

SL1000

High-Speed Data Acquisition Unit

U S E R ' S M A N U A L

GiGAZoom
ENGINE™

Product Registration

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Thank you for purchasing the SL1000 High-Speed Data Acquisition Unit. This user's manual contains useful information about the instrument's functions and operating procedures and lists the handling precautions of the SL1000. 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. 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	This manual. 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	Explains the specifications of the input modules that can be installed in the SL1000.
701992/701994 Xviewer User's Manual	IM 701992-01E	Explains all functions and procedures of the Xviewer software used to display the measured data as waveforms on a PC.

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.
- Copying or reproducing all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.
- The TCP/IP software of this product and the document concerning the TCP/IP software have been developed/created by YOKOGAWA based on the BSD Networking Software, Release 1 that has been licensed from University of California.

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- Other company and product names are registered trademarks or trademarks of their respective holders.

Revisions

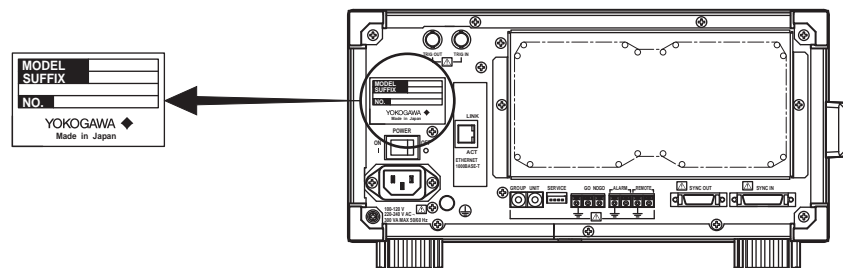
- 1st Edition: December 2007

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If some of the contents are not correct or missing or if there is physical damage, contact the dealer from which you purchased them.

SL1000

Check that the model name and suffix code given on the name plate on the rear panel match those on your order.



MODEL	Suffix Code	Description
720120		SL1000 High-Speed Data Acquisition Unit 8 slots, up to 128 MW memory With 1 license for the Xviewer Standard Edition (701992-SP01)
Power cord	-D	UL/CSA Standard power cord (Part No.: A1006WD) Maximum rated voltage: 125 V, Maximum rated current: 7 A
	-F	VDE Standard Power Cord (Part No.: A1009WD) Maximum rated voltage: 250 V, Maximum rated current: 10 A
	-Q	BS Standard Power Cord (Part No.: A1054WD) Maximum rated voltage: 250 V, Maximum rated current: 10 A
	-R	AS Standard Power Cord (Part No.: A1024WD) Maximum rated voltage: 250 V, Maximum rated current: 10 A
	-H	GB Standard Power Cord (Part No.: A1064WD) Maximum rated voltage: 250 V, Maximum rated current: 10 A
Options	/HD1	40-GB internal HDD
	/C10	Ethernet interface
	/P4	Four probe power outputs
	/XV0	Xviewer Less ^{1, 2}
	/XV1	Xviewer MATH Edition (701992-GP01) ²

1 Xviewer required to access the internal hard disk via USB.

2 The /XV0 and /XV1 options cannot be specified simultaneously.

No. (Instrument No.)

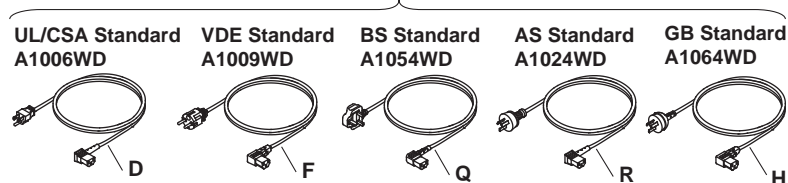
When contacting the dealer from which you purchased the instrument, please give them this number.

Standard Accessories

The standard accessories below are supplied with the instrument. Check that all contents are present and undamaged.

Model	Part Number	Qty.	Specifications
Power cord	One of the following power cords is supplied according to the instrument's suffix codes.		
	A1006WD	1	UL/CSA Standard power cord Maximum rated voltage: 125 V, Maximum rated current: 7 A
	A1009WD	1	VDE Standard Power Cord Maximum rated voltage: 250 V, Maximum rated current: 10 A
	A1054WD	1	BS Standard Power Cord Maximum rated voltage: 250 V, Maximum rated current: 10 A
	A1024WD	1	AS Standard Power Cord Maximum rated voltage: 250 V, Maximum rated current: 10 A
	A1064WD	1	GB Standard Power Cord Maximum rated voltage: 250 V, Maximum rated current: 10 A
Acquisition Software (CD) ¹	B8073ZA	1	Acquisition software used to configure and control the SL1000.
Soft case	B8081HG	1	For storing accessories.
Cover panels	B8073CY	8	For empty module slots.
Rubber feet	A9088ZM	2	Two rubber feet in one set.
User's manuals	IM 720120-01E	1	This manual
	IM 720120-61E	1	Acquisition Software User's Manual
	IM 720120-51E	1	Input Module User's Manual
	IM 701992-01E	1	Xviewer User's Manual ²
	IM 720120-92	1	User's Manual for China

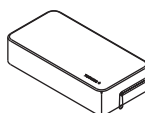
Power Cord (one of the following power cords is supplied according to the instrument's suffix codes)



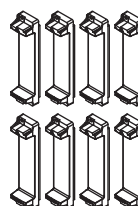
Acquisition Software B8073ZA (CD)¹



Soft case B8081HG



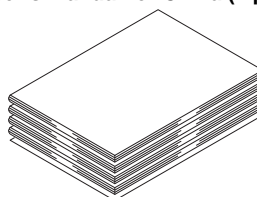
Cover panels B8073CY 8 pieces



Rubber feet A9088ZM



**User's manual (1 piece, this manual)/
Acquisition Software User's Manual (1 piece)/
Input Module User's Manual (1 piece)/
Xviewer User's Manual² (1 piece)/
User's manual for China (1 piece)**



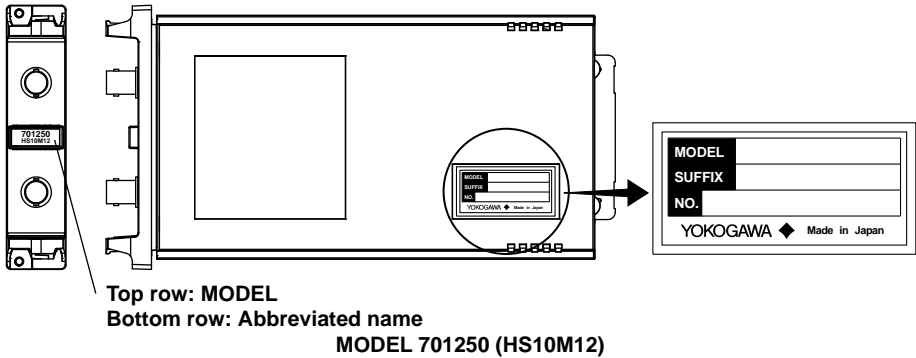
1 The CD includes 1 license for the Xviewer Standard Edition in addition to the SL1000 Acquisition Software.
The /XV1 option includes 1 license for the Xviewer MATH Edition.
The /XV0 option does not include a license for Xviewer.

2 Not included with the /XV0 option.

Modules (Sold Separately)

Check that the MODEL indicated on the module is what you ordered.

MODEL	Name	Minimum Q'ty	Abbreviation
720210	High-Speed 100 MS/s, 12-Bit Isolation Module (2CH)	1	HS100M12
701250	High-Speed 10 MS/s, 12-Bit Isolation Module	1	HS10M12
701251	High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module	1	HS1M16
701255	High-Speed 10 MS/s, 12-Bit Non-Isolation Module	1	NONISO_10M12
701260	High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS)	1	HV(with RMS)
701261	Universal (Voltage/Temp.) Module	1	UNIVERSAL
701262	Universal (Voltage/Temp.) Module (with AAF)	1	UNIVERSAL(AAF)
701265	Temperature, High Precision Voltage Isolation Module	1	TEMP/HPV
701270	Strain Module (NDIS)	1	STRAIN_NDIS
701271	Strain Module (DSUB, Shunt-Cal)	1	STRAIN_DSUB
701275	Acceleration/Voltage Module (with AAF)	1	ACCL/VOLT
701280	Frequency Module	1	FREQ



This user's manual refers to the input modules by MODEL (abbreviation).
For example, the High-Speed 10 MS/s, 12-Bit Isolation Module is indicated as 701250 (HS10M12). However, the module may be indicated only by the model (701250) if a description about the same module is given immediately before it.

Optional Accessories (Sold Separately)

The optional accessories below are available for purchase separately. For information and ordering, contact your nearest YOKOGAWA dealer.

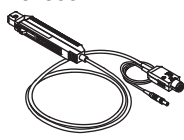
Model	Part Number	Min. Q'ty	Specifications
Isolated Probe	700929	1	1000Vrms-CAT II, for the 701250/701251/701260/720210 (10:1)
Current Probe	701933	1	30 Arms, DC to 50 MHz, used by connecting to the Probe Power Terminal (/P4 option) or the Probe Power Supply (701934) sold separately
	701930	1	150 Arms, DC to 10 MHz, used by connecting to the Probe Power Terminal (/P4 option) or the Probe Power Supply (701934) sold separately
	701931	1	500 Arms, DC to 2 MHz, used by connecting to the Probe Power Terminal (/P4 option) or the Probe Power Supply (701934) sold separately
Passive Probe (10:1)	701940	1	Non-isolated: 600 Vpk (701255), isolated: 42 V or less (others)
1:1 BNC Safety Adapter Lead	701901	1	1000Vrms-CAT II, for the 701250/701251/701260/720210. Used with the 701954, 701959, 758922, 758929, or 758921 sold separately
Alligator Clip (dolphin type)	701954	1 set	1000 Vrms-CAT II, red and black
Safety Mini-Clip (hook type)	701959	1 set	1000 Vrms-CAT II, red and black
Alligator Clip Adapter Set (300 V rating)	758922	1 set	300 Vrms-CAT II, red and black
Alligator Clip Adapter Set (1000 V rating)	758929	1 set	1000 Vrms-CAT II, red and black
Fork Terminal Adapter Set	758921	1 set	1000 Vrms-CAT II, red and black
1:1 BNC-Alligator Clip Cable	366926	1	Non-isolated: 42 V or less, for the 701250/701251/701255/720210, 1 m
1:1 Banana-Alligator Clip Cable	366961	1	Non-isolated: 42 V or less, for the 701261/701262/701265, 1.2 m
Safety BNC-to-Banana Adapter	758924	1	500Vrms-CAT II, for the 701250/701251/701255/701260/720210
Safety BNC Cable (1 m)	701902	1	1000Vrms-CAT II (BNC-BNC)
Safety BNC Cable (2 m)	701903	1	1000Vrms-CAT II (BNC-BNC)
Probe Power Supply	701934	1	Large current output, power supply for external probes (4 outputs)
Shunt Resistor	438920	1	250 $\Omega \pm 0.1\%$
	438921	1	100 $\Omega \pm 0.1\%$
	438922	1	10 $\Omega \pm 0.1\%$
Bridge Head	701955	1	NDIS, bridge resistance: 120 Ω , with a 5-m cable
	701956	1	NDIS, bridge resistance: 350 Ω , with a 5-m cable
	701957	1	DSUB, bridge resistance: 120 Ω , shunt-cal support, with a 5-m cable
	701958	1	DSUB, bridge resistance: 350 Ω , shunt-cal support, with a 5-m cable

Checking the Contents of the Package

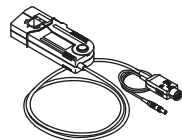
**Isolated Probe
700929**



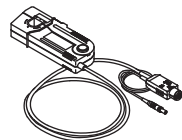
**Current Probe
701933**



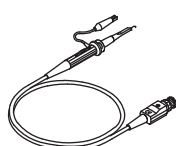
**Current Probe
701931**



**Current Probe
701930**



**Passive Probe (10:1)
701940**



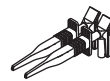
**1:1 BNC Safety
Adapter Lead
701901***



**Alligator Clip
(dolphin type)
701954**



**Safety Mini-Clip
(hook type)
701959**



**Alligator Clip Adapter
Set (Rating 300 V)
758922**



**Alligator Clip Adapter
Set (Rating 1000 V)
758929**



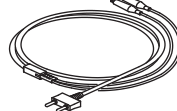
**Fork Terminal
Adapter Set
758921**



**1:1 BNC-Alligator
Clip Cable
366926**



**1:1 Banana-Alligator
Clip Cable
366961**



**Safety
BNC-to-Banana
Adapter
758924**



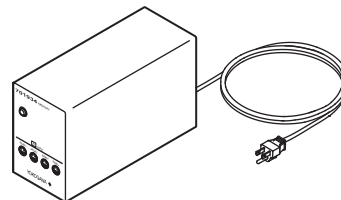
**Safety BNC Cable
(1 m) 701902**



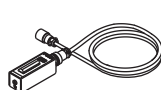
**Safety BNC Cable
(2 m) 701903**



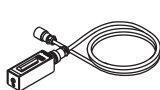
**Probe Power Supply
701934**



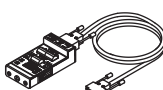
**Bridge Head
701955 (NDIS, 120 Ω)**



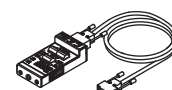
**Bridge Head
701956 (NDIS, 350 Ω)**



**Bridge Head
701957 (DSUB, 120 Ω)**



**Bridge Head
701958 (DSUB, 350 Ω)**



* The 1:1 BNC safety adapter lead (701901) is used in combination with the following accessories sold separately: alligator clip (dolphin type 701954), safety mini-clip (hook type: 701959), alligator adapter (758922 or 758929), and/or the fork terminal adapter (758921).

Safety Precautions

This instrument is an IEC safety class I instrument (provided with a terminal for protective earth grounding).

The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. Yokogawa Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.



Warning: handle with care. Refer to the user's manual or service manual. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.



Protective grounding or protective grounding terminal



Ground (earth) or functional ground terminal (do not use this terminal as a protective ground terminal.)



Alternating current



Direct current



ON (power)



OFF (power)

Be sure to comply with the precautions below. Not complying might result in injury or death.



WARNING

Use the Correct Power Supply

Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.

Use the Correct Power Cord and Plug

To prevent electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. Do not disable this protection by using an extension cord without protective earth grounding.

Connect the Protective Grounding Terminal

Be sure to connect the protective earth to prevent electric shock before turning ON the power. The power cord that comes with the instrument is a three-prong type power cord. Connect the power cord to a properly grounded three-prong outlet.

Do Not Impair the Protective Grounding

Never cut off the internal or external protective earth wire or disconnect the wiring of the protective earth terminal. Doing so poses a potential shock hazard.

Do Not Operate with Defective Protective Grounding or Fuse

Do not operate the instrument if the protective earth or fuse might be defective. Also, make sure to check them before operation.

Do Not Operate in an Explosive Atmosphere

Do not operate the instrument in the presence of flammable liquids or vapors. Operation in such an environment constitutes a safety hazard.

Do Not Remove Covers

The cover should be removed by YOKOGAWA's qualified personnel only. Opening the cover is dangerous, because some areas inside the instrument have high voltages.

Ground the Instrument before Making External Connections

Securely connect the protective grounding before connecting to the item under measurement or to an external control unit. If you are going to touch the circuit, make sure to turn OFF the circuit and check that no voltage is present.

Precautions to Be Taken When Using the Modules

- Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
- To prevent electric shock, be sure to furnish protective earth grounding of the instrument.
- To prevent electric shock, be sure to fasten the module screws. Otherwise, the electrical protection function and the mechanical protection function will not be activated.
- Avoid continuous connection under an environment in which the allowable surge voltage or greater voltage may occur.
- Be careful not to exceed the maximum input voltage of a module in the following cases.
 - When the probe attenuation is 1:1.
 - When the module input coupling is set to AC.

A DC voltage at the same electric potential as the probe input is applied to the module input.

Precautions to Be Taken When Using the Probes

- If you are measuring high voltages using the 720210 (HS100M12), 701250 (HS10M12) or the 701251 (HS1M16), use the isolated probe (700929) or 1:1 safety cable (combination of 701901 and 701954).
 - If you are using the 701255 (NONISO_10M12), be sure to fasten the module screws. Fastening the module screws activates the protection function and the non-isolation function. It is extremely dangerous if you do not fasten the screws. In addition, if you are measuring high voltage above 42 V, be sure to use the passive probe (701940).
 - The BNC part of the passive probe (701940) is made of metal. Therefore, use the probe at 42 V or less for isolated inputs (720210 (HS100M12), 701250 (HS10M12), 701251 (HS1M16), 701260 (HV (with RMS)), etc.) for safety reasons. (Do not connect voltage above 42 V to both the High and Low sides.) For non-isolated inputs (701255 (NONISO_10M12), etc.), fasten the module screws as described before.
 - If you are applying high voltage using the 701260 (HV (with RMS)), use the 1:1 safety cable (combination of 701901 and 701954) or the isolated probe (700929).
 - The measurement category of the 701260 (HV (with RMS)) is 400V-CAT II for the low side and 700V-CAT II for the high side. Use caution because the overvoltage tolerance differs between the low and high sides.
-

See below for operating environment limitations.

CAUTION

This product is a Class A (for industrial environments) product. Operation of this product in a residential area may cause radio interference in which case the user will be required to correct the interference.

Waste Electrical and Electronic Equipment



Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC

(This directive is only valid in the EU.)

■ This product complies with the WEEE Directive (2002/96/EC) marking requirement. This marking indicates that you must not discard this electrical/electronic product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control instrumentation" product.

Do not dispose in domestic household waste. When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

How to Use This Manual

Structure of the Manual

This user's manual consists of the following sections.

Chapter	Title	Description
1	Names and Uses of Parts	Describes the names and uses of each part and the screen display.
2	Explanation of Functions	Describes the measurement principles and the functions of the instrument. Operational details are not given in this chapter. However, reading this chapter will help you understand the operating procedures given in the chapters that follow.
3	Before Starting Measurements	Describes handling precautions, how to install the instrument, how to connect to the power supply, how to turn ON/OFF the power switch, how to install modules, how to connect probes, and so on.
4	Starting/Stopping Measurements	Describes how to connect the instrument to a PC and how to start/stop measurements.
5	External I/O Terminals	Describes external trigger input, trigger output, external clock, alarm output, GO/NO-GO output, etc.
6	Maintenance	Gives troubleshooting advice; explains screen messages and self-test operation.
7	Specifications	Summarizes the main specifications of the instrument in tables.
	Appendix	Provides information about the TCP and UDP port numbers used in the Ethernet communications; and so on.
	Index	

Conventions Used in This Manual

Unit

k: Denotes 1000. Example: 100 kS/s (sampling rate)

K: Denotes 1024k. Example: 710 KB (file size)

Bold Characters

Bold characters used in the procedural explanations indicate characters that are marked on the panel keys or the characters of the soft keys displayed on the screen menu.

Markings

The following markings are used in this manual.



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 users 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.

Note

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

Subheadings

On pages that describe the operating procedures in chapters 3 and 4, the following symbols are used to distinguish the procedures from their explanations.

Procedure

Carry out the procedure according to the step numbers. All procedures are written with inexperienced users in mind;experienced users may not need to carry out all the steps.

Explanation

This section describes the setup items and the limitations regarding the procedures. It may not give a detailed explanation of the function. For a detailed explanation of the function, see chapter 2.

