NoiseKen

INSTRUCTION MANUAL

IMPULSE NOISE SIMULATOR

MODEL INS-4020/4040

NOISE LABORATORY CO., LTD.

Edition 2.03
AEB00319-00E-1D

NOTICE

The contents of this booklet are subject to change without prior notice.

The contents of this booklet have been thoroughly checked. However, if a doubtful point, an error in writing or a missing is found, please contact us.

Noise Laboratory Co., Ltd. shall have no liability for any trouble resulting from the misuse or improper handling of this product regardless of the contents of this booklet or arising from the repair or remodeling of this product by a third party other than Noise Laboratory Co., Ltd. or its authorized person.

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1 IMPORTANT SAFETY PRECAUTIONS

This manual contains important information pertaining to the operation and maintenance of your Impulse Noise Simulator Model: INS-4020/4040. In order to obtain the highest performance from this simulator, it is recommended that the contents of this manual be thoroughly understood and used as ready reference for operation and maintenance.

The "Important Safety Precautions" explain rules that must be followed to prevent any risk of harm or injury to the user of the instrument or to other people.

- **The instrument may only be used by trained EMC technicians (electrical technicians)**
  Failure to follow this rule risks death or serious injury.
- **The instrument may not be used by people fitted with electronic medical devices such as pacemakers and such people may not enter the testing site while the instrument is operating**
  The medical device may malfunction since the instrument emits more electromagnetic wave than the regulated value.
- **Do not use the instrument for any purposes other than the EMC testing purposes described in this instruction manual**.
  The instrument is not supposed to be used in manufacturing process of a factory.
- **The instrument may not be used in a location where fire is prohibited or there is a risk of explosion**
  Failure to follow this rule risks igniting a fire due to an electrical discharge.
- **The supplied AC power cable of the instrument is intended only for Japan and North America.**
  In case of using the instrument in other countries than the above, use an AC power cable that is certified for use under the safety rules of the country in which the instrument is being used.

Before building test set up, connecting the instrument, power supply or EUT, or starting testing, be sure to read Section 4 BASIC SAFETY PRECAUTIONS.

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2 APPLICATION FORM FOR INSTRUCTION MANUAL

We place an order for an instruction manual.

Model: INS-4020/4040

Serial No.:

Applicant:

Company name: _____

Address: _____

_____

Department: _____

Person in charge: _____

Tel No.: _____

Fax No.: _____

Cut off this page "application form for instruction manual" from this volume and keep it for future use with care.

When an INSTRUCTION MANUAL is required, fill in the above Application Form and mail or fax it to your nearest sales agent of Noise Laboratory or Noise Laboratory.

Your sales agent:

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NOISE LABORATORY CO., LTD.
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4 Preface

This manual contains important information pertaining to the operation and maintenance of your Impulse Noise Simulator Model: INS-4020/4040. In order to obtain the highest performance from this simulator, it is recommended that the contents of this manual be thoroughly understood and used as ready reference for operation and maintenance.

5 BASIC SAFETY PRECAUTIONS

5.1 Warning signs and their meanings

This sign is shown at areas where HV voltages potentially hazardous to human are present.

Sign for caution. For potential dangers or mishandling that could cause injuries or material damage, this instruction manual shall be referred to.

Sign for a protective earth terminal.

Means a danger.

If such a danger is not avoided, it leads to a state of critical urgency, which should result in a death or serious injury.

Means a warning.

If such a danger is not avoided, a potential danger which may result in a death or serious injury will be caused.

Means a caution.

If such a danger is not avoided, a potential danger which may result in a minor or medium degree of injury will be caused.

5.2 Basic safety precautions

1. Any person who has an implanted pacemaker in the body should not operate this unit. Furthermore, such a person should not enter the test area while this unit is operating.
【Precautions for human body and operation】

2. Use of this unit in an explosive area such as "No fire" area etc. is prohibited. If used in such an area, it is liable to cause combustion or ignition due to discharge.
【Precautions for human body and environments】

3. The AC INPUT (AC inlet) terminal on the rear panel has a conductor for safety grounding connection. This unit shall be connected to a properly grounded service outlet through the AC INPUT. When this unit is not grounded through the AC INPUT, PE terminal positioned next to it shall be used.

【Precautions for connection】

4. Before connecting the EUT LINE INPUT to a power supply, be sure to turn off the power supply, otherwise supply power voltage may cause an electric shock hazard.
【Precautions for human body and connections】

5. High voltages exist inside the unit. Never open the covers, except when a mercury relay replacement is required. 【Precautions for human body】

6. Mishandling and careless operation of this unit will result in a deadly injury.
【Precautions for human body, operation, environment and connection】

⚠WARNING 警告

1. The test rig used in conjunction with this unit should be insulated against a minimum voltage of 8kV (when the built-in 50Ω terminator disconnected from the test circuit).
【Precautions for environments】

2. Be sure to connect the ground plane to the safety ground.
【Precautions for operation and safety】

3. When connecting cables and carrying out settings, place the unit in the STOP conditions and interrupt the EUT supply beforehand, otherwise, an electric shock due to high voltage may be caused or the unit may be damaged. Even in the STOP conditions, allow 5 seconds to elapse, as residual voltages may exist.
【Precautions for human body and connection】

4. The coaxial connectors used for this unit is of NoiseKen original design. Use of other type of connectors may cause electric shock hazards or malfunctions of the unit.
【Precautions for handling and safety】

5. Fully put in each coaxial connector and make sure connections by rotating it clockwise until a “click” is heard. Insufficient connection leads to unwanted discharges inside the coaxial connectors. 【Precautions for human body and connection】

6. Any other connection than the supplied SG short plug shall not be connected to the SG connector of this unit. Wrong connections may apply HV pulses to the ground plane, causing a shock hazard.
【Precautions for human body and connection】

7. To ensure safety in operation, use the accessories (use power cord and LINE input cable with relevant safety agency approval) and optional equipment supplied by our company. Use of others may degrade the safety and performance of this unit.
【Precaution for handling and safety】

8. This unit has no built-in protection circuit for EUT supply. An external protective device such as fuses, circuit breaker or protector meeting the EUT rating shall be installed.

9. When conducting coupling tests to the EUT LINE, the signal ground of the HV pulse generator circuit and one line of the EUT LINE may be connected, causing a shock hazard if the users touch the outer conductor of the HV coaxial connectors. In addition, if the outer conductor of the HV coaxial connectors is connected to any grounded object, leak current will flow, tripping the ground fault interrupter

embedded in the facilities. To avoid these two types of events, use of an isolation transformer is indispensable. Be sure to connect the EUT LINE INPUT to the isolation transformer secondary. 【Precautions for human body and connection】

10. When connecting cables and carrying out settings, place the unit in the STOP conditions and interrupt the EUT supply beforehand, otherwise, an electric shock due to high voltage may be caused or the unit may be damaged. Even in the STOP conditions, allow 5 seconds to elapse, as residual voltages may exist.
【Precautions for human body and connection】

11. While this unit is producing pulses or EUT power is being supplied to the EUT LINE INPUT, do not touch the HV coaxial connectors. Touching them may cause a shock hazard.
【Precautions for human body and operation】

12. NOISE LABORATORY and its sales agents shall have no liability against any accident resulting in injury or death, any damage to equipment or any resultant damage thereof, which is caused by abuse or careless handling of this unit.
【Precautions for human body, operation, environments and connection】

1. As this unit employs a mercury relay, it shall be positioned horizontally only.
【Precautions for handling】

2. Do not supply voltage exceeding the rated voltage range. Do not connect the EUT exceeding the rated power capacity of this unit.
【Precautions for installation and connection】

3. The SG terminal provided on the front panel of this unit functions as the signal reference ground for testing. The PE terminal (EUT) is for the protective earth conductor for the EUT. The protective earth terminals for this unit itself are the AC inlet earth pin (AC INPUT) and PE positioned in close proximity to it. These SG, EUT PE, the simulator PE are independent each other. When conducting tests, make connections according to Section 10 test Set-ups.
【Precautions for operation and connection】

4. The supplied SG short plug shall not be connected to any other port than L1, L2, PE injection connector or SG coaxial connectors. Connection to the wrong port may damage the unit.
【Precautions for operation and connection】

5. The PE terminals of EUT LINE INPUT and EUT LINE OUTPUT are floating from the chassis of this unit similarly to L1 and L2 terminals. When using the PE line, use an appropriate power cord meeting your country's safety regulations and EUT power rating.

6. During test, high level of electromagnetic radiation may be generated depending on the type or nature of the EUT and thus causing interference with nearby electronic equipment and radio communication equipment. In such case, the user may have to take measures such as a faraday cage, shielded room, and shielded cable and so on. 【Precaution for environments】

7. Do not use nor keep the unit in a hot or cold environment (Operating temperature: 15°C~35°C/Operating humidity range: 25~75%) otherwise, the unit may be damaged or only exhibit limited performance. 【Precaution for

environments】

8. If condensation is found, fully dry the unit before operating it, otherwise, the unit may be damaged or only exhibit limited performance. 【Precautions for environments】

9. The coaxial connectors used for this unit may have a shortened life due to a poor insulation capability caused by a metal powder accumulation on the connecting part, generated by a frictional wear with insertion and removal. Clean the connectors by blowing a high pressure air. 【Precautions for handling】

10. When installing the unit, do not block the vent. 【Precaution for environments】

11. Do not drop the unit or do not give strong shock to the unit.
【Precaution for handling】

12. Do not wipe off the body and peripheral equipment with thinner, alcohol or other solvent. When the unit is dirty, soak a cloth in a detergent, wring it and wipe the unit with this cloth. Using solvents may spoil the appearance.
【Precautions for handling】

13. Only a service engineer authorized by our company should perform repair, maintenance work and internal adjustment.
【Precaution for handling and safety】

14. **This unit employs a user-replaceable mercury switch. The component shall be disposed of in conformity to the local regulations. Similarly, when scrapping the product, follow the regulations.**

5.3 When warning label is missing

1. When warning label is lost, or peeled off or dirty, put up a new one for extra safety.

2. When warning label is lost, contact our company's sales dept. or maintenance dept. for issuance.

5.4 Restrictions to comply with CE marking requirements

1. **Restrictions to comply with Low Voltage Directive (EN61010-1).**
   Use an AC cord and LINE Input cord with European Safety Agency approvals.

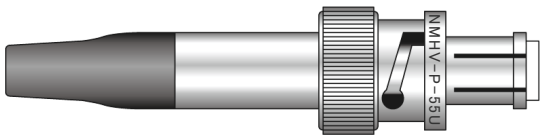
2. **Installation category (for details, refer to IEC 664)**
   Installation category II: local level, appliances, portable equipment etc., with smaller transient over voltages than installation category III.

3. **Pollution degree**
   Pollution degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

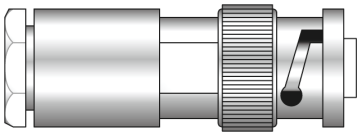
5.5 Coaxial connectors used for this product

The coaxial connectors used for this unit is of NoiseKen original design. Use of other type of connectors may cause electric shock hazards or malfunctions of the unit. Be sure to use accessories and options supplied by our company.

We have updated coaxial connector specifications to match the output pulse voltage from the NoiseKen INS. This product (INS-4020/4040) uses a custom design connector called NMHV which our company designed for 3kV or higher voltage application. In the market, there are some other types of coaxial connectors similar to the NMHV. Even when they have similar appearances, they are different from the NMVH in terms of the inner conductor projection and length of the insulator. Misconnection of a different type of connector to the NMHV may cause internal discharges, leading to an unexpected shock hazard or a failure of this product. For avoiding this kind of misuse, a marking of “NMHV-P-55U” is given on the fringe of the leading edge of a connector lock. If NMHV connectors have been mixed up with other types of connectors, discriminate NMHV connectors and use them only. Before adoption of the NMHV, our company used the other type connector called MHV for INS-400 series (2kV pulse output) such as model INS-410, INS-420 etc. and their options. The MHV connector cannot be used for this product (INS-4020/4040) for the above mentioned reason. The NMHV and MHV connectors are quite different in appearance and thus they can be easily identified.
When using an external coupling unit such as IJ-4050 or other optional products, check the connector type and use accessory and cables supplied by our company.



NMHV：INS-4020／4040



MHV：INS-400 seris

6 GENERAL DESCRIPTION

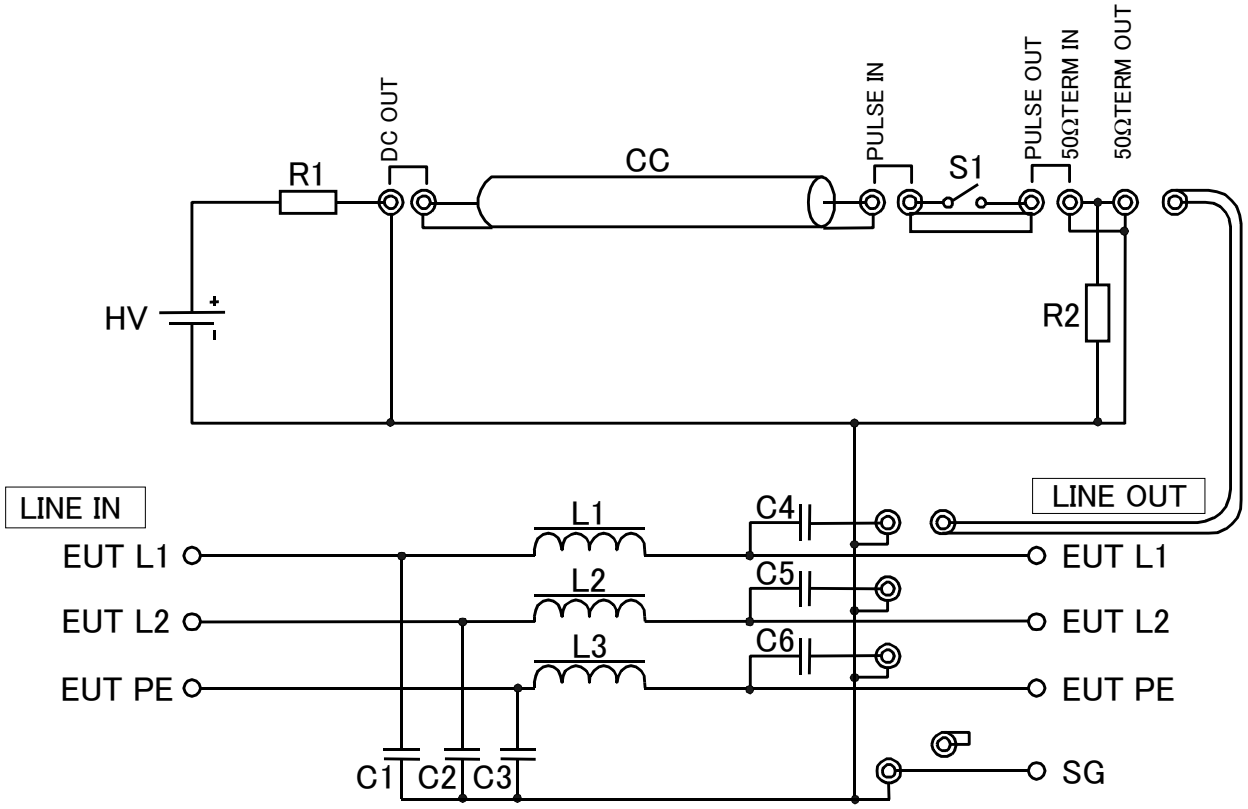
This unit generates fast rise time square wave pulses and couples them to the power supply lines of the EUT for noise testing purpose.

6.1 Features

- Generates pulses of less than 1ns rise time up to 4kV (INS-4040) or up to 2kV (INS-4020).
- Selectable pulse widths from 50ns to 1000ns at a step of 50ns, 10ns available as the shortest width.
- Easily selectable coupling modes to EUT power lines.
- Maximum EUT voltage and current rating: 240V AC, 16A.
- Generates pulses in synchronization with EUT power line frequency. Placement phase angle can be controlled from 0 to 360 degrees.
- Capability for a single pulse by using the manual trigger and for synchronization with external signals.
- Automatic ramp capability provided for the output voltage, placement phase angle and pulse repetition period.
- 3 phases coupling unit (415V/50A) is optionally available and operation in synchronization with the relevant supply is also available.
- Triangular wave pulse unit is optionally available.
- Built-in terminator.
- Optional outlet panels are available for an easy connection of the EUT to this unit and for better reproducibility in testing. Various receptacle types are available.
- Optionally provided are radiation probes, coupling clamps and others.

6.2 Pulse generation principle

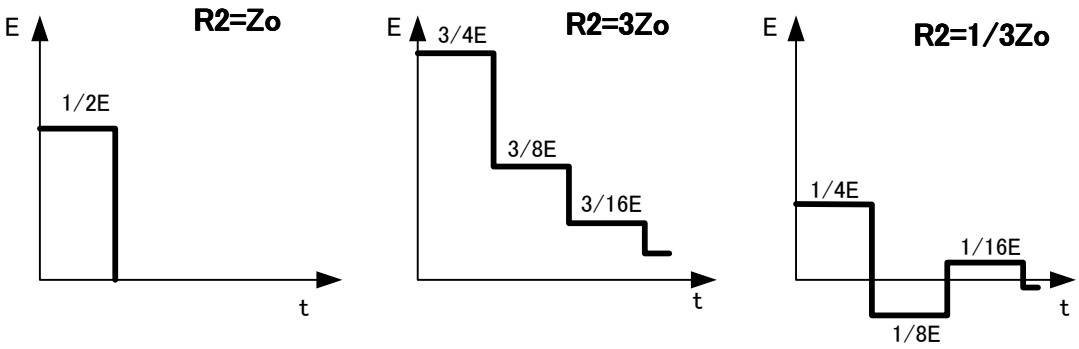
The main components of the pulse generator circuitry of this unit are coaxial cables, HV power supply, charging resistor, mercury relay and terminating resistor. The coaxial cables form a distributed constant circuit consisting of the inductance of the inner conductor and capacitance of the inner conductor to outer conductor. When a 50Ω resistance terminates this line, it works as a square wave pulse generator. Pulse widths vary depending on the delay time of the coaxial line (length of the cable). The proportion of pulse widths to the length is approximately 10 ns per meter. Pulse waveforms and voltages depend on the relation between terminator resistance and coaxial cable characteristic impedance. The HV power supply charges up the capacitance component of the coaxial line through the charging resistor when the mercury relay is in off status. The stored energy is discharged when the mercury relay contacts turn on, generating a HV square wave pulse across the terminating resistor. The injection unit couples this pulse through a capacitor to a EUT LINE. Also provided is a Decoupling circuit consisting of an inductor and capacitor, working as a high impedance circuit when seen from the injection point. This enables to effectively couple the interference signals to the EUT and to reduce them to leak into the power supply side (LINE IN).



HV: HV power supply R1: Charging resistor CC: Coaxial cable
S1: Mercury relay R2: Termination resistor C4,5,6: Coupling capacitor
L1/C1,L2/C2,L3/C3: Filter

6.3 For perfect matching

Pulse waveforms and amplitudes are dependent on the value of a termination resistor being connected to the PULSE OUT terminal. The figures and equation shown below describe these relations. To generate square wave pulses, this unit adopts a 50Ω (strictly, 53.5Ω), equal value to the characteristic impedance of the coaxial cables.



$Vp = R_2 \div (Z_0 + R_2) \times E$ ····· (equation 1)

E : Output voltage from the HV power supply
Vp : voltage being measured across the terminating resistor
Z0 : characteristics impedance of the cable cables
R2 : value of terminating resistor

6.4 Range of settings for pulse and other parameters

This unit can be set in the range in the table shown below.

Table 1 Range of settings

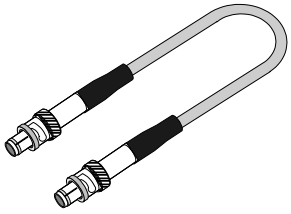
Parameters	Specifications
Output voltage	0.01kV~2kV (INS-4020) at 0.01kV step 0.01kV~4kV (INS-4040) at 0.01kV step
Pulse polarity	Positive/Negative
Pulse width	50ns~1μs (50ns step) and 10ns
Trigger mode	PHASE (EUT line synchronization) VARIABLE (asynchronization)
Placement phase angle in PHASE mode	0~359° at 0° step
Pulse repetition in VARIABLE mode	10~999ms(INS-4020) at 1ms step 16~999ms (INS-4040) at 1ms step

(Note 1) The output voltage display reads the correct pulse voltage only when the built-in terminating resistor terminates the coaxial line (at the PULSE OUT) When the terminating resistor is disconnected from the test circuit, the actual pulse amplitude is approximately 1.8 times of output voltage display reading and its waveform no longer square (damped). An automatic correction for the voltage indicator is available by means of turning on the unit with a different key operation. For details, refer to Section 9.10.

(Note 2) The fastest repetition of generated pulses (VARIABLE) is 10ms for INS-4020 and 16ms for INS-4040. This comes from different construction of the two types of mercury relay.

7 INCLUDED ACCESSORIES

This product includes the following accessories.



