the strain sensor perimeter, bridge head, and cable wiring.</li> <li>Depending on the noise environment, an error may result in the balance. Check the influence before making measurements.</li> <li>The bridge head specified by YOKOGAWA has high noise resistance.</li> <li>When executing shunt calibration, be sure to calculate the shunt resistance in advance, and execute it in a range so that the measured values do not exceed the range even when the shunt resistance is ON.</li> <li>Some of the strain gauge sensors and bridge heads made by other manufacturers do not have sensing wires connected. (No such problems with bridge heads made by YOKOGAWA.) If such products are used, an error may result in the bridge voltage leading to measurement errors, because sensing does not work effectively. Perform sensing as close to the bridge head as possible. (There is no conversion cable for sensing on D-Sub connector types.)</li> <li>The connector shell is connected to the case potential.</li> <li>When a bridge head (701957 or 701958) is used, the connector shell, cable shield, and the bridge head case are all connected to the case potential of the SL1000 Unit.</li> <li>When a bridge head (701957 or 701958) is used, the floating GND is connected to the bridge head case inside the bridge head.</li> <li>Be sure to execute balancing again when you change the range or the bridge voltage.</li> </ul>

1 Value measured under standard operating conditions.

2 The typical value is a representative or standard value. It is not strictly warranted.

### Module front View



- 1: Floating common
- 2: Sense- (positive bridge voltage sensing)
- 3: Shuntcal- (negative shunt signal)
- 4: Shuntcal+ (positive shunt signal)
- 5: Sense+ (positive bridge voltage sensing)
- 6: Bridge- (negative bridge voltage)
- 7: Input- (negative measurement signal)
- 8: Input+ (positive measurement signal)
- 9: Bridge+ (positive bridge voltage)

# 12 Acceleration/Voltage Module (with AAF) (701275) Specifications

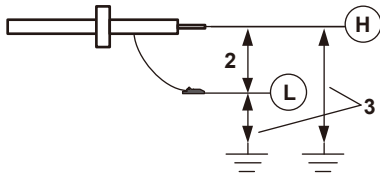
Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, GND, ACCL (acceleration), and GND
Maximum sample rate	100 kS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	Waveform observation mode: DC to 40 kHz Acceleration measurement mode: 0.4 Hz to 40 kHz
Voltage-axis range setting	50 mV range to 100 V range (1-2-5 steps) (when using 1:1 probe attenuation) Acceleration (±5 V = ×1 range): ×0.1 to ×1 to ×100 (in 1-2-5 steps)
Maximum input voltage (at a frequency of 1 kHz or less)	42 V (DC+ACpeak) <sup>2</sup>
Maximum rated voltage to earth Between input and case Between each input (at a frequency of 1 kHz or less)	Working voltage of safety standard 42 V (DC+ACpeak) (CAT II, 30 Vrms) <sup>3</sup>
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	Waveform measurement mode DC accuracy: ±(0.25% of range) Acceleration measurement mode: ±(0.5% of range) at 1 kHz
Input connector	BNC connector (metal type)
Input impedance	1 MΩ±1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	0.4 Hz or less (0.04 Hz or less when using the 701940) (typical value <sup>4</sup> )
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>4</sup> )
Residual noise level (Input section shorted)	±100 μV or ±0.1% of range, whichever is greater (typical value <sup>4</sup> )
A/D conversion resolution	16 bits (24000 LSB/range)
Temperature coefficient	When in waveform measurement mode (excluding AUTO filter) Zero point: ±(0.02% of range)/°C (typical value <sup>4</sup> ) Gain: ±(0.02% of range)/°C (typical value <sup>4</sup> )
Bandwidth limit	Select from Full, Auto, 4 kHz, 400 Hz, and 40 Hz Cutoff characteristics: -12 dB/OCT (typical value <sup>4</sup> , excluding AUTO) Cutoff frequency (fc) when set to AUTO Sample rate of 100 kHz or higher: fc = 40 kHz Sample rate of 100 Hz to 50 kHz: fc = 40% of the sampling rate Sample rate of 50 Hz or less: fc = 20 Hz Cutoff characteristics when set to AUTO: -65 dB at 2 × fc (typical value <sup>4</sup> )
Probe attenuation setting	Voltage probe 1:1, 10:1, 100:1, or 1000:1 Current probe 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A:1 V (for the 701930/701931)
Compatible probes/cables	Connection cable (for low voltage 1:1) 366926 (non-isolated type BNC-alligator clip × 2: For measuring low voltage less than or equal to 42 V (DC+ACpeak)) Voltage probe (10:1 passive probe) 701940 17 to 46 pF: For measuring 600 V (DC+ACpeak) or less Current probe (power can be supplied from the SL1000 Unit) 701930 (150 A), 701931 (500 A), 701932 (30 A), 701933 (30 A)
Sensor supply current (voltage)	OFF/4 mA ± 10% (approx. 22 VDC)
Applicable acceleration sensor	Built-in amplifier type Kistler Instrument Corporation: Piezotron, PCB Piezotronics Incorporated: ICP, ENDEVCO Corporation: ISOTRON, etc.

## 12 Acceleration/Voltage Module (with AAF) (701275) Specifications

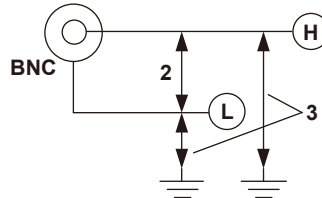
Item	Specifications		
Table of Cutoff Frequency Characteristics of the Anti-Aliasing Filter (AAF)	When the filter is set to Auto, the anti-aliasing filter and low-pass filter are automatically set according to the sample rate.		
	Sample Rate	AAF	Low-pass filter
	100 kS/s	40 kHz	OFF
	50 kS/s	20 kHz	OFF
	20 kS/s	8 kHz	OFF
	10 kS/s	4 kHz	4 kHz
	5 kS/s	2 kHz	4 kHz
	2 kS/s	800 Hz	4 kHz
	1 kS/s	400 Hz	400 Hz
	500 S/s	200 Hz	400 Hz
	200 S/s	80 Hz	400 Hz
	100 S/s	40 Hz	40 Hz
	50 S/s	20 Hz	40 Hz
	20 S/s to 5 S/s	20 Hz	40 Hz
	2 S/s or less	20 Hz	40 Hz
	Ext sample	40 kHz	OFF

1 Value measured under standard operating conditions.

**Combined with the 10:1 passive probe (701940)**



**Direct input (cable that does not comply with the safety standards)**



4 The typical value is a representative or standard value. It is not strictly warranted.

# 13 Frequency Module (701281) Specifications

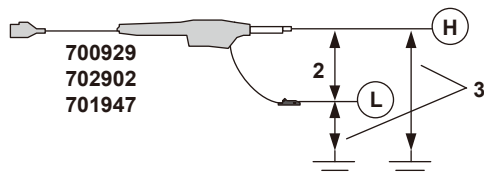
Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Measurement function	Frequency, RPMs, RPSs, period, duty cycle, power supply frequency, pulse width, pulse integration, and velocity
Number of input channels	2
Data update rate	1 MHz (1 μs)
Output delay time	Approx. 3 μs
Input format	Isolated unbalanced
Input connector	BNC connector (isolated type)
Maximum input voltage	Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>2</sup> 420 V (DC+ACpeak) Combined with the (701901 + 701954) (1:1) or direct input (cable that does not comply with the safety standards): <sup>4</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth Between input and case Between each input	Working voltage of safety standard Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>3</sup> 300 Vrms (CAT II) Combined with the (701901 + 701954) (1:1) or direct input (cable that does not comply with the safety standards): <sup>5</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Withstand voltage	2300 Vrms for 2 seconds (across each terminal and earth) (60 Hz)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
Minimum measurement resolution	625 ps
Measured data resolution	16 bits (24000 LSB/range)
Measurement accuracy <sup>1</sup>	<ul style="list-style-type: none"> <li>• <b>When in frequency, RPM, RPS, or velocity measurement mode<sup>6</sup></b> Measurement accuracy is specified according to the measurement range and input frequency [Definition of measurement accuracy] ±(0.05% of range + accuracy dependent on the input frequency) [Accuracy dependent on the input frequency] When input frequency is 2 kHz or less: 0.05% of the input frequency + 0.001 Hz Input frequency of 2 kHz to 50 kHz: 0.05% of the input frequency Input frequency of 50 kHz to 100 kHz: 0.1% of the input frequency Input frequency of 100 kHz to 200 kHz: 0.2% of the input frequency Input frequency of 200 kHz to higher: 0.5% of the input frequency</li> <li>• <b>When in power supply frequency mode<sup>7</sup></b> When the center frequency is 50/60 Hz: ±0.03 Hz (0.01 Hz resolution) When the center frequency is 400 Hz: ±0.3 Hz (0.01 Hz resolution) (Input set to AC100 V or AC200 V with sine wave input)</li> <li>• <b>When in period measurement mode<sup>6</sup></b> Measurement accuracy is specified according to the measurement range and input period [Definition of measurement accuracy] ±(0.05% of range + accuracy dependent on the input period) [Accuracy dependent on the input period] Input period of 500 μs or greater: 0.05% of the input period Input period of 20 μs to 500 μs: 0.1% of the input period + 0.1 μs Input period of 10 μs to 20 μs: 0.2% of the input period + 0.1 μs Input period of 10 μs or less: 0.5% of the input period + 0.1 μs</li> <li>• <b>When in duty cycle measurement mode<sup>8</sup></b> Dependent on the input frequency Input frequency of 50 kHz or less: ±0.1% Input frequency of 50 kHz to 100 kHz: ±0.2% Input frequency of 100 kHz to 200 kHz: ±0.5% Input frequency of 200 kHz to 500 kHz: ±1.0%</li> </ul>

