For your reference:

Please note that this product is no longer available and is provided as a reference technical document.

AC POWER SUPPLY

EPO4000S／8000S／10000S／12000S
EPO6000M／12000M／18000M
24000M／36000M

INSTRUCTION MANUAL

P-STATION EPO

NF Corporation

D:510038

EPO 4000S/8000S/10000S/12000S
EPO 6000M/12000M/18000M
24000M/36000M
Instruction Manual

AC POWER SUPPLY

P-STATION

EPO

If the document is incorrectly collated, contact NF representatives for replacement.

Notes:

- Copy and reprint of any or all of the contents of this document without permission are prohibited by law.
- Contents of this document are subject to change without notice.
- We shall not be responsible for damage resulted from the contents of this document although careful elaboration has been exerted in preparation of the document.
- We shall not be responsible for effects of consequence of operation performed according to the document.

Caution prior to exportation

- It is prohibited to export or bring out this product from Japan to any foreign country without permission. The predetermined formalities must be done following the applicable laws and rules.

Instructions for safe use of the product

For safe use of P-STATION/EPO unit, observe the instructions in the following section. The company shall not be responsible for, nor take compensation of, the damage resulting from violation of these instructions.

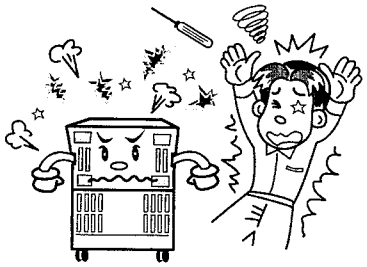
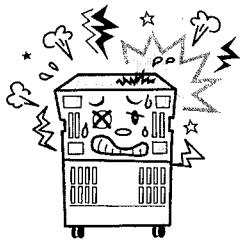
Observe the contents of this document

This instruction manual contains instructions for safe operation and use of P-STATION/EPO unit.

Be sure to read first this manual before starting operation. After thorough reading, store the document carefully so that it will be accessible for reference when uncertainty is encountered in the future.

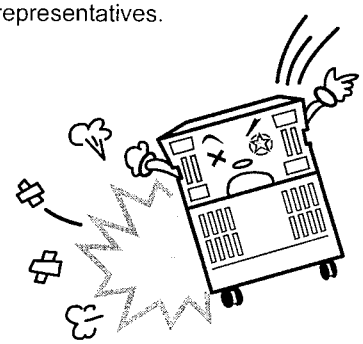
Observe the descriptions of ⚠WARNING!, ⚠CAUTION!

Be sure to observe descriptions of WARNING and CUATION contained in this manual and those affixed on P-STATION/EPO units because they are intended to prevent hazard that may result in serious accidents.

⚠WARNING!	This note on the product or in the manual indicates information to avoid hazard which the life or body of the user is subject to during handling of the equipment. 
⚠CAUTION!	This note on the product or in the manual indicates information to avoid damage to the P-STATION /EPO unit. 
⚠	This symbol on the product indicates controls or functions the use of which requires reference to this instruction manual in advance.

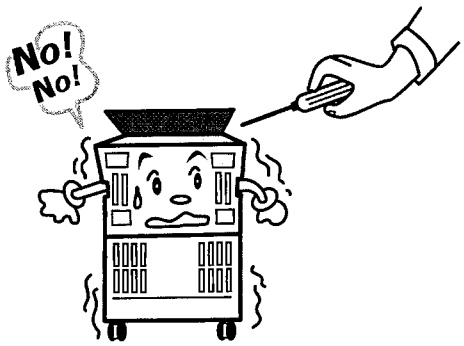
Damage during transport and storage

- If the P-STATION/EPO unit is found damaged by vibration or impact during transport or storage, safety protection functions may have been lost. Keep the unit as it is and immediately contact NF representatives.



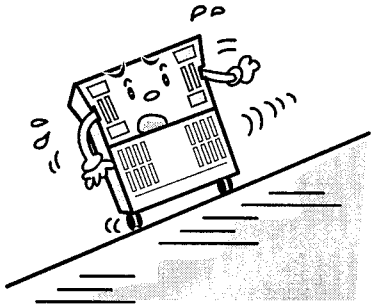
Do not remove the cover or modify the unit

- Never remove the cover. Do not attempt repair, inspection or adjustment of parts inside.
- Never attempt to modify parts inside. This may result in system failure or accidents.

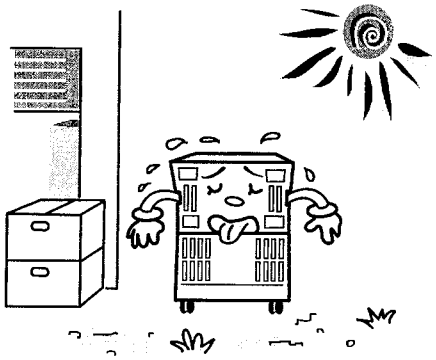


Install the unit in flat and rigid place

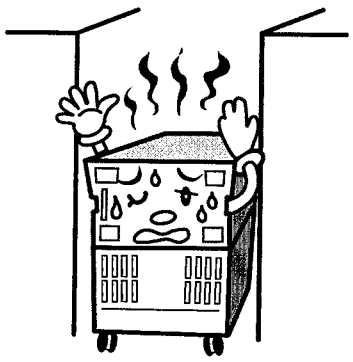
- For unit installation, select a flat and strong place free from tilting or vibration that can support easily the weight of the P-STATION/EPO unit (approximately 85 to 525 kg per unit).



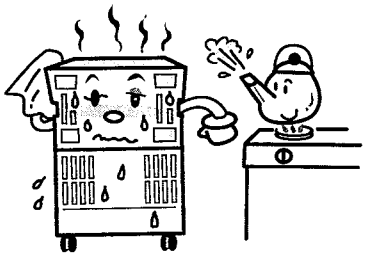
Never select any of the following places for installation



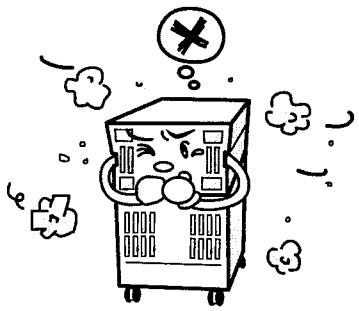
- Outdoor or sunny places



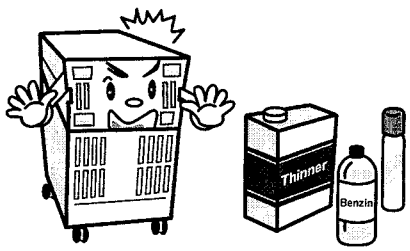
- Small places with poor ventilation



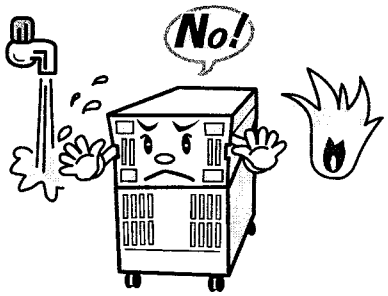
- Places subject to high humidity or condensation



- Dusty and dirty places



- Places exposed to corrosive, explosive or flammable gases

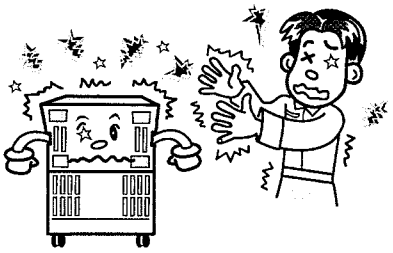


- Places exposed to fire or moisture

⚠ WARNING!

Avoid electric shock

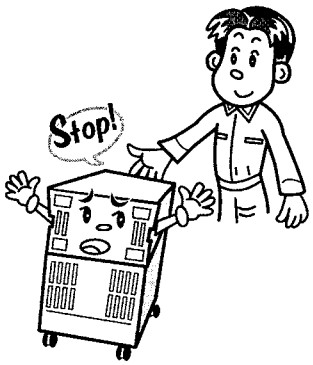
- Be sure to shut off the switch on the power switchboard before connecting the power supply cord.
- Turn off the power switch of the P-STATION/EPO unit before connecting output cables.
- Connect the protective grounding terminal of the P-STATION/EPO unit positively to the electric ground which ground resistance is less than 100Ω.
- Do not touch by hand the chassis that is not connected to a ground because a line filter is incorporated in the power input section.



- Securely tighten screws and positively plug connectors so that input and output cords and other cables will not be unplugged accidentally. Also pay attention to cord and cable placement to protect them from treading and jerking.

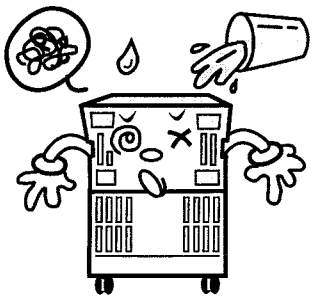
Be alert to burning

- Pay attention to prevent personnel from direct touch on the exhaust port of the P-STATION/EPO unit.



Be aware of electric shock and failure

- If condensation comes into notice, wait until the condensation disappears before connecting the power supply.
- Do not connect other wires other than the grounding wire to the protective grounding terminal.
- Never put foreign matters or liquids in the P-STATION/EPO unit.

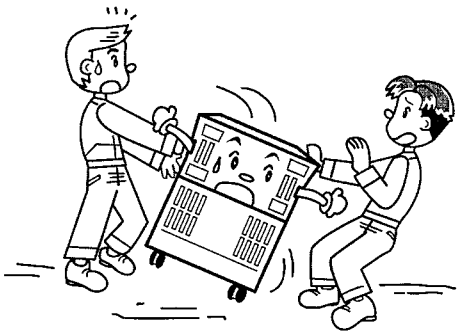


- Wiring in the input and output sections should be carried out elaborately so that the conductive part of the connection cord will not be exposed.

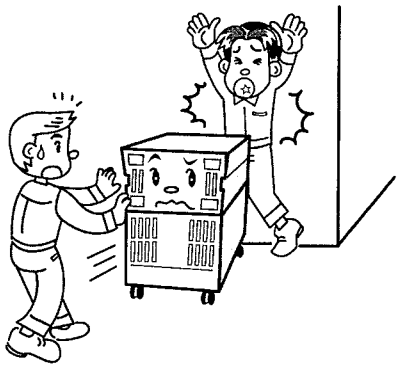
⚠ WARNING!

Be careful when moving the main unit

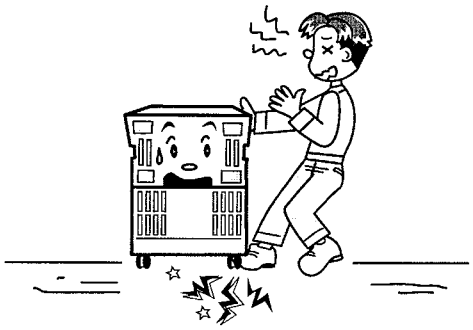
- The P-STATION/EPO unit can fall down during movement.



- During movement, be careful not to get caught between the P-STATION/EPO unit and a wall or door.



- During movement, your foot can be run over by casters and be injured.



Handle the P-STATION/EPO unit with extreme care.

Power supply cord

Option

- The power supply cord is one of the optional components.
  Use the supplied power supply cord for power input. If any other cprd is used for unavoidable reasons, select one that has electrical and mechanical properties equivalent to that.

⚠ CAUTION!

Instructions on use

- Use the product within the specified range of ambient temperature and humidity.

  For operation: 0 to 40 ℃, 10 to 90%RH

  For storage: -10 to 50 ℃, 10 to 90%RH

  For guarantee of performance:

  5 to 35 ℃, 50 ±10%RH

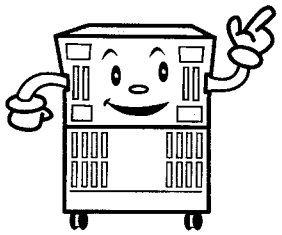
  (No condensation)

- Select a power supply to the P-STATION /EPO unit in the rated range (three-phase AC power supply of 48 to 62 Hz, 170 to 230 V).

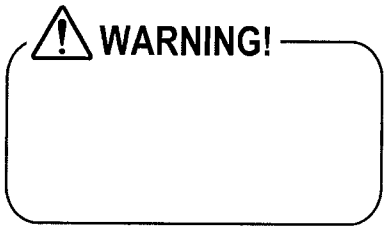
- In order to maintain proper forced air cooling, place the unit so that front and rear sections will be 50 cm or more away from walls for adequate ventilation.

- The P-STATION/EPO unit consumes electric power of about 5.6 to 50.4 kVA at the maximum. This means, the input current will be 30 to 173 A if the power supply voltage is 170 V. Therefore, select a power supply with sufficient capacity.

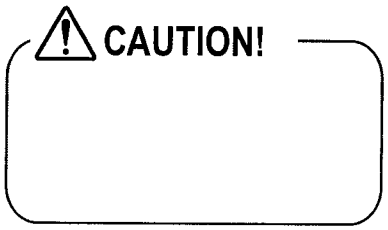
- The heat release value of the cabinet is approx. 1.6 to 14.4 kW (approx. 1380 to 12420 kcal/h). When P-STATION/EPO unit is installed in a small and enclosed room, an air conditioner is required



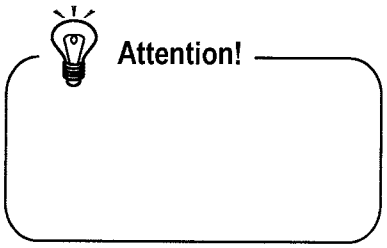
Safety and instructive expressions used in this manual



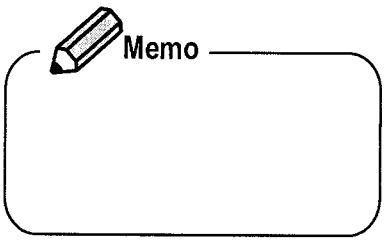
This note on the product or in the manual indicates information to avoid hazard which the life or body of the user is subject to during handling of equipment.



This note on the product or in the manual indicates information to avoid damage to the P-STATION/EPO unit.



An instruction on operations in which users are likely to do wrong things.



Introduction of a function useful in some future occasions.

Contents of Each Chapter

8 **GPIB Interface**

This chapter contains the description of the GPIB interface, intended for programmers and program users.

9 **RS-232 Interface**

This chapter contains the description of the RS-232 interface, intended for programmers and program users.

10 **Maintenance**

This chapter describes the backup battery and calibration.

11 **Troubleshooting**

This chapter describes the causes of possible troubles and the actions to take for those troubles.

12 **Rating**

13 **Terminology**

This chapter takes up some of the terms referred to in this manual and describes those terms in association with the features of the P-STATION/EPO unit and from the aspect of application.

Table Contents

4. Fundamental Use - for beginners -

5. Versatile Use - for advanced users -

6. Use of Multi-phase System

- use units in a three-phase or single-phase three-wire configuration -

9. RS-232 Interface

10. Maintenance

11. Solution of Trouble

1

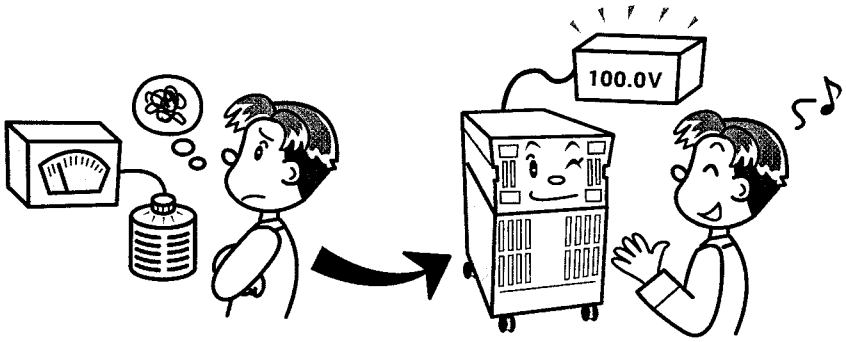
Introduction

Outline of P-STATION/EPO unit

Hi, there. My name is "High-efficiency System Power Supply, P-STATION/EPO". Oh, this may be too long for you. Then call me "Epo" in short. Before going to sections of detailed description, I will introduce some of my fortes.

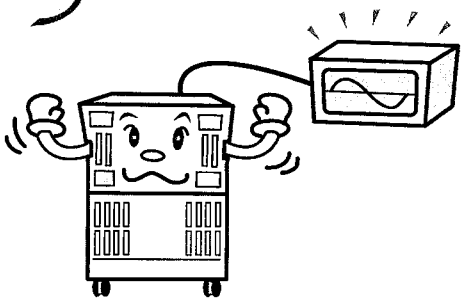
You do simple setting and I will supply high-accuracy voltage.

※ Just turn the dial to the desired spot, or use an external numeric keypad (optional) to enter your desired value. This easy setting enables me to provide output voltage of 0 to 300 V in AC or 0 to 424 V in DC with the frequency of 5 to 500 Hz as you desire.



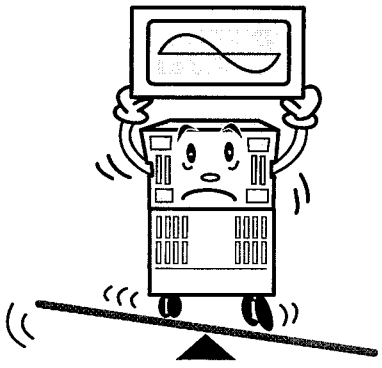
I supply clean and stable voltage.

※ Even if the load current fluctuates, I continue to supply a voltage that is mostly constant and free of distortion. Stability of output voltage versus fluctuation to load is 0.5% (typically) or less.



I strive to supply constant output even if the input power fluctuates severely.

※ I provide stable output even in an adverse power environment since the range of my tolerance to power supply voltage is so wide (170 V to 250 V) and I have a high tolerance ability against instantaneous power interruptions; namely, the maximum tolerance time is as long as 20 ms typically.



<Higher efficiency and less heating>

The efficiency is improved to the level of about 76% at the maximum. Internal loss at the rated output (2 kVA) is as low as 1/3 of the conventional products (NF's P-STATION/series [Q]), namely, about 600 W.

<I am small and light, needing only a limited space>

The P-STATION/EPO unit has been made smaller and lighter than the conventional products. Because the unit becomes lightweight, the installation floor area required has been drastically reduced to save space.

<I am ready to supply rush current>

I can provide a flow of 2.8 times the rated current (in RMS value) for a short time, and even four times at peak. Also can provide motor starting current without problem.

<I can show you the behavior of rush current>

Since setting of the AC voltage phase is available in the range of 0° to 270° in 90° increment, you can observe the behavior of the rush current flowing to the load while changing the conditions. In addition, my "peak hold" function allows you to observe the highest peak value of the current that flowed at that moment.

<I can provide not only AC output, but also DC>

Similarly to AC output, setting of voltage value (0 to 424 V) is simple. You can use DC output when testing a DC/DC converter or the like.

<Possible to use P-STATION/EPO unit as three-phase three-wire power supply>
* for multi-phase systems only

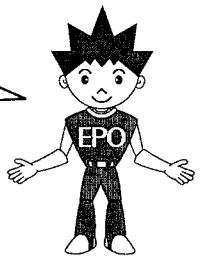
The single-phase, three-phase, and single-phase three-wire modes can be toggled so that one power supply system can be used in several ways.

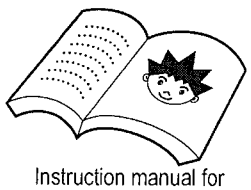
<I am provided with an interface for computer control>

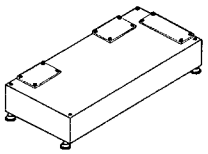
Two types are provided for standard: one is GPIB, a standard interface for instrumentation and the other is RS-232, commonly incorporated in personal computers.

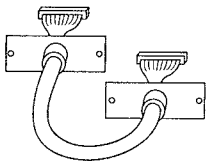
Check accessories in package first!

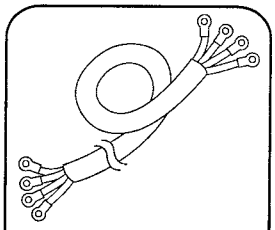
The P-STATION/EPO unit is thoroughly tested and inspected so that the unit operates correctly and then under that condition the unit is shipped. When a package of product reaches you, check for all items first. The package should contain the following accessories:

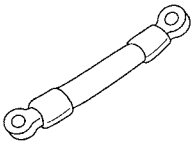



Instruction manual for "P-STATION/EPO" (this document)


Output box


Booster control cable


Power cord (Option)

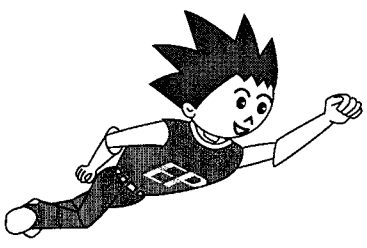

Output junction cable

Models \ Accessories	Instruction manual	Power cord (Option)	Output box	Output junction cable	Booster control cable
EPO 4000S	One	Vinyl insulated cable:One (VCT5.5mm2 4-core)	—	—	—
EPO 8000S		Vinyl insulated cable:One (VCT22mm2 4-core)			
EPO 10000S					
EPO 12000S					
EPO 6000M		Vinyl insulated cable:One (VCT5.5mm2 4-core)			
EPO 12000M		Vinyl insulated cable:One (VCT22mm2 4-core)			
EPO 18000M		Vinyl insulated cable:Three (VCT5.5mm2 4-core)	One	Single-core cable: 15 pcs	2 pcs
EPO 24000M		Vinyl insulated cable:Two (VCT22mm2 4-core)	One	Single-core cable: 10 pcs	1 pcs
EPO 36000M		Vinyl insulated cable:Three (VCT22mm2 4-core)	One	Single-core cable: 15 pcs	2 pcs

If any of the above is missing, contact NF representatives.

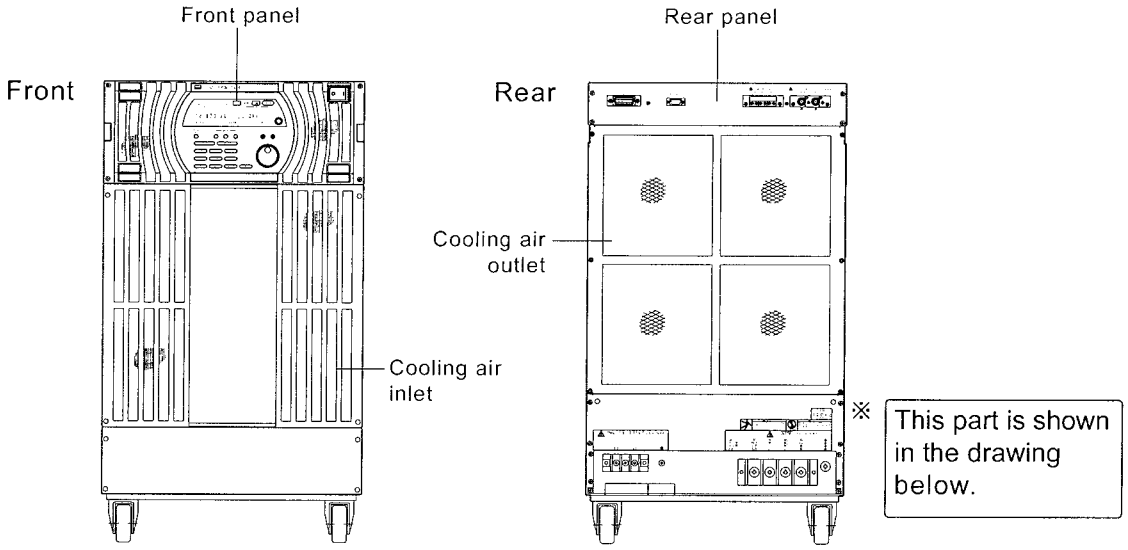
2

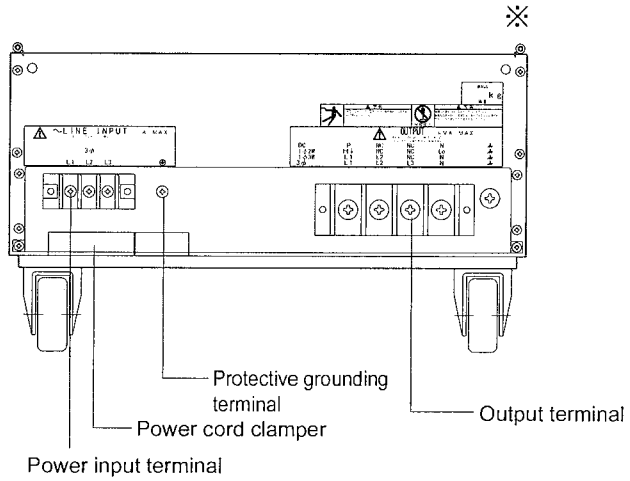
Name of Parts



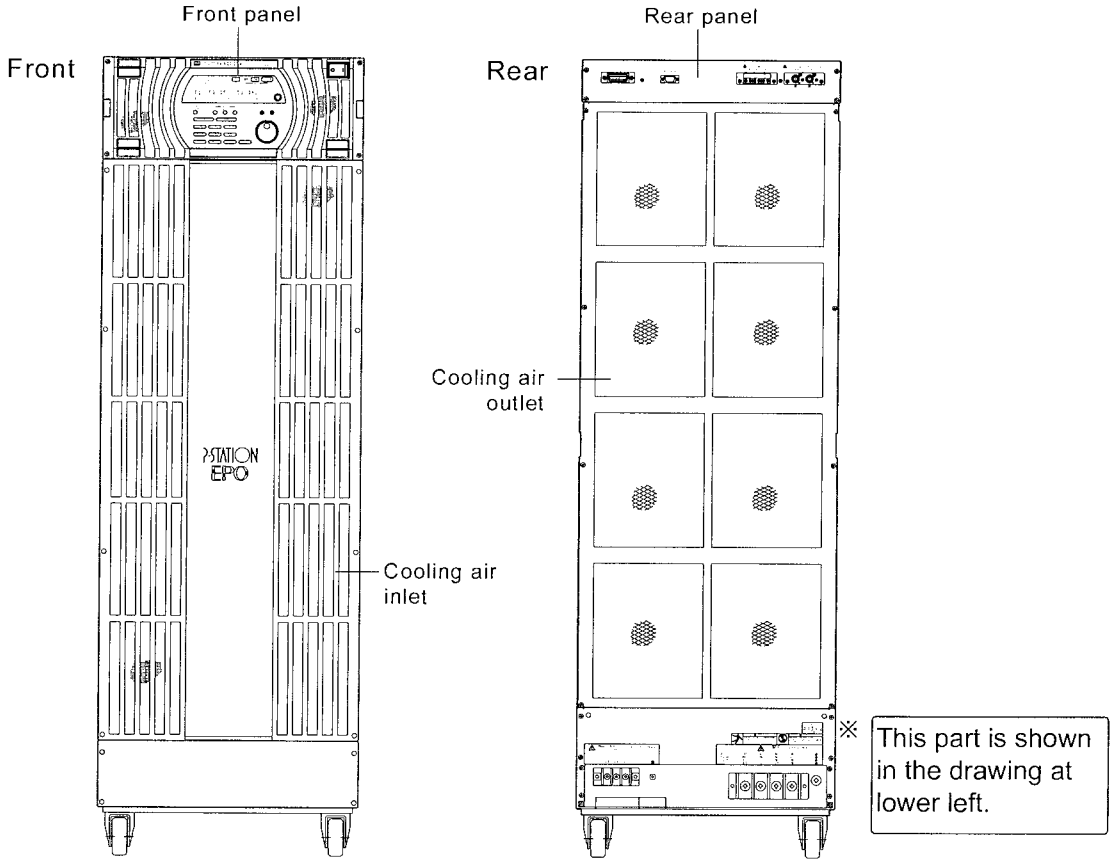
Single phase system

EPO 4000S



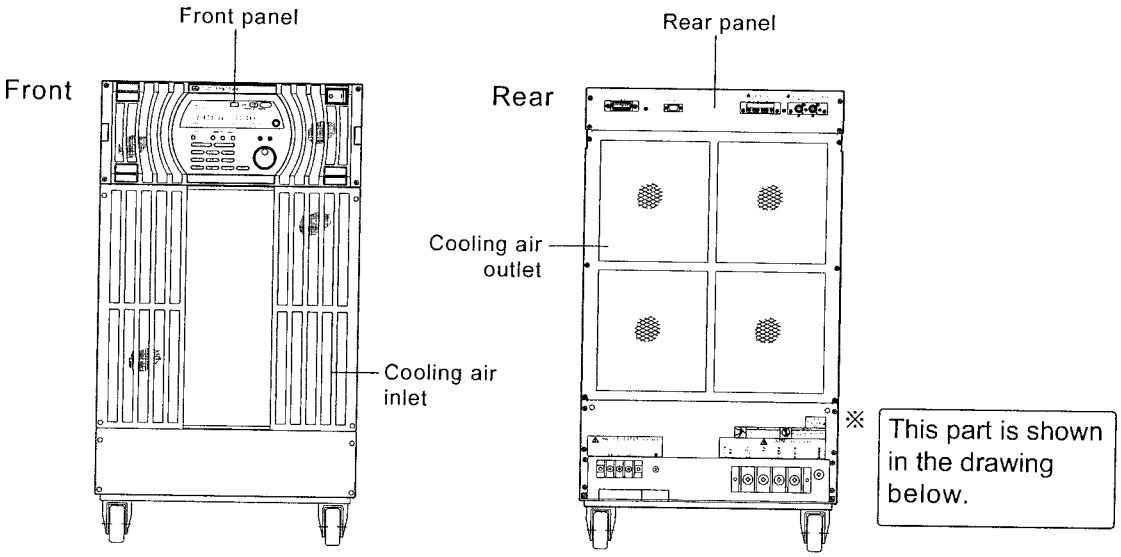


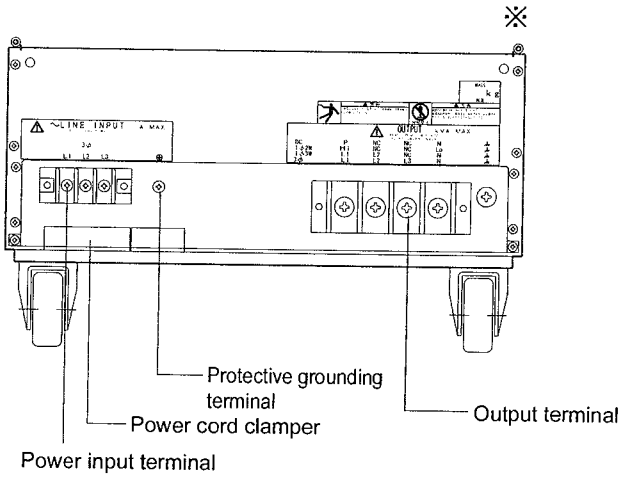
EPO 8000S, EPO 10000S, EPO 12000S



Multi phase system

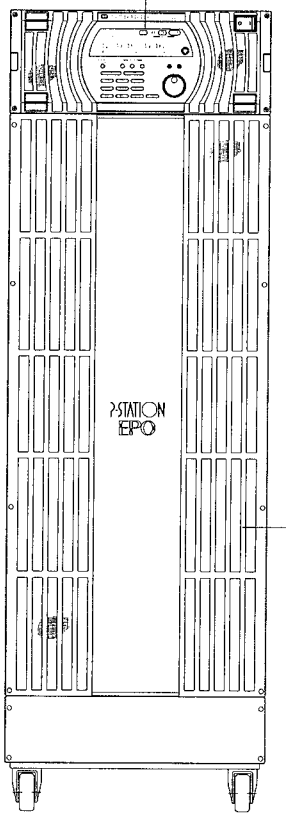
EPO 6000M



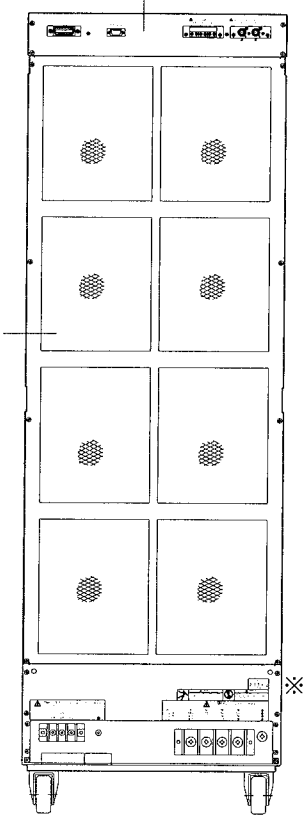


EPO 12000M

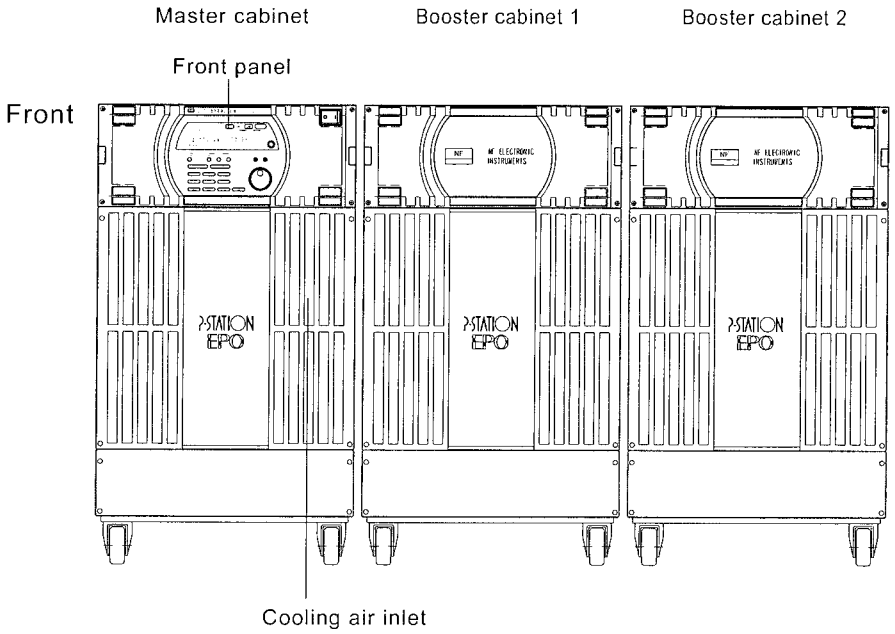
Front



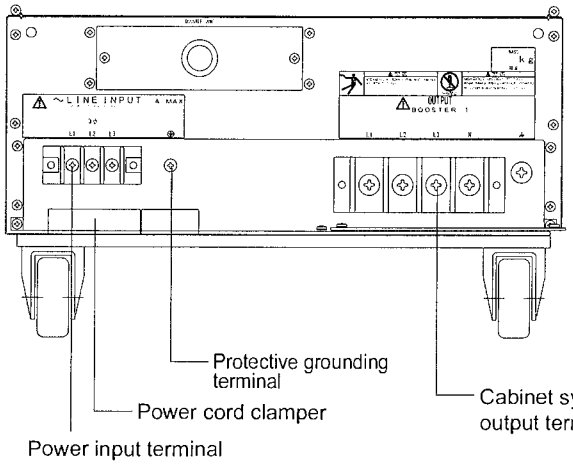
Rear



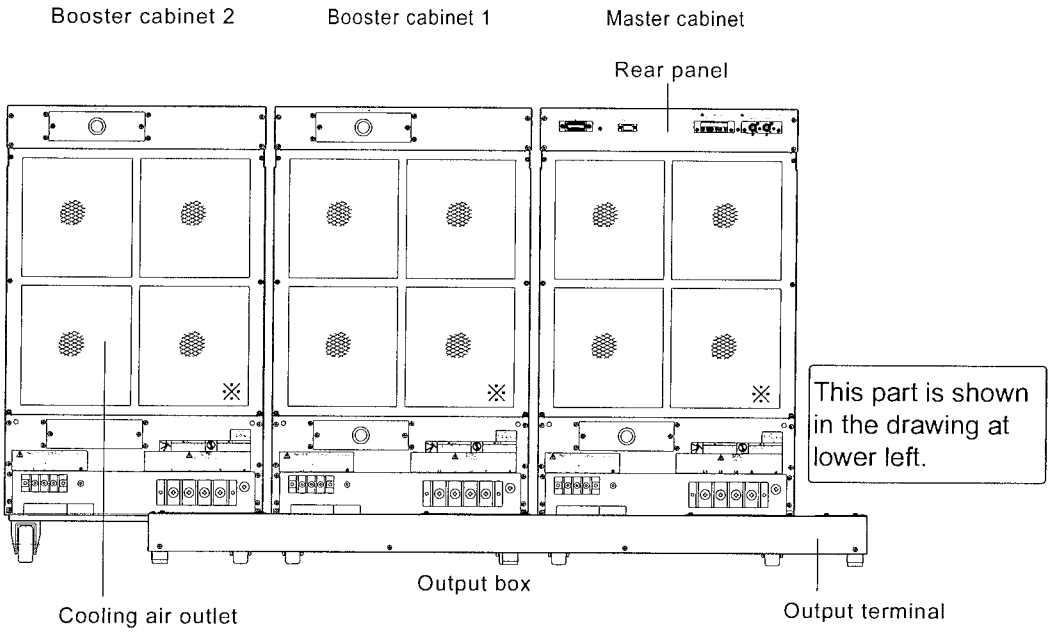
※ This part is shown in the drawing at lower left.


Master cabinet
Booster cabinet 1
Booster cabinet 2
Front panel
Front
Cooling air inlet

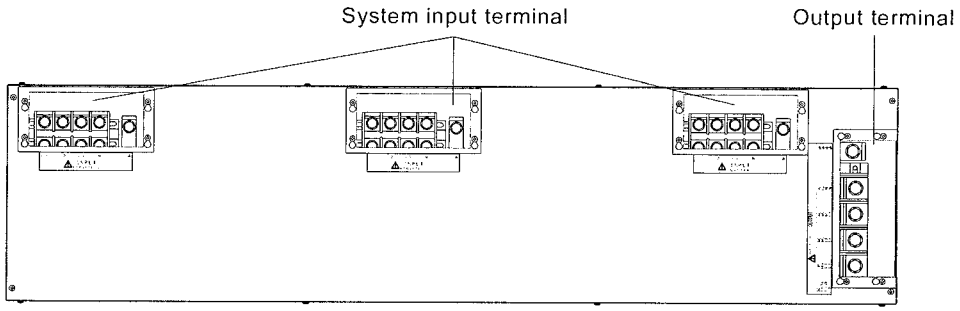
※


Protective grounding terminal
Power cord clamper
Power input terminal
Cabinet system output terminal

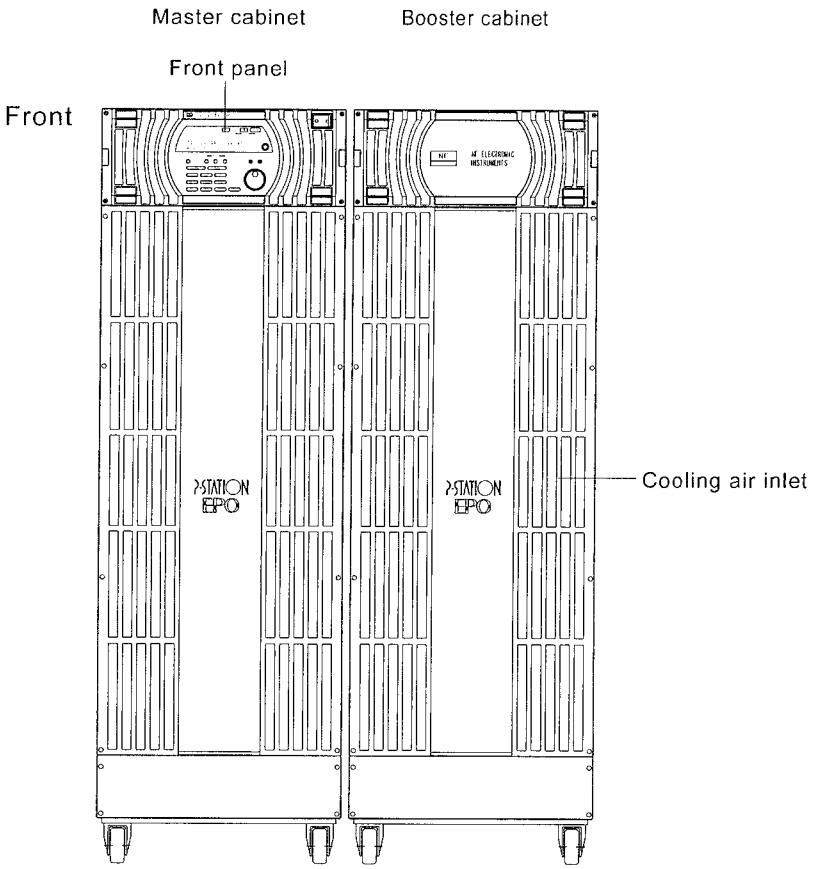
Rear



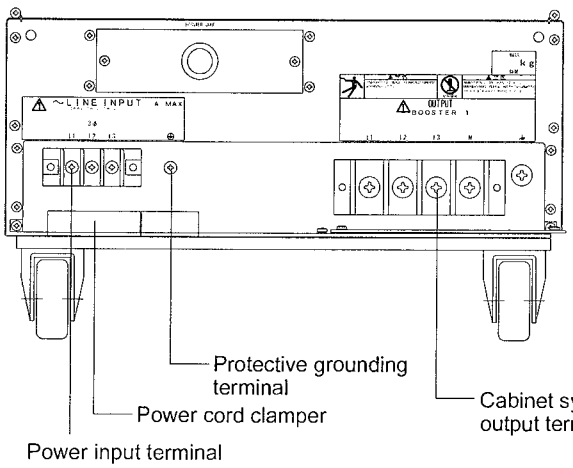
Top of the output box

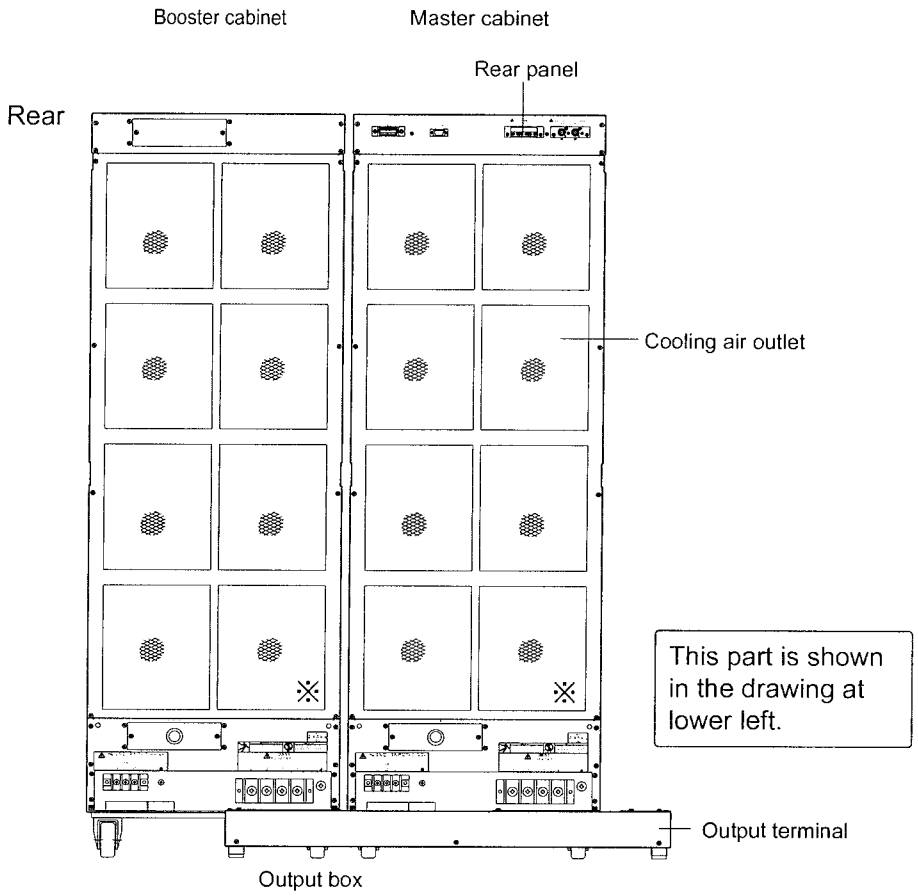


EPO 24000M

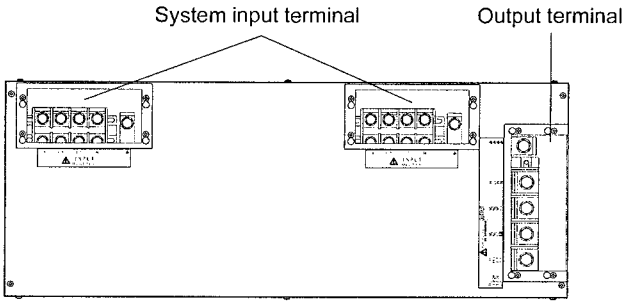

Master cabinet
Booster cabinet
Front panel
Front
Cooling air inlet

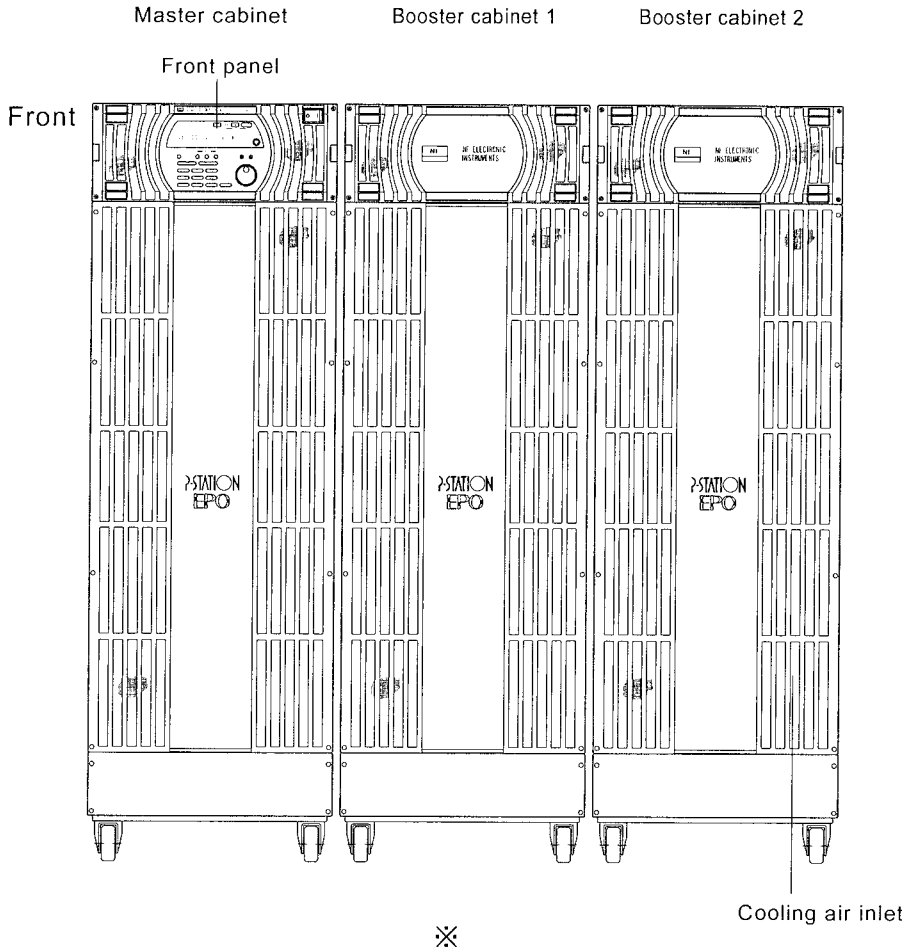
※


Protective grounding terminal
Power cord clamper
Cabinet system output terminal
Power input terminal

