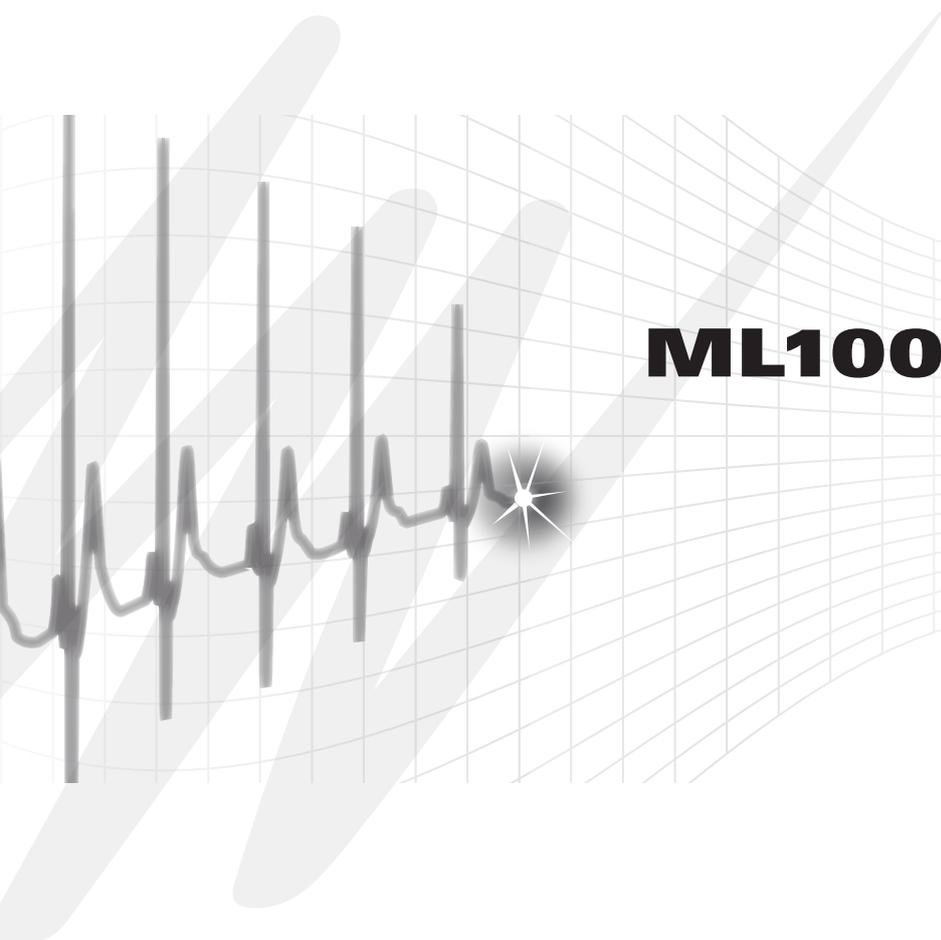




**ML1001 Electronic
Stimulator**
Owner's Guide





**ML1001 Electronic
Stimulator**
Owner's Guide





This document was, as far as possible, accurate at the time of release. However, changes may have been made to the software and hardware it describes since then. ADInstruments Pty Ltd. reserves the right to alter specification as required. Late-breaking information may be supplied separately.

Trademarks of ADInstruments

LabTutor[®], LabChart[®], PowerLab[®] and MacLab[®] are registered trademarks of ADInstruments Pty Ltd. The names of specific recording units, such as PowerLab 15T, are trademarks of ADInstruments Pty Ltd. LabAuthor, Chart and Scope (application programs) are trademarks of ADInstruments Pty Ltd.

Other Trademarks

Apple, Mac and Macintosh are registered trademarks of Apple Computer, Inc.

Windows, Windows 2000, Windows XP and Windows Vista are either registered trademarks or trademarks of Microsoft Corporation.

All other trademarks are the property of their respective owners.

 DANGER	This alerts the user to imminent death or serious injury arising from misuse of the stimulator.
 WARNING	This alerts the user to possible death or serious injury arising from misuse of the stimulator.
 CAUTION	This alerts the user to possible injury or damage to property arising from misuse of the stimulator.

Notes are also provided in this manual to alert the user to specific instructions or recommendations.

General

WARNING

This device is designed for experimental and research applications and must not be used for therapeutic purposes.

Precautions regarding settings

CAUTION

Always use the supplied 3-pin cable for the power cable. If any other power cable is used, it may result in an electric shock to the operator.

CAUTION

Do not touch the connector pins. Discharge electrostatic energy by touching a grounded metal part before connecting. The instrument may be damaged by electrostatic energy.

CAUTION

If this instrument is connected to other peripheral devices, be sure that they are connected in the manner specified by the manufacturer.

Only connect devices specified by the manufacturer. Connection to non-specified devices may result in electric shock to the operator by current of leakage.

Precautions regarding maintenance

CAUTION

When maintaining (cleaning, sterilizing, etc.) the stimulator, be sure to turn the power off and unplug the power cable from the power outlet first. Failure to do so may result in an electric shock or malfunction.

CAUTION

The electronic stimulator has a high voltage output capacity of up to ± 50 V.

Directly touching the output terminals or electrodes during stimulation or when the power cord is connected during inspection and the stimulator is operable may result in electric shock.

GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel. Use only our approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

- 1. To safely and effectively use the instrument, its operation must be fully understood.**
- 2. When installing or storing the instrument, take the following precautions:**
 - (1) Avoid moisture or contact with water, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and saline or sulphuric air.
 - (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
 - (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
 - (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
 - (5) Choose a room where a proper grounding facility is available.
- 3. Before Operation**
 - (1) Check that the instrument is in perfect operating order.
 - (2) Check that the instrument is grounded properly.
 - (3) Check that all cords are connected properly.
 - (4) Pay extra attention when the instrument is combined with other instruments to avoid misdiagnosis or other problems.
- 4. During Operation**
 - (1) The instrument must receive continual, careful attention.
 - (2) Turn power off or remove electrodes and/or transducers when necessary to assure the safety.
- 5. To Shutdown After Use**
 - (1) Turn power off with all controls returned to their original positions.
 - (2) Remove the cords gently; do not use force to remove them.
 - (3) Remove the power cord from the AC SOURCE socket to isolate the instrument from the AC supply mains.
 - (4) Clean the instrument together with all accessories for their next use.
- 6. The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.**
- 7. The instrument must not be altered or modified in any way.**
- 8. Maintenance and Inspection:**
 - (1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
 - (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.
 - (3) Technical information such as parts list, descriptions, calibration instructions or other information is available for qualified user technical personnel upon request from your distributor.

CAUTION

United States law restricts this device to sale by or on the order of a physician.

EMC RELATED CAUTION

This equipment and/or system complies with the International Standard IEC 60601-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in IEC 60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

- 1. Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
Install the equipment and/or system at another location. Keep the emitter source such as cellular phone away from the equipment and/or system, or turn off the cellular phone.
- 2. Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.
- 3. Effect of direct or indirect electrostatic discharge:**
Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it. A humid room can help lessen this problem.
- 4. Electromagnetic interference with any radio wave receiver such as radio or television:**
If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.
- 5. Interference of lightning:**
When lightning occurs near the location where the equipment and/or system is installed, it may induce an excessive voltage in the equipment and/or system. In such a case, use an uninterruptible power supply.
- 6. Use with other equipment:**
When the equipment and/or system is adjacent to or stacked with other equipment, the equipment and/or system may affect the other equipment. Before use, check that the equipment and/or system operates normally with the other equipment.
- 7. Use of unspecified accessory, transducer and/or cable:**
When an unspecified accessory, transducer and/or cable is connected to this equipment and/or system, it may cause increased electromagnetic emission or decreased electromagnetic immunity. The specified configuration of this equipment and/or system complies with the electromagnetic requirements with the specified configuration. Only use this equipment and/or system with the specified configuration.

Caution - continued

8. Use of unspecified configuration:

When the equipment and/or system is used with the unspecified system configuration different than the configuration of EMC testing, it may cause increased electromagnetic emission or decreased electromagnetic immunity. Only use this equipment and/or system with the specified configuration.

9. Measurement with excessive sensitivity:

The equipment and/or system is designed to measure bioelectrical signals with a specified sensitivity. If the equipment and/or system is used with excessive sensitivity, artifact may appear by electromagnetic interference and this may cause mis-diagnosis. When unexpected artifact appears, inspect the surrounding electromagnetic conditions and remove this artifact source.

If the above suggested remedial actions do not solve the problem, consult your distributor for additional suggestions.

NOTE about Waste Electrical and Electronic Equipment (WEEE) directive 2002/96/EEC

For the member states of the European Union only:

The purpose of WEEE directive 2002/96/EEC is, as a first priority, the prevention of waste electrical and electronic equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such waste so as to reduce the disposal of waste.

Contact your representative for disposal at the end of its working life.

