TEXIO
Test and Measurement Solutions

INSTRUCTION MANUAL

750W SERIES DC POWER SUPPLY
PU SERIES

PU6-100	6V/100A	PU8-90	8V/90A
PU12.5-60	12.5V/60A	PU20-38	20V/38A
PU30-25	30V/25A	PU40-19	40V/19A
PU60-12.5	60V/12.5A	PU80-9.5	80V/9.5A
PU100-7.5	100V/7.5A	PU150-5	150V/5A
PU300-2.5	300V/2.5A	PU600-1.3	600V/1.3A

■ About Brands and Trademarks

TEXIO is the product brand in the industrial-use electronics equipment of our company.

The company and product names described in this manual are the brands and trademarks owned by the respective companies or organizations in each country and region.

■ About the Instruction Manual

 Be aware that the product specifications and the contents of this manual are subject to change for the purpose of improvement.

CONTENTS

USING THE PRODUCT SAFELY

■ Preface

To use the product safely, read instruction manual to the end.
Before using this product, understand how to correctly use it.
If you read the manuals but you do not understand how to use it, ask us or your local dealer.
After you read the manuals, save it so that you can read it anytime as required.

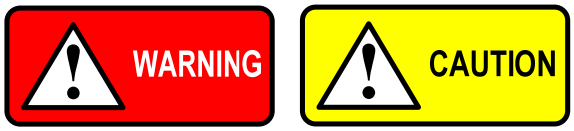
■ Pictorial indication

The manuals and product show the warning and caution items required to safely use the product.
The following pictorial indication and warning character indication are provided.

<Pictorial indication>	
	Some part of this product or the manuals may show this pictorial indication. In this case, if the product is incorrectly used in that part, a serious danger may be brought about on the user's body or the product. To use the part with this pictorial indication, be sure to refer to the manuals.
	If you use the product, ignoring this indication, you may get killed or seriously injured. This indication shows that the warning item to avoid the danger is provided.
	If you incorrectly use the product, ignoring this indication, you may get slightly injured or the product may be damaged. This indication shows that the caution item to avoid the danger is provided.

Please be informed that we are not responsible for any damages to the user or to the third person, arising from malfunctions or other failures due to wrong use of the product or incorrect operation, except such responsibility for damages as required by law.

USING THE PRODUCT SAFELY



■ Do not remove the product's covers and panels

Never remove the product's covers and panels for any purpose.
Otherwise, the user's electric shock or fire may be incurred.

■ Warning on using the product

Warning items given below are to avoid danger to user's body and life and avoid the damage or deterioration of the product. Use the product, observing the following warning and caution items.

■ Warning items on power supply

● Power supply voltage

The rated power supply voltages of the product are 100, 120, 220 and 240VAC. The rated power supply voltage for each product should be confirmed by reading the label attached on the back of the product or by the “rated” column shown in the instruction manual. The specification of power cord attached to the products is rated to 125VAC for all products which are designed to be used in the areas where commercial power supply voltage is not higher than 125VAC. Accordingly, you must change the power cord if you want to use the product at the power supply voltage higher than 125VAC. If you use the product without changing power cord to 250VAC rated one, electric shock or fire may be caused. When you used the product equipped with power supply voltage switching system, please refer to the corresponding chapter in the instruction manuals of each product.

● Power cord

(IMPORTANT) The attached power cord set can be used for this device only.

If the attached power cord is damaged, stop using the product and call us or your local dealer.
If the power cord is used without the damage being removed, an electric shock or fire may be caused.

● Protective fuse

If an input protective fuse is blown, the product does not operate. For a product with external fuse holder, the fuse may be replaced. As for how to replace the fuse, refer to the corresponding chapter in the instruction manual.
If no fuse replacement procedures are indicated, the user is not permitted to replace it. In such case, keep the case closed and consult us or your local dealer. If the fuse is incorrectly replaced, a fire may occur.

■ Warning item on Grounding

If the product has the GND terminal on the front or rear panel surface, be sure to ground the product to safely use it.

■ Warnings on Installation environment

● Operating temperature and humidity

Use the product within the operating temperature indicated in the “rating” temperature column.
If the product is used with the vents of the product blocked or in high ambient temperatures, a fire may occur.
Use the product within the operating humidity indicated in the “rating” humidity column.
Watch out for condensation by a sharp humidity change such as transfer to a room with a different humidity.
Also, do not operate the product with wet hands. Otherwise, an electric shock or fire may occur.

● Use in gas

Use in and around a place where an inflammable or explosive gas or steam is generated or stored may result in an explosion and fire. Do not operate the product in such an environment.
Also, use in and around a place where a corrosive gas is generated or spreading causes a serious damage to the product. Do not operate the product in such an environment.

● Installation place

Do not insert metal and inflammable materials into the product from its vent and spill water on it.
Otherwise, electric shock or fire may occur.

USING THE PRODUCT SAFELY

■ Do not let foreign matter in

Do not insert metal and inflammable materials into the product from its vent and spill water on it.
Otherwise, electric shock or fire may occur.

■ Warning item on abnormality while in use

If smoke or fire is generated from the product while in use, stop using the product, turn off the switch, and remove the power cord plug from the outlet. After confirming that no other devices catch fire, ask us or your local dealer.

■ Input / Output terminals

Maximum input to terminal is specified to prevent the product from being damaged.
Do not supply input, exceeding the specifications that are indicated in the "Rating" column in the instruction manual of the product. Also, do not supply power to the output terminals from the outside.
Otherwise, a product failure is caused.

■ Calibration

Although the performance and specifications of the product are checked under strict quality control during shipment from the factory, they may be deviated more or less by deterioration of parts due to their aging or others.
It is recommended to periodically calibrate the product so that it is used with its performance and specifications stable.
For consultation about the product calibration, ask us or your local dealer.

■ Daily Maintenance

When you clean off the dirt of the product covers, panels, and knobs, avoid solvents such as thinner and benzene. Otherwise, the paint may peel off or resin surface may be affected. To wipe off the covers, panels, and knobs, use a soft cloth with neutral detergent in it.
During cleaning, be careful that water, detergents, or other foreign matters do not get into the product.
If a liquid or metal gets into the product, an electric shock and fire are caused.
During cleaning, remove the power cord plug from the outlet.

Use the product correctly and safely, observing the above warning and caution items.
Because the instruction manual indicates caution items even in individual items, observe those caution items to correctly use the product.

If you have questions or comments about the manuals, ask us or E-Mail us.

1. GENERAL INFORMATION

This user's manual contains the operating instructions, installation instructions and specifications of the PU 750W power supply series. The instructions refer to the standard power supplies, including the built-in RS232/485 serial communication. For information related to operation with the optional GP-IB programming.

◆ Refer to User Manual for Power Supply GP-IB programming Interface.

PU power supplies are wide output range, high performance switching power supplies. The PU series is power factor corrected and operates from worldwide AC voltage range continuously. Output voltage and current are continuously displayed and LED indicators show the complete operating status of the power supply. The Front panel controls allow the user to set the output parameters, the protection levels (Over-Voltage protection, Under-Voltage limit and Foldback) and preview the settings. The rear panel includes the necessary connectors to control and monitor the power supply operation by remote analog signals or by the built-in serial communication (RS232/485). GP-IB programming and Isolated-Analog programming/monitoring are optional.

1-1. Features and options

- Constant Voltage / Constant Current with automatic crossover.
- Harmonics current control circuit built-in and EN61000-3-2 class A conformity (Power factor 0.99 [with a built-in active filter]).
- Universal Input Voltage 85-265V AC, continuous operation.
- Embedded Microprocessor Controller.
- Built in RS232/485 Interface.
- Voltage & Current high resolution adjustment by digital encoders.
- High accuracy programming/readback-16 bit.
- Software Calibration (no internal trimmers / potentiometers).
- Last Setting Memory.
- Independent Remote ON/OFF (opt-isolated) and Remote Enable/Disable.
- Parallel operation (Master/Slave) with Active current sharing.
- Remote sensing to compensate for voltage drop of power leads.
- Cooling fan speed control for low noise and extended fan life.
- Zero stacking- no ventilation holes at the top and bottom surface of the power supply.
- Optional GP-IB interface (SCPI compatible).
- Optional Isolated Analog programming/monitoring (0V to 5V or 0V to 10V, user selectable and 4mA to 20mA).
- The PU power supplies series can be configured into a programmable power system of up to 31 units using the built-in RS232/RS485 communication port in the power supply and the RS485 linking cable provided with each power supply.
- In a GP-IB system, each power supply can be controlled using the optional GP-IB controller (factory installed).
- PU power supplies of the same output voltage and current rating can be paralleled in master-slave configuration with automatic current sharing to increase power available.

1-2. Analog voltage programming and monitoring

Analog inputs and outputs are provided at the rear panel for analog control of the power supply. The output voltage and the current limit can be programmed by analog voltage or by resistor, and can be monitored by analog voltage. The power supply output can be remotely set to On or Off and analog signals monitor the proper operation of the power supply and the mode of operation (CV/CC).

1-3. Control via the serial communication port

The following parameters can be programmed via the serial communication port:

1. Output voltage setting.
2. Output current setting.
3. Output voltage measurement.
4. Output current measurement.
5. Output on/off control.
6. Foldback protection setting.
7. Over-voltage protection setting and readback.
8. Under-Voltage limit setting and readback.
9. Power-supply start up mode (last setting or safe mode).

1-4. Output connections

Output connections are made to rear panel bus-bars for models up to 60V and to a 4-terminal wire clamp connector for models above 60V rated output voltage. Either the positive or negative terminal may be grounded or the output may be floated. Models up to 60VDC Rated Output shall not float outputs more than ±60VDC above/below chassis ground. Models >60VDC Rated Output shall not float outputs more than ±600VDC above/below chassis ground. Contact factory for assistance with higher float voltage applications.

Local or remote sense may be used. In remote sense, the voltage drop on the load wires should be minimized.

◆ Refer to "APPENDIX C SPECIFICATIONS". for the maximum voltage drop value.

1-5. Cooling and mechanical construction

The PU series is cooled by internal fans. At the installation, care must be taken to allow free airflow into the power supply via the front panel and out of the power supply via the rear panel. The PU power supplies have a compact and lightweight package, which allows easy installation and space saving in the application equipment.

Observe all torque guidelines within this manual. Over torque may damage unit or accessories. Such damage is not covered under manufacturers warranty.

1-6. Models covered by this manual

Table1-1: Models covered by the manual

Model	Voltage range (V)	Current range (A)	Model	Voltage range (V)	Current range (A)
PU6-100	0 to 6	0 to 100	PU60-12.5	0 to 60	0 to 12.5
PU8-90	0 to 8	0 to 90	PU80-9.5	0 to 80	0 to 9.5
PU12.5-60	0 to 12.5	0 to 60	PU100-7.5	0 to 100	0 to 7.5
PU20-38	0 to 20	0 to 38	PU150-5	0 to 150	0 to 5
PU30-25	0 to 30	0 to 25	PU300-2.5	0 to 300	0 to 2.5
PU40-19	0 to 40	0 to 19	PU600-1.3	0 to 600	0 to 1.3

2. PRIOR TO USE

2-1. Initial inspection

Prior to shipment this power supply was inspected and found free of mechanical or electrical defects. Upon unpacking of the power supply, inspect for any damage, which may have occurred in transit. The inspection should confirm that there is no exterior damage to the power supply such as broken knobs or connectors and that the front panel and meters face are not scratched or cracked. Keep all packing material until the inspection has been completed. If damage is detected, file a claim with carrier immediately and notify our agent nearest you.

2-2. Accessories

Make sure the accessories are attached correctly. If there are any problems, please contact one of our sales branches. Accessories vary by model.

◆ Refer to "APPENDIX D ACCESSORIES".

2-3. Installation

This section contains instructions for initial inspection, preparation for use and repackaging for shipment. Connection to PC, setting the communication port and linking PU power supplies are described in

◆ Refer to "6. RS232 & RS485 REMOTE CONTROL".

PU power supplies generate magnetic fields, which might affect the operation of other instruments.
If your equipment is susceptible to magnetic fields, do not position it adjacent to the power supply.

2-4. Preparation for use

In order to be operational the power supply must be connected to an appropriate AC source. The AC source voltage should be within the power supply specification.

◆ Do not apply power before reading, "2-7. AC source requirements", "2-8. AC input power connection".

Table 2-1 below, describes the basic setup procedure. Follow the instructions in Table 2-1 in the sequence given to prepare the power supply for use.

Table 2-1: Basic setup procedure

Step No.	Item	Description	Reference
1	Inspection	Initial physical inspection of the power supply	2-1. Initial inspection
2	Installation	Installing the power supply, Ensuring adequate ventilation.	2-5. Rack mounting 2-6. Location, mounting and cooling
3	AC source	AC source requirements Connecting the power supply to the AC source.	2-7. AC source requirements 2-8. AC input power connection
4	Test	Turn-on checkout procedure.	2-9. Turn-on checkout procedure
5	Load connection	Wire size selection. Local /Remote sensing. Single or multiple loads.	2-10-6. Making the load connections
6	Default setting	The power supply setting at shipment.	6-1-1. Default setting

2-5. Rack mounting

Contact our service center.　When Rack Mounting Kit is required.

2-6. Location, mounting and cooling

This power supply is fan cooled.　The air intake is at the front panel and the exhaust is at the rear panel.
Upon installation allow cooling air to reach the front panel ventilation inlets.　Allow minimum 15cm of unrestricted air space at the front and the rear of the unit.　The power supply should be used in an area that the ambient temperature does not exceed +50°C.

2-7. AC source requirements

The PU series can be operated from a nominal 100V to 240V, single phase, 47Hz to 63Hz.

- ◆ The input voltage range and current required for each model is specified in "APPENDIX C SPECIFICATIONS".
- ◆ Ensure that under heavy load, the AC voltage supplied to the power supply does not fall below the specifications described in "APPENDIX C SPECIFICATIONS".

2-8. AC input power connection

Connection of this power supply to an AC power source should be made by an electrician or other qualified personnel.
There is a potential shock hazard if the power supply chassis (with cover in place) is not connected to an electrical safety ground via the safety ground in the AC input connector.
Some components inside the power supply are at AC voltage even when the On/Off switch is in the "Off" position.　To avoid electric shock hazard, disconnect the line cord and load and wait two minutes before removing cover.

2-8-1. AC input connector

An IEC connector is provided on the rear panel for connecting the unit to the AC power source with an AC cord.
The IEC connector also provides the safety ground connection while the AC cord is plugged into an appropriate AC receptacle.

2-8-2. AC input cord

The AC input cord is the disconnect device of the power supply. The plug must be readily identifiable and accessible to the user.　The AC input cord must be no longer than 3m.

2-8-3. Time to heat beforehand

In order to obtain the performance of regulation of this machine, please carry out aging 30 minutes or more.

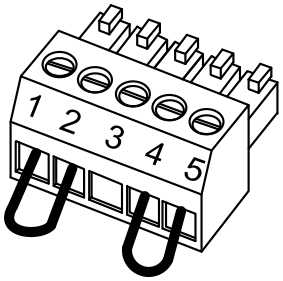
2-9. Turn-on checkout procedure

The following procedure ensures that the power supply is operational and may be used as a basic incoming inspection check. Refer to Fig.3-1 and Fig.3-2 for the location of the controls indicated in the procedure.

2-9-1. Prior to operation

1. Ensure that the power supply is configured to the default setting:
   - AC On/Off switch at Off position.
   - Dip switch : All positions at Down (”Off”) position.
   - Sense connector : Configured to Local Sense as shown in Fig.2-1:

Plug P/N: MC 1.5/5-ST-3.81 (Phoenix)



1	Remote (+) sense	+S
2	Local (+) sense	+LS
3	Not connected	
4	Local (-) sense	-LS
5	Remote (-) sense	-S

Fig.2-1: Sense connector default connection

   - For units equipped with GP-IB option, ensure that the GP-IB_En switch is in Up (default) position, if checkout is to be done in GP-IB mode.

2. Connect the unit to an AC source.
3. Connect a DVM with appropriate cables for the rated voltage to the output terminals.
4. Turn the front panel AC power switch to On.

2-9-2. Constant voltage check

1. Turn on the output by pressing OUTPUT pushbutton so the OUTPUT LED illuminates.
2. Observe the power supply VOLT display and rotate the Voltage encoder. Ensure that the output voltage varies while the VOLT encoder is rotated. The minimum control range is from zero to the maximum rated output for the power supply model. Compare the DVM reading with the front panel VOLT display to verify the accuracy of the VOLT display. Ensure that the front panel CV LED is on.
3. Turn off the front panel AC power switch.

2-9-3. Constant current check

1. Ensure that the front panel AC power switch is at Off position and the DVM connected to the output terminals shows zero voltage.
2. Connect a DC shunt across the output terminals. Ensure that the shunt and the wires' current ratings are higher than the power supply rating. Connect a DVM to the shunt.
3. Turn the front panel AC power switch to on position.
4. Turn on the output by pressing OUTPUT pushbutton so the OUTPUT LED illuminates.
5. Observe the power supply CURRENT display and rotate the CURRENT encoder. Ensure that the output current varies while the CURRENT encoder is rotated. The minimum control range is from zero to the maximum rated output for the power supply model.
6. Compare the DVM reading with the front panel CURRENT display to verify the accuracy of the CURRENT display. Ensure that the front panel CC LED is on.
7. Turn off the front panel AC power switch.
8. Remove the shunt from the power supply output terminals.

2-9-4. OVP check

◆ Refer to "4-2. Over voltage protection (OVP)".

1. Turn the front panel AC power switch to On position and turn on the output by pressing OUTPUT pushbutton.
2. Using the VOLT encoder, adjust the output voltage to approx.10% of the unit voltage rating.
3. Momentarily press the OVP/UVL button so that the CURRENT display shows “OUP”.
   The VOLTAGE display will show the last setting of the OVP level.
4. Rotate the VOLT encoder CCW to adjust the OVP setting to 50% of the unit voltage rating.
5. Wait a few seconds until the VOLT display returns to show the output voltage.
6. Adjust the output voltage toward it’s maximum and check that the output voltage cannot be increased more than the OVP setting.
7. Adjust OVP limit to the maximum by repeating step 3 and rotating the VOLT encoder CW.

2-9-5. UVL check

◆ Refer to "5-3. Remove voltage programming of output voltage and current limit".

1. Press the OVP/UVL button TWICE so that the CURRENT display shows "UUL". The VOLTAGE display will show the last setting of the UVL level.
2. Rotate the VOLT encoder to adjust the UVL level to approx.10% of the unit voltage rating.
3. Wait a few seconds until the VOLT display returns to show the output voltage.
4. Adjust the output voltage toward it’s minimum and check that the output voltage cannot be decreased below the UVL setting.
5. Adjust the UVL limit to the minimum by repeating step1 and rotating the VOLT encoder CCW.

2-9-6. Foldback check

Shorting the output may expose the user to hazardous voltages. Observe proper safety procedures.

◆ Refer to "4-4. Foldback protection".

1. Ensure that the output voltage is set to approx. 10% of the unit rating.
2. Adjust the CURRENT encoder to set the current limit to approx. 10% of the unit rating.
3. Momentarily press the FOLD button. Ensure that the FOLD LED illuminates. The output voltage remains unchanged.
4. Short the output terminals momentarily (approx. 0.5 sec.). Ensure that the output voltage falls to zero, the VOLT display shows “Fb” and the ALARM LED blinks.
5. Press the FOLD button again to cancel the protection. The output voltage remains zero.
6. Press OUTPUT button. Ensure that the output voltage returns to it’s last setting.
7. Turn the output off by pressing OUTPUT button. Ensure that the VOLT display shows “OFF”.

2-9-7. Address setting

1. Press and hold the RMT／LCL button for approx. 3sec. The VOLT display will show the communication port address.
2. Using the VOLT adjust encoder, check that the address can be set within the range of 0 to 30.