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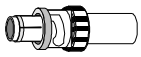

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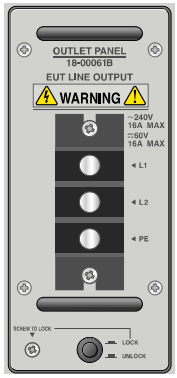

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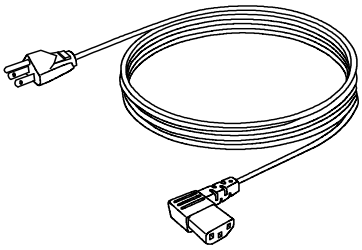

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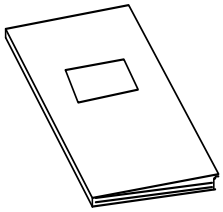


E

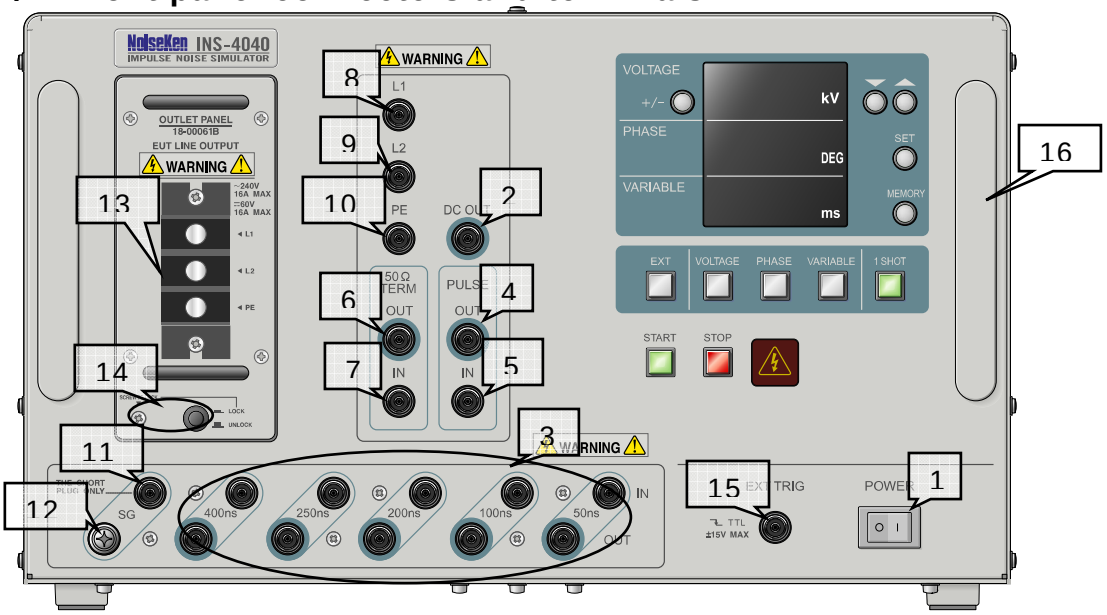
List of the included accessories

	Description		Quantity	Note
A	Coaxial cable	02-00013A	8	30cm length
B	SG short plug	02-000106A	1	
C	Outlet panel (Terminal block type)	18-00061B	1	AC240V/16A DC60V/16A maximum Leaves the factory with this panel attached to the main unit.
D	AC cable		1	AC100-115V 3-p, 2.4m
E	Instruction manual		1	

8 CONTROLS AND DISPLAY FUNCTIONS

On the front of the simulator, control, setting and output sections are provided. On the rear, mains input terminals for the simulator and mains input terminals for EUT are provided.

8.1 Front panel connecters and terminals



INS-4020/4040 front panel

1. POWER key
   Controls main POWER on and off. The | side is on position and the 0 side is off position.

2. DC OUT
   HV DC OUTPUT connector. This terminal shall be connected to PULSE WIDTH terminal by using a supplied coaxial cable.

3. PULSE WIDTH
   Selects a pulse width among 50ns, 100ns, 200ns, 250ns, 400ns and any combination thereof. Pulse width can be set from 50ns to 1000ns at a 50ns step by using supplied coaxial cables. For more details, refer to Chapter 8 Operation.

4. PULSE OUT
   PULSE OUTPUT connector. Outputs the pulses set through PULSE WIDTH section.

5. PULSE IN
   PULSE INPUT connector. The DC output set through PULSE WIDTH section is input to this terminal through a supplied coaxial cable.

6. 50Ω TERM OUT
   Output at 50Ω termination resistance. The pulse output with the selected peak amplitude exists across this terminal.

7. 50Ω TERM IN
   Input connector for 50Ω termination resistor. The HV output pulses from PULSE OUT terminal are input to this terminal through a supplied coaxial cable.

8. L1

Pulse injection connector, to L1
Couples to the L1 line of the EUT LINE from 50Ω TERM OUT terminal through a coaxial cable. When conducting normal mode test of pulses being input to the L2 terminal, the supplied SG short plug shall plug the L1 terminal.

9. L2
   Pulse injection connector, to L2
   Couples to the L2 line of the EUT LINE from 50Ω TERM OUT terminal through a coaxial cable. When conducting normal mode test of pulses being input to the L1 terminal, the supplied SG short plug shall plug the L2 terminal.

10. PE
    Pulse injection connector, to PE
    couples to the PE line of the EUT LINE from 50Ω TERM OUT terminal through a coaxial cable. When conducting common mode test (pulses being coupled with reference to PE) the supplied SG short plug shall plug the PE terminal.

11. SG connector (coaxial)
    HV pulse signal ground connector.
    When conducting common mode test with reference to ground plane, the supplied SG short pulse shall plug the SG connector. For details, please refer to Chapter 10 Test set-up

n the supplied SG short plug shall not be connected to the SG connector of this unit. A wrong connector may cause a shock hazard.

12. SG terminal
    HV pulse signal ground terminal. When conducting common mode test with reference to ground plane, this terminal shall be connected to the reference ground plane by using a low impedance cable (short and thick > 3.5 mm^2 braided wire recommended).

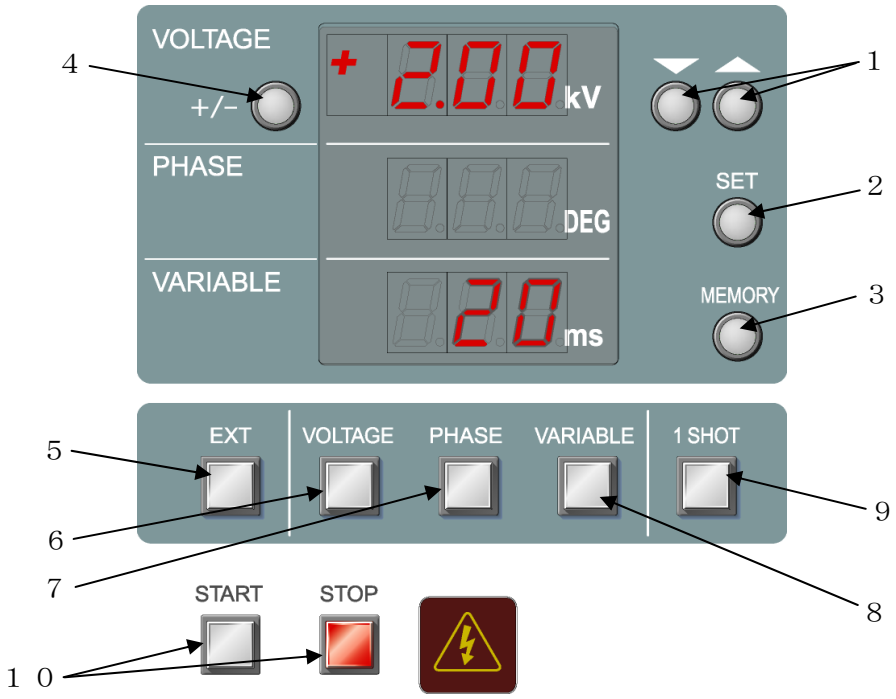
13. EUT LINE OUTPUT terminals L1, L2 and PE (terminal block type outlet panel)
    EUT line output, terminals to which EUT is connected. The output pulses are coupled to this line L1, L2 or PE depending on coupling mode setting. The screw size on the terminals is M5.

14. Outlet panel lock button and screw
    The button locks the panel when pushed in the down position. When taking the panel off from the equipment body, remove the screw and then pulls the lock button to unlock the panel first and then pull the panel off.

15. EXT TRIG input connector
    External trigger input connector. Signals are input externally from an external CDN unit or others. The type of this connector is BNC.

16. HANDLE
    it shall be used for carrying this unit.

8.2 Front panel controls and displays



INS-4020/4040 Control panel

1. Increment and decrement of the selected parameter. Alters the output voltage, placement phase angle and pulse period. The upward triangle button is used for increment and the reverse triangle is for decrement. For fast change in value, continue to press either key.

2. SET button
Confirms the setting for each parameter in ramp mode and in memory saving. This button is also used for the VOLTAGE indicator correction by means of being pressed and held.

3. MEMORY button
Saves or calls up test settings.

4. POLARITY selection button
selects the pulse polarity. The selected polarity is shown on the right side of the button. When the simulator is in the START status or until approximately 1 second has passed after the transition from the START to STOP, polarity cannot be switched over for circuit protection.

5.EXT button
Places the unit in EXT TRG mode: the unit generates pulses in synchronization with signal inputs. While the unit is in the STOP status, EXT TRG mode can be selected by pressing the EXT TRG button. When selected, the lamp is lit. Appropriate signal inputs shall be done to the EXT TRIG BNC connector. Their characteristics are 10ms repetition or slower (INS-4020) or 16 ms or slower (INS-4040), 1ms or longer pulse width and negative polarity. (As +5V pull up circuits is built-in, TTL signal or open-collector can be applied. Pulse generation synchronize with the input signal's the falling edge)

6. VOLTAGE button

Places the unit in status to accept the output voltage a change. When blinking, changes can be done by means of Increment and Decrement buttons from 0.00V to 2.05kV (4.10kV for INS-4040). Pressing and holding the button enables voltage ramp with the lamp illuminating.

7. PHASE mode button

places the unit in PHASE mode: the output pulses synchronize with the frequency of the LINE (EUT). When blinking, change can be done by means of Increment and Decrement buttons from 0 to 360° at 1° step. Pressing and holding the button enables phase ramp with the lamp illuminating. The unit does not generate pulses when no AC source is connected to the EUT LINE INPUT.

8. VARIABLE mode button

Places the unit in VARIABLE mode: pulses generated irrelevantly to the EUT supply AC frequency. When blinking, change can be done by means of Increment and Decrement buttons from 10ms for INS-4020 or 16ms for INS-4040 to 999ms at 1ms step. Pressing and holding the button enables VARIABLE ramp with the lamp illuminating.

9.1 SHOT button

Enables 1 SHOT function. Each time the button is pressed, a single pulse is generated. With the lit button, 1 SHOT function is enabled. In PHASE mode, pulse generation timing matches the selected placement phase angle. In VARIABLE mode, pulse placement entirely depends on the timing of the manual trigger (1SHOT button being pressed).

10. START/STOP buttons

The START button places the unit in START status: the START lamp is lit and the unit generates pulses according to settings. Pressing the STOP button stops the pulse generation and turn off the START lamp. While the unit is in the START status, connection changes shall not be done as it is generating HV pulses.

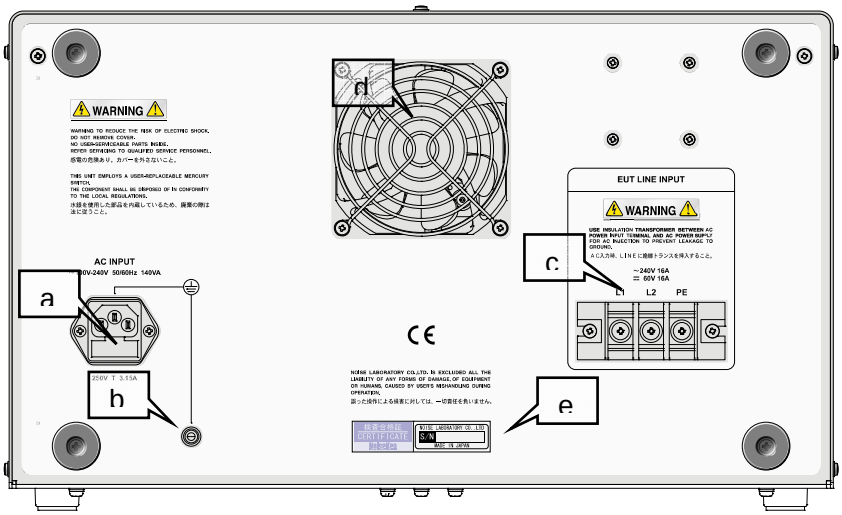
These two buttons control pulse START/STOP only. Even while the unit is in STOP status, the EUT LINE is not automatically disconnected. Voltages supplied to the EUT LINE INPUT terminals remain present on the EUT LINE OUTPUT terminals. Care shall be taken to avoid a shock hazard.

When change connections, check to see that the EUT supply has been interrupted and the unit is in the STOP status beforehand and allow a 5 seconds lapse as residual voltages may exist.

11.Warning lamp

This lamp blinks when the high voltage circuitry is on. It interacts with START and STOP button, blinking when the START button is pressed and being off when the STOP button is pressed.

8.3 Rear panel



INS-4020/4040 rear panel

a. AC INPUT
AC mains input to operate this unit. The center pin is the protective each conductor. On 100V to 115V operation, the supplied AC cord can be used for connection to an appropriately grounded AC supply. (The unit operates on a range of 100V to 240V AC. In case of 200-240V operation, user shall use an appropriate 3-pin AC cord, with an each conductor, meeting the local safety regulations). This AC inlet has built-in fuses at the bottom. When a fuse has been blown off, check the reason of this and solve the problem before replacing with a brand new fuse (rated at 250V T3.15A)

b. PE
Terminal for connection to safety earth. This terminal is electrically connected to the center conductor of the AC INPUT. This terminal shall be connected to the safety earth of the unit installation area by using an appropriate wire when the unit is not grounded through AC INPUT earth conductor.

c. EUT LINE INPUT
Power supply input to the EUT. An appropriate cord shall be used. The maximum rating of EUT LINE is 240VAC/60VDC, and 16A. Use a cord meeting the specifications of this unit and the local safety regulations. The screw size of the terminals is M5. When connecting an AC source, an isolation transformer shall be inserted between the AC source and EUT LINE INPUT. This unit has no built-in protection circuit for EUT supply. An external protective device such as fuses, circuit breaker or protector meeting the EUT rating shall be installed. AC voltage input between L1 and L2 of the EUT LINE INPUT works as a phase angle control reference in PHASE (EUT LINE synchronization) mode operation.

d. Fan
Cools the internal circuits. Ventilation shall be kept.

e. Serial number sticker
Shows the product serial number.

9 OPERATION

Observe the Section 1 IMPORTANT SAFETY PRECAUTIONS and Section 4 BASIC SAFETY PRECAUTIONS when conducting a test by using this simulator.

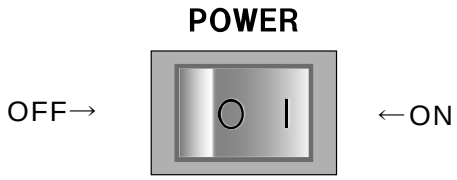
9.1 Operating precautions

As this simulator incorporates a mercury relay, set it horizontally. **This unit does not work when it is positioned vertically or considerably on the tilt.**

Fully put in each coaxial connector and make sure connection by rotating it clockwise until a “click” is heard.

9.2 Turning ON and OFF power

Connect an appropriate AC cord (the supplied one or other meeting the local supply voltage) to AC INPUT on the rear panel. Press the I side of the POWER button to turn on the unit. The unit turns on with the previous settings for all parameters. But HV circuitry is always off at the unit power on. To turn off the unit, press the 0 side of the button. Even when the unit power turns off, the EUT LINE is not automatically interrupted. Voltages on the EUT LINE OUTPUT terminals (terminal block outlet panel) remain present. Be sure to interrupt supply input to the EUT LINE INPUT before changing cable connections on the INS.



9.3 Setting the pulse width

Pulse width can be set by combinations of connections between each PULSE WIDTH connector by using supplied coaxial cables. Examples of setting for 50ns, 350ns, 800ns and 10ns are shown here. Other pulse widths are available with the combinations shown on the table.

The following table indicates connecting points.

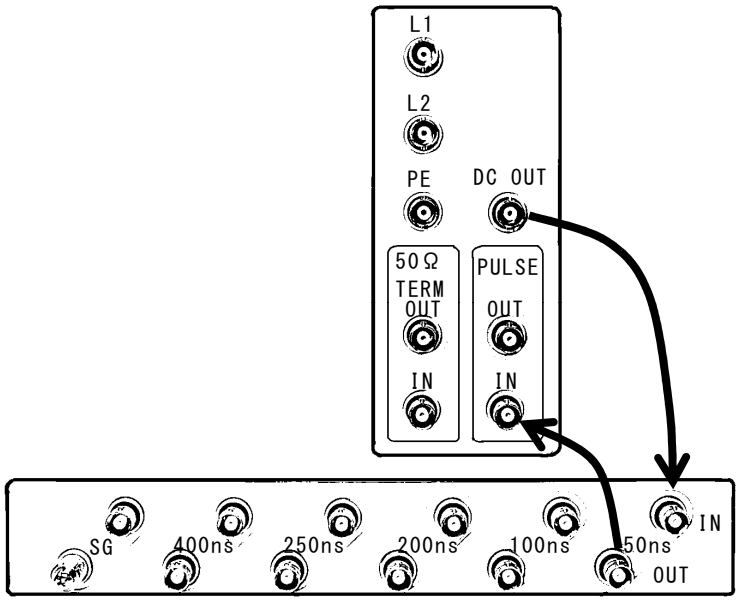
Pulse width	50ns connector	100ns connector	200ns connector	250 ns connector	400 ns connector
10ns					
50ns	▲				
100ns		▲			
150ns	△	●			
200ns			▲		
250ns				▲	
300ns	△			●	
350ns		△		●	
400ns					▲
450ns	△				●
500ns		△			●
550ns	△	○			●
600ns			△		●
650ns				△	●
700ns	△			○	●
750ns		△		○	●
800ns	△	○		○	●
850ns			△	○	●
900ns	△		○	○	●
950ns		△	○	○	●
1000ns	△	○	○	○	●

△ is for connecting from DC OUT to other pulse width connector.
▲ is to be connected from DC OUT to PULSE IN.
○ is to be connected between other pulse width connectors.
● is to be connected from other pulse width connector to PULSE IN.
For a blank, there is no need to be connected.

All combinations are not shown here.

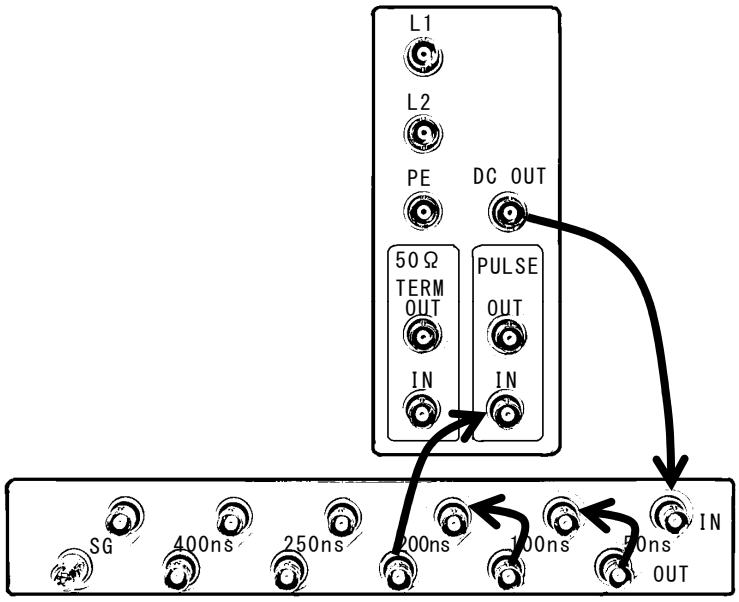
9.3.1 Setting for 50ns

Connect DC OUT terminal to 50ns IN terminal of PULSE WIDTH, and connect 50ns OUT terminal to PULSE IN terminal by using coaxial cables.



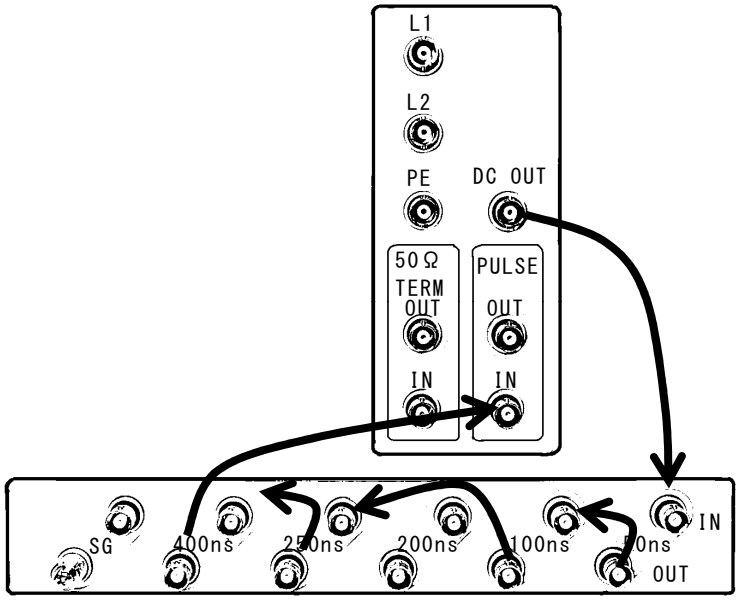
9.3.2 Setting for 350ns

Connect DC OUT terminal to 50ns IN terminal of PULSE WIDTH, connect 50ns OUT terminal to 100ns IN terminal, and connect 100ns OUT terminal to 200ns IN terminal by using coaxial cables. Connect 200ns OUT terminal to PULSE IN terminal by using a coaxial cable.



