PART NO. Z1-005-670, IB025263
Dec. 2015

Setup Guide

DC Power Supply
PAT-TM/TMX Series
Smart Rack System

16 kW System

PAT20-800TM/TMX **PAT30-532TM/TMX**
PAT40-400TM/TMX **PAT60-266TM/TMX**
PAT80-200TM/TMX **PAT160-100TM/TMX**
PAT250-64TM/TMX **PAT350-45.6TM/TMX**
PAT500-32TM/TMX **PAT650-24.6TM/TMX**
PAT850-18.8TM/TMX

24 kW System

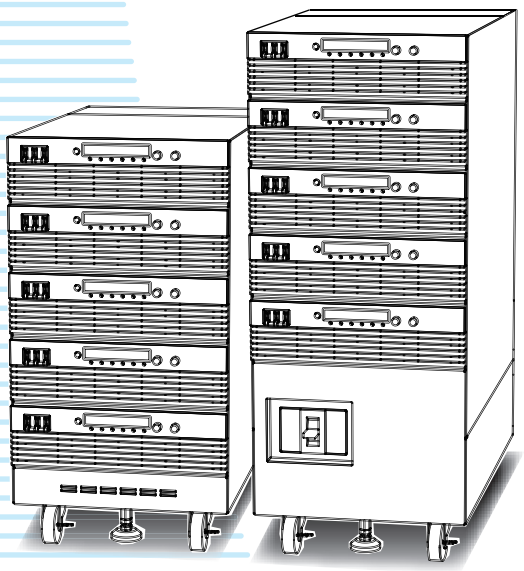
PAT20-1200TM/TMX **PAT30-798TM/TMX**
PAT40-600TM/TMX **PAT60-399TM/TMX**
PAT80-300TM/TMX **PAT160-150TM/TMX**
PAT250-96TM/TMX **PAT350-68.4TM/TMX**
PAT500-48TM/TMX **PAT650-36.9TM/TMX**

32 kW System

PAT20-1600TM/TMX **PAT30-1064TM/TMX**
PAT40-800TM/TMX **PAT60-532TM/TMX**
PAT80-400TM/TMX **PAT160-200TM/TMX**
PAT250-128TM/TMX **PAT350-91.2TM/TMX**
PAT500-64TM/TMX **PAT650-49.2TM/TMX**

40 kW System

PAT20-2000TM/TMX **PAT30-1330TM/TMX**
PAT40-1000TM/TMX **PAT60-665TM/TMX**
PAT80-500TM/TMX **PAT160-250TM/TMX**
PAT250-160TM/TMX **PAT350-114TM/TMX**
PAT500-80TM/TMX **PAT650-61.5TM/TMX**



环境保护使用期限

Environment-friendly Use Period

该标记为适用于在中华人民共和国销售的电子信息产品的环境保护使用期限。

只要遵守有关该产品的安全及使用注意事项，从制造年月起计算，在该年度内，就不会对环境污染、人身、财产产生重大的影响。

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http://www.kikusui.co.jp/pi/

有毒有害物质或元素名称及含有標示

Name of hazardous materials and symbol of element in the equipment and quantity

型号 / Model: PAT-T, PAT-TM, PAT-TMX						
部件名称 Name of part	有毒有害物质或元素 Hazardous material and symbol of element					
	铅 Pb	汞 Hg	镉 Cd	六价铬 Cr(VI)	多溴联苯 PBB	多溴二苯醚 PBDE
印刷电路板组装品 PCB assemblies	×	○	×	○	○	○
内部接线 Internal wirings	×	○	○	○	○	○
外壳 Enclosure	×	○	○	○	○	○
底盘组装品 （含变压器） Chassis assy (xfrs included)	×	○	×	○	○	○
辅助设备 Accessories	×	○	○	○	○	○

本表格依据 SJT 11364 的规定编制。

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Thank you for purchasing the PAT-TM/TMX series “Smart rack System” DC Power Supply.

About Operation Manual

There are six PAT-TM/TMX series “Smart Rack System” Manuals listed as follows.

- Setup Guide (this manual)
  This manual is intended for users who are using the PAT-TM/TMX series “Smart Rack System” for the first time. It includes covers topics related to setting up the product such as installing the product, wiring the power cables and load cables, and connecting the connectors.
- Product specifications (HTML)
  This document describes the specifications of the PAT-TM/TMX series.
- User's manual of base model PAT-T series (PDF)
  This manual describes the base model PAT-T series. It provides an overview of the base model and notes on usage. It also gives various settings, operation procedures, maintenance and so on. Read first the setup guide to set up the PAT-TM/TMX series, next read the User's manual to use the functions of the product effectively.
- Quick Reference
  This manual explains Panel description and operation briefly.
- Safety Information
  This document contains general safety precautions for this product. Keep them in mind and make sure to observe them.
- The communication interface manual (HTML, some PDF)
  This manual contains details about remotely controlling the tester using SCPI commands.
  The interface manual is written for readers with sufficient basic knowledge of how to control measuring instruments using a PC.
  The SCPI commands list is in PDF format.

The operation manuals are intended for users of the product or persons teaching other users on how to operate the product.

Explanations are given under the presumption that the reader has knowledge about Power Supply.

PDF and HTML are provided on the included CD-ROM.
Adobe Reader 6.0 or later is required to view the PDF file.
Microsoft Internet Explorer 6.0 or later is required to view the HTML file.

If you find any incorrectly arranged or missing pages in the manual, they will be replaced. If the manual gets lost or soiled, a new copy can be provided for a fee. In either case, please contact Kikusui distributor/agent, and provide the “Kikusui Part No.” given on the cover.

The Operation Manual has been prepared with the utmost care; however, if you have any questions, or note any errors or omissions, please contact Kikusui distributor/agent.

After reading, always keep the manual nearby so that you may refer to it as needed.

KIKUSUI ELECTRONICS CORP.

1-1-3 Higashiyamata, Tsuzuki-ku, Yokohama,
224-0023, Japan
Tel: +81-45-593-7570 Fax: +81-45-593-7571

Website http://www.kikusui.co.jp/en

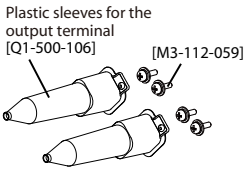
The newest version of the operation manual can be downloaded from Download service of Kikusui website.

Checking the Package Contents

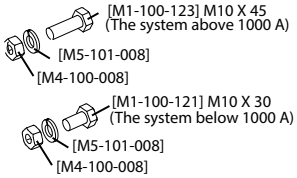
When you receive the product, check that all accessories are included and that the unit and accessories have not been damaged during transportation.

If any of the accessories are damaged or missing, contact your Kikusui agent or distributor.

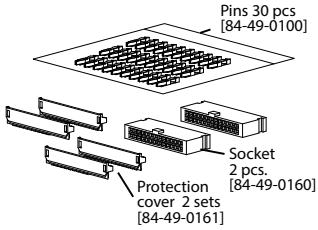
We recommend that all packing materials be saved, in case the product needs to be transported at a later date.



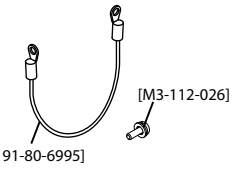
☐ Plastic sleeves for the output terminal (2 sets)
＊ Only 16 kW system



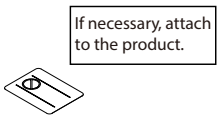
☐ Output terminal bolt (M10)
The system above 1000 A (8 sets)
The system below 1000 A (4 sets)



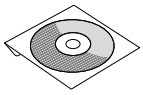
☐ J1/J2 connector kit



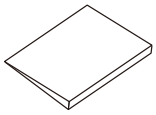
☐ Chassis connection wire set
(1 set)



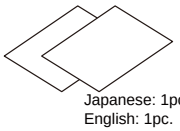
☐ Heavy object warning label (1 pc.)
16 kW system
[A8-900-157]
24 kW system or greater
[A8-900-158]



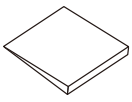
☐ CD-ROM (1 pc.)



☐ Setup guide (This manual, 1 pc.)



☐ Quick Reference



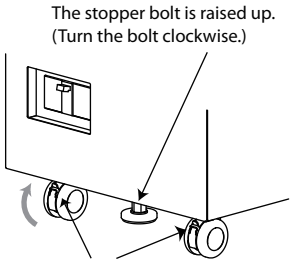
☐ Safety information (1pc.)

⚠ Precautions Concerning Installation

When installing this product, be sure to observe the precautions provided in “Precautions Concerning Installation Location” and “Precautions to Be Taken When Moving the Product” in the Safety information manual. Items specific to this product are given below.

- Avoid locations where the product is exposed to high temperature or direct sunlight.
  Do not install the product near a heater or in areas subject to drastic temperature changes.
  Operating temperature range: 0 °C to +40 °C (32 °F to +104 °F)
  Storage temperature range: 25 °C to +70 °C (-13 °F to +158 °F)
- Avoid humid environments.
  Do not install the product in high-humidity locations–near a boiler, humidifier, or water supply.
  Operating humidity range: 20 %rh to 85 %rh (no condensation)
  Storage humidity range: 90 %rh or less (no condensation)
  Condensation may occur even within the operating relative humidity range. If this happens, do not use the product until the condensation dries up completely.
- When you are moving the product from one location to another, if you must leave it unattended, be sure to use the caster locks or the stopper bolt to ensure that the product stays in place.