### 13 Frequency Module (701281) Specifications

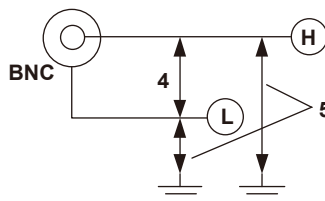
Item	Specifications
	<ul style="list-style-type: none"> <li><b>When in pulse width measurement mode<sup>8</sup></b>                      Measurement accuracy is specified according to the measurement range and input pulse width                      [Definition of measurement accuracy]  <math>\pm(0.05\%</math> of range + accuracy dependent on the input pulse width)                      [Accuracy dependent on the input pulse width]                      Input pulse width of 500 <math>\mu</math>s or greater: 0.05% of the input pulse width                      Input pulse width of 20 <math>\mu</math>s to 500 <math>\mu</math>s: 0.1% of the input pulse width + 0.1 <math>\mu</math>s                      Input pulse width of 10 <math>\mu</math>s to 20 <math>\mu</math>s: 0.2% of the input pulse width + 0.1 <math>\mu</math>s                      Input pulse width of 10 <math>\mu</math>s or less: 0.5% of the input pulse width + 0.1 <math>\mu</math>s</li> </ul>
Input voltage range ( $\pm$ FS)	When using 1:1 probe attenuation: $\pm 1$ V, $\pm 2$ V, $\pm 5$ V, $\pm 10$ V, $\pm 20$ V, $\pm 50$ V ( $\pm$ FS)
Input impedance	1 M $\Omega$ $\pm$ 1 approx. 35 pF Pull-up function: 10 k $\Omega$ , approx. 5 V (pull-up can be turned ON only when the input is set to Pull-up 5 V)
Input coupling settings	AC, DC
Probe attenuation setting	10:1, 1:1
Minimum voltage width for pulse detection	200 mV <sub>P-P</sub>
Bandwidth limit	Select from Full, 100 kHz, 10 kHz, 1 kHz, and 100 Hz Cutoff characteristics: -12 dB/OCT (typical value <sup>9</sup> )
Threshold	Set within the FS of the voltage range. Set in units of 1% of the FS.
Hysteresis	Select $\pm 1\%$ , $\pm 2.5\%$ , or $\pm 5\%$ of the FS of the voltage range
Preset function	Logic (5 V/3 V/12 V/24 V), electromagnetic pickup, zero crossing, pull-up, AC100 V, AC200 V, and user-defined
Slope selection	Select rising or falling
Lower -3 dB point when AC coupled	0.5 Hz or less (0.05 Hz or less when using the 700929 or 702902, 0.005 Hz or less when using the 701947) (typical value <sup>9</sup> )
Chatter elimination function	OFF or 1 to 1000 ms (1 ms resolution) Eliminates the chatter that occurs such when the contact input is turned ON/OFF. Can discard the signal changes over the specified interval.
Input status indication function	Input status indication through the LEDs of each channel function When in operation: Illuminates in green when pulse input is detected When overdriven: Illuminates in red when the input voltage exceeds the range
Compatible probes/cables	Connection cable (1:1): Recommended 1 366926 Voltage probe: Recommended 2 700929 (10:1 safety probe), 20 to 45 pF 702902 (10:1 safety probe), 25 to 40 pF 701947 (100:1 probe), 15 to 45 pF

1 Value measured under standard operating conditions.

**Combined with the 700929, 702902, or 701947**



**Combined with the (701901 + 701954) or direct input (cable that does not comply with the safety standards)**



6 Input waveform of 1 V<sub>pp</sub>, rectangular wave, rise/fall time within 1  $\mu$ s (input range:  $\pm 10$  V, bandwidth limit: Full, and hysteresis:  $\pm 1\%$ )

7 Input waveform of 90 V<sub>rms</sub>, sine wave (input range: AC100 V, bandwidth limit 100 kHz, and hysteresis:  $\pm 1\%$ )

8 Input waveform of 1 V<sub>pp</sub>, rectangular wave, rise/fall time within 5 ns (input range:  $\pm 10$  V, bandwidth limit: Full, and hysteresis:  $\pm 1\%$ )

9 Typical value represents a typical or average value. It is not strictly warranted.

### 13 Frequency Module (701281) Specifications

#### Specifications by Measurement Modes

Item	Specifications
Frequency	
Measurable frequency range	0.01 Hz to 500 kHz
Selectable vertical axis range	1 Hz range to 1 MHz range (1-2-5 steps)
Minimum resolution	0.001 Hz
RPMs	
Measurable RPMs range	0.01 rpm to 100000 rpm (where the input frequency is DC to 500 kHz).
Selectable vertical axis range	1 rpm range to 100000 rpm range (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation RPMs = Frequency/(pulse/rotate value) × 60
Selectable pulse/rotate range	1 to 99999
RPSs	
Measurable RPSs range	0.001 rps to 2000 rps (where the input frequency is DC to 500 kHz).
Selectable vertical axis range	0.1 rps range to 2000 rps range (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation RPSs = Frequency/(pulse/rotate value)
Selectable pulse/rotate range	1 to 99999
Period	
Measurable period range	2 μs to 50 s (where the minimum pulse width is 1 μs)
Selectable vertical axis range	100 μs range to 50 s range (1-2-5 steps)
Minimum resolution	0.1 μs
Duty cycle	
Measurable duty cycle range	0 to 100%
Selectable vertical axis range	10 % range to 200 % range (1-2-5 steps)
Measurable frequency range	0.1 Hz to 500 kHz
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.1 μs
Power supply frequency	
Measurable frequency range	30 Hz to 70 Hz (when the center frequency is 50 Hz), 40 Hz to 80 Hz (when the center frequency is 60 Hz), 380 Hz to 420 Hz (when the center frequency is 400 Hz)
Selectable vertical axis range	1 Hz range to 20 Hz range (0.01 Hz resolution)
Center frequency setting	Select 50 Hz, 60 Hz, or 400 Hz
Minimum resolution	0.01 Hz
Pulse width	
Measurable pulse width	1 μs to 50 s (where the input frequency is up to 500 kHz)
Selectable vertical axis range	100 μs range to 50 s range (1-2-5 steps)
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.1 μs
Pulse integration	
Maximum pulse count	2×10 <sup>9</sup> pulses
Selectable vertical axis range	5.000E+21 value range to 100.0E-21 value range (1-2-5 range: total of 123 ranges)
Frequency measuring range	0.1 Hz to 500 kHz (where the minimum pulse width is 1 μs)
Computation function	Set the physical amount per pulse and display by converting the values into physical values such as distance and flow rate.
Selectable Unit/Pulse range	-9.9999E+30 to +9.9999E+30
Counter reset	Manual reset and over-limit reset
Velocity	
Selectable vertical axis range	5.000E+21 value range to 100.0E-21 value range (1-2-5 range: total of 123 ranges)
Computing method	Set the amount of displacement per pulse and compute the velocity from the frequency Automatic unit time conversion of s, min, and hour.
Selectable Distance/Pulse range	-9.9999E+30 to +9.9999E+30

### Functional Specifications

Item	Specifications
Deceleration prediction	<p>Computes the deceleration condition in realtime when the pulse input is cut off. Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity</p>
Stop prediction	<p>Sets the frequency to 0 after a certain time elapses after the pulse input is cut off. Stop interval setting: Set in the range of 1.5 to 10 times (10 settings) the period of the pulse measured last Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity</p>
Smoothing	<p>Computes the moving average of the measured data using the specified time Specified time: 0.1 to 1000 ms (0.1 ms resolution) Can be specified on all measurement parameters</p>
Pulse average	<p>Performs frequency measurement per specified number of pulses. When fluctuation exists periodically in the pulse interval, the fluctuation can be eliminated. Specified number of pulses: 1 to 4096 Can be specified when measuring the frequency, RPMs, RPSs, power supply frequency, period, pulse integration, and velocity</p>
Offset function	<p>Observe fluctuation with respect to the offset frequency Offset range: Can be set up to 100 times the maximum range value</p> <ul style="list-style-type: none"> <li>• Frequency: 0 Hz to 500 kHz</li> <li>• RPMs: 0 rpm to 50 krpm</li> <li>• RPSs: 0 rps to 1000 rps</li> <li>• Period: 0 s to 50 s</li> <li>• Duty cycle: 0% to 100%</li> <li>• Pulse width: 0 s to 50 s</li> <li>• Pulse integration: <math>-1.0000 \times 10^{22}</math> to <math>1.0000 \times 10^{22}</math></li> <li>• Velocity: <math>-1.0000 \times 10^{22}</math> to <math>1.0000 \times 10^{22}</math></li> </ul>



