

**NoiseKen**

**INSTRUCTION MANUAL**

**IMPULSE NOISE SIMULATOR**

**MODEL INS-AX2 Series**

**NOISE LABORATORY CO., LTD.**

1.12 Edition  
AEB00331-00E-0

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# 1 IMPORTANT SAFETY PRECAUTIONS

The following is very important matters in order to safely handle this product (called unit hereafter). Read carefully and strictly observe them.

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.
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.
3. Before connecting the equipment under test (called EUT hereafter), check to see that the unit is in the STOP conditions 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.
4. AC power supply connection to EUT LINE INPUT of the simulator shall be always done through an insulating transformer. Connection without using an insulating transformer may cause an electric shock and may also actuate the earth leakage breaker of the power supply due to leak current.
5. When connecting each cable and changing the connection setting, etc., turn off POWR switch of the simulator and interrupt power to EUT LINE INPUT beforehand. Generated pulses and power supply may cause an electric shock. Change connection after a lapse of more than 5 seconds with power turned off.
6. Fully put in each coaxial connector and make sure connection by rotating it clockwise until a "click" is heard.
7. Be careful of an electric shock caused by generated pulse and power supply to EUT.
8. The simulator is not provided with a protective device against the overcurrent and overvoltage of EUT LINE. Fit a protective device such as fuse, circuit breaker or circuit protector that meets the specified rating to power supply to EUT.
9. A number of safety recommendations are listed in "BASIC SAFETY PRECAUTIONS " mentioned later. Be sure to read them before setting a test environment, connection and starting a test.



## 2 APPLICATION FORM FOR INSTRUCTION MANUAL

We place an order for an instruction manual.

**Model:** \_\_\_\_\_

**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 the following sales department of our company.

**To: Noise Laboratory Co., Ltd.**

**1-4-4 Chiyoda Chuo-ku Sagamiara City,**

**Kanagawa Pref., 252-0237 Japan**

**Tel: +81-(0)42-712-2051 Fax: +81-(0)42-712-2050**

Cut  
line



## 3 BASIC SAFETY PRECAUTIONS

### 3.1 Warning signs and their meanings



**WARNING TO REDUCE THE RISK OF ELECTRIC SHOCK.  
DO NOT REMOVE COVER.  
NO USER-SERVICEABLE PARTS INSIDE.  
REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.**  
感電の危険あり。カバーを外さないこと。

**Means a warning.**

The mentioned warning label is marked on the simulator, and shows the danger of an electric shock.

**NOISE LABORATORY CO.,LTD. IS EXCLUDED ALL THE  
LIABILITY OF ANY FORMS OF DAMAGE, OF EQUIPMENT  
OR HUMANS, CAUSED BY USER'S MISHANDLING DURING  
OPERATION.**

誤った操作による損害に対しては、一切責任を負いません。



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



Sign for handling caution  
In order to protect the human body and equipment, refer to this instruction manual.



Sign for protective earth terminal.



**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.

### 3.2 Basic Safety Precautions

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1. Any person who has an implanted pacemaker or other electric medical device in the body should not operate the simulator. Furthermore, such a person should not enter the test area while the simulator is operating. 【Precautions for human body and operation】
2. Mishandling and careless operation of the simulator will result in a fatal injury. 【Precautions for human body, operation, environments and connection】
3. Use of the simulator in an explosive area such as "No fire" area etc. is prohibited. If it is used in such an area, it may cause combustion or ignition due to electric discharge. 【Precautions for human body and environments】
4. Before connecting the simulator and EUT power supply, turn off POWER switch of the simulator and interrupt power to EUT. The generated pulse voltage and supply power voltage to EUT may cause an electric shock. 【Precautions for human body and connection】
5. Supply power to EUT LINE INPUT of the simulator through an insulating transformer.  
When power is supplied without using an insulating transformer, EUT power supply voltage is injected to the outside of the coaxial connector by settings. Therefore, if the user touches it, he may receive an electric shock. In addition, if the user touches the conductive part of the coaxial connector connected to any grounded subject, EUT power circuit breaker may actuate by leak current according to circumstances. 【Precautions for human body and connection】
6. When connecting cables, place the simulator in the STOP conditions for more than 5 seconds and interrupt the EUT power supply beforehand; The generated high voltage may cause an electric shock. Otherwise, the simulator may be damaged. 【Precautions for human body and connection】
7. The simulator is not provided with a protective device against the overcurrent and overvoltage of EUT LINE.  
EUT power supply shall be provided with protective devices, such as fuse, breaker and circuit protector that meet the rated capacity of EUT to be used.
8. When using a coaxial connector, fully insert it and make sure connection by rotating it clockwise until a "click" is heard. Insufficient connection may lead to unwanted discharges inside the coaxial connectors. 【Precautions for human body and connection】
9. Securely ground the power supply for driving the simulator by using a 3-core AC cable with a grounding conductor which is compatible with power-supply voltage and current for driving the simulator. When grounding from the power supply is not possible, ground it using the protective earth terminal from the rear panel. 【Precautions for human body and connection】



10. Be extremely careful of an electric shock due to the generated pulses and power supply to EUT. 【Precautions for human body and connection】
11. High voltages exist inside the simulator. Never open the covers.  
【Precautions for human body】
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 the simulator.  
【Precautions for human body, operation, environments and connection】



13. The protective earth terminals for the simulator are the AC inlet and the protective earth terminal at the side of the AC inlet. PE of EUT line is provided exclusive for EUT line and it is independent from the protective earth of the simulator. The SG terminal provided on the front panel of the simulator functions as a reference ground for noise testing, and it is floated from the protective earth and FG of the simulator.  
When conducting tests, make connections according to "ENVIRONMENTS, INSTALLATION AND TEST METHOD" mentioned in this manual.【Precautions for connection】
14. The test rig used in conjunction with the simulator should be insulated against a minimum voltage of 8kV (when the built-in 50Ω terminator disconnected from the test circuit). 【Precaution for environments】
15. During EUT test using the simulator, high level of electromagnetic radiation may be generated from EUT and its connecting cable, and thus causing interference with nearby electronic equipment and radio communication equipment.  
When conducting a test, the user may have to take measures such as a faraday cage, shielded room, shielded cable and so on to eliminate these harmful influences. 【Precaution for environments】
16. Be sure to connect the ground plane for noise testing to the safety ground.  
【Precautions for connection and safety】
17. 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. 【Precautions for handling and safety】
18. Do not use nor keep the simulator in a hot or cold environment.(Operating temperature: 15°C~35°C/Operating humidity range: 25~75%) 【Precaution for environments】
19. If condensation is found, fully dry the simulator before operating it. 【Precaution for environments】
20. Do not drop the simulator or do not give strong shock to the simulator.  
【Precautions for handling】
21. When installing the simulator, do not block the vent. 【Precautions for installation and connection】
22. Do not supply voltage exceeding the rated voltage range. 【Precautions for installation and connection】

23. Only a service engineer authorized by our company should perform repair, maintenance work and internal adjustment, except when changing the mercury relay on the user side. **【Precautions for handling and safety】**
24. Do not wipe off the body of the simulator with thinner, etc. When the simulator is dirty, soak a cloth in a detergent, wring it and wipe the simulator with this cloth. **【Precautions for handling】**
25. The simulator is a weighty article. When installing or moving it, two or more persons should work while taking safety measures. **【Precautions for handling and safety】**
26. The simulator employs component parts containing mercury. When scrapping the simulator, dispose of the component following the local regulations. **【Precautions for human body and environments】**
27. As mercury is used in the mercury relay unit, it falls under the category of industrial waste and its disposal is contracted to a waste handler. Therefore, it is not permitted that the user disposes of it as ordinary waste. When disposing of the used mercury relay unit, perform waste treatment in accordance with the regulations of each country or return it to Noise Laboratory or its distributor/agent nearest to you. **【Precautions for human body and environments】**
28. The coaxial connectors used for the simulator is of NoiseKen original design. Use of other type of connectors may cause electric shock hazards or malfunctions of the simulator. **【Precautions for handling and safety】**
29. As the simulator employs a mercury relay, it shall be positioned horizontally only. **【Precautions for handling】**

### **3.3 When warning label is missing:**

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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 to Noise Laboratory or its distributor/agent nearest to you.

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## 5 GENERAL DESCRIPTION

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

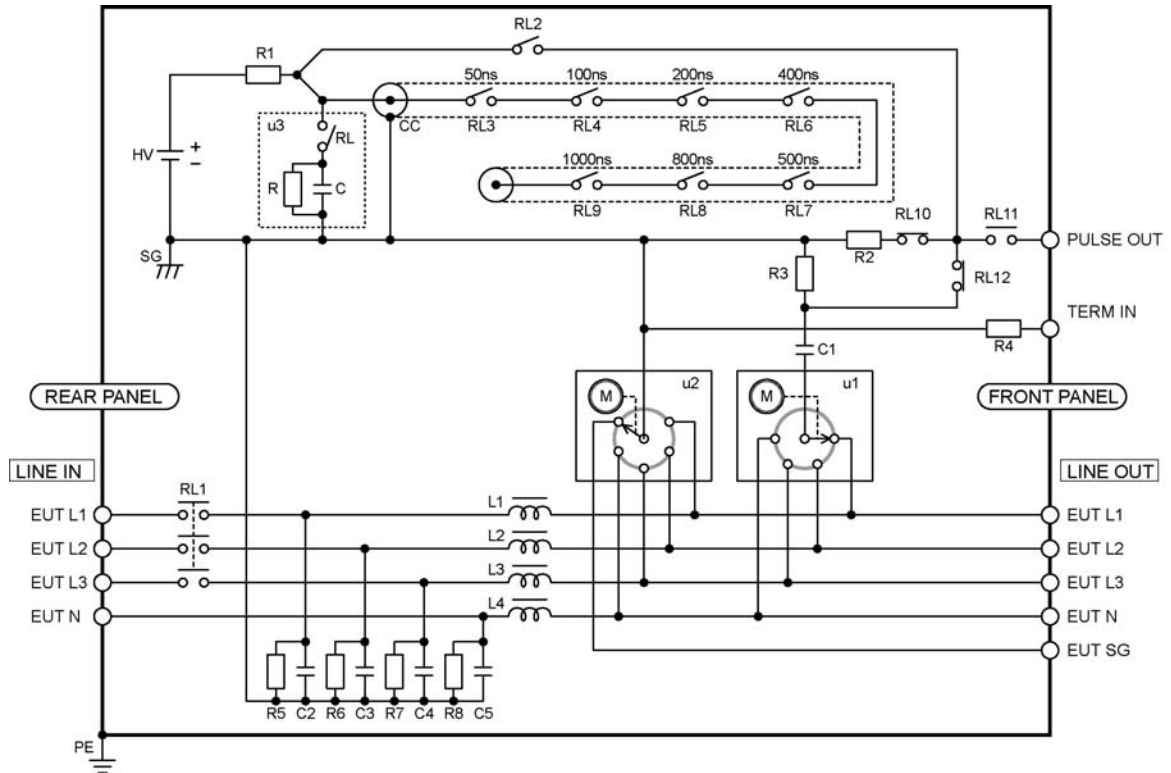
### 5.1 Features

- Generates high voltage square pulses of less than 1ns rise time up to 4kV (INS-AX2 420<sup>(\*)</sup>/450/450<sup>(\*\*)</sup>) or up to 2kV (INS-AX2 220<sup>(\*)</sup>/250/250<sup>(\*\*)</sup>).
- Generates high voltage triangle pulses of 1 $\mu$ s pulse width with less than 40ns rise time, up to 4kV (INS-AX2 420T/450T/450TH)
- Selectable pulse widths from among 8 waves: 10ns, 50ns, 100ns, 200ns, 400ns, 500ns, 800ns and 1000ns.
- Square wave high-voltage pulse can be injected to EUT power line. The injection method between normal mode and common mode can be automatically switched.
- EUT power-capacity for testing: Single phase AC240V 20A and DC65V 20A 420<sup>(\*)</sup>/450/450<sup>(\*\*)</sup>, 3-phase 4 wire AC300V 50A/DC65V 50A (250<sup>(\*)</sup>/450<sup>(\*)</sup>), 3-phase 4 wire AC500V 50A/DC250V 50A (250<sup>(\*\*)</sup>/450<sup>(\*\*)</sup>).
- Generates high voltage pulses synchronized with EUT power line frequency. Synchronization phase angle can be controlled from 0 to 360 degrees.
- Program setting makes it possible to perform a test by changing voltage, injection phase angle, repetition period, etc. automatically.
- 50 $\Omega$  terminating resistor is incorporated.
- Pulse generating circuit is floated.
- Various outlet panels are optionally available. Optional outlet panels make it possible to perform easy noise tests for better reproducibility. Various receptacle types are available.
- Radiation probe and coupling clamp are optionally available.

## 5.2 Square Wave Pulse Generation Principle

The main components of the pulse generator circuitry of this simulator are HV power supply, coaxial cables, charging resistor, mercury relay and 50Ω 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 the shield. When a 50Ω resistor terminates this line, the pulse width is approximately 10ns per meter. Pulse widths vary depending on the delay time of the coaxial line (length of the cable). Pulse waveforms and voltages depend on the relation between 50Ω terminating resistor 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 contact opens. The stored energy is discharged when the mercury relay contact closes, generating a HV pulse at both ends of the 50Ω terminating resistor. The injection unit couples this pulse through a capacitor to the power line. Also a decoupling circuit consisting of a coil and a capacitor makes the impedance of the power supply side higher than that of the EUT side so as to supply high voltage pulses to the EUT side efficiently and reduce the leak of high voltage pulses to the power supply side.





INS-AX2-250/250\*/450/450\*

HV : HV power supply      R1 : Charging resistor      CC : Coaxial cable  
 RL2 : Mercury relay      R2 : Terminating resistor(60 Ω)      R3 : Terminating resistor(500 Ω)  
 C1 : Coupling capacitor      RL1 : Contactor      U3 : Triangular wave generating part (\*\*\*)

R4 : Terminating resistor for options (60 Ω)      L1/C2/R5, L2/C3/R6, L3/C4/R7, L4/C5/R8 : Filter

RL10 : ON when the incorporated terminating resistor(60 Ω) is connected.

RL11 : ON when outputting from PULSE OUT coaxial connector

RL12 : ON when INJECTION phase is set.

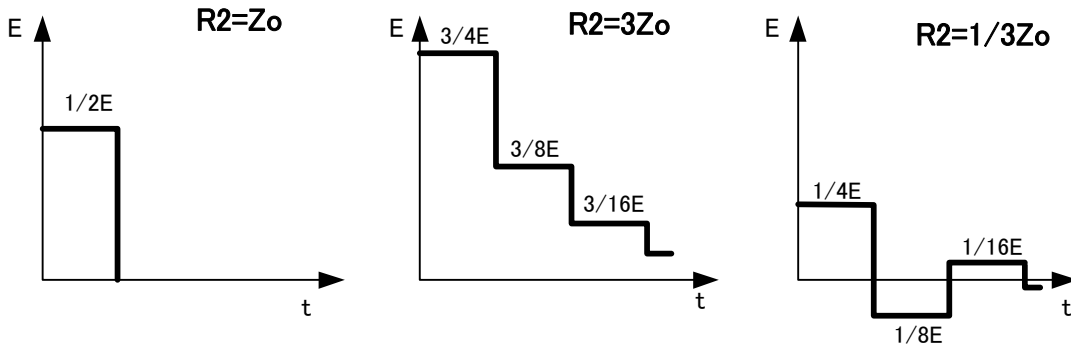
(\*\*\*) u3 : only for T models (which can generate triangular waves).

Since 60 Ω and 500 Ω are parallel as terminating resistors when line injection is selected, the composite resistance value is 53.5 Ω, which is same as the characteristic impedance of the coaxial cables.

### 5.3 Relation between Value of Terminating Resistor, and Characteristic Impedance of Coaxial Cable

Pulse waveforms shown in the following figure appear at both ends of the terminating resistor. To generate square wave pulses, this simulator adopts a 53.5Ω, equal value to the characteristic impedance of the coaxial cables as the resistance of the terminating resistor.

Pulse output voltage can be obtained by equation 1.



$$V_p = R_2 \div (Z_0 + R_2) \times E \dots \dots \dots (\text{equation 1})$$

- $V_p$  : Pulse output voltage
- $E$  : Output voltage of HV power supply
- $Z_0$  : Characteristic impedance of coaxial cables (53.5Ω)
- $R_2$  : Built-in terminating register (53.5Ω)

## 5.4 Setting Range for Test Conditions

This simulator is capable of conducting high-voltage pulse tests shown in the following table:

Table 1. Setting range for pulse test conditions

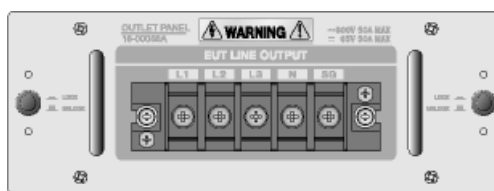
Parameters		Specifications
Output voltage		0.01kV to 2kV (220 <sup>(*)</sup> /250/250 <sup>(**)</sup> ) at 0.01kV step
Ramp, program setting possible		0.01kV to 4kV (420 <sup>(*)</sup> /450/450 <sup>(**)</sup> ) at 0.01kV step
Polarity		Positive/Negative
Program setting possible		
Pulse width		10, 50, 100, 200, 400, 500, 800, 1000ns and Triangle (220T/420T/250T/250TH/450T/450TH)
Program setting possible		
Line synchronous injection phase angle		0-360DEG At 1DEG step
Ramp, program setting possible		
Repetition period in VARIABLE mode		10-999ms (220 <sup>(*)</sup> /250/250 <sup>(**)</sup> ) at 1ms step
Ramp, program setting possible		16-999ms (420 <sup>(*)</sup> /450/450 <sup>(**)</sup> ) at 1ms step
Injection phase		L1, L2, PE phase (220 <sup>(*)</sup> /420 <sup>(*)</sup> )
Program setting possible		L1, L2, L3, N phase (250/250 <sup>(**)</sup> /450/450 <sup>(**)</sup> ) PULSE OUT coaxial connector output
Return phase		L1, L2, PE phase, and SG (220 <sup>(*)</sup> /420 <sup>(*)</sup> )
Program setting possible		L1, L2, L3, N phase, and SG (250/250 <sup>(**)</sup> /450/450 <sup>(**)</sup> )
1SHOT		Manual one shot pulse output.
PAUSE		Pause of pulse out
Pushing key for long time		Termination resistance change mode. Correct voltage set value is displayed by setting termination resistance.
Display	"53.5"	53.5Ω at internal termination resistance connection.
	"Op"	OPEN
	"50.0"	50.0Ω at external termination resistance connection
	"60.0" *1	Can be set up only when outputting from PULSE OUT coaxial connector. *1 Set it, when terminating at TERMINATE coaxial connector.
EUT LINE ON / OFF		Turning ON/OFF at contactor.
Number of program settings in the simulator		Ordinary run and memory can be performed at No.1-20.
EUT LINE ON/OFF of each program setting		Turning ON/OFF at contactor.
Injection time in each program mode		1-9999s 1s step and manual change by STOP/START button ("ooo" displayed).
Interval time in each program mode		1-999s 1s step and manual change ("ooo" displayed) and continuous change ("Cnt" displayed) by STOP/START button.