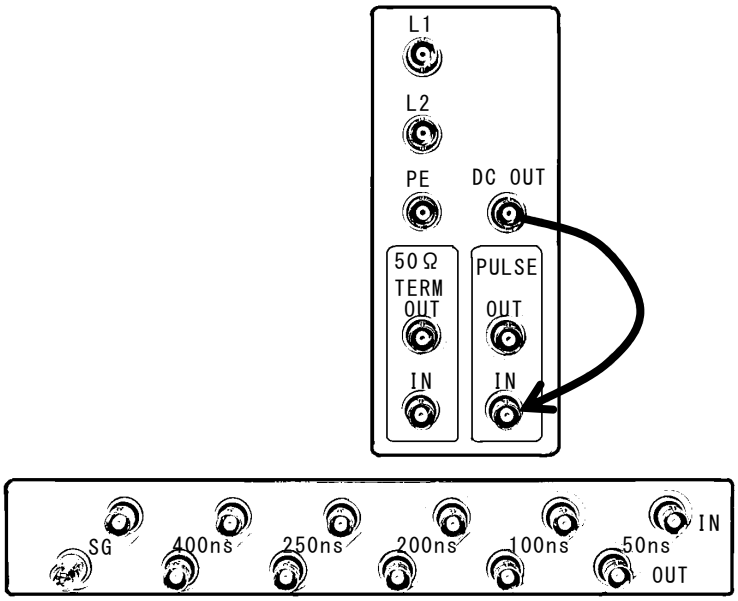
9.3.3 Setting for 800ns

Connect DC OUT terminal to 50ns IN terminal of PULSE WIDTH, connect 50ns OUT terminal to 100ns IN terminal, connect 100ns OUT terminal to 250 ns IN terminal, and connect 250ns OUT terminal to 400ns IN terminal by using coaxial cables. Connect 400ns OUT terminal to PULSE IN terminal by using a coaxial cable.



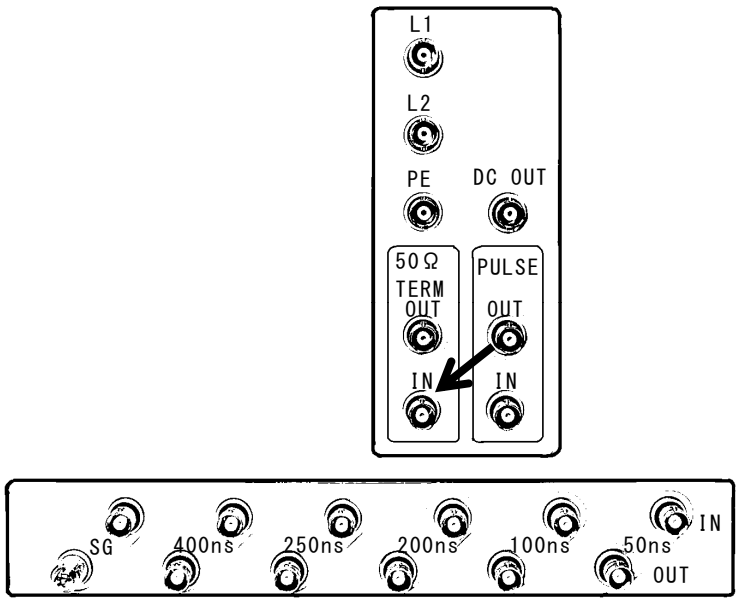
9.3.4 Setting for 10ns

Connect DC OUT terminal to PULSE IN terminal by using a coaxial cable.



9.4 Connecting termination resistance

Connect PULSE OUT terminal to 50Ω TERM IN terminal by using a coaxial cable.



The route of the supplied coaxial cables shall be as follows:

DC OUT→PULSE WIDTH (according to the desired pulse width)→PULSE IN→PULSE OUT→50Ω TERM IN→50Ω TERM OUT→the phase to which the pulse are coupled.

⚠WARNING 警告

Before changing cable connection, press the STOP button and be sure to allow 5 seconds to elapse and interrupt EUT supply (EUT LINE INPUT).

9.5 Select injection line

Connect 50Ω TERM OUT terminal to pulse injection terminal (L1, L2, or PE) by using a coaxial cable.

WARNING: DO NOT CONNECT A COAXIAL CABLE FOR PULSE WIDTH SELECTION TO SG CONNECTOR.

The supplied SG short plug selects the line to which the signal ground of the output pulse is connected. All of the permissible settings are shown below.

Terminal				Test mode
L1	L2	PE	SG	
HOT			PLUG	Ground plane reference - L1 common mode
	HOT		PLUG	Ground plane reference - L2 common mode
		HOT	PLUG	Ground plane reference - PE common mode
HOT		PLUG		EUT PE reference – L1 to PE line to line mode
	HOT	PLUG		EUT PE reference – L2 to PE line to line mode
HOT	PLUG			L2 reference – L1 to L2 normal mode
PLUG	HOT			L1 reference – L2 to L1 normal mode

HOT : Connection from 50Ω TERM OUT.
PLUG : Plugged by the SG short plug

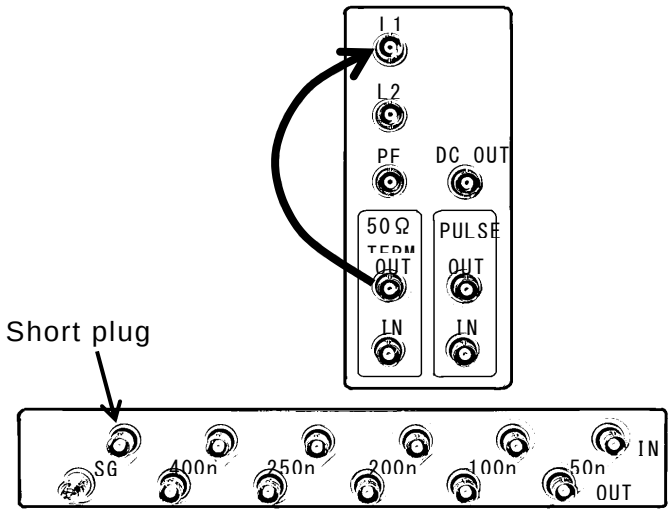
・ Any other connection than the supplied SG short plug shall not be connected to the SG connector of this unit. Wrong connections may apply HV pulses to the ground plane, causing a shock hazard.

・ When this unit is producing pulses or EUT power is being supplied to the EUT LINE INPUT, do not touch the HV coaxial connectors. Touching them may cause a shock hazard.

・ When conducting coupling tests to the EUT LINE, the signal ground of the HV pulse generator circuit and one line of the EUT LINE may be connected, causing a shock hazard if the users touch the outer conductor of the HV coaxial connectors. In addition, if the outer conductor of the HV coaxial connectors is connected to any grounded object, leak current will flow, tripping the ground fault interrupter embedded in the facilities. To avoid these two types of events, use of an isolation transformer is indispensable. Be sure to connect the EUT LINE INPUT to the isolation transformer secondary

Examples of coupling mode settings are shown.

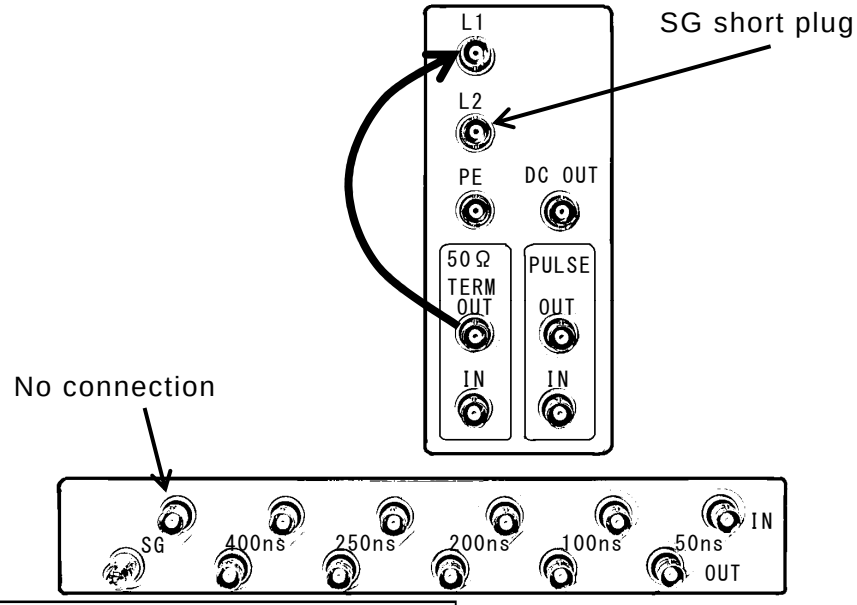
Example: Ground plane reference - L1 common mode



WARNING 警告

Any other connector than the supplied SG short plug shall not be connected to the SG connector of this unit. Do not touch the HV coaxial connectors. Touching a HV connector may cause a shock hazard. An isolation transformer is indispensable for power supply input to the EUT. Power supply connection to the EUT LINE INPUT shall be always done trough an isolation transformer. The reference ground plane shall be grounded to a safety earth.

Example: L2 reference – L1 to L2 normal mode

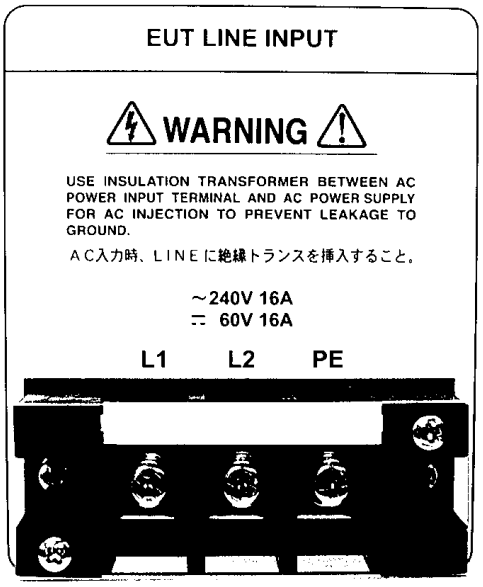


WARNING 警告

Do not touch the HV coaxial connectors. Touching a HV connector may cause a shock hazard. An isolation transformer is indispensable for power supply input to the EUT. Power supply connection to the EUT LINE INPUT shall be always done trough an isolation transformer. The reference ground plane shall be grounded to a safety earth.

9.6 EUT line input connection

Before connecting the equipment under test, check to see that this unit power is turned off and that the EUT supply is interrupted (EUT LINE INPUT), otherwise supply power voltage or the generated pulse voltage may cause an electric shock hazard.



Prepare an AC supply and AC cable suitable for the EUT power rating. When connecting an AC supply, an isolation transformer shall be inserted between the AC supply and EUT LINE INPUT. The screw size on the terminals is M5. Attach a 5 φ solderless terminal to each conductor of the AC cable. After connection of the AC cable to the EUT LINE INPUT terminals, put the cover back on the terminals. AC voltage input between L1 and L2 of the EUT LINE INPUT works as a phase angle control reference in PHASE (EUT LINE synchronization) mode operation. For details, refer to Section 8.10 (operation in PHASE mode)

⚠WARNING 警告

This unit has no built-in protection circuit for EUT supply. An external protective device such as fuses, circuit breaker or protector meeting the EUT rating shall be installed.

For your information, an optional external circuit breaker box for circuit protection and also for on/off control of the EUT LINE is available. Model 18-00072A: AC250V, DC65V, single phase 20A

9.7 Mount and dismount Outlet panel

Checking for the right direction, gently insert the Outlet panel fully to the depth. And press the Outlet panel lock button to lock the Outlet panel and fasten the lock screw. When dismounting, unlock the Outlet panel lock button and remove the lock screw and pull it gently. The lock screw can eliminate a risk of the panel accidentally dismounted. The lock screw shall be tightened before the EUT connection.

⚠WARNING 警告

Before mounting and dismounting the outlet panel, check to see that the EUT supply has been interrupted and the unit is in the STOP status and allow a 5 seconds lapse as residual voltages may exist, otherwise supply power voltage or the generated pulse voltage may cause an electric shock hazard or a failure of this unit.

9.8 EUT connection

Before connection of the EUT to this unit, be sure to check that all power switches on the EUT supply, this unit and EUT itself are off.

Prepare a cord meeting the local safety regulations and the EUT power rating and attach a 5 φ solderless terminal to each conductor of the cord. After connection of the AC cord to the terminals on the EUT LINE OUTPUT, put the plastic cover on the terminals at it was.

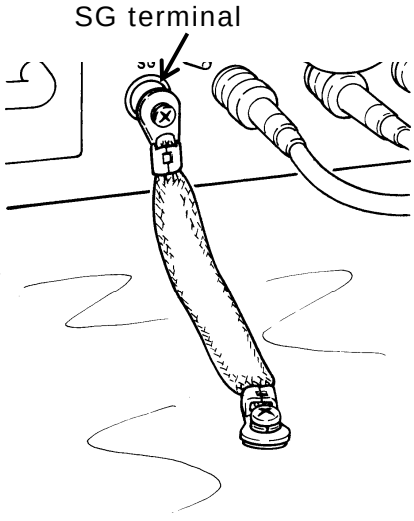
The included outlet panel is of terminal block type. Outlet panels for a CEE (240V/16A) plug and for a UL/Japan (125/15 20A) are optionally available. These options provide facility for easy direct connection of the AC plug of the EUT to the plug receptacle mounted on the simulator.

9.9 Connection of signal ground (SG) terminal

When conducting tests in coupling mode with reference to the ground plane, connect SG terminal to the ground plane by using a low RF impedance cable (3.5mm² or thicker braided wire recommended) of the shortest possible length. For connection, use M4 screws of 8mm or shorter length.

IMPORTANT

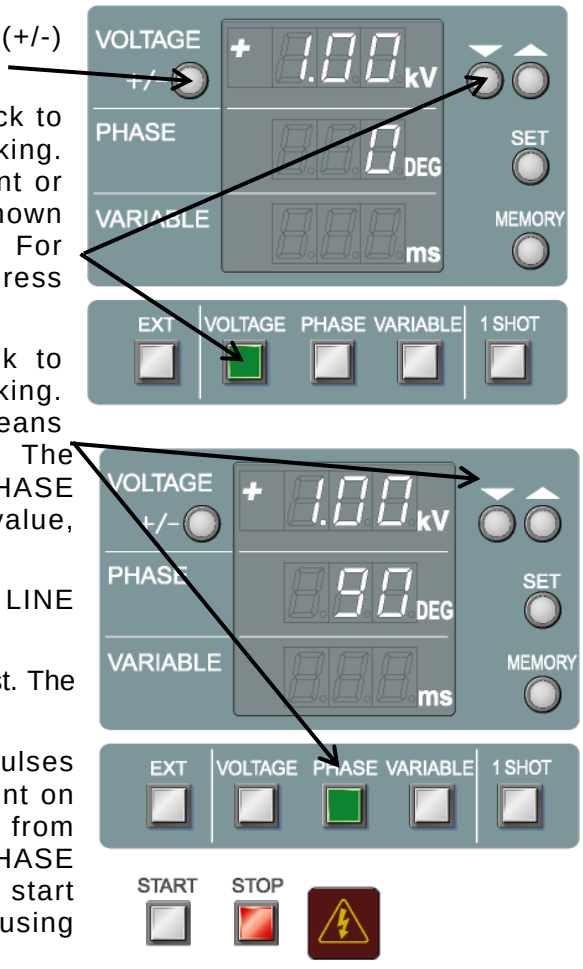
Unlike old types of the INS simulators, this SG co can remain installed for line to line (normal mode too, since the port (coaxial connector) to wh supplied SG short plug is connected selects the r ground, in both of common and normal modes.



9.10 Operation in PHASE mode

In this mode, the unit generates pulses synchronizing with the frequency of AC supply for the EUT. One pulse is generated every cycle. The unit does not generate pulses when no AC source is connected to the EUT LINE INPUT terminal or the EUT LINE INPUT power supply is DC (when the frequency of AC supply is not within a 45Hz to 65Hz range, the unit recognizes it as DC.)

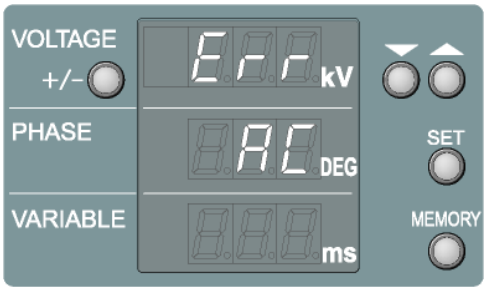
1) Complete the connection referring to section 1 to 9. (For test set-up, refer to Chapter 10.)
2) Select the polarity + or – by polarity (+/-) selection button.
3) Press the VOLTAGE button and check to see the button lamp starts blinking. Adjust voltage by means of Increment or Decrement button, Voltage set is shown on the output VOLTAGE indicator. For fast change in value, continue to press either key.
4) Press the PHASE button and check to see the button lamp starts blinking. Adjust placement phase angle by means of Increment or Decrement button. The selected angle is shown on the PHASE indicator. For fast change in value, continue to press either key.
5) Check the connection for EUT LINE INPUT.
6) Press the START button to run the test. The warning lamp starts blinking.
7) Even when the test is in progress (pulses are being generated), pulse placement on the LINE AC can be controlled from 0°~359°. To do this, press the PHASE button first to let the button lamp start blinking and then alter the value by using Increment or Decrement button.



8) Even when the test is in progress (pulses are being generated), the output voltage can be controlled. To do this, press the VOLTAGE button first to let the button lamp start blinking and then alter the value by using Increment or Decrement button.

The maximum pulse output voltages from the INS-4020 and INS-4020 are 2.05kV and 4.10kV, respectively. Operation in PHASE MODE is available when this unit works with an optional external Coupling Unit Model IJ-4050. For details, refer to section 8.13 Operation in EXTernal Trigger mode.

IMPORTANT



The unit does not generate pulses when no AC source is connected to the EUT LINE INPUT terminal or the EUT LINE INPUT power supply is DC (when the frequency of AC supply is out of a 45Hz to 65Hz range), In this case, an Err sign is shown upon pressing the START button. To return to the normal operation state, press the STOP button. Connect an appropriate supply to the EUT LINE INPUT and then press the START button. The same procedures shall be taken against an interruption of AC supply during testing.

Pulse placement (phase angle) control in common mode testing

AC voltage input between L1 and L2 of the EUT LINE INPUT works as a phase angle control reference in PHASE (EUT LINE synchronization) mode operation. In Japan, generally, single phase AC supply is a system where L2 (N) is earthed. L1 and L2 lines are irrelevant with the PE in terms of phase correlation, therefore, theoretically, no setting of phase angle placement in common mode testing comes to be defined. With the real test set up, however, L1 and L2 of the EUT LINE are balanced thanks to the external isolation transformer and decoupling capacitors within this unit, allowing L2 to have a 180° phase difference with respect to L1. The table shown below indicates required the correction value.

INJECTED LINE	CORRECTON	PHASE SETTING EXAMPLE FOR 90°
L1 - L2	＋0°	90 DEG
L1 - PE	＋0°	90 DEG
L2 - PE	＋180°	270 DEG *

* to place pulses at 90°of L2 – PE , 90°(the value you want to set)＋180°(correction)＝270°　The PHASE display shall be set to 270 DEG

9.11 Operation in VARIABLE mode

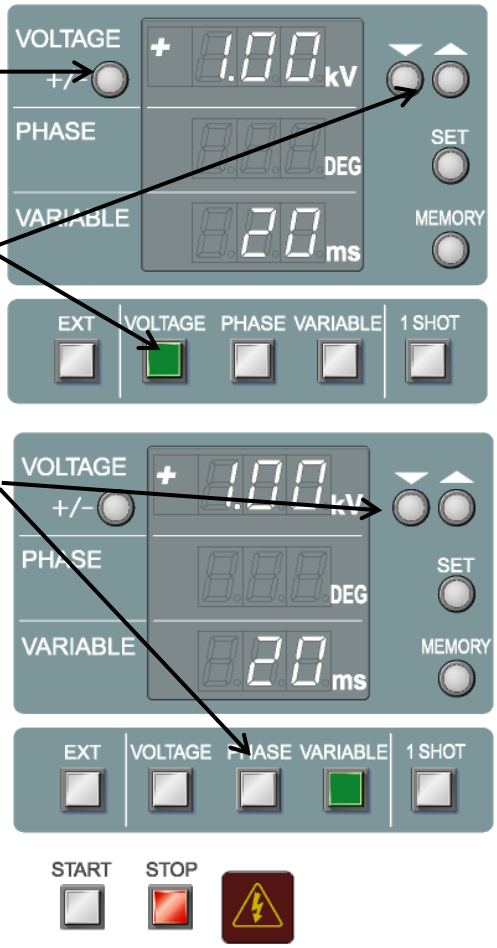
In this mode, this unit generates pulses at the selected pulse period, irrespective of the frequency of AC supply to the EUT LINE. The shortest pulse period varies depending on the product model. When an optional accessory such as Coupling Adaptor or Radiation Probe is used, operate this unit in this mode. The INS-4020 allows 10ms~999ms period and the INS-4040 allows 16ms~999ms.