# 14 Frequency Module (720281) Specifications

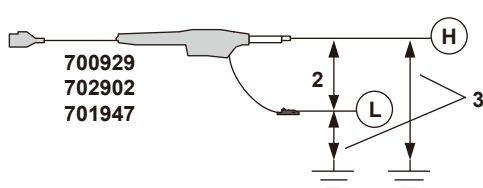
Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Measurement function	Frequency, RPMs, RPSs, period, duty cycle, power supply frequency, pulse width, pulse integration, and velocity
Number of input channels	2
Data update rate	1 MHz (1 μs)
Output delay time	Approx. 3 μs
Input format	Isolated unbalanced
Input connector	BNC connector (isolated type)
Maximum input voltage	Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>2</sup> 420 V (DC+ACpeak) Combined with the (701901 + 701954) (1:1) or direct input (cable that does not comply with the safety standards): <sup>4</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth Between input and case Between each input	Working voltage of safety standard Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>3</sup> 400 Vrms (CAT II) Combined with the (701901 + 701954) (1:1) or direct input (cable that does not comply with the safety standards): <sup>5</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Withstand voltage	2300 VACrms for 2 seconds (across each terminal and earth)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
Minimum measurement resolution	625 ps
Measured data resolution	16 bits (2400 LSB/div)
Measurement accuracy <sup>1</sup>	<ul style="list-style-type: none"> <li>• <b>When in frequency, RPM, RPS, or velocity measurement mode<sup>6</sup></b> Measurement accuracy is specified according to the measurement range and input frequency [Definition of measurement accuracy] ±(0.05% of range + accuracy dependent on the input frequency) [Accuracy dependent on the input frequency] When input frequency is 2 kHz or less: 0.05% of the input frequency + 0.001 Hz Input frequency of 2 kHz to 50 kHz: 0.05% of the input frequency Input frequency of 50 kHz to 100 kHz: 0.1% of the input frequency Input frequency of 100 kHz to 200 kHz: 0.2% of the input frequency Input frequency of 200 kHz to higher: 0.5% of the input frequency</li> <li>• <b>When in power supply frequency mode<sup>7</sup></b> When the center frequency is 50/60 Hz: ±0.03 Hz (0.01 Hz resolution) When the center frequency is 400 Hz: ±0.3 Hz (0.01 Hz resolution) (Input set to AC100 V or AC200 V with sine wave input)</li> <li>• <b>When in period measurement mode<sup>6</sup></b> Measurement accuracy is specified according to the measurement range and input period [Definition of measurement accuracy] ±(0.05% of range + accuracy dependent on the input period) [Accuracy dependent on the input period] Input period of 500 μs or greater: 0.05% of the input period Input period of 20 μs to 500 μs: 0.1% of the input period + 0.1 μs Input period of 10 μs to 20 μs: 0.2% of the input period + 0.1 μs Input period of 10 μs or less: 0.5% of the input period + 0.1 μs</li> <li>• <b>When in duty cycle measurement mode<sup>8</sup></b> Dependent on the input frequency Input frequency of 50 kHz or less: ±0.1% Input frequency of 50 kHz to 100 kHz: ±0.2% Input frequency of 100 kHz to 200 kHz: ±0.5% Input frequency of 200 kHz to 500 kHz: ±1.0%</li> </ul>

## 14 Frequency Module (720281) Specifications

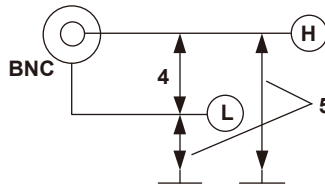
Item	Specifications
	<ul style="list-style-type: none"> <li>• <b>When in pulse width measurement mode<sup>8</sup></b>                      Measurement accuracy is specified according to the measurement range and input pulse width                      [Definition of measurement accuracy]  <math>\pm(0.05\%</math> of range + accuracy dependent on the input pulse width)                      [Accuracy dependent on the input pulse width]                      Input pulse width of 500 <math>\mu</math>s or greater: 0.05% of the input pulse width                      Input pulse width of 20 <math>\mu</math>s to 500 <math>\mu</math>s: 0.1% of the input pulse width + 0.1 <math>\mu</math>s                      Input pulse width of 10 <math>\mu</math>s to 20 <math>\mu</math>s: 0.2% of the input pulse width + 0.1 <math>\mu</math>s                      Input pulse width of 10 <math>\mu</math>s or less: 0.5% of the input pulse width + 0.1 <math>\mu</math>s</li> </ul>
Input voltage range ( $\pm$ FS)	When using 10:1 probe attenuation (Combined with the 700929): $\pm 10$ V, $\pm 20$ V, $\pm 50$ V, $\pm 100$ V, $\pm 200$ V, $\pm 500$ V ( $\pm$ FS)
Input impedance	1 M $\Omega$ $\pm$ 1 approx. 35 pF Pull-up function: 10 k $\Omega$ , approx. 5 V (pull-up can be turned ON only when the input is set to Pull-up 5 V)
Input coupling settings	AC, DC
Probe attenuation setting	10:1, 1:1
Minimum voltage width for pulse detection	200 mV <sub>P-P</sub>
Bandwidth limit	Select from Full, 100 kHz, 10 kHz, 1 kHz, and 100 Hz Cutoff characteristics: -12 dB/OCT (typical value <sup>9</sup> )
Threshold	Set within the FS of the voltage range. Set in units of 1% of the FS.
Hysteresis	Select $\pm 1\%$ , $\pm 2.5\%$ , or $\pm 5\%$ of the FS of the voltage range
Preset function	Logic (5 V/3 V/12 V/24 V), electromagnetic pickup, zero crossing, pull-up, AC100 V, AC200 V, and user-defined
Slope selection	Select rising or falling
Lower -3 dB point when AC coupled	0.5 Hz or less (0.05 Hz or less when using the 700929 or 702902, 0.005 Hz or less when using the 701947) (typical value <sup>9</sup> )
Chatter elimination function	OFF or 1 to 1000 ms (1 ms resolution) Eliminates the chatter that occurs such when the contact input is turned ON/OFF. Can discard the signal changes over the specified interval.
Input status indication function	Input status indication through the LEDs of each channel function When in operation: Illuminates in green when pulse input is detected When overdriven: Illuminates in red when the input voltage exceeds the range
Compatible probes/cables	Connection cable (1:1): Recommended 1 366926 Voltage probe: Recommended 2 700929 (10:1 safety probe), 20 to 45 pF 702902 (10:1 safety probe), 25 to 40 pF 701947 (100:1 probe), 15 to 45 pF

1 Value measured under standard operating conditions.

**Combined with the 700929, 702902, or 701947**



**Combined with the (701901 + 701954) or direct input (cable that does not comply with the safety standards)**



6 Input waveform of 1 V<sub>pp</sub>, rectangular wave, rise/fall time within 1  $\mu$ s (input range:  $\pm 10$  V, bandwidth limit: Full, and hysteresis:  $\pm 1\%$ )

7 Input waveform of 90 V<sub>rms</sub>, sine wave (input range: AC100 V, bandwidth limit 100 kHz, and hysteresis:  $\pm 1\%$ )

8 Input waveform of 1 V<sub>pp</sub>, rectangular wave, rise/fall time within 5 ns (input range:  $\pm 10$  V, bandwidth limit: Full, and hysteresis:  $\pm 1\%$ )