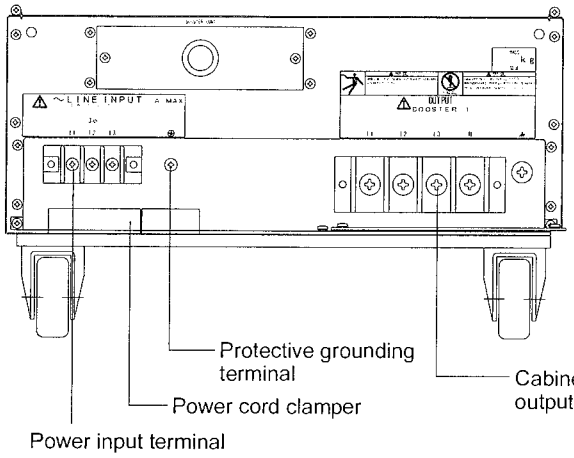


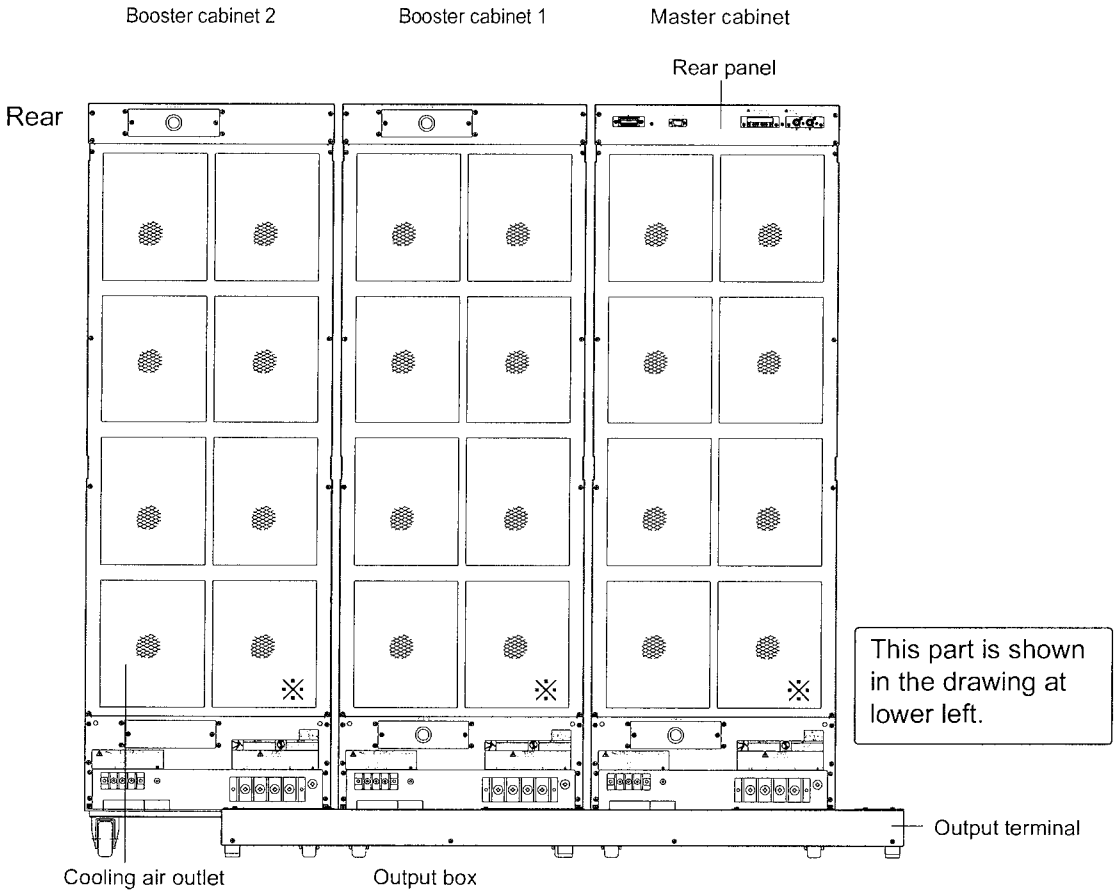
Top of the output box



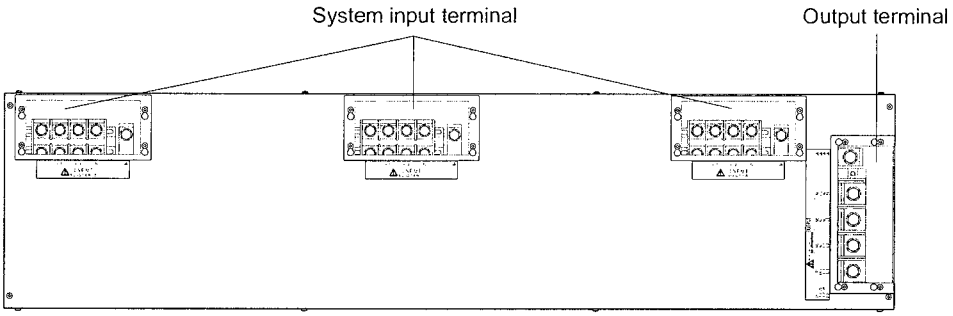

Master cabinet
Booster cabinet 1
Booster cabinet 2
Front panel
Front
Cooling air inlet

※


Protective grounding terminal
Power cord clamper
Power input terminal
Cabinet system output terminal

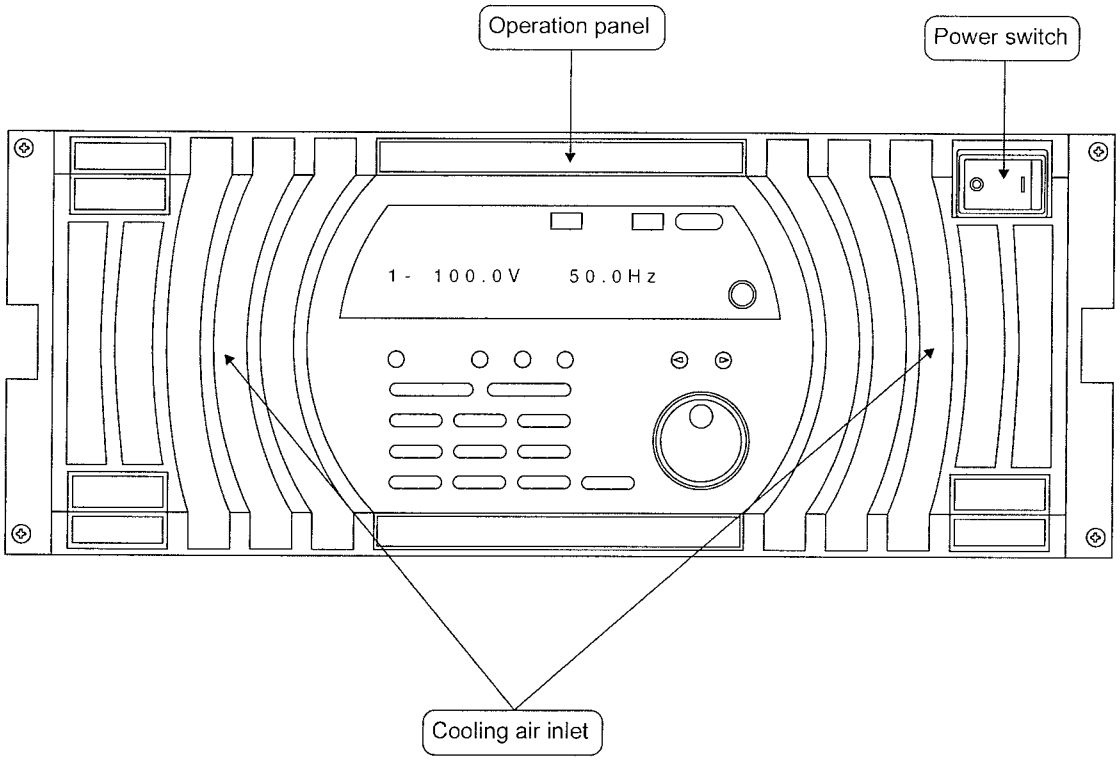


Top of the output box

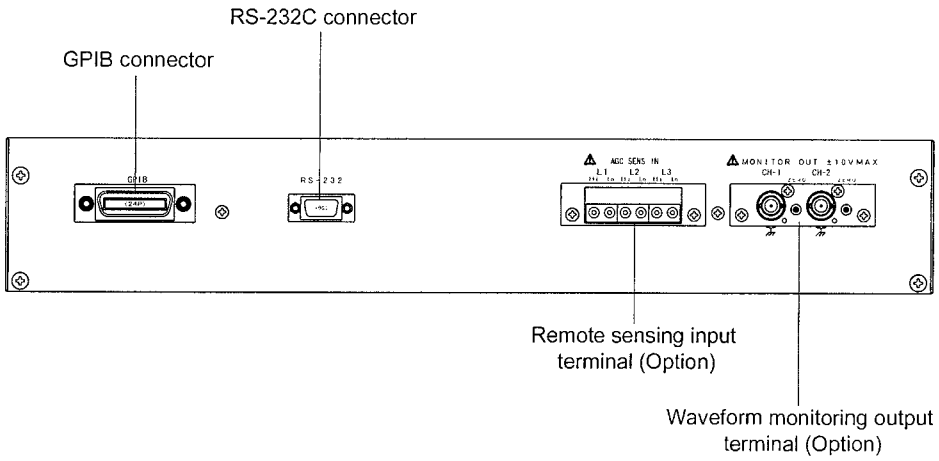


Panel detail

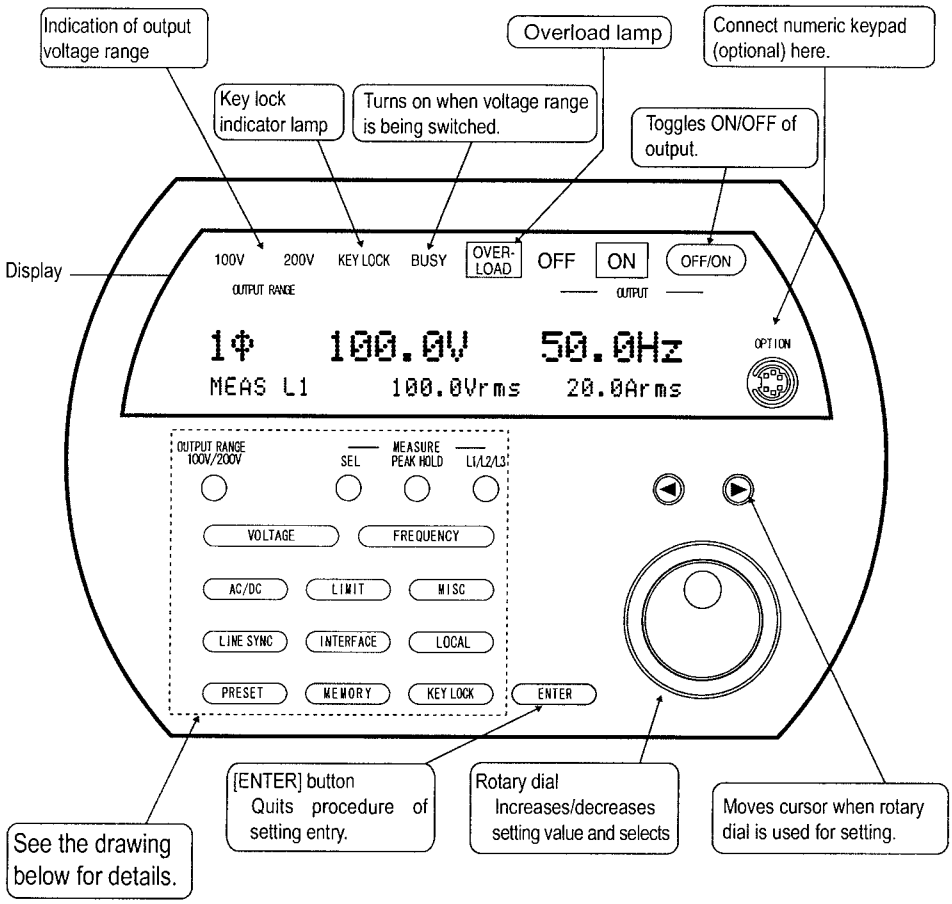
Front panel

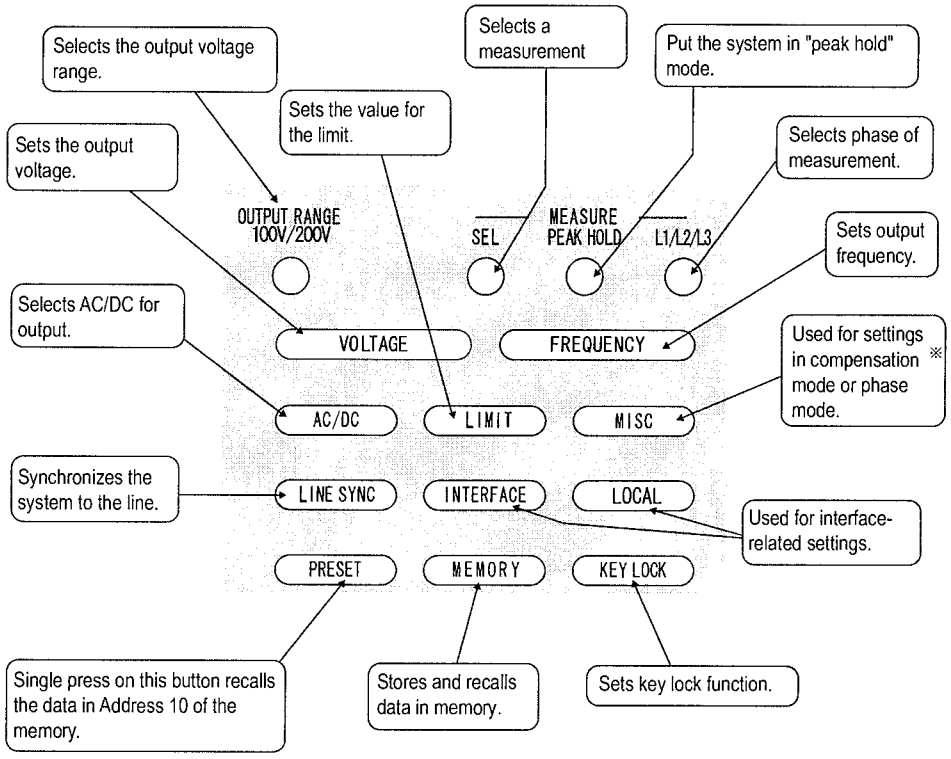


Rear panel



Operation panel

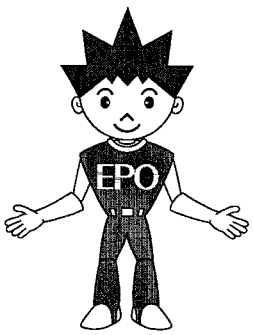




※: ☞ Refer to "11. Troubleshooting"

3

Installation and Connection



Moving P-STATION/EPO unit

⚠ WARNING!

Check the weight of the P-STATION/EPO unit beforehand because it is a heavy unit. Take extreme care when moving the unit.

When moving P-STATION/EPO unit

- The cabinet is equipped with casters so that you can move the P-STATION/EPO unit by pushing it on a flat floor.
- You cannot push the unit, going over steps.
- The front casters are free-wheel type and the rear casters are fixed type.

When lifting P-STATION/EPO unit

- On an uneven floor, you have to lift the unit when moving it.
- Use a lift or a crane.

  When using a crane, contact NF representatives.

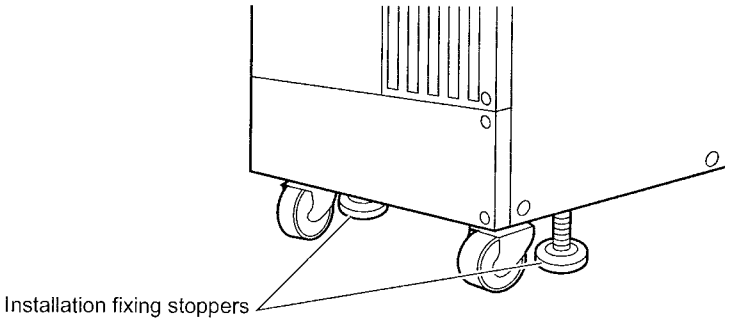
  When a lift or crane is used, a qualified operator of the relevant equipment must operate it.

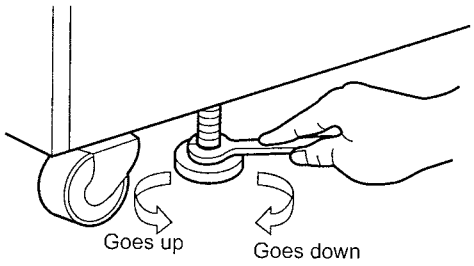
When transporting P-STATION/EPO unit

- Pack the unit in a wooden frame case.
- Do not lay the unit sideways and do not turn it over.

When relocating P-STATION/EPO unit after installation

- Disconnect all the connected wires.
- Lift the installation fixing stoppers from the floor face. Stoppers are attached to two places in the front bottom of the cabinet, one for each place.





- The stopper goes up when it is turned to the left (counterclockwise) (when viewed from above), and goes down when it is turned to the right (clockwise). Using a tool such as a spanner (bore diameter: 19 mm), lift the unit to the fullest.

⚠ WARNING!

The input terminal is energized even when the P-STATION/EPO unit power supply switch is turned off.
Be sure to shut off power from the power switchboard before disconnecting wires.

⚠ WARNING!

When moving the P-STATION/EPO unit, be sure to lift the installation fixing stoppers to the fullest.

Installation location

Install the unit in a wide area with allowance

- Because forced air-cooling by fan is used, install the unit to keep the front and rear sections of the unit more than 50 cm away from the wall for adequate ventilation.
- Install the unit so that a flow of air around the cooling air inlet and outlet will not be obstructed.
- Hot air comes out from the cooling air outlet. Do not put something sensitive to heat there.
- If the unit is installed in a small and enclosed room, an air conditioner is required because the cabinet generates heat. The heat release value of the cabinet for each system is as follows:

System	Heat release value (at rated output)	
EPO 4000S	approx. 1.6kW	approx. 1380kcal/h
EPO 8000S	approx. 3.2kW	approx. 2760kcal/h
EPO 10000S	approx. 4.0kW	approx. 3450kcal/h
EPO 12000S/12000M	approx. 4.8kW	approx. 4140kcal/h
EPO 6000M	approx. 2.4kW	approx. 2070kcal/h
EPO 18000M	approx. 7.2kW	approx. 6210kcal/h
EPO 24000M	approx. 9.6kW	approx. 8280kcal/h
EPO 36000M	approx. 14.4kW	approx. 12420kcal/h

Install P-STATION/PRO in a place where the weight of the unit

- Install the unit on a solid floor. The mass of the cabinet of each system is as follows:

System	Mass
EPO 4000S	approx. 85kg
EPO 8000S	approx. 140kg
EPO 10000S	approx. 160kg
EPO 12000S/12000M	approx. 175kg
EPO 6000M	approx. 100kg
EPO 18000M	approx. 300kg
EPO 24000M	approx. 350kg
EPO 36000M	approx. 525kg

Install P-STATION/PRO on a level ground

- Install the unit in a place where the ground is not sloped and without vibration.

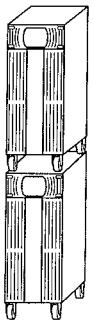
How to install the unit

Installation of cabinet

- Do not lay the cabinet sideways nor turn it over.
- When installing two or more cabinets, do not stack them and do not place them back and forth. Place them side by side, instead

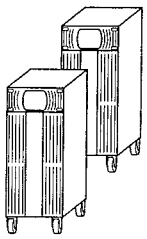
Stacking cabinets

- Because the gravity point becomes higher, the cabinets can easily fall down.
- The cabinet is not designed to support heavy objects.



Placing cabinets back and forth

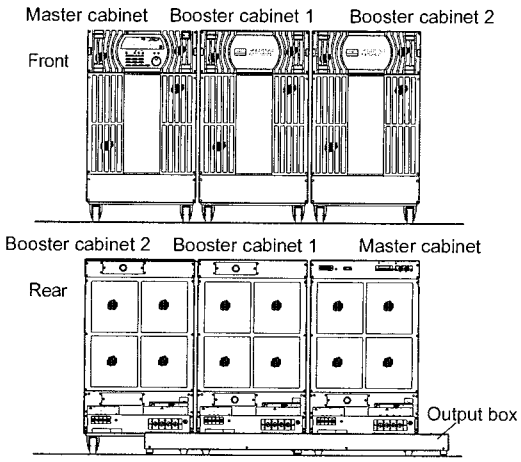
- The product placed behind overheats from exhaust heat, resulting in a short product life.



Cabinet installation order for EPO 18000M/24000M/35000M

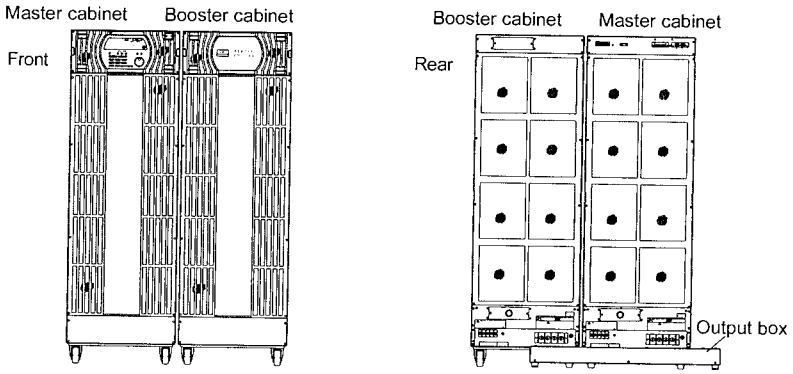
- The master cabinet and booster cabinets must be placed in the determined sequence.Place the master cabinet on the left side (viewed from the front). Place the booster cabinet to the immediately right of the master cabinet. Place the output box behind the cabinet on the floor.

Installation of EPO 18000M/36000M



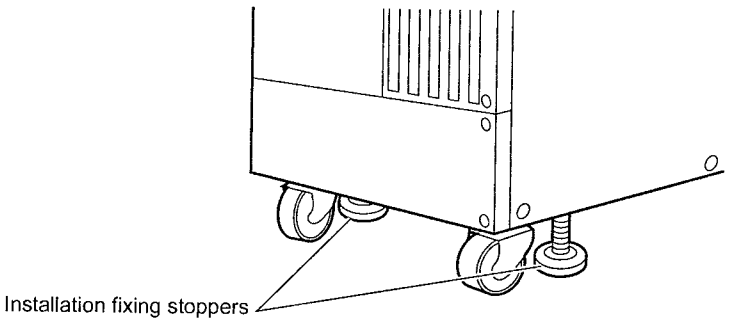
- Cabinets can also be installed, with the left and right in reversed direction. However, performance such as fluctuation to load goes down slightly.

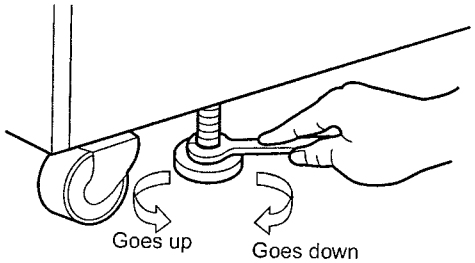
Installation of EPO24000M



Fix the cabinet with stoppers

●Lowers the installation fixing stoppers to the floor ground. Stoppers are provided at two places in the front bottom of the cabinet, one at each place. After installation, be sure to fix the cabinet securely using these stoppers.





●The stopper goes up when it is turned to the left (counterclockwise) (when viewed from above), and goes down when it is turned to the right (clockwise). Using a tool such as a spanner (bore diameter: 19 mm), lift the unit to the fullest.

Selection of power supply environment

To ensure safety, use the product in a power supply environment that meets the following conditions:

- Three-phase 200 V system power input, three-phase three-wire
- Rating range (three-phase line-to-line voltage: 170 V to 230 V rms, 48 to 62 Hz)
- Power switchboard capacity

System	Power switchboard capacity (when power supply voltage is 170 V rms)
EPO 4000S	30A
EPO 8000S	44A
EPO 10000S	58A
EPO 12000S/12000M	58A
EPO 6000M	30A
EPO 18000M	89A
EPO 24000M	116A
EPO 36000M	173A

MEMO

Considering power supply voltage drop, use a power switchboard that can supply electrical requirements at three-phase 170 V input.

Grounding

Be sure to connect the protective grounding terminal  positively to the electric ground which ground resistance is less than 100Ω to avoid risk of electric shock.

⚠ WARNING!

Electric shock will be caused if you touch the chassis that is not connected to the ground because a line filter is used in the power input section.

Be sure to connect the protective grounding terminal before plug in the power cord.

Connection to power input and output terminals(EPO 4000S/8000S/10000S/12000S/6000M/12000M)

Connection to power input terminal

⚠ WARNING!

Be sure to shut off the power supply on the power switchboard before connection in order to avoid risk of electric shock.

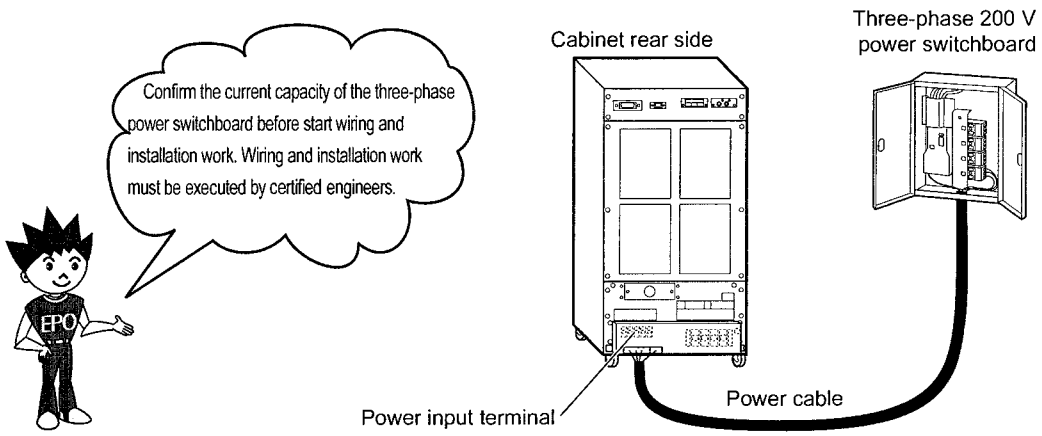
Information on power input terminal

- Terminal screw diameter: M5
- Maximum wire diameter: 22 mm^2
- Solderless ring tongue terminals: wire size 22 mm^2, stud size M5 (width 12mm)
- Phillips screws
- To tighten screws, use a Phillips screwdriver suited for the M5 screw size.
- Tightening torque: 2.35N・m (24 kgf・cm)

Power input cable

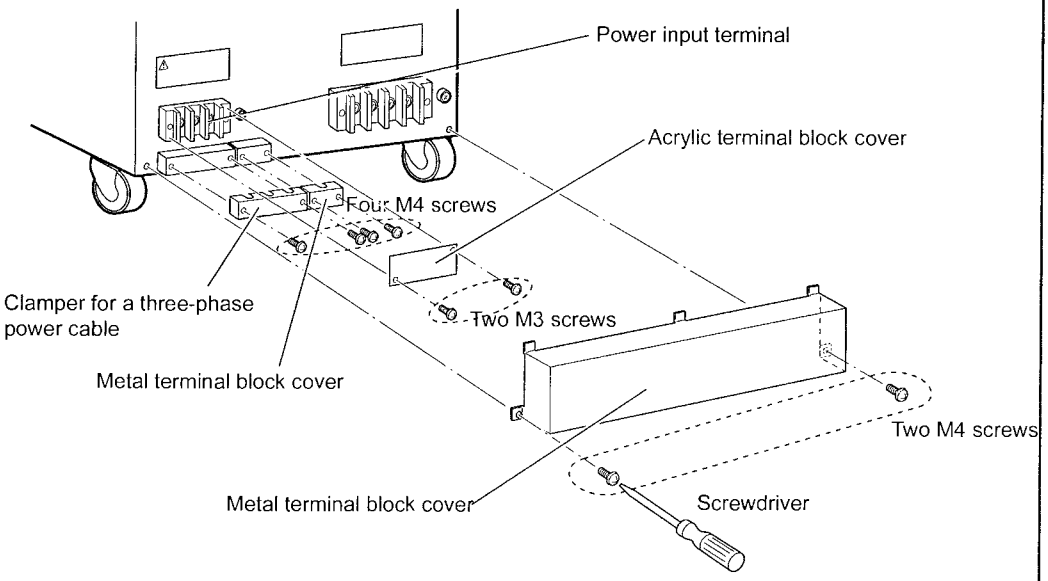
- Power input cable is optional.
  Power input cable: 5.5 mm^2, 5 m (for EPO 4000S/6000M)
  Power input cable: 22 mm^2, 5 m (for EPO 8000S/10000S/12000S/12000M)
- Power switchboard side of the optional power input cable is unprocessed. Connect the power input cable securely using crimped terminals that suit for the power switchboard terminal screws.
- When using a power input cable other than the optional cable specification, use a cable sufficiently large considering electrical requirements. For protective grounding cable, use a cable having the same diameter as the power input cable.

Connection to the power input terminal



Connection procedure

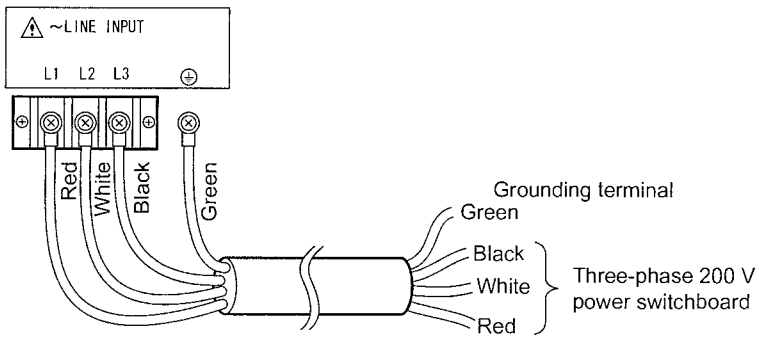
① Remove the terminal block covers and cable clampers from the rear bottom of the cabinet.



Two types of terminal block covers are used, an acrylic cover attached to the terminal block and a metal cover that covers the input/output terminal block.

Two types of cable clampers are used. One is used for a three-phase power cable and the other is used for a protective grounding cable.

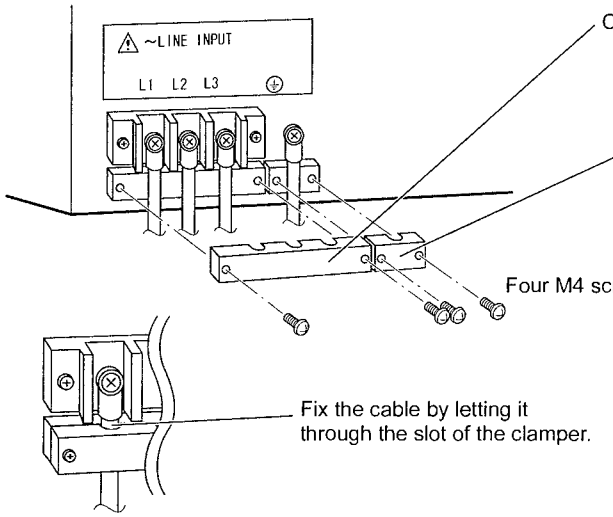
② Connect the power cable.



Power cable (optional) cabtier cable, four-core

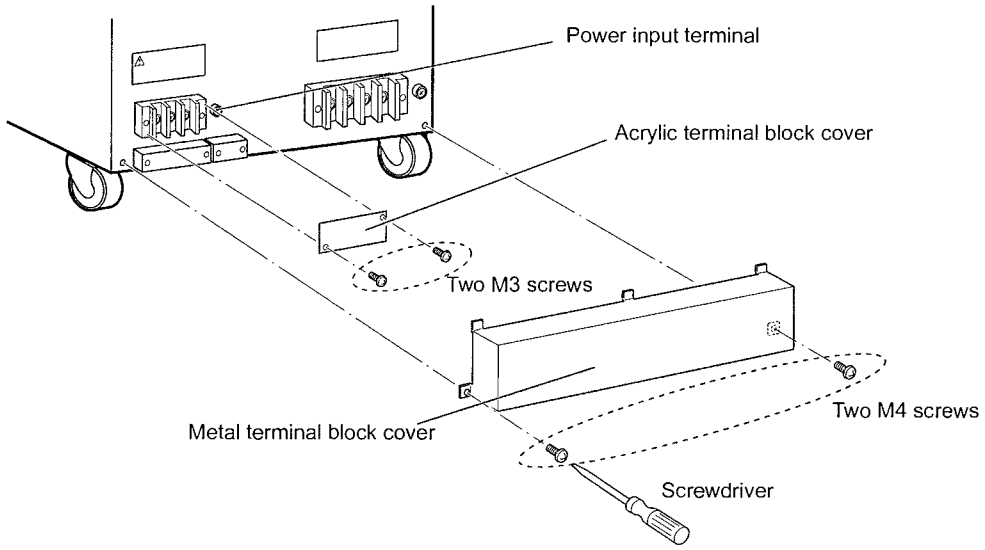
The screws of the terminal block must be tightened securely.

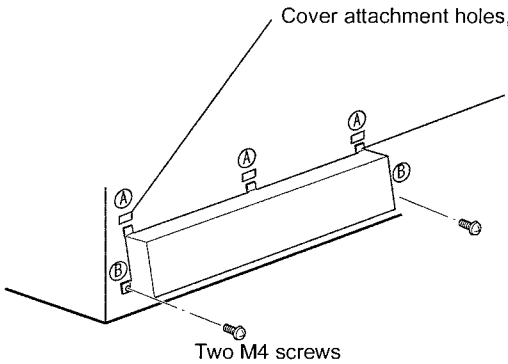
3 Attach the cable clampers.



Attach the clamper securely and confirm that the cable is fixed with the clamper.

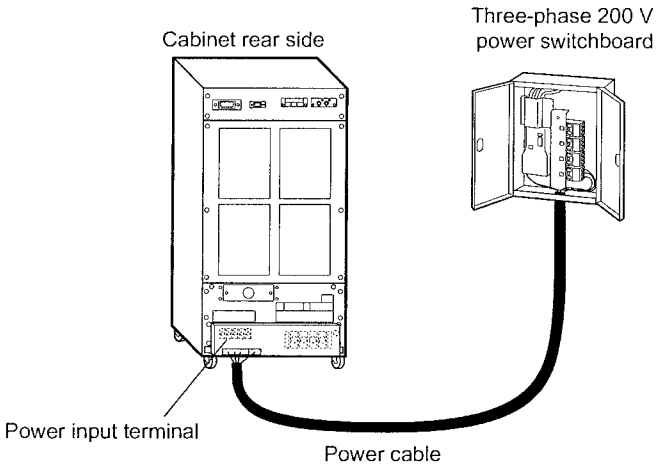
4 Attach the terminal block covers.





Insert the prongs of the cover into the cover attachment holes Ⓐ and fix the cover with screws at Ⓑ.

⑤ Connect the power cable to the three-phase 200 V power switchboard.



☞ Power switchboard capacity ⇒¨ See "Power Supply Environment."

Connection to output terminal

⚠ WARNING!

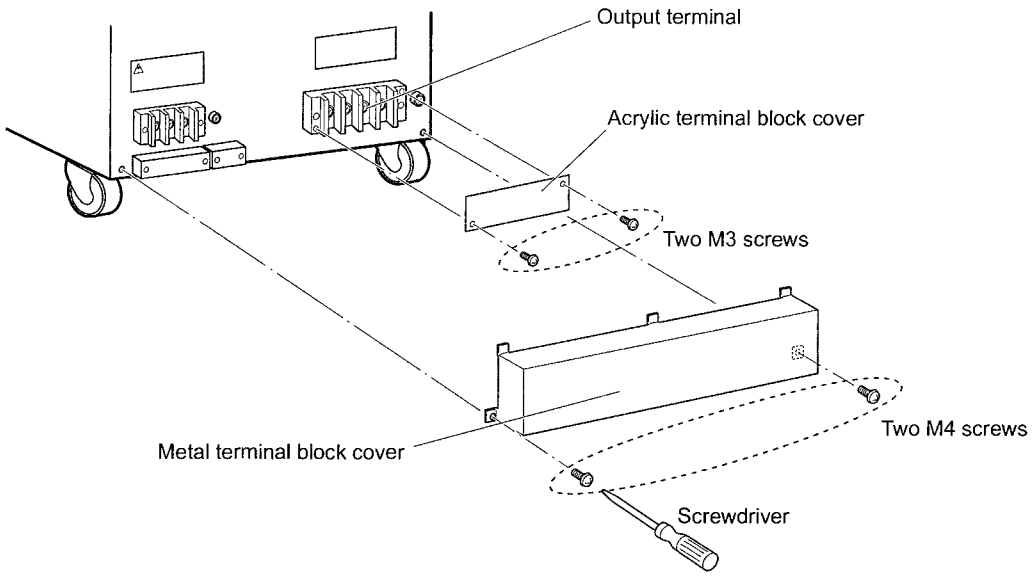
Turn off the power to the P-STATION/EPO unit before safe connection of output.

Information on output terminal of cabinet

- Terminal screw diameter: M8
- Maximum wire diameter: 60 mm^2
- Solderless ring tongue terminals: wire size 60 mm^2, stud size M8
- Hexagon bolts
- To tighten screws, use a socket wrench suited for the 13 mm size.
- Tightening torque: 6.47N・m (66 kgf・cm)

Connection of load

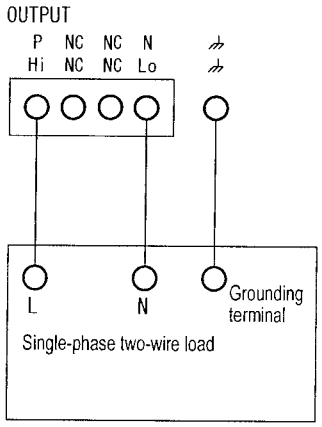
① Remove the terminal block covers.



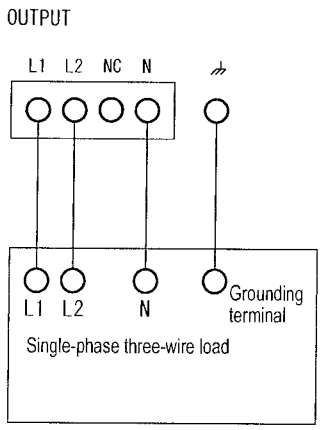
Two types of terminal block covers are used, an acrylic cover attached to the terminal block and a metal cover that covers the input/output terminal block.

② Connect the target load.

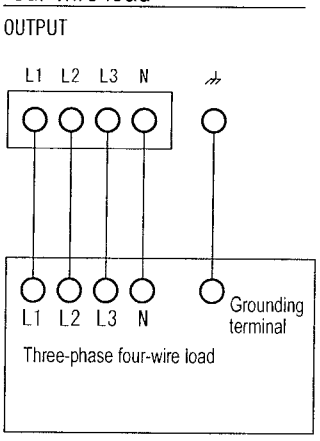
In the case of a single-phase two-wire load



In the case of a single-phase three-wire load



In the case of three-phase four-wire load



* In the case of a three-phase three-wire load, N(neutral line) is not required.

Check the power input type of the load and connect the power cable of the load to the output terminal of the cabinet.

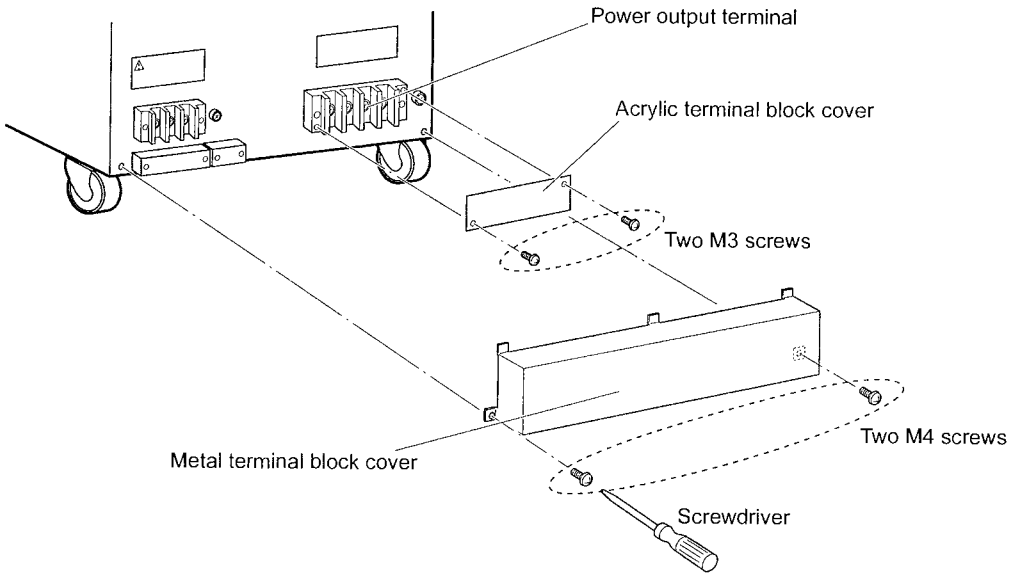
EPO 4000S/8000S/10000S/12000S are single-phase systems. They output single-phase two-wire output.

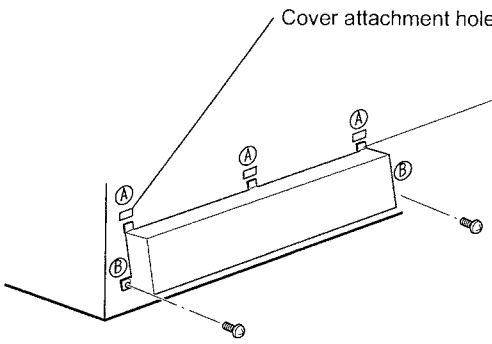
EPO 6000M/12000M are multi-phase systems. They can output in four modes: single-phase two-wire, single-phase three-wire, three-phase three-wire or three-phase four-wire output mode.

NC terminals determined from the type of output must be left open.

When the load has a grounding terminal ⏚, connect it to the grounding terminal.

3 Attach the terminal block covers.





Insert the prongs of the cover into the cover attachment holes Ⓐ and fix the cover with screws at Ⓑ.

Memo

- The output is insulated from the power input and chassis. When using as a one-wire grounding system, the Lo terminal (for single-phase one-wire) or N terminal (for single-phase and three-phase) can be connected to the grounding terminal.

⚠ CAUTION!

- Output one-wire grounding must be connected to the Lo terminal or N terminal. Hi terminal and L side terminal cannot be used for this purpose.
- Do not connect anything to the NC terminal.

⚠ WARNING!

- If one-wire is not grounded (when used as balanced output), voltage is generated between the chassis and the output terminal even if the output is off because an output noise filter is used. Be sure to turn off the system power supply before connecting the output terminal.
- Be sure to attach the terminal block cover after connecting the cable,

Select a proper output cable, considering the output current. You should consider the cable rating, temperature rise, and others.

The P-STATION/EPO unit internal circuit controls the output terminal voltage so that it will be kept constant. Therefore, the load regulation at the end of the load is affected by the wiring impedance to the load. High impedance causes poor load regulation.

Do not use an unnecessary long cable between the output terminal and the load. Use a cable with a large cross-sectional area.

See the table below and the materials provided on the next page.

* Calculated with ambient temperature at 30℃ and a VCT cable.
* See the values enclosed in ( ) for voltage drop. This value is a voltage drop per 1 m of cable (cable length to the load is 2 m when including a return cable).

System	Single-phase	Single-phase three-wire output	Three-phase output
EPO 4000S	5.5mm²(0.26V)	—	—
EPO 8000S	22mm²(0.13V)	—	—
EPO 10000S	38mm²(0.094V)	—	—
EPO 12000S	38mm²(0.12V)	—	—
EPO 6000M	14mm²(0.16V)	3.5mm²(0.10V)	3.5mm²(0.16V)
EPO 12000M	38mm²(0.12V)	14mm²(0.077V)	8mm²(0.14V)

Memo

Select a proper cable referring to the table below that shows the relationship between cables and allowable current.

Allowable current for two-core vinyl cabtire cable

* For VCT cables as per JIS C 3312

(At ambient temperature of 30°C or below)

Nominal cross section [mm²]	Allowable current [A]
2	22
3.5	32
5.5	42
8	51
14	71
22	95
38	130

(At ambient temperature higher than 30°C)

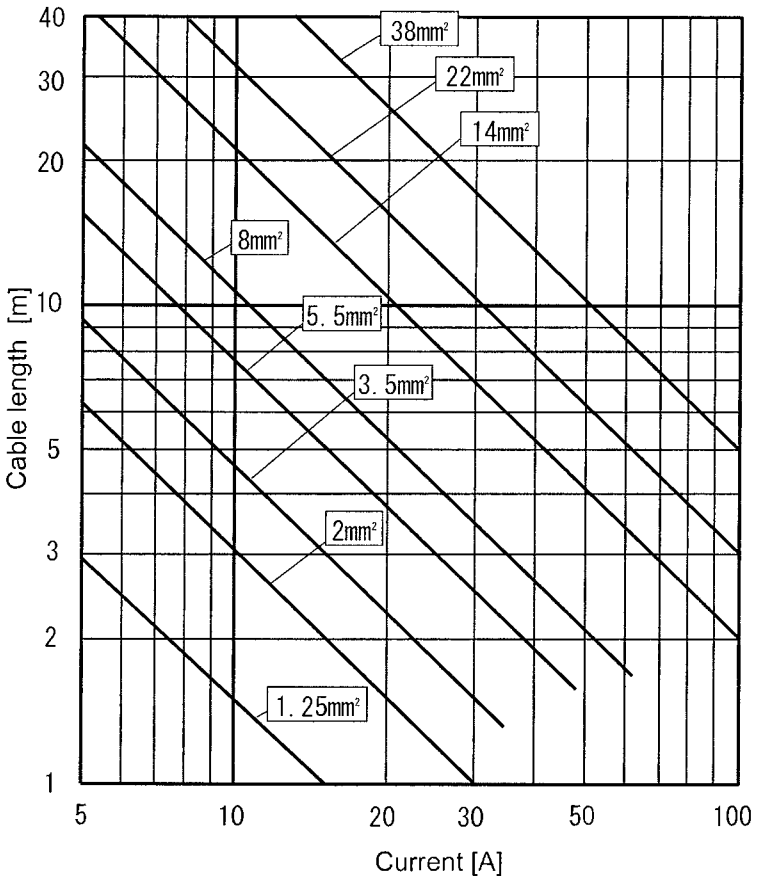
* Multiply the allowable current value shown in the left table with the reduction factor in the table below

Ambient temperature [°C]	Reduction factor to allowable current
30	1.00
35	0.91
40	0.82
45	0.71
50	0.58

* From JEAC 8001-1986

Relationship between cable length and voltage drop (JIS C 3307 IV cable)

* Use of too long cable causes a voltage drop due to the excessive cable resistance.