1) Complete the connection referring to Section 1 to 9 (For test set-up, refer to Chapter 10.

2) Select the polarity + or – by polarity (+/-) selection button.

3) Press the VOLTAGE button and check to see the button lamp starts blinking. Adjust voltage by means of Increment or Decrement button. Voltage set is shown on the VOLTAGE indicator. For fast change in value, continue to press either key.

4) Press the VARIABLE button and check to see the button lamp starts blinking. Adjust the pulse period by means of Increment or Decrement button. The selected pulse period is shown on the VARIABLE indicator. For fast change in value, continue to press either key.



5) Check the connection for EUT LINE INPUT.

6) Press the START button to run the test. The waring lamp starts blinking. In VARIABLE mode, this unit can START (pulse generated) even when power supply is not fed to the EUT LINE INPUT.

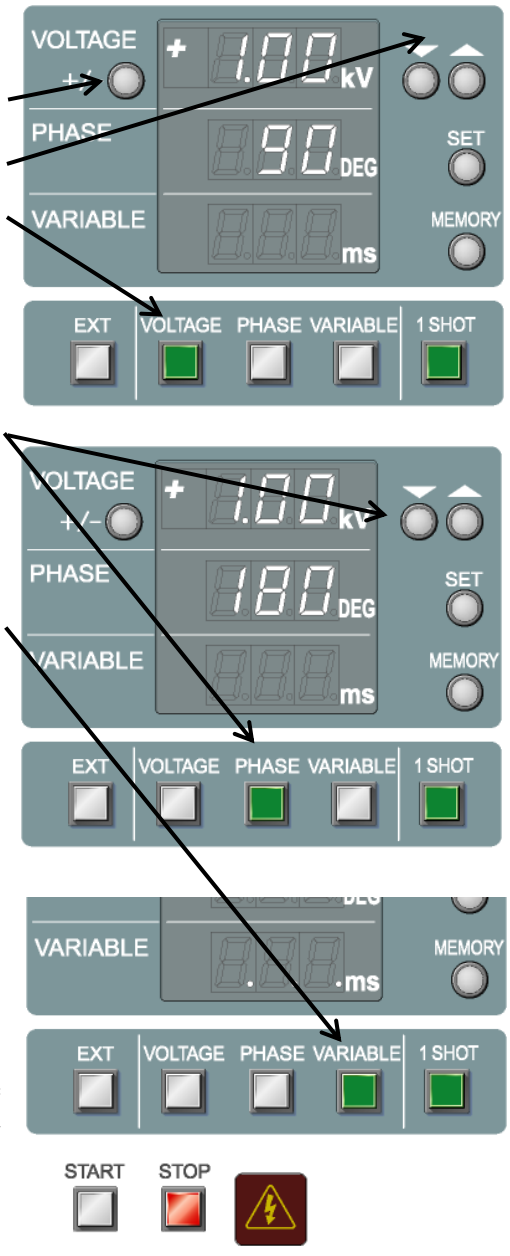
7) Even when the test is in progress (pulses are being generated), pulse period can be controlled. To do this, press the VARIABLE button first to let the button lamp start blinking and then alter the value by using Increment or Decrement button.

8) Even when the test is in progress (pulses are being generated), the output voltage can be controlled. To do this, press the VOLTAGE button first to let the button lamp start blinking and then alter the value by using Increment or Decrement button.

9.12 Operation in 1 SHOT mode

In this mode, this unit generates single pulse by pressing a button. Each time the 1 SHOT button is pressed, the unit generates a single pulse. When PHASE mode has been selected, pulse generation synchronizes with the AC frequency and its placement can be set on PHASE indicator. When VARIABLE mode has been selected, pulse generation completely depends on the timing of the 1SHOT button being pressed (the mercury relay requires 3 to 4ms delay to turn on).

1) Complete the connection referring to section 1 to 9 (For test set-up, refer to Chapter 11.
2) Select the polarity + or – by polarity (+/-) selection button.
3) Press the VOLTAGE button and check to see the button lamp starts blinking. Adjust voltage by means of Increment or Decrement button. Voltage set is shown on the output VOLTAGE indicator. For fast change in value, continue to press either key.
4) To generate pulses synchronizing with AC frequency, press the PHASE button and check to see the button lamp starts blinking. Adjust placement phase angle by using Increment or Decrement button.
5) To generate pulses in VARIABLE mode, press the VARIABLE button. Pulse release depends on timing of the 1 SHOT button being pressed. Setting on the VARIABLE indicator cannot be done.
6) Press the 1 SHOT button and the button lamp will be lighted. (This unit is in 1SHOT mode with lighted 1SHOT button)
7) Press the START button to let this unit stand by for a pulse release
8) Each time the 1 SHOT button is pressed, the unit generates a single pulse. When PHASE mode has been selected, pulse generation synchronizes with the AC frequency and when VARIABLE mode has been selected, pulse generation completely depends on the timing of the 1SHOT button being pressed (the mercury relay requires 3 to 4ms delay to turn on.



IMPORTANT

In the PHASE mode, the unit does not generate pulses when no AC source is connected to the EUT LINE INPUT terminal or the EUT LINE INPUT power supply is DC (when the frequency of AC supply is out of a 45Hz to 65Hz range), In this case, an Err sign is shown upon pressing the START button. To return to the normal operation state, press the STOP button. Connect an appropriate supply to the EUT LINE INPUT and then press the START button.

9.13 Operation in EXTernal Trigger mode

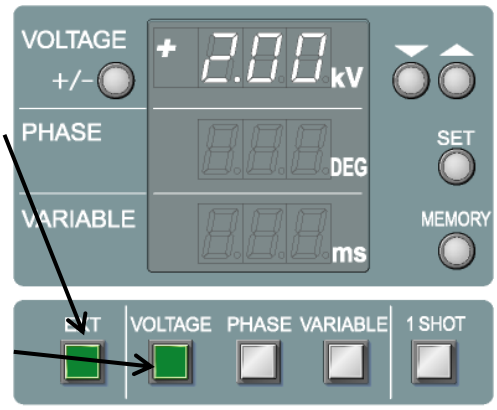
The EXT TRIG input connector on the front panel can be used for pulse generation synchronization with inputs from an external signal generator or Coupling Unit, or control by using a contact switch. External trigger inputs function in the way shown below table.

Operation mode	Function	Signal source
VARIABLE	Trigger pulse	Signal generator
PHASE	Zero-cross reference signal	Coupling Unit

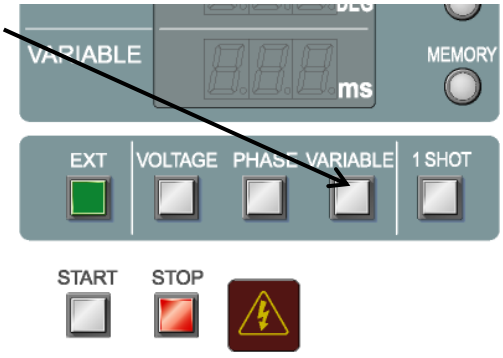
9.13.1 Synchronization with inputs from an external signal generator

This mode is used to generate pulses in synchronization with signals to EXT TRIG input terminal. Appropriate signal inputs shall be done to the terminal. Pulse generation synchronizes with the falling edge of the signal whose characteristics shall be TTL or open-collector, of the negative polarity, 16ms repetition rate or slower for INS-4040 and 10ms or slower for INS-4020.

1) Complete the connection referring to section 1 to 9 (For test set-up, refer to Chapter 10.)
2) Input appropriate signals to EXT TRIG input connector.
3) Press the EXT trigger mode button and the button lamp will be lighted. (This unit is in EXT trigger mode with lighted EXT button)
4) Select the polarity + or – by polarity (+/-) selection button.
5) Press the VOLTAGE button and check to see the button lamp starts blinking. Adjust voltage by means of Increment or Decrement button. For fast change in value, continue to press either key.



6) Press the VARIABLE button. The VOLTAGE button lamp will turn off and the VARIABLE button lamp will start blinking. Now that the unit in in VARIABLE mode, it reacts to signal inputs to the EXT TRIG input connector.
7) Press the START button to let the unit stand by for pulse generation.
8) Each time a signal is input, the unit generates a single pulse.



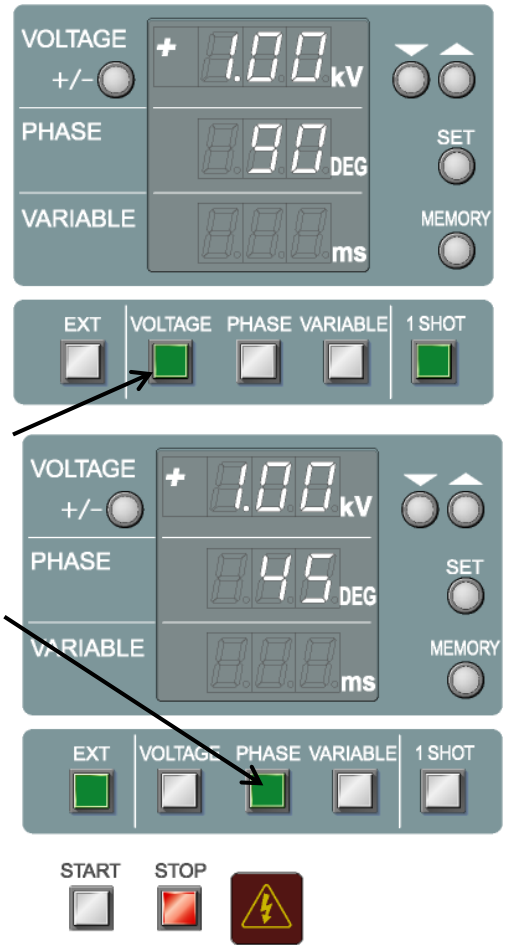
The unit generates pulses with a 3 to 4ms delay from the falling edge of the signal. The shortest periods 16ms and 10ms are specified but the longest limits are not specified.

9.13.2 Synchronization with zero-cross reference signal inputs form an external Coupling Unit

The EXT TRIG input connector is also used for zero-cross signal input from an external CDN unit (Option). To do this, place the unit in PHASE mode. Falling edges of the signals with the following period are recognized as zero-cross reference signals for the EUT supply.

INS-4020 15.3ms minimum (65Hz) to 22.2 maximum (45Hz)
INS-4040 16.0ms minimum (62.5Hz) to 22.2 maximum (45Hz)

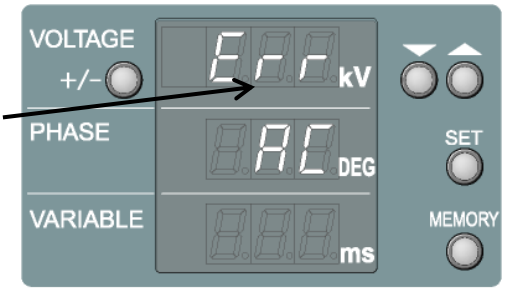
1. Complete the connection referring to Section 1 to 9 (For test set-up, refer to Chapter 10.
2. Input appropriate signals to EXT TRIG terminal from the external Coupling Unit.
3. Press the EXT trigger mode button and the button lamp will be lighted. (This unit is in EXT trigger mode with lighted EXT button)
4. Select the polarity + or – by polarity (+/-) selection button.
5. Press the VOLTAGE button and check to see the button lamp starts blinking. Adjust voltage by means of Increment or Decrement button. For fast change in value, continue to press either key.
6. Press the PHASE button and check to see the PHASE button lamp is lighted. Select the desired placement phase angle.
7. Press the START button to run the test. Pulses are generated on the phase angle selected in the Step 6, with same repetition rate as the zero-cross signals from the Coupling Unit.



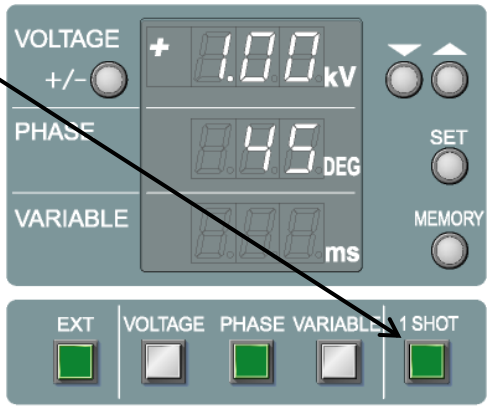
IMPORTANT

When operating this unit in PHASE mode, input the zero-cross reference signals from the external Coupling Unit to the EXT TRIG input terminal before pressing the START button. This unit does not generate pulses when no AC source is connected to the EUT LINE INPUT terminal or when no signal input to the EXT TRIG is present. In this case, an Err sign is shown upon pressing the START button.

Signals outside of the aforementioned ranges are regarded as a non-compliant AC, and the unit does not produce pulses, showing Error sign. To return to the normal operation mode, press the STOP button. Check the signal inputs from the Coupling Unit and press the START button again.

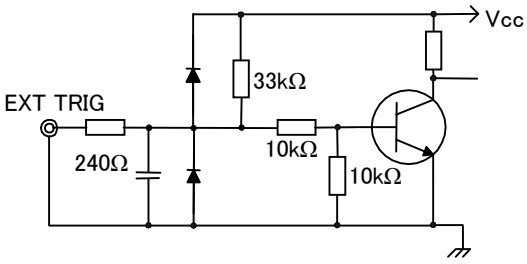


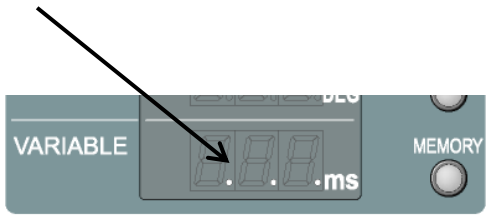
In External Trigger mode, 1 SHOT button functions if the PHASE mode has been selected. With a signal input to the EXT TRIG input, this unit is ready to generate a pulse when the START button is pressed. Each time the 1 SHOT button is pressed, a single pulse is released at the selected phase angle.



9.13.3 Control by using a contact switch

Additionally provided is a pulse timing control by using on/off control of a contact switch. This mode can be active when the operator presses and holds the EXT button in the VARIABLE mode. In this mode, the unit ignores relay bounces generated by a push button or similar device, as the low state with 20ms or longer duration can only be regarded as a valid input. The VARIABLE indicator shows" . . . "

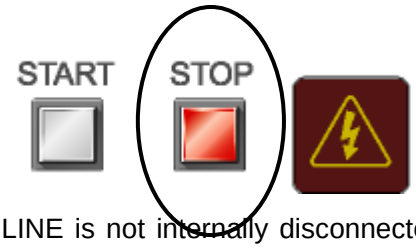




External synchronization signal input circuit

9.14 Stop the unit

Pressing the STOP button stops the pulse generation and turns off the START lamp. The high voltage circuitry within the unit turns off but requires approx. 4 seconds to eliminate residual voltages. When changing a connection, allow 5 seconds or more to elapse after pressing the button. When changing pulse polarity, press the STOP button first, selection is only available after 1 second has passed.



IMPORTANT

Even when the unit is in the STOP state, EUT LINE is not internally disconnected. The LINE output terminals (terminal block outlet panel) are still live. Be sure to disconnect the EUT supply from the EUT LINE INPUT.

WARNING 警告

When changing connections, check to see that the EUT supply has been interrupted and the unit is in the STOP status beforehand and allow a 5 seconds lapse as residual voltages may exist.

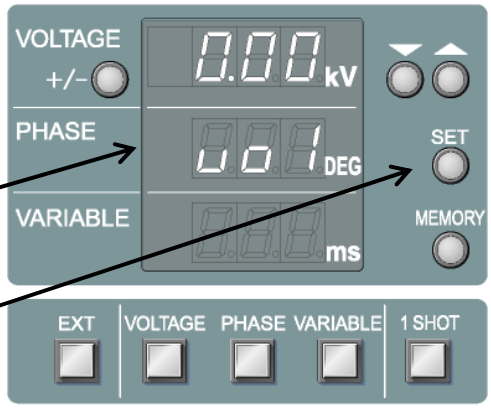
10 OPERATION FOR WIDE APPLICATION

10.1 VOLTAGE ramp setting

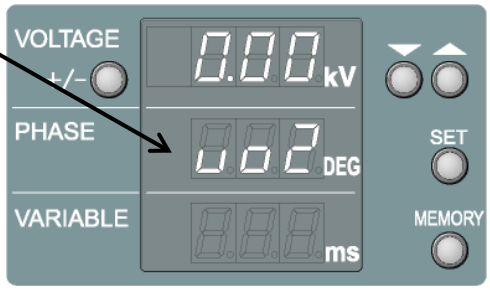
The output voltage can be automatically ramped according to the setting. The following 5 parameters shall be set: initial, final and step voltages, test duration for each step and interval between each step. Voltage ramping enables an automatic test run to the preset final test voltage according to the preset test duration and interval settings. Manual ramping by using the START and STOP buttons is also available.

1） Press the VOLTAGE button and hold it for 2 seconds, the unit will be placed in voltage ramp mode.

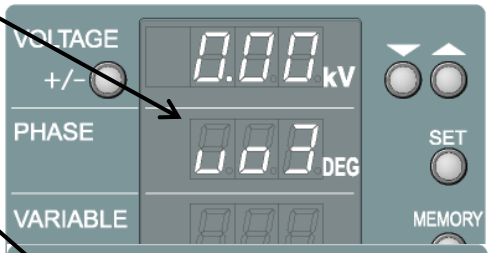
2） First set the desired initial voltage. (In this instance, the second row indicator shows “vo 1” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.



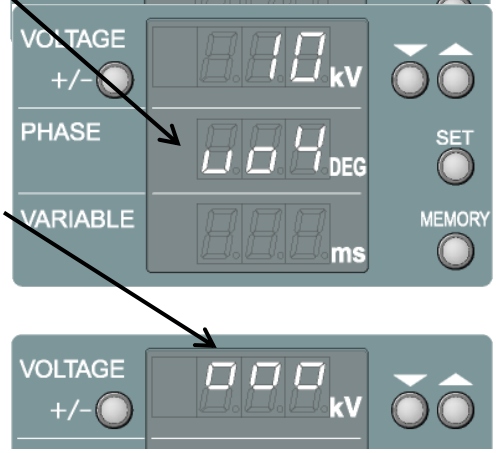
3） Secondly, set the desired final voltage. (In this instance, the second row indicator shows “vo 2” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.



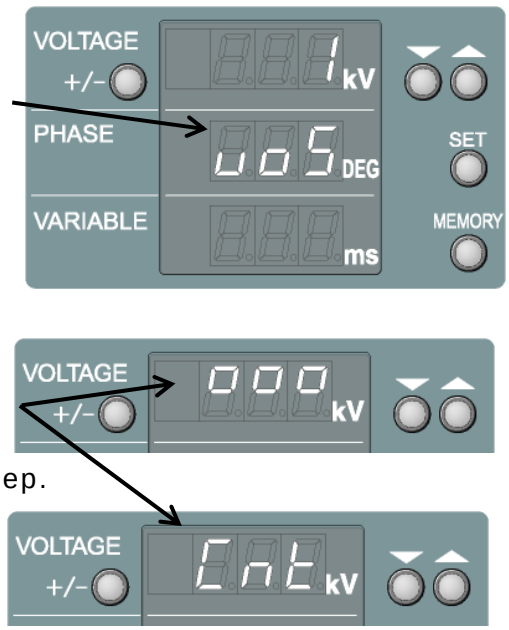
4） Thirdly, set the desired step voltage. (In this instance, the second row indicator shows “vo 3” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.



5） Next, set the desired duration. (In this instance, the second row indicator shows “vo 4” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting. This parameter can also be set to ” o o o „ (manual pause and restart). With this, the operator shall stop the test run by pressing the STOP button and shall restart by pressing the START button again.



6） When any specific duration is set, interval shall be selected. The second row indicator shows “vo 5” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting. This parameter can also be set to ” ０ ０ ０ ” (manual restart) for the mode where the operator shall restart the test run by pressing the START button. One more setting is available: “Cnt” enables the unit to run with no interval inserted between each step.



7） Upon completion of the above settings, the unit is automatically placed in voltage ramp mode, with the VOLTAGE button lamp lighted.

8） To disable voltage ramp, press the VOLTAGE button again. The button lamp will start blinking.

9） To enable voltage ramp, carry out the above steps 1) to 6) or press the VOLTAGE button again while the lamp is blinking in case all parameters have been already set.