Contents

Introduction	2	Specifications	28
Features	2	Stimulation Trigger.....	28
Configuration	3	Main Interval.....	28
Peripheral Devices	3	Stimulation Waveform Setup	28
Electronic Stimulator 1001 Hardware Configuration	4	Stimulation Output	29
Precautionary Labels and Indications	5	Synchronized Output Signal	30
Front	5	Language.....	30
Rear	5	Power Source	30
List of Symbols	6	Environment	30
Description of Parts	7	Operating Environment	30
Front	7	Storage Environment	30
Power On/Off	7	Durability.....	31
Keys and Dial	7	Installation	31
Main Interval.....	8	Safety Standards	31
External Trigger (EXT TRIG)	10	Dimensions and Weight.....	31
Stimulation Waveform Setup	12	Electromagnetic Compatibility	31
Stimulation Waveform Output	14		
BIPHASIC, MIX, MODU, DC, ALTN	16		
Memory	18		
Rear	19		
Power	19		
External Signal Input Terminals	20		
Synchronizing Signal Output Terminal	22		
Serial Output	23		
General Handling Precautions	24		
Preparation	26		
Installing the Stimulator	26		
Connection of Cables	26		

Introduction

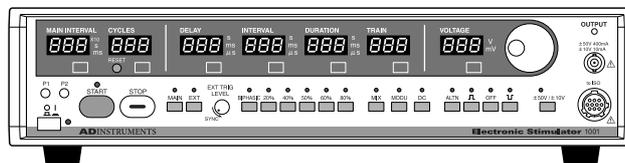
The electronic stimulator is used for the basic physiological and pharmacological research and experiments.

⚠ WARNING

This device is designed for experimental and research applications and must not be used for therapeutic purposes.

By simple operation of the panel, a single pulse, pair pulse, train pulse and repeat pulse according to main interval can be output, as well as various mixed waveforms in combination with an external signal, and a biphasic pulse.

The stimulator is also equipped with a booster amplifier to allow field stimulation.

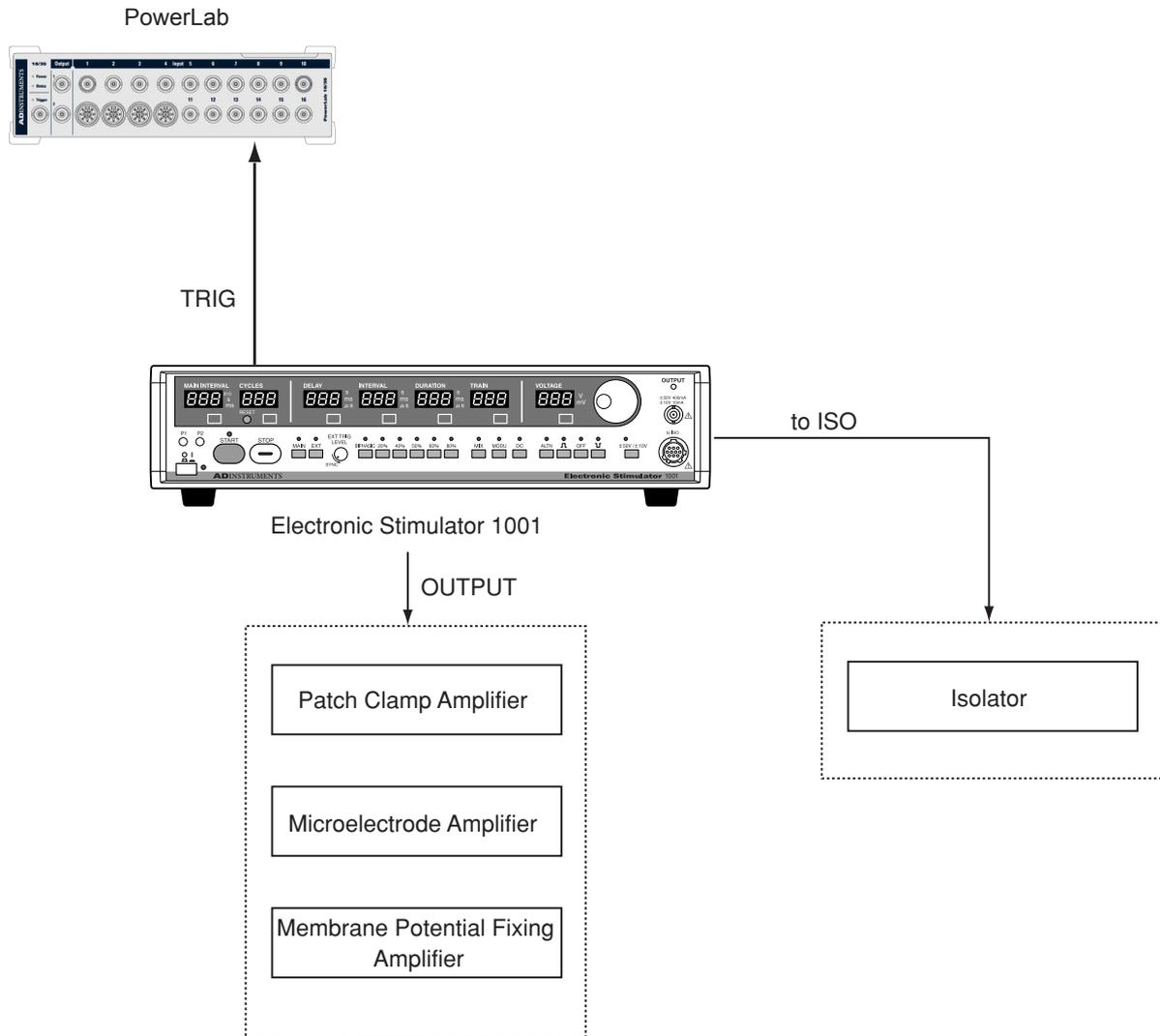


Features

- **Simple train stimulation**
A single pulse, pair pulse or train pulse can easily be output.
- **Built-in main interval function, independent of stimulation waveform setup**
Starting/Stopping and the repeat time and repeat count can be set separately using the main interval function, ensuring simple, reliable operation.
- **Field stimulation**
The built-in booster amplifier with a maximum output of ± 50 V and 400 mA enables direct field stimulation with any stimulation waveform.
- **Simple biphasic pulse stimulation**
- **Mixing and modulation input terminals that allow output of mixed and modulated waves through combination with an external signal**
- **Alternate stimulation by the addition of an evoked response to eliminate**
- **High precision, high reliability design**
By adopting a crystal oscillator as the internal base oscillation source and combined with IC technology, time-related items can be controlled with extreme precision, ensuring excellent reliability and reproducibility as well as stable operation.
- **Fine adjustment of output voltage**
The output voltage setting can be adjusted up to 10 V.
- **Input/Output protection circuit**
The built-in protection circuit prevents damage in the event of an accidental short circuit in the output terminal or synchronization signal output terminal or excessive voltage (max. 50 V) to the input terminal.