Contents

Checking the Contents of the Package	ii
Safety Precautions.....	vii
Waste Electrical and Electronic Equipment	x
How to Use This Manual.....	xi
Chapter 1 Names and Uses of Parts	
1.1 Front Panel and Rear Panel.....	1-1
1.2 Keys and Indicators	1-3
1.3 Display.....	1-4
Chapter 2 Explanation of Functions	
2.1 System Configuration and Block Diagram	2-1
2.2 Input Modules	2-4
2.3 Operating Configuration.....	2-5
Chapter 3 Making Preparations for Measurements	
3.1 Handling Precautions	3-1
⚠ 3.2 Installing the Instrument.....	3-3
⚠ 3.3 Installing Modules	3-6
⚠ 3.4 Connecting the Power Supply	3-10
⚠ 3.5 Connecting the Probes	3-13
⚠ 3.6 Compensating the Probe (Phase Correction).....	3-19
⚠ 3.7 Connecting Measuring Leads	3-21
⚠ 3.8 Connecting Thermocouples.....	3-22
⚠ 3.9 Connecting a Bridge Head	3-23
⚠ 3.10 Connecting Acceleration Sensors	3-26
⚠ 3.11 Connecting Sensors to the Frequency Module	3-28
Chapter 4 Starting/Stopping Measurements	
4.1 Connecting to a PC	4-1
4.2 Starting/Stopping Measurements	4-5
Chapter 5 External I/O Terminals	
⚠ 5.1 Connecting the External Clock Input Terminal (EXT CLK IN)	5-1
⚠ 5.2 Connecting the External Trigger Input Terminal (TRIG IN).....	5-2
⚠ 5.3 Connecting the Trigger Output Terminal (TRIG OUT)	5-3
⚠ 5.4 Connecting the Alarm Output Terminals (ALARM)	5-5
⚠ 5.5 Connecting the Remote Input Terminals (REMOTE).....	5-7
⚠ 5.6 Connecting the GO/NO-GO Output Terminals	5-9
Chapter 6 Maintenance	
6.1 Troubleshooting	6-1
6.2 Codes and Corrective Actions	6-2
6.3 Recommended Replacement Parts	6-4

Chapter 7 Specifications

7.1	Input Section.....	7-1
7.2	Display Section.....	7-1
7.3	Storage	7-1
7.4	External I/O Section	7-2
7.5	Computer Interface	7-3
7.6	General Specifications.....	7-4
7.7	External Dimensions.....	7-7

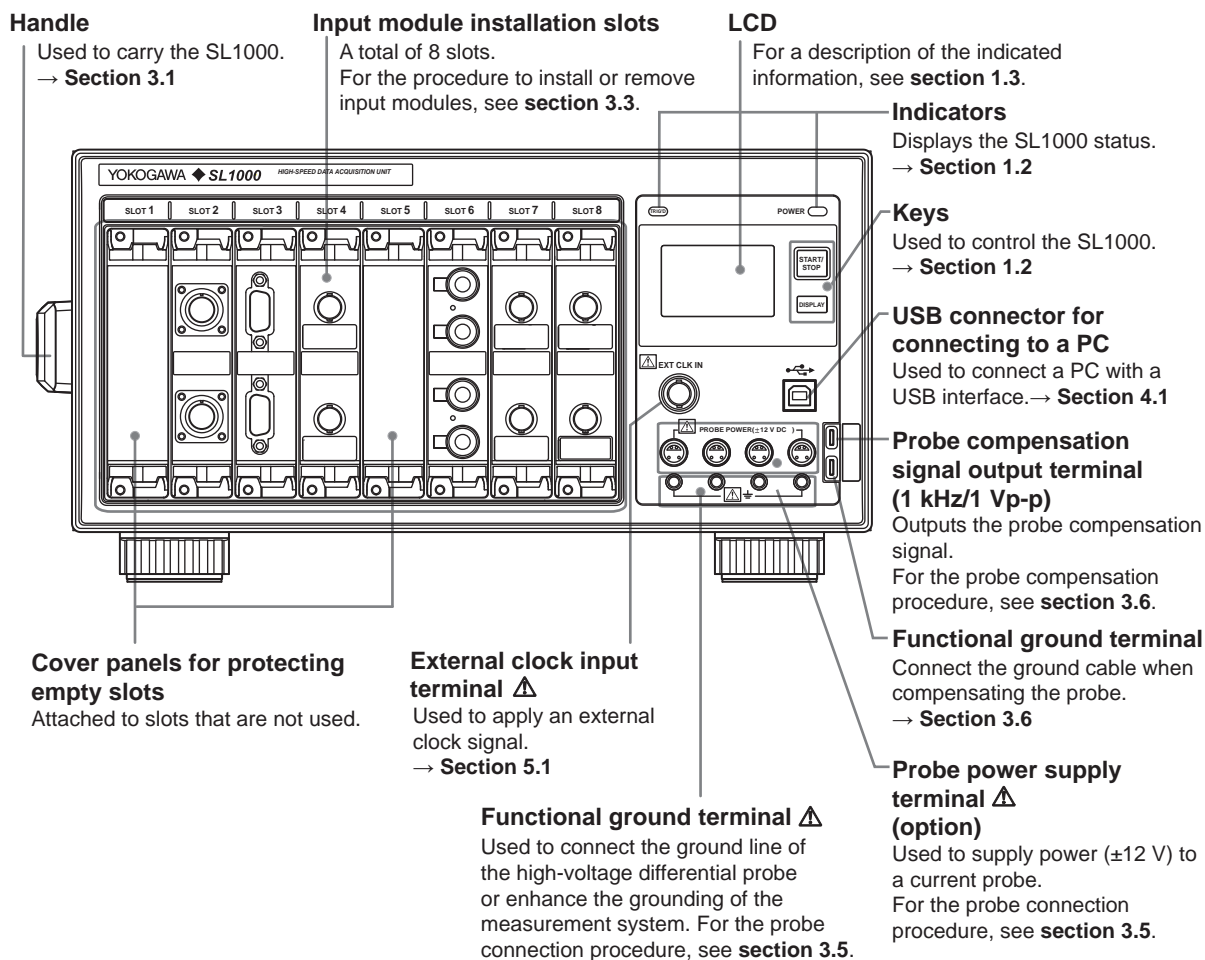
Appendix

Appendix 1	TCP and UDP Port Numbers Used in Ethernet Communications.....	App-1
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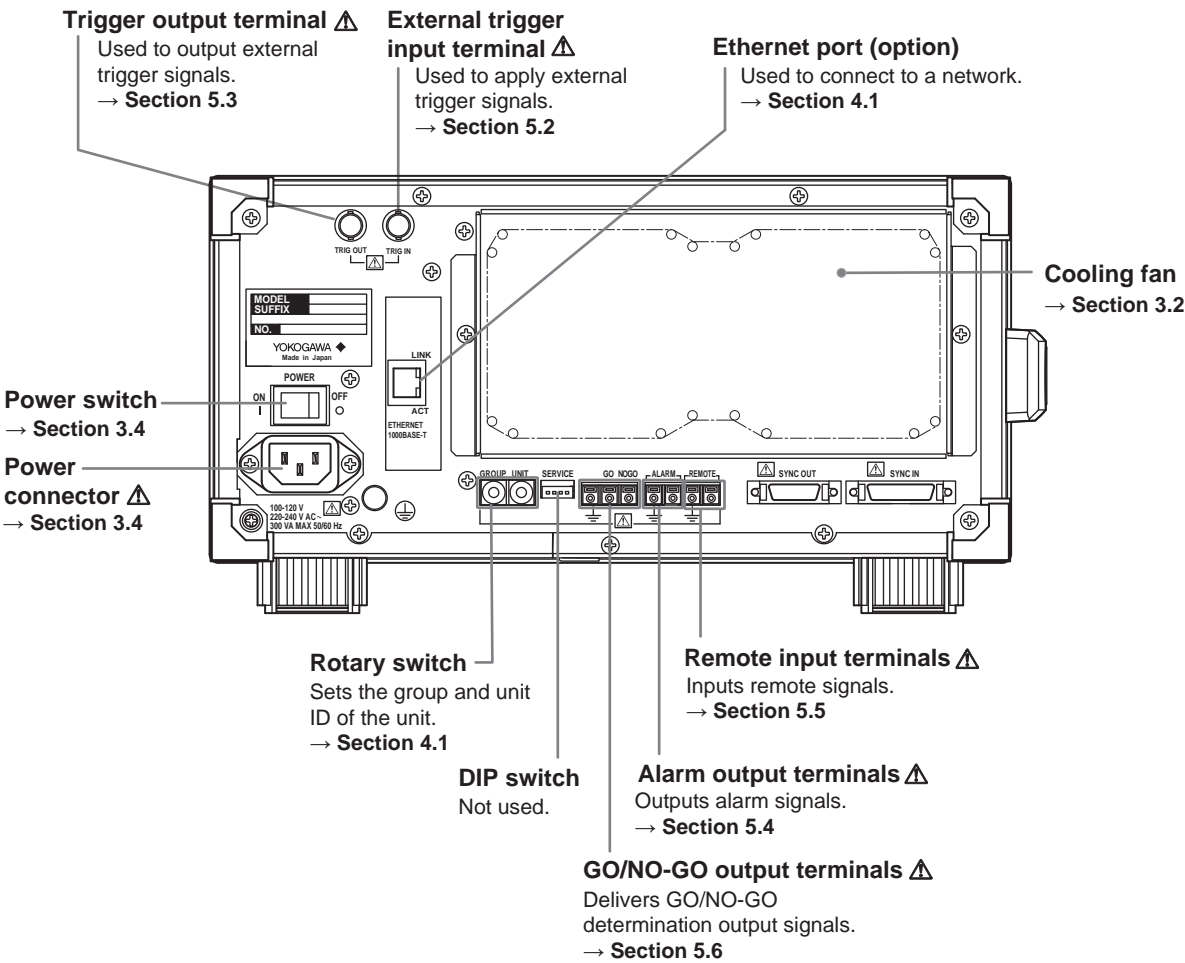
Index

1.1 Front Panel and Rear Panel

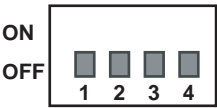
Front Panel



Rear Panel

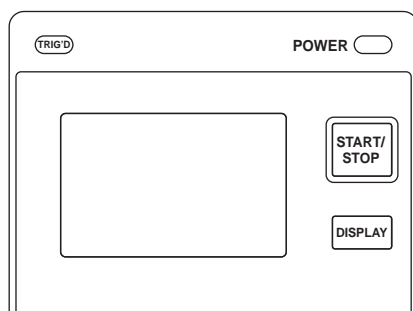


Note
Be sure to use the DIP switch at the factory default setting. If you change the setting, the SL1000 may not operate properly.



Factory default settings				
bit	1	2	3	4
Status	OFF	OFF	OFF	OFF

1.2 Keys and Indicators



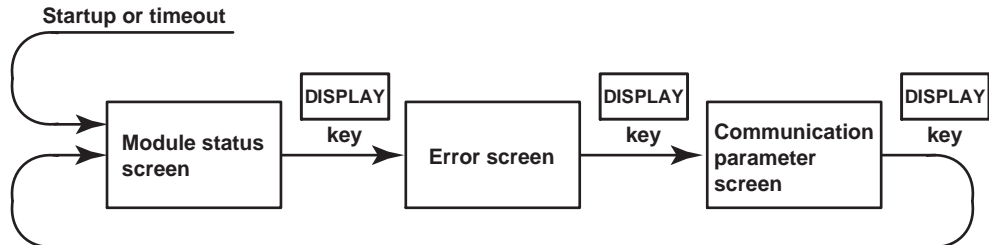
Name	Function
START/STOP key ¹	Starts or stops the measurement or measurement and recording. ³ The key illuminates while measurement is in progress. ON: Measuring OFF: Stopped
DISPLAY key ²	Switches the screen. Module status screen, system error screen, and communication parameter screen
POWER indicator	Displays the power status. ON: Power ON OFF: Power OFF
TRIG'D indicator	Indicates the trigger status. ON: Trigger activated OFF: Trigger not activated

- 1 If keys are locked, you cannot operate the keys. Hold down DISPLAY to release key lock.
- 2 You can operate the keys even when the keys are locked.
- 3 Varies depending on the specified measurement conditions.

1.3 Display

Screens

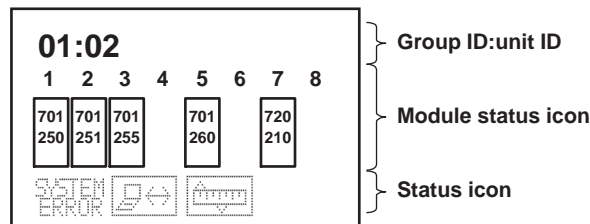
The available SL1000 screens are the module status screen, error screen, and communication parameter screen.



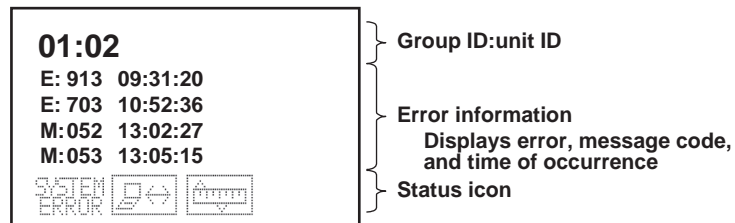
- At startup, the module status screen appears.
- Press DISPLAY to switch screens.
- If there is no key operation for 30 seconds, the screen returns to the module status screen.

Screen Description

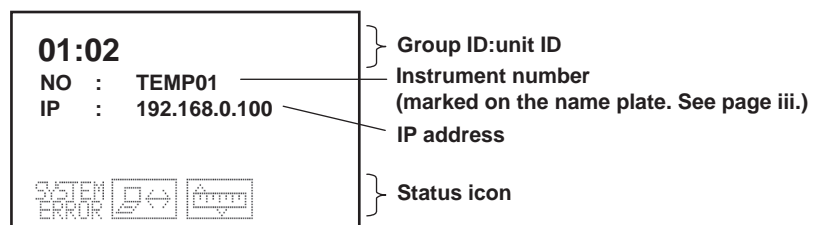
Module status screen



Error screen



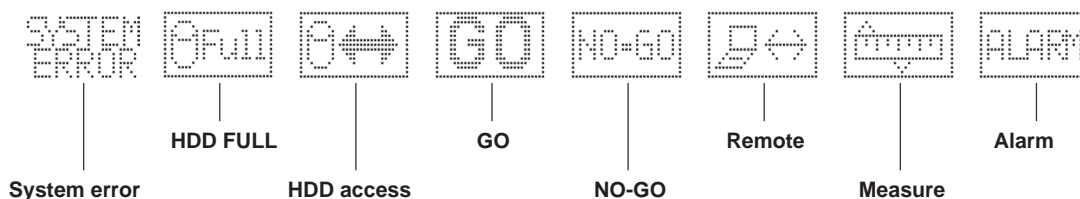
Communication parameter screen



Displayed Items	Function
Group ID	Displays the group ID of the unit that you have set using the rotary switch (GROUP) on the rear panel.
Unit ID	Displays the unit ID that you have set using the rotary switch (UNIT) on the rear panel.
Module status icon	Displays the module installation status for each slot using icons. With model display: Indicated module installed No display: No module installed
Error information	Displays an error or message code and the time of occurrence An error is indicated with "E:" before the code. A message is indicated with "M:" before the code. The time of occurrence is expressed in hour:minute:second (hh:mm:ss). Displays the most recent four errors. For details on errors and messages, see section 6.2.
Instrument No.	Displays the SL1000 unit's instrument number.
IP address	Displays the IP address setting of the SL1000.
Status icon	Indicates the SL1000 status using icons. <ul style="list-style-type: none"> • System error icon Blinking: System error status* OFF: Normal system status • HDD FULL icon Blinking: No free space on the internal hard disk OFF: Free space available on the internal hard disk • HDD access icon Blinking: Internal hard disk in access OFF: Internal hard disk not in access • GO icon ON: Delivering GO output OFF: Not delivering GO output • NO-GO icon ON: Delivering NO-GO output OFF: Not delivering NO-GO output • Remote icon ON: Remote mode OFF: Local mode • Measure icon ON: Measuring OFF: Stopped • Alarm icon ON: Delivering alarm signal OFF: Not delivering alarm signal

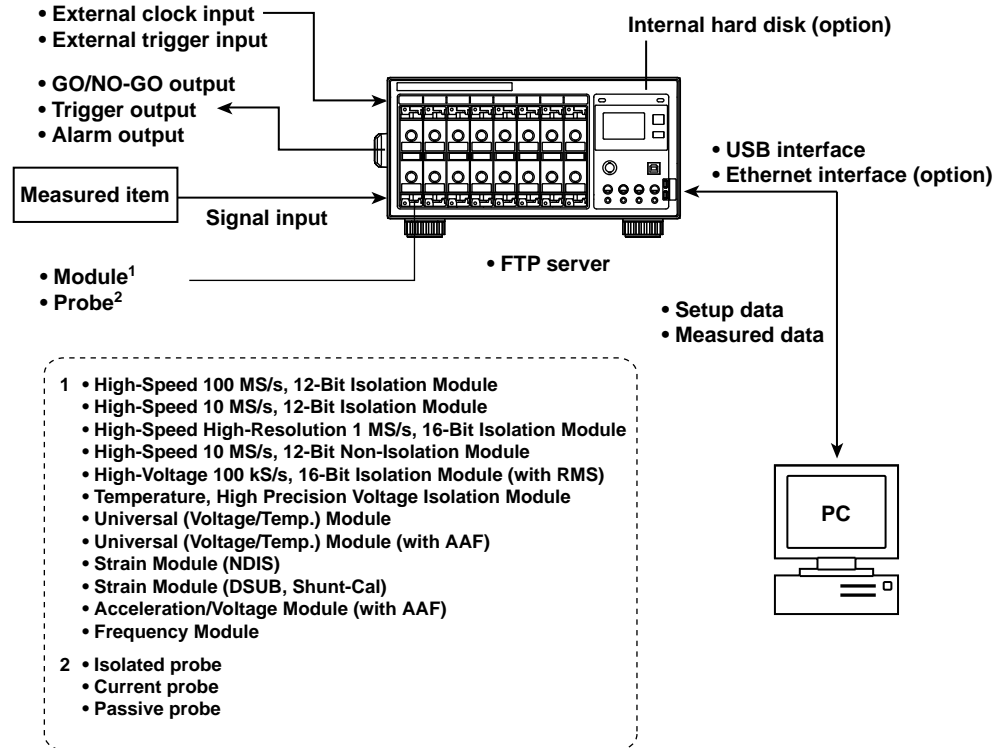
* Does not blink while an error other than a system error is occurring.

