KIKUSUI

Part No. IB029742
Mar. 2016

User's Manual

Regulated DC Power Supply

PAV Series

200W type

PAV10-20 PAV160-1.3
PAV20-10 PAV320-0.65
PAV36-6 PAV650-0.32
PAV60-3.5
PAV100-2

400W type

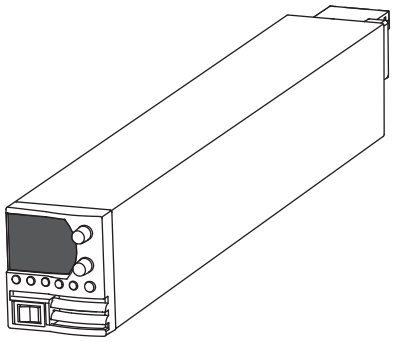
PAV10-40 PAV160-2.6
PAV20-20 PAV320-1.3
PAV36-12 PAV650-0.64
PAV60-7
PAV100-4

600W type

PAV10-60 PAV160-4
PAV20-30 PAV320-2
PAV36-18 PAV650-1
PAV60-10
PAV100-6

800W type

PAV10-72 PAV160-5
PAV20-40 PAV320-2.5
PAV36-24 PAV650-1.25
PAV60-14
PAV100-8



About PAV manual

The manuals are intended for users of the PAV series and their instructors. Explanations are given under the presumption that the reader has knowledge of the electrical aspects of the power supply.

Manual construction

- Setup Guide
  This guide is intended for first-time users of the product. It gives an overview of the product, connecting procedures, safety precautions, etc.
  Please read this guide before you operate the product.
- Quick Reference
  The quick reference briefly explains the control panel and the basic operation of it.
- Safety Information
  This document contains general safety precautions for this product. Keep them in mind and make sure to observe them.
- User's Manual (this manual, PDF)
  This manual is intended for first-time users of this product. It provides an overview of the product, notes on usage, and specifications. It also explains how to connect the product, configure the product, operate the product, perform maintenance on the product, and so on.
- USB/RS232/RS485 Communication Interface Manual (PDF)
  This manual explains how to control the product remotely using SCPI commands.
  The interface manual is written for readers with sufficient basic knowledge of how to control measuring instruments using a PC.
- LAN Interface Manual (PDF)
  This manual explains how to control the product remotely for users of the PAV series with the optional LAN interface.
  The interface manual is written for readers with sufficient basic knowledge of how to control measuring instruments using a PC.

You can download the most recent version of these manuals from the Kikusui Electronics Corporation website (http://www.kikusui.co.jp/en/download/).

You can view the PDF files using Adobe Reader 10 or later.

Firmware versions that this manual covers

This manual applies to products with firmware versions 2.2X.
When contacting us about the product, please provide us with:
Model (marked in the top section of the front panel)
The firmware version (see "Checking the Firmware Version" *(p.22)*)
The serial number (marked in the bottom section of the rear panel)

How to read this guide

This guide is designed to be read from beginning to end. We recommend that you read it thoroughly before using this product for the first time.

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Notations used in this manual

- The PAV series is categorized into four types according to the output capacity. This manual contains sections that describe each type separately or several types collectively. The type categories are provided on the front cover.
- The term “PC” is used to refer generally to both personal computers and workstations.
- The following markings are used in the explanations 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.

⚠ Safety precautions

When using this product, be sure to observe the “Safety Precautions” in the Safety information manual.

⚠ Precautions when choosing the installation location

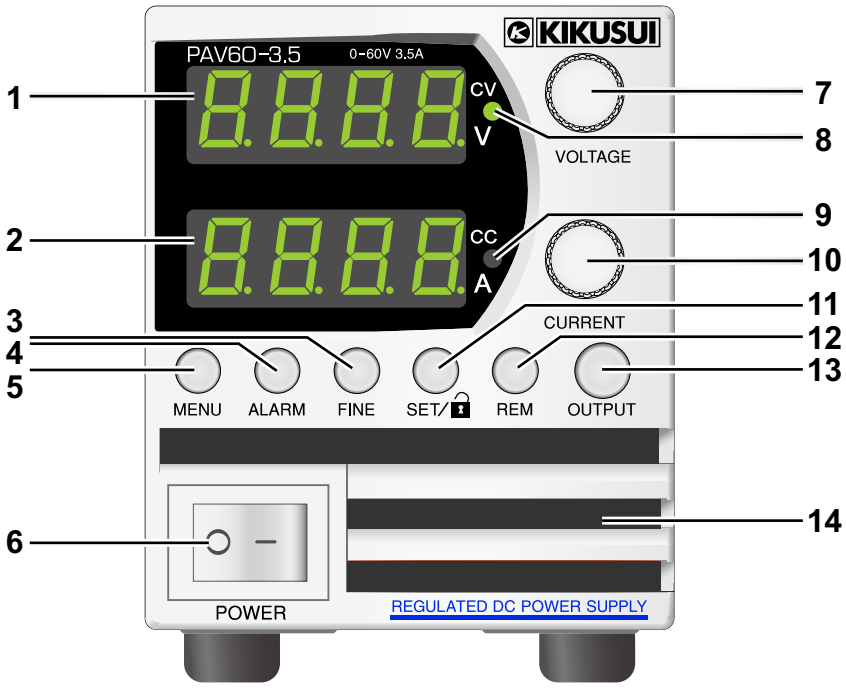
When installing this product, be sure to observe the “Precautions When Choosing the Installation Location” in the Safety information manual. The following precautions pertain only to this product.

- When installing this product, be sure to observe the temperature and humidity ranges indicated below.
  Operating temperature range: 0 °C to +50 °C (32 °F to +122 °F)
  Operating humidity range: 20 %rh to 90 %rh (no condensation)
- When storing this product, be sure to observe the temperature and humidity ranges indicated below.
  Storage temperature range: -20 °C to +85 °C (-4 °F to 185 °F)
  Storage humidity range: 10 %rh to 95 %rh (no condensation)

Contents

Component Names

Front Panel

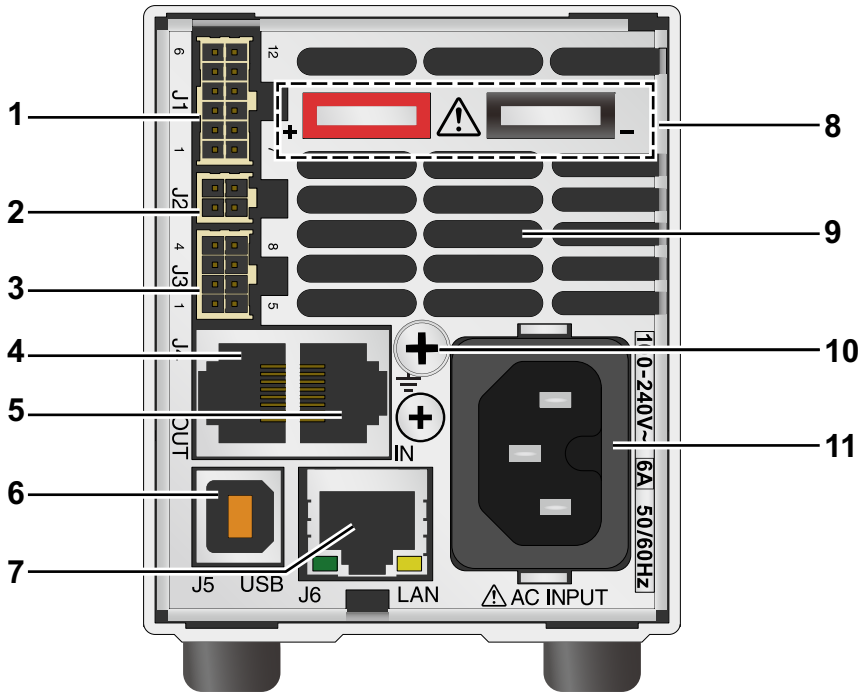


No.	Name	Function	See
1	Voltmeter	A 4-digit 7-segment LED. Usually displays the output voltage. Pressing the SET key displays the output voltage setting.	*p.36*
		In menu mode, subsystem and function items are displayed.	*p.58*
2	Ammeter	A 4-digit 7-segment LED. Usually displays the output current. Pressing the SET key displays the output current setting.	*p.38*
		In menu mode, parameter items are displayed.	*p.58*
3	FINE key (with LED)	Selects the voltage and current setting resolution mode. The mode toggles between coarse adjustment and fine adjustment every time you press the key. In fine adjustment (FINE) mode, the LED lights green, and you can set down to the least significant digit (1-count interval). In coarse adjustment mode, values can be set at low resolution (six turns to cover the full scale).	*p.37* *p.39*
4	ALARM key (with LED)	The LED blinks red when a protection function (OVP, UVP/UVL, OTP, foldback, output on/off control, or AC failure) is activated.	*p.42*
		In protection function menu mode, the LED lights green.	*p.64*
5	MENU key (with LED)	In main menu mode, the LED lights green.	*p.58*
6	POWER switch	Turns the AC input on (|) and off (◯).	*p.20*
7	VOLTAGE knob	A high precision rotary encoder for setting the output voltage.	*p.36*
		Press the knob to select menu items (subsystems and functions).	*p.58*
8	CV LED	Lights green in constant voltage (CV) mode.	*p.36*

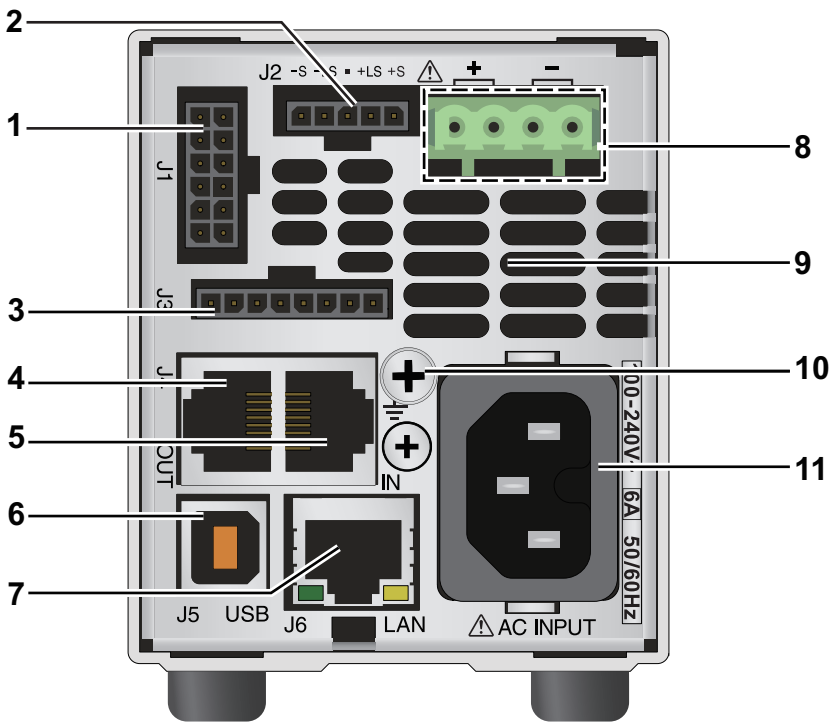
No.	Name	Function	See
9	CC LED	Lights green in constant current (CC) mode.	*p.38*
10	CURRENT knob	A high precision rotary encoder for setting the output current.	*p.38*
		Press the knob to select menu items (parameters).	*p.58*
11	SET/🔒 key (with LED)	Press the key to light its LED and display the output voltage and output current settings.	*p.36* *p.38*
		Locks the front panel (key lock function).	*p.51*
12	REM key (with LED)	Switches from remote mode to local mode. This key is disabled in local lockout mode.	*p.62*
		In communication function menu mode, the LED lights green.	*p.62*
13	OUTPUT key (with LED)	The output switches between ON and OFF each time you press the key. When the output is on, the LED lights.	*p.40*
		Selects safe or auto start mode.	*p.40*
		Releases the OVP, UVP, or foldback protection function.	*p.44* *p.46* *p.48*
		Releases the OTP or AC failure alarm function.	*p.50* *p.50*
14	Air inlet	Forced air cooling using an internal fan. Air is sucked through the front panel and expelled through the air outlet on the rear panel.	-

Rear Panel

Models whose rated output voltage is 10 V to 100 V



Models whose rated output voltage is 160 V to 650 V



No.	Name	Function	See
1	J1 connector	Connector for external control and monitoring. The reference voltage is connected to -S inside the PAV series.	*p.68*
2	J2 connector	• Models whose rated output voltage is 10 V to 100 V J2 connector model: IPL1-102-01-RA-K (SAMTEC) Remote sensing connector. Use this connector to compensate for the voltage drop in the wiring from the output terminal to the load terminal.	*p.29*
		• Models whose rated output voltage is 160 V to 650 V J2 connector model: 43650-0501 (MOLEX) Remote sensing connector. Use this connector to compensate for the voltage drop in the wiring from the output terminal to the load terminal.	*p.30*
3	J3 connector	Connector for external control and monitoring. The reference voltage is isolated between the PAV series output and the inside.	*p.77*
4	Serial communication remote output terminal	RJ-45 connector. RS232/RS485 output port used to connect between the PAV series power supplies for remote control.	-
5	Serial communication remote input terminal	RJ-45 connector. RS232/RS485 input port used to connect between the PAV series and PC for remote control. If several PAV series power supplies are used in a system, it is the input port of the first PAV (between the PC and PAV). For subsequent PAVs, it functions as an input port connected to the previous PAV.	-
6	USB port	Type B USB port	-
7	LAN port (option)	RJ-45 connector for LAN connection.	-
8	Output terminal	• Models whose rated output voltage is 10 V to 100 V Bus bar: M6 screws can be used.	*p.26*
		• Models whose rated output voltage is 160 V to 650 V PAV connector: IC 2.5/ 4-G-5.08 (PHOENIX CONTACT) Plug model: IC 2.5/ 4-ST-5.08 (PHOENIX CONTACT)	*p.27*
9	Air outlet	Forced air cooling using an internal fan. Air is sucked through air inlet on the front panel and expelled through the rear panel.	-
10	Chassis grounding screw	The PAV is connected to the chassis (FG) through this screw.	-
11	AC INPUT connector	• An AC inlet. IEC320, C16 connector. A C15 AC cable is required.	*p.18*

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1

General Description

This chapter gives an overview of the PAV series and explains the options that are available for it.

Product Overview

The PAV series is a 2U-high, compact high-performance switching power supply. The AC input area has a harmonic current suppression circuit and supports worldwide voltage from 85 Vac to 265 Vac.

From the front panel, you can set the output (output voltage, output current) and protection functions (overvoltage protection, undervoltage protection/undervoltage limit, foldback protection). The display area shows the output voltage and current and the operating status.

Various functions are set from the menu. You can control the menu using the voltage and current setting knobs and push buttons.

The rear panel has analog signal remote control connectors and serial communication (USB/RS232/RS485) connectors. A LAN port can be included as an option.

Features

- **Auto constant voltage/constant current mode switching**
- **Built-in harmonic current suppression circuit**
- **Wide AC input voltage range (85 Vac to 265 Vac)**
- **Integrated microprocessor controller**
- **High-resolution voltage and current settings using digital encoders**
- **High-precision control/readback (16 bit)**
- **Configuration storage when AC input is off**
  When the AC input or power switch is shut off, the settings are saved in internal memory. Therefore, reconfiguration is not necessary.
- **Two systems of remote output on/off function**
  Isolated from the PAV series output with photocouplers.
- **Parallel operation using active current sharing (master-slave operation)**
- **Remote sensing**
  Compensates for voltage drops in load cables.
- **Voltage and current adjustment using external voltage or external resistance and voltage and current monitoring function**
- **Fan speed control for low noise and prolonged fan service life**
- **Built-in USB/RS232/RS485 ports**
- **The LAN port is an option (SCPI compatible).**
- **Compact, lightweight, easily installable, and space saving**
- **Advanced output programmable function (sequence function)**
  Preset voltage or current can be output using input triggers (up to 12 values can be output in a sequence).
  Output can only be set using SCPI commands, but execution is possible from the front panel.
  Application software SD024-PAV (sold separately) can be used to easily create a sequence data.

Multi-output system configuration

A variable power supply system of up to 31 channels can be configured using the built-in USB/RS232/RS485 ports. A LAN port can be includes as a factory option.

Control using serial communication (USB/RS232/RS485)

The following items can be controlled through the serial ports.

- Output voltage setting
- Output current setting
- Output voltage measurement
- Output current measurement
- Output on/off
- Foldback protection setting
- Overvoltage protection (OVP) setting and readout
- Undervoltage protection (UVP) setting and readout
- Undervoltage limit (UVL) setting and readout
- Start mode setting (auto or safe)

Control and monitoring using analog signals

The output voltage and current can be controlled by applying analog voltage or external resistance through the external control terminal on the rear panel. In addition, the output voltage and current can be monitored by monitoring the terminal voltage.

Further, the output on/off state can be controlled, and the operating status and constant voltage/constant current (CV/CC) operation mode can be monitored.

Parallel operation

Parallel operation is possible using several PAV series power supplies with the same voltage and current ratings (up to six using master-slave parallel connection with output current balance function).

Output connection

■ Models whose rated output voltage is 10 V to 100 V

The output terminal of products whose rated output voltage is 10 V or 100 V is the bus bar on the rear panel.

Either the positive or negative terminal can be grounded, or the output can be floating. However, for products whose rated output voltage is 100 V or less, keep the potential difference between the output terminal and chassis (FG) as follows.

- Models whose rated output voltage is 10 V, 20 V or 36 V: ±60 Vdc or less
- Models whose rated output voltage is 10 V or 100 V: ±100 Vdc or less

■ Models whose rated output voltage is 160 V to 650 V

The output terminal of products whose rated output voltage is 160 V, 320 V, or 650 V is the connector on the rear panel.

Either the positive or negative terminal can be grounded, or the output can be floating. Keep the potential difference between the output terminal and chassis (FG) no greater than 650 V.

Options

Power cord

NOTE

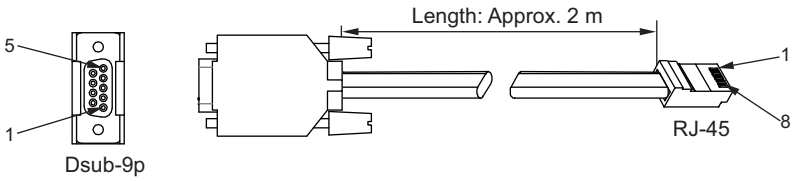
- The power cord is exclusive to the PAV series. The AC INPUT connector of the PAV series has a special groove, so typical power cords cannot be used.

Model	Region of use	Specification and plug type
PAV/J(PSE)	Japan	15 Aac, 125 Vac, 2 m (JIS C 8303 type)
PAV/U(UL)	United States	13 Aac, 125 Vac, 2 m (NEMA-5-15P type)
PAV/E(EN)	Europe	10 Aac, 250 Vac, 2 m (IEC60884-1 type)
PAV/O	-	10 Aac, 250 Vac, 2 m (plugless type)

RS232 and RS485 cables

Model: PAG/232-9

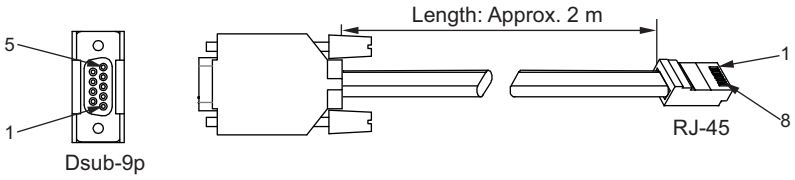
RS232 cable with Dsub 9-pin and RJ-45 connectors



Dsub connector		RJ-45 connector		Note
Pin no.	Name	Pin no.	Name	
Housing	Shield	Housing	Shield	-
2	RX	2	TX	Twisted pair wires
3	TX	1	RX	
5	SG	8	SG	-

Model: PAG/485-9

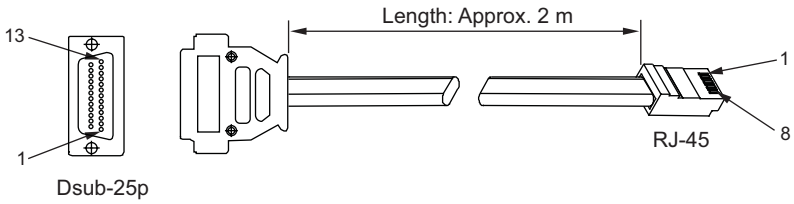
RS485 cable with Dsub 9-pin and RJ-45 connectors



Dsub connector		RJ-45 connector		Note
Pin no.	Name	Pin no.	Name	
Housing	Shield	Housing	Shield	-
9	TXD-	3	RXD-	Twisted pair wires
8	RXD+	6	TXD+	
1	SG	8	SG	-
5	RXD-	4	TXD-	Twisted pair wires
4	RXD+	5	TXD+	

Model: PAG/232-25

RS232 cable with Dsub 25-pin and RJ-45 connectors

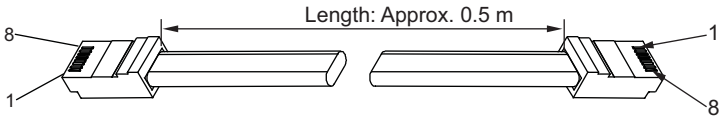


Dsub connector		RJ-45 connector		Note
Pin no.	Name	Pin no.	Name	
1	Shield	Housing	Shield	-
2	TX	1	RX	Twisted pair wires
3	RX	2	TX	
7	SG	8	SG	-

RS485 link cable

Model: PAG/RJ45

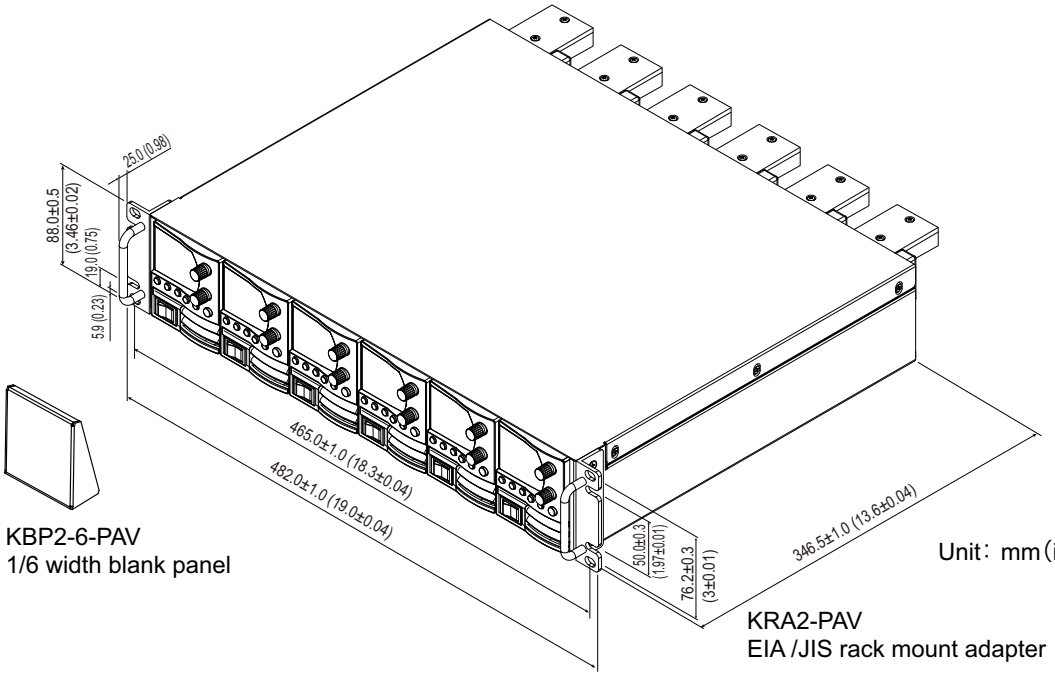
Serial link cable with shielded RJ-45 connectors



RJ-45 connector		RJ-45 connector		Note
Pin no.	Name	Pin no.	Name	
Housing	Shield	Housing	Shield	-
8	SG	8	SG	-
3	TXD-	3	RXD-	Twisted pair wires
6	RXD+	6	RXD+	
4	RXD-	4	TXD-	Twisted pair wires
5	RXD+	5	TXD+	

Rack mount adapter

The PAV series is designed so that six power supplies can be mounted on a standard 19-inch 2U rack. The following options are available for rack mounting.



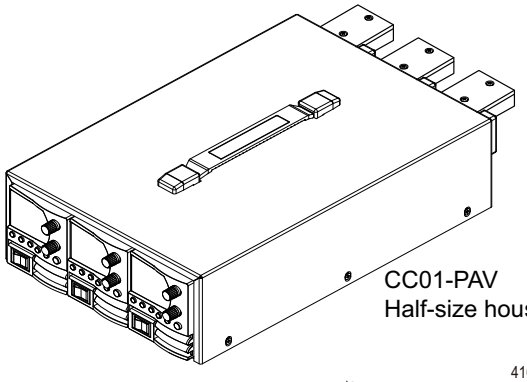
KBP2-6-PAV
1/6 width blank panel

Unit：mm（inch）

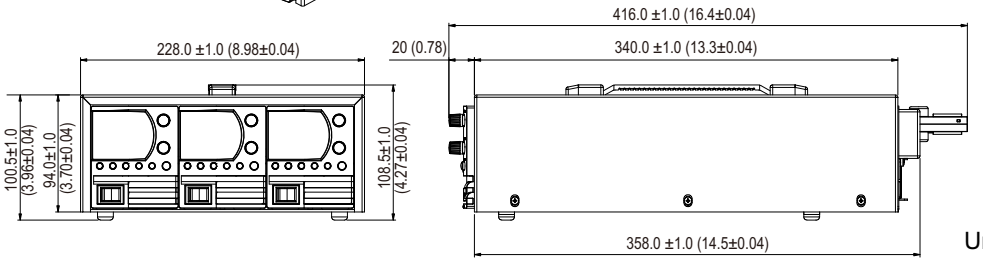
KRA2-PAV
EIA /JIS rack mount adapter

Half-size housing cover

The housing cover is for joining three PAV series power supplies into a single grouping. The width of the cover is one-half the size of the rack mount adapter. The 1/6 width blank panels of the rack mount adapter can also be used.



CC01-PAV
Half-size housing cover



Unit：mm（inch）

2

Preparation

This chapter describes how to prepare this product before you use it.

Connecting the Power Cord

⚠WARNING **Risk of electric shock.**

- **This product conforms to IEC Safety Class I (equipment that has a protective conductor terminal). Be sure to earth ground the product.**
  The product is grounded through the power cord ground wire. Connect the protective conductor terminal to earth ground.
- **Even after you turn off the POWER switch on the front panel, the components inside the product will retain voltage. It takes about 2 minutes for this voltage to discharge after removing the input and output wiring from this product.**

NOTE The power cord with a plug can be used to disconnect the product from the AC power line in an emergency. Connect the plug to an easily accessible power outlet so that the plug can be removed from the outlet at any time. Be sure to provide adequate clearance around the power outlet.

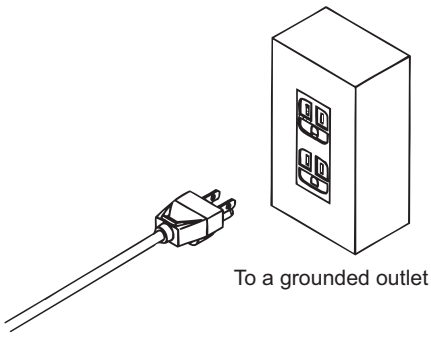
This product conforms to IEC Overvoltage Category II (energy-consuming equipment that is supplied from a fixed installation).

1 **Turn the POWER switch off.**

2 **Check that the AC power line meets the nominal input rating of the PAV series.**

The product can receive a single-phase nominal line voltage ranging from 100 Vac to 240 Vac in the range of 50 Hz to 60 Hz.

3 **Connect the power cord to the rear-panel AC INPUT (AC inlet), and then connect the power plug to an outlet that has a ground terminal.**



To a grounded outlet

Basic Operation Check

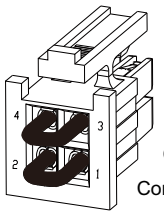
Check the operation of the most basic operation modes: constant voltage (CV) and constant current (CC). Check the following items first before starting operation.

■ The POWER switch is turned off.

■ J2 connector *(p.29)* is connected for local sensing.

- **Models whose rated output voltage is 10 V to 100 V**

Plug type: IPD1-02-D-K (SAMTEC)



1: Local (-) sensing
2: Remote (-) sensing
3: Remote (+) sensing
4: Local (+) sensing

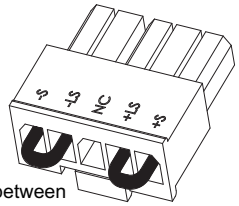
Connect between 4 and 3.