Example setting in VOLTAGE ramp

When running a test from 1.00kV to 2.00kV at 0.1kV step for 5 seconds duration with 10 seconds interval, each parameter shall be set as follows: vo 1=1.00, vo 2=2.00, vo 3=0.1, vo4=5, vo5=10. During parameter settings for voltage ramp operation, setting is suspended if either of the VOLTAGE, VARIABLE or PHASE button is pressed. While the VOLTAGE button lamp is blinking, the unit accepts voltage change. While the VOLTAGE button lamp is lighted, the unit is in voltage ramp mode.

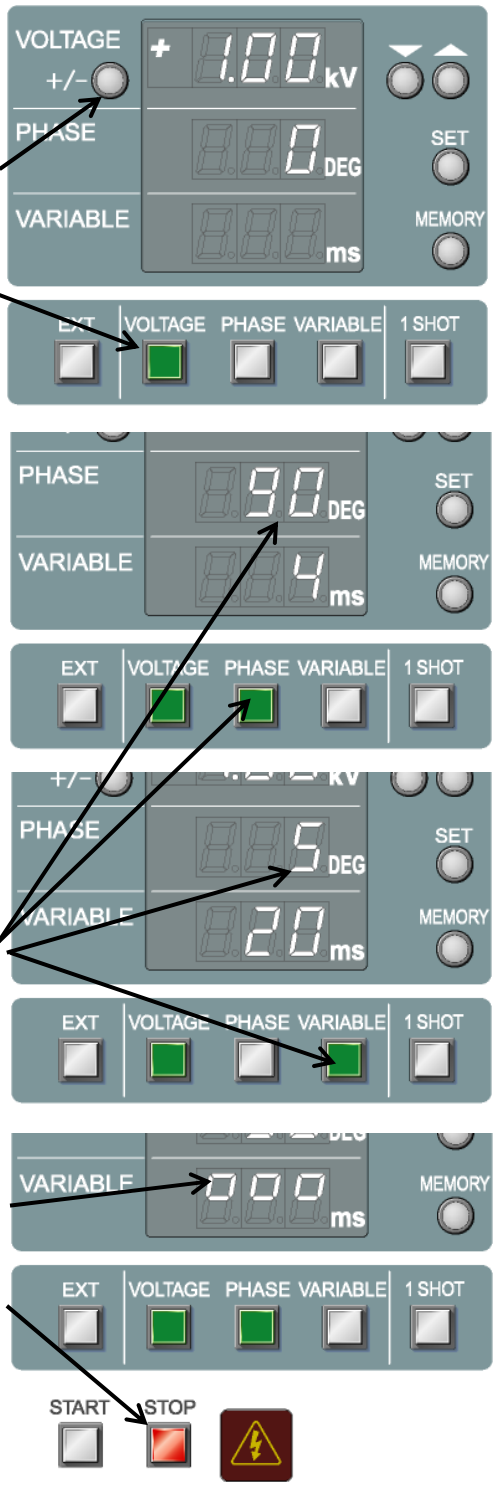
Code	Parameter	Allowable setting
Vo 1	Initial voltage	0～4.00kV（2.00ｋV）
Vo 2	Final voltage	0～4.00kV（2.00ｋV）
Vo 3	Step voltage	0～4.00kV（2.00ｋV）
Vo 4	Duration	1～999s, manual
Vo 5	Interval	1～999s, manual and continuous

Numbers in parentheses are for INS-4020

10.2 VOLTAGE ramp test run

The unit executes the test according to the settings of initial, final and step voltages, test duration for each step and interval between each step

1) Complete the connection referring to Chapter 8. (For test set-up, refer to Chapter 10.)
2) Select the polarity + or – by polarity (+/-) selection button
3) Complete the settings for VOTLAGE ramp operation referring to Section 9.1 VOTLAGE ramp setting or press the VOLTAGE button to be illuminated and to enable voltage ramp function.
4) Select either the PHASE or VARIABLE mode
5) Check the connection for EUT LINE INPUT.
6) Press the START button to start the test run. Even during the test run, PHASE and VARIABLE buttons and their associated Increment and Decrement buttons are operative.
7) The unit indicates remaining time in second on the third row indicator in PHASE mode and on the second row indicator in VARIABLE mode. Upon completion of the step duration, the unit temporarily stops the test run. In case the step duration has been set to " o o o ", the operator shall pause and restart the test run by pressing the STOP and START buttons, respectively.
8) In case the interval has been set to " o o o ", the operator shall restart the test run by pressing the START button. On other settings, the unit automatically restarts the test run.
9) Reaching the final voltage, the unit automatically stops the test.



10.3 VARIABLE ramp setting

The pulse repetition period can be automatically ramped according to the settings. The following 5 parameters shall be set: initial, final and step periods, test duration for each step and interval between each step. Pulse repetition period ramping enables an automatic test run to the preset final repetition period according to the preset test duration and interval setting. Manual ramping by using the START and STOP buttons is also available.

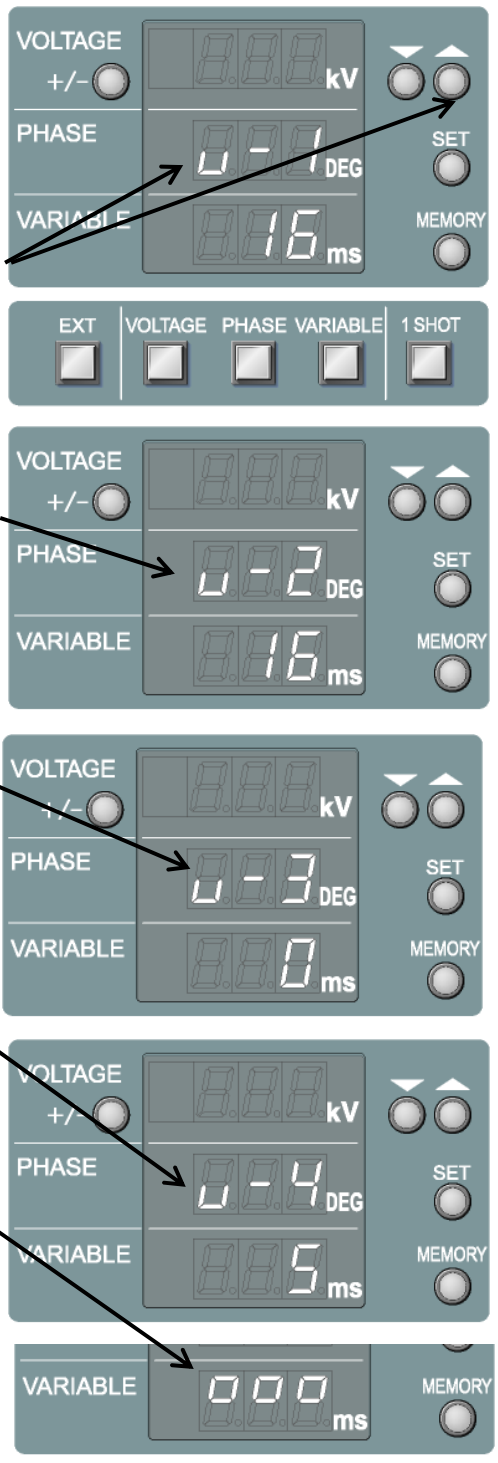
1) Press and hold (>2s) the VARIABLE button, the unit will be placed in VARIABLE ramp mode.

2) First set the desired initial period. (In this instance, the second row indicator shows “v-1” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.

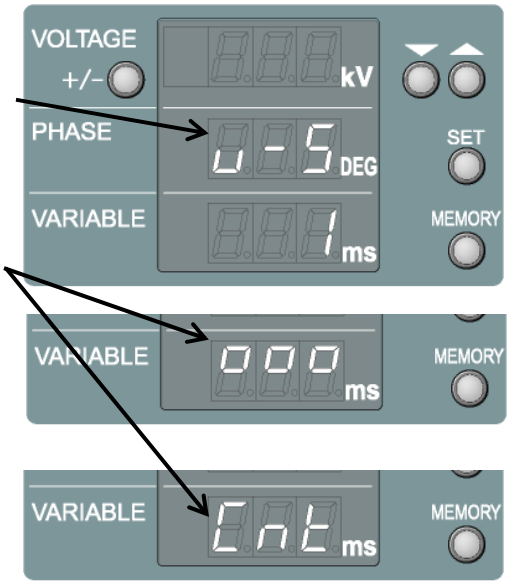
3) Secondly, set the desired final period. (In this instance, the second row indicator shows “v-2” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.

4) Thirdly, set the desired step period. (In this instance, the second row indicator shows “v-3” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.

5) Next, set the desired duration. (In this instance, the second row indicator shows “v-4” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting. This parameter can also be set to ” o o o” (manual selection) With this, the operator shall stop the test run by pressing the STOP button and shall restart by pressing the START button again.



6) When any specific duration is set, an interval shall be selected. The second row indicator shows “v-5” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting. This parameter can also be set to ” o o o ” (manual selection) for the mode where the operator shall restart the test run by pressing the START button. One more setting is available: “Cnt” enables the unit to run with no interval inserted between each step.



7) Upon completion of the above settings, the unit is automatically placed in period ramp mode with the VARIABLE button lamp lighted.

8) To disable period ramp, press the VARIABLE button again (the button lamp will start blinking) or press the PHASE button to select PHASE mode operation.

9) To enable period ramp, carry out the above steps 1) to 6) or press the VARIABLE button while the lamp is blinking in case all parameters have been already set

Example setting in VARIABLE ramp

When running a test with 20ms period to 100ms at 10ms step for 5 seconds duration for each step and with 7 seconds interval, each parameters shall be set as follows: v-1=20, v-2=100, v-3=10, v-4=5, v-5=7. During those parameters setting for period ramp operation, setting is suspended if either of the VOLTAGE, VARIABLE or PHASE button is pressed. While the VARIBALE button lamp is **blinking,** the unit accepts pulse period setting by the user. While the VARIABLE button lamp is **lighted**, the unit is in VARIABLE ramp mode.

Code	Parameter	Allowable setting
V-1	Initial period	16 (10)～999 ms
V-2	Final period	16 (10)～999 ms
V-3	Step period	0～999 ms
V-4	Duration	1～999s, manual
V-5	Interval	1～999s, manual and continuous

Numbers in parentheses are for INS-4020

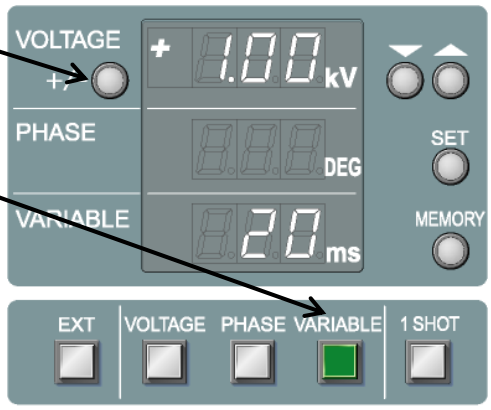
10.4 VARIABLE ramp test run

The unit executes the test according to the settings of initial, final and step periods, test duration for each step and interval between each step.

1) Complete the connection referring to Chapter 8. (For test set-up, refer to Chapter 10.)

2) Select the polarity + or – by polarity (+/-) selection button.

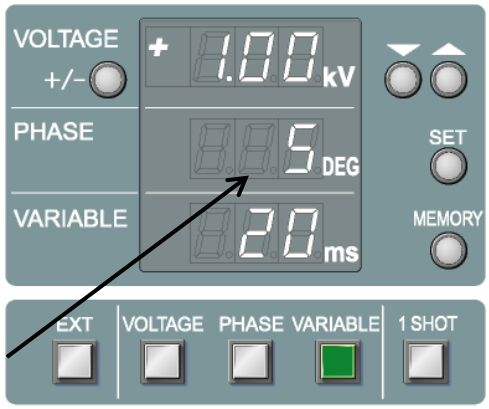
3) Complete the settings for VARIALBE ramp operation referring to Section 9.3 VARIABLE ramp setting or press the VARIABLE button to be illuminated and to enable VARIABLE ramp function.



4) Press the VOLTAGE button and select the desired voltage by using the Increment or Decrement button

5) Check the connection for EUT LINE INPUT.

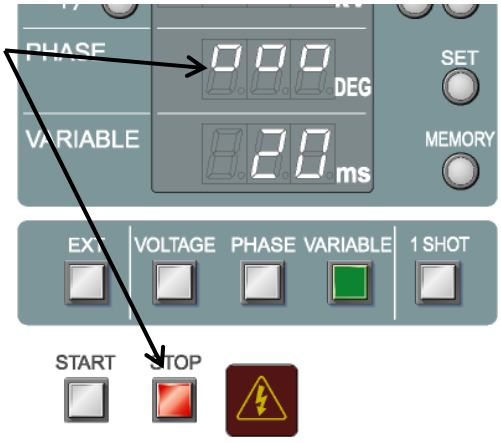
6) Press the START button to run the test. Even during the test run, the output voltage can be changed by means of Increment or Decrement button.



7) The unit indicates remaining time in second on the second row indicator. Upon completion of the step duration, the unit temporarily stops the test run. In case the step duration has been set to "0 0 0", the operator shall pause and restart the test run by pressing the STOP and START buttons, respectively.

8) In case the interval has been set to "0 0 0", the operator shall restart the test run by pressing the START button. For other settings, the unit automatically restarts the test run.

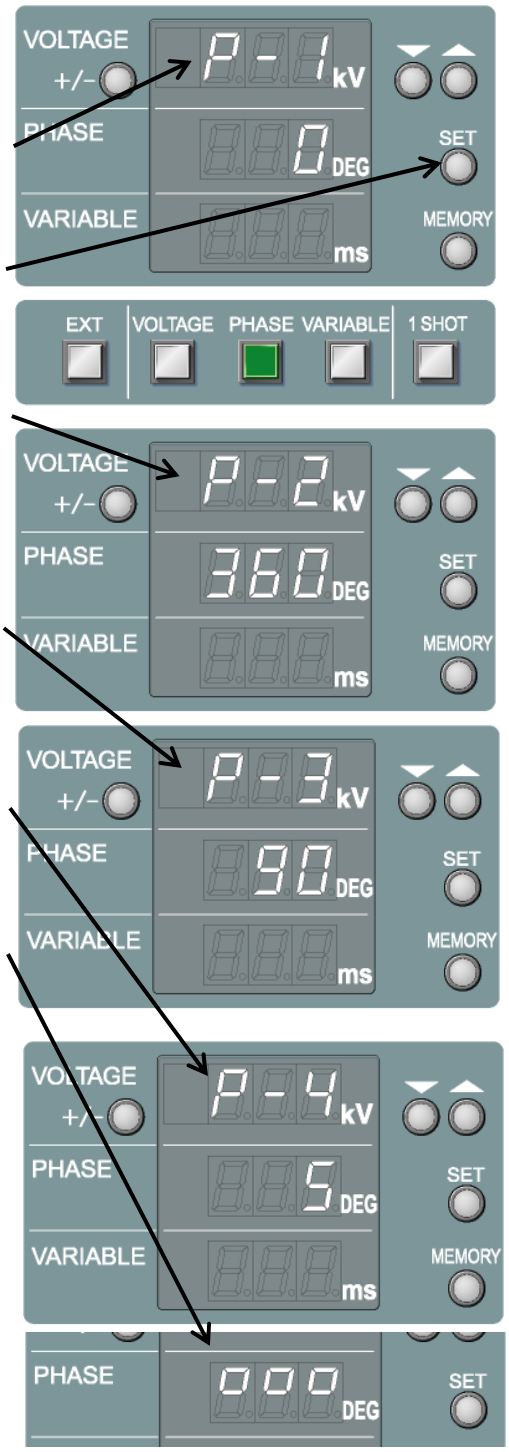
9) Reaching the final period, the unit automatically stops the test



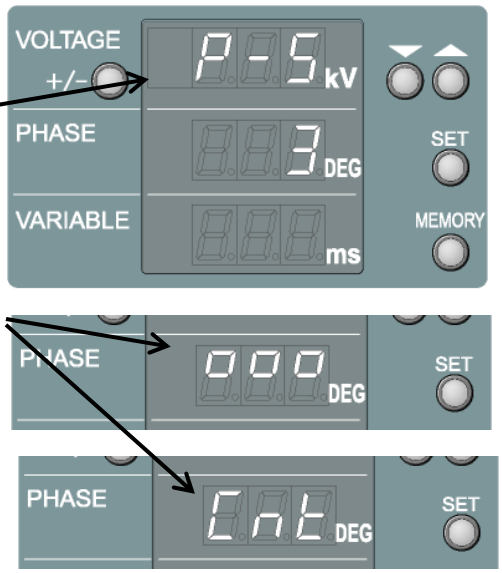
10.5 PHASE ramp setting

The placement phase angle can be automatically ramped according to the setting. The following 5 parameters shall be set: initial, final and step angles, test duration for each step and interval between each step. Placement phase angle ramping enables an automatic test run to the preset final phase angle according to the preset test duration and interval setting. Manual ramping by using the START and STOP buttons is also available.

1) Press and hold (>2s) the PHASE button, the unit will be placed in PHASE ramp mode.
2) First set the desired initial phase angle. (In this instance, the first row indicator shows “P-1” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.
3) Secondly, set the desired final phase angle. (In this instance, the first row indicator shows “P-2” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.
4) Thirdly, next set the desired step angle. (In this instance, the first row indicator shows “P-3” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting.
5) Next the desired duration. (In this instance, the first row indicator shows “P-4” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting. This parameter can also be set to ” ooo” (manual selection) .With this, the operator shall stop the test run by pressing the STOP button and shall restart by pressing the START button again.



6) When any specific duration is set, an interval shall be selected. The first row indicator shows “P-5” Adjust the value by using Increment or Decrement button and press the SET button to confirm the setting. This parameter can also be set to ” ooo” for the mode where the operator shall restart the test run by pressing the START button. One more setting is available: “Cnt” enables the unit to run with no interval inserted between each step.



7) Upon completion of the above settings, the unit is automatically placed in PHASE ramp mode, with the PHASE button lamp lighted. In this instance, VOLTATE button lamp is blinking. Set the desired voltage by using Increment or Decrement button. The SET button does not have to be pressed. When the VOLTAGE button lamp is blinking, the output voltage can be changed by means of Increment or Decrement button even during the test run.

8) To disable PHASE ramp, press the PHASE button again (the button lamp will start blinking) or press the VARIABLE button to select VARIABLE mode operation.

9) To enable PHASE ramp, carry out the above steps 1) to 6) or press the PHASE button while the lamp is blinking in case all parameters have been already set.

Example setting in PHASE ramp

When running a test from 0° to 270° placement at 90° step for 5 seconds duration for each step and with 7 seconds interval, each parameters shall be set as follows: P-1=0, P-2=270, P-3=90, P-4=5, P-5=7. During those parameters setting for PHASE ramp operation, setting is suspended if either of the VOLTAGE, VARIABLE or PHASE button is pressed. While the PHASE button lamp is **blinkin**g, the unit accepts placement (phase angle) setting by the user. While the PHASE button lamp is **lighted**, the unit is in PHASE ramp mode.

Code	Parameter	Allowable setting
P-1	Initial angle	0～360°
P-2	Final angle	0～360°
P-3	Step angle	0～360°
P-4	Duration	1～999s, manual
P-5	Interval	1～999s, manual and continuous

10.6 PHASE ramp test run

The unit executes the test according to the settings of initial, final and step phase angles, test duration for each step and interval between each step.

1) Complete the connection referring to Chapter8. (For test set-up, refer to Chapter 10.

2) Select the polarity + or – by polarity (+/-) selection button.

3) Complete the settings for PHASE ramp operation referring to Section 9.5 PHASE ramp setting or press the PHASE button to be illuminated and to enable voltage ramp function.

4) Press the VOLTAGE button and select the desired voltage by using the Increment or Decrement button.

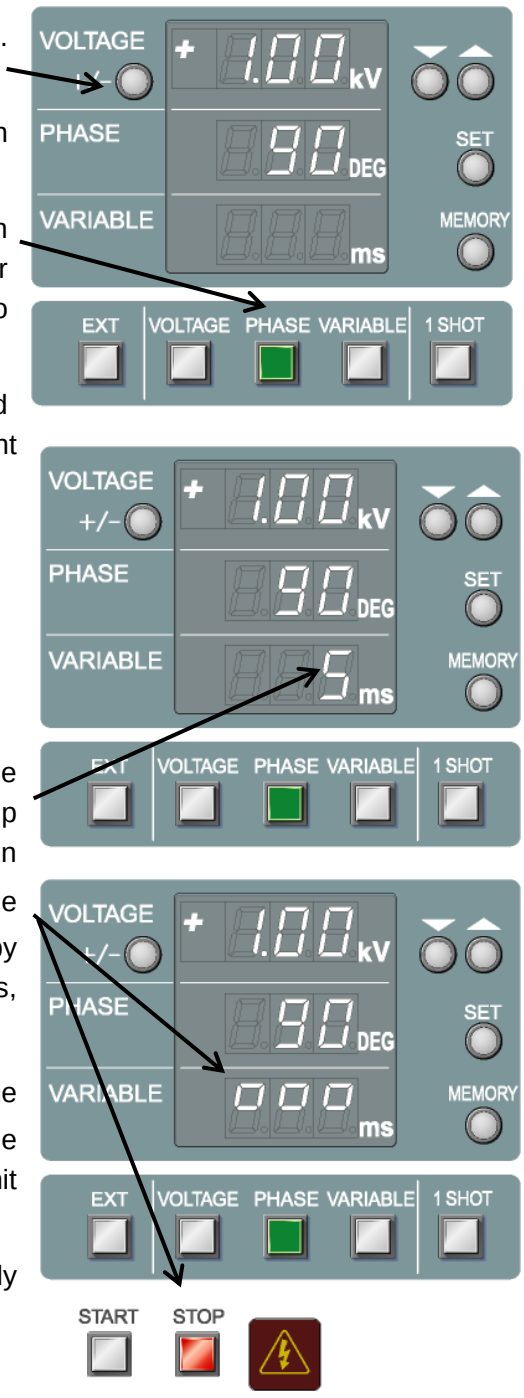
5) Check the connection for EUT LINE INPUT

6) Press the START button to run the test. Even during the test run, the output voltage can be changed by means of Increment or Decrement button.