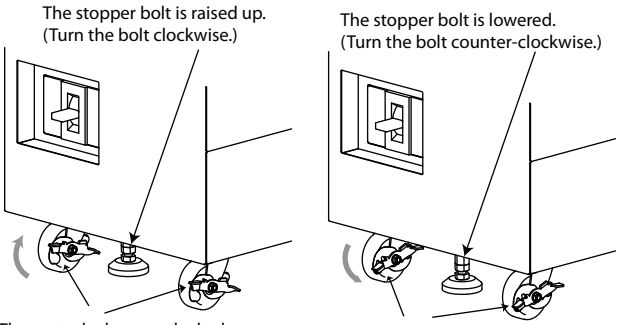
16 kW and 24 kW systems . . . . . .



The caster locks are unlocked.
(The lock levers are in the up position.)

The caster locks are locked.
(The lock levers are in the down position.)

32 kW and 40 kW systems . . . . . .



The caster locks are unlocked.
(The lock levers are in the up position.)

The caster locks are locked.
(The lock levers are in the down position.)

⚠ Product Overview

This product consists of multiple 8 kW PAT-T regulated DC power supplies of the same model on a rack mount. The power supplies can operate in parallel to increase the output current. In this system, one unit is the master unit and all the other units, which are of the same model, are slave units. You can control the whole system by operating the master unit. Additionally, you can control the product remotely through a variety of interfaces such as RS232C (included as standard), GP-IB (factory option), USB (factory option), and LAN (factory option). You can also use external analog signals to control the product.

The different variations of this product consist of multiple power supplies (all of which are the same model) from the 8 kW PAT-T series regulated DC power supplies. Two, three, four, or five power supplies can be combined to create a 16 kW, 24 kW, 32 kW, or 40 kW system. (See p. 5 for the different variations).

Notations used in this manual

- The PAT-TM/TMX series “Smart Rack System” is also referred to as the Rack System or PAT-TM/TMX series in this manual.
- The following markings are used in this manual.

⚠WARNING

Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which, if ignored, may result in damage to the product or other property.

NOTE

Indicates information that you should know.

DESCRIPTION

Explanation of terminology or operation principle.

See

Indicates reference to detailed information.

Contents of the Included CD-ROM

Insert the program CD-ROM in the drive. The menu program window will appear momentarily. If the menu program window does not appear, open the CD-ROM folder in Windows Explorer, and then double-click index.htm to start the menu program.

Accompanying CD-ROM contains following the items.

- IVI-COM Driver
- KI-VISA Driver
- Setup Guide (PDF)
- User’s manual (PDF)
- Specifications (HTML)
- Communication interface manual (HTML)
- Quick Reference (PDF)
- Option (PDF)
- Safety Information (PDF)

1 System Configuration

This chapter describes the system configuration of product.

System Configuration

The output current of each system is equal to the product of the rated output current of one of the standard PAT-T power supplies in the system and the number of power supplies in the system. The output current can be expanded up to 2000 A. There are two types of this product. One type is equipped with a main power breaker that is used to manage all the input sources of each power supply in the rack all at once (PAT-TMX), and the other type is not equipped with a breaker (PAT-TM).

Table1-1 PAT-TM/TMX series system configuration

System configuration	16 kW system	24 kW system	32 kW system	40 kW system
Rated output voltage	20.00 V			
Rated output current	800.0 A	1200 A	1600 A	2000 A
Base model PAT20-400T	PAT20-800TM	PAT20-1200TM	PAT20-1600TM	PAT20-2000TM
	PAT20-800TMX	PAT20-1200TMX	PAT20-1600TMX	PAT20-2000TMX
Rated output voltage	30.00 V			
Rated output current	532.0 A	798 A	1064 A	1330 A
Base model PAT30-266T	PAT30-532TM	PAT30-798 TM	PAT30-1064TM	PAT30-1330TM
	PAT30-532TMX	PAT30-798 TMX	PAT30-1064TMX	PAT30-1330TMX
Rated output voltage	40.00 V			
Rated output current	400 .0A	600.0 A	800.0 A	1000 A
Base model PAT40-200T	PAT40-400TM	PAT40-600TM	PAT40-800TM	PAT40-1000TM
	PAT40-400TMX	PAT40-600TMX	PAT40-800TMX	PAT40-1000TMX
Rated output voltage	60.00 V			
Rated output current	266.0 A	399.0 A	532.0 A	665.0 A
Base model PAT60-133T	PAT60-266TM	PAT60-399TM	PAT60-532TM	PAT60-665TM
	PAT60-266TMX	PAT60-399TMX	PAT60-532TMX	PAT60-665TMX
Rated output voltage	80.00 V			
Rated output current	200.0 A	300 A	400 A	500 A
Base model PAT80-100T	PAT80-200TM	PAT80-300TM	PAT80-400TM	PAT80-500TM
	PAT80-200TMX	PAT80-300TMX	PAT80-400TMX	PAT80-500TMX
Rated output voltage	160.0 V			
Rated output current	100.0 A	150.0 A	200.0 A	250.0 A
Base model PAT160-50T	PAT160-100TM	PAT160-150TM	PAT160-200TM	PAT160-250TM
	PAT160-100TMX	PAT160-150TMX	PAT160-200TMX	PAT160-250TMX
Rated output voltage	250.0 V			
Rated output current	64 A	96 A	128 A	160 A
Base model PAT250-32T	PAT250-64TM	PAT250-96TM	PAT250-128TM	PAT250-160TM
	PAT250-64TMX	PAT250-96TMX	PAT250-128TMX	PAT250-160TMX

System configuration	16 kW system	24 kW system	32 kW system	40 kW system
Rated output voltage	350.0 V			
Rated output current	45.6 A	68.4 A	91.2 A	114 A
Base model PAT350-22.8T	PAT350-45.6TM	PAT350-68.4TM	PAT350-91.2TM	PAT350-114TM
	PAT350-45.6TMX	PAT350-68.4TMX	PAT350-91.2TMX	PAT350-114TMX
Rated output voltage	500.0 V			
Rated output current	32 A	48 A	64 A	80 A
Base model PAT500-16T	PAT500-32TM	PAT500-48TM	PAT500-64TM	PAT500-80TM
	PAT500-32MX	PAT500-48TMX	PAT500-64TMX	PAT500-80TMX
Rated output voltage	650.0 V			
Rated output current	24.60 A	36.90 A	49.20 A	61.50 A
Base model PAT650-12.3T	PAT650-24.6TM	PAT650-36.9TM	PAT650-49.2TM	PAT650-61.5TM
	PAT650-24.6TMX	PAT650-36.9TMX	PAT650-49.2TMX	PAT650-61.5TMX
Rated output voltage	850.0 V	–	–	–
Rated output current	18.8 A	–	–	–
Base model PAT850-18.8T	PAT850-18.8TM	–	–	–
	PAT850-18.8TMX	–	–	–

Front panel

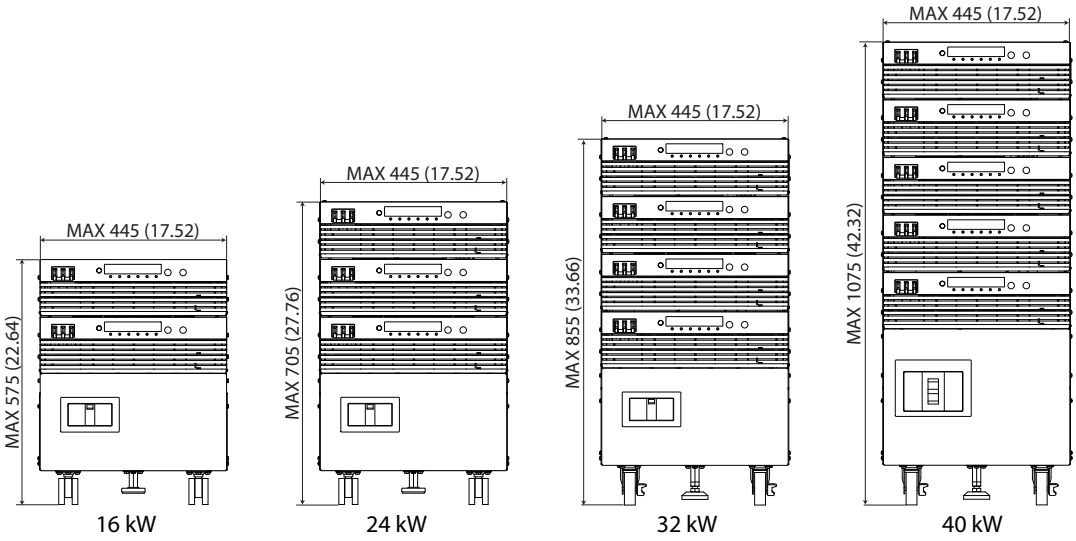


Fig1-1 PAT-TMX series (with breaker) system configuration Unit: mm (inch)