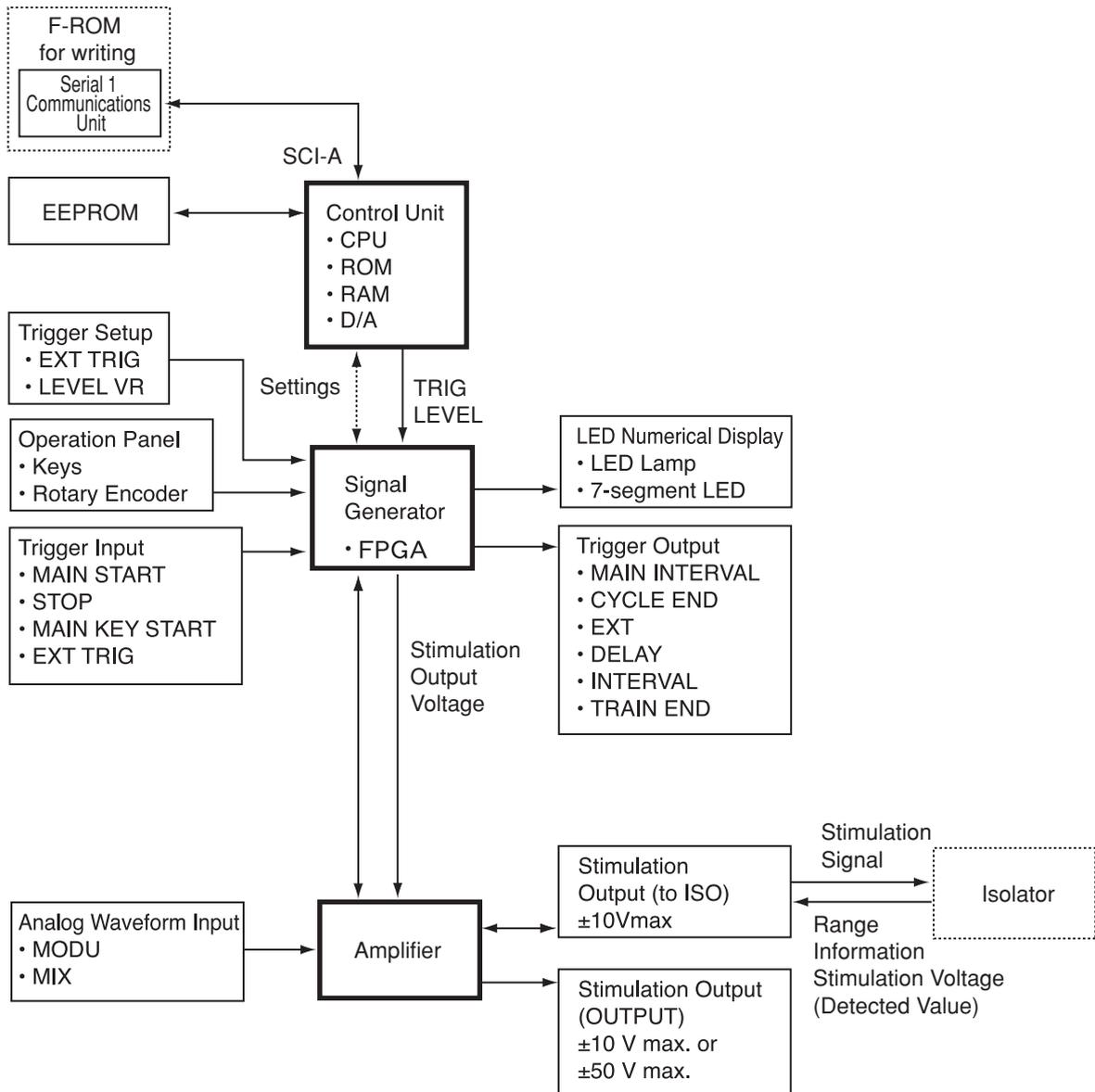
Configuration

Peripheral Devices



[Fig.1]

Electronic Stimulator 1001 Hardware Configuration



[Fig.2]

Precautionary Labels and Indications

See the relevant reference page for details of each label or indication.

⚠ CAUTION

If this instrument is connected to other peripheral devices, be sure that they are connected in the manner specified by the manufacturer.

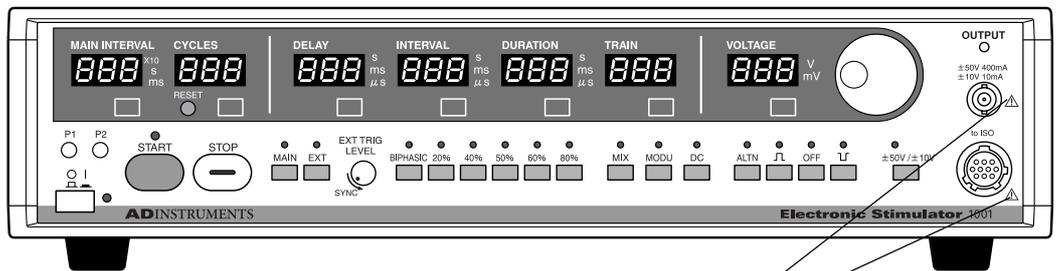
Only connect devices specified by the manufacturer.

Connection to non-specified devices may result in electric shock to the operator by current of leakage.

⚠ CAUTION

Do not touch the connector pins. Discharge electrostatic energy by touching a grounded metal part before connecting. The instrument may be damaged by electrostatic energy.

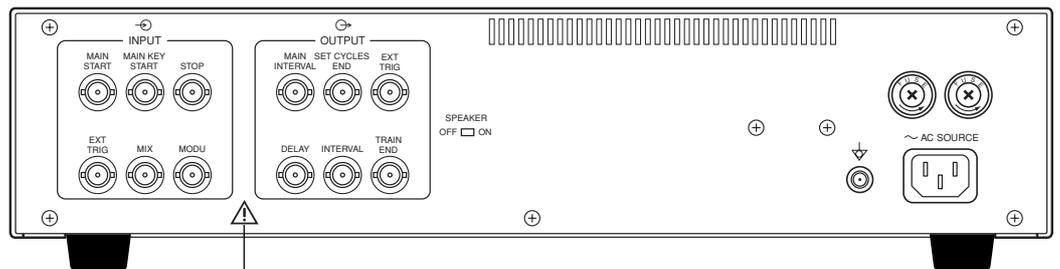
Front



See P.1-14

[Fig.3]

Rear



See P.1-20, 1-22

[Fig.4]

List of Symbols

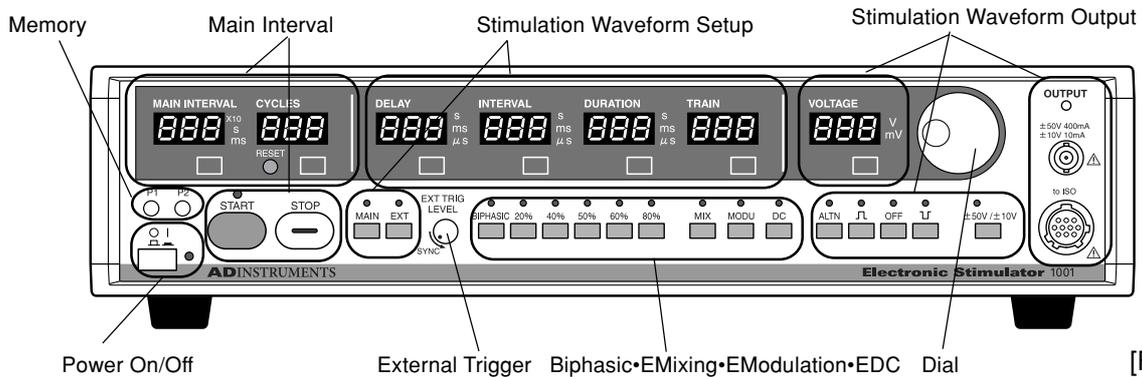
The following symbols are used in connection with the stimulator.
An explanation of each symbol is given in the table below.

* When the description of a symbol used for the stimulator differs from JIS standards, it is shown in brackets.

Symbol	Description	Symbol	Description
	Caution / See attached materials		[Serial I/O Terminal]
	Power ON		Input [Terminal]
	Power OFF		Output [Terminal]
	ON position [Power ON]		Equipotential Ground [Terminal]
	OFF position [Power OFF]		[Positive Polarity]
	Alternative Current (AC)		[Negative Polarity]
	The products marked with this symbol apply to the European WEEE directive 2002/96/EEG and require separate waste collection. For the products labeled with this symbol, contact your representative for disposal at the end of its working life.		

Description of Parts

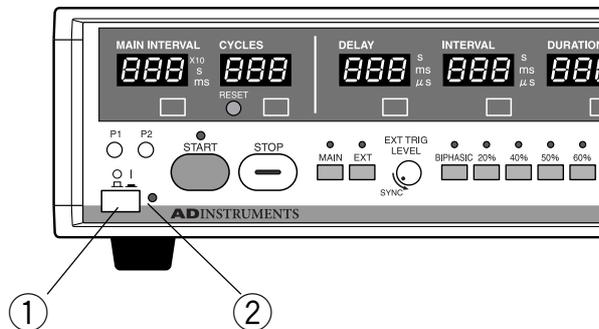
Front



[Fig.5]

Power On/Off

This button is used to turn the power on and off.



[Fig.6]

Name

Function

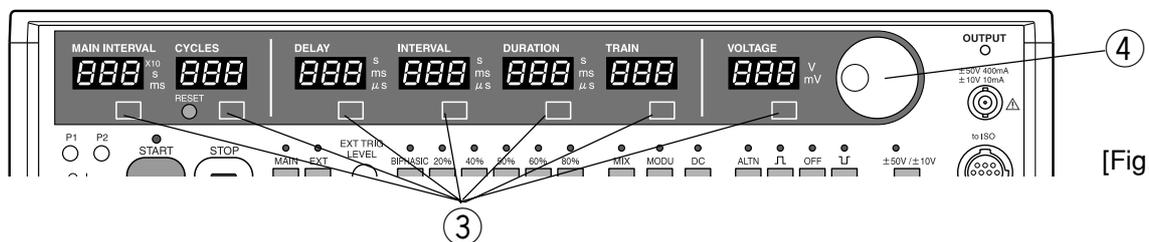
① Power Button

② Power Indicator Lamp

When the power button is pressed (ON position), the power indicator lamp lights and the power is turned on. To turn the power off, press the button again. When the power is turned on, all the LEDs light once (self-check).

Keys and Dial

Used to increase or decrease the set values. (See P.2 for details.)