Connect between 2 and 1.

NOTE On models whose rated output voltage is 10 V to 100 V, a collective cover can be placed over the J1, J2, and J3 connectors. After wiring the connectors, attach the cover.

- **Models whose rated output voltage is 160 V to 650 V**

Plug type: 43645-0500 (MOLEX)



-S: Local (-) sensing
-LS: Remote (-) sensing
NC: Not used
+LS: Remote (+) sensing
+S: Local (+) sensing

Connect between -S and -LS.

Connect between +LS and +S.

■ The power cord is connected correctly.

Checking the constant voltage (CV) mode

Turn the POWER switch on, and check the following three items.

- Display status
- That constant voltage mode is enabled
- That the output voltage can be changed

NOTE If the foldback protection is set to "CU" (CV), it will activate when you press OUTPUT. Turn off the foldback protection according to "Setting the foldback protection"*(p.47)*.

1 **Turn the POWER switch on (|).**

The display shows "8888," all the LEDs light for an instant, and the voltmeter shows "OFF." "OFF" indicates that the output is off.

2 **Press OUTPUT.**

The OUTPUT key lights, and the output is turned on.

3 **Check that the CV LED is lit, showing that constant voltage mode is enabled.**

If the CC LED is lit, turn the CURRENT knob clockwise.

4 **Turn the VOLTAGE knob.**

Check that the output voltage changes on the voltmeter.

The voltage setting range is from zero to the rated output voltage of the model in use.

5 **Turn the POWER switch off (○).**

The voltmeter shows "RC," the ammeter shows "FA IL," and the ALARM key (red) blinks for about 3 seconds.

Checking the constant current (CC) mode

Turn the POWER switch on, and check the following three items.

- Display status
- That constant current mode is enabled
- That the output current can be changed

NOTE If the foldback protection is set to "CC" (CC), it will activate when you press OUTPUT. Turn off the foldback protection according to "Setting the foldback protection"*(p.47)*.

1 Check that the POWER switch is in the off (◯) position and that all displays are turned off.

2 Short the output terminals.

Be sure to use a cable that can at least handle the rated current.

3 Turn the POWER switch on (|).

The display shows "8888," all the LEDs light for an instant, and the voltmeter shows "OFF." "OFF" indicates that the output is off.

4 Press OUTPUT.

The OUTPUT key lights, and the output is turned on.

5 Check that the CC LED is lit, showing that constant current mode is enabled.

If the CV LED is lit, turn the VOLTAGE knob clockwise.

6 Turn the CURRENT knob.

Check that the output current changes on the ammeter.

The current setting range is from zero to the rated output current of the model in use.

7 Turn the POWER switch off (◯).

The voltmeter shows "RC," the ammeter shows "FA IL," and the ALARM key (red) blinks for about 3 seconds.

8 Remove the cable from the output terminal.

Checking the Firmware Version

Using the front panel menu, check the firmware version of the PAV series.

1 **Press MENU.**

The MENU key (green) lights, and the voltmeter shows "SEt."

2 **Turn the VOLTAGE knob until the voltmeter shows " InFo."**

(" InFo": INFORMATION)

3 **Press the VOLTAGE knob.**

The voltmeter shows "rEv," and the ammeter shows the firmware version. ("rEv": REVISION)

If you do not press the MENU key for about 15 seconds, the MENU key will turn off, and the menu will close. The voltmeter will show "OFF."

3

Connecting the Load

This chapter describes the cables for connecting a load to the output terminal of the PAV series, the connection procedure, remote sensing, and other issues that should be considered when connecting the load.

Load Cables

⚠WARNING

Risk of fire.

- **Use load cables whose capacity is adequate for the product's rated output current.**
- **The output terminal and its surrounding area become very hot. Use cables whose covers have heat resistance at 85 °C or higher.**

Risk of electric shock.

- **Use load cables with a insulation voltage rating that meets or exceeds the product's rated output voltage.**

■ Current capacity of load cables

If you use load cables whose capacity meets or exceeds the rated output current, even if the load is shorted, the cables will not be damaged. The load cables that you use must have a current capacity that allows the product's rated output current to flow.

■ The cables' allowable current depends on the insulation's maximum allowable temperature.

A cable's temperature is determined by the resistive loss based on the current, the ambient temperature, and the cable's external thermal resistance. The following table shows the current capacity of heat-resistant vinyl wires that have a maximum allowable temperature of 60 °C when one of the wires is separated and stretched out horizontally in air in an ambient temperature of 30 °C. The current capacity must be reduced under certain conditions, such as when vinyl cables that have a low heat resistance are used, when the ambient temperature is 30 °C or higher, or when cables are bundled together and little heat is radiated.

Nominal cross-sectional area of cables and allowable currents (reference)

Wire size AWG	Nominal cross-sectional area [mm^2]	Allowable current[1] [A] (Ta = 30 °C)	Kikusui-recommended current [A]
16	1.25	19	-
14	2	27	10
12	3.5	37	-
10	5.5	49	20
8	8	61	30
6	14	88	50
4	22	115	80
2	30	139	-

1 Excerpt from Japanese laws related to electrical equipment.

■ Taking measures against noise

When connecting cables that have the same heat resistance, separating the cables as much as possible to increase heat radiation enables a greater amount of current to flow. However, running the + (positive) and - (negative) output load cables side by side or bundling them together is more effective against unwanted noise. The Kikusui-recommended currents shown in the above table are allowable currents that have been reduced in consideration of the potential bundling of load cables. Use these values as a guideline when connecting cables.

■ Recommended cable length

Select cables so that the voltage drop in one side of the cable (positive or negative output wire) at the maximum rated current is 1.0 V or less. We recommend that the voltage drop be kept from exceeding 1 V in order to reduce power loss in the load cables and improve the product's response to load variation. The following table shows the estimated maximum cable lengths.

Maximum cable length (m) to keep the voltage drop from exceeding 1 V

Wire size AWG	Nominal cross-sectional area [mm^2]	Resistivity [Ω /km]	Maximum cable length [m] to keep the voltage drop from exceeding 1 V					
			2.5 A	5 A	10 A	20 A	50 A	80 A
24	0.2	84.22	4.7	-	-	-	-	-
20	0.5	33.31	12.0	6.0	-	-	-	-
16	1.25	13.17	30.4	15.2	7.6	-	-	-
14	2	8.286	48.3	24.1	12.1	-	-	-
12	3.5	5.211	76.7	38.4	19.2	9.6	-	-
10	5.5	3.277	122	61.0	30.5	15.3		-
8	8	2.061	-	97.0	48.5	24.3	9.7	
6	14	1.296	-	-	77.1	38.6	15.4	9.6
4	22	0.8152	-	-	-	61.3	24.5	15.3
2	38	0.5127	-	-	-	-	39.0	24.4

To determine the maximum cable length for current not shown in the table, use the value obtained by the following equation as a guideline.

Maximum cable length (m) = 1000/(current × resistivity)

Current: A

Resistivity: Ω/km

Connecting to the Output Terminals

⚠ WARNING

- **Be sure to shut off the AC input before connecting or changing the wiring on the rear panel.**
- **On models whose rated output voltage exceeds 60 V, dangerous voltage may appear at the output terminals and the load end. To prevent electric shock, check that there are no live parts that can be touched on the load and connection areas.**
- **Check that the insulation rating of the load cables is at least equivalent to the maximum output voltage of the PAV series.**

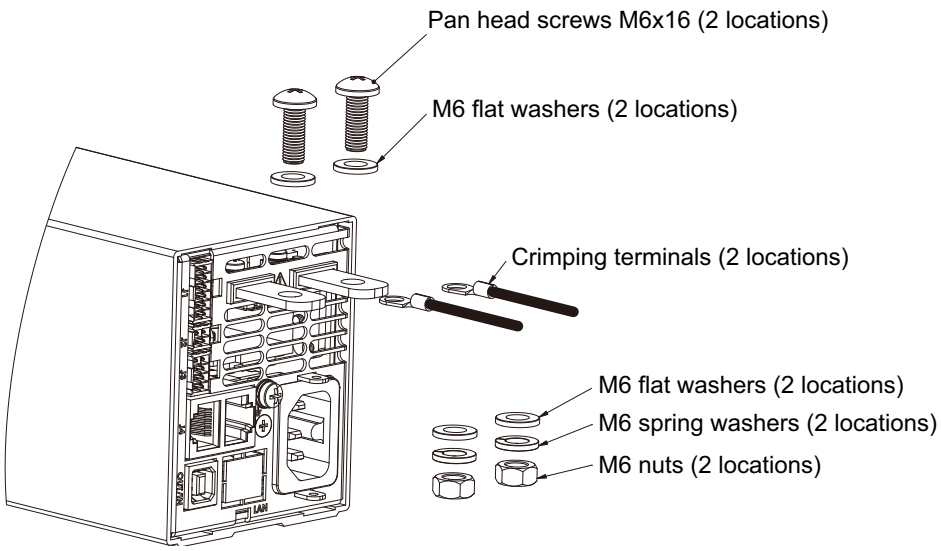
Connecting to the bus bar

- **This connection applies to models whose rated output voltage is 10 V to 100 V.**

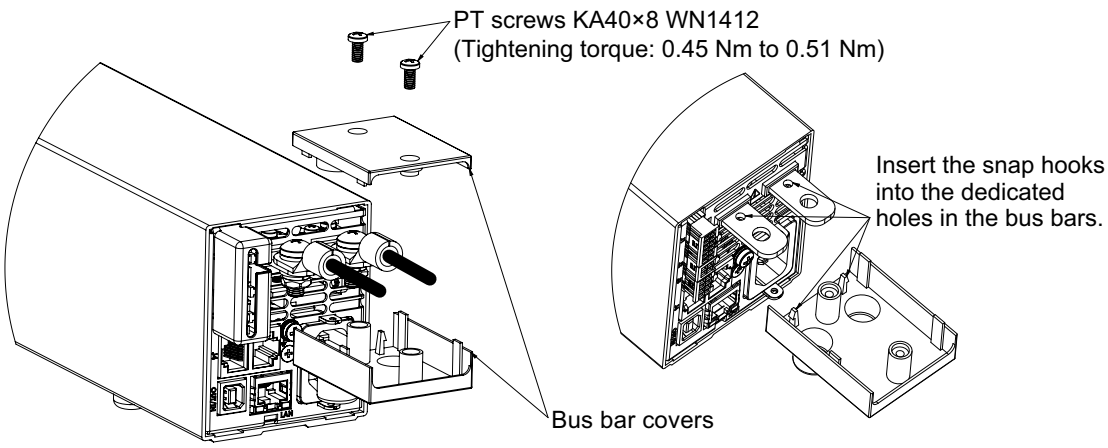
⚠ CAUTION

- Check that the output terminals are not shorted by crimping terminals or other metallic objects.
- The connection may become loose or the output bus bar may bend due to the weight of the load cables. Take measures to prevent them.

1 **Connect the load cables to the bus bar.**



2 **Attach the bus bar cover to the output terminals.**



Connecting to the wire clamp connectors

- **This connection applies to models whose rated output voltage is 160 V to 650 V.**

WARNING

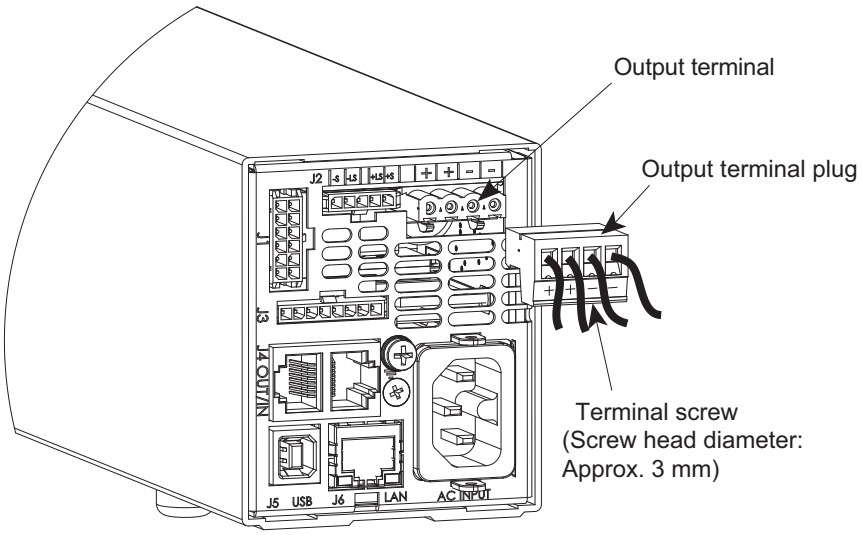
Risk of electric shock.

- **Attach the output terminal plug securely.**
- **Attach the output terminal cover properly using the supplied PT screws.**

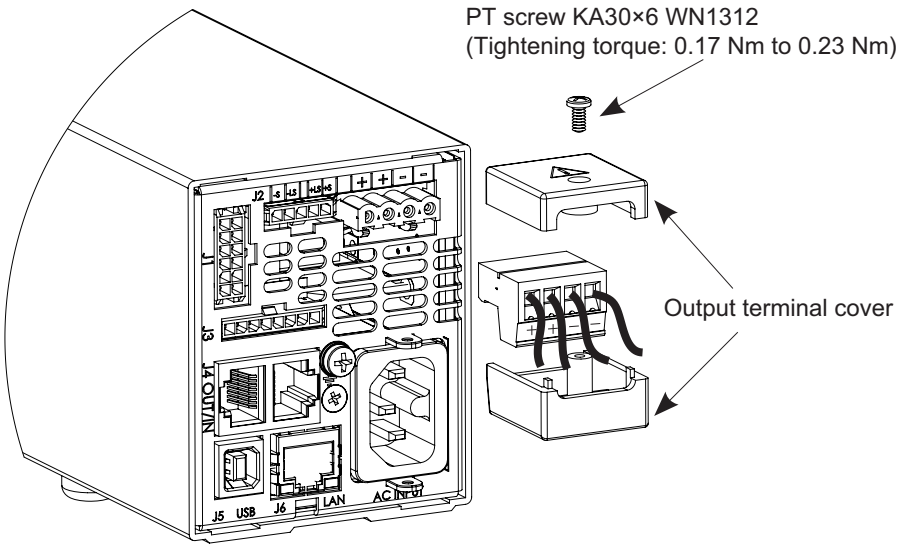
Output connector specifications

Connector model: IC 2.5/ 4-G-5.08 (PHOENIX CONTACT)
Plug model: IC 2.5/ 4-ST-5.08 (PHOENIX CONTACT)
Compatible cable: 16 AWG to 24 AWG
Cable screw tightening torque: 0.5 Nm to 0.6 Nm

1. **Strip about 10 mm of the covering from each load cable.**
2. **Loosen the output terminal plug's terminal screws.**
3. **Insert the stripped cables into the plug terminals, and fasten securely with terminal screws.**



4 **Attach the cover over the output terminal plug.**



5 **Connect the output terminal plug to the output terminal on the rear panel.**

Output grounding

The positive or negative output terminal of the PAV series can be grounded to its chassis (FG). To reduce the noise caused by the common-mode current flowing from the load to the ground, connect the output terminal to the chassis (FG) using the shortest cable possible.

Regardless of the grounding of the system, use a pair (positive and negative) of cables to connect the load to the PAV series.

⚠WARNING

- **Risk of electric shock. Make the potential difference between the grounding terminal (chassis) and output terminal as follows.**
  - **Models whose rated output voltage is 10 V, 20 V, or 36 V: ±60 Vdc or less**
  - **Models whose rated output voltage is 60 V, or 100 V: ±100 Vdc or less**
  - **Models whose rated output voltage is 160 V, 320 V, or 650 V: ±650 Vdc or less**
- **On models whose rated output voltage or the total voltage across a series connection exceeds 400 V, if the positive output terminal is grounded, there is a risk of electric shock at the USB/RS232/RS485 and LAN ports. If you are using the USB/RS232/RS485 or LAN port under the above condition, do not connect the positive output terminal.**

Output Voltage Sensing

J2 connector

The J2 connector on the rear panel is for local or remote output voltage sensing.

WARNING

- **On models whose rated voltage exceeds 60 V, there is a risk of electric shock at the sensing terminals. Local sensing cables and remote sensing cables must have an insulation rating of at least the maximum output voltage. To prevent contact with dangerous voltage, thoroughly check that live parts on the load end are covered.**

CAUTION

- In local sensing, connecting the +LS or +S terminal to the -V, -S, or -LS terminal may damage the PAV series.
- Regardless of whether remote sensing or local sensing is used, connecting the sensing cables in reverse may damage the PAV series.

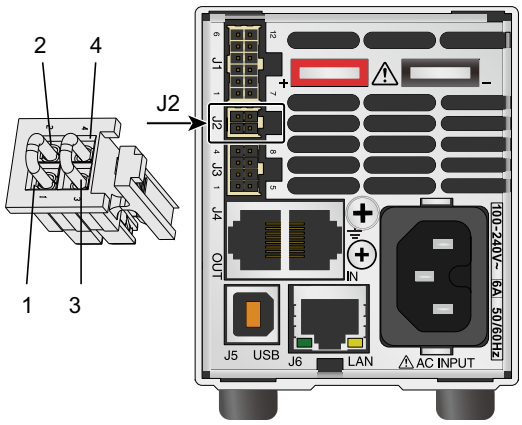
If the sensing cables come loose, the output voltage across the load may become unstable, and an excessive voltage may be applied to the load. If an appropriate OVP trip point is set, the OVP will trip before an excessive voltage is generated.

If you are not going to use remote sensing, return the PAV series to local sensing mode.

Models whose rated output voltage is 10 V to 100 V

Terminal	Symbol	Function
J2-1	-LS	Negative local sensing. Connect to the internal negative output terminal.
J2-2	-S	Negative remote sensing.
J2-3	+S	Positive remote sensing.
J2-4	+LS	Positive local sensing. Connect to the internal positive output terminal.

Connector model	IPL1-102-01-S-D-RA-K (SAMTEC)
Plug model	IPD1-02-D-K (SAMTEC)
Contact pin	CC79L-2024-01-L (SAMTEC)
Crimping tool	CAT-HT-179-2030-13 (SAMTEC)
Compatible cable	24 AWG to 20 AWG

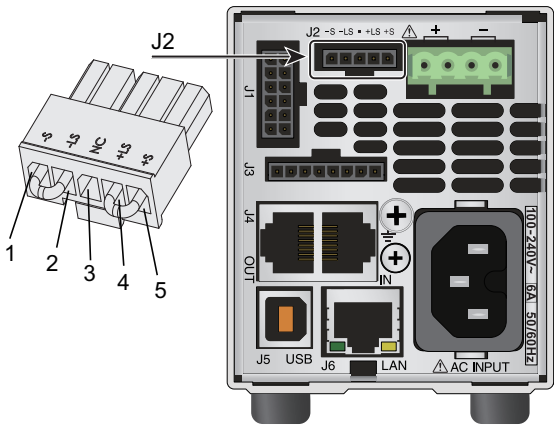


NOTE On models whose rated output voltage is 10 V to 100 V, a collective cover can be placed over the J1, J2, and J3 connectors. After wiring the connectors, attach the cover.

Models whose rated output voltage is 160 V to 650 V

Terminal	Symbol	Function
J2-1	-S	Negative remote sensing.
J2-2	-LS	Negative local sensing. Connect to the internal negative output terminal.
J2-3	NC	No connection
J2-4	+LS	Positive local sensing. Connect to the internal positive output terminal.
J2-5	+S	Positive remote sensing.

Connector model	43650-0501 (MOLEX)
Plug model	43645-0500 (MOLEX)
Contact pin	43030-0002 (MOLEX)
Crimping tool	63819-0000 (MOLEX)
Compatible cable	24 AWG to 20 AWG

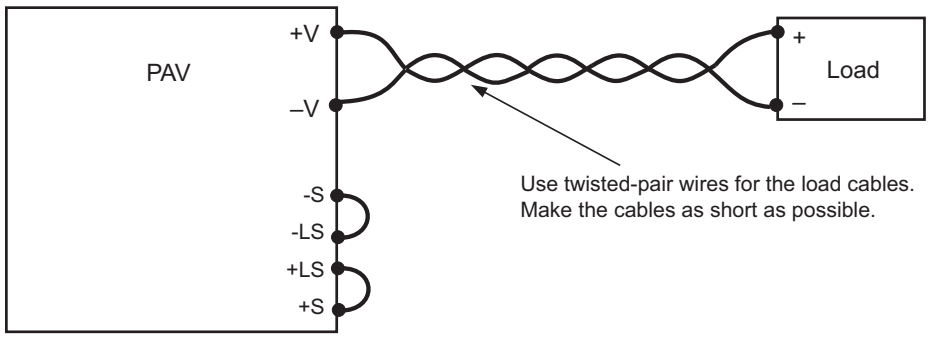


Local sensing

By factory default, the PAV series is set to local sensing (the rear panel J2 connector is hard wired). The sensing point during local sensing is the output terminal. This method does not compensate for the voltage drop in the load cable, so use this method when the load current is small or when you do not need to consider the load regulation voltage.

Connecting a single load using local sensing

The method of connecting to a single load using local sensing is shown below. In the figure, local sensing is connected through the J2 connector on the rear panel.



Remote sensing

WARNING

- **On models whose rated voltage exceeds 60 V, there is a risk of electric shock at the sensing point. To prevent contact with dangerous voltage, thoroughly check that live parts on the load end are covered.**
- **Do not operate by only connecting the remote sensing cables (without connecting the output terminals and load). Check that the connections are correct before use, and do not remove cables during operation. Improper handling may cause electric shock or damage the PAV series.**

CAUTION When using shielded sensing cables, ground the shield at one point. The grounding point is the PAV series chassis (FG) or the positive or negative output terminal.

Limitations of the remote sensing function

Load cables have resistance. As the cable becomes longer or the current becomes larger, the voltage drop in the cable becomes greater. This results in a smaller voltage applied to the load end. The PAV series has a sensing function that compensates for this voltage drop up to 5 V (varies depending on the model; see the following table) for a single line. If the voltage drop exceeds this level, use cables that have a greater cross-sectional area.

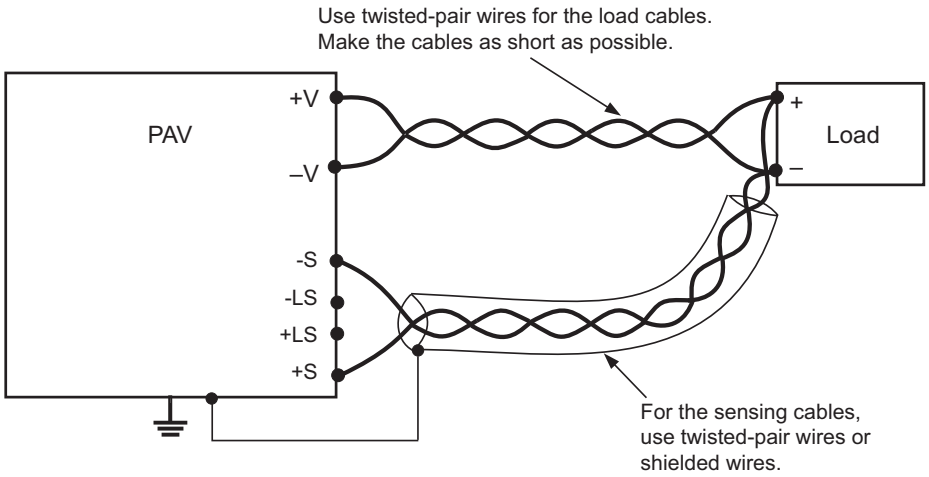
PAV rated voltage (V)	Remote sensing compensation voltage (maximum value V)
10	1
20	1
36	2
60	3
100	5
160	5
320	5
650	5

Connecting the remote sensing cables

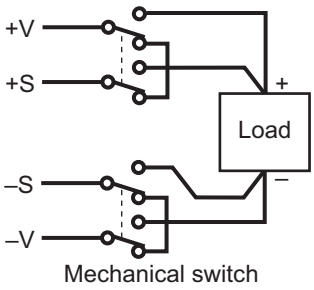
1. **Check that the POWER switch is turned off.**
2. **Remove the J2 plug from the J2 connector on the rear panel.**
3. **Connect the negative sensing cable to the J2-2 (-S) plug and the positive to the J2-3 (+S) plug.**
4. **Insert the J2 plug into the J2 connector on the rear panel.**
5. **Turn the POWER switch on.**

Connecting a single load using remote sensing

The method of connecting to a single load using remote sensing is shown below. In constant voltage mode, remote sensing is effective in reducing voltage variation on the load end. To reduce the effect of noise, use twisted-pair or shielded cables for the sensing cables. When you use shielded cables, connect the shield to the chassis (FG) of the PAV series or the load ground, but not both. Check and decide the best point to connect the shield with the actual device.



⚠CAUTION If you want to include a mechanical switch in the load cables, be sure to also include a switch for the sensing cables as shown in the following figure and turn on and off the load and sensing cables simultaneously. Before you turn the mechanical switch on or off, be sure to turn the OUTPUT key or the POWER switch off.



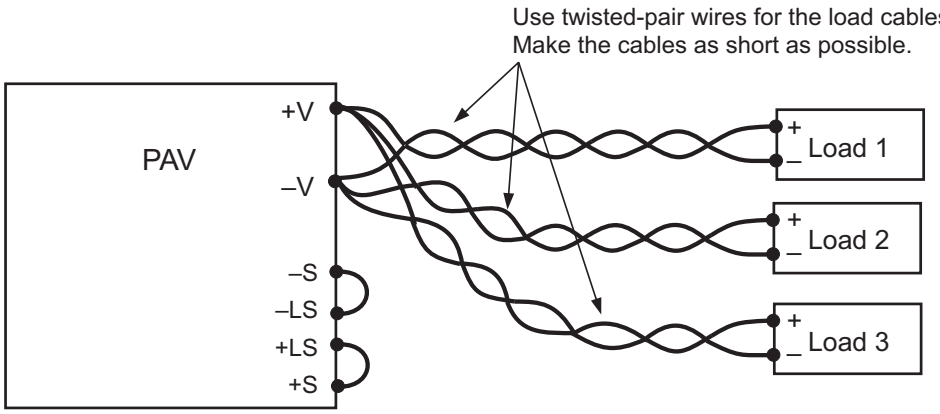
Mechanical switch

Load Considerations

When connecting to multiple loads

Local sensing

The following figure shows how to connect to multiple loads from a single PAV series. Use separate load cables between each load and the PAV series. Make each pair of load cables as short as possible. To reduce the effect of noise and radiation noise, use twisted or shielded cables.

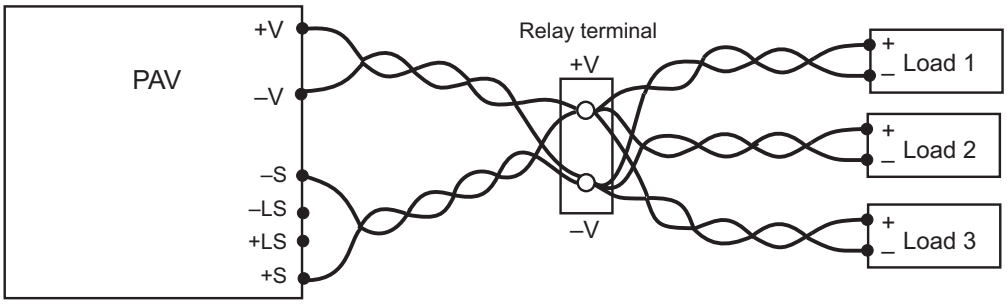


When using sensing cables, connect them to the output terminals of the PAV series or to a single load that you want to reduce the load variation the most.

Remote sensing using a relay terminal

If the relay terminal is far away from the PAV series, use twisted-pair or shielded cables to connect from the PAV output to the relay terminal. Use separate cables to connect from the relay terminal to each load.

If you need to use remote sensing, connect the sensing cables to the relay terminal or to a single load that you want to reduce the load variation the most.



Noise and impedance effects

To reduce noise from being mixed in and the effects of radiation noise, use the shortest twisted-pair cable possible for the load cables and remote sensing cables. Shielding may be necessary for sensing cables in noisy areas. If you use shielded cables, connect the shield wire to the chassis grounding screw on the rear panel.

Even when there is no effect of noise, use twisted-pairs for the load cables and remote sensing cables. This reduces the cross coupling between the load cables and remote sensing cables and helps the stable operation of the PAV series.

Separate the remote sensing cables and load cables as far apart as possible.