## 6 STANDARD ACCESSORIES

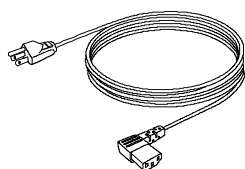
This product comes with the following standard accessories:



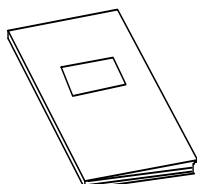
A-1 (for 220<sup>(\*)</sup>/420<sup>(\*)</sup>) \*1



A-2 (for 250/250T/450/450T) \*1  
A-3 (for 250H/250TH/450H/450TH) \*1



B



C



D

### List of standard accessories

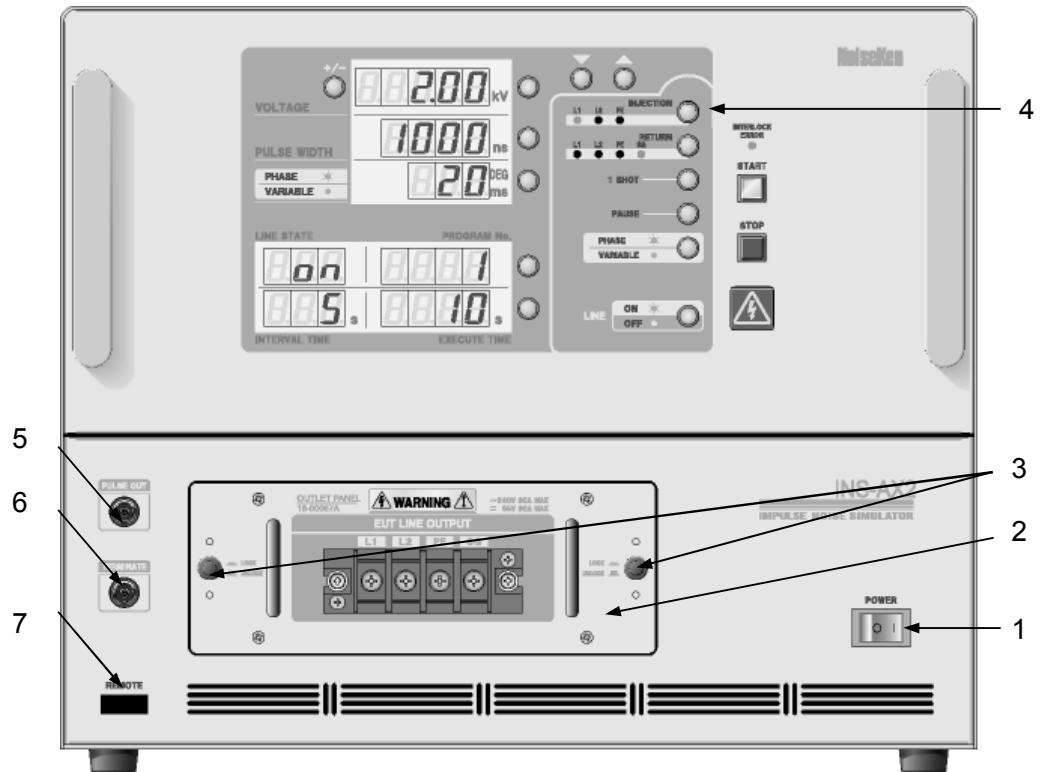
	Description		Quantity	Remarks
A-1	Outlet panel (Single phase terminal block type)	(18-00067A)	1	AC240V/DC65V20A max (220 <sup>(*)</sup> /420 <sup>(*)</sup> )
A-2	Outlet panel (3-phase terminal block type)	(18-00068A)	1	AC300V/DC65V50A max (250/250T/450/450T)
A-3	Outlet panel (3-phase terminal block type)	(18-00074A)	1	AC500V/DC250V50A max (250H/250TH/450H /450TH)
B	Power cable		1	
C	Instructions manual for this simulator (This book)		1	
D	Bag		1	

**\*1 Either A-1, A-2, or A3 is mounted on this simulator at shipment.**

## 7 CONTROLS AND DISPLAY FUNCTIONS

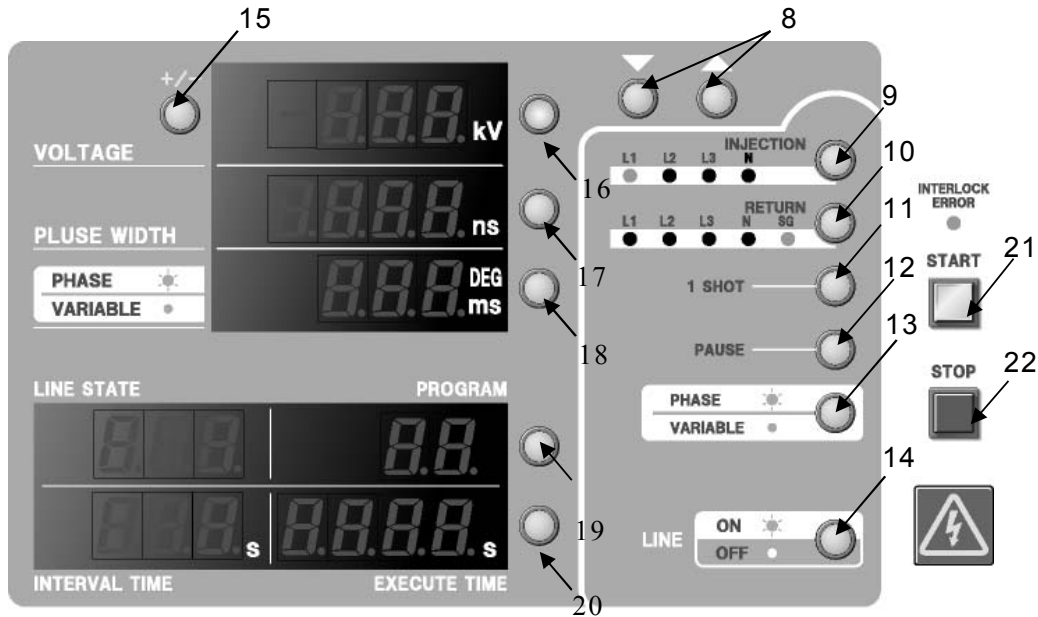
On the front of the simulator, control, setting and output sections are provided. On the rear, mains input terminals for the simulator and terminal block for EUT power supply are provided.

### 7.1 INS-AX20-220/420 front panel



1. POWER key  
Controls main power ON and OFF. [I] ON position and [O] OFF position.
2. Outlet Panel  
EUT line output terminals connecting to EUT. Output pulses are coupled to this line.
3. Outlet Panel Lock Button  
Used to lock outlet panel. Pressing this button locks outlet panel.  
To remove outlet panel, pull both lock buttons and draw it out with holding handle of outlet panel. Use this simulator with both lock buttons locked.
4. Operating Panel  
Used to perform various settings. For details, refer to 7.2 Front panel control and displays.
5. PULSE OUT Coaxial Connector  
Pulse output coaxial connector for options (coupling adapter, radiation probe, etc.). Used to set output by pressing INJECTION Phase Setting button (9) for long time. Pressing PAUSE button (12) for long time makes it available to select Connection/No connection of Internal 50Ω termination.
6. TERM IN Coaxial Connector  
50Ω termination resistance for options. It is used when coupling adapter CA-805B etc. are used. Set termination resistance at "60.0" by pressing PAUSE button (12) for long time.
7. Remote Control Connector  
Connect optical cable, when doing remote operation.

## 7.2 Front panel controls and displays

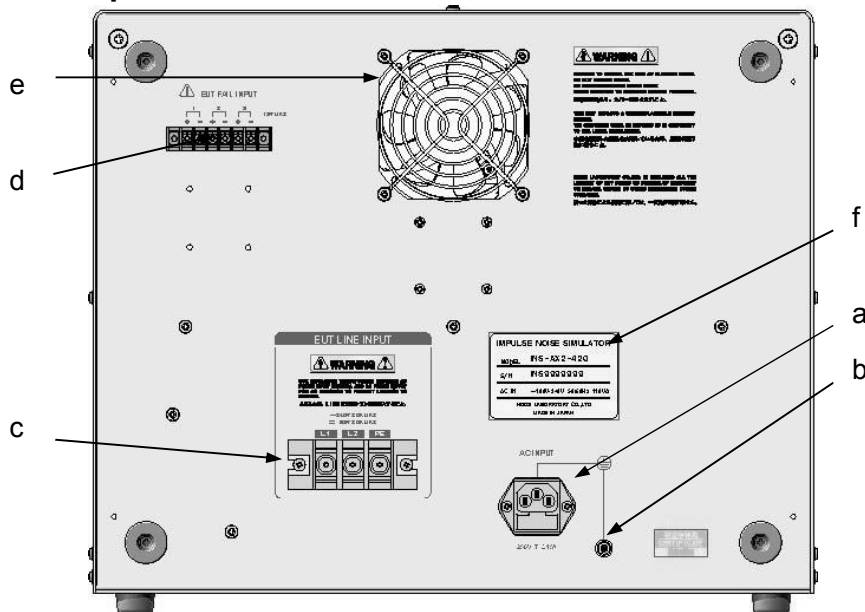


Control panel (250/450)

8.  $\Delta$ UP/ $\nabla$ DOWN  
Used to change set value. Changes values, such as pulse voltage, phase angle, repetition period and pulse width.  
Continuing to press UP/DOWN increases increment and decrement.
9. INJECTION Phase Setting button (Selector Switch of PULSE OUT Coaxial Connector)  
Used to select injection phase. Pressing this key for long time blinks all LED, and pulse is output from PULSE OUT (5).
10. RETURN Phase Setting button  
Used to select return phase of pulse.
11. 1 SHOT button  
Selector button for use in manual one shot pulse output mode. Lamp is on while 1 SHOT mode selected. While lamp is on, 1 SHOT button serves as trigger switch, and pulse is output for each trigger input.  
In case of PHASE mode, pulse is output in synchronized with phase angle.  
In case of VARIABLE mode, pulse is output at timing of pressing (at 3 to 4ms delay of mercury relay operation time).
12. PAUSE button (Termination Resistance Selector button)  
Used to pause execution of injection. PAUSE button blinks during pause. When restarting injection, press PAUSE button once again.  
Connection/No connection of internal 53.5 $\Omega$  termination resistance and external 50 $\Omega$  termination resistance can be selected by pressing this key for long time. Correct voltage set value is displayed by setting termination resistance.
13. PHASE/VARIABLE Changeover button  
Each pressing the button selects PHASE injection and VARIABLE injection alternately.  
The button lamp is on with PHASE selected.

14. LINE ON/OFF Setting button  
Used to turn ON/OFF EUT LINE.  
The button lamp is on with EUT LINE turned on.
15. POLARITY Setting button  
Used to select polarity of output pulse.
16. VOLTAGE Setting button (VOLTAGE Ramp Setting button)  
Used to select change of pulse voltage.  
It is possible to select pulse voltage from 0.00V to 2.05kV (to 4.10kV for 420<sup>(\*)</sup>/450/450<sup>(\*\*)</sup>) at 0.01kV step by means of  $\Delta$ UP/ $\nabla$ DOWN, while lamp is blinking.  
VOLTAGE ramp setting is selected by pressing this key for long time.  
VOLTAGE ramp is active while lamp is on.
17. Pulse Width and Triangle Pulse Setting button  
Used to select change of pulse width. It cannot be changed during pulse injection.  
It is possible to select pulse width from among 10ns, 50ns, 100ns, 200ns, 400ns, 500ns, 800ns, and 1000ns by means of  $\Delta$ UP/ $\nabla$ DOWN, while lamp is blinking.  
\*Triangle pulse available models (220T/250T/250TH/420T/450T/450TH) select the triangle pulse with "tri".
18. PHASE /VARIABLE Setting button (PHASE /VARIABLE Ramp button)  
Used to select phase angle with PHASE and select change of injection interval (time) with VARIABLE.  
It is possible to select phase angle 0°-360° at 1° step and select cycle from 10ms(220<sup>(\*)</sup>/250/250<sup>(\*\*)</sup>)/16ms(420<sup>(\*)</sup>/450/450<sup>(\*\*)</sup>)~999ms at 1ms step by means of  $\Delta$ UP/ $\nabla$ DOWN, while lamp is blinking. When no AC power is supplied to EUT LINE INPUT, pulse output in PHASE selection is not performed. Ramp setting is available by pressing this button for long time. Ramp is active while lamp is on.
19. PROGRAM No./LINE STATE Setting button  
Used to select program number and EUT LINE ON/OFF at program execution.  
It is possible to select program OFF, program No. 1~20 and each EUT LINE ON/OFF by means of  $\Delta$ UP/ $\nabla$ DOWN, while lamp is blinking.  
This simulator is capable of executing and storing up to 20 programs.  
When EXECUTE TIME (pulse injection time) is not specified, state of EUT LINE is not displayed.
20. EXECUTE TIME/INTERVAL TIME Setting button  
Used to select change of pulse injection time and interval time.  
Used to select change of pulse injection time and interval time. It is possible to select pulse injection time from 1~9999s at 1s step by means of  $\Delta$ UP/ $\nabla$ DOWN, select manual change ("ooo" displayed) by means of STAR/STOP button and select interval time from 1~999s at 1s step by means of STOP/START button or select manual change ("ooo" displayed) and continuous change ("Cnt" displayed) by means of STOP/START button, while lamp is blinking. When pulse injection time is not specified, interval time is not displayed.
21. START/STOP button  
Pressing START button lights up lamp, outputting set pulses. Pressing STOP button turns off START lamp, stopping pulse output.  
EUT LINE is not turned off by means of STOP button.

### 7.3 Rear panel



- a. Inlet for AC INPUT  
AC mains input to operate this simulator. Input power-supply range is AC 100~240V. In case of AC100~120V operation, connect with supplied power cord for protective grounding. In case of AC220~240V operation, use 3-core power cord with protective earth terminal that conforms to national safety standard. A fuse is mounted under inlet. When changing fuse, use rated one (250V T 3.15A).
- b. PE Terminal  
Terminal for connection to safety earth. Use it when needed.
- c. EUT LINE INPUT Terminal Block  
Power supply input terminal block for EUT. Use power cable conforming to national safety standard.  
220(\*)/420(\*) models, Single-phase AC240V/DC65V 20Amax  
250(\*)/450(\*) models, 3-phase 4-wire AC300V/DC65V 50Amax  
250\*\*/450\*\* models, 3-phase 4-wire AC500V/DC250V 50Amax  
Supply power to EUT LINE INPUT through insulating transformer. This unit has no built-in protection for overcurrent and overvoltage to EUT LINE. Use external protective device such as fuses, circuit breaker or protector meeting EUT rating for connection.
- d. EUT FAIL INPUT Terminal Block  
Stops the test by voltage input of DC5~15V with the 50ms duration. Three independent input systems are provided.  
Example of use: When voltage is input to EUT FAIL INPUT terminal with malfunction of EUT detected, operation stops at pulse injection setting at that time, thus making it possible to know set value when malfunction occurs. Prepare malfunction sensing device on user side.
- e. Fan  
Keeps internal circuits cool. Ventilation should be kept.
- f. Serial number seal  
Shows product serial number.

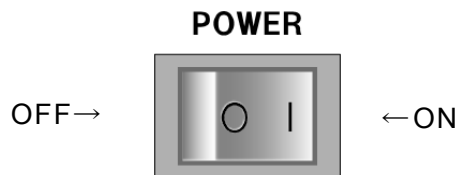


## 8 OPERATION

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

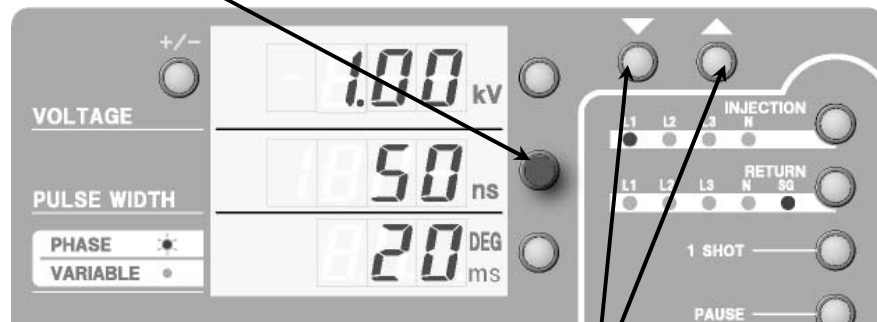
### 8.1 Turning ON and OFF power supply

Connect the supplied power cord (standard accessory) to AC INPUT on the rear panel (In case of AC 100~120V). Connect a 3-core power cord with protective earth terminal conforming to national safety standard to AC INPUT (in case of AC220-240V). Press POWER key to ON side to turn on power supply. Each indicator on the operating panel lights up and the internal automatic switching unit is initialized. The simulator turns on with the previous settings, but high voltage power supply is off. To turn off the simulator, press the OFF side of POWER key.



### 8.2 Setting the pulse width and triangle pulse

- 1) Press the button so that pulse width can be changed.



- 2) Set pulse width with  $\Delta$  UP/ $\nabla$  DOWN button.

The pulse width button and the pulse width indicator blink in the setting state. Set pulse width from among 8 kinds: 10ns, 50ns, 100 ns, 200 ns, 400 ns, 500 ns, 800ns and 1000ns (and "tri" in case of triangle pulse available models; 220T/420T/250T/250TH/450T/450TH).

### 8.3 Setting the pulse voltage and polarity

- 1) Press VOLTAGE setting button so that voltage can be set. The VOLTAGE setting button and voltage indicator blink in the voltage setting state.

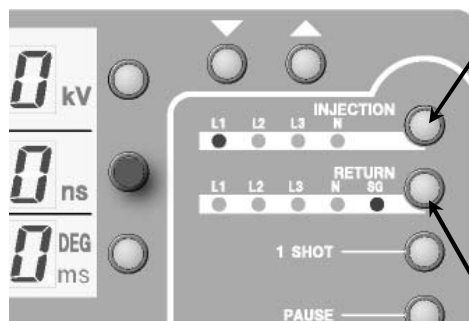


- 2) Set voltage value with  $\triangle$  UP/ $\nabla$  DOWN. Continuing to press UP/DOWN increases and decreases the value largely.
- 3) Select injection polarity with +/- POLARITY setting button.

With 4kV model (420<sup>(\*)</sup>/450/450<sup>(\*\*)</sup>), voltage value can be set from 0.00kV to 4.10kV, and with 2kV model (220<sup>(\*)</sup>/250/250<sup>(\*\*)</sup>), voltage value can be set from 0.00kV to 2.05kV at unit of 0.01kV.

As for injection polarity, no sign is shown for positive polarity, and minus sign for negative polarity.

### 8.4 Setting the pulse injection line



Select a injection phase with the INJECTION phase setting button.

LED of the selected phase lights up.

With the single-phase model (220<sup>(\*)</sup>/420<sup>(\*)</sup>), select from among L1/L2/PE, and with the 3-phase model (250/250<sup>(\*\*)</sup>/450/450<sup>(\*\*)</sup>), select from among L1/L2/L3/N.

Select a return phase (signal ground of pulse) with the RETURN phase setting button.

With the single-phase model (220<sup>(\*)</sup>/420<sup>(\*)</sup>), select from among L1/L2/PE/SG, and with the 3-phase model (250/250<sup>(\*\*)</sup>/450/450<sup>(\*\*)</sup>), select from among L1/L2/L3/N/SG.

The injection phase and return phase cannot be selected in the same phase.

When injecting to coupling clamp etc., press the INJECTION phase setting button for long time (2 seconds), so that all the INJECTION phase LED's blink, outputting to the PULSE OUT coaxial connector.