2-9-8. Baud rate setting

1. Press and hold the RMT/LCL button for approx. 3sec. The CURRENT display will show the communication port Baud Rate.
2. Using The CURRENT adjust encoder, check that the Baud Rate can be set to 1200, 2400, 4800, 9600 and 19200.

2-10. Connecting the load

Turn off the AC input power before making or changing any rear panel connection. Ensure that all connections are securely tightened before applying power. There is a potential shock hazard when using a power supply with a rated output greater than 40V.

2-10-1. Load wiring

The following considerations should be made to select wiring for connecting the load to the power supply:

- Current carrying capacity of the wire.
  - ◆ Refer to "2-10-2. Current carrying capacity".
- Insulation rating of the wire should be at least equivalent to the maximum output voltage of the power supply.
- Maximum wire length and voltage drop.
  - ◆ Refer to "2-10-2. Current carrying capacity".
- Noise and impedance effects of the load wiring.
  - ◆ Refer to "2-10-4. Noise and impedance effects".

2-10-2. Current carrying capacity

Two factors must be considered when selecting the wire size:

1. Wires should be heavy enough not to overheat while carrying the power supply load current at the rated load, or the current that would flow in the event the load wires were shorted, whichever is greater.
2. Wire size should be selected to enable voltage drop per lead to be less than 1.0V at the rated current. Although units will compensate for up to 5V in each load wire, it is recommended to minimize the voltage drop (1V typical maximum) to prevent excessive output power consumption from the power supply and poor dynamic response to load changes. Please refer to Tables 2-2 and 2-3 for maximum wire length to limit voltage drop in American and European dimensions respectively.

Table 2-2: Maximum wire length for 1V drop on lead (in AWG)

Wire size AWG	Resistivity Ω/km	Maximum length in meters to limit voltage drop to 1V or less				
		5A	10A	20A	50A	150A
14	8.287	24.4	12.2	6.1	2.4	0.8
12	5.213	36.6	18.3	9.1	3.7	1.2
10	3.2789	61.0	30.5	15.2	6.1	2.0
8	2.0620	97.6	48.8	24.4	9.8	3.3
6	1.2969	152.4	76.2	38.1	15.2	5.1
4	0.8156	243.8	121.9	61.0	24.4	8.1
2	0.5131	365.8	182.9	91.4	41.1	13.7
0	0.3225	609.6	304.8	152.4	61.0	20.3

Table 2-3: Maximum wire length for 1V drop on lead (in meters)

Cross sect. Area (mm^2)	Resistivity Ω/km	Maximum length in meters to limit voltage drop to 1V or less				
		5A	10A	20A	50A	150A
2.5	8.21	24.0	12.0	6.0	2.4	0.8
4	5.09	39.2	18.6	9.8	4.0	1.4
6	3.39	59.0	29.4	14.8	5.8	2.0
10	1.95	102.6	51.2	25.6	10.2	3.4
16	1.24	160.0	80.0	40.0	16.0	5.4
25	0.795	250.0	125.0	62.0	25.2	8.4
35	0.565	354.0	177.0	88.0	35.4	11.8

For currents not shown in Table 3-2 and 3-3, use the formula:

Maximum length=1000/(current x resistivity)

where current is expressed in Amperes and resistivity in ohms/km.

2-10-3. Wire termination

The wires should be properly terminated with terminals securely attached. DO NOT use unterminated wires for load connection at the power supply.

When local sensing, a short from +LS or +S to -V or -S or -LS, will cause damage to the power supply. Reversing the sense wires might cause damage to the power supply in local and remote sensing. (Do not connect -S to +V or +S to -V).

2-10-4. Noise and impedance effects

To minimize the noise pickup or radiation, the load wires and remote sense wires should be twisted pairs to the shortest possible length. Shielding of sense leads may be necessary in high noise environments. Where shielding is used, connect the shield to the chassis via a rear panel Ground screw. Even if noise is not a concern, the load and remote sense wires should be twisted-pairs to reduce coupling, which might impact the stability of power supply. The sense leads should be separated from the power leads. Twisting the load wires reduces the parasitic inductance of the cable which could produce high frequency voltage spikes at the load and the output of power supply, because of current variation in the load itself. The impedance introduced between the power supply output and the load could make the ripple and noise at the load worse than the noise at the power supply rear panel output. Additional filtering with bypass capacitors at the load terminals may be required to bypass the high frequency load current.

2-10-5. Inductive loads

Inductive loads can produce voltage spikes that may be harmful to the power supply. A diode should be connected across the output. The diode voltage and current rating should be greater than the power supply maximum output voltage and current rating. Connect the cathode to the positive output and the anode to the negative output of the power supply. Where positive load transients such as back EMF from a motor may occur, connect a surge suppressor across the output to protect the power supply. The breakdown voltage rating of the suppressor must be approximately 10% higher than the maximum output voltage of the power supply.

2-10-6. Making the load connections

WARNING

Hazardous voltages exist at the outputs and the load connections when using a power supply with a rated output greater than 40V. To protect personnel against accidental contact with hazardous voltages, ensure that the load and its connections have no accessible live parts. Ensure that the load wiring insulation rating is greater than or equal to the maximum output voltage of the power supply.

CAUTION

Ensure that the load wiring mounting hardware does not short the output terminals. Heavy connecting cables must have some form of strain relief to prevent loosening the connections or bending the bus-bars.

6V to 60V Models

Refer to Fig.2-2 for connection of the load wires to the power supply bus-bars and to Fig.2-3 for mounting the bus-bars shield to the chassis.

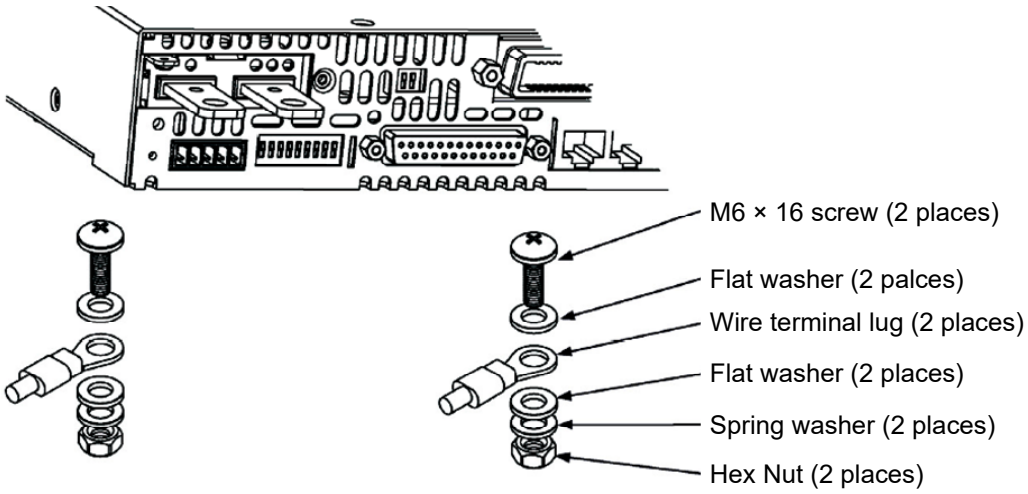


Fig. 2-2: Load wires connection, 6V to 60V models.

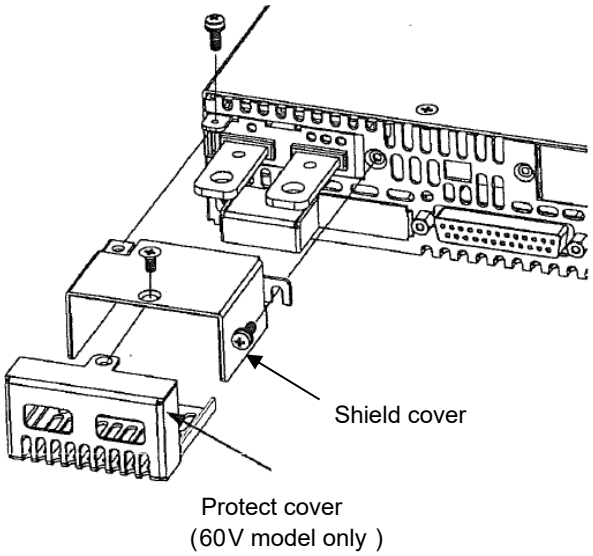


Fig. 2-3: Bus-bars shield mounting

80V to 600V Models

WARNING

Hazardous voltages exist at the outputs and the load connections. To protect personnel against accidental contact with hazardous voltages, ensure that the load and its connections have no accessible live parts.
Ensure that the load wiring insulation rating is greater than or equal to the maximum output voltage of the power supply.

The 80V to 600V models have a four terminal wire clamp output connector. The two left terminals are the positive outputs and the other two right terminals are the negative outputs. The connector requirements are as follows:

- Connector type: GIC-2.5/4-G-7.62 (Phoenix).
- Plug type: GIC-2.5/4- ST-7.62 (Phoenix).
- Wires: AWG12 to AWG24.
- Tightening torque: 0.55 to 0.59Nm (5.6 to 6.1kgf·cm).

Follow the below instructions for connection of the load wires to the power supply:

1. Strip approx.10mm at the end of each of the wires.
2. Loosen the mating connector terminal screws.
3. Insert the stripped wires into the terminal and tighten the terminal screw securely (see Fig.2-4).

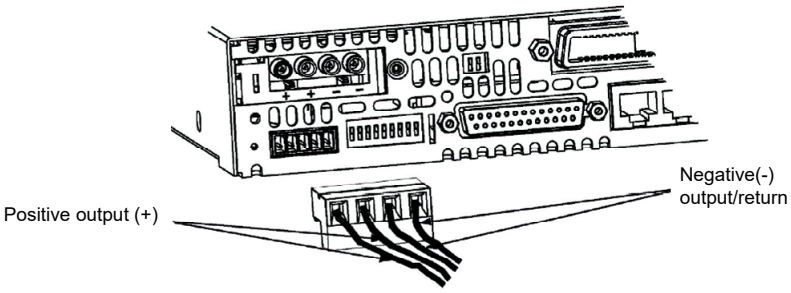


Fig.2-4: Load wires connection to the output connector

4. Loosen the chassis screw marked “A” halfway as shown in Fig.2-5.
5. Assemble the protective shield to the chassis and tighten the two screws to fix the shield to the chassis. Screws tightening torque:0. 50Nm to 0.59Nm (5.1kgf.cm to 6.1kgf·cm).

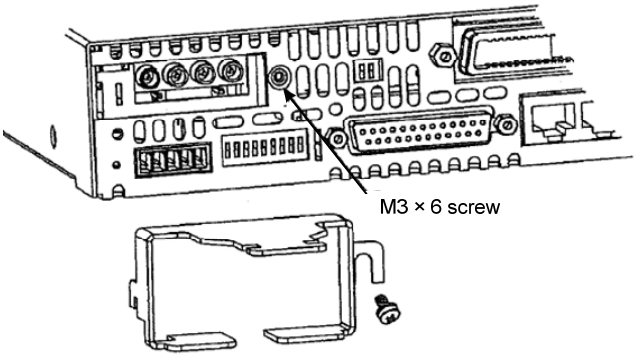


Fig.2-5: Shield assembly

6. Tighten the wires to one of the shield sides using ty-wrap or equivalent. Refer to Fig.2-6. Ensure that the wire length inside the shield is long enough to provide strain relief.

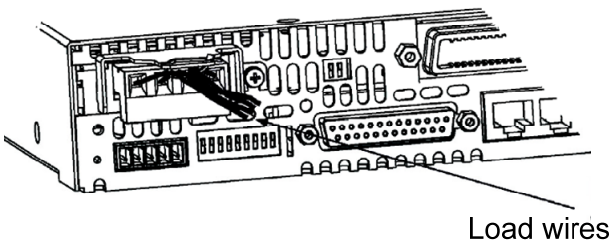


Fig.2-6: Protective shield and wires assembly

2-10-7. Connecting single loads, local sensing (default)

Fig.2-7 shows recommended load and sensing connections for a single load. The local sense lines shown are default connections at the rear panel J2 sense connector. Local sensing is suitable for applications where load regulation is less critical.

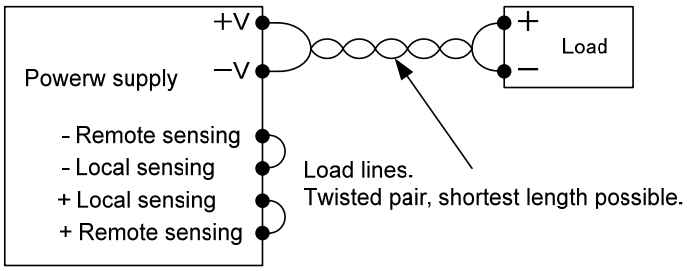


Fig.2-7: Single load connection, local sensing

2-10-8. Connecting single loads, remote sensing

Fig.2-8 shows recommended remote sensing connection for single loads.
Remote sensing is used when, in Constant Voltage mode, the load regulation is important at the load terminals.
Use twisted or shielded wires to minimize noise pick-up. If shielded wires are used, the shield should be connected to the ground at one point, either at the power supply chassis or the load ground. The optimal point for the shield ground should be determined by experimentation.

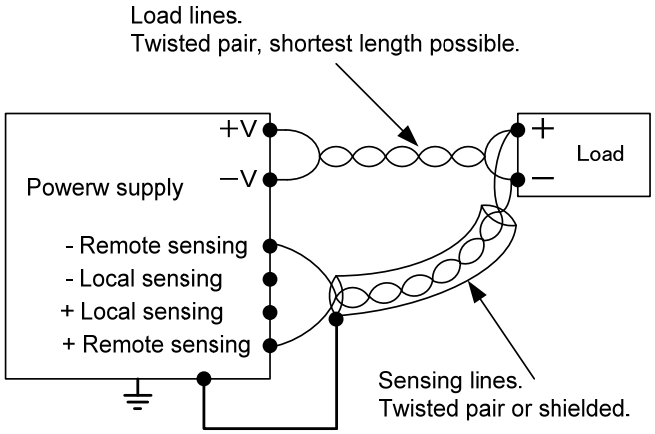


Fig.2-8: Remote sensing, single load

2-10-9. Connecting multiple loads, radial distribution method

Fig.2-9 shows multiple loads connected to one supply. Each load should be connected to the power supply's output terminals using separate pairs of wires. It is recommended that each pair of wires will be as short as possible and twisted or shielded to minimize noise pick-up and radiation.

The sense wires should be connected to the power supply output terminals or to the load with the most critical load regulation requirement.

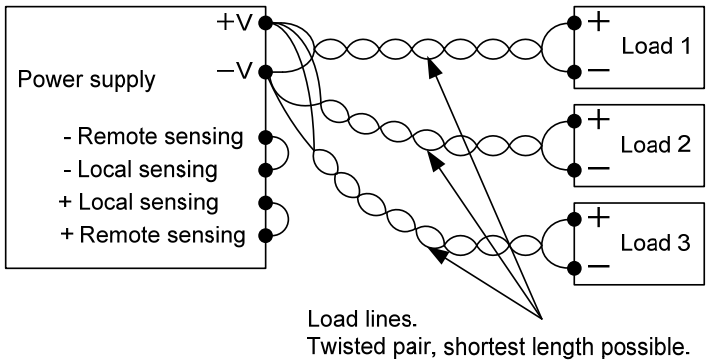


Fig.2-9: Multiple loads connection, radial distribution, local sense

2-10-10. Multiple load connection with distribution terminals

If remotely located output distribution terminals are used, the power supply output terminals should be connected to the distribution terminals by a pair of twisted and/or shielded wires. Each load should be separately connected to the remote distribution terminals (see Fig.2-10). If remote sensing is required, the sensing wires should be connected to the distribution terminals or at the most critical load.

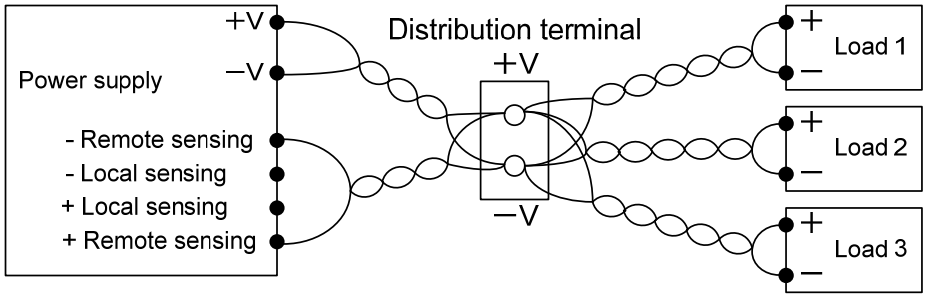


Fig.2-10: Multiple loads connection with distribution terminal

2-10-11. Grounding outputs

Either the positive or negative output terminals can be grounded. To avoid noise problems caused by common-mode current flowing from the load to ground, it is recommended to ground the output terminal as close as possible to the power supply chassis ground. Always use two wires to connect the load to the power supply regardless of how the system is grounded.

Models up to 60VDC Rated Output shall not float outputs more than ±60VDC above/below chassis ground. Models > 60VDC Rated Output shall not float outputs more than ±600VDC above/below chassis ground.

OUTPUT TERMINAL GROUNDING

There is a potential shock hazard at the RS232/485 and the GP-IB ports when using power supplies with rated or combined voltage greater than 400V with the Positive Output of the power supplies is grounded. Do not connect the Positive Output to ground when using the RS232/485 or GP-IB under the above conditions.

2-11. Local and remote sensing

The rear panel J2 sense connector is used to configure the power supply for local or remote sensing of the output voltage. Refer to Fig.2-11 for sense connector location.

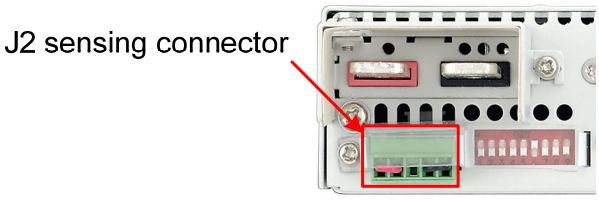


Fig.2-11: Sense connector location

There is a potential shock hazard at the sense connector when using a power supply with a rated output voltage greater than 40V. Local sense and remote sense wires should have a minimum insulation rating equivalent or greater than the maximum output voltage of the power supply. Ensure that the connections at the load end are shielded to prevent accidental contact with hazardous voltages.

2-11-1. Local sensing

The power supply is shipped with the rear panel J2 sense connector wired for local sensing of the output voltage. See Table 2-4 for J2 terminals assignment. With local sensing, the output voltage regulation is made at the output terminals. This method does not compensate for voltage drop on the load wires, therefore it is recommended only for low load current applications or where the load regulation is less critical.

Table 2-4 for J2 terminals assignment

Terminal	Marks	Function
J2-1	+S	Remote positive sense.
J2-2	+LS	Local positive sense. Connected internally to the positive output terminal.
J2-3	NC	Not connected.
J2-4	-LS	Local negative sense. Connected internally to the negative output terminal.
J2-5	-S	Remote negative sense.

2-11-2. Remote sensing

There is a potential shock hazard at the sense point when using power supply with a rated output voltage greater than 40V. Ensure that the connections at the load end are shielded to prevent accidental contact with hazardous voltages.

When using shielded sense wires, ground the shield in one place only. The location can be the power supply chassis or one of the output terminals.

Use remote sense where the load regulation at the load end is critical. In remote sense, the power supply will compensate for voltage drop on the load wires.

◆ Refer to "APPENDIX C SPECIFICATIONS" for the maximum voltage drop on load wires.

The voltage drop is subtracted from the total voltage available at the output. Follow the instructions below to configure the power supply for remote sensing:

1. Ensure that the AC On/Off is in the Off position.
2. Remove the local sense jumpers from J2.
3. Connect the negative sense lead to terminal J2-5 (-S) and the positive sense lead to terminal J2-1 (+S) of the J2 mating connector. Ensure that the J2 mating connector is plugged securely into the rear panel sense connector, J2.
4. Turn On the power supply.