Twisting the load cables reduces the cables' coupling impedance. This coupling impedance may cause high-frequency voltage spikes to occur at the PAV series output end and load end due to load current variation. The impedance between the output end and load end (load cables) causes the (ripple) noise at the load end to be larger than that at the output end. Adding a filter circuit with a bypass capacitor to the load end will allow the high-frequency load current to bypass through the circuit and thereby reduce noise.

Inductive load

Inductive load can cause voltage spikes that can affect the PAV series. If this occurs, you need to connect a diode between the output terminals. Select a diode with voltage and current ratings that are higher than those of the PAV series.

Connect the cathode end to the PAV series positive output and the anode end to the negative output. If a positive transient voltage, such as the reverse voltage from a motor, will occur, connect a surge suppressor between the output terminals to protect the PAV series.

Select a surge suppressor with an operating voltage range that is about 10 % higher than the maximum output voltage of the PAV series.

4

Basic Operation

This chapter explains the basic operation from the front panel and the protection functions.

Operation Modes

The PAV series has two operation modes: constant voltage (CV) and constant current (CC).

Auto switching between CV and CC modes

- Switching from CV mode to CC mode

  When the PAV series is running in CV mode and the load current exceeds the current setting, the PAV series automatically switches to CC mode. Then if the load current returns to the current setting or below, the PAV series automatically returns to CV mode.
- Switching from CC mode to CV mode

  When the PAV series is running in CC mode and the load voltage exceeds the voltage setting, the PAV series automatically switches to CV mode. Then if the load voltage returns to the voltage setting or below, the PAV series automatically returns to CC mode.

The operation mode is automatically determined by the voltage setting, current setting, and load resistance.

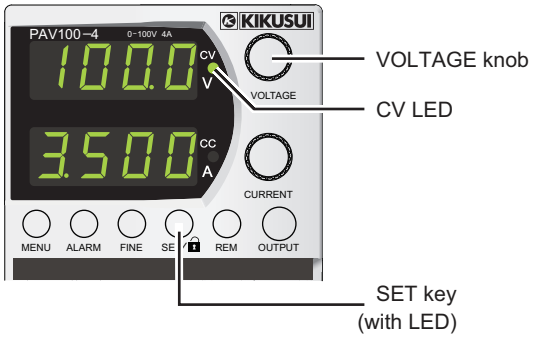
NOTE If the foldback protection is enabled, the output is shut off when the PAV series switches from constant voltage mode to constant current mode or vice versa. For details, see “Foldback protection” *(p.47)*.

Constant voltage (CV) mode

In constant voltage mode, the output voltage is held at the specified value even when the load current changes. The CV LED on the front panel lights in constant voltage mode.

NOTE The output voltage and output current can be set up to 105 % of their ratings. Be sure to use them within their ratings. Use exceeding the ratings is outside the guaranteed range.

Setting the output voltage



Voltmeter display example

OFF SET key Off: Output off

100.0 SET key Off: Output voltage display
SET key On: Voltage setting display

1 **Press SET.**

The SET key lights. The voltmeter shows the voltage setting, and the ammeter the current setting (setting display state).

2 **Turn the VOLTAGE knob to set the voltage.**

The voltmeter shows the present voltage setting.

3 **Turn the CURRENT knob to set the current.**

The ammeter shows the present current setting. To prioritize constant voltage mode, set the current higher than the expected output current. The current setting is the limit current that can flow through the load in constant voltage mode.

When 5 seconds elapse after operating the knobs, the conditions at that point become the settings. At that point, the SET key turns off, and the voltmeter shows "OFF."

If you press SET, the SET key turns off without the 5 second wait, and the voltmeter shows "OFF."

■ Turning the output on

4 **Press OUTPUT.**

■ The CV LED and the OUTPUT key light (the SET key turns off), and the output is turned on. The voltage setting becomes the output voltage (shown on the voltmeter). The voltage set by turning the VOLTAGE knob is immediately applied to the output voltage.

■ Turning the output off

5 **Press OUTPUT again.**

The output is turned off. The voltmeter display changes to "OFF."

NOTE

- The output current is determined by the output voltage and load resistance.
- To prioritize constant voltage mode, set the current higher than the output current. If the output current exceeds the current setting, the PAV series automatically switches to constant current mode.
- When the output is turned on, if the voltmeter display is different from the voltage that was set, the PAV series may be running in constant current (CC) mode (CC LED lit). Check the CV LED, CC LED, load current, and the PAV series output current setting.

Changing the setting resolution

1 **Press FINE.**

The FINE key lights. You can perform fine adjustment using the VOLTAGE knob.

2 **Press FINE again.**

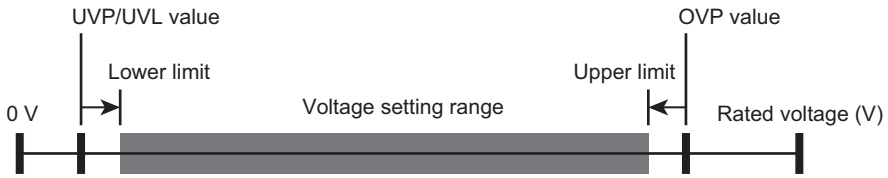
The FINE key turns off, and the mode returns to coarse adjustment. The mode toggles between fine adjustment and coarse adjustment every time you press FINE. The FINE key is effective regardless of the SET on/off and output on/off states.

In fine adjustment (FINE) mode, the LED lights green, and you can set down to the least significant digit (1-count interval). In coarse adjustment mode, values can be set at low resolution (six turns to cover the full scale).

Voltage setting limit by the protection function

The voltage setting is limited to the following range by the overvoltage protection (OVP) *(p.43)*, and undervoltage protection/undervoltage limit (UVP/UVL) *(p.45)*.

- The upper limit of the voltage setting is approximately 95 % of the OVP value.
- The lower limit of the voltage setting is approximately 105 % of the UVP/UVL value.

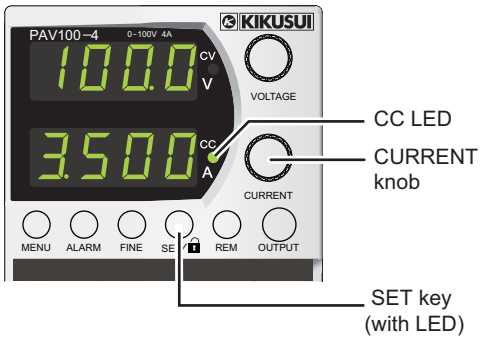


Constant current (CC) mode

In constant current mode, the output current is held at the specified value even when the output voltage changes. The CC LED on the front panel lights in constant current mode.

NOTE The output voltage and output current can be set up to 105 % of their ratings. Be sure to use them within their ratings. Use exceeding the ratings is outside the guaranteed range.

Setting the output current



Ammeter display example

SET key Off: Output current display
SET key On: Current setting display

1 **Press SET.**

The SET key lights. The voltmeter shows the voltage setting, and the ammeter the current setting (setting display state).

2 **Turn the CURRENT knob to set the current.**

The ammeter shows the present current setting.

3 **Turn the VOLTAGE knob to set the voltage.**

The voltmeter shows the present voltage setting. To prioritize constant current mode, set the voltage higher than the expected output voltage. The voltage setting is the limit value that can be applied to the load in constant current mode.

When 5 seconds elapse after operating the knobs, the conditions at that point become the settings. At that point, the SET key turns off, and the voltmeter shows "OFF."

If you press SET, the SET key turns off without the 5 second wait, and the voltmeter shows "OFF."

■ Turning the output on

4 **Press OUTPUT.**

The CC LED and the OUTPUT key light (the SET key turns off), and the output is turned on. The current setting becomes the output current (shown on the ammeter). The current set by turning the CURRENT knob is immediately applied to the output current.

■ Turning the output off

5 **Press OUTPUT again.**

The output is turned off. The voltmeter display changes to "OFF."

NOTE

- The output voltage is determined by the output current and load resistance.
- To prioritize constant current mode, set the voltage higher than the output voltage. If the output voltage exceeds the voltage setting, the PAV series automatically switches to constant voltage mode.
- When the output is turned on, if the ammeter display is different from the current that was set, the PAV series may be running in constant voltage (CV) mode (CV LED lit). Check the load voltage and the PAV series output voltage setting.

Changing the setting resolution

1 **Press FINE.**

The FINE key lights. You can perform fine adjustment using the CURRENT knob.

2 **Press FINE again.**

The FINE key turns off, and the mode returns to coarse adjustment. The mode toggles between fine adjustment and coarse adjustment every time you press FINE. The FINE key is effective regardless of the SET on/off and output on/off states.

In fine adjustment (FINE) mode, the LED lights green, and you can set down to the least significant digit (1-count interval). In coarse adjustment mode, values can be set at low resolution (six turns to cover the full scale).

Output Operation

Turning the output on and off

The output toggles between on and off every time you press OUTPUT.

1 **Press OUTPUT.**

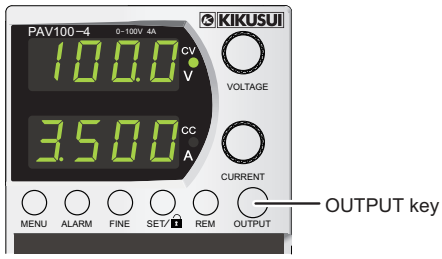
The OUTPUT key lights, and the output is turned on.

The voltmeter and ammeter display the output voltage and output current.

2 **Press OUTPUT again.**

The OUTPUT key turns off, and the output is turned off.

The voltmeter will show "OFF."



Voltmeter display example

OUTPUT key Off: Output off

OUTPUT key On: Output on

- You can turn the output on and off using the output on/off control (ILC) of the J3 connector *(p.77)* or the communication interface.
- You cannot turn the output on and off when key lock is enabled or when a protection function is activated.
- The OUTPUT key releases activated protection functions. If a protection function (OVP, UVP, or foldback protection) *(p.42)* is activated, clear the protection activation condition first, and then press OUTPUT.

Self start and auto start

When the POWER switch is turned on

When the POWER switch is turned on, the PAV series starts using the settings that were used immediately before the AC input was turned off. However, the output on/off state at startup varies depending on the start mode. There are two start modes: safe and auto. The factory default setting is safe start mode.

- **Safe start mode (SAFE)**

The output is always off when the PAV series starts. If you want to turn the output on, check the voltage shown on the voltmeter, and then press OUTPUT.

- **Auto start mode (AUTO)**

When the PAV starts, the output is in the state that it was in immediately before the AC input was turned off.

For conditions other than when the POWER switch is turned on

The start mode setting also affect the PAV operation in the following conditions.

- When the overtemperature protection (OTP) *(p.50)* is released
- When the AC input is restored (turned back on) after the output has been turned off due to an AC failure alarm *(p.50)*

- When the output is turned on after the output has been turned off through the external control J3-5 (SO) *(p.79)*.
- When the output is turned on after the output has been turned off through the external control J3-4 (ILC) *(p.82)*.

Setting self start or auto start

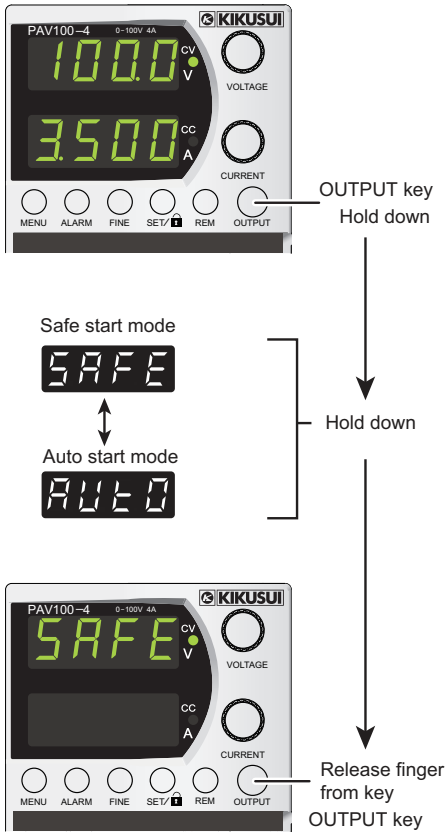
1 **Hold down OUTPUT.**

The voltmeter alternates showing "SAFE" and "AUTO" at 3-second intervals.

2 **Release OUTPUT when the mode that you want to use appears.**

The PAV series is set to the selected start mode.

If 5 seconds elapses after you release OUTPUT, the PAV series returns to its original state, or the voltmeter shows "OFF."



Advanced output programmable function (sequence function)

The advanced output programmable function is used to output preset voltage or current using input triggers. There are three modes: FIX, LIST, and WAVE.

In FIX mode, you can only set one voltage or current. In LIST (step transition) and WAVE (ramp transition) modes, you can set up to 12 voltages or currents to produce sequence output.

Mode selection and voltage and current settings can only be specified using commands, but other conditions and the execution of sequence output can be specified using commands or from the front panel as well.

For the operating procedure, see chapter 3, "Advanced Output Programmable Function," in the Communication Interface Manual.

Application software SD024-PAV (sold separately)

SD024-PAV is a software application that you can use to easily create sequence data for LIST and WAVE modes, without using commands. Sequence output can also be executed from the PC.

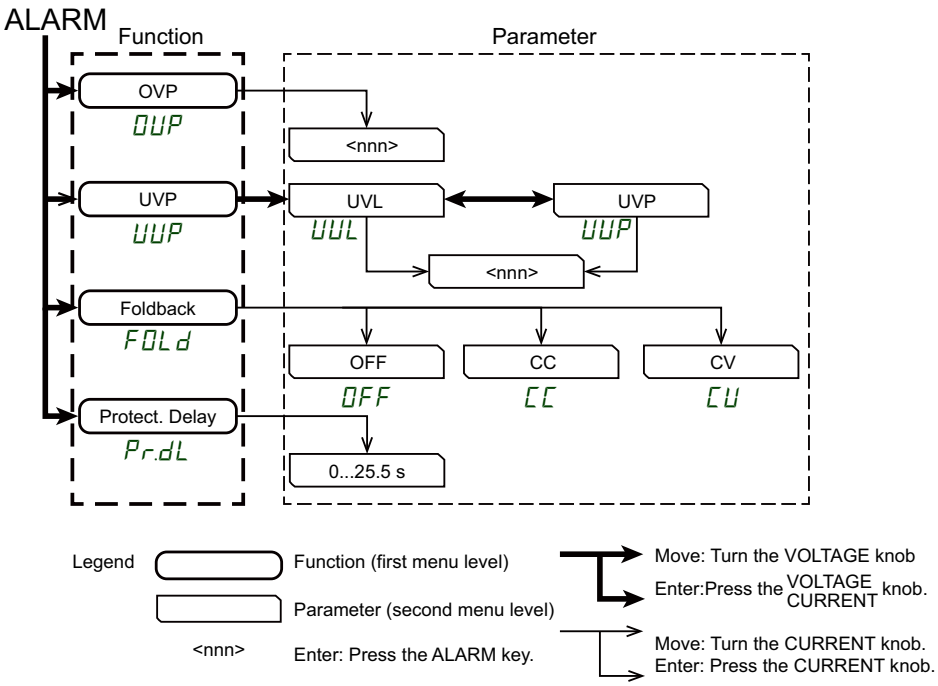
Since LIST/WAVE sequence data that you create is saved in the PAV series memory, you can execute sequence output even from the front panel if you do not have a PC.

Protection Functions

When a protection function is activated, the ALARM key blinks red, and the output is shut off. If two or more protection functions are consecutively activated, the first protection function is displayed. If the first protection function is released but the second is still activated, the second is displayed. The following protection functions are available.

- Overvoltage protection (OVP)
- Undervoltage protection/undervoltage limit (UVP/UVL)
- Foldback protection (FOLD)
- AC failure alarm
- Overtemperature protection (OTP)

Protection function structure and parameters



■ Function

The first menu level.

Item	Function	See
OVP	Overvoltage protection (OVP)	p.43
UVP/UVL	Undervoltage protection/undervoltage limit (UVP/UVL)	p.45
Foldback	Foldback protection	p.47
Protect. Delay	Protection activation delay time (UVP and FOLD delay time)	p.49

■ Parameters

The second menu level. There are parameter items according to each function.

Overvoltage protection (OVP)

The OVP circuit is activated when there is an error in the voltage setting specified through the communication interface or front panel or when there is a problem with the output voltage. When the OVP is activated, the output is shut off. The voltmeter shows "OUP," the ammeter shows "FA IL ?" and the ALARM key blinks red.

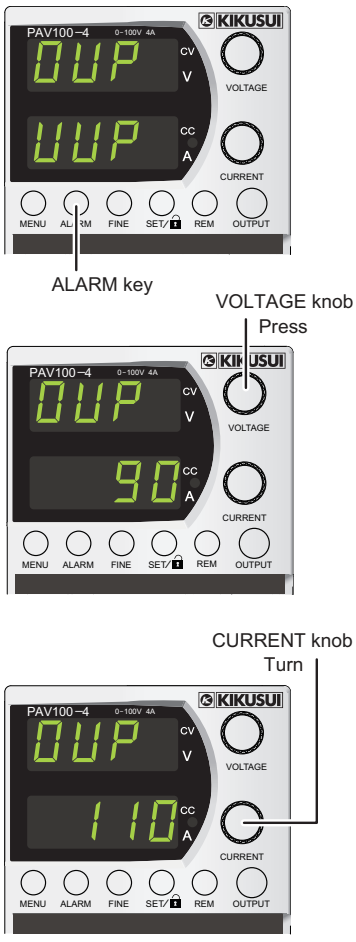
- The voltage setting specified through the communication interface or front panel is limited so that it does not exceed the OVP value.
- If the OVP value is exceeded at the sensing point where the output voltage is monitored, the output is shut off to protect the load.

NOTE Up to 6 ms is required for the output to be shut off after an overvoltage is detected.

Setting the OVP voltages

You can set the OVP values regardless of whether the output is on or off.

There are two OVP values: upper limit and lower limit. The lower limit is approximately 105 % of the output voltage setting or the minimum OVP value shown in the following table, whichever is higher. The upper limit is the maximum OVP value shown in the following table.



1 Press ALARM.

The ALARM key lights green. The voltmeter shows "OUP," and the ammeter shows "UUP." ("OUP": OVP, "UUP": UVP)

2 Press the VOLTAGE knob.

The ammeter shows the present OVP value.

3 Turn the CURRENT knob to set the OVP value.

4 Press ALARM twice.

The ALARM key turns off, and the PAV series exits from OVP setting mode.

The OVP value is applied when you press ALARM once to move back one level.

Rated output voltage	Maximum OVP value	Minimum OVP value	Rated output voltage	Maximum OVP value	Minimum OVP value
10 V	12.0 V	0.5 V	160 V	176 V	5 V
20 V	24.0 V	1.0 V	320 V	353 V	5 V
36 V	40.0 V	2.0 V	650 V	717 V	5 V
60 V	66.0 V	5.0 V			
100 V	110.0 V	5.0 V			

■ Releasing an activated OVP

If the OVP is activated and the output is shut off, reset the OVP circuit according to the following procedure.

1 **Turn the VOLTAGE knob to set the output voltage setting less than or equal to the OVP value.**

2 **Check that the load cables and sensing cables are connected properly.**

3 **Perform any of the following operations.**

- Press OUTPUT to turn the output on.
- Turn the POWER switch off and then back on.
- Turn the output on using the output on/off control (ILC) terminal of the J3 connector *(p.77)*.
- Turn the output on by sending a command through the communication interface.

NOTE If the release procedure is incomplete, the OVP will be activated again.

Checking the OVP

In constant voltage mode, gradually increase the output voltage from a low value. Check that the voltage cannot be set higher than the OVP value.

The following example shows how to set the OVP value to 50 % of the rated voltage. We assume that the UVP/UVL value *(p.46)* is set to 0 V.

The overvoltage protection (OVP) *(p.43)* is set from the menu. Before checking the following, see the explanation on overvoltage protection (OVP).

1 **Turn the POWER switch on (|).**

2 **Press OUTPUT.**
The OUTPUT key lights, and the output is turned on.

3 **Turn the VOLTAGE knob to set the output voltage to approximately 10 % of the rated voltage.**
Press FINE to fine-adjust the voltage.

4 **Set the OVP value to 50 % of the rated voltage.**
Wait a few seconds until the output voltage appears on the voltmeter.

5 **Turn the VOLTAGE knob to increase the output voltage.**
Check that the output voltage cannot be set higher than the OVP value. The value cannot be set higher than approximately 95 % of the OVP value.

6 **Set the OVP value to the maximum value.**
In checking the OVP operation, the OVP value is set to the maximum value. However, in an actual operation, the OVP value is set according to the load.

7 **Turn the POWER switch off (○).**

Undervoltage protection/undervoltage limit (UVP/UVL)

UVP is a function that detects output voltage drops in an abnormal situation and shuts off the output to prevent damage to the load. UVL limits the voltage setting to the specified lower output voltage limit.

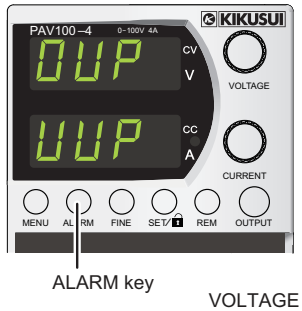
The combination of UVP/UVL, and OVP protects the load device from overvoltage and voltage drops.

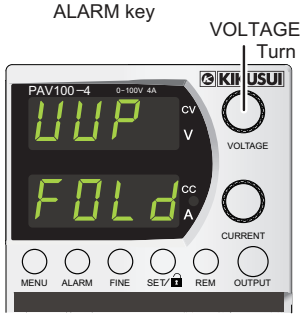
When the UVP is activated, the output is shut off. The voltmeter shows "UUP," the ammeter shows "FAIL," and the ALARM key blinks red.

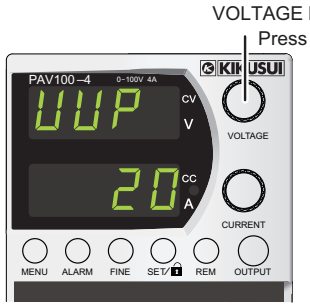
Setting the UVP/UVL voltages

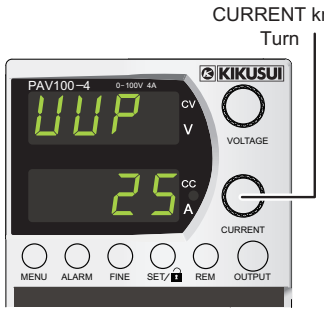
You can set the UVP/UVL value regardless of whether the output is on or off. You can only set a single value for the UVP and UVL. (You cannot set the UVP and UVL values separately.)

The upper UVP/UVL limit is approximately 95 % of the output voltage setting. You cannot set the voltage setting above this limit. The lower UVP/UVL limit is zero. If the UVP/UVL value is less than 5 % of the rated output voltage, the function operates as UVL.









1 **Press ALARM.**

The ALARM key lights green. The voltmeter shows "OUP," and the ammeter shows "UVP." ("OUP": OVP, "UUP": UVP)

2 **Turn the VOLTAGE knob until the voltmeter shows "UUP."**

3 **Press the VOLTAGE knob.**

The ammeter shows the present UVP/UVL value.

4 **Turn the VOLTAGE knob to select "UUP" or "UUL."**

("UUL": UVL)

"UUP" is the undervoltage protection setting, and "UUL" the undervoltage limit setting.
The same value applies regardless of which one you set.

5 **Turn the CURRENT knob to set the UVP and UVL values.**

6 **Press ALARM twice.**

The ALARM key turns off, and the PAV series exits from UVP/UVL setting mode.

The UVP/UVL value is applied when you press ALARM once to move back one level.

- **UVP/UVL value setting range**

Rated output voltage	Maximum UVP/UVL value	Minimum UVP/UVL value	Rated output voltage	Maximum UVP/UVL value	Minimum UVP/UVL value
10 V	9.5 V	0 V	160 V	152 V	0 V
20 V	19.0 V		320 V	304 V	
36 V	34.2 V		650 V	617.5 V	
60 V	57/0 V				
100 V	95.0 V				

■ Releasing an activated UVP

If the UVP is activated and the output is shut off, reset the UVP circuit according to the following procedure.

1 **Turn the VOLTAGE knob to set the output voltage setting greater than or equal to the UVP value.**

2 **Check that the load cables and sensing cables are connected properly.**

3 **Perform any of the following operations.**

- Press OUTPUT to turn the output on.
- Turn the POWER switch off and then back on.
- Turn the output on using the output on/off control (ILC) terminal of the J3 connector *(p.77)*.
- Turn the output on by sending a command through the communication interface.

NOTE If the release procedure is incomplete, the UVP will be activated again.

Checking the UVP/UVL

In constant voltage mode, gradually decrease the output voltage from the rated voltage value. Check that the voltage cannot be set lower than the UVP/UVL value.

You can set the UVP/UVL values regardless of whether the output is on or off. The upper limit is approximately 95 % of the output voltage setting. You cannot set the voltage setting above this limit. The lower limit is zero.

The undervoltage protection (UVP) and undervoltage limit (UVL) *(p.45)* are set from the menu. Before checking the following, see the explanation on undervoltage protection (UVP) and undervoltage limit (UVL).

1 **Turn the POWER switch on (|).**

2 **Turn the VOLTAGE knob to set the output voltage to approximately 10 % of the rated voltage.**
Press FINE to fine-adjust the voltage.

3 **Set the UVP/UVL value (from the menu).**

4 **Turn the VOLTAGE knob to decrease the output voltage.**
Check that the output voltage cannot be set lower than the UVP/UVL value. The value cannot be set higher than approximately 105 % of the UVP/UVL value.

5 **After checking, set the UVP/UVL value to the minimum value (0 V).**

6 **Turn the POWER switch off (○).**

Foldback protection

The foldback protection is a function that limits the transition of operation modes. You can select from CV, CC and OFF.

- CV: Activated when a transition is made from constant current mode to constant voltage mode
- CC: Activated when a transition is made from constant voltage mode to constant current mode
- OFF: Not activated regardless of the transition between constant voltage mode and constant current mode (factory default setting).

When the foldback protection is activated, the output is shut off. The voltmeter shows "FOLd," the ammeter shows "FAIL," and the ALARM key blinks red.

NOTE If the foldback protection is activated when the output is turned on, the operation mode at power-on and the foldback protection are set to the same value. Change the foldback protection setting.

Setting the foldback protection

You can set the foldback protection regardless of whether the output is on or off.

1 Press ALARM.
The ALARM key (green) lights, and the voltmeter shows "OUP."

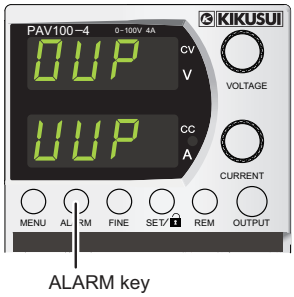
2 Turn the VOLTAGE knob until the voltmeter shows "FOLd."

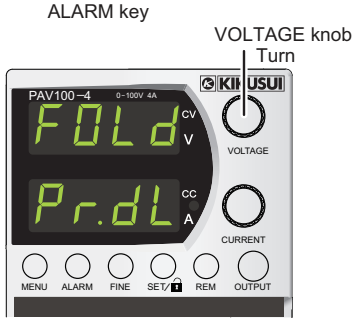
3 Press the VOLTAGE knob.
The ammeter shows the present setting ("OFF," "CC," or "CU").

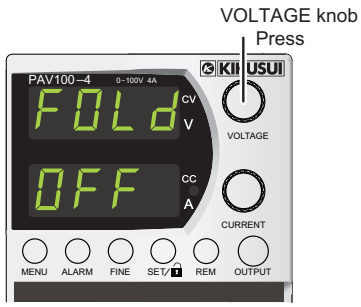
4 Turn the CURRENT knob to select "OFF," "CC," or "CU."

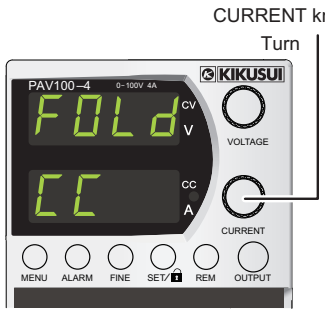
5 Press the CURRENT knob.
The display blinks once, and the setting is entered.

6 Press ALARM.
The ALARM key turns off, and the ammeter display returns to the original state.









■ Releasing an activated foldback protection

If the foldback protection is activated and the output is shut off, reset the foldback protection according to the following procedure.

1 Change the setting.

- If the CC foldback protection is activated, use the CURRENT knob to increase the current.
- If the CV foldback protection is activated, use the VOLTAGE knob to increase the voltage.
- You can change the foldback protection operation mode even when the protection is activated. Follow the procedure in “Foldback protection” *(p.47)*.