The following test contents are available by a combination of the injection phase and return phase (signal ground of pulse). (HOT means an injection phase and RET shows a return phase.)

Table of tests for 3-phase model (250/250\*\*/450/450\*\*)

Setting					Test contents	
L1	L2	L3	N	SG		
HOT				RET	Ground plane reference potential	Common mode test of L1 line
	HOT			RET	Ground plane reference potential	Common mode test of L2 line
		HOT		RET	Ground plane reference potential	Common mode test of L3 line
			HOT	RET	Ground plane reference potential	Common mode test of N lines
HOT			RET		N line reference potential	Test between L1 line-N line
	HOT		RET		N line reference potential	Test between L2 line-N line
		HOT	RET		N line reference potential	Test between L3 line-N line
RET	HOT				L1 line reference potential	Normal mode test of L2 line
RET		HOT			L1 line reference potential	Normal mode test of L3 line
HOT	RET				L2 line reference potential	Normal mode test of L1 line
	RET	HOT			L2 line reference potential	Normal mode test of L3 line
HOT		RET			L3 line reference potential	Normal mode test of L1 line
	HOT	RET			L3 line reference potential	Normal mode test of L2 line

Table of tests for single-phase model (220\*/420\*)

Connector				Test contents	
L1	L2	PE	SG		
HOT			RET	Ground plane reference potential	- Common mode test of L1 line
	HOT		RET	Ground plane reference potential	- Common mode test of L2 line
		HOT	RET	Ground plane reference potential	- Common mode test of PE line
HOT		RET		PE reference potential of EUT	- Test between L1 line-PE line
	HOT	RET		PE reference potential of EUT	- Test between L2 line-PE line
HOT	RET			L2 line reference potential	- Normal mode test of L1 line
RET	HOT			L1 line reference potential	- Normal mode test of L2 line

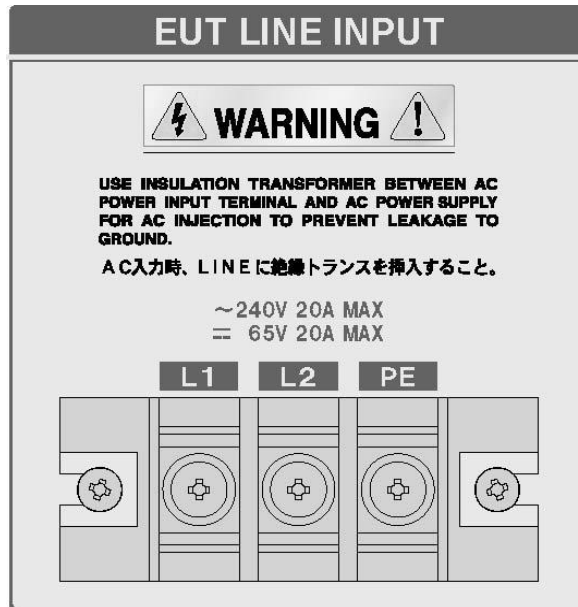


Supply power to EUT LINE INPUT through an insulating transformer.  
 When power is supplied without using an insulating transformer, EUT power supply voltage is injected to the outside of the coaxial connector by settings. Therefore, if the user touches it, he may receive an electric shock.  
 In addition, if the user touches the conductive part of the coaxial connector connected to any grounded subject, EUT power circuit breaker may actuate by leak current according to circumstances.

## 8.5 Connection of EUT LINE INPUT

Before connecting the simulator to EUT power supply, interrupt power supply to EUT and turn off the POWER key of the simulator. The generated pulse voltage and power supply to EUT may cause an electric shock.

Prepare a power cable that conforms to the national safety standard and meets EUT power capacity. Fit a pressure connection terminal of  $\phi 5$  and connect through an insulating transformer. Be sure to fit a protective cover after making connection.



EUT LINE INPUT (220<sup>(\*)</sup>/420<sup>(\*)</sup>)

The simulator is not provided with a protective device against the overcurrent and overvoltage of EUT LINE. It shall be provided with protective devices, such as fuse, breaker and circuit protector that meet the rated capacity of EUT to be used.

## 8.6 Mounting and Dismounting of Outlet Panel and Removal

When mounting the outlet panel, check its direction and slowly insert it to the inner part. Check that the surface panel has stuck to the simulator, and then press both lock buttons. When dismounting, draw out the outlet panel slowly with both lock buttons released. When the outlet panel is dismounted with power to the simulator turned on, an error state will occur, thereby stopping high voltage pulses and interrupting power supply to EUT. However, continue to work with POWER key of the simulator turned off.

## 8.7 Connection of EUT

Before connecting the simulator to EUT, turn off the EUT power supply, simulator and EUT.

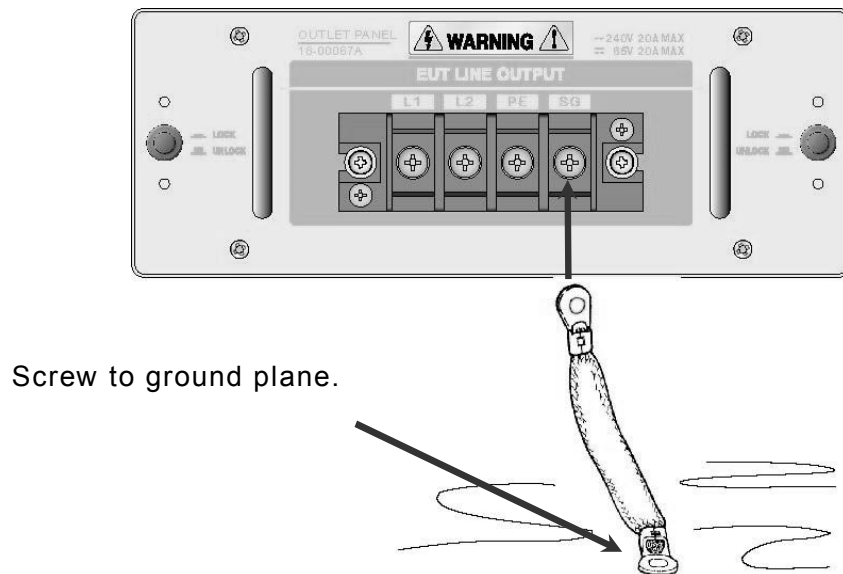
Prepare a power cable that conforms to the national safety standard and meets EUT power capacity. Fit a pressure connection terminal of  $\phi 5$  and then make connection. Be sure to fit a protective cover after making connection.

The included outlet panel is of a terminal block type. Outlet panels of CEE plug socket type, 125V/15A plug socket type (with G) and multiple plug socket type are optionally available.

These options provide facility for easy direct connection of the EUT to the plug receptacle mounted on the simulator.

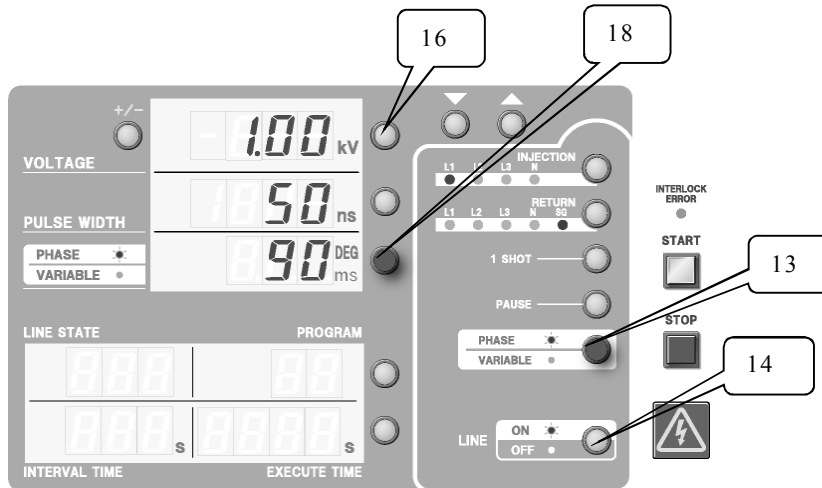
## 8.8 Connection of SG

Connect SG terminal to the ground plane by using a low RF impedance cable (3.5mm<sup>2</sup> or more braided wire recommended) of the shortest possible length, when needed. For details, refer to "Environment, Installation and Test Method".



## 8.9 Operation in PHASE (LINE Synchronization) Mode

In this mode, the simulator generates pulses synchronizing with the frequency of AC supply for the EUT. One pulse is generated every cycle. The simulator does not generate pulses when no power supply is connected to the EUT LINE INPUT terminal or power supply voltage is below AC90V or over 50/60Hz  $\pm$  10% or in case of DC input.



- 1) Select pulse width, injection phase, return phase, pulse voltage, polarity, etc. by referring to the previous clause.
- 2) Press PHASE/VARIABLE changeover button (13) to select PHASE injection mode with the lamp on.
- 3) Press PHASE/VARIABLE setting button (18) and set a phase angle by means of  $\Delta$ UP/ $\nabla$ DOWN while the lamp is blinking.
- 4) Turn on EUT power supply by means of LINE ON/OFF setting button (14).
- 5) Press START button to start injection.
- 6) When changing the phase angle during injection, press PHASE/VARIABLE setting button (18), and change the phase angle by means of  $\Delta$ UP/ $\nabla$ DOWN while the lamp is blinking.
- 7) When changing the pulse voltage during injection, press VOLTAGE setting button (16), and change the pulse voltage by means of  $\Delta$ UP/ $\nabla$ DOWN while the lamp is blinking.

When AC power supply is not supplied to EUT LINE INPUT (including a case where power voltage is below AC90V or over  $50/60\text{Hz} \pm 10\%$ ), or when LINE ON/OFF setting button (14) is OFF (the light is off), even if START button is pressed, an error is displayed and operation will not start.

In this case, **press STOP button to recover from error**, check AC power supply and then press START button again.

When AC power supply interrupts during [START] status, follow the same procedure as above-mentioned.

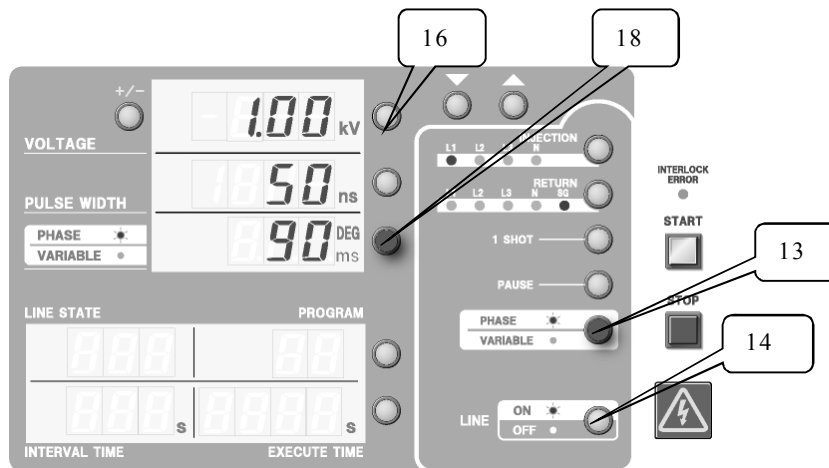


Phase angle can be set  $0^\circ$ - $360^\circ$ .

The maximum voltage that can be injected is 4.10kV in case of 4kV model (420<sup>(\*)</sup>/450/450<sup>(\*\*)</sup>), and 2.05kV in case of 2kV model (220<sup>(\*)</sup>/250/250<sup>(\*\*)</sup>).

## 8.10 Operation in VARIABLE Mode

In this mode, this simulator injects pulses at a certain period. The period can be set within a range of 10ms~999ms for 2kV model (220<sup>(\*)</sup>/250/250<sup>(\*)</sup>), and 16ms~999ms for 4kV model (420<sup>(\*)</sup>/450/450<sup>(\*)</sup>).

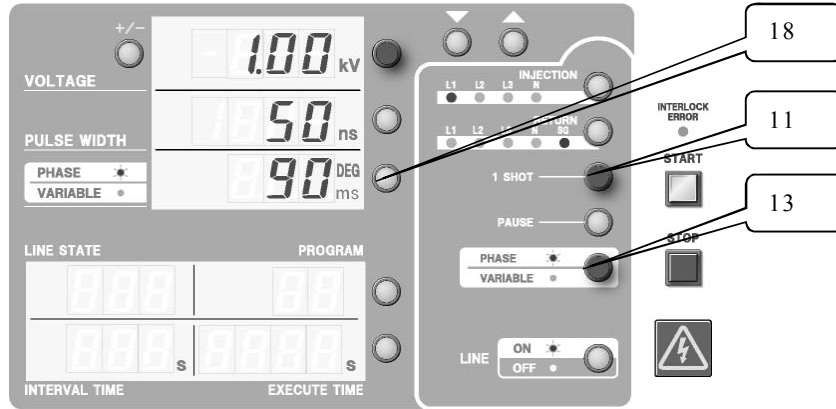


- 1) Select pulse width, injection phase, return phase, pulse voltage, polarity, etc. by referring to the previous clause.
- 2) Press PHASE/VARIABLE changeover button (13) to select VARIABLE injection mode with the lamp off.
- 3) Press PHASE/VARIABLE setting button (18) and set a repetition period by means of  $\triangle$ UP/ $\nabla$ DOWN while the lamp is blinking.
- 4) Turn on EUT power supply by means of LINE ON/OFF setting button (14). (VARIABLE injection can be performed, even if EUT power supply is not turned on.)
- 5) Press START button to start injection.
- 6) When changing the interval during injection, press PHASE/VARIABLE setting button (18), and change the interval by means of  $\triangle$ UP/ $\nabla$ DOWN while the lamp is blinking.
- 7) When changing the pulse voltage during injection, press VOLTAGE setting button (16), and change the pulse voltage by means of  $\triangle$ UP/ $\nabla$ DOWN while the lamp is blinking.

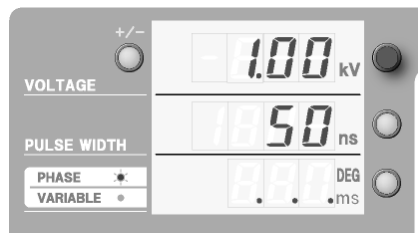


### 8.11 Operation in 1 SHOT Mode

In this mode, the simulator generates a single pulse for injection by manual operation. Lamp is on while 1 SHOT mode is selected. While lamp is on, 1 SHOT button serves as a trigger switch, and pulse is output for each trigger input. In case of PHASE mode, pulse is output in sync. with phase angle. In case of VARIABLE mode, pulse is output at timing of pressing (at 3~4ms delay of mercury relay operation time).



- 1) Select pulse width, injection phase, return phase, pulse voltage, polarity, etc. by referring to the previous clause.
- 2) Press PHASE/VARIABLE changeover button (13) to choose between PHASE mode with the lamp on and VARIABLE mode with the lamp off.
- 3) Press PHASE/VARIABLE setting button (18) and set a phase angle by means of  $\Delta$ UP/ $\nabla$ DOWN while the lamp is blinking. There is no setting in VARIABLE mode. VARIABLE display in 1 SHOT mode is as follows:



- 4) Select 1 SHOT button (11). (Lamp is on while 1 SHOT mode is selected.)
- 5) Press START button, and the simulator is ready for injection.
- 6) The simulator injects a single pulse to a phase based on the phase angle setting in case of PHASE mode, each time the 1 SHOT button is pressed, and injects it at timing when 1 SHOT button is pressed in case of VARIABLE mode. (Operating time of the mercury relay delays by 3~4ms.)

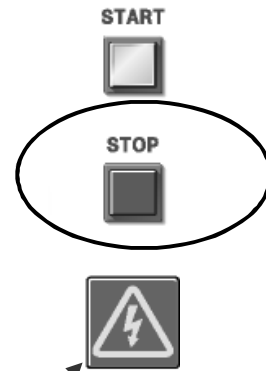
When EUT power supply is not turned on in case of PHASE mode, an error occurs.

### 8.12 Stopping the Simulator

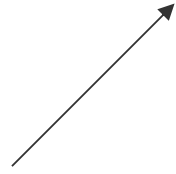
Pressing the STOP switch stops pulse injection immediately, turning off the START button lamp and high voltage power lamp.  
When pulse injection is stopped, applying high voltage interrupts, too.

Even if the simulator is in STOP state, EUT LINE is not internally disconnected.

When connecting each cable and changing connection settings, turn off the POWER key of this simulator and interrupt power supply to EUT LINE INPUT for more than 5 seconds beforehand.



High voltage power lamp



### 8.13 Type of Errors and Countermeasures

When an abnormality occurs in the automatic switching unit and internal cooling fan, the simulator indicates an error number or error message, stops operation and turning off EUT LINE.

"Err" appears at 1st line.

An error number or message appears at 2nd line.



Error Nos. and messages are as follows.

Display	State	Countermeasure
1	Injection unit home detection error	Repair is required. Contact to Noise Laboratory or its distributor/agent closest to you.
2	Injection unit inserting/drawing error	Repair is required. Contact to Noise Laboratory or its distributor/agent closest to you.
3	Return unit error	Repair is required. Contact to Noise Laboratory or its distributor/agent closest to you.
4	Cooling fan error	If some factor that blocks the operation of the cooling fan on the rear panel, eliminate such a factor and then turn on power supply again.
EEP	EEPROM information error	Repair is required. Contact to Noise Laboratory or its distributor/agent closest to you.
6	Emergency input state	Optional emergency stop button has been turned on. Release emergency stop button and turn on power supply again.
7	Interlock error	Front outlet panel has come off or is not normally mounted. Mount outlet panel again and release error state with STOP button.
AC	AC input error	Simulator tried to perform PHASE injection (line synchronized injection), but AC power is not input, power supply is below AC90V or over 50/60Hz $\pm$ 10%, or LINE ON/OFF button is OFF (the light is off). Press STOP button and check AC input.

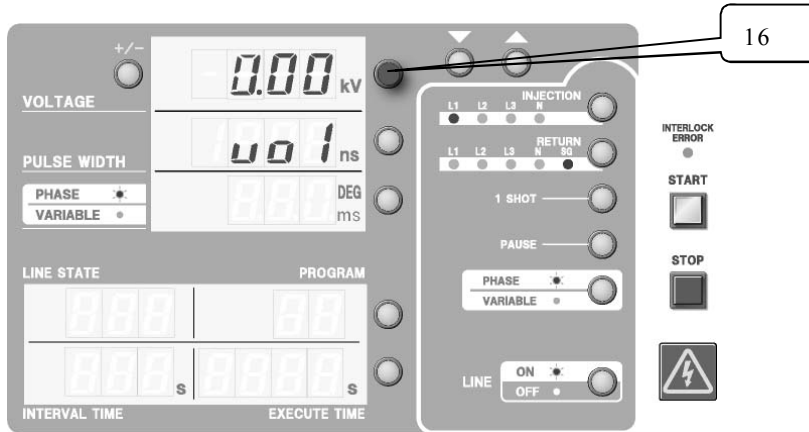
In addition, when the error cannot be released even by taking the above-mentioned countermeasures, it is necessary to repair the simulator.

Contact to Noise Laboratory or its distributor/agent closest to you.

## 9 OPERATION FOR WIDE APPLICATIONS

### 9.1 VOLTAGE Ramp Setting

The following 5 parameters should be set: Initial pulse voltage, end pulse voltage, step voltage, injection time, and interval time. Change set value with  $\Delta$ UP/ $\nabla$ DOWN .