* The diagonal lines indicate the cable length at which voltage drop is 0.5 V due to wiring resistance.

* Values in the rectangle indicate the cross section of the ▭

P-STATION/EPO

Connection to power input and output terminals (EPO 18000M/24000M/36000M)

Connection to power input terminal

⚠ WARNING!

Be sure to shut off the power supply on the power switchboard before connection in order to avoid risk of electric shock.

Information on power input terminal

- Terminal screw diameter: M5
- Maximum wire diameter: 22 mm^2
- Solderless ring tongue terminals: wire size 22 mm^2, stud size M5 (width 12mm)
- Phillips screws
- To tighten screws, use a Phillips screwdriver suited for the M5 screw size.
- Tightening torque: 2.35N · m (24 kgf · cm)

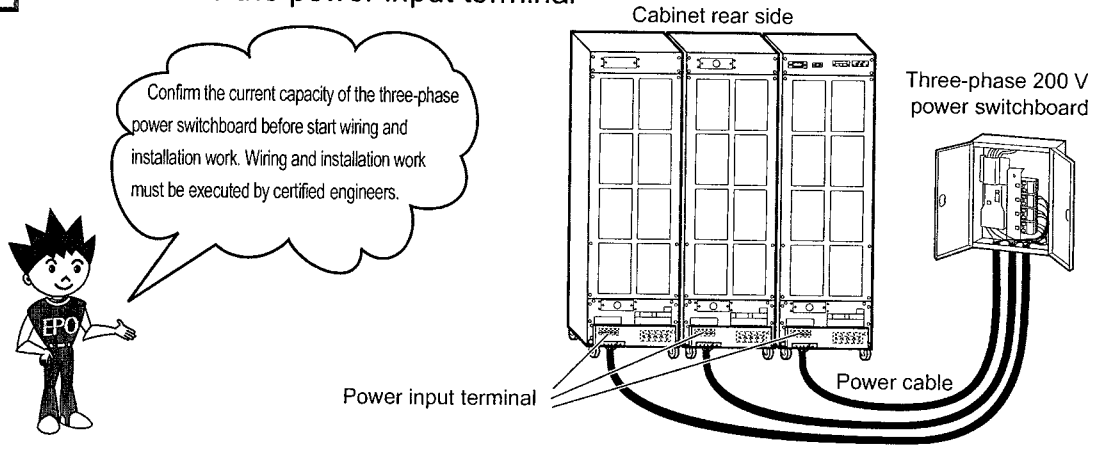
Power input cable

- Power input cable is optional.

  Power input cable: 5.5 mm^2, 5 m Three (for EPO 18000M)
  Power input cable: 22 mm^2, 5 m Two (for EPO 24000M)
  Power input cable: 22 mm^2, 5 m Three (for EPO 36000M)

- Power switchboard side of the optional power input cable is unprocessed. Connect the power input cable securely using crimped terminals that suit for the power switchboard terminal screws.
- When using a power input cable other than the optional cable specification, use a cable sufficiently large considering electrical requirements. For protective grounding cable, use a cable having the same diameter as the power input cable.

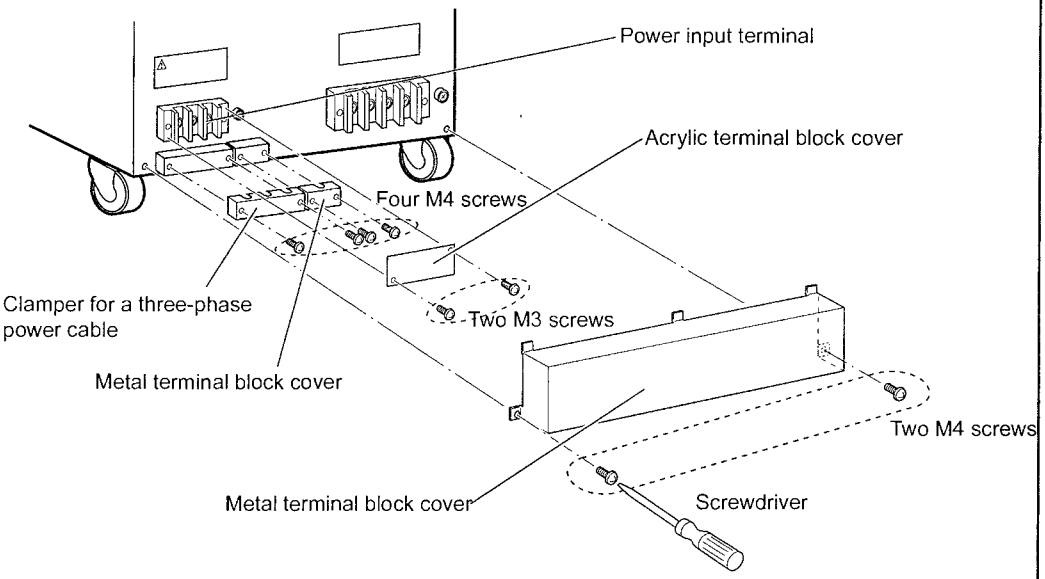
Connection to the power input terminal



Connection procedure

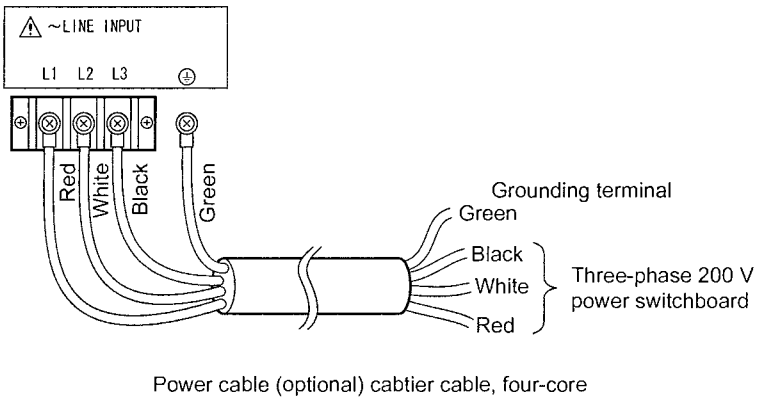
For EPO/18000M/36000M, you must connect to the power input terminals for the master cabinet, booster cabinet 1 and booster cabinet 2.
For EPO 24000M, you must connect to the power input terminals for the master cabinet and booster cabinet.

① Remove the terminal block covers and cable clampers from the rear bottom of the cabinet.



Two types of terminal block covers are used, an acrylic cover attached to the terminal block and a metal cover that covers the input/output terminal block.
Two types of cable clampers are used. One is used for a three-phase power cable and the other is used for a protective grounding cable.

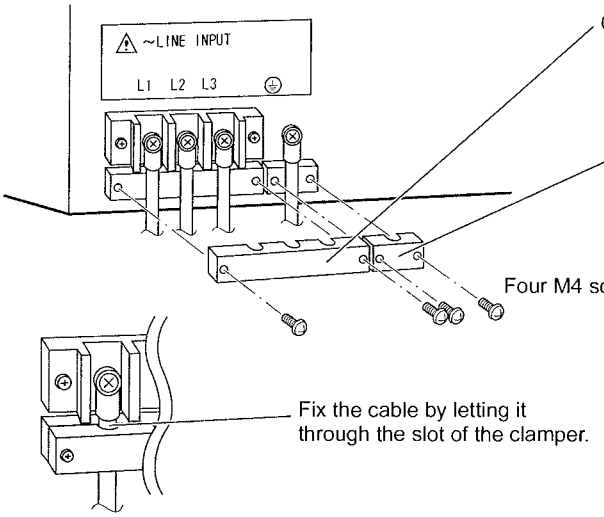
② Connect the power cable.



Power cable (optional) cabtier cable, four-core

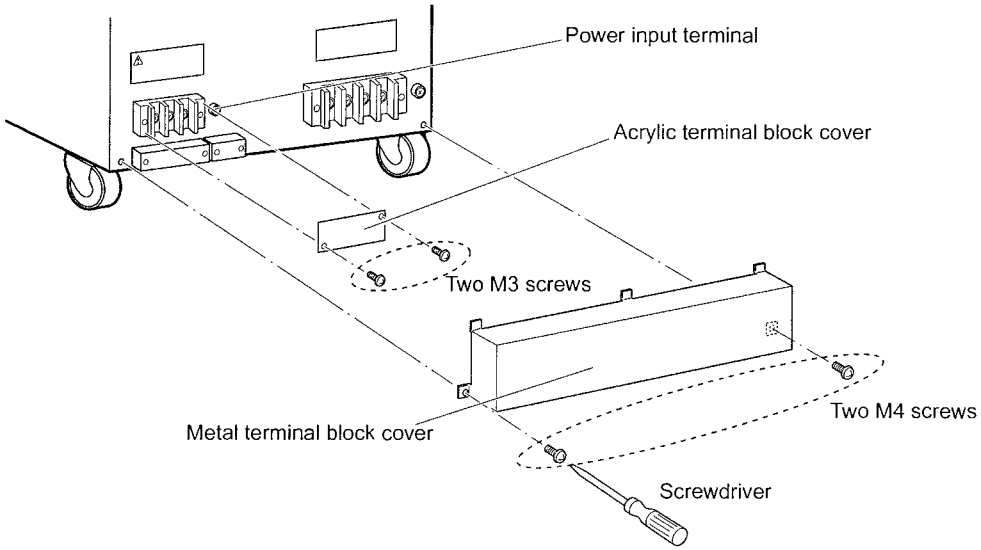
The screws of the terminal block must be tightened securely.

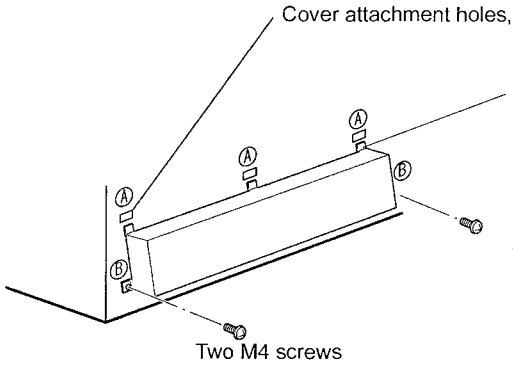
3 Attach the cable clampers.



Attach the clamper securely and confirm that the cable is fixed with the clamper.

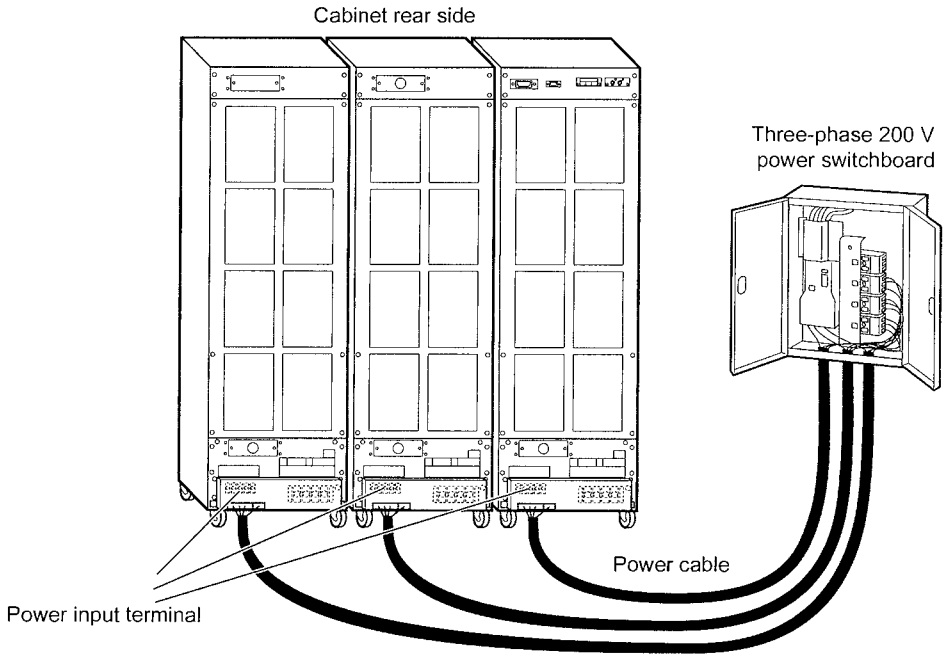
4 Attach the terminal block covers.





Insert the prongs of the cover into the cover attachment holes Ⓐ and fix the cover with screws at Ⓑ.

(5) Connect the power cable to the three-phase 200 V power switchboard.



☞ Power switchboard capacity ⇒¨ See "Power Supply Environment."

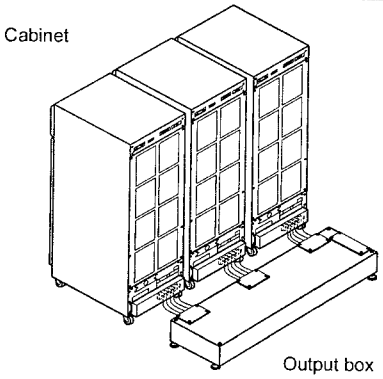
Connection to output box

⚠ WARNING!

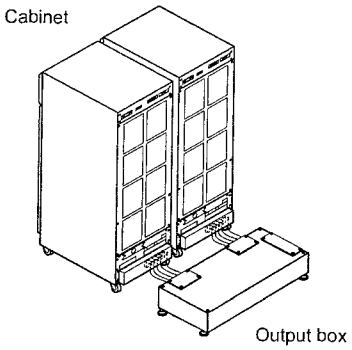
Turn off the power to the P-STATION/EPO unit before safe connection of output.

- EPO 18000M/24000M/36000M are equipped with an output box.
- Place the output box in the back of the cabinet.
- Be sure to use a cable shipped with the P-STATION/EPO unit for the output junction cable that connects the output box and the cabinet.
- The output junction cable is a 38 mm^2 single-core vinyl cable, with a crimped terminal at both ends.

Connection of EPO 18000M/36000M output box



Connection of EPO 24000M output box



Information on output terminal of cabinet

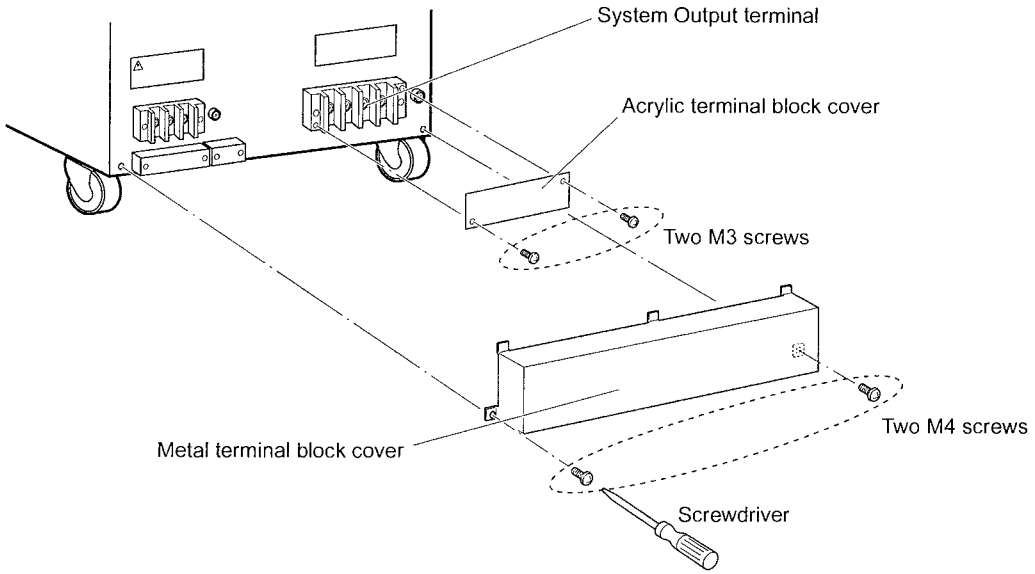
- Terminal screw diameter: M8
- Maximum wire diameter: 60 mm^2
- Solderless ring tongue terminals: wire size 60 mm^2, stud size M8
- Hexagon bolts
- To tighten screws, use a socket wrench suited for the 13 mm size.
- Tightening torque: 6.47N · m (66 kgf · cm)

Information on input terminal of output box

- Terminal screw diameter: M8
- Maximum wire diameter: 38 mm^2
- Solderless ring tomgue terminals: wire size 60 mm^2, stud size M8
- Hexagon bolts
- To tighten screws, use a socket wrench suited for the 13 mm size.
- Tightening torque: 8 to 10N · m (81.6 to 102 kgf · cm)

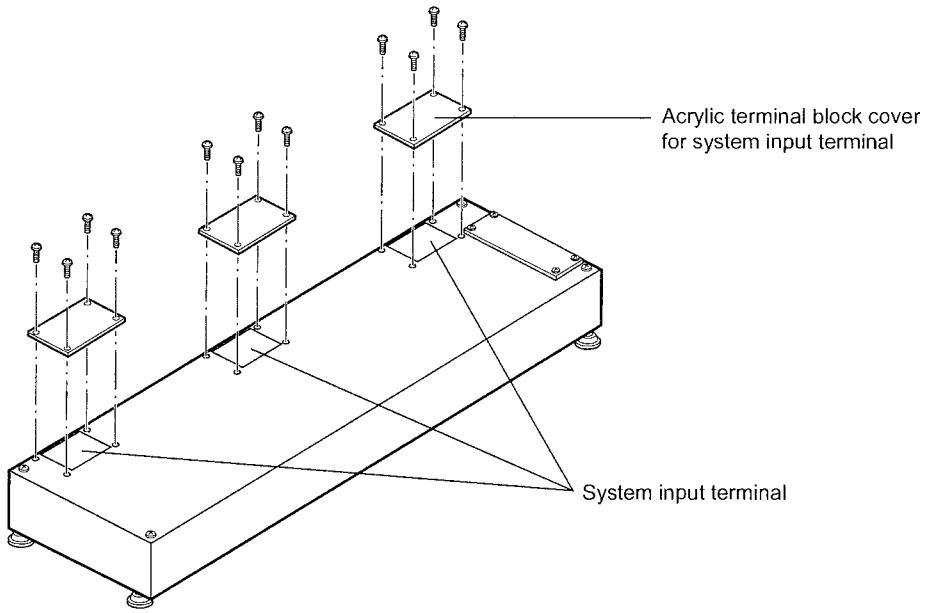
Connection of output junction cable

① Remove the terminal block covers.

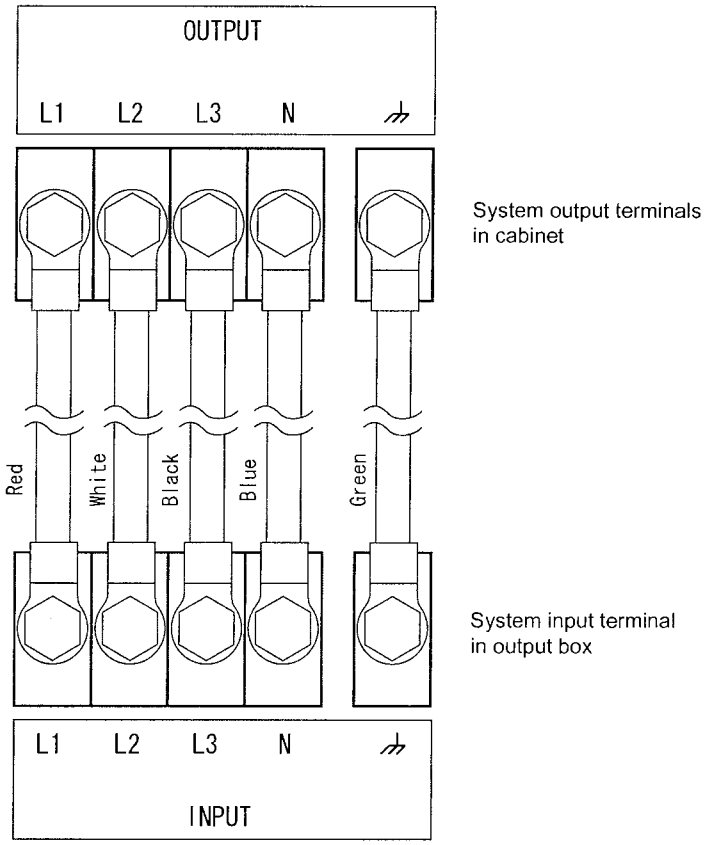


Two types of terminal block covers are used, an acrylic cover attached to the terminal block and a metal cover that covers the input/output terminal block.

② Remove the acrylic terminal block covers of system input terminals in the output box.



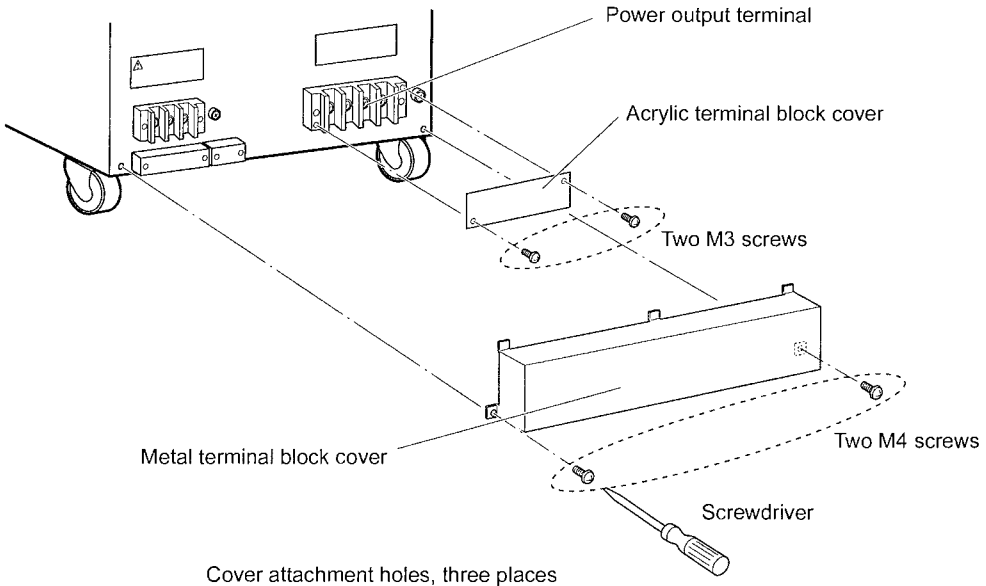
③ Connect the output junction cables

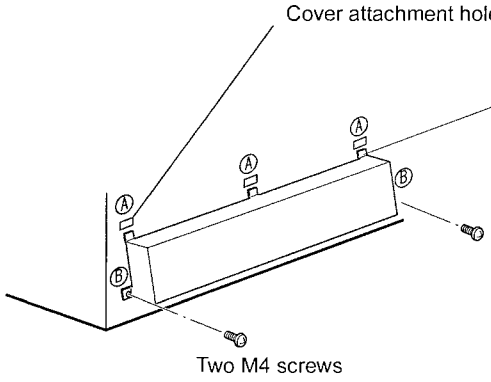


As for the output junction cables, there are 15 pieces for EPO 18000M/36000M and 10 pieces for EPO 24000M.

All cables are used for connection.

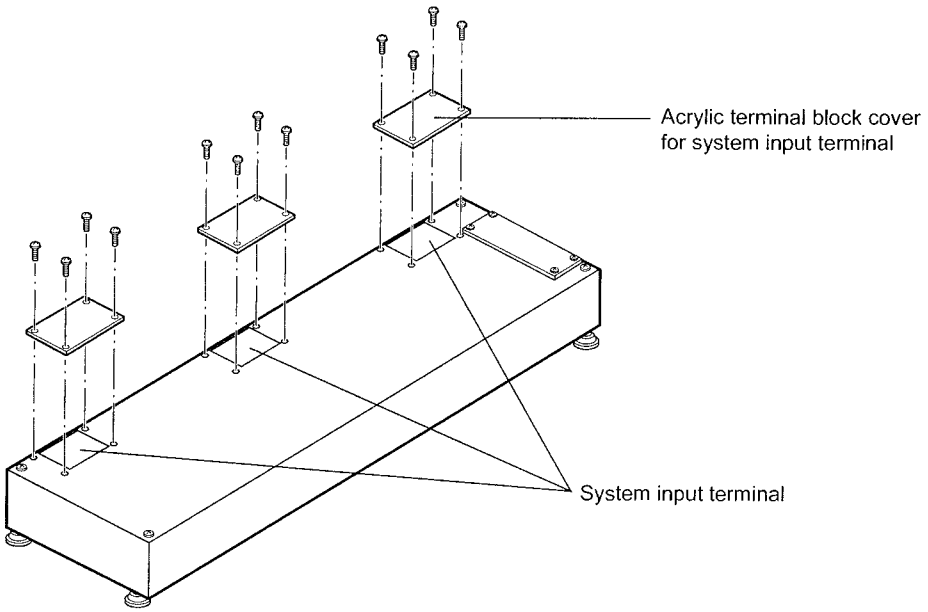
4 Attach the terminal block covers.





Insert the prongs of the cover into the cover attachment holes Ⓐ and fix the cover with screws at Ⓑ.

5 Remove the acrylic terminal block covers of system input terminals in the output box.

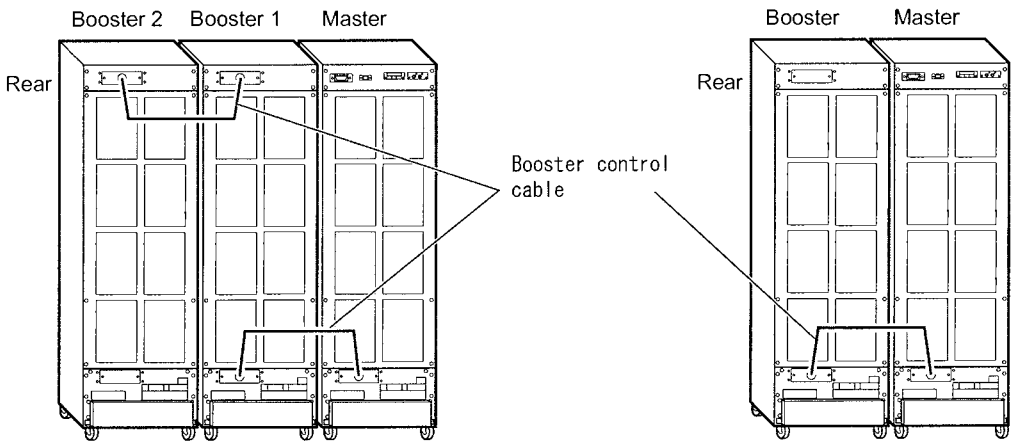


Connection of booster cables

⚠ WARNING!

Be sure to shut off the power supply on the power switchboard before connection in order to avoid risk of electric shock.

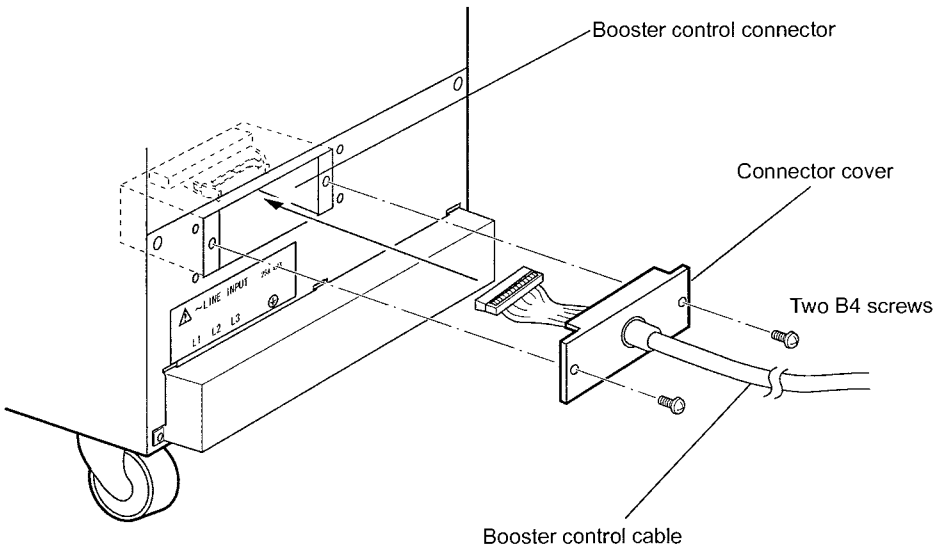
Connect the master cabinet and the booster cabinets with booster control cables.
The connection part of the connector is a flat cable connector.



EPO 18000M/36000M　　EPO 24000M

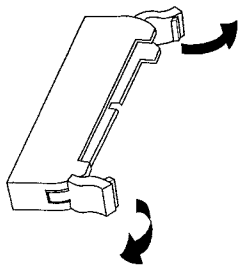
Connection procedure

1. Connect the connector.
2. After connecting the connector, be sure to fix the connector cover with screws.

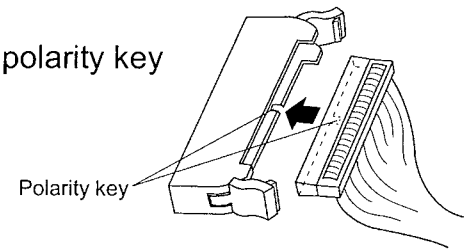


Inserting the flat cable connector

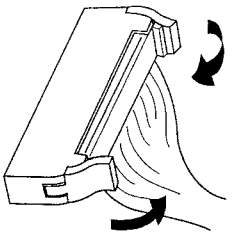
1. Open the left and right locks.



2. Insert the connector, with the polarity key facing downward.

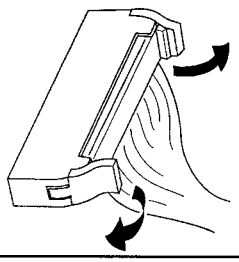


3. Confirm that the connector is locked.

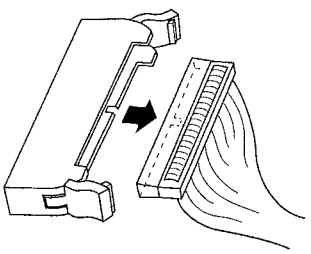


Removing the flat cable connector

1. Open the right and left locks.



2. The connector comes up ready to be removed.



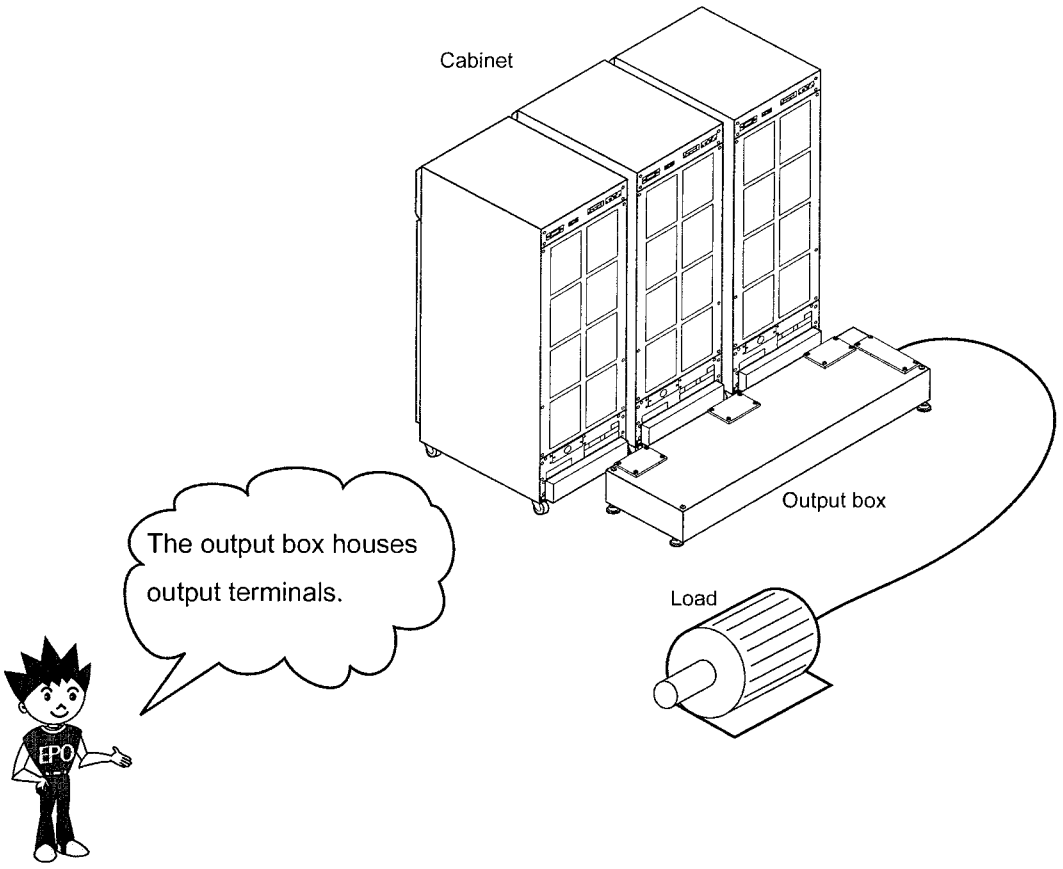
Connection to output box

⚠ WARNING!

Turn off the power to the P-STATION/EPO unit before safe connection of output.

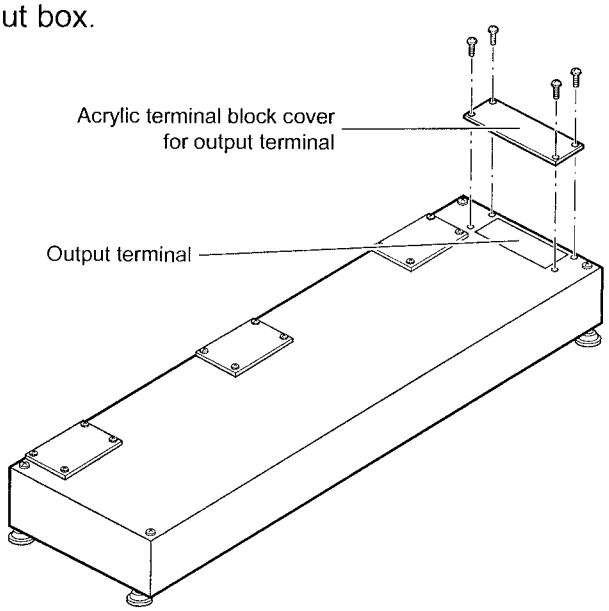
Information on output terminal of output box

- Terminal screw diameter: M10
- Maximum wire diameter: 100 mm^2
- Solderless ring tongue terminals: wire size 100 mm^2, stud size M10
- Hexagon bolts
- To tighten screws, use a socket wrench suited for the 17 mm size.
- Tightening torque: 15 to 20N・m (153 to 204 kgf・cm)



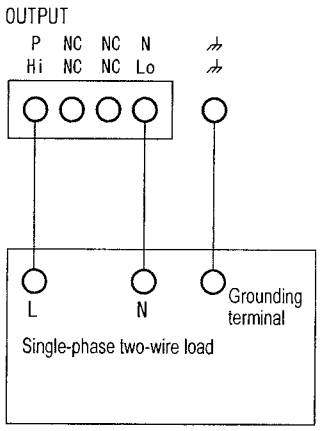
Connection of load

① Remove the acrylic terminal block covers of output terminals in the output box.

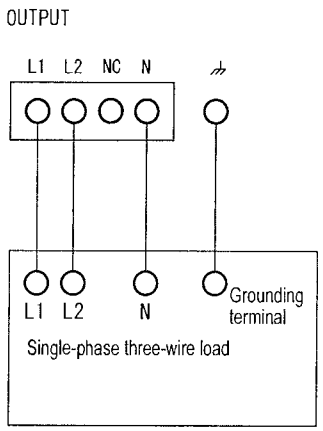


② Connect the target load.

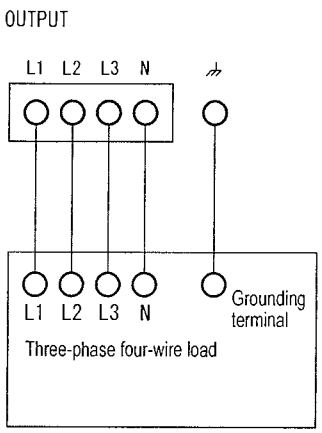
In the case of a single-phase two-wire load



In the case of a single-phase three-wire load



In the case of three-phase four-wire load



* In the case of a three-phase three-wire load, N(neutral line) is not required.

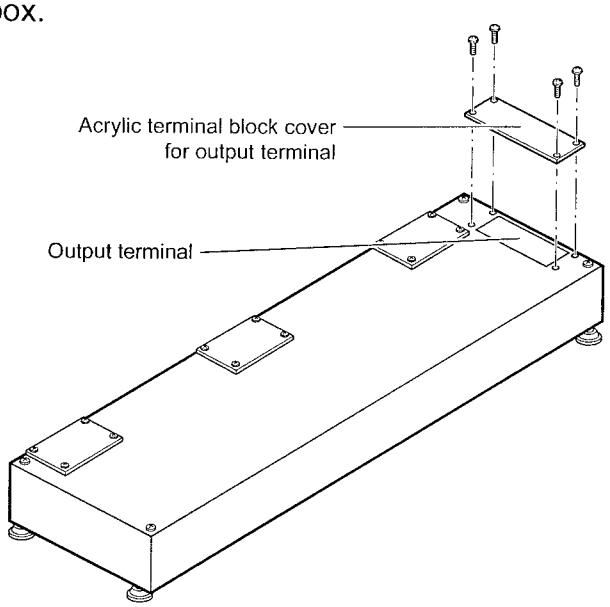
Check the power input type of the load and connect the power cable of the load to the output terminal of the cabinet.

EPO 18000M/24000M/36000M are multi-phase systems. They can output in four modes: single-phase two-wire, single-phase three-wire, three-phase three-wire or three-phase four-wire output mode.

NC terminals determined from the type of output must be left open.

When the load has a grounding terminal ⏚ , connect it to the grounding terminal.

(3) Attach the acrylic terminal block covers of output terminals in the output box.



MEMO

- The output is insulated from the power input and chassis. When using as a one-wire grounding system, the Lo terminal (for single-phase one-wire) or N terminal (for single-phase and three-phase) can be connected to the grounding terminal.

CAUTION!

- Output one-wire grounding must be connected to the Lo terminal or N terminal. Hi terminal and L side terminal cannot be used for this purpose.
- Do not connect anything to the NC terminal.

WARNING!

- If one-wire is not grounded (when used as balanced output), voltage is generated between the chassis and the output terminal even if the output is off because an output noise filter is used. Be sure to turn off the system power supply before connecting the output terminal.
- Be sure to attach the terminal block cover after connecting the cable,

Select a proper output cable, considering the output current. You should consider the cable rating, temperature rise, and others.

The P-STATION/EPO unit internal circuit controls the output terminal voltage so that it will be kept constant. Therefore, the load regulation at the end of the load is affected by the wiring impedance to the load. High impedance causes poor load regulation.

Do not use an unnecessary long cable between the output terminal and the load. Use a cable with a large cross-sectional area.

See the table below and the materials provided on the next page.

* Calculated with ambient temperature at 30°C and a VCT cable.
* See the values enclosed in ( ) for voltage drop. This value is a voltage drop per 1 m of cable (cable length to the load is 2 m when including a return cable).

System	Single-phase	Single-phase three-wire output	Three-phase output
EPO 18000M	80mm²(0.080V)	22mm²(0.065V)	14mm²(0.12V)
EPO 24000M	80mm²(0.089V)	38mm²(0.57V)	22mm²(0.10V)
EPO 36000M	80mm²(0.089V)	38mm²(0.040V)	50mm²(0.064V)

MEMO

Select a proper cable referring to the table below that shows the relationship between cables and allowable current.

Allowable current for two-core vinyl cabtire cable

* For VCT cables as per JIS C 3312

(At ambient temperature of 30°C or below)

Nominal cross section [mm²]	Allowable current [A]
2	22
3.5	32
5.5	42
8	51
14	71
22	95
38	130

(At ambient temperature higher than 30°C)

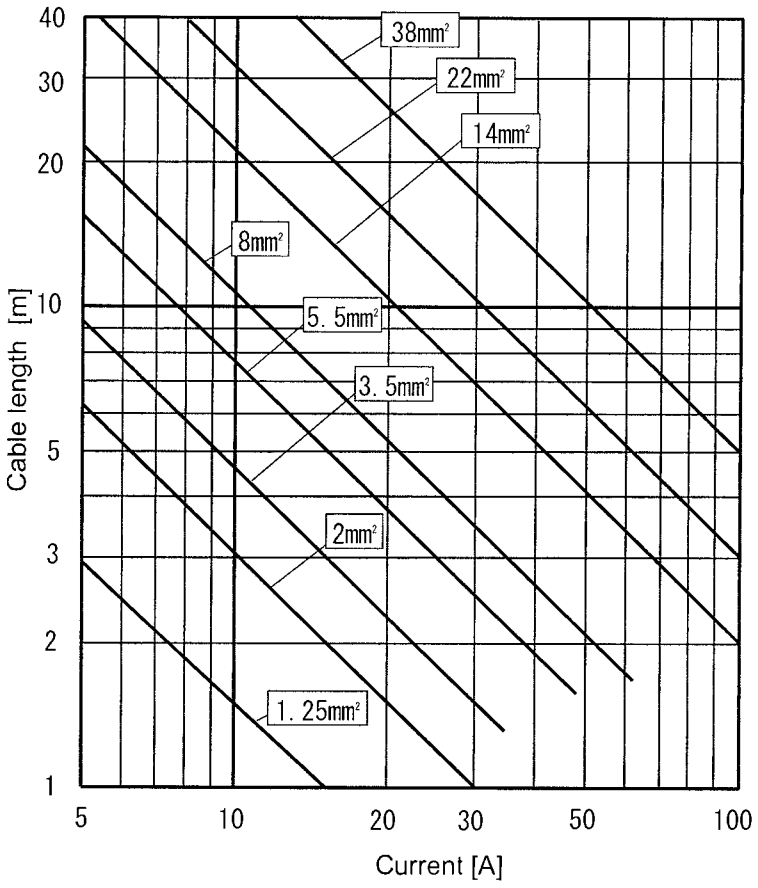
* Multiply the allowable current value shown in the left table with the reduction factor in the table below

Ambient temperature [°C]	Reduction factor to allowable current
30	1.00
35	0.91
40	0.82
45	0.71
50	0.58

* From JEAC 8001-1986

Relationship between cable length and voltage drop (JIS C 3307 IV cable)

* Use of too long cable causes a voltage drop due to the excessive cable resistance.



* The diagonal lines indicate the cable length at which voltage drop is 0.5 V due to wiring resistance.

* Values in the rectangle indicate the cross section of the ▭

Prior to starting operation

Since the P-STATION/EPO unit can provide a voltage of 600 Vac (424 Vdc) at the maximum, wrong operation may cause damage to the connected load or electric shock. Check the following items before starting operation.

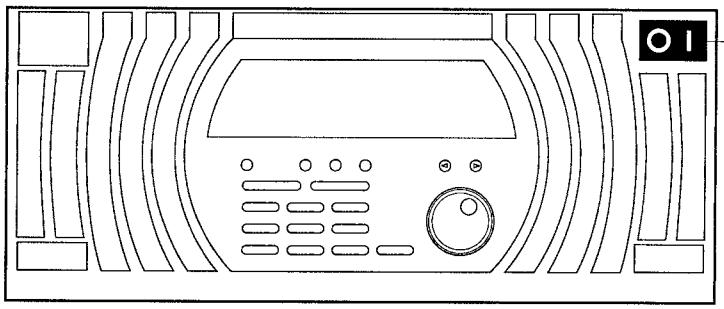
- If this is the first operation of your unit, connect nothing to the output and you should try rehearsal operation referring to the instruction manual.
- Are you sure with the output connection? Confirm that proper cables are used to the maximum current.
- Are you sure with the power input connection? Confirm that our specified cables are used.

4

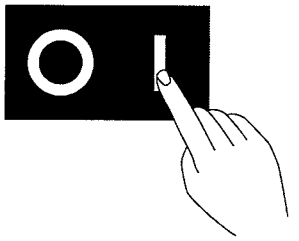
Fundamental Use

- for beginners -

Turning ON/OFF power supply

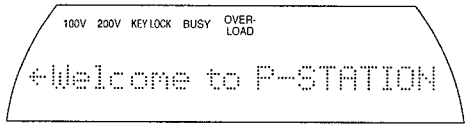


Turning on the power

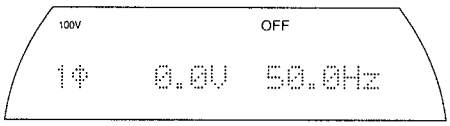


Press the | side of the power switch.

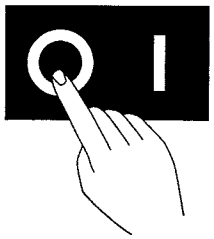
All lamps light up and the display shows a running message.



Then a normal screen appears on the display.



Turning off the power



Press the ◎ side of the power switch.

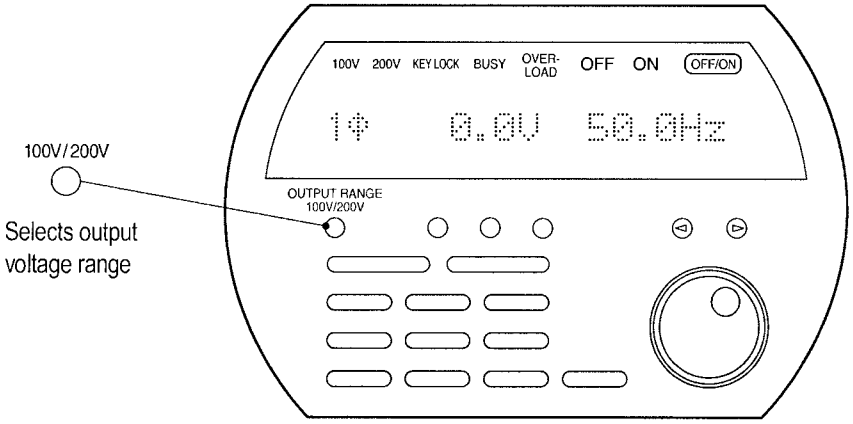
All indications go out. Cooling fan continues running for a moment until ....