2 Check that the load cables and sensing cables are connected properly.

3 Perform any of the following operations.

- Press OUTPUT to turn the output on.
- Turn the POWER switch off and then back on.
- Turn the output on using the output on/off control (ILC) terminal of the J3 connector *(p.77)*.
- Turn the output on by sending a command through the communication interface.

NOTE If the release procedure is incomplete, the foldback protection will be activated again.

Checking the foldback protection

In constant voltage mode, shorting the output causes the PAV series to switch to constant current mode. When you do this, check that the foldback protection function is activated and the output is turned off.

The foldback protection *(p.47)* is set from the menu. Before checking the following, see the explanation on foldback protection.

1 Connect separate cables to the positive and negative output terminals.

⚠WARNING
- **Risk of electric shock and sparks. Check that the cables are connected properly before turning on the POWER switch.**
- **Use cables with a insulation voltage rating that meets or exceeds the PAV series’s rated output voltage.**

2 Turn the POWER switch on (|).

3 Turn the VOLTAGE knob to set the output voltage to 1 V.

4 Turn the CURRENT knob to set the current to 0.1 A.

5 Set foldback to constant current (“CC”) mode.

6 Press OUTPUT.
The OUTPUT key lights, and the output is turned on.

7 Short the output for an instant (approx. 0.5 seconds) at the ends of the connected cables.

8 Check that the output voltage drops to zero.

9 **Check that the voltmeter shows "FOLd," the ammeter shows "FAIL," and the ALARM key blinks red.**
Foldback protection function activation

10 **Set foldback to "OFF."**
The output voltage remains at zero.

11 **Press OUTPUT.**
The output voltage returns to the previous set value.

12 **Press OUTPUT again.**
The output is turned off. The voltmeter will show "OFF."

13 **Turn the POWER switch off (◯).**

Protection activation delay time

For UVP and foldback protection, you can set a delay time between detection and activation (output shutoff). The delay time is determined by the following equation.

- UVP delay time = 500 ms + delay setting (0 s to 25.5 s)
- Foldback protection delay time = Tfb + delay setting (0 s to 25.5 s)

Rated output voltage	10 V	20 V	36 V	60 V	100 V	160 V	320 V	650 V
Tfb	0.1 s	0.3 s	0.3 s	0.5 s	0.7 s	1 s	1 s	1.5 s

Setting the protection activation delay time

1 **Press ALARM.**
The ALARM key (green) lights, and the voltmeter shows "OUP."

2 **Turn the VOLTAGE knob until the voltmeter shows "Pr.dL."**
("Pr.dL": PROTECTION DELAY)

3 **Press the VOLTAGE knob.**
The ammeter shows the present setting.

4 **Turn the CURRENT knob to set the delay time.**
The setting range is 0 s to 25.5 s.

5 **Press the CURRENT knob.**
The delay time is entered. The display blinks once and returns to the original state.

6 **Press ALARM.**
The ALARM key turns off, and the ammeter display returns to the original state.

Overtemperature protection (OTP)

The OTP circuit shuts off the output before the internal heat exceeds the safe operation temperature. When the output is shut off due to OTP, the voltmeter shows "OTP" (OTP), the ammeter shows "FAIL," and the ALARM key blinks red.

Releasing and restoring an activated OTP

If the internal heat falls below the safe operation temperature, the activated OTP is automatically released, and the PAV series returns to the state that it was in before the activation. However, the output on/off state varies depending on the start mode.

- **In safe start mode**

Even when the OTP returns to the state before it was activated, the output remains off. To turn the output on, perform either of the following steps.

- Press OUTPUT.
- Send a command through the communication interface.

- **In auto start mode**

The output returns to the state before the OTP was activated.

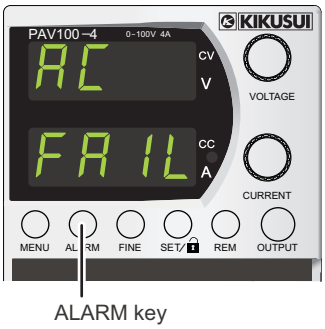
AC failure alarm

When the AC input is shut off, the AC failure alarm is activated, and the output is turned off. The voltmeter shows "AC," the ammeter shows "FAIL," and the ALARM key blinks red.

The AC failure alarm is activated even when the POWER switch is turned on in a normal way. The voltmeter shows "AC," the ammeter shows "FAIL," and the ALARM key (red) blinks for about 3 seconds.

Releasing and restoring an AC failure alarm

When the AC input is received again, the AC failure alarm is automatically released, and the PAV series returns to the state it was in before the activation. However, the output on/off (p.40) state varies depending on the start mode.



ALARM key

- **In safe start mode**

Even when the AC failure alarm returns to the state before it was activated, the output remains off, and the voltmeter shows "OFF."

To turn the output on, press OUTPUT.

- **In auto start mode**

The output returns to the state before the AC failure alarm was activated.

Panel control lock (key lock)

You can lock the front panel controls to prevent accidental changes to the settings. To switch between lock disabled mode (UFP: Unlocked Front Panel) and enabled mode (LFP: Locked Front Panel), use the SET key.

- **Unlocked front panel (UFP)**

In this mode, the front panel controls are unlocked, and normal control is possible from the front panel.

- **Locked front panel (LFP)**

In this mode, the following operations from the front panel are locked and cannot be used.

- Settings using the VOLTAGE and CURRENT knobs
- Output on/off using the OUTPUT key

If you try to perform the above operations in locked mode, the voltmeter shows "LFP" for approximately 5 seconds.

You can check the output voltage and output current settings using the SET key. If you press the ALARM key to enter the protection menu, you can check the OVP value and UVP/UVL value.

Unlocking (UFP) and locking (LFP)

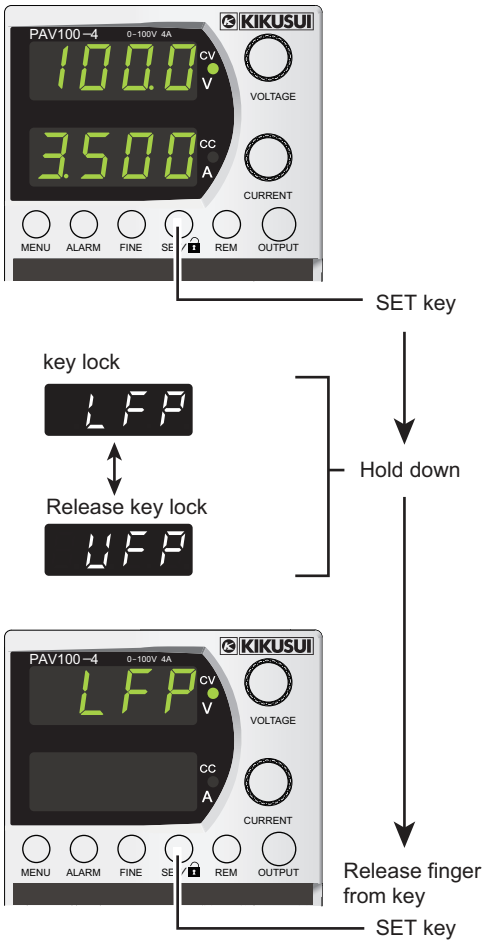
1 **Hold down SET.**

The voltmeter alternates showing "LFP" and "UFP" at 3-second intervals.

2 **Release SET when the mode that you want to use appears.**

The PAV series is set to the selected mode.

If you select LFP and stop operation, the voltmeter shows "LFP." After 5 seconds, the PAV series exits from key lock setting mode.



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5

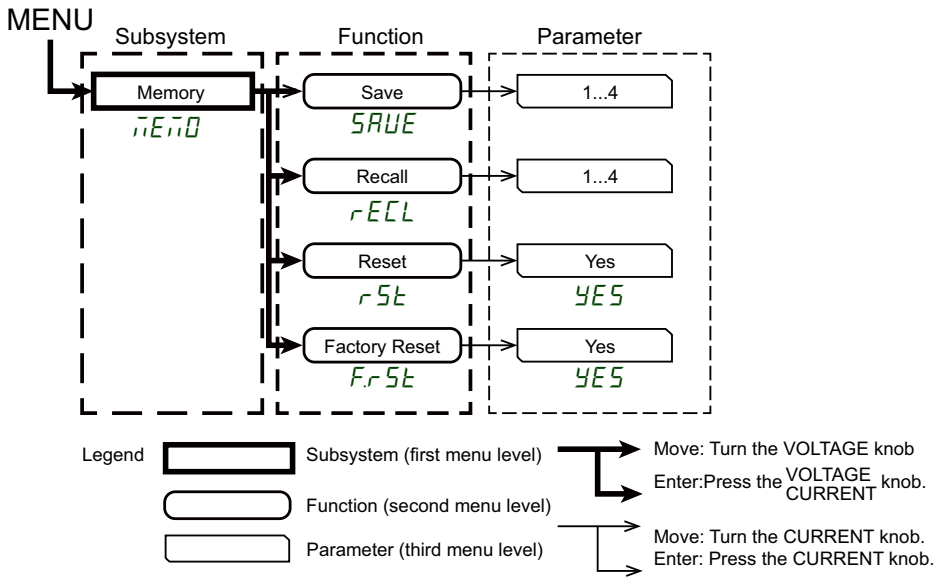
Memory and Menu

This chapter explains the memory and menu functions of the PAV series.

Memory

The PAV series has four conditions and a memory for storing the setting conditions immediately before the AC input is shut off. For the contents that are stored, see “Memory content” *(p.57)*.

Memory structure and parameters



■ Subsystem

The first menu level.

■ Function

The second menu level.

Item	Function	See
Save	Saves conditions	p.54
Recall	Recalls conditions	p.55
Reset	Resets settings	p.55
Factory Reset	Resets to factory default settings	p.56

■ Parameter

The third menu level. There are parameter items according to each function.

Storing the settings

Up to four conditions can be stored. For the contents that are stored, see “Memory content” *(p.57)*. The stored information is retained even after the AC input is turned off.

1 **Press MENU.**

The MENU key (green) lights, and the voltmeter shows “SEt.” (“SEt”: SET)

2 **Turn the VOLTAGE knob until the voltmeter shows "mEmO."**
("mEmO": MEMORY)

3 **Press the VOLTAGE knob.**
The voltmeter shows "SAVE." ("SAVE": SAVE)

4 **Press the VOLTAGE knob.**
The ammeter shows the present memory number (" 1" to "4").

5 **Turn the CURRENT knob to set the memory number (" 1" to "4").**

6 **Press the CURRENT knob.**
The display blinks, and the present conditions are stored in the specified memory number. After storing, the menu returns to the original level.

7 **Press MENU twice.**
The display returns to the original state, and the MENU key turns off.

Recalling settings

Up to four conditions can be recalled. For the contents that can be recalled, see "Memory content" *(p.57)*.

1 **Press MENU.**
The MENU key (green) lights, and the voltmeter shows "SEt."

2 **Turn the VOLTAGE knob until the voltmeter shows "mEmO."**

3 **Press the VOLTAGE knob.**
The voltmeter shows "SAVE," and the ammeter shows "rECL." ("rECL": RECALL)

4 **Press the CURRENT knob.**
The ammeter shows the present memory number (" 1" to "4").

5 **Turn the CURRENT knob to set the memory number ("1" to "4").**

6 **Press the CURRENT knob.**
The display blinks, and the contents of the specified memory number is recalled. The recalled contents are applied to the PAV conditions.

7 **Press MENU twice.**
The display returns to the original state, and the MENU key turns off.

Resetting

For details on the settings, see "Memory content" *(p.57)*.

1 **Press MENU.**
The MENU key (green) lights, and the voltmeter shows "SEt."

2 **Turn the VOLTAGE knob until the voltmeter shows "mEmO."**

3 **Press the VOLTAGE knob.**
The voltmeter shows "SAVE."

4 **Turn the VOLTAGE knob until the voltmeter shows "rSt."**
("rSt": RESET)

5 **Press the VOLTAGE knob.**
The ammeter shows "YES." ("YES": YES)

6 **Press the CURRENT knob.**
The display blinks, and the preset memories are reset. Then the menu returns to the original level.

7 **Press MENU twice.**
The display returns to the original state, and the MENU key turns off.

Factory default settings

For details on the settings, see "Memory content" *(p.57)*.

1 **Press MENU.**
The MENU key (green) lights, and the voltmeter shows "SEt."

2 **Turn the VOLTAGE knob until the voltmeter shows "MEM0."**

3 **Press the VOLTAGE knob.**
The voltmeter shows "SAVE."

4 **Turn the VOLTAGE knob until the voltmeter shows "F.rSt."**
("F.rSt": FACTORY RESET)

5 **Press the VOLTAGE knob.**
The ammeter shows "YES."

6 **Press the CURRENT knob.**
The ammeter shows "HOLd" for about 1 second, blinks, and the preset memories are reset to the factory default conditions. Then the menu returns to the original level.

7 **Press MENU twice.**
The display returns to the original state, and the MENU key turns off.

NOTE When reset to factory default settings, the external communication function is disabled, and the PAV series returns to local mode.

Storing the settings when the AC input is shut off

When the AC input or power switch is shut off, the settings are stored in internal memory.

For details on the memory content, see "Memory content" *(p.57)*.

When the AC input is applied again or the POWER switch is turned on, the PAV series starts using the settings that were saved.

Memory content

The following table shows the memory content of factory default settings and settings after resetting. The table also shows whether each item is stored when the AC input is shut off and whether it is saved and recalled.

<table>
<tr><th>Item</th><th>Factory default setting</th><th>Setting after resetting</th><th>Stored and recalled</th><th>Stored when the AC input is shut off</th></tr>
<tr><td>Output on/off</td><td>OFF</td><td>OFF</td><td rowspan="9">Yes</td><td rowspan="23">Yes</td></tr>
<tr><td>Voltage setting</td><td>0 V</td><td>0 V</td></tr>
<tr><td>Current setting</td><td>MAX</td><td>0 A</td></tr>
<tr><td>Foldback protection</td><td>OFF</td><td>OFF</td></tr>
<tr><td>OVP value</td><td>MAX</td><td>MAX</td></tr>
<tr><td>UVP/UVL selection</td><td>OFF (UVL)</td><td>OFF (UVL)</td></tr>
<tr><td>UVP/UVL value</td><td>0 V</td><td>0 V</td></tr>
<tr><td>Safe start (SAFE)/
auto start mode (AUTO)</td><td>SAFE</td><td>SAFE</td></tr>
<tr><td>General-purpose output 1
(pin 1 of the J3 connector)</td><td>High</td><td>High</td></tr>
<tr><td>General-purpose output 2
(pin 6 of the J3 connector)</td><td>High</td><td>High</td><td>High</td></tr>
<tr><td>Input trigger source</td><td>EXT</td><td>EXT</td><td>No</td></tr>
<tr><td>Protection activation delay time</td><td>0 ms</td><td>0 ms</td><td>Yes</td></tr>
<tr><td>Control voltage setting signal
(Remote “Analog” /Panel “Digital”)</td><td>Digital</td><td rowspan="4">No</td><td rowspan="7">No</td></tr>
<tr><td>Control current setting signal
(Remote “Analog” /Panel “Digital”)</td><td>Digital</td></tr>
<tr><td>External control signal
and monitor signal range</td><td>5 V</td></tr>
<tr><td>Current display mode for master-slave parallel operation</td><td>(Master H1)</td></tr>
<tr><td>Output on/off control
Signal logic</td><td>OFF (disabled)</td><td>OFF (disabled)</td></tr>
<tr><td>Shutdown signal logic</td><td>1 (positive)</td><td>No</td></tr>
<tr><td>Remote/local</td><td>LOC</td><td>LOC</td><td>Yes</td></tr>
<tr><td>Communication interface</td><td>RS232</td><td rowspan="5">No</td><td rowspan="7">No</td></tr>
<tr><td>Address</td><td>6</td></tr>
<tr><td>Baudrate</td><td>9600</td></tr>
<tr><td>Language</td><td>SCPI</td></tr>
<tr><td>Panel control lock</td><td>Unlock</td></tr>
<tr><td>LIST and WAVE subsystem</td><td>OFF</td><td>OFF</td><td rowspan="2">No</td></tr>
<tr><td>LIST and WAVE subsystem’s current display mode</td><td>AUTO</td><td>No</td></tr>
<tr><td>Trigger signal output</td><td>OFF</td><td>OFF</td><td rowspan="2">Yes</td><td rowspan="2">Yes</td></tr>
<tr><td>PS_OK signal activation delay time</td><td>0 ms</td><td>0 ms</td></tr>
<tr><td>Enable register</td><td>Clear</td><td>Clear</td><td rowspan="2">No</td><td rowspan="2">No</td></tr>
<tr><td>Event register</td><td>Clear</td><td>Clear</td></tr>
</table>

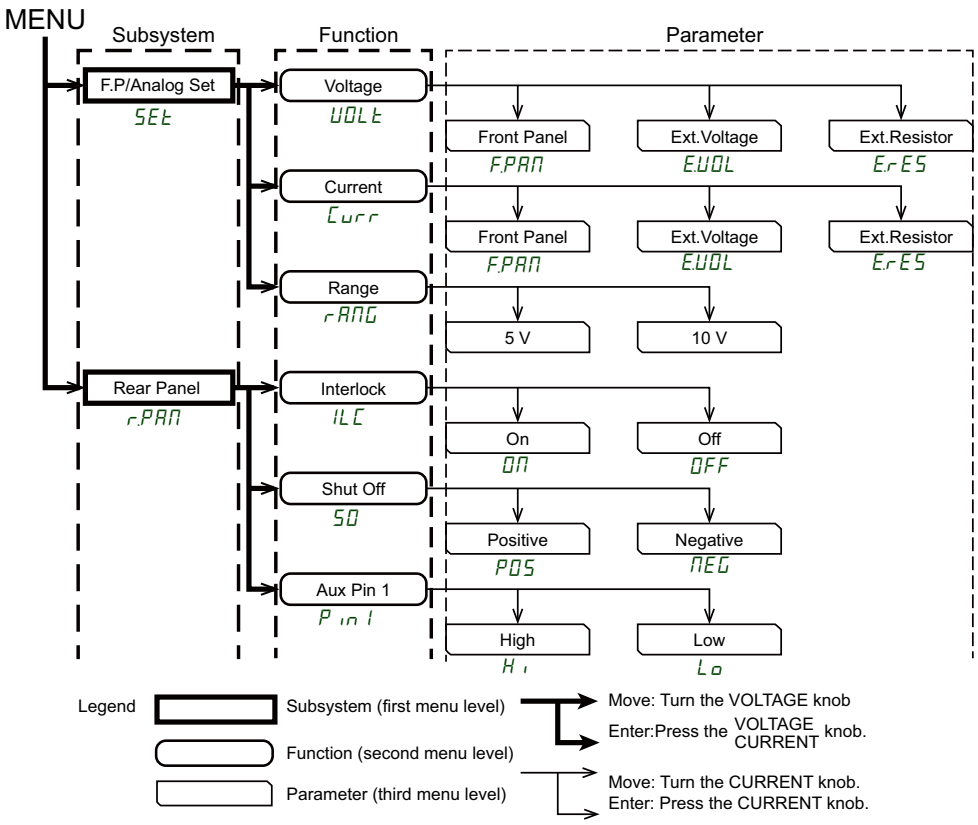
Menu Operation

The following three menus are available. A dedicated key is assigned to each menu.

- Main menu (MENU key): Use this menu to configure functions other than the communication and protection functions.
- Communication setup menu (REM key): Use this menu to configure the communication function.
- Protection function menu (ALARM key): Use this menu to configure the protection function.

Main menu

The main menu is made up of three levels: subsystem, function, and parameter.



■ Subsystem

The first menu level. It contains the following seven items.

Item	Description
F.P/Analog set	External control settings
Rear Panel	Rear panel J3 connector function settings
Memory	Memory
Parallel Oper.	Parallel operation
Trigger Set	Trigger function settings
Program	LIST and WAVE mode settings
Info	Firmware version

■ Function

The second menu level. There are function items according to each subsystem.

■ Parameter

The third menu level. There are parameter items according to each function.

Main menu operation

■ Selecting the subsystem

1 **Press MENU.**
The MENU key (green) lights, and the voltmeter and ammeter show subsystem (first level) items.

2 **Turn the VOLTAGE knob to select the subsystem item you want to set.**
You can scroll through the subsystem list (first level).

3 **Press the VOLTAGE knob.**
The subsystem item is selected. The voltmeter shows a function (second level) item.

NOTE Turning the VOLTAGE knob displays the subsystem (first level) items on the voltmeter and ammeter. To proceed to the functions (second level) for the item displayed on the voltmeter or ammeter, press the knob corresponding to the display (VOLTAGE knob for the item displayed on the voltmeter and CURRENT knob for the item displayed on the ammeter).

■ Selecting the function

4 **Turn the VOLTAGE knob to select the function item you want to set.**
You can scroll through the function (second level) items.

5 **Press the VOLTAGE knob.**
The function item is selected. The voltmeter shows the selected function (second level), and the ammeter shows a parameter item.

■ Selecting the parameter

6 **Turn the CURRENT knob to select the parameter item you want to set.**
You can scroll through the parameter (third level) items.

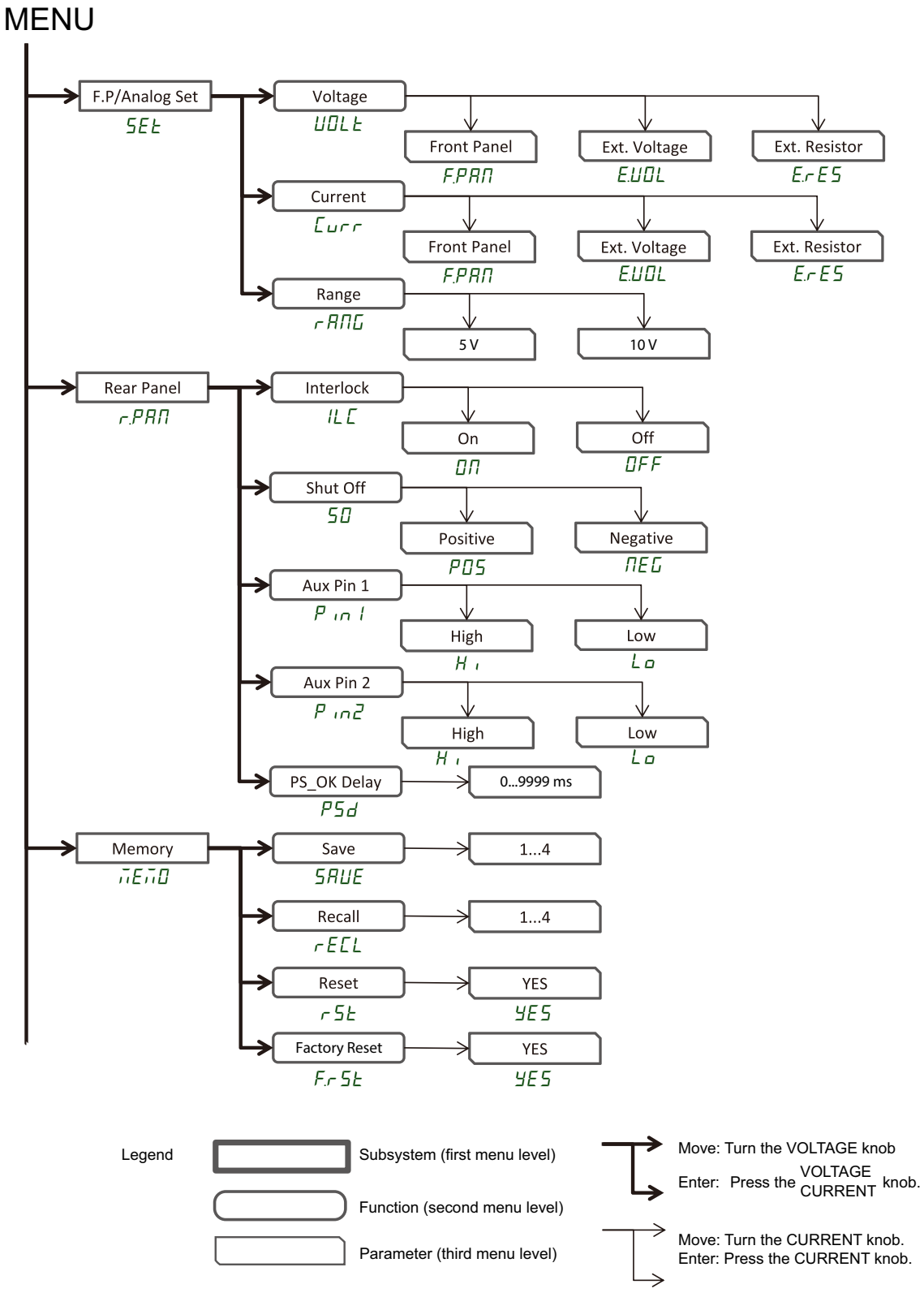
7 **Press the CURRENT knob.**
The parameter item is selected. The ammeter shows the selected parameter item. When the parameter setting is complete, the display blinks and returns to the previous level.

Exiting the main menu

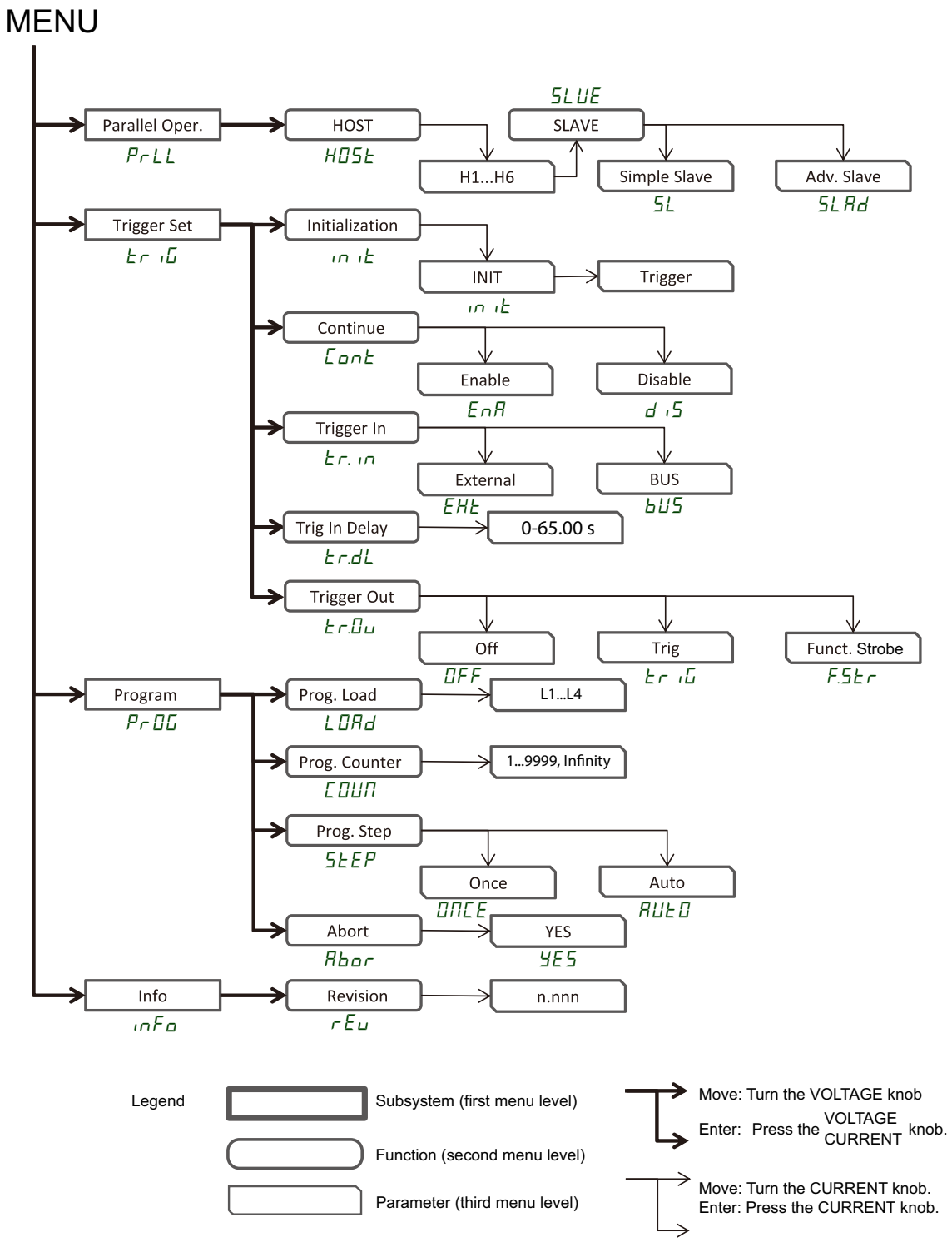
The following three methods are available.