- 1) Press VOLTAGE setting button (16) for long time (about 2 seconds) to select the VOLTAGE ramp setting mode, and the above display appears.
- 2) Set initial voltage "vo1" in increments of 0.01kV and finalize with VOLTAGE setting button (16).
- 3) Set final voltage "vo2" in increments of 0.01kV and finalize with VOLTAGE setting button (16).
- 4) Set step voltage"vo3" in increments of 0.01kV, and finalize with VOLTAGE setting button (16).
- 5) Set injection time "vo4" in increments of 1 second, and finalize with VOLTAGE setting button (16).

When selecting the manual change with STOP button, select the following "ooo" display.



- 6) Set interval time "vo5" in increments of 1 second, and finalize with VOLTAGE setting button (16). When selecting the manual change with START button, select the following "ooo" display. When selecting continuous change without putting in an interval, select the following "Cnt" display.



- 7) Upon completion of the above settings, the simulator is automatically set to VOLTAGE ramp mode, with the lamp of the VOLTAGE button (16) lighted.
- 8) To disable voltage ramp, press the VOLTAGE setting button (16) again. The button lamp will start blinking.
- 9) To enable voltage ramp again, press the VOLTAGE setting button (16) while the VOLTAGE setting button lamp is blinking to light up the lamp and enable voltage ramp, or set voltage ramp again.

### Example of VOLTAGE ramp setting

When running a test from 1.00kV to 2.00kV at 0.1kV step for 5 seconds duration with 10 seconds interval, set as follows:

vo 1= 1.00, vo 2= 2.00, vo 3= 0.10, vo4=5, vo 5= 10

When any other button than VOLTAGE, UP, and DOWN is pressed during ramp setting, setting is discontinued.

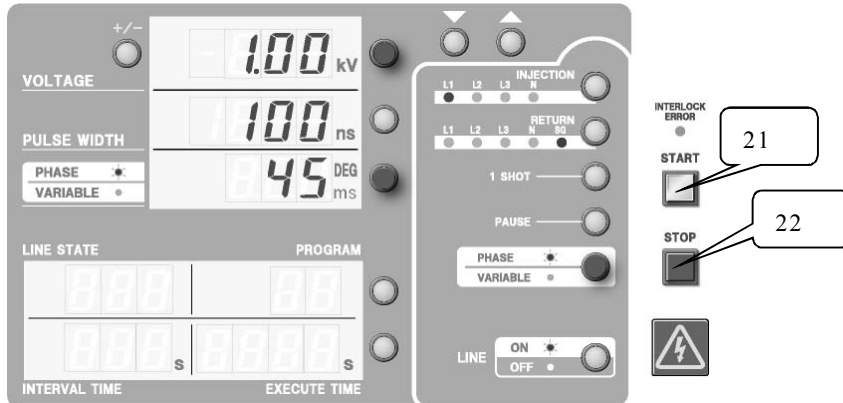
When the VOLTAGE setting button lamp is **on**, VOLTAGE ramp is enabled. The VOLTAGE setting button lamp is **blinking** during ordinary setting state.

Code	Setting contents	Setting range
vo1	Initial voltage value	0~4.10kV (2.05kV)
vo2	Final voltage value	0~4.10kV (2.05kV)
vo3	Step voltage value	0~4.10kV (2.05kV)
vo4	Injection time	1~9999 seconds, manual
vo5	Interval time	1~999 seconds, manual, continuous

\*Numbers in parentheses are for 2kV model (220\*/250/250\*/\*).

## 9.2 VOLTAGE ramp Test Run

The simulator starts injection from the initial voltage, slides by an amount of step voltage and executes injection up to the final voltage according to the settings of VOLTAGE ramp.



- 1) Enable voltage ramp.
- 2) Press START button (21).
- 3) The countdown of remaining injection time is displayed on EXECUTE TIME in seconds during ramp injection as follows:  
As "ooo" is displayed in case of manual change by STOP button, stop pulse injection with STOP button (22) temporarily.

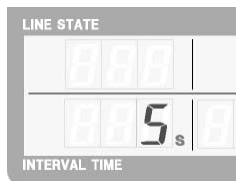


Display of remaining injection time

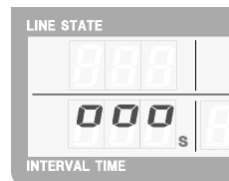


Display of manual change

- 4) The count-down of remaining interval time is displayed on INTERVAL TIME in seconds during interval execution as follows:  
As "ooo" is displayed in case of manual change by START button, restart pulse injection with START button (21).



Display of remaining interval time



Display of manual change

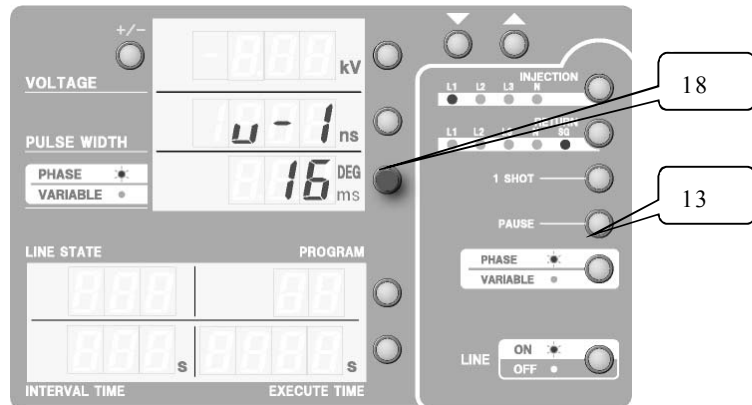
- 5) When reaching the final voltage, the simulator automatically stops the ramp.

When reaching the final voltage, the simulator automatically stops the ramp.

It is possible to stop the ramp temporarily and cancel temporary stopping with PAUSE button.

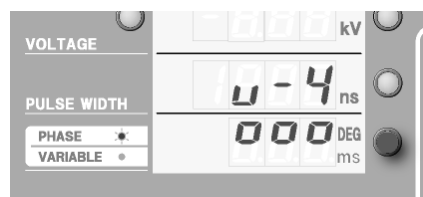
### 9.3 VARIABLE Ramp Setting

The pulse repetition period can gradually be changed according to the settings. The following 5 parameters should be set: Initial repetition period, final repetition period, step interval, injection time and interval time. Change set value with  $\Delta$ UP/ $\nabla$ DOWN.

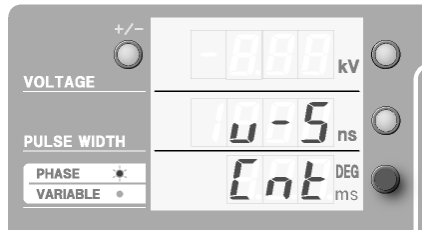


- 1) With PHASE/VARIABLE change-over button (13) VARIABLE mode (the light is off), press PHASE/VARIABLE setting button (18) for long time (about 2 seconds) to select the VARIABLE ramp setting mode, and the above display appears.
- 2) Set initial repetition period "v-1" in increments of 1ms and finalize with PHASE/VARIABLE setting button (18).
- 3) Set final repetition period "v-2" in increments of 1ms and finalize with PHASE/VARIABLE setting button (18).
- 4) Set step repetition period "v-3" in increments of 1ms and finalize with PHASE/VARIABLE setting button (18).
- 5) Set injection time "v-4" in increments of 1 second and finalize with PHASE/VARIABLE setting button (18).

When selecting the manual change with STOP button, select the following "ooo" display.



- 6) Set interval time "v-5" in increments of 1 second, and finalize with PHASE/VARIABLE setting button (18). When selecting the manual change with START button, select the following "ooo" display. When selecting the continuous change without setting an interval, select the following "Cnt" display.



- 7) Upon completion of the above settings, the simulator is automatically set to VARIABLE ramp mode, with the lamp of the PHASE/VARIABLE button (18) lighted.
- 8) To disable the ramp, press the PHASE/VARIABLE setting button (18) again. The button lamp will start blinking.
- 9) To enable the ramp again, press the PHASE/VARIABLE setting button (18) while the PHASE/VARIABLE setting button lamp is blinking to light up the lamp and enable the ramp, or set the ramp again.

**Example of VARIABLE ramp setting**

When running a test from 20ms to 100ms at 10ms step for 5 seconds duration with 7 seconds interval, set as follows:

v-1=20, v-2=100, v-3=10, v-4=5 and v-5=7

When any other button than PHASE/VARIABLE, UP, and DOWN is pressed during ramp setting, setting is discontinued.

When the PHASE/VARIABLE setting button lamp is **on**, VARIABLE ramp is enabled.

The PHASE/VARIABLE setting button lamp is **blinking** during ordinary setting state.

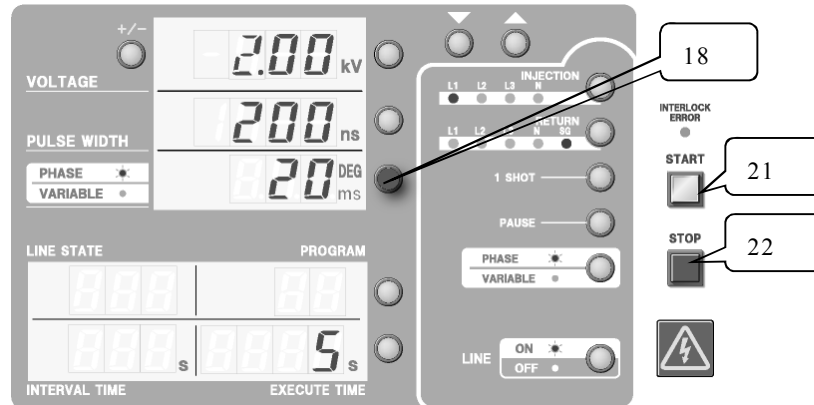
Code	Setting contents	Setting range
v-1	Initial period	16(10)~999ms
v-2	Final period	16(10)~999ms
v-3	Step period	0~999ms
v-4	Injection time	1~9999 seconds, manual
v-5	Interval time	1~999 seconds, manual, continuous

\*Numbers in parentheses are for 2kV model (220\*/250/250/\*\*).



## 9.4 VARIABLE Ramp Test Run

The simulator starts injection from the initial period, slides the repetition period by an amount of step period and executes injection up to the final period according to the settings of VARIABLE ramp.



- 1) Enable VARIABLE ramp.
- 2) Press START button (21).
- 3) The countdown of remaining injection time is displayed on EXECUTE TIME in seconds during ramp injection as follows:  
As "000" is displayed in case of manual change by STOP button, stop pulse injection with STOP button (22) temporarily.

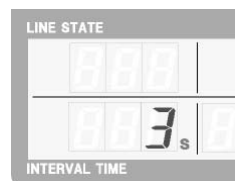


Display of remaining injection time

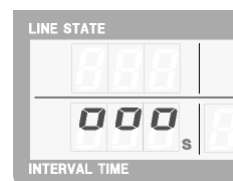


Display of manual change

- 4) The countdown of remaining interval time is displayed on INTERVAL TIME in seconds during interval execution as follows:  
As "000" is displayed in case of manual change by START button, restart pulse injection with START button (21).



Display of remaining interval



Display of manual change

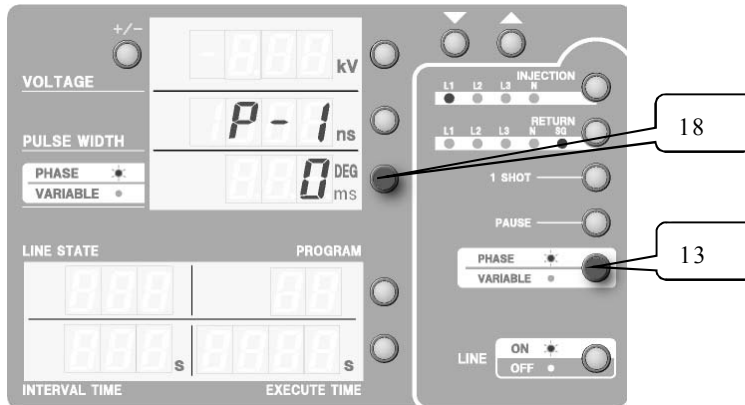
- 5) When reaching the final period, the simulator automatically stops the ramp.

The pulse voltage can also be changed by means of  $\Delta$ UP/ $\nabla$ DOWN during pulse injection.

It is possible to stop the ramp temporarily and cancel temporary stopping with PAUSE button.

## 9.5 PHASE Ramp Setting

The phase injection angle can gradually be changed according to the settings. The following 5 parameters should be set: Initial phase angle, final phase angle, step phase angle, final phase angle, injection time and interval time Change set value with  $\Delta$ UP/ $\nabla$ DOWN.



- 1) With PHASE/VARIABLE change-over button (13) PHASE mode (the light is turned on), press PHASE/VARIABLE setting button (18) for long time (about 2 seconds) to select the PHASE ramp setting mode, and the above display appears.
- 2) Set initial phase angle "P-1" in increments of 1° and finalize with PHASE/VARIABLE setting button (18).
- 3) Set final phase angle "P-2" in increments of 1° and finalize with PHASE/VARIABLE setting button (18).
- 4) Set step phase angle "P-3" in increments of 1° and finalize with PHASE/VARIABLE setting button (18).
- 5) Set injection time "P-4" in increments of 1 second and finalize with PHASE/VARIABLE setting button (18).

When selecting the manual change with STOP button, select the following "ooo" display.



- 6) Set injection time "P-5" in increments of 1 second and finalize with PHASE/VARIABLE setting button (18). Select the "ooo" display, when making it the manual change by a START button. When selecting the continuous change without setting an interval, select the following "Cnt" display.



- 7) Upon completion of the above settings, the simulator is automatically set to PHASE ramp mode, with the PHASE/VARIABLE setting button lamp lit.
- 8) To disable PHASE ramp, press the PHASE/VARIABLE setting button (18) again. The button lamp will start blinking.
- 9) To enable the ramp again, press the PHASE/VARIABLE setting button (18) while the lamp of the PHASE/VARIABLE setting button (18) is blinking to light up the lamp and enable the ramp, or set the ramp again.

#### Example of PHASE ramp setting

When running a test from 0° to 270° at 90° step for 5 seconds of pulse injection with 7 seconds interval, set as follows:

P-1=0, P-2=270, P-3=90, P-4=5, P-5=7

When any other button than PHASE/VARIABLE, UP, and DOWN is pressed during ramp setting, setting is discontinued.

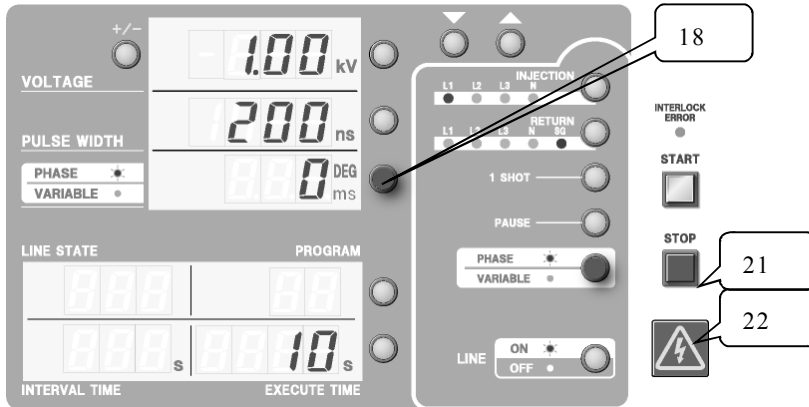
When the PHASE/VARIABLE setting button lamp is **on**, PHASE ramp is enabled.

The PHASE/VARIABLE setting button lamp is **blinking** during ordinary setting state.

Code	Setting contents	Setting range
P-1	Initial angle	0°-360°
P-2	Final angle	0°-360°
P-3	Step angle	0°-360°
P-4	Injection time	1-9999 seconds, manual
P-5	Interval time	1-999 seconds, manual, continuous

## 9.6 PHASE Ramp Test Run

The simulator starts injection from the initial phase angle, slides by an amount of step phase angle and executes pulse injection up to the final phase angle according to the settings of PHASE ramp.



- 1) Enable Phase ramp.
- 2) Press START button (21).
- 3) The countdown of remaining injection time is displayed on EXECUTE TIME in seconds during ramp injection as follows:  
As "000" is displayed in case of manual change by STOP button, stop pulse injection with STOP button (22) temporarily.

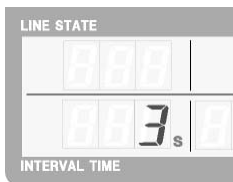


Display of remaining injection time

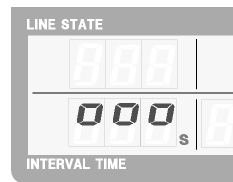


Display of manual change

- 4) The countdown of remaining interval time is displayed on INTERVAL TIME in seconds during interval execution as follows:  
As "000" is displayed in case of manual change by START button, restart pulse injection with START button (21).



Display of remaining interval



Display of manual change

5) When reaching the final phase angle, the simulator automatically stops the ramp. The pulse voltage can also be changed by means of  $\Delta$ UP/ $\nabla$ DOWN during pulse injection. It is possible to stop the ramp temporarily and cancel temporary stopping with PAUSE button.

When AC power supply is not supplied to EUT LINE INPUT (including a case where power voltage is below AC90V or over  $50/60\text{Hz} \pm 10\%$ ), or when LINE ON/OFF setting button (14) is OFF (the light is off), even if START button is pressed, an error is displayed and operation will not start.



In this case, **press STOP button to recover from error**, check AC power supply and then press START button again.

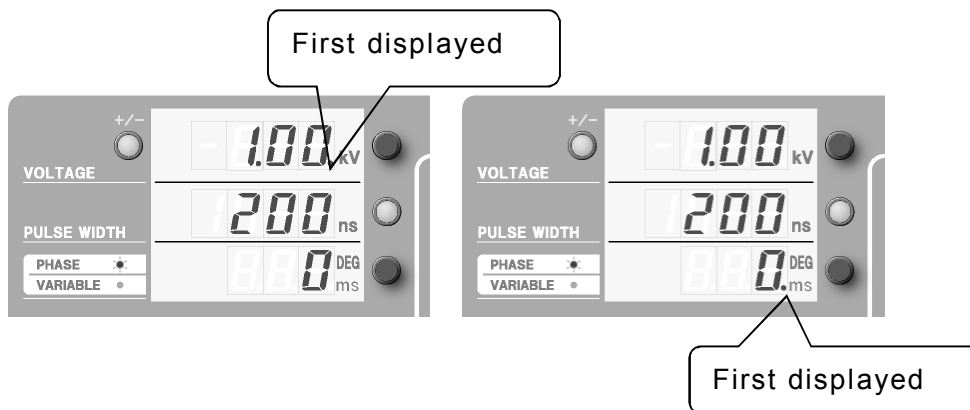
When AC power supply interrupts during starting, follow the same procedure as above-mentioned.

## 9.7 Combined ramp mode

Combinations of VOLTAGE ramp with VARIABLE ramp and with PHASE ramp are available. In either combination mode, the simulator executes ramp according to the specified order.

### Example of combined ramps

- VOLTAGE ramp is set from 1.00kV to 2.00kV at 0.25kV step, and PHASE ramp is set from 0° to 270° at 90° step.
- VOLTAGE ramp is selected first and PHASE ramp is selected next, the simulator 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 ramp is selected first and VOLTAGE ramp is selected next; the simulator 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.
- VARIABLE ramp is performed in the same manner as PHASE ramp.
- The first enabled ramp is displayed with a dot.