Status icon



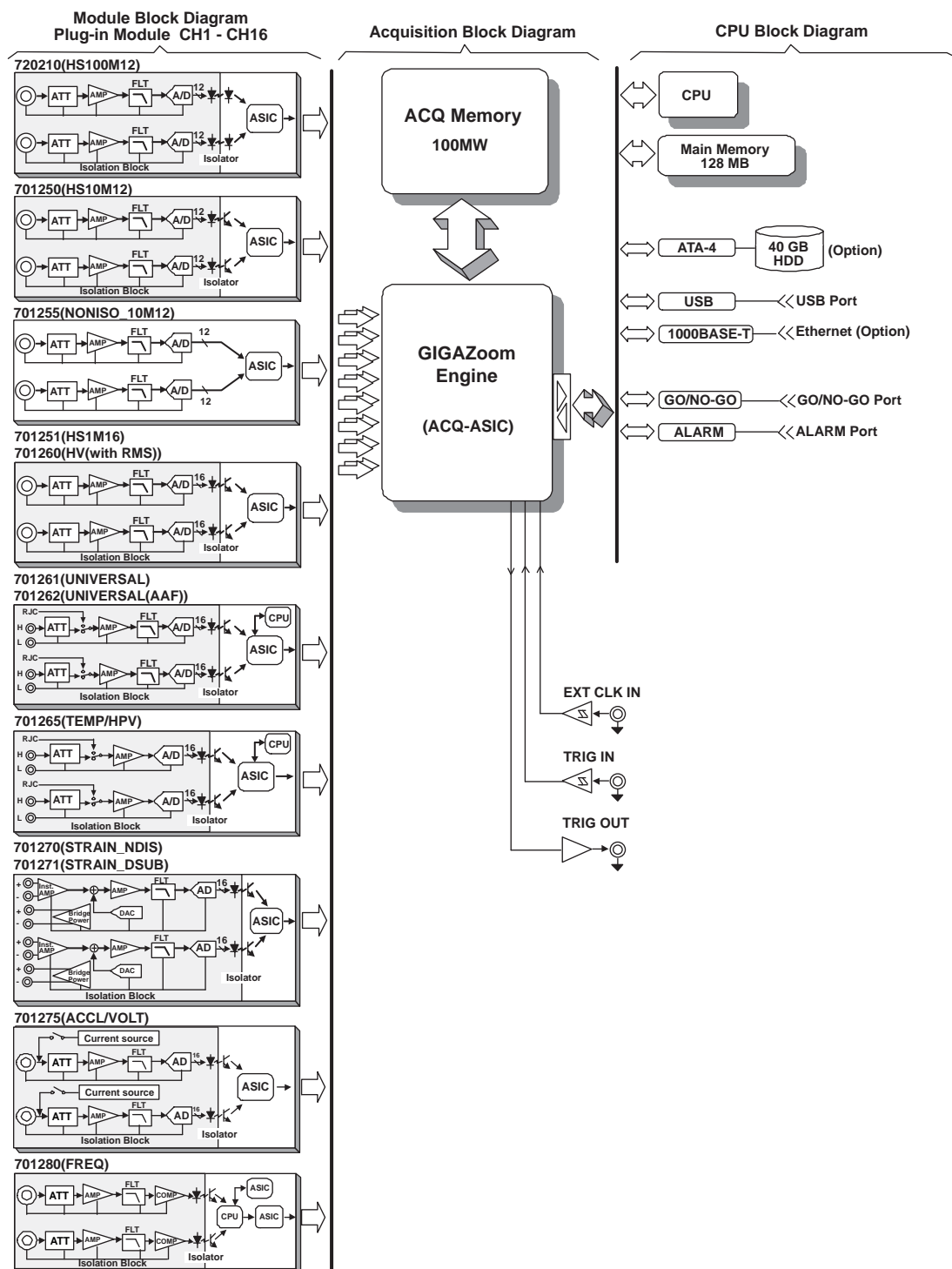
2.1 System Configuration and Block Diagram

System Configuration



2.1 System Configuration and Block Diagram

Block Diagram



Signal Flow on the SL1000

The flow of the signal applied to the input terminal varies depending on the input module. Here, the High-Speed 100 MS/s, 12-Bit Isolation Module (720210 (HS100M12)) will be used as an example to describe the signal flow. (For details on the signal flow on each module, see the block diagram.)

The signals applied to the two input terminals are first processed by the input section of each module.

The 720210 (HS100M12) attenuates or amplifies the input signal using the attenuator (ATT) and amplifier (AMP) to normalize it to a voltage level that the A/D converter can process.

Then, the filter (FLT) limits the bandwidth, and the A/D converter samples the input signal at 100 MS/s and converts the samples into digital data through quantization.

The digital data passes through the isolator and ASIC and enters the waveform processing ASIC (ACQ-ASIC).

The 16-channel digital data collected at the ACQ board passes through the waveform processing ASIC (ACQ-ASIC) and are stored in the acquisition memory (ACQ Memory). The digital data stored in the ACQ Memory is compressed by the high-speed waveform processing ASIC (ACQ-ASIC) and is transferred to a PC as waveform display data at a high data rate via the USB or Ethernet interface. If data is recorded to the hard disk in real time, the digital data stored in the ACQ Memory is transferred to the internal hard disk using a high-speed internal bus separately from the waveform display data. At the same time, the data is also transferred to a PC via the USB or Ethernet interface and stored to the PC internal hard disk.

2.2 Input Modules

The SL1000 supports the following 12 input modules.

MODEL	Name	Abbreviation
720210	High-Speed 100 MS/s, 12-Bit Isolation Module	HS100M12
701250	High-Speed 10 MS/s, 12-Bit Isolation Module	HS10M12
701251	High-Speed 1 MS/s, 16-Bit Isolation Module	HS1M16
701255	High-Speed 10 MS/s, 12-Bit Non-Isolation Module	NONISO_10M12
701260	High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS)	HV (with RMS)
701261	Universal (Voltage/Temp.) Module	UNIVERSAL
701262	Universal (Voltage/Temp.) Module (with AAF)	UNIVERSAL (AAF)
701265	Temperature, High Precision Voltage Isolation Module	TEMP/HPV
701270	Strain Module (NDIS)	STRAIN_NDIS
701271	Strain Module (DSUB, Shunt-Cal)	STRAIN_DSUB
701275	Acceleration/Voltage Module (with AAF)	ACCL/VOLT
701280	Frequency Module	FREQ

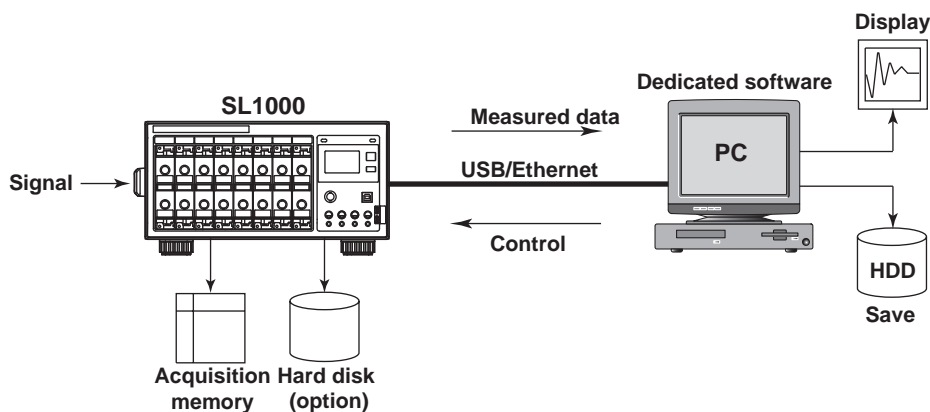
2.3 Operating Configuration

Online Operation

In this configuration, you connect the SL1000 to a PC via the USB or Ethernet (option) interface and use a dedicated software program to specify measurement conditions and carry out measurements.¹

You use a dedicated software program to start or stop measurements. The SL1000 measures and holds the data in its acquisition memory, and the PC reads it. The software shows the data on the PC display and saves it to the hard disk. The data can also be saved to the SL1000 internal hard disk (option) by configuring the settings.² If you lock the SL1000 keys using the software during online operation, the SL1000 enters Remote mode, which prohibits the SL1000 to be controlled from the front panel. You can use the dedicated software program to display and analyze the data saved to the PC.

For the operating procedures in online operation, see the *Acquisition Software User's Manual IM720120-61E*. For the procedure to display and analyze the saved data, see the *Xviewer User's Manual IM 701992-01E*.

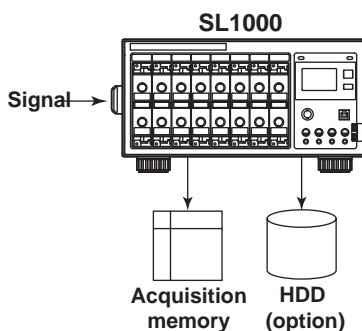


- 1 Specifying and controlling measurement conditions: Acquisition Software
Displaying and analyzing saved data: Xviewer
- 2 Waveform data, waveform parameters, and setup data can be saved to the internal hard disk.

Standalone Operation

In this configuration, you make measurements on the SL1000 without connecting it to a PC.

You start or stop measurements using the START/STOP key on the SL1000 front panel. The measured data can be stored to the SL1000 acquisition memory or saved to the internal hard disk (option). If you turn the SL1000 power OFF, the measured data stored in the acquisition memory will be lost.



2.3 Operating Configuration

Note

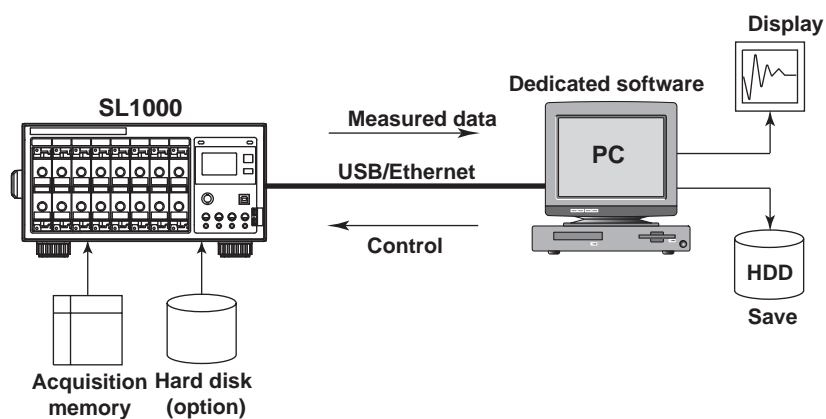
You cannot specify measurement conditions directly on the SL1000. To make measurements in the standalone configuration, specify the SL1000 measurement conditions online in advance.

In standalone configuration, you can connect the SL1000 to a PC via the USB or Ethernet (option) interface after measurements are complete and read the measured data on a PC.

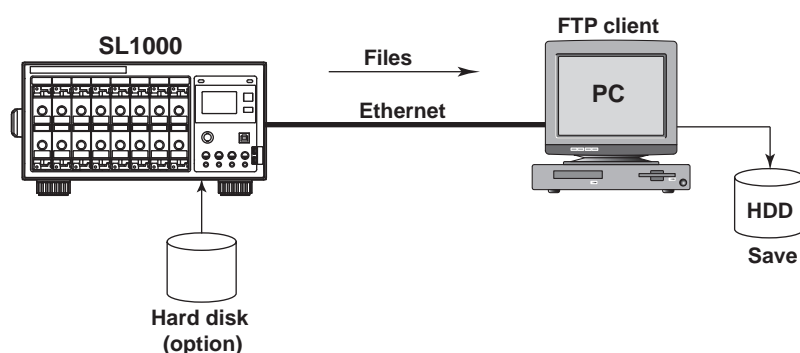
You can use the dedicated software program or an FTP connection to read the data. For the procedure to read the data using the dedicated software program and the procedure to configure an FTP server, see the *Acquisition Software User's Manual IM720120-61E*.

Method	Connection	SL1000 Readout Destination
Dedicated software	USB or Ethernet	Acquisition memory or hard disk
FTP connection	Ethernet	Hard disk

Dedicated Software



FTP Connection



3.1 Handling Precautions

Safety Precautions

If you are using this instrument for the first time, make sure to thoroughly read “Safety Precautions” on pages viii to x.

Do Not Remove the Case

Do not remove the case from the instrument. Some parts of the instrument use high voltages, which are extremely dangerous. For internal inspection and adjustment, contact your nearest YOKOGAWA dealer.

Unplug If Abnormal Behavior Occurs

If you notice any symptoms of trouble such as unusual odors or smoke coming from the instrument, immediately turn OFF the power switch and unplug the power cord. If these symptoms occur, contact your nearest YOKOGAWA dealer.

Handle the Power Cord with Care

Do not place objects on top of the power cord and keep it away from any heat sources. When unplugging the power cord from the outlet, never pull by the cord itself. Be sure to hold and pull by the plug. If the power cord is damaged, contact your dealer for replacement. Refer to page ii for the part number when placing an order.

General Handling Precautions

Do Not Place Objects on Top of the Instrument

Never place other instruments or objects containing water on top of the instrument, otherwise a breakdown may occur.

Do Not Apply Shock to the Input Section

Applying shock to the input connectors or probes may turn into electrical noise and enter the instrument via the signal lines.

Do Not Damage the LCD

Because the LCD screen is very vulnerable and can be easily scratched, do not allow any sharp objects near it. Also, it should not be exposed to vibrations and shocks.

Unplug during Extended Non-Use

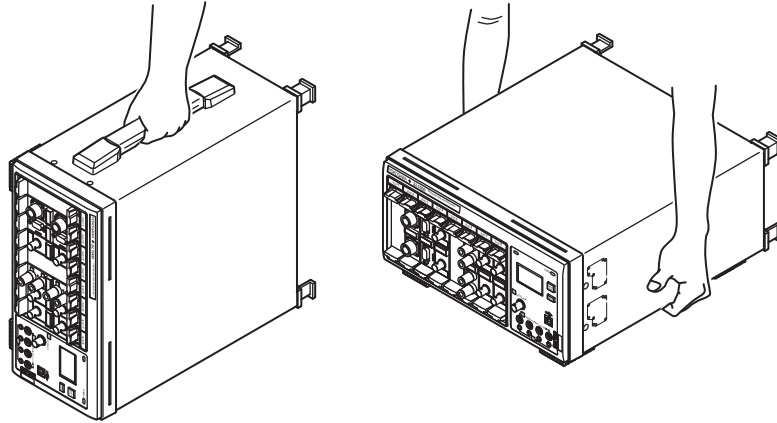
Unplug the power cord from the outlet.

3.1 Handling Precautions

Carry the Instrument Properly

First, remove the power cord and connection cables. The instrument weighs approximately 6 kg without any modules installed and 9 kg when eight modules are installed.

Carry the instrument by the handles as shown below or carry it with both hands.



Cleaning

When cleaning the case or the operation panel, first remove the power cord from the outlet. Then, wipe with a dry, soft, clean cloth. Do not use volatile chemicals such as benzene or thinner for cleaning, as this may lead to discoloration or deformation.

3.2 Installing the Instrument

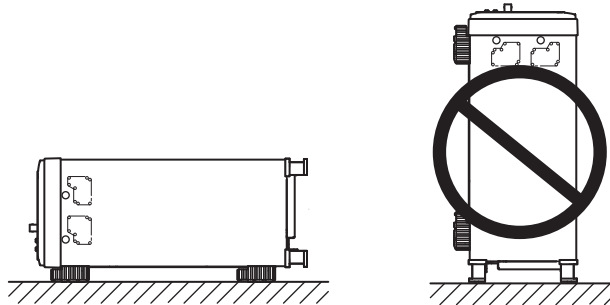
Installation Orientation



WARNING

To prevent fire, never use the instrument with the rear panel facing down. There are vent holes for the cooling fan on the rear panel. Placing the instrument with the rear panel down can cause a fire when the instrument malfunctions.

- Place the instrument in a horizontal position as shown below.
- If you are installing the instrument on a slippery surface, attach the rubber feet (two pieces) to the rear feet on the bottom panel.

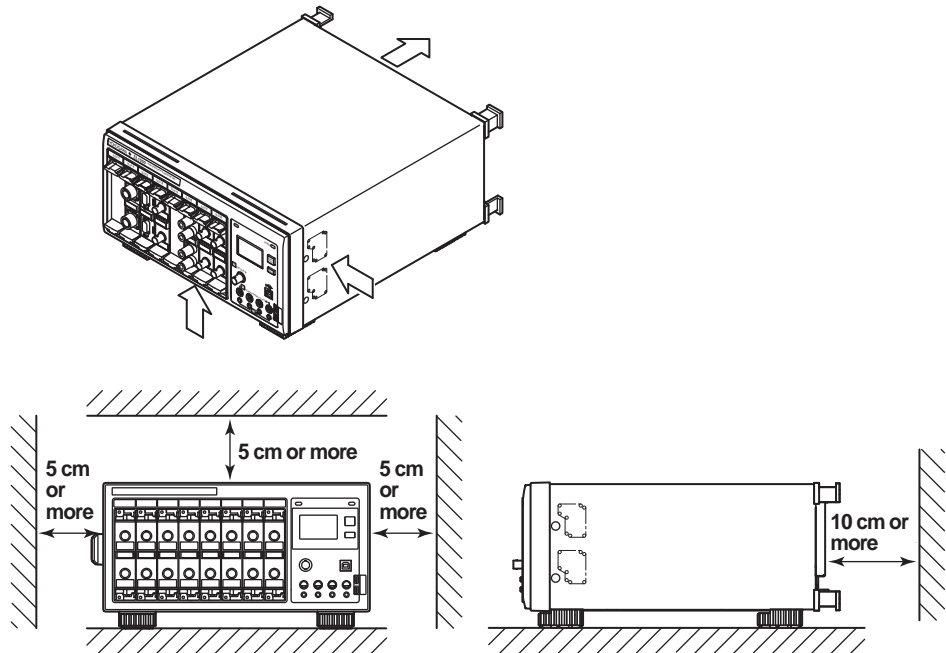


Installation Conditions

Install the instrument in a place that meets the following conditions:

Well-Ventilated Location

There are vent holds on the right and bottom panels of this instrument. In addition, there are exhaust holes for the cooling fan on the rear panel. To prevent internal overheating, allow for enough space around the instrument (see the figure below) and do not block the vent and inlet holes.



When you are installing modules or connecting cables, allow extra working space.

Ambient Temperature and Humidity

Use the instrument in the following environment.

- Ambient temperature: 5 to 40°C
- Ambient humidity: 20 to 85%RH, no condensation.

Note

- To ensure high measurement accuracy, operate the instrument in the $23 \pm 5^\circ\text{C}$ temperature range and $55 \pm 10\%$ RH.
- Condensation may occur if the instrument is moved to another place where the ambient temperature is higher, or if the temperature changes rapidly. If condensation occurs, allow the instrument adjust to the ambient temperature for at least an hour before using the instrument.

Do Not Install the Instrument in the Following Places

- In direct sunlight or near heat sources.
- Where an excessive amount of soot, steam, dust, or corrosive gas is present.
- Near strong magnetic field sources.
- Near high voltage equipment or power lines.
- Where the level of mechanical vibration is high.
- In an unstable location.

Storage Location

- We strongly recommend you store the SL1000 in an environment with a temperature between 5 and 40°C and a relative humidity between 20 to 80%RH.
- When storing the SL1000, avoid the following locations.
- In direct sunlight.
- Where the temperature is 60°C or higher.
- Where the relative humidity is 80% or more.
- Near heat sources.
- Where the level of mechanical vibration is high.
- Where corrosive or explosive gas is present.
- Where an excessive amount of soot, dust, salt, and iron are present.
- Where water, oil, or chemicals may splash.

3.3 Installing Modules



WARNING

- To prevent electric shock and damage to the instrument, make sure to turn OFF the power before installing or removing an input module.
- Check that the input cable is not connected to the input terminals before installing or removing an input module.
- To prevent electric shock and to satisfy the specifications, make sure to put the accessory cover plate on the slots that are not being used. Otherwise, dust may enter the instrument and may cause malfunction due to a rise in the internal temperature.
- If an input module happens to come out of the slot while it is in use, it may cause electric shock or cause damage to the instrument or the input module. Make sure to screw the input module in place at the two locations (top and bottom).
- Do not put your hand inside the slot, because there are protrusions along the module guide that may injure your fingers.
- Precautions to Be Taken When Using the Modules
 - Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
 - To prevent electric shock, be sure to furnish protective earth grounding of the instrument.
 - To prevent electric shock, be sure to fasten the module screws. Otherwise, the electrical protection function and the mechanical protection function will not be activated.
 - Avoid continuous connection under an environment in which the surge voltage may occur.
 - If you are measuring high voltages using the 720210 (HS100M12), 701250 (HS10M12) or the 701251 (HS1M16), use the isolated probe (700929) or 1:1 safety cable (combination of 701901 and 701954).
 - If you are using the 701255 (NONISO_10M12), be sure to fasten the module screws. Fastening the module screws activates the protection function and the non-isolation function. It is extremely dangerous if you do not fasten the screws. In addition, if you are measuring high voltage above 42 V, be sure to use the passive probe (701940).
 - The BNC part of the passive probe (701940) is made of metal. Therefore, use the probe at 42 V or less for isolated inputs (720210 (HS100M12), 701250 (HS10M12), 701251 (HS1M16), 701260 (HV (with RMS)), 701275 (ACCL/VOLT), or 701280 (FREQ)) for safety reasons. (Do not connect voltage above 42 V to both the High and Low sides.) For non-isolated inputs (701255 (NONISO_10M12), etc.), fasten the module screws as described before.
 - If you are applying high voltage using the 701260 (HV (with RMS)), use the 1:1 safety cable (combination of 701901 and 701954) or the isolated probe (700929).
 - The measurement category of the 701260 (HV (with RMS)) is 400V-CAT II for the low side and 700V-CAT II for the high side. Use caution because the overvoltage tolerance differs between the low and high sides.
 - If you are applying high voltage to the 701280 (FREQ), use the isolated probe (700929).