1. **If the power supply is operating in remote sense and either the positive or negative load wire is not connected, an internal protection circuit will activate and shut down the power supply. To resume operation, turn the AC On/Off to the Off position, connect the open load wire, and turn On the power supply.**
2. **If the power supply is operated without the remote sense lines or local sense jumpers, it will continue to work, but the output voltage regulation will be degraded. Also, the OVP circuit may activate and shut down the power supply.**

2-11-3. J2 sense connector technical information

- J2 connector type : MC1.5/5-G-3.81, Phoenix.
- Plug type : MC1.5/5-ST-3.81, Phoenix.
- Wire AWG : 28 up to 16.
- Stripping length : 7mm.
- Tightening torque : 0.22Nm to 0.25Nm (2.2kgf.cm to 2.6kgf･cm).

3. FRONT AND REAR PANEL CONTROLS AND CONNECTORS

3-1. Front panel controls and indicators

See Fig.3-1 to review the controls, indicators and meters located on the power supply front panel.

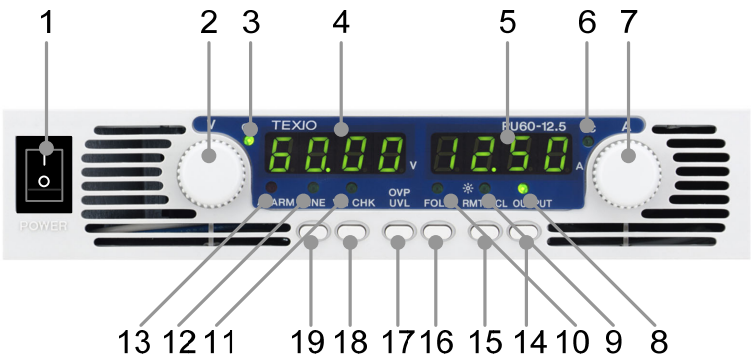


Fig.3-1: Front panel controls and indicators (PU60-12.5 Model)

1. AC power switch

- AC On/Off control.

2. VOLTAGE control

- High resolution rotary encoder for adjusting the Output Voltage. Also adjusts the OVP/UVL levels and selects the Address.
  - ◆ Refer to "4-1-1. Constant voltage mode", "4-2-1. Setting the OVP level", "4-3-1. Setting the UVL level" and "6-1-2. Address setting".

3. CV indicator

- Green LED, lights for Constant-Voltage mode operation.

4. VOLTAGE display

- 4 digit, 7-segment LED display, Normally displays the output voltage. When the V/I CHK button is pressed, the display indicates the programmed setting of the output voltage. When the OVP/UVL button is pressed, the Voltage display indicates the OVP/UVL setting.

5. CURRENT display

- 4 digit, 7-segment LED display, Normally displays the output current. When the V/I CHK button is pressed, the display indicates the programmed setting of output current.

6. CURRENT display

- Green LED, lights for Constant-Current mode operation.

7. CURRENT control

- High resolution rotary encoder for adjusting the Output Current. Also selects the Baud-Rate of the communication port.
  - ◆ "4-1-2. Constant current operation" and "6-1-4. Baud rate setting".

8. OUTPUT indicator

- Green LED, lights when the DC output is enabled.

9. RMT/LCL indicator

- Green LED, lights when the unit is in Remote mode.

10. FOLD indicator

- Green LED, lights when Foldback protection is On.

11. V/I CHK indicator

- Green LED, lights when V/I CHK button is pressed.

12. FINE indicator

- Green LED, lights when the unit is in Fine mode.

13. ALARM indicator

- Red LED, blinks in case of fault detection. OVP, OTP Foldback, Enable and AC fail detection will cause the ALARM LED to blink.

14. OUTPUT button

- **Main function:**

Output ON/OFF control. Press OUTPUT to set the output On or OFF. Press to reset and turn On the output after OVP or FOLD alarm events have occurred.

◆ Refer to "4-5. Output ON/OFF control".

- **Auxiliary function:**

Selects between “Safe-Start” and ”Auto-Restart” modes.

Press and hold OUTPUT button to toggle between “Safe-Start” and “Auto-Restart”. The VOLT display will cycle between “SAF” and “AUT”. Releasing the OUTPUT button while one of the modes is displayed, selects that mode.

◆ Refer to "4-10. Safe start and auto-restart modes".

15. RMT/LCL button

- **Main function:**

Go to local. Press RMT/LCL to put the unit into Local (RMT/LCL button is disabled at Local Lockout mode).

◆ Refer to "6-1-5. Setting the unit into Remote or Local mode".

- **Auxiliary function:**

Address and Baud Rate setting. Press and hold RMT/LCL for 3sec. To set the Address with the VOLTAGE encoder and the Baud Rate with the CURRENT encoder.

◆ Refer to "6-1-2. Address setting" and "6-1-4. Baud rate setting".

16. FOLD button

- Foldback protection control.
- Press FOLD to set Foldback protection to On.

To release Foldback alarm event, press OUT to enable the output and re-arm the protection. Press FOLD again to cancel the Flocdback protection.

◆ Refer to "4-4. Foldback protection".

17. OVP/UVL button

- Over Voltage Protection and Under Voltage limit setting.

Press once to set OVP using VOLTAGE encoder (the current display shows “OUP”). Press again to set the UVL using VOLTAGE encoder (the current display shows “UUL”).

◆ Refer to "4-2. Over voltage protection (OVP)" and "4-3. Under voltage limit (UVL)".

18. V/I CHK button

- **Main function:**

Press V/I CHK to display the output voltage and current limit setting. For 5 sec. The display will show the setting and than it will return to show the actual output voltage and current.

◆ Refer to "4-16. Front panel locking".

- **Auxiliary function:**

Front Panel Lock. Press and hold V/I CHK button to toggle between “Locked from panel” and “Unlocked front panel”. The display will cycle between “LFP” and “UFP”.

Releasing the V/I CHK button while one of the modes is displayed, selects that mode.

◆ Refer to "4-16. Front panel locking".

19. FINE button

- Voltage and Current Fine/Coarse adjustment control. Operates as a toggie switch. In Fine mode, the VOLTAGE and CURRENT encoders operate with high resolution and in Coarse mode with lower resolution (approx. 6 turns).

3-2. Rear panel

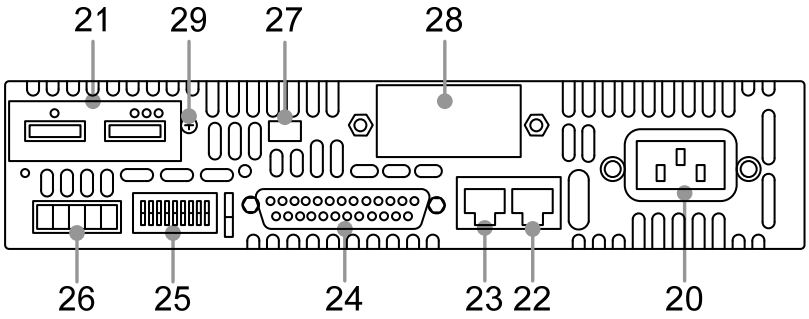
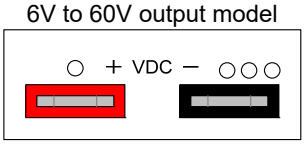
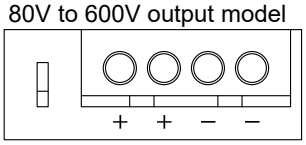


Fig.3-2: Rear panel connections and controls (PU60-12.5 Model)

20. AC input connector
  - IEC connector
    ◆ Refer to "2-8-1. AC input connector".
21. DC output
  - Bus-bars for 6V to 60V models.
  - Wire clamp connector for 80V to 600V models.
    ◆ Refer to "2-10-6. Making the load connections".





22. Remote-In connector
  - RJ-45 type connector, use for connecting power supplies to RS232 or RS485 port of computer for remote control purposes. When using several power supplies in a power system, the first unit Remote-In is connected to the computer and the remaining units are chained, Remote-In to Remote-Out.
    ◆ Refer to "6-2. RS232/485 connector" and "6-3. Connecting power supply to RS232 or RS485 bus".
23. Remote Out connector
  - RJ-45 type connector, used for chaining power supplies to form a serial communication bus.
    ◆ Refer to "6-2. RS232/485 connector" and "6-3. Connecting power supply to RS232 or RS485 bus".
24. Programming and monitoring connector
  - Connector for remote analog interface. Includes output voltage and current limit programming and monitoring signals, Shut-off control (electrical signal), Enable/Disable control (dry-contact), power supply ok (PS_OK) signal and operation mode (CV/CC) signal.
    ◆ Refer to "3-4. J1 programming and monitoring connector".
25. SW1 Setup switch
  - Nine position DIP switch for selecting remote programming and monitoring modes for Output Voltage, Current Limit and other control functions.
    ◆ Refer to "3-3. SW1 setup switch", "3-3-1. SW1 position functions" and "3-3-2. Resetting the SW1 switch".
26. Remote sense connector
  - Connector for making remote sensing connections to the load for regulation of the load voltage and compensation of load wire drop.
    ◆ Refer to "2-9-1. Prior to operation", "2-11-1. Local sensing" and "2-11-2. Remote sensing".
27. GP-IB switch
  - Two position DIP switch for selecting GP-IB mode or RS232/485 mode when GP-IB option is installed.
28. Blank Sub-plate
  - Blank sub-plate for standard units. Isolated Remote Analog programming connector for unit equipped with Isolated Analog control option. GP-IB connector for units equipped with GP-IB programming option
29. Ground screw
  - M4 x 8 screw for chassis ground connection.

3-3. SW1 setup switch

The SW1 Setup switch (see Fig.3-3) is a 9-position DIP switch that allows the user to choose the following:

- Internal or remote programming for Output Voltage and Current Limit.
- Remote voltage or resistive programming of Output Voltage and Output Current limit.
- Select range of remote voltage and resistive programming.
- Select range of Output Voltage and Output Current monitoring.
- Select the Remote Shut-Off control logic.
- Select between RS232 or RS485 communication interface.
- Enable or disable the rear panel Enable/Disable control (dry contact).

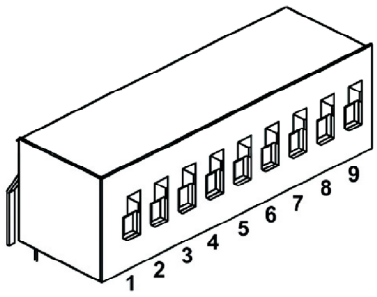


Fig.3-3: SW1 setup DIP switch

3-3-1. SW1 position functions

Refer to Table 3-1 for description of SW1 position functions. The factory default setting is Down for all positions.

Table 3-1: SW1 positions functions

Position	Function	Down(Factory default)	Up
SW1-1	Output Voltage remote analog programming	Output Voltage programmed by Front Panel	Output Voltage programmed by remote analog voltage
SW1-2	Output Current limit remote analog programming	Output Current limit programmed by Front Panel	Output current limit programmed by remote analog voltage
SW1-3	Programming range select (Remote voltage/resistive)	0V to 5V/(0kΩ to 5kΩ)	0V to 10V/(0kΩ to 10kΩ)
SW1-4	Output Voltage and Current Monitoring range	0V to 5V	0V to 10V
SW1-5	Shut Off logic select *1	On: High (2V to 15V) or Open Off: Low (0V to 0.6V) or Short	On: Low (0V to 0.6V) or Short Off: High (2V to 15V) or Open
SW1-6	RS232/485 select	RS232 interface	RS485 interface
SW1-7	Output Voltage resistive programming	Output Voltage programmed by Front Panel	Output Voltage programmed by external resistor
SW1-8	Output Current limit resistive programming	Output Current limit programmed by Front Panel	Output Current limit programmed by external resistor
SW1-9	Enable/Disable control *2	Rear panel Enable/Disable control is not active	Rear pane, Enable/Disable control is active

*1 Refer to "4-6. Output SHUT-OFF (SO) control via rear panel J1 connector".

*2 Refer to "4-7. ENABLE/DISABLE control via rear panel J1 connector".

3-3-2. Resetting the SW1 switch

Before making any changes to the SW1 switch setting, disable the power supply output by pressing the front panel OUTPUT button. Ensure that the output voltage falls to zero and OUTPUT LED is off, and then use any small flat-bladed screwdriver to change the SW1 switch setting.

3-4. J1 programming and monitoring connector

The J1 Programming and Monitoring connector is a DB25 subminiature connector located on the power supply rear panel.

◆ Refer to Table 4-4 for description of the connector functions.

The power supply default configuration is Local operation, which does not require connections to J1. For remote operation using J1 signals use the plug provided with power supply or equivalent type. It is essential to use plastic body plug to conform with Safety Agency requirements. If a shield is required for J1 wires, connect the shield to a power supply chassis ground screw.

3-4-1. Making J1 connections

- J1 connector type : AMP: 5747461-3
- Plug type: AMP : 745211-2.
- Wire dimension range : AWG26 to 22.
- Manual Pistol Grip tool : AMP Handle type : 58074-1
  : AMP Head type : 58063-2
- Insertion/Extraction tool : AMP 91232-1 or equivalent.

Before making any connection, turn the AC On/Off switch to the Off position and wait until the front.

Terminals 12, 22 and 23 of J1 are connected internally to the negative sense (-S) potential of the power supply. Do not attempt to bias any of these terminals relative to the negative sense. Use the Isolated Programming interface option to allow control from a programming source at a different potential relative to the power supply negative. To prevent ground loop and to maintain the isolation of the power supply when programming from J1, use an Ungrounded programming source.

There is a potential shock hazard at the output when using a power supply with rated output greater than 40V. Use wires with minimum insulation rating equivalent to the maximum output voltage of the power supply.

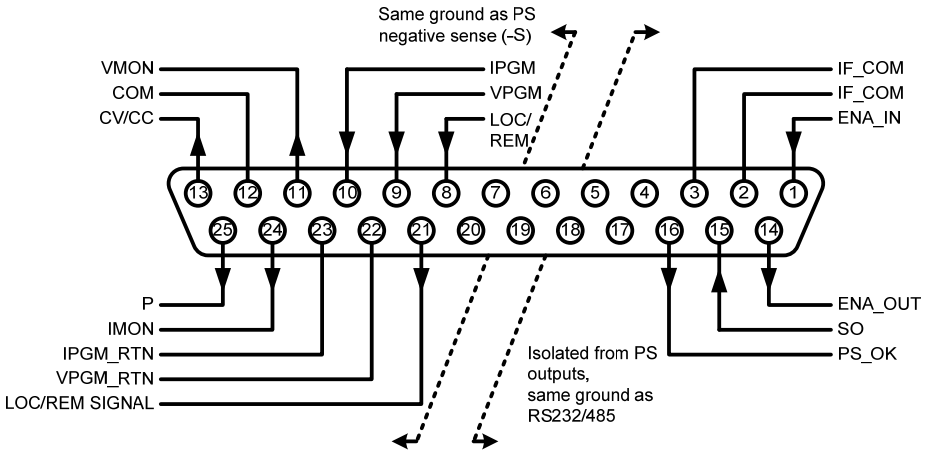


Fig.3-4: J1 connector terminals and functions

Table 3-2: J1 connector terminals and functions

J1 contact	Signal name	Function
J1-1	ENA_IN	Enable/Disable the power supply output by dry-contact (short/open). ◆ Refer to "4-7. ENABLE/DISABLE control via rear panel J1 connector".
J1-2 J1-3	IF_COM	Isolated Interface Common. Return for the SO control, PS_OK signal and for the optional GP-IB interface. ◆ Refer to "4-6. Output SHUT-OFF (SO) control via rear panel J1 connector". ◆ Refer to "4-9. PS_OK signal".
J1-4 to 7	N/C	No Connection
J1-8	LOCAL/ REMOTE	Input for selecting between Local or Remote analog programming of output voltage and output current. ◆ Refer to "5-1. LOCAL /REMOTE analog control".
J1-9	VPGM	Input for remote analog voltage/resistance programming of the Output Voltage. ◆ Refer to "5-3. Remove voltage programming of output voltage and current limit". ◆ Refer to "5-4. Resistive programming of output voltage and current".
J1-10	IPGM	Input for remote analog voltage/resistance programming of the Output Current. ◆ Refer to "5-3. Remove voltage programming of output voltage and current limit". ◆ Refer to "5-4. Resistive programming of output voltage and current".
J1-11	VMON	Output for monitoring the power supply Output Voltage. ◆ Refer to "5-5. Remote monitoring of output voltage and current".
J1-12	COM	Control Common. Return for VMON, IMON, CV/CC, RMT/LCL. Connected internally to the negative sense potential (-S).
J1-13	CV/CC	Output for Constant-Voltage/Constant-Current mode indication. ◆ Refer to "4-8. CV/CC signal".
J1-14	ENA_OUT	Enable/Disable the power supply output by dry-contact (short/open) with ENA_IN. ◆ Refer to "4-7. ENABLE/DISABLE control via rear panel J1 connector".
J1-15	SO	Input for Shut-Off control of the power supply output. ◆ Refer to "4-6. Output SHUT-OFF (SO) control via rear panel J1 connector".
J1-16	PS_OK	Output for indication of the power supply status. ◆ Refer to "4-9. PS_OK signal".
J1-17 to 20	N/C	No Connection
J1-21	LOC/REM SIGNAL	Output for indicating if the unit is in Local or Remote analog programming mode. ◆ Refer to "5-2. LOCAL/REMOTE analog indication".
J-22	VPGM_RTN	Return for VPGM input. Connected internally to the “-S”. ◆ Refer to "5-3. Remove voltage programming of output voltage and current limit". ◆ Refer to "5-4. Resistive programming of output voltage and current".
J1-23	IPGN_RTN	Return for IPGM input. Connected internally to the “-S”. ◆ Refer to "5-3. Remove voltage programming of output voltage and current limit". ◆ Refer to "5-4. Resistive programming of output voltage and current".
J1-24	IMON	Output for monitoring the power supply Output Current. ◆ Refer to "5-5. Remote monitoring of output voltage and current".
J1-25	P	Output for current balance in parallel operation. ◆ Refer to "4-14. Parallel operation".

4. LOCAL OPERATION

This Chapter describes the operating modes that are not involved in programming and monitoring the power supply via its serial communication port (RS232/RS485) or by remote analog signals. Ensure that the RMT/LCL on the front panel is off, indicating Local mode. If the RMT/LCL LED is on, press the front panel RMT/LCL button to change the operating mode to local.

◆ For information regarding remote analog programming refer to "5. REMOTE ANALOG PROGRAMMING".

◆ For information regarding usage of the serial communication port refer to "6. RS232 & RS485 REMOTE CONTROL".

4-1. Standard operation

The power supply has two basic operating modes: Constant Voltage Mode and Constant Current Mode. The mode in which the power supply operates at any given time depends on the output voltage setting, output current limit setting and the load resistance.

4-1-1. Constant voltage mode

1. In constant voltage mode, the power supply regulates the output voltage at the selected value, while the load current varies as required by the load.
2. While the power supply operates in constant voltage mode, the CVLED on the front panel illuminates.
3. Adjustment of the output voltage can be made when the power supply output is enabled (Output On) or disabled (Output Off). When the output is enabled, simply rotate the VOLTAGE encoder knob to program the output voltage. When the output is disabled, press the V/I CHK button and then rotate the VOLTAGE encoder knob.
   The VOLTAGE meter will show the programmed output voltage for 5 seconds after the adjustment has been completed. Then the VOLTAGE meter will display "OFF".
4. Adjustment resolution can be set to coarse or fine resolution.
   Press FINE button to select between the lower and higher resolution. The FINE LED turns On when the resolution is set to FINE.

If after completing the adjustment, the display shows a different value than the setting, the power supply may be at constant current made limit. Check the load condition and the power supply constant current made setting.
The maximum and minimum setting values of the output voltage are limited by the Over Voltage protection and Under Voltage limit setting.