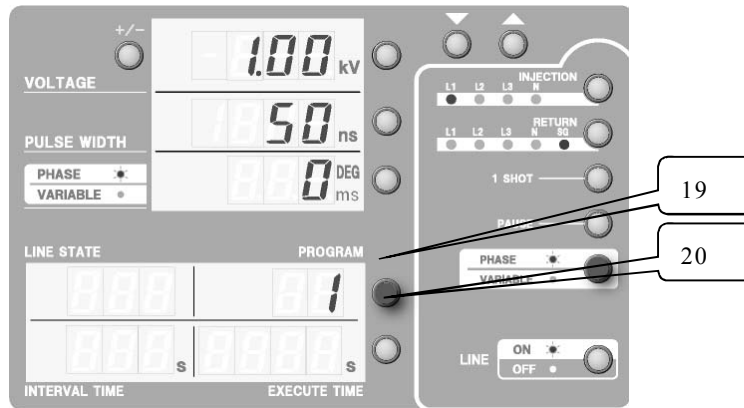
## 9.8 Combined Ramp Test Run

- 1) Enable VOLTAGE ramp and PHASE or VARIABLE ramp.
- 2) Press START button.
- 3) During the test run of combined ramp, parameters cannot be changed.
- 4) The countdown of remaining injection time is displayed on EXECUTE TIME in seconds during ramp injection as follows: As "ooo" is displayed in case of manual change by STOP button, stop pulse injection with STOP button temporarily.
- 5) The countdown of remaining interval time is displayed on INTERVAL TIME in seconds during interval execution as follows: As "ooo" is displayed in case of manual change by START button, restart pulse injection with START button.
- 6) When reaching the final voltage and final phase angle or period, the simulator automatically stops the ramp.

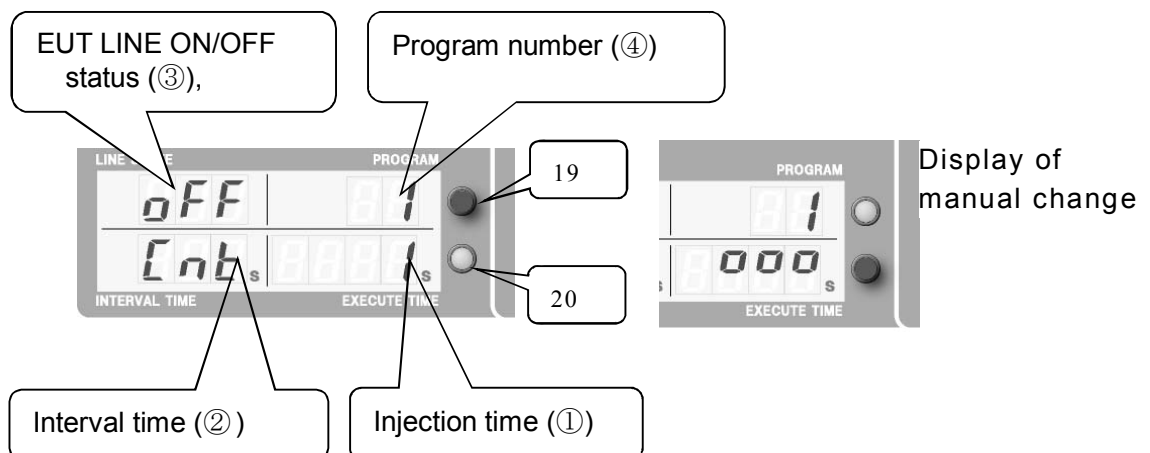
## 9.9 Program Mode Setting

When the program mode is used, sequential execution of up to 20 kinds (1-20) of injection settings can be carried out. Injection phase, return phase, pulse voltage, polarity, pulse width, injection interval (phase angle), and the state of EUT LINE can be set for each program. Ramp can also be set for each program.

In case of setting a program with no ramp

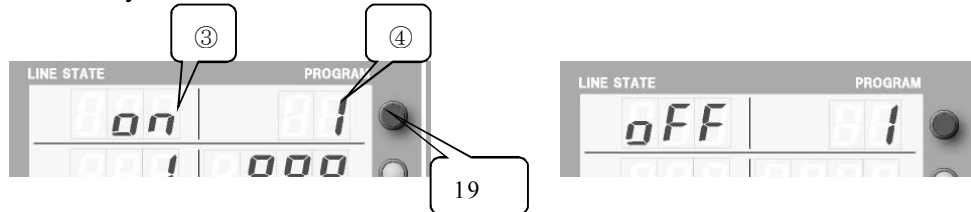


- 1) Press PROGRAM No./LINE STATE setting button (19) and the lamp and the items of PROGRAM start blinking. With this status, select a program number (④) by  $\Delta$ UP/ $\nabla$ DOWN (Refer to the figure as below).
- 2) Set each item according to the way mentioned in 8. OPERATION.
- 3) Press EXECUTE TIME/INTERVAL TIME setting button (20) (the lamp is blinking), and set pulse injection time (①) by  $\Delta$ UP/ $\nabla$ DOWN as 1~9999 seconds or manual change ("ooo" displayed). When these parameters are set, the program is enabled, and interval time (②) and EUT LINE ON/OFF status (③) are displayed.



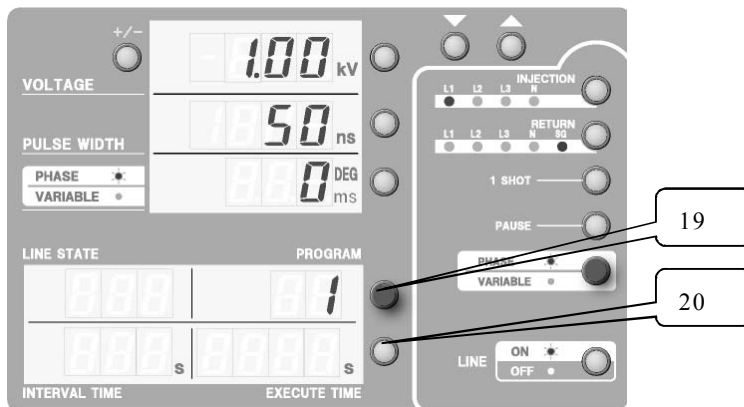
- 4) When pulse injection time (①) is not set, the program is not run and EUT LINE ON/OFF status (③) and interval time (②) are not displayed. When pulse injection time (①) is set, the program is enabled. EUT LINE ON/OFF status (③) and Interval time (②) are displayed.

- 5) With pulse injection time ( ① ) selecting status, press EXECUTE TIME/INTERVAL TIME setting button (20) again to set interval time ( ② ). Set injection time by  $\Delta$ UP/ $\nabla$ DOWN as 1~9999 seconds, manual change ("ooo") or continuous change ("Cnt")..
- 6) With program number ( ④ ) selecting status, press PROGRAM No./LINE STATE setting button (19) again to set EUT LINE ON/OFF status ( ③ ). Set EUT line status by  $\Delta$ UP/ $\nabla$ DOWN.

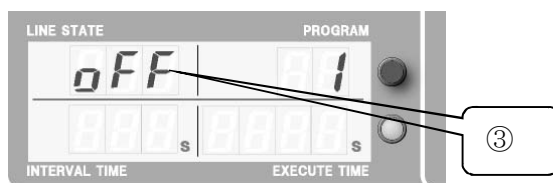


- 7) Press PROGRAM No./LINE STATE setting button (19). With program number ( ④ ) selecting status, select a program number by  $\Delta$ UP/ $\nabla$ DOWN to set a program.

In case of setting a program with ramp

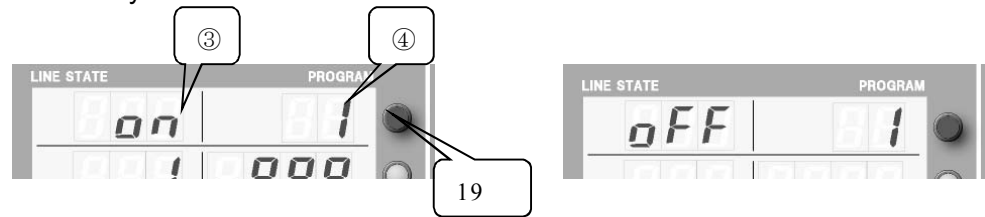


- 1) Press PROGRAM No./LINE STATE setting button (19). With program number ( ④ ) selecting status, select a program number by  $\Delta$ UP/ $\nabla$ DOWN.
- 2) Set each item according to the way mentioned in 8. OPERATION.
- 3) Set sweep mode according to the way mentioned in 9.1~9.7. EUT LINE ON/OFF status ( ③ ) is displayed.





- 4) With program number (④) selecting status, press PROGRAM No./LINE STATE setting button (19) again to set EUT LINE ON/OFF status (③). Set EUT line status by  $\Delta$ UP/ $\nabla$ DOWN.



- 5) Press PROGRAM No./LINE STATE setting button (19). With program number (④) selecting status, select a program number by  $\Delta$ UP/ $\nabla$ DOWN to set a program.

(To return to ordinary mode, press  $\nabla$ DOWN when “1” is displayed in EUT LINE ON/OFF status (③). Each indication of EUT LINE ON/OFF status (③), program number (④), interval time (②), and injection time (①) is turned off. The indication returns to status just before program mode. But in case of turning on or off EUT power supply by means of LINE ON/OFF setting button (14), the change of EUT line status is retained.)

))) Notice (((

When the power supply of this simulator is OFF, the memory of setting value is retained with an internal backup battery. The retainment time of the backup battery is approximate one month. If the term is over, the setting returns to initial setting.

## 9.10 Program Test Run

Sequential execution of the set program is run from 1. The programs to be run are programs for which pulse injection time is specified and programs for which ramp is enabled.

The programs for which both of these parameters are not specified are not to be run.

- 1) Set a program according the way mentioned in 9.9 Program Mode Setting.
- 2) Press START button (21) in program mode status.
- 3) While pulse injection is executed, the remaining pulse injection execution time (unit: second) is displayed and counted down in EXECUTE TIME (①). In case of manual change ("ooo" is displayed EXECUTE TIME), press STOP button to stop pulse injection temporarily.
- 4) In interval time, the remaining interval time (unit: second) is displayed and counted down in INTERVAL TIME (②). In case of manual change ("ooo" is displayed INTERVAL TIME), press START button to restart pulse injection.
- 5) When all of valid program numbers are completed, the test stops automatically.

PAUSE button can pause a program and can restart. If STOP button (22) is pressed while in pausing, execution of the program is canceled.

Even though interval time is set as 0 (Cnt), if eliminating electricity is necessary (e.g. in case of changing polarity), or if injection or return phase is changed, continuous pulse injection cannot be conducted.

### ))) Notice (((

When the power supply of this simulator is OFF, the memory of setting value is retained with an internal backup battery. The retainment time of the backup battery is approximate one month. If the term is over, the setting returns to initial setting.

## 9.11 Setting and Reference of Termination Resistance

The initial setting of termination resistance is set as resistance of the pulse output to EUT line on outlet panel (built-in termination resistance:  $53.5\ \Omega$ ). Since the set value of termination resistance is initialized to  $53.5\ \Omega$  (built-in termination resistance) each time power is turned on, set the value each time if necessary.

With matching the termination resistance value to the real termination resistance value which is used for test actually, the display of VOLTAGE is matched to the actual pulse output voltage. Set the termination resistance value previously in case of using an optional product, connecting an external  $50\ \Omega$  termination resistor, or so on. If the termination resistance value is not set correctly, the display of VOLTAGE value is not equal to output pulse voltage.

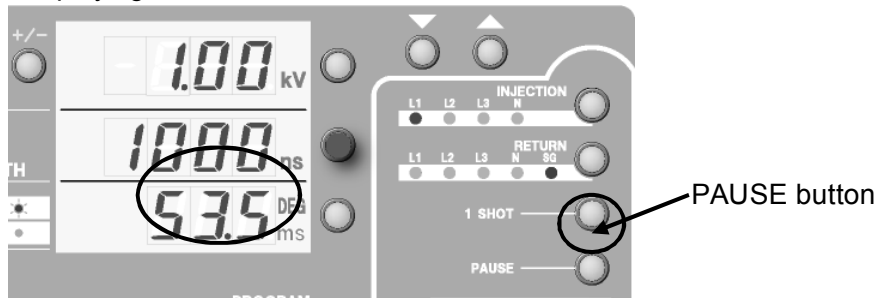
Types and applications of the display of Termination Resistance value

Selection	Status of termination and its application	Output port
53.5 $\Omega$	For when pulses are output from EUT line on outlet panel. Internally terminated by a $50\ \Omega$ system ( $53.5\ \Omega$ ).	Outlet panel only
50.0 $\Omega$	Internally not terminated. For when an external $50\ \Omega$ terminator is used. For when optional AT-810 attenuator is used.	Outlet panel
		PULSE OUT Coaxial connector
OPEN	Internally not terminated. For when testing is done without termination on the simulator.	Outlet panel
		PULSE OUT coaxial connector
l 60.0 $\Omega$	Internally terminated by a $50\ \Omega$ system ( $60\ \Omega$ ). For when an optional Radiation Probe is used.	PULSE OUT coaxial connector only
o 60.0 $\Omega$	Internally not terminated. Connect a $50\ \Omega$ system terminator ( $60\ \Omega$ ) with TERM IN connector. Noise Laboratory's NMHV coaxial cable is necessary for connection. For when an optional coupling adapter (CA-805B etc) is used.	PULSE OUT Coaxial connector only

### 9.11.1 How to set termination resistance value

- 1) Press PAUSE button for long time (2 seconds) with no pulse injected in STOP status, and the present termination resistance value is displayed on the 3rd line. (It returns to a usual display 3 seconds later.)
- 2) Press PAUSE button with the termination resistance value displayed. Every pressing changes the value.
  - In case output port is outlet panel. Setting 53.5  $\Omega$ , 50.0  $\Omega$ , and OPEN is available.
  - In case output port is PULSE OUT coaxial connector. Setting 160.0  $\Omega$ , 60.0  $\Omega$ , 50.0  $\Omega$ , and OPEN is available.
- 3) When termination resistance has been selected, wait for about 3 seconds in this state or press other button. Thus, setting of termination resistance is finished, returning to the ordinary display.

Displaying 53.5  $\Omega$



Displaying 50.0  $\Omega$



Displaying 60.0  $\Omega$



Displaying "OPEN"



Displaying 160.0  $\Omega$



### 9.11.2 Maximum pulse voltage at each termination resistance

The maximum pulse voltage at each termination resistance is as follows.

Model name	53.5 $\Omega$ termination	50.0 $\Omega$ ***1) termination	OPEN	60.0 $\Omega$ ***2) termination
220 <sup>(*)</sup> /250/250 <sup>(*)</sup> *	2.05kV	1.98kV	4.00kV	2.05kV
420 <sup>(*)</sup> /450/450 <sup>(*)</sup> *	4.10kV	3.96kV	8.00kV	4.10kV

))) Notice (((

\*\*\*1) Connect an external 50  $\Omega$  termination resistor.

\*\*\*2) Connect Noise Laboratory's terminal resistor externally or connect TERM IN coaxial connector to terminate.

Set termination resistance to each program, respectively.

Except settings in the program mode, termination resistance is initialized to 53.5  $\Omega$  at the time of turning on power supply.

### 9.12 How to Use EUT FAIL INPUT

EUT FAIL INPUT on the rear panel has the function of stopping the test by voltage input of DC 5~15V with the 50ms duration. However, EUT LINE OFF is not automatically done. Turn off manually as required.

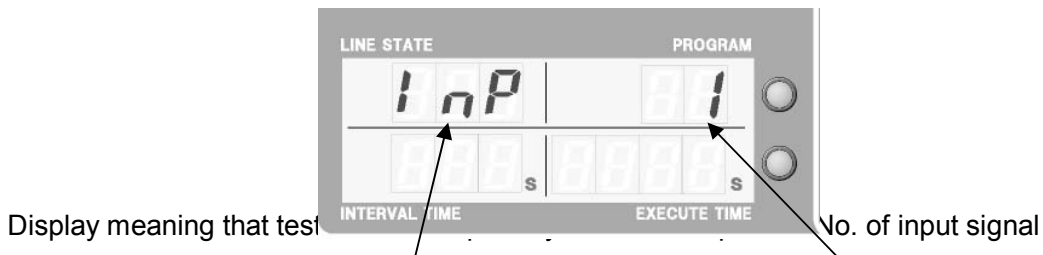
**Example of use:**

When voltage is input to EUT FAIL INPUT terminal with malfunction of EUT detected, operation stops at pulse injection setting at that time. Thus making it possible to know set value when malfunction occurs. Prepare malfunction sensing device on the user side. In addition, it is necessary to take EMC countermeasures for connection.

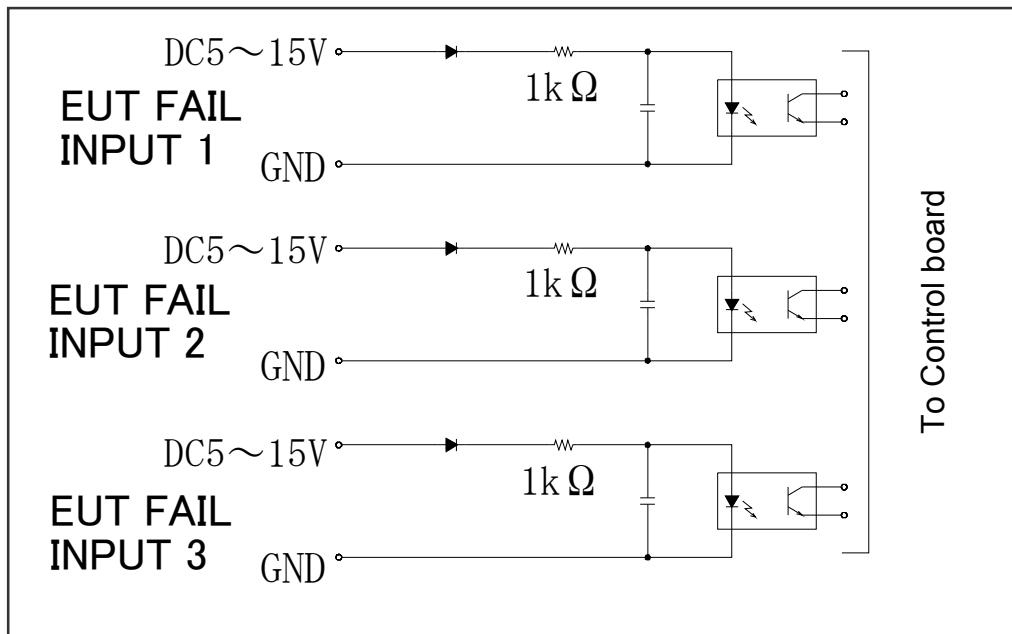
To cancel the EUT FAIL IN state, stop the voltage input to EUT FAIL INPUT and presses STOP button.

Three independent input systems are provided.

When EUT FAIL is input during test, it will be displayed as follows:



EUT FAIL INPUT internal circuit



## **10 ENVIRONMENTAL, INSTALLATION AND TEST METHOD**

### **10.1 Test parameters**

The following test parameters are to be considered and evaluated.

- Noise coupling mode (Next clause)
- Pulse polarity
- Evaluation of "Malfunction pulse voltage" test against "Pulse width"
- Evaluation of "Malfunction high-voltage pulse" test against "Pulse repetition period"
- Evaluation of "Malfunction high-voltage pulse" test against "LINE PHASE" (in case of AC line).