- Press MENU twice or three times. The MENU key turns off, and the display returns to the condition before you started the menu operation. (This is the operation to move from a low menu level to outside the menu.)
- Hold down MENU for about 3 seconds. The MENU key turns off, and the display returns to the condition before you started the menu operation.
- Leave the PAV series standing for about 15 seconds. The MENU key turns off, and the display returns to the condition before you started the menu operation.

Main menu hierarchy chart (1/2)



main menu hierarchy chart (2/2)



Communication setup menu

The communication setup menu is made up of three levels: subsystem, function, and parameter. Some subsystems do not have parameters.

■ Subsystem

The first menu level. It contains the following seven items.

Item	Function
Interface	Interface type setting
Address	Address setting
Baud Rate	Baudrate setting
Language	Language setting
IP Address[1]	IP address setting
MAC Address[1]	MAC address confirmation
LAN Reset[1]	LAN reset

1 Displayed on models with LAN installed when LAN is selected

■ Function

The second menu level. There are function items according to each subsystem.

■ Parameter

The third menu level. There are parameter items according to each function.

Communication setup menu operation

■ Selecting the subsystem

1 **Press REM.**

The REM key lights, and the voltmeter shows a subsystem (first level) item.

The rest of the procedure is the same as that for the main menu *(p.59)*.

When the parameter setting is complete, the display blinks and returns to the previous level.

Exiting the communication setup menu

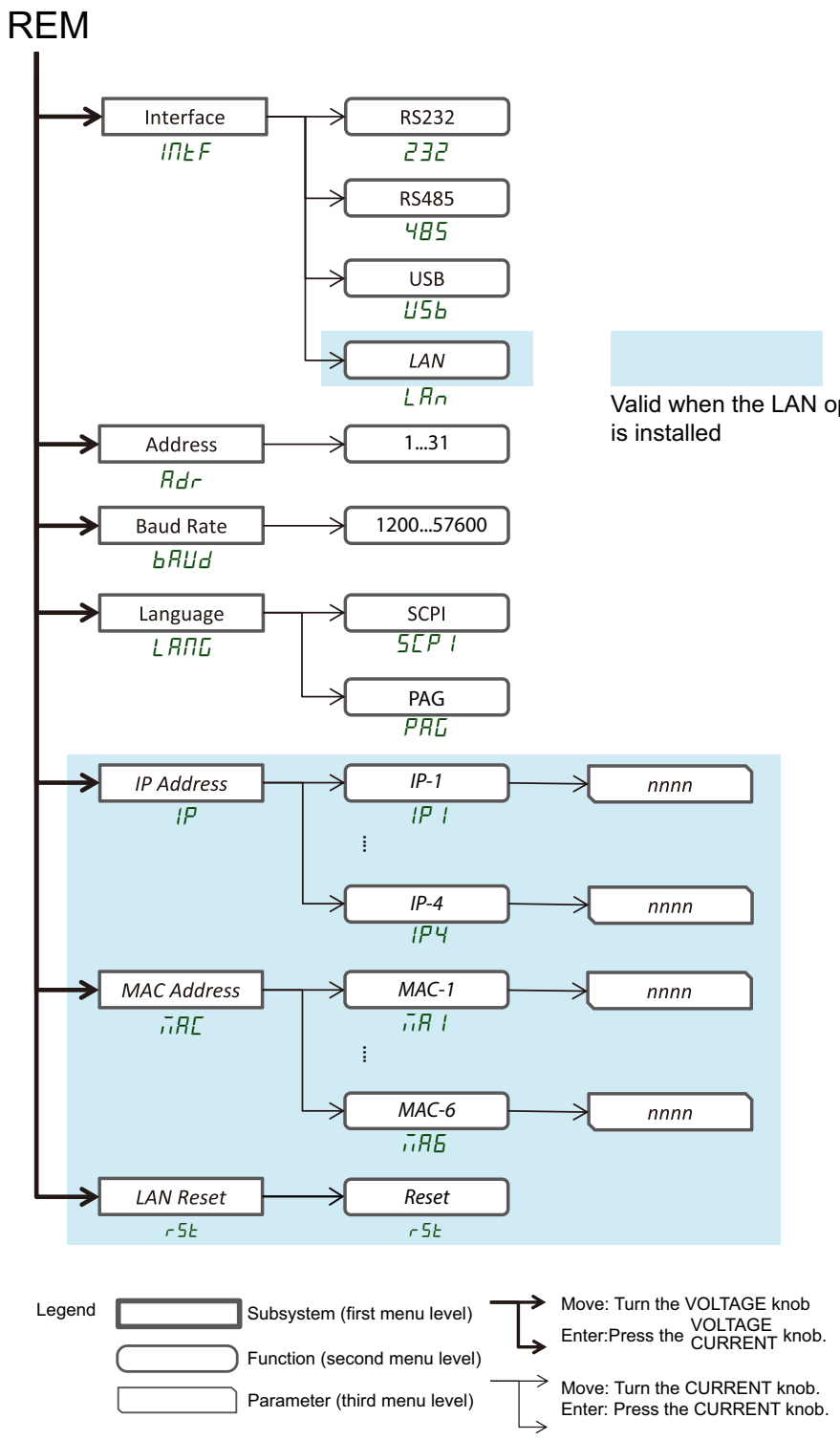
The following three methods are available.

- Press REM one or twice times. The REM key turns off, and the display returns to the condition before you started the menu operation. (This is the operation to move from a low menu level to outside the menu.)
- Hold down REM for about 3 seconds. The REM key turns off, and the display returns to the condition before you started the menu operation.
- Leave the PAV series standing for about 15 seconds. The REM key turns off, and the display returns to the condition before you started the menu operation.

Switching to local mode with the REM key

If the PAV series is in remote mode (REM key (green) is lit), pressing REM will switch from remote mode to local mode. The REM key will turn off. In local lockout mode, the REM key is disabled.

Communication setup menu hierarchy chart



Protection function menu

The protection function menu is made up of two levels: function and parameter.

■ Function

The first menu level. It contains the following four items.

Item	Function
OVP	Overvoltage protection (OVP)
UVP/UVL	Undervoltage protection/undervoltage limit (UVP/UVL)
Foldback	Foldback protection
Protect. Delay	Protection activation delay time (UVP and FOLD delay time)

■ Parameter

The second menu level. There are parameter items according to each function.

Protection function menu operation

■ Selecting the function

1 **Press ALARM.**

The ALARM key lights, and the voltmeter shows a function (first level) item.

The rest of the procedure is the same as that for the main menu *(p.59)*.

When the parameter setting is complete, the display blinks and returns to the previous level.

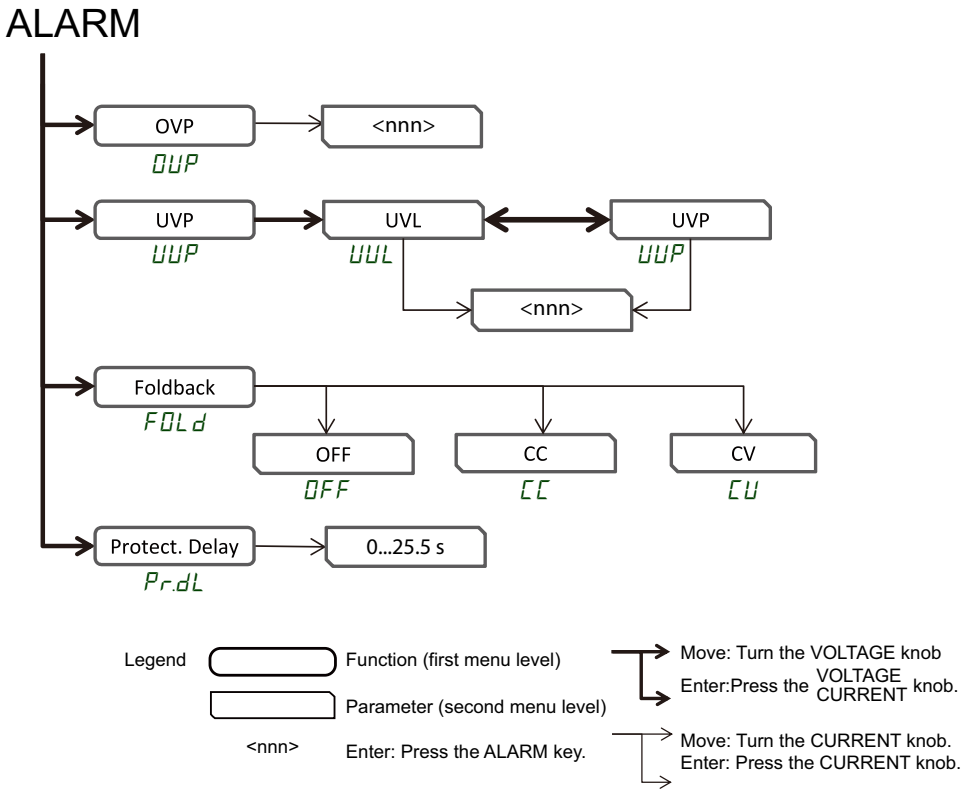
However, for the OVP and UVP/UVL voltage settings, press ALARM without pressing the CURRENT knob to return to the previous level.

Exiting the protection function menu

The following three methods are available.

- Press ALARM one or twice times. The ALARM key turns off, and the display returns to the condition before you started the menu operation. (This is the operation to move from a low menu level to outside the menu.)
- Leave the PAV series standing for about 15 seconds. The ALARM key turns off, and the display returns to the condition before you started the menu operation.

Protection function menu hierarchy chart



Characters Displayed on the Voltmeter and Ammeter

Display	Description
Abor	ABORT
AC	AC
Adr	ADDRESS
AUtO	AUTO (RESTART)
bAUd	BAUD RATE
bUS	BUS
Cont	CONTINUE
COUN	COUNTER
Curr	CURRENT
CC	CC
CU	CV
d iS	DISABLE
EnA	ENABLE
E.rES	EXT.RESISTOR
Err	ERROR
E.UOL	EXT.VOLTAGE
EHt	EXTERNAL
F.rSt	FACTORY RESET
FA IL	FAIL
FOLd	FOLDBACK
F.PAN	FRONT PANEL
F.Str	FUNCTION STROBE
HOLd	HOLD
HOSt	HOST
INF	INFINITY
inFo	INFORMATION
in it	INITIALIZE
INtF	INTERFACE
ILC	INTERLOCK
IP	IP
LAn	LAN
LFP	LOCKED FRONT PANEL
LANG	LANGUAGE
LOAd	LOAD
NEG	NEGATIVE
MAC	MAC
MEMO	MEMORY
OFF	OFF

Display	Description
ON	ON
ONCE	ONCE
OtP	OTP
OUP	OVP
PAG	PAG LANGUAGE
PrLL	PARALLEL
P in1	PIN 1
P in2	PIN 2
POS	POSITIVE
PrOG	PROGRAM
Pr.dL	PROTECTION DELAY
PSd	PS_OK DELAY
rANG	RANGE
r.PAN	REAR PANEL
rECL	RECALL
rSt	RESET
rEv.	REVISION
232	RS232
485	RS485
SAFE	SAFE (START)
SAVE	SAVE
SCPI	SCPI
SO	SHUT OFF
SEt	SET
SLUE	SLAVE
SLAd	SLAVE (ADVANCED)
SL	SLAVE (BASIC)
StEP	STEP
tr iG	TRIGGER
tr.dL	TRIGGER DELAY
tr. In	TRIGGER IN
tr.Ou	TRIGGER OUT
UFP	UNLOCKED FRONT PANEL
USb	USB
UUL	UVL
UUP	UVP
UOLt	VOLTAGE
YES	YES

6

External Control

This chapter explains external control and external monitoring using the J1 and J3 connectors.

Overview of External Control

You can control and monitor the PAV series using external analog signals through the J1 and J3 connectors. Control and monitoring conditions are set from the menu. The main control functions are shown below.

■ J1 connector

- Local (panel)/remote switching
- Output voltage and output current control using external voltage
- Output voltage and output current control using external resistance
- Output voltage and output current monitoring
- CV/CC operation mode monitoring

■ J3 connector

- Output on and off using an external contact
- Output shutoff using an external contact
- Trigger input/output
- Operating status monitoring

NOTE

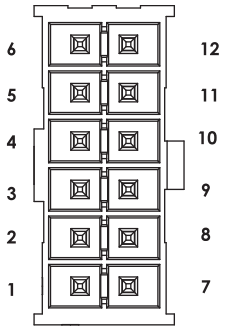
- Use shielded cables for external control signals. If you have to use cables without shields, attach an EMI ferrite clamp filter to the cables as close to the PAV series as possible or take other similar measures.
- In external control, you can use the SET key to check the output voltage and output current settings.
- In external control, settings can be controlled through communication except for the output voltage and output current settings.

J1 Connector

J1 connector specifications

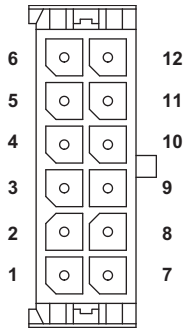
- **Models whose rated output voltage is 10 V to 100 V**

Connector model: IPL1-106-01-S-D-RA-K (SAMTEC)
Plug model: IPD1-06-D-K (SAMTEC)
Contact pin: CC79L-2024-01-L (SAMTEC)
Crimping tool: CAT-HT-179-2030-13 (SAMTEC)
Compatible cable: 24 AWG to 20 AWG



- **Models whose rated output voltage is 160 V to 650 V**

Connector model: 43024-1208 (MOLEX)
Plug model: 43025-1208 (MOLEX)
Contact pin: 43030-0002 (MOLEX)
Crimping tool: 63819-0000 (MOLEX)
Compatible cable: 24 AWG to 20 AWG



Signals and functions

Pin no.	Signal name	Function	See
J1-1	LOC/REM SELECT	Local/remote switching	p.70
J1-2	P	Current balance terminal for master-slave parallel operation	p.88
J1-3	I_MON	Output current monitoring terminal	p.71
J1-4	LOC/REM MON	Local/remote status output	p.71
J1-5	IPGM	Output current control using external voltage or external resistance	p.72
J1-6	VPGM	Output voltage control using external voltage or external resistance	
J1-7	COM	Common ground for VMON, IMON, CV/CC, and LOC/REM signals (connected internally to the negative sensing terminal (-S))	-
J1-8	CV/CC	Constant voltage/constant current operation mode indication terminal (The ground is COM.)	p.71
J1-9	COM	Common ground for VMON, IMON, CV/CC, and LOC/REM signals (connected internally to the negative sensing terminal (-S))	-
J1-10	V_MON	Output voltage monitoring terminal	p.71
J1-11	IPGM_RTN	Ground for IPGM	-
J1-12	VPGM_RTN	Ground for VPGM (connected internally to the negative sensing terminal (-S))	-

⚠CAUTION Risk of malfunction. J1 connector's COM (J1-7, J1-9) and VPGM_RTN (J1-12) are connected internally to the negative sensing terminal (-S). Do not connect these terminals to an electric potential other than the negative sensing terminal (-S).

NOTE

- The reference voltage for the control and monitor terminals is the negative sensing terminal (-S).
- On models whose rated output voltage is 10 V to 100 V, a collective cover can be placed over the J1, J2, and J3 connectors. After wiring the connectors, attach the cover.

J1 Connector I/O Signals

Switching to external control (LOC/REM SELECT)

By shorting the J1 connector's J1-1 terminal (LOC/REM SELECT) and J1-7 and J1-9 terminals (COM) (or setting them to TTL low level), you can externally control the output voltage and output current. In contrast, by opening the J1-1 terminal (LOC/REM SELECT) and J1-7 and J1-9 terminals (COM) (or setting them to TTL high level), you can use local control.

In local mode, you can use the front panel VOLTAGE and CURRENT knobs or USB/RS232/RS485 ports to set the output voltage and current. In remote mode, you can set the output voltage and current through the J1 connector (J1-5 and J1-6) (using external voltage or external resistance).

Relationship with menu settings

The following table shows the different combinations that are available depending on the relationship between the J1-1 terminal (LOC/REM SELECT) and J1-7 (COM) and J1-9 (COM) terminal signal setting and menu setting.

		No.	Menu setting		J1-4 status signal output
			Voltage (output voltage)	Current (output current)	
J1-1 terminal signal	Shorted or TTL low level	00	Front Panel	Front Panel	Open
		10	Ext. Voltage or Ext. Resistor	Front Panel	TTL low level (0 V to 0.6 V)
		01	Front Panel	Ext. Voltage or Ext. Resistor	
		11	Ext. Voltage or Ext. Resistor	Ext. Voltage or Ext. Resistor	
	Open or TTL high level	-	Menu setting unavailable		Open

Table explanation

By shorting the J1-1 terminal (LOC/REM SELECT) and J1-7 and J1-9 terminals (COM) (or setting them to TTL low level), you can externally control the output voltage and output current. You can also configure the PAV series from the menu *(p.74)* to enable them to be controlled using the front panel VOLTAGE and CURRENT knobs. Further, you can mix front panel control and external control (using external voltage or external resistance).

The above table shows the combinations of these setting elements and the status signal states.

Example: Explanation of number 10

This example is for controlling the output voltage using the front panel VOLTAGE knob and the output current using external voltage or external resistance. Set the J1-1 terminal and menu as follows. The status signal output is TTL low level (0 V to 0.6 V).

- J1-1 terminal: Set to TTL low level (external control mode)
- Menu: Set Voltage to Front Panel.
  Set Current to Ext. Voltage or Ext. Resistor.

Status signal output (LOC/REM MON)

The status signal output (J1-4 terminal) is at TTL low level or open depending on conditions. See the table in “Relationship with menu settings”*(p.70)*.

The status signal output is an open collector output. To use this signal, prepare an external power supply (30 V max.), and connect a pull-up resistor between the status signal output and the positive output terminal of the external power supply.

Select a pull-up resistor so that the sink current (at TTL low level) will be 5 mA or less. Connect the negative output terminal of the external power supply to the J1-7 or J1-9 terminal of the PAV series.

Output voltage and output current monitoring (V_MON, I_MON)

The output current and output voltage can be monitored through the J1-3 and J1-10 terminals, respectively. The monitoring signal range is 0 V to 5 V or 0 V to 10 V. From the menu, you can switch between these two ranges.

The monitoring signal range represents 0 % to 100 % of the output voltage and current. The monitor signal changes in proportion to the output voltage and current. The internal series resistance at the monitoring output is 500 Ω.

To monitor properly, make sure that the input impedance of the external circuit that you connect is at least 500 kΩ.

Operation mode signal output (CV/CC)

The J1-8 terminal’s CV/CC signal indicates whether the operation mode is constant voltage (CV) or constant current (CC). The output circuit is open collector. The reference potential is the J1-7 COM terminal, which is connected internally to the negative output terminal. The maximum application voltage between the two terminals is 30 V. The terminal is open in constant voltage mode and low level in constant current mode. The maximum sink current is 10 mA.

⚠CAUTION Do not apply more than 30 V to the J1-8 terminal.

Current balance terminal for parallel operation (P)

The J1-2 terminal *(p.89)* is used for master-slave parallel operation.

Control Using External Voltage or External Resistance

In external control, you can use external voltage or external resistance to set the output voltage or output current. You cannot set the output voltage or output current through the communication interface.

To reduce radiation noise, use shielded cables for external control signals. If you have to use cables without shields, attach an EMI ferrite clamp filter to the cables as close to the PAV series as possible or take other similar measures.

NOTE

- The output voltage and output current can be set up to 105 % of their ratings. Be sure to use them within their ratings. Use exceeding the ratings is outside the guaranteed range.
- In external control, the front panel voltmeter and ammeter cannot display settings. The front panel voltmeter and ammeter can display settings only when you are using the VOLTAGE or CURRENT knob or communication interface to specify the settings.

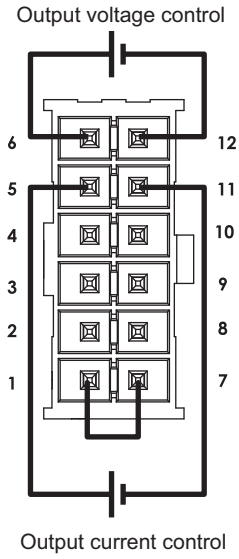
Output voltage and output current control using external voltage

⚠CAUTION Use independent, insulated voltage signal source (e.g., variable power supply) for the external voltage to prevent ground loops.

Before performing external voltage control, configure the PAV series from the menu *(p.74)*.

From the menu, set Voltage (output voltage) to Ext. Voltage and Current (output current) also to Ext. Voltage. Set Range (external voltage range) to 5 V or 10 V.

To control the output voltage and output current, connect external voltages between J1-6 and J1-12 and between J1-5 and J1-11.



1 **Connect them as shown in the figure on the right.**

2 **Short between J1-1 and J1-7.**

3 **Change the external voltages to set the output.**

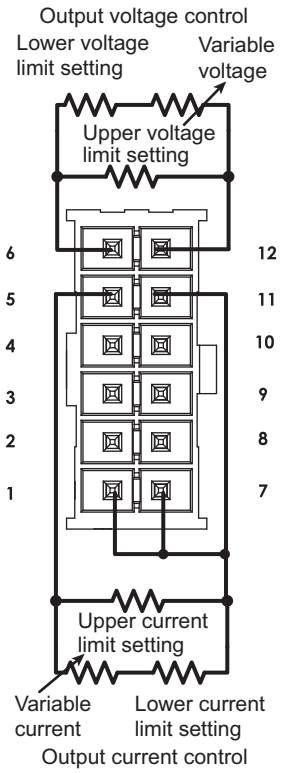
You can change the output from zero to the maximum rating in proportion to the voltage.

Output voltage and output current control using external resistance

Before performing external resistance control, configure the PAV series from the menu *(p.74)*.

From the menu, set Voltage (output voltage) to Ext. Resistor and Current (output current) also to Ext. Resistor. Set Range (external resistance range) to 0 Ω to 5 kΩ or 0 Ω to 10 kΩ. To meet the temperature variation specifications of the PAV series, use stable, low-noise external resistors with a temperature coefficient of 50 ppm/°C or less.

To control the output voltage and output current, a constant current of 1 mA flows from the PAV series through the external resistor across J1-6 and J1-12 and that across J1-5 and J1-11. The PAV series is controlled by the voltage that appears across the external resistors due to this current.



1 **Connect the external resistors as shown in the figure on the right.**

2 **Connect J1-1 and J1-7 to J1-11.**

3 **Change the external resistances to set the output.**

You can change the output from zero to the maximum rating in proportion to the resistance. If you use a variable resistor, you can control the output over its entire range.

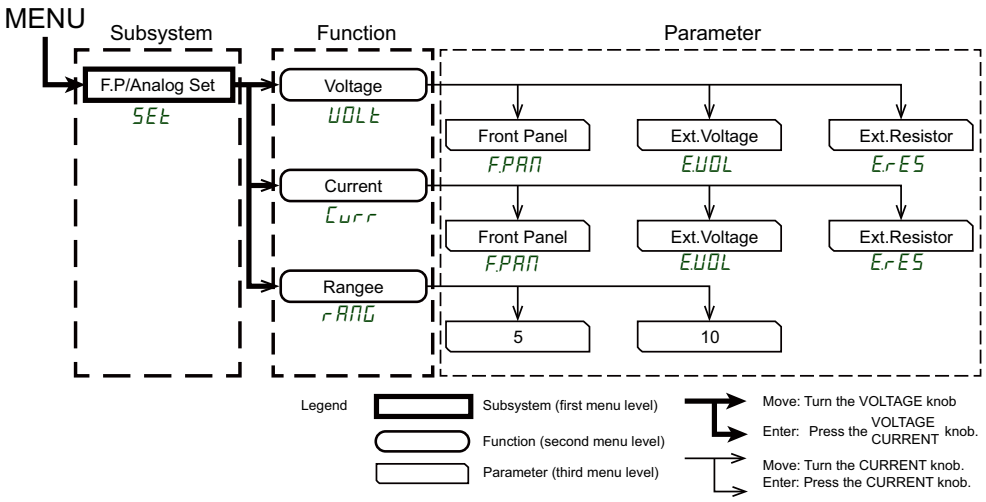
By combining a variable resistor with other resistors connected in series and parallel, you can limit the output range.

Setting functions from the menu

In external voltage or external resistance control, you need to set the following three items from the menu.

- Set Voltage (output voltage control) to Ext. Voltage or Ext. Resistor.
- Set Current (output current control) to Ext. Voltage or Ext. Resistor.
- Set Range (external voltage or resistance range) to 5 V (0 Ω to 5 kΩ) or 10 V (0 Ω to 10 kΩ).

External control structure and parameters



■ Subsystem

The first menu level. This represents external control.

■ Function

The second menu level.

Item	Function
Voltage	Selects the external control method for the output voltage
Current	Selects the external control method for the output current
Range	Sets the external voltage and external resistance ranges, and the monitoring signal voltage range for output voltage and output current

■ Parameters

The third menu level. There are parameter items according to each function.

Setting the control method and range

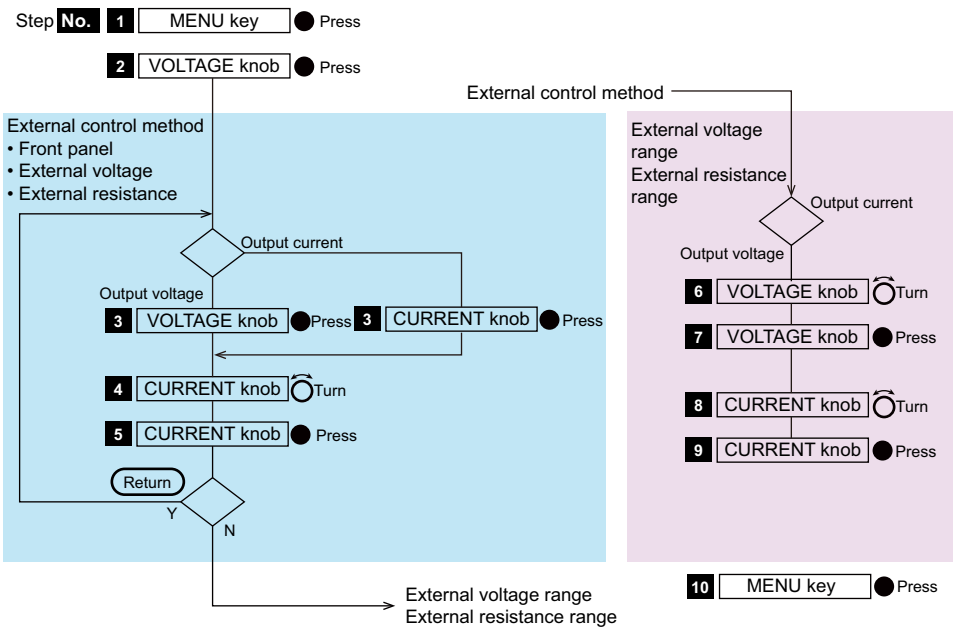
The following three menu settings are available.

- Selecting the external control method for the output voltage
- Selecting the external control method for the output current
- Setting the external voltage and external resistance ranges

There are two range settings: "5" or "10."

"5" sets the external voltage range to 5 V and the external resistance range to 0 Ω to 5 kΩ.

"10" sets the external voltage range to 10 V and the external resistance range to 0 Ω to 10 kΩ.



1 **Press MENU.**

The MENU key (green) lights, and the voltmeter shows "SEt."

2 **Press the VOLTAGE knob.**

The voltmeter shows "UOLt" and the ammeter "Curr."

■ Setting the control method for output voltage and output current

3 **To set the output voltage control method, press VOLTAGE.**
To set the output current control method, press CURRENT.

Pressing VOLTAGE shows "UOLt" on the voltmeter.
Pressing CURRENT shows "Curr" on the voltmeter.

4 **Turn the CURRENT knob to select the control method.**

Turning the CURRENT knob shows "F.PAn," "E.UOL," or "E.rES" on the ammeter. ("F.PAn": FRONT PANEL, "E.UOL": EXT.VOLTAGE, "E.rES": EXT.RESISTOR)

5 **When the control method that you want to select appears, press the CURRENT knob.**

The control method will be entered.
The voltmeter shows "UOLt" and the ammeter "Curr."
Repeat steps 3 to 5 to set the control method for the other (voltage or current).

■ Setting the external voltage and external resistance ranges

6 **Turn the VOLTAGE knob until the voltmeter shows "rAnG."**

("rAnG": RANGE)

7 **Press the VOLTAGE knob.**

The ammeter shows the present setting ("5" or " 10").

- "5" sets the external voltage range to 5 V and the external resistance range to 0 Ω to 5 kΩ.
- " 10" sets the external voltage range to 10 V and the external resistance range to 0 Ω to 10 kΩ.

8 **Turn the CURRENT knob to select "5" or " 10."**

9 **Press the CURRENT knob.**
The external voltage or external resistance range is entered.