◆ **Refer to "4-2. Over voltage protection (OVP)" and "4-3. Under voltage limit (UVL)".**

4-1-2. Constant current operation

1. In constant current mode, the power supply regulates the output current at the selected value, while the voltage varies with the load requirement.
2. While the power supply is operating in constant current mode, the CCLED on the front panel illuminates.
3. Adjustment of the output current limit can be made when the power supply output is enabled (Output On) or disabled (Output Off).
   - Disabled output (Off): Press V/I CHK button and then rotate the Current encoder knob. The CURRENT meter will show the programmed constant current made for 5 seconds after the adjustment has been completed. Then the VOLTAGE meter will display "OFF".
   - Enabled output, power supply in Constant Voltage mode: Press the V/I CHK button and then rotate the CURRENT encoder knob. The CURRENT meter will show the programmed constant current made for 5 seconds after the adjustment has been completed, and then will return to show the actual load current.
   - Enabled output, power supply in Constant Current mode: Rotate the CURRENT encoder knob to adjust the constant current made.
4. Adjustment resolution can be set to Coarse or Fine adjustment. Press the FINE button to select between the Coarse and Fine resolution. The FINE LED turns On when the resolution is set to FINE.

4-1-3. Automatic crossover

If the power supply operates in Constant Voltage mode, while the load current is increased to greater than the constant current made setting, the power supply will automatically switch to Constant Current mode. If the load is decreased to less than the current limit setting, the power supply will automatically switch back to Constant Voltage mode.

4-2. Over voltage protection (OVP)

The OVP circuit protects the load in the event of a remote or local programming error or a power supply failure. The protection circuit monitors the voltage at the power supply sense points and thus providing the protection level at the load. Upon detection of an Over Voltage condition, the power supply output will shut down.

4-2-1. Setting the OVP level

The OVP can be set when the power supply output is Enabled (On) or Disabled (Off). To set the OVP level, press the OVP/UVL button, so that the CURRENT meter shows "OUP".
The VOLTAGE meter shows the OVP setting level. Rotate the VOLTAGE encoder knob to adjust the OVP level. The display will show "OUP" and the setting value for 5 seconds after the adjustment has been completed and then will return to it's previous state.

Table 4-1: Maximum OVP setting levels

Model (V)	Max. OVP (V)	Model (V)	Max. OVP (V)
6	7.5	60	66.0
8	10.0	80	88.0
12.5	15.0	100	110.0
20	24.0	150	165.0
30	36.0	300	330.0
40	44.0	600	660.0

To preview the OVP setting, press OVP/UVL pushbutton so that the CURRENT display will show "OUP". At this time, the VOLTAGE display will show the OVP setting. After 5 seconds, the display will return to it's previous state.

4-2-2. Activated OVP protection indications

When the OVP is activated the power supply output shuts down. The VOLTAGE display shows "OUP" and the ALARM LED blinks.

4-2-3. Resetting the OVP circuit

To reset the OVP circuit after it activates:

1. Reduce the power supply Output Voltage setting below the OVP set level.
2. Ensure that the load and the sense wiring is connected properly.
3. There are four methods to reset the OVP circuit.
   - 3.1 Press OUTPUT button.
   - 3.2 Turn the power supply off using the AC On/Off switch, wait until the front panel display turns Off, then turn the power supply on using the AC On/Off switch.
   - 3.3 Turn the power supply output off and then On using the SO control. In this method the power supply should be set to Auto-Restart mode.
     - ◆ Refer to "4-6. Output SHUT-OFF (SO) control via rear panel J1 connector".
   - 3.4 Send OUT 1 command via the RS232/485 communication port.

4-3. Under voltage limit (UVL)

The UVL prevents adjustment of the output voltage below a certain limit. The combination of UVL and OVP functions, allow the user to create a protection window for sensitive load circuitry.

4-3-1. Setting the UVL level

Setting the UVL can be made when the power supply output is Enabled (On) or Disabled (Off). To set the UVL level, press the OVP/UVL button TWICE, so that the CURRENT meter shows “UUL”. The VOLTAGE meter shows the UVL setting level. Rotate the VOLTAGE encoder knob to adjust the UVL level. The display will show “UUL” and the setting value for 5 seconds after the adjustment has been completed and then will return to it’s previous state. UVL setting values are limited at the maximum level to approximately 5% below the Output Voltage setting. Attempting to adjust the UVL above this limit will result in no response to the adjustment attempt. The minimum UVL setting is zero.

4-4. Foldback protection

Foldback protection will shut down the power supply output if the load current exceeds the current limit setting level. This protection is useful when the load circuitry is sensitive to an over current condition.

4-4-1. Setting the Foldback protection

To arm the Foldback protection, the FOLD button should be pressed so that the FOLD LED illuminates. In this condition, transition from Constant Voltage to Constant Current mode will activate the Foldback protection. Activation of the Foldback protection disables the power supply output, causes the ALARM LED to blink and display " Fb " on the VOLTAGE meter.

4-4-2. Resetting activated Foldback protection

There are four methods to reset an activated Foldback protection.

1. Press the OUTPUT button. The power supply output is enabled and the Output Voltage and current will return to their last setting. In this method, the Foldback protection remains armed, therefore if the load current is higher than the current limit setting, the Foldback protection will be activated again.
2. Press the FOLD button to cancel the Foldback protection. The power supply output will be disabled and the VOLTAGE display will show “OFF”. Press the OUTPUT button to enable the power supply output.
3. Turn the power supply output Off and then On using the SO control. In this method the foldback protection remains armed, therefore if the load current is higher than the current limit setting the foldback protection will be activated.
   ◆ Refer to "4-6. Output SHUT-OFF (SO) control via rear panel J1 connector".
4. Turn the power supply Off using the AC On/Off switch, wait until the front panel display turns Off, then turn the unit back ON again. The power supply output is enabled and the Output Voltage and Current will return to their last setting. In this method, the Foldback protection remains armed, therefore if the load current is higher than the current limit setting, the Foldback protection will be activated again.

4-5. Output ON/OFF control

The Output On/Off enables or disables the power supply output. Use this function to make adjustments to either the power supply or the load without shutting off the AC power. The Output On/Off can be activated from the front panel using the OUTPUT button or from the rear panel J1 connector. The OUTPUT button can be pressed at any time to enable or disable the power supply output. When the output is disabled, the output voltage and current fall to zero and the VOLTAGE display shows “OFF”.

4-6. Output SHUT-OFF (SO) control via rear panel J1 connector

Contacts 2, 3 and 15 of J1 (Fig.3-2, Item 24) serve as Output Shut-Off (SO) terminals. The SO terminals accept a 2.5V to 15V signal or Open-Short contact to disable or enable the power supply output. The SO function will be activated only when a transition from On to Off is detected after applying AC power to unit.(Thus, in Auto-Restart mode, the output will be enabled after applying AC power, even if SO is in Off level.). After On to Off transition is detected, the SO will enable or disable the power supply output according to the signal level or the short/open applied to J1. This function is useful for connecting power supplies in a “Daisy-chain”. The SO control can be used also to reset the OVP and Fold Protection.

◆ Refer to "4-2. Over voltage protection (OVP)" and "4-3. Under voltage limit (UVL)". When the unit is shut-off by J1 signal, the VOLTAGE display will show “SO” to indicate the unit state. J1 contact 15 is the SO signal input and contacts 2 and 3, IF_COM, are the signal return (connected internally). Contacts 2, 3 and 15 are optically isolated from the power supply output. The SO control logic can be selected by the rear panel SW1 Setup switch.

◆ Refer to Table 4-2 for SW1 setting and SO control logic.

In Auto-Restart mode the output will re-rise automatically after reset the So control, but in safe start mode pushing OUTPUT button is needed to raise the output again after reset.

Table 4-2: SO logic selection

SW1-5 setting	SO signal level J1-2(3), 15	Power supply output	Display
Down (default)	2V to 15V or Open 0V to 0.6V or Short	On Off	Voltage/Current “SO”
Up	2V to 15V or Open 0V to 0.6V or Short	Off On	“SO” Voltage/Current

This function cannot be used with Output OFF. Please turn ON an output using the function of output interception (SO).

4-7. ENABLE/DISABLE control via rear panel J1 connector

Contacts 1 and 14 of J1 (Fig.4-2, Item 24) serve as Output Enable/Disable terminals by switch or relay. This function is enabled or disabled by the SW1 Setup switch position 9.

◆ Refer to Table 4-3 for Enable/Disable function andSW1setting.

Table 4-3: Enable/Disable function and SW1 setting

SW1-9 setting	Enable/Disable inputs	Power supply output	Display	ALARM LED
Down (default)	Open or Short	On	Voltage/Current	Off
Up	Open	Off	“ENA”	Blinking
	Short	On	Voltage/Current	Off

To prevent possible damage to the unit, do not connect any of the Enable/Disable inputs to the positive or negative output potential.

If the Enable/Disable inputs are opened in Safe Start mode, it is required to short the Enable /Disable inputs and then press OUTPUT button or send OUT1 command to resume operation. But in auto-restart mode set these inputs short, and then the output will rise up automatically after output-off by this function.

4-8. CV/CC signal

CV/CC signal indicates the operating mode of the power supply, Constant Voltage or Constant Current.
CV/CC signal is an open collector output with a 30V parallel zener, at J1-13, referenced to the COM potential at J1-12 (connected internally to the negative sense potential). When the power supply operates in Constant Voltage mode, CV/CC output is open. When the power supply operates in Constant Current mode, CV/CC signal output is low (0-0.6), with maximum 10mA sink current.

Do not connect CV/CC signal to a voltage source higher than 30VDC.
Always connect CV/CC signal to the voltage source with a series resistor to limit the sink current to less than 10mA.

4-9. PS_OK signal

PS_OK signal indicates fault condition in the power supply. PS_OK is a TTL signal output at J1-16, referenced to IF_COM at J1-2,3 (Isolated Interface Common)). When a fault condition occurs, PS_OK level is low, with maximum sink current of 1mA, when no fault condition occurs, PS_OK level is high with maximum source current of 2mA.
The following faults will set the PS_OK to Fault state:

OTP	Enable/Disable open
OVP	SO (Rear panel Shut-Off)
Foldback	GP-IB failure (with optional GP-IB interface)
AC fail	Output Off

4-10. Safe start and auto-restart modes

When turning on the power supply AC On/Off, it can start to its last setting of Output Voltage and Current limit with the output enabled (Auto-restart) or start with the output disabled (Safe mode).
Press and hold the OUTPUT button to select between Safe start and Auto-restart modes. The VOLTAGE display will continuously cycle between "SAF" and "AUT" every 3 seconds. Releasing OUTPUT pushbutton while one of the modes is displayed, selects that mode. The default setting at shipment is Safe mode.

4-10-1. Automatic start mode

In this mode, the power supply restores its last operation setting. Upon start-up, the output is enabled or disabled according to its last setting.

4-10-2. Safe start mode

In this mode, the power supply restores its last operation setting and sets the Output to off state. At start-up, the output is disabled and the output voltage and current are zero. To enable the output and restore the last output voltage and current limit values, momentarily press OUTPUT button.

4-11. Over temperature protection (OTP)

The OTP circuit shuts down the power supply before the internal components can exceed their safe internal operating temperature. When an OTP shutdown occurs, the display shows "OTP" and the ALARM LED blinks. Resetting the OTP circuit can be automatic (non-latched) or manual (latched) depending on the Safe or Automatic restart mode.

1. Safe start mode:
In Safe start mode, the power supply stays off after the over temperature condition has been removed. The display continue to shows "OTP" and the ALARM LED continues to blink. To reset the OTP circuit, press OUTPUT button (or send OUT ON command via the serial port).

2. Auto-restart mode:
In Auto-restart mode, the power supply recovers to it's last setting automatically when the over temperature condition is removed.

4-12. Last setting memory

The power supply is equipped with Last Setting Memory, which stores power supply parameters at each AC turn-off sequence.

STOREDPARAMETERS:

1. Output voltage setting
2. Output current setting
3 .OVP level
4. UVL level
5. FOLD setting
6. Start-up mode (Safe or Auto-restart)
7. Remote/Local (If the last setting was Local Lockout, the supply will return to Remote mode)
8. Address setting
9. Baud rate
10. Locked /Unlocked front panel

◆ Items 7, 8, 9 are related to Remote digital control operation and explained in "6. RS232 & RS485 REMOTE CONTROL".

4-13. Series operation

Power supplies of the SAME MODEL can be connected in series to obtain increased output voltage.
Split connection of the power supplies gives positive and negative output voltage.

CAUTION **Do not connect power supplies from different manufacturers in series or in parallel.**

4-13-1. Series connection for increased output voltage

In this mode, two units are connected so that their outputs are summed. Set the current limit of each power supply to the maximum that the load can handle without damage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage during start up sequence or in case one of the units shuts down. Each diode should be rated to at least the power supply rated output voltage and output current.

◆ Refer to Fig.4-1 and 4-2 for series operation with local and remote sensing.

WARNING

When power supplies are connected in series, and the load or one of the output terminals is grounded, no point may be at a greater potential of ±60VDC from ground for models up to 60VDC Rated Output and ±600VDC from ground for models >60VDC Rated Output.

◆ **When using RS232/485 or GP-IB, refer to the OUTPUT TERMINALS GROUNDING warning, "2-10-1. Load wiring".**

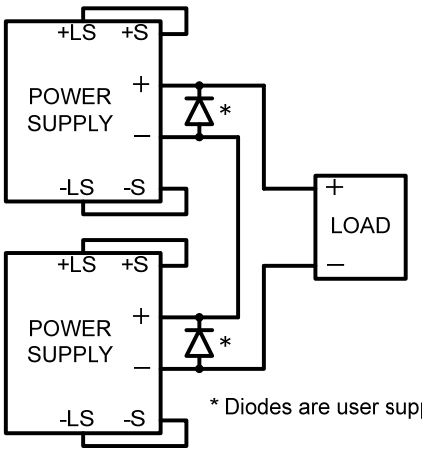


Fig.4-1: Series connection, local sensing

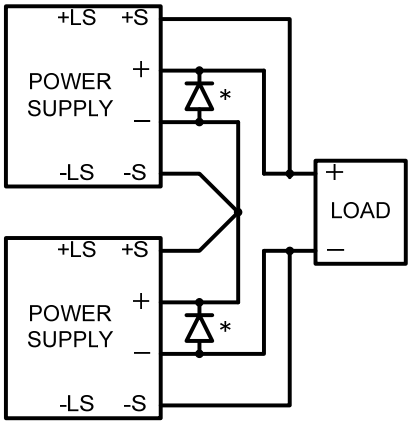


Fig.4-2: Series connection, remote sensing

Remote programming in series operation for increased output voltage:

1. Programming by external voltage:
   The analog programming circuits of this power supply are referenced to the negative Sense (-S) potential.
   Therefore, the circuits used to control each series connected unit must be separated and floated from each other.
2. Using the SO function and PS_OK signal:
   The Shut-Off and PS_OK circuits are referenced to the isolated interface common, IF_COM (J1-2,3).
   The IF_COM terminals of different units can be connected to obtain a single control circuit for the power supplies connected in series.
3. Programming by external resistor:
   Programming by external resistor is possible.
   ◆ Refer to "5-4. Resistive programming of output voltage and current".
4. Programming via the Serial Communication port (RS232/RS485):
   The communication port is referenced to the IF_COM which is isolated from the power supply output potential.
   Therefore power supplies connected in series can be chained using the Remote-In and Remote-Out connectors.
   ◆ Refer to "6. RS232 & RS485 REMOTE CONTROL".

4-13-2. Series connection for positive and negative output voltage

In this mode, two units are configured as a positive and negative output. Set the current limit of each power supply to the maximum that the load can handle without damage. It is recommended that diodes be connected in parallel with each unit output to prevent reverse voltage during start-up or in case one of the units shuts down. Each diode should be rated to at least the power supply rated output voltage and output current.

◆ Refer to Fig.4-3 for this operating mode.

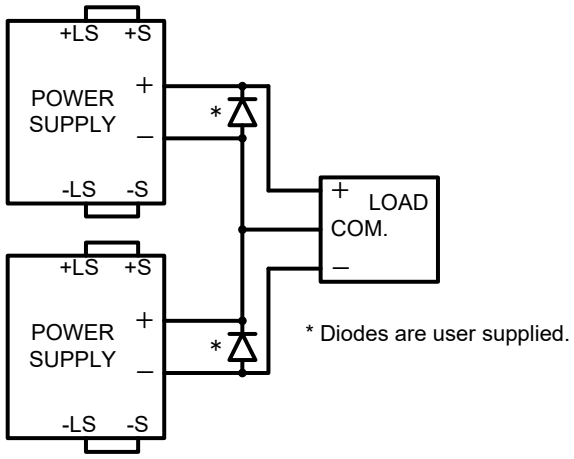


Fig.4-3: Series connection for positive/negative output voltages

Remote programming in series operation for positive and negative output voltage

1. Programming by external voltage:
   The analog programming circuits of this power supply are referenced to the negative Sense potential.
   Therefore, the circuits used to control each series connected unit must be separated and floated from each other.
2. Using the SO function and PS_OK signal:
   The Shut-Off and PS_OK circuits are referenced to the isolated interface common, IF_COM (J1-2,3).
   The IF_COM terminals of the units can be connected to obtain a single control circuit for the power supplies connected in series.
3. Programming by external resistor :
   Programming by external resistor is possible.
   ◆ Refer to "5-4. Resistive programming of output voltage and current".
4. Programming via the Serial Communication port (RS232/RS485):
   The communication port is referenced to the IF_COM which is isolated from the power supply output potential.
   Therefore power supplies connected in series can be chained using the Remote-In and Remote-Out connectors.

4-14. Parallel operation

4-14-1. Parallel operation (1)

Up to four units of the same VOLTAGE and CURRENT rating can be connected in parallel to provide up to four times the output current capability. One of the units operates as a master and the remaining units are slaves. The slave units are analog programmed by the master unit. In remote digital operation, only the master unit can be programmed by the computer while the slave units may be connected to the computer for voltage, current and status readback only. Follow the following procedure to configure multiple supplies for parallel operation.

1. Setting up the Master unit

Set the master unit output voltage to the desired voltage. Program the current limit to the desired load current limit divided by the number of parallel units. During operation, the master unit operates in CV mode, regulating the load voltage at the programmed output voltage. Connect the sensing circuit to local or remote sensing as shown in Fig.4-4 or Fig.4-5.

2. Setting up the Slave units

- The output voltage of the slave units should be programmed higher than the output voltage of the master unit to prevent interference with the master unit's control. The current limit of each unit should be programmed to the desired load current limit divided by the number of parallel units.
- Set the rear panel setup switch SW1 position 2 to it's up position.
- Connect short between J1-8 and J1-12.
- Connect J1 terminal 10 (IPGM) of the slave unit to J1 terminal 25 (P) of the master unit.

During operation the slave units operate as a controlled current source following the master output current. It is recommended that the power system is designed so that each unit supplies up to 95% of its current rating because of the imbalance which may be caused by cabling and connections voltage drop.

3. Setting Over Voltage protection

The master unit OVP should be programmed to the desired OVP level. The OVP of the slave units should be programmed to a higher value than the master OVP. When the master unit shuts down, it programs the slave unit to zero output voltage. If a slave unit shuts down (when its OVP is set lower than the master output voltage), only that unit would shut down and the remaining slave units would supply all the load current.

4. Setting Foldback protection

Foldback protection if desired, may only be used with the master unit. When the master unit shuts down it programs the slave units to zero output voltage.

5. Connection to the load

In parallel operation, power supplies can be connected in local or remote sensing.

◆ Refer to Fig.4-4 and 4-5 for typical connections of parallel power supplies. The figures show connection of two units, however the same connection method applies up to 4 units.