Types of Input Modules

The following 12 input modules are available.

- High-Speed 100 MS/s, 12-Bit Isolation Module: 720210 (HS100M12)
- High-Speed 10 MS/s, 12-Bit Isolation Module: 701250 (HS10M12)
- High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module: 701251 (HS1M16)
- High-Speed 10 MS/s, 12-Bit Non-Isolation Module: 701255 (NONISO_10M12)
- High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS): 701260 (HV (with RMS))
- Universal (Voltage/Temp.) Module: 701261 (UNIVERSAL)
- Universal (Voltage/Temp.) Module (with AAF): 701262 (UNIVERSAL (AAF))
- Temperature, High Precision Voltage Isolation Module: 701265 (TEMP/HPV)
- Strain Module (NDIS): 701270 (STRAIN_NDIS)
- Strain Module (DSUB, Shunt-Cal): 701271 (STRAIN_DSUB)
- Acceleration/Voltage Module (with AAF): 701275 (ACCL/VOLT)
- Frequency Module: 701280 (FREQ)

Precautions to Be Taken When Installing or Removing Input Modules

Switching the installed input module with a different module and turning ON the power initializes the settings on that channel. If you want to save the settings, use the SL1000 Acquisition Software to specify the save destination medium and save the settings. For details, see section 8.2 in the *Acquisition Software User's Manual IM720120-61E*.

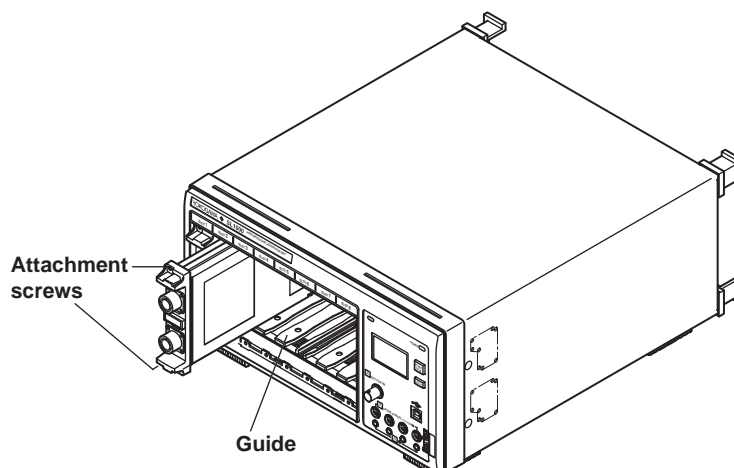


CAUTION

Insert or remove an input module along the guide straight and slowly. Inserting or removing a module at an angle can cause failure and damage.

Installation Procedure of Modules

1. Check that the power switch on the rear panel of the instrument is OFF.
2. Check the slot number indicated above the slots for installing the input modules on the front panel of the instrument. Then, install the module along the guide. Holding the handles on the top and bottom of the input module, press firmly until it clicks in place. If there is a cover plate on the slot in which to install the module, remove the cover plate, first.
3. Make sure to screw the two locations, top and bottom, of the input module firmly into place (screw tightening torque: 60 N•cm).



Removal Procedure of Modules

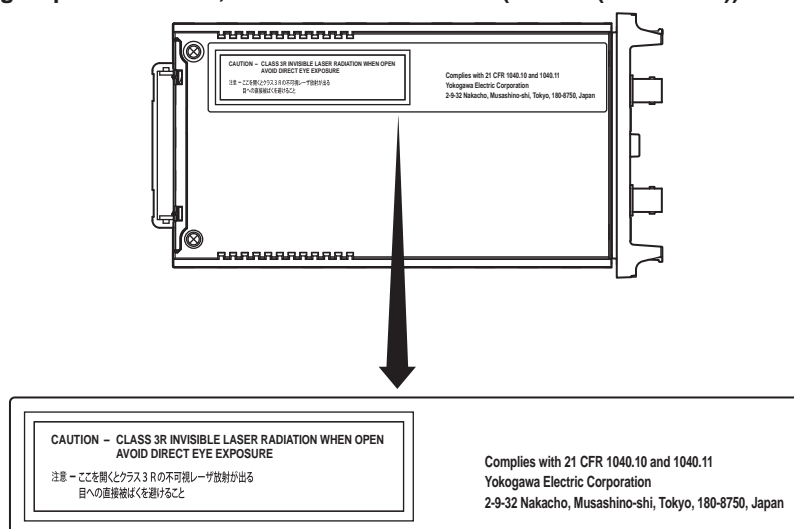
1. Check that the power switch is OFF.
2. Loosen the two screws holding the input module in place.
3. Holding the handles on the top and bottom of the input module, pull out the module.

About the High-Speed 100 MS/s, 12-Bit Isolation Module

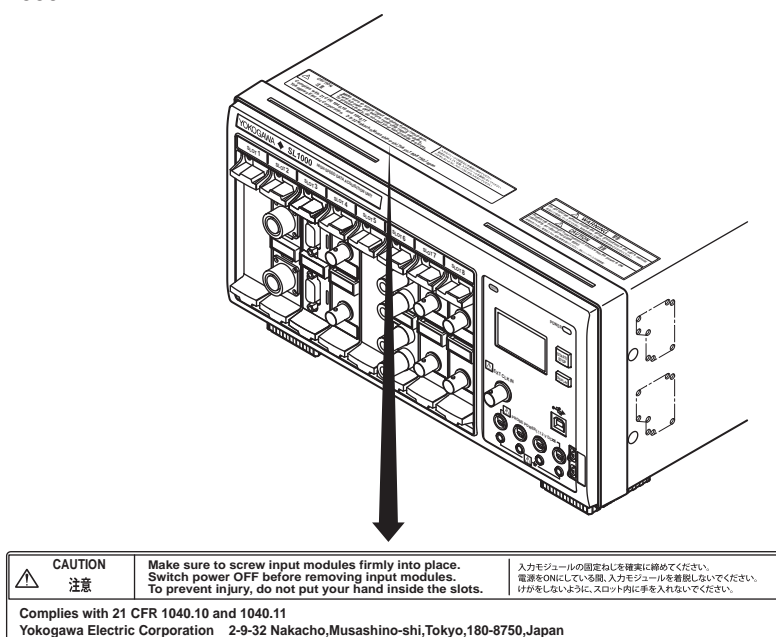
Safety Precautions for Laser Products

The High-Speed 100 MS/s, 12-Bit Isolation Module (720210 (HS100M12)) has a laser light source on the inside. The 720210 (HS100M12) is a Class 1 laser product as defined by IEC60825-1:2001 Safety of Laser Products-Part 1: Equipment Classification, Requirements and User's Guide.

High-Speed 100 MS/s, 12-Bit Isolation Module (720210 (HS100M12))



SL1000



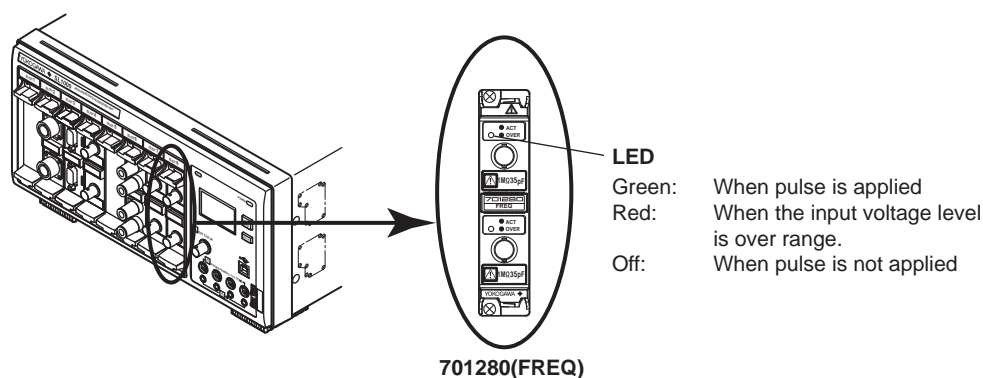
Laser Specifications

Center wavelength: 850 nm
 PULSE width: ≤ 10 ms (100 MHz), ≤ 2.5 ns (2 GHz)
 Output: ≤ 1 mW

If you use the instrument in a manner not specified in this manual, the protection provided by the instrument may be impaired. Yokogawa Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

LEDs on the Frequency Module

On the front panel of the frequency module (701280 (FREQ)) are LEDs for each channel. These LEDs allow you to check the input condition of the pulse.

**Note**

- The LEDs on the frequency module illuminate in green when pulse is applied and red when the input voltage level is over range. It is independent of the start/stop condition of the waveform acquisition of the SL1000.
- If the frequency module preset (see the *Acquisition Software User's Manual IM720120-61E*) is set to "EM Pickup (electromagnetic pickup)," the LED does not illuminate in red even if the input voltage level is over range.

3.4 Connecting the Power Supply

Before Connecting the Power Supply

Make sure that you observe the following points before connecting the power. Failure to do so may cause electric shock or damage to the instrument.



WARNING

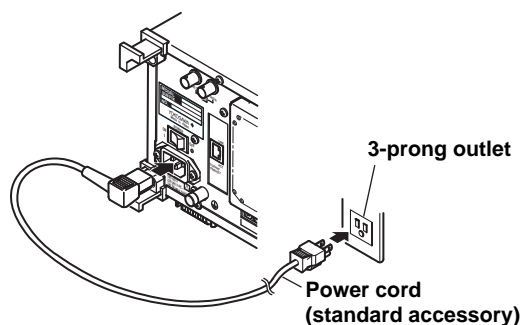
- Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.
- Make sure that the power switch of the instrument is turned OFF before connecting the power cord.
- To prevent electric shock or fire, be sure to use the power cord for the instrument that is supplied by YOKOGAWA.
- Make sure to connect protective earth grounding to prevent electric shock. Connect the power cord to a three-prong power outlet with a protective earth terminal.
- Do not use an extension cord without protective earth ground. The protective features of the instrument will be rendered ineffective.
- If an AC outlet that matches the power cord provided is unavailable and protective grounding cannot be furnished, do not use the instrument.

Connecting the Power Cord

1. Check that the power switch on the rear panel is OFF.
2. Connect the power cord plug to the power connector on the rear panel.
3. Connect the plug on the other end of the power cord to the outlet that meets the conditions below. The AC outlet must be of a three-prong type with a protective earth ground terminal.

Item	
Rated supply voltage*	100 to 120 VAC or 220 to 240 VAC (automatic switching)
Permitted supply voltage range	90 to 132 VAC, 198 to 264 VAC
Rated power supply frequency	50/60 Hz
Permitted power supply frequency range	48 to 63 Hz
Maximum power consumption	Approx. 300 VA

* The instrument can use a 100-V or a 200-V system for the power supply. The maximum rated voltage of the power cord varies depending on its type. Check that the voltage supplied to the instrument is less than or equal to the maximum rated voltage of the provided power cord (see page iii) before using it.



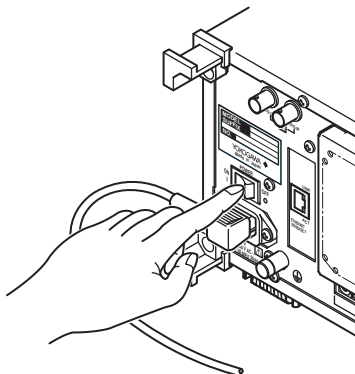
Turn ON the Power Switch

Items to Be Checked before Turning ON the Power

- Check that the instrument is properly installed. For details, see section 3.2, "Installing the Instrument."
- Check that the power cord is properly connected. For details, see the previous page.

Turn ON the Power Switch

1. Press the ON (I) side of the power switch on the rear panel.



Turning OFF the Power Switch

CAUTION

If you suddenly turn OFF the power switch or remove the power cord while data is being saved, the save destination medium (internal hard disk) may break. The contents of the data being saved may also be corrupt. Be sure to turn OFF the power switch after the data save operation is complete.

Turning OFF the Power Switch

1. Press the OFF (O) side of the power switch on the rear panel.

Power Up Operation

Self-test and calibration start automatically when the power switch is turned ON. This procedure takes approximately 30 seconds. If the procedure completes successfully, the module status display appears.

Note

- Allow at least 10 seconds after you turn the power switch OFF to turn it back ON.
- If self-test and calibration do not start when the power is turned ON or if the normal module status display does not appear, turn OFF the power switch and check the following items.
 - Check that the power cord is securely connected.
 - Check that the correct voltage is being supplied from the AC outlet. (See the previous page.)

If the instrument still fails to power up after checking these items, contact your nearest YOKOGAWA dealer for repairs.

To Make Accurate Measurements

- Allow the instrument to warm up for at least 30 minutes after turning ON the power switch.
- After warm-up, calibrate the instrument (see the *Acquisition Software User's Manual IM720120-61E*). If auto calibration is turned ON, the calibration starts automatically at the start of waveform acquisition.

Power Down Operation

The settings that exist immediately before the power switch is turned OFF are saved. The instrument powers up using those settings the next time the power switch is turned ON.

Note

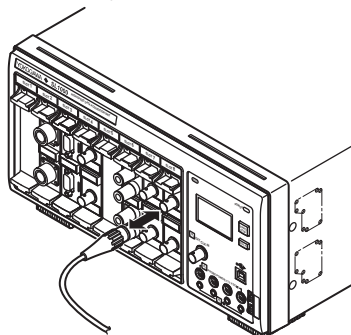
The settings are stored using an internal lithium battery. The battery lasts for approximately 5 years if it is used at an ambient temperature of 23°C. The user cannot replace the battery. Contact your nearest YOKOGAWA dealer to have the battery replaced.

3.5 Connecting the Probes

Connecting the Probe

Connect the probes (or other input cables such as BNC cables) to any of the input terminals of the modules below. The input impedance is $1\text{ M}\Omega \pm 1\%$ and approximately 35 pF.

- High-Speed 100 MS/s, 12-Bit Isolation Module: 720210 (HS100M12)
- High-Speed 10 MS/s, 12-Bit Isolation Module: 701250 (HS10M12)
- High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module:
701251 (HS1M16)
- High-Speed 10 MS/s, 12-Bit Non-Isolation Module: 701255 (NONISO_10M12)
- High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS):
701260 (HV (with RMS))
- Acceleration/Voltage Module (with AAF): 701275 (ACCL/VOLT)
- Frequency Module: 701280 (FREQ)



WARNING

- When connecting an item to be measured to the SL1000, be sure to turn OFF the power to the item. Connecting or disconnecting the measuring lead while the item being measured is turned ON is very dangerous.
- Precautions to Be Taken When Using the Modules
 - Do not apply input voltage exceeding the maximum input voltage, withstand voltage, or allowable surge voltage.
 - To prevent electric shock, be sure to furnish protective earth grounding of the instrument.
 - To prevent electric shock, be sure to fasten the module screws. Otherwise, the electrical protection function and the mechanical protection function will not be activated.
 - Avoid continuous connection under an environment in which the surge voltage may occur.
 - Be careful not to exceed the maximum input voltage of a module in the following cases.
 - When the probe attenuation is 1:1.
 - When the module input coupling is set to AC.
 A DC voltage at the same electric potential as the probe input is applied to the module input.
 - Use only the specified cables. Using cables that do not meet the safety specifications is extremely dangerous (especially when using high voltages (42 V or higher)).

3.5 Connecting the Probes

- If you are measuring high voltages using the 720210 (HS100M12), 701250 (HS10M12) or the 701251 (HS1M16), use the isolated probe (700929) or 1:1 safety cable (combination of 701901 and 701954).
 - If you are applying high voltage using the 701260 (HV (with RMS)), use the 1:1 safety cable (combination of 701901 and 701954) or the isolated probe (700929).
 - The BNC part of the passive probe (701940) is made of metal. Therefore, use the probe at 42 V or less for isolated inputs (720210 (HS100M12), 701250 (HS10M12), 701251 (HS1M16), 701260 (HV (with RMS)), 701275 (ACCL/VOLT), or 701280 (FREQ)) for safety reasons. (Do not connect voltage above 42 V to both the High and Low sides.) For non-isolated inputs (701255 (NONISO_10M12), etc.), fasten the module screws.
 - The measurement category of the 701260 (HV (with RMS)) is 400V-CAT II for the low side and 700V-CAT II for the high side. Use caution because the overvoltage tolerance differs between the low and high sides.
 - If you are applying high voltage to the 701280 (FREQ), use the isolated probe (700929).
-
- Applying a voltage exceeding the value indicated below may damage the input section. If the frequency is above 1 kHz, the input section may be damaged even if the voltage is less than the indicated values.
- 720210 (HS100M12)
Maximum input voltage (at a frequency of 1 kHz or less)
 - Combined with the isolated probe 700929 (10:1)¹
1000 V (DC+ACpeak)
 - Safety cable (1:1) (combined with 701901+701954)⁵ or direct input⁹
200 V (DC+ACpeak)Maximum allowable common mode voltage (at a frequency of 1 kHz or less)
 - Combined with the isolated probe 700929 (10:1)²
Or safety cable (1:1) (combined with 701901+701954)⁸
1000 Vrms (CAT II)
 - Direct input¹⁰
42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)
 - 701250 (HS10M12)
Maximum input voltage (at a frequency of 1 kHz or less)
 - Combined with the isolated probe 700929 (10:1)¹
600 V (DC+ACpeak)
 - Safety cable (1:1) (combined with 701901+701954)⁵ or direct input⁹
250 V (DC+ACpeak)Maximum allowable common mode voltage (at a frequency of 1 kHz or less)
 - Combined with the isolated probe 700929 (10:1)²
Or safety cable (1:1) (combined with 701901+701954)⁸
400 Vrms (CAT I), 300 Vrms (CAT II)
 - Direct input¹⁰
42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)

- 701251 (HS1M16)

Maximum input voltage (at a frequency of 1 kHz or less)

 - Combined with the isolated probe 700929 (10:1)¹
600 V (DC+ACpeak)
 - Safety cable (1:1) (combined with 701901+701954)⁵ or direct input⁹
140 V (DC+ACpeak)

Maximum allowable common mode voltage (at a frequency of 1 kHz or less)

 - Combined with the isolated probe 700929 (10:1)²
Or safety cable (1:1) (combined with 701901+701954)⁸
400 Vrms (CAT I), 300 Vrms (CAT II)
 - Direct input¹⁰
42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)
- 701255 (NONISO_10M12)

This module is non-isolated. Be sure to fasten the module screws when measuring a voltage above 42 V on this module. In addition, use the dedicated 701940 non-isolated passive probe (10:1).