### **10.2 Noise coupling mode and method**

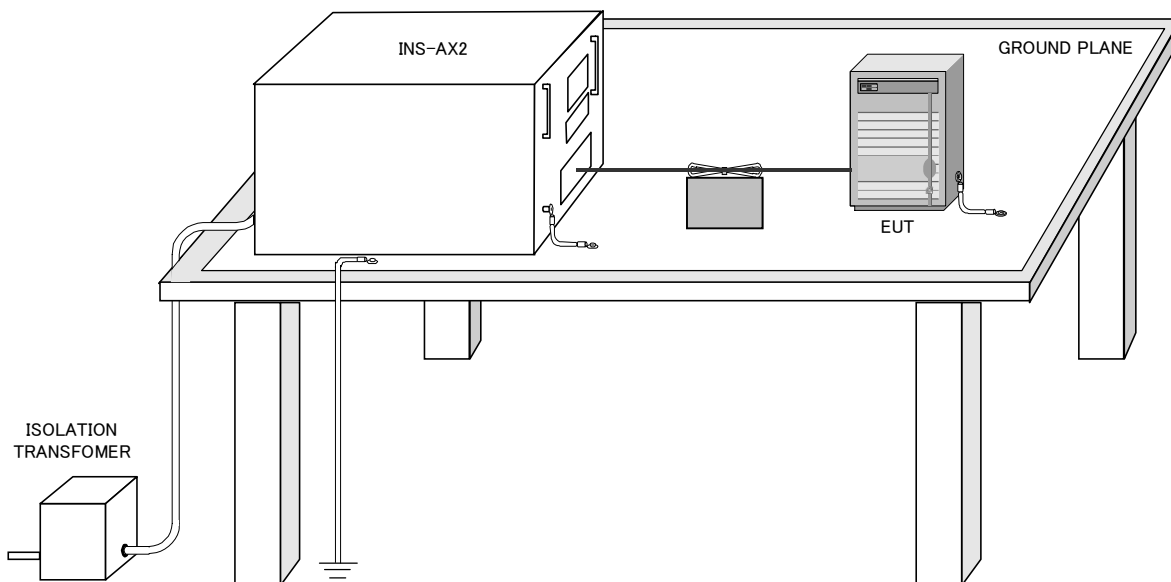
The following coupling modes and methods are shown in later pages.

- 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

### 10.3 Test Environments

A recommended test environment is shown here. It consists of the following:

- Wooden test table
- Ground plane and ground connecting cable
- Power supply for the simulator
- Power supply for the EUT and an isolation transformer (AC powered testing)
- DC power supply (DC powered testing)
- Coupling adapter (for signal lines testing)



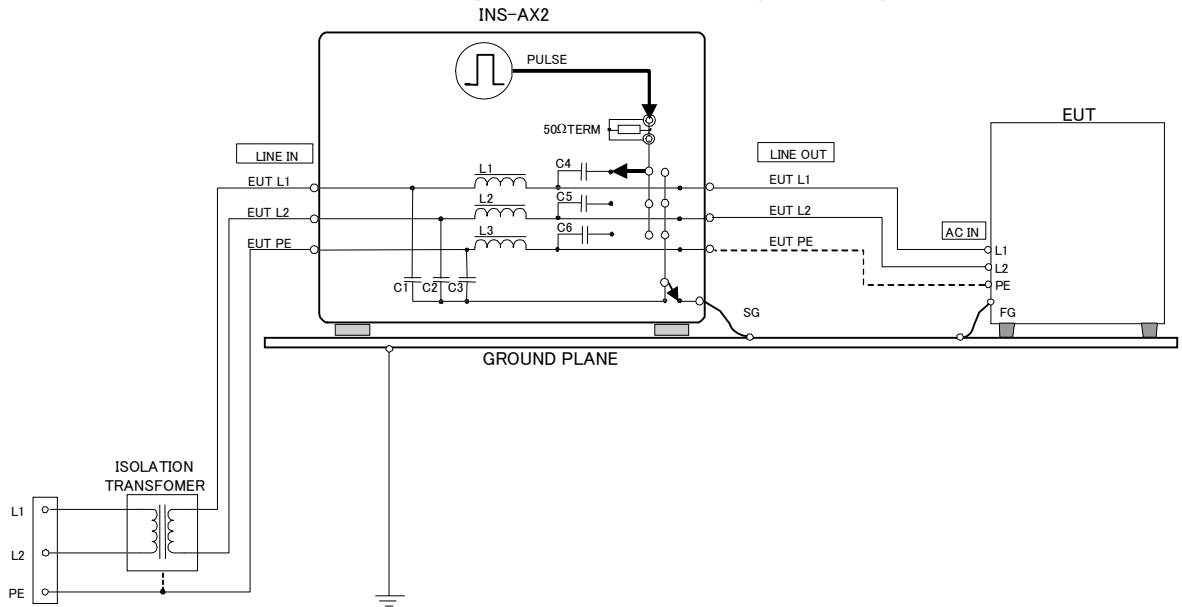
#### [Key Points]

- 1) When power supply for EUT is AC, connect the power supply for EUT to EUT LINE INPUT through an insulating transformer.
- 2) Be sure to place the ground plane under the simulator and EUT, and ground it. Place an insulating sheet between the ground plane and simulator for safety.
- 3) When the power cable of EUT is long, bundle it to prevent short looping, and carefully handle it so that it may not run in parallel or intersect with other communication cables etc. In order to improve test reproducibility, keep it apart 10cm from the ground plane.
- 4) Connect SG terminal of the simulator to the ground plane, and FG terminal (if any) of EUT to the ground plane with a wire rod of low impedance (ground cables such as braided wire of 3.5mm<sup>2</sup>, etc.)  
When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.  
For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT.  
**When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 5) Do not connect the PE terminal of the simulator to the ground plane or SG terminal directly. For power supply of the simulator, use 3-line AC cable with grounding conductor for protective earth of PE.



## 10.4 Test set-up

### 10.4.1 Line to ground mode for AC operated equipment (Common Mode) Example of single-phase model (220 type/ 420 type)



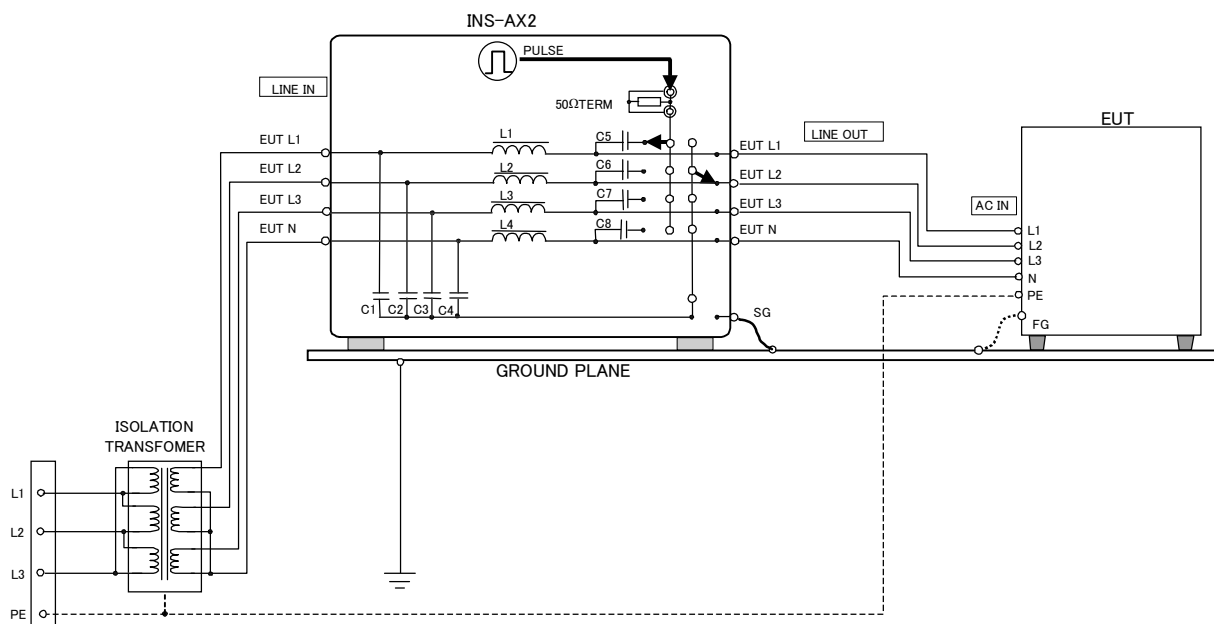
#### [Key points]

- 1) Turn off power for EUT.
- 2) When power supply for EUT is AC, connect the power supply for EUT to EUT LINE INPUT through an insulating transformer.
- 3) Connect OUTLET PANEL of the simulator to EUT with the power cable.
- 4) Connect SG terminal of the simulator and the FG terminal (if any) of EUT to the ground plane.  
When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.
- 5) For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT.  
**When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 6) Supply power supply to EUT, turn on the line switch to make EUT operative.
- 7) Set the injection phase to L1, L2, and PE as necessity.
- 8) Set the return phase to SG.

(Note) FG is an abbreviation for "Frame Ground".

SG is an abbreviation for "Signal Ground" for high voltage pulses.

## 10.4.2 Line to line mode (normal mode) for AC operated equipment



Example of 3-phase model (250 type / 450 type)

### [Key points]

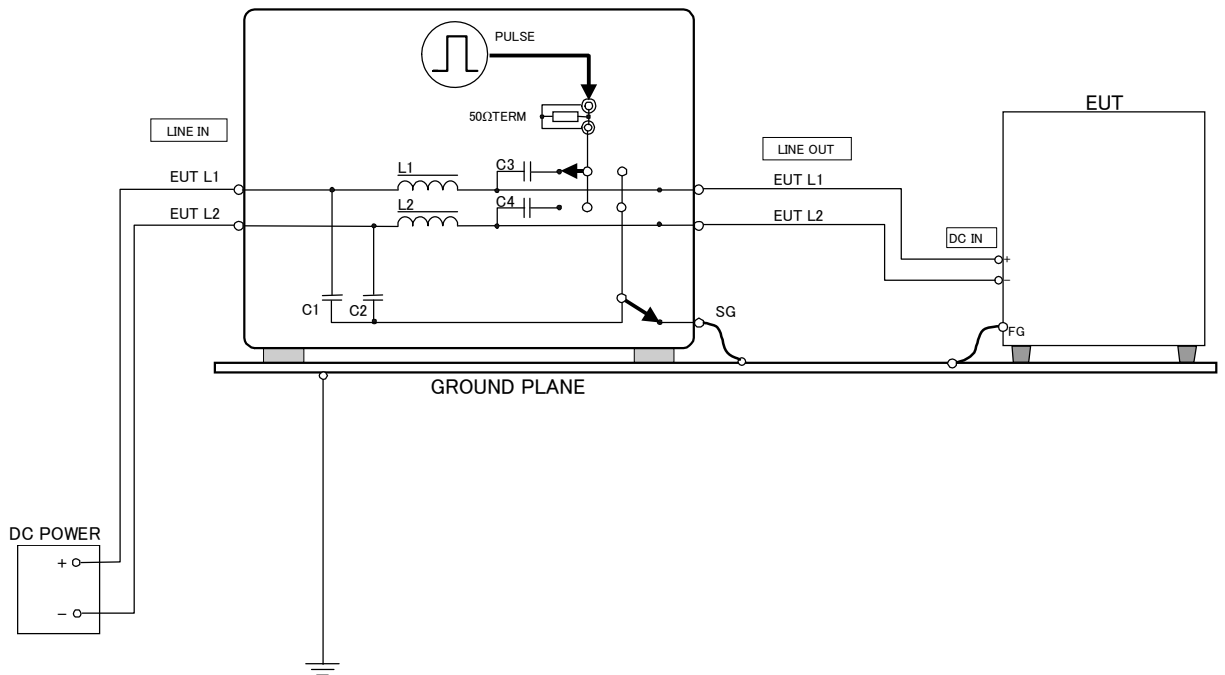
- 1) Turn off power to EUT.
- 2) Connect the power supply for EUT to EUT LINE INPUT through an insulating transformer.
- 3) Connect OUTLET PANEL of the simulator to EUT with the power cable.
- 4) Connect SG terminal of the simulator and the FG terminal (if any) of EUT to the ground plane. When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.
- 5) For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT.  
**When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 6) Supply power supply to EUT, turn on the line switch to make EUT operative.
- 7) Set the injection phase to L1, L2, or L3.
- 8) Set the return phase to a phase (L1, L2, or L3) to which no pulse is injected. Even when the SG terminal of the simulator is connected to the ground plane in this setting, it is internally disconnected, so that the normal mode test can be performed.

(Note) FG is an abbreviation for "frame ground".  
SG is an abbreviation for "signal ground" for high voltage pulses.

### CAUTION:

**When conducting normal mode test, the outer conductor of the HV coaxial connectors and one line of the EUT LINE is connected. Although the isolation transformer eliminates the risks of a shock hazard, be careful not to have short circuit events caused by touching the HV connector outer conductor to the other lead, wire or housing.**

### 10.4.3 Line to ground mode (common mode) for DC operated equipment



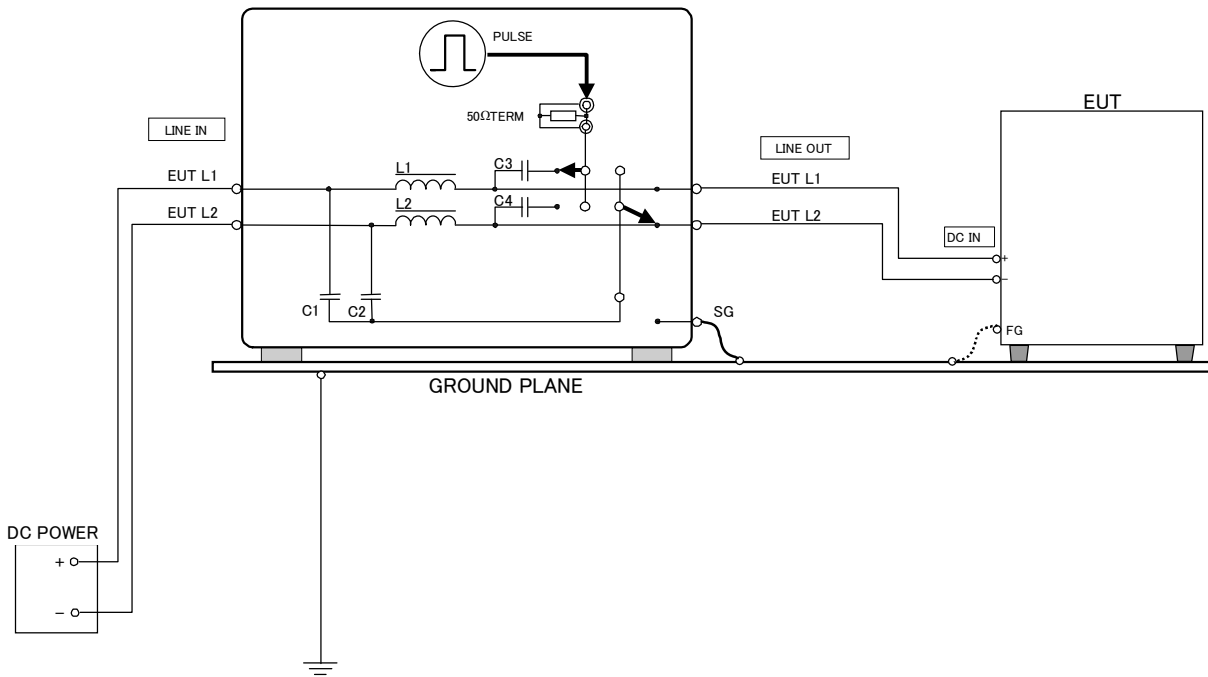
(Part of the above-mentioned circuit is omitted)

#### [Key points]

- 1) Turn off power to EUT.
- 2) Connect DC power supply for EUT to EUT LINE INPUT.
- 3) Connect OUTLET PANEL of the simulator to EUT with the power cable.
- 4) Connect SG terminal of the simulator and the FG terminal (if any) of EUT to the ground plane. When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.
- 5) For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT. **When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 6) Supply power supply to EUT, turn on the line switch to make EUT operative.
- 7) Set injection phase L1 or L2.
- 8) Set the return phase to SG.

(Note 1) FG is an abbreviation for "Frame Ground".  
SG is an abbreviation for "Signal Ground" for high voltage.

#### 10.4.4 Line to line mode (normal mode) for DC operated equipment



(Part of the above-mentioned circuit is omitted)

##### [Key points]

- 1) Turn off power to EUT.
- 2) Connect DC power supply for EUT.
- 3) Connect OUTLET PANEL of the simulator to EUT with the power cable.
- 4) Connect SG terminal of the simulator and the FG terminal (if any) of EUT to the ground plane. When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.
- 5) For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT.  
**When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 6) Supply power supply to EUT, turn on the line switch to make EUT operative.
- 7) Set injection phase to L1, L2.
- 8) Set the return phase to a phase (L1 or L2) to which no pulse is injected. Even when the SG terminal of the simulator is connected to the ground plane in this setting, it is internally disconnected, so that the normal mode test can be performed.

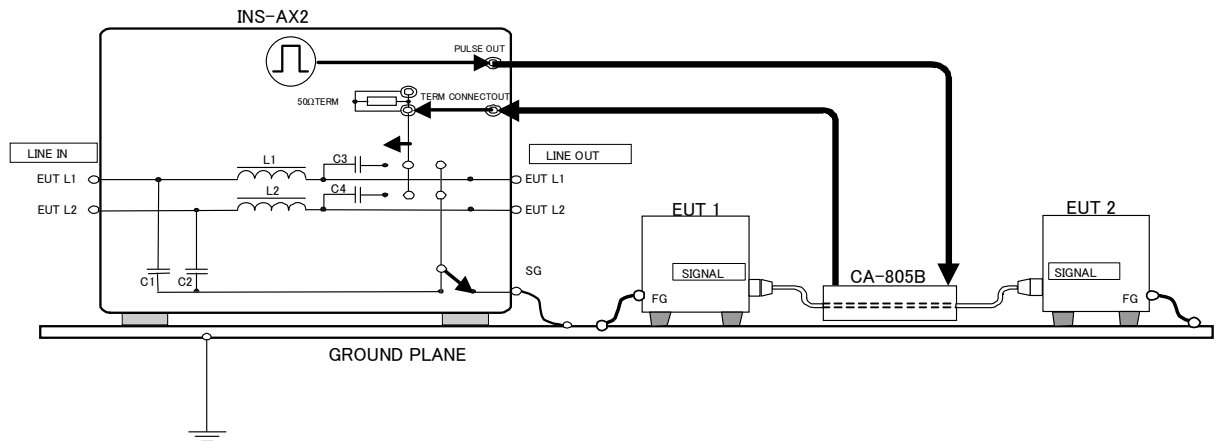
(Note 1) FG is an abbreviation for "Frame Ground".  
 SG is an abbreviation for "Signal Ground" for high voltage.