4-14-2. Parallel operation (2)

In this method, multiple supplies can be configured to parallel operation as a single power supply. The total load current and output voltage are displayed by the Master unit and can be readback from the Master unit. The Slave units display only their operating status (ON, OFF or Fault condition).

(1) Basic configuration

◆ Refer to the following procedure to configure multiple supplies for advanced parallel operation.

(2) Setting the units as Master or Slave

- Depress and hold the FINE button for 3 seconds. The Master/Slave configuration will be displayed on the Current Display. Rotate the CURRENT encoder to obtain the desired mode.
  Refer to Table 4-4 for the CURRENT display and modes of operation.
- When the desired configuration is obtained, depress and release the FINE button or wait approx. 5 seconds.

Table 4-4 Setting mode of operation

Current display	Operating mode
H1	Single supply（default）
H2	Master supply with 1 Slave supply
H3	Master supply with 2 Slave supply
H4	Master supply with 3 Slave supply
S	Slave supply

(3) Master and Slave units default operation

① When a unit is programmed to Slave mode it enters the Remote mode with Local Lockout. In this mode, the front panel controls are disabled to prevent accidental setting change.

② The Slave units parameters will automatically set the following:

- Output voltage to approximate. 102% of rated output voltage.
- Programmed Current to zero.
- UVL to zero volts
- OVP to its maximum value
- AST ON
- Out ON
- Foldback protection OFF

③ The Master and Slave modes are stored in the power supply EEPROM when the AC power is turned off. The system will return to the Master/Slave mode upon re-application of AC power.

(4) Current display accuracy

In the advanced parallel mode, the total current is programmed and reported by the Master. In this method, the CURRENT display accuracy is 2% ±1 count. In cases that higher accuracy is required, it is recommended to use the basic parallel operation mode.

(5) To release units from Slave mode

Slave units can be released using the following procedure:

- Depress FINE button for 3 seconds.
  The Master/Slave configuration will be displayed on the CURRENT display.
- Select H1 mode using the CURRENT encoder.
- Depress FINE button again or wait 5 seconds.
- Turn the AC power OFF to store the new setting.

Make sure that the connection between -Vo terminals are reliable to avoid disconnection during operation. Disconnection may cause damage to the power supply.

With local sensing it is important to minimize the wire length and resistance.
Also the positive and negative wire resistance should be close as possible to each other to achieve current balance between power supplies.

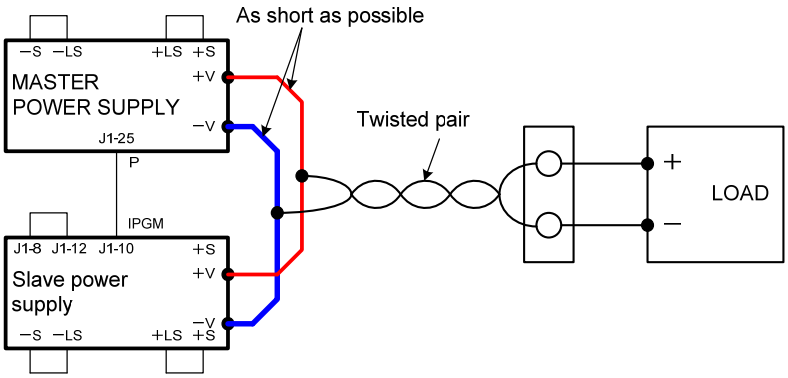


Fig.4-4: Parallel connection with local sensing

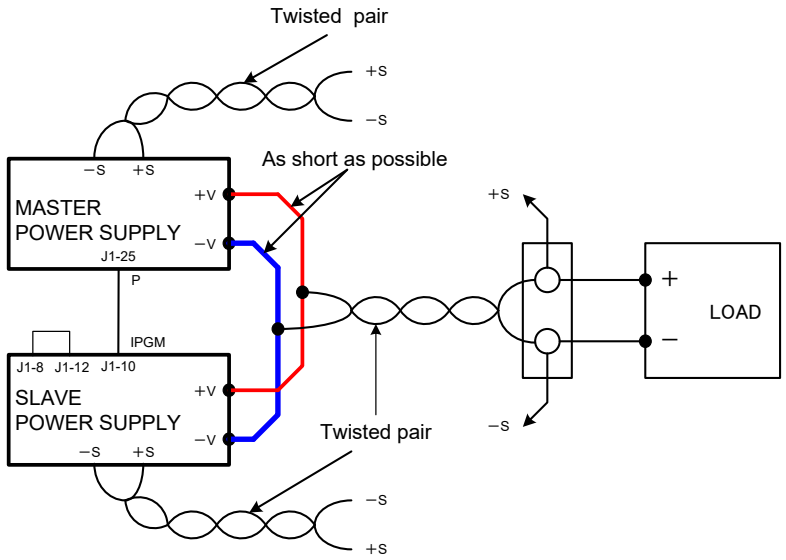


Fig.4-5: Parallel operation with Remote sensing

4-15. Daisy-chain connection

It is possible to configure a multiple power supply system to shut down all the units when a fault condition occurs in one of the units. When the fault is removed, the system recovers according to its setting to Safe start mode or Automatic restart. Setup switch SW1 position 5 should be set to its Down position to enable the Daisy-chain operation. Other SW1 positions can be set according to the application requirements. If a fault occurs in one of the units its PS_OK signal will be set to low level and the display will indicate the fault. The other units will shut off and their display will indicate "SO". When the fault condition is removed, the units will recover to their last setting according to their Safe start or Auto-restart setting. Fig.4-6 shows connection of three units, however the same connection method applies to systems with a larger number of units.

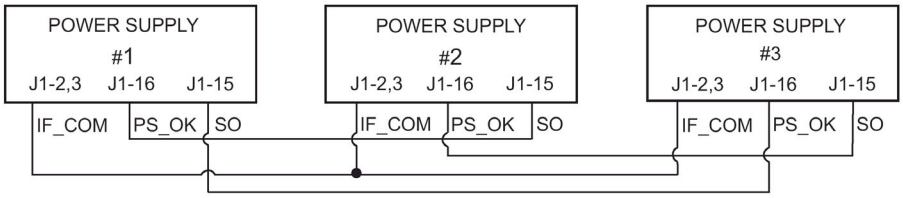


Fig.4-6. daisy-chain connection

4-16. Front panel locking

The front panel controls can be locked to protect from accidental power supply parameter change.
Press and hold V/I CHK button to toggle between “Locked front panel” and “Unlocked front panel”.
The display will cycle between “LFP” and “UFP”. Releasing the V/I CHK button while one of the modes is displayed, selects that mode.

4-16-1. Unlocked front panel

In this mode, the front panel controls are enabled to program and monitor the power supply parameters.

4-16-2. Locked front panel

In this mode the following front panel controls are disabled:

- VOLTAGE and CURRENT encoders.
- FOLD button.
- OUTPUT button.

The power supply will not respond to attempts to use these controls. The VOLT display will show “LFP” to indicate that the front panel is locked.
OVP/UVL button is active to preview the OVP and UVL setting.
Use V/I CHK button to preview the output voltage and current setting or to unlock the front panel.

5. REMOTE ANALOG PROGRAMMING

The rear panel connector J1 allows the user to program the power supply output voltage and current limit with an analog device. J1 also provides monitoring signals for output voltage and output current.
The programming range and monitoring signals range can be selected between 0V to 5V or 0V to 10V using the setup switch SW1. When the power supply is in Remote Analog programming, the serial communication port is active and can be used to read the power supply parameters.

COM (J1-12), VPGM_RTN (J1-22) and IPGM_RTN (J1-23) terminals of J1connect internally to the -Sense potential (-S). Do not connect these terminals to any potential other than -Sense (-S), as it may damage the power supply.

5-1. LOCAL /REMOTE analog control

Contact 8 of J1 (Fig. 3-2, item 24) accepts TTL signal or Open-Short contact (referenced to J1-12) to select between Local or Remote Analog programming of the output voltage and current limit.
In Local mode, the output voltage and current limit can be programmed via the front panel VOLTAGE and CURRENT encoders or via the RS232/485 port. In Remote Analog mode, the output voltage and current limit can be programmed by analog voltage or by programming resistors via J1 contacts 9 and 10.

- ◆ Refer to "5-3. Remove voltage programming of output voltage and current limit". and "5-4. Resistive programming of output voltage and current".
- ◆ Refer to Table 5-1 for Local/Remote Analog control (J1-8) function and Setup switch SW1-1, 2 setting.

Table 5-1: Local/Remote Analog control function

SW1-1,2 setting	J1-8 function	Output voltage/Current setting
Down (default)	No effect	Local
Up	“0” or Short	Remote
	“1” or Open	Local

5-2. LOCAL/REMOTE analog indication

Contact 21 of J1 (Fig. 3-2, item 24) is an open collector output that indicates if the power supply is in Local mode or in Remote Analog mode. To use this output, connect a pull-up resistor to a voltage source of 30Vdc maximum. Choose the pull-up resistor so that the sink current will be less than 5mA when the output is in low state.

- ◆ Refer to Table 5-2 for J1-21 function.

Table 5-2: Local/Remote Analog indication

J1-8	SW1-1	SW1-2	J1-21 signal
TTL “0” or short	Down	Down	Open
	Down	Up	0V to 0.6V
	Up	Down	0V to 0.6V
	Up	Up	0V to 0.6V
TTL “1” or open	Down or Up	Down or Up	Open

5-3. Remove voltage programming of output voltage and current limit

CAUTION

To maintain the isolation of power supply and prevent ground loops, use an isolated programming source when operating the power supply via remote analog programming at J1 connector.

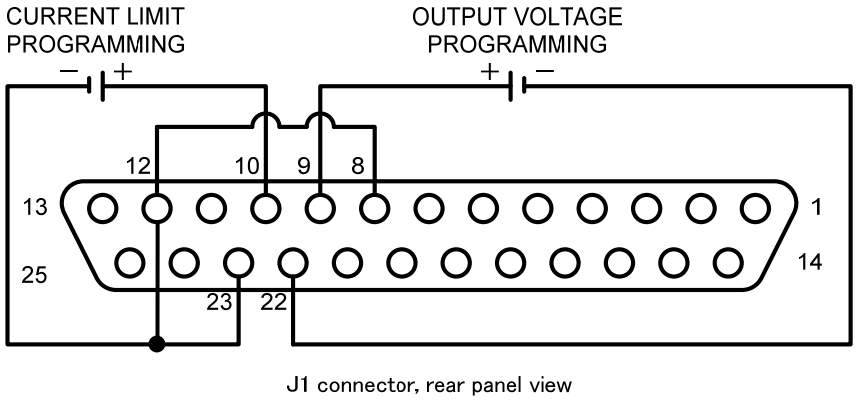
Perform the following procedure to set the power supply to Remote Voltage programming :

1. Turn the power supply AC On/Off switch to Off.
2. Set setup switch SW1 position 1 and 2 to their UP position.
3. Set SW1 position 3 to select programming voltage range according to Table 5-3.
4. Ensure that SW1 positions 7 and 8 are at their Down (default) position.
5. Connect a short between J1-8, J1-12 and J1-23.
   ◆ Refer to Table 3-2.
6. Connect the programming source to the mating plug of J1 as shown in Fig.5-1. Observe correct polarity for the voltage source.
   ◆ Refer to "3-4-1. Making J1 connections".
7. Set the programming sources to the desired levels and turn the power supply ON. Adjust the programming sources to change the power supply output.

1. SW1 positions 4,5,6 and 9 are not required for remote programming. Their setting can be determined according the application.
2. The control circuits allow the user to set the output voltage and current limit up to 5% over the model-rated maximum value. The power supply will operate within the extended range, however it is not recommended to operate the power supply over its voltage and current rating and performance is not guaranteed.
3. When voltage programming is used, front panel and computer control (via serial communication port) of output voltage and current are disabled.

Table 5-3: SW1-3 setting and programming range

SW1-3 setting	Output Voltage programming VPGM (J1-9)	Current limit programming IPGM (J1-10)
UP	0V to 10V	0V to 10V
DOWN	0V to 5V	0V to 5V



J1 connector, rear panel view

Fig.5-1: Remote voltage programming connection

5-4. Resistive programming of output voltage and current

For resistive programming, internal current sources, for output voltage and/or output current control, supply 1m acurrent through external programming resistors connected between J1-9 & 22 and 1-10 & 23. The voltage across the programming resistors is used as a programming voltage for the power supply. Resistance of Resistance of 0kΩ to 5kΩor 0kΩ to 10kΩcan be selected to program the output voltage and current limit from zero to full scale. A variable resistor can control the output over its entire range, or a combination of variable resistor and series/parallel resistors can control the output over restricted portion of its range.

Perform the following procedure to set the power supply to Resistive programming:

1. Turn the AC On/Off switch to Off.
2. Set setup switch SW1 positions 1 and 2 to their UP position.
3. Set SW1 position 3 to select programming resistor range.
   ◆ Refer to Table 5-4.
4. Set SW1 positions 7 and 8 to their UP position to enable resistive programming mode.
5. Connect a short between J1-8, J1-12 and J1-23.
   ◆ Refer to "3-4-1. Making J1 connections".
6. Connect the programming resistors to the mating plug of J1-22(VPGM_RTN),J1-23(IPGM_RTN)as shown in Fig.5-2.
   ◆ Refer to "3-4-1. Making J1 connections".
7. Set the programming resistors to the desired resistance and turn the power supply ON.
   Adjust the resistors to change the power supply output.

1. SW1 positions 4, 5, 6 and 9 are not required for remote programming. Their setting can be determined according to the application requirements.
2. The control circuits allow the user to set the output voltage and current limit up to 5% over the model-rated maximum value. The power supply will operate within the extended range, however it is not recommended to operate the power supply over its voltage and current rating and performance is not guaranteed.
3. To maintain the temperature stability specification of the power supply, the resistors used for programming should be stable and low noise resistors, with temperature coefficient of less than 50ppm.
4. When resistive programming is used, front panel and computer control (via serial communication port) of output voltage and current are disabled.

Table 5-4: SW1-3 setting and programming range

SW1-3 setting	Output Voltage programming VPGM (J1-9)	Current limit programming IPGM (J1-10)
UP	0kΩ to 10kΩ	0kΩ to 10kΩ
DOWN	0kΩ to 5kΩ	0kΩ to 5kΩ

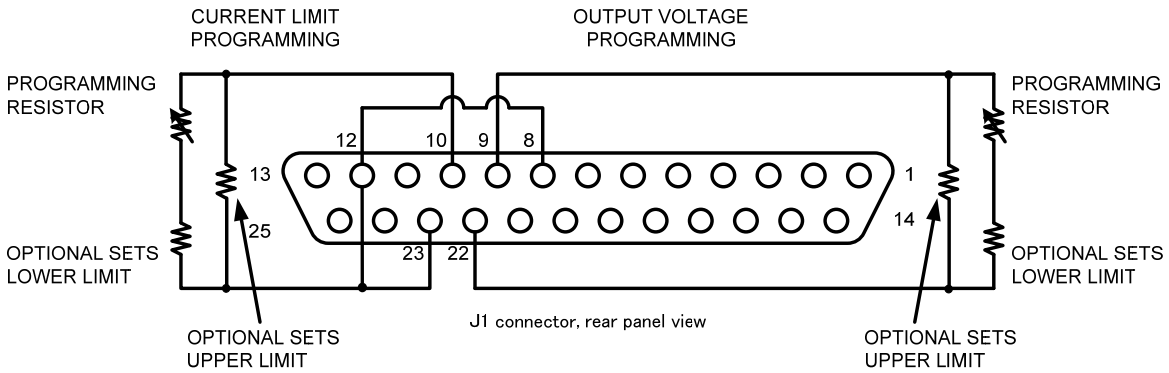


Fig.5-2: Remote resistive programming

5-5. Remote monitoring of output voltage and current

The J1 connector, located on the rear panel provides analog signals for monitoring the output voltage and output current. Selection of the voltage range between 0V to 5V or 0V to 10V is made by setup switch SW1-4. The monitoring signals represent 0% to 100% of the power supply output voltage and output current. The monitor outputs have 500Ωseries output resistance. Ensure that the sensing circuit has an input resistance of greater than 500kΩor accuracy will be reduced.

Refer to Table 5-5 for required J1 connection, SW1-4 setting and monitoring voltage range.

Table 5-5 Monitoring signals setting

Signal Name	Signal function	J1 connection		Range	SW1-4
		Signal (+)	Return (-)		
VMON	Vout monitor	J1-11	J1-12	0V to 5V	Down
IMON	Iout monitor	J1-24			
VMON	Vout monitor	J1-11	J1-12	0V to 10v	Up
IMON	Iout monitor	J1-24			

Notes:

1. Radiated emissions, FCC requirements:
   FCC requirements for radiated emissions, use shielded cable for the analog control signals. In case of using unshielded cable, attach an EMI ferrite suppressor to the cable, as close as possible to the power supply.
2. Front panel encoders operation:
   In Remote analog mode the output voltage and current can't be set by the VOLTAGE and CURRENT encoders.
3. Front panel V/I CHK button:
   Use V/I CHK button to display the output voltage and current setting defined by the encoders or communication.
4. Communication:
   In Remote analog mode, power supply parameters can be programmed and readback via the communication port except output voltage and current setting.

6. RS232 & RS485 REMOTE CONTROL

This chapter describes the operation of the PU750W power supplies via the serial communication port. Details of the initial set-up, operation via RS232 or RS485, the command set and the communication protocol are described in this chapter.

6-1. CONFIGURATION

6-1-1. Default setting

The power supply is shipped with the following setting:

- Address	6	- Output	Off
- Baud-rate	9600	- Start up mode	Safe start
- RS232/485	RS232	- OVP	Maximum
- V out setting	0	- UVL	0
- I out setting	0	- Foldback	Off

6-1-2. Address setting

The power supply address can be set to any address between 0 and 30. Follow the instructions described below to set the address.

1. If the unit is in Remote mode (front panel RMT/LCL LED illuminates), press RMT/LCL button to put the unit into Local mode.
2. Press and hold for approximately 3sec. the RMT/LCL button. The VOLTAGE display will indicate the communication port address.
3. Using the VOLTAGE adjust encoder, select the address.

To preview the address at any time, press and hold the RMT/LCL button for approx. 3sec. The VOLTAGE display will indicate the power supply address.

6-1-3. RS232 or RS485 selection

To select between RS232 or RS485 set the rear panel setup switch SW1-6 position to:

- Down for RS232
- Up for RS485

6-1-4. Baud rate setting

Five optional rates are possible: 1200, 2400, 4800, 9600 and 19200. To select the desired rate, the following steps should be taken:

1. If the unit is in Remote mode (front panel RMT/LCL LED illuminates), press RMT/LCL button to put the unit into Local mode.
2. Press and hold for approx. 3sec. the RMT/LCL button. The CURRENT display will show the communication port Baud Rate.
3. Using the CURRENT adjust encoder, select the desired Baud Rate.

6-1-5. Setting the unit into Remote or Local mode

1. The unit will be put into Remote mode only via serial communication command.
   Commands that will put the unit into Remote mode are:
   RST PV n
   OUT n PC n
   RMT n ◆ For n values see "6-6-2. Initialization control commands", "6-6-4. Output control commands", tables 6-8, 6-9 and 6-10.
2. There are two Remote modes:
   - Remote: In this mode, return to local can be made by the front panel RMT/LCL or via serial port command RMT 0. Set the unit into Remote mode via serial port RMT 1 command.
   - Local Lock out: In this mode the unit can be returned to Remote mode via the serial port RMT 1 command or by turning off the AC power until the display turns off and then turn it to on again. In Local Lockout mode, the front panel RMT/LCL button is not active. Set the unit into Local Lockout mode via serial port RMT 2 command.

6-1-6. RS232/485 port in Local mode

When the power supply is in local mode, it can receive queries or commands. If a query is received, the power supply will reply and remain in Local mode. If a command that affects the output is received, the power supply will perform the command and change to Remote mode.