Maximum input voltage (at a frequency of 1 kHz or less)

 - Combined with the 701940 passive probe (10:1)
600 V (DC+ACpeak)
 - Direct input⁹
250 V (DC+ACpeak)
- 701260 (HV (with RMS))

Maximum input voltage (at a frequency of 1 kHz or less)

 - Combined with the isolated probe 700929 (10:1)¹
1000 V (DC+ACpeak)
 - Safety cable (1:1) (combined with 701901+701954)⁵ or direct input⁹
850 V (DC+ACpeak)

Maximum allowable common mode voltage (at a frequency of 1 kHz or less)

 - Combined with the 700929 isolated probe (10:1)
1000 Vrms (CAT II) on the H side³, 400 Vrms (CAT II) on the L side⁴
 - Safety cable (1:1) (combined with 701901+701954)
700 Vrms (CAT II) on the H side⁶, 400 Vrms (CAT II) on the L side⁷
 - Direct input¹⁰
30 Vrms (42 VDC + ACpeak) (CAT I or CAT II)
- 701275 (ACCL/VOLT)

Maximum input voltage (at a frequency of 1 kHz or less)

 - Combined with the 701940 passive probe (10:1)¹¹ or direct input⁹
42 V (DC+ACpeak)

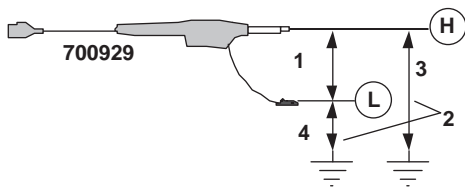
Maximum allowable common mode voltage (at a frequency of 1 kHz or less)

 - Combined with the 701940 passive probe (10:1)¹² or direct input¹⁰
30 Vrms (CAT I and CAT II)

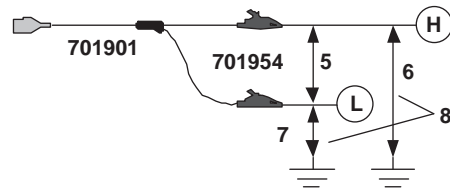
3.5 Connecting the Probes

- 701280 (FREQ)
Maximum input voltage (at a frequency of 1 kHz or less)
 - Combined with the isolated probe 700929 (10:1)¹
420 V (DC+ACpeak)
 - Safety cable (1:1) (combined with 701901+701954)⁵ or direct input⁹
42 V (DC+ACpeak)Maximum allowable common mode voltage (at a frequency of 1 kHz or less)
 - Combined with the isolated probe 700929 (10:1)²
300 Vrms (CAT I and CAT II)
 - Safety cable (1:1) (combined with 701901+701954)⁸ or direct input¹⁰
30 Vrms (CAT I and CAT II)

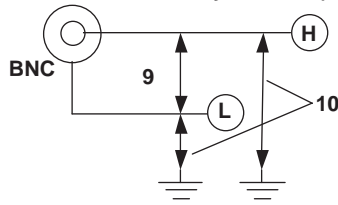
Combined with the 700929



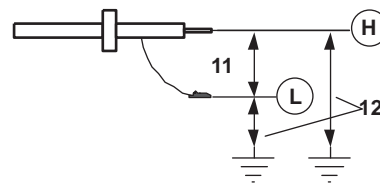
Combined with the 701901+701954



Direct input (cable not complying with the safety standard)



Combined with the 10:1 passive probe (701940)



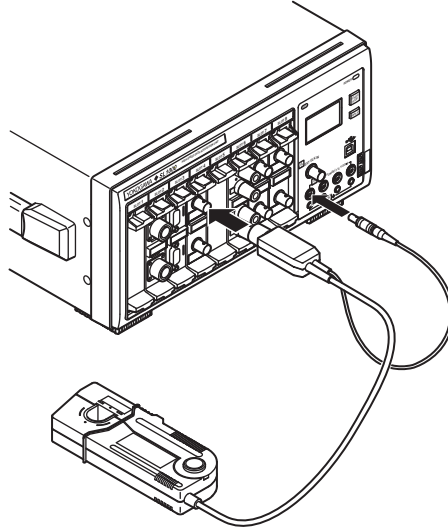
Precautions to Be Taken When Connecting the Cable

- When connecting a probe to the instrument for the first time, perform phase correction of the probe as described in section 3.6, "Compensating the Probe (Phase Correction)." Otherwise, the gain across different frequencies will not be constant, and measurements will not be correct. Perform the phase correction for each channel to which a probe is to be connected.
- You cannot perform phase correction of the probe on the frequency module (701280 (FREQ)). Perform phase correction of the probe on another module before connecting the probe to the 701280 (FREQ).
- If the object to be measured is connected to the instrument directly, without using a probe, correct measurement cannot be performed due to the input impedance.
- If using a voltage probe other than the isolated probe (700929), correct measured values cannot be displayed if the probe's attenuation is not 1:1, 10:1, 100:1, or 1000:1.

Connecting a Current Probe (701930, 701931, or 701933)

If you are using a YOKOGAWA's current probe (701930, 701931, or 701933), use the probe power supply (option) on the front panel or a probe power supply sold separately (701934) to supply power to the probe.

For details on the connection procedure, see the manual that comes with each probe.

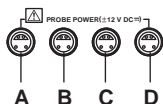
**CAUTION**

Use the probe power supply (option) on the front panel of the SL1000 only to supply power to the current probes (701930, 701931, or 701933). Also, be sure to use only the number of probes allowed. Otherwise, the SL1000 or the device connected to the probe power supply terminal may break.

3.5 Connecting the Probes

Precautions to Be Taken When Using the Current Probe (701930, 701931, or 701933)

When connecting the current probe to the probe power supply terminal (option) on the front panel, make sure that the current does not exceed the range shown below. Otherwise, the SL1000 operation may become unstable due to the activation of the excessive current protection circuit of the power supply.

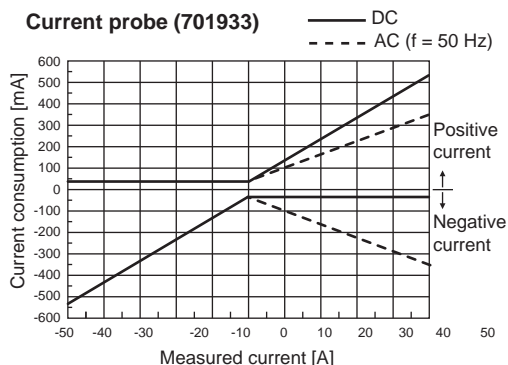
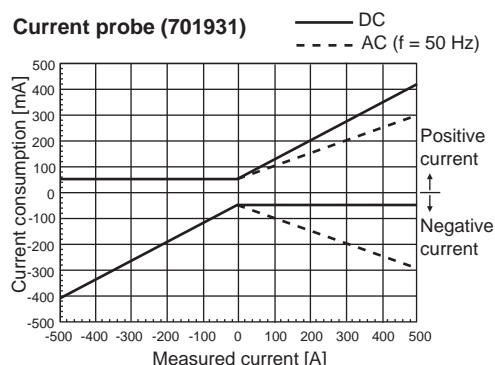
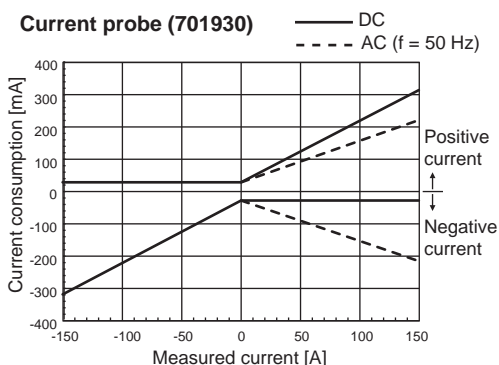


When each terminal is assigned names A through D
(Total current consumption by A through D) < 1300 mA

Specifications of the Probe Power Supply (Option)

Item	Specifications
Number of probes that can be used	4
Compatible probes	Current probe (701930, 701931, or 701933)
Number of current probes that can be used	701930 (150 A): 4 701931 (500 A): 3 701933 (30 A): 2
Supplied voltage	±12 V 2 outputs (up to a total of 1300 mA)

When using current probes, the number of probes that can be used is limited by the current that runs through the device under measurement (current measured by the current probe). The characteristics of the measured current versus the current consumption of a current probe that can be connected to the SL1000 are shown below.



For details on the usage conditions of each probe, see “Relationship between the current being measured and probe’s current consumption” on the following Web page.

<http://www.yokogawa.co.jp/tm/Bu/probe/>

3.6 Compensating the Probe (Phase Correction)

When making measurements using a probe on the following modules, be sure to perform phase correction of the probe first.

- High-Speed 100 MS/s, 12-Bit Isolation Module: 720210 (HS100M12)
- High-Speed 10 MS/s, 12-Bit Isolation Module: 701250 (HS10M12)
- High-Speed High-Resolution 1 MS/s, 16-Bit Isolation Module: 701251 (HS1M16)
- High-Speed 10 MS/s, 12-Bit Non-Isolation Module: 701255 (NONISO_10M12)
- High-Voltage 100 kS/s, 16-Bit Isolation Module (with RMS): 701260 (HV (with RMS))
- Acceleration/Voltage Module (with AAF): 701275 (ACCL/VOLT)
- Frequency Module: 701280 (FREQ)

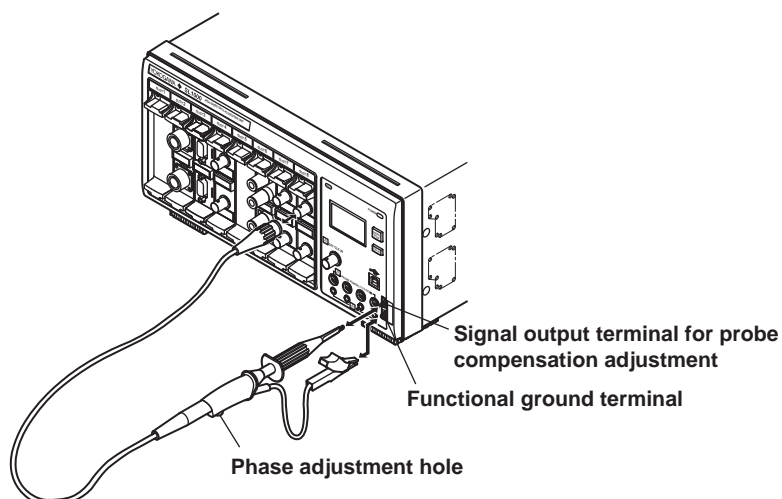


CAUTION

Do not apply external voltage to the probe compensation signal output terminal, as it may damage the internal circuit.

Procedure

1. Turn ON the power switch.
2. Connect the probe to the input terminal to which the signal is to be applied.
3. Connect the probe's tip to the probe compensation signal output terminal on the front panel and connect the earth wire to the functional earth terminal.
4. Insert a flat-blade screwdriver to the phase correction hole and turn the variable capacitor to make the displayed waveform a correct rectangular wave.



Explanation

Why Phase Correction of the Probe Is Necessary

The probe comes with its phase corrected approximately to match the input capacitance of the relevant measuring instrument. However, there is some error in the input resistance and input capacitance of each input channel of individual measuring instruments. This results in a mismatch in the voltage divider ratio between low and high frequency signals and causes uneven frequency characteristics.

The probe is equipped with a variable capacitor used to adjust the voltage divider ratio (trimmer) for high frequency signals. This trimmer is used to correct the phase so that even frequency characteristics are obtained.

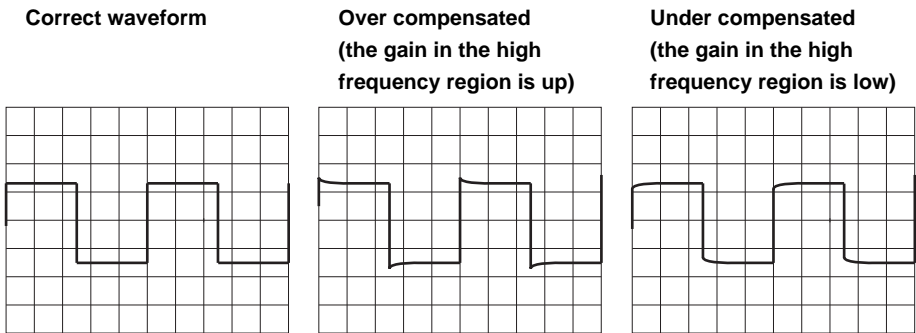
When using a probe for the first time, make sure to perform phase correction. Because the input capacitance varies on each channel, probe compensation is also required when the probe is switched from one channel to another.

Phase Compensation Signal

The probe compensation signal output terminal delivers the following rectangular wave signal.

Frequency: Approx. 1 kHz
Amplitude: Approx. 1 V

Differences in the Waveform Caused by the Phase Correction of the Probe



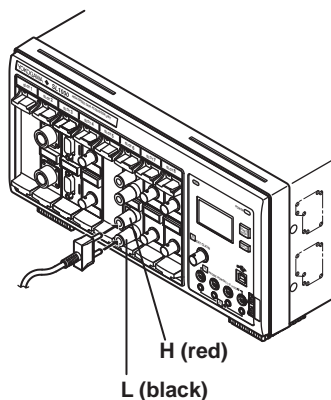
Precautions to Be Taken When Using a Probe on the Frequency Module (701280 (FREQ))

You cannot perform phase correction of the probe on the frequency module. Perform phase correction of the probe on another module before connecting the probe to the frequency module for use.

3.7 Connecting Measuring Leads

Connecting Measurement Leads

If measuring the voltage on the 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV), connect the measurement leads of a bipolar banana plug terminal to the input terminal (binding post terminal) as shown below.



WARNING

- When connecting an item to be measured to the SL1000, be sure to turn OFF the power to the item. Connecting or disconnecting the measuring lead while the item being measured is turned ON is very dangerous.
- To prevent electric shock, make sure to use a measurement lead suitable for the voltage range being measured on the input terminals of the 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV).
- Applying a voltage exceeding the value indicated below may damage the input section. If the frequency is above 1 kHz, the input section may be damaged even if the voltage is less than the indicated values.

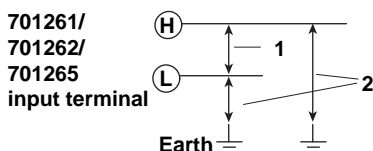
701261, 701262, and 701265

Maximum input voltage (across the input terminals, H and L,¹ at a frequency of 1 kHz or less)

42 V (DC+ACpeak)

Maximum allowable common mode voltage (across the input terminals, H or L, and earth,² at a frequency of 1 kHz or less)

42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)

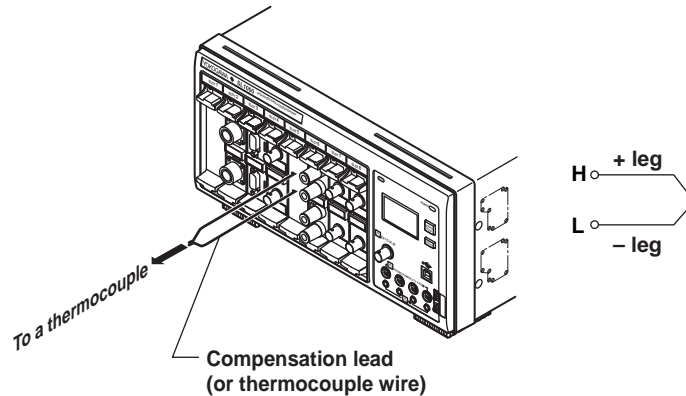


- If a measurement lead comes loose from a module's connector, do not touch the measurement lead terminal. Doing so can cause electric shock. If a measurement lead comes loose, turn OFF the device under measurement.

3.8 Connecting Thermocouples

Connecting a Thermocouple

To connect the compensation lead of the thermocouple to the input terminal (binding post terminal) of the 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV), loosen the terminal knob, pass the lead through the terminal, and tighten the knob.



CAUTION

- The 701261 (UNIVERSAL), 701262 (UNIVERSAL (AAF)), or 701265 (TEMP/HPV) is isolated from the SL1000. However, applying a voltage exceeding the value below may damage the input section. If the frequency is above 1 kHz, the input section may be damaged even if the voltage is less than the indicated values.
Maximum input voltage (across the input terminals, H and L, at a frequency of 1 kHz or less)
42 V (DC+ACpeak)
Maximum allowable common mode voltage (across the input terminal L and earth at a frequency of 1 kHz or less)
42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)
- Correct measurements cannot be made if the positive and negative legs of the thermocouple are reversed.
- Immediately after connecting the thermocouple, the heat balance may be disturbed at the input terminal section and may cause measurement errors. Therefore, wait about 10 minutes before making a measurement.
- In an environment where the air from the air conditioning is directly applied to the input terminals or where there are effects from a heat source, the heat balance may be disturbed at the input terminal section and cause measurement errors. When making measurements in this type of environment, take preventive measures such as changing the position.

3.9 Connecting a Bridge Head

Strain is measured by connecting a strain gauge bridge (bridge head) or a strain gauge transducer to the strain module (701270 (STRAIN_NDIS) or 701271 (STRAIN_DSUB)). This section will mainly describe the procedures and precautions related to the connection of the bridge head (Model 701955/701956/701957/701958). For the connection of other strain gauge bridges or strain gauge transducers, see the respective manuals.

CAUTION

Only connect a strain gauge bridge (bridge head) or a strain gauge transducer to the strain module. Connecting other devices or applying a voltage that exceeds the values indicated below to the strain module may damage the input section.

- Maximum input voltage (between Input+ and Input-)
 - 10 V (DC+ACpeak)
- Maximum allowable common mode voltage (between each terminal and earth ground)
 - 42 V (DC+ACpeak) (CAT I and CAT II, 30 Vrms)

Connecting the Strain Gauge

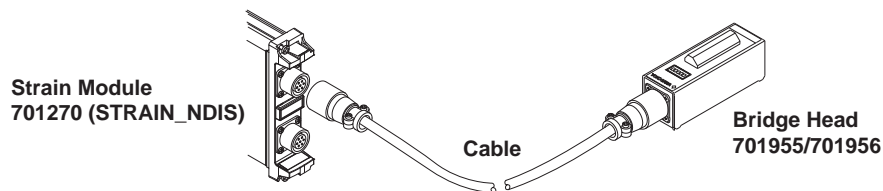
The bridge head (701955/701956/701957/701958) supports six types of connection methods: single-gauge method, single-gauge three-wire method, adjacent-side two-gauge method, opposite-side two-gauge method, opposite-side two-gauge three-wire method, and four-gauge method. For details, see the manual that comes with the bridge head (701955/701956/701957/701958).

If you are using a strain gauge bridge or a strain gauge transducer other than the bridge head (701955/701956/701957/701958), see the respective manuals.

Connecting the Strain Module and the Bridge Head

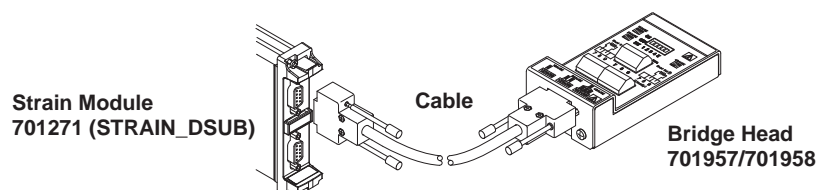
When Using the Strain Module (701270) and the Bridge Head (701955/701956)

Connect the bridge head to the 701270 (STRAIN_NDIS) using the cable that comes with the bridge head (701955/701956).



When Using the Strain Module (701271) and the Bridge Head (701957/701958)

Connect the bridge head to the 701271 (STRAIN_DSUB) using the cable that comes with the bridge head (701957/701958).