Complete stop comes several seconds later.

Memo

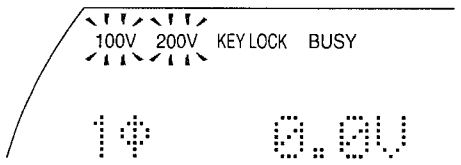
- Just after the power energizing, the settings are those stored at Address 1 of the memory.
  You can enter familiar settings in Address 1 of the memory for your convenience in operation.
- You may turn on the power switch again when the cooling fan is running after power turning off. This causes no problem.

Setting the output voltage range

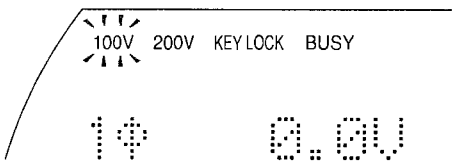


100V/200V

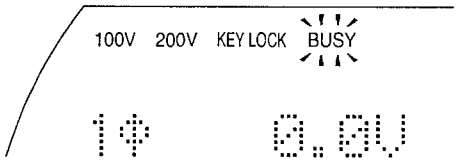
1 Every press on the ◯ button toggles the range between 100 V and 200 V.



2 Select the desired voltage range for output.



BUSY keeps lighting during the selection process; any button operation is not accepted at the moment.



Attention!

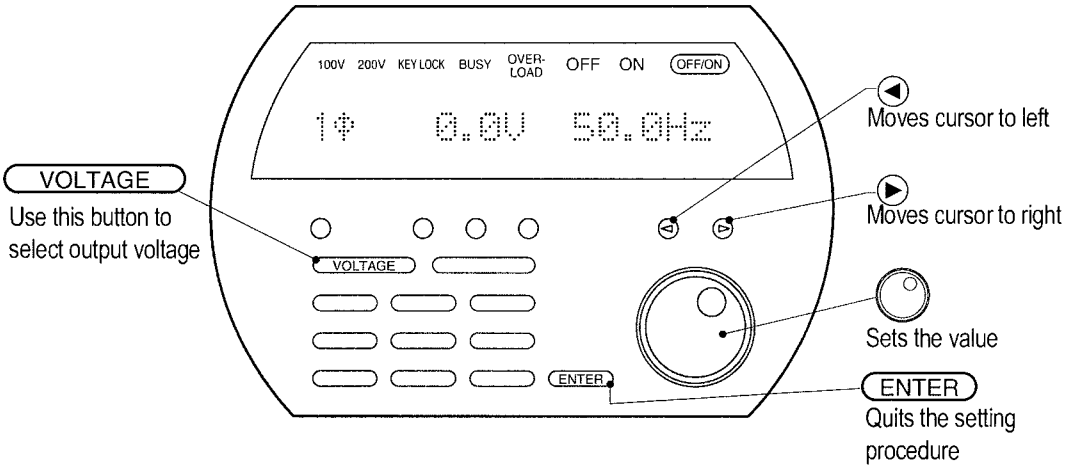
The maximum output current depends on the selected range.

Voltage range	Output range
100 V range	< 150V < 40A
200 V range	< 300V < 20A

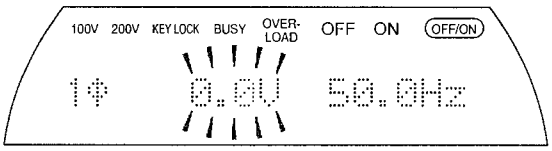
Attention!

- When the range is changed, the output is turned off.
- If the setting of output voltage is out of the range of 100 V range, the 100 V range cannot be selected. Lower the voltage setting first before changing the range.

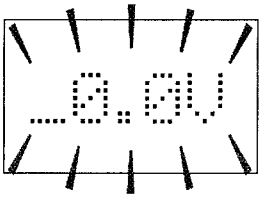
Setting the output voltage



1 Press VOLTAGE and the voltage indication blinks.



2 Press ◀ and ▶ to locate the cursor.

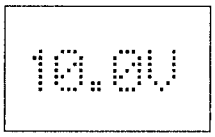


3 Turn ◯ to set the voltage.

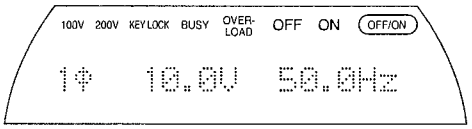
*The set value is fixed.

◯ Clockwise turn increases the value.

◯ Counterclockwise turn decreases the value.



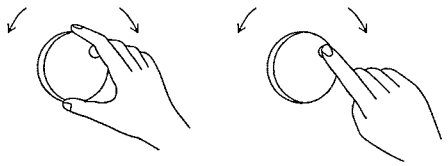
4 Press ENTER to quit the setting procedure.



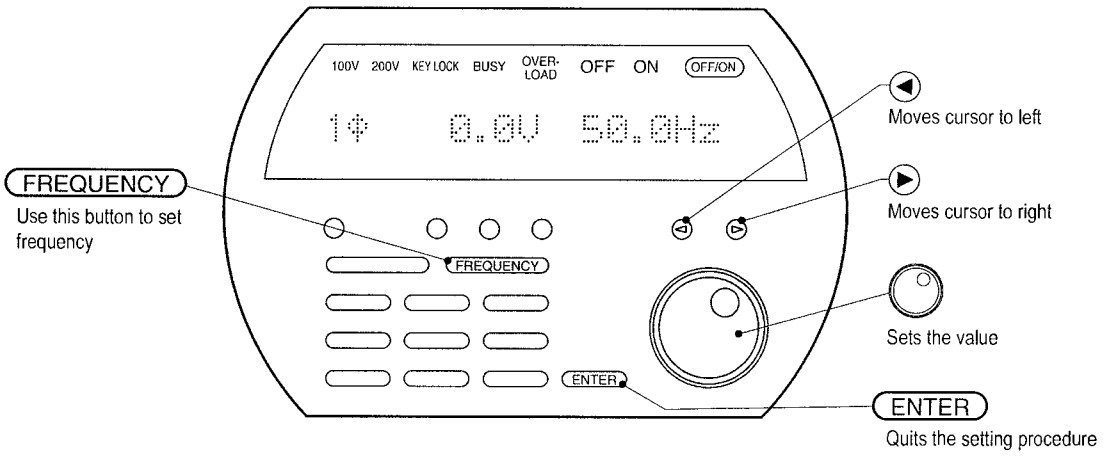
Memo

How to turn the rotary dial

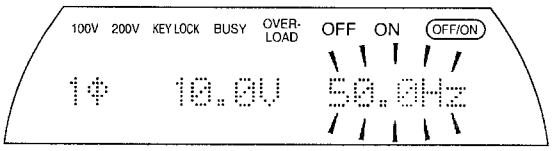
[Moderate turn] [Quick turn]



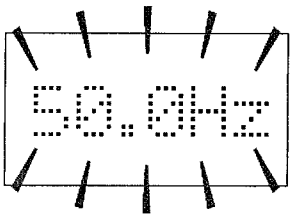
Setting the output frequency



1 Press FREQUENCY and the frequency indication blinks.



2 Press ◀ and ▶ to locate the cursor.

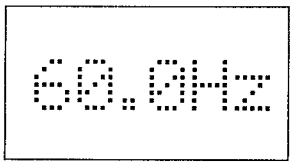


3 Turn ◯ to set the frequency.

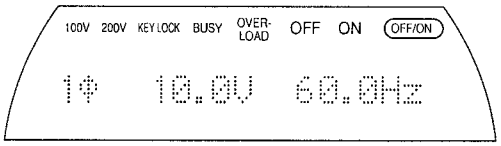
*The set value is fixed.

◯ Clockwise turn increases the value.

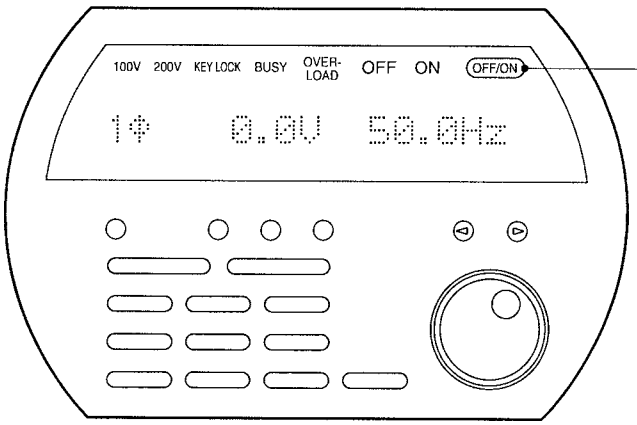
◯ Counterclockwise turn decreases the value.



4 Press ENTER to quit the setting procedure.

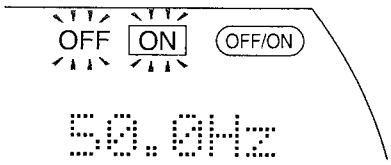


Turning ON/OFF the output

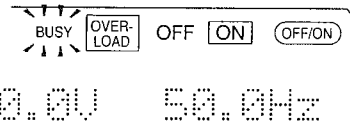


OFF/ON
Turning ON/OFF the output.

1 Every press on OFF/ON toggles the output between ON and OFF.

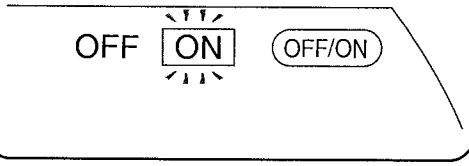


BUSY keeps lighting during switching process.



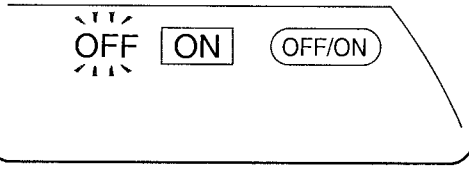
Output is ON

ON keeps lighting.

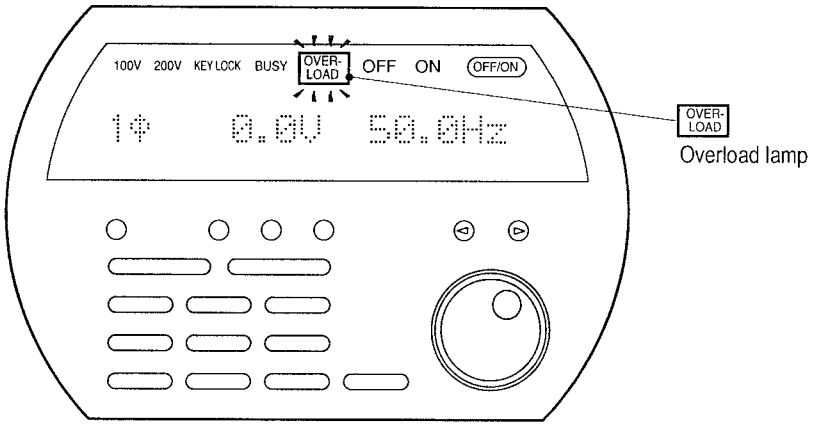


Output is OFF

OFF keeps lighting.



Indication of overload



When output current exceeds the rated value, or if the output is short-circuited accidentally, control restrains the output current. The overload lamp keeps lighting during output restraint and the output voltage waveform is distorted.

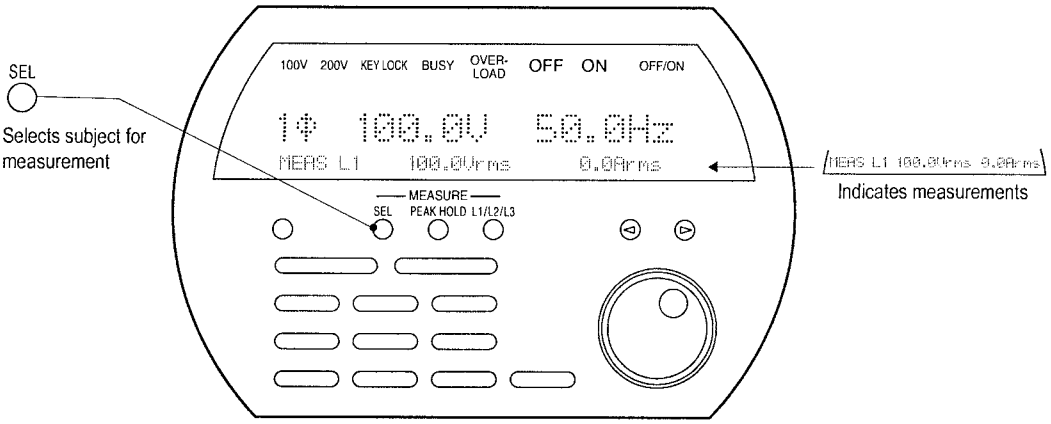
In addition, the overload lamp lights when the remote sensing AGC setting is ON and the compensation range using this function is exceeded under this condition.

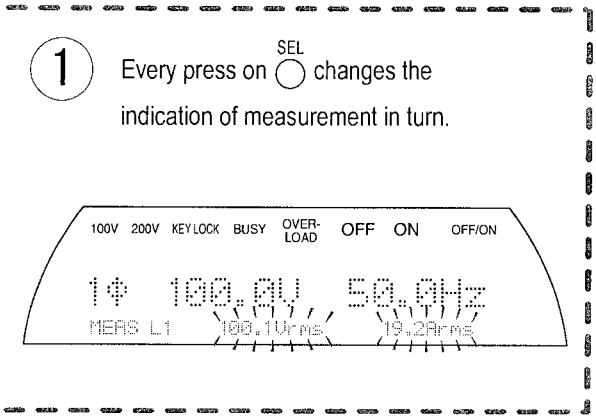
Memo

This protective function will be automatically released when the cause is eliminated.

Even when a great current flows temporarily, for example, on motor startup, the output will be supplied continuously instead of being turned off. When the current decreases to the rated value or lower, the normal output is restored, with the overload lamp going out.

Using measuring functions





Measurements are shown in the bottom line of the display. The user can carry out setting while monitoring the real output value shown in the measurement field. The display shows the following values in turn:
[RMS values of voltage and current]
[Peak values of voltage and current]
[Apparent power and effective power]
[Power factor]

[Example]

RMS values of voltage and current
MEAS L1 100.1Vrms 19.2Arms

Peak values of voltage and current
MEAS L1 141.6Vpk 27.2Apk

Apparent power and effective power
MEAS L1 1.92kVA 1.92kW

Power factor
MEAS L1 PF 1.000

Attention!

- The measurement range is automatically changed by detection of the peak values of the voltage and current RMS values.
- The measurement range cannot be fixed.

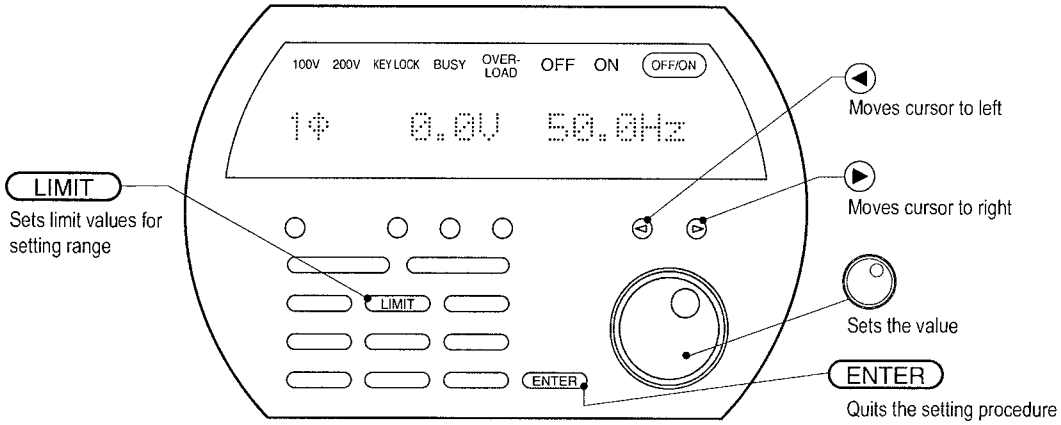
Attention!

- Voltage and current are measured properly only when the frequency is in the range of 40 to 500 Hz.
- Effective power is measured properly only when the frequency is in the range of 45 to 65 Hz.

Memo

- The display shows the peak value in positive or that in negative whichever is greater.
- Apparent power and power factor are determined through calculation from other measurements.

Setting limits to output



Setting of limit values can limit the setting range of output voltage and output frequency. If the user sets in advance a limit(s) according to the allowable input range of the connected load, it can prevent failure of the load caused by application of excessive voltage or other factors.

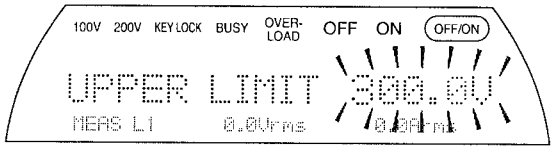
Three types of limits are available for setting: upper limit to output voltage, upper limit to output frequency, and lower limit to output frequency.

Memo

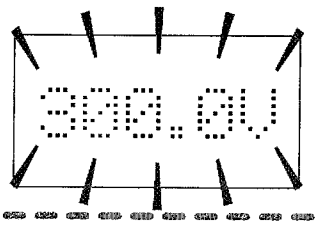
Once a limit value is entered, press (ENTER) to quit the setting procedure, and the display returns to the normal screen. If you want to enter another limit setting, then press (LIMIT) instead of (ENTER) and go to the next limit entry.

Setting an upper limit to output voltage

1 Press LIMIT , and the display shows a screen for setting an upper limit to output voltage.



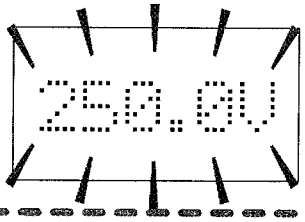
2 Press ◀ and ▶ to locate the cursor.



3 Turn ◯ to set the desired upper limit to the output voltage.

◯ Clockwise turn increases the value.

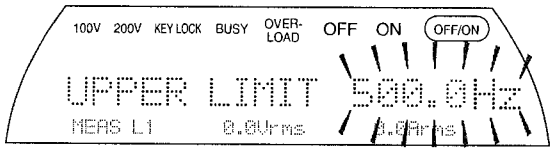
◯ Counterclockwise turn decreases the value.



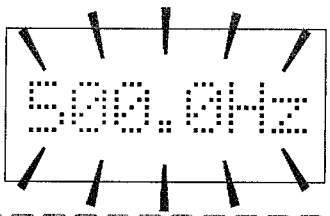
Press ENTER to quit the setting procedure.

Setting an upper limit to output frequency

1 While the display keeps showing the screen for setting an upper limit to output voltage, press LIMIT , and the display shows a screen for setting an upper limit to output frequency.



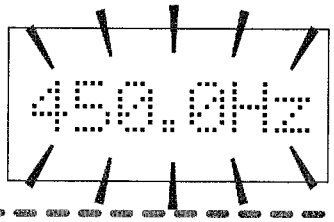
2 Press ◀ and ▶ to locate the cursor.



3 Turn ◯ to set the desired upper limit to the output frequency.

◯ Clockwise turn increases the value.

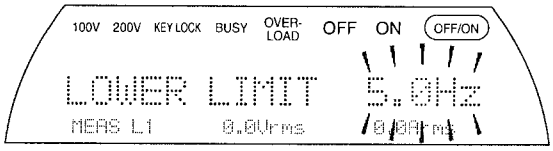
◯ Counterclockwise turn decreases the value.



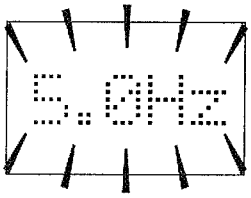
Press ENTER to quit the setting procedure.

Setting a lower limit to output frequency

1 While the display keeps showing the screen for setting an upper limit to output frequency, press LIMIT , and the display shows a screen for setting a lower limit to output frequency.



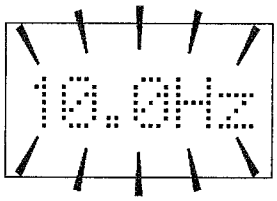
2 Press ◀ and ▶ to locate the cursor.



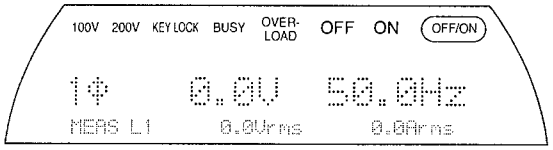
3 Turn ◯ to set the desired lower limit to the output frequency.

◯ Clockwise turn increases the value.

◯ Counterclockwise turn decreases the value.



4 Press LIMIT or ENTER to quit the setting procedure and the display returns to the normal screen.



Attention!

When setting a voltage limit value, you cannot specify a value that is lower than the already set output voltage. Similarly for output frequency limit value, you cannot make setting that will exclude the value then set frequency from the intended range.

Attention!

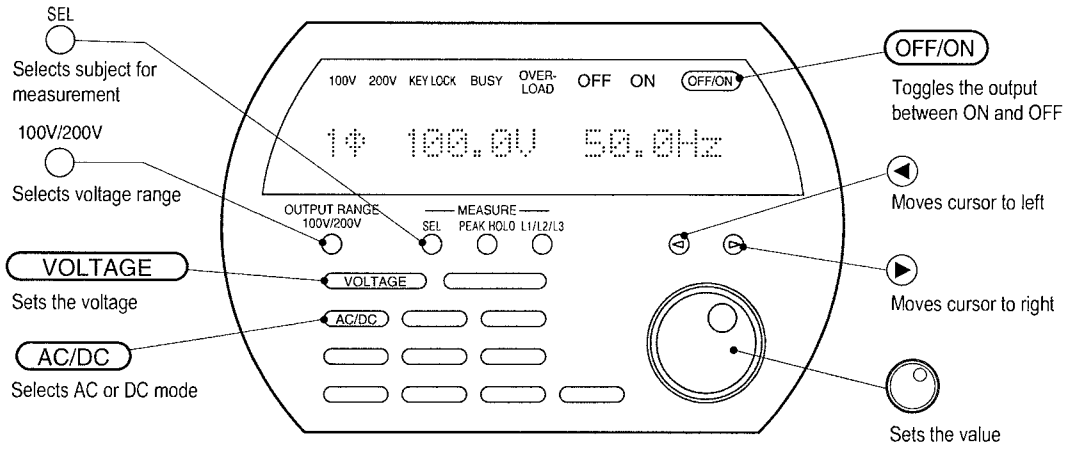
When the system is in a line-synchronized condition or in DC output mode, setting a limit to output frequency is not available.
(In the above situation, only output voltage upper limit can be set with LIMIT .)

5

Versatile Use

- for advanced users -

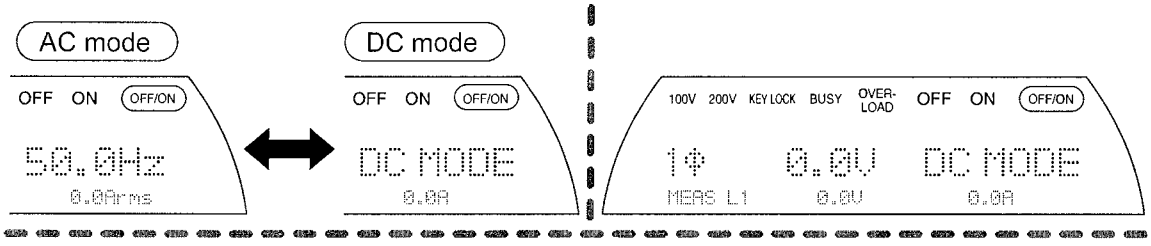
Using the unit as a DC power supply



Selecting DC output mode

1 Pressing this AC/DC button toggles the output mode between AC and DC.

2 Press AC/DC to select the DC output mode.



Memo

- The unit supplies only AC current in AC output mode and DC current in DC output mode.
- The value set in either of AC output mode or DC output mode is kept remain even when the mode selection is provided in AC/DC output modes.

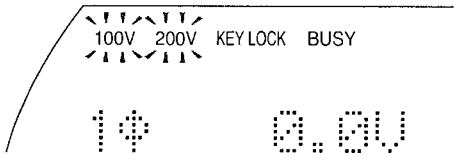
Attention!

- The output mode cannot be switched to DC when line synchronization is enabled.
- The output mode cannot be switched to DC when the system is in three-phase mode or single-phase three-wire mode.
- Output will be turned off if AC/DC switching operation is attempted while output current is supplied.

Setting an output voltage range

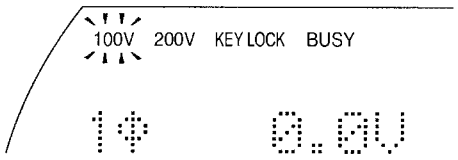
100V/200V

① This ◯ button toggles the output voltage range between 100 V and 200 V.



100V/200V

② Press ◯ to select the desired voltage range.



Attention!

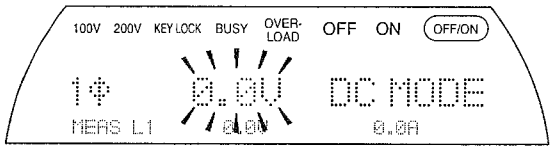
The maximum output current depends on the selected range as follows;

Voltage range	Maximum output power	Maximum voltage	Rated voltage	Maximum output current
100 V range	2538W	212. 0V	141. 0V	18A
200 V range		424. 0V	282. 0V	9A

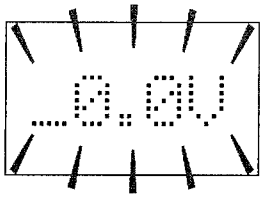
The table shows the EPO 4000S rating. Refer to 12 "Rating" for other models.

Setting an output voltage

① Press (VOLTAGE), and the voltage indication will blink.



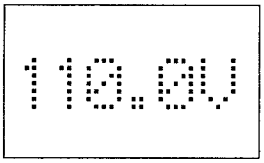
② Press ◀ and ▶ to locate the cursor.



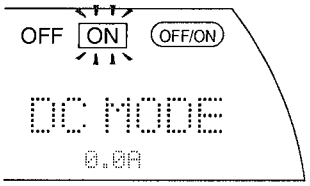
③ Turn ◯ to set the desired voltage.

Clockwise turn increases the value.

Counterclockwise turn decreases the value.

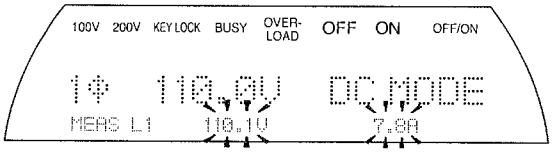


④ Press (OFF/ON) to turn ON the output.



Using the measurement functions

① Every press on SEL ◯ changes the indication of measurement in turn.



Measurements are shown in the bottom line of the display.

* Measurements of "Voltage", "Current" and "Power" are displayed when in DC output mode.

[Example] (Mean value of voltage and current)

MEAS L1 110.1V 7.8A

(Effective power) ↕

MEAS L1 0.86kW

Attention!

- The measurement range is switched automatically.
- The measurement range cannot be fixed.

Attention!

- Mean values are displayed for voltage and current in DC output mode, and AC components are not measured.

Memo

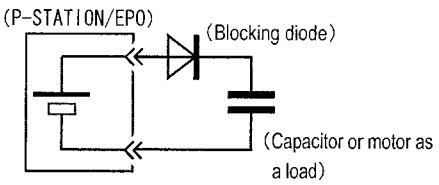
- If the current contains an AC component, a peak value will be detected and this switches the DC measurement range to a higher range.

Attention!

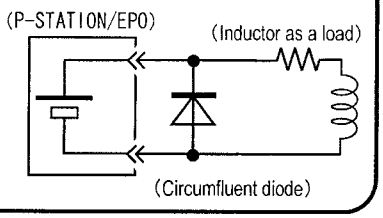
- Load connecting method in DC mode

For fault prevention and safety, if a capacitor, motor or an inductor is used as a load, connect a protective diode (with the maximum inverse voltage of 600 V at least) between the load and the P-STATION/EPO output. Select a large one with the forward current of which the rating if 1.5 times or more of the applied system maximum current.

- If a capacitor (of 150 uF at least) or a motor is used as a load, connect a blocking diode which prevents the backflow of the current.



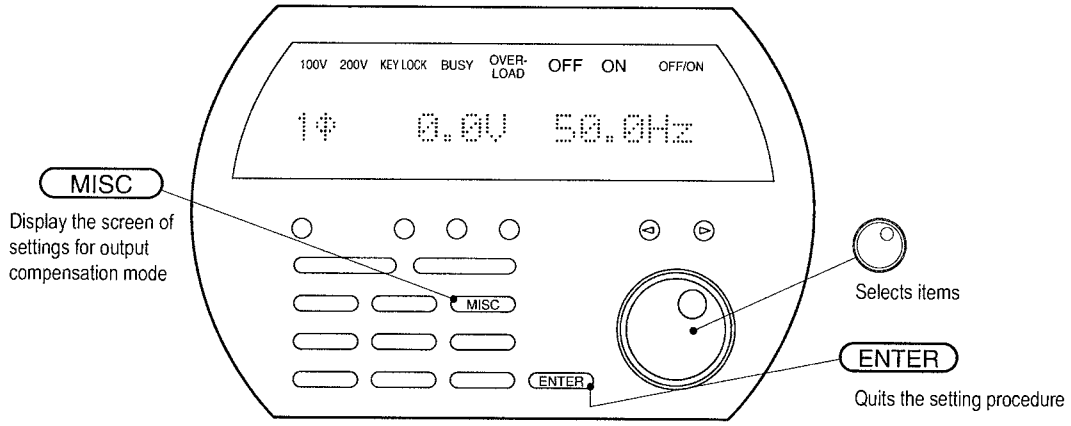
- If an inductor is used as a load, connect a circumfluent diode so that the counter electromotive force generated when the output is off is absorbed.



Memo

Most of the switching power units used by connecting with an AC power supply can be operate in DC mode and the measurement of efficiency is sometimes performed with a DC power supply. If this is the case, it is not necessary to connect a protective diode because the backflow from the capacitor, etc. inside the circuit is blocked by the action of the commutating diode (normally of a bridge configuration) located in the input section of the switching power unit.

Settings for output compensation mode



This function selects a high or low level of the compensation sensitivity to maintain the output voltage at a constant value against load current and its fluctuation.

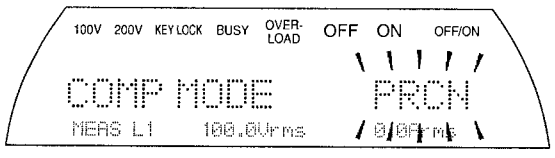
If you select high sensitivity (or precision), then high-precision control is secured against the fluctuation of load current, with the variation of the output voltage restrained to a low level. However, this tends to allow unstable operation under a high capacitive load (e.g., capacitor).

If you select low sensitivity (or high stability), on the contrary, improved stability can be maintained under a capacitive load although the output voltage fluctuates in a wider range.

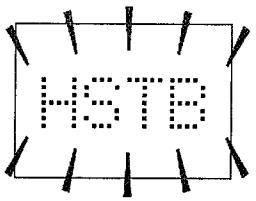
The unit is set to low sensitivity (or high stability) on shipping.

Selecting low sensitivity (or high stability)

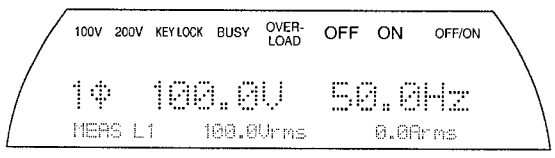
1 Press MISC couples of times until an output compensation mode setting screen



2 Turn the dial and select HSTB.

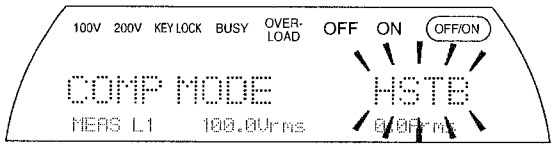


3 Press ENTER to quit the selection procedure, and the display returns to the normal

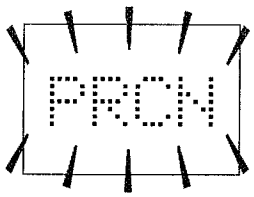


Selecting high sensitivity (or precision)

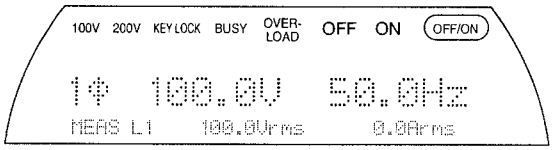
1 Press MISC couples of times until an output compensation mode setting screen appears.



2 Turn the dial and select PRCN.



3 Press ENTER to quit the selection procedure, and the display returns to the normal screen.



Memo

【Stability under capacitive load】

The upper limit of capacitive load that allows stable control is about 5 μF in precision mode. In high stability mode, the unit allows stable control up to 150 μF or so.

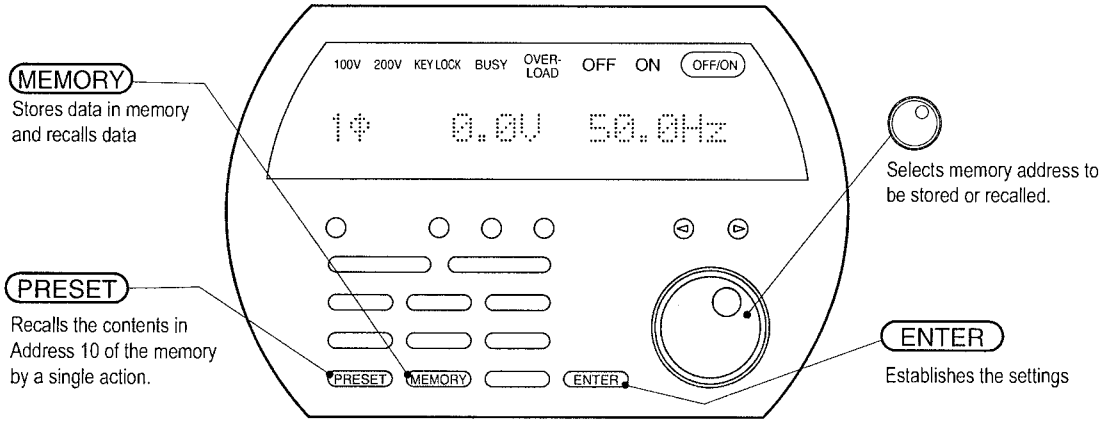
Memo

If a line filter is used in an RF anechoic chamber, select high stability mode.

Memo

To reduce waveform distortion near a voltage peak under the load of the capacitor input type rectifier, use the equipment in precision mode.

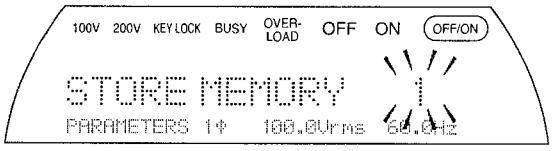
Using storage function



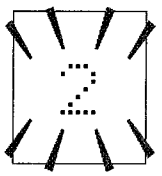
This function stores setting values or statuses. Pieces of data are stored in the incorporated memory backed up by a battery, and they can be recalled as necessary.

Storing settings

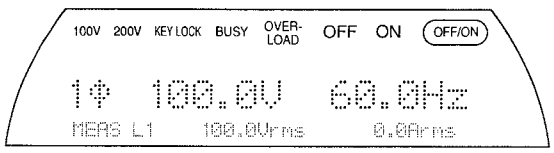
1 Press (MEMORY) once, and a store execution screen appears.



2 Turn the dial to select the desired memory address (from 1 to 10).



3 Press (ENTER) and the current status is stored and the display returns to the normal screen.



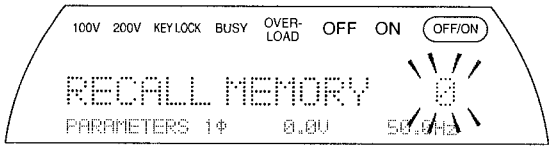
Attention!

The unit has eleven memory addresses from 0 to 10. Addresses 1 to 10 allow the user to store a desired specified status.
The user can recall Address 0 to reduce all settings in the memory to those set on shipping. Address 0 does not allow the user to store any data.

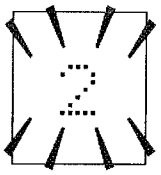
Recalling settings

1 Press (MEMORY) twice, and a recall execution screen appears.

* Repeat pressing (MEMORY), and the display shows in turn a store execution screen, a recall execution screen, and the normal screen.

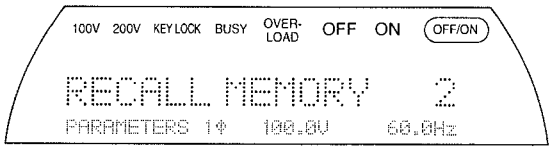


2 Turn the dial to select the desired memory address (from 0 to 10).

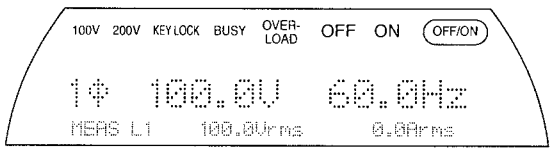


3 The bottom line of the display shows the phase mode, output voltage, and output frequency stored at that address.

* Phase mode: 1 ϕ, 2 ϕ, and 3 ϕ stand for single-phase, single-phase three-wire and three-phase, respectively.



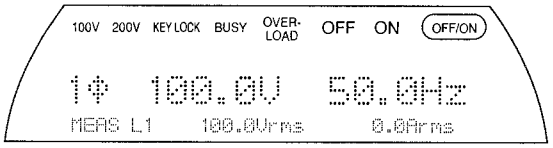
4 Press (ENTER) and the data at the address is recalled and then the display returns to the normal screen.



Recalling at one action with preset key

1 Press (PRESET), and the data stored at Address 10 is recalled.

【Example】 Single-phase 100V and 50Hz are stored in the memory address 10.



Memo

Store your favorite (or frequently used) settings or status at Address 10. You can press (PRESET) to retrieve the data immediately.

Retrieving on-shipping settings

① Recall Address 0 of the memory to reinstate the unit into the status of settings made on shipping.

Memo

When the unit is powered, the settings stored at Address 1 are automatically recalled. Thus, if the status of normal operation is stored at Address 1, you will be released from the setting works every time in the beginning of operation.

Memo

Use of the optional numeric keypad enables the user to recall any of Addresses 1 to 9 with a single button action.

This will be useful in operation of inspecting power voltage range.

Setting items for memory storage and on-shipping settings

Setting items		On-shipping settings
Output voltage range	AC	100 V range
	DC	100 V range
Output voltage	AC	0.0[V]
	DC	0.0[Vdc]
AC voltage setting mode		Phase-voltage setting
Output frequency		50.0[Hz]
Selection of AC/DC output mode		AC output mode
Output compensation mode		High stability
ON/OFF of line synchronization		OFF
Resetting frequency from line synchronization		50.0[Hz]
Limit value	Upper limit to AC phase voltage	300.0[V]
	Upper limit to AC line-to-line voltage (three-phase)	519.6[V]
	Upper limit to AC line voltage (single-phase three-wire)	600.0[V]
	Upper limit to DC voltage	424.0[Vdc]
	Upper limit to frequency	550.0[Hz]
	Lower limit to frequency	5.0[Hz]
Power-on phase when output is ON		0[deg]
Phase mode		Single-phase mode
Remote Sensing AGC (Option)		OFF
Monitor-output	CH1	L1 Phase Voltage
(Option)	CH2	L1 Phase Current x 1 (one)

Attention!

When any memory is recalled, the output is always turned OFF for safety reason. Depending on settings, however, memory can be recalled with the output maintained ON. This function can be used to quickly change the output voltage or frequency against the load.

(Settings for memory recall with the output kept ON)

◎Before and after memory recall, the following parameters must be the same:

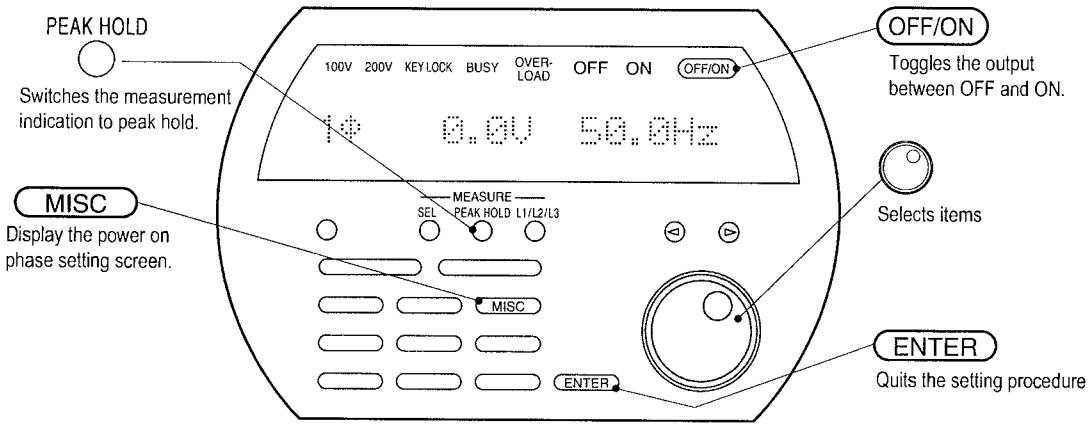
(1) AC/DC output mode

(2) Line-synchronization status

(3) Output voltage range

(4) Phase mode

Measuring rush current

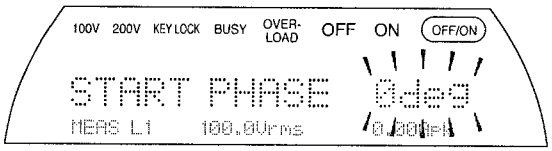


This function can measure the amount of rush current flowing in a load such as a cleaner and air conditioner that entails a rush current flow.

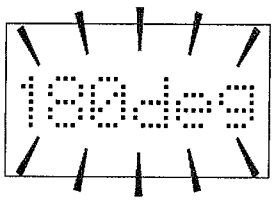
In addition, the user can observe the change in the flow of rush current because the system allows the user to set the power-on phase at the time of output turn-on by the step of 90 degrees.

Setting the power-on phase on output turn-on

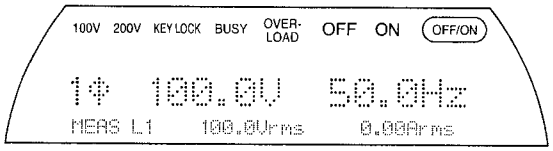
1 Press MISC couples of times until a power-on phase setting screen appears.



2 Turn the dial and select the desired power-on phase.



3 Press ENTER to establish the setting, and the display returns to the normal screen.

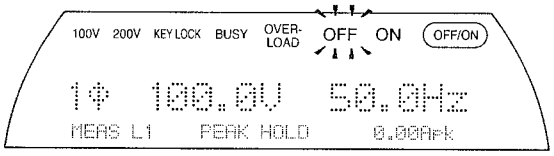


You can select the power-on phase out of 0, 90, 180 and 270 degrees.

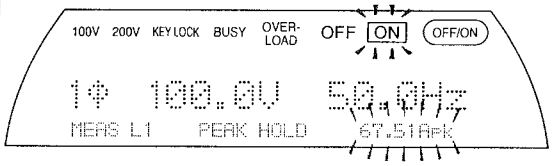
Using the peak hold function

① Press PEAK HOLD when the output remains turned OFF.

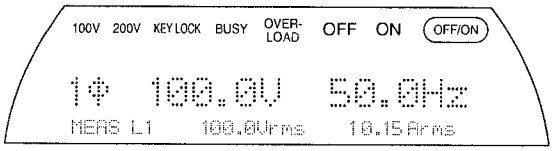
* The measurement indication in the bottom line of the display changes to peak hold (PEAK HOLD).



② Press the OFF/ON button to turn ON the output, and the display shows the maximum value of the rush current that flowed at the moment.



③ Press PEAK HOLD, and the display returns to the normal screen.



Attention!

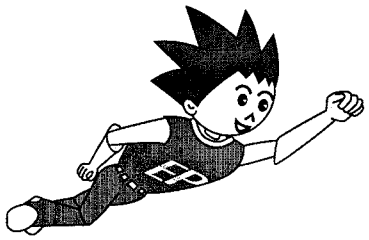
This peak current holding function shows the maximum value out of the peak values detected during the five cycles after turning on the output.

Therefore, normal measurement may not be achieved if you try to detect the peak current through ON/OFF operation on the load with the output being kept ON.

6

Use of Multi-phase System

- use units in a three-phase or single-phase three-wire configuration -



Attention!

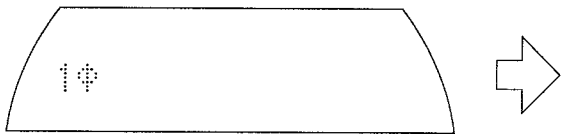
The operation described in this chapter is applicable to multi-phase system only..

What functions are available by multi-phase system ?

Multi-phase system can be used in one of the three modes: single-phase, single-phase three-wire or three-phase.

Phase mode

The phase modes of system include three modes: single-phase, single-phase three-wire and three-phase. The phase mode of the system is shown on the master's display.



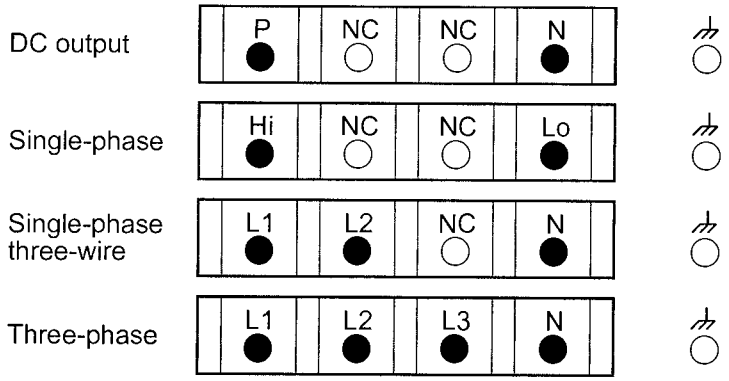
Indication	Phase mode
1φ	Single-phase
2φ	Single-phase three-wire
3φ	Three-phase

The phase mode of the system can be changed on the multi-phase system.

Output terminal

One set of output terminal is shared between each mode.

To change the phase mode, reconnect the cables to the load as follows:



Restraints on memory

Even if the stored phase mode differs from the present phase mode, the stored item can be recalled. When recalled, for reason of safety, the output will be shut off.