Serial commands may be sent to set the status registers and read them while the unit is in Local mode. If the Enable registers are set the power supply will transmit SRQ's while in Local.

◆ Refer to "6-7. Status, error and SRQ registers".

6-1-7. Front panel in Remote mode

Front panel control in Remote mode is disabled except for:

1. V/I CHK: use to preview the Voltage and Current limit setting.
2. OVP/UVL: use to preview the OVP/UVL setting.
3. RMT/LCL use to set the unit into Local mode.
   In Local Lockout mode, only PREV and OVP/UVL are active.

6-2. RS232/485 connector

The RS232/485 interface is accessible through the rear panel RS232/485 IN and RS485 OUT connectors.

The connectors are 8 contact RJ-45. The IN and OUT connectors are used to connect power supplies in a RS232 or RS485 chain to a controller.

◆ Refer to Fig.6-1 for IN/OUT connectors.

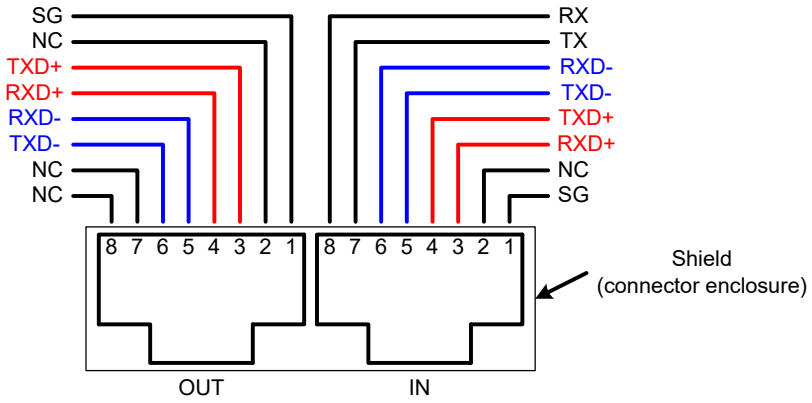


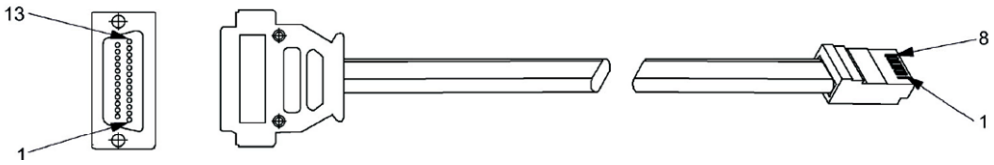
Fig.6-1: J3 rear panel IN/OUT connectors pinout

NOTE:
Tx and Rx are used for RS232 communication. Txd ±and Rxd ±are used for RS485 communication.
Refer to RS232 and RS485 cables description for connection details.

6-3. Connecting power supply to RS232 or RS485 bus

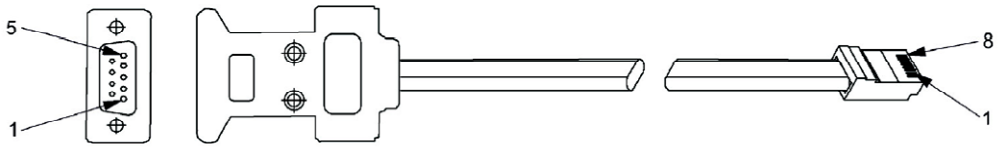
6-3-1. Single power supply

1. Select the desired interface RS232 or RS485 using rear panel setup switch SW1-6.
   ◆ Refer to "3-3. SW1 setup switch".
   - RS232: Down position
   - RS485: Up position
2. Connect rear panel IN connector to the controller RS232 or RS485 port using a suitable shielded cable.
   ◆ Refer to Fig. 6-2, 6-3 and 6-4 for available RS232 and RS485 cables.



DB-25 connector		8 Pin connector		Remarks
Pin No.	Name	Pin No.	name	
1	SHIELD		SHIELD	
2	TX	8	RX	Twisted pair
3	RX	7	TX	
7	SG	1	SG	

Fig.6-2: RS232 cable with DB25 connector



DB-9 connector		8 Pin connector		remarks
Pin No.	Name	Pin No.	name	
Housing	SHIELD	Housing	SHIELD	
2	RX	7	TX	Twisted pair
3	TX	8	RX	
5	SG	1	SG	

Fig.6-3: RS232 cable with DB9 connector

DB-9 connector		8 Pin connector		remarks
Pin No.	Name	Pin No.	name	
Housing	SHIELD	Housing	SHIELD	
9	TXD-	6	RXD-	Twisted pair
8	TXD+	3	RXD+	
1	SG	1	SG	
5	RXD-	5	TXD-	Twisted pair
4	RXD+	4	TXD+	

Fig.6-4: RS485 cable with DB9 connector

6-3-2. Multi power supply connection to RS232 or RS485 bus

Up to 31 units can be connected to RS232 or RS485 bus. The first unit connects to the controller via RS232 or RS485 and the other units are connected with RS485 bus.

1. First unit connection:
   - ◆ Refer to "6-3-1. Single power supply" for connecting the first unit to the controller.
2. Other units connection: The other units on the bus are connected via their RS485 interface.
   - ◆ Refer to fig.6-5 for typical connection.
     - Set rear panel setup switch SW1-6 to it's UP position.
     - Using the Linking cable supplied with each unit (refer to Fig.6-6), connect each unit OUT connector to the next unit IN connector.

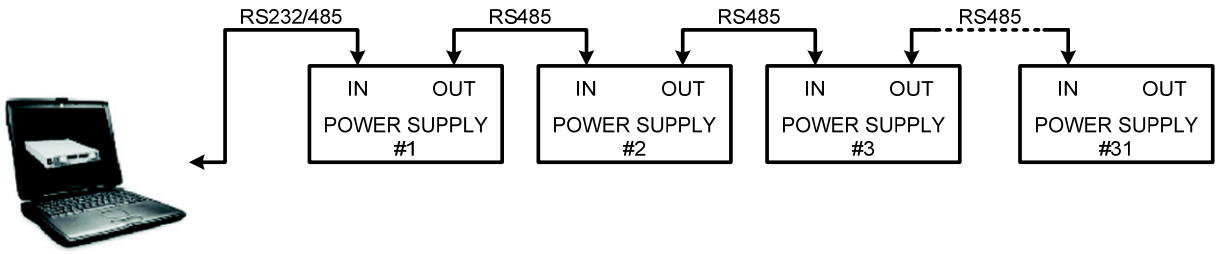
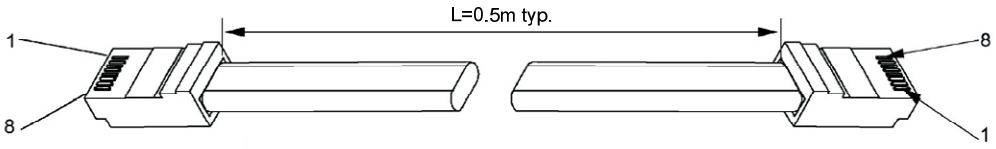


Fig.6-5: Multi power supplies RS232/485 connection



DB-9 connector		8 Pin connector (out)	
Pin No.	Name	Pin No.	name
Housing	SHIELD	Housing	SHIELD
1	SG	1	SG
6	TXD-	6	RXD-
3	TXD+	3	RXD+
5	RXD-	5	TXD-
4	RXD+	4	TXD+

Fig.6-6: Serial link cable with RJ-45 shielded connectors

6-4. Communication interface protocol

The address (ADR n: refer to "6-6-2. Initialization control commands") command must return an “OK” response before any other commands are accepted.

6-4-1. Data format

Serial data format is 8 bit, one start bit and one stop bit. No parity bit.

6-4-2. Addressing

The Address is sent separately from the command.

◆ Refer to "6-6-2. Initialization control commands".

6-4-3. End of Message

The end of message is the Carriage Return character (ASCII 13).

The power supply ignores the Line Feed (ASCII 10) character.

6-4-4. Checksum

The user may optionally add a checksum to the end of the command. The checksum is "$" followed by two hex characters. If a command or a query has checksum, the response will also have one

There is no CR between the command string and the "$" sign.

Example: STT?$3A

STAT?$7B

6-4-5. Acknowledge

The power supply acknowledges received command by returning message ("OK" or other). If an error is detected, the power supply will return an error message (refer to sec.7-6). The rules of checksum apply also to the acknowledge.

And in rare cases, the power supply can not respond because of losing any word from PC. For the case that power supply can not respond within 200ms, send same command again with 200ms interval, This 200ms is recommended interval between command to next command. This power supply does not have "Time-out" function.

For the case that power supply fails to receive "correct command", this incorrect command is still in buffer.

To refresh this buffer, needs to send same command repeatedly. Then power supply should send error message ("C03" or other) and this shows buffer is refreshed.

6-4-6. Backspace

The backspace character (ASCII 8) clears the last character sent to the power supply.

6-5. Error messages

The power supply will return error messages for illegal commands and illegal programming parameters.

◆ Refer to Table 6-1 for programming error messages and Table 6-2 for commands error messages.

Table 6-1: Programming error messages

Error Code	Description
E01	Returned when program voltage (PV) is programmed above acceptable range. Example: PV above ‘105% of supply rating’ or ‘PV above 95% of OVP setting’.
E02	Returned when programming output voltage below UVL setting.
E04	Returned when OVP is programmed below acceptable range. Example: OVP less than ‘5% of supply voltage rating’ plus ‘voltage setting’.
E06	Returned when UVL is programmed above the programmed output voltage.
E07	Returned when programming the Output to ON during a fault shut down.

Table 6-2: Commands error messages

Error Code	Description
C01	Illegal command or query
C02	Missing parameter
C03	Illegal parameter
C04	Checksum error
C05	Setting out of range

6-6. Command set description

1. Any command or argument may be in capital letters or small letters.
2. In commands with an argument, a space must be between the command and the argument.
3. For any command that sets a numeric value, the value may be up to 12 characters long.
4. Carriage Return: If the CR character (ASCII 13) is received by itself, the power supply will respond with "OK" and CR.

6-6-1. Command set categories

The PU750W series command set is divided into four categories as follows:

1. Initialization control
2. ID control
3. Output control
4. Status control

6-6-2. Initialization control commands

Table 6-3: Initialization control commands

No.	Command	Description
1	ADR n	ADR is followed by address which can be 0 to 30 and is used to access the power supply. (Please set the standby time about 200ms before the ADR command.)
2	CLS	Clear status. Sets FEVE and SEVE registers to zero. ◆ Refer to "6-7. Status, error and SRQ registers".
3	RST	Reset command. Brings the power supply to a safe and known state: Output voltage: zero, Remote: non-latched remote, Output current: zero, Auto-start: Off, Output: Off, OVP: maximum, FOLD: Off, UVL: zero The conditional registers (FLT and STAT) are updated, the other registers are not changed.
4	RMT	Sets the power supply to local or remote mode: 1. RMT 0 or RMT LOC, ssets the power supply into Local mode. 2. RMT 1 or RMT REM, sets the unit into remote mode. 3. RMT 2 or RMT LLO, sets the unit into Local Lockout mode (latched remote mode).
5	RMT?	Returns the Remote mode setting: 1."LOC"-The unit is in Local mode. 2."REM"-The unit is in Remote mode. 3."LLO"-The unit is in Local Lockout (latched remote) mode.

6-6-3. ID control commands

Table 6-4: ID control commands

No.	Command	Description
1	IDN?	Returns the power supply model identification as an ASCII string. (Example: TEXIO, PU6-100)
2	REV?	Returns the software version as an ASCII string.
3	SN?	Returns the unit serial number. Up to 12 characters.

6-6-4. Output control commands

Table 6-5: Output control commands

No.	Command	Description
1	PV n	Sets the output voltage value in Volts. The range of voltage value is described in Table 7-3. The maximum number of characters is 12. See the following examples for PV n format: PV 12, PV 012, PV 12.0, PV 012.00, etc....
2	PV?	Reads the output voltage setting. Returns the string "n" where "n" is the exact string sent in the PV n command. When in Local mode, returns the V/I CHK (front panel) settings in a 5 digits string.
3	MV?	Reads the actual output voltage. Return 5 digits string. Example: 60V supply sends 01.150, 15.012, 50.000, etc...
4	PC n	Sets the output current value in Amperes. The range of current values is described in Tables 6-4. The maximum number of characters is 12. See the following examples for PC n format: PC 10, PC 10.0, PC 010.00, etc...
5	PC?	Reads the output current setting. Returns the string "n" where "n" is the exact string sent in the PC n command. When in Local mode, returns the V/I CHK (front panel) settings in a 5 digits string.
6	MC?	Reads the actual output current. Returns 5 digits string. Example: 90A supply sends 90.000.
7	OUT n	Turns the output to ON or OFF. Recover from Safe-Start, OVP or FLD fault. OUT 1(or OUT ON)-Turn On. OUT 0(or OUT OFF)-Turn Off.
8	OUT?	Returns the output On/Off status string. ON-output on. OFF-output off.
9	FLD n	Sets the Foldback protection to ON or OFF. FLD 1(or FOLD ON)-Arms the Foldback protection. FLD 0(or FOLF OFF)-Cancels the Foldback protection. When the Foldback protection has been activated, OUT 1 command will release the protection and re-arm it, while FLD 0 will cancel the protection.

No.	Command	Description
10	FLD?	Returns the Foldback protection status string: “ON”-Foldback is armed, “OFF”-Foldback is canceled.
11	OVP n	Sets the OVP level. ◆ The OVP setting range is given in Table 6-10. The number of characters after OVP is up to 12. The minimum setting level is 5% of full rating plus the output voltage set value. Attempting to program the OVP below this level will result in execution error response (“E04”). The OVP setting stays unchanged.
12	OVP?	Returns the setting “n” where “n” is the exact string in the user’s “OVO n”. When in Local mode, returns the last setting from the front panel in a 4 digit string.
13	OVM	Sets OVP level to the maximum level. ◆ Refer to Table 6-10.
14	UVL n	Sets Under Voltage Limit. Value of “n” may be equal to PV setting, but returns “E06” if higher. ◆ Refer to Table 6-10 for UVL programming range.
15	UVL?	Returns the setting “n” where “n” is the exact string in the user’s “UVL n”. When in Local mode, returns the last setting from the front panel in a 4 digit string.
16	ASTn	Sets the auto-restart mode to ON or OFF. AST 1 (or AST ON)-Auto restart on. AST 0 (or AST OFF)-Auto restart off.
17	AST?	Returns the string auto-restart mode status. “ON”-Auto restart is on. “OFF”-Auto restart is off.
18	SAV	Saves present settings. The settings are the same as power-down last settings. These settings are erased when the supply power is switched off and the new “last settings” are saved.
19	RCL	Recalls last settings. Settings are from the last power-down or from the last “SAV” command.
20	MODE?	Returns the power supply operation mode. When the power supply is ON (OUT 1) it will return “CV” or “CC”. When the power supply is OFF (OUT 0) it will return “OFF”.

6-6-5. Global output commands

All supplies, even if not the currently addressed supply, receiving a global command will execute the command.

No response to the PC issuing the command will be returned to the PC.

The PC is suing the command will be responsible to delay and any other communications until the command is execute. 200 Ms minimum is the suggested delay.

If the command contains an error, out of range values for example, no error report will be sent to the issuing PC.

Table 6-6: Output control commands

No.	Command	Description
1	GRST	Reset. Brings the power supply to a safe and known state: Output voltage: 0V, output current: 0A, out: OFF, Remote: RMT 1’ AST: OFF PVP: Max. UVL: 0 The conditional register (FLT and STAT) are updated. Other registers are not changed. Non-Latching faults (FB, OVP, SO) are cleared, OUT fault stays.
2	GPV n	Sets the output voltage value in volts. The range of voltage values is shown in Table 6-3 ‘n’ may be up to 12 char plus dec. pt
3	GPC n	Program the output current value in amperes. The range of current values is shown in Table 6-4 ‘n’ may be up to 12 char plus dec. pt
4	GOUT	Tums the output to ON or OFF: “OUT 1/ON”= turn on “OUT 0/OFF”= turn off, clears CV and CC bits in the Status Condition (STAT) OUT ON will respond with “E07” if the output can not be turned on because of a latching fault (OTP < AC, ENA, SO) shut down.
5	GSAV	Save present settings. Same settings as power-down last settings listed in Error! Reference source not found. Except the address and baud rate are not saved. Saves to the RAM. These settings are erased when the supply power is switched off and the new ‘last settings’ are saved.
6	GRCL	Recall last settings. Settings are from last power-down or from last ‘SAV’ or ‘GSAV’ command. Address and baud rate are not recalled so communication is not interrupted.

Table 6-7: Voltage programming range

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)	Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
6	0.0000	6.0000	60	00.000	60.000
8	0.000	8.000	80	00.00	80.00
12.5	00.000	12.500	100	000.00	100.00
20	00.000	20.000	150	000.00	150.00
30	00.000	30.000	300	000.00	300.00
40	00.000	40.000	600	000.00	600.00

The power supply can accept values higher by 5% than the table values, however it is not recommended to program the power supply over the rated values.

Table 6-8: Current programming range

Model	Minimum(A)	Maximum(A)	Model	Minimum(A)	Maximum(A)
PU6-100	000.00	100.00	PU60-12.5	00.000	12.500
PU8-90	000.00	900.00	PU80-9.5	00.000	9.500
PU12.5-60	000.00	60.000	PU100-7.5	00.000	7.500
PU20-38	00.00	38.000	PU150-5	00.000	5.000
PU30-25	00.000	25.000	PU300-2.5	0.000	2.500
PU40-19	00.000	19.000	PU60-12.5	0.000	12.500

Table 6-9: OVP programming range

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)	Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
6	0.5	7.50	60	5.0	66.0
8	0.5	10.0	80	5.0	88.0
12.5	1.0	15.0	100	5.0	110
20	2.0	24.0	150	5.0	165
30	2.0	36.0	300	5.0	330
40	2.0	44.0	600	5.0	660

Table 6-10: UVL programming range

Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)	Model Rated Output Voltage (V)	Minimum (V)	Maximum (V)
6	0	5.70	60	0	57.0
8	0	7.60	80	0	76.0
12.5	0	11.9	100	0	95.0
20	0	19.0	150	0	142
30	0	28.5	300	0	285
40	0	38.0	600	0	570

6-6-6. Status control commands

◆ Refer to "6-7. Status, error and SRQ registers".

Table 6-11: Status control commands

#	Command	Description
1	STT?	Reads the complete power supply status. Returns ASCII characters representing the following data, separated by commas: MV<actual (measured) voltage> PC<programmed (set) current> PV<programmed (set) voltage > SR<status register, 2-digit hex> MC<actual (measured) current> FR<fault register, 2-digit hex> Example response: MV(45.201), PV(45), MC(4.3257), PC(10), SR(30), FR(00)
2	FLT?	Reads Fault Conditional Register. Return 2-digit hex.
3	FENA	Set Fault Enable Register using 2-digit hex.
4	FENA?	Reads Fault Enable Register. Returns 2-digit hex.
5	FEVE?	Reads Fault Event Register. Returns 2-digit hex. Clears bits of Fault Event Register.
6	STAT?	Reads Status Conditional Register. Returns 2-digit hex.
7	SENA	Set Status Enable Register using 2-digit hex.
8	SENA?	Reads Status Enable Register. Returns 2-digit hex.
9	SEVE?	Reads Status Event register. Returns 2-digit hex. Clears bits of Status Event resister.

6-7. Status, error and SRQ registers

This section describes the various status error and SRQ registers structure. The registers can be read or set via the RS232/485 commands. When using the GP-IB option, refer to the user manual for PU Power Supply GP-IB Programming interface.

Refer to Fig.6-7 for the Status and Error Registers Diagram.