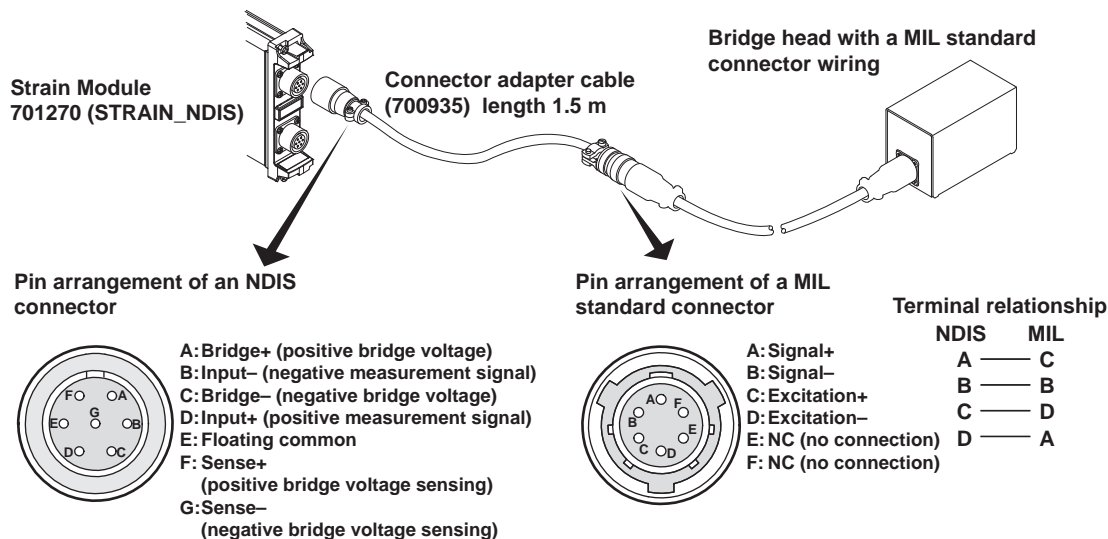


3.9 Connecting a Bridge Head

If Using a Bridge Head with a MIL Standard (MIL-C-26482) Connector Wiring

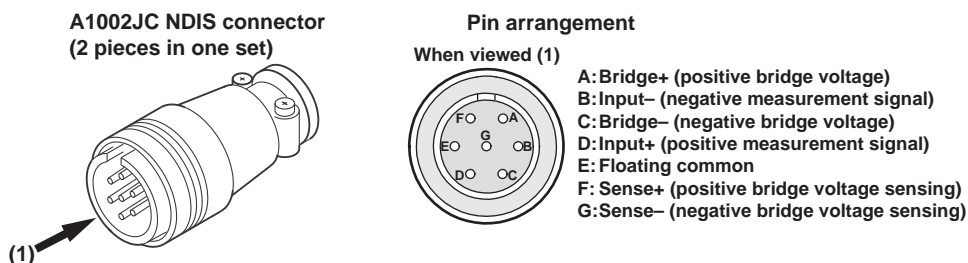
The connector on the 701270 (STRAIN_NDIS) is an NDIS connector.* Use a connector adapter cable (700935) by YOKOGAWA to make a MIL-NDIS conversion and connect the bridge head to the Strain Module (701270).

* A connector recommended by JSNDI (The Japanese Society for Non-destructive Inspection)



If Using the A1002JC Connector by YOKOGAWA

You can create your own cable by using the YOKOGAWA A1002JC connector that is compatible with the strain module and use the cable to connect a strain gauge bridge or a strain gauge transducer to the strain module.



Note

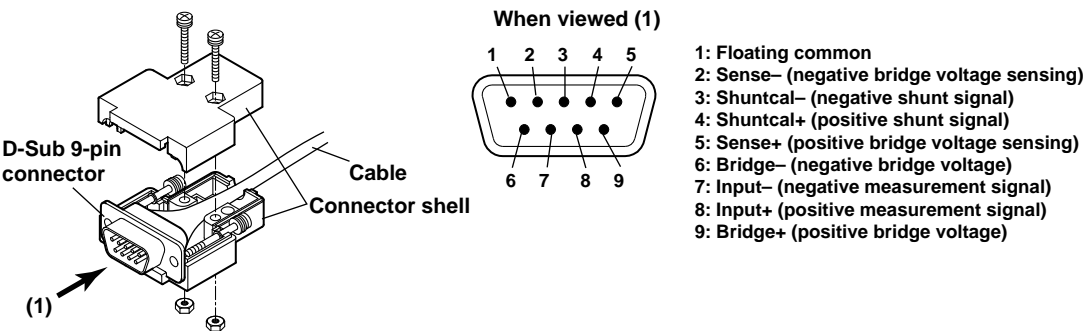
- The connector shell is connected to the case potential (earth) of the SL1000.
- Signals A through G are isolated inside the module.
- When creating your own cable, we recommend that you use a shielded cable in order to shut out external noise.



CAUTION

Take extra care when wiring the connectors. If the wiring is shorted or incorrect, it can damage the SL1000 or other instruments that are connected it.

Pin Arrangement of the D-Sub Connector



3.10 Connecting Acceleration Sensors

An acceleration sensor is connected when measuring acceleration on the 701275 (ACCL/VOLT). For a details on acceleration sensors, see the respective manuals.



CAUTION

- Applying a voltage that exceeds the values indicated below to the 701275 (ACCL/VOLT) may damage the input section.
Maximum input voltage: 42 V (DC+ACpeak)
- Connect acceleration sensors without supplying bias current to the sensor. Otherwise, damage to the internal circuitry of the acceleration sensors may result.
- The SL1000 only supports acceleration sensors that are driven by constant current with driving current of 4 mA and driving voltage of 22 V.

Connecting the Acceleration Sensor

When Connecting Built-in Amplifier Type Acceleration Sensors

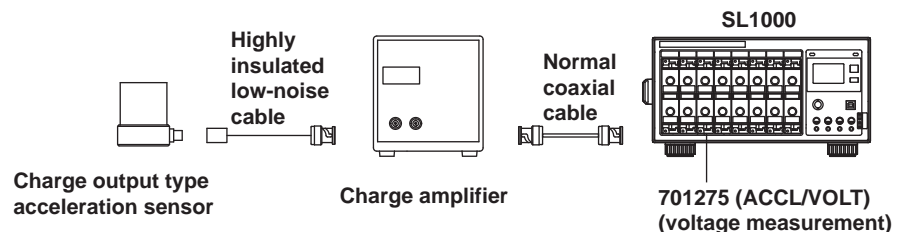
The SL1000 allows built-in amplifier type (low impedance) acceleration sensors to be directly connected. To connect built-in amplifier type acceleration sensors, use BNC cables. Use cables that are appropriate for the acceleration sensors being used. Connect the acceleration sensors with the bias current turned OFF. After connection, turn ON the supply current to the acceleration sensors to make measurements.

When Connecting Charge Output Type Acceleration Sensors

Since the charge output type (high impedance) acceleration sensors do not have a built-in amplifier circuit, they cannot be directly connected to the SL1000. Use either of the following two methods to connect the sensors.

Using the Charge Amplifier

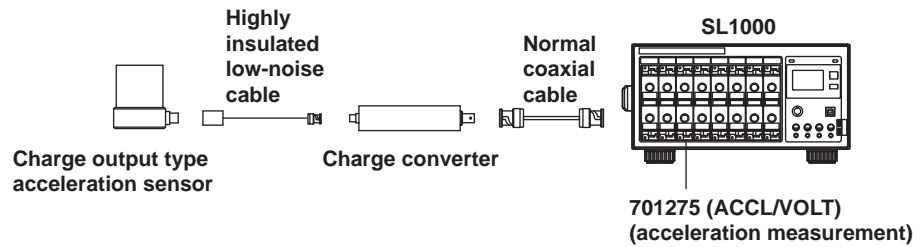
Connect the charge output type acceleration sensor to a charge amplifier using a highly isolated low-noise cable. The acceleration signal (charge signal) that has been converted to a voltage signal by the charge amplifier is applied to the SL1000 using a normal coaxial cable. The SL1000 measures the signal in the voltage measurement mode. The measured data can be converted to acceleration values using the scale conversion function of the SL1000.



When Using the Charge Converter

Connect the charge output type acceleration sensor to a charge converter using a highly isolated low-noise cable. By driving the charge converter using a constant current from the SL1000, voltage signals similar to those of the built-in amplifier type acceleration sensor can be obtained. The SL1000 measures the signals in the acceleration measurement mode and supplies bias current to the charge converter. Set the input sensitivity of the SL1000 according to the charge converter gain and the sensitivity of the charge output type acceleration sensor.

The SL1000 only supports charge converters that are driven by constant current with driving current of 4 mA and driving voltage of 22 V.

**Note**

The unit of measurement of acceleration on the SL1000 is m/s^2 . The sensitivity is sometimes expressed in units of mV/G depending on the acceleration sensor. In such cases, convert the unit. ($1 \text{ G} = 9.81 \text{ m/s}^2$)

Precautions

- Do not apply shock outside the specifications (see the manual for the acceleration sensor) to the acceleration sensors. Doing so can damage the sensors.
- Do not impose drastic temperature changes on the acceleration sensors. Temperature changes may affect the output value of the acceleration sensors.
- By default, the bias current on the acceleration sensors is turned OFF. Be sure to turn it ON before using the acceleration sensors. Bias current is valid only when measuring acceleration. When measuring other parameters, it is automatically turned OFF. The ON/OFF setting of the bias current is retained even when you turn OFF the SL1000.

3.11 Connecting Sensors to the Frequency Module

Sensors and Signal Output Sources That Can Be Connected

The table below shows the sensor and signal output source that can be connected. Appropriate input presets are provided for each sensor and signal output source. For the procedure to set presets, see the *Acquisition Software User's Manual IM720120-61E*.

Sensor and Signal Output Source	Preset Name
5-V logic signal, 5-V output sensor, and sensor with TTL output	Logic 5V
3-V logic signal and 3-V output sensor	Logic 3V
12-V driven relay/sequence circuit and 12-V driven sensor	Logic 12V
24-V driven relay/sequence circuit and 24-V driven sensor	Logic 24V
Sensor/Encoder that outputs positive and negative voltages and sensor that outputs sine waves	ZeroCross
100-VAC power supply (connected via the isolated probe (700929))	AC100V
200-VAC power supply (connected via the isolated probe (700929))	AC200V
Power-generating electromagnetic pickup	EM Pickup
Open collector output (0 to 5 V output) and contact output	Pull-up 5V

Precautions to Be Taken When Connecting to Sensors or Signal Output Sources

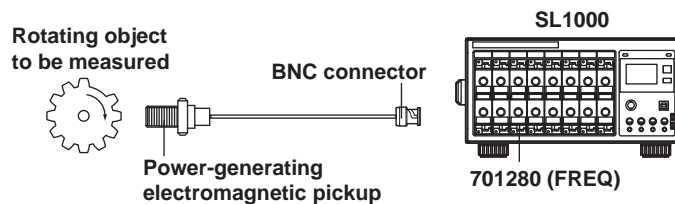


CAUTION

- The maximum input voltage for direct input is indicated below. Applying a voltage exceeding this value can damage the input section. If you are applying high voltage that exceeds 42 V, be sure to use the isolated probe (700929).
Maximum input voltage: 42 V (DC + ACpeak) (CAT I or CAT II)
- The minimum input voltage is 0.2 Vpp. At voltage amplitude less than 0.2 Vpp, the measured values may be unstable.
- Attach/Remove the sensors after confirming that the rotating object to be measured is stopped.
- Set the preset to electromagnetic pickup (EM Pickup) only when using the electromagnetic pickup.

Connecting the Electromagnetic Pickup

- The SL1000 allows power-generating electromagnetic pickup to be connected directly. The SL1000 does not support electromagnetic pickups that require external power supply or those that require a terminator at the output.
- To connect electromagnetic pickups, use BNC cables. Use cables that are appropriate for the electromagnetic pickups being used.
- When the input is set to electromagnetic pickup, determination is not made on whether the input voltage level exceeds the specified input voltage range. Therefore, the LEDs (see page 3-9) do not illuminate even when the input voltage level is over range.



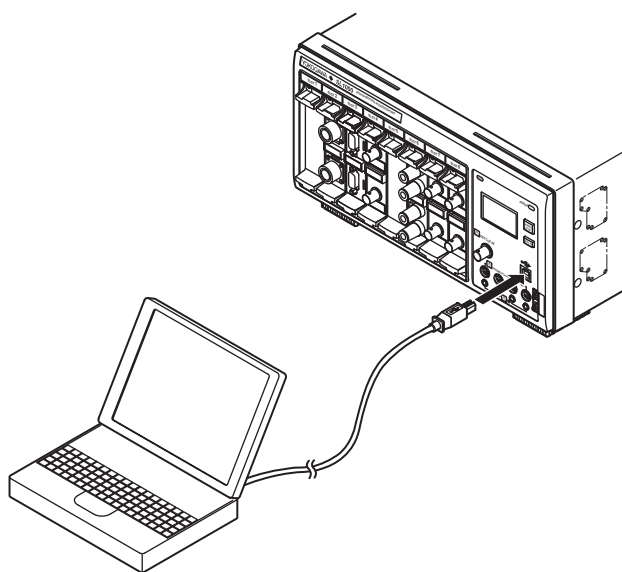
4.1 Connecting to a PC

Connecting Using the USB

USB Interface Specifications

There is a USB port on the front panel of the SL1000.

Item	Specifications
Electrical and mechanical specifications	Conforms to USB Rev. 2.0
Connector	Type B connector (receptacle)
Number of ports	1
Power supply	Self-powered
Compatible PC systems	A PC running Windows 2000 or Windows XP with a standard USB port (a separate device driver is necessary to connect to a PC)



Connection via the USB Interface

Precautions to Be Taken When Connecting the Cable

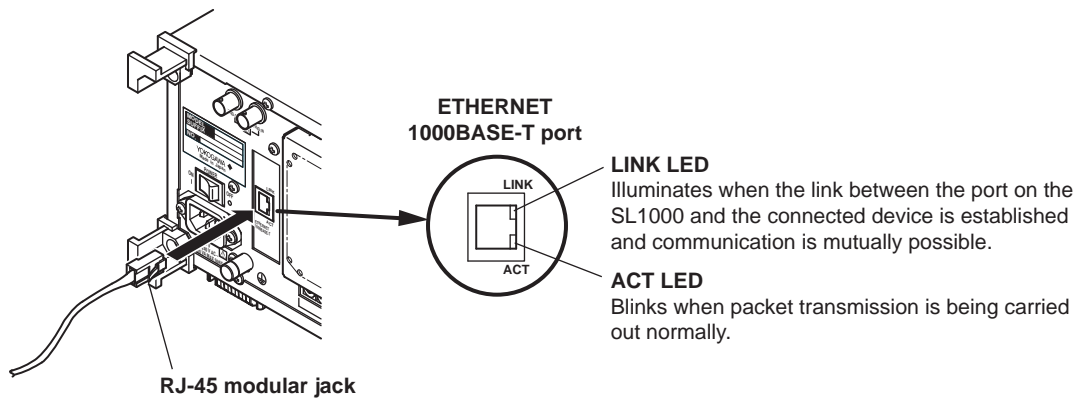
- Connect the USB cable by inserting the connector firmly into the USB connector.
- When connecting multiple devices using USB hubs, connect the SL1000 to the USB hub that is closest to the controller.

Connecting Using the Ethernet Interface (Option)

Ethernet Interface Specifications

There is a 1000BASE-T port on the rear panel of the SL1000.

Item	Specifications
Number of Ethernet ports	1
Electrical and mechanical specifications	Conforms to IEEE802.3
Transmission system	Ethernet (1000BASE-T/100BASE-TX)
Communication protocol	TCP/IP
Supported services	DHCP client, DNS client, FTP server, SMTP client, SNMP client, and VXI-11
Connector type	RJ-45 connector



Items Necessary for Connection

Be sure to use one the following cables for connection.

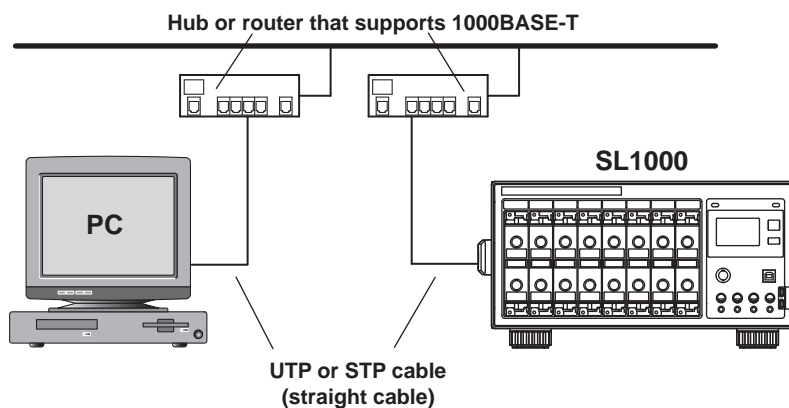
- UTP (Unshielded Twisted-Pair) cable (Category 6 or better)
- STP (Shielded Twisted-Pair) cable (Category 6 or better)

Note

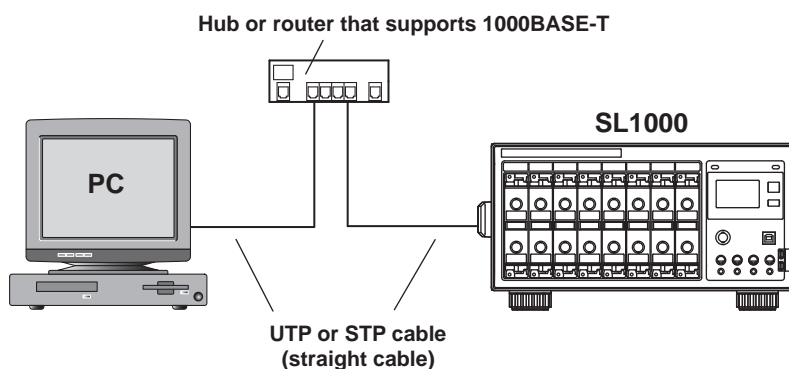
The TCP/IP is configured using the Acquisition Software. For details, see section 3.2 in the *Acquisition Software User's Manual IM720120-61E*.

Connection Procedure**To Connect to a PC on a Network**

1. Turn OFF the SL1000.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 1000BASE-T port on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Turn ON the SL1400.

**To Make a One-to-One Connection with a PC**

1. Turn OFF the SL1000 and the PC.
2. Connect one end of the UTP (or STP) cable to the ETHERNET 1000BASE-T port on the rear panel.
3. Connect the other end of the UTP (or STP) cable to a hub or router.
4. Likewise, connect the PC to a hub or router.
5. Turn ON the SL1400.

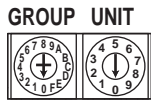
**Note**

- To make a one-to-one connection with a PC, the NIC in the PC must support auto negotiation (auto switching between 1000BASE-T and 100BASE-TX).
- Use only a UTP cable or STP cable (straight cable) of Category 6 or better.
- Avoid connecting the PC directly to the SL1000 without going through the hub or router. Operations are not guaranteed for communications using direct connection.
- You can connect the SL1000 to a network that has DHCP turn ON without having to change the Ethernet settings of the SL1000.
- You must change the Ethernet settings of the SL1000 if the network DHCP is turned OFF. For a description of Ethernet settings, see section 3.2 in the *Acquisition Software User's Manual IM720120-61E*.

Setting the Group and Unit IDs

Set the group and unit IDs that are used to search using the Acquisition Software.

Procedure



Setting the Group ID

1. Turn OFF the SL1000.
2. Insert a screwdriver in the rotary switch (GROUP) on the rear panel and set the group number.

Setting the Unit ID

3. Insert a screwdriver in the rotary switch (UNIT) on the rear panel and set the unit ID.
4. Turn ON the SL1400.

Explanation

Group ID

Set the group ID to which the unit belongs.

Selectable range: 0 to F

Unit ID

Set the unit ID.

Set the unit ID to "0".

Note

- Rotary switch (UNIT) positions 8 and 9 are invalid.
 - The group and unit IDs are not changed while the SL1000 is turned ON. To change the group or unit ID, set them after you turn OFF the SL1000.
-

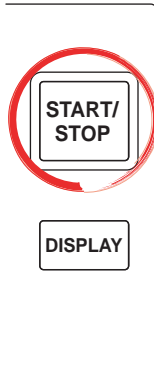
4.2 Starting/Stopping Measurements

You start or stop measurements in standalone mode.