9 Typical value represents a typical or average value. It is not strictly warranted.

## 14 Frequency Module (720281) Specifications

### Specifications by Measurement Modes

Item	Specifications
Frequency	
Measurable frequency range	0.01 Hz to 500 kHz
Selectable vertical axis range	1 Hz range to 1 MHz range (1-2-5 steps)
Minimum resolution	0.001 Hz
RPMs	
Measurable RPMs range	0.01 rpm to 100000 rpm (where the input frequency is DC to 500 kHz).
Selectable vertical axis range	1 rpm range to 10000 rpm range (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation RPMs = Frequency/(pulse/rotate value) × 60
Selectable pulse/rotate range	1 to 99999
RPSs	
Measurable RPSs range	0.001 rps to 2000 rps (where the input frequency is DC to 500 kHz).
Selectable vertical axis range	0.1 rps range to 2000 rps range (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation RPSs = Frequency/(pulse/rotate value)
Selectable pulse/rotate range	1 to 99999
Period	
Measurable period range	2 μs to 50 s (where the minimum pulse width is 1 μs)
Selectable vertical axis range	100 μs range to 50 s range (1-2-5 steps)
Minimum resolution	0.1 μs
Duty cycle	
Measurable duty cycle range	0 to 100%
Selectable vertical axis range	10% range to 20% range (1-2-5 steps)
Measurable frequency range	0.1 Hz to 500 kHz
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.1 μs
Power supply frequency	
Measurable frequency range	30 Hz to 70 Hz (when the center frequency is 50 Hz), 40 Hz to 80 Hz (when the center frequency is 60 Hz), 380 Hz to 420 Hz (when the center frequency is 400 Hz)
Selectable vertical axis range	1 Hz range to 20 Hz range (0.01 Hz resolution)
Center frequency setting	Select 50 Hz, 60 Hz, or 400 Hz
Minimum resolution	0.01 Hz
Pulse width	
Measurable pulse width	1 μs to 50 s (where the input frequency is up to 500 kHz)
Selectable vertical axis range	100 μs range to 50 s range (1-2-5 steps)
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.1 μs
Pulse integration	
Maximum pulse count	2×10 <sup>9</sup> pulses
Selectable vertical axis range	5.000E+21 value range to 100.0E-21 value range (1-2-5 range: total of 123 ranges)
Frequency measuring range	0.1 Hz to 500 kHz (where the minimum pulse width is 1 μs)
Computation function	Set the physical amount per pulse and display by converting the values into physical values such as distance and flow rate.
Selectable Unit/Pulse range	-9.9999E+30 to +9.9999E+30
Counter reset	Manual reset and over-limit reset
Velocity	
Selectable vertical axis range	5.000E+21 value range to 100.0E-21 value range (1-2-5 range: total of 123 ranges)
Computing method	Set the amount of displacement per pulse and compute the velocity from the frequency Automatic unit time conversion of s, min, and hour.
Selectable Distance/Pulse range	-9.9999E+30 to +9.9999E+30

### Functional Specifications

Item	Specifications
Deceleration prediction	Computes the deceleration condition in realtime when the pulse input is cut off. Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity
Stop prediction	Sets the frequency to 0 after a certain time elapses after the pulse input is cut off. Stop interval setting: Set in the range of 1.5 to 10 times (10 settings) the period of the pulse measured last Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity
Smoothing	Computes the moving average of the measured data using the specified time Specified time: 0.1 to 1000 ms (0.1 ms resolution) Can be specified on all measurement parameters
Pulse average	Performs frequency measurement per specified number of pulses. When fluctuation exists periodically in the pulse interval, the fluctuation can be eliminated. Specified number of pulses: 1 to 4096 Can be specified when measuring the frequency, RPMs, RPSs, power supply frequency, period, pulse integration, and velocity
Offset function	Observe fluctuation with respect to the offset frequency Offset range: Can be set up to 1000 times the maximum div value <ul style="list-style-type: none"> <li>• Frequency: 0 Hz to 500 kHz</li> <li>• RPMs: 0 rpm to 50 krpm</li> <li>• RPSs: 0 rps to 1000 rps</li> <li>• Period: 0 s to 50 s</li> <li>• Duty cycle: 0% to 100%</li> <li>• Pulse width: 0 s to 50 s</li> <li>• Pulse integration: <math>-1.0000 \times 10^{22}</math> to <math>1.0000 \times 10^{22}</math></li> <li>• Velocity: <math>-1.0000 \times 10^{22}</math> to <math>1.0000 \times 10^{22}</math></li> </ul>

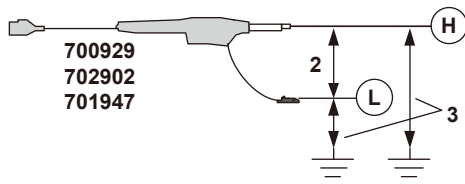
# 15 High-Speed 100 MS/s, 12-Bit Isolation Module (720210 and 720211) Specifications

Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, and GND
Maximum sample rate	100 MS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when sine wave of amplitude 60 % of range is input)	DC to 20 MHz
Voltage-axis range setting	100 mV range to 200 V range (1-2-5 steps) (when using 1:1 probe attenuation)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>2</sup> 1000 V (DC+ACpeak) CAT II Combined with the 701901+701954 (1:1): <sup>4</sup> 200 V (DC+ACpeak) Direct input (cable that does not comply with the safety standards): <sup>6</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth Between input and case Between each input (at a frequency of 1 kHz or less)	Working voltage of safety standard In combination with 700929 (10:1)/702902 (10:1)/701947 (100:1), <sup>3</sup> or in combination with 701901+701954 (1:1): <sup>5</sup> 1000 Vrms (CAT II) Combined with the 702902 (10:1): <sup>3</sup> 1000 V (DC+ACpeak) Direct input (cable that does not comply with the safety standards): <sup>7</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	100 mV range to 200 V range: ±(0.5% of range)
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	10 Hz or less (1 Hz or less when using the 700929 or 702902, 0.1 Hz or less when using the 700929)
Common mode rejection ratio	80 dB (50/60 Hz) or more (typical value <sup>8</sup> )
Residual noise level (Input section shorted)	±1.1 mV or ±1.5% of range whichever is greater (typical value <sup>8</sup> )
Withstand voltage	5400 Vrms for 2 seconds (across each terminal and earth) (60 Hz)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	12 bit (1500 LSB/range)
Temperature coefficient	Zero point: 100 mV range to 200 V range: ±(0.1% of range)/°C (typical value <sup>8</sup> ) Gain: ±(0.05% of range)/°C (typical value <sup>8</sup> )
Bandwidth limit	Select from Full and 2 MHz Cut-off characteristics: -12 dB/OCT (typical value <sup>8</sup> ) Cutoff frequency: 1.28 MHz, 640 kHz, 320 kHz, 160 kHz, 80 kHz, 40 kHz, 20 kHz, 10 kHz Filter format: IIR
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A: 1 V (for the 701930/701931)

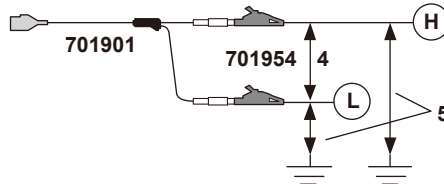
1 Value measured under standard operating conditions.

## 15 High-Speed 100 MS/s, 12-Bit Isolation Module (720210 and 720211) Specifications

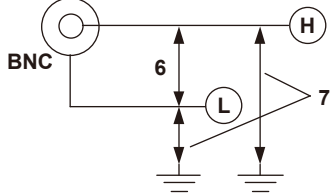
Combined with the 700929, 702902, or 701947



Combined with the 701901 + 701954



Direct input (cable that does not comply with the safety standards)



8 Typical value represents a typical or average value. It is not strictly warranted.

### **Note**

You can install up to four 720210 modules, and these modules must be installed in the top slots.

## 16 Basic Defining Equation of Strain

### Definition of Strain

$$\Delta L/L = \varepsilon \quad (1)$$

$\varepsilon$  Strain

L: Initial length of the material

$\Delta L$ : Amount of change due to external strain

### Definition of the Gauge Factor

Gauge factor (K) refers to the ratio between the mechanical strain and the change in the resistance of the strain gauge resistor.

$$\varepsilon = \frac{\Delta L}{L} = \frac{\Delta R/R}{K} \quad (2)$$

$$(\Delta R/R) = K \times \varepsilon \quad (3)$$

R Gauge resistance

$\Delta R$  Amount of change in resistance when a strain is received

Normally,  $K=2.0$ . However, the value varies depending on the strain gauge material.

### General Equation of the Measured Voltage (V) and Strain ( $\varepsilon$ ) of the Wheatstone Bridge (1 Gauge Method)

If we assume V to be the voltage measured on the bridge and E to be the voltage applied to the bridge,

$$V = (1/4) \times E \times (\Delta R/R) \quad (4)$$

From equation (3)

$$(\Delta R/R) = K \times \varepsilon$$

$$\text{Thus, } V = (1/4) \times E \times K \times \varepsilon \quad (5)$$

#### When Determining the Strain ( $\varepsilon$ ) from the Measured Voltage (V) (Strain Gauge (1Gauge Method))

If we derive  $\varepsilon$  from equation (5)

$$\varepsilon = (4/K) \times (V/E) \quad (6)$$

#### When Determining the Measured Value of the Strain Gauge Sensor (e) from the Voltage Measured on the Bridge (V) (Strain Gauge Sensor)

Assuming e to be the measured value (measured value of the strain gauge sensor: mV/V unit) and substituting  $\varepsilon = e$  in equation (6),