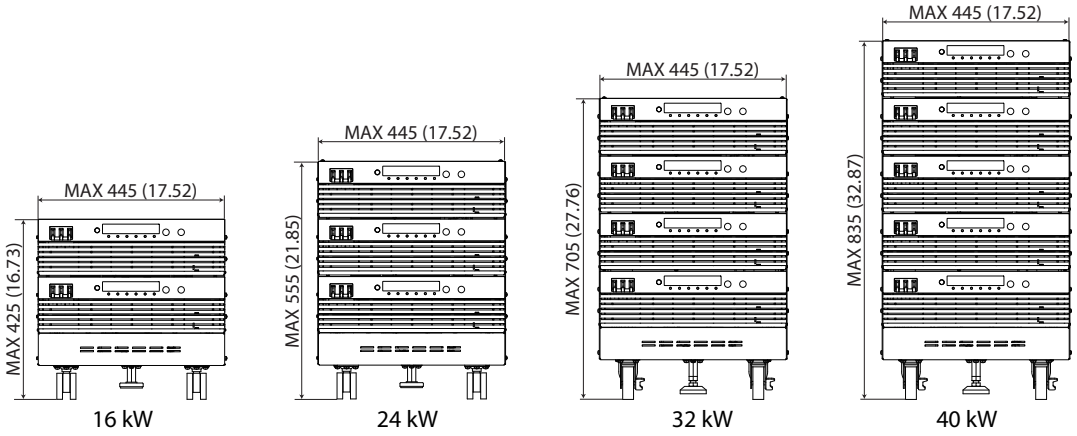
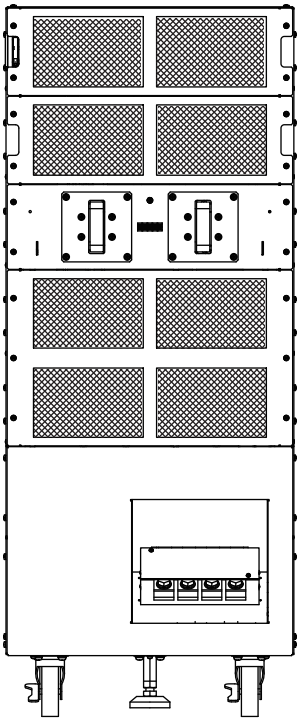
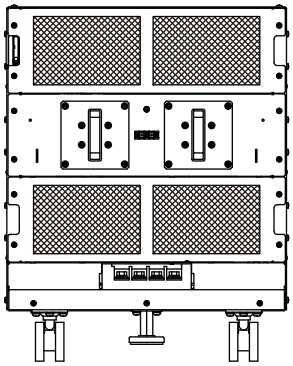


Fig1-2 PAT-TM series (with no breaker) system configuration Unit: mm (inch)

Rear panel



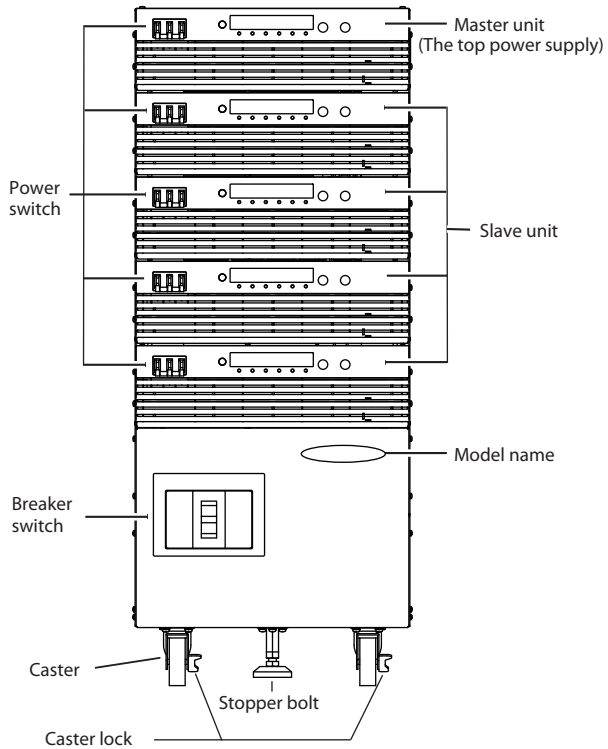
PAT-TMX series (with breaker)
40 kW system



PAT-TM series (with no breaker)
24 kW system

Fig1-3 PAT-TM/TMX series system configuration

Component names



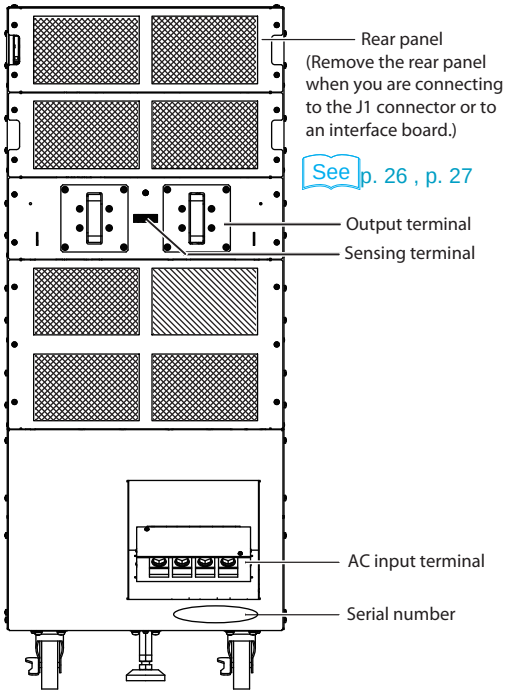


Fig1-4 Example for 40 kW system of PAT-TMX series

2 Preparation

This chapter describes the procedures of preparation of the PAT-TM/TMX series before use.

Connecting the Power Cable

This product is designed as an equipment of IEC Overvoltage Category II (energy-consuming equipment supplied from the fixed installation)

.

WARNING **Possible electric shock.**

- **Turn off the switchboard breaker (switch that cuts off the power supply from the switchboard) before making the connection.**
- **This product is an IEC Safety Class I equipment (equipment with a protective conductor terminal). Be sure to ground the product to prevent electric shock.**
- **Connect the ground terminal to earth ground.**
- **Be sure to have a qualified engineer connect the power cable to the switchboard.**
- **A power cable is not included with this product. A maximum current of 160 A flows when this product operates at its rated load (40 kW systems). Use a power cable whose current capacity can sufficiently handle the input current of the PAT-TM/TMX series. For information on the cable's current capacity, see "Current capacity of the load cable" on page 16.**

NOTE The breaker switch or POWER switch of each power supply the product can be used to disconnect the product from the AC line in an emergency. Provide adequate space around the breaker switch or POWER switch of each power supply so that the breaker switch or POWER switch of each power supply can be turned off at any time.

■ Connection example

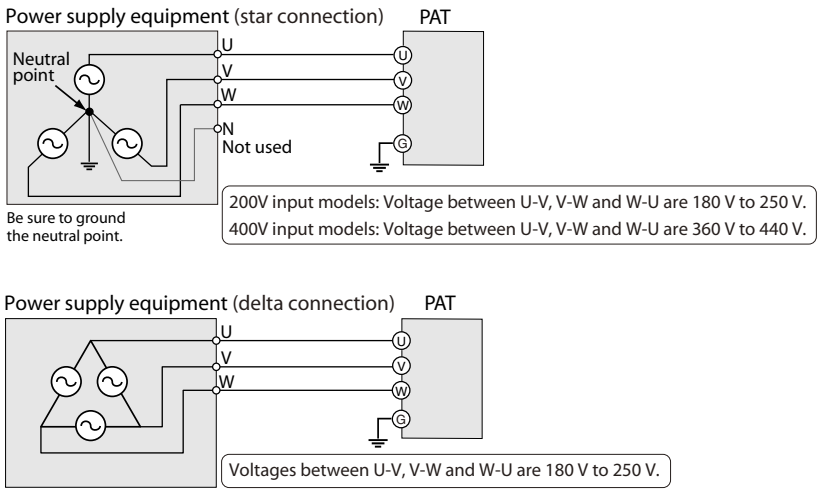


Fig2-1 Connection example

■ Connection procedure

1 **Check that the AC power supply meets the nominal input rating of the product.**

A model with a nominal input rating of 200 Vac to 240 Vac can receive voltages within the range of 180 Vac to 250 Vac. 400 V input models (whose nominal input rating is 400 Vac) can receive voltages within the range of 360 Vac to 440 Vac. The frequency is 50 Hz or 60 Hz.

⚠CAUTION The PAT-TM/TMX series may be damaged.
Do not connect a 400 V input model to a power line if the voltage between any of the line's phase terminals and the ground shown in Fig2-1 exceeds 254 Vac.

2 **PAT-TMX series is turn off the breaker switch, PAT-TM series is turn off the POWER switch of each power supply.**

3 **Remove the input terminals cover.**

4 **Connect the power cable by matching the U, V, W, and ⏚(GND) of the AC INPUT terminal block as shown in Fig2-2.**

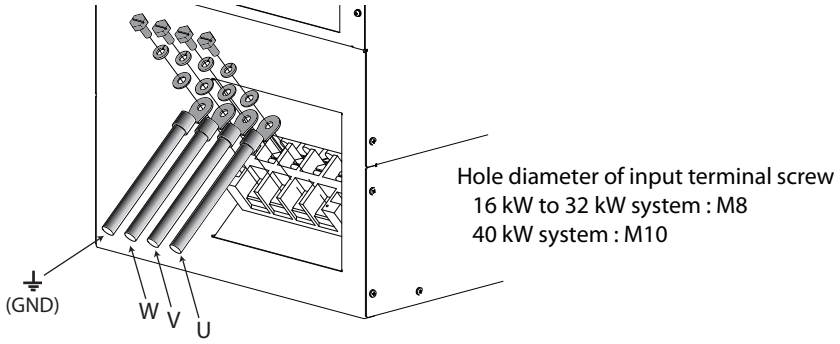


Fig2-2 Example for connecting power cable of PAT-TMX series

5 **Attach the input terminals cover.**

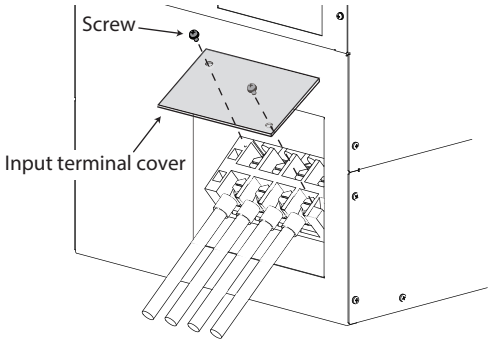


Fig2-3 Example for attach the input terminal cover of PAT-TMX series

6 **Attach crimping terminals to the switchboard end of the power cable. Use crimping terminals that conform to the switchboard's terminal screws.**

7 **Turn off the switchboard breaker.**

8 **Connect the power cable by matching the U, V, W, and ⏚(GND) of the switchboard.**

Make sure to connect the GND terminal of the AC INPUT terminal block to the GND terminal of the switchboard.