[Fig.7]

Name

Function

③ Keys

④ Dial

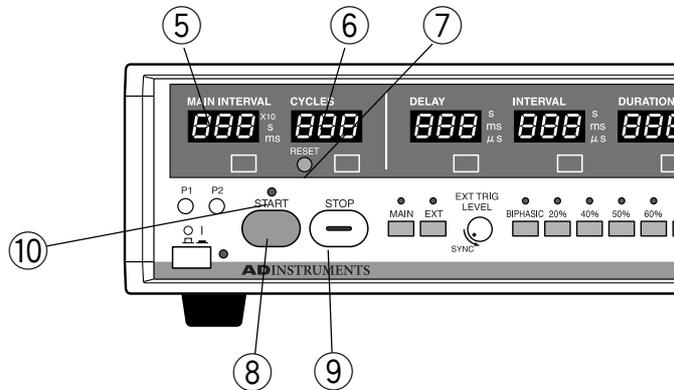
Press to adjust the set values. The indicator for the selected key blinks. The set value changes each time the key is pressed.

Adjusts the set value selected with the selector key. Turn clockwise to increase the value and counterclockwise to decrease the value. When the dial is pressed, the last selected set value blinks and is set.

Main Interval

Controls the repeat cycle (T1) and repeat count (N1) as well as starting and stopping of stimulation.

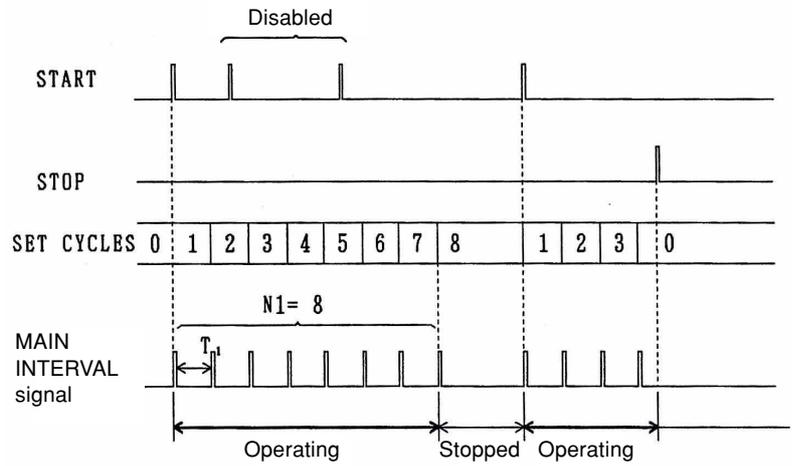
(The timing signal created here acts becomes the trigger as MAIN INTERVAL and is not a direct stimulation waveform.)



[Fig.8]

Name	Function
⑤ Stimulation interval (T1) indicator (MAIN INTERVAL)	Displays the repeat interval (T1) setting. Setting range: 1 ms to 9990 s
⑥ Stimulation count indicator (CYCLES)	<p>Displays the repeat count (N1) setting.</p> <ul style="list-style-type: none"> • CYCLES switches from displaying the repeat count (CYCLES) to displaying the repeat setting (SET CYCLES). (Normally CYCLES is displayed and the indicator is lit.) • When the selector key is pressed, the display changes to SET CYCLES and the indicator blinks. (It automatically returns to CYCLES after about 10 seconds.) • SET CYCLES can be changed by turning the dial while the indicator is blinking. • While CYCLES is displayed, it is synchronized with stimulation output and shows the stimulation count. <p>Setting range: 1 to 999 or to continuous operation (run). When the START signal is received, the set number of pulses is output by MAIN INTERVAL at the set interval (T1) and operation stops. When continuous operation is set (run), after the START signal is received, the MAIN INTERVAL signal continues to be sent at the set interval (T1). Operation continues until the STOP key is pressed.</p>
⑦ Stimulation count cancel key (RESET)	Resets the stimulation repeat count.
⑧ Stimulation start key (START <MANUAL>)	Used to start stimulation manually. When this key is pressed, MAIN INTERVAL operation Starts. The START key is disabled during MAIN INTERVAL operation. (No restart.)
⑨ Stimulation stop key (STOP <MANUAL>)	Used to stop stimulation manually. When this key is pressed, MAIN INTERVAL and all other operation stops and the stimulator returns to initial status.

Name	Function
⑩ MAIN INTERVAL operation lamp	Lights when MAIN INTERVAL is operating. (As it is sometimes difficult to tell whether MAIN INTERVAL is operating when a long interval has been set, operation can be judged by checking the lamp.)

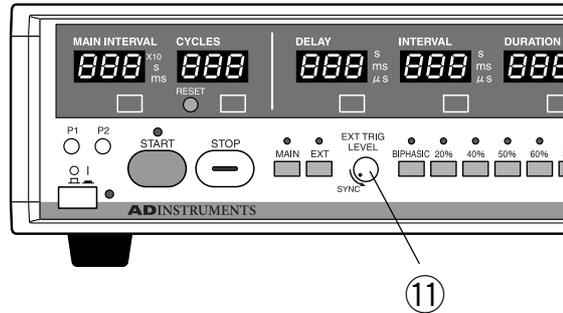


[Fig.9] MAIN INTERVAL operation when SET CYCLES is set to 008

External Trigger (EXT TRIG)

Like MAIN INTERVAL, this generates a trigger pulse. It is used to control the stimulation repeat cycle by an external signal.

When EXT is selected with the trigger selector button, stimulation occurs in synchronization with the signal that is input to the external trigger terminal on the rear of the stimulator.

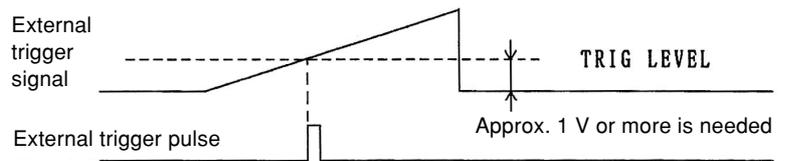


[Fig.10]

Name	Function
① Trigger level adjustment knob (EXT TRIG LEVEL)	Selects whether the trigger is activated at the signal level that is input to the external trigger terminal (on rear). Adjustment range: 0 to ± 10 V.

If the sweep-wave output from the oscilloscope is used as the external trigger signal, the stimulation pulse can be monitored at any position on the oscilloscope tube by setting the level adjustment knob.

Allowing for a noise margin and hysteresis in the built-in comparator, use a trigger signal to oscillate up to about 1 V lower than the trigger level.



[Fig.11]

When set to SYNC

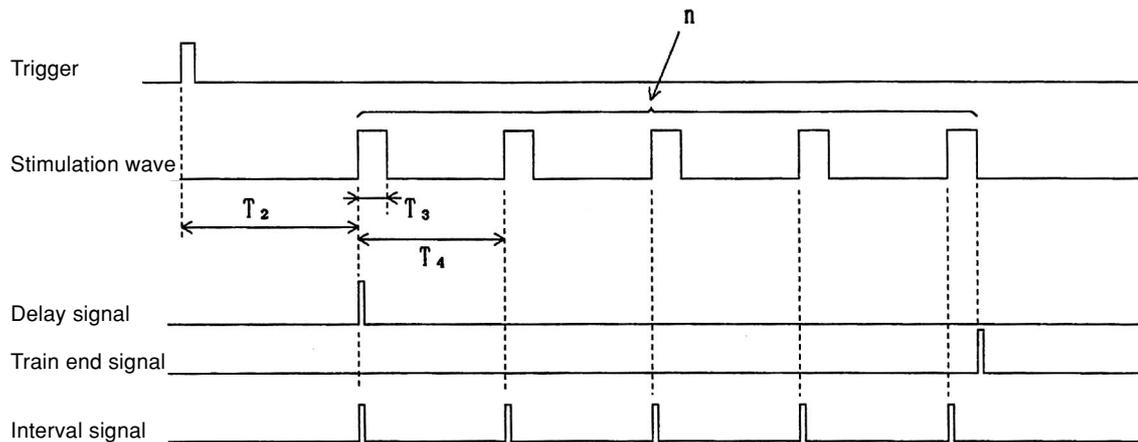
When the knob is turned fully counterclockwise until it locks (SYNC position), the trigger level is approximately +3 V.

When activating the trigger at a pulse of +5 V, the inconvenience of setting the level can be avoided by using this position.

Stimulation Waveform Setup

This component receives the main interval trigger signal, external trigger signal, etc., sets the stimulation wave and timing and sends the signal for stimulation output.

The stimulation wave is determined by the four parameters in the figure below.