10 **Press MENU twice.**
The MENU key turns off, and the PAV series returns to the original state.

Setting the monitoring output range

The output current and output voltage can be monitored through the J1-3 and J1-10 terminals, respectively. There are two monitoring signal range settings: "5" or " 10."

"5" sets the voltage range to 5 V.

" 10" sets the voltage range to 10 V.

NOTE
- When you set the external voltage and external resistance ranges to "5," the monitoring output range is also set to 5 V. The same hold true for "10."
- If you set the monitoring output range to "5," the external voltage and external resistance ranges are also set to 5 V and 5 kΩ. The same holds true for "10."

The monitoring output voltage represents 0 % to 100 % of the output voltage and current. The monitor signal changes in proportion to the output voltage and current. The internal series resistance at the monitoring output is 500 Ω. To improve the detection accuracy of this signal, make sure that the input impedance of the external circuit that you connect is at least 500 kΩ.

1 **Press MENU.**
The MENU key (green) lights, and the voltmeter shows "SEt."

2 **Press the VOLTAGE knob.**
The voltmeter shows "UOLt" and the ammeter "Curr."

3 **Turn the VOLTAGE knob until the voltmeter shows "rANG."**

4 **Press the VOLTAGE knob.**
The ammeter shows the present setting ("5" or " 10").
- "5" represents the voltage range of 5 V.
- " 10" represents the voltage range of 10 V.

5 **Turn the CURRENT knob to select "5" or " 10."**

6 **Press the CURRENT knob.**
The monitoring signal range is entered.

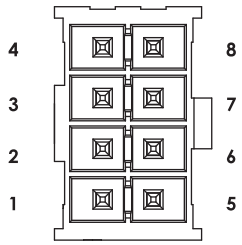
7 **Press MENU twice.**
The MENU key turns off, and the PAV series returns to the original state.

J3 Connector Functions and Settings

J3 connector specifications

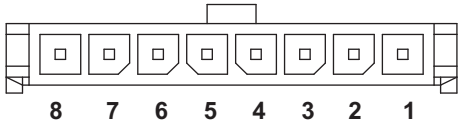
- **Models whose rated output voltage is 10 V to 100 V**

Connector model: IPL1-104-01-S-D-RA-K (SAMTEC)
Plug model: IPD1-04-D-K (SAMTEC)
Contact pin: CC79R-2024-01-L (SAMTEC)
Crimping tool: CAT-HT-179-2024-11 (SAMTEC)
Compatible cable: 24 AWG to 20 AWG



- **Models whose rated output voltage is 160 V to 650 V**

Connector model: 43650-0801 (MOLEX)
Plug model: 43645-0800 (MOLEX)
Contact pin: 43030-0002 (MOLEX)
Crimping tool: 63819-0000 (MOLEX)
Compatible cable: 24 AWG to 20 AWG



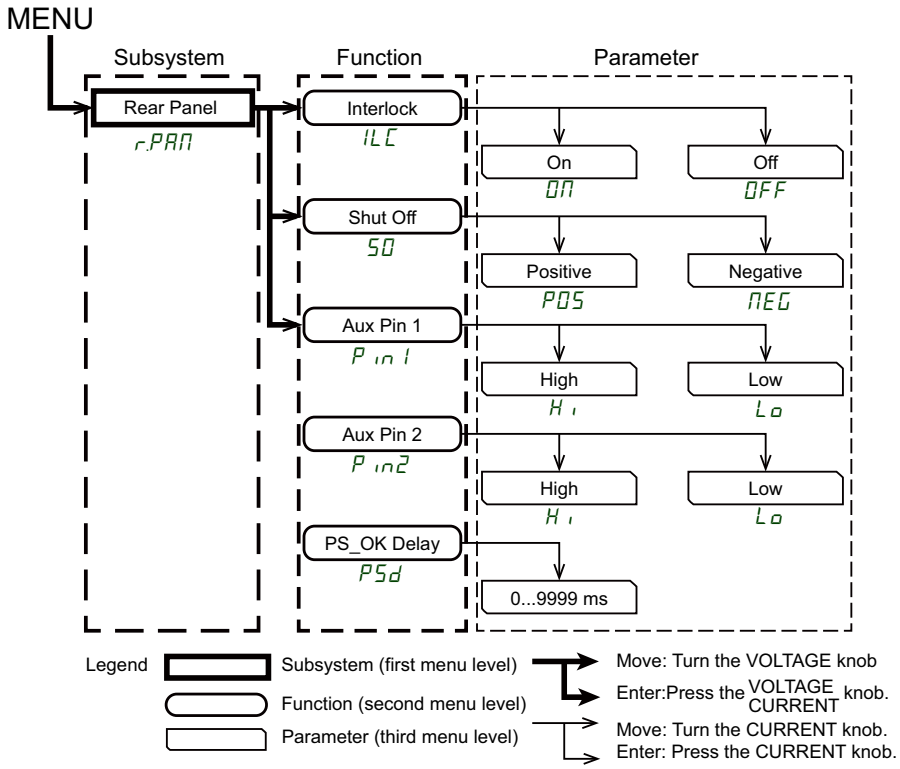
Signals and functions

Pin no.	Signal name	Function	See
J3-1	Aux Pin 1	General-purpose open collector output (1)	p.83
J3-2	PS_OK	Status output terminal indicating the output state (on/shut off)	p.81
J3-3	Trigger Out	Trigger output terminal	p.84
J3-4	ILC	Output on/off control input terminal Output on when shorted; output off when open (isolated from the output)	p.82
J3-5	Shut Off (SO)	Output shutoff control terminal (isolated from the output)	p.79
J3-6	Aux Pin 2	General-purpose open collector output (2)	p.83
J3-7	IFC_COM	J3 common ground (isolated from the output)	-
J3-8	Trigger In	Trigger input terminal	p.84

The J3 connector's control and monitor terminals are isolated from the PAV series output.

NOTE On models whose rated output voltage is 10 V to 100 V, a collective cover can be placed over the J1, J2, and J3 connectors. After wiring the connectors, attach the cover.

J3 connector function setting structure and parameters



■ Subsystem

The first menu level. This represents the rear panel J3 connector settings.

■ Function

The second menu level.

Item	Function
Interlock	Output on/off control input
Shut Off	Output shutoff control input
Aux Pin 1	General-purpose output 1
Aux Pin 2	General-purpose output 2
PS_OK Delay	Protection function activation status signal output

■ Parameters

The third menu level. There are parameter items according to each function.

Output shutoff control input (Shut Off)

The J3-5 Shut Off terminal can be used to shut off the PAV series output with an external signal. This terminal isolated from the output terminal. You can turn the output on and off by applying a signal ranging from 4 V to 15 V between the J3-5 (SO) and J3-7 (IFC_COM) terminals or by opening or shorting the terminals with a contact.

If the output is shut off through the SO terminal, the voltmeter shows "SO" (SHUT OFF), but the ALARM key (red) will not blink.

If the output off state is released, the PAV series will recover according to the specified output start mode *(p.40)* (safe or auto).

To turn the output on and off externally, set the start mode to auto start, turn the output on using the OUTPUT key, and then start the external control.

Setting the Shut Off input logic

1 **Press MENU.**
The MENU key (green) lights. The voltmeter shows "SEt," and the ammeter shows "r.PAn." ("r.PAn": REAR PANEL)

2 **Press the CURRENT knob.**
The voltmeter shows " ILC," and the ammeter shows "SO." (" ILC": INTERLOCK)

3 **Press the CURRENT knob.**
The ammeter shows the present setting.

4 **Turn the CURRENT knob to select** "POS" or "nEG."

5 **Press the CURRENT knob.**
The display blinks, and the parameters are entered.

6 **Press MENU twice.**
The MENU key turns off, and the PAV series returns to the original state.

Shut Off input logic and signal level

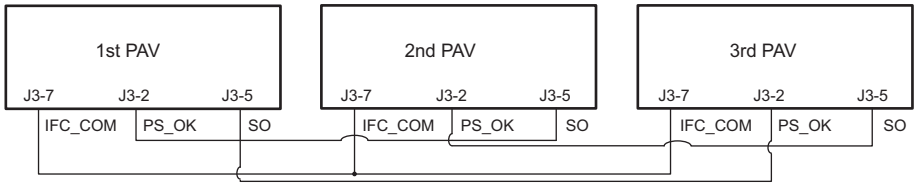
SO signal logic	SO input signal level (between J3-5 and J3-7)	PAV output	PS_OK signal output
Positive (factory default setting)	4 V to 15 V or open	On	High level
	0 V to 0.6 V or short	Off "SO"	Low level
Negative	4 V to 15 V or open	Off "SO"	Low level
	0 V to 0.6 V or short	On	High level

Output shutoff in a daisy chain connection

In a PAV system consisting of several power supplies, you can use the J3-5 terminal Shut Off signal input and J3-2 terminal PS_OK signal output to shut off the output of the entire PAV series power supplies in the system when the output is turned off on any of the power supplies due to a problem. If the problem is resolved, the system will recover according to the specified output start mode (safe or auto).

Set the Shut Off terminal logic to positive. If an error occurs on any of the PAV series power supplies, the PS_OK signal is set to low level, and the display shows the error. The output on the other PAV series power supplies is shut off, and the panel shows "50." If the problem is resolved, the PAV series will recover according to the specified output start mode (safe or auto).

The following figure shows a connection example of three power supplies. This can be applied to systems with more PAV series power supplies connected in the same manner.



Protection function activation status signal output (PS_OK)

J3-2 (PS_OK) terminal outputs a TTL level signal relative to the J3-7 (IFC_COM) terminal. The terminal is set to low level (the maximum sink current is 1 mA) when a protection function is activated. It is set to high level (the maximum source current is 2 mA) when no protection functions are activated.

The PS_OK signal is set to low level if any problem occurs with the output.

Setting the PS_OK signal activation delay time

When the PAV series returns to normal, the PS_OK signal changes from low level to high level. The time to start changing the PS_OK level from low level to high level (delay time) can be set from the front panel. This function is used to keep the PS_OK signal output from changing to high level (low level duration) until the output reaches the specified voltage.

■ Setting from the menu

1 **Press MENU.**
The MENU key (green) lights.
The voltmeter shows "SEt," and the ammeter shows "r.PRn."

2 **Press the CURRENT knob.**
The voltmeter shows " ILC."

3 **Turn the VOLTAGE knob until the voltmeter shows "PSd."**
("PSd": PS_OK DELAY)

4 **Press the VOLTAGE knob.**
The ammeter shows the present setting.

5 **Turn the CURRENT knob to set the delay time. (0 ms to 9999 ms)**

6 **Press the CURRENT knob.**
The display blinks, and the delay time is entered.

7 **Press MENU twice.**
The MENU key turns off, and the PAV series returns to the original state.

Output on/off control (ILC)

The J3-4 (ILC) terminal is used as an interlock to turn the PAV series output on and off with an external signal. This terminal isolated from the output terminal. Connect the external signal between the J3-4 (ILC) and J3-7 (IFC_COM) terminals.

⚠CAUTION Risk of damaging the PAV series. Do not allow the output on/off control terminal (J3-4, J3-7) and output terminal to make contact.

The output on/off control function is designed to shut off the output using a switch or relay contact. It can be used to shut off the output in an emergency.

If the output off state is released, the PAV series will recover according to the specified output start mode *(p.40)* (safe or auto).

To turn the output on and off externally, set the start mode to auto start, turn the output on using the OUTPUT key, and then start the external control.

Setting the output on/off control input

1 Press MENU.
The MENU key (green) lights.
The voltmeter shows "SEt," and the ammeter shows "r.PAn."

2 Press the CURRENT knob.
The voltmeter shows " ILC."

3 Press the VOLTAGE knob.
The ammeter shows the present setting.

4 Turn the CURRENT knob to select "On" or "OFF."

5 Press the CURRENT knob.
The display blinks, and the parameters are entered.

6 Press MENU twice.
The MENU key turns off, and the PAV series returns to the original state.

Parameters	Output on/off control input	PAV output	Display	ALARM key
OFF (factory default setting)	(Output on/off control is disabled.)			
On	Open	Off	EnA	Blinking (red)
	Short	On	Voltage or current	Off

General-purpose signal output 1, 2 (Aux Pin 1/2)

The J3-1 (Aux Pin 1) and J3-6 (Aux Pin 2) terminals are open collector output. The maximum application voltage is 25 V, and the maximum sink current 100 mA. They can be controlled from the front panel or communication interface.

⚠CAUTION Do not apply a voltage exceeding 25 V to the J3-1 (Aux Pin 1) and J3-6 (Aux Pin 2) terminals.

Setting the signal level logic

1. **Press MENU.**
   The MENU LED (green) lights.
   The voltmeter shows "SEt," and the ammeter shows "r.PAn."
2. **Press the CURRENT knob.**
   The voltmeter shows " ILC."
3. **Turn the VOLTAGE knob to select "P in 1" or "P in2."**
4. **Press the VOLTAGE knob.**
   The ammeter shows the present setting.
5. **Turn the CURRENT knob to select "H i" (Hi) or "Lo" (Lo).**
6. **Press the CURRENT knob.**
   The display blinks, and the signal level is entered.
7. **Press MENU twice.**
   The MENU LED turns off, and the PAV series returns to the original state.

Trigger In

A preset voltage or current can be output using a trigger signal applied to the J3-8 (Trigger In) terminal. For details on this function, see chapter 3, “Advanced Output Programmable Function,” in the Communication Interface Manual.

The trigger input signal specifications are shown below.

Item	Specifications
Maximum low level input signal	0.8 V
Minimum high level input signal	3.5 V
Maximum high level input signal	5 V
Maximum sink current	16 mA
Positive edge trigger span	10 µs (min)
Tr/Tf	1 µs (max)

Trigger Out

Trigger signals can be output from the J3-3 (Trigger Out) terminal according to preset conditions. For details on this function, see chapter 3, “Advanced Output Programmable Function,” in the Communication Interface Manual.

The trigger input signal specifications are shown below.

Item	Specifications
Maximum low level output signal	0.8 V
Minimum high level output signal	3.8 V
Maximum high level output signal	5 V
Maximum source current	16 mA
Output trigger signal span	20 µs (typ)

7

Parallel/Series Operation

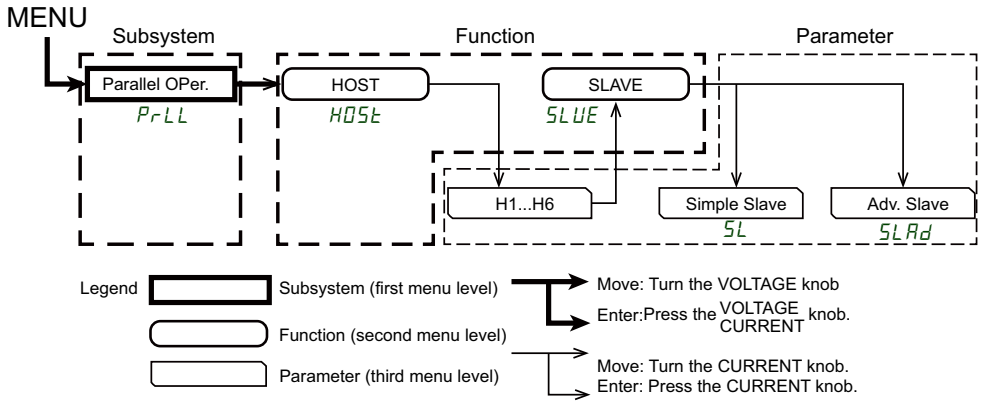
This chapter describes parallel operation and series operation.

Master-Slave Parallel Operation

Master-slave parallel operation is a function used to control an entire system made up of several power supplies of the same model by assigning one of the power supplies to be the master unit and the rest to be slave units. The entire system is controlled through the master.

Up to six PAV series power supplies with the same rating can be connected in parallel to increase the output current about six times. Slave units are controlled using analog signals from the master unit. In serial communication, only the master unit is controlled from the PC. It is possible to read the voltage, current, and status of slave units (readback function).

Master-slave parallel operation settings are stored in EEPROM when the AC input is shut off. Thus, the system will run in master-slave mode when the AC input is applied again.



■ Subsystem

The first menu level. This represents the parallel operation settings.

■ Function

The second menu level.

Item	Function
HOST	Master unit
SLAVE	Slave unit

■ Parameters

The third menu level.

Item	Description				See
H1	Standalone operation (factory default setting)				p.87
H2	Master unit	1 unit	Slave unit	1 unit	p.91
H3				2 units	
H4				3 units	
H5				4 units	
H6				5 units	
Simple Slave	Basic mode				p.87
Adv. Slave	Advanced mode				p.92

Basic parallel operation

In basic mode, the output voltage and current of each PAVs in parallel operation are displayed on the voltmeter and ammeter of each PAV. Therefore, the total current of the entire system is the sum of the output currents of each PAV.

Configuring the master unit

Set the output voltage of the master unit. Set the current to a value obtained by dividing the required total current by the number of PAV series power supplies connected in parallel. In master-slave parallel operation, the master unit runs in constant voltage (CV) mode. The front panel's default setting is "H 1" (standalone operation).

1. **Press MENU.**
   The MENU key (green) lights.
   The voltmeter shows "SEt," and the ammeter shows "r.PAn."
2. **Turn the VOLTAGE knob until the voltmeter shows "PrLL."**
   ("PrLL": PARALLEL)
3. **Press the VOLTAGE knob.**
   The voltmeter shows "HOSt," and the ammeter shows "H 1." ("HOSt": HOST)
4. **Turn the CURRENT knob until the ammeter shows "H 1."**
5. **Press the CURRENT knob.**
   When "H 1" is entered, the display blinks and returns to the previous level.
6. **Press MENU twice.**
   The display returns to the original state, and the MENU key turns off.

Configuring the slave unit

When configured as a slave unit, the slave unit receives external voltage from the master unit and runs in current control (CC) mode. The current and voltage on slave units are set to 105 % of the settings on the master unit. Slave units supply current in accordance with the output current of the master unit and runs in CC (constant current) mode. Current may become unbalanced due to voltage drops in wiring and connections, so we recommend that the output of each PAV set to no more than 95 % of the rated output current.

1. **Press MENU.**
   The MENU key (green) lights.
   The voltmeter shows "SEt," and the ammeter shows "r.PAn."
2. **Turn the VOLTAGE knob until the voltmeter shows "PrLL."**
3. **Press the VOLTAGE knob.**
   The voltmeter shows "HOSt," and the ammeter shows "H 1."

4 **Turn the CURRENT knob until the ammeter shows "SL."**
("SL": SLAVE)

5 **Press the CURRENT knob.**
When "SL" is entered, the display blinks and returns to the previous level.

6 **Press MENU twice.**
The display returns to the original state, and the MENU key turns off.

Setting the OVP value

Set the master unit's OVP value *(p.43)* to the required voltage, and set the slave units' OVP values higher than the master unit's setting.

Setting the foldback protection

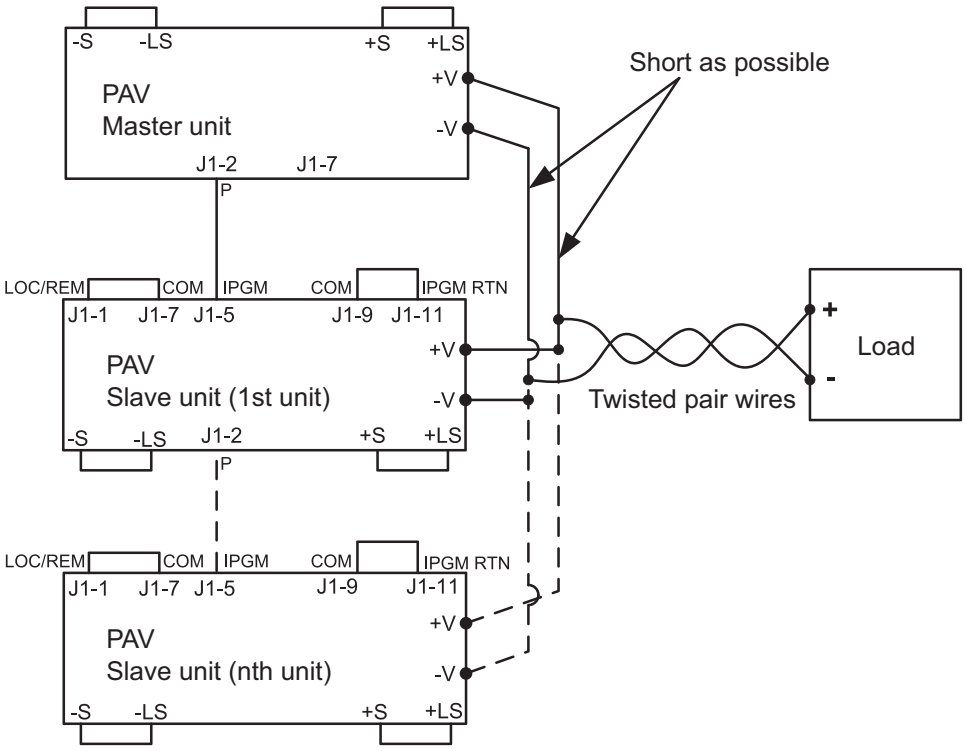
Set the foldback protection *(p.47)* on the master unit. There is no need to set the slave units. When the master unit shuts off, the master unit controls the slave units' output voltages to zero.

Wiring the load (local sensing)

The figure shows the parallel operation connection for local sensing. Up to six units can be operated in parallel.

⚠CAUTION During parallel operation, make sure that the negative output cables between PAVs is connected firmly. If a negative output cable comes loose, the PAV series may break.

NOTE In local sensing, make the length of the load cables as short as possible to minimize cable resistance. To maintain the current balance between PAVs, make the length and core diameter of each cable nearly the same as possible.

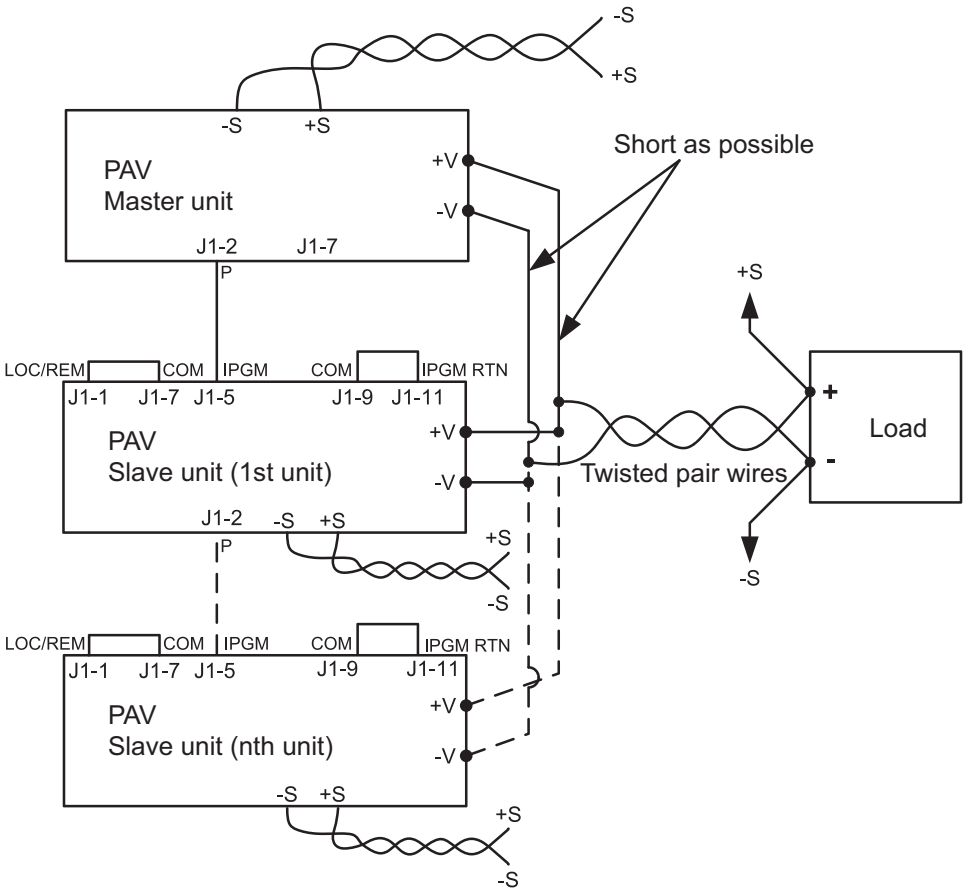


J1 terminals used (the same for local and remote sensing)

Pin no.	Signal name	Function
J1-1	LOC/REM SELECT	Enables external control mode
J1-2	P	External control signal output
J1-5	IPGM	External control signal input
J1-7	COM	Common ground for VMON, IMON, CV/CC, and LOC/REM signals (connected internally to the negative sensing terminal (-S))
J1-9	COM	
J1-11	IPGM_RTN	Ground for IPGM

Wiring the load (remote sensing)

The figure shows the parallel operation connection for remote sensing. Up to six units can be operated in parallel.



Advanced Parallel Operation

The total current of a parallel operation system can be displayed on the ammeter of the master unit. In this mode, the slave units display "ON" and "SLVE."

The value displayed on the ammeter of the master unit is the result of multiplying the master unit's output current by the number of PAV series power supplies connected in parallel.

If highly accurate ammeter reading is required, we recommend "Basic parallel operation" *(p.87)*.

Configuring the master unit

Set the output voltage of the master unit. Set the current to a value obtained by dividing the required total current by the number of PAV series power supplies connected in parallel.

In master-slave parallel operation, the master unit runs in constant voltage (CV) mode. For sensing connection, see "Basic parallel operation" *(p.87)*.

1 **Press MENU.**
The MENU key (green) lights.
The voltmeter shows "SEt," and the ammeter shows "r.PAn."

2 **Turn the VOLTAGE knob until the voltmeter shows "PrLL."**

3 **Press the VOLTAGE knob.**
The voltmeter shows "HOSt," and the ammeter shows "H 1."

4 **Turn the CURRENT knob to set the total number of units connected in parallel (master unit + slave units) ("H2" to "H6").**
For example, if the total number of units is 3, set "H3."

5 **Press the CURRENT knob.**
When "H3" is entered, the display blinks and returns to the previous level.

6 **Turn the POWER switch off.**
The settings are stored in memory.

7 **Turn the POWER switch back on.**

Configuring the slave unit

When configured as a slave unit, the slave unit receives external voltage from the master unit and runs in current control (CC) mode. The current and voltage on slave units are set to 105 % of the settings on the master unit. Slave units supply current in accordance with the output current of the master unit and runs in CC (constant current) mode. Current may become unbalanced due to voltage drops in wiring and connections, so we recommend that the output of each PAV set to no more than 95 % of the rated output current.

Slave units operate in local lockout mode. Front panel operations are disabled to prevent unintentional setting changes. However, configuration from the menu is still possible. Commands through the communication interface are not accepted. Only readback of voltage, current, and the like is possible.

1 **Press MENU.**
The MENU key (green) lights.
The voltmeter shows "SEt," and the ammeter shows "r.PAn."

2 **Turn the VOLTAGE knob until the voltmeter shows "PrLL."**

3 **Press the VOLTAGE knob.**
The voltmeter shows "HOSt," and the ammeter shows "H 1."

4 **Turn the CURRENT knob until the ammeter shows "SLAd."**

5 **Press the CURRENT knob.**
When "SLAd" is entered, the display blinks and returns to the previous level.

6 **Turn the POWER switch off.**
The settings are stored in memory.

7 **Turn the POWER switch back on.**

NOTE To disable advanced parallel operation, press MENU and select "H1."

Series Operation

You can connect PAV series with the same rating in series to increase the output voltage. By using the connection point as the reference potential, bipolar output configuration is possible (up to two units).

⚠ WARNING

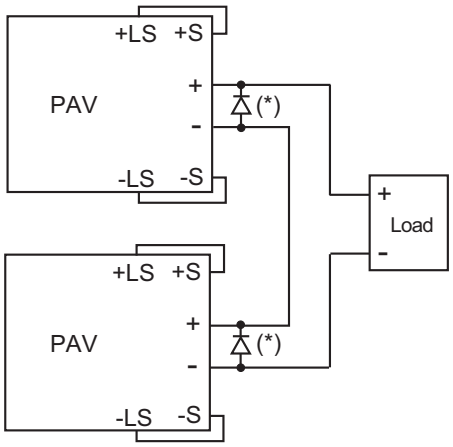
- **Risk of electric shock. When you connect the PAV series power supplies in series and ground the negative side or the output terminal, make the potential difference between the grounding terminal (chassis) and output terminal as follows.**
  - **Models whose rated output voltage is 10 V, 20 V, or 36 V: ±60 Vdc or less**
  - **Models whose rated output voltage is 60 V, or 100 V: ±100 Vdc or less**
  - **Models whose rated output voltage is 160 V, 320 V, or 650 V: ±650 Vdc or less**
- **On models whose total voltage across a series connection exceeds 400 V, if the positive output terminal is grounded, there is a risk of electric shock at the USB/RS232/RS485 and LAN ports. If you are using the USB/RS232/RS485 or LAN port under the above condition, do not connect the positive output terminal.**

⚠ CAUTION Risk of malfunction. Do not connect power supplies from other manufactures in series.