⚠CAUTION The CONFIG settings can be configured so that the output is automatically turned on when the POWER switch is turned on. When this function is enabled, the PAT-TM/TMX series powers up with the output turned on even if the output was off when the PAT-TM/TMX series was turned off the last time. However, there is a possibility that a load may break, if you connect a different load and turn the power and output on simultaneously without changing the OVP and OCP settings to appropriate values.

Turn on the power supply (PAT-TMX series)

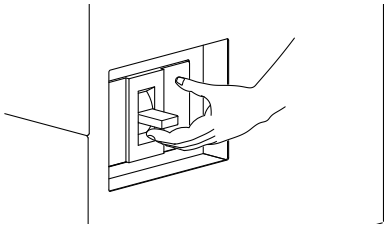
With the PAT-TMX series, you can turn the power on or off by flipping the breaker switch while each power supply's POWER switch is in the on position.

1 **Check that the power cable is correctly connected.**

2 **Check that the POWER switch of each power supply unit is turn on.**

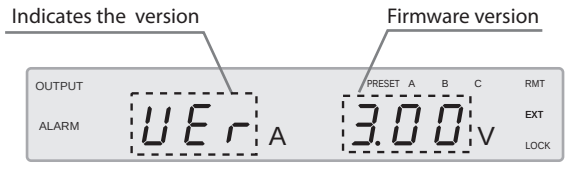
3 **Raise the lever of breaker switch to turn the power on.**

If an odd sound, odd odor, fire, or smoke occurs around or in the PAT-TMX series, lower the breaker lever to turn it off.



4 **Check the firmware version on the front panel display of each power supply.**

The voltmeter and ammeter show the PAT-T series firmware version for approximately 1 second.



Firmware version display at power-on (example for Ver.3.00)

The measuring value will be shown after the firmware version is displayed.

The master unit information can also be obtained using the *IDN? remote control command. The model name, serial number, and firmware version will be returned.

With the PAT-TMX series, an inrush current of approximately 500 Amax. (approximately 200 Amax. for 400 V input model) flows when the breaker switch is flipped to the on position (in the case of the 40 kW systems). Check that sufficient current capacity is available in the AC power line and the switchboard.

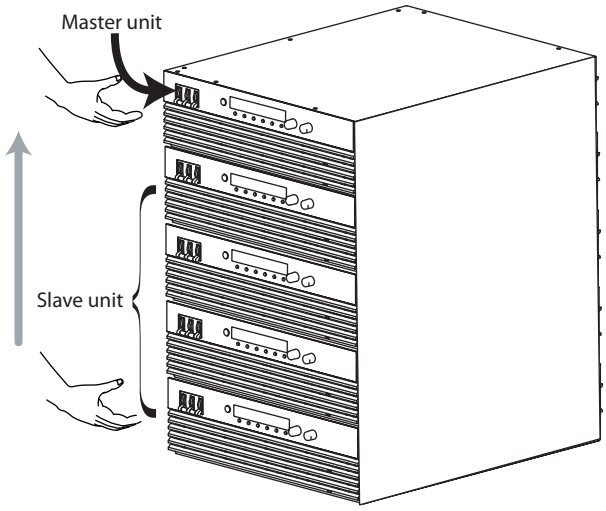
Turn on the power supply (PAT-TM series)

1 **Check that the power cable is correctly connected.**

2 **Raise the POWER switch lever of slave units to turn the power on.**

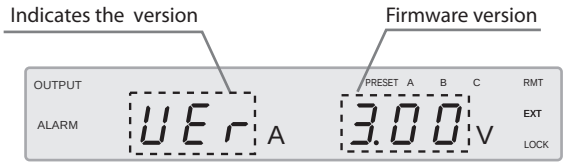
3 **Raise the POWER switch lever of the master unit to turn the power on. The master unit is the top unit.**

If an odd sound, odd odor, fire, or smoke occurs around or in the PAT-TM series, lower the POWER switch lever to turn it off.



4 **Check the firmware version on the front panel display of each power supply.**

The voltmeter and ammeter show the PAT-T series firmware version for approximately 1 second.



Firmware version display at power-on (example for Ver.3.00)

The measuring value will be shown after the firmware version is displayed.

The master unit information can also be obtained using the *IDN? remote control command. The model name, serial number, and firmware version will be returned.

With the PAT-TM series, an inrush current of approximately 100 Amax. (approximately 40 Amax. for 400 V input model) flows when each power supply's POWER switch is flipped to the on position. Check that sufficient current capacity is available in the AC power line and the switchboard.

If an error is displayed after power-on

If front panel display shows indicated in Table2-1 after power-on, follow the corresponding remedy. If the remedy does not correct the problem, contact your Kikusui agent or distributor.

Table2-1 Panel display during and after power-on

Panel Display		Cause and Remedy
SYS1 ERR		The PAT-TM/TMX series may have malfunctioned. Contact your Kikusui agent.
SYS2 ERR		The calibration has not been completed normally. The PAT-TM/TMX series may have malfunctioned. Contact your Kikusui agent.
CLR ABC		Preset memories A, B, and C have been reset to factory default settings because the values were abnormal. To continue the operation, press any panel switch.
CLR SET		The voltage and current calibration values have been reset to factory default settings, because the values were abnormal. To continue the operation, press any panel switch.
CLR CONF		The CONFIG settings have been reset to factory default values, because the values were abnormal. To continue the operation, press any panel switch.

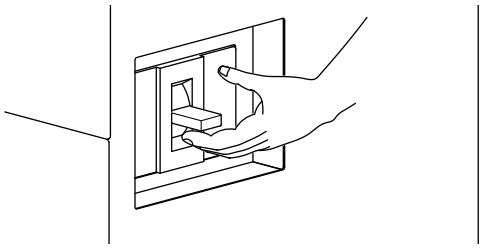
NOTE The factory default settings are the initial values of the individual power supplies that make up the system. If the settings are reset to the factory default settings, you must set the number of units in master-slave parallel operation in the CONFIG settings (CF24) to the number of units that make up the system. For more information, see "CONFIG Settings" in the individual power supply's operation manual.

Turn off the power supply (PAT-TMX series)

With the PAT-TMX series, you can turn the power on or off by flipping the breaker switch while each power supply's POWER switch is in the on position.

⚠CAUTION When turning the breaker switch off and then back on, allow at least 10 seconds (40 seconds for 400 V input model) after the fan stops. Repeated ON/OFF of the breaker switch at short intervals can cause damage to the inrush current limiter or shorten the service life of the breaker switch and the internal input fuse.

1 **Lower the lever of breaker switch to turn the power off.**



2 **Check that the power of each power supply units is turned off.**
Also check that each power supply's POWER switch is in the on position.

When the breaker switch is turned off, the front panel display shows the characters indicated in the following figure for about 10 to 15 seconds.

The PAT-TMX series stores the panel settings (excluding output on/off condition) immediately before the breaker switch is turned off. For these items, the PAT-TMX series starts up using the settings that existed when the breaker switch was turned off the last time.

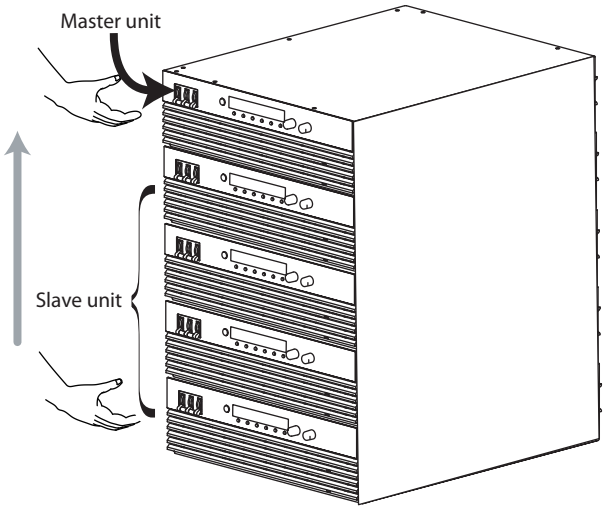
If the breaker switch is turned off immediately after changing the settings, the last settings may not be stored.

Turn off the power supply (PAT-TM series)

⚠CAUTION When turning the POWER switch of each power supply unit off and then back on, allow at least 10 seconds (40 seconds for 400 V input model) after the fan stops. Repeated ON/OFF of the POWER switch at short intervals can cause damage to the inrush current limiter or shorten the service life of the POWER switch and the internal input fuse.

1 **Lower the POWER switch lever of slave units to turn the power off.**

2 **Lower the POWER switch lever of the master unit to turn the power off. The master unit is the top unit.**



3 **Check that the power of all power supply units is turned off.**

When the POWER switch is turned off, the front panel display shows the characters indicated in the following figure for about 10 to 15 seconds.

The PAT-TM series stores the panel settings (excluding output on/off condition) immediately before the POWER switch is turned off. For these items, the PAT-TM series starts up using the settings that existed when the POWER switch was turned off the last time.

If the POWER switch is turned off immediately after changing the settings, the last settings may not be stored.

Voltage display and current display

The voltage is displayed only on the master unit. It is not appeared on the display of the slave unit.