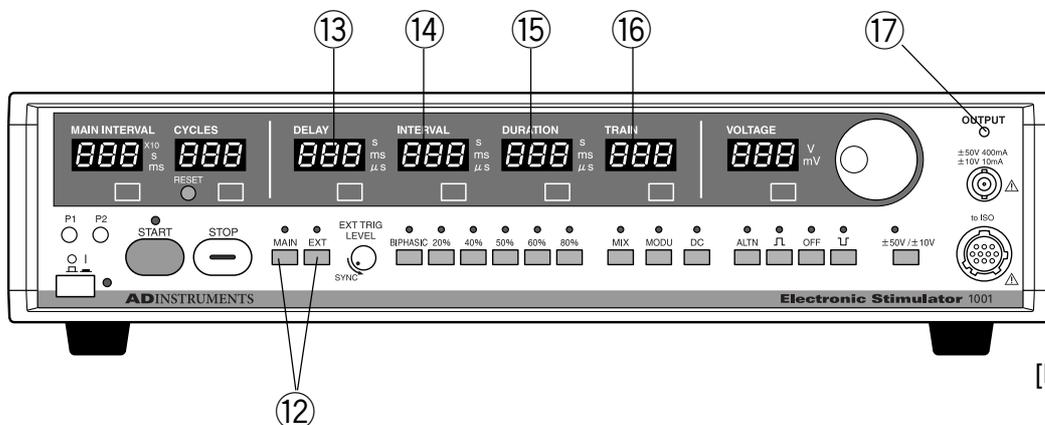
[Fig.12]

T₂ = DELAY: delay time from trigger to start of stimulation

T₃ = DURATION: duration of stimulation pulse

T₄ = INTERVAL: interval between stimulation pulses

n = TRAIN: number of stimulation pulses



[Fig.13]

Name	Function
⑫ Trigger signal selector key (MAIN, EXT)	Selects a trigger signal. The lamp for the selected key lights. MAIN: Signal generated by MAIN INTERVAL described above EXT: Signal generated by EXTERNAL TRIGGER described above
⑬ Delay time display (DELAY)	Sets the delay time (T2) until the channel outputs a stimulation pulse after the trigger signal is received. The timing is shown in Fig.12.

Number	Setting range	Unit
3 digits	0-99.9 sec	s, ms, μ s

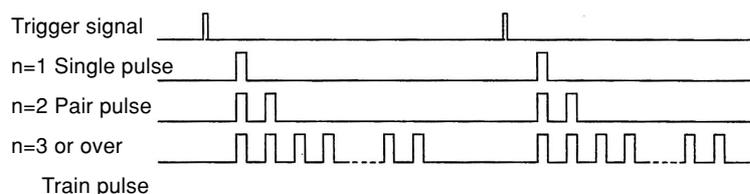
⑭ Stimulation pulse interval display (INTERVAL)	Sets the pulse interval (T4) when the number of stimulation pulses is set by TRAIN to 2 pulses or more or to continuous stimulation (run). The timing is shown in Fig.12.
---	---

Number	Setting range	Unit
3 digits	100 μ sec to 999 sec	s, ms, μ s

⑮ Stimulation pulse duration display (DURATION)	Sets the stimulation pulse duration (T3). The timing is shown in Fig.12.
---	--

Number	Setting range	Unit
3 digits	10 μ sec to 99.9 sec	s, ms, μ s

⑯ Stimulation pulse count display (TRAIN)	Sets the number (n) of stimulation pulses. Fig.12 shows an example when n=5. Setting range: 0 to 999. Single pulse stimulation occurs at n=001, pair pulse stimulation at n=002 and train pulse stimulation at n=003 or over.
---	--



[Fig.14]

When run (set value: 000) is set, continuous stimulation occurs. After the trigger is initiated and the delay time has elapsed, pulse output continues at the set interval (T4).

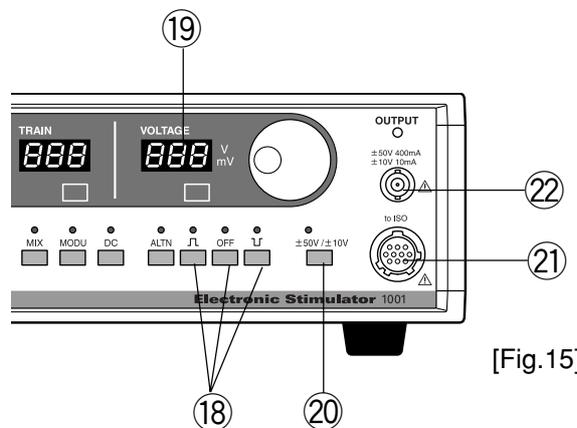
Continuous stimulation continues until the STOP button is pressed.

The following trigger signals are disabled during stimulation.

⑰ Monitor lamp (OUTPUT)	Stimulation pulse monitor lamp. It lights for at least 50 ms in synchronization with the stimulation pulse. If the duration of the stimulation pulse is 50 ms or more, the lamp stays lit for the duration of the pulse. As the purpose of the lamp is to monitor the timing of the stimulation pulse, it operates regardless of the polarity selector key, VOLTAGE setting or MIX key.
----------------------------	--

Stimulation Waveform Output

This sets the polarity of the waveform generated by stimulation waveform setup and the output voltage.



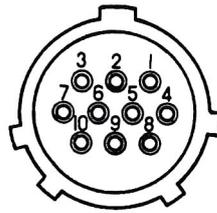
[Fig.15]

Name	Function
⑱ Polarity selector key (⏏, OFF, ⏏)	Switches the polarity of the stimulation pulse. ⏏ indicates positive polarity and ⏏ negative polarity. The selection governs both the isolator connector and the output terminals. Output is 0 V when OFF is selected.
⑲ Output voltage display (VOLTAGE)	Sets the output voltage of the stimulation waveform. Setting is performed by the same method as for other settings. Normally, setting is 0 mV or from 10 mV to 10 V. If ±50 V is selected, setting is 0 mV or from 10 mV to 50 V. (1 mV to 9 mV cannot be set.) This setting does not affect the mixing signal or modulation signal. DC voltage in DC mode is also set. When negative polarity (⏏) is selected with the polarity selector key, it is read as it is as minus voltage. Output precision in relation to the command is within ±5% ±50 mV.

Name	Function
⑳ Output selector key ($\pm 50\text{ V} / \pm 10\text{ V}$)	When the key is pressed, the lamp lights and 5 times the normal voltage of 0 to $\pm 10\text{ V}$ is supplied to the output terminal. This can be used for field stimulation. (max. 0 to $\pm 50\text{ V}$, 400 mA) Additionally, key operation does not affect output to the isolator (to ISO connector).

㉑ to ISO
(Isolator output connector)

Drives the isolator when connected to the connector.



Pin No.	Signal
1, 2	+15V
3	-15V
4	SIGNAL OUT
5	Range data
6	E
7	Range data synchronizing clock
8, 9, 10	Void

[Fig.16]

㉒ Output terminal

As the output waveform is the same as that of the isolator output connector, this is useful for monitoring the stimulation waveform.

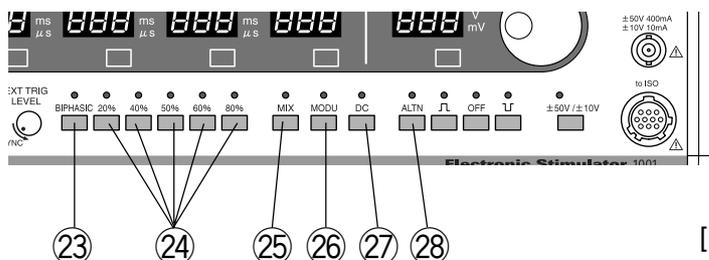
It can also be used for the stimulation signal to the microelectrode amplifier or membrane potential fixing amplifier.

However, when output is switched to $\pm 50\text{ V}$, the waveform is not the same as the isolator output connector signal, and five times the voltage is generated. Use this terminal directly for field stimulation.

[Note] Take care to avoid short-circuiting during stimulation, otherwise no stimulation will occur.

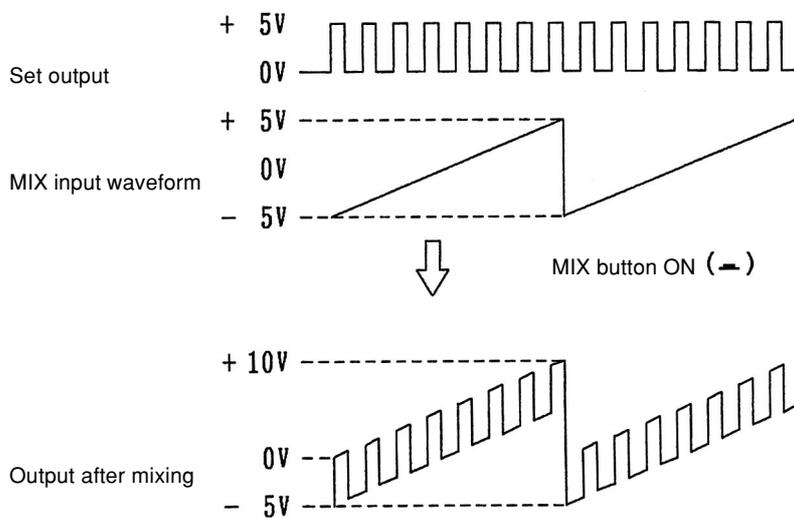
BIPHASIC, MIX, MODU, DC, ALTN

These keys are used when stimulation is performed by biphasic wave, a composite wave created by mixing with an external waveform, a waveform where the external signal has been modulated by internal oscillation, or with DC voltage.