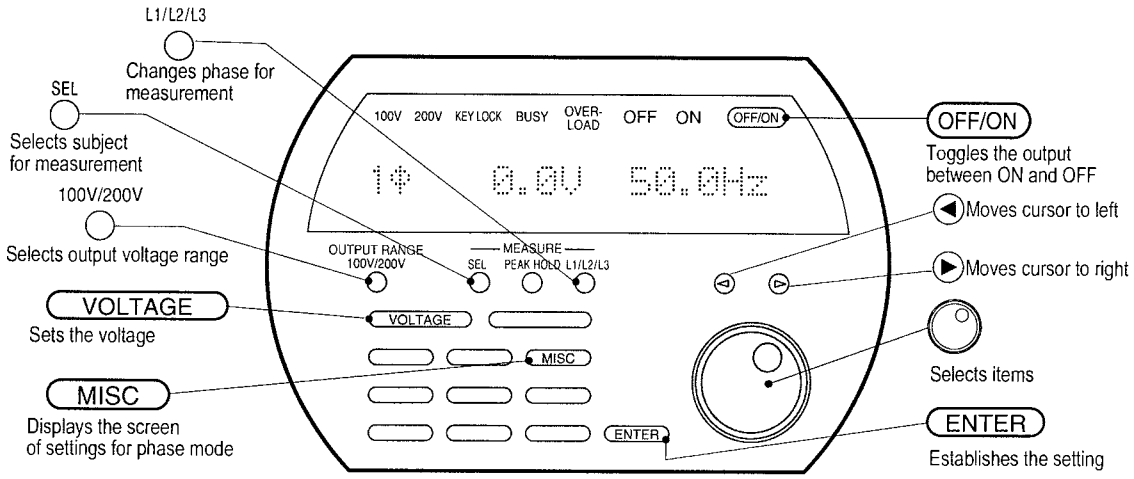
DC output mode limitations

DC output mode can be used only in the single-phase mode.

In addition, phase mode cannot be changed in the DC output mode.

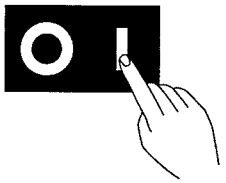
Using the system as a three-phase power supply

A three-phase power system will be achieved.
The output voltage can be set in either phase voltage or line-to-line voltage.
☞ Refer to Chapter 3 "Installation and Connection" for proper connection between load and the P-STATION/EPO terminals.



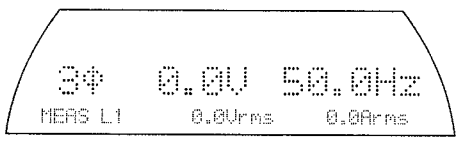
Turning ON/OFF the power

1. Turn ON the power switches on the P-STATION/EPO unit



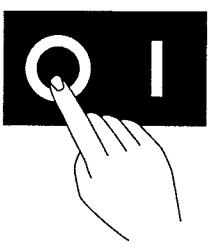
2. The system will be available as a three-phase power supply

Normal screen



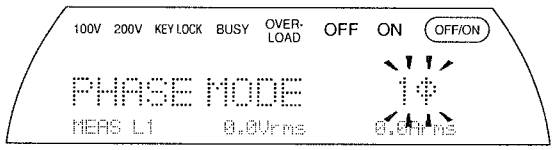
※If the phase mode is not 3 ϕ, then carry out the "Changing to three-phase mode" procedure in the following section.

3. To shut off the power input, turn off the power switch on the P-STATION/EPO unit.

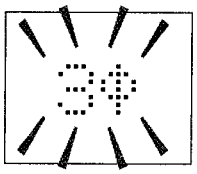


Changing to three-phase mode

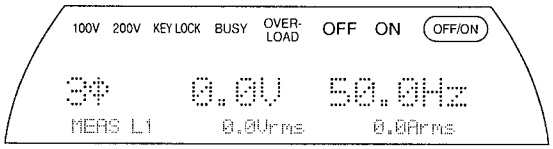
① Press (MISC) couples of times until a phase setting screen appears.



② Turn the dial and select 3φ.



③ Press (ENTER) to change three-phase mode.



The indication denotes the phase mode of "single-phase", "single-phase three-wire" and "three-phase" as follows:

Indication	Phase mode
1φ	Single-phase
2φ	Single-phase three-wire
3φ	Three-phase

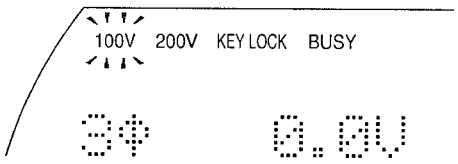
Attention!

When the power is turned on, the system starts up with the contents stored at Address 1 of the memory. After the change of phase mode, store afresh the status of normal use into Address 1.

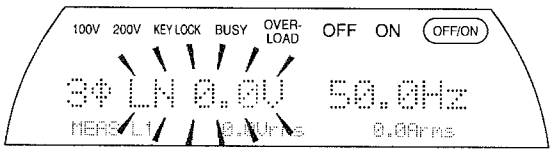
Exemplary voltage setting: supplying three-phase 200 V output

1 Press 100V/200V ○ to select the voltage range.

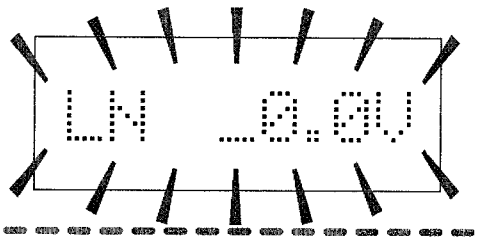
※To supply three-phase 200 V (line-to-line voltage of 200 V) output, select the 100 V range.



2 Press (VOLTAGE) to blink the voltage indication, and pressing (VOLTAGE) again toggles between "Phase voltage" and "Line-to-line voltage" setting screens.

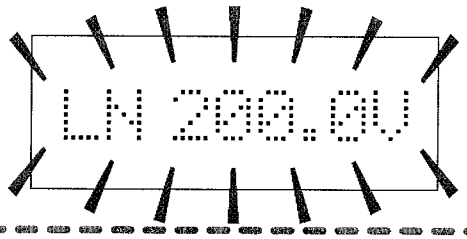


3 Press ◀ and ▶ to locate the cursor.



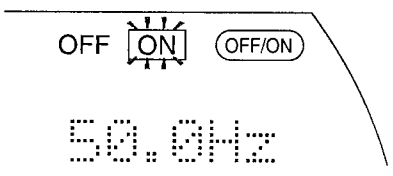
4 Turn the dial ◯ to select the desired output voltage

※To supply three-phase 200 V output, select 115.5 V in phase voltage or 200.0 V in line-to-line voltage.

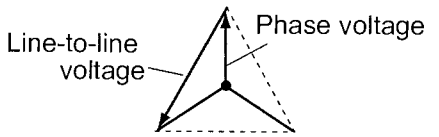


5 Press (OFF/ON) to turn on the output.

※Now the system is ready to provide three-phase power.

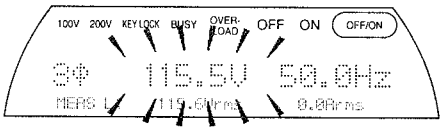


Attention!

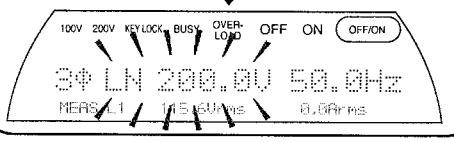


Voltage range	Maximum phase voltage	Maximum line-to-line voltage
100 V range	150.0V	259.8V
200 V range	300.0V	519.6V

Phase voltage setting



Line-to-line voltage setting



Memo

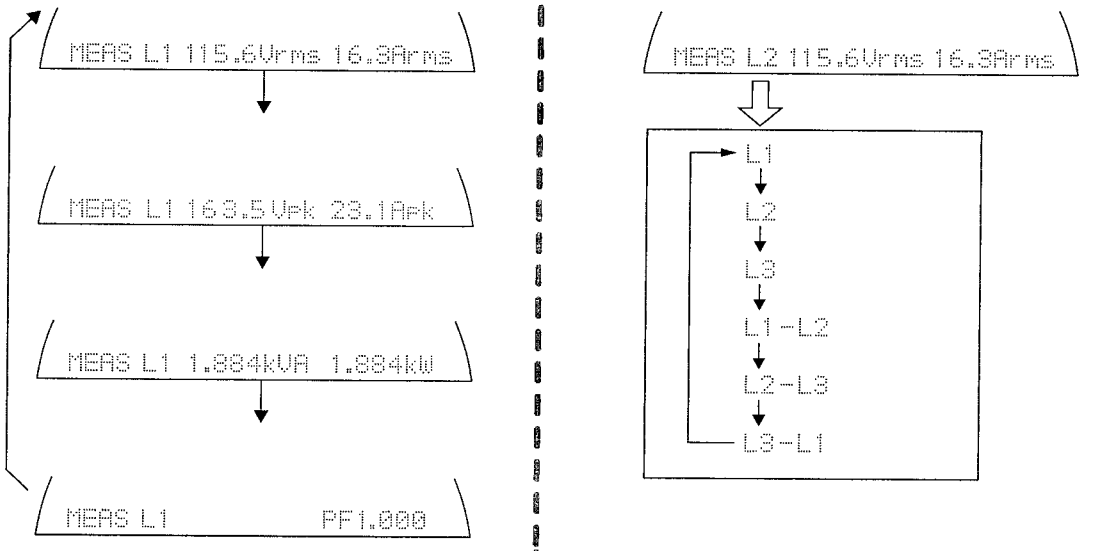
- If voltage setting is selected in line-to-line voltage, then the normal screen and the upper limit to output voltage are also shown in line-to-line voltage.
- Line-to-line voltage setting is made in 0.2 V resolution.

Using a measuring function in three-phase configuration

This function measures and displays "RMS value of voltage and current", "peak value of voltage and current", "apparent power", "effective power", and "power factor".
It is possible to change the phase of measurement.

① Every press on SEL ○ shows in turn different measurements in the bottom line as follows:

② A press on L1/L2/L3 ○ changes the phase of measurement



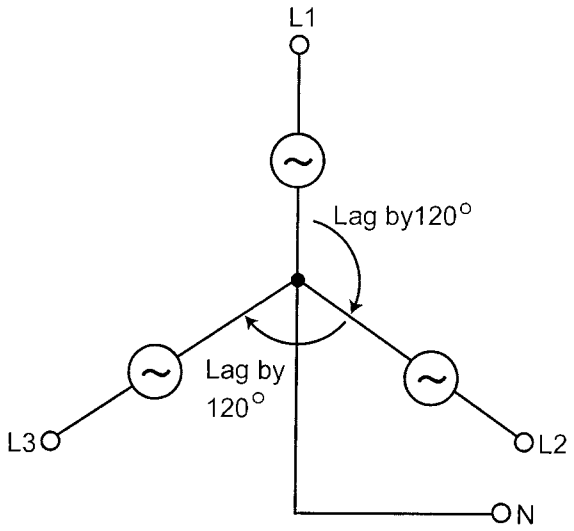
Different measurements are displayed one after another as shown below.

Measurement phase changes by press on L1/L2/L3 ○	Indication of measurements			
	Vrms, Arms	Vpk, Apk	kVA, kW	PF
L1	L1-phase voltage, L1-phase current		L1-phase apparent power L1-phase effective power	L1-phase power factor
L2	L2-phase voltage, L2-phase current		L2-phase apparent power L2-phase effective power	L2-phase power factor
L3	L3-phase voltage, L3-phase current		L3-phase apparent power L3-phase effective power	L3-phase power factor
L1-L2	L1-L2 line-to-line voltage, L1-phase current		Phase-total apparent power Phase-total effective power	All-phase power factor
L2-L3	L2-L3 line-to-line voltage, L2-phase current			
L3-L1	L3-L1 line-to-line voltage, L3-phase current			

Different functions in three-phase mode

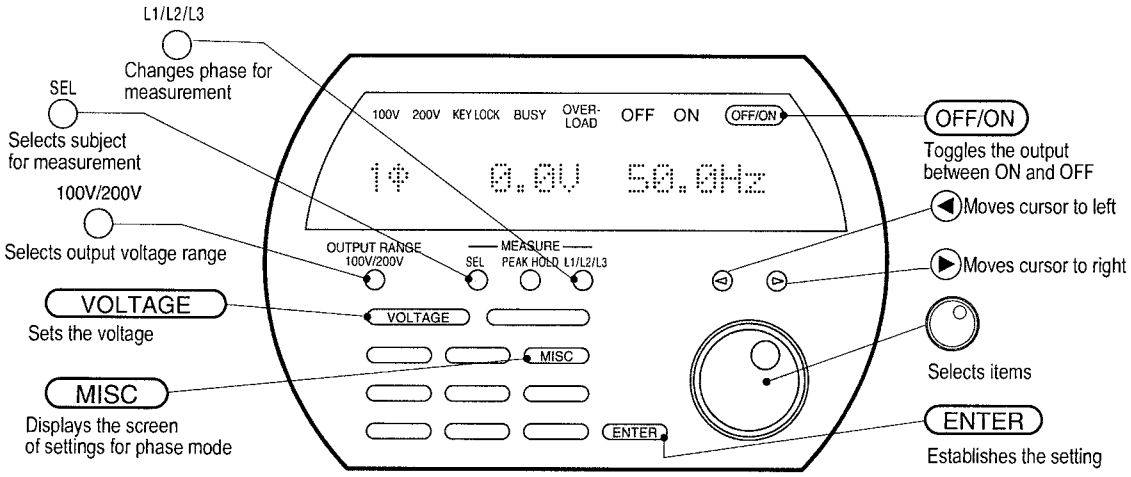
Output limit setting	Range of upper limit to output voltage and upper/lower limit to output frequency can be set as the same way of single-phase mode. If the normal screen is shown in line-to-line voltage, the upper limit to output voltage is also indicated and can be set in line-to-line voltage.
DC output mode	Not available.
Storage function	Recall is possible to the address at which different phase mode is stored. The output is turned to off because of safety reason.
Setting the power-on phase on output turn-on	Power-on phase can be set on the basis of L1-phase. L2-phase and L3-phase start together with L1-phase.
Peak current retaining function	Measurement is available similarly to that in single-phase mode. The phase of measurement can be changed as well.

Phase (L1, L2, L3) indication and phases



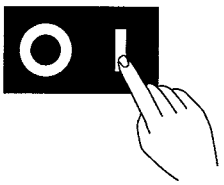
Using the system as a single-phase three-wire power supply

This system can be used as a single-phase three-wire power supply system.
The output voltage can be set in either phase voltage or line-to-line voltage.
☞ Refer to Chapter 3 "Installation and Connection" for proper connection between load and the P-STATION/EPO terminals.



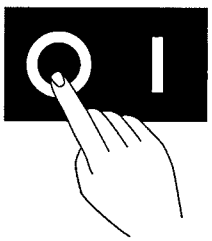
Turning ON/OFF the power

① Turn ON the power switches on the P-STATION/EPO unit

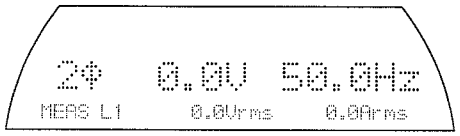


② TThe system will be available as a single-phase three-wire power supply.

③ To shut off the power input, turn off the power switch on the P-STATION/EPO unit.



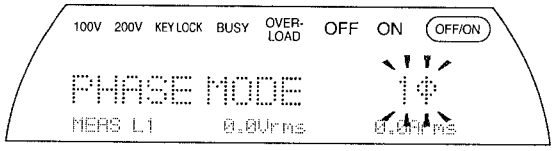
Normal screen



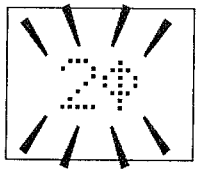
※If the phase mode is not 2 ϕ , then carry out the "Changing to single-phase three-wire mode" procedure in the following section.

Changing to single-phase three-wire mode

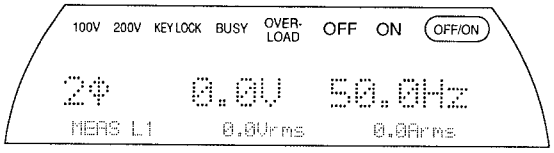
① Press (MISC) couples of times until a phase setting screen appears.



② Turn the dial and select 2φ.



③ Press (ENTER), and a mode will be changed to a single-phase three mode.



The indication denotes the phase mode of "single-phase", "single-phase three-wire" and "three-phase" as follows:

Indication	Phase mode
1φ	Single-phase
2φ	Single-phase three-wire
3φ	Three-phase

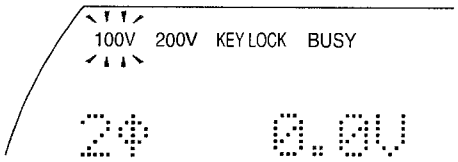
Attention!

When the power is turned on, the system starts up with the contents stored at Address 1 of the memory. After the change of phase mode, store afresh the status of normal use into Address 1.

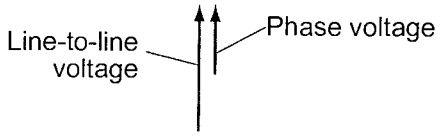
Exemplary voltage setting: supplying single-phase three-wire 200 V output

① Press 100V/200V ○ to select the voltage range.

※To supply single-phase three-wire 200 V (line voltage of 200 V) output, select the 100 V range.

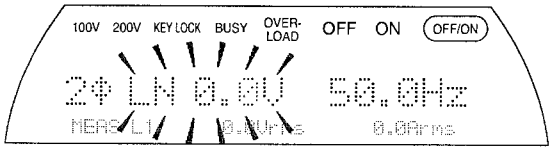


Attention!

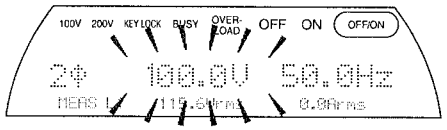


Voltage range	Maximum phase voltage	Maximum line-to-line voltage
100 V range	150.0V	300.0V
200 V range	300.0V	600.0V

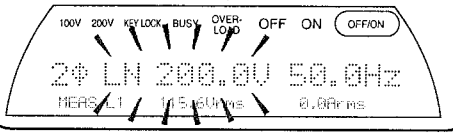
② Press VOLTAGE to blink the voltage indication, and pressing VOLTAGE again toggles between "Phase voltage" and "Line-to-line voltage" setting screens.



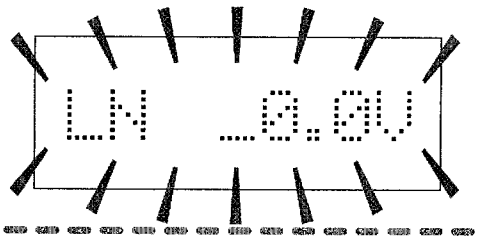
Phase voltage setting



Line-to-line voltage setting

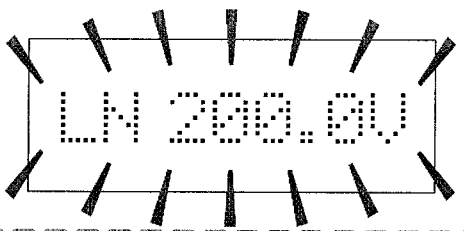


③ Press ◀ and ▶ to locate the cursor.



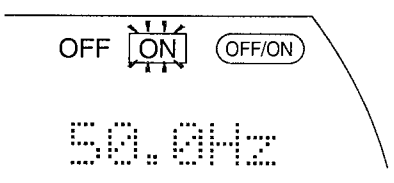
④ Turn the dial ○ to select the desired output voltage

※To supply single-phase three-wire 200 V output, select 100 V in phase voltage or 200.0 V in line voltage.



⑤ Press OFF/ON to turn on the output.

※Now the system is ready to provide single-phase three-wire power.



Memo

- If voltage setting is selected in line-to-line voltage, then the normal screen and the upper limit to output voltage are also shown in line-to-line voltage.
- Line-to-line voltage setting is made in 0.2 V resolution.

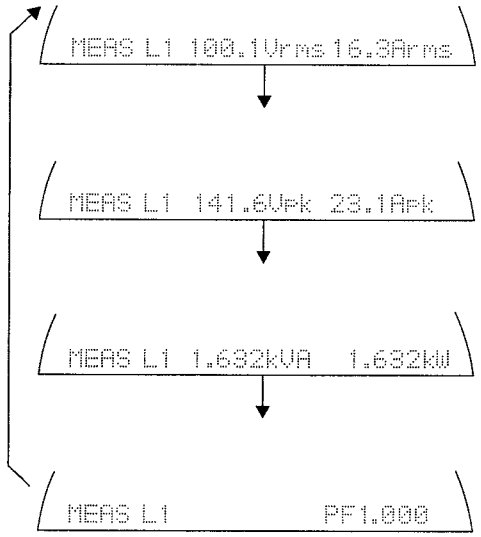
Memo

- If the user needs an AC power supply with 300 V or higher voltage, then configure a single-phase three-wire system. This can supply up to line 600 Vac power.

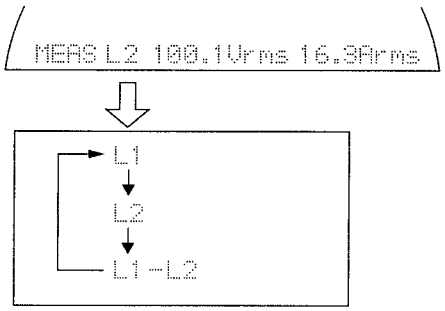
Using a measuring function in single-phase three-wire configuration

This function measures and displays "RMS value of voltage and current", "peak value of voltage and current", "apparent power", "effective power", and "power factor".
It is possible to change the phase of measurement.

① Every press on SEL ○ shows in turn different measurements in the bottom line as follows:



② A press on L1/L2/L3 ○ changes the phase of measurement



Different measurements are displayed one after another as shown below.

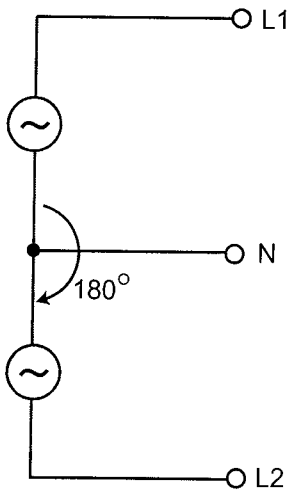
Measurement phase changes by press on L1/L2/L3 ○	Indication of measurements			
	Vrms, Arms	Vpk, Apk	kVA, kW	PF
L1	L1-phase voltage, L1-phase current		L1-phase apparent power L1-phase effective power	L1-phase power factor
L2	L2-phase voltage, L2-phase current		L2-phase apparent power L2-phase effective power	L2-phase power factor
L1-L2	L1-L2 line-to-line voltage, L1-phase current		Phase-total apparent power Phase-total effective power	All-phase power factor

P-STATION/EPO

Different functions in single-phase three-wire

Output limit setting	Range of upper limit to output voltage and upper/lower limit to output frequency can be set as the same way of single-phase mode. If the normal screen is shown in line-to-line voltage, the upper limit to output voltage is also indicated and can be set in line-to-line voltage.
DC output mode	Not available.
Storage function	Recall is possible to the address at which different phase mode is stored. The output is turned to off because of safety reason.
Setting the power-on phase on output turn-on	Power-on phase can be set on the basis of L1-phase. L2-phase starts together with L1-phase.
Peak current retaining function	Measurement is available similarly to that in single-phase mode. The phase of measurement can be changed as well.

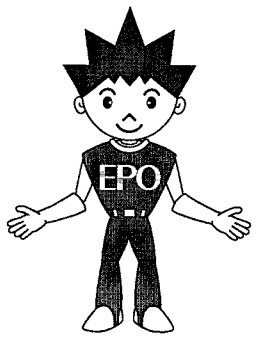
Single-phase three-wire (L1, L2) indication and phases



7

Useful Functions

- Versatile functions are ready for use -



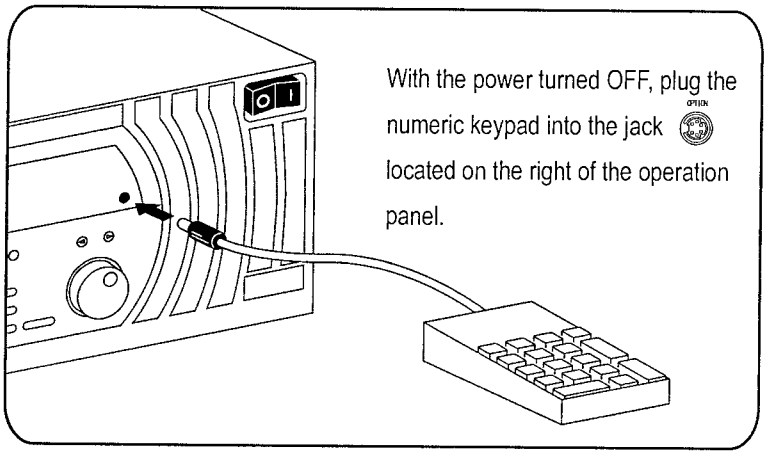
Using numeric keypad for setting (option)

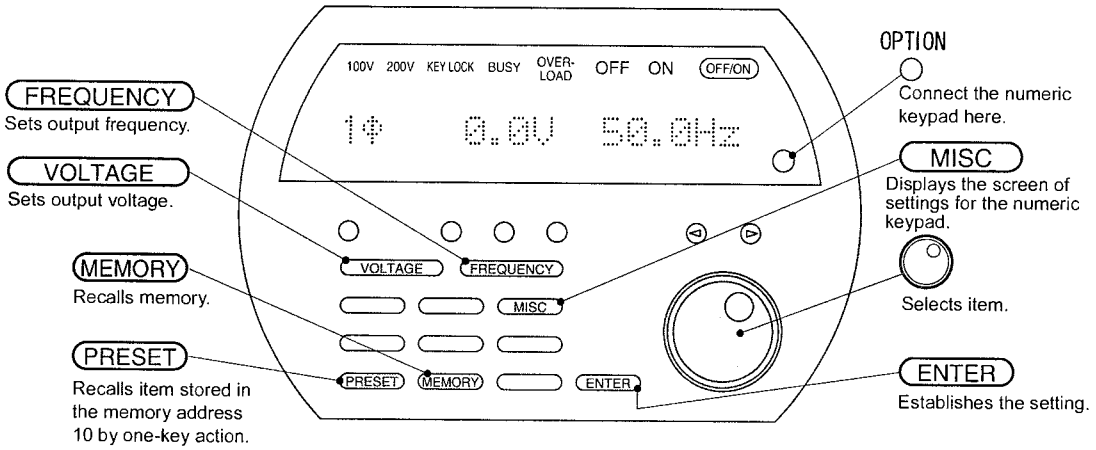
With the optional numeric keypad, the user can directly enter values to set the output voltage, output frequency and other setting items. In addition, memory can be recalled by a single touch on the keypad.

⚠ CAUTION!

The numeric keypad must be connected prior to power charging. With the power being supplied, connection or disconnection of the numeric keypad may cause malfunction.

Connecting the numeric keypad

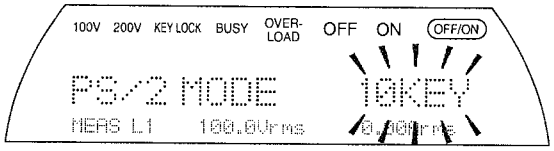




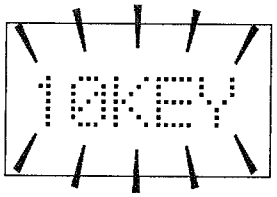
Selecting operation mode of numeric keypad

Select either of two operation modes of the numeric keypad.
The "10KEY" mode allows the user to directly entry the value of output voltage, output frequency and other items (this mode is selected on shipping).
The other "RECALL" mode can recall the contents stored in the memory by a single button touch on the numeric keypad. This mode is effective in sequential tests under preset conditions.

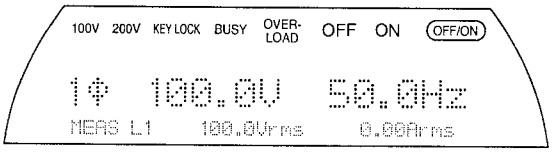
1 Press (MISC) couples of times until a numeric keypad operation setting screen appears.



2 Turn the dial and select either of "10KEY" and "RECALL".



3 Press (ENTER) to establish the selection, and the display returns to the normal screen.



Memo

If "10KEY" is selected for operation mode, numeric entry is available for the following setting items:

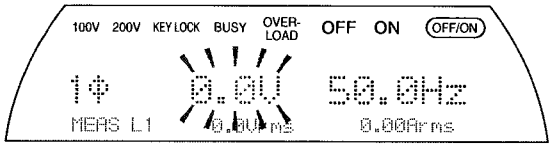
- Output voltage (phase/line/DC)
- Upper limit to output voltage (phase/line/DC)
- Lower limit to output frequency
- Recall memory number
- Output frequency
- Upper limit to output frequency
- Storage memory number
- GPIB address

Operation in numeric entry (10KEY) mode

The following section describes operation by taking "output voltage" and "memory recall address" as example.

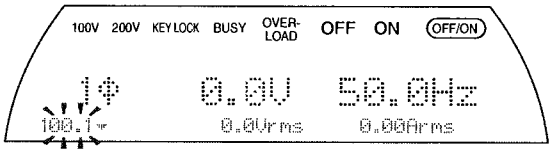
Setting the output voltage by numeric entry

1 Press (VOLTAGE) to show the output voltage setting screen.



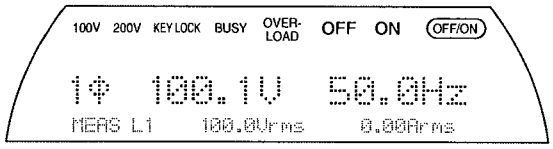
2 From the numeric keypad, enter the desired value for setting (values appears in the bottom line).

Example: To specify 100.1 V, enter [1] [0] [0] [.] [1] on the keypad.



3 Press [ENTER] on the keypad to establish the entered value.

※ Here, press [ENTER] on the keypad instead of that on the operation panel.



Attention!

Dissimilar to setting on rotary dial, just numeric entry does not establish the entered value.

Be sure to press [ENTER] on the numeric keypad at the end of entry.

Memo

If any wrong number is entered, press the slash [/] button. This cancels the last entered number and allows you to continue setting.

Memo

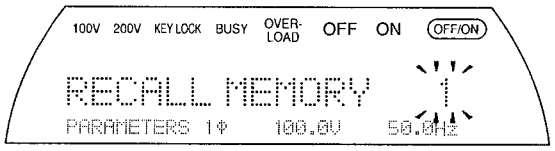
If you press (ENTER) on the operation panel during value setting on the numeric keypad, the numbers that have been entered so far will be discarded. The output voltage setting prior to starting this setting will become effective and the display returns to the normal screen.

Memo

Even if you attempt to set a value that is out of the setting range or a value that exceeds the upper limit to the output voltage, numeric entry is accepted. However, when your press [ENTER] on the keypad, the numbers that have been entered so far will be discarded and the display returns to the output voltage setting screen.

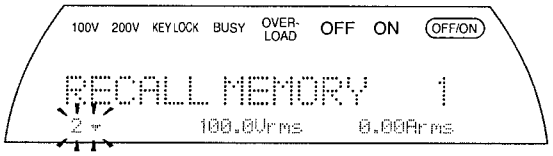
Setting memory recall address by numeric entry

① Press (MEMORY) twice to show the memory recall setting screen.



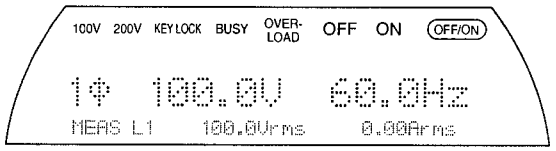
② From the numeric keypad, enter the desired value for setting (values appears in the bottom line).

Example: To specify 2, enter [2] on the keypad.



③ Press (ENTER).

※You may press either (ENTER) on the operation panel or on the numeric keypad to establish the entered value.



Memo

If any wrong number is entered, press the slash [/] button. This cancels the last entered number and allows you to continue setting.

Memo

Even if you attempt to set a value that is out of the setting range, numeric entry is accepted. However, when your press [ENTER] on the keypad, the numbers that have been entered so far will be discarded and the display returns to the memory recall setting screen.

Operation in memory recall (RECALL) mode

Recalling the contents in memory by a single button touch on the numeric keypad

① Press the desired memory address for recall.

Example: To recall memory 3, then enter [3].

This numeric keypad operation can recall memory at Addresses 0 to 9. To recall memory address 10, press (PRESET).

Memo

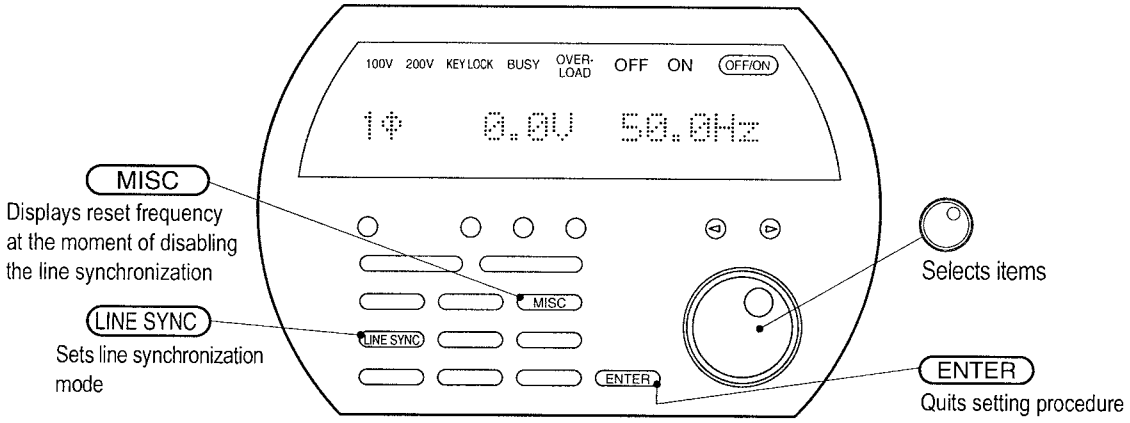
You do not have to press (ENTER) to recall memory dissimilar to numeric entry of output voltage.
On the other hand, you cannot correct wrong entry of memory address on the keypad.

Memo

Similarly to memory call on the operation panel, some memory cannot be recalled depending on the conditions of AC/DC, phase mode (single-phase/single-phase three-wire/three-phase) and other factors.

☞ For further information, refer to Chapter 5 "Versatile Use - for advanced users -".

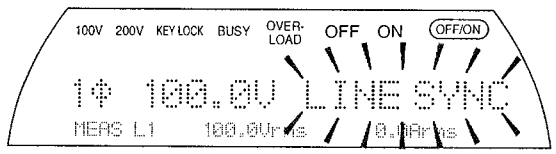
Line synchronization



This function synchronizes the output frequency to the frequency of the AC power supply line.
Synchronization is available to the power supply line in the range of 48 to 62 Hz .
It is possible to specify 50 Hz or 60 Hz for the reset frequency at the moment of disabling the line synchronization.

Enabling line synchronization

1. Press (LINE SYNC), and the system enters a status of enabled line synchronization and a line synchronization screen appears.

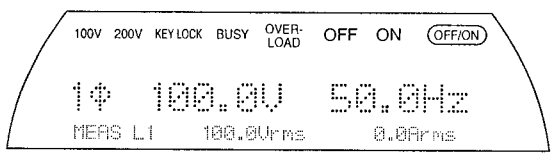


Memo

If line synchronization is switched between ON and OFF with the output supply being kept ON, the output will be turned OFF.

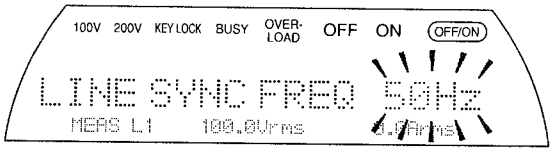
Disabling line synchronization

1. Press (LINE SYNC), and the system quits the status of line synchronization and the display returns to the normal screen.

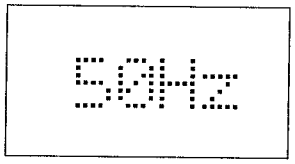


Setting the reset frequency at the line synchronization OFF moment

1 Press (MISC) couples of times until a screen for setting the reset frequency appears at the line synchronization OFF moment.

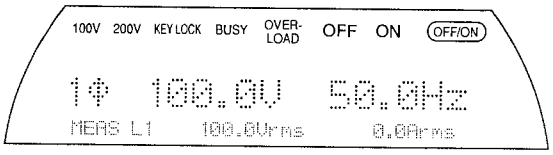


2 Turn the dial and select the reset frequency at the line synchronization OFF moment.



Frequency of 50 or 60 Hz is available for setting.

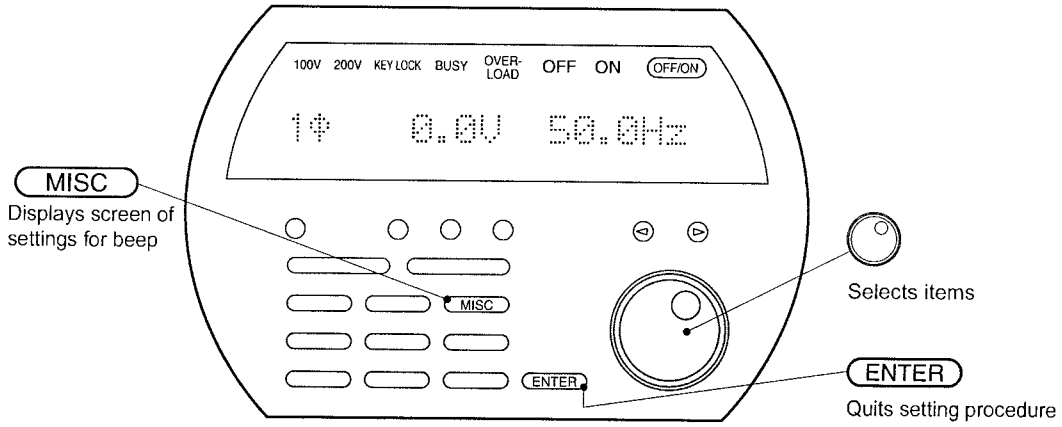
3 Press (ENTER) to quit the selection procedure, and the display returns to the normal screen.



Attention!

If the frequency setting range defined by the setting of frequency limiting value(s) does not contain the range from 50 or 60 Hz, line synchronization cannot be enabled.

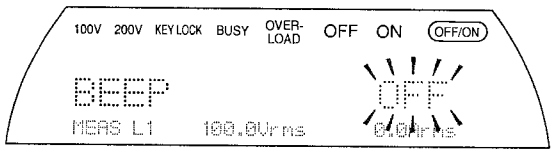
Switching ON/OFF beep warning



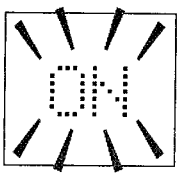
A beep is issued for warning if any impermissible setting is attempted or when the system suffers overload. This function can be disabled if the beep warning is not necessary.

Enabling/disabling beep warning

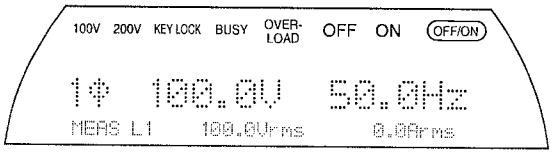
1 Press MISC couples of times until a beep warning setting screen appears.



2 Turn the dial and select "ON" or "OFF".

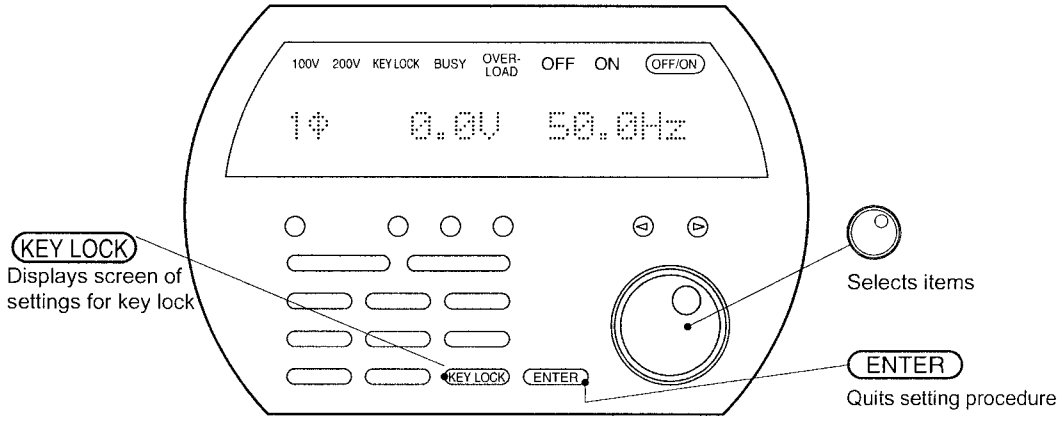


3 Press ENTER to quit the selection procedure, and the display returns to the normal screen.



"ON" for enabling beep warning.
"OFF" for disabling beep warning.

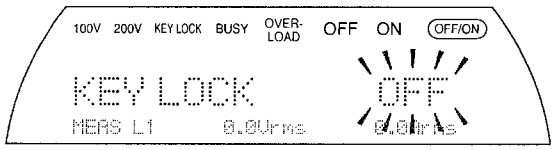
Key lock



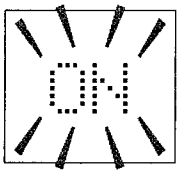
This function prevents settings from accidental modification caused by wrong operation.

Enabling key lock

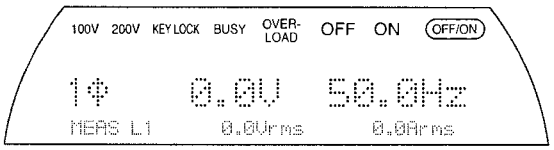
1. Press KEY LOCK to show the key lock setting screen.



2. Turn the dial and select "ON".

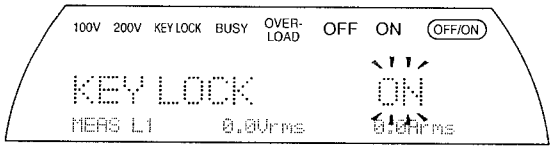


3. Press ENTER to quit the selection procedure, and the display returns to the normal screen.

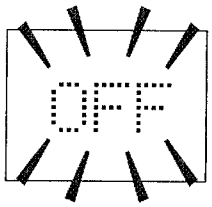


Disabling key lock

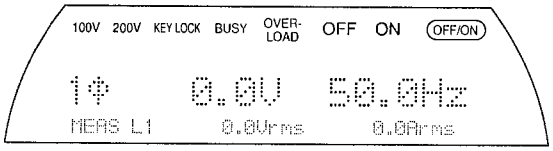
1. Press (KEY LOCK) to show the key lock setting screen.



2. Turn the dial and select "OFF.



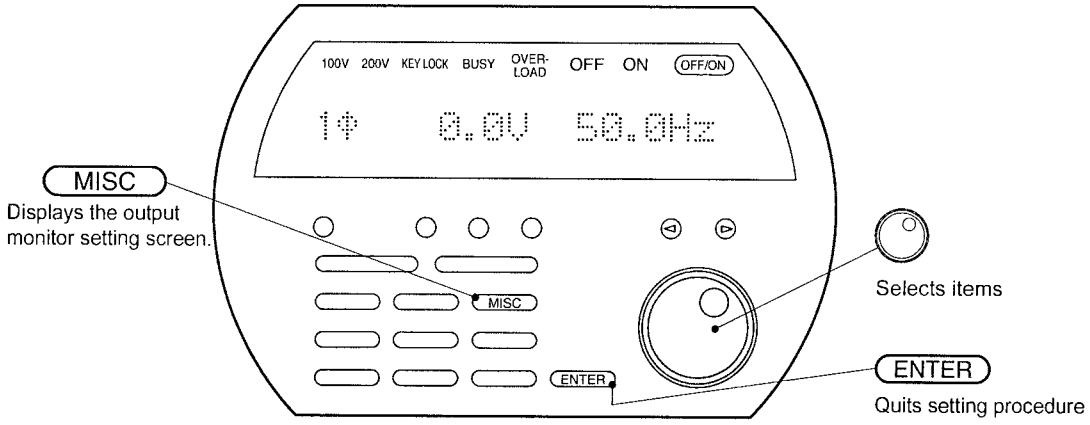
3. Press (ENTER) to quit the selection procedure, and the display returns to the normal screen.



Attention!

When the key lock function is ON, the system accepts only the operation to disable the key lock (i.e., operation of (KEY LOCK), (ENTER) and rotary dial).

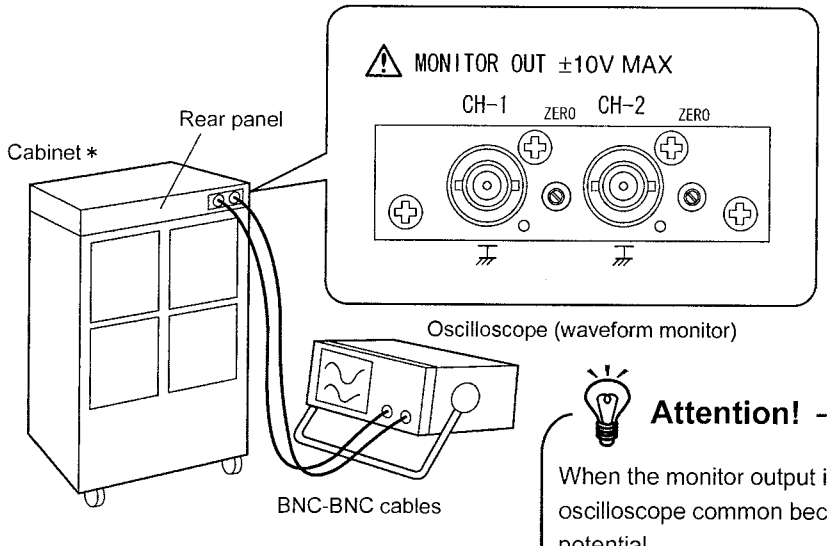
Output waveform monitor (option item when you place an order)



The voltage and the current waveforms of the P-STATION/EPO output can be monitored in oscilloscope.
The output waveform monitor has two output terminals. The output voltage and the output current can be monitored simultaneously in the single-phase mode. In the case of single-phase three-wire mode and three-phase mode, two waveforms you desire can be selected to monitor.
The monitor output is a voltage output and its common is connected to chassis ground.

Connection of output waveform monitor

The output waveform monitor terminals are BNC terminals. Use a BNC-BNC type cable to connect to the waveform monitor.



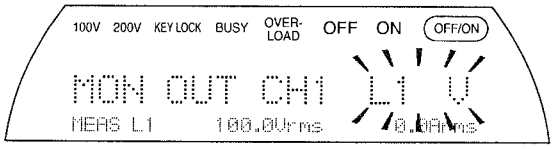
* In the case of EPO 18000M/24000M/36000M systems, the cabinet becomes the master cabinet.

Attention!