The total value of current in which the number of unit connected in the parallel operation is displayed in the current display part of the master unit. As for the voltage display part, the voltage value which was set at as the last setting on the master unit will be displayed. When the maximum output current value exceeds 999.9, the maximum current displays 9999.

3 Connecting the Load

This chapter describes the consideration to be given to the load, explains how to connect the load wires, and explains how to connect to the output terminals.

Load Considerations

Note that the output will become unstable if the following types of loads are connected.

Load with peaks and pulse-shaped current

The PAT-TM/TMX series indicates only mean values. Even when the indicated value is less than the preset current value, the peak values may actually exceed the preset current value. If this happens, the PAT-TM/TMX series is instantaneously put into constant-current operation mode, and the output voltage drops accordingly.

For these types of loads, you must increase the preset current value or increase the current capacity.

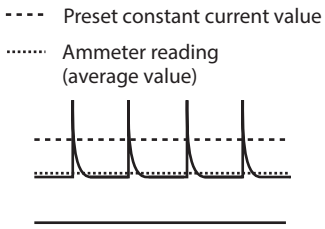


Fig3-1 Load current with peaks

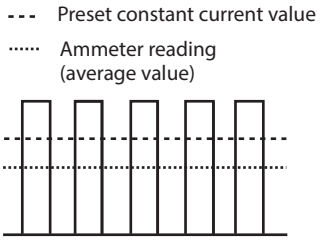


Fig3-2 Pulse-shaped load current

Load that generates reverse current to the power supply

The PAT-TM/TMX series cannot absorb reverse current from the load. Therefore, if a regenerative load (such as an inverter, converter, or transformer) is connected, the output voltage increases and becomes unstable.
For these types of loads, connect a resistor R_D as shown in Fig3-3 to bypass the reverse current. However, the amount of current to the load decreases by max. reverse current I_{rp}.

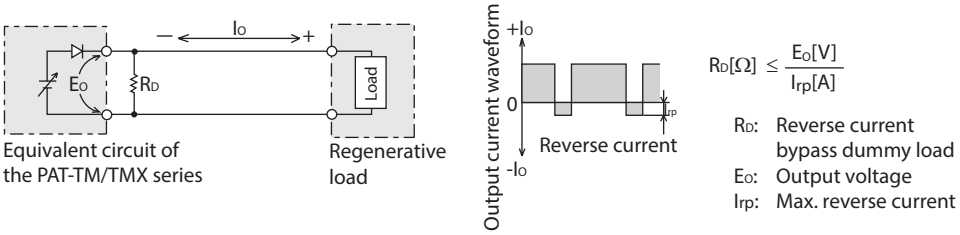


Fig3-3 Remedy for regenerative load

⚠CAUTION

- Use a resistor with sufficient rated power for resistor R_D.
- If a resistor with insufficient rated power for the circuit is used, resistor R_D may burn out.

Load with accumulated energy

Connecting a load with accumulated energy, such as a battery, to the PAT-TM/TMX series may cause current to flow from the load to the internal circuit of the PAT-TM/TMX series. This current may damage the PAT-TM/TMX series or reduce the life of the battery.
For this type of loads, connect a reverse-current-prevention diode (DRP) between the PAT-TM/TMX series and the load in series as shown in Fig3-4.

This cannot be used in conjunction with remote sensing.

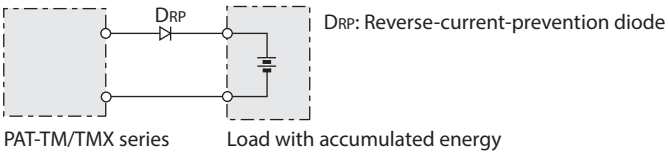


Fig3-4 Remedy against load with accumulated energy

⚠CAUTION

- Use a reverse-current-prevention diode (DRP) complied to the following references.
  Reverse voltage withstand capacity is at least twice the rated output voltage of the PAT-TM/TMX series.
  Forward current capacity is three to ten times the rated output current of the PAT-TM/TMX series.
  A diode with small loss.
- Be sure to take into account the heat generated by reverse-current-prevention diode DRP. Reverse-current-prevention diode DRP may burn out with inadequate heat dissipation.

Load Cable

⚠WARNING

To prevent the possibility of fire.

- **Use a load cable with sufficient current capacity with respect to the rated output current of the PAT-TM/TMX series.**
- **The output terminal and its area nearby gets very high temperature, use the cable with sufficient heat resistance higher than 85 °C of the covering materials.**

Possible electric shock.

- **Use a load cable with a higher voltage rating than the isolation voltage of the PAT-TM/TMX series. For the isolation voltage of each model, For details on commands, see the "Product specifications" on the accompanied CD-ROM.**

Current capacity of the load cable

If their current rating exceeds the maximum rated output current, the cable will remain intact even if the load is short-circuited. Load cables must be rated to carry the maximum rated output current of the PAT-TM/TMX series.

Allowable current of the cable dependent on the maximum allowable temperature of the cable insulation

The cable temperature is determined by a current-caused resistance loss, ambient temperature, and thermal resistance to the outside. Table3-1 shows the allowable capacity of current that can flow through a heat-resistant PVC wire (single wire) having a maximum allowable temperature of 60 °C when the wire is stretched horizontally in the air at an ambient temperature of 30 °C. If the condition is such that PVC wires with lower heat-resistant temperature are used, the ambient temperature exceeds 30 °C, or the wires are bundled resulting in low heat radiation, the current capacity needs to be reduced.

Table3-1 Nominal cross-sectional area of cables and allowable currents

Nominal cross-sectional area [mm^2]	AWG	(Reference cross-sectional area) [mm^2]	Allowable current *1 [A] (Ta = 30 °C)	Current recommended by Kikusui [A]
2	14	(2.08)	27	10
3.5	12	(3.31)	37	-
5.5	10	(5.26)	49	20
8	8	(8.37)	61	30
14	6	(13.3)	88	50
22	4	(21.15)	115	80
30	2	(33.62)	139	-
38	1	(42.41)	162	100
50	1/0	(53.49)	190	-
60	2/0	(67.43)	217	-
80	3/0	(85.01)	257	200
100	4/0	(107.2)	298	-
125	-	-	344	-
150	-	-	395	300
200	-	-	469	400
250	-	-	556	-
325	-	-	650	600
400	-	-	745	-
500	-	-	842	-

*1. Excerpts from Japanese laws related to electrical equipment.

Taking measures against noise

When connecting wires that have the same heat-resistant temperature, more current can flow by separating the wires to make heat radiation as great as possible. However, installing the + (pos.) and - (neg.) output wires of the load cable side by side or bundling them together is more effective against unwanted noise. The Kikusui-recommended currents shown in Table3-1 are allowable current values that have been reduced in consideration of the potential bundling of load cables. Use these values as a guideline when connecting load cables.

Limitations of the sensing function

All wires have resistance. The voltage drop in wires becomes greater as the wire becomes longer or the current becomes larger. This results in the voltage applied at the load end to be smaller. The PAT-TM/TMX series has a sensing function that compensates for this voltage drop up to approximately 0.6 V for a single line. If the voltage drop exceeds this level, wires having a greater sectional area should be used.

Connecting the load cable (16 kW System)

⚠WARNING **Possible electric shock.**

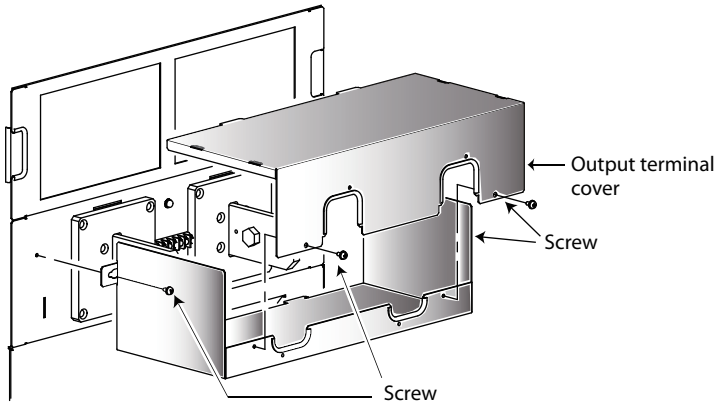
- **Turn the power off before you touch the output terminals. On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off.**
- **Be sure to attach the OUTPUT terminal cover after wiring the load.**

Target model

PAT20-800TM/TMX	PAT30-532TM/TMX	PAT40-400TM/TMX
PAT60-266TM/TMX	PAT80-200TM/TMX	PAT160-100TM/TMX
PAT250-64TM/TMX	PAT350-45.6TM/TMX	PAT500-32TM/TMX
PAT650-24.6TM/TMX	PAT850-18.8TM/TMX	

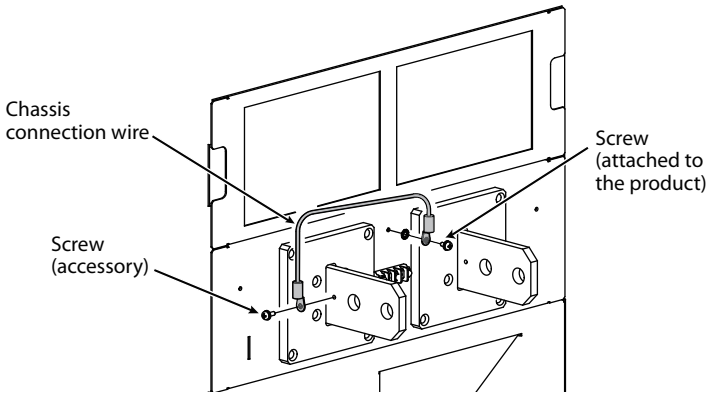
1 **On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off, slave units first and then the master unit.**