7) The unit indicates remaining time in second on the thirrd row indicator. Upon completion of the step duration, the unit temporarily stops the test run. In case the duration has been set to " O O O ", the operator shall pause and restart the test run by pressing the STOP and START buttons, respectively.

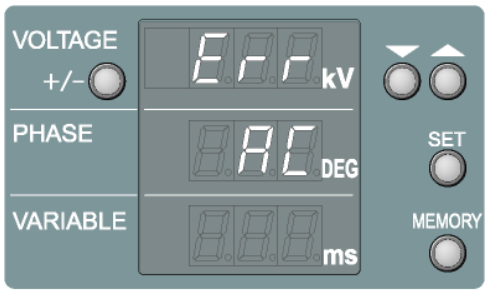
8) In case the interval has been set to " O O O ", the operator shall restart the test run by pressing the START button. For other settings, the unit automatically restarts the test run.

9) Reaching the final angle, the unit automatically stops the test.



Like in the static PHASE mode, in PHASE ramp mode, the unit generates pulses synchronized with the EUT supply AC frequency or external synchronization signals. The unit does not generate pulses when no AC source is connected to the EUT LINE INPUT terminal or the EUT LINE INPUT power supply is DC (when the frequency of AC supply is out of the 45Hz to 65Hz range), In this case, an Err sign is shown upon pressing the START button.

To return to the normal operation state, press the STOP button. Connect an appropriate supply to the EUT LINE INPUT or check to see correct external synchronization signals are present, and then press the START button. The same procedures shall be taken against an interruption of AC during testing.



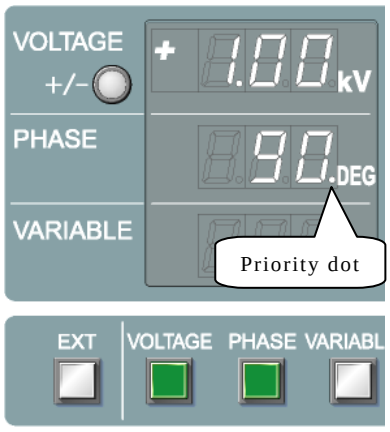
10.7 Combined ramp mode

Combinations of VOLTAGE ramp with VARIABLE ramp or with PHASE ramp are available. In either combination mode, the unit executes ramping according to the order of selection. For example, when PHASE ramp is set from 0° to 270° at 90° step, and VOLTAGE ramp is set from 1.00kV to 2.00kV at 0.25kV step , VOLTAGE ramp is selected first and PHASE （VARIABLE）ramp is selected next, the unit carries out 1.00kV to 2.00kV ramping at 0.25kV step first all on 0° phase angle and repeat the same voltage ramping this time on 90°
In contrast, when PHASE (VARIABLE) ramp is selected first and VOLTAGE ramp is selected next; the unit generates 1.00kV pulses on 0° to 270° at 90° step, repeat the same phase ramping this time at 1.25kV, and repeats this step until 2.00kV pulses are done for all the selected angles.

1） Complete the connection referring to Chapter 8. (For test set-up, refer to Chapter10)

2） Select the polarity + or – by polarity (+/-) selection button.

3） Conduct test settings for VOLTAGE ramp and PHASE (VARIABLE) ramp（see the relevant sections）and enable each ramp function. (Can be known by lighted ramps) The first selected mode is identified with a dot sign on the indicator.



4） Check the connection for EUT LINE INPUT.

5） Press the START button to run the est.

6） During the test run, parameters cannot be changed.

7） In case the duration is set to ” ０００” (manual), the operator shall pause the test run by pressing the STOP button and shall restart by pressing the START button again. In case any specific duration has been set, the unit automatically temporarily stops the test run.

8） In case the interval is set to ” ０００” (manual), the operator shall restart the test run by pressing the START button. With the selected time interval, the unit automatically resumes the test run.

9） The unit automatically stops the test run when reaching the final voltage or final phase angle (period).

10.8 Remote START and STOP

Instead of pressing the START and STOP buttons, the operator can control the test run by means of the EXT TRG connector. This feature is provided for the purpose of extension of the START and STOP buttons to a remote area. The output voltage, repetition, phase angle and others shall be set by the front panel controls.

1) To enable this mode, turn on this unit while pressing and holding the EXT button. In Remote START and STOP mode, the EXT button lamp blinks.
2) Complete the connection referring to Chapter 8. (For test set-up, refer to Chapter 10.)
3) Select the desired voltage, polarity and period or angle.
4) Check the connection for EUT LINE INPUT
5) A low-level signal input starts the test run and a high level signal stops the test. (HV supply turns off) The STOP button on the front panel is still operative.
6) Other controls than test start and stop shall be done by front panel buttons.

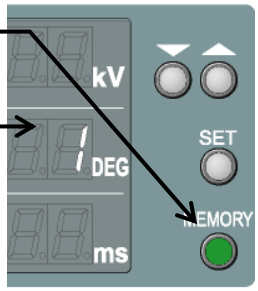
In Remote START and STOP mode, TTL or open collector signals shall be applied to the EXT TRIG input connector. The low state with 20ms or longer duration can only be regarded as a valid input. A high level signal (open) stops pulse generation. Another mode in Remote START and STOP is available. Turn on this unit while pressing and holding EXT and VOLTAGE buttons. In this mode, the unit starts the test at the first transition for high to low signal (and ignores low to high transition) and stops the test at the next high to low transition).

During operation in Remote START and STOP mode, ramp mode test cannot be done. Initial turn-on releases Remote START and STOP mode.

10.9 Memory function

The unit can save the current settings for the output voltage (kV), phase angle (deg), and pulse period (ms) and also the settings for ramp mode. The memory is operative unless the backup battery is discharged.

How to save settings

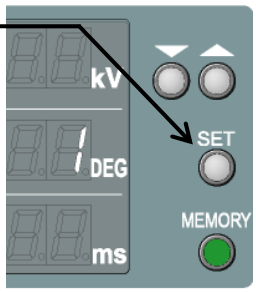


1) Press the MEMORY button.

2) The MEMORY button becomes alight. The memory number currently selected is displayed in the second column.

3) Select the desired memory number with Increment and Decrement button.

4) Press the SET button. The unit saves the current settings under the selected memory number.



*To skip the saving procedure, press any other button than MEMORY, SET, Increment and Decrement. The unit will not save the current settings and its display will return to ordinary status.

How to call up settings

1) Press the MEMORY button.

2) The MEMORY button becomes alight. The memory number currently selected is displayed in the second column.

3) Select the desired memory number with Increment and Decrement button.

4) Press the MEMORY button again. The unit calls up the settings saved under the selected memory number.

*To skip the calling procedure, press any other button than MEMORY, SET Increment and Decrement. When the battery for back up would be ended, the memory contents are lost and this unit returns to the initial (at the time of shipment) settings

10.10 Terminating resistor

10.10.1 Voltage indicator correction

Voltage values shown on the indicator match the actual output when the built-in terminator is connected. The default setting is 53.5 ohm (built-in terminating resistor). While testing with no termination or testing with an optional triangular wave unit, voltages values shown on the indicator are different from the actual output voltages. To avoid this, this unit provides (software) corrections by calculating them from the output voltage from the high voltage power supply and terminating resistor being used, which enable voltage values shown on the indicator to match the actual outputs. These corrections are operative only when the correct connections are made. For example, selection of open circuit (no termination) on the selector allows the unit to read the correct value when no termination is actually connected.

Terminating resistors and their applications	
Setting	Application
53.5Ω	This is the value of the terminating resistor built in this unit and this is the default setting of the provided correction function. This setting shall be used for power line coupling testing where the EUT is connected to the EUT LINE OUTPUT terminals. This setting shall be also used to testing with optional accessories such as Coupling Adapter and Radiation Probe, which are connected to 50ΩTERM IN - 50Ω TERM OUT.
50.0Ω	This setting shall be used when measuring a waveform from this unit by using the AT-810 attenuator and an appropriate scope with 50 ohm input. When inserting a 50 ohm terminator between the AT-810 and scope which does not have 50 ohm input, this setting shall be used.
OPEN (op)	When using no terminating resistor, whether internal or external, this setting shall be selected.
Triangular wave (tri)	This setting shall be used when using an optional Triangular Wave Unit (Model 02-00099A). Due to the nature of this optional unit, the VOLTAGE indicator cannot provide the correct value (matching the actual output). For details, refer to Section 9.10.2

For your info

An external Triangular Wave Unit is optionally available.

- MODEL 02-00099A：4kV max,　pulse width (at 50% duration) 1 us.

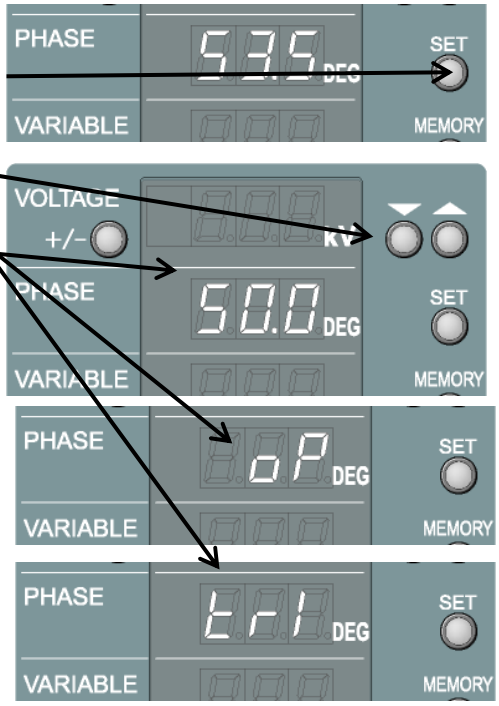
10.10.2 Setting of voltage indicator correction

To utilize this function, a special step when turning on the unit is required.

1) While holding the SET button, turn on the unit. The second row indicator shows the default setting.

2) Select the desired correction by using the Increment or Decrement button. Four selections are available; “53.5”, “50.0” “oP (no termination)”, “trl (triangular wave unit being connected)”

3) When the desired setting has been selected, press the SET button to confirm the setting. When checking the current setting, press and hold (>2s) the SET button. The current selection is shown for 4s on the second row indicator in VARIABLE mode or on the third row indicator in PHASE mode.



The maximum output voltages in each correction are different among product models. For details, refer to Section 9.10.3.

The correction is reset to 53.5 ohm each time the unit is turned on. When required, take the procedures shown here every time.

10.10.3 Maximum voltage for different models and different settings

The table below shows the maximum values which can be set on the VOLTAGE indicator. Values are different depending on the correction setting.

Model No.	53.5Ω (default setting)	50.0Ω*1	OPEN	Tri *2 (Triangular Wave Unit)
INS-4020	2.05ｋV	1.98ｋV	4.00ｋV	4.00ｋV
INS-4040	4.10ｋV	3.96ｋV	8.00ｋV	6.00ｋV

*1 With this setting, an external terminating resistor shall be used instead of the terminating resistor built in the INS unit.
*2 Due to the nature of this optional unit, the VOLTAGE indicator cannot provide the correct value (matching the actual output).

The voltage values shown in the table are values displayed on the VOLTAGE indicator. As mentioned, this unit provides (software) corrections by calculating them from the output voltage from the high voltage power supply and terminating resistor being used, which enable voltage values shown on the indicator to match the actual outputs.

Due to the nature of the Triangular Wave Unit, however, with the setting of “tri”, the value shown on the VOLTAGE indicator cannot be identical to the actual output from the Triangular Wave Unit. The deviation between the two is proportional to pulse repetition frequency. For example, when 2kv output form the Triangular Wave Unit is required at a 10ms period, the setting on the VOLTAGE indication shall be 3.4kV*3. When the output voltage accuracy is required, a scope measurement is required to establish a difference between the indication on the VOLTAGE indicator and the value measured on the scope.

*3 This is just an example. This value varies unit to unit (machine to machine) due to an individual difference in high voltage supplies and mercury relays.

11 TEST SET-UPS AND ENVIRONMENT

11.1 Precautions for use

Follow the Section 1 IMPORTANT SAFETYPRECAUTIONS and Section 3 BASIC SAFETY PRECAUTIONS.

11.2 Test parameters

The following test parameters are to be considered and evaluated.

- Coupling mode
- Test voltage
- Pulse width
- Pulse polarity
- Pulse repetition frequency
- Pulse placement phase angle on AC line (in case of AC powered equipment)

11.3 Coupling modes

The following coupling modes and methods are shown in later pages.

- Line to ground mode (common mode) for AC operated equipment
- Line to line mode (normal mode) for AC operated equipment
- Line to ground mode (common mode) for DC operated equipment
- Line to line mode (normal mode) for DC operated equipment
- Capacitive coupling test for signal lines
- Test by using a radiation probe

11.4 Test set-ups

A recommended test set-up example is shown here. Included are the following main comonents (NoiseKen product model numbers):

・Test table (wooden) (03-00039A)：for the table top equipment under test. A metal sheet working as the ground plane (originally designed for a horizontal coupling plane for indirect application of ESD, model 03-00020A) shall be fixed on the table top. An insulation sheet (03-00004A) shall be put on the ground plane.

・Ground plane (03-00007A)： for floor standing equipment under test. If the test room has a metal floor, the floor works as the ground plane.

・Insulation support (wooden) (03-00024A)：for floor standing equipment under test. This support shall be installed on the floor ground plane.

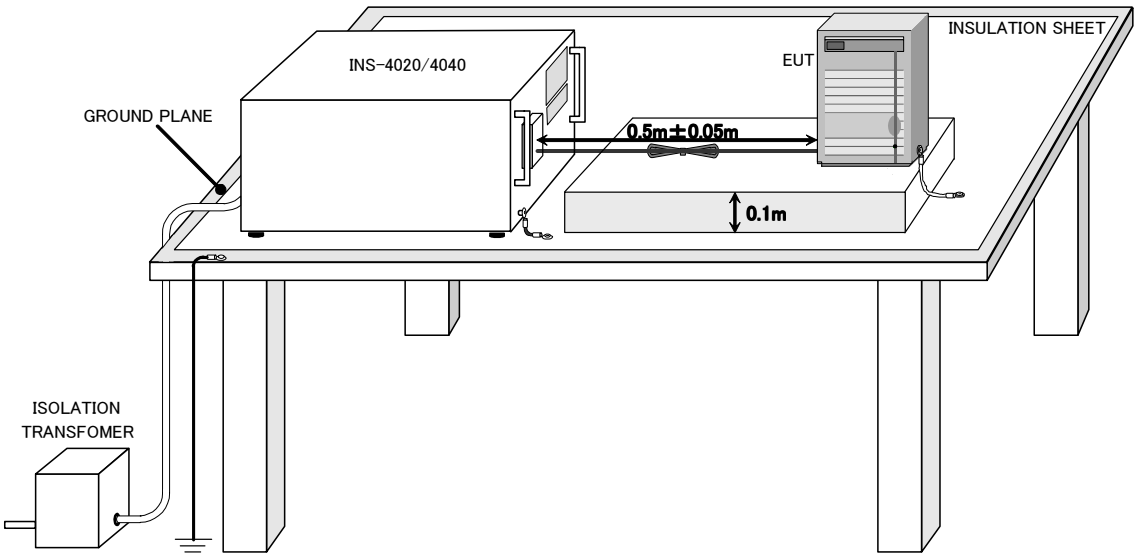
・ Ground connection cable ：a short braided wire of >3.5mm^2 recommended。

・ Cubic insulation block (wooden) (03-00029A)：used as 0.1m separators of the EUT and its cable from the ground plane.

・AC power supply for EUT and isolation transformer or DC source

・Coupling Adapter (CA-805B, CA-803A, 15-00007A（CA-806）)：testing for external interconnection lines

・ Radiation Probe (01-00006A/7A/8A/9A/10A, H2-B) : for immunity debugging tool on circuit boards, modules, components, etc)



[Points]

1. A test table shall be installed 0.5m or more distant from surrounding metallic structures such a wall of the room. Fix a ground plane on the top of the table. For safety, the ground plane shall be connected to a protective earth terminal of the room and put an insulation sheet on it.
2. This unit (INS simulator) shall be put on the insulation sheet. The EUT shall be put on an insulation support of 0.1m height. The simulator and EUT shall be positioned so that the both are 0.5m±0.05m away each other.
3. Connect SG terminal of the simulator to the ground plane, and FG (frame ground) terminal (if any) of EUT to the ground plane with a low impedance cable (braided wire of 3.5mm^2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications.
4. Connect the AC power cord of the EUT to the EUT LINE OUTPUT terminals. When the cord is too long, bundle it so that the length of it becomes 0.5m±0.05m to prevent short looping, and so that that it may not run in parallel or intersect with other communication cables etc. Record this cable layout for reproduction in future testing. The reason why the cord shall be put on the 0.1m height support is to obtain good test reproducibility.
5. Check to see that the power supply for EUT is off. For the AC operating EUT, connected the EUT supply to the EUT LINE INPUT terminals only though an isolation transformer.

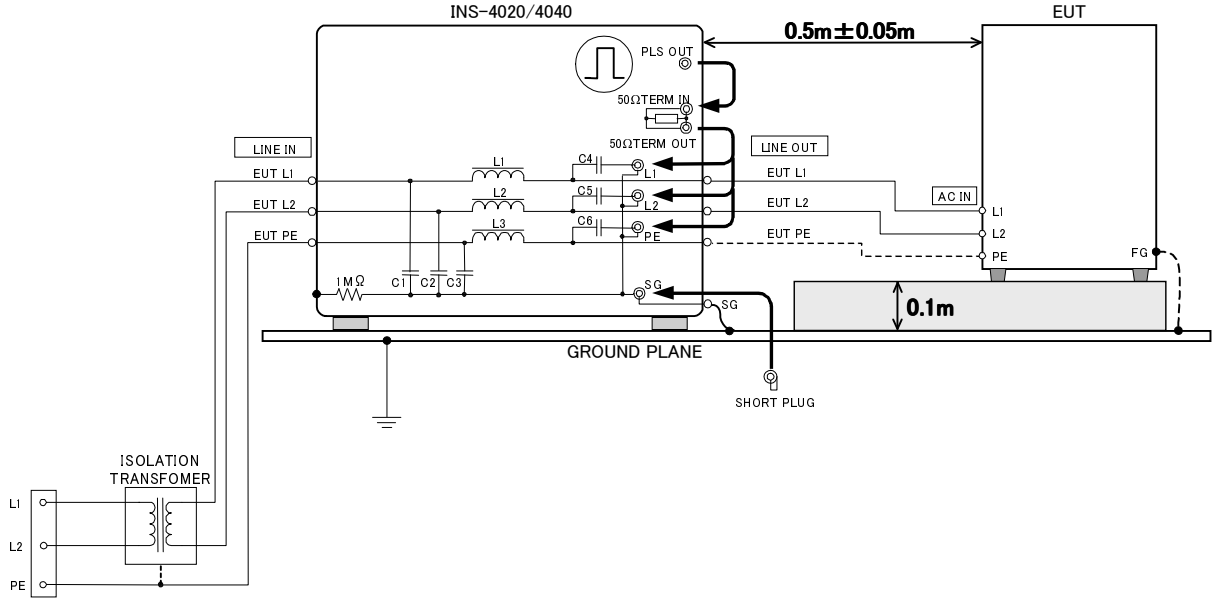
(Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

IMPORTANT

The SG terminal on the front panel and PE terminal on the rear panel play different roles. The SG terminal shall be connected to the ground plane as functioning as a stable ground reference for the generated pulses. These two terminals are independent each other. The PE terminal ( ) is the protective earth terminal electrically connected to the center conductor of the AC INPUT. This terminal shall be connected to the safety earth of the unit installation area by using an appropriate wire when the unit is not grounded through AC INPUT earth conductor. The PE terminal shall not be connected to the ground plane or SG terminal, either.