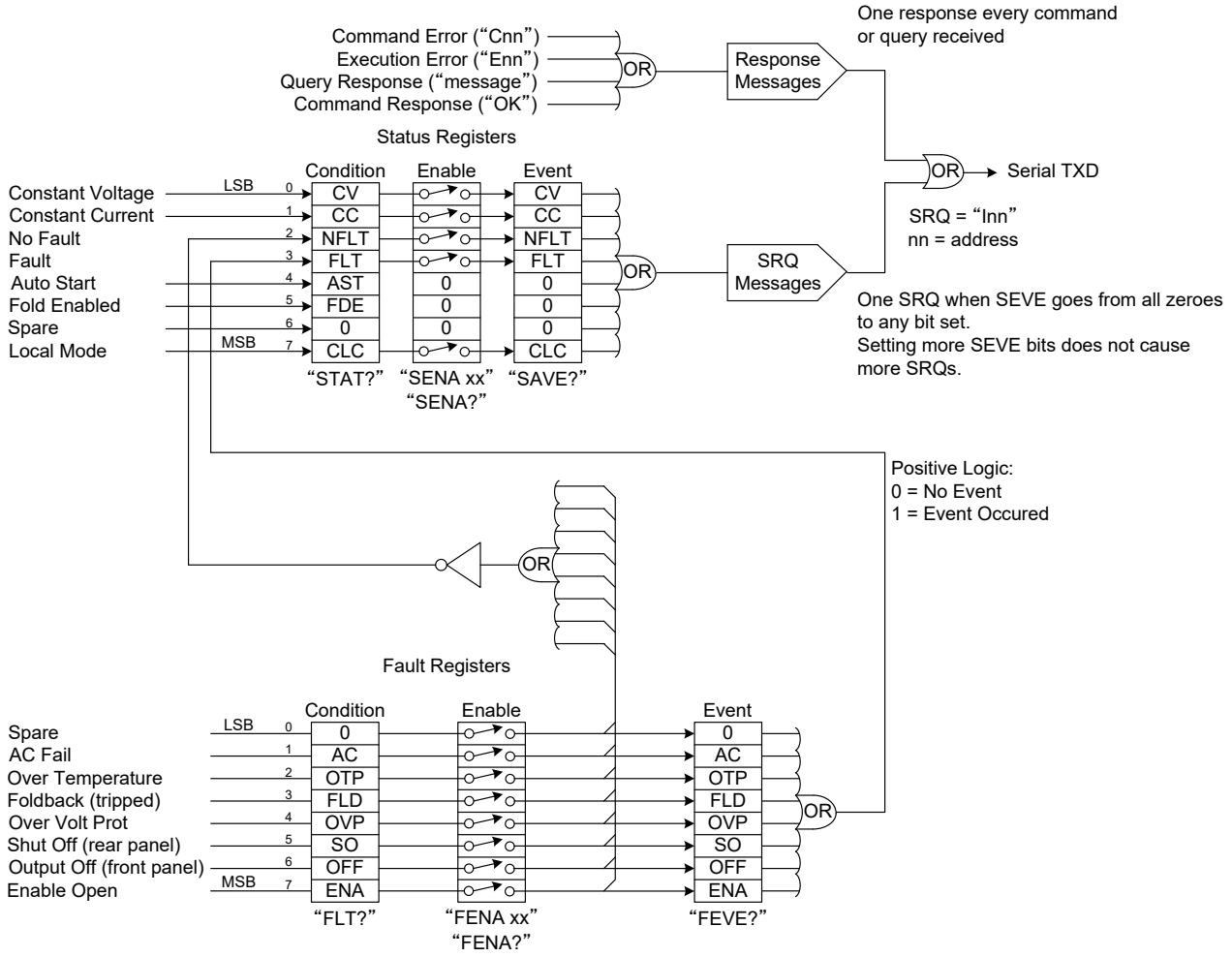


Fig.6-7: Status and Error Registers Diagram

6-7-1. Conditional registers

The fault Condition Register and the Status Condition Register are read only registers that the user may read to see the condition of the supply.

◆ Refer to table 6-12 for description of the Fault Condition Register bits and Table 6-13 for the Status Condition register bits.

Table 6-12: Fault Condition Register

BIT	Fault name	Fault symbol	Bit Set condition	Bit Reset condition
0(LSB)	Spare bit	SPARE	Fixed to zero	Fixed to zero
1	AC Fail	AC	AC fail has occurred.	The AC input returns to normal.
2	Over Temperature	OTP	OTP shutdown has occurred.	The power supply cool down.
3	Foldback	FOLD	Foldback shutdown has occurred.	The supply output is termed On by front panel button or OUT 1 command.
4	Over voltage	OVP	OVP shutdown has occurred.	The supply output is turned On by front panel button or OUT 1 command.
5	Shut Off	SO	Rear panel J1 “Shut Off” condition has occurred. *1	Rear panel J1 “Shut Off” condition removed.
6	Output Off	OFF	Front panel OUT button pressed to Off.	The supply output is turned On by front panel button or OUT 1 command.
7(MSB)	Enable	ENA	Rear panel J1 Enable terminals (J1-1&J1-14) opened. *2	Rear panel J1 Enable terminals closed.

*1 ◆ Refer to "4-6. Output SHUT-OFF (SO) control via rear panel J1 connector".

*2 ◆ Refer to "4-7. ENABLE/DISABLE control via rear panel J1 connector".

Table 6-13: Status Condition Register

BIT	Fault name	Fault symbol	Bit Set condition	Bit Reset condition
0(LSB)	Constant Voltage	CV	Output is On and the supply in CV.	Output is ON and the supply is not in CV.
1	Constant Current	CC	Output is ON and the supply in CC.	Output is ON and the supply is not in CC.
2	No Fault	NFLT	The power supply is operating normally or fault reporting is not enabled. See “OUT n” command in Section 7-6-5	One or more faults are active and fault reporting is enabled (using “FENA xx”).
3	Fault active	FLT	One or more faults are enable and occur.	Fault Event Resister cleared (FEVE?).
4	Auto-Restart Enabled	AST	Supply is in Auto-Restart mode (from Front Panel or serial command).	Supply is in Safe-Start mode (from Front Panel or serial command).
5	Fold Enabled	FDE	Fold protection enabled (from Front Panel or serial command).	Fold protection disabled (from Front Panel or serial command).
6	Spare bit	SPARE	Fixed to zero.	Fixed to zero.
7(MSB)	Local Mode	LCL	Supply in Local mode.	Supply in Remote mode or Local-Lockout mode.

6-7-2. Service Request: Enable and Event Registers

The conditional Registers are continuously monitored. When a change is detected in a register bit, which is enabled, the power supply will generate an SRQ message.

The SRQ message is: "!nn" terminated by CR, where the nn is the power supply address.

The SRQ will be generated either in Local or Remote mode.

◆ Refer to Tables 6-14 to 6-17 for details of the Enable and Event registers.

1. Fault Enable Register

The Fault Enable Register is set to the enable faults SRQs.

Table 6-14: Fault Enable Register

BIT	Enable bit name	Fault symbol	Bit Set condition	Bit Reset condition
0(LSB)	Spare bit	SPARE	User command: "FENA nn" where nn is hexadecimal	User command: "FENA nn" where nn is hexadecimal (if nn="00", no fault SRQs will be generated).
1	AC Fail	AC		
2	Over Temperature	OTP		
3	Foldbck	FOLD		
4	Over Voltage	OVP		
5	Shut Off	SO		
6	Output Off	OFF		
7(MSB)	Enable	ENA		

2. Fault Event Register

The Fault Event will set a bit if a condition occurs and it is enabled. The register is cleared when FEVE?, CLS or RST commands are received.

Table 6-15: Fault Event Register

BIT	Enable bit name	Fault symbol	Bit Set condition	Bit reset condition
0(LSB)	Spare bit	SPARE	Fault condition occurs and it is enabled. The fault can set a bit, but when the fault clears the bit remains set.	Entire Event Register is cleared when user sends "FEVE?" command to read the register. "CLS" and power-up also clear the Fault Event Register.
1	AC Fail	AC		
2	Over Temperature	OTP		
3	Foldbck	FOLD		
4	Over Voltage	OVP		
5	Shut Off	SO		
6	Output Off	OFF		
7(MSB)	Enable	ENA		

3. Status Enable register

The Status Enable Register is set by the user to enable SRQs from changes in power supply status.

Table 6-16: Status Enable Register

BIT	Status name	Status symbol	Bit Set condition	Bit reset condition
0(LSB)	Constant Voltage	CV	User command: "SENA nn" is received, where nn is hexadecimal bits.	User command: "SENA nn" is received, where nn is hexadecimal bits. If "nn"=00, no SRQ is sent where there is a change in Status Condition Register.
1	Constant Current	CC		
2	Not Fault	NFLT		
3	Fault active	FLT		
4	Auto-Restart enabled	AST	Always zero	Always zero
5	Fold enabled	FDE	Always zero	Always zero
6	Spare	SPARE	Always zero	Always zero
7(MSB)	Local Mode	LCL	"SENA nn" command	"SENA nn" command

4. Status Event Register

The Status Event Register will set a bit if a change in the power supply status occurs and it is enabled. The register is cleared when the "SEVE?" or "CLS" commands are received. A change in this register will generate SRQ.

Table 6-17: Status Event Register

BIT	Status name	Status symbol	Bit Set condition	Bit reset condition
0(LSB)	Constant Voltage	CV	Changes in Status occurs and it is enabled. The change can set a bit, but when the change clears the bit remains set.	Entire Event Register is cleared when user sends “SEVE?” command to read the register. “CLS” and power-up also clear the Status Event Register.
1	Constant Current	CC		
2	No Fault	NFLT		
3	Fault active	FLT		
4	Not used	0	Always zero	
5	Not used	0	Always zero	
6	Not used	0	Always zero	
7(MSB)	Local Mode	LCL	Unit is set to Local by pressing front panel RMT/LCL button.	

6-8. Serial communication test set-up

Use the following instructions as basic set-up to test the serial communication operation.

1. Equipment: PC with Windows Hyper Terminal, private edition, software installed, PU power supply, RS232 cable.

2. PC set-up: .....2.1 Open Hyper Terminal — New Connection.

2.2 Enter a name

2.3 Connect to — Direct to Com1 or Com 2

2.4 Configure port properties

Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

2.5 Open Properties in the program File — Properties

2.6 Setting: ASCII Set Up

Select Echo characters locally, select send line ends with line feed.

On some PC systems, pressing the number keypad "Enter" will distort displayed messages. Use the alphabetic "Enter" instead.

3. Power supply set-up:

3.1 Connect the power supply to the PC using the RS232 cable.

3.2 Set via the front panel: Baud Rate: 9600, Address: 06.

3.3 Set via the rear panel: RS232/485 to RS232.

◆ Refer to "3-3. SW1 setup switch".

4. Communication Test:

4.1 Model identification:

PC: write: ADR 06

Power supply response: "OK"

4.2 Command test:

PCwrite: OUT 1

Power supply response: "OK"

PCwrite: PV n

Power supply response: "OK"

PCwrite: PCn (for n values seeTables 6-8 and 6-9)

Power supply response: "OK"

The power supply should turn on and the display will indicate the output voltage and the actual output current.

7. ISOLATED ANALOG PROGRAMMING OPTION

Isolated Analog Programming is an internal option card for analog programming of the PU power supply series. The option is factory installed and cannot be obtained with GP-IB (GP-IB) Interface. Output Voltage and Current Limit can be programmed and readback through optically isolated signals which are isolated from all other ground references in the power supply.

There are two types of Isolated Analog programming cards:

1. 0V to 5V/0V to 10V option: Using 0V to 5V or 0V to 10V signals for programming and readback.
2. 4mA to 20mA option: Using current signals for programming and readback.

7-1. Specifications

7-1-1. 0V to 5V/0V to 10V option

Programming Inputs	Output voltage programming accuracy	%	±1
	Output current programming accuracy	%	±1
	Output voltage programming temperature coefficient	ppm/℃	±100
	Output current programming temperature coefficient	ppm/℃	±100
	Input impedance	Ω	1M
	Absolute maximum voltage	Vdc	0 to 15
	Max. voltage between program inputs and supply outputs	Vdc	600
Monitoring Outputs	Output voltage monitoring accuracy	%	±1.5
	Output current monitoring accuracy	%	±1.5
	Output impedance (see note)	Ω	100
	Max. voltage between monitoring outputs and supply outputs	Vdc	600

Use 100kΩ minimum input impedance for the monitoring circuits to minimize the readback error.

7-1-2. 4mA to 20mA option

Programming Inputs	Output voltage programming accuracy	%	±1
	Output current programming accuracy	%	±1
	Output voltage programming temperature coefficient	ppm/°C	±200
	Output current programming temperature coefficient	ppm/°C	±200
	Input impedance	Ω	50
	Absolute maximum input current	mA	0 to 30
	Max. voltage between program inputs and supply outputs	Vdc	600
Monitoring Outputs	Output voltage monitoring accuracy	%	±1.5
	Output current monitoring accuracy	%	±1.5
	Maximum load impedance	Ω	500
	Max. voltage between monitoring outputs and supply outputs	Vdc	600

7-2. Isolated programming and monitoring connector

Refer to Table 7-1 for detailed description of the rear panel Isolated Programming & Monitoring connector.
To provide the lowest noise performance, it is recommended to use shielded-twisted pair wiring.
Refer to Fig.7-1 for description of the connector.
Isolated programming plug P/N: MC1.5/8-ST-3.81, Phoenix.

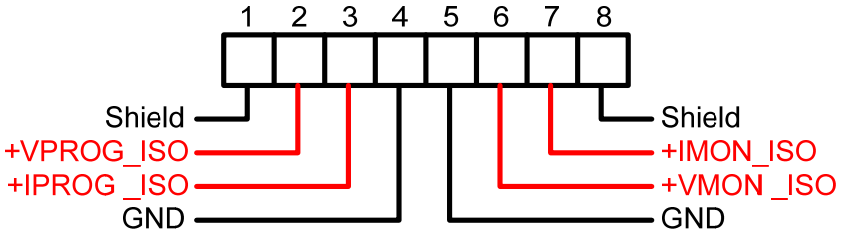


Fig.7-1: Isolated Programming & Monitoring connector

Table 7-1: Detailed description of Isolated programming & Monitoring connector

Terminal	Signal name	Function	Range 0V to 5V/0V to 10V IS510 option	Rang 4mA to 20mA IS420 option
1	SHLD	Shield, connected internally to chassis of the supply.	Chassis ground	
2	+VPROG_ISO	Output voltage programming input	0V to 5V/0V to 10V	4mA to 20mA
3	+IPROG_ISO	Output current programming input	0V to 5V/0V to 10V	4mA to 20mA
4	GND	Ground for programming signals.	Ground	Ground
5	GND	Ground for programming signals.	Ground	Ground
6	+VMON_ISO	Output voltage monitoring output	0V to 5V/0V to10V	4mA to 20mA
7	+IMON_ISO	Output current monitoring output	0V to5V/0V to 10V	4mA to 20mA
8	SHLD	Shield, connected internally to chassis of the supply.	Chassis ground	

When the Isolated Analog Option is installed, do not apply any signals to the non-isolated VPGM and IPGM (J1-9 and J1-10) pins. All other J1 features may be used normally.

◆ **Refer to "6-4. Communication interface protocol" for a description of J1 features.**

7-3. Setup and operating instructions

To prevent damage to the unit, do not program the output voltage and current to higher then the power supply rating.

7-3-1. Setting up the power supply for 0V to 5V/0V to 10V Isolated Programming and Monitoring

Perform the following procedure to configure the power supply:

1. Turn the power supply AC power switch to off.
2. Connect a short between J1-8 and J1-12.
3. Set the Setup switch SW1 positions 1 and 2 to their Up position.
4. Set SW1 position 3 to select the programming voltage range: Down=0-5V, Up=0-10V.
5. Set SW1 position 4 to select the monitoring range: Down=0-5V, Up=0-10V.
6. Ensure that SW1 positions 7 and 8 are in their down position.
7. Connect the programming sources to the mating plug of the Isolated Programming connector. Observe for correct polarity of the voltage source.
8. Set the programming sources to the desired levels and turn the power supply ON.

J1-8 and J1-12 must be shorted together with a jumper.

7-3-2. Setting up the power supply for 4mA to 20mA Isolated Programming and Monitoring

Perform the following procedure to configure the power supply:

1. Turn the power supply AC power switch to off.
2. Connect a short between J1-8 and J1-12.
3. Set the Setup switchSW1positions 1 and 2 to their Up position.
4. Set SW1 position 3 to it's up position.
5. Set SW1 position 4 to it's up position.
6. Ensure that SW1 positions 7 and 8 are in their Down position.
7. Connect the programming source to the mating plug of the Isolated Programming connector. Observe for correct polarity of the voltage source.
8. Set the programming sources to the desired levels and turn the power supply ON.

SW1 position 3 and 4 must be in their Up position for operation with 4-20mA Isolated Programming and Monitoring.

8. MAINTENANCE

This chapter provides information about maintenance, calibration and troubleshooting.

8-1. Units under warranty

Units requiring repair during the warranty period should be returned to a our authorized service facility. Refer to the addresses listing on the back cover of this manual. Unauthorized repairs performed by other than the authorized service facilities may void the warranty. Be careful not to tear a seal.

8-2. Periodic maintenance

No routine maintenance of the power supply is required except for periodic cleaning. To clean, disconnect the unit from the AC supply and allow 30sec. for discharging internal voltage. The front panel and the metal surfaces should be cleaned using mild solution of detergent and water. The solution should be applied onto a soft cloth, and not directly to the surface of the unit. Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. Use low pressure compressed air to blow dust from the unit.

8-3. Fan exchange

(1) Please recommend to set up a maintenance period for fan exchange. However, please do not exchange in yourself.

(2) A fan life should keep in mind that it changes lifetime sharply by the difference in use environment (temperature, humidity, dust) etc.

(3) In the fan exchange in a maintenance, it becomes onerous. Please contact your dealer or our distributor.

8-4. Parts replacement and repairs

As repairs are made only by the manufacturer or by authorized service facilities, no parts replacement information is provided in the manual. In case of failure, unusual or erratic operation of the unit, contact a our agent nearest you. Please refer to the our agent addresses listing on the back cover of this user manual.

8-5. Fuse rating

There are no user replaceable fuses in the power supply. Internal fuses are sized for fault protection and if a fuse was opened it would indicate that service is required. Fuse replacement should be made by qualified technical personnel.

Table 8-1: Internal fuses

Fuse designation	750W model
F301	20A / 250VAC Time delay
F302, F304	2A / 400VDC、Normal

APPENDIX A TROUBLESHOOTING

If the power supply appears to operating improperly, use the troubleshooting guide to determine whether the power supply, load or external control circuits are the cause.

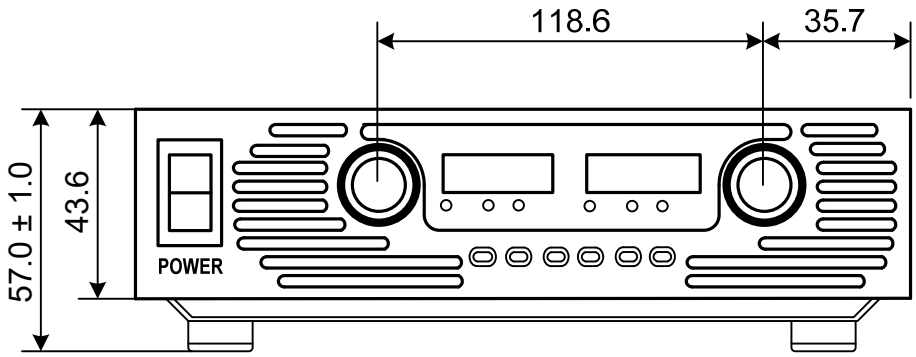
Configure the power supply for basic front panel operation and perform the tests of "2-9. Turn-on checkout procedure" to determine if the problem is with the supply.