2 **Remove the output terminal cover that is attached to the rear panel.**



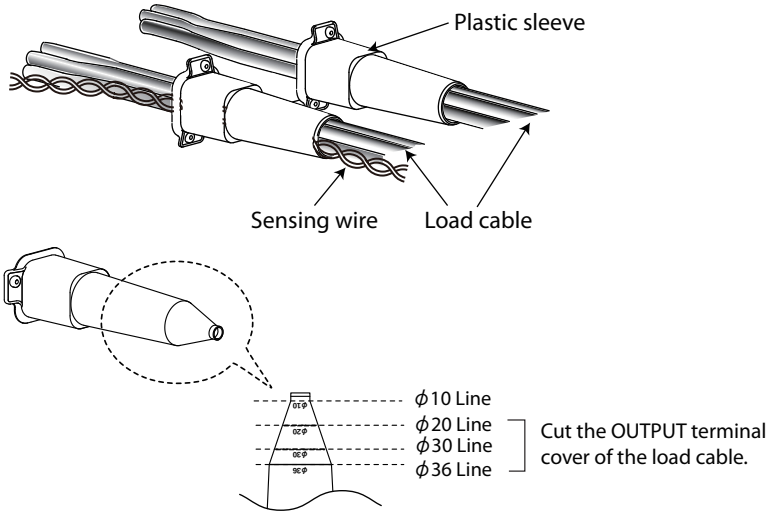
3 **Using the chassis connection wire set that comes with the package, connect the chassis terminal to either the negative or positive DC output terminal.**

There are holes in the output terminals for connecting the included chassis connection wire. Use the screw that is attached to the product and the included screw to attach the chassis connection wire.



4 Pass the load cables and the sensing wires through the included plastic sleeve.

Cut the sleeve of the OUTPUT terminal cover for the appropriate size of the load cable.

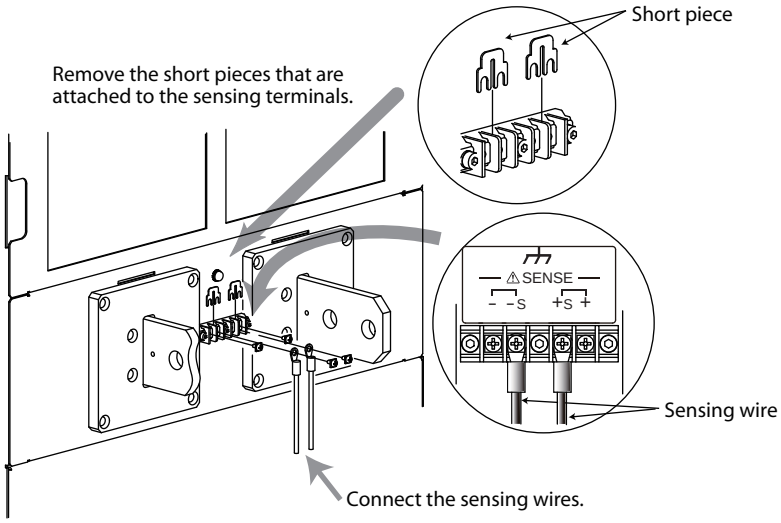


5 Connect the sensing wire.

When this product is shipped, two short pieces are attached to the sensing terminals. If you are connecting sensing wires to the load, remove these short pieces before you connect the sensing wires.

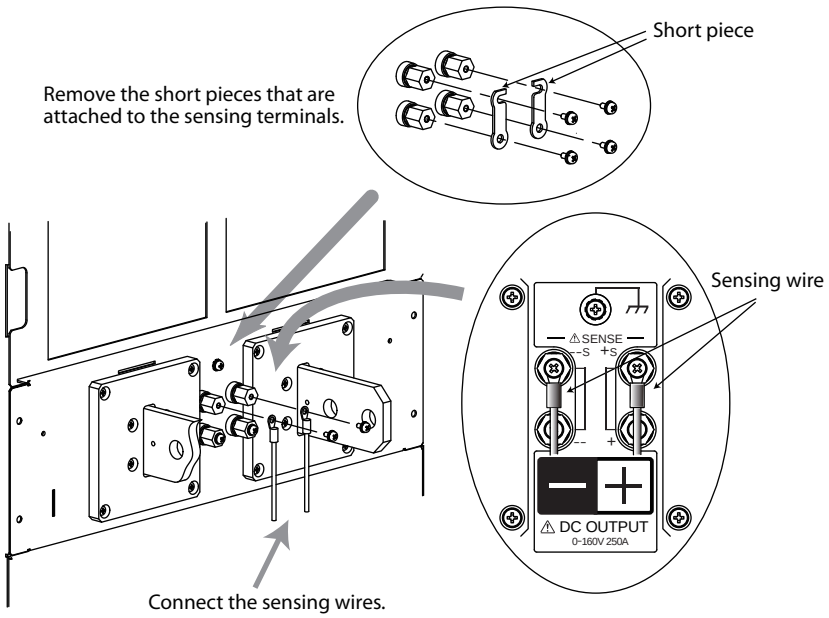
■ How to connect sensing wires to the following models

PAT20-800TM/TMX **PAT30-532TM/TMX** **PAT40-400TM/TMX**
PAT60-266TM/TMX **PAT80-200TM/TMX** **PAT160-100TM/TMX**



How to connect sensing wires to the following models

PAT250-64TM/TMX **PAT350-45.6TM/TMX** **PAT500-32TM/TMX**
PAT650-24.6TM/TMX **PAT850-18.8TM/TMX**



WARNING **Possible electric shock or damage to the internal circuitry.**

- **Do not wire the sensing terminals on the PAT-TMX series if the breaker switch is in the on position. Do not wire the sensing terminals on the PAT-TM series if each power supply's POWER switch is in the on position.**
- **For sensing cables, use cables with a higher voltage rating than the isolation voltage of the PAT-TM/TMX series. Protect the uncovered section of the shielded wire by using insulation tubes with a withstand voltage greater than the isolation voltage of the PAT-TM/TMX series. For the isolation voltage of each model, see the "Product specifications" on the accompanied CD-ROM.**
- **The sensing terminals are at approximately the same potential as the - (neg.) output terminal of the PAT-TM/TMX series.**

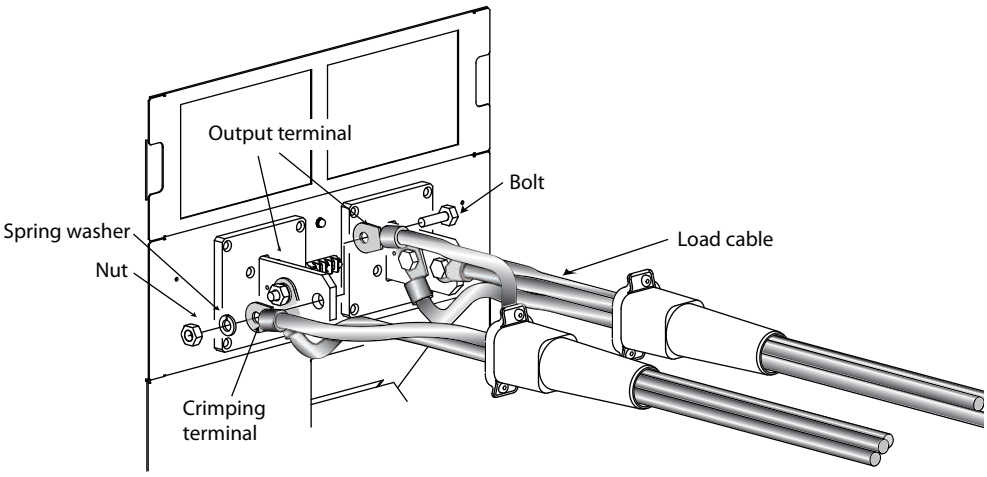
CAUTION If the sensing wires come loose, the output voltage across the load cannot be stabilized. If you are not sensing the load, be sure to attach the two short pieces to the sensing terminals.

6 Attach crimping terminals to the load cable.

The positive and negative output terminals each have two open bolt holes to connect load cables to. Attach the crimping terminal that matches the bolt used.

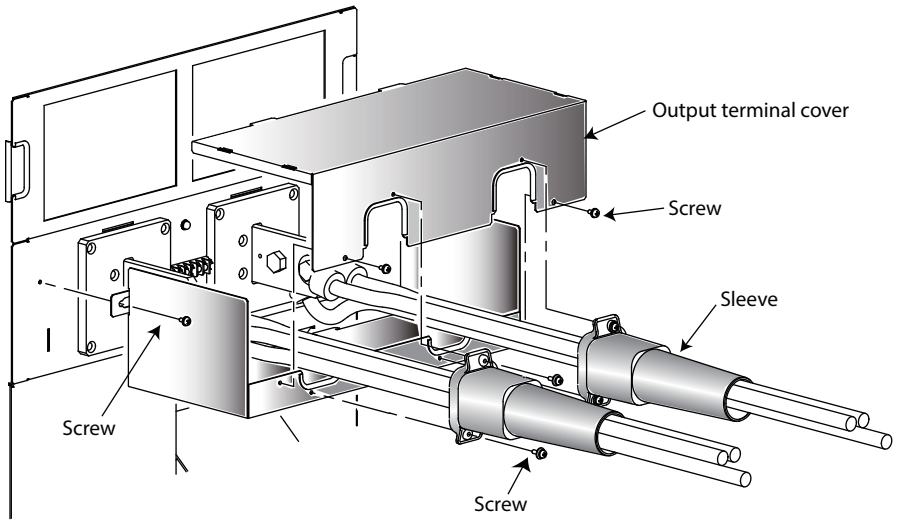
7 Connect the load cable on the output terminal.