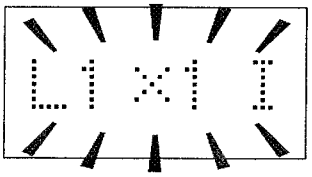
When the monitor output is connected, oscilloscope common becomes the ground potential.
If another potential waveform such as the output terminal is observed at the same time, abnormal current may flow between the two common lines and it may be difficult to observe two waveforms at the same time.

Monitor settings

1 Press (MISC) any times as necessary to show the output monitor CH1 setting screen.
* The default on the CH1 screen is L1 V.



2 Turn the dial and the desired monitor item and its conversion rate.



Single-phase mode

Display	Phase	Voltage/Current	Conversion rate
L1 V	L1-phase	Voltage	1V/100V
L1 X1 I		Current	1V/50A
L1 X10 I			1V/5A

Single-phase three-wire mode

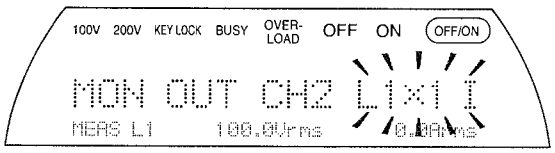
Display	Phase	Voltage/Current	Conversion rate
L1 V	L1-phase	Voltage	1V/100V
L1 X1 I		Current	1V/50A
L1 X10 I			1V/5A
L2 V	L2-phase	Voltage	1V/100V
L2 X1 I		Current	1V/50A
L2 X10 I			1V/5A

Three-phase mode

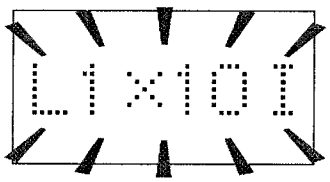
Display	Phase	Voltage/Current	Conversion rate
L1 V	L1-phase	Voltage	1V/100V
L1 X1 I		Current	1V/50A
L1 X10 I			1V/5A
L2 V	L2-phase	Voltage	1V/100V
L2 X1 I		Current	1V/50A
L2 X10 I			1V/5A
L3 V	L3-phase	Voltage	1V/100V
L3 X1 I		Current	1V/50A
L3 X10 I			1V/5A

※No changes occur beyond the point of arrow even if turning further.
Turning clockwise goes down and turning counterclockwise goes up.

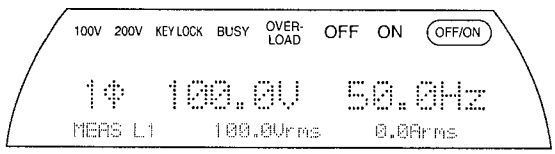
3 Press (MISC) to show the output monitor CH1 setting screen.
* The default on the CH1 screen is L1 V.



4 Turn the dial and the desired monitor item and its conversion rate.



5 Press (ENTER) to quit the selection procedure, and the display returns to the normal screen.



Memo

If the zero point of waveform monitor output has been shifted, adjust the zero point by turning the ZERO trimmer using a small-size flathead screwdriver.

P-STATION/EPO

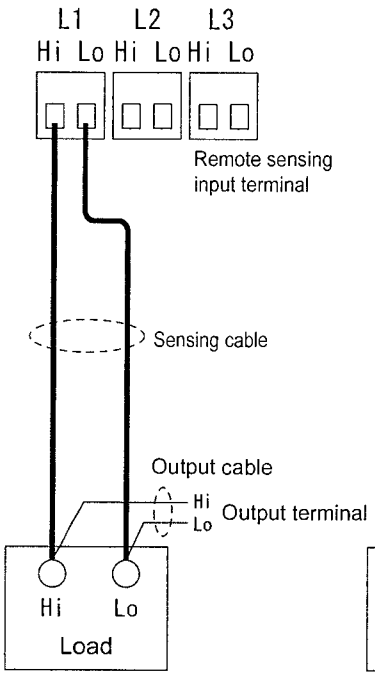
Remote sensing AGC (option item when you place an order)

The remote sensing AGC is a function to control and keep the voltage constant at a location away from the main unit by detecting the output voltage there. It can be used to maintain the voltage across the load constant by compensating the voltage drop caused by the output cable.
The P-STATION/EPO remote sensing system takes out only the amplitude component from the detected voltage signal and controls the output voltage so that the amplitude component remains constant. In this method, you can obtain the stable voltage not affected by the impedance component of the cable.
However, it may take extra time to stabilize the voltage when a certain load is connected or when the output voltage or output frequency changes suddenly.
The output compensation range is 5%. Under the condition that this compensation range cannot be maintained, the overload lamp lights and the compensated operation no longer works. In this case, turn off the output and check whether the output cables and/or the sensing cables are not broken or check whether they are not erroneously connected.
In addition, if the cross sectional area of the output cables is not large enough, voltage drop becomes too large and the same error as above occurs. Select an appropriate size of output cables.
Refer to Chapter 3, "Installation and Connection."

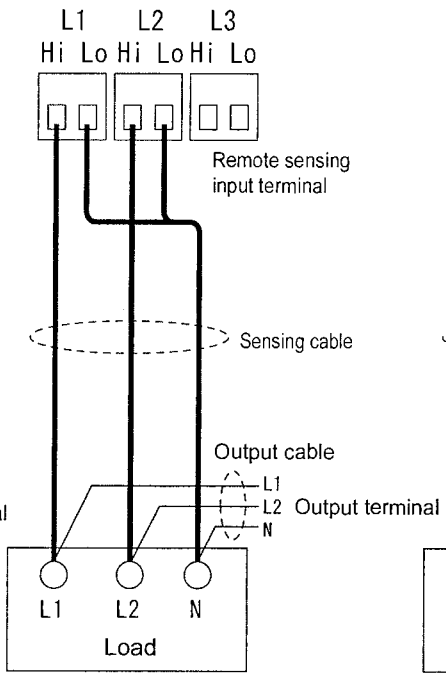
Cable connections for remote sensing

Connection diagram

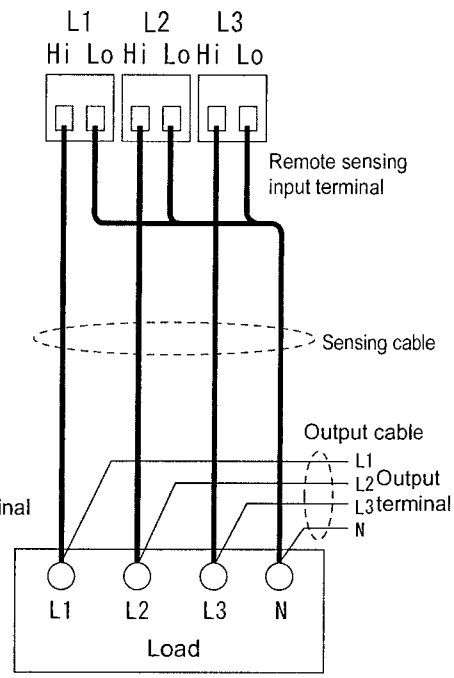
Connection for single-phase mode



Connection for single-phase three-wire mode



Connection for three-wire mode



WARNING!

The voltage at the remote sensing input terminal is the same as the output voltage. For safety reason, turn off power when connecting the cable.

CAUTION!

Use 1.25 to 2 mm^2 vinyl insulated wires (nominal value) for remote sensing cables.
Connect the cables securely.
If the cables are disconnected or broken while remote sensing is performed, excessive voltage appears on the output line and may destroy the load.

Attention!

When a magnetic contactor is installed between the output terminal and the load to turn on or off the output, the output detection point must be switched interlocked with the magnetic contractor.

Attention!

The remote sensing input terminal and the output detection point must be connected correctly with their polarity matched. In the three-phase mode and in the single-phase three-wire mode, connect the cables with each L1, L2 and L3 phases matched.
Twist the sensing cables with Hi and Lo in pairs.

Connection method

The cable connection point can be removed if you pull it toward you. If the wiring is inconvenient for you to work, you can remove it.

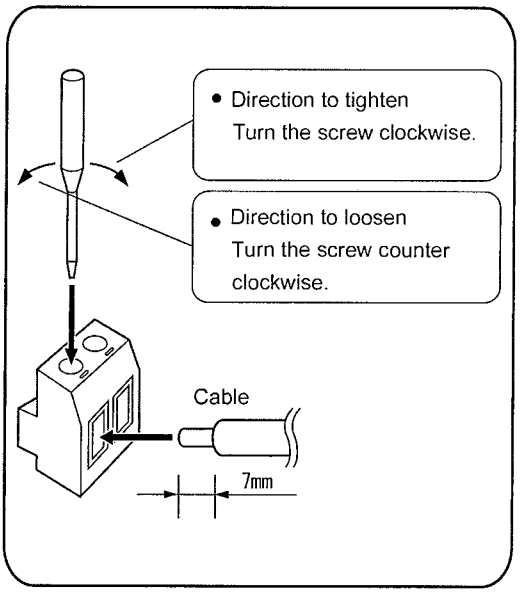
Remove the insulation coating of the cable about 7 mm from the end of the cable.

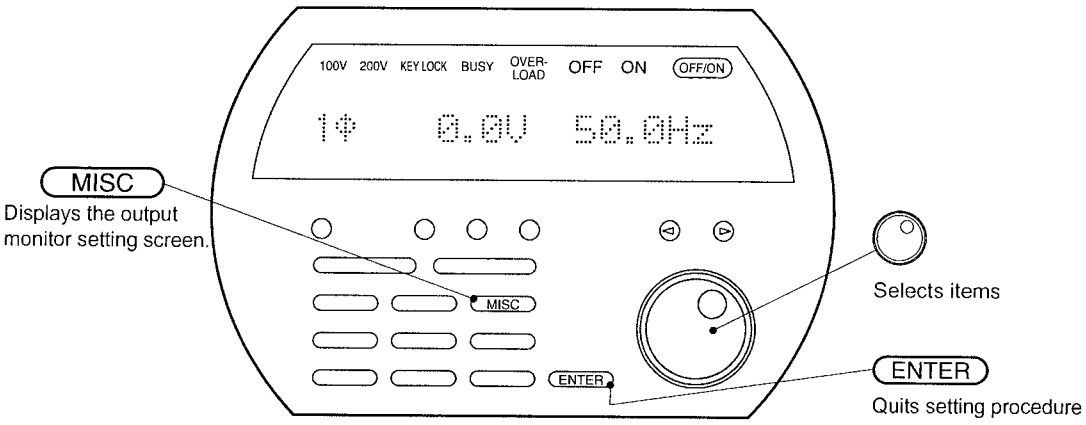
Loosen the terminal screw with a small-size flat-head screwdriver to open the cable entry port.

Insert the core wire of the cable.

Tighten the terminal screw.

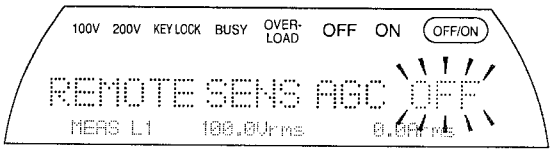
Appropriate tightening torque is 0.5 to 0.6 N・m (5.1 to 6.1 kgf・cm).



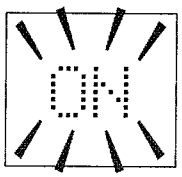


Turning on or off the remote sensing AGC

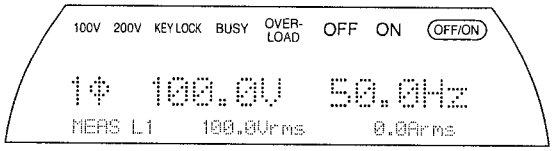
1. Press MISC as many times as necessary to show the remote sensing setting screen.
   * The default screen is "off".



2. Turn the dial and select "ON" or "OFF".



3. Press ENTER to quit the selection procedure, and the display returns to the normal screen.



8

GPIB Interface

Outline of GPIB

The P-STATION/EPO unit can control most of functions that are operated from the panel using GPIB.
If functions can be controlled by GPIB, then they can be controlled also by RS-232 except some other functions.
Actual operation or programming depends on the programming language on the contorller side or the GPIB driver. For further information, see their respective instruction manual and related documents together with this manual.

Functions that cannot be operated via GPIB

- Turning ON/OFF of power supply
- Initialization to on-shipping settings
- Switching between GPIB and RS-232
- Setting of GPIB address and message terminator on sending occasion
- Setting of baud rate, parity and character length of RS-232

Functions that can be controlled via the GPIB but cannnot be operated from the panel

- GPIB proper functions (e.g., status byte, remote/local etc.)

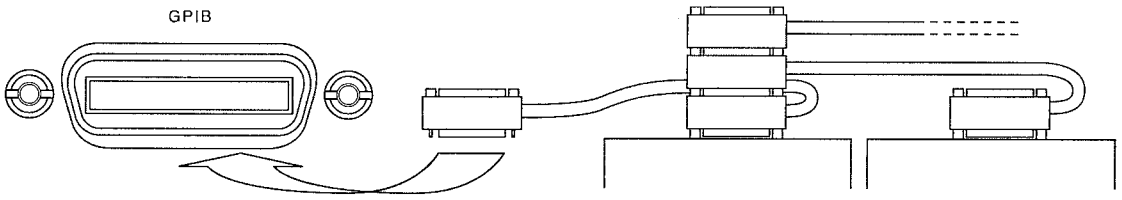
Applicable specifications

- Conforming to IEEE standard 488.1-1987
- Interface functions (See the table below.)

SH1	Provides all functions of source handshake
AH1	Provides all functions of acceptor handshake
T6	Provides functions of basic talker, serial poll and listener-defined talker-releasing; does not provides talk-only function
L4	Provides functions of basic listener and listener-defined listener-releasing; does not provide listen-only function
SR1	Provides all functions of service request
RL1	Provides all functions of remote/local
PP0	Does not provide parallel poll function
DC1	Provides all functions of device clear
DT1	Provides all functions of device trigger
C0	Does not provide controller functions

Connection of GPIB cable

Connect a GPIB cable that meets the specifications to the GPIB bus line.
With a GPIB cable that meets the specifications, connect the GPIB bus lines. Before connection to the bus, turn off power to all devices connected. Securely tighten the connector fixing screws to prevent loosening.



Connection of GPIB cable

Attention!

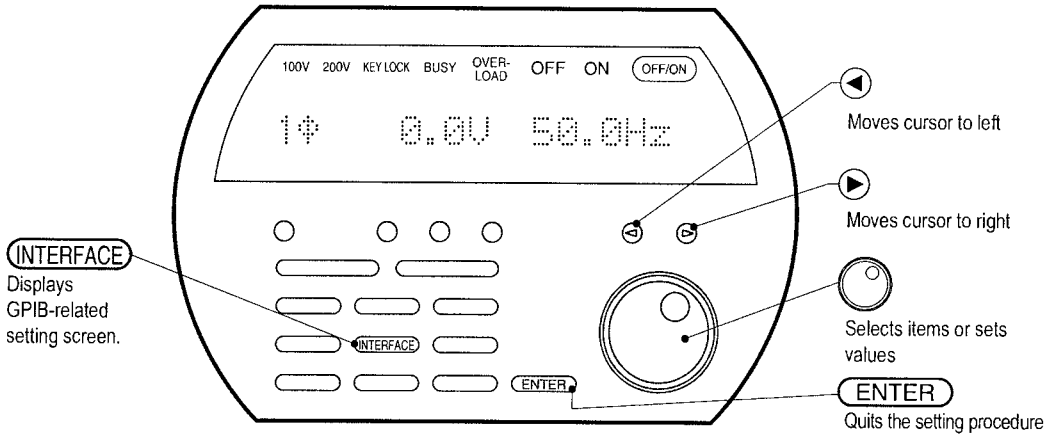
When a magnetic contactor is installed between the output terminal and the load to turn on or off the output, the output detection point must be switched interlocked with the magnetic contractor.

Instructions on use of GPIB

When using GPIB, follow the general instructions listed below.

- Connection or disconnection of GPIB connector with the power supply turned on may damage the equipment. Turn off the power to all devices that are (to be) connected to the bus.
- To enable GPIB functions, turn on the power to all devices connected to the bus.
- Up to 15 devices can be connected to the bus including the controller.
- When determining the cable length, make sure it does not exceed the following length:
  The length of a cable between devices must be 4m or less.
  Total length of cables must be 2m multiplied by the number of devices or 20m whichever is shorter.
- Assign a different address to each device connected to a bus.
- Assigning the same address to two or more devices may not only cause the devices to operate abnormally but also damage the devices.
  A terminator (delimiter of message) must be unified in a system.
- If the terminator is different between the talker and the listener, the system may not function properly.

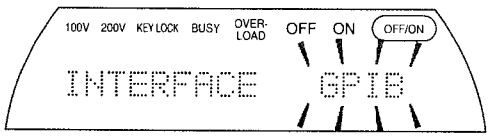
Setting for GPIB use



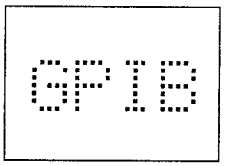
To use the GPIB interface, connect to the unit to the computer with the GPIB interface cable and carry out "Selection of interface", "Setting of GPIB address" and "Setting of terminator".

Selecting the interface

1. Press (INTERFACE) to show the interface setting screen.
   * "GPIB" is selected on shipping.

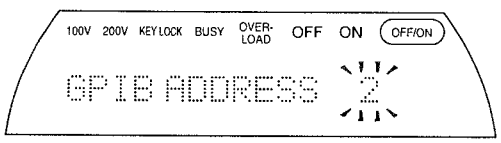


2. Turn the dial to select "GPIB".

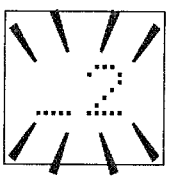


Setting the GPIB address

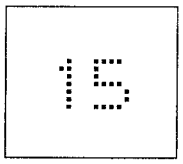
1. Press (INTERFACE) to show the GPIB address setting screen.



2. Press ◀ and ▶ to locate the cursor.



3 Turn the dial to specify the address.

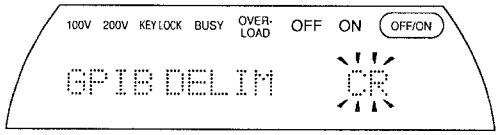


Select a desired one out of 0 to 30 addresses.

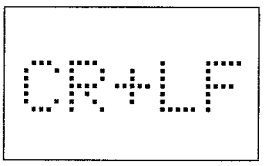
Number "2" is set on shipping.

Selecting a terminator

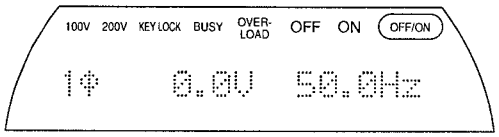
1 Press (INTERFACE) to show the GPIB terminator setting screen.



2 Turn the dial to select the desired terminator.



3 Press (INTERFACE) or (ENTER) to establish the selection and the display returns to the normal screen.

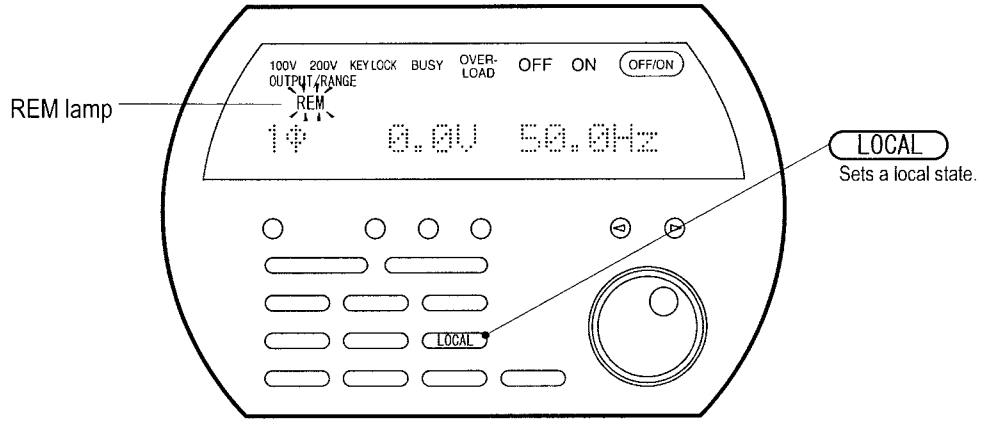


Select one out of terminators: CR+LF, CR and LF.

Attention!

- GPIB and RS-232 cannot be used simultaneously. Select one interface to be used.
- GPIB is selected as the default interface (on-shipping setting).
- During a remote operation using GPIB, any keys other than (LOCAL) (local mode) and (OFF/ON) on the operation panel cannot be operated. (OFF/ON) can only be used when the output is OFF for an emergency stop.

Remote status and release from remote condition



Remote state

With REN (Remote ENable) set to TRUE, sending a program message from the GPIB controller will put the unit in a remote state and cause the REM lamp on the panel to light up.

Local state

This unit remains in a local state until it receives control from the GPIB controller. All keys can be operated from the panel in the local state.

To set the unit in a local state from the GPIB controller, select either of the following two:

- Specify the GPIB address and send a GTL interface message.
- Set REN (Remote ENable) to FALSE

Setting the system to "Local lockout"

It is also possible to operate LOCAL from the panel to set a local state, but the operation varies depending on whether "Local lockout" (LLO) is set or not.

- When LLO is not set.

In a remote state, only LOCAL on the panel is accepted and operating LOCAL puts the unit in a local state.

- When LLO is set.

In a remote state, no key operations from the panel are accepted.

To set LLO, send an LLO interface message in the remote state. To release LLO, set REN (Remote ENable) to FALSE.

Attention!

- The method of using interface messages varies depending on the GPIB controller (GPIB driver). See their respective instruction manuals.
- LLO is generally used when it is inconvenient to carry out operations from the panel during GPIB control, but if it is preferable to enable panel operations in the case of abnormalities, etc., it is recommendable not to use LLO.

Service request and status structure

Outline of status report

When various events occur, a GPIB device can generally send a service request (SRQ) to the controller for interrupt processing. The user can see the status at that moment by reading the contents of each register.

Status byte

A GPIB device has some pieces of status data and they are summarized in the status byte of the device.

Sending a service request

If a bit of the service request enable register is set to 1, then the system will send a service request (SRQ) when the corresponding status bit of the status byte becomes 1..

Capture of an event

The situation of a GPIB device is shown in the condition register and its change is recorded in the event register. If the corresponding bit of the event enable register is set to 1, each bit of the event register will be summarized in the specific one bit of the status byte.

Grasp of queue situation

A GPIB device has a queue to retain the information of output waiting. The status byte contains a status bit that indicates whether the queue has information or not.
P-STATION/EPO provides an MAV bit that indicates the queue situation of response message.

Memo

When a user wants to monitor the condition of a GPIB device, the user sometimes performs serial poll or sends a querying message. These methods, however, are not preferable because they apt to affects the operating speed of the controller (computer) and the GPIB device.
In such situations, the user can extend the interval of query or use a service request in order to enhance the performance.

Status byte register and sending a service request

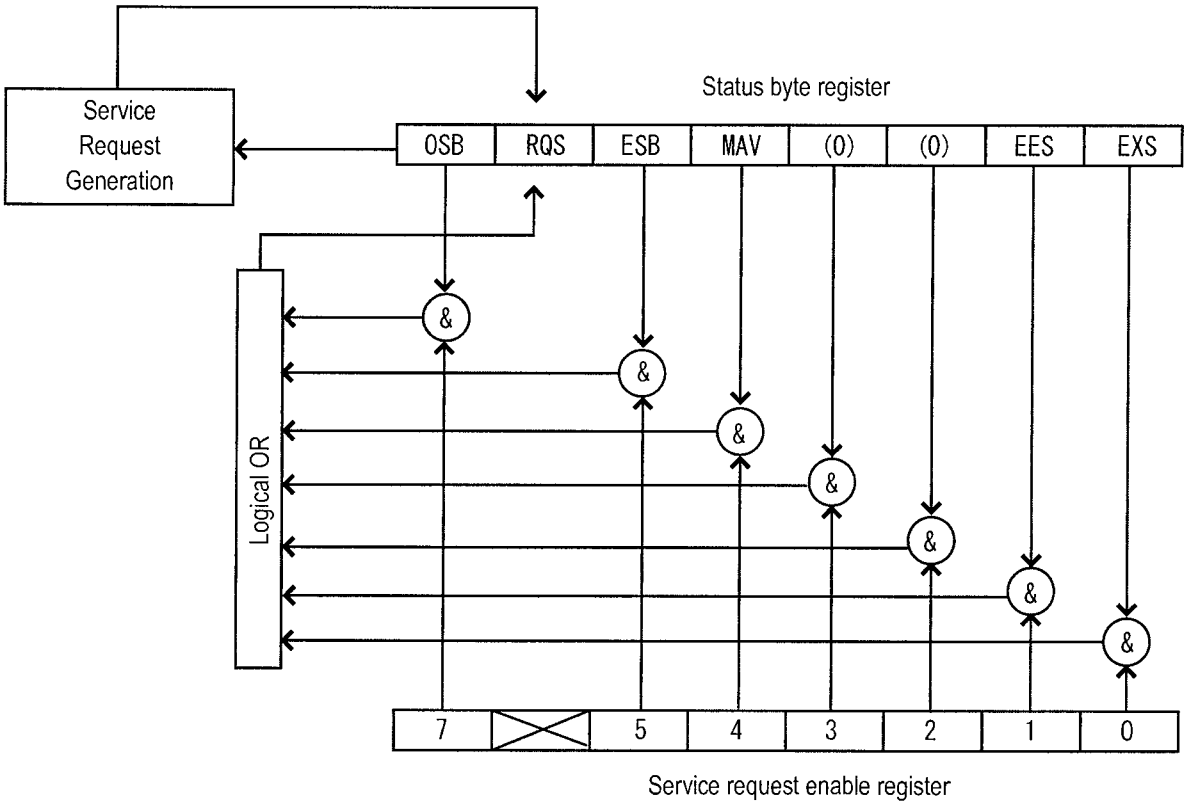
A status byte register contains a summarized data of the situation of a GPIB device.
If a bit of a service request enable register is set to 1, then the system will send a service request (SRQ) when the corresponding status bit becomes 1.
The user can read the status byte by using either of the following two methods:

- Serial poll
- Query via a command "?STB" (the response message will be in a decimal integer.)

Reading a status byte register will not clear the bits (except that the RQS bit is reset when serial poll is performed).
Serial poll is a GPIB function in which the controller assigns an address to read the status byte of each GPIB device. The method of describing a program depends on the language on the controller side and the GPIB driver software.
In the P-STATION/EP0 unit, the service request enable register can execute setting and query using the following message:

- Setting: by a command "SRE" (the data to be set is in a decimal integer and initial value is "0".)
- Query: by a command "?SRE" (the response data will be in a decimal integer.)

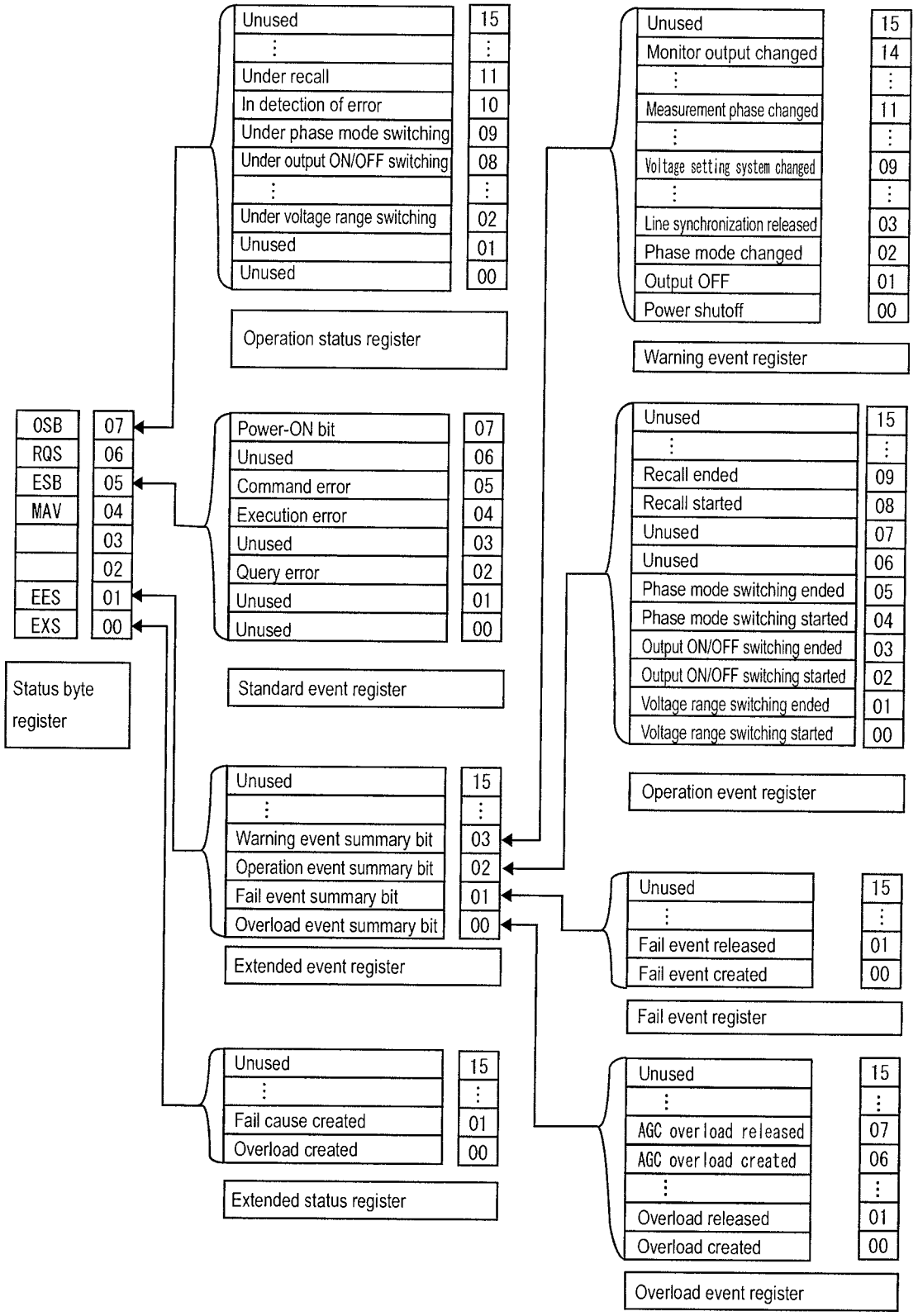
The data to be set and the response data are decimal integers with addition of the weight of the bit that was set to 1 of each register.



Bit	Weight	Description
OSB(7)	128	**Operation event status register summary bit** If any of the effective bits of the above register becomes 1, this will be set to 1, and if all of them become 0, then this will be cleared to 0.
RQS(6)	64	**Request service bit** If a service request takes place, this will be set to 1 and if serial poll is performed, this will be cleared to 0.
ESB(5)	32	**Standard event status register summary bit** If any of the effective bits of the above register becomes 1, this will be set to 1, and if all of them become 0, then this will be cleared to 0.
MAV(4)	16	**Response message output enabled** If, answering to the querying message, a response is written in the queue, enabling the output, this will be set to 1, and if the queue becomes empty, this will be cleared to 0.
3	8	**Always 0 (not used)**
2	4	**Always 0 (not used)**
EES(1)	2	**Extended event register summary bit** If any of the effective bits of the above register becomes 1, this will be set to 1, and if all of them become 0, then this will be cleared to 0.
EXS(0)	1	**Extended status register summary bit** If any of the effective bits of the above register becomes 1, this will be set to 1, and if all of them become 0, then this will be cleared to 0.

Detailed structure of status

The previous status prior to summarizing in a status byte register exists in several event registers. In every event register, exists a corresponding enable register, and summary into status byte can be permitted or prohibited by bits.
Further, the event register will not be cleared to 0 even if the status byte register is read by serial poll.



Standard event status register and related registers

The standard event status register is a register that is commonly given to every GPIB device that conforms to IEEE-488.2 standards. This register expresses the condition of a device. (See "Bit assignment of the standard event status register".)

A standard event status register can be queried with the following message:

- ?ESR (the response data will be in a decimal integer.)

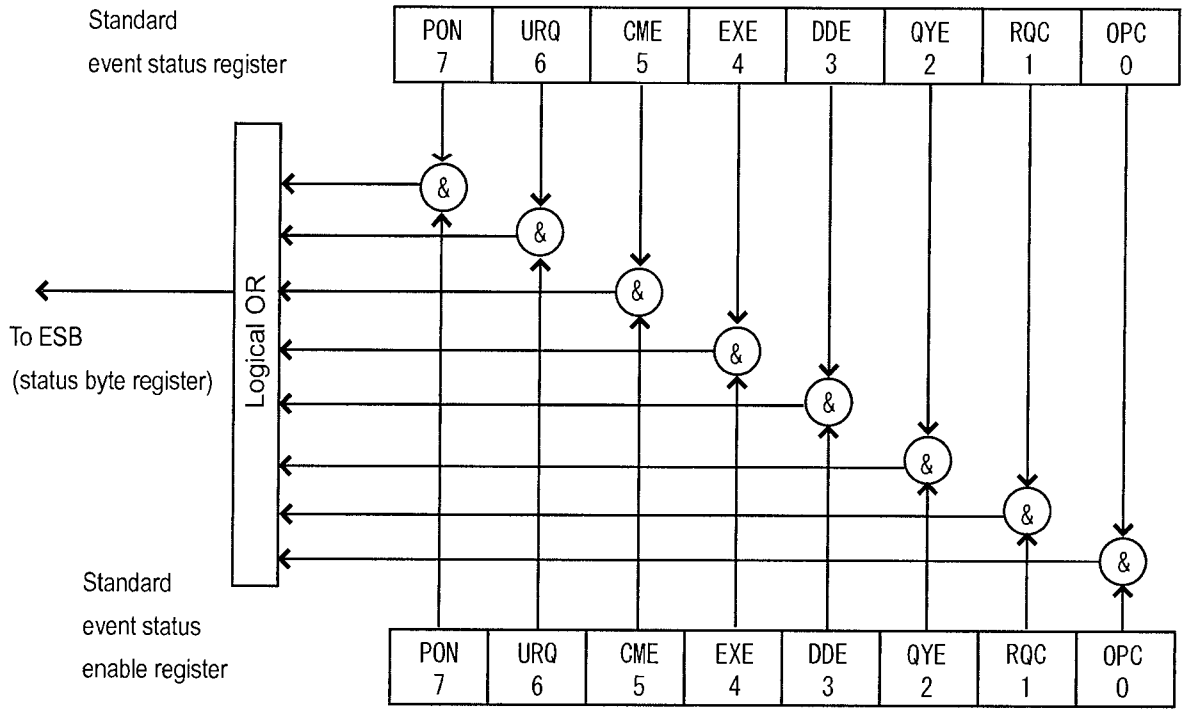
Every bit of a standard event status register will be cleared to 0 when:

- A standard event status register is read.

Every bit of a standard event status register can be summarized into an ESB bit of the status byte register by setting the corresponding bit of the standard event status enable register to 1.

A standard event status enable register can be set or queried using the following messages where the data is the total of the weight of factors that are set to 1.

- Setting: ESE (the data to be set is in a decimal integer and initial value is "0".)
- Query: ?ESE (the response data will be in a decimal integer.)



Bit assignment of standard event status register

Bit (weight)	Mnemonic	Description
7(128)	PON	Power-ON This is set to 1 when power is charged. When it is read and cleared to 0, it remains 0 until the power is charged again.
6(64)	URQ	User request Always 0 (not used)
5(32)	CME	Message error This will be set to 1 if any syntax error is detected in the program message.
4(16)	EXE	Execution error This will be set to 1 if the program data is out of the setting range or specified setting is not possible due to the current situation.
3(8)	DDE	Device definitive (or proper) error Always 0 (not used)
2(4)	QYE	Query error This will be set to 1 if any of the following occurs: • Reading is attempted when the queue contains no response message (RS-232 does not yield this error.) • Queue capacity limit (256 characters) is exceeded. • A next program message was received when sending of a response message to a query has not been completed.
1(2)	RQC	Request for control authority Always 0 (not used)
0(1)	OPC	Operation completed Always 0 (not used)

Operation status register and related registers

The operation status register is a register that indicates that internal processing is in progress. This register can be queried by the following message:

- ?OSC (the response data will be in a decimal integer.)

Every bit of the operation status register changes from 0 to 1 when its cause or operation starts and changes from 1 to 0 when its cause or operation ends.

Every bit of the operation status register is cleared to 0 when the following event occurs:

- Its cause corresponding to each bit or operation ends.

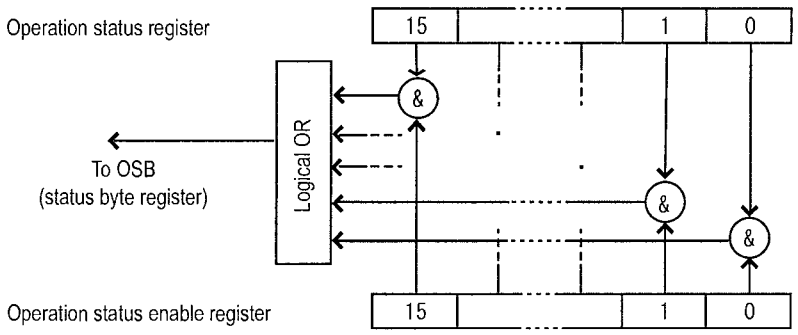
Every bit of the operation status register can be summarized into the OSB bit of the status byte register by setting the corresponding bit of an operation status enable register to 1.

An operation status enable register can be set or queried using the following messages where the data is the total of the weight of factors that are set to 1.

- Setting: OSE (the data to be set is in a decimal integer and initial value is "0".)
- Query: ?OSE (the response data will be in a decimal integer.)

Bit assignment of operation status register

Bit (weight)	Description
15	Always 0 (not used)
14	
13	
12	
11 (2048)	Under recall
10 (1024)	Under detection of fail cause Some causes may shut off the power to the power section in order to protect the system. This indicates some causes have been detected.
9 (512)	Under switching of phase mode
8 (256)	Under switching of output ON/OFF
7	Always 0 (not used)
6	
5	
4	
3	
2 (4)	Under switching of output voltage range
1	Always 0 (not used)
0	



Extended event register and related registers

The extended event register is a register to organize contents of several event registers. This register can be queried by the following message:

- ?XEC (the response data will be in a decimal integer.)

When the logical sum of the warning event register, operation event register and fail event register changes from 0 to 1, the corresponding bit of the extended event register will be set to 1.

Every bit of the extended event register is cleared to 0 when any of the following occurs:

- When a warning event register is read (corresponding bit only).
- When an operation event register is read (corresponding bit only).
- When a fail event register is read (corresponding bit only).
- When an overload event register is read (corresponding bit only).
- When a message CLS (Clear Status related registers) is sent.

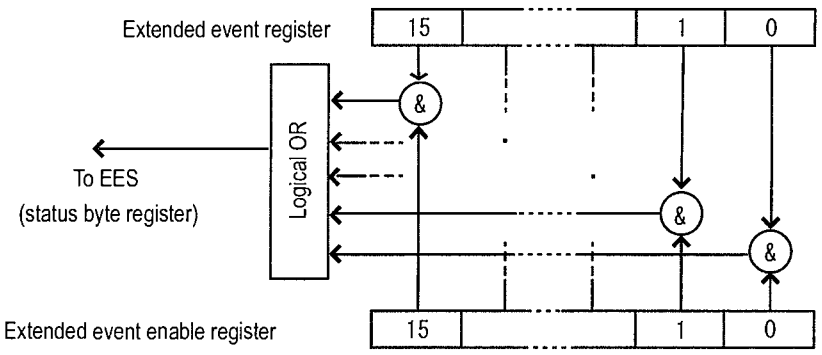
Every bit of an extended event register can be summarized into an EES bit of the status byte register by setting the corresponding bit of the extended event enable register to 1.

An extended event enable register can be set or queried using the following program messages where the data is the total of the weight of factors that are set to 1.

- Setting: XEE (the data to be set is in a decimal integer and initial value is "0".)
- Query: ?XEE (the response data will be in a decimal integer.)

Bit assignment of extended event register

Bit (weight)	Description
15	Always 0 (not used)
14	
⋮	
⋮	
4	
3 (8)	Warning event register summary bit
2 (4)	Operation event register summary bit
1 (2)	Fail event register summary bit
0 (1)	Overload event register summary bit



Warning event register and related registers

The warning event register is a register that indicates an especially important operating state of a device such as shutdown. This register can be queried by the following message:

- ?WSC (the response data will be in a decimal integer.)

Every bit of the warning register is cleared to 0 when either of the following events occurs:

- A warning event register is read
- A message CLS (Clear Status related registers) is sent

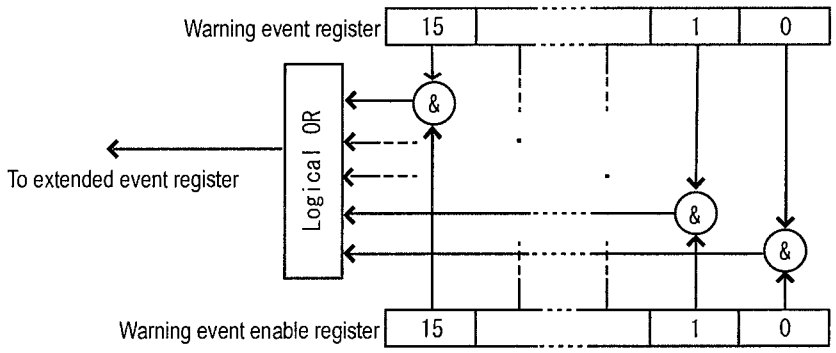
Every bit of the warning event register can be summarized into the corresponding bit (bit 03) of the extended event register by setting the corresponding bit of the warning event enable register to 1. A warning event enable register can be set or queried using the following program messages where the data is the total of the weight of factors that are set to 1.

- Setting : WSE (the data to be set is in a decimal integer and initial value is "0".)
- Query : ?WSE (the response data will be in a decimal integer.)

Bit assignment of warning event register

Bit (weight)	Description
15	Always 0 (not used)
14(16384)	After switching phase mode, sets monitor output to initial value. *1
⋮	Always 0 (not used)
11(2048)	When switching phase mode, changes selection of measurement phase to L1 phase. *1
⋮	Always 0 (not used)
9(512)	When switching phase mode, sets AC voltage setting system to phase voltage. *1
⋮	Always 0 (not used)
3(8)	Line synchronization released
2(4)	Phase mode switched *1
1(2)	Output OFF Output is turned OFF for protection when an overload condition lasted for a long time or similar cases.
0(1)	Power supply to the power section is shut off for protective measure.

*1 In the case of EP02000S or EP02000X, always set to 0.



Operation event register and related registers

The operation event register is a register to notify the start or end of processing of a cause whose internal processing time is relatively long. This register can be queried by the following message:

- ?OPC (the response data will be in a decimal integer.)

Every bit of the operation event register is cleared to 0 when either of the following events occurs:

- An operation event register is read
- A message CLS (Clear Status related registers) is sent

Every bit of the operation event register can be summarized into the corresponding bit (bit 02) of the extended event register by setting the corresponding bit of the operation event enable register to 1.

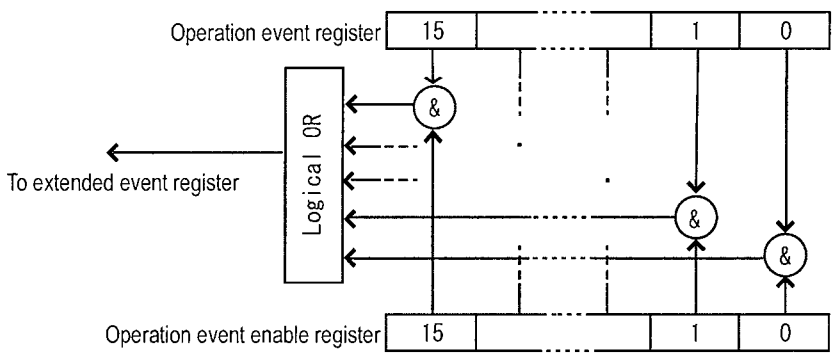
An operation event enable register can be set or queried using the following program messages where the data is the total of the weight of factors that are set to 1.

- Setting : OPE (the data to be set is in a decimal integer and initial value is "0".)
- Query :?OPE (the response data will be in a decimal integer.)

Bit assignment of operation event register

Bit (weight)	Description
15	Always 0 (not used)
14	
⋮	
11	
10	
9 (512)	Memory recall operation ended
8 (256)	Memory recall operation started
7	Always 0 (not used)
6	
5 (32)	Phase mode switching ended *1
4 (16)	Phase mode switching started *1
3 (8)	Output ON/OFF ended
2 (4)	Output ON/OFF started
1 (2)	Range switching ended
0 (1)	Range switching started

*1 In the case of EP02000S or EP02000X, always set to 0.



Fail event register and related registers

The fail event register is set when especially important problems (fail causes) are detected to protect the internal circuit. This register can be queried by the following message:

- ?FLC (the response data will be in a decimal integer.)

Every bit of the fail event register is cleared to 0 when either of the following events occurs:

- A fail event register is read
- A message CLS (Clear Status related registes) is sent

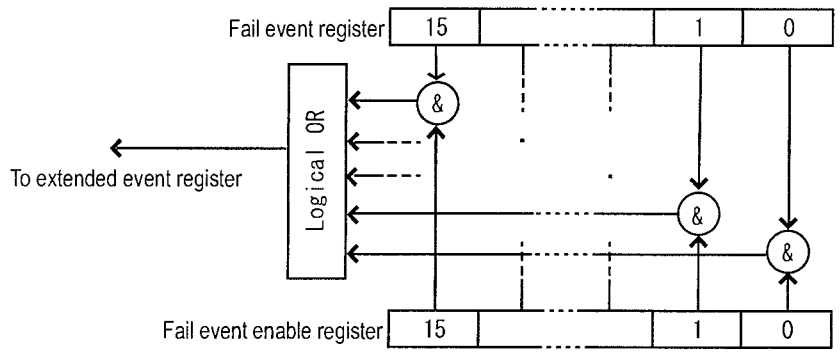
Every bit of the fail event register can be summarized into the corresponding bit (bit 01) of the extended event register by setting the corresponding bit of the fail event enable register to 1.

A fail event enable register can be set or queried using the following messages where the data is the total of the weight of factors that are set to 1.

- Setting : FLE (the data to be set is in a decimal integer and initial value is "0".)
- Query : ?FLE (the response data will be in a decimal integer.)

Bit assignment of fail event register

Bit (weight)	Description
15	Always 0 (not used)
14	
⋮	
⋮	
2	
1 (2)	Recovery from fail (shutoff of power supply to the power section) cause
0 (1)	Detection of fail (shutoff of power supply to the power section) cause



Overload event register and related registers

The overload event register is a register that reflects the output overload situation. This register can be queried by the following message:

- ?OVC (the response data will be in a decimal integer.)