11.5 Test set-up

11.5.1 Line to ground mode (common mode) for AC operated equipment

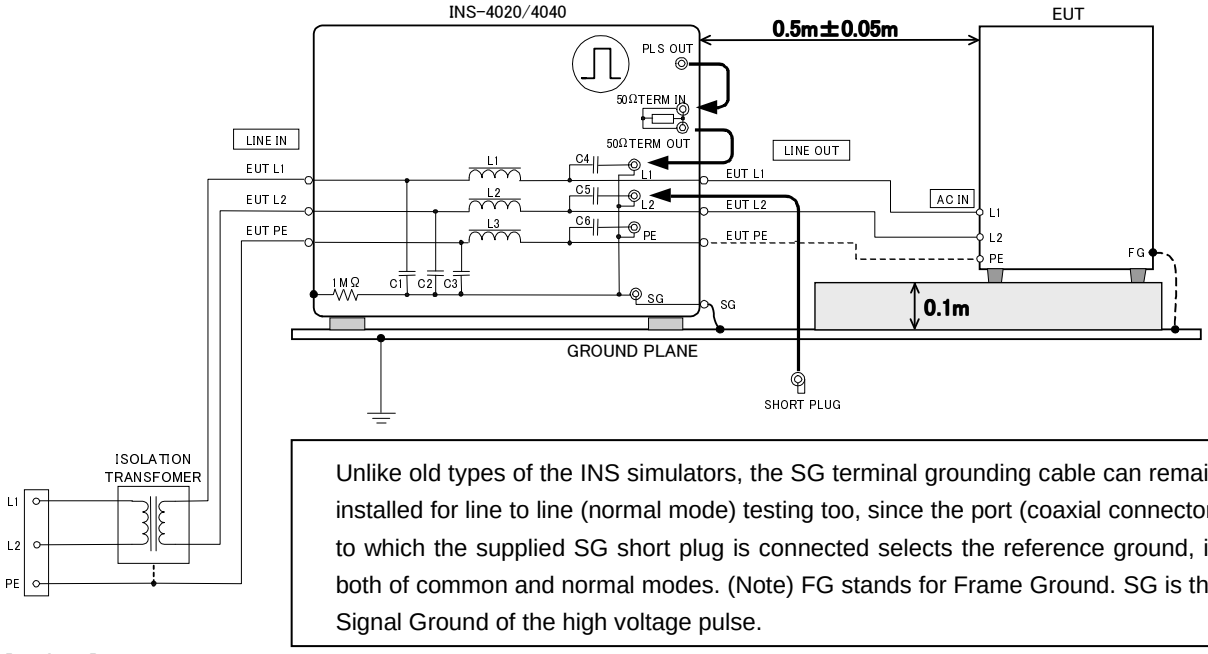


(Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

[Points]

1. Connect SG terminal of the simulator to the ground plane, and FG (frame ground) terminal (if any) of EUT to the ground plane with a low impedance cable (braided wire of 3.5mm^2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications.
2. Plug the SG connector with the supplied SG short plug
3. Connect the AC power cord of the EUT to the EUT LINE OUTPUT terminals. When the cord is too long, bundle it so that the length of it becomes 0.5m±0.05m to prevent short looping, and so that that it may not run in parallel or intersect with other communication cables etc. When the EUT has a protective earth conductor in its AC cord (PE: shown as a dotted line in the above figure), the line also shall be likewise connected.
4. Turn off the AC supply for the EUT.
5. Connect the AC supply for the EUT to the EUT LINE INPUT terminals through an isolation transformer.
6. Connect supplied coaxial cables to PULSE WIDTH connectors and 50ΩTERM IN/OUT (terminating resistor)
7. Connect the 50ΩTERM OUT terminal to either of L1 or L2 (PE when required) by using the supplied coaxial cables. This is the selection of the line to which the pulses are injected.
8. Turn on the POWER of this unit. Set the required test voltage, polarity and test mode. For details, refer to Section 8 or 9. Voltage indicator correction shall not be changed from the default 53.5Ω setting.

11.5.2 Line to line (normal mode) for AC operated equipment



Unlike old types of the INS simulators, the SG terminal grounding cable can remain installed for line to line (normal mode) testing too, since the port (coaxial connector) to which the supplied SG short plug is connected selects the reference ground, in both of common and normal modes. (Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

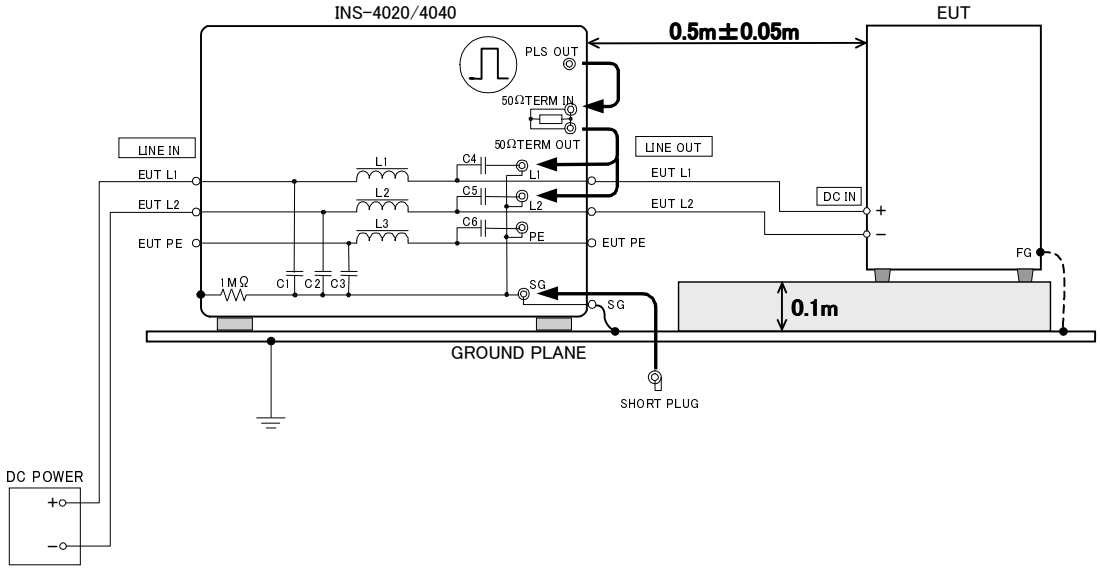
[Points]

1) Connect SG terminal of the simulator to the ground plane, and FG (frame ground) terminal (if any) of EUT to the ground plane with a low impedance cable (braided wire of 3.5mm^2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications
2) Connect the AC power cord of the EUT to the EUT LINE OUTPUT terminals. When the cord is too long, bundle it so that the length of it becomes 0.5m±0.05m to prevent short looping, and so that that it may not run in parallel or intersect with other communication cables etc. When the EUT has a protective earth conductor in its AC cord (PE: shown as a dotted line in the above figure), the line also shall be likewise connected.
3) Turn off the AC supply for the EUT.
4) Connect the AC supply for the EUT to the EUT LINE INPUT terminals through an isolation transformer.
5) Connect supplied coaxial cables to PULSE WIDTH connectors and 50ΩTERM IN/OUT (terminating resistor)
6) Connect the 50ΩTERM OUT terminal to either of L1 or L2 pulse injection connector by using the supplied coaxial cables. This is the selection of the line to which the pulses are injected.
7) Plug the other connector (than the selected connector in Step 6) of L2 or L1 pulse injection connector with the SG short plug
8) Turn on the POWER of this unit. Set the required test voltage, polarity and test mode. For details, refer to Section 8 or 9. Voltage indicator correction shall not be changed from the default 53.5Ω setting.

⚠WARNING 警告

When conducting coupling tests to the EUT LINE, the signal ground of the HV pulse generator circuit and one line of the EUT LINE may be connected, causing a shock hazard if the users touch the outer conductor of the HV coaxial connectors. In addition, if the outer conductor of the HV coaxial connectors is connected to any grounded object, leak current will flow, tripping the ground fault interrupter embedded in the facilities. To avoid these two types of events, use of an isolation transformer is indispensable. Be sure to connect the EUT LINE INPUT to the isolation transformer secondary.

11.5.3 Line to ground mode (common mode) for DC operated equipment

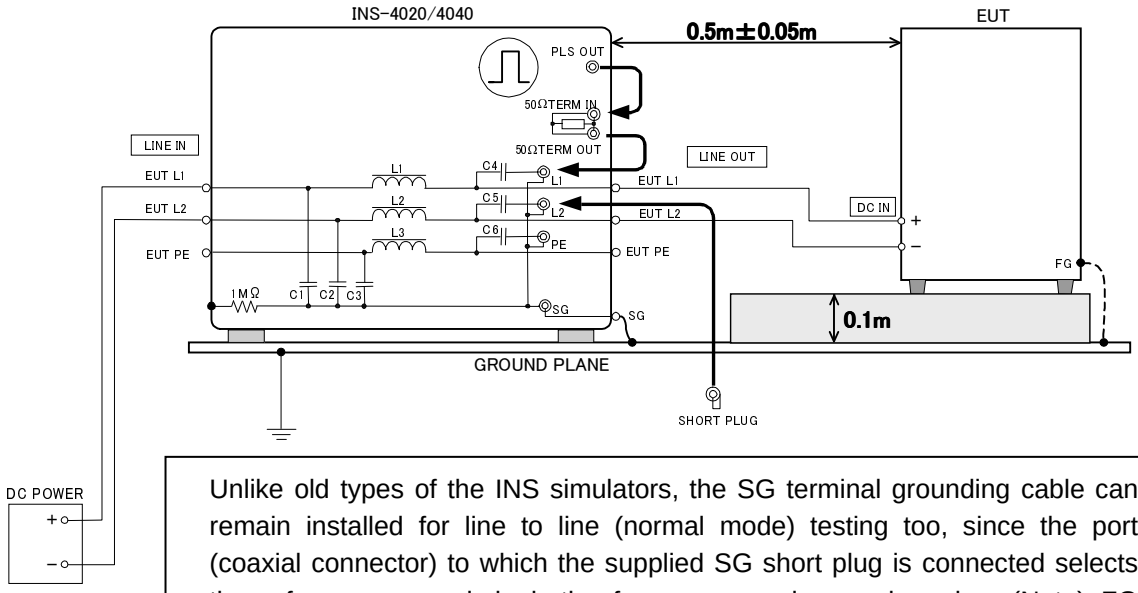


(Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

[Points]

1. Connect SG terminal of the simulator to the ground plane, and FG (frame ground) terminal (if any) of EUT to the ground plane with a low impedance cable (braided wire of 3.5mm^2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications
2. Connect the DC power cord of the EUT to the EUT LINE OUTPUT terminals. The positive (+) side of the DC inputs shall be connected to L1 of the EUT LINE OUT and the negative (-) side shall be connected to L2. When the cord is too long, bundle it so that the length of it becomes 0.5m±0.05m to prevent short looping, and so that that it may not run in parallel or intersect with other communication cables etc.
3. Turn off the DC source for the EUT.
4. Connect the DC supply for the EUT to the EUT LINE INPUT terminals. In case of two-voltage source such as DC +/-15V, connect +15V to L1, -15V to L2, and 0V to PE.
5. Connect supplied coaxial cables to PULSE WIDTH connectors and 50ΩTERM IN/OUT (terminating resistor)
6. Connect the 50ΩTERM OUT terminal to either of L1 or L2 pulse injection connector by using the supplied coaxial cables. This is the selection of the line to which the pulses are injected.
7. Plug the SG connector with the supplied SG short plug.
8. Turn on the POWER of this unit. Set the required test voltage, polarity and test mode. For details, refer to Section 8 or 9. Voltage indicator correction shall not be changed from the default 53.5Ω setting.

11.5.4 Line to line mode (normal mode) for DC operated equipment



Unlike old types of the INS simulators, the SG terminal grounding cable can remain installed for line to line (normal mode) testing too, since the port (coaxial connector) to which the supplied SG short plug is connected selects the reference ground, in both of common and normal modes. (Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

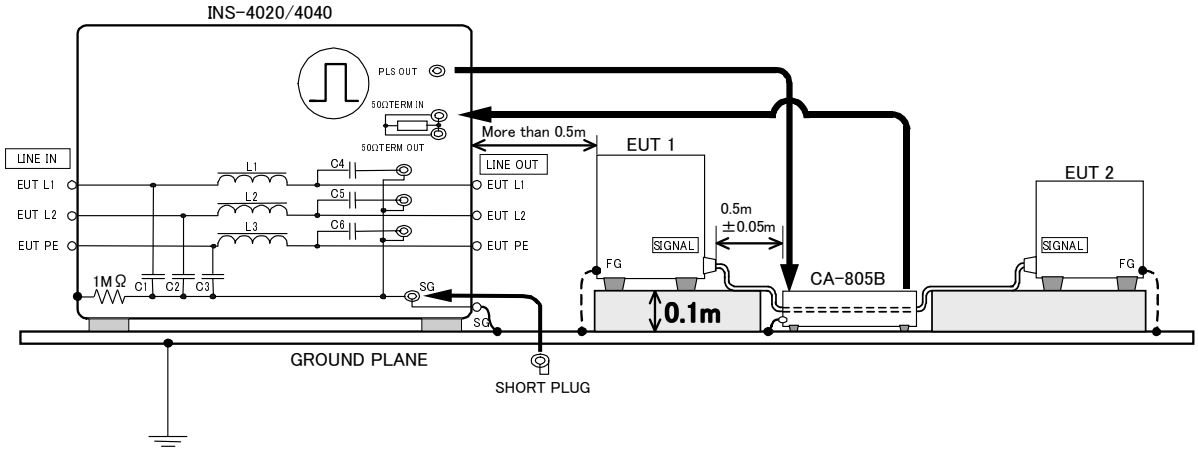
[Points]

1. Connect SG terminal of the simulator to the ground plane, and FG (frame ground) terminal (if any) of EUT to the ground plane with a low impedance cable (braided wire of 3.5mm2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications
2. Connect the DC power cord of the EUT to the EUT LINE OUTPUT terminals. The positive (+) side of the DC inputs shall be connected to L1 of the EUT LINE OUT and the negative (-) side shall be connected to L2. When the cord is too long, bundle it so that the length of it becomes 0.5m±0.05m to prevent short looping, and so that that it may not run in parallel or intersect with other communication cables etc.
3. Turn off the DC source for the EUT.
4. Connect the DC supply for the EUT to the EUT LINE INPUT terminals. In case of two-voltage source such as DC +/-15V, connect +15V to L1, -15V to L2, and 0V to PE.
5. Connect supplied coaxial cables to PULSE WIDTH connectors and 50ΩTERM IN/OUT (terminating resistor)
6. Connect the 50ΩTERM OUT terminal to either of L1 or L2 pulse injection connector by using the supplied coaxial cables. This is the selection of the line to which the pulses are injected.
7. Plug the other connector (than the selected connector in Step 6) of L2 or L1 pulse injection connector with the SG short plug.
8. Turn on the POWER of this unit. Set the required test voltage, polarity and test mode. For details, refer to Section 8 or 9. Voltage indicator correction shall not be changed from the default 53.5Ω setting.

⚠WARNING 警告

When conducting coupling tests to the EUT LINE, the signal ground of the HV pulse generator circuit and one line the DC supply for the EUT are connected each other, which may cause a shock hazard if the users touch the chassis or coaxial connectors of this unit.

11.5.5 Capacitive coupling test for signal lines (by using CA-805B coupling adapter)



(Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

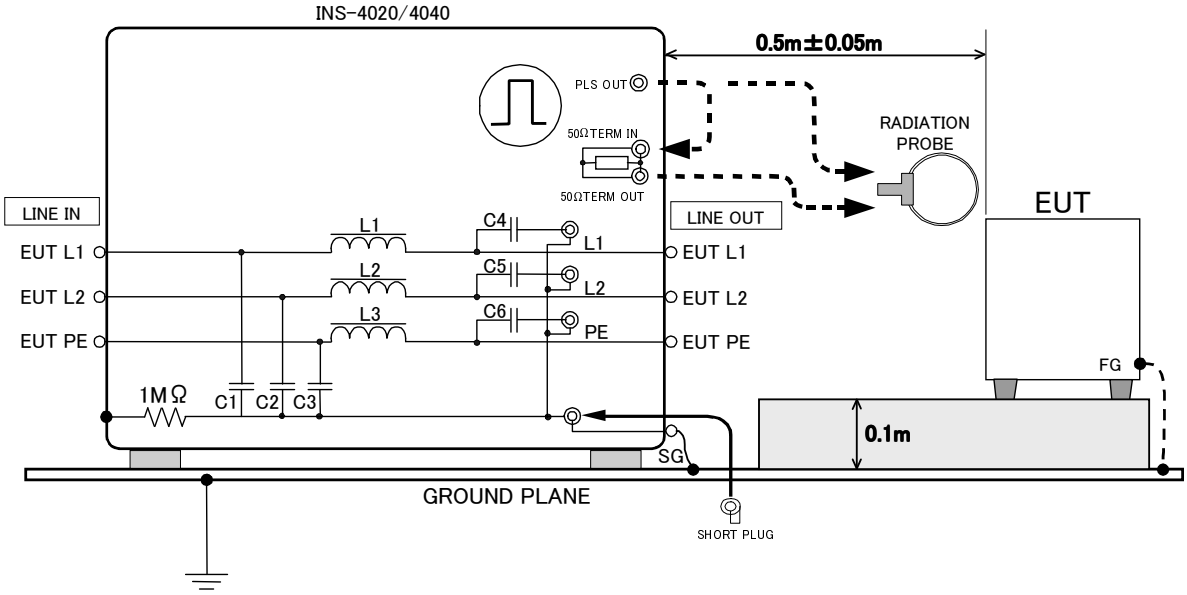
[Points]

1. Put the Coupling Adapter (Model CA-805B) on the insulation sheet. For the floor standing EUT, install the adapter on the floor ground plane. The EUT 1 (equipment under test) and EUT 2 (auxiliary equipment required to operate the EUT 1) on a 0.1m height insulating support. The simulator and EUT1 shall be positioned so that the distance between the two is 0.5m or longer. The length of the cable to be tested from the CA-805B to EUT 1 shall be 0.5m±0.05m. The length of the cable from the CA-805B to EUT 2 is not specified but recommended to be recorded for reproduction of the same test set up for future testing.
2. Connect SG terminal of the simulator to the ground plane, and FG (frame ground) terminal (if any) of EUT to the ground plane with a low impedance cable (braided wire of 3.5mm^2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications
3. Open the coupling adapter and clamp the interface cable under test. The PULSE OUT terminal shall be connected to one side of the adapter and the 50Ω TERM IN terminal shall be connected to the other side. (Changing the injection and termination sides is also recommended as test results may vary.)
4. Plug the SG connector with the supplied SG short plug.
5. The power cord of the EUT shall be connected to a service outlet or external source directly but not to the EUT LINE OUTPUT. Connection of the EUT to the EUT LINE OUPUT is not permitted as the injected signals onto the Coupling Adapter may return to the INS via the wrong route (power cord of the EUT).
6. Turn on the POWER of this unit. Testing shall be done in VARIABLE mode only. For details, refer to Section 8.11. With no input to the EUT LINE INPUT, test cannot start in other modes than VARIABLE, pressing the START button causing an error shown on the display. Voltage indicator correction shall not be changed from the default 53.5Ω setting.

IMPORTANT

Please refer to the operation manual of the coupling adapter being used. Also available are Inductive Coupling Adaptors CA-803A and 15-00007A (also referred to as CA-806)

11.5.6 Test by using a radiation probe (optional accessory)



(Note) FG stands for Frame Ground. SG is the Signal Ground of the high voltage pulse.

[Point]

1. The EUT shall be put on the 0.1m height insulating support. The simulator and EUT shall be positioned so that the distance between the two is 0.5m or longer.
2. The FG (frame ground) terminal (if any) of EUT shall be connected to the ground plane with a low impedance cable (braided wire of 3.5mm^2, etc.) When there are two or more EUT(s), connect each FG terminal to the ground plane. For the EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the FG terminal to the ground plane. Whether to ground the EUT or not shall be decided following the EUT specifications
3. The Radiation Probe (Model 01-0006A/7A/9A/10A (option) shall be connected to the simulator at either of the following connectors:

   PULSE OUT – the probe is used with no termination resistor

   50Ω TERM OUT – the probe is used with 50 ohm resistor termination. In this case the PULSE OUT and 50Ω TERM IN connectors shall be connected with a supplied coaxial cable.
4. Plug the SG connector with the supplied SG short plug.
5. The power cord of the EUT shall be connected to a service outlet or external source directly but not to the EUT LINE OUTPUT. Connection of the EUT to the EUT LINE OUPUT is not permitted as the induced currents on the EUT circuit, generated by the probe, may return to the INS via the wrong route (power cord of the EUT).
6. Turn on the POWER of this unit. Testing shall be done in VARIABLE mode only. For details, refer to Section 8.11. With no input to the EUT LINE INPUT, test cannot start in other modes than VARIABLE, pressing the START button causing an error shown on the display. Voltage indicator correction shall not be changed from the default 53.5Ω setting.

IMPORTANT

Please refer to the operation manual of the Radiation Probe being used. The H2-B EMS probe kit suitable for noise radiation in close proximity is also available.