Pass the bolts through the holes on the load cable's crimping terminal and on the output terminal, and fasten them in place with nuts and spring washers. You can connect load cables to either the left or right side of the output terminals.



8 Attach the output terminal cover and sleeve.

Use the screws that you removed in step 2 to fix the output terminal cover and sleeves in place.



⚠CAUTION Connect an electrolytic capacitor (C) with a capacity of a few hundreds of µF to a few tens of thousands of µF to the load terminals as necessary.
The wiring inductance and capacitance can cause phase shifting at a level that must be dealt with and can also cause oscillation. Connecting an electrolytic capacitor will prevent such oscillation.
Use an electrolytic capacitor that has a withstand voltage that is at least 120 % of the product's rated output voltage.

Connecting the Load cable (24, 32, 40 kW System)

⚠WARNING **Possible electric shock.**

- **Turn the power off before you touch the output terminals. On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off.**
- **Be sure to attach the OUTPUT terminal cover after wiring the load.**

Target model (24 kW system)

PAT20-1200TM/TMX	PAT30-798TM/TMX	PAT40-600TM/TMX
PAT60-399TM/TMX	PAT80-300TM/TMX	PAT160-150TM/TMX
PAT250-96TM/TMX	PAT350-68.4TM/TMX	PAT500-48TM/TMX
PAT650-36.9TM/TMX		

(32 kW system)

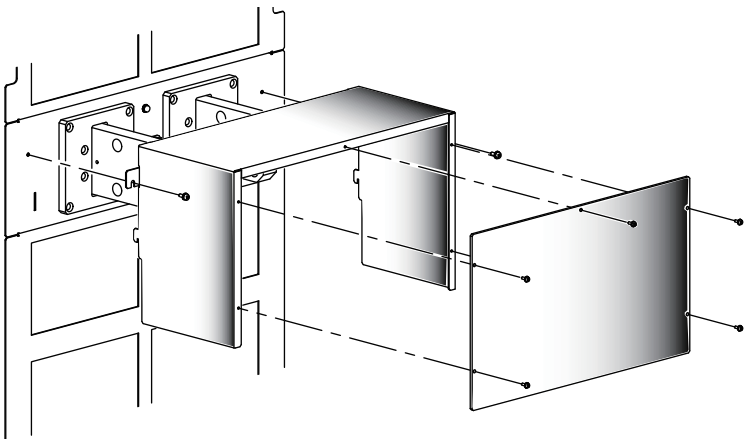
PAT20-1600TM/TMX	PAT30-1064TM/TMX	PAT40-800TM/TMX
PAT60-532TM/TMX	PAT80-400TM/TMX	PAT160-200TM/TMX
PAT250-128TM/TMX	PAT350-91.2TM/TMX	PAT500-64TM/TMX
PAT650-49.2TM/TMX		

(40 kW system)

PAT20-2000TM/TMX	PAT30-1330TM/TMX	PAT40-1000TM/TMX
PAT60-665TM/TMX	PAT80-500TM/TMX	PAT160-250TM/TMX
PAT250-160TM/TMX	PAT350-114TM/TMX	PAT500-80TM/TMX
PAT650-61.5TM/TMX		

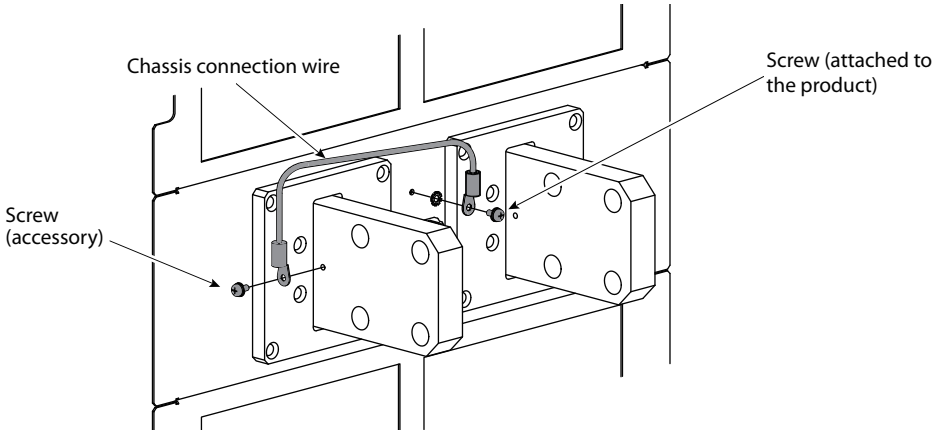
1 **On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off, slave units first and then the master unit.**

2 **Remove the output terminal cover that is attached to the rear panel.**



3 Using the chassis connection wire set that comes with the package, connect the chassis terminal to either the negative or positive DC output terminal.

There are holes in the output terminals for connecting the included chassis connection wire. Use the screw that is attached to the product and the included screw to attach the chassis connection wire.

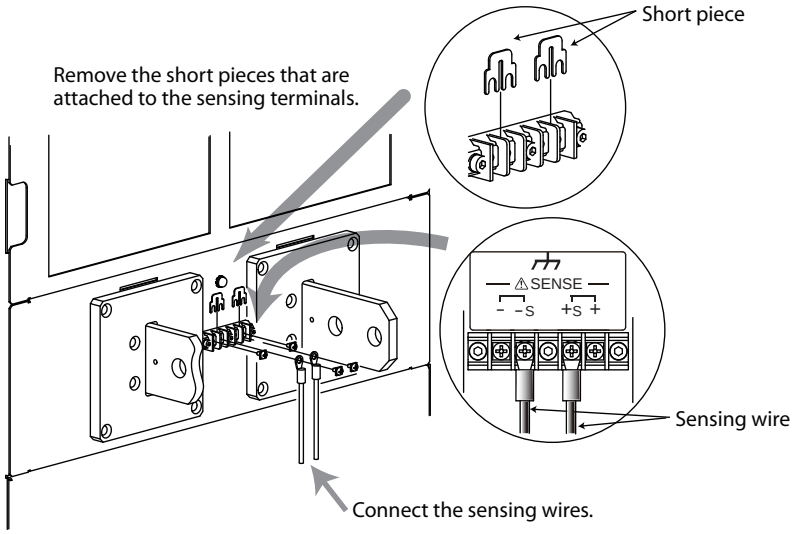


4 Connect the sensing wire.

When this product is shipped, two short pieces are attached to the sensing terminals. If you are connecting sensing wires to the load, remove these short pieces before you connect the sensing wires.

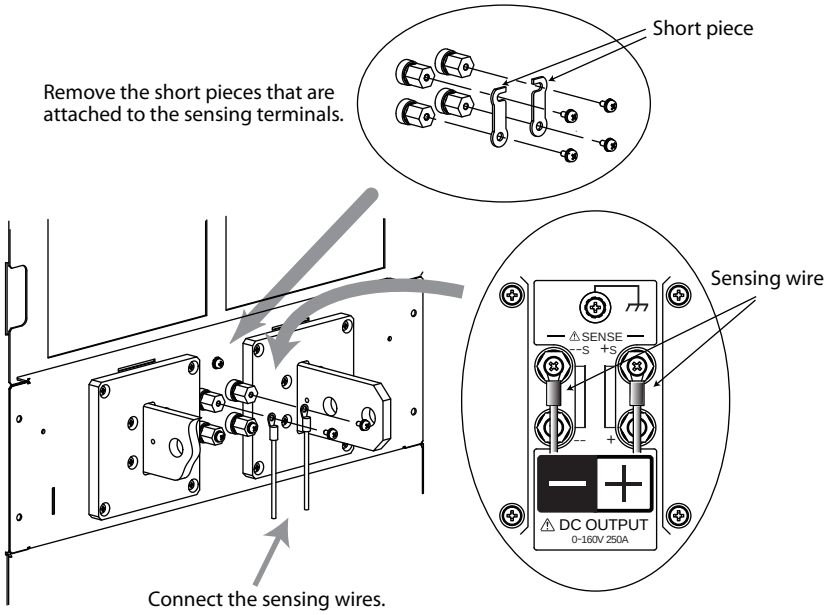
■ How to connect sensing wires to the following models

PAT20-1200TM/TMX	PAT30-798TM/TMX	PAT40-600TM/TMX
PAT60-399TM/TMX	PAT80-300TM/TMX	PAT160-150TM/TMX
PAT20-1600TM/TMX	PAT30-1064TM/TMX	PAT40-800TM/TMX
PAT60-532TM/TMX	PAT80-400TM/TMX	PAT160-200TM/TMX
PAT20-2000TM/TMX	PAT30-1330TM/TMX	PAT40-1000TM/TMX
PAT60-665TM/TMX	PAT80-500TM/TMX	PAT160-250TM/TMX



How to connect sensing wires to the following models

PAT250-96TM/TMX **PAT350-68.4TM/TMX** **PAT500-48TM/TMX**
PAT650-36.9TM/TMX
PAT250-128TM/TMX **PAT350-91.2TM/TMX** **PAT500-64TM/TMX**
PAT650-49.2TM/TMX
PAT250-160TM/TMX **PAT350-114TM/TMX** **PAT500-80TM/TMX**
PAT650-61.5TM/TMX



WARNING **Possible electric shock or damage to the internal circuitry.**

- **Do not wire the sensing terminals on the PAT-TMX series if the breaker switch is in the on position. Do not wire the sensing terminals on the PAT-TM series if each power supply's POWER switch is in the on position.**
- **For sensing cables, use cables with a higher voltage rating than the isolation voltage of the PAT-TM/TMX series. Protect the uncovered section of the shielded wire by using insulation tubes with a withstand voltage greater than the isolation voltage of the PAT-TM/TMX series. For the isolation voltage of each model, see the "Product specifications" on the accompanied CD-ROM.**
- **The sensing terminals are at approximately the same potential as the - (neg.) output terminal of the PAT-TM/TMX series.**