Every bit of the overload event register is cleared to 0 when either of the following events occurs:

- An overload event register is read
- A message CLS (Clear Status related registers) is sent

Every bit of the overload event register can be summarized into the corresponding bit (bit 00) of the extended event register by setting the corresponding bit of the overload event enable register to 1.

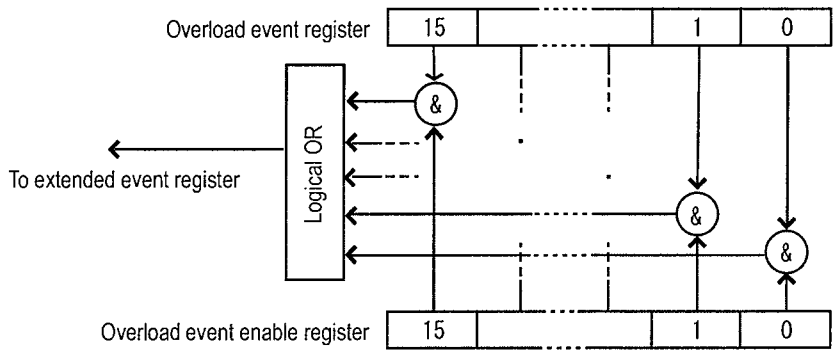
An overload event enable register can be set or queried using the following program messages where the data is the total of the weight of factors that are set to 1.

- Setting : OVE (the data to be set is in a decimal integer and initial value is "0".)
- Query :?OVE (the response data will be in a decimal integer.)

Bit assignment of overload event register

Bit (weight)	Description
15 ⋮	Always 0 (not used)
7(128) ⋮	Release from AGC overload condition. Remote sensing AGC changed the condition of the unit from outside the correction range to within the correction range.
6 (64) ⋮	Occurrence of AGC overload condition Remote sensing AGC put the unit outside the correction range.
⋮	Always 0 (not used)
1(2)	Releases from overload condition
0(1)	Occurrence of overload condition

* Remote sensing AGC is not available in the EP02000X or EP02000S.
  Related bits are always set to 0.



Extended status register and related registers

The extended status register is provided with bits indicating fail causes or overload condition. This register can be queried by the following message:

- ?XSC (the response data will be in a decimal integer.)

Every bit of the extended status register changes from 0 to 1 when its cause or operation begins and changes from 1 to 0 when its cause or operation ends.

Every bit of an extended status register is cleared to 0 when the following event occurs:

- The cause corresponding to each bit or operation ends.

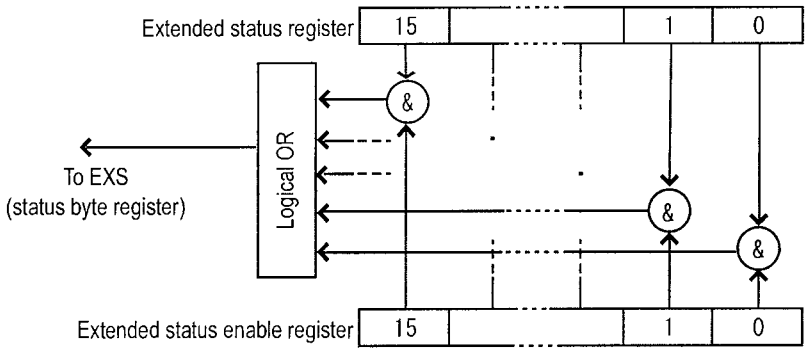
Every bit of an extended status register can be summarized into the EXS bit of the status byte register by setting the corresponding bit of the extended status enable register to 1.

An extended status enable register can be set or queried using the following messages where the data is the total of the weight of factors that are set to 1.

- Setting : XSE (the data to be set is in a decimal integer and initial value is "0".)
- Query : ?XSE (the response data will be in a decimal integer.)

Bit assignment of extended status register

Bit (weight)	Description
15	Always 0 (not used)
14	
⋮	
⋮	
2	
1 (2)	A fail (shutoff of power supply to the power section) cause being produced
0 (1)	An overload being produced



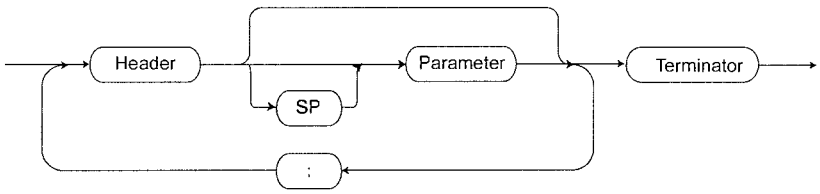
Program messages

A program message is tentatively stored in the input buffer. When a terminator is received, the message is interpreted and executed in the FIFO order. The input buffer has a capacity of 256 characters (i.e., 256 bytes) and nulls (00H) and terminators are not accepted in the input buffer.

When interpretation and execution are completed, the input buffer is emptied to admit the next coming data.

If a program message that exceeds 256 characters is sent, only valid part of the message included in the first 256 characters is executed, then an error occurs.

A program message consists of a header and a parameter. Messages can be sent successively if each of them does not exceed the character capacity of the input buffer. The format of a program message is shown below.



To send two or more program messages at a time, a semicolon ";" must be inserted between the program messages.

Program messages are broadly classified into two categories of "setting messages" that execute setting or operation directive and "querying messages" that query status or settings.

Program message basic form

A basic format of setting message is shown below. This example sets frequency to 50 Hz and output voltage to 100 Vrms.

(Example of setting message) Sets frequency to 50 Hz and output voltage to 100 Vrms.

FRQ _ 50 ; VLT _ 100
a b c d a b c

(Example of query message) Query of voltage measured value or current measured value

?MVR __ ; ___ ?MCR
a b d b a

a: This is called a header. Both upper and lower case alphabets are available and even mixture of them may be used. A query message is headed by "?".

b: This is a space to improve legibility. Any number of spaces or a null space may be used.

c: Parameter section. This begins with a sign (+ or -), number, or a decimal point. When a sign is omitted, control recognizes it as a positive value.

d: This is a semicolon (or a message terminator) to divide two or more setting messages.

Setting messages

Data form in setting message

The following two parameter data forms are available:

- NR1 form

This is an integer type. A virtual decimal point is deemed to be placed at the end of the digits.

± DDDD

◎Leading zeros are ignored.

◎The sign is expressed by "+" or "-", and if omitted, it is considered to be "+".

Examples : +01234

-50001

18

- NR2 form

This is a real number type. A decimal point is expressed with a period ".". Digits in the decimal places may be omitted, and omitted digits are taken to be all "0". An exponential form can also be used.

± DD. DD

◎Leading zeros are ignored.

◎The sign is expressed by "+" or "-", and if omitted, it is considered to be "+".

Examples : +0.1234

-50.001

1.8

1.00E+2

200

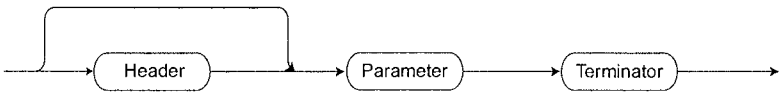
Querying messages

This is a program message to query the status of selection, setting and other items. This is always headed by a question mark "?".

If "talker" is specified after sending a querying message, the response to it will be output.

When two or more queries are made at a time, two or more responses will be output each divided with a semicolon ";". A response character string exceeding 255 characters in total will produce an error and no response is returned. If a query is made without specifying the talker (receiving a response) and a further query(ies) is made, then up to five responses will be stored. However, other excessive data will be deleted from the oldest response.

Output format for response is shown below.



It is possible to set ON/OFF of the header included in response data by a setting message of "HDR 1" or "HDR 0". When power is turned on, the header is set to ON (to output the header).

Form of response data to a querying message

The following three parameter data forms are available:

- NR1 form

  This is an integer type.

  DDDD

  ◎Numeral part of an integer

  ◎Sign part, which is null for a positive integer and "-" for negative integer.

  ◎The number of digits of a parameter is the same for each output information.

  Examples : RNG 1

  This indicates that the output voltage range is set to the 200 V range.

- NR2 form

  This is a real number type.

  DD. DD

  ◎Integer part of a real number, inevitably containing a decimal point ".".

  ◎Sign part, which is null for a positive real number and "-" for negative real number.

  Examples : FRQ 50.0

  This indicates that the output frequency is set to 50.0 Hz.

- STRING form

  This is character string data using ASCII (ISO 7-bit) codes

Situation in which no message is accepted (BUSY)

In general, a computer serving as the GPIB controller, etc. is expected to be free from the constraints by specific processing and able to perform various kinds of processing simultaneously.

When a GPIB device under the control of the GPIB controller spends a long time for its internal processing, if it stops communication (handshake) by attaching greater importance to message exchange processing, the GPIB device can no longer perform other processing in the meantime, resulting in reduced throughput on the GPIB controller side.

From this standpoint, when a specific message is sent from the GPIB controller, the P-STATION/EP0 unit continues to perform handshake as it is and stores the message in the internal buffer temporarily, but does not interpret or execute it, which results in an execution error. Such a situation is called "BUSY".

Duration of BUSY varies depending on the processing content, but is at least approximately 700ms.

BUSY is indicated by a BUSY lamp on the panel and it is possible to recognize BUSY by referencing the status related register from the GPIB controller.

To continue setting after sending a BUSY-related message, refer to the contents of these registers in

BUSY related messages

Header	Function	BUSY duration	Caution
OUT	Output ON/OFF switching	Approx. 700ms	During overload, etc., the output may be forcibly turned OFF for internal protection and BUSY occurs in this case.
RNG	Selection of output voltage range	Approx. 700ms	The output voltage range can be set for AC and DC separately. When AC/DC switching is performed, if the voltage range changes before and after the switching, a range switching may occur producing BUSY.
DCM	AC/DC output switching	Approx. 700ms	
PMD	Phase mode switching	Max. approx. 2s	BUSY duration varies depending on phase mode state before and after switching and system capacity.
RCL	Memory recall	Approx. 700ms	A change to any one of the settings above before and after a recall may produce BUSY.

To recognize BUSY state from controller

It is possible to recognize the start and end of the BUSY state by referencing the operation event register. Likewise, it is possible to know whether BUSY is in place or not by referencing the operation status register.

Attention!

Also see a processing example included in the sample program.

List of program messages

Commands are used in common when GPIB and RS-232 interfaces are used.
However, the function indicated by a header "STB" would be ineffective if the RS-232 interface is used.
In addition, a space " " can be inserted between the header and the parameter of a command in order to improve the legibility.

Setting of output voltage and output range

Header	Function	Parameter	Data Form		Default
			Setting	Query	
RNG	To select AC output voltage range	0 : 100 V range 1 : 200 V range	NR1	NR1	100 V range
	To select DC output voltage range	0 : 100 V range 1 : 200 V range	NR1	NR1	100 V range
VLT	To set AC output phase voltage	0.0 to 300.0 Unit: [Vrms] Resolution: 0.1 [Vrms]	NR2	NR2	0.0 [Vrms]
	To set AC output line-to-line voltage (three-phase)	0.0 to 519.6 Unit: [Vrms] Resolution: 0.2 [Vrms]	NR2	NR2	0.0 [Vrms]
	To set AC output line voltage (single-phase three-wire)	0.0 to 600.0 Unit: [Vrms] Resolution: 0.2 [Vrms]	NR2	NR2	0.0 [Vrms]
	To set DC output voltage	0.0 to 424.0 Unit: [Vdc] Resolution: 0.1 [Vdc]	NR2	NR2	0.0 [Vdc]
VMD	To select AC output voltage setting method	0: phase voltage setting method 1: line-to-line voltage setting method	NR1	NR1	Phase voltage setting method

RNG:Range
VLT:Voltage
VMD:Voltage Mode

Example : To set the output voltage range to 100 V range and output voltage to 100 Vrms.

Setting of output voltage range to 100 V range RNG 0
Setting of output voltage to 100 Vrms VLT 100.0

Attention!

- With the output voltage range set to 100 V, a setting that exceeds the following value will cause an error:
  150 Vrms in AC mode 212 Vrms in DC mode
  In the above case, select 200 V for the output voltage range. In addition, if the set voltage sent from the voltage setting is higher than the voltage limit level, an error will be caused. If this is the case, check the voltage limit value.
- When the system is switching the output voltage range, any command will not be interpreted. If a subsequent command is sent at this moment, this will also cause an error. Confirm that the range has been switched by the status byte before sending a subsequent command.

Setting of output frequency

Header	Function	Parameter	Data Form		Default
			Setting	Query	
FRQ	To set an output frequency	5.0～550.0 Unit: [Hz] Resolution: 0.1 [Hz]	NR2	NR2	50.0 [Hz]

FRQ : Frequency

Example : To set an output frequency to 60 Hz.

To set output frequency to 60.0 Hz FRQ 60.0

Switching ON/OFF the output

Header	Function	Parameter	Data Form		Default
			Setting	Query	
OUT	To switch ON/OFF the output	0: Output OFF 1: Output ON	NR1	NR1	Output OFF

OUT : Output

Example : To set ON/OFF of output

To set the output to ON OUT 1

To set the output to OFF OUT 0

Measuring function

Header	Function	Parameter	Data Form		Default
			Setting	Query	
MVR	To query result of RMS AC voltage measurement		None	NR2	None
	To query result of DC voltage measurement		None	NR2	None
MVP	To query result of peak AC voltage measurement		None	NR2	None
MCR	To query result of RMS AC current measurement		None	NR2	None
	To query result of DC current measurement		None	NR2	None
MCP	To query result of peak AC current measurement		None	NR2	None
	To query result of peak hold		None	NR2	None
MWT	To query result of effective power measurement		None	NR2	None
MVA	To query result of apparent power measurement		None	NR2	None
MPF	To query result of power factor measurement		None	NR2	None
MSL	To select measurement parameter indication	0: RMS voltage, current 1: Peak voltage, current 2: Effective, apparent power 3: Power factor	NR1	NR1	RMS voltage, current
CPH	To change ON/OFF of current peak hold measurement	0: OFF 1: ON	NR1	NR1	OFF
MPH	To select phase of measurement	0: L1 phase 1: L2 phase 2: L3 phase 3: L1-L2 line-to-line 4: L2-L3 line-to-line 5: L3-L1 line-to-line	NR1	NR1	L1 phase

MVR:Measurement Voltage RMS
MVP:Measurement Voltage Peak
MCR:Measurement Current RMS
MCP:Measurement Current Peak
MWT:Measurement Wattage
MVA:Measurement VA
MPF:Measurement Power_Factor
MSL:Current Select
CPH:Current Peak Hold
MPH:Measurement Phase

Attention!

- To a query of measurement, returned will be the measurement for the phase that was selected for measurement, or the line-to-line measurement.
- The response data when queried with a message "MCP" varies depending on the setting state of the message "CPH" (current peak hold measurement ON/OFF).
  When CPH 0 (peak hold OFF) has been selected: Result of peak AC current measurement
  When CPH 1 (peak hold ON) has been selected: Result of peak hold measurement

Setting limit values

The user may put a limit(s) to the setting range of the output voltage and output frequency.

Header	Function	Parameter	Data Form		Default
			Setting	Query	
VUP	To set an upper limit to AC output phase voltage	0.0 to 300.0 Unit: [Vrms] Resolution: 0.1 [Vrms]	NR2	NR2	300.0[Vrms]
	To set an upper limit to DC output voltage	0.0 to 424.0 Unit: [Vdc] Resolution: 0.1 [Vdc]	NR2	NR2	424.0[Vdc]
	To set an upper limit to AC output line-to-line voltage (three-phase)	0.0 to 519.6 Unit: [Vrms] Resolution: 0.2 [Vrms]	NR2	NR2	519.6[Vrms]
	To set an upper limit to AC output line voltage (single-phase three-wire)	0.0 to 600.0 Unit: [Vrms] Resolution: 0.2 [Vrms]	NR2	NR2	600.0[Vrms]
FUP	To set an upper limit to output frequency	5.0 to 550.0 Unit: [Hz] Resolution: 0.1 [Hz]	NR2	NR2	550.0[Hz]
FLW	To set a lower limit to output frequency	5.0 to 550.0 Unit: [Hz] Resolution: 0.1 [Hz]	NR2	NR2	5.0[Hz]

VUP:Voltage Upper limit

FUP:Frequency Upper limit

FLW:Frequency Lower limit

Example : To limit the output voltage to 220 V at the maximum, and limit the frequency to 65 Hz at the maximum.

To set the output voltage upper limit to 220 V VUP 220.0

To set the output frequency upper limit to 65 Hz FUP 65.00

Attention!

- An error will be caused if the user attempts to set a value lower than the already set output voltage in the course of upper voltage limit setting procedure.
- An error will be caused if the user attempts to set a value lower than the already set output frequency in the course of upper frequency limit setting procedure. Also, an error will be caused if the user attempts to set a value lower than the already set lower frequency limit.
- An error will be caused if the user attempts to set a value higher than the already set output frequency in the course of lower frequency limit setting procedure. Also, an error will be caused if the user attempts to set a value higher than the already set upper frequency limit.
- An upper limit to the output in a three-phase system and in a single-phase three-wire system will be effective to the phase voltage of all phases.

Setting a Power-ON phase

The user may set the Power-ON phase on output turn-on moment.

Header	Function	Parameter	Data Form		Default
			Setting	Query	
SPH	To set a Power-ON phase	0: 0[deg] 1: 90[deg] 2: 180[deg] 3: 270[deg]	NR1	NR1	0[deg]

SPH:Start Phase

Precision mode and high stability mode setting

This function sets the condition of the output compensation.

The user can select the precision mode to minimize the fluctuation of output voltage against the change of load current. On the contrary, the user can select the high stability mode to maintain good stability against the capacitive load although the fluctuation of output voltage is a little higher.

Header	Function	Parameter	Data Form		Default
			Setting	Query	
PRC	To switch the mode between precision and high stability	0: High stability 1: Precision	NR1	NR1	Precision

PRC:Precision

Example: To set the status of output compensation to high stability.

To set the mode to high stability PRC 0

Line synchronization

The user can synchronize the output frequency to the frequency of the commercial input power line to which the P-STATION/EPO is connected. The user can also set the frequency for the time of disabling the synchronization function.

Header	Function	Parameter	Data Form		Default
			Setting	Query	
LSY	To switch ON/OFF of line synchronization	0 : Line synchronization OFF 1 : Line synchronization ON	NR1	NR1	Line synchronization OFF
LSF	To set the frequency for line synchronization OFF moment	0 : 50[Hz] 1 : 60[Hz]	NR1	NR1	50[Hz]

LSY:Line Sync

LSF:Line Sync off Frequncy

AC/DC selection

Header	Function	Parameter	Data Form		Default
			Setting	Query	
DCM	To switch AC/DC output	0: AC output 1: DC output	NR1	NR1	AC output

DCM:Direct Current Mode

Attention!

Setting of AC/DC selection will be accepted only when single-phase has been set in the phase mode. When single-phase three-wire or three-phase has been set in the phase mode, this attempt will result in an error.

Phase mode

Header	Function	Parameter	Data Form		Default
			Setting	Query	
PMD	To switch phase mode	0: Single-phase 1: Single-phase three-wire 2: Three-phase	NR1	NR1	Single-phase

PMD:Phase Mode

Attention!

- This setting will be accepted when AC has been set in AC/DC selection. When DC has been set in AC/DC selection, this attempt will result in an error.
- This message is invalid in the EP02000S or EP02000X.

Beep

Header	Function	Parameter	Data Form		Default
			Setting	Query	
BEE	To switch ON/OFF of beep	0: OFF 1: ON	NR1	NR1	ON

BEE:Beep

Remote sensing AGC

Header	Function	Parameter	Data Form		Initial value
			Setting	Query	
AGC	Remote sensing AGC ON/OFF switching	0: OFF 1: ON	NR1	NR1	OFF

Monitor output

Header	Function	Parameter	Data Form		Initial value
			Setting	Query	
M01	Setting of monitor output CH1 output source	0: L1-phase voltage 1: L1-phase voltage x1 2: L1-phase voltage x10 3: L2-phase voltage 4: L2-phase voltage x1 5: L2-phase voltage x10 6: L3-phase voltage 7: L3-phase voltage x1 8: L3-phase voltage x10	NR1	NR1	L1-phase voltage
M02	Setting of monitor output CH2 output source	0: L1-phase voltage 1: L1-phase voltage x1 2: L1-phase voltage x10 3: L2-phase voltage 4: L2-phase voltage x1 5: L2-phase voltage x10 6: L3-phase voltage 7: L3-phase voltage x1 8: L3-phase voltage x10			L1-phase voltage x1

Attention!

Messages related to the remote sensing AGC and monitor output are invalid in the EP02000S or EP02000X.

Memory

The user can store and recall set values and statuses in the battery-backup memory incorporated in the unit. Eleven memory addresses from 0 to 10 are provided.

Header	Function	Parameter	Data Form		Default
			Setting	Query	
STO	To store data	1～10	NR1	None	None
RCL	To recall data	0～10	NR1	None	None

STO : Store

RCL : Recall

Example : To store the current setting in memory address 2 and recall the data in memory address 2.

To store the current setting in memory address 2 STO 2

To recall the data in memory address 2 RCL 2

⚠ CAUTION!

Once a setting by a message from GPIB is stored in memory, the setting stored in memory will not be changed even when operation is performed from the panel. Therefore, unexpected operation may occur when it is recalled.

If the user wants to change from interface control to manual operation, it is recommended to execute "Recall of Address 0" in order to return the memory to the initial status before doing so.

Attention!

In the EPO2000S or EPO2000X if system cable connection is altered, settings stored in the master unit's memory will be erased, and all data in every memory address will turn into the same initial setting values as that at address 0.

Attention!

- Memory address 0 contains default values, and it permits only recalling access. In addition, these default values cannot be modified. Memory address 1 is read on every occasion of power charging to the unit. Thus the user can store the normally used settings at this address so that the user will not have to set them every time at the beginning of operation.
- The GPIB address and other interface parameters are not the subject of memory store/recall function.
- Also some other settings are not the subject of memory store/recall function.

Hardware structure

Header	Function	Parameter	Data Form		Default
			Setting	Query	
IDX	To query the model name	"P-STATION/EPO"	None	String	None
VER	To query the ROM version number	"1.00"	None	String	None
OPR	To query the hardware structure status	0~32767	None	NR1	None

D15 - D14 Unused (always 0)

D13 - D08 System capacity (Note 2)

Capacity	Value
2kVA	1
4kVA	2
≀	≀
36kVA	18

D07 - D06 Unused (always 0)

D05 Monitor output option (Note 1)

0	Yes
1	No

D04 Remote sensing AGC option (Note 1)

0	Yes
1	No

D03 Phase system type (Note 2)

0	Single-phase system
1	Multi-phase system

D02 EP02000 type

0	EPO 2000S
1	EPO 2000X

D01 - D00 Unused (always 0)

IDX : ID code X VER : Version OPR : Operation

(Note1) Always 0 in the case of EPO2000S / EPO2000X.

(Note2) The correspondence between a product model name and response data is shown below.

Capacity		D15	~	D13	D12	D11	D10	D09	D08	~	D03	D02	~
EPO36000M		These bits are irrelevant to the product model name.		0	1	0	0	1	0	These bits are irrelevant to the product model name.	1	0	D00 - D01 are always 0.
EPO24000M				0	0	1	0	1	0		1	0	
EPO18000M				0	0	1	0	0	1		1	0	
EPO12000M				0	0	0	1	1	0		1	0	
EPO6000M				0	0	0	0	1	1		1	0	
EPO12000S				0	0	0	1	1	0		0	0	
EPO10000S				0	0	0	1	0	1		0	0	
EPO6000S				0	0	0	0	1	1		0	0	
EPO4000S				0	0	0	0	1	0		0	0	
EPO2000S				0	0	0	0	0	1		0	0	
EPO2000X	(1 unit)			0	0	0	0	0	1		1	1	
	(2 units)			0	0	0	0	1	0		1	1	
	(3 units)			0	0	0	0	1	1		1	1	

Interface and Status related

Header	Function		Parameter	Data Form		Default
				Setting	Query	
HDR	To select header ON/OFF		0: Header OFF 1: Header ON	NR1	NR1	Header ON
CLS	To clear status-related registers Specify 0 for the following register: • Standard event register • Warning event register • Operation event register • Fail event register • Overload event register		None	Only header	None	None
STB	Status byte register	Query	0～255	None	NR1	None
SRE		Enable register setting/query		NR1		0
ESR	Standard event status register	Query	Same as above			
ESE		Enable register setting/query				
OSC	Operation status register	Query	0～32767	None	NR1	None
OSE		Enable register setting/query		NR1		0
XEC	Extended event register	Query	Same as above			
XEE		Enable register setting/query				
WSC	Warning event register	Query	Same as above			
WSE		Enable register setting/query				
OPC	Operation event register	Query	Same as above			
OPE		Enable register setting/query				
FLC	Fail event register	Query	Same as above			
FLE		Enable register setting/query				
OVC	Overload event register	Query	Same as above			
OVE		Enable register setting/query				
XSC	Extended status register	Query	Same as above			
XSE		Enable register setting/query				

- Each status/event register is provided with an enable register, which can enable/disable a detection cause bit by bit.
- The enable register can not only set but also read a status. However, each status/event register can, by nature, only read a state by a query.

☞ For details of the register-related messages, see "Detailed structure of status".

Response to interface message

Responses to interface message sent from the GPIB controller are listed below.

IFC	< Interface Clear > Initializes GPIB interface. Releases specified listener and talker.
DCL SDC	< Device Clear > < Selected Device Clear > Clears the input buffer and aborts interpretation and execution of command. Clears the input buffer and also clear bit 4 (MAV) of the status byte register. Releases SRQ sending.
LLO	< Local Lockout > Disables operation of the (LOCAL) button in the operation section.
GTL	< Go To Local > Puts the unit in a local status.

Usage of interface messages varies with the GPIB driver on the controller side.

For details, refer to the manual for the GPIB driver.

Sample GPIB program

Outline of sample program

The following section introduces samples of remote control that uses GPIB interface.

Here, the following two cases are shown:

- Case where Microsoft's Visual Basic and Keithley's (Keithley Instruments Inc.) GPIB interface board are used
- Case where Visual Basic and National Instruments' GPIB interface board are used

The following two programs are presented for explanation.

a) Setting

This is a simplest program of initialization followed by setting of arbitrary voltage and frequency, then turning on the output.

b) Use of Query and SRQ

This program uses SRQ to detect range selection and turn-on/off operation while conducting the setting of arbitrary voltage and frequency.

In both examples, parameter range check etc. are omitted. When the user prepares a practical program, take into consideration error processing and initialization procedure.

In addition, these sample programs are prepared assuming a situation in which the unit is energized in the on-shipping condition. Note that the program may not operate properly in other conditions.

These sample programs can be downloaded from our homepage:

http://www.nfcorp.co.jp/

Case where Visual Basic and Keithley's GPIB interface board are used

When receiving (entering) a response message using Keithley's GPIB interface board and driver software, the length of the reception buffer character string variable is changed appropriately. The maximum number of characters to be received and the number of characters actually received are set by parameters different from those of the buffer.

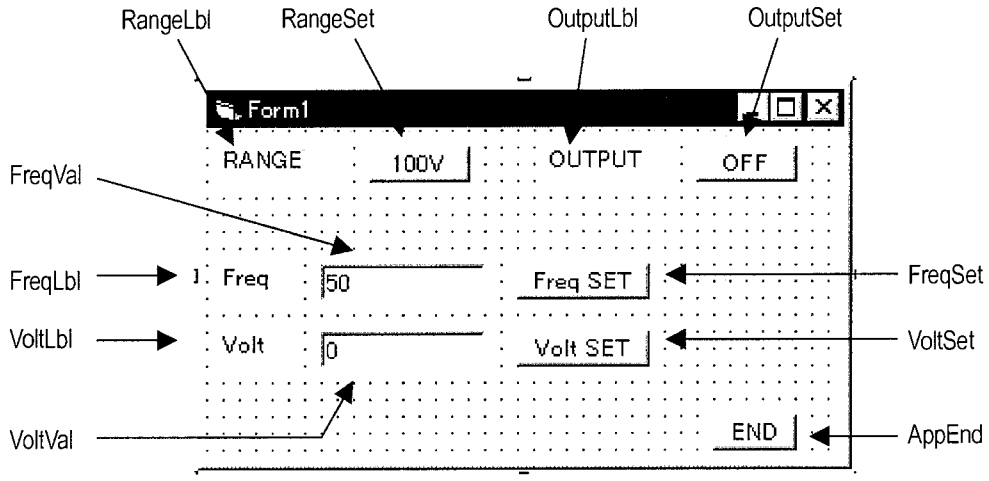
a) Setting -KI

If the button of range or output is pressed, the system changes its status and displays the set status.

The values entered in the text box of frequency and voltage will be set when the setting button of each item is pressed.

Necessary initialization is executed by load of form.

Here, the device descriptor (Dev) is opened with the timeout of 200ms, GPIB address 2, E01 valid and terminator LF.




```
Option Explicit
Const Adr As Integer = 2
Dim Rng As Boolean
Dim Out As Boolean

Private Sub AppEnd_Click()
   Dim stat As Integer
   transmit "UNL LSTEN" & CStr(Adr) & "GTL", stat 'Go To Local
   End
End Sub

Private Sub Form_Load()
   Dim stat As Integer

   initialize 0, 0              'Open the device
   settimeout (300)             'Set time out
   transmit "DCL" stat          'Clear the device

   Rng = False
   Out = False
End Sub
```

```
Private Sub FreqSet_Click()
   Dim stat As Integer
   send Adr, "FRQ" & FreqVal.Text,stat  'Set the frequency
End Sub

Private Sub OutputSet_Click()
   Dim stat As Integer
   If Out = False Then
       send Adr, "OUT 1", stat          'Set the output to ON
       OutputSet.Caption = "ON"
       Out = True
   Else
       send Adr, "OUT 0", stat          'Set the output to OFF
       OutputSet.Caption = "OFF"
       Out = False
   End If
End Sub

Private Sub RangeSet_Click()
   Dim stat As Integer
   If Rng = False Then
       send Adr, "RNG 1", stat          'Set the range to 200V
       RangeSet.Caption = "200V"
       Rng = True
   Else
       send Adr, "RNG 0", stat          'Set the range to 100V
       RangeSet.Caption = "100V"
       Rng = False
   End If
End Sub

Private Sub VoltSet_Click()
   Dim stat As Integer
   send Adr, "VLT" & VoltVal.Text,stat  'Set the voltage
End Sub
```

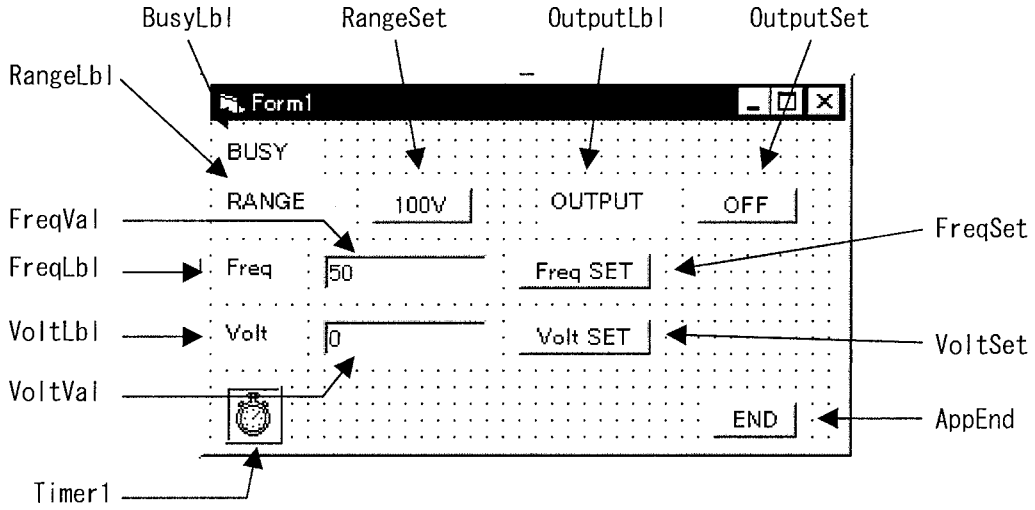
b) Use of Query and SRQ -KI

This operation is similar to that of the above sample a) except that the control detects that the system enters a BUSY condition on the point of range selection and output ON/OFF switching and queries related status and then temporarily disables command sending.

In the case of Keithley's GPIB driver, use the method by polling monitoring using a timer.

Polling can query the content of the event register or status register every time, but serial poll can reduce the load of the firmware of the device more than polling. To shorten polling intervals, use of serial poll is recommended.

Note that before and after the serial poll routine spoll of Keithley's GPIB driver, universal commands SPE and SPD are required.




```
Option Explicit
Const Adr As Integer = 2
Dim Rng As Boolean
Dim Out As Boolean

Private Sub AppEnd_Click()
   Dim stat As Integer
   transmit "UNL LSTEN" & CStr(Adr) & "GTL", stat ' Go To Local
   End
End Sub

Private Sub Form_Load()
   Dim stat As Integer
   Dim rbbuf As String
   Dim I As Integer
   initialize 0, 0                    'Open the device
   settimeout (300)                   'Set time out
   transmit "DCL", stat               'Clear the device
   send Adr, "SRE 2;XEE 14;OPE 15", stat'Set the SRQ enable register
   send Adr, "?OPC", stat
   enter rbbuf, 256, I, Adr, stat
   send Adr, "?stb", stat
   enter rbbuf, 256, I, Adr, stat
   Rng = False
   Out = False
   BusyLbl.Enabled = False
   Timer1.Enabled = False
   Timer1.Interval = 500
End Sub
```

```
Private Sub FreqSet_Click()
   Dim stat As Integer
   send Adr, "FRQ" & FreqVal.Text, stat 'Set the frequency
End Sub

Private Sub OutputSet_Click()
   Dim stat As Integer
   If Out = False Then
       send Adr, "OUT 1", stat          'Set the output to ON
       OutputSet.Caption = "ON"
       Out = True
   Else
       send Adr, "OUT 0", stat          'Set the output to OFF
       OutputSet.Caption = "OFF"
       Out = False
   End If
   Timer1.Enabled = True                'Because RQS occurs on occasion of output setting
End Sub

Private Sub RangeSet_Click()
   Dim stat As Integer
   If Rng = False Then
       send Adr, "RNG 1", stat          'Set the range to 200V
       RangeSet.Caption = "200V"
       Rng = True
   Else
       send Adr, "RNG 0", stat          'Set the range to 100V
       RangeSet.Caption = "100V"
       Rng = False
   End If
   Timer1.Enabled = True                'Because RQS occurs on occasion of range selection
End Sub

Private Sub Timer1_Timer()
   Dim stat As Integer
   Dim stb As Integer
   Dim rbbuf As String
   Dim I As Integer
   Dim opc As Integer
   transmit "SPE", stat                 'Required in KI board
   spoll Adr, stb, stat                 'Serial poll
   transmit "SPD", stat                 'Required in KI board
   If stb And 64 Then                   'RQS cause check
       If stb And 2 Then
           send Adr, "?OPC", stat
           enter rbbuf, 256, I, Adr, stat
           opc = CInt(Right(rbbuf, 1))
           If (opc And 1) Or (opc And 4) Then
                BusyLbl.Enabled = True
                RangeSet.Enabled = False
                OutputSet.Enabled = False
                FreqSet.Enabled = False
                VoltSet.Enabled = False
           Else
                BusyLbl.Enabled = False
                RangeSet.Enabled = True
                OutputSet.Enabled = True
                FreqSet.Enabled = True
                VoltSet.Enabled = True
                Timer1.Enabled = False
           End If

           If (Out = True) And (opc = 9) Then
                OutputSet.Caption = "OFF"
                Out = False
           End If
       End If
   End If
End Sub

Private Sub VoltSet_Click()
   Dim stat As Integer
   send Adr, "VLT" & VoltVal.Text, stat 'Set the voltage
End Sub
```

Case where Visual Basic and National Instruments GPIB interface board are used

When using National Instruments GPIB interface board and driver software, a EOS character needs to be added to a character string to be sent.

Moreover, when receiving a response message (ibrd), the number of characters to be received is limited to the capacity of the reception buffer. The sample program presented here uses fixed-length character strings. If the user wants to use variable-length character strings, it is necessary to secure the capacity of the reception buffer using space(), etc. in front of ibrd. The number of received characters can be obtained by means of the global variable ibcnt.

a) Setting -NI

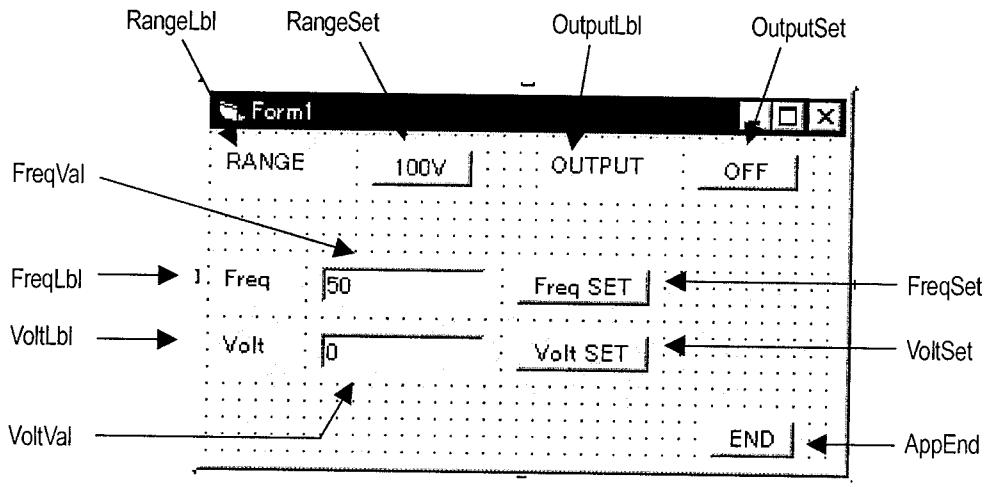
If the button of range or output is pressed, the system changes its status and displays the set status.

The values entered in the text box of frequency and voltage will be set when the setting button of each item is pressed.

Necessary initialization is executed by load of form.

Here, the device descriptor (Dev) is opened with the timeout of 200ms, GPIB address 2, E01 valid and terminator LF.

Pressing the [END] button reinstates the system into a local status and closes the program




```
Option Explicit
Const Adr As Integer = 2
Const EOSCHAR As Integer = &HA
Const EOS As Integer = XEOS + REOS + EOSCHAR
Dim Dev As Integer
Dim Rng As Boolean
Dim Out As Boolean

Private Sub AppEnd_Click()
   Dim v As Integer
   v = 0
   ibloc Dev                          'Go To Local
   ibonl Dev, v                       'Set the device off line
   End
End Sub

Private Sub Form_Load()
```

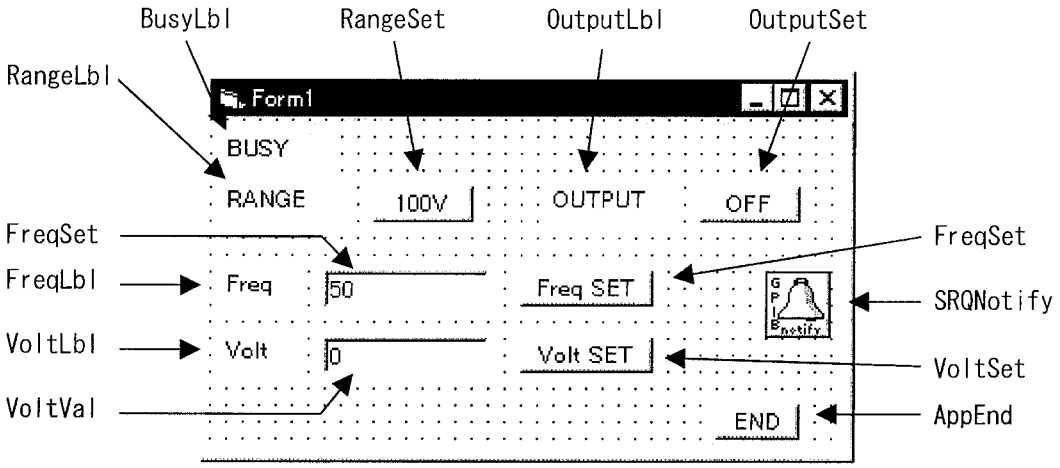
```
    ibdev 0, Adr, 0, T300ms, 1, EOS, Dev 'Open the device
    ibclr Dev 'Clear the device

    Rng = False
    Out = False
End Sub

Private Sub FreqSet_Click()
    ibwrt Dev, "FRQ" & FreqVal.Text & Chr(EOSCHAR) 'Set the frequency
End Sub

Private Sub OutputSet_Click()
    If Out = False Then
        ibwrt Dev, "OUT 1" & Chr(EOSCHAR) 'Set the output to ON
        OutputSet.Caption = "ON"
        Out = True
    Else
        ibwrt Dev, "OUT 0" & Chr(EOSCHAR) 'Set the output to OFF
        OutputSet.Caption = "OFF"
        Out = False
    End If
End Sub

Private Sub RangeSet_Click()
    If Rng = False Then
        ibwrt Dev, "RNG 1" & Chr(EOSCHAR) 'Set the range to 200V
        RangeSet.Caption = "200V"
        Rng = True
    Else
        ibwrt Dev, "RNG 0" & Chr(EOSCHAR) 'Set the range to 100V
        RangeSet.Caption = "100V"
        Rng = False
    End If
End Sub

Private Sub VoltSet_Click()
    ibwrt Dev, "VLT" & VoltVal.Text & Chr(EOSCHAR) 'Set the voltage
End Sub
```

b) Use of Query and SRQ -NI

This operation is similar to that of the above sample a) except that the control detects that the system enters a BUSY condition on the point of range selection and output ON/OFF switching and queries related status and then temporarily disables command sending.

To monitor SRQ and generate an event, use the GPIBNotify control. The GPIBNotify control is made available by selecting "gpibNotify OLE Control Module" from "Component" in the "Project" menu of Visual Basic.

Event procedure (SRQNotify_Notify), which is started by SRQ, detects the BUSY condition by querying the serial poll and operation event register.




```
Option Explicit
Const Adr As Integer = 2
Const EOSCHAR As Integer = &HA
Const eos As Integer = XEOS + REOS + EOSCHAR
Dim Dev As Integer
Dim Rng As Boolean
Dim Out As Boolean

Private Sub AppEnd_Click()
   Dim v As Integer
   v = 0
   ibloc Dev
   ibonl Dev, v
   End
End Sub

Private Sub Form_Load()
   Dim x As Long, y As Long
   Dim stat As Integer
   Dim rdbuf As String * 10

   ibdev 0, Adr, 0, T300ms, 1, eos, Dev 'Open the device
   ibclr Dev                             'Clear the device

   ibwrt Dev, "SRE 2" & Chr(EOSCHAR)
   ibwrt Dev, "XEE 14" & Chr(EOSCHAR)
   ibwrt Dev, "OPE 15" & Chr(EOSCHAR)
```

```
    ibwrt Dev, "?OPC" & Chr(EOSCHAR)
    ibrd Dev, rdbuf
    ibwrt Dev, "?STB" & Chr(EOSCHAR)
    ibrd Dev, rdbuf
    stat = SRQNotify.SetupNotify(Dev, RQS)
    Rng = False
    Out = False
    BusyLbl.Enabled = False
End Sub

Private Sub FreqSet_Click()
    ibwrt Dev, "FRQ" & FreqVal.Text & Chr(EOSCHAR) 'Set the frequency
End Sub

Private Sub SRQNotify_Notify(ByVal LocalUd As Long, ByVal Locallbsta As Long, ByVal
Locallberr As Long, ByVal Locallbcntl As Long, RearmMask As Long)
        Dim stb As Integer
        Dim opc As Integer
        Dim rdbuf As String * 10
        If (Locallbsta And RQS) Then
            ibrsp Dev, stb
            If (stb And 2) Then
                ibwrt Dev, "?OPC" & Chr(EOSCHAR)
                ibrd Dev, rdbuf
                opc = CInt(Right(rdbuf, 6))
                If (opc And 1) Or (opc And 4) Then
                    BusyLbl.Enabled = True
                    RangeSet.Enabled = False
                    OutputSet. Enabled = False
                    FreqSet. Enabled = False
                    VoltSet. Enabled = False
                Else
                    BusyLbl. Enabled = False
                    RangeSet. Enabled = True
                    OutputSet. Enabled = True
                    FreqSet. Enabled = True
                    VlotSet. Enabled = True
                End If
            End If
            If (Out = True) And (opc = 9) Then
                OutputSet.Caption = "OFF"
                Out = False
            End If
            RearmMask = RQS
        End If
    End Sub

Private Sub OutputSet_Click()
    If Out = False Then
        ibwrt Dev, "OUT 1" & Chr(EOSCHAR) 'Set the output to ON
        OutputSet.Caption = "ON"
        Out = True
    Else
        ibwrt Dev, "OUT 0" & Chr(EOSCHAR) 'Set the output to OFF
        OutputSet.Caption = "OFF"
        Out = False
    End If
End Sub

Private Sub RangeSet_Click()
    If Rng = False Then
        ibwrt Dev, "RNG 1" & Chr(EOSCHAR) 'Set the range to 200V
        RangeSet.Caption = "200V"
        Rng = True
    Else
        ibwrt Dev, "RNG 0" & Chr(EOSCHAR) 'Set the range to 100V
        RangeSet.Caption = "100V"
        Rng = False
    End If
End Sub

Private Sub VoltSet_Click()
    ibwrt Dev, "VLT" & VoltVal.Text & Chr(EOSCHAR) 'Set the voltage
End Sub
```

9

RS-232 Interface

Outline of RS-232 Interface

With RS-232 interface, the system can perform external control similarly to the case of GPIB except for GPIB proper functions. It can perform setting and query using the same program messages as GPIB. Response messages to queries have the same format as that for GPIB.
Since much overlapping is found between the two, the same contents as those for GPIB are omitted here. When the user is to use RS-232 for external control, also refer to materials for GPIB.

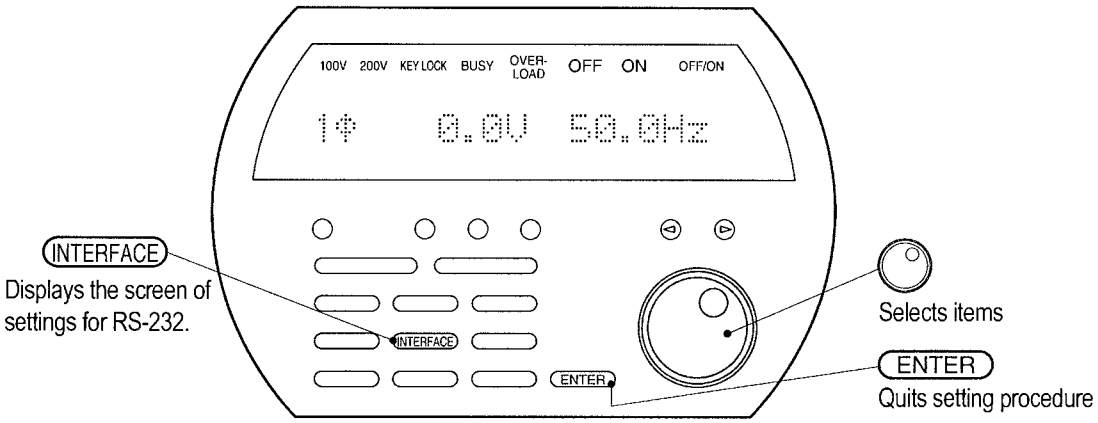
Functions that GPIB does have but RS-232 does not (GPIB proper functions)

- Selection of remote/local
- Interrupt to controller by means of service request and serial pole
  The user can read status using a querying message (?STB) etc.
- GPIB proper command such as "Device Clear"
- Connection of multiple devices
  RS-232 supports only one-to-one connection.