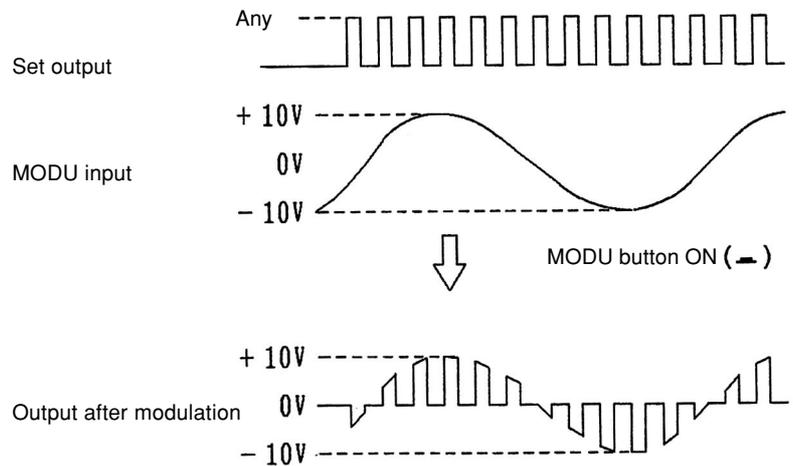
[Fig.17]

Name	Function
②③ Biphasic waveform key (BIPHASIC)	Press to output a biphasic waveform. (The lamp lights.)
②④ Biphasic negative polarity voltage selector key (20%, 40%, 50%, 60%, 80%)	Selects a time percentage in relation to the value set by DURATION of the positive-polarity pulse in biphasic waveform. The set value becomes the time percentage of the positive-polarity pulse and the remaining time becomes the negative-polarity pulse. The lamp for the selected key lights.
②⑤ Waveform mixing key (MIX)	When the MIX key is pressed, the set stimulation waveform can be combined with another waveform. (The lamp lights.) Amplitude is added in units of 1. The waveform becomes distorted if the voltage after mixing exceeds a range of ± 10 V.



[Fig.18]

Name	Function
②⑥ Waveform modulation key (MODU)	Press this key to modulate the external signal to the waveform created in stimulation waveform setup described above. (The lamp lights.) Connect the modulated signal to the MODU terminal on the rear of the stimulator. The VOLTAGE setting is disabled when this key is pressed.



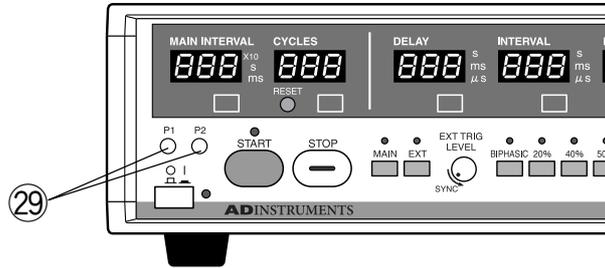
[Fig.19]

The range of the input voltage is within ± 10 V. Output is modulated in the same amplitude as the input signal.

②⑦ Direct current key (DC)	Press this key to create DC stimulation. (The lamp lights.) When this key is pressed, a DC signal is output, regardless of the setting or action of the stimulation waveform setup described above. The output voltage is set by VOLTAGE. When the polarity selector key is set to \lrcorner , plus-voltage is generated, and when it is set to \llcorner , minus- voltage is generated. There is no output when set to OFF.
②⑧ Alternate key (ALTN)	Stimulation waveforms can be output by alternate polarity. Both the isolator connector and the output terminals are affected. The polarity is not switched in relation to the MIXING or MODULATION signal.

Memory

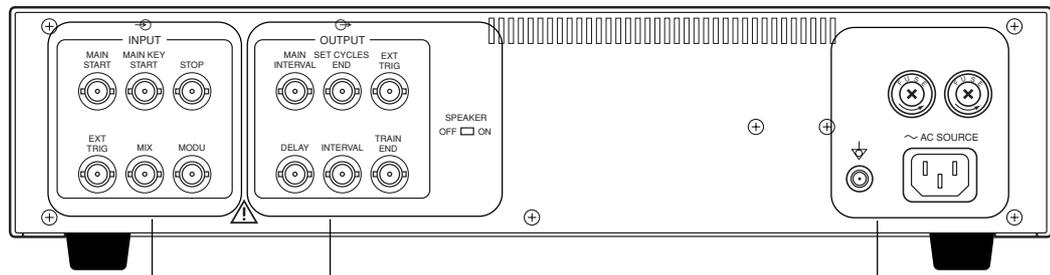
Settings can be saved for retrieval later.



[Fig.20]

Name	Function
② Memory keys (P1, P2)	To save the settings, press P1 or P2 for more than 2 seconds. The current settings are saved to the selected memory. Pressing P1 or P2 briefly later will retrieve and apply the saved settings.

Rear



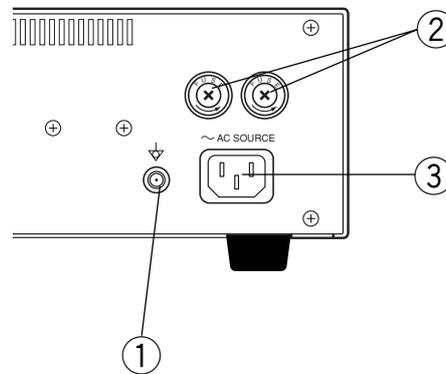
External input terminals

Synchronization signal output terminals

Power

[Fig.21]

Power

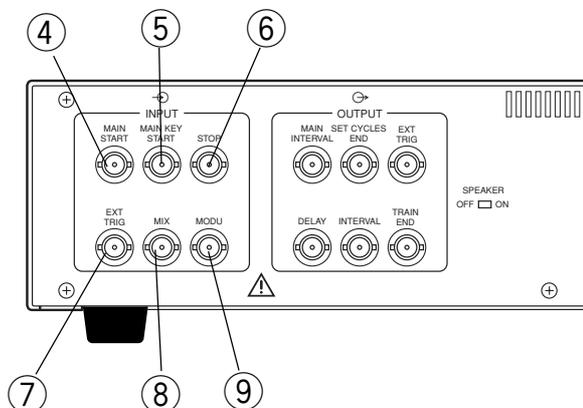


[Fig.22]

Name	Function
① Equipotential ground terminal	Connect the ground wires of accessory devices to ground the devices.
② Fuse holder (FUSE)	Contains a time-lag fuse. The fuse should only be changed by Nihon Kohden sales personnel or a qualified electrician. To change the fuse, turn the “+” groove in the holder with a screwdriver, remove the fuse and insert the supplied new fuse.
③ Power IN connector (AC SOURCE)	Connect the supplied power cable to supply AC power to the stimulator.

External Signal Input Terminals

[Note] Input the signals to the input terminals in the range specified in the input conditions. If the signal exceeds the range, it may cause failure or malfunction.



[Fig.23]

Name	Function
④ Main start signal input terminal (MAIN START)	Input the signal to this terminal to commence main interval operation by an external signal. It has the same function as the START button on the front panel. The input signal must be a pulse waveform of +3.5 V or over with a width of 10 μ sec or over.
⑤ Main key start terminal (MAIN KEY START)	When this terminal is short-circuited to the E (Earth) terminal, MAIN INTERVAL operation commences. The function is the same as the START button on the front panel.
⑥ Stop signal input terminal (STOP)	Input the signal to this terminal to stop stimulation by an external signal. The function is the same as the STOP button on the front panel. The input signal conditions are the same as for START.
⑦ External trigger input terminal (EXT TRIG)	Input a signal to this terminal to trigger stimulation by an external signal. Setting range: 0 to +10 V. (See “External trigger level knob”) <ul style="list-style-type: none"> • Input conditions <ul style="list-style-type: none"> Input impedance: approx. 100 kilohms Allowable range of input voltage: 0 to +50 V

Name	Function
⑧ Mixing signal input terminal (MIX)	<p>Input the desired signal to this terminal to combine it with an external signal when performing stimulation.</p> <p>The mixed signal can be obtained by pressing the MIX key on the front panel after connecting the signal.</p> <ul style="list-style-type: none"> • Input conditions <ul style="list-style-type: none"> Input impedance: approx. 100 kilohms Effective input voltage range: ± 10 V
⑨ Modulation signal input terminal (MODU)	<p>Input the signal to this terminal to modulate the external waveform by internal oscillation. When the waveform has been modulated by the internally created pulse, it can be output by pressing the MODU key on the front panel after connecting the signal.</p> <ul style="list-style-type: none"> • Input conditions <ul style="list-style-type: none"> Input impedance: approx. 100 kilohms Effective input voltage range: ± 10 V

Synchronizing Signal Output Terminal

The following signal is provided as a synchronizing signal for other devices.