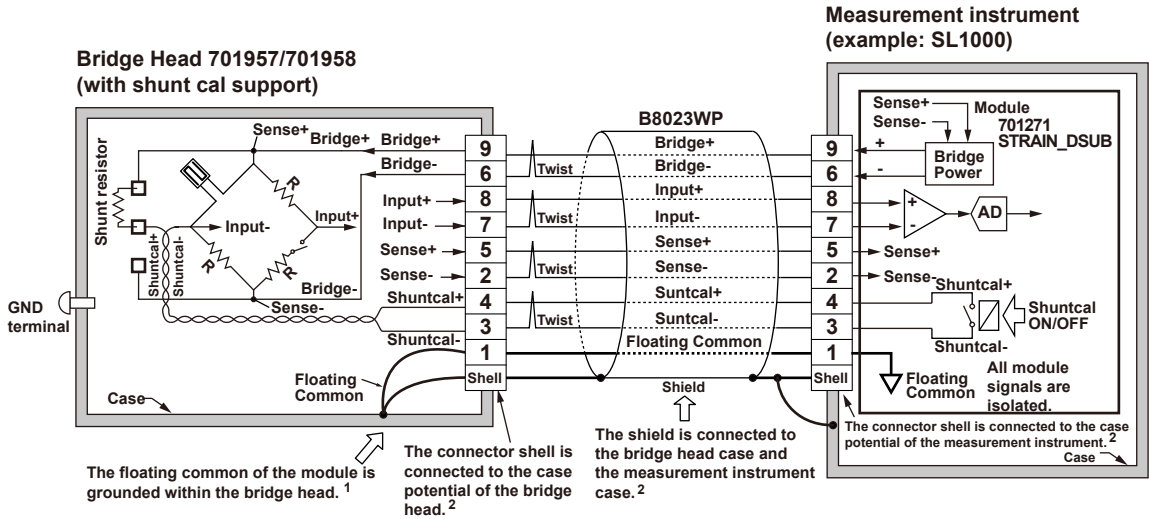
$$e = (4/K) \times (V/E) \quad (7)$$

In the case of a strain gauge sensor, set the Gauge Factor (K) to 2 on the SL1000 unit. If you change the value of K, conversion is made using the above equation.

# 17 Shunt Calibration of the Strain Module

Shunt calibration is used to correct the gain of strain measurements by inserting a known resistance (shunt calibration resistance (shunt resistance)) in parallel with the strain gauge. The Strain Module (701271)(STRAIN\_DSUB) supports shunt calibration and contains a built-in relay circuit for shunt calibration.

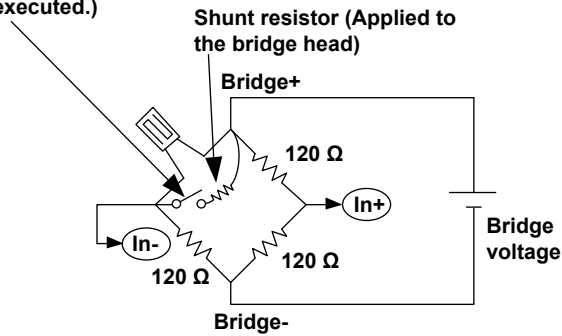
To execute shunt calibration, a bridge head that supports shunt calibration (701957/701958) is needed.



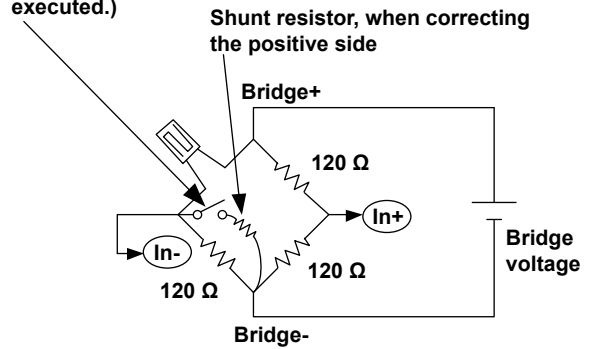
1. The GND (floating common) of the module is connected to the case potential inside the bridge box.
2. The bridge head case, the cable shield, and the measurement instrument case are connected as measures against noise.

- When correcting the gain on the negative side (normal)
- When correcting the gain on the positive side

**Shunt calibration relay circuit (Built into the strain module. Turns ON/OFF automatically when shunt calibration is executed.)**



**Shunt calibration relay circuit (Built into the strain module. Turns ON/OFF automatically when shunt calibration is executed.)**

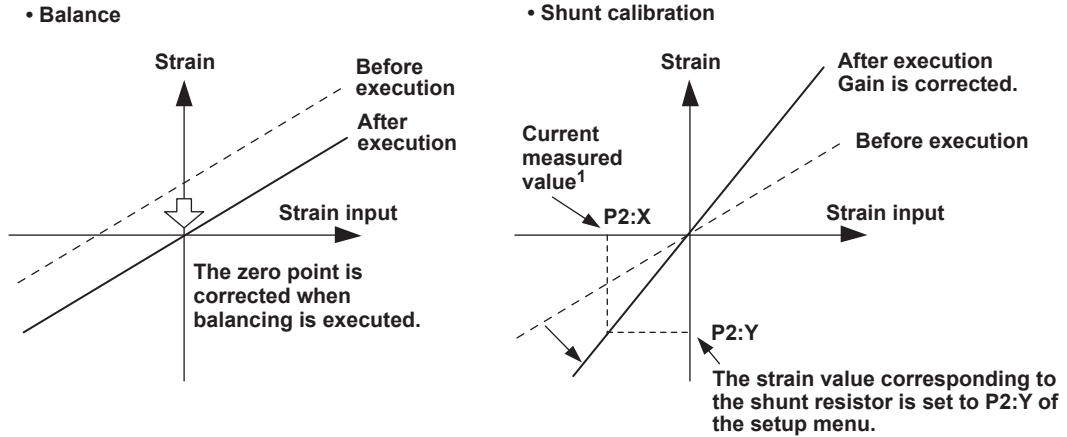




## Shunt Calibration Procedure

1. Calculate the strain value ( $\mu\text{STR}$ ) corresponding to the shunt resistor to be used. For the calculation procedure, see “Calculating the Shunt Resistance” in the next section.
2. Execute balancing without applying a load to the strain gauge and correct the zero point.
3. Execute shunt calibration and correct the gain.

Usually, the negative gain is corrected. However, if you are correcting the positive gain, change the position of the shunt resistor as shown in the right figure in the previous page.



1. Automatically obtained when shunt calibration is executed.

## Executes Shunt Calibration

Execute shunt calibration according to the procedures appropriate for the instrument that you are using (SL1000 unit for example).

### Note

- When executing shunt calibration, select an appropriate range so that the measured values do not exceed the range when the shunt calibration relay circuit is ON. The SL1000 unit attempts shunt calibration within the current specified range.
- If shunt calibration fails (the measured value exceeds the range, for example), an error message is displayed. In such case, change the range and execute shunt calibration again.

## Taking Measures against Noise

Because measurements are made at the  $\mu\text{V}$  level, the strain gauge is extremely susceptible to noise. If the execution of balancing or shunt calibration fails, it may be due to the effect of noise. Check the following points.

- Because the strain gauge is attached away from the bridge head, it is recommended that twisted wire be used for extension.
- Use a bridge head with high noise resistance. It is recommended that YOKOGAWA bridge head (701957/701958) with high noise resistance be used.

## Calculation of the Shunt Resistance

To execute shunt calibration, the shunt resistance ( $R_s$ ) and the expected strain ( $\epsilon$ ) need to be calculated in advance. Use  $\epsilon$  as given in the equation below (normally a negative value). Enter the value into "P2Y" under the shunt calibration execution menu. However, when using the general method given for shunt calibration (the easy method), an error of 1 to 2% can be introduced as the strain value ( $\epsilon$ ) increases. Therefore, calculate using the detailed method whenever possible. Also, you must select a setting range value that will not result in an overrange.

## Equation for $R_s$ and $\epsilon$ When Executing Shunt Calibration

### General Equation

$$\Delta R/R = K \times \epsilon \quad (1): \text{Basic Equation of Strain}$$

$$\Delta R = R - R/R_s \quad (2): \text{Equation of the change in resistance when the shunt resistance is ON}$$

In this manual, the parallel equation of resistors are expressed as follows:

$$R/R_s = \frac{1}{\frac{1}{R} + \frac{1}{R_s}} = \frac{R \times R_s}{R + R_s}$$

If  $\Delta R$  is cancelled out from (1) and (2),

$$R_s = R \times (1 - K \times \epsilon) / (K \times \epsilon) \quad (\text{Equation A}): \text{General equation used to calculate the shunt resistance (includes error)}$$

- $\epsilon$ : Strain (strain you wish to generate when the shunt resistance is turned ON)
- K: Gauge factor
- R: Bridge resistance
- $\Delta R$ : Resistance change
- $R_s$ : Shunt resistance (shunt resistance you wish to derive)

### General Equation

$$V_0 = E \times (R_1 \times R_3 - R_2 \times R_4) / \{(R_1 + R_2) \times (R_3 + R_4)\} \quad (1): \text{Basic Equation of Wheatstone Bridge}$$

When shunt calibration is ON,

$$V_0 = E \times (R_1 \times R_3 - R' \times R_4) / \{(R_1 + R') \times (R_3 + R_4)\} \quad (2): \text{Equation when turned ON}$$

$$R' = R_2 // R_s \quad (3): \text{Equation of combined resistance } R'$$

$$R_1 = R_2 = R_3 = R_4 = R \quad (4): \text{Since } R_1 \text{ to } R_4 \text{ are equal, we represent them as } R$$