Specifications

- Baud rate: 1200, 2400, 4800, and 9600
- Length of data bit: 7, 8
- Length of stop bit: 1, 2
- Parity: none, even, odd

Settings for using RS-232

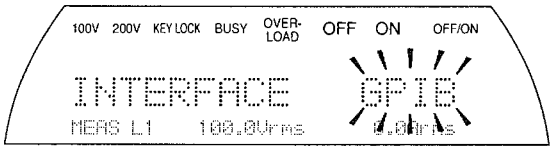


To use an RS-232 interface, connect the system to a computer for use with an RS-232 straight cable and carry out settings of "Selection of interface", "Transfer rate", "Delimiter for sending", "Parity", "Stop bit" and "Character length".

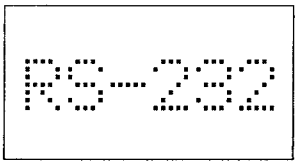
Selecting the interface

1. Press (INTERFACE) to show the interface setting screen.

   * "GPIB" is set on shipping.

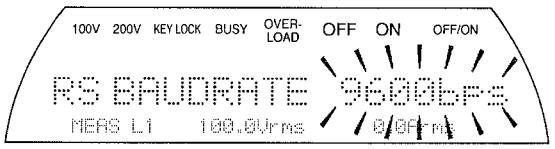


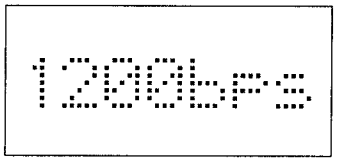
2. Turn the dial to select "RS-232".



Setting the transfer rate

1. Press (INTERFACE) to show the transfer rate setting screen.
2. Turn the dial to select the transfer rate.

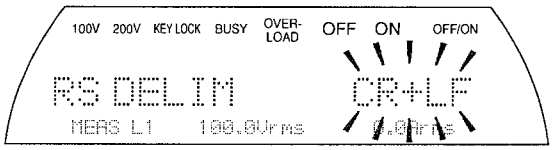


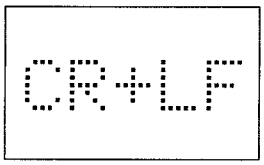


Select a transfer rate out of 1200, 2400, 4800, 9600 bps.

Setting a delimiter for sending

1. Press (INTERFACE) to show the delimiter setting screen.
2. Turn the dial to select the delimiter.

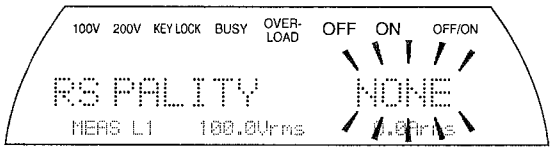


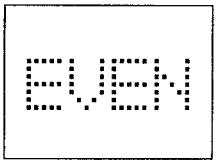


Select one out of delimiters: CR+LF, CR and LF.

Setting the parity

1. Press (INTERFACE) to show the parity setting screen.
2. Turn the dial to select the parity.



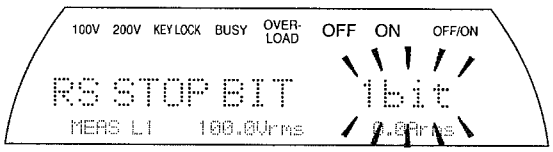


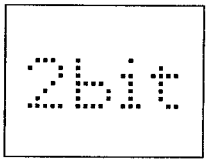
Select parity out of NONE, EVEN and ODD.

Setting the stop bit

① Press (INTERFACE) to show the stop bit setting screen.

② Turn the dial to select the stop bit.



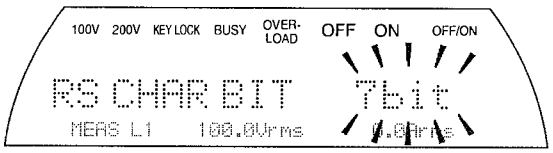


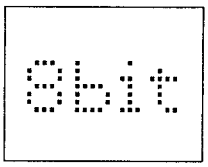
Select either of 1bit and 2bit for the stop.

Setting the character length

① Press (INTERFACE) to show the character length setting screen.

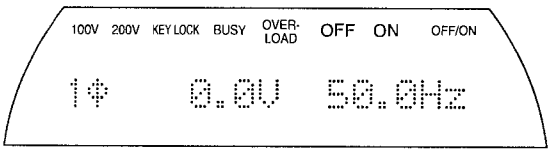
② Turn the dial to select the character length.





③ Press (INTERFACE) or (ENTER) to quit the setting procedure, and the display returns to the normal screen.

Select either of 8bit and 7bit for the character length.



Attention!

Once RS-232 is selected, an REM indication appears and the system disables operations other than (INTERFACE) and (OFF/ON) button operations. The (OFF/ON) button is available only to turn off the output for emergency stop.

Memo

[Difference between RS-232 and GPIB]
Control of RS-232 interface differs from that of GPIB interface as listed below:

- Does not support parallel connection of devices.
- Does not specify addresses because the system performs one-to-one data communications.
- Does not have the service request (SRQ) function.
- Does not have the remote/local function.

Attention!

- Both GPIB and RS-232 cannot be used simultaneously. The user must select either of them.
- The initial state (on-shipping condition) has GPIB set for default.
- When a remote operation is excuted with GPIB, only the local mode (LOCAL) and (OFF/ON) button are operable.
  The (OFF/ON) button is available only to turn off the output for emergency stop.

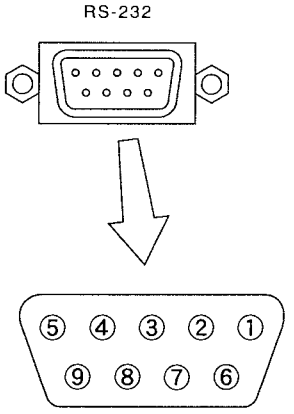
Attention!

Interface related parameters are stored in the battery-backup memory.
When the backup battery deteriorates, the voltage lowers and as a result, backup data may be erased or destroyed. Such a failure is checked when the system power is turned on and the system is initialized to the state of factory default.
For further information, refer to the section titled "Backup battery" in Chapter 10 "Maintenance".

Attention!

- When RS-232 is under selection, only the (INTERFACE) and (OFF/ON) buttons are operable. The (OFF/ON) button is available only to turn off the output for emergency stop.

Connection of RS-232 cable



Pin array of RS-232 connector

Connect with a cable the controlling computer and the unit at the RS-232 connector on the rear panel of the unit.
The RS-232 connector of the P-STATION/EPO unit, which conforms to common PC-AT compatible computers, accepts marketed straight cables.

Select a cable protected with double shield that is connected to the metallic shell of its connector in order to avoid unnecessary radiation of electromagnetic fields. Use of an inferior cable may give disturbances to the surroundings.

Connection of cable available for connection is shown below.

P-STATION/EPO			PC-AT compatible machine	
Pin No.	Name of signal		Pin No.	Name of signal
1	N.C. No connection	→	1	CD Carrier Detect
2	TD Transmitted data	→	2	RD Received Data
3	RD Received data	←	3	TD Transmitted Data
4	DSR Indicates the partner is active. If not active, sending from this device will be kept waiting.	←	4	DTR Data Terminal Ready
5	SG Signal ground (connected to chassis)	—	5	SG Signal Ground
6	DTR Indicates this device is active.	→	6	DSR Data Set Ready
7	CTS Indicates the partner is receptive. If not active, sending from this device will be kept waiting.	←	7	RTS Request To Send
8	RTS Indicates this device is receptive.	→	8	CTS Clear To Send
9	N.C. No connection	→	9	RI Ring Indicator
DSUB type 9-pin male (fixing screw: inch)			DSUB type 9-pin female	

Handshake

The user can make use of hardware handshake in the P-STATION/EPO system.

Handshake is performed by DTR-DSR/CTS-RTS through connection via straight cable described in "Connection of RS-232 cable".

Details of handshake operation

Reception from controller

Depending on the condition of reception buffer (255 characters), this product performs the following processing:

- If about 2/3 or more is used: disables RTS and DTR.
- If about 2/3 or more is emptied: enables RTS and DTR.

Transmission to controller

Suspends transmission temporarily if either of the following condition is entered:

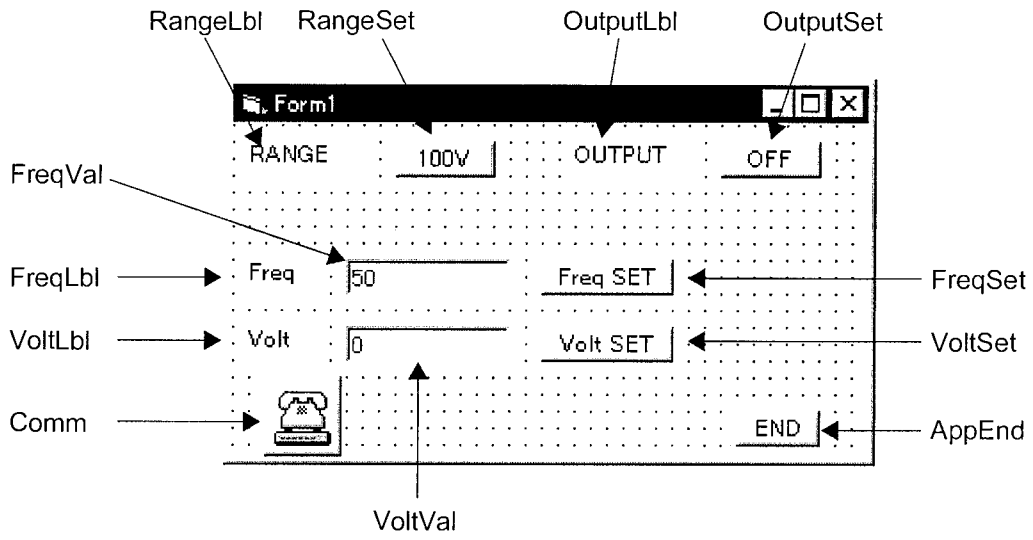
- CTS is disabled.
- DSR is disabled.

Sample RS-232 program

The following section introduces samples of remote control that uses RS-232 interface. Presented here is a case of simple setting in which Visual Basic (excluding Learning EDITION) is used.
The contents of program is almost the same as "a) Setting" of the sample GPIB program, a "Case in which Visual Basic and National Instruments' GPIB interface board are used" in Chapter 8.
For the use of program messages, which is similar to GPIB, also refer to "Sample GPIB program" of Chapter 8 "GPIB Interface".

Exsample of Visual Basic (Setting)

This is a simplest program of initialization followed by setting of arbitrary voltage and frequency, then turning on the output.
To use RS-232 with Visual Basic, it would be easy to resort to communication control (MSComm). From "Component" of Visual Basic "Project" menu, select "Microsoft Comm Control" to reach this communication control.

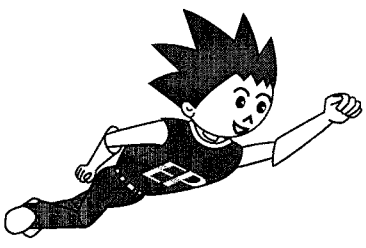



```
Option Explicit
Dim DELIM As String
Dim Rng As Boolean
Dim Out As Boolean

Private Sub AppEnd_Click()
        Comm1.PortOpen = False                    ' Close the port
        End
End Sub

Private Sub Form_Load()
        Comm1.Settings = "9600,N,8,1"             ' Set communications conditions
        Comm1.Handshaking = comNone                     ' Set conditions of handshake
        Comm1.CommPort = 1                              ' Specify Port 1
        Comm1.PortOpen = True                           ' Open the port

        Rng = Fal
        Out = False
        DELIM = Chr(&H13) & Chr(&HA)
End Sub

Private Sub FreqSet_Click()
        Comm1.Output = "FRQ" & FreqVal.Text & DELIM     ' Set the frequency
End Sub
```

```
Private Sub OutputSet_Click()
        If Out = False Then
                Comm1.Output = "OUT 1" & DELIM          ' Set the output to ON
                OutputSet.Caption = "ON"
                Out = True
        Else
                Comm1.Output = "OUT 0" & DELIM          ' Set the output to OFF
                OutputSet.Caption = "OFF"
                Out = False
        End If
End Sub

Private Sub RangeSet_Click()
        If Rng = False Then
                Comm1.Output = "RNG 1" & DELIM          ' Set the range to 200V
                RangeSet.Caption = "200V"
                Rng = True
         Else
                Comm1.Output = "RNG 0" & DELIM  ' Set the range to 100V
                RangeSet.Caption = "100V"
                Rng = False
        End If
End Sub

Private Sub VoltSet_Click()
        Comm1.Output = "VLT" & VoltVal.Text & DELIM     'Set the voltage
End Sub
```

10

Maintenance



Backup battery

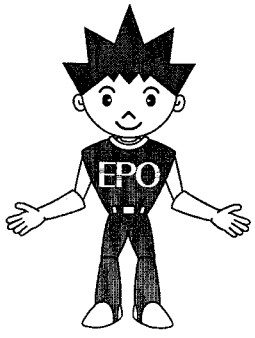
The P-STATION/EPO unit uses a lithium battery for backup power.
The battery can backup the unit about five years if the unit is left un-powered. However, this period varies with the temperature and working conditions.
When the battery is consumed, a message of "BACKUP MEMORY LOST" appears on the display when the unit is powered up. The unit starts up with all stored data initialized. Frequent occurrence of this condition indicates that the battery should be replaced. Contact NF representatives.

Calibration

If your P-STATION/EPO unit is found to be demanding calibration, contact NF representatives.

11

Solution of Trouble



Fault diagnosis

When the power to the unit is turned on, the unit carries out diagnosis over its parts. If any error is detected on booting, the control stops power energizing to the major internal power sections and displays an error message in order to prevent the trouble from expanding.
The following table describes causes and necessary measures for each message.

Message	Cause	Measures or description
SYSTEM FAIL 001	Corrupt contents of internal ROM (program memory)	The system will not boot up, with the message only displayed. Possibility of failure. Note the message and contact the company or the dealer.
SYSTEM FAIL 002	Errors found in result of operation check of internal RAM	
SYSTEM FAIL 003	No response from control section	
SYSTEM FAIL 004		
SYSTEM FAIL 005	Trouble found in control section	
SYSTEM FAIL 006	Trouble found in signal generation section	
SYSTEM FAIL 007	There is an error in cable connection between Master, Booster 1 and Booster 2. There is an error in power amplifier section.	While the message is displayed, the system will not boot up. Check the cables between Master, Booster 1 and Booster 2. If the problem remains, contct NF representative.
BACKUP MEMORY LOST	Data stored in battery-backup memory has been lost.	When the message is displayed, initialize all stored data to the factory settings and boot the system. If this error frequently occurs, backup battery is deteriorated. Contact the company or the dealer because battery replacement is regarded as "repair".
	The first power up after version up of program memory	When the message is displayed, initialize all stored data to the factory settings and boot the system.
PARAMETER CLEAR	Cables between Master, Booster 1 and Booster 2 are changed. There is an error in power amplifier section	When the message is displayed, initialize those contents stored by the storage function to the factory settings and boot the system.

Settings retained by backup battery

The table below lists settings that will be stored and maintained by the backup battery even when the power switch is turned off.
If the fault diagnosis function finds any problem, the control erases the data stored in the battery-backup memory and initializes the data to the factory settings according to the table below.

Settings supported by backup battery	Factory setting	Problem found by fault diagnosis		
		Damaged data in memory	Version-updated program memory	Cable connections between Master, Booster 1 and Booster 2 have been changed or there is an error in power amplifier section.
Data stored by storage function	(☞See Chap. 5 "Versatile Use - for advanced users -".)	To be erased		
Key lock	Off			
Selection of interface	GPIB	To be erased		Not to be erased
GPIB address	2			
GPIB delimiter	CR+LF			
RS-232 transfer rate	9600bps			
RS-232 delimiter	CR+LF			
RS-232 parity	None			
RS-232 stop bit	1bit			
RS-232 character length	8bits			
Beep	On			
Ten keypad operation mode	10KEY			

Protective functions

These functions monitor the internal condition and they exert protective functions if any error is detected. Two types of protective functions are provided: output restraint and shutoff of power.
1. When the protective operation of output restraint is exerted, the system is protected from overload and [OVER-LOAD] lights up. When overload or other error disappears, the system automatically restored to normal output.
2. In the case of a severe error, the function shuts off the power to internal major power sections to secure safety.
If beep warning is set to ON, the system warns with beep during output restraint and power shutoff period.

Subject of protection	Status under protection			Description
	Message on power shutoff	Output restraint	Power shutoff	
Output current restraint	(Power will not be shut off.)	○		Restrains the output current to a constant level or lower. Particularly, waveform clips when AC output is supplied.
Output power restraint				Restrains the output power to a constant level or lower. Particularly, waveform clips when AC output is supplied.
Power amplifier input voltage error	SYSTEM DOWN FL0201 (last two digits indicate the unit number)	○	○	Turns off the output or shut off the input depending on the degree.
Overcurrent in power amplifier	SYSTEM DOWN FL0301 (last two digits indicate the unit number)	○	○	
Overheated internal heat sink	SYSTEM DOWN FL0601 (last two digits indicate the unit number)	○	○	Shuts off the input.
DC power section inoperative	SYSTEM DOWN FL0101 (last two digits indicate the unit number)		○	Shuts off the input by detecting suspended operation due to blown fuse etc.
No response from power amplifier	SYSTEM DOWN FL0400 (last two digits are always 00)		○	Disconnection arouse inside.

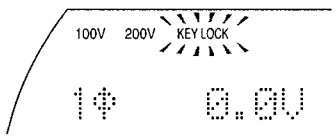
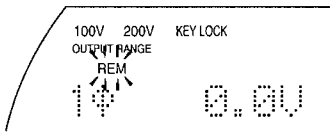
Troubleshooting

If the user experiences a condition that would lead to potential system failure during the P-STATION/EPO operation, refer to the following section to check for wrong operation, procedure, or connection.
If any of the following descriptions does not apply to the condition, do not turn on the power and contact NF representatives.

Phenomenon on power turning on

Phenomenon	Cause or conditions	Measures or description
Will not start any action on power turning on.	Is the power input positively supplied?	Ensure the power input is positively supplied.

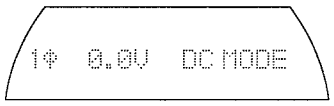
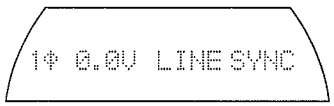
Buttons are inoperable

Phenomenon	Cause or conditions	Measures or description
Almost all buttons do not work.	Is KEYLOCK lighting? 	Turn off key lock. (☞See the section of "Key lock", Chap. 7 "Useful Functions".)
	Is REM lighting? 	If RS-232 is selected for interface, then change it to GPIB. (☞See "Setting for GPIB use", Chap. 8 "GPIB Interface".)
		If GPIB is selected for interface, the keypad of the unit is inoperable when the system is controlled by the PC.

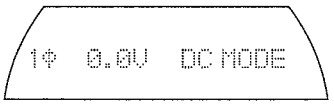
Phenomenon relating to voltage setting

Phenomenon	Cause or conditions	Measures or description
Cannot switch voltage range from 200V to 100V.	If AC output has been selected, is the setting of output voltage higher than the phase voltage of 150V?	Set the voltage to 150V or lower.
	If DC output has been selected, is the setting of output voltage higher than 212V?	Set the voltage to 212V or lower.

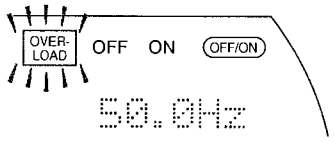
Phenomenon relating to frequency setting

Phenomenon	Cause or conditions	Measures or description
Cannot set frequency.	Is DC output selected? 	Select AC output before going ahead. (☞See "Using the unit as a DC power supply", Chap. 5 "Versatile Use".)
	Is line synchronization enabled? 	Disable line synchronization before going ahead. (☞See "Line synchronization", Chap. 7 "Useful Functions".)

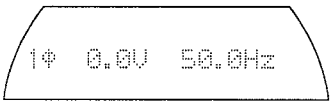
Phenomenon relating to line synchronization

Phenomenon	Cause or conditions	Measures or description
Cannot enable line synchronization.	Is the reset frequency for the line synchronization OFF moment (50 Hz or 60 Hz) out of the range between the upper limit and lower limit to the frequency?	Change the value of upper and/or lower limit frequency. (☞See "Setting limits to output", Chap. 4 "Fundamental Use".)
	Is DC output selected? 	Change to AC output. (☞See "Using the unit as a DC power supply", Chap. 5 "Versatile Use".)

Phenomenon relating to overload

Phenomenon	Cause or conditions	Measures or description
Overload lamp lights up. 	Is the system in overloaded condition?	Check the load and ensure the load is within the rated ranges.
	Was it noticed on an output turning ON occasion?	Lamp lighting for a short time is normal. A rush current triggered the protective function and the output was restrained. However, the measurement of rush current is not correct because waveform clips.
Overload lamp lights when the optional remote sensing circuit is used.	If the compensation range (5%) is exceeded, the overload lamp lights and the compensation value returns to zero. The light continues until you shut off the output.	Check whether the remote sensing cables are disconnected or broken. If no irregularity is found, change the output cables to larger section and shorter ones.

Phenomenon relating to measurement function

Phenomenon	Cause or conditions	Measures or description
L1/L2/L3 ○ does not function.	Is it on single-phase system(Is there S in the last character of the model name?)?	This button has no effects in single-phase system.
	Is single-phase selected for phase-mode? 	This button has no effects in single-phase mode.

Phenomenon on power turning off

Phenomenon	Cause or conditions	Measures or description
The unit persists operation for a while after turning off the power.	This is normal. Operation autmatically stops when the internal voltage has lowered down to a sufficiently safe level.	Do nothing and wait for a while. Operation will stop about five second later.

If a motor is connected as load

Phenomenon	Cause or conditions	Measures or description
When the unit is supplying power to the motor, output occasionally stops by some chance. Or, the power input is unexpectedly shut off.	When the system is providing power to a motor, the rotor generally continues to run by the inertia even after stop of the power supply. At this moment, a reverse voltage is applied to the terminal that has been supplying the power. If the user turns on the output of P-STATION/EPO in this situation, this voltage may flow back to EPO depending on the condition. This may cause abnormal rise of power supply voltage within the EPO unit, and, at worst, resulting in equipment damage. To protect the unit from this, detection of an abnormal rise of internal voltage automatically turns off the output and, depending on the degree, shuts off the input power.	Do not turn on the output when the motor continues turning after turning off the output. Wait until the rotation stops before turning on the output. Take extreme care because the operation is likely to give impact in the EPO unit.

If a transformer is connected as load

Phenomenon	Cause or conditions	Measures or description
Current seems abnormal and saturated in the load of transformer.	Although the output of P-STATION/EPO is controlled by its electronic circuitry to prevent abnormal DC voltage from arising, complete 0V is not achieved due to the limit of control. This small DC voltage excites the core by the force of DC and thus the exciting current of the transformer sometimes presents abnormal level depending on the transformer connected.	The DC offset voltage of EPO is typically ± 100 mVtyp. When to connect a transformer as load, take into consideration the effects of this value.

Frequently asked questions and answers to them

【Questions】	【Answers and explanation】
Can I superimpose AC on DC?	No, you cannot do that with P-STATION/EPO units. However, you can do it with our P-STATION/series [Q].
I want to perform a test to give quick change of voltage or frequency to the load. What should I do?	You can do it using the storage function. You can change the condition with the output kept ON when recalling the memory if you have stored in memory settings of which a set of four parameters ("output voltage range","phase-mode" "line synchronization" and "AC/DC mode") are the same as the current parameters respectively in advance. * For more complicated tests, it is recommended to use our P-STATION/series [Q].
We are using the system for three-phase load and our desire is to monitor not only the line-to-line voltage but also line-to-line current. What can we do?	The units do not have a function to display line-to-line current. Only phase current is measured and displayed.
How can I check the software version number of the software used within?	A message appears on the display when power is turned on. When the message stops, the version number appears for 2 seconds on the bottom side of the display.

【Questions】

【Answers and explanation】

What does MISC mean?

MISC stands for miscellaneous. This is a multi-purpose key to set the functions not assigned to special keys.

How the screen changes when [MISC] is pressed?

The screen changes in the following order. Some screens do not appear when its option is not installed or when the system is used in the DC output mode.

Normal screen	
↓	
COMP MODE	Output compensation mode
↓	
START PHASE	Power-on phase when output is ON
↓	
LINESYNC FREQ	Resetting frequency from line synchronization
↓	
REMOTE SENS AGC	Remote sensing AGC
↓	
MON OUT CH1	Output waveform monitor CH1
↓	
MON OUT CH2	Output waveform monitor CH2
↓	
BEEP	Beep sound
↓	
PHASE MODE	Phase mode
↓	
PS/2 MODE	Ten keypad operation mode
↓	
Normal screen	

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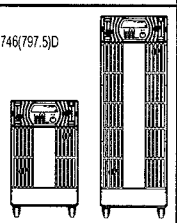
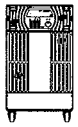
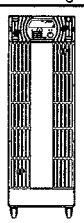
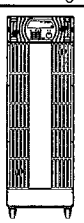
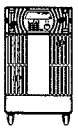
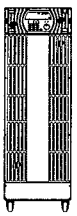
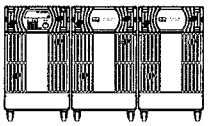
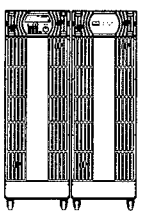
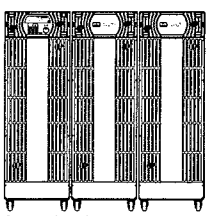
Rating

■Specification

				Single-phase system			
				EPO 4000S	**EPO 8000S**	**EPO 10000S**	**EPO 12000S**
Output (AC mode)	Capacity			4kVA	8kVA	10kVA	12kVA
	Number of phases			Single-phase			
	Voltage setting range		100V	0 to 150.0V (resolution 0.1V)			
			200V	0 to 300.0V (resolution 0.1V)			
	Maximum current*1	Single-phase 100V/200V		40A / 20A	80A / 40A	100A / 50A	120A / 60A
		Three-phase*2 100V/200V		-	-	-	-
		Single-phase three-wire*2 100V/200V		-	-	-	-
	Maximum rush current (RMS, Short time)			2.8 times the maximum current (RMS)			
	Maximum peak current*3 (peak value, Continuity)			4 times the maximum current (RMS)			
	Power factor of load			0 to 1 (leading or lagging phase)			
	Distortion factor			0.5% or less			
	Starting phase on output turn-ON			Either of 0, 90, 180 and 270 degree by selection			
	Frequency			Setting range: 5.0 to 550.0Hz (resolution 0.1Hz) Setting accuracy: within ±0.01% of the setting, Stability: within ±0.005% of the setting			
	Line synchronization			Supplies AC output synchronized to power line frequency			
Output (DC mode) *4	Voltage setting range		100V	0 to 212.0V (resolution 0.1V)			
			200V	0 to 424.0V (resolution 0.1V)			
	Maximum current		100V	18A	36A	45A	54A
			200V	9A	18A	22.5A	27A
	Maximum output power			2538W	5076W	6345W	7614W
Output voltage stability	Current fluctuation to load			DC: 40.0 to 120.0Hz: within ±0.5%, 120.0 to 500.0Hz: within ±1.0%			
	Input voltage fluctuation to power supply			within ±0.2%			
	Fluctuation to ambient temperature			within ±100ppm/°C(typ)			
Input	Voltage and frequency			170 to 230V 48 to 62Hz			
	Number of phases			Three-phase			
	Efficiency and power factor			76% or higher (typ), * Input voltage of 200V (line to line voltage)			
	Input current*5			25A or less	37A or less	49A or less	49A or less
	Power consumption			6.1kVA or less	11.4kVA or less	14.2kVA or less	16.8kVA or less
Measuring function *6	AC mode *7	Voltage		RMS: 170V/340V range (self switching), resolution 0.1V, accuracy within ±1% FS Peak: 240V/480V range (self switching), resolution 0.1V, accuracy within ±3% FS			
		Current		RMS: 14A/28A/70A/140A/280A/560A range (self switching), resolution 0.01A(14A/28A/70A range), 0.1A(140A/280A/560A range), accuracy within ±2% FS Peak: 20A/40A/100A/200A/400A/800A range (self switching), resolution 0.01A (0.1 A for 200 A/400 A/800A range), accuracy within ±5% FS			
		Effective power		2.2 kW/22 kW range, resolution 0.01 kW (at 2.2 kW)/0.1 kW (at 22 kW), accuracy within ±3% FS			
		Apparent power and power factor		Calculated from voltage, current and effective power measurements and displayed			
		Peak current holding function		20A/40A/100A/200A/400A/800A range, resolution 0.01A (0.1A for 200A/400A/800A range), accuracy within ±5% FS			
	DCモード	Voltage		Mean value: 240V/480V range (self switching), resolution 0.1V, accuracy within ±1% FS			
		Current		Mean value: 20A/40A/100A/200A/400A range (self switching), resolution 0.01A (0.1A for 200A/400A), accuracy within ±2% FS			
		Power		Calculated from voltage and current measurements and displayed			
	Others			Fault diagnosis function, protective function, storage function, preset function, limiter function, GPIB/RS-232 interface, external keypad entry, key lock function, beep warning			
Environment, mass etc	Withstand voltage*8			1.5 kV AC, 50/60 Hz for one minute			
	Insulation resistance (at 500V DC)*8			5 MΩ or higher	2.5 MΩ or higher	2 MΩ or higher	1.6 MΩ or higher
	Ambient temperature and humidity			Operation: 0 to 40°C; Storage: -10 to 50°C, 10 to 90% RH (no condensation)			
	Mass*9			85kg	140kg	160kg	175kg
Dimensions	●L-type cabinet 448W x 1284(1366)H x 746(797.5)D ●M-type cabinet 448W x 706(788)H x 746(797.5)D * Units in mm; values in parentheses include projections						

Remarks : [A] means [Arms], [V] means [Vrms] unless any other special description is given. Signal waveform is a sinusoidal wave.
*1 Output current decreases if output frequency is 40 Hz or lower. *2 Phase-voltage is set to 100V in 100V range. Phase-voltage is set to 200V in 200V range.
*3 A short period until mean value protection operates. However, repeated application is allowed to capacitor input type rectifying load (at 48 to 62 Hz).

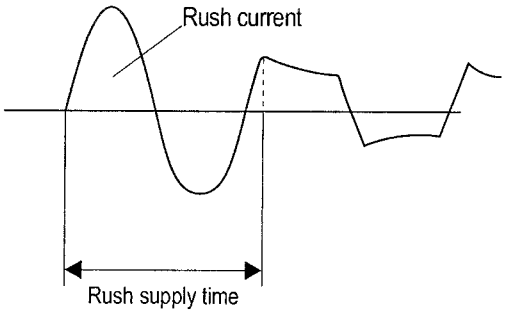
Multi-phase system				
EPO 6000M	**EPO 12000M**	**EPO 18000M**	**EPO 24000M**	**EPO 36000M**
6kVA	12kVA	18kVA	24kVA	36kVA
Single-phase/Three-phase/Single-phase three-wire				
0 to 150.0V (resolution 0.1V)*10				
0 to 300.0V (resolution 0.1V)*10				
60A / 30A	120A / 60A	180A / 90A	200A / 100A	200A / 100A
20A / 10A	40A / 20A	60A / 30A	80A / 40A	120A / 60A
20A / 10A	60A / 30A	80A / 40A	120A / 60A	180A / 90A
2.8 times the maximum current (RMS)				
4 times the maximum current (RMS)				
0 to 1 (leading or lagging phase)				
0.5% or less				
Either of 0, 90, 180 and 270 degree by selection				
Setting range: 5.0 to 550.0Hz (resolution 0.1Hz), Setting accuracy: within ± 0.01% of the setting, Stability: within ±0.005% of the setting				
Supplies AC output synchronized to power line frequency				
0 to 212.0V (resolution of 0.1V)				
0 to 424.0V (resolution of 0.1V)				
27A	54A	81A	90A	90A
13.5A	27A	40.5A	45A	45A
3807W	7614W	11421W	12690W	12690W
DC: 40.0 to 120.0Hz: within ± 0.5%, 120.0 to 500.0Hz: within ±1.0%				
within ±0.2%				
within ±100ppm/ ℃ (typ)				
170 to 230V 48 to 62Hz				
Three-phase				
76% or higher (typ), * Input voltage of 200V (line to line voltage)				
25A or less	49A or less	75A or less	98A or less	147A or less
8.4kVA or less	16.8kVA or less	25.2kVA or less	33.6kVA or less	50.4kVA or less
RMS: 170V/340V range (self switching), resolution 0.1V, accuracy within ±1% FS Peak: 240V/480V range (self switching), resolution 0.1V, accuracy within ±3% FS				
RMS: 14A/28A/70A/140A/280A/560A range (self switching), resolution 0.01A(14A/28A/70A range), 0.1A(140A/280A/560A range), accuracy within ±2% FS Peak: 20A/40A/100A/200A/400A/800A range (self switching), resolution 0.01A (0.1 A for 200 A/400 A/800A range), accuracy within ±5% FS				
2.2 kW/22 kW range, resolution 0.01 kW (at 2.2 kW)/0.1 kW (at 22 kW), accuracy within ±3% FS				
Calculated from voltage, current and effective power measurements and displayed				
220A/40A/100A/200A/400A/800A range, resolution 0.01A (0.1A for 200A/400A/800A range), accuracy within ±5% FS				
Mean value: 240V/480V range (self switching), resolution 0.1V, accuracy within ±1% FS				
Mean value: 20A/40A/100A/200A/400A range (self switching), resolution 0.01A (0.1A for 200A/400A), accuracy within ±2% FS				
Calculated from voltage and current measurements and displayed				
Fault diagnosis function, protective function, storage function, preset function, limiter function, GPIB/RS-232 interface, external keypad entry, key lock function, beep warning				
1.5 kV AC, 50/60 Hz for one minute				
3.3MΩ or higher	1.6MΩ or higher	3.3MΩ or higher *11	1.6MΩ or higher *11	1.6MΩ or higher *11
Operation: 0 to 40 ℃; Storage: -10 to 50 ℃, 10 to 90% RH (no condensation)				
100kg	175kg	300kg	350kg	525kg
		 *Output box is attached.	 *Output box is attached.	 *Output box is attached.

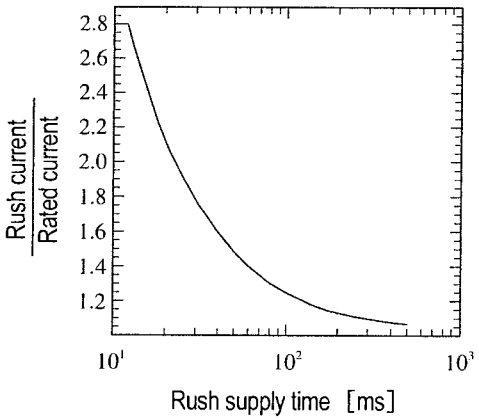
*4 DC mode cannot be used in single-phase three-wire or three-phase system. *5 At input voltage of 200V.
*6 Measurement accuracy is for full scale (FS) of each measurement range.
*7 Effective measurement range of voltage and current is 40 to 500 Hz. In addition, the effective measurement range of peak value and effective power is 45 to 65 Hz. *8 Stipulated with chassis - power supply input in package versus output, chassis - output in package versus power supply input.
*9 Accessories and optional items are excluded. *10 At three-phase/three-phase three-wire set. Avilable for setting in line-to-line voltage (resolution 0.2V).
*11 Value for each cabinet.

Rush current versus supply time

* Vo = 100.0 V (100 V range) or 200.0 V (200 V range), f = 50 Hz, at Power-ON phase 0°
This indicates the time (rush supply time) spent until the output is restrained by the protective circuit operation when rush current is applied to a resistance load.

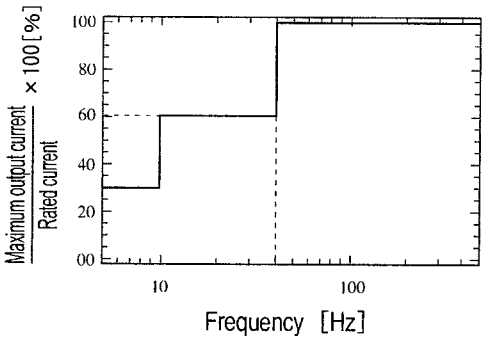
Rated current = 20 A (100 V range), 10 A (200 V range)





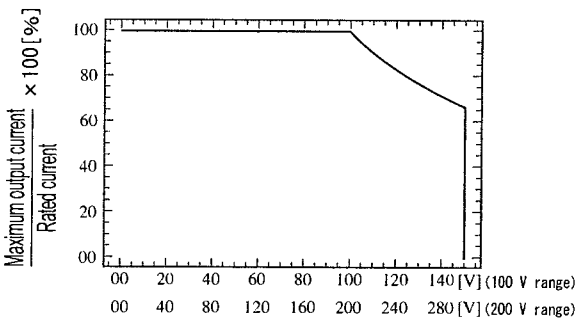
Maximum output current versus frequency

* Maximum current decreases at frequency lower than 40 Hz.



Maximum output current versus output voltage (AC mode)

* Maximum current decreases at voltage higher than 100.0 V (for 100 V range) or 200.0 V (for 200 V range).



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Terminology

Explanation of terms

AC stabilizing power supply

Power (commercial power) supplied through the wall outlet or power switchboard at home or factory fluctuates in voltage value and its waveform is distorted.

To suit for the above phenomenon, we have some means to stabilize the power at the reception end. Conventionally used solutions include devices that use saturable reactors and method that controls slide regulators by servo, which had such remarkable defects that response speed is slow and waveform is not improved yet.

Therefore, device that use electronic circuitry is proposed.

P-STATION/EPO

P-STATION/EPO employs a power amplifier system and provides AC voltage of low distortion and high stability by means of incorporated signal generator.

Power supply higher harmonic current

Household appliances and industrial applications often use switching power sources. A capacitor input rectifying circuit, which is used in their power input section has a drawback that the input current is greatly distorted and deformed so that it contains a number of harmonics.

If high volume of higher harmonic current flows into power lines, the voltage will be distorted so that other equipment malfunctions, transformers used for commercial power supply are overheated and other problems are caused, possibly resulting in accidents.

P-STATION/EPO

P-STATION/EPO, which adopts a circuit to effectively restrain this harmonic current, controls the level of harmonics down to almost the regulatory value and, at the same time, markedly improves the power factor (about 97%, typ).

Condenser-input rectifier circuit

Switching power supplies used in various types of equipment utilize a capacitor-input type rectifier circuit, as it is simple in its circuit and low cost. Input current for equipment like this flows only near the peak value of the sinusoidal voltage of commercial power supply. Therefore, peak value is larger than the effective value of consumption current and the power contains many more harmonic components.

The rate of the peak value to the effective value is called Crest Factor (CF). When the load is a pure resistance, CF becomes 1.41 but the factor increases as high as 3 for the capacitor input type rectifier circuit.

P-STATION/EPO

This system can supply current with CF as high as 4 (CF=4) (precision mode). Therefore, this system can supply distortion-free voltage even for a load such as the capacitor-input rectifier circuit.

Effective power and apparent power

Suppose power is supplied to load from AC power supply with load current I_L, voltage V_L (both I_L and V_L are effective values), the product of these ($I_L V_L$) is called apparent power and displayed in [VA].

Assuming that the instantaneous values of I_L and V_L as i_L and v_L respectively,

$$\frac{1}{T}\int_0^T i_L V_L \, dt$$

the following is called effective power and is displayed in [W].

The ratio of these, [Effective power]/[Apparent power]= [W]/[VA] is called power factor.

That is, apparent power is the power that AC power supplies and effective power is the power used as energy consumed by load.

Power factor is considered as usage rate of the supplied power in the load. Therefore, with power factor of 0.5 (or 50%), half of the supplied power is consumed in the load and the rest is returned to the power source.

P-STATION/EPO

This system contains a measuring function. Not only the apparent power, effective power and power factor can also be displayed by calculation using the instantaneous values of the measured voltage and current.

Power supply immunity to harmonics

Ability of equipment to withstand the harmful effects of harmonic currents.

P-STATION/EPO

Even if harmonic currents enter from commercial power supply, this system supplies quality power with little effect from harmonics. In addition, this system can supply voltage with less distortion even when the voltage waveform of commercial power supply is distorted.

Rush current (or inrush current)

In motors and other electrical products that use capacitor input rectifying circuit, a considerably high current flows in a short time immediately after turning on the power switch compared to the rating condition. This current is called a rush current.

If the power supply cannot afford to provide this rush current sufficiently, motors or some products may not be started. We have a certain regulation that limits this rush current. This test, however, must be performed with a test power supply that has a sufficient rush supplying capacity.

P-STATION/EPO

P-STATION/EPO series have ability to provide rush current that is 2.8 times the rated current. Users do not have to furnish their facilities with another power supply of excessive capacity to provide rush current.

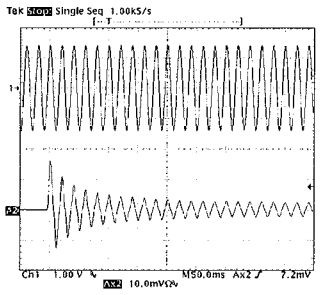
Example of rush current:

Power drill

(rated to 100V AC 260W)

Top: voltage (100V/div)

Bottom: rush current (10A/div)



Evev in a small power drill, a 15 Apk (about 10 Arms) rush current flows just after power charging. This rush current is four times the rated current of 2.6 Arms

Output voltage stability

Various types of performance are required in power supply. Among them, particular one is the resistance to the effects of load fluctuation and power input voltage fluctuation. This characteristic is called "Output voltage stability".

- Current fluctuation versus load change
  This means the fluctuation of output voltage due to the change of load condition.
  In general, the ratio of the output voltage change in a load-connected condition against the voltage in a no-load condition is expressed in [%].

- Input fluctuation versus power supply change
  This means the fluctuation of output voltage caused by the change of power input voltage.
  In general, the ratio of the output voltage change against the maximum and minimum values of the input voltage of the power supply is expressed in [%].

- Fluctuation versus ambient temperature change
  This means the fluctuation of output voltage against the change of ambient temperature.
  In general, the ratio of the output voltage change per 1 °C of ambient temperature is expressed in [%] or in [ppm] (1000 ppm = 0.1%).

Tolerance to instantaneous power interruption and fluctuation of power supply voltage

In general commercial power supply lines, power companies provide power environments of a constant quality. Even if an unexpected natural disaster such as lightning takes place and causes trouble in power transmission lines, they change lines in a second in order to minimize the influence of power failure.
However, in this short period of time to be spent for the line change, the power supply voltage becomes 0 (this is called an instantaneous power interruption), or lowers to an abnormal level. Those electrical products that are not able to endure this interruption cannot continue proper operation.
Ability of equipment to withstand the above interruption and fluctuation is called as the tolerance to fluctuation of power supply voltage.

P-STATION/EPO

Our P-STATION/EPO units have sufficient tolerance ability against these phenomena even in a relatively poor power environment, and they can minimize the impact in the output.

Stability to capacitive load

If your AC power source is of power amplifier type, it electrically compensates the fluctuation in output voltage due to load variances. However, if a capacitive load of extremely high level (large capacitor line filter etc.) is connected, stability may be broken, causing oscillation and other abnormal phenomena.

P-STATION/EPO

our P-STATION/EPO provides that users can select the compensation mode.
The tolerance against capacitive load is about 10 μF in "Precision mode" to ensure high accuracy while "High stability mode" allows the user to connect a load of maximum 150 μF to secure stability.

Application to RF anechoic chamber

An RF anechoic chamber (or a shielded room) is a facility to measure unnecessary radio noise produced from various electronic devices and verify the legitimacy of the device to EMC standards. This facility is required to have an extremely low noise environment so that the detection and measurement of electromagnetic wave emitted from the subject device to be measured will not be affected by noise.

Therefore, a noise filter with particularly high restraining effects is used in the power input section of the anechoic chamber. However, in general, operation may become unstable under conditions of the capacity being several tens μF or higher capacitance, with the power supply unit of power amplifier type providing only insufficient compensation.

P-STATION/EPO

In high stability mode, even in the above situation, our P-STATION/EPO will ensure high stability, which does not prevent selection of filter.

RMS value and peak value

To express the magnitude of voltage or current in the case of AC power supply, most common one is RMS value. This expresses the magnitude with the DC power supply that exerts the same work. A common expression of "100 V AC" means an AC current that has an RMS value of 100 V. To indicate that the value is in RMS, notation of 100 [Vrms] is used.

A peak value is the voltage at the instant at which the voltage is the highest in the course of waveform. Notation of [Vpk] is used to express this.

Also for AC current, RMS values in [Arms] and peak values in [Apk] are used similarly to AC voltage.

WARRANTY

NF Corporation certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory.

All **NF** products are warranted against defects in materials and workmanship for a period of one year from the date shipment. During the warranty period of, **NF** will, at its option, either will repair the defective product without any charge for the parts and labor, or either repair or replace products which prove to be defective. For repair service under warranty, the product must be returned to a service center designated by **NF**. Purchaser shall be prepay shipping charge, duties, and taxes for the product to **NF** from another country, and **NF** shall pay shipping charge to returned the product to purchaser.

This warranty shall not apply to any defect, failure or damage caused by improper use, improper or inadequate maintenance and care or modified by purchaser or personnel other than **NF** representatives.

NF Corporation

WABUN: (≈D:509313-3)

If there are any misplaced or missing pages, we will replace the manual. Contact the sales representative.

NOTES:

- Reproduction of the contents of this manual is forbidden by applicable laws.
- The contents of this manual may be revised without notice.
- Information provided in this manual is intended to be accurate and reliable. However, we assume no responsibility for any damage regarding the contents of this manual.
- We assume no responsibility for influences resulting from the operations in this manual.

EPO 4000S/8000S/10000S/12000S/EPO 6000M/12000M/18000M/ 24000M/36000M Instruction Manual

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