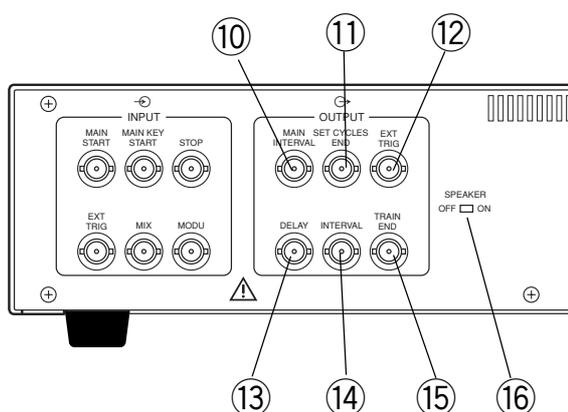
The synchronizing signal is output regardless of the MIX, MODU or DC polarity selector keys or the VOLTAGE setting.

For example, even when the DC key is pressed and no pulse is output, the END and DELAY pulses are output according to stimulation waveform setup.

Output impedance: approx. 1 kilohm

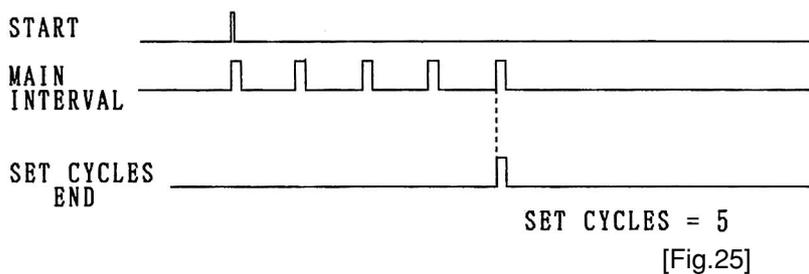
Amplitude: approx. +5 V

Pulse duration: approx. 500 μ s



[Fig.24]

Name	Function
Main interval output terminal (MAIN INTERVAL)	Generates a pulse that is synchronized with the MAIN INTERVAL trigger signal.
Set cycle end signal output (SET CYCLES END)	Generates a pulse that is synchronized with the last MAIN INTERVAL repeat pulse. When CYCLES is set to 005 and MAIN INTERVAL is started, the pulse is output at the fifth main interval.
External trigger output terminal (EXT TRIG)	Generates a pulse that is synchronized with the trigger signal created by the external trigger signal.



[Fig.25]

name	Function
Delay signal output terminal (DELAY)	Generates a pulse that is synchronized with the delay signal generated by stimulation waveform setup. (See Fig.12 for the timing.)
Interval signal output terminal (INTERVAL)	Generates a pulse that is synchronized with the interval. (See Fig.12 for the timing.)
Train end signal output terminal (TRAIN END)	Generates a pulse that is synchronized with the train end signal generated by stimulation waveform setup. (See Fig.12 for the timing.)
Synchronized sound on/off switch (SPEAKER ON/OFF)	Switches the synchronized sound on and off.

General Handling Precautions

⚠ CAUTION

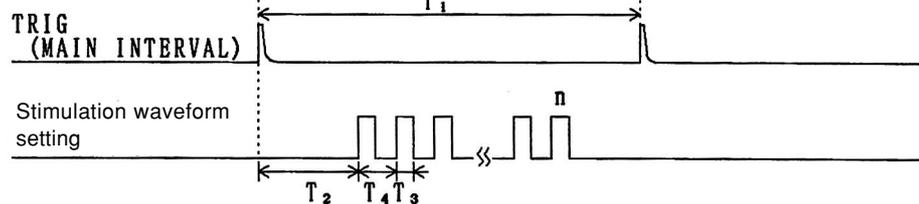
The electronic stimulator has a high voltage output capacity of up to ± 50 V.

Directly touching the output terminals or electrodes during stimulation or when the power cable is connected during inspection and the stimulator is operable may result in electric shock.

1. The timing for each stimulation waveform setting is set automatically according to the following equation.

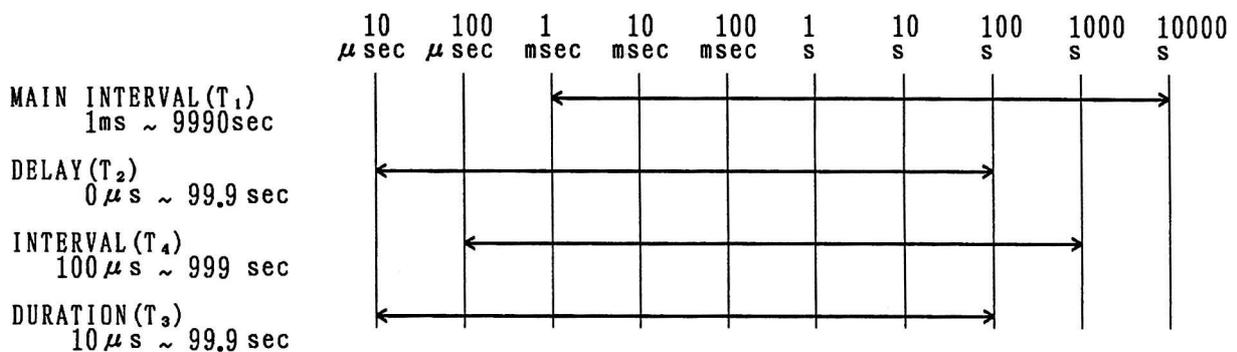
$$T_1 > T_2 + T_4 \times (n - 1) + T_3$$

$$T_4 > T_3$$



[Fig.27]

Setting is performed in the order $T_1 > T_2 > T_4 > T_3 > n$.



[Fig.28]

2. Make sure that operation has stopped before pressing the keys. If the keys are pressed while the stimulator is operating, the new setting will be reflected in stimulator operation immediately. Care must therefore be taken as unexpected stimulation may result.

3. When all the number settings on the dial are set to 0, the following occurs.

CYCLE: Continuous stimulation (indicated as "run")

DELAY: Delay time = 0

TRAIN: Continuous stimulation (indicated as "run")

5. The output terminal has a short-circuit protective circuit, but avoid short-circuiting for long periods as this may adversely affect the performance of the stimulator.
6. When the power is turned on, output is momentarily unstable and a spike pulse may be generated. When stimulating, this spike may become the stimulation pulse. Turn the power on before attaching the electrodes.
7. Do not use the stimulator with the cover on as this may cause overheating.

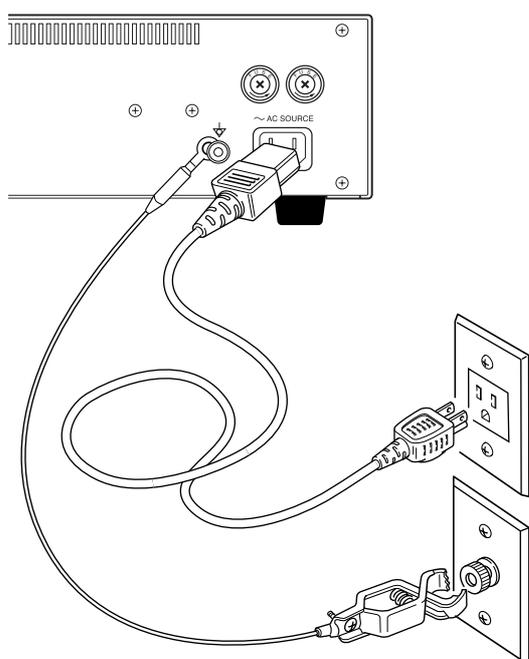
Preparation

Installing the Stimulator

Take the following precautions when installing the stimulator.

1. Avoid contact with water or chemicals. Also, avoid direct contact with mist or humidified air from a humidifier as this may cause malfunction or reduce the service life of the stimulator.
2. Keep out of direct sunlight as this may result in an unexpected rise in temperature, causing malfunction or reducing the service life of the stimulator.
3. Make sure that the area is well ventilated. If the temperature inside the stimulator rises, it may cause malfunction or reduce the service life of the stimulator.
4. Do not place blankets or other objects on top of the stimulator.
5. Avoid placing in an area that is exposed to dust.
6. The power source must have sufficient capacity to supply the necessary power requirements of the stimulator. Reduced power resulting from insufficient capacity may affect the performance of the stimulator or activate the breaker, causing a power failure.
7. If any irregularity occurs when the power is turned on, turn the power off immediately and unplug the power cable from the power outlet. At the same time, mark the stimulator clearly as “Out of Order” and do not use it until it has been inspected and repaired.

Connection of Cables



[Fig.29]

1. Ground wire

Connect the supplied ground wire to the ground terminal and connect the other end to a reliable grounding conductor.