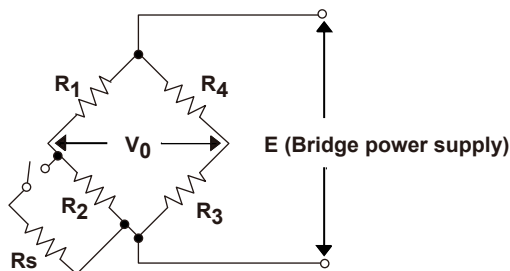
Also, from the basic equation of strain,

$$V_0/E = K \times \epsilon / 4 \quad (5): \text{Basic equation of strain}$$

If  $V_0/E$  and  $R_1$  to  $R_4$  are cancelled out from (2), (3), (4), and (5),

$$R_s = R \times (1 - K \times \epsilon / 2) / (K \times \epsilon) \quad (\text{Equation B}): \text{Detailed equation used to calculate the shunt resistance (no error)}$$

- E: Bridge voltage
- $V_0$ : Bridge output voltage
- $R_1$  to  $R_4$ : Bridge resistance (except,  $R_1 = R_2 = R_3 = R_4$ )
- $R_s$ : Shunt resistance (shunt resistance you wish to derive)
- $R'$ : Combined resistance when the relay is turned ON ( $R' = R // R_s$ )



**Calculation Example**

**When Determining the Corresponding Shunt Resistance (Rs) from the Strain (ε)**

Given a gauge factor (K) of 2,

Detailed equation  $R_s = R \times (1 - \epsilon) / (2 \times \epsilon)$  (6)

(equation B)

General equation  $R_s = R \times (1 - 2 \times \epsilon) / (2 \times \epsilon)$  (7): Error of 1 to 2% present

(equation A)

Desired Strain ε(μSTR)	Derived by the Detailed Equation (6) Rs Value (Ω)		Rs value (Ω) Derived by the General Equation (7)	
	R = 120Ω	R = 350Ω	R = 120Ω	R = 350Ω
1,000	59,940	174,825	59,880	174,650
2,000	29,940	87,325	29,880	87,150
5,000	11,940	34,825	11,880	34,650
10,000	5,940	17,325	5,880	17,150

**When Determining the Corresponding Strain (ε) from the Shunt Resistance (Rs)**

If we derive ε from equation (6) and (7),

Detailed equation  $\epsilon = 1 / (1 + 2 \times R_s / R)$  (8)

(equation B)

General equation  $\epsilon = 1 / \{2 \times (1 + R_s / R)\}$  (9): Error of 1 to 2% present

(equation A)

• **When the Bridge Resistance R is 120 Ω**

RS Value (Ω)	Strain ε(μSTR) Derived by the Detailed Equation (8)	Strain ε(μSTR) Derived by the General Equation (9)
60,000	999	998
30,000	1,996	1,992
12,000	4,975	4,950
6,000	9,901	9,804

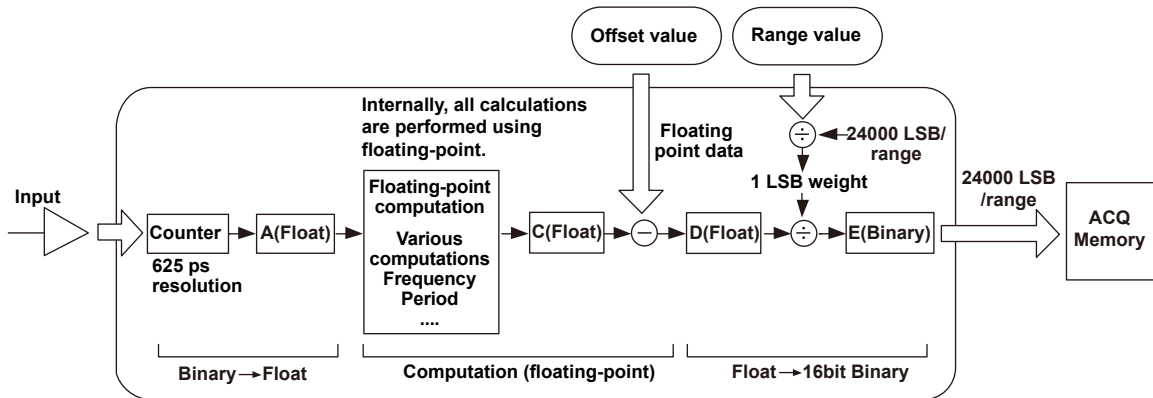
• **When the Bridge Resistance R is 350 Ω**

RS Value (Ω)	Strain ε(μSTR) Derived by the Detailed Equation (8)	Strain ε(μSTR) Derived by the General Equation (9)
180,000	971	970
90,000	1,941	1,937
36,000	4,838	4,814
18,000	9,629	9,537

# 18 Measurement Principles (Measurement Method and Update Rate) of the Frequency Module

## Computation Format (Resolution) of the Frequency Module

The computation flow on the frequency module is indicated below.



The frequency module measures the period of the input signal at a resolution of 625 ps. Therefore, the minimum resolution is 625 ps.

Computations are performed in floating point format. The data that is output from the frequency module and written to the acquisition memory (ACQ Memory) is 16-bit binary data. The frequency module converts the data using a weight of 1 LSB that is determined by Value/div. The data is normalized to 24000 LSB/range when displayed on the screen.

### Input: Conversion from Counter Values to Floating Point Values

The frequency module converts the count value that it obtains at 625 ps resolution to floating point format, and determines period A using the following equation.

$$\text{Period: } A(\text{float}) = (\text{count value}) \times 625 \text{ ps}$$

### Computation

Various computations are performed in floating point format based on the settings.

$$\text{Example) Frequency: } C(\text{float}) = 1/A(\text{float})$$

### Calculation of the 1 LSB Weight of the Output

The 1 LSB weight of the output is determined from the range.

Since range = 24000 LSB,

$$1 \text{ LSB weight of the output} = \text{range}/24000$$

### Computation Output: Conversion from Floating Point to 16-bit Binary (When Offset Is 0)

When the offset value is 0, offset calculation is not performed, and  $C(\text{float}) = D(\text{float})$ .

The data is converted into 16-bit binary data and written to the acquisition memory (ACQ Memory).

$$16\text{-bit binary data: } E(\text{binary}) = D(\text{float}) / (1 \text{ LSB weight of the output})$$

### Offset Computation

When the offset value is not 0, the offset value is computed in floating point format using the following equation and converted to 16-bit binary data.

$$D(\text{float}) = C(\text{float}) - \text{offset value}(\text{float})$$

In offset computation, if the computed result C is equal to the offset value, the output is 0. If the computed result C (float) is less than the offset value, E (binary) is negative.

## Filter Characteristics (Time Delay) of the Smoothing Filter

The smoothing filter is a moving average filter in which computation is performed in realtime. The computation interval of moving average is 40  $\mu$ s (25 kHz). It is constant independent of the sampling rate of the main unit.

The moving average order (the number of points of moving average) is specified in time.

The maximum value is 25000 order (when set to 1000 ms).

The characteristics of the smoothing filter are as follows:

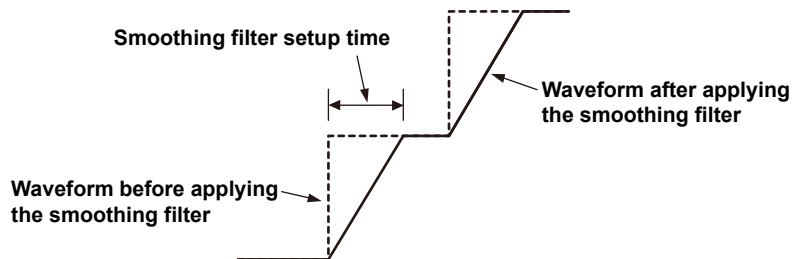
- The filter is a low-pass filter.
- Pass band is flat.
- Has linear phase characteristics and constant group delay by filter order.

The group delay is derived using the following equation.

$$\text{Group delay} = (\text{the number of points of moving average} - 1) \times 40 \mu\text{s}/2$$

- Has comb-shaped bandwidth characteristics.

The figure below shows the result when the smoothing filter is applied to a waveform that changes in steps. The switching filter setup time follows the step change.



# Appendix 1 High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701260) Specifications

The specifications for the High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701260) are provided below. This input module (701260) does not comply with safety standard EN61010-1 or EN61010-2-030 as of September 30, 2013.