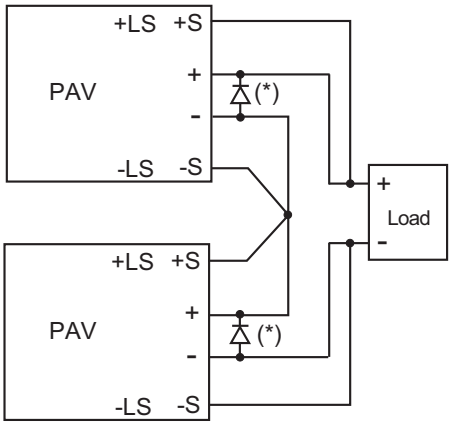
Serial connection to increase output voltage

The following figure shows the connection for increasing the output voltage using two PAV series power supplies. To prevent damaging the load due to decreased output, set the current of each PAV to the maximum value. Also, connect a diode in parallel to each PAV's output. This is necessary to prevent reverse voltage from being applied while the output is rising up or when one of the power supplies is shut off. Use diodes whose ratings are at least the rated voltage and rated current of the PAV series.

Series connection using local sensing



Series connection using remote sensing

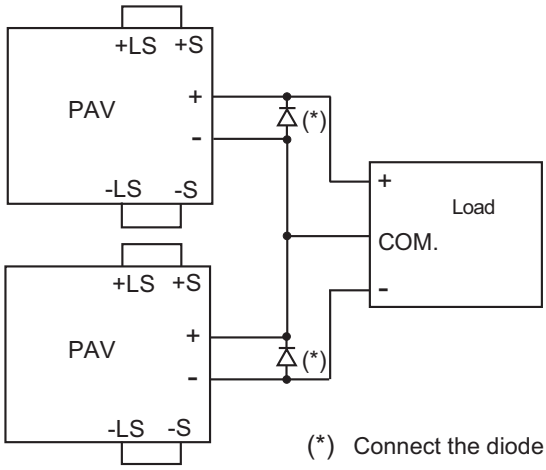


(*) Connect the diode externally.

Series connection for positive and negative output

You can configure a positive and negative output system using two PAV series power supplies. To prevent damaging the load due to decreased output, set the current of each PAV to the maximum value. Also, connect a diode in parallel to each PAV's output. This is necessary to prevent reverse voltage from being applied while the output is rising up or when one of the power supplies is shut off. Use diodes whose ratings are at least the rated voltage and rated current of the PAV series.

For the connection, see the following diagram.



(*) Connect the diode externally.

External control during series operation

- **Output control using external voltage**

The PAV series's external control circuit uses the negative output (-V) potential as the reference. Thus, keep each external control power supply separate and floating.

- **Output control using external resistance**

Keep each external control resistors separate and floating.

- **SO and PS_OK signals**

The reference potential for the SO and PS_OK signals is IFC_COM (J3-7) and is isolated from the output voltage. Even in a series connection, you can connect the IFC_COM terminals of different units together to configure a single control circuit system.

- **Control via serial port (USB/RS232/RS485)**

The reference potential for the communication ports is the IFC_COM terminal, which is isolated from the output.

The serial communication remote input terminal (J4 IN) and remote output terminal (J4 OUT) can be linked together between the PAVs connected in series.

For details, see the USB/RS232/RS485 communication interface manual.

8

Specifications

This chapter contains the specifications and outline drawing of the PAV series.

200W Type Specifications

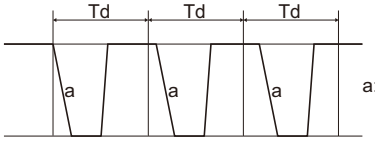
200W type	PAV 10-20	PAV 20-10	PAV 36-6	PAV 60-3.5	PAV 100-2	PAV 160-1.3	PAV 320-0.65	PAV 650-0.32	Unit
Output									
Rated output voltage[1]	10	20	36	60	100	160	320	650	V
Rated output current[2]	20	10	6	3.5	2	1.3	0.65	0.32	A
Rated output power	200	200	216	210	200	208	208	208	W
AC input									
Nominal input rating	100 Vac to 240 Vac continuous input, 50 Hz to 60 Hz, single phase								---
Input voltage range	85 to 265								Vac
Input frequency range	47 to 63								Hz
Input current (typ)[3] (100 Vac/200 Vac)	2.65/1.31	2.62/1.29	2.76/1.37	2.69/1.33	2.55/1.26	2.64/1.30			A
Power factor (typ) (100 Vac/200 Vac, at the rated output power)	0.99/0.98								---
Efficiency (typ)[3]	76/77.5	77/79	79/80.5	79/80.5	79/81	79/81			%
Inrush current (100 Vac/200 Vac)[4]	15/30 or less					25/25 or less			A

1. The minimum voltage is 0.1 % of the rated output voltage.
2. The minimum current is 0.2 % of the rated output current.
3. Input voltage 100 Vac/200 Vac, at the rated output power, ambient temperature 25 °C
   If the LAN option is built in, the efficiency decreases by 0.5 % and the input current increases by 0.5 %.
4. Excludes input surge current (duration 0.2 ms or less) applied to the built-in noise filter section.

200W type	PAV 10-20	PAV 20-10	PAV 36-6	PAV 60-3.5	PAV 100-2	PAV 160-1.3	PAV 320-0.65	PAV 650-0.32	Unit
Constant voltage mode									
Maximum line regulation[1] (for the rated output voltage)	0.01 % +2 mV					0.01 %			---
Maximum load regulation[2] (for the rated output voltage)									---
Ripple noise[3]									
20 MHz, p-p	50	50	50	50	80	100	150	250	mV
5 Hz to 1 MHz, rms	5	6	6	7	8	10	25	60	mV
Temperature coefficient	30 (after a 30 minute warm-up, for the rated output voltage)								PPM/°C
Aging drift[4] (for the rated output voltage)	0.02								%
Initial drift[5] (for the rated output voltage)	0.05 %+2 mV					0.05 %			---
Maximum remote sensing compensation voltage (single line (positive or negative))	1	1	2	3	5	5			V
Rise time[6]	15	30	30	50	50	110	170	170	ms
Fall time									
At full load[6]	12	25	30	40	50	180	270	270	ms
Td (typ)[7]	210	250	320	380	1200	---			ms
No load a[8]	40	65	85	100	250	---			ms
No load b[9]	200	200	290	310	1100	2000	2500	3000	ms

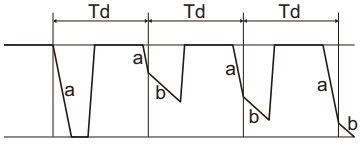
200W type	PAV 10-20	PAV 20-10	PAV 36-6	PAV 60-3.5	PAV 100-2	PAV 160-1.3	PAV 320-0.65	PAV 650-0.32	Unit
Constant voltage mode (continued)									
Transient response time[10]	1 ms or less					2 ms or less			ms
Output hold time (typ)[11]	15	16				16	16	15	ms
Constant current mode									
Maximum line regulation[1] (at the rated output current)	0.01 % +2 mA					0.02 %			---
Maximum load regulation[12] (at the rated output current)	0.01 % +5 mA					0.09 %		0.15 %	---
Change in the load due to the temperature drift of internal components (at the rated output current)	0.05 % or less (for 30 minutes after the load conditions are changed)								---
Ripple noise[13] (5 Hz to 1 MHz, rms)	25	15	8	4	3	1.2	0.8	0.5	mA
Temperature coefficient	100 (after a 30 minute warm-up, at the rated output current)								PPM/°C
Aging drift[4] (at the rated output current)	0.05								%
Initial drift[5] (at the rated output current)	0.1								%

1. 85 Vac to 132 Vac or 170 Vac to 265 Vac, fixed load
2. With the input voltage held constant, the sensing point was measured using remote sensing from no load to full load.
3. Models with rated output voltages from 10 V to 100 V were measured using an RC-9131 A 1:1 probe that conforms to the JEITA specifications.
   Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe.
4. When at least 8 hours has passed after a 30 minute warm-up with the input voltage, load, and ambient temperature held constant
5. For 30 minutes after turning on the power with the input voltage, load, and ambient temperature held constant
6. Between 10 % and 90 % of the rated resistive load and rated output voltage
7. If the output voltage is repeatedly decreased, Td is the minimum duration from a given voltage drop to the next voltage drop.
8. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is longer than Td.



a: Slope of the fall time of a at no load

9. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is shorter than Td.



a: Slope of the fall time of a at no load
a: Slope of the fall time of b at no load

10. The amount of time required for the output voltage to return to a value within 0.5 % of the rated output voltage.
    The change in the load current is 10 % to 90 % of the rating. The output voltage is between 10 % and 100 % of the rating.
    During local sensing.
11. At the rated output power
12. The value when the output voltage is changed from the lower limit to the rated voltage in constant current mode with the input voltage held constant
13. For models with a 10 V rated output voltage, this is the value for when the output voltage is 2 V to 10 V at the rated output current.
    For other models, this is the value for when the output voltage is 10 % to 100 % of the rating at the rated output current.
    Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe.

200W type	PAV 10-20	PAV 20-10	PAV 36-6	PAV 60-3.5	PAV 100-2	PAV 160-1.3	PAV 320-0.65	PAV 650-0.32	Unit
Protection functions									
Foldback protection	Turns off the output when the operation switches from constant voltage mode to constant current mode or vice versa. Can be set as necessary.								---
Overvoltage protection (OVP)	Inverter shutoff system. Prevents the output voltage from being set higher than the OVP value. Also shuts off the output when an output overvoltage (exceeding the OVP value) occurs.								---
Overvoltage protection voltage setting range	0.5 to 12	1 to 24	2 to 40	5 to 66	5 to 110	5 to 176	5 to 353	5 to 717	V
Undervoltage limit (UVL)	Prevents the output voltage from being set lower than the UVL value. Disabled during external control.								---
Undervoltage protection (UVP)	Shuts off the output when the output voltage falls below the UVP value.								---
Overheat protection	Shuts off the output before the temperature of the internal components exceeds the safe operation temperature.								---
Setting and readback (USB, RS232, RS485, optional LAN interface)									
Output voltage setting									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Number of decimal digits	3 digits				2 digits				---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current setting									
Accuracy[1]	0.1 % of output current +0.1 % of the rated output current					0.2 % of the rated output current			---
Number of decimal digits	3 digits		4 digits						---
Resolution	Approx. 1/60000 of rated output current								---
Output voltage readback									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current readback									
Accuracy[1]	0.1 % of output current +0.3 % of the rated output current								---
Resolution	Approx. 1/60000 of rated output current								---
Front panel									
Control function	• Separate knobs (encoders) for setting the output voltage and output current (setting resolution switchable). • Knobs (encoders) for setting OVP, UVP, and UVL. • Protection functions (OVP, UVP, UVL, foldback) • Output shutoff function (output on/off control, shutdown) • Communication functions: Standard equipped with USB, RS232, RS485. LAN optional. • Baudrate, address setting • External control: Configuration using external voltage (5 V or 10 V) or external resistance (5 kΩ or 10 kΩ), output voltage/current monitor output (5 V or 10 V), output on/off, front panel operation lock								---
Output voltage display									
Accuracy	0.5 % of the rated output voltage ± 1 count								---
Number of decimal digits	2 digits				1 digit				---
Output current display									
Accuracy	0.5 % of the rated output current ± 1 count								---
Number of decimal digits	2 digits		3 digits						---
LED display	Green: FINE, MENU, SET, ALARM, REM, OUTPUT, CV, CC Red: ALARM (OVP, UVP, OTP, FOPLD, AC FAIL)								---
Setting keys	FINE, MENU, SET, ALARM, REM, OUTPUT								---

1. In output current control, the current, linearity, and monitor accuracies do not include the load variation caused by initial drift and temperature drift of internal components.

400W Type Specifications

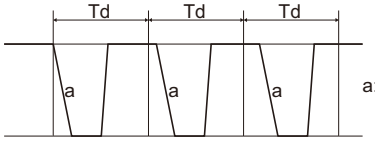
400W type	PAV 10-40	PAV 20-20	PAV 36-12	PAV 60-7	PAV 100-4	PAV 160-2.6	PAV 320-1.3	PAV 650-0.64	Unit
Output									
Rated output voltage[1]	10	20	36	60	100	160	320	650	V
Rated output current[2]	40	20	12	7	4	2.6	1.3	0.64	A
Rated output power	400	400	432	420	400	416	416	416	W
AC input									
Nominal input rating	100 Vac to 240 Vac continuous input, 50 Hz to 60 Hz, single phase								---
Input voltage range	85 to 265								Vac
Input frequency range	47 to 63								Hz
Input current (typ)[3] (100 Vac/200 Vac)	5.05/2.47	4.98/2.45	5.25/2.57	5.10/2.50	4.80/2.37	5/2.44			A
Power factor (typ) (100 Vac/200 Vac, at the rated output power)	0.99								---
Efficiency (typ)[3]	80/82	81/83	83/85	83/85	84/88	84/86			%
Inrush current (100 Vac/200 Vac)[4]	25/25 or less					25/25 or less			A

1. The minimum voltage is 0.1 % of the rated output voltage.
2. The minimum current is 0.2 % of the rated output current.
3. Input voltage 100 Vac/200 Vac, at the rated output power, ambient temperature 25 °C
   If the LAN option is built in, the efficiency decreases by 0.5 % and the input current increases by 0.5 %.
4. Excludes input surge current (duration 0.2 ms or less) applied to the built-in noise filter section.

400W type	PAV 10-40	PAV 20-20	PAV 36-12	PAV 60-7	PAV 100-4	PAV 160-2.6	PAV 320-1.3	PAV 650-0.64	Unit
Constant voltage mode									
Maximum line regulation[1] (for the rated output voltage)	0.01 % +2 mV					0.01 %			---
Maximum load regulation[2] (for the rated output voltage)									---
Ripple noise[3]									
20 MHz, p-p	50	50	50	50	80	100	150	250	mV
5 Hz to 1 MHz, rms	5	6	6	7	8	10	25	60	mV
Temperature coefficient	30 (after a 30 minute warm-up, for the rated output voltage)								PPM/°C
Aging drift[4] (for the rated output voltage)	0.02								%
Initial drift[5] (for the rated output voltage)	0.05 %+2 mV					0.05 %			---
Maximum remote sensing compensation voltage (single line (positive or negative))	1	1	2	3	5	5			V
Rise time[6]	15	30	30	50	50	80	150	150	ms
Fall time									
At full load[6]	10	10	15	30	50	100	150	150	ms
Td (typ)[7]	210	250	320	380	1200	---			ms
No load a[8]	40	65	85	100	250	---			ms
No load b[9]	200	200	290	310	1100	2000	2500	3000	ms

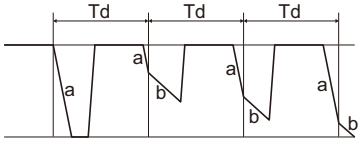
400W type	PAV 10-40	PAV 20-20	PAV 36-12	PAV 60-7	PAV 100-4	PAV 160-2.6	PAV 320-1.3	PAV 650-0.64	Unit
Constant voltage mode (continued)									
Transient response time[10]	1 ms or less					2 ms or less			ms
Output hold time (typ)[11]	15	16				16		15	ms
Constant current mode									
Maximum line regulation[1] (at the rated output current)	0.01 % +2 mA					0.02 %			---
Maximum load regulation[12] (at the rated output current)	0.01 % +5 mA					0.09 %			---
Change in the load due to the temperature drift of internal components (at the rated output current)	0.05 % or less (for 30 minutes after the load conditions are changed)								---
Ripple noise[13] (5 Hz to 1 MHz, rms)	70	40	15	8	3	1.5	1	0.6	mA
Temperature coefficient	100 (after a 30 minute warm-up, at the rated output current)								PPM/°C
Aging drift[4] (at the rated output current)	0.05								%
Initial drift[5] (at the rated output current)	0.1								%

1. 85 Vac to 132 Vac or 170 Vac to 265 Vac, fixed load
2. With the input voltage held constant, the sensing point was measured using remote sensing from no load to full load.
3. Models with rated output voltages from 10 V to 100 V were measured using an RC-9131 A 1:1 probe that conforms to the JEITA specifications.
   Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe.
4. When at least 8 hours has passed after a 30 minute warm-up with the input voltage, load, and ambient temperature held constant
5. For 30 minutes after turning on the power with the input voltage, load, and ambient temperature held constant
6. Between 10 % and 90 % of the rated resistive load and rated output voltage
7. If the output voltage is repeatedly decreased, Td is the minimum duration from a given voltage drop to the next voltage drop.
8. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is longer than Td.



a: Slope of the fall time of a at no load

9. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is shorter than Td.



a: Slope of the fall time of a at no load
a: Slope of the fall time of b at no load

10. The amount of time required for the output voltage to return to a value within 0.5 % of the rated output voltage.
    The change in the load current is 10 % to 90 % of the rating. The output voltage is between 10 % and 100 % of the rating.
    During local sensing.
11. At the rated output power
12. The value when the output voltage is changed from the lower limit to the rated voltage in constant current mode with the input voltage held constant
13. For models with a 10 V rated output voltage, this is the value for when the output voltage is 2 V to 10 V at the rated output current.
    For other models, this is the value for when the output voltage is 10 % to 100 % of the rating at the rated output current.
    Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe.

400W type	PAV 10-40	PAV 20-20	PAV 36-12	PAV 60-7	PAV 100-4	PAV 160-2.6	PAV 320-1.3	PAV 650-0.64	Unit
Protection functions									
Foldback protection	Turns off the output when the operation switches from constant voltage mode to constant current mode or vice versa. Can be set as necessary.								---
Overvoltage protection (OVP)	Inverter shutoff system. Prevents the output voltage from being set higher than the OVP value. Also shuts off the output when an output overvoltage (exceeding the OVP value) occurs.								---
Overvoltage protection voltage setting range	0.5 to 12	1 to 24	2 to 40	5 to 66	5 to 110	5 to 176	5 to 353	5 to 717	V
Undervoltage limit (UVL)	Prevents the output voltage from being set lower than the UVL value. Disabled during external control.								---
Undervoltage protection (UVP)	Shuts off the output when the output voltage falls below the UVP value.								---
Overheat protection	Shuts off the output before the temperature of the internal components exceeds the safe operation temperature.								---
Setting and readback (USB, RS232, RS485, optional LAN interface)									
Output voltage setting									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Number of decimal digits	3 digits				2 digits				---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current setting									
Accuracy[1]	0.1 % of output current +0.1 % of the rated output current					0.2 % of the rated output current			---
Number of decimal digits	3 digits				4 digits				---
Resolution	Approx. 1/60000 of rated output current								---
Output voltage readback									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current readback									
Accuracy[1]	0.1 % of output current +0.3 % of the rated output current								---
Resolution	Approx. 1/60000 of rated output current								---
Front panel									
Control function	• Separate knobs (encoders) for setting the output voltage and output current (setting resolution switchable). • Knobs (encoders) for setting OVP, UVP, and UVL. • Protection functions (OVP, UVP, UVL, foldback) • Output shutoff function (output on/off control, shutdown) • Communication functions: Standard equipped with USB, RS232, RS485. LAN optional. • Baudrate, address setting • External control: Configuration using external voltage (5 V or 10 V) or external resistance (5 kΩ or 10 kΩ), output voltage/current monitor output (5 V or 10 V), output on/off, front panel operation lock								---
Output voltage display									
Accuracy	0.5 % of the rated output voltage ± 1 count								---
Number of decimal digits	2 digits				1 digit				---
Output current display									
Accuracy	0.5 % of the rated output current ± 1 count								---
Number of decimal digits	2 digits			3 digits					---
LED display	Green: FINE, MENU, SET, ALARM, REM, OUTPUT, CV, CC Red: ALARM (OVP, UVP, OTP, FOPLD, AC FAIL)								---
Setting keys	FINE, MENU, SET, ALARM, REM, OUTPUT								---

1. In output current control, the current, linearity, and monitor accuracies do not include the load variation caused by initial drift and temperature drift of internal components.

600W Type Specifications

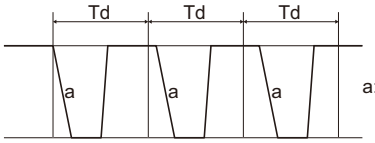
600W type	PAV 10-60	PAV 20-30	PAV 36-18	PAV 60-10	PAV 100-6	PAV 160-4	PAV 320-2	PAV 650-1	Unit
Output									
Rated output voltage[1]	10	20	36	60	100	160	320	650	V
Rated output current[2]	60	30	18	10	6	4	2	1	A
Rated output power	600	600	648	600	600	640	640	650	W
AC input									
Nominal input rating	100 Vac to 240 Vac continuous input, 50 Hz to 60 Hz, single phase								---
Input voltage range	85 to 265								Vac
Input frequency range	47 to 63								Hz
Input current (typ)[3] (100 Vac/200 Vac)	7.48/3.69	7.22/3.56	7.70/3.80	7.13/3.52	7.13/3.52	7.47/3.69		7.59/3.75	A
Power factor (typ) (100 Vac/200 Vac, at the rated output power)	0.99/0.98								---
Efficiency (typ)[3]	81/83	84/86	85/87	85/87	85/87	86.5/88.5	87/88.5	86.5/88.5	%
Inrush current (100 Vac/200 Vac)[4]	30/30 or less					30/30 or less			A

1. The minimum voltage is 0.1 % of the rated output voltage.
2. The minimum current is 0.2 % of the rated output current.
3. Input voltage 100 Vac/200 Vac, at the rated output power, ambient temperature 25 °C
   If the LAN option is built in, the efficiency decreases by 0.5 % and the input current increases by 0.5 %.
4. Excludes input surge current (duration 0.2 ms or less) applied to the built-in noise filter section.

600W type	PAV 10-60	PAV 20-30	PAV 36-18	PAV 60-10	PAV 100-6	PAV 160-4	PAV 320-2	PAV 650-1	Unit
Constant voltage mode									
Maximum line regulation[1] (for the rated output voltage)	0.01 % +2 mV					0.01 %			---
Maximum load regulation[2] (for the rated output voltage)									---
Ripple noise[3]									
20 MHz, p-p	50	50	50	50	80	100	150	250	mV
5 Hz to 1 MHz, rms	5	5	5	12	15	10	30	60	mV
Temperature coefficient	30 (after a 30 minute warm-up, for the rated output voltage)								PPM/°C
Aging drift[4] (for the rated output voltage)	0.05					0.02			%
Initial drift[5] (for the rated output voltage)	0.05 %+2 mV					0.05 %			---
Maximum remote sensing compensation voltage (single line (positive or negative))	1	1	2	3	5	5			V
Rise time[6]	50	50	50	50	100	55	75	75	ms
Fall time									
At full load[6]	25	25	25	25	80	65	85	85	ms
Td (typ)[7]	285	425	450	570	1370	---			ms
No load a[8]	65	110	155	175	375	---			ms
No load b[9]	280	470	470	500	1200	2000	2500	3000	ms

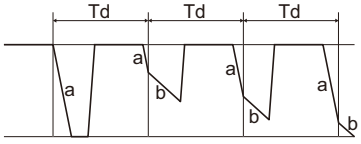
600W type	PAV 10-60	PAV 20-30	PAV 36-18	PAV 60-10	PAV 100-6	PAV 160-4	PAV 320-2	PAV 650-1	Unit
Constant voltage mode (continued)									
Transient response time[10]	1 ms or less					2 ms or less			ms
Output hold time (typ)[11]	15		20			16		14	ms
Constant current mode									
Maximum line regulation[1] (at the rated output current)	0.01 % +2 mA					0.02 %			---
Maximum load regulation[12] (at the rated output current)	0.01 % +5 mA					0.09 %			---
Change in the load due to the temperature drift of internal components (at the rated output current)	0.15 % or less (for 30 minutes after the load conditions are changed)					0.05 % or less (for 30 minutes after the load conditions are changed)			---
Ripple noise[13] (5 Hz to 1 MHz, rms)	150	75	25	8	5	2	1.5	1	mA
Temperature coefficient	100 (after a 30 minute warm-up, at the rated output current)								PPM/°C
Aging drift[4] (at the rated output current)	0.05								%
Initial drift[5] (at the rated output current)	0.3	0.15		0.1		0.1			%

1. 85 Vac to 132 Vac or 170 Vac to 265 Vac, fixed load
2. With the input voltage held constant, the sensing point was measured using remote sensing from no load to full load.
3. Models with rated output voltages from 10 V to 100 V were measured using an RC-9131 A 1:1 probe that conforms to the JEITA specifications.
   Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe. At an ambient temperature of 0 °C, measurement was performed after at least 1 minute had passed after startup.
4. When at least 8 hours has passed after a 30 minute warm-up with the input voltage, load, and ambient temperature held constant
5. For 30 minutes after turning on the power with the input voltage, load, and ambient temperature held constant
6. Between 10 % and 90 % of the rated resistive load and rated output voltage
7. If the output voltage is repeatedly decreased, Td is the minimum duration from a given voltage drop to the next voltage drop.
8. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is longer than Td.



a: Slope of the fall time of a at no load

9. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is shorter than Td.



a: Slope of the fall time of a at no load
a: Slope of the fall time of b at no load

10. The amount of time required for the output voltage to return to a value within 0.5 % of the rated output voltage.
    The change in the load current is 10 % to 90 % of the rating. The output voltage is between 10 % and 100 % of the rating.
    During local sensing.
11. At the rated output power
12. The value when the output voltage is changed from the lower limit to the rated voltage in constant current mode with the input voltage held constant
13. For models with a 10 V rated output voltage, this is the value for when the output voltage is 2 V to 10 V at the rated output current.
    For other models, this is the value for when the output voltage is 10 % to 100 % of the rating at the rated output current.
    Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe.

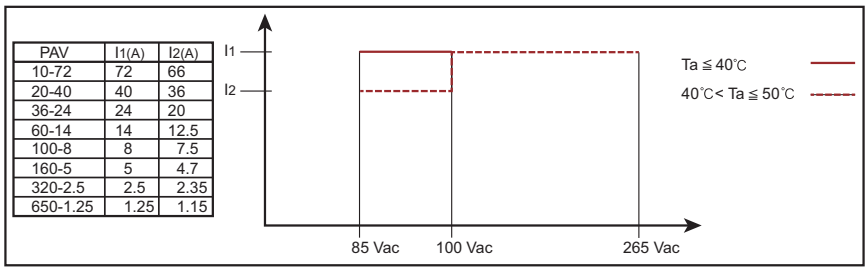
600W type	PAV 10-60	PAV 20-30	PAV 36-18	PAV 60-10	PAV 100-6	PAV 160-4	PAV 320-2	PAV 650-1	Unit
Protection functions									
Foldback protection	Turns off the output when the operation switches from constant voltage mode to constant current mode or vice versa. Can be set as necessary.								---
Overvoltage protection (OVP)	Inverter shutoff system. Prevents the output voltage from being set higher than the OVP value. Also shuts off the output when an output overvoltage (exceeding the OVP value) occurs.								---
Overvoltage protection voltage setting range	0.5 to 12	1 to 24	2 to 40	5 to 66	5 to 110	5 to 176	5 to 353	5 to 717	V
Undervoltage limit (UVL)	Prevents the output voltage from being set lower than the UVL value. Disabled during external control.								---
Undervoltage protection (UVP)	Shuts off the output when the output voltage falls below the UVP value.								---
Overheat protection	Shuts off the output before the temperature of the internal components exceeds the safe operation temperature.								---
Setting and readback (USB, RS232, RS485, optional LAN interface)									
Output voltage setting									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Number of decimal digits	3 digits				2 digits				---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current setting									
Accuracy[1]	0.1 % of output current +0.1 % of the rated output current					0.2 % of the rated output current			---
Number of decimal digits	3 digits				4 digits				---
Resolution	Approx. 1/60000 of rated output current								---
Output voltage readback									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current readback									
Accuracy[1]	0.1 % of output current +0.3 % of the rated output current								---
Resolution	Approx. 1/60000 of rated output current								---
Front panel									
Control function	• Separate knobs (encoders) for setting the output voltage and output current (setting resolution switchable). • Knobs (encoders) for setting OVP, UVP, and UVL. • Protection functions (OVP, UVP, UVL, foldback) • Output shutoff function (output on/off control, shutdown) • Communication functions: Standard equipped with USB, RS232, RS485. LAN optional. • Baudrate, address setting • External control: Configuration using external voltage (5 V or 10 V) or external resistance (5 kΩ or 10 kΩ), output voltage/current monitor output (5 V or 10 V), output on/off, front panel operation lock								---
Output voltage display									
Accuracy	0.5 % of the rated output voltage ± 1 count								---
Number of decimal digits	2 digits				1 digit				---
Output current display									
Accuracy	0.5 % of the rated output current ± 1 count								---
Number of decimal digits	2 digits				3 digits				---
LED display	Green: FINE, MENU, SET, ALARM, REM, OUTPUT, CV, CC Red: ALARM (OVP, UVP, OTP, FOPLD, AC FAIL)								---
Setting keys	FINE, MENU, SET, ALARM, REM, OUTPUT								---

1. In output current control, the current, linearity, and monitor accuracies do not include the load variation caused by initial drift and temperature drift of internal components.