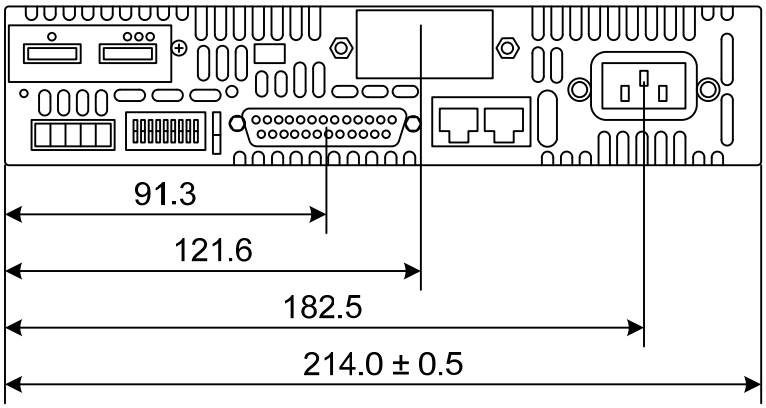
Table A-1 provides the basic checks that can be performed to diagnose problems, and references to sections of this manual for further information.

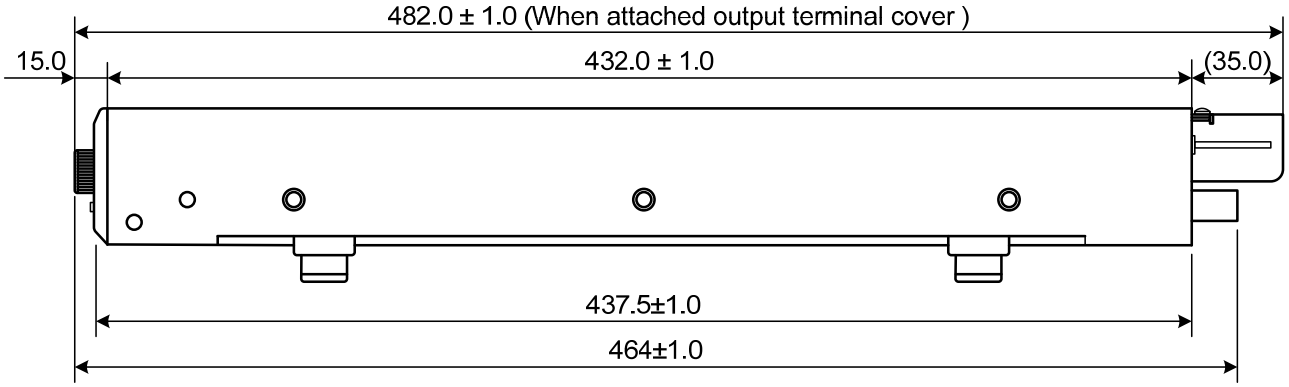
Table A-1: Troubleshooting guide

SYMPTOM	CHECK	ACTION
No output. All displays and indicators are blank.	Is the AC power cord defective?	Check continuity, replace if necessary. ◆ Refer to "2-8. AC input power connection".
	Is the AC input voltage within range?	Check input AC voltage. Connect to appropriate voltage source. ◆ Refer to "2-7. AC source requirements" "2-8. AC input power connection"
Output is present momentarily but shuts off quickly. The display indicates “AC”.	Does the AC source voltage sag when load is applied?	Check input AC voltage. Connect to appropriate voltage source. ◆ Refer to "2-7. AC source requirements".
Output is present momentarily but shuts off quickly. The display indicates “OUP”.	Is the power supply configured to Remote sense?	Check if the positive or negative load wire is loose. ◆ refer to "2-10-6. Making the load connections" "2-10-8. Connecting single loads, remote sensing"
Output voltage will not adjust. Front panel CC LED is on.	Is the unit in constant current mode?	Check current limit setting and load current. ◆ Refer to "4-1-1. Constant voltage mode" "4-1-2. Constant current operation"
Output voltage will not adjust. Front panel CV LED is on.	Check if output voltage is adjusted above OVP setting or below UVL setting.	Set OVP or UVL so they will not limit the output. ◆ Refer to "4-2. Over voltage protection (OVP)" "4-3. Under voltage limit (UVL)"
Output current will not adjust. Front panel CV LED is on.	Is the unit in constant voltage mode?	Check current limit and voltage setting. ◆ refer to "4-1. Standard operation".
Large ripple present in output.	Is the power supply in remote sense? Is the voltage drop on the load wire high?	Check load and sense wires connection for noise and impedance effects. Minimize the drop on the load wires. ◆ Refer to "2-10-4. Noise and impedance effects" "2-10-8. Connecting single loads, remote sensing"
No output. Display indicates “OUP”	Over Voltage Protection circuit is tripped.	Turn off the Ac power switch. Check load connections. If analog programming is used, check if the OVP is set lower than the output. ◆ Refer to "4-2. Over voltage protection (OVP)".
No output. Front panel ALARM LED is blinking.	Display indicates “ENA”	Check rear panel J1 ENABLE connection. ◆ Refer to "4-7. ENABLE/DISABLE control via rear panel J1 connector"
		Setup switch SW1 setting. ◆ Refer to "3-3. SW1 setup switch".
	Display indicates “SO”	Check rear panel J1 Output Shut-Off connection. ◆ Refer to "4-7. ENABLE/DISABLE control via rear panel J1 connector"
	Display indicates “OTP”	Check if air intake or exhaust are blocked. Check if the unit is installed adjacent to heat generating equipment.
	Display indicates “Fb”	Check Foldback setting and load current. ◆ Refer to "4-4. Foldback protection"
Poor Load regulation Front panel CV LED is on.	Are sensing wires connected properly?	Connect the sense wires according to User’s manual instructions.
The front panel controls are nonfunctional.	Is the power supply in Local-Lockout mode?	Turn Off the AC power and wait unit the display turns off. Turn on the AC power and press front panel REM/LOC button. ◆ Refer to "6-1-5. Setting the unit into Remote or Local mode"

APPENDIX B PU 750W POWER SUPPLIES OUTPUT DRAWINGS







APPENDIX C SPECIFICATIONS

C-1. Output rating

MODEL		6-100	8-90	12.5-60	20-38	30-25	40-19	60-12.5	80-9.5	100-7.5	150-5	300-2.5	600-1.3
1. Rated output voltage(*1)	V	6	8	12.5	20	30	40	60	80	100	150	300	600
2. Rated output current 1500w(*2)	A	100	90	60	38	25	19	12.5	9.5	7.5	5	2.5	13
3. Rated output power	W	600	720	750	760	750	760	750	760	750	750	750	780

C-2. Input characteristics

	V	6	8	12.5	20	30	40	60	80	100	150	300	600
1. Input voltage/freq.(*3)	-	85VAC to 265VAC continuous,47Hz to 63Hz,single phase.											
2. Input current(at 100VAC/200VAC)	A	10.5 (AC100V) / 5 (AC200V) for 750W models.											
3. Power Factor	-	0.99 @100VAC/200VAC, rated output power.											
4. Efficiency (*4)	%	76/78	77/80	81/84	82/85	82/85	83/87	83/87	83/87	83/87	83/87	83/87	83/87
5. Inrysh current at 100V/200V	A	Less than 25A for 750W models.											

C-3. Constant voltage mode

		V	6	8	12.5	20	30	40	60	80	100	150	300	600
1. Max. Line regulation (*5)		-	0.01% of rated output voltage ＋2mV											
2. Max. Load regulation (*6)		-	0.01% of rated output voltage ＋2mV											
3. Ripple and noise (p-p,20MHz) (Following 30 minutes warm-up)		mV	60	60	60	60	60	60	60	80	80	100	150	300
4. Ripple r.m.s.,5Hzto1MHz (Following 30 minutes warm-up)		mV	8	8	8	8	8	8	8	8	8	10	25	60
5. Temperature coefficient		ppm/°C	100ppm/°C from rated output voltage,following,30 minutes warm-up.											
6. Temperature drift		-	0.05% of rated Volt over 8hours interval following 30 minutes warm-up. Constant line, load & temp.											
7. Rem. sense compensation/wire		V	1	1	1	1	1.5	2	3	4	5	5	5	5
8. Up-prog.response time,0 to Vomax (*9)		ms	90					120		150				250
9.Down-prog.response time	Full load	ms	10	50			80			150				250
	No load	ms	500	600	700	900	1000	1100	1200	1400	1700	2400	3000	4800
10.Transient response time		ms	Time for the output voltage to recover within 0.5% of its rated output for a load change 10% to 90% of rated output current. Output set-point:10% to 100% Less than 1m.s, for models up to and including 100V. 2m.s, for models above 100V.											
11.Hold-up time		ms	More than 20m.s, 100Vac, rated output power.											

C-4. Constant current mode

	V	6	8	12.5	20	30	40	60	80	100	150	300	600
1. Max. Line regulation (*5)	-	0.01% of rated output current ＋2mA											
2. Max. Load regulation (*7)	-	0.02% of rated output current ＋5mA											
3.Ripple r.m.s 5Hz to 1MHz (*8)	mA	200	180	120	76	63	48	38	29	23	18	13	8
4.Temperature coefficient	ppm/°C	100 ppm/°C from rated output current, following 30 minutes warm-up.											
5.Temperature drift	-	0.05% of rated Iout over 8hours interval following 30 minutes warm-up. Constant line, load & temp.											

C-5. Analog programming and monitoring

1.Vout voltage programming	--	0% to 100%, 0V to 5V / 0V to 10V, user select, Accuracy and linearity:±0.5% of rated Volt.
2.Iout voltage programming	--	0% to 100%, 0V to 5V / 0V to 10V, user select, Accuracy and linearity:±1% of rated Iout.
3.Vout resistor programming	--	0% to 100%, 0kΩ to 5kΩ/ 0kΩ to 10kΩ full scale, user select, Accuracy and linearity:±1% of rated Volt.
4.Iout resistor programming	--	0% to 100%, 0kΩ to 5kΩ / 0kΩ to 10kΩfull scale, user select, Accuracy and linearity:±1.5% of rated Iout.
5.ON/OFF control	--	By electrical Voltage: 0V to 0.6V/2V to 15V, or dry contact, user selectable logic.
6.Output current monitor	--	0V to 5V or 0V to 10V、user selectable. Accuracy:1%.
7.Output voltage monitor	--	0V to 5V or 0V to 10V、user selectable. Accuracy:1%.
8.Power supply OK signal	--	4V to 5V OK, 0V-Fail. 500Ω series resistance.
9.Parallel operation (*10)	--	Possible, up to 4 units in master/slave mode with single wire current balance connection.
10.Series operation	--	Possible (with external diodes), up to 2 units.
11.CV/CC indicator	--	Open Collector. CC mode: On, CV mode: Off. Maximum voltage: 30V, maximum sink current: 10mA
12.Enable/Disable	--	Dry contact. Open: off, Short: on. Max. Voltage at Enable/Disable in: 6V.
13.Local/Remote analog Control	--	By electrical signal or Open/Short: 0V to 0.6V or short: Remote, 2V to 15V or open: Local
14.Local/Remote analog Indicator	--	Open collector, Local: Open, Remote: On, Maximum voltage: 30V, maximum sink current: 10mA.

C-6. Programming and readback (RS232/485, optional GP-IB interface) (At the time of 23°C±5°C)

1.Vout programming accuracy	--	0.1% +0.05% of rated output voltage
2.Iout programming accuracy	--	0.1% +0.15% of rated output current
3.Vout programming resolution	--	0.012% of full scale
4.Iout programming resolution	--	0.012% of full scale
5.Vout readback accuracy	--	0.1% + 0.15% of rated output voltage
6.Iout readback accuracy	--	0.1% + 0.35% of rated output current
7.Vout readback resolution	--	0.012% of full scale
8.Iout readback resolution	--	0.012% of full scale

C-7. Protective functions

	V	6	8	12.5	20	30	40	60	80	100	150	300	600
1. Foldback protection	--	Output shut-down when power supply change from CV to CC User presetable.											
2. Over-voltage protection	--	Inverter shut-down, manual reset by AC input recycle or by OUT button or by communication port command.											
3. Over-voltage trip point	V	0.5 to 7.5	0.5 to 10	1 to 15	1 to 24	2 to 36	2 to 44	5 to 66	5 to 88	5 to 110	5 to 165	5 to 330	5 to 660
4. Output under voltage limit	--	Preset by front panel or communication port. Prevents from adjusting Vout bellow limit.											
5.Over temperature protection	--	User selectable, latched or non latched.											

C-8. Front panel

1.Contlol functions	--	Vout/Iout manual adjust by separate encoders(coarse and fine adjustment).	
	--	OVP/UVL manual adjust by Vout. Adjust encoder.	
	--	Address selection by Voltage Adjust encoder. No of addresses:31	
	--	Go to local control.	
	--	Output on/off	
	--	AC on/off	
	--	Front panel Lock	
	--	Foldback control	
	--	Baud rate selection: 1200, 2400, 4800, 9600, and 19200.	
	--	Re-start modes (automatic restart, safe mode).	
2. Display	--	Vout:	4 digits, accuracy: 0.5% rated output voltage ±1count.
	--	Iout:	4 digits, accuracy: 0.5% rated output current ±1count
3. Indications	--	VOLTAGE,CURRENT,ALARM,FINE,PREVIEW,FOLDBACK,LOCAL,OUTPUT ON	

C-9. Environmental conditions

1.Operating temperature	--	0°C to 50°C,100% load.
2. Storage temperature	--	-20°C to 70°C
3. Operating humidity	--	30% to 90% RH (no condensation)
4. Storage humidity	--	10% to 95% RH (no condensation)
5. Altitude	--	Maximum 3000m. Derate output current by 2%/100m above 2000m. Alternatively, derate maximum ambient temperature by 1°C /100m above 2000m.

C-10. Mechanical

1. Cooling	--	Forced air cooling by internal fans.
2. Weight	Kg	Less than 4.5kg
3. Dimensions(W×H×D)	mm	W: 2140、H: 43.6(57.0 Benchtop Version)、D: 437.5 (Refer to Outline drawing)
4. Vibration	--	MIL-810E, method 514.4, test condition 1-3.3.1
5. Shock	--	Less than 20G, half sine, 11mS. Unit is unpacked.

C-11. Safety/EMC

1.Applicable standards: Safety	--	Designed to meet EN61010-1 Vout≤60V: Output is Non Hazardous, GP-IB/Isolated analog are Non Hazardous. 60<Vout=400V: Output is hazardous, GP-IB/Isolated analog are Non Hazardous. 400<Vout=600V: Output is hazardous, GP-IB/Isolated analog are Hazardous.
EMC		EN55035
2.Withstand voltage	--	Vout≤40V models: Input-Outputs (Non Hazardous): 4242VDC 1min, Input-Ground: 2828VDC 1min, 40<Vout≤150V models: Input- Output (Hazardous.): 3425VDC 1min, Output (Hazardous.)-Ground: 1414VDC 1min, Input-Non Hazardous: 4242VDC 1min,Output (Hazardous.)-Non Hazardous: 2307VDC 1min, Input-Ground: 2828VDC 1min. 150<Vout≤600V models: Input- Output (Hazardous.): 3490VDC 1min, Output (Hazardous.)-Ground: 2738VDC 1min, Input-Non Hazardous: 4242VDC 1min,Output (Hazardous.)-Non Hazardous: 4242VDC 1min, Input-Ground: 2828VDC 1min.
3.Insulation resistance	--	More than 100Mohm at 25°C、70%RH
4.Conducted emission	--	EN55032
5.Radiated emission	--	EN55032

NOTES：

*1. Minimum voltage is guaranteed to maximum 0.2% of the rated output voltage.

*2: Minimum current is guaranteed to maximum 0.4% of the rated output current.

*3: For cases where conformance to various safety standards (UL, IEC etc.) is required, to be described as 100VAC to 240VAC (50Hz/60Hz).

*4: At 100VAC/200VAC input voltage and maximum output power.

*5: From 85VAC to 132VAC or 170VAC to 265VAC, constant load.

*6: From No-load to Full-load, constant input voltage. Measured at the sensing point in Remote Sense.

*7: For load voltage change, equal to the unit voltage rating, constant input voltage.

*8: For 6V models the ripple is measured at 2V to 6V output voltage and full output current. For other models, the ripple is measured at 10% to 100% output voltage and full output current.

*9: From 10% to 90% of rated output voltage, With rated resistive load.

*10: From 90% to 10% of rated output voltage, with rated resistive load.

*11: From 90% to 10% of rated output voltage.

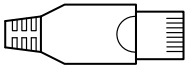
C-12. Supplemental characteristics

The supplemental characteristics data is held in each our sales and service facility. For further details please contact the our agent nearest you.

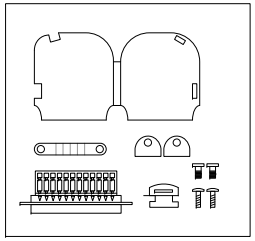
APPENDIX D ACCESSORIES

Accessories	PU6-100	PU8-90	PU12.5-60	PU20-38	PU30-25	PU40-19	PU60-12.5	PU80-9.5	PU100-7.5	PU150-5	PU300-2.5	PU600-1.3
Terminal	●	●	●	●	●	●	●	●	●	●	●	●
D-SUB25pin Connector set （749809-9, AMP）	●	●	●	●	●	●	●	●	●	●	●	●
Linking cable*1	●	●	●	●	●	●	●	●	●	●	●	●
Output terminal shield cover	●	●	●	●	●	●	●					
Screws for output terminal shield cover	●	●	●	●	●	●	●					
Nut set	●	●	●	●	●	●	●					
Output terminal protect cover	—	—	—	—	—	—	●	—	—	—	—	—
Screws for output terminal protect cover	—	—	—	—	—	—	●	—	—	—	—	—
Rubber shoes set	●	●	●	●	●	●	●	●	●	●	●	●
AC cable	●	●	●	●	●	●	●	●	●	●	●	●

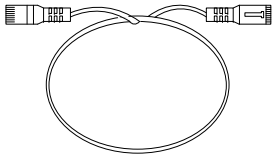
*1: Only the linking cable is individually sold.



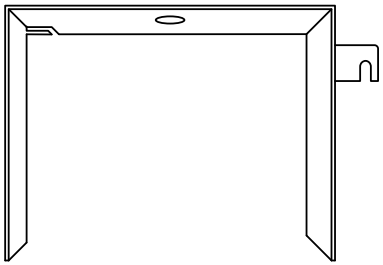
Terminal



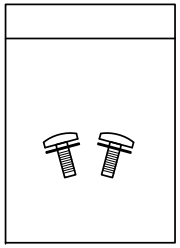
D-SUB25pin connector set（749809-9, AMP）



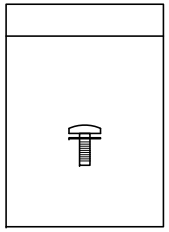
Linking cable



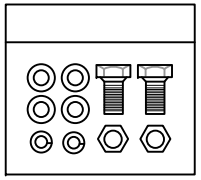
Output terminal shield cover



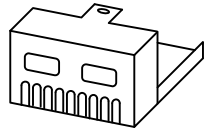
Screws for output terminal shield cover (6V to 60V)



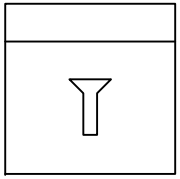
Screws for output terminal shield cover
(80V to 600V)



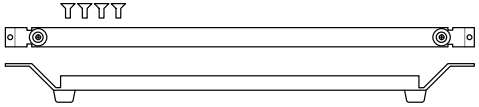
Nut set



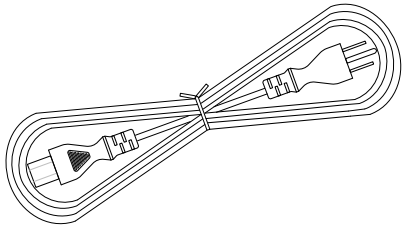
Output terminal protect cover



Screws for output terminal protect cover



Rubber shoes set



AC cable

CAUTION: The form of accessories varies according to a model.

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