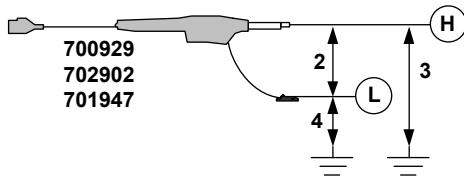
Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Number of input channels	2
Input coupling	AC, DC, GND, AC-RMS, and DC-RMS
Maximum sample rate	100 kS/s
Input format	Isolated unbalanced
Frequency characteristics <sup>1</sup> (-3 dB point when a sine wave of amplitude 60 % of range is input)	Waveform observation mode: DC to 40 kHz RMS observation mode: DC, 40 Hz to 10 kHz
Voltage-axis range setting	200 mV range to 2 kV range (1-2-5 steps) (when using 1:1 probe attenuation)
Maximum input voltage (at a frequency of 1 kHz or less)	Combined with the 700929 (10:1), 702902 (10:1) or 701947 (100:1): <sup>2</sup> 1000 V (DC+ACpeak) Combined with the 701901+701954 (1:1): <sup>5</sup> 850 V (DC+ACpeak) Direct input or cable not complying with the safety standard: <sup>8</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth (at a frequency of 1 kHz or less)	Working voltage of safety standard Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1) Across probe tip H and earth: <sup>3</sup> 1000 Vrms (CAT II) Across probe tip L and earth: <sup>4</sup> 400 Vrms (CAT II) Combined with the 701901+701954 (1:1) Across tip H and earth: <sup>6</sup> 700 Vrms (CAT II) Across tip L and earth: <sup>7</sup> 400 Vrms (CAT II) Direct input or cable not complying with the safety standard Across the input terminal, H or L, and earth: <sup>9</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Vertical (voltage) axis accuracy DC accuracy <sup>1</sup>	Waveform observation mode DC accuracy ±(0.25% of range) RMS observation mode DC accuracy ±(1.0% of range) AC accuracy (when a sine wave is input) ±(1.5% of range) At frequency of 40 Hz to 1 kHz AC accuracy (when the crest factor is 2 or less) ±(2.0% of range) At frequency of 40 Hz to 1 kHz AC accuracy (when the crest factor is 3 or less) ±(3.0% of range) At frequency of 40 Hz to 1 kHz
Input connector	BNC connector (isolated type)
Input impedance	1 MΩ ± 1%, approx. 35 pF
-3 dB point when AC coupled low frequency attenuation point	1 Hz or less (0.1 Hz or less when using the 700929 or 702902, 0.01 Hz or less when using the 701947)
Common mode rejection ratio	80 dB (50/60 Hz) or more (Typical <sup>10</sup> )
Residual noise level (Input section shorted)	±1 mV or ±0.2% of range whichever is greater (Typical <sup>10</sup> )
Withstand voltage	3700 Vrms for 1 minute (across each terminal and earth) (60 Hz)
Allowable transient surge voltage (instantaneous)	±5200 Vpeak (across each input terminal and earth)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
A/D conversion resolution	16 bit (24000 LSB/range)
Temperature coefficient	Zero point: ±(0.02% of range)/°C (Typical <sup>10</sup> ) Gain: ±(0.02% of range)/°C (Typical <sup>10</sup> )
Response time (only when observing RMS)	Rising (0 to 90% of range): 100 ms (Typical <sup>10</sup> ) Falling (100 to 10% of range): 250 ms (Typical <sup>10</sup> )
Bandwidth limit	Select from Full, 10 kHz, 1 kHz, and 100 Hz Cut-off characteristics: -12 dB/OCT (Typical <sup>10</sup> )

## Appendix 1 High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS) (701260) Specifications

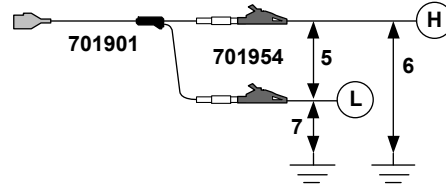
Item	Specifications
Probe attenuation setting	Voltage probe: 1:1, 10:1, 100:1, 1000:1 Current probe: 1 A:1 V, 10 A:1 V (for the 701932/701933), 100 A: 1 V (for the 701930/701931)
Compatible probes/ cables	Connection cable (for high voltage 1:1): Recommended 1 701901 (isolated type BNC-safety alligator clip adapter ×2: For measuring 850 V (DC+ACpeak) or less), 701954 (alligator clip (dolphin type) red/black 2-piece set) is required separately Voltage probe: Recommended 2 700929 (10:1 safety probe), 20 to 45 pF: For measuring 1000 V (DC+ACpeak) or less 702902 (10:1 safety probe), 25 to 40 pF: For measuring 1000 V (DC+ACpeak) or less 701947 (100:1 probe), 15 to 45 pF: For measuring 1000 V (DC+ACpeak) or less Current probe (power can be supplied from the SL1000 Unit. Option) 701930 (150 A), 701931 (500 A), 701932 (30 A), 701933 (30 A)

1 Value measured under standard operating conditions.

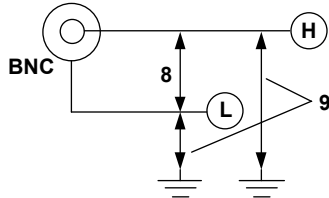
### Combined with the 700929, 702902, or 701947



### Combined with the 701901+701954



### Direct input (cable that does not comply with the safety standards)



10 The typical value is a representative or standard value. It is not strictly warranted.



## WARNING

- To receive high voltage with the module, use a 1:1 safety cable (combination of 701901 and 701954), isolated probe (700929, 701947), or passive probe 702902.
- Note that the overvoltage tolerance of the low and high sides of this module may differ depending on the combination of the connected probe, measurement lead, and clip.

## French



## AVERTISSEMENT

- Pour recevoir une tension élevée avec le module, utiliser un câble de sécurité 1:1 (combinaison de 701901 et 701954), une sonde isolée (700929, 701947) ou une sonde passive 702902.
- Noter que la tolérance de surtension des du bas et du haut de ce module peut être différente suivant la combinaison de sonde reliée, de fil de mesure et de pince.

## Appendix 2 Frequency Module (701280) Specifications

The specifications for the Frequency Module (701280) are provided below. This module does not comply with environmental standard EN50581.

Item	Specifications
Standard operating conditions	Temperature: 23 ±5°C Humidity: 20 to 80% RH After a 30-minute warm-up and after calibration
Measurement function	Frequency, RPMs, RPSs, period, duty cycle, power supply frequency, pulse width, pulse integration, and velocity
Number of input channels	2
Data update rate	25 kHz (40 µs)
Output delay time	Up to 2 computation periods
Input format	Isolated unbalanced
Input connector	Metal BNC connector
Maximum input voltage	Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>2</sup> 420 V (DC+ACpeak) Combined with the (701901 + 701954) (1:1) or direct input (cable that does not comply with the safety standards): <sup>4</sup> 42 V (DC+ACpeak)
Maximum rated voltage to earth	Working voltage of safety standard Combined with the 700929 (10:1), 702902 (10:1), or 701947 (100:1): <sup>3</sup> 300 Vrms (CAT II) Combined with the (701901 + 701954) (1:1) or direct input (cable that does not comply with the safety standards): <sup>5</sup> 42 V (DC+ACpeak) (CAT II, 30 Vrms)
Withstand voltage	1500 Vrms for 1 minute (across each terminal and earth) (60 Hz)
Allowable transient surge voltage (instantaneous)	±2100 Vpeak (across each input terminal and earth)
Insulation resistance	500 VDC, 10 MΩ or more (across each input terminal and earth)
Minimum measurement resolution	50 ns
Measured data resolution	16 bits (24000 LSB/range)
Measurement accuracy <sup>1</sup>	<ul style="list-style-type: none"> <li>• <b>When in frequency, RPM, RPS, or velocity measurement mode<sup>6</sup></b> Measurement accuracy is specified according to the measurement range and input frequency [Definition of measurement accuracy] ±(0.05% of range + accuracy dependent on the input frequency) [Accuracy dependent on the input frequency] When input frequency is 2 kHz or less: 0.05% of the input frequency + 0.001 Hz Input frequency of 2 kHz to 10 kHz: 0.1% of the input frequency Input frequency of 10 kHz to 20 kHz: 0.3% of the input frequency Input frequency of 20 kHz or higher: 0.5% of the input frequency</li> <li>• <b>When in power supply frequency mode<sup>7</sup></b> When the center frequency is 50/60 Hz: ±0.03 Hz (0.01 Hz resolution) When the center frequency is 400 Hz: ±0.3 Hz (0.01 Hz resolution) (Input set to AC100 V or AC200 V with sine wave input)</li> <li>• <b>When in period measurement mode<sup>6</sup></b> Measurement accuracy is specified according to the measurement range and input period [Definition of measurement accuracy] ±(0.05% of range + accuracy dependent on the input period) [Accuracy dependent on the input period] Input period of 500 µs or greater: 0.05% of the input period Input period of 100 µs to 500 µs: 0.1% of the input period Input period of 50 µs to 100 µs: 0.3% of the input period Input period of 50 µs or less: 0.5% of the input period + 0.1 µs</li> </ul>