800W Type Specifications

800W type		PAV 10-72	PAV 20-40	PAV 36-24	PAV 60-14	PAV 100-8	PAV 160-5	PAV 320-2.5	PAV 650-1.25	Unit
Output										
Rated output voltage[1]		10	20	36	60	100	160	320	650	V
Rated output current[2]	100 Vac ≤ Vin[3] Ta[4] ≤ 50°C	72	40	24	14	8	5	2.5	1.25	A
	Vin<100 Vac Ta ≤ 40°C	72	40	24	14	8	5	2.5	1.25	
	Vin<100 Vac 40°C <Ta ≤ 50°C	66	36	20	12.5	7.5	4.7	2.35	1.15	
Rated output power	100 Vac ≤ Vin Ta ≤ 50°C	720	800	864	840	800	800	800	812.5	W
	Vin<100 Vac Ta ≤ 40°C	720	800	864	840	800	800	800	812.5	
	Vin<100 Vac 40°C <Ta ≤ 50°C	660	720	720	750	750	752	752	747.5	
AC input										
Nominal input rating		100 Vac to 240 Vac continuous input, 50 Hz to 60 Hz, single phase								---
Input voltage range		85 to 265								Vac
Input frequency range		47 to 63								Hz
Input current (typ)[5] (100 Vac/200 Vac)		9.00/ 4.45	9.65/ 4.75	10.30/ 5.10	10.00/ 4.95	9.50/ 4.7	9.34/ 4.61	9.34/ 4.59	9.43/ 4.66	A
Power factor (typ) (100 Vac/200 Vac, at the rated output power)		0.99/0.98								---
Efficiency (typ)[5]		81/83	84/86	85/87	85/87	85/87	86.5/88.5	86.5/89	87/89	%
Inrush current (100 Vac/200 Vac)[6]		30/30 or less								A

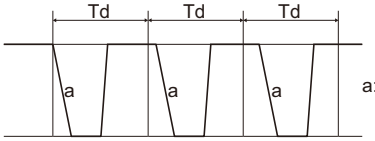
1. The minimum voltage is 0.1 % the rated output voltage.
2. The minimum current is 0.2 % of the rated output current.
3. Vin: Input voltage
4. Ta: Ambient temperature (performance depending on the input voltage versus rated output current and ambient temperature shown below)
5. Input voltage 100 Vac/200 Vac, at the rated output power, ambient temperature 25 °C
   If the LAN option is built in, the efficiency decreases by 0.5 % and the input current increases by 0.5 %.
6. Excludes input surge current (duration 0.2 ms or less) applied to the built-in noise filter section.



800W type	PAV 10-72	PAV 20-40	PAV 36-24	PAV 60-14	PAV 100-8	PAV 160-5	PAV 320-2.5	PAV 650-1.25	Unit
Constant voltage mode									
Maximum line regulation[1] (for the rated output voltage)	0.01 % +2 mV					0.01 %			---
Maximum load regulation[2] (for the rated output voltage)									---
Ripple noise[3]									
20 MHz, p-p	50	50	50	60	80	100	150	250	mV
5 Hz to 1 MHz, rms	5	5	5	12	15	10	30	60	mV
Temperature coefficient	30 (after a 30 minute warm-up, for the rated output voltage)								PPM/°C
Aging drift[4] (for the rated output voltage)	0.05					0.02			%
Initial drift[5] (for the rated output voltage)	0.05 % +2 mV					0.05 %			---
Maximum remote sensing compensation voltage (single line (positive or negative))	1	1	2	3	5	5			V
Rise time[6]	50	50	50	50	100	45	55	55	ms
Fall time									
At full load[6]	25	25	25	25	80	55	65	65	ms
Td (typ)[7]	285	425	450	570	1370	---			ms
No load a[8]	65	110	155	175	375	---			ms
No load b[9]	280	470	470	500	1200	2000	2500	3000	ms
Transient response time[10]	1 ms or less					2 ms or less			ms
Output hold time (typ)[11]	10					13	11.5		ms
Constant current mode									
Maximum line regulation[1] (at the rated output current)	0.01 % +2 mA					0.02 %			---
Maximum load regulation[12] (at the rated output current)	0.01 % +5 mA					0.09 %			---
Change in the load due to the temperature drift of internal components (at the rated output current)	0.15 % or less	0.1 % or less				0.05 % or less			---
	(for 30 minutes after the load conditions are changed)								
Ripple noise[13] (5 Hz to 1 MHz, rms)	180	100	31	28	12	2	1.5	1	mA
Temperature coefficient	100 (after a 30 minute warm-up, at the rated output current)								PPM/°C
Aging drift[4] (at the rated output current)	0.05								%
Initial drift[5] (at the rated output current)	0.3					0.1			%

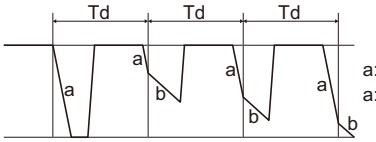
1. 85 Vac to 132 Vac or 170 Vac to 265 Vac, fixed load
2. With the input voltage held constant, the sensing point was measured using remote sensing from no load to full load.
3. Models with rated output voltages from 10 V to 100 V were measured using an RC-9131 A 1:1 probe that conforms to the JEITA specifications.
   Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe. At an ambient temperature of 0 °C, measurement was performed after at least 1 minute had passed after startup.
4. When at least 8 hours has passed after a 30 minute warm-up with the input voltage, load, and ambient temperature held constant
5. For 30 minutes after turning on the power with the input voltage, load, and ambient temperature held constant
6. Between 10 % and 90 % of the rated resistive load and rated output voltage
7. If the output voltage is repeatedly decreased, Td is the minimum duration from a given voltage drop to the next voltage drop.

8. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is longer than Td.



a: Slope of the fall time of a at no load

9. Duration for the voltage to change from 90 % to 10 % of the rated output voltage when the output voltage is repeatedly decreased and the duration from a given voltage drop to the next voltage drop is shorter than Td.



a: Slope of the fall time of a at no load
a: Slope of the fall time of b at no load

10. The amount of time required for the output voltage to return to a value within 0.5 % of the rated output voltage. The change in the load current is 10 % to 90 % of the rating. The output voltage is between 10 % and 100 % of the rating. During local sensing.
11. At the rated output power
12. The value when the output voltage is changed from the lower limit to the rated voltage in constant current mode with the input voltage held constant
13. For models with a 10 V rated output voltage, this is the value for when the output voltage is 2 V to 10 V at the rated output current. For other models, this is the value for when the output voltage is 10 % to 100 % of the rating at the rated output current. Models with rated output voltage from 160 V to 650 V were measured using a 10:1 probe.

800W type	PAV 10-72	PAV 20-40	PAV 36-24	PAV 60-14	PAV 100-8	PAV 160-5	PAV 320-2.5	PAV 650-1.25	Unit
Protection functions									
Foldback protection	Turns off the output when the operation switches from constant voltage mode to constant current mode or vice versa. Can be set as necessary.								---
Overvoltage protection (OVP)	Inverter shutoff system. Prevents the output voltage from being set higher than the OVP value. Also shuts off the output when an output overvoltage (exceeding the OVP value) occurs.								---
Overvoltage protection voltage setting range	0.5 to 12	1 to 24	2 to 40	5 to 66	5 to 110	5 to 176	5 to 353	5 to 717	V
Undervoltage limit (UVL)	Prevents the output voltage from being set lower than the UVL value. Disabled during external control.								---
Undervoltage protection (UVP)	Shuts off the output when the output voltage falls below the UVP value.								---
Overheat protection	Shuts off the output before the temperature of the internal components exceeds the safe operation temperature.								---
Setting and readback (USB, RS232, RS485, optional LAN interface)									
Output voltage setting									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Number of decimal digits	3 digits				2 digits				---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current setting									
Accuracy[1]	0.1 % of output current +0.1 % of the rated output current					0.2 % of the rated output current			---
Number of decimal digits	2 digits	3 digits				4 digits			---
Resolution	Approx. 1/60000 of rated output current								---
Output voltage readback									
Accuracy	0.05 % of the rated output voltage					0.05 % of the output voltage + 0.05 % of the rated output voltage			---
Resolution	Approx. 1/60000 of rated output voltage								---
Output current readback									
Accuracy[1]	0.1 % of output current +0.3 % of the rated output current								---
Resolution	Approx. 1/60000 of rated output current								---

1. In output current control, the current, linearity, and monitor accuracies do not include the load variation caused by initial drift and temperature drift of internal components.

800W type	PAV 10-72	PAV 20-40	PAV 36-24	PAV 60-14	PAV 100-8	PAV 160-5	PAV 320-2.5	PAV 650-1.25	Unit
Front panel									
Control function	• Separate knobs (encoders) for setting the output voltage and output current (setting resolution switchable). • Knobs (encoders) for setting OVP, UVP, and UVL. • Protection functions (OVP, UVP, UVL, foldback) • Output shutoff function (output on/off control, shutdown) • Communication functions: Standard equipped with USB, RS232, RS485. LAN optional. • Baudrate, address setting • External control: Configuration using external voltage (5 V or 10 V) or external resistance (5 kΩ or 10 kΩ), output voltage/current monitor output (5 V or 10 V), output on/off, front panel operation lock								---
Output voltage display									
Accuracy	0.5 % of the rated output voltage ± 1 count								---
Number of decimal digits	2 digits				1 digit				---
Output current display									
Accuracy	0.5 % of the rated output current ± 1 count								---
Number of decimal digits	2 digits				3 digits				---
LED display	Green: FINE, MENU, SET, ALARM, REM, OUTPUT, CV, CC Red: ALARM (OVP, UVP, OTP, FOPLD, AC FAIL)								---
Setting keys	FINE, MENU, SET, ALARM, REM, OUTPUT								---

Specifications Common to All Types

Item	Common specifications	Unit
External control		
Output voltage control using external voltage	0 % to 100 % of the rated output voltage (application voltage range selectable: 0 V to 5 V or 0 V to 10 V) Accuracy and linearity: ±0.5 % of the rated output voltage	---
Output current control using external voltage	0 % to 100 % of the rated output current (application voltage range selectable: 0 V to 5 V or 0 V to 10 V) Accuracy and linearity: ±1 % of the rated output current	---
Output voltage control using external resistance	0 % to 100 % of the rated output voltage (application resistance range selectable: 0 Ω to 5 kΩ or 0 Ω to 10 kΩ) Accuracy and linearity: ±1 % of the rated output voltage	---
Output current control using external resistance[1]	0 % to 100 % of the rated output current (application resistance range selectable: 0 Ω to 5 kΩ or 0 Ω to 10 kΩ) Accuracy and linearity: ±1.5 % of the rated output current	---
Output shutoff (SO) control	External voltage application: 0 V to 0.6 V , 4 V to 15 V, or a contact switch Positive or negative logic selectable.	---
Output current monitor[1]	Monitor voltage range selectable: 0 V to 5 V or 0 V to 10 V, Accuracy: 1 %	---
Output voltage monitor	Monitor voltage range selectable: 0 V to 5 V or 0 V to 10 V, Accuracy: 1 %	---
Normal operation status signal	Normal (4 V to 5 V), abnormal (0 V), output resistance 500 Ω	---
Parallel operation[2, 3]	Possible up to six power supplies. Master-slave operation with a current balance function.	---
Series operation[4]	Possible up to two power supplies.	---
Constant voltage/constant current mode (CV/CC) signal	Open collector output (maximum application voltage 30 V, maximum sink current 10 mA) Low level (on) during constant current (CC) mode High level (off) during constant voltage (CV) mode	---
Output on/off control (ILC)	Output can be shut off using a contact switch or the like (maximum voltage between terminals: 5 V). When open: Output off When shorted: Output on	---
Local/remote	Can be switched by applying an external voltage or by opening or shorting the circuit. Local: 2 V to 15 V or open Remote: 0 V to 0.6 V or shorted	---
External control status signal	Open collector output (maximum application voltage 30 V, maximum sink current 10 mA) High level (off) during local mode Low level (on) during external control	---
Trigger output signal	Maximum low level output signal: 0.8 V Minimum high level output signal: 3.8 V, maximum high level output signal: 5 V Maximum source current: 16 mA, output trigger signal span: 20 µs (typ)	---
Trigger input signal	Maximum low level input signal: 1.2 V Minimum high level input signal: 3.5 V, maximum high level input signal: 5 V Maximum sink current: 16 mA, positive edge trigger span: 10 µs (min), Tr/Tf: 1 µs (max)	---
Program signal output 1	Open collector output (maximum application voltage 25 V, maximum sink current 100 mA)	---
Program signal output 2		---

1. In output current control, the current, linearity, and monitor accuracies do not include the load variation caused by initial drift and temperature drift of internal components.
2. For parallel operation of two or more PAV series power supplies with the same rating, the minimum load current is 5 % of the rating or higher.
   For parallel operation of four or less models with rated output voltage of 160 V to 650 V, the minimum load current is 5 % of the rating or higher. For parallel operation of more than four, the minimum load current is 20 % of the rating or higher.
3. The ammeter's display accuracy when the total current is displayed on the master unit is 2 % ±1 count of the total of rated currents.
4. An external protection diode is necessary.

Item	Common specifications	Unit
Environmental conditions		
Operating ambient temperature and humidity	0 °C to 50 °C (32 °F to 122 °F) 20 %rh to 90 %rh (no condensation)	---
Storage ambient temperature and humidity	-20 °C to 85 °C (-4 °F to 185 °F) 10 %rh to 95 %rh (no condensation)	---
Installation location	Indoor use, Overvoltage category II Altitude: Up to 3 000 m (at 2000 m and above, the operating ambient temperature must be reduced), At 2000 m to 3000 m, the operating ambient temperature is 0 °C to 40 °C (32 °F to 104 °F).	---
Structure		
Cooling method	Forced air cooling using internal fan	---
Weight	1.9 kg (4.2 lb) or less: 200 W, 400 W types (models whose rated output voltage is 10 V to 100 V and 160 V to 650 V) 2.0 kg (4.4 lb) or less: 600 W, 800 W types (models whose rated output voltage is 160 V to 650 V) 2.1 kg (4.6 lb) or less: 600 W, 800 W types (models whose rated output voltage is 10 V to 100 V)	---
Dimensions	See the outline drawing.	---
Vibration resistance	IEC60068-2-64	---
Shock resistance	196.1 m/s^2 (20 G) or less, half sine, 11 ms, when not packaged, when not operating (IEC 60068-2-27)	---
Safety/EMC		
Safety standards	Complies with the requirements of the following directive and standards. Low Voltage Directive 2014/35/EU UL/EN/IEC 61010-1 (Class I[1], Pollution degree 2[2]) (Design to meet UL/EN 60950-1) • Models whose rated output voltage is 10 V, 20 V, 36 V, or 60 V Output terminals and signal terminals produce non-hazardous voltage. • Models whose rated output voltage is 100 V, 160 V, 320 V, or 650 V Output terminals and J1 and J2 terminals produce hazardous voltage (other signal terminals produce non-hazardous voltage).	---
EMC standards	Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN/IEC 61326-1 (Design to meet EN 55022/EN 55024)	---

1. This is a Class I equipment. Be sure to ground the product's protective conductor terminal. The safety of this product is only guaranteed when the product is properly grounded.
2. Pollution is addition of foreign matter (solid, liquid or gaseous) that may produce a reduction of dielectric strength or surface resistivity. Pollution Degree 2 assumes that only non-conductive pollution will occur except for an occasional temporary conductivity caused by condensation.

Item	Common specifications	Unit
Safety/EMC (continued)		
Withstanding voltage[1]	• Models whose rated output voltage is 10 V, 20 V, or 36 V 4242 Vdc: Between input and output (including between signal terminals) 2828 Vdc: Between input and FG 707 Vdc: Between output (including between signal terminals) and FG • Models whose rated output voltage is 60 V or 100 V 4242 Vdc: Between input and output (including between signal terminals) 2828 Vdc: Between input and FG 707 Vdc: Between signal terminals (excluding J1/J2) and FG 1910 Vdc: Between output as well as J1/J2 terminals and signal terminals (excluding J1/J2) 1380 Vdc: Between output as well as J1/J2 terminals and FG • Models whose rated output voltage is 160 V or 320 V 2970 Vdc: Between input and output (including between signal terminals) 2828 Vdc: Between input and FG 707 Vdc: Between signal terminals (excluding J1/J2) and FG 4242 Vdc: Between input and signal terminals (excluding J1/J2) 3200 Vdc: Between output as well as J1/J2 terminals and signal terminals (excluding J1/J2) 2000 Vdc: Between output as well as J1/J2 terminals and FG • Models whose rated output voltage is 650 V 3704 Vdc: Between input and output (including between signal terminals) 2828 Vdc: Between input and FG 707 Vdc: Between signal terminals (excluding J1/J2) and FG 4242 Vdc: Between input and signal terminals (excluding J1/J2) 4244 Vdc: Between output as well as J1/J2 terminals and signal terminals (excluding J1/J2) 2780 Vdc: Between output as well as J1/J2 terminals and FG	---
Insulation resistance	100 MΩ or higher (25 °C, 70 %rh)	---
Conducted emission	IEC/EN 61326-1, Class B, FCC part15-B, VCCI-B	---
Radiated emission	IEC/EN 61326-1, Class A[2], FCC part15-A, VCCI-A	---

1. Test voltage application time: 1 minute
2. This is a Class A equipment. The product is intended for use in an industrial environment. This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

Accessories

■ Models whose rated output voltage is 10 V to 100 V

Name		Quantity
Bus bar screw set		
	Flat washer M6	4
	Spring washer M6	2
	Hex nut M6	2
	Pan head screw M6×16	2
Bus bar cover (top and bottom)		1 each
PT screws KA40×8 WN1412		2
J1, J2, and J3 connector cover		1
Connector housing 12P (IPD1-06-D-K by SAMTEC)		1
Connector housing 8P (IPD1-04-D-K by SAMTEC)		1
Connector housing 4P (IPD1-02-D-K by SAMTEC)		1
Contact pins (CC79L-2024-01-L by SAMTEC)		26

■ Models whose rated output voltage is 160 V to 650 V

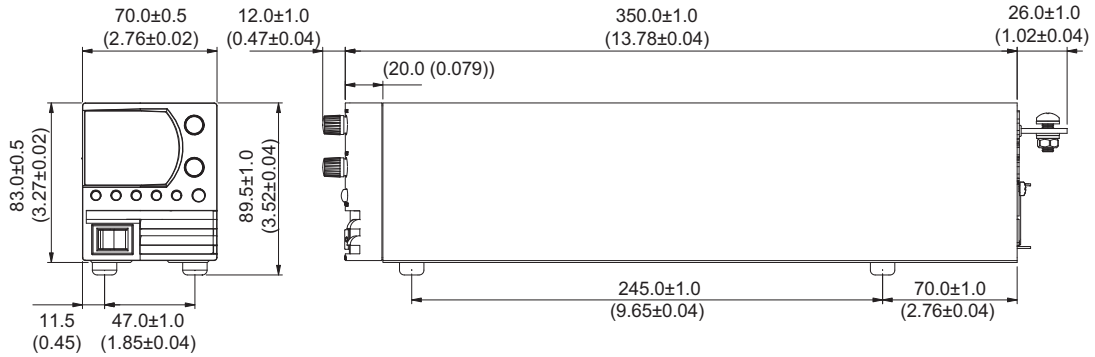
Name	Quantity
Output terminal plug 4P (IC2.5/4-ST-5.08 by PHOENIX CONTACT)	1
Output terminal cover (top and bottom)	1 each
PT screws KA30×6 WN1312	1
Connector housing 12P (43024-1208 by MOLEX)	1
Connector housing 8P (43645-0800 by MOLEX)	1
Connector housing 5P (43645-0500 by MOLEX)	1
Contact pins (43030-0002 by MOLEX)	26

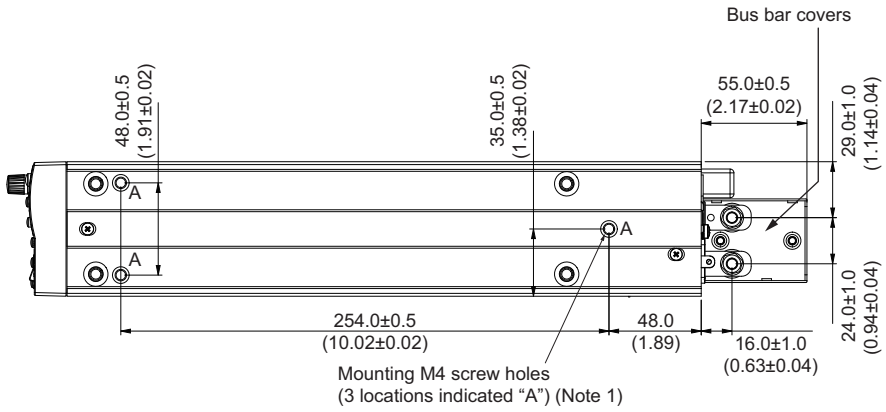
■ Common to all models

Name	Quantity
Setup Guide	1 copy
Quick Reference	1 English copy 1 Japanese copy
Safety Information	1 copy
Power code	1
RS485 link cable	1
CD-ROM	1 pc.

Outline Drawing

■Models whose rated output voltage is 10 V to 100 V

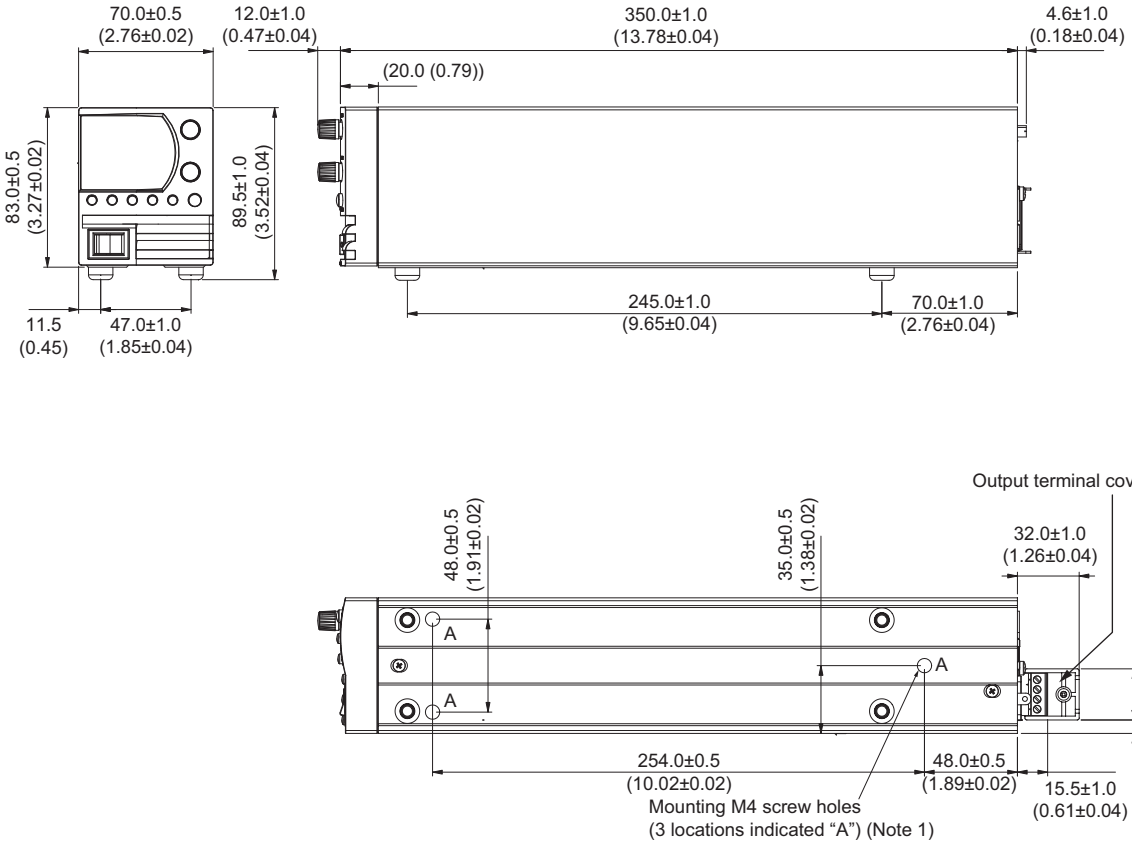




(Note 1) Keep screw insertion depth to 6 mm or less.

Unit: mm (inches)

■Models whose rated output voltage is 160 V to 650 V



(Note 1) Keep screw insertion depth to 6 mm or less.

Unit: mm (inches)

Appendix Troubleshooting

Symptom	Inspection	Remedy	See
No output is generated. None of the displays (voltmeter, ammeter, LEDs) light.	Is there a problem with the power cord?	Check the connection, and replace it if necessary.	p.18
	Is the AC input voltage within the rating?	Check the AC input voltage. Connect the PAV series to an appropriate AC power supply.	
Output is generated momentarily but is immediately shut off. The voltmeter shows "AC."	Does the AC input voltage drop when you increase the load?	Check the AC input voltage. Connect the PAV series to an appropriate AC power supply.	p.18
Output is generated momentarily but is immediately shut off. The voltmeter shows "OUP."	Are you using remote sensing?	Check whether the positive or negative load cable is loose.	p.29 p.42
The output voltage cannot be set correctly. The CC LED is lit.	Is the PAV series in constant current mode?	Check the current setting and load current.	p.36
The output voltage cannot be set correctly. The CV LED is lit.	Check that the output voltage is set less than or equal to the OVP value and greater than or equal to the UVP/UVL value.	Set the output voltage greater than or equal to the UVP/UVL value and less than or equal to the OVP value.	p.43 p.45
The output current cannot be set correctly. The CV LED is lit.	Is the PAV in constant voltage mode?	Check the current setting and voltage setting.	p.36
The output ripple noise is large.	Are remote sensing cables connected? Is the voltage drop in the load cable is large?	• Check whether the connection of the load cables and sensing cables are increasing the noise and impedance. • Use thicker load cables to minimize the voltage drop in the cables.	p.31
No output is generated. The voltmeter shows "OFF."	Is the OUTPUT key turned off?	Press OUTPUT to turn the output on.	p.40
No output is generated. The voltmeter shows "OUP." The ALARM key is blinking.	Is the overvoltage protection circuit activated?	• Turn the POWER switch off. • Check the load cable connection. • If you are using external control, press ALARM to check the OVP value. • Set the output voltage setting to less than or equal to the OVP value.	p.43
No output is generated.	The voltmeter is showing "SO."	Check the rear panel J3's SO (output shutoff) connection.	p.79
No output is generated. The ALARM key is blinking.	The voltmeter is showing "EnA."	Check the rear panel J3's output on/off control connection.	p.82
	The voltmeter is showing "OtP."	• Check that the air inlet and outlet are not blocked. • Check whether the PAV series is installed near a heat radiating device.	p.50
	The voltmeter is showing "FOLd."	Check the foldback protection setting and load current.	p.47
Voltage variation due to the load is large. The CV LED is lit.	Are remote sensing cables properly connected?	Connect sensing cables according to the procedure in this manual.	p.29
Unable to control from the front panel.	Is the PAV series in local lockout mode?	Turn the POWER switch off and wait for the display to turn off. Then turn the POWER switch back on. Press REM.	p.62
	When you turn the VOLTAGE or CURRENT knob, is "LFP" displayed?	Hold down SET to change the display to "UFP," and then release the key to unlock the keys.	p.51

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Index

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If you find any misplaced or missing pages in the manuals, 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 your Kikusui agent or distributor. At that time, inform your agent or distributor of the “Part No.” written on the front cover of this manual.

Every effort has been made to ensure the accuracy of this manual. However, if you have any questions or find any errors or omissions, please contact your Kikusui agent or distributor.

After you have finished reading this manual, store it so that you can use it for reference at any time.

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