For the operating procedures in online mode, see the *Acquisition Software User's Manual IM720120-61E*.

Procedure

Starting the Measurement



Note

Set the measurement conditions in advance using a dedicated software before starting a measurement. For the setup procedure, see the *Acquisition Software User's Manual IM720120-61E*.

1. Press **START/STOP**. The measurement starts, and the START/STOP key illuminates.

Stopping the Measurement

2. Press **START/STOP**. The measurement stops, and the START/STOP key turns OFF.

Explanation

If you start a measurement by pressing the START/STOP key, measuring start and recording start are executed. If you stop a measurement by pressing the START/STOP key, measuring stop and recording stop are executed. However, recording start and recording stop change depending on the measurement conditions that were set in online mode.

For details, see the *Acquisition Software User's Manual IM720120-61E*.

5.1 Connecting the External Clock Input Terminal (EXT CLK IN)



CAUTION

Only input signals that meet the specifications below. Otherwise, undesirable signal such as excessive voltage may damage the SL1000.

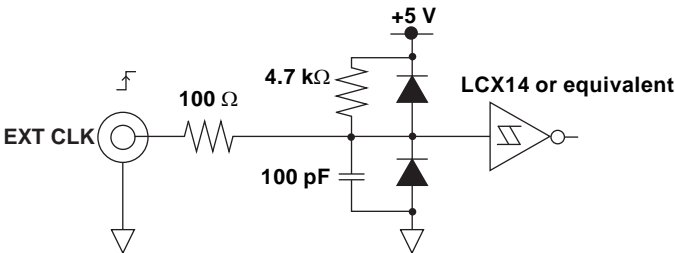
External Clock Input Terminal

Use this terminal if you want to operate the SL1000 using an external clock signal.



Item	Specifications
Connector type	BNC
Input level	TTL level (0 to 5 V)
Valid edge	Rising edge
Minimum pulse width	100 ns or more for high and low
External clock frequency range	5 MHz maximum
Sampling jitter	Within (100 ns + 1 sample period)

Circuit Diagram of the External Clock Input



5.2 Connecting the External Trigger Input Terminal (TRIG IN)



CAUTION

Only input signals that meet the specifications below. Otherwise, undesirable signal such as excessive voltage may damage the SL1000.

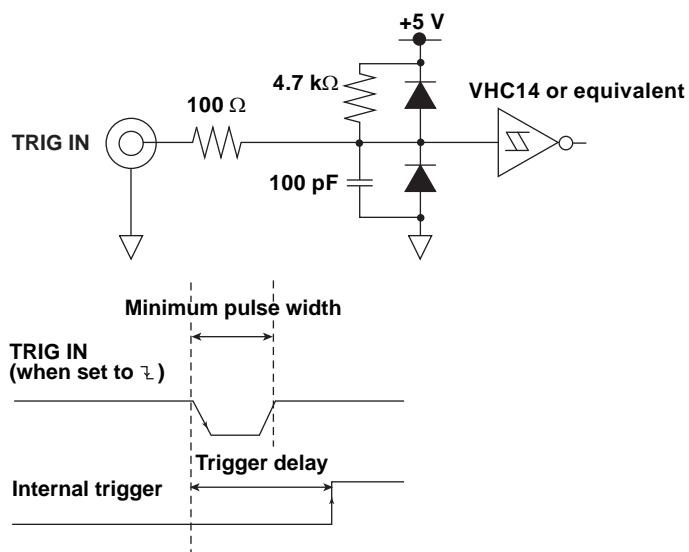
External Trigger Input Terminal

Use this terminal to use an external signal for the trigger source.



Item	Specifications
Connector type	BNC
Input level	TTL level (0 to 5 V)
Minimum pulse width	100 ns
Valid edge	Rising edge or falling edge
Trigger delay	Within (100 ns + 1 sample period)

Circuit Diagram and Timing Chart of the External Trigger Input



5.3 Connecting the Trigger Output Terminal (TRIG OUT)



CAUTION

Do not apply external voltage to the TRIG OUT terminal. If you do, the SL1000 may malfunction.

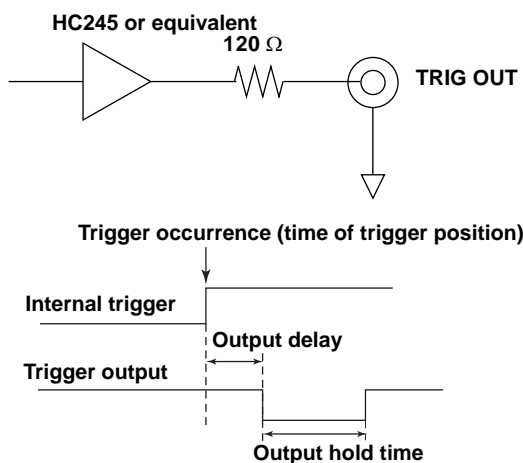
Trigger Output Terminal

This terminal outputs a CMOS signal when a trigger occurs. The signal level is normally high and switches to low when a trigger is activated.

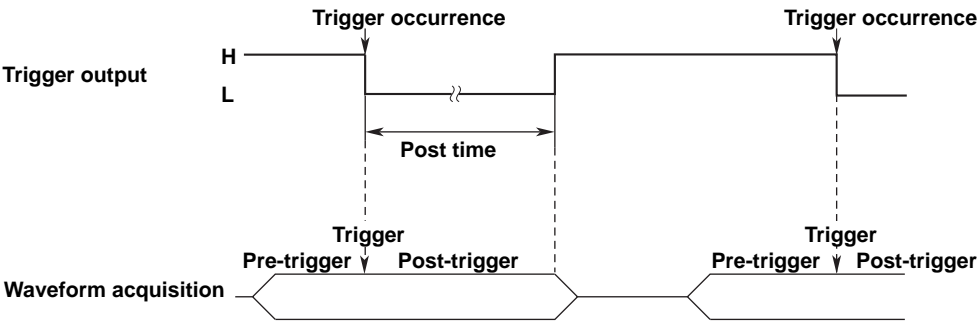


Item	Specifications
Connector type	BNC
Output level	CMOS level (0 to 5 V)
Logic	Falls when the trigger is activated, rises after completing acquisition
Output delay	Within (100 ns + 1 sample period)
Output hold time	100 ns or longer

Circuit Diagram and Timing Chart of the Trigger Output



Hold Time of the Low and High Level Signals



5.4 Connecting the Alarm Output Terminals (ALARM)

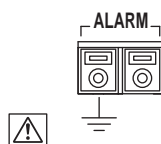


CAUTION

- Do not apply external voltage to the alarm output terminals. If you do, the SL1000 may malfunction.
- Do not short between alarm output terminals. If you do, the SL1000 may malfunction.
- Be sure to turn OFF the power switch when connecting (or removing) signal wires to the alarm output terminals.

Alarm Output Terminals

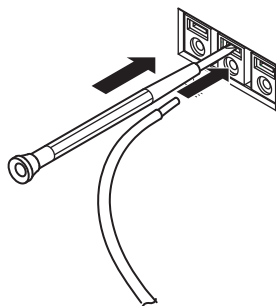
Outputs a TTL signal when an alarm occurs. The signal level is normally high and switches to low when an alarm occurs.



Item	Specifications
Connector type	Screwless terminal
Output level	TTL level (0 to 5 V)
Logic	High level when normal, low level when an alarm occurs.

Connecting the Signal Wires

Press down on the top section of the screwless terminal with a flat-blade screwdriver and insert the stripped tip of the signal wire into the terminal. Check that the signal wire is securely locked to the terminal.



To remove a signal wire, press down on the top section of the screwless terminal with a flat-blade screwdriver and pull the wire out.

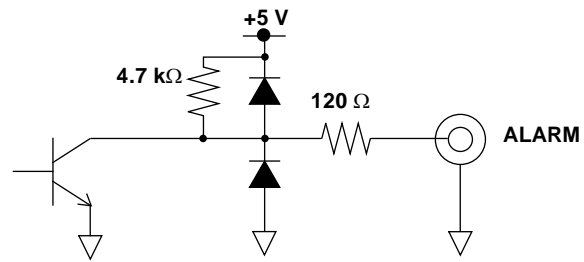
Note

Be sure to hold the SL1000 firmly while pressing down on the top section of the screwless terminal with a flat-blade screwdriver.

Use the following signal wires for the alarm output.

- Signal wire thickness (single wire): $\phi 0.4$ to 1.0 (AWG26 to 18)
(stranded wire): 0.3 to 0.75 mm^2 (AWG22 to 20)
- Recommended length of stripped wire: 10 mm

Circuit Diagram of the Alarm Output



5.5 Connecting the Remote Input Terminals (REMOTE)

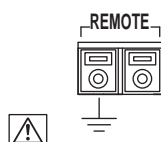


CAUTION

- Only input signals that meet the specifications below. Otherwise, undesirable signal such as excessive voltage may damage the SL1000.
- Be sure to turn OFF the power switch when connecting (or removing) signal wires to the remote input terminals.

Remote Input Terminals

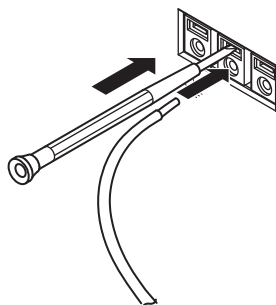
The remote input terminal is used to start/stop acquisition with a remote signal. A low-level signal starts acquisition, and a high-level signal stops it..



Item	Specifications
Connector type	Screwless terminal
Output level	TTL level (0 to 5 V)
Logic	Low-level signal to start, high-level signal to stop

Connecting the Signal Wires

Press down on the top section of the screwless terminal with a flat-blade screwdriver and insert the stripped tip of the signal wire into the terminal. Check that the signal wire is securely locked to the terminal.



To remove a signal wire, press down on the top section of the screwless terminal with a flat-blade screwdriver and pull the wire out.

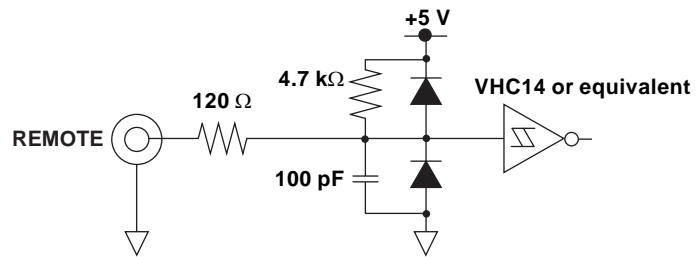
Note

Be sure to hold the SL1000 firmly while pressing down on the top section of the screwless terminal with a flat-blade screwdriver.

Use the following signal wires for the remote input.

- Signal wire thickness (single wire): $\phi 0.4$ to 1.0 (AWG26 to 18)
(stranded wire): 0.3 to 0.75 mm² (AWG22 to 20)
- Recommended length of stripped wire: 10 mm

Circuit Diagram of the Remote Input



5.6 Connecting the GO/NO-GO Output Terminals

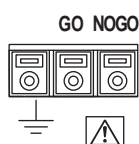


CAUTION

- Do not apply external voltage to the GO/NO-GO output terminals. If you do, the SL1000 may malfunction.
- Do not short between GO/NO-GO output terminals. If you do, the SL1000 may malfunction.
- Be sure to turn OFF the power switch when connecting (or removing) signal wires to the GO/NO-GO output terminals.

GO/NO-GO Output Terminals

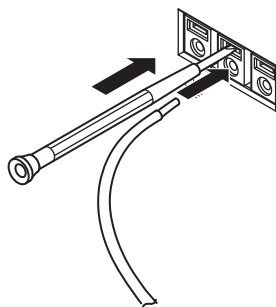
The GO/NO-GO judgement result on the SL1000 can be output externally.



Item	Specifications
Connector type	Screwless terminal
Output level	TTL level (0 to 5 V)
Logic	High level when normal, low level when a given judgment is made

Connecting or Removing the Signal Wires

Press down on the top section of the screwless terminal with a flat-blade screwdriver and insert the stripped tip of the signal wire into the terminal. Check that the signal wire is securely locked to the terminal.



To remove a signal wire, press down on the top section of the screwless terminal with a flat-blade screwdriver and pull the wire out.

Note

Be sure to hold the SL1000 firmly while pressing down on the top section of the screwless terminal with a flat-blade screwdriver.

Use the following signal wires for the GO/NO-GO output.

- Signal wire thickness (single wire): $\phi 0.4$ to 1.0 (AWG26 to 18)
(stranded wire): 0.3 to 0.75 mm² (AWG22 to 20)
- Recommended length of stripped wire: 10 mm

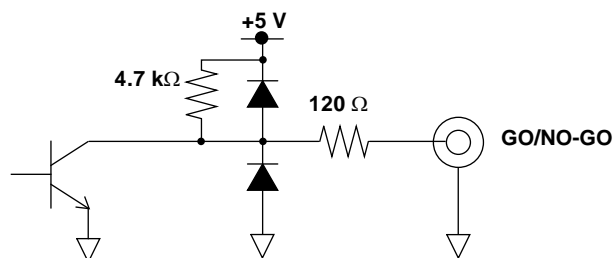
NO-GO OUT Signal

When the judgment result is NO-GO (fail), the output signal level (TTL level) temporarily changes from high to low.

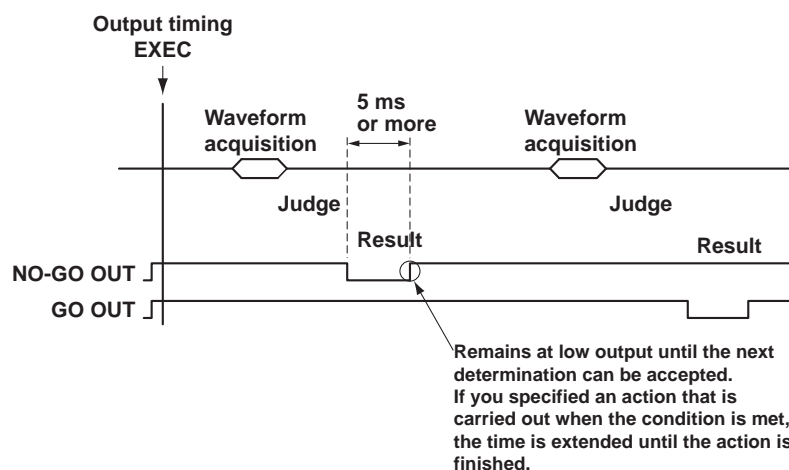
GO OUT Signal

When the judgment result is GO (pass), the output signal level (TTL level) temporarily changes from high to low.

Circuit Diagram of the GO/NO-GO Output



GO/NO-GO OUT Output Timing



6.1 Troubleshooting

Troubleshooting

- If a message is displayed on the screen, read the next section.
- If servicing is necessary, or if the instrument is not operating correctly after performing the corrective actions, contact your nearest YOKOGAWA dealer.

Description	Probable Cause	Corrective Action	Reference Section
The power does not turn ON.	Using a power supply outside the ratings.	Use a correct power supply.	3.4
The display is strange.	The system is not operating properly.	Power-cycle the SL1000.	3.4
Keys do not work.	The SL1000 is in remote mode.	Hold down START/STOP to switch to local mode.	1.2
	Other causes.	Servicing is required.	—
Trigger does not activate.	The trigger settings are not appropriate.	Set the trigger conditions correctly.	*
Measured values are not correct.	Insufficient warm-up.	Warm up the SL1000 for 30 minutes after turning ON the power.	—
	Not calibrated.	Perform a calibration.	*
	The probe's phase has not been corrected.	Correct the phase properly.	3.6
	The probe attenuation is not correct.	Set an appropriate value.	*
	Other causes.	Perform a calibration. If the measured value is still odd, servicing is required.	*
Cannot save to the specified medium.	The medium is not formatted.	Format the medium.	—
	No more free space on the medium.	Delete unneeded files.	—
Cannot change settings or control the operation of the SL1000 via the communication interface.	The address of the SL1000 used by the program is different from the specified address.	Match the address used in the program to the address of the SL1000.	*
	The interface is not used in a way that conforms to the electrical or mechanical specifications.	Use it in a way that conforms to the specifications.	*

* See the *Acquisition Software User's Manual IM720120-61E*.

6.2 Codes and Corrective Actions

Error Codes

An error code may appear on the screen during operation. This section describes the meanings of the messages and their corrective actions. If the corrective action indicates servicing, contact your nearest YOKOGAWA dealer for repairs.

In addition to the error codes below, there are Acquisition Software error messages. These are described in the *Acquisition Software User's Manual IM720120-61E*.

Status Messages

Type	Code	Description	Corrective Action	Reference Section
M	52	Auto setup is in progress.	—	IM720120-61E
M	53	Auto setup is complete.	—	
M	58	Undoing auto setup.	—	
M	59	Auto setup has been undone.	—	
M	66	Strain balancing in progress.	—	
M	67	Strain balancing is complete.	—	
M	69	Calibrating (for manual calibration).	—	
M	70	Calibration is complete (for manual calibration).	—	
M	70	Internal hard disk formatting is complete.	—	
M	78	Undoing initialization.	—	
M	79	Initialization has been undone.	—	
M	88	Initializing settings.	—	
M	89	Initialization is complete.	—	

Execution Errors

Type	Code	Description	Corrective Action	Reference Section
E	703	Cannot undo because auto setup nor initialization – is not in progress.	—	IM720120-61E
E	713	Auto calibration failed.	Check the input signal at the specified channel.	
E	724	Strain balancing failed.	Check the connection at the specified channel.	
E	755	The time base cannot be set to external clock for Envelope and Box Average.	Switch to internal clock.	
E	777	Range-over occurred during shunt calibration.	Increase the measuring range and execute the calibration again.	

Configuration Errors

Type	Code	Description	Corrective Action	Reference Section
E	806	Cannot change settings while GO/NO-GO is in progress.	Abort GO/NO-GO and then change the settings.	IM720120-61E
E	821	Cannot change the trigger delay when using external clock.	Switch to internal clock.	
E	877	Cannot change settings because there are too many display channels for the current record length.	Shorten the record length.	

System Errors

Type	Code	Description	Corrective Action	Reference Section
E	904	Buffer overrun occurred. Could not write data within a specified time.	Lower the sample rate or reduce the number of measuring channels.	IM720120-61E
E	905	Buffer overrun occurred on internal hard disk. Could not write data within a specified time.		
E	906	The cooling fan has stopped.	Turn OFF the power immediately. Servicing is required.	Section 3.4
E	913	The disk is full.	Delete unnecessary files or move files to your PC to free up space.	IM720120-61E
E	938	Keys are locked.	Hold down START/STOP to release key lock.	Section 1.2
E	941	Probe power error occurred.	Check the measured current and the number of probes that you are using.	Section 3.5

File Errors

Type	Code	Description	Corrective Action	Reference Section
E	1001	File access failed.	Test the hard disk using the self-test feature of the Acquisition Software. If the test fails, servicing will be required.	IM720120-61E
E	1002	Invalid characters in file name.	Change the file name.	
E	1003	The file name is too long.	Change the file name length to 256 characters or less.	
E	1004	File comments are too long.	Change the file comment length to 250 characters or less.	
E	1005	Not enough free space on media.	Delete unneeded files or use another storage medium.	
E	1117	Measurement stopped because the maximum amount of auto recording data in Free Run mode has been reached.	To cancel recording, click abort.	

Examples

E: 913 09:31:20
E: 703 10:52:36
M:052 13:02:27
M:053 13:05:15

└─ Time of occurrence (hh:mm:ss)
 └─ Error code
 └─ Type
 E: Error
 M: Message

6.3 Recommended Replacement Parts

The three-year warranty applies only to the main unit of the instrument (starting from the day of delivery) and does not cover any other items nor expendable items (items which wear out).