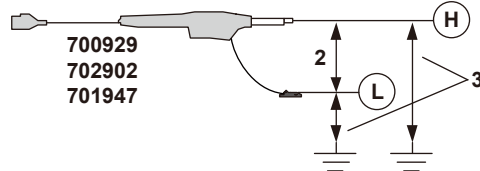


## Appendix 2 Frequency Module (701280) Specifications

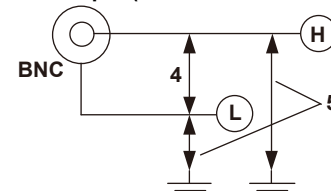
Item	Specifications
	<ul style="list-style-type: none"> <li>• <b>When in duty cycle measurement mode<sup>8</sup></b> Dependent on the input frequency Input frequency of 1 kHz or less: <math>\pm 0.1\%</math> Input frequency of 1 kHz to 10 kHz: <math>\pm 0.2\%</math> Input frequency of 10 kHz to 50 kHz: <math>\pm 1.0\%</math> Input frequency of 50 kHz to 100 kHz: <math>\pm 2.0\%</math> Input frequency of 100 kHz to 200 kHz: <math>\pm 4.0\%</math></li> <li>• <b>When in pulse width measurement mode<sup>8</sup></b> Measurement accuracy is specified according to the measurement range and input pulse width [Definition of measurement accuracy] <math>\pm(0.05\%</math> of range + accuracy dependent on the input pulse width) [Accuracy dependent on the input pulse width] Input pulse width of 500 <math>\mu\text{s}</math> or greater: 0.05% of the input pulse width Input pulse width of 100 <math>\mu\text{s}</math> to 500 <math>\mu\text{s}</math>: 0.1% of the input pulse width Input pulse width of 50 <math>\mu\text{s}</math> to 100 <math>\mu\text{s}</math>: 0.3% of the input pulse width Input pulse width of 50 <math>\mu\text{s}</math> or less: 0.5% of the input pulse width + 0.1 <math>\mu\text{s}</math></li> </ul>
Input voltage range ( $\pm\text{FS}$ )	When using 1:1 probe attenuation: $\pm 1\text{ V}, \pm 2\text{ V}, \pm 5\text{ V}, \pm 10\text{ V}, \pm 20\text{ V}, \pm 50\text{ V}$ ( $\pm\text{FS}$ )
Input impedance	1 M $\Omega$ $\pm$ 1 approx. 35 pF Pull-up function: 4.7 k $\Omega$ , approx. 5 V (pull-up can be turned ON only when the input is set to Pull-up 5 V)
Input coupling settings	AC, DC
Probe attenuation setting	10:1, 1:1
Minimum voltage width for pulse detection	200 mV <sub>P-P</sub>
Bandwidth limit	Select from Full, 100 kHz, 10 kHz, 1 kHz, and 100 Hz Cutoff characteristics: -12 dB/OCT (Typical <sup>9</sup> )
Threshold	Set within the FS of the voltage range. Set in units of 1% of the FS.
Hysteresis	Select $\pm 1\%$ , $\pm 2.5\%$ , or $\pm 5\%$ of the FS of the voltage range
Preset function	Logic (5 V/3 V/12 V/24 V), electromagnetic pickup, zero crossing, pull-up, AC100 V, AC200 V, and user-defined
Slope selection	Select rising or falling
Lower -3 dB point when AC coupled	0.5 Hz or less (0.05 Hz or less when using the 700929 or 702902, 0.005 Hz or less when using the 701947) (Typical <sup>9</sup> )
Chatter elimination function	OFF or 1 to 1000 ms (1 ms resolution) Eliminates the chatter that occurs such when the contact input is turned ON/OFF. Can discard the signal changes over the specified interval.
Input status indication function	Input status indication through the LEDs of each channel function When in operation: Illuminates in green when pulse input is detected When overdriven: Illuminates in red when the input voltage exceeds the range
Compatible probes/cables	Connection cable (1:1): Recommended 1 366926 Voltage probe: Recommended 2 700929 (10:1 safety probe), 20 to 45 pF 702902 (10:1 safety probe), 25 to 40 pF 701947 (100:1 probe), 15 to 45 pF

1 Value measured under standard operating conditions.

### Combined with the 700929, 702902, or 701947



### Combined with the (701901 + 701954) or direct input (cable that does not comply with the safety standards)



6 Input waveform of 1 V<sub>pp</sub>, rectangular wave, rise/fall time within 1 ms (input range:  $\pm 10\text{ V}$ , bandwidth limit: Full, and hysteresis:  $\pm 1\%$ )

7 Input waveform of 90 V<sub>rms</sub>, sine wave (input range: AC100 V, bandwidth limit 100 kHz, and hysteresis:  $\pm 1\%$ )

8 Input waveform of 1 V<sub>pp</sub>, rectangular wave, rise/fall time within 5 ns (input range:  $\pm 10\text{ V}$ , bandwidth limit: Full, and hysteresis:  $\pm 1\%$ )

9 Typical value represents a typical or average value. It is not strictly warranted.

Specifications by Measurement Modes

Item	Specifications
Frequency	
Measurable frequency range	0.01 Hz to 200 kHz
Selectable vertical axis range	1 Hz range to 500 kHz range (1-2-5 steps)
Minimum resolution	0.001 Hz
RPMs	
Measurable RPMs range	0.01 rpm to 100000 rpm (where the input frequency is DC to 200 kHz).
Selectable vertical axis range	1 rpm range to 100000 rpm range (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation RPMs = Frequency/(pulse/rotate value) × 60
Selectable pulse/rotate range	1 to 99999
RPSs	
Measurable RPSs range	0.001 rps to 2000 rps (where the input frequency is DC to 200 kHz).
Selectable vertical axis range	0.1 rps range to 2000 rps range (1-2-5 steps)
Computing method	Computed from the frequency based on the number of pulses per rotation RPSs = Frequency/(pulse/rotate value)
Selectable pulse/rotate range	1 to 99999
Period	
Measurable period range	5 μs to 50 s (where the minimum pulse width is 2 μs)
Selectable vertical axis range	100 μs range to 50 s range (1-2-5 steps)
Minimum resolution	0.1 μs
Duty cycle	
Measurable duty cycle range	0 to 100%
Selectable vertical axis range	10 % range to 200 % range (1-2-5 steps)
Measurable frequency range	0.1 Hz to 200 kHz
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.01%
Power supply frequency	
Measurable frequency range	30 Hz to 70 Hz (when the center frequency is 50 Hz), 40 Hz to 80 Hz (when the center frequency is 60 Hz), 380 Hz to 420 Hz (when the center frequency is 400 Hz)
Selectable vertical axis range	1 Hz range to 20 Hz range (0.01 Hz resolution)
Center frequency setting	Select 50 Hz, 60 Hz, or 400 Hz
Minimum resolution	0.01 Hz
Pulse width	
Measurable pulse width	2 μs to 50 s (where the input frequency is up to 200 kHz)
Selectable vertical axis range	100 μs range to 50 s range (1-2-5 steps)
Measurement pulse selection	Select positive or negative pulse
Minimum resolution	0.1 μs
Pulse integration	
Maximum pulse count	2×10 <sup>9</sup> pulses
Selectable vertical axis range	5.000E+21 value range to 100.0E-21 value range (1-2-5 range: total of 123 ranges)
Frequency measuring range	0.1 Hz to 200 kHz (where the minimum pulse width is 2 μs)
Computation function	Set the physical amount per pulse and display by converting the values into physical values such as distance and flow rate.
Selectable Unit/Pulse range	-9.9999E+30 to +9.9999E+30
Counter reset	Manual reset and over-limit reset
Velocity	
Selectable vertical axis range	5.000 E+21 value range to 100.0 E-21 value range (1-2-5 range: total of 123 ranges)
Computing method	Set the amount of displacement per pulse and compute the velocity from the frequency Automatic unit time conversion of s, min, and hour.
Selectable Distance/Pulse range	-9.9999E+30 to +9.9999E+30

## Appendix 2 Frequency Module (701280) Specifications

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### Functional Specifications

Item	Specifications
Deceleration prediction	Computes the deceleration condition in realtime when the pulse input is cut off. Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity
Stop prediction	Sets the frequency to 0 after a certain time elapses after the pulse input is cut off. Stop interval setting: Set in the range of 1.5 to 10 times (10 settings) the period of the pulse measured last Can be specified when measuring the frequency, RPMs, RPSs, period, and velocity
Smoothing	Computes the moving average of the measured data using the specified time Specified time: 0.1 to 1000 ms (0.1 ms resolution) Can be specified on all measurement parameters
Pulse average	Performs frequency measurement per specified number of pulses. When fluctuation exists periodically in the pulse interval, the fluctuation can be eliminated. Specified number of pulses: 1 to 4096 Can be specified when measuring the frequency, RPMs, RPSs, power supply frequency, period, pulse integration, and velocity
Offset function	Observe fluctuation with respect to the offset frequency Offset range: Can be set up to 100 times the maximum range value • Frequency: 0 Hz to 200 kHz • RPMs: 0 rpm to 50 krpm • RPSs: 0 rps to 1000 rps • Period: 0 s to 50 s • Duty cycle: 0% to 100% • Pulse width: 0 s to 50 s • Pulse integration: $-1.0000 \times 10^{22}$ to $1.0000 \times 10^{22}$ • Velocity: $-1.0000 \times 10^{22}$ to $1.0000 \times 10^{22}$