

# Linear DC Power Supply

GPR-U Series

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## USER MANUAL

GW INSTEK PART NO. 82PR-3520HME1



ISO-9001 CERTIFIED MANUFACTURER

**GW INSTEK**

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# S SAFETY INSTRUCTIONS

This chapter contains important safety instructions that should be followed when operating and storing the device. Read the following before any operation to ensure your safety and to keep the device in the best condition.

## Safety Symbols

These safety symbols may appear in this manual or on the device.

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Warning: Identifies conditions or practices that could result in injury or loss of life.



Caution: Identifies conditions or practices that could result in damage to the device or to other objects or property.



**DANGER** High Voltage



Attention: Refer to the Manual



Protective Conductor Terminal



Equipotentiality



**DANGER** Hot Surface



Do not dispose electronic equipment as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased.

## Safety Guidelines

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### General Guideline



#### CAUTION

- Do not place heavy objects on the device.
- Avoid severe impact or rough handling that may damage the device.
- Avoid discharges of static electricity on or near the device.
- Use only mating connectors, not bare wires, for the terminals.
- Do not block the cooling fan vent.
- The device should only be disassembled by a qualified technician.

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### Power Supply



#### WARNING

- AC Input voltage: 120V  $\pm$  10%, 50/60Hz (AC 220V or 240V order made)
- Connect the protective grounding conductor of the AC power cord to an earth ground.

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### Cleaning the power supply

- Disconnect the power cord before cleaning the power supply.
- Use a soft cloth dampened in a solution of mild detergent and water. Do not spray any liquid into the power supply.
- Do not use chemicals containing harsh products such as benzene, toluene, xylene, and acetone.

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### Operation Environment

- Location: Indoor, no direct sunlight, dust free, almost non-conductive pollution.
- Relative Humidity: < 80%
- Temperature: 0°C to 40°C

**Storage environment**

- Location: Indoor
  - Relative Humidity: < 70%
  - Temperature: -10°C to 70°C
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**Disposal**

Do not dispose this instrument as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased. Please make sure discarded electrical waste is properly recycled to reduce environmental impact.

# T HEORY OF OPERATION

## Low Voltage Circuit

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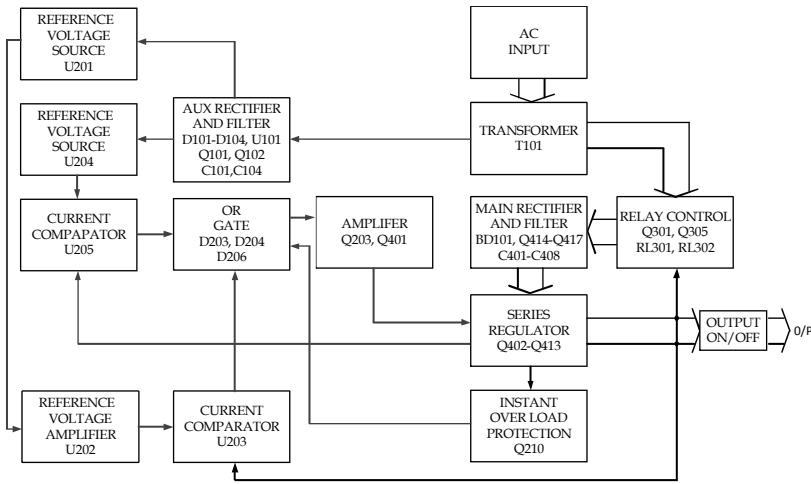
### Background

- The power supply can be divided into the following blocks: (1) AC input circuit, (2) transformer, (3) bias supply consisting of a rectifier and filter providing a reference voltage source, (4) main regulator circuit consisting of the main rectifier and associated filters, (5) series regulator, (6) current comparator, (7) voltage comparator, (8) reference voltage amplifier, (9) instant over load protection circuit and (10) relay control circuit.
- The circuit elements consist of several integrated circuit (U201~U205, U101).
- The circuit arrangement is shown as block diagram in Fig. 1.
- Single Phase input power is applied to the transformer through the input circuit.
- Auxiliary rectifier D101-D104 provides a bias voltage filtered by capacitor C101~ C104 for the pre-regulator U101, Q101 and Q102.
- The main rectifier is a full wave bridge rectifier. The power is filtered by capacitor C401-C408 and then regulated via a series regulator.
- U204 provides a reference voltage for U205

which acts as a current limiter. U201 provides a reference voltage for U202 (inverter amplifier). U203 is a comparator amplifier. Both U205 and U203 are used to calibrate the input to Q203.

- Q210 is an instant over load protection circuit. It controls Q203 current magnitude to limit the output current.
- The output voltage is controlled by the output switch.
- The relay control circuit provides limited power dissipation in series regulator.

Fig. 1 Block diagram (Less than 100V)





## High Voltage Circuit

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