Contact your nearest YOKOGAWA dealer to have parts replaced.

Parts Name	Replacement Period
LCD backlight	Approx. 50,000 hours under normal use

Parts Name	Warranty Period
Internal hard disk	One year after purchase (data is excluded)

The following items are expendable items. We recommend that you replace them according to the period indicated below. Contact your nearest YOKOGAWA dealer to have parts replaced.

Parts Name	Recommended Replacement Period
Cooling fan	3 years
Backup battery (lithium battery)	5 years

7.1 Input Section

Item	Specifications
Maximum number of input channels	16
Type	Plug-in input unit
Number of slots	8
Maximum record length	Depends on the number of channels used
	1 or 2 50 MW/CH
	3 or 4 25 MW/CH
	5 to 8 10 MW/CH
	9 to 16 5 MW/CH

7.2 Display Section

Item	Specifications
Display	FSTN monochrome LCD
Effective display screen size	45.2 mm x 27.0 mm
Display resolution	128 x 64
Displayed contents	Common area <ul style="list-style-type: none"> • SL1000 group ID and unit ID • Status icons Displays the following information one at a time (switched by pressing DISPLAY) <ul style="list-style-type: none"> • Module status • Error information • Communication parameters (when the /C10 option is installed)

7.3 Storage

Internal Hard Disk (/HD1 Option)

Item	Specifications
Number of drives	1
Size	2.5 inch
Hard disk capacity	40 GB FAT32
Name	Supports long file names (ANK16 characters)

7.4 External I/O Section

External Clock Input (EXT CLK IN)

Item	Specifications
Connector type	BNC
Input level	TTL (0 to 5 V)
Valid edge	Rising edge
Minimum pulse width	100 ns or more for high and low
External clock frequency range	5 MHz maximum
Sampling jitter	Within (100 ns + 1 sample period)

External Trigger Input (TRIG IN)

Item	Specifications
Connector type	BNC
Input level	TTL (0 to 5 V)
Minimum pulse width	100 ns
Valid edge	Rising edge or falling edge
Trigger delay	Within (100 ns + 1 sample period)

Trigger Output (TRIG OUT)

Item	Specifications
Connector type	BNC
Output level	CMOS level (0 to 5 V)
Logic	Falls when a trigger occurs, rises after completing acquisition
Output delay	Within (100 ns + 1 sample period)
Output hold time	100 ns or longer

Alarm Output (ALARM)

Item	Specifications
Connector type	Screwless terminal
Output level	TTL level (0 to 5 V)
Logic	High level when normal, low level when an alarm occurs.

Remote Input (REMOTE)

Item	Specifications
Connector type	Screwless terminal
Output level	TTL level (0 to 5 V)
Logic	.

GO/NO-GO Output

Item	Specifications
Connector type	Screwless terminal
Output level	TTL level (0 to 5 V)
Logic	High level when normal, low level when judgment is made

COMP Output (Rectangular Signal Output for Probe Compensation)

Item	Specifications
Output frequency	1 kHz \pm 1%
Output amplitude	1 Vp-p \pm 10%

Probe Power Output (/P4 Option)

Item	Specifications
Number of output terminals	4
Output voltage	±12 V 2 outputs (up to a total of 1300 mA)
Compatible probes	Current probe 701930 (150A) Up to 4 probes Current probe 701931 (500A) Up to 3 probes Current probe 701933 (30A) Up to 2 probes

7.5 Computer Interface**USB-PC Connection**

Item	Specifications
Connector type	USB type B connector (receptacle)
Electrical and mechanical specifications	Conforms to USB Rev. 2.0
Supported transfer standards	HS (High Speed) mode (480 Mbps) and FS (Full Speed) mode (12 Mbps)
Number of ports	1
Supported protocols	USBTMC-USB488 (USB Test and Measurement Class Ver.1.0)
Compatible PC systems	A PC running Windows XP/2000 with a USB port.

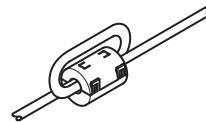
Ethernet (/C10 Option)

Item	Specifications
Connector type	RJ-45 connector
Number of ports	1
Electrical and mechanical specifications	Conforms to IEEE802.3
Transmission system	Ethernet (1000BASE-T/100BASE-TX)
Communication protocol	TCP/IP
Supported services	DHCP, DNS, SNMP client, SMTP client, FTP server, and VXI-11
LED indicators	LINK (illuminates when a link is established) and ACT (illuminates when packets are transmitted or received)

7.6 General Specifications

Item	Specifications
Standard operating conditions	Ambient temperature: $23 \pm 5^{\circ}\text{C}$ Ambient humidity: $55 \pm 10\% \text{ RH}$ Error in supply voltage and frequency: Within $\pm 1\%$ of rating After a 30-minute warm-up and after calibration
Recommended calibration period	1 year
Warm-up time	At least 30 minutes
Storage conditions	Temperature: -20 to 60°C Humidity: 20 to 80% RH (no condensation) Altitude: 3000 m or less
Operating conditions	Temperature: 5 to 40°C Humidity: 20 to 80% RH (no condensation) Altitude: 2000 m or less
Rated supply voltage	100 to 120 VAC or 220 to 240 VAC (automatic switching)
Permitted supply voltage range	90 to 132 VAC/198 to 264 VAC
Rated supply frequency	50/60 Hz
Permitted power supply frequency range	48 to 63 Hz
Power fuse	Built in (irreplaceable)
Maximum power consumption	Approx. 300 VA
Withstand voltage	1500 VAC between power supply and case for 1 minute
Insulation resistance	10 M Ω or higher at 500 VDC between power supply and case
External dimensions	319 mm (W) \times 154 mm (H) \times 350 mm (D) (excluding projections)
Weight	Approx. 6 kg (the SL1000 only) Approx. 9 kg (the SL1000 + eight High-Speed 100 MS/s, 12-Bit Isolation Modules)
Cooling method	Forced air cooling, inlet on the right and bottom panels, exhaust from the rear panel
Battery backup	Backs up setup data and clock with the internal lithium battery
Backup battery life	Approx. 5 years (at ambient temperature of 25°C)
Safety standard ¹	Complying standard EN61010-1 <ul style="list-style-type: none"> • Installation category (overvoltage category) II¹ • Measurement category II² • Pollution degree 2³ Already certifi (701250/701251/701255/701260/701261/701260/701261/ 701262/701265/720210/700986/700987/701955/701956/701957/701958)

Item	Specifications
Emission1	<p>Complying standard EN61326 Class A, C-Tick AS/NZS CISPR11</p> <p>Already certified (701250/701251/701255/701260/701261/701262/701265/720210/700986/700987/701955/701956/701957/701958)</p> <ul style="list-style-type: none"> This product is a Class A (for industrial environment) product. Operation of this product in a residential area may cause radiointerference in which case the user is required to correct the interference. <p>Test Item</p> <ol style="list-style-type: none"> Power supply terminal noise EN61326:ClassA Electromagnetic radiation disturbance EN61326:ClassA power supply harmonics restriction EN61000-3-2 Supply voltage fluctuation & flicker EN61000-3-3 <p>Cable conditions</p> <ul style="list-style-type: none"> Current probe <p>When connecting a current probe to the input terminal and probe power terminal of a module, pass the two cables together through a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) at the SL1000 end.</p> USB cable <p>Use a shielded cable (YOKOGAWA: A1421WL) and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to the SL1000 end of the cable.</p> <p>Use a cable that is 3 m or less in length.</p> External trigger input, external clock input, and external clock output <p>Use a BNC cable and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to the SL1000 end of the cable.</p> <p>Use a cable that is 3 m or less in length.</p> Ethernet connector <p>Use a category 6 or better Ethernet cable and attach a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) to the SL1000 end of the cable.</p> <p>Use a cable that is 3 m or less in length.</p> GO/NO-GO/ALARM/REMOTE I/O terminal <p>Use a twisted-pair cable. Connect one cable to the I/O terminal and the other cable to the functional ground terminal within the terminal. Wind the two cables together once around a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) at the SL1000 end.</p> <p>Use a cable that is 3 m or less in length.</p> Probe connected to a module <p>Wind the cable of a probe, which will be connected to a module, once around a ferrite core (TDK: ZCAT2035-0930A, YOKOGAWA: A1190MN) at the SL1000 end of the cable.</p> <p>Example of winding a cable around a ferrite coref</p>



Immunity	<p>Complying standard EN61326 industrial environment</p> <p>Already certified (701210/701230/701250/701251/701255/701260/701261/701262/701265/720210/700986/700987/701955/701956/701957/701958)</p> <ul style="list-style-type: none"> Influence in the immunity environment (performance criterion A) <p>701250: $\leq \pm 5$ mV (1:1 input, 50 mV range conversion)</p> <p>701251: $\leq \pm 3$ mV (1:1 input, 10 mV range conversion)</p> <p>701255: $\leq \pm 25$ mV (1:1 input, 50 mV range conversion)</p> <p>701260: $\leq \pm 30$ mV (1:1 input, 200 mV range conversion)</p> <p>701261/701262: $\leq \pm 3$ mV</p> <p>701265: $\leq \pm 0.05$ mV</p> <p>701270: $\leq \pm 100$ μSTR (when equivalent to ± 100 mV, gauge factor = 2, and bridge voltage = 2 V)</p> <p>701271: $\leq \pm 100$ μSTR (when equivalent to ± 100 mV, gauge factor = 2, and bridge voltage = 2 V)</p> <p>701275: $\leq \pm 3$ mV (1:1 input, 50 mV range conversion)</p> <p>701280: Within the specifications</p> <p>720210: $\leq \pm 25$ mV (1:1 input, 100 mV range conversion)</p>
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7.6 General Specifications

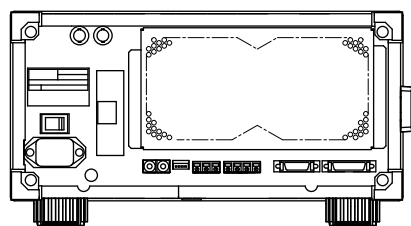
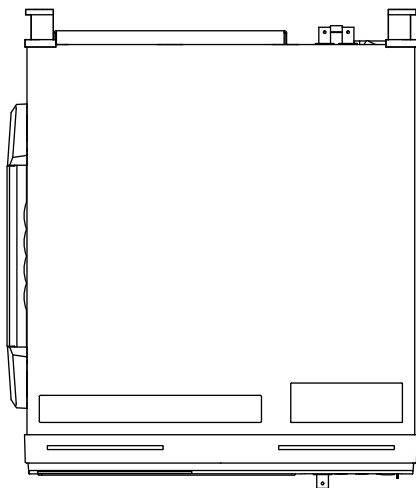
Item	Specifications		
Immunity1	Test condition	701250:	10 MS/s, envelope mode, 500 mV range, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701251:	1 MS/s, envelope mode, 100 mV range, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701255:	10 MS/s, envelope mode, 500 mV range, no input filter, with the tip of the probe (701940 (10:1)) shorted
		701260:	100 kS/s, envelope mode, 2 V range, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701261/701262:	100 kS/s, envelope mode, 50 mV range, no input filter, with the end of the 3-m twisted-pair cable shorted
		701265:	100 kS/s, envelope mode, 1 V range, no input filter, with the end of the 3-m twisted-pair cable shorted
		701270:	100 kS/s, envelope mode, 500 μ STR, gauge factor: 2.0, no input filter
			701955 bridge voltage: 2 V
			701956 bridge voltage: 10 V
		701271:	100 kS/s, envelope mode, 500 μ STR, gauge factor: 2.0, no input filter
			701957 bridge voltage: 2 V
			701958 bridge voltage: 10 V
		701275:	100 kS/s, envelope mode, 500 mV range, no input filter, with the tip of the probe (700929 (10:1)) shorted
		701280:	25 kS/s, envelope mode, Frequency, 1 Hz range, no input filter
			User (± 1 V, threshold level: 0 V, hysteresis: $\pm 1\%$), with the tip of the probe (700929 (10:1)) shorted
		720210:	100 MS/s, envelope mode, 1 V range, no input filter, with the tip of the probe (700929 (10:1)) shorted
Test Item	1. Electrostatic discharge		EN61000-4-2
	2. Radiated immunity		Air discharge: ± 8 kV, contact discharge: ± 4 kV, criteria B EN61000-4-3
			80 MHz to 1 GHz, 1.4 GHz to 2 GHz, 10 V/m Criteria A
			2 GHz to 2.7 GHz, 3 V/m Criteria A Criteria A
	3. Conducted immunity		EN61000-4-6
			3 V, criteria A
	4. Electrical fast transient/burst		EN61000-4-4
			Power line: ± 2 kV, signal line: ± 1 kV, criteria B
	5. Power frequency magnetic field		EN61000-4-8
			30 A/m, 50 Hz, criteria A
	6. Surge immunity		EN61000-4-5
			Between lines: ± 1 kV, common: ± 2 kV, criteria B
	7. Voltage dip and interruption		EN61000-4-11
			1 cycle, both polarities, 100%, criteria A
			10 cycle, both polarities, 60%, criteria A
			25 cycle, both polarities, 30%, criteria A
			250 cycle, both polarities, 100%, criteria C
	Definitions of criteria A, B and C		
	• Criteria A	Aforementioned "Influence in the immunity environment" is met during the test.	
	• Criteria B	This apparatus continues to operate without hang-up or falling into uncontrollable conditions during the test. No change of actual operating state or stored data is allowed.	
	• Criteria C	When the noise is applied, temporary degradation or loss of function is observed and to recover the normal condition, an operator intervention or system reset is required.	

1. The Overvoltage Category (Installation Category) is a value used to define the transient overvoltage condition and includes the impulse withstand voltage regulation. I applies to electrical equipment that is powered by a circuit with overvoltage control. II applies to electrical equipment that is powered by a fixed installation such as a distribution board.
2. Measurement category II (CAT II) applies to measurement of electrical equipment which is supplied from fixed installations such as a wall outlet wired from a distribution board, or of the wires themselves.
3. Pollution Degree: Applies to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).

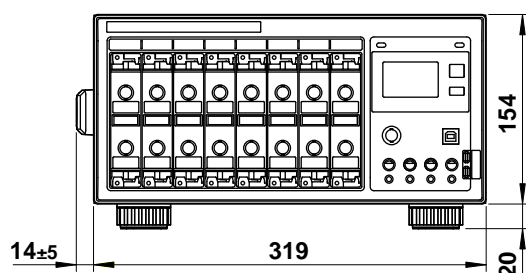
7.7 External Dimensions

SL1000

Unit: mm



Rear View



Unless otherwise specified, tolerance is $\pm 3\%$ (however, tolerance is ± 0.3 mm when below 10 mm).

Appendix 1 TCP and UDP Port Numbers Used in Ethernet Communications

The TCP and UDP port numbers that the SL1000 Ethernet interface uses are as follows:

TCP Port Numbers That the SL1000 Uses

Port Number	Description	Function
20	File Transfer [Default Data]	FTP server
21	File Transfer [Control]	FTP server
25	Simple Mail Transfer Protocol	SMTP client
111	VXI-11	SL1000 control via the Ethernet interface
1024		
1025		

UDP Port Numbers That the SL1000 Uses

Port Number	Description	Function
67	Bootstrap Protocol Server	DHCP client
68	Bootstrap Protocol Client	(receive wait port)
123	Network Time Protocol	SNTP client
111	VXI-11	SL1000 control via the Ethernet interface

Index

Symbols

1000BASE-T port	4-2
-----------------------	-----

A

acceleration sensor	3-26
accessories.....	iii, v
acquisition memory.....	2-5
Acquisition Software	2-5
ALARM	5-5, 5-7
alarm icon	1-5
alarm output.....	7-2
alarm output terminals	1-2, 5-5
ambient humidity	3-4
ambient temperature	3-4

B

block diagram	2-2
bridge head.....	3-23
built-in amplifier type acceleration sensors.....	3-26

C

charge amplifier.....	3-26
charge converter.....	3-27
charge output type acceleration sensors.....	3-26
communication parameter screen	1-4
COMP output.....	7-2
computer interface.....	7-3
configuration error	6-2
cover panels	1-1
current probe	3-17, 3-18

D

dedicated software	2-5
DIP switch.....	1-2
DISPLAY key	1-3, 1-4
display section	7-1

E

electromagnetic pickup.....	3-28
error code	6-2
error information	1-5
error screen	1-4
Ethernet	2-5, 7-3
Ethernet interface	4-2
Ethernet interface connection.....	4-2
Ethernet port.....	1-2
execution error.....	6-2
EXT CLK IN	5-1
external clock input.....	7-2
external clock input terminal.....	1-1, 5-1
external dimensions.....	7-7
external I/O section.....	7-2
external trigger input.....	7-2
external trigger input terminal	1-2, 5-2

F

factory default setting	1-2
file error	6-3
frequency module	3-28
frequency module, LEDs	3-9
front panel.....	1-1
FTP connection	2-6
functional ground terminal	1-1

G

general specifications	7-4, 7-5, 7-6
GO/NO-GO judgment.....	5-9
GO/NO-GO output.....	7-2
GO/NO-GO output terminals	1-2, 5-9
GO icon	1-5
GO OUT	5-10
group ID.....	1-5, 4-4

H

handling precautions	3-1
HDD access icon.....	1-5
HDD FULL icon	1-5
High-Speed 100 MS/s, 12-Bit Isolation Module.....	3-8

I

indicators	1-1
input module	2-4, 3-6
input module installation slots.....	1-1
input section	7-1
installation conditions	3-4
installation orientation.....	3-3
instrument No.	ii
internal hard disk	7-1

K

keys	1-1
------------	-----

L

laser products, safety precautions.....	3-8
laser specifications	3-9
lithium battery	3-12

M

measure icon.....	1-5
measurement, start.....	4-5
measurement, stop.....	4-5
measurement leads	3-21
model.....	ii
module.....	iv, 3-6
module, installation procedure.....	3-7
module, removal procedure.....	3-8
module status icon.....	1-5
module status screen	1-4

N

NO-GO icon.....	1-5
NO-GO OUT	5-10
No.	ii

Index

O	Page	X	Page
online operation	2-5	Xviewer.....	2-5
P	Page		
phase compensation	3-19		
phase compensation signal	3-20		
power consumption	3-10		
power cord.....	3-10		
POWER indicator	1-3		
power switch.....	3-11		
power switch, turning OFF.....	3-11		
power switch, turning ON	3-11		
probe	3-13		
probe, connection.....	3-13		
probe, phase correction.....	3-19, 3-20		
probe compensation signal output terminal.....	1-1		
probe power output.....	7-3		
probe power supply	3-18		
probe power supply terminal	1-1		
R	Page		
rated power supply frequency	3-10		
rated supply voltage	3-10		
rear panel	1-2		
recommended replacement parts.....	6-4		
remote icon.....	1-5		
remote mode	2-5		
rotary switch	1-2, 4-4		
rubber feet	3-3		
S	Page		
signal flow.....	2-3		
standalone operation	2-5		
START/STOP key.....	1-3, 4-5		
status icon	1-5		
status message	6-2		
storage.....	7-1		
strain gauge, connection	3-23		
strain module and bridge head, connection.....	3-23		
suffix	ii		
symbols	vii		
system configuration.....	2-1		
system error.....	6-3		
system error icon.....	1-5		
T	Page		
TCP port numbers	App-1		
thermocouple.....	3-22		
TRIG'D indicator.....	1-3		
trigger output	7-2		
trigger output terminal.....	1-2, 5-3		
TRIG IN	5-2		
TRIG OUT	5-3		
troubleshooting	6-1		
U	Page		
UDP port numbers.....	App-1		
unit ID	1-5, 4-4		
USB	2-5		
USB connection.....	4-1, 7-3		
USB connector for a PC	1-1		
USB interface	4-1		
USB port	4-1		