- Avoid using water pipes as the grounding conductor as their grounding capability may not be reliable.
- It is prohibited by law to use gas pipes as a grounding conductor.

2. Power cable

Insert the supplied power cable with 3-pin plug into the power socket and insert the other end into an AC wall outlet.

⚠ CAUTION

Always use the supplied 3-pin cable for the power cable.
If any other power cable is used, it may result in an electric shock to the operator.

[Note] When the power cable with 3-pin plug is grounded in a 3-pin outlet with grounding electrode, the stimulator is automatically grounded. However, to prevent the effects of a broken ground wire inside the power cable, double grounding is recommended using the supplied ground wire.

3. When stimulating with the isolator, connect the isolator to the [to ISO] output connector.

[Note] • When connecting the isolator, tighten the screw firmly to prevent the cable from coming loose.

- When connecting the stimulation output cable, connect the cable securely to prevent it from coming loose.

4. If necessary, connect an oscilloscope and recorder and data acquisition/analysis system, etc. as peripheral devices to measure and record phenomena after stimulation.

Specifications

Stimulation Trigger

Main Interval

(1) START

- A) MANUAL switch (front panel)
- B) START INPUT (rear)
 - Input pulse: +3.5 V or over, 10 μ s or over
 - Input impedance: 10 kilohms or over
- C) Short-circuit of KEY terminal (rear) and E terminal

2) STOP

- A) MANUAL switch (front panel)
- B) STOP INPUT (rear)
 - Input pulse: +3.5 V or over, 10 μ s or over
 - Input impedance: 10 kilohms and over

3) SET CYCLES

- Setting range: 1 ms to 9990 s, within $\pm 0.1\%$
- Unit: ms, s
- Number: 3 digits

4) CYCLES

- Repeat count: 1 to 999
- Continuous stimulation: when set to "run"

5) External trigger

- TRIG LEVEL: 0 to +10 V continuous variable
 - Approx. 3 V when turned fully counterclockwise
- Input impedance: 100 kilohms or over

Stimulation Waveform Setup

1) DELAY

- Setting range: 0 to 99.9 s, $\pm 1\%$, within $\pm 2 \mu$ s
- Unit: μ s, ms, s
- Number: 3 digits

2) INTERVAL

- Setting range: 100 μ to 999s, within $\pm 0.1\%$
- Unit: μ s, ms, s
- Number: 3 digits

3) DURATION

- Setting range: 10 μ to 99.9 s, $\pm 1\%$, within $\pm 2 \mu$ s
- Unit: μ s, ms, s
- Number: 3 digits

4) TRAIN

Setting range: 1 to 999

Continuous operation when set to "run"

Stimulation Output

1) Output polarity and OFF

Polarity switch: Positive/negative polarity

(No effect on MODULATION or MIXING polarity)

OFF: No output to ISOLATOR or OUTPUT

2) MODULATION

Amplitude: Depends on amplitude of external signal including polarity (Max. ± 10 V)

Linearity: within $\pm 7\%$ at ± 1 V to ± 10 V

Input impedance: 100 kilohms or over

No modulation in relation to MIXING waveform

3) MIXING

Mixing method: Analog addition

Mixing voltage range: 0 to ± 10 V

(Voltage after mixing: max. ± 10 V)

Linearity: within $\pm 7\%$ at ± 1 V to ± 10 V

Input impedance: 100 kilohms or over

4) DC

Output voltage: Direct current 0 to ± 10 V

Direct current 0 to ± 50 V when ± 50 V output is selected

5) Isolator output (to ISO)

Pin: 1, 2 +15 V

3 -15 V

4 Signal output

5 Range data

6 E

7 Range data synchronizing clock

8 Void

9 Void

10 Void

The fourth signal is not output fivefold when ± 50 V output is selected. (± 10 V)

6) Output

Linearity: 0 to ± 1 V, within ± 50 mV

Within ± 1 V to ± 10 V $\pm 5\%$

Output impedance: 100 kilohms or less (at $R_L \geq 2$ kilohms)

Output waveform: 3 μ s or less both rising and falling

Excessive deviation: 5% or less

7) ± 50 V output

Linearity: 0 to ± 5 V, within ± 100 mV

± 5 V to ± 50 V, within $\pm 5\%$

Output impedance: 10 ohms or less

Output waveform: 7 μ s or less both rising and falling

Excessive deviation: 10% or less

Maximum output current: 400 mA or over

Synchronized Output Signal

1) Output signal name

MAIN INTERVAL

SET CYCLES END

EXT TRIG

DELAY

INTERVAL

TRAIN END

2) Output signal

Amplitude: +5 V

Pulse width: approx. 500 μ s

Rising: 3 μ s or less

Output impedance: 1 kilohm or less

Language

English

Power Source

Voltage: AC 110 V, 220 V or 240 V $\pm 10\%$

(Changed voltage range by the connector)

Frequency: 50/60 Hz

Power input: 70 VA

Environment

Main operating environment: Laboratory

Operating Environment

Temperature: 10 to 40°C

Humidity: 30 to 90%

Atmospheric pressure: 70 to 106 kPa

Storage Environment

Temperature: -20 to 60°C

Humidity: 10 to 95%

Atmospheric pressure: 70 to 106 kPa

Durability

6 years (based on self-certification of company data)

Installation

Indoor installation type

Safety Standards

Applicable safety standards: IEC 60601-1

IEC 60601-1-2 :2001

Type of protection against electrical shock: Class I

Degree of protection against electrical shock where attached:

B applied parts

Degree of protection against harmful ingress or liquids:

IPX0 (devices w/o special protection)

Mode of operation: Continuous operation

Voltage endurance: AC 1500 V, 1 minute

Leakage current: 100 μ A or less for both earth leakage and enclosure leakage

Insulation resistance: 50 megohms or over (DC 500 V)

Mechanical strength of stimulator: Compliant with impact NS7231-5.7, vibration NS7231-5.8

Dimensions and Weight

Dimensions: 430 (W) x 98 (H) x 300 (D) mm

Weight: Approx. 8.3 kg

Electromagnetic Compatibility

IEC 60601-1-2 :2001

EMC level (CISPR11) Class B

Guidance and manufacture's declaration - electromagnetic emissions

This Model 1001 is intended for use in the electromagnetic environment specified below.

The customer or the user of the 1001 should assure that it is used in such an environment.

Emissions test	Compliance	Electromagnetic environment guidance
RF emissions CISPR 11	Group 1	The 1001 uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The 1001 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-3	Complies	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Guidance and manufacture's declaration - electromagnetic immunity

This Model 1001 is intended for use in the electromagnetic environment specified below.

The customer or the user of the 1001 should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment -Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/ burst IEC 61000-4-4	± 2 kV for power supply lines	± 2 kV for power supply lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_t (>95% dip in U_t) for 0.5 cycle 40% U_t (60% dip in U_t) for 5 cycles 70% U_t (30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5s	<5% U_t (>95% dip in U_t) for 0.5 cycle 40% U_t (60% dip in U_t) for 5 cycles 70% U_t (30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5s	Mains power quality should be that of a typical commercial or hospital environment. If the user of the 1001 requires continued operation during power mains interruptions, it is recommended that the 1001 be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_t is the AC mains voltage prior to application of the test level.			

Guidance and manufacture's declaration - electromagnetic immunity

This Model 1001 is intended for use in the electromagnetic environment specified below.

The customer or the user of the 1001 should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
<p>Conducted RF IEC 61000-4-6</p> <p>Radiated RF IEC 61000-4-3</p>	<p>3 Vrms 150 kHz to 80 MHz</p> <p>3 V/m 80 MHz to 2.5 GHz</p>	<p>3 Vrms 150 kHz to 80 MHz</p> <p>3 V/m 80 MHz to 2.5 GHz</p>	<p>Portable and mobile RF communications equipment should be used no closer to any part of the 1001, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p>Recommended separation distance</p> $d = 1.2\sqrt{P}$ <p>$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz</p> <p>where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey*¹, should be less than the compliance level in each frequency range*².</p> <p>Interference may occur in the vicinity of equipment</p> 
<p>NOTE1: At 80 MHz and 800 MHz, the higher frequency range applies.</p> <p>NOTE2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p>			
<p>*¹ Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the 1001 is used exceeds the applicable RF compliance level above, the 1001 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the 1001.</p> <p>*² Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.</p>			

Recommended separation distances between portable and mobile RF communications equipment and the 1001

This Model 1001 is intended for use in the electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the 1101 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the 1001 as recommended below, according to the maximum output power of the communications.

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter (m)		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.72
1	1.2	1.2	2.3
10	3.8	3.8	7.2
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
NOTE2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

System Composition for EMC test

This 1001 is tested to comply with IEC 60601-1-2 :2001 with the following composition. If any part which is not specified by our company is used, the EMC specifications might not be satisfied.

Units	Cable length
1001 Electronic stimulator	—
Output Code (12pc)	2 m