12 SPECIFICATIONS

12.1 Specifications

Table Specifications of this product

Parameters		Specifications	Note
Output voltage		0.01～0.09 kV±0.04kV 0.10～2.00kV±10%（INS-4020） 0.10～4.00kV±10%（INS-4040）	When the output is terminated by the built-in terminator.
Polarity		Positive/negative	
Square wave	Pulse width	50,100,200,250,400ns ±10% and any combination thereof, maximum width 1uS, and minimum width 10ns±3ns	
	Rise time	<1ns	
	Output impedance	50Ω system (53.5Ω)	
Pulse repetition mode	PHASE	50Hz/60Hz, placement phase angle 0 to 360°, synchronized with L1, L2 of the EUT supply (LINE IN) or with external triggers input.	
	VALIABLE	10ms～999ms ±10%（INS-4020） 16ms～999ms ±10%（INS-4040）	
	EXT trigger	Period：>10ms（INS-4020） ：>16ms（INS-4040） Input signal level：TTL/open collector negative logic Pulse width：>1ms Also functions for timing reference signals input from an external injection unit.	
	1 SHOT	Single pulse generation, each time the 1 SHOT button is pressed. Synchronized (phase angle set on the PHASE control) or asynchronized pulse period.	
Power capacity of EUT		AC240V Single phase, DC60V, 16A	
HV Coaxial Connector		NMHV	Noiseken original
Power supply		AC100-240V 50/60 Hz ±10%	
Power consumption		140VA	
Operating temperature		15～35℃	
Operating humidity		25～75%	
Dimensions (mm)		W 430×H 249×D 420 mm	Projection excluded
Weight		Approx. 19 kegs.	

12.2 Consumable parts

The following components used within this unit are consumable and excluded from the scope of the warranty and servicing for the relevant part or supply for a replacement part is chargeable.

Coaxial cables and connectors

Coaxial cables and connectors within this unit and supplied as included accessories are all deemed consumable. Check them for insulation using an insulation resistance meter once per 6 months or at intervals of 200 operating hours. When the measurement is lower than 100MΩ/DC1000V, it is recommended that the cable and connector shall be replaced with a new one.

Mercury relay

The mercury relay is a consumable item. Performance is deteriorated associated with the use of this unit. Unstable output voltages or unstable pulse repetition frequencies are typical examples. Expected life considerably varies depending on usage conditions. When used with the maximum voltage setting and with no resistor termination, the life of the relay becomes very short. If a symptom described above happens, contact the company (Noiseken) or the company's distributor.

When users replace the mercury relay, follow the procedures and instructions given in Sections 1 Important Safety Precautions, 13 Relay Unit and 5 Basic Safety Precautions. After replacement, perform a waveform check to Section 12 Waveform check and phase angle correction to Section 14.

Noise Laboratory Co., Ltd. shall have no liability against any accident or damage caused by the user's own replacement work.

13 WAVEFORM CHECK

A check for the output waveform prior to testing is highly recommended. The bandwidth of an oscilloscope used for this purpose shall be at least 100MHz, as instrumentation with less than 100MHz may lack brightness. Use an AT-810 40dB attenuator (option), since an ordinary probe has a limited withstand voltage of 400V or so and it may be damaged depending on setting of the output voltage from this unit.

IMORTANT

The AT-810 cannot exactly read the pulse rise time due to its limited frequency bandwidth. Different scopes may bring different results in peak amplitude and duration of the pulse. The AT-810 can be used for the purpose of a rough check for the output only. For the VOLTAGE indicator correction, select 50.0Ω setting for terminating resistor. (For details, refer to Section 9.10)

13.1 Instrument required

- Oscilloscope (Bandwidth 100MHz or more)
- AT-810 attenuator

13.2 Oscilloscope settings

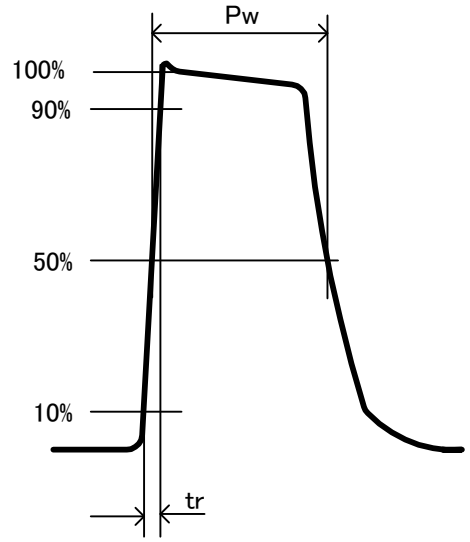
- Time div: 1μ/div or less
- Volt div: Maximum range
- Input impedance: 50.0Ω

13.3 Settings on this unit

- Pulse width: 1μs
- Terminating resistor (VOLTAGE indicator correction): 50.0Ω
- Polarity: Positive
- Voltage setting: Any voltages (maximum input to the AT-810: 4000V)
- Mode: Fastest repetition setting in VARIABLE mode (10ms for INS-4020, 16ms for INS-4040)

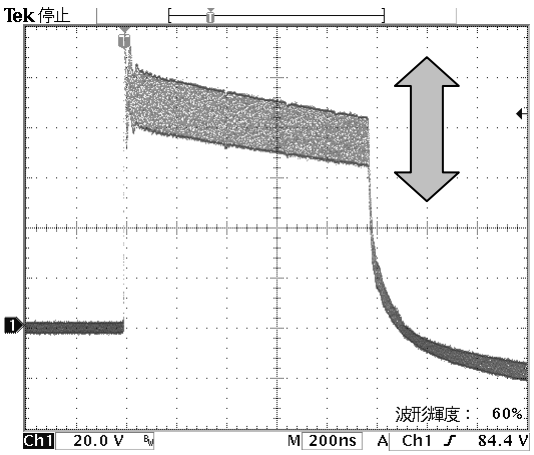
13.4 Checking the waveform

- Disconnect the SG short plug from this unit. The SG short plug is not required for waveform check.
- Connect the OUTPUT connector of the AT-810 to a 50 ohm input port of the scope. When the scope does not have 50 ohm input, the AT-810 output shall be connected through an external coaxial 50 ohm terminator.
- Connect the INPUT connector of the AT-810 to the PULSE OUT of the simulator by using the coaxial cable (NMHV-P to NMHV-P: 1m) supplied with the AT-810.
- Raise gradually the output voltage. Care should be taken not to exceed the maximum input voltage of the oscilloscope. Be sure to adjust the trigger control properly. Check that the waveform as shown below is seen on the screen.

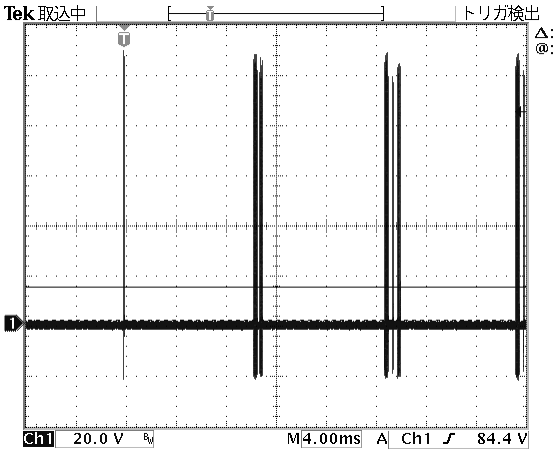


tr: rise time
Pw: pulse width

When events like shown below are encountered, the mercury is about to reach the end of the life. Replace it with a brand new one.



Changing amplitude, the top vertically



Unstable pulse period (increased

※captured at the scope setting for overwriting mode

14 RELAY UNIT

The mercury relay employed within this unit is a consumable item. Performance is deteriorated associated with the use of this unit. Unstable output voltages or unstable pulse repetition frequencies are typical examples of deterioration. Expected life considerably varies depending on usage conditions. When used with the maximum voltage setting and with no resistor termination, the life of the relay becomes very short. If a symptom described in Section 12 happens, contact the company (Noiseken) or the company's distributor. When users replace the mercury relay, follow the procedures and instructions given in Section 1 Important Safety Precautions, 13 Relay Unit and 5 Basic Safety Precautions. After replacement, perform a waveform check to Section 12 Waveform Check and a phase angle correction to Section 14. Noise Laboratory Co., Ltd. shall have no liability against any accident or damage caused by the user's own replacement work.

14.1 2kV relay unit and 4kV relay unit

INS-4020 has a 2kV mercury relay unit mounted and INS-4040 model has a 4kV mercury relay unit mounted. The correct type shall be used.

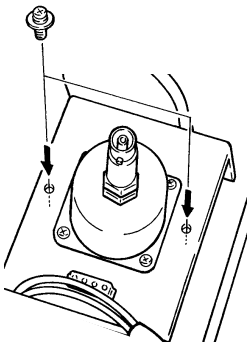
- INS-4020 2kV type relay unit Model 04-00014A
- INS-4040 4kV type relay unit Model 04-00015A

14.2 How to replace the relay unit

Follow the following steps:

1. Before removing cable connections, allow 5 seconds to elapse after turning off the EUT, EUT supply and this unit (INS)

2. Take off the cover by removing the 12 screws on the top and side panels of this unit.
3. Removing the relay unit. Disconnect the coaxial lead from the top of the relay unit and the signal leads from the connector. Remove the 2 screws fixing the relay unit and gently move up it. Disconnect the coaxial lead from the bottom of the unit.



4. Place a new relay unit. First connect the coaxial lead to the bottom of the unit. Fully put in each coaxial connector and make sure connection by rotating the ring clockwise until a "click" is heard. Fix the relay unit to the original position by fastening the two screws. Connect the coaxial lead to the top of the unit and the signal leads to the connector.
5. Put the cover back and fix it to the chassis by fastening the 12 screws.
6. Perform a waveform check following the procedures given in Section 12 Waveform check.
7. Perform the phase angle correction procedures following Section 14 Phase Angle Correction.

IMORTANT

After a relay replacement, this unit may exhibit an error of >±10° ($_{DEG}$)
This comes from an individual difference in mercury relays and is not a failure or malfunction.
For accurate testing, be sure to carry out the procedures required for angle correction.

⚠CAUTION 注意

Mercury is contained in mercury relays, thus the component shall be disposed of in conformity to the local regulations.

15 PHASE ANGLE CORRECTION

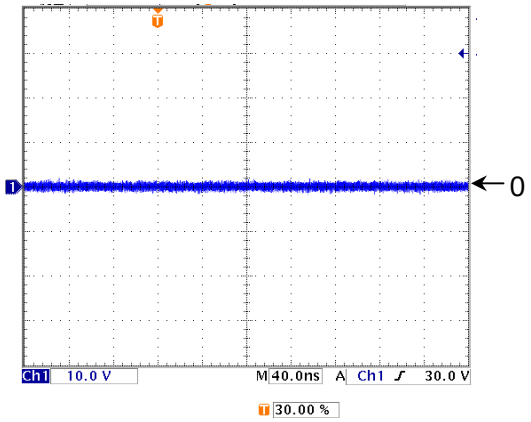
Pulse generation timing varies depending on the characteristic of each relay (having individual difference) and pulse voltages. After a relay replacement, this unit may exhibit an error exceeding the specifications of ±10° (DEG). To minimize this error, be sure to perform the phase angle correction procedures described below. All shipping inspections are done by using a 50Hz AC source. The use of this unit on 60Hz mains may lead to a larger error on 50Hz. In this case, the same steps shall be taken to minimize an error.

15.1 Equipment required

- Oscilloscope (>100MHz bandwidth)
- High voltage probe: the minimum input voltage shall be the value of 2.05kV for INS-4020 and 4.1kV for INS-4040 plus the maximum peak value of power supply voltage for the EUT
- Regulated AC power source: capable of generating a stable and non-distorted sine waveform.
- Isolation transformer: this shall be inserted between the EUT LINE INPUT of this unit and the AC power source.

15.2 Connections and settings

1) Scope connection and setting
Connect a HV probe to the scope.
Vertical axis shall be set at 10V/div and horizontal axis shall be set at 40ns/Div. Set the trigger level at 30V. Make a short-circuit connection between the Hot to Ground leads of the probe and adjust the ground reference to the vertical center of the screen.



2) Connection and setting on this unit

⚠WARNING 警告

①Prior to connection, turn off this unit and AC power source.

②The AC power source shall be connected to the EUT LINE INPUT terminals trough an isolation transformer. (The L of the AC shall be connected L1 of the EUT LINE INPUT an N to L2)

③Set the pulse width at 1000ns and terminating resistor at 50 ohm. Injection shall be done to the L1 inaction connector. Plug the L2 injection connector with the supplied SG short plug.

④Connect the probe Hot and Ground leads to L1 and L2 terminal of the EUT LINE OUTPUT, respectively.

⑤Turn on this unit power.

⑥Set the output voltage at 0.1kV

⑦Set the placement phase angle at 360 deg by pressing PHASE button first and consequently the Increment and Decrement buttons.

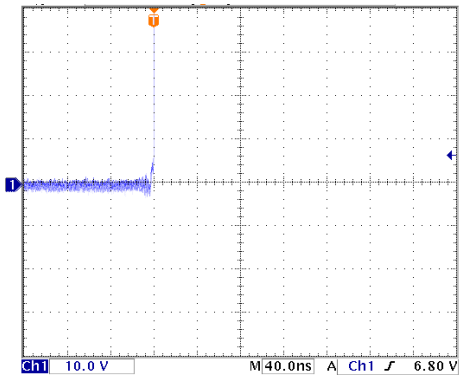
15.3 Setting up Correcting phase angle

In this section, setting on the INS is written as “DEG” and reading on the scope is written as “° “. To obtain a better correction, the following three points are adjusted.

-Phase angle error at 0.1kV setting
-Voltage at 0° reading against 0 ”DEG” setting.
-Phase angle error at the maximum output (at 2.05kV for INS-4020 and at 4.1kV for INS-4040)

All three points shall be adjusted at one try without pressing the STOP button. Once the STOP button is presses, this unit recognizes an interruption of the procedures and return to the setting prior to the correction setting.

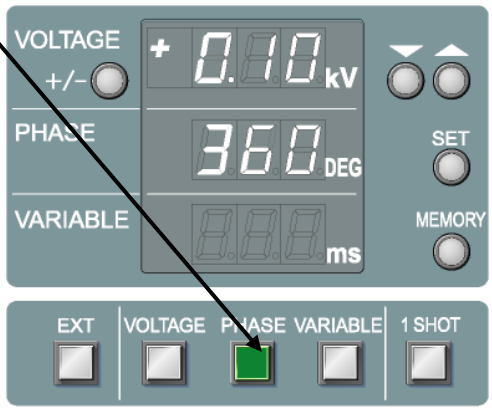
IMORTANT
Be careful not to mistake the 0°and 180°positions on the oscilloscope.



1.Turn on the regulated AC source and set the output to 100-240VAC sine waveform. After checking that there is no distortions on it by observing the output at the EUT LINE OUTPUT, enlarge a zero-cross point referring to the right figure for an easier adjustment work.

2.Press the START button and this unit starts generating pulses in PHASE mode

3.Press and hold (1sec) the PHASE switch. The unit now accepts correction setting with beeps generated.



4. Search for the setting on the PHASE (from 360-330 DEG) by pressing the Increment and Decrement giving 0°angle on the scope. Press and hold (1sec) the SET button. Now Phase angle error at 0.1kV setting has been corrected with beeps generated.

5.Set to 0 DEG on the PHASE. Search for the setting on the VOLTAGE by pressing the Increment and Decrement giving 0°angle on the scope. Press and hold (1sec) the SET button. Now Votlage at 0° reading against 0 ”DEG” setting has been corrected with beeps generated.

6.Set the VOLTAGE indicator to 2.05kV for INS-4020 and 4.10kV for INS-4040. Search for the setting on the PHASE (from 0 to 30 DEG) by pressing the Increment and Decrement giving 0°angle on the scope. Press and hold (1sec) the SET button. Phase angle error at the maximum output has been corrected with beeps generated.

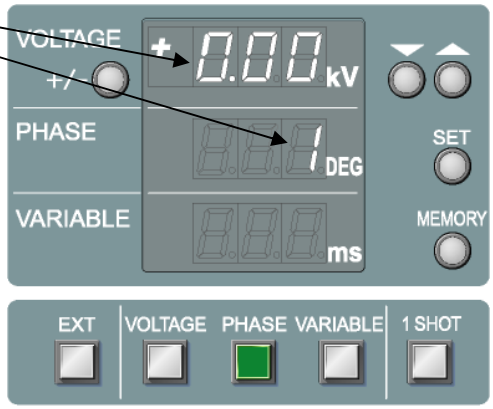
During the above steps, if events such as that 0°angle placement cannot be obtained from 360 to 390 DEG for phase angle error at 0.1kV setting or that 0°angle placement cannot be obtained from 0 to 30 DEG for phase angle error at the maximum output are encountered, the relay may be defective, requiring a replay replacement or servicing by our company. When the battery for back up would be ended, it must be unavailable for setting up point and will be the condition, which cannot provide phase correction.

⚠WARNING 警告

When working for PHASE ANGLE CORRECTION, the high voltage pulses and AC voltages are present at the EUT LINE OUTPUT terminals. Care shall be taken to avoid a shock hazard.

15.4 Releasing Phase Angle Correction

The corrections already set can be cancelled to the following steps:



1. Check to see that AC voltages from 100 to 240V (50Hz or 60Hz) are present at the EUT LINE OUTPUT terminals.

2. Set any other value than 0.10kV, 2.05kV or 4.1kV on the VOLTAGE indicator and set any other value than 0 DEG on the PHASE. Start pulse generation by pressing the START button.

3. Press and hold (1sec) the PHASE button for phase angle correction mode. (beeps generated)

4. Press and hold (1sec) the SET button to release mode from phase correction.

5. Press and hold (1sec) the PHASE button. The unit now has cancelled the settings for phase angle correction. (beeps generated)

Suspended or incorrect operation cannot cancel the correction. Stopping pulse generation (by pressing the STOP button) cannot either.

16 WARRANTY

Servicing terms

The following terms are applicable to servicing by Noise Laboratory Co., Ltd., (hereafter referred to as the Company) provided to maintain the intended performance of its products.

1. Scope
   The following terms shall apply only to products made by the Company.

2. Technical servicing fee
   In the event of a failure of a product within the warranty period (see warranty section), the Company will repair a product without charge. After the warranty expires, repairs will be billed at a nominal cost.

3. Ownership of defective parts
   Any defective part exchanged under the Company's servicing belongs to it.

4. Limited liability
   In the event that damages resulting from servicing by the Company are intentional or caused by negligence, the Company will pay the cost but at the purchase value of the relevant product maximum. But, notwithstanding the foregoing, the Company shall not be responsible for any incidental or consequential damages of any nature, including without limitation thereof loss of would-be profit or compensation demanded from a third party

5. Refusal to offer servicing
   The company may not accept a repair order in the following cases:
   - More than 5 years have passed since the product discontinued
   - More than 8 years have passed after delivery
   - Required component for servicing already discontinued and no alternative is available.
   - Product changed, repaired or remodeled without obtaining a prior permission from the Company.
   - Product severely damaged to the extent it has lost its original form

Limited warranty

Noise Laboratory Co., Ltd. (hereafter referred to as the Company) warrants its products to be free from defects in materials and workmanship under normal use and service for a period of one year from date of delivery. In the event of failure of a product covered by this warranty, the Company will repair the product or may, at its option, replace it in lieu of repair without charge.

Not withstanding the foregoing, the Company shall not be responsible for any incidental or consequential damages of any nature, including without limitation thereof loss of would-be profit or compensation demanded from a third party. This warranty is valid only in Japan.

1. Scope
   This warranty shall only apply to products made by the Company.

2. Period
   One year from date of delivery. The warranty may be valid in 6 months after servicing if the same failure on the same component has repeated.

3. Exclusions
   The followings are exclusions from this warranty:

   - Consumable parts (including HV relay)
   - Failure caused by misuse, neglect, accident or abnormal conditions of operation
   - Failure caused by remodeling on the user side without prior permission from the Company
   - Failure caused by servicing by unauthorized personnel by the Company
   - Failure due to force majeure including but not limited to, acts of God, fire, war, riot, rebellion and others
   - Failure due to shock or drop in or after transit
   - Failure due to operation in environment being out of ambient specifications.
   - A unit shipped to overseas.

17 MAINTENANCE

1. When repair, maintenance or internal adjustment of the unit is required, a qualified service engineer takes charge of such work.

2. Maintenance on the user side is restricted to the outside cleaning and functional check of the unit.

3. When checking or replacing the fuse, turn off the switch of the unit and disconnect the plug socket beforehand.

4. When cleaning the unit, turn off the switch of this unit and the connected equipment and disconnect the plug socket beforehand.

5. Avoid using chemicals for cleaning. Otherwise, the coating of the unit may peel off or the sight glass may be broken.

6. Do not open the cover of this unit.

18 NOISE LABORATORY SUPPORT NETWORK

- If a symptom that seems a trouble is found, check the symptom against the following check sheet and inform the model name and serial Number of the product together with the symptom to Noise Laboratory or our nearest sales agent in your area.

- When the product is returned to Noise Laboratory, write the state of the trouble, contents of your request, model name and serial number in a repair order, pack the product and repair order sheet in the former package or equivalent suitable for transit, and send them back.

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