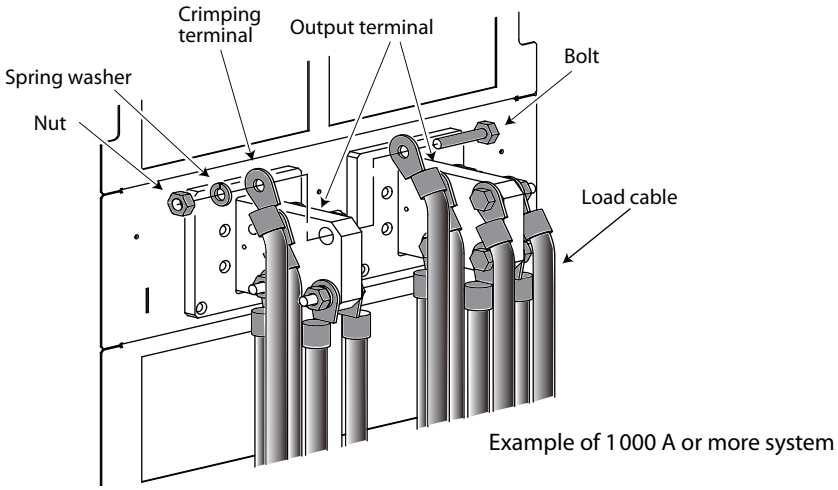
CAUTION If the sensing wires come loose, the output voltage across the load cannot be stabilized. If you are not sensing the load, be sure to attach the two short pieces to the sensing terminals.

5 Attach crimping terminals to the load cable.

The positive and negative output terminals each have two (for systems that generate less than 1000 A) or four (for systems that generate 1000 A or more) open bolt holes to connect load cables to. Attach the crimping terminal that matches the bolt used.

6 Connect the load cable on the output terminal.

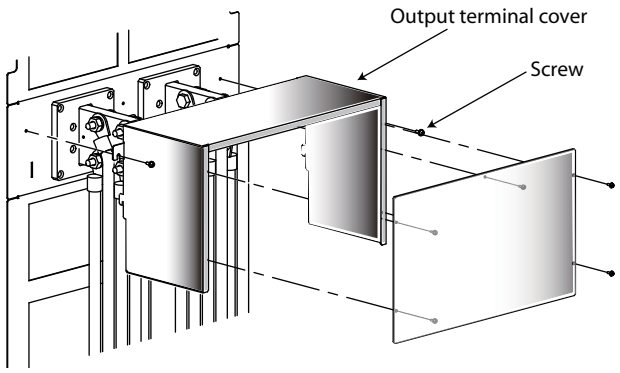
Pass the bolts through the holes on the load cable's crimping terminal and on the output terminal, and fasten them in place with nuts and spring washers. You can connect load cables to either the left or right side of the output terminals.



Example of 1 000 A or more system

7 Attach the output terminal cover and sleeve.

Use the screws that you removed in step 2 to fix the output terminal cover in place.



⚠ CAUTION Connect an electrolytic capacitor (C) with a capacity of a few hundreds of µF to a few tens of thousands of µF to the load terminals as necessary.
The wiring inductance and capacitance can cause phase shifting at a level that must be dealt with and can also cause oscillation. Connecting an electrolytic capacitor will prevent such oscillation.
Use an electrolytic capacitor that has a withstand voltage that is at least 120 % of the product's rated output voltage.

4 Connecting to Control Connectors

This chapter explains how to connect to the J1 connector to perform external control and how to connect to a factory optional interface board to perform remote control.

Connecting the J1 Connector

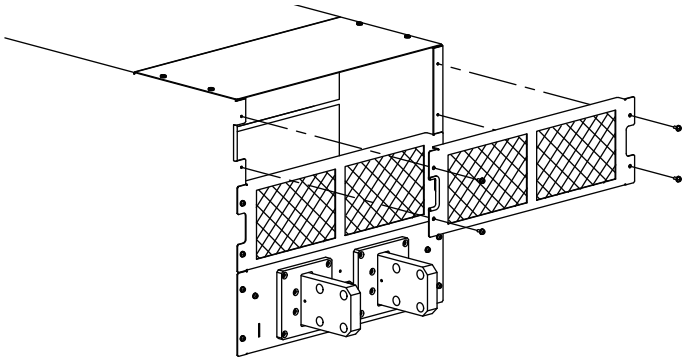
You can control the PAT-TM/TMX series externally through the J1 connector on the rear panel of the master unit.
For details on external control and how to perform it, see the PAT series operation manual.

⚠WARNING **Possible electric shock.**

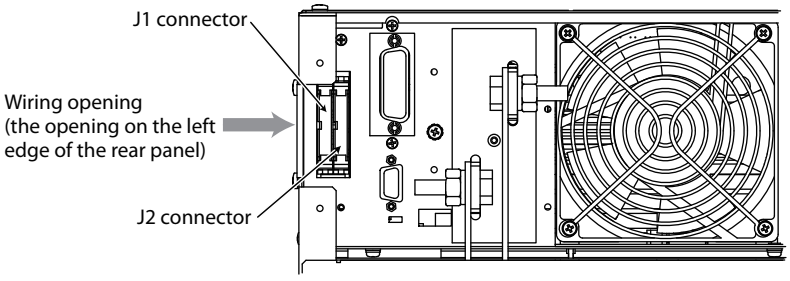
- **Turn the power off before you remove the rear panel. On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off.**
- **Never remove the rear panel and wire the J1 connector if the PAT-TM/TMX series is on (the breaker switch is in the on position or any of the POWER switches are in the on position).**

1 **On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off, slave units first and then the master unit.**

2 **Remove the topmost rear panel.**
You can now see the master unit rear panel.



3 **Remove the protective socket that is attached to the J1 connector.**



4 **Wire the J1 connector.**

If you disconnect the parallel operation cable that is connected to the J2 connector, be sure to reconnect it after you finish wiring the J1 connector.

5 **Attach the rear panel that you removed in step 2 . When you attach the rear panel, pass the cables that you wired to the J1 connector through the open space on the left edge of the panel.**

Connecting the Interface Connector (Factory Option)

In addition to controlling the panel from the front panel, you can control it remotely through the factory optional interface. To do so, the interface connector on the rear panel of the master unit is used. For details on remote control and how to perform it, see the PAT series operation manual.

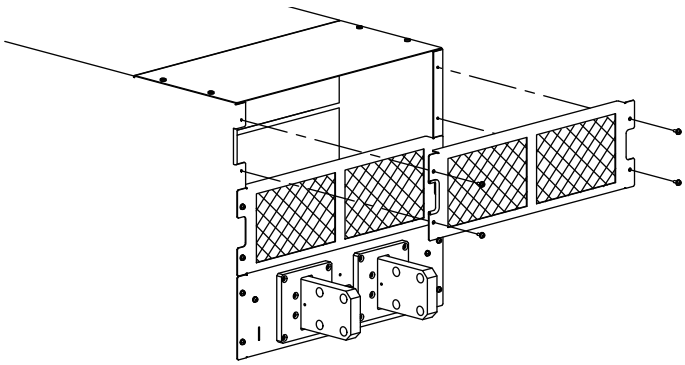
⚠WARNING **Possible electric shock.**

- **Turn the power off before you remove the rear panel. On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off.**
- **Never remove the rear panel and connect the interface connector if the PAT-TM/TMX series is on (the breaker switch is in the on position or any of the POWER switches are in the on position).**

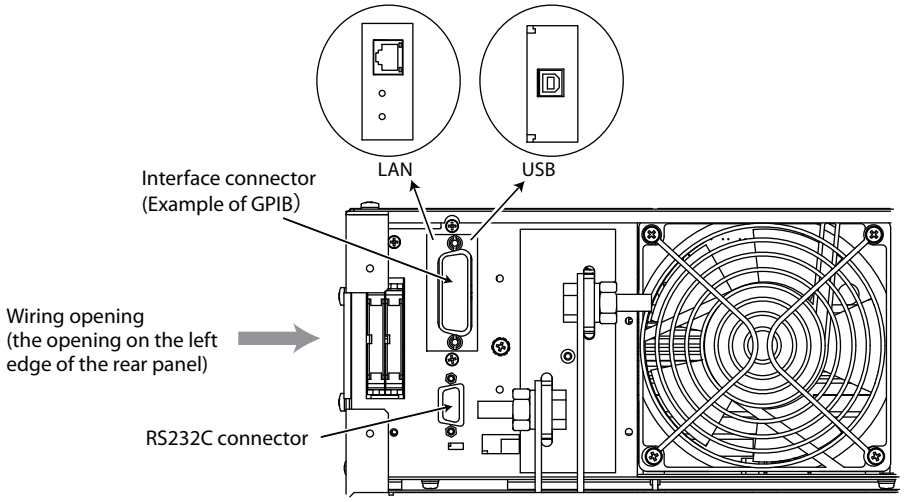
1 **On the PAT-TMX series, turn the breaker switch off. On the PAT-TM series, turn each power supply's POWER switch off, slave units first and then the master unit.**

2 **Remove the topmost rear panel.**

You can now see the master unit rear panel.



3 **Connect the cable to the factory optional interface connector.**



4 **Attach the rear panel that you removed in step 2 . When you attach the rear panel, pass the cable that you connected to the interface connector through the open space on the left edge of the panel.**