##### **CAUTION:**

**When conducting normal mode test, the outer conductor of the HV coaxial connectors and one line of the EUT LINE is connected.**

**Although the isolation transformer eliminates the risks of a shock hazard, be careful not to have short circuit events caused by touching the HV connector outer conductor to the other lead, wire or housing.**

#### 10.4.5 Capacitive coupling test for signal lines (by using CA-805B coupling adapter: Option)



(Part of the above-mentioned circuit is omitted)

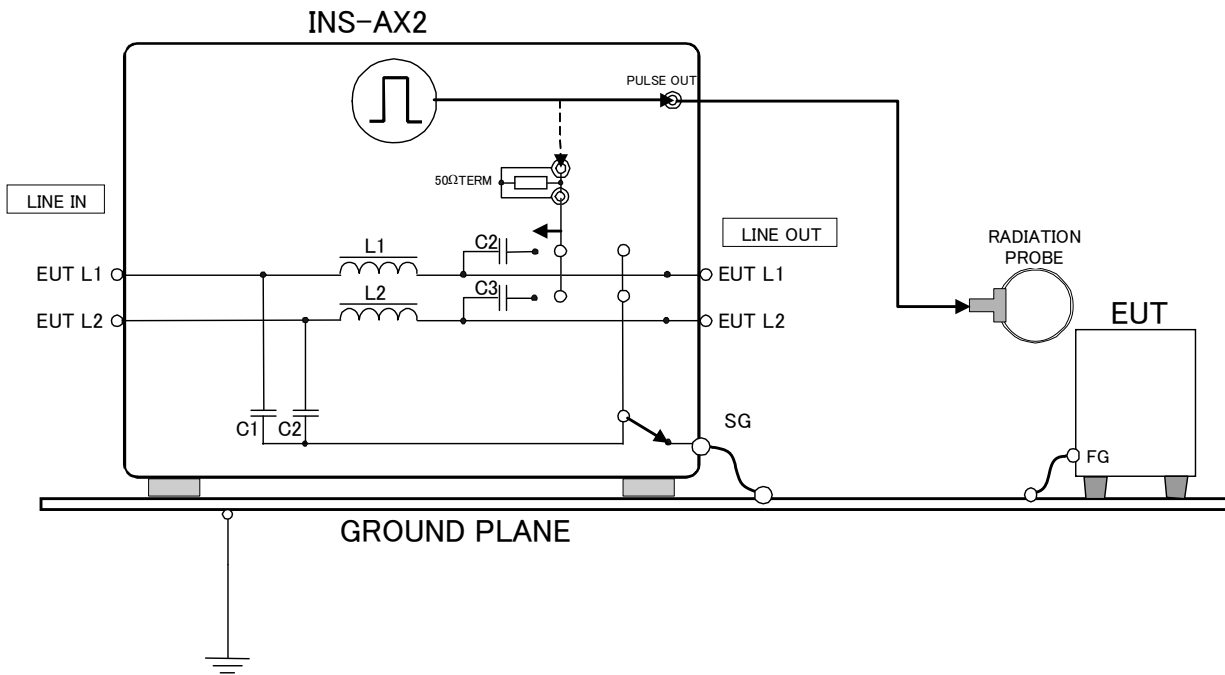
#### [Key points]

- 1) Press PAUSE button for long time (approximately 2 seconds) and set termination indication "o60.0".  
\*For details, refer 9.11 Setting and Reference of Termination resistance.
- 2) Open the coupling adapter (option) and clamp the interface cable under test. The PULSE OUT terminal shall be connected to one side of the adapter and the 50 Ω TERM IN terminal shall be connected to the other side (Changing the injection and termination sides is also recommended as test results may vary.)
- 3) Connect the SG terminal of the simulator and the FG terminal (if any) of each unit of the EUT to the ground plane. When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.
- 4) For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT. **When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 5) EUT power can be supplied from the service outlet directly.
- 6) Injection phase should be the PULSE OUT coaxial connector output.
- 7) Set the return phase to SG.

(Note 1) FG is an abbreviation for "frame ground".  
SG is an abbreviation for "signal ground" for high voltage pulses.

When using a coupling adaptor, read the instructions manual for coupling adaptor.

#### 10.4.6 Test by using a radiation probe (optional accessory)



(Part of the above-mentioned circuit is omitted)

#### [Key points]

- 1) Press PAUSE button for long time (approximately 2 seconds) and set termination indication "o60.0".  
\*For details, refer 9.11 Setting and Reference of Termination resistance.
- 2) Set the injection phase to the PULSE OUT, set the return phase to SG, and conduct a test by switching the internal termination resistance between connection and disconnection. Connect a radiation probe (optional accessory) to the connector of PULSE OUT. High-voltage pulse voltage varies according to the existence of a termination resistance.
- 3) Connect SG terminal of the simulator and the FG terminal (if any) of EUT to the ground plane. When there are two or more EUT(s), connect each FG terminal (if any) to the ground plane.
- 4) For EUT without FG terminal or EUT to be used without grounding the FG terminal, the test should be performed without connecting the ground plane to the FG terminal of EUT. **When connecting between the FG terminal (if any) of EUT and the ground plane, make connection conforming to EUT specifications.**
- 5) EUT power can be supplied from the service outlet directly.
- 6) Injection phase should be the PULSE OUT coaxial connector output.
- 7) Set the return phase to SG.

(Note 1) FG is an abbreviation for "frame ground".

SG is an abbreviation for "signal ground" for high voltage pulses.

When using a radiation probe, read the instructions manual for radiation probe.

# 11 SPECIFICATIONS AND FUNCTIONS

Table Specifications of this product

Parameters		Specifications	Remarks
Pulse output voltage		0.01 ~ 0.09kV ± 0.04kV 0.10 ~ 2.00kV ± 10% (220※/250※※) 0.10 ~ 4.00kV ± 10% (420※/450※※)	When the output is terminated by the built-in terminator: 0.01kV step
Output polarity		Positive /Negative	
Pulse	Pulse width	50,100,200,400,500,800,1000ns±0% 10ns±3ns	Rectangular Wave
		1μs±30% (220T/420T/250T/250TH/450T/450TH)	Triangle Wave
	Rise time	<1 ns	Rectangular Wave
		< 40 ns (220T/420T/250T/250TH/450T/450TH)	Triangle Wave
Output impedance	50Ω system (53. 5Ω)		
Pulse repetition mode	LINE PHASE	Injection phase angle: 0-360DEG±10DEG EUT power supply: Operates on AC90V or more, 50Hz/60Hz±10%.	
	VALIABLE	10ms~999ms±10%(220 <sup>(*)</sup> /250/250 <sup>(**)</sup> ) 16ms~999ms±10%(420 <sup>(*)</sup> /450/450 <sup>(**)</sup> )	
	1SHOT TRIG	Single pulse generation, each time the 1 SHOT button is pressed. Synchronized output with phase angle setting in PHASE mode	
Maximum power capacity of EUT		Single-phase AC240V/DC65V, 20A(220 <sup>(*)</sup> /420 <sup>(*)</sup> ) 3-phase AC300V/DC65V, 50A (250 <sup>(*)</sup> /450 <sup>(*)</sup> ) 3-phase AC500V/DC250V, 50A(250 <sup>(**)</sup> /450 <sup>(**)</sup> ) 50/60Hz±10%	
HV Coaxial connector		NMHV	Noiseken original
Power supply		AC100-240V±10% 50Hz/60Hz±10%	
Power consumption		110VA	
Operating temperature range		15-35°C	
Operating humidity range		25-75%	
Dimensions (mm)		W 430 x H 350 x D 470 mm	Projection excluded
Weight		Approx. 30kg (220 <sup>(*)</sup> /420 <sup>(*)</sup> ) Approx. 40kg (250/450/250 <sup>(**)</sup> /450 <sup>(**)</sup> )	

**Coaxial cable and high-voltage coaxial connector**

The high-voltage coaxial cable (incorporated in the simulator) and high-voltage coaxial connector (external) are consumable supplies. Check the high-voltage coaxial cable and high-voltage coaxial connector with an insulation-resistance tester every half-year or when they are used for about 200 hours. When the performance drops below DC1000V/100M $\Omega$ , change them for new ones.

**Mercury relay**

Mercury relays are consumable parts. The service life varies according to operating conditions. Especially when it is used at 8kV maximum without using a termination resistance, the relay life may sometimes extremely shorten. If it is necessary to change the mercury relay due to unstable output pulse or other symptoms, please ask Noise Laboratory or its distributor/agent closest to you for replacement.

When the mercury relay is changed on the user side, thoroughly read "RELAY UNIT", "IMPORTANT SAFETY PRECAUTIONS" and " BASIC SAFETY PRECAUTIONS " before starting replacement work.

After completion of work, be sure to read "HOW TO CHECK THE WAVEFORM" and "CORRECTING PHASE ANGLE" to check the output waveforms and set phase angle correction. Please note that Noise Laboratory Co., Ltd. shall have no liability against any accident or damage arising from any work performed on the user side.

**Contactors for EUT LINE ON/OFF**

Contactors are consumable parts. The service life varies according to operating conditions. If it is necessary to change the contactor, please ask Noise Laboratory or its distributor/agent closest to you for replacement.

**Automatic switching unit**

The automatic switching unit is a consumable part. The service life varies according to operating conditions. When it is necessary to change or repair the automatic switching unit, please ask Noise Laboratory or its distributor/agent closest to you for replacement.



## 12 HOW TO CHECK THE WAVEFORM

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

### 12.1 Instrument required

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

### 12.2 Oscilloscope settings

- Time div. : 1 $\mu$ s/div or less
- Volt div. : Maximum range
- Input impedance : 50  $\Omega$

### 12.3 Simulator settings

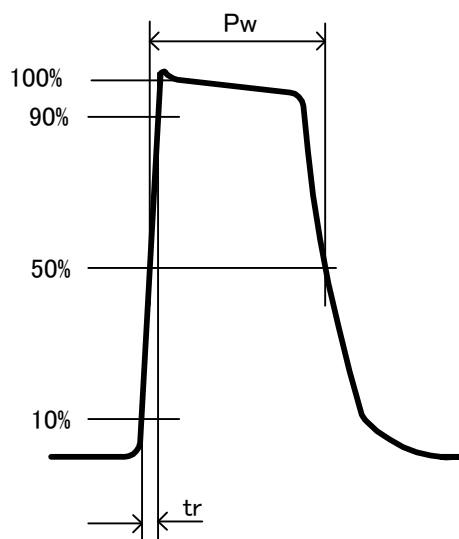
- Pulse width : 1000ns
- Output to : PULSE OUT coaxial connector  
(Press INJECTION Phase Setting button for long time to blink LED—showing output comes from PULSE OUT.)
- Terminator display setting : 50  $\Omega$   
(Press PAUSE button to display termination resistor value. Set the value 50  $\Omega$  with PAUSE button.)
- Polarity : Positive
- Voltage setting : Any voltage
- Mode : Fastest repetition setting in Variable mode

### 12.4 Checking the waveform

- Connect the output terminal of the AT-810 to the 50 $\Omega$  input terminal of the oscilloscope.
- Connect the PULSE OUT terminal of the simulator to the input terminal of the AT-810.
- Raise 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 in the next page is seen on the screen.

#### CAUTION:

**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. AT-810 can be used for the purpose of a rough check for the output only.**



tr: Rise time  
Pw: Pulse width

**Notice**

When checking the waveform injected on AC line, connect an appropriate HV probe conforming to the output voltage to the Outlet panel terminals at the shortest possible length. In this case, fully be careful not to receive an electric shock. In case of measurement with a high voltage-proof probe, the 50Ω system impedance comes down. As a result, an overshoot at the rising edge and the subsequent oscillatory waveform are observed. Some change comes out according to the method of measurement, such as how to apply the probe. However it is not an abnormality.

The probe calibration fitting to the oscilloscope which is used for checking the output pulse voltage value can reduce a margin of error in measurement. The value of rise time of the output pulse varies depending on the frequency reange of the oscilloscope and frequency characteristics of the probe. As for characteristics and compensation of measurement instruments, read the instruction manuals of the instruments to be used.

## 13 CORRECTING PHASE ANGLE

Pulse generation timing varies depending on the characteristic of each relay (having individual difference) and pulse voltages. Therefore, a large phase-angle setting error occurs after the relay is changed. In order to correct the phase-angle setting error, set the correction value in accordance with the following procedure:

As the phase angle has been corrected at AC50Hz at the time of shipment, some errors may be found at AC60Hz. Setting the same correction value can reduce an error of phase angle setting.

### 13.1 Wording in This Chapter

In this chapter, the unit of “phase angle” is indicated as follows.

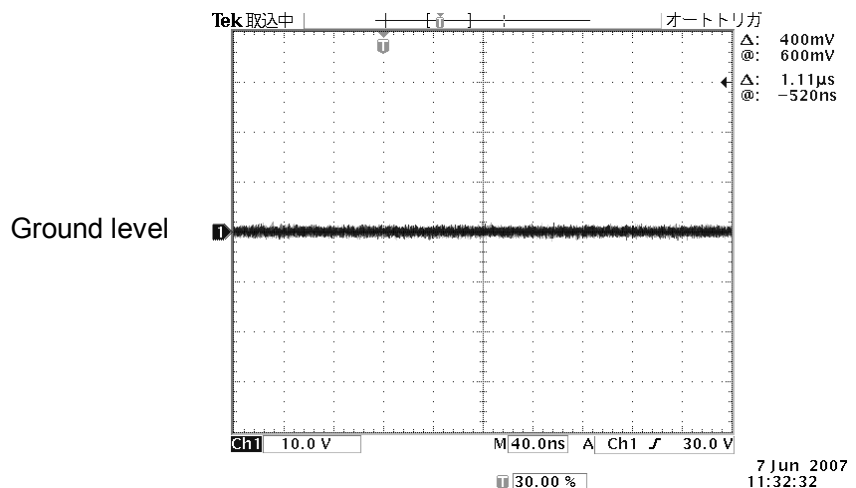
Indication	Meaning
“DEG”	Set value of INS
“°”	Monitored value of oscilloscope

### 13.2 Preparation and Setting

In order to set value correcting, prepare a high voltage-proof oscilloscope and a high voltage-proof probe (maximum voltage: 2.05kV or more for 220 type/250 type and 4.10kV or more for 420 type /450 type).

#### 1) Setting the oscilloscope

- ✧ Connect the HV probe to the oscilloscope.
- ✧ As for the setting of the oscilloscope, make the vertical section 10V/Div., the horizontal section 40ns/Div., and the trigger level 30V.
- ✧ Make HOT-GND of the HV probe short-circuited and position the ground level at the center of the screen.



## 2) Setting INS

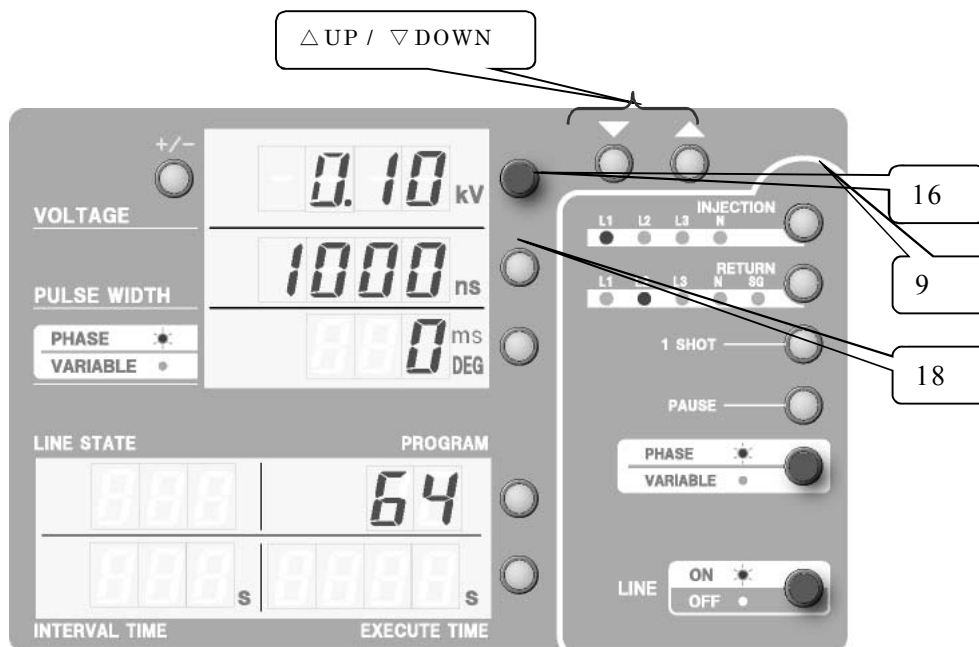
- ◇ Input 50Hz or 60Hz to EUT INPUT at Sin wave within the rated voltage by AC regulated power supply etc. through an isolation transformer.
  - ◇ Connect HV probe to the output terminal on the outlet panel (HOT-L1, GND-L2).
  - ◇ Turn on INS with POWER switch.
  - ◇ Set INJECTION phase L1.
  - ◇ Set RETURN phase L2.
  - ◇ Set pulse width 1000ns.
  - ◇ Set VOLTAGE 0.10kV.
  - ◇ Set PHASE/VARIABLE setting button as "PHASE".
  - ◇ Set PHASE as "0 DEG".
- ※ For preventing mishandling, only in the above setting, the correcting procedure can start.

### 13.3 Explanation of Phase-Angle Correction Setting

Be careful not to be injured electrically during EUT LINE ON setting working, because there are high voltage pulse and AC.

Before following procedure, prepare the instruments according to 13.2 Preparation and Setting.

- 1) Set EUT LINE ON status with LINE ON/OFF setting button.
- 2) Press START button.
- 3) Press PHASE/VARIABLE setting button (18) for long time to select the phase angle setting mode. (The warning buzzer produces a beep sound.)

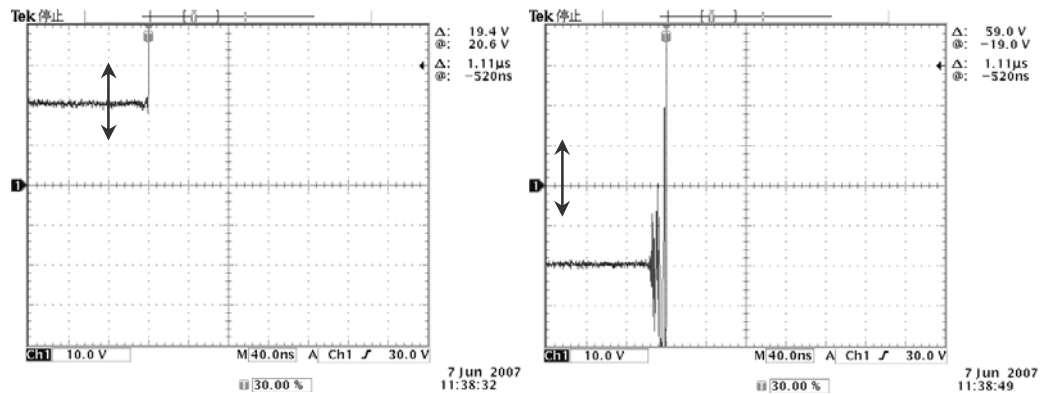


- 4) Adjust the phase angle set value by means of  $\Delta$ UP/ $\nabla$ DOWN so that the phase-angle setting errors of the upper side and the lower side against the ground level are almost same on the oscilloscope reading at 0.10kV and maximum voltage (2.05kV for 220 type/250 type and 4.10kV for 420 type /450 type).  
For outputting 0.10kV and maximum voltage, press VOLTAGE setting button (16) to output them alternately.

The oscilloscope shows waveforms as below.

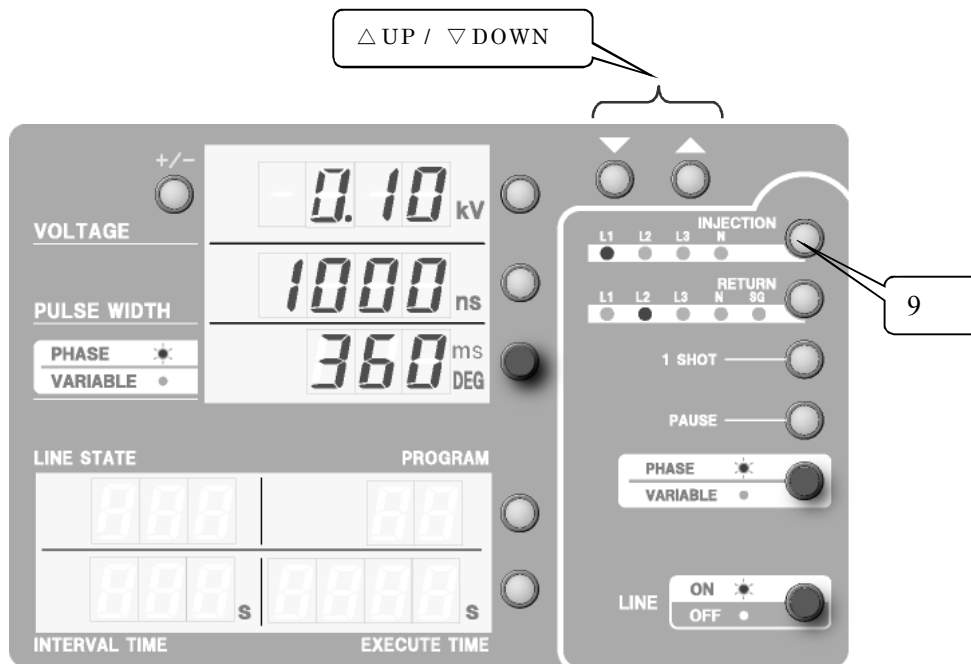
A waveform appears on the upper side at 0.10kV and on the lower side at maximum voltage.

If the error is so big that the waveform exists out of the screen, adjust the value by means of  $\Delta$ UP/ $\nabla$ DOWN so as to move the waveform into the screen and then adjust them in order to make positions of upper and lower side against the ground level almost same.



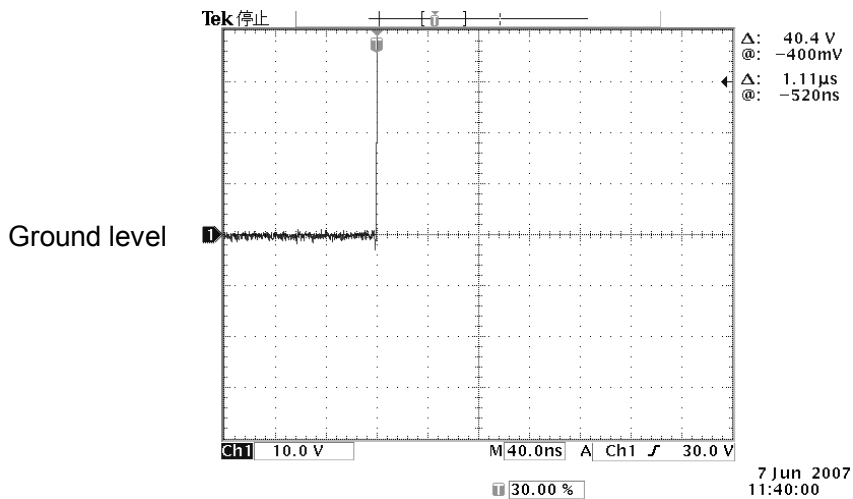
- 5) Press INJECTION button (9) for long time to finalize it. (The buzzer sounds)

- 6) The settings change automatically to VOLTAGE: 0.10kV and PHASE: 360.



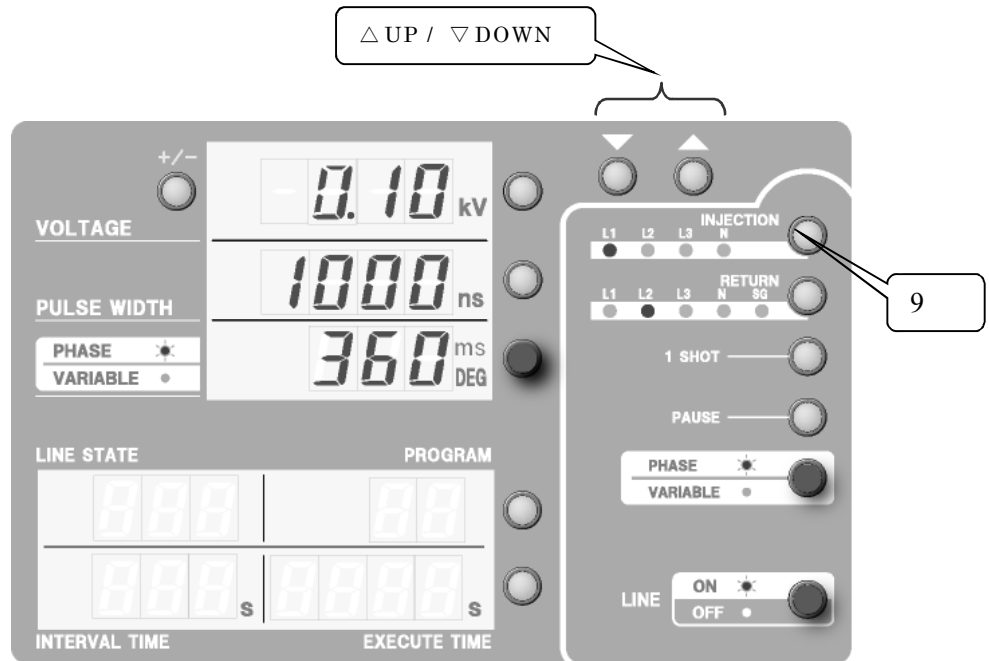
Adjust PHASE value by means of  $\Delta$ UP/ $\nabla$ DOWN so that the injection phase angle gets to the position of  $0^\circ$  (the ground level on the oscilloscope screen). (Adjustable range of PHASE value: 360~330DEG)

The figure as below shows the waveform which is set on the position that the injection phase angle is  $0^\circ$  (the ground level on the oscilloscope screen).



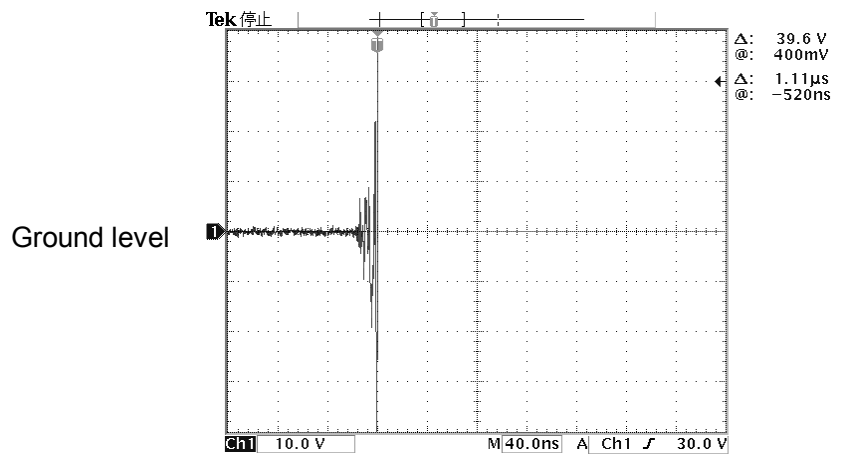
- 7) Press INJECTION button (9) for long time to finalize it. (The buzzer sounds)

- 8) The settings changes automatically to VOLTAGE: 0.10kV, PHASE: 0, and VOLTAGE setting button: blinking.



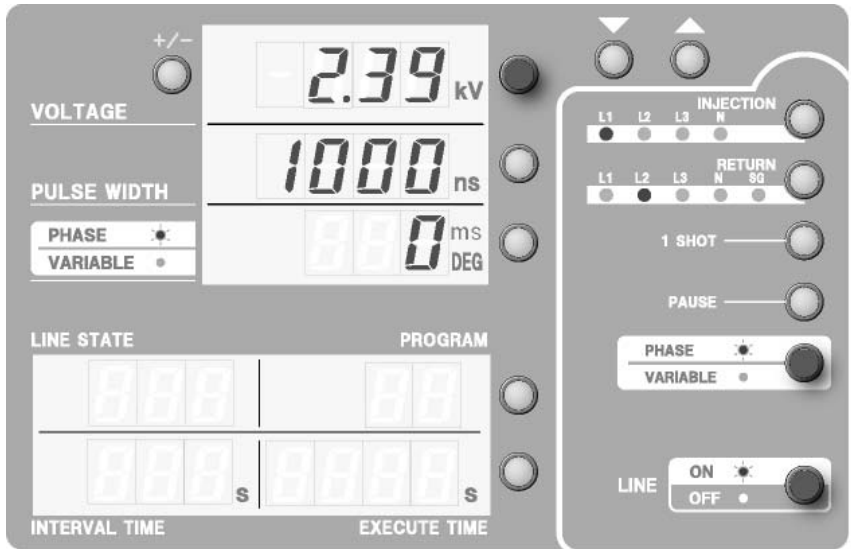
Adjust VOLTAGE value by means of  $\Delta$ UP/ $\nabla$ DOWN so that the injection phase angle gets to the position of  $0^\circ$  (the ground level on the oscilloscope screen).

The figure as below shows the waveform which is set on the position that the injection phase angle is  $0^\circ$  (the ground level on the oscilloscope screen).

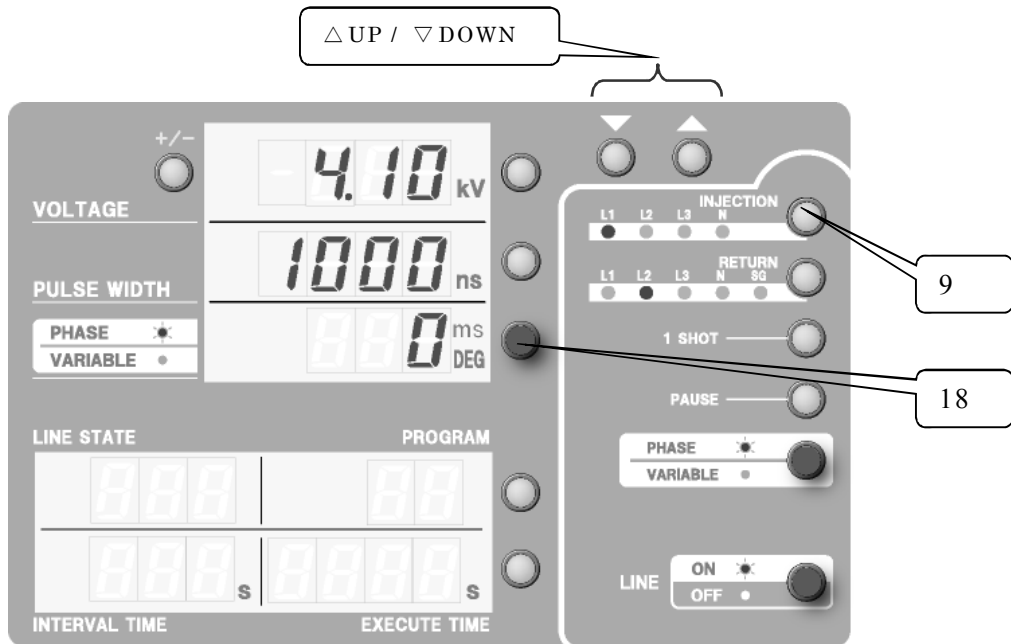


- 9) Press INJECTION button (9) for long time to finalize it. (The buzzer sounds)

An example of display of INS-AX2-420 type or 450 type after 9) procedure



- 10) Make VOLTAGE value maximum (2.05kV for 220 type/250 type and 4.10kV for 420 type /450 type) by means of  $\Delta$ UP.

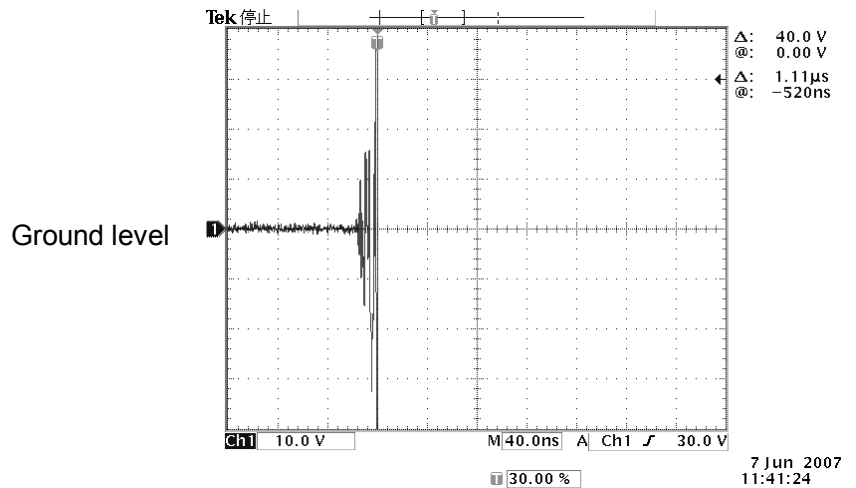


When VOLTAGE gets to the maximum value, PHASE setting button (18) starts blinking automatically.



- 11) Adjust PHASE value by means of  $\Delta$ UP/ $\nabla$ DOWN so that the injection phase angle gets to the position of  $0^\circ$  (the ground level on the oscilloscope screen). (Adjustable range of PHASE value: 0~30DEG)

The figure as below shows the waveform which is set on the position that the injection phase angle is  $0^\circ$  (the ground level on the oscilloscope screen).



- 12) Press INJECTION button (9) for long time to finalize it. (The buzzer sounds)

With the above procedure, setting has been completed.

Setting up the phase correction can be cancelled when the STOP button is pressed and the simulator returns to the status before starting the phase correction.

After exchanging relay on user side, if setting for phase angle correction is not performed, an error may be sometimes over  $\pm 10$  DEG at the time of LINE PHASE setting. This is caused by the individual difference of the mercury relay, and it is not a trouble.

- ※ If adjustment cannot be made within adjustable range, there is possibility that the relay is deficient or that life span of the relay is over. Enquire your sales agent or Noise Laboratory.

### 13.4 Simplified Chart of Phase-Angle Correction Setting

Setting the oscilloscope	Set the vertical section 10V/Div., the horizontal section 40ns/Div., and the trigger level 30V. Position the ground level at the center of the screen.
Setting INS	Set INJECTION phase: L1, RETURN phase: L2, Pulse width: 1000ns, VOLTAGE: 0.10kV, and PHASE: 0 DEG.
To adjust correction set value	△UP/▽DOWN button
To finalize correction set value	Press INJECTION button (9) for long time

No.	Settings	Adjustments
1) ~ 3)	Starting phase angle correction	Press LINE ON/OFF setting button (14). Press START button (21). Press PHASE/VARIABLE setting button (18) for long time.
4) ~ 5)	Basic adjustments	Adjust the phase angle set value by means of △UP/▽DOWN so that the phase-angle setting errors of the upper side and the lower side against the ground level are almost same on the oscilloscope reading at 0.10kV and maximum voltage (2.05kV for 220 type/250 type and 4.10kV for 420 type /450 type). For outputting 0.10kV and maximum voltage, press VOLTAGE setting button (16) to output them alternately.
6) ~ 7)	Adjusting phase angle at 0.10kV	Adjust PHASE value by means of △UP/▽DOWN so that the injection phase angle gets to the position of 0° (the ground level on the oscilloscope screen). (Adjustable range of PHASE value: 360~330DEG※)
8) ~ 9)	Adjusting voltage value at 0 DEG	Adjust VOLTAGE value by means of △UP/▽DOWN so that the injection phase angle gets to the position of 0° (the ground level on the oscilloscope screen).
10) ~ 12)	Adjusting phase angle at maximum voltage value	Set VOLTAGE value maximum (2.05kV for 220 type/250 type and 4.10kV for 420 type /450 type). Adjust PHASE value by means of △UP/▽DOWN so that the injection phase angle gets to the position of 0° (the ground level on the oscilloscope screen). (Adjustable range of PHASE value: 0~30DEG※)

※ If adjustment cannot be made within adjustable range, there is possibility that the relay is deficient or that life span of the relay is over. Enquire your sales agent or Noise Laboratory.

## 14 RELAY UNIT

This product uses a mercury relay for pulse generation.

Mercury relays are consumable supplies and the service life varies according to operating conditions.

Especially when it is used at 8kV maximum without using a termination resistance, the relay life may sometimes extremely shorten.

If it is necessary to change the mercury relay due to unstable output pulse or other symptoms, please ask Noise Laboratory or its distributor/agent closest to you for replacement.

When the mercury relay is changed on the user side, thoroughly read "IMPORTANT SAFETY PRECAUTIONS" and "BASIC SAFETY PRECAUTIONS" before starting replacement work and perform correct work in accordance with the following "HOW TO REPLACE THE RELAY UNIT".

After completion of work, be sure to check the output waveforms and set for phase angle correction.

Please note that Noise Laboratory Co., Ltd. shall have no liability against any accident or damage arising from any work performed on the user side.

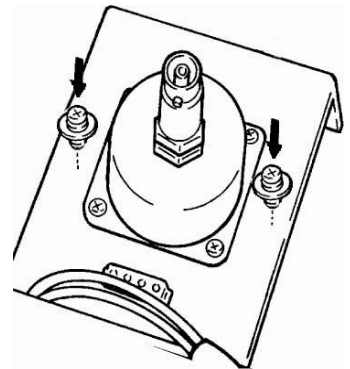
### 14.1 2kV relay unit and 4kV relay unit

INS-AX2-220 type / 250 type has 2kV mercury relay unit mounted and INS-AX2-420 type / 450 type has 4kV mercury relay unit mounted. The correct type shall be used.

- INS-AX2-220, 220T, 250, 250T, 250H, 250TH  
2kV mercury relay unit····· 04-00014A
- INS-AX2-420, 420T, 450, 450T, 450H, 450TH  
4kV mercury relay unit····· 04-00015A

### 14.2 How to replace the relay unit

- Turn off EUT power supply, the simulator and EUT and disconnect all connections after a lapse of more than 5 seconds.
- Remove all the screws on the top and side panels of the simulator and move up the cover.
- Remove the high-voltage coaxial connector and control connector on the top of the relay unit. Remove two setting screws of the relay unit and carefully move it up. Remove the high-voltage coaxial connector from the bottom of the simulator, and remove the used relay unit.
- Fit the high-voltage coaxial connector on the bottom. At this time, rotate the ring of the high-voltage coaxial connector to lock it until a click is heard. Fix the relay unit with 2 screws, fit the upper high-voltage coaxial connector and control connector, and then fit the new relay unit.
- Put the cover and tighten all the screws on the top and side panels of the simulator.
- Read "HOW TO CHECK THE WAVEFORM" and check the waveform.
- Read "CORRECTING PHASE ANGLE" and set for phase angle correction. When setting for phase angle correction is not performed, an error may be sometimes over  $\pm 10$  DEG at the time of LINE PHASE setting. This is caused by the individual difference of the mercury relay, and it is not a trouble.



**Do not perform any work other than the above-mentioned procedure.**

**CAUTION:**

**As mercury is used in the mercury relay unit, it falls under the category of industrial waste and its disposal is contracted to a waste handler. Therefore, It is not permitted that the user disposes of it as ordinary waste.**

**When disposing of the used mercury relay unit, perform waste treatment in accordance with the regulations of each country or return it to Noise Laboratory or its distributor/agent closest to you.**

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## 15 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.

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. 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.

## 16 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.

## **17 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 its distributor/agent closest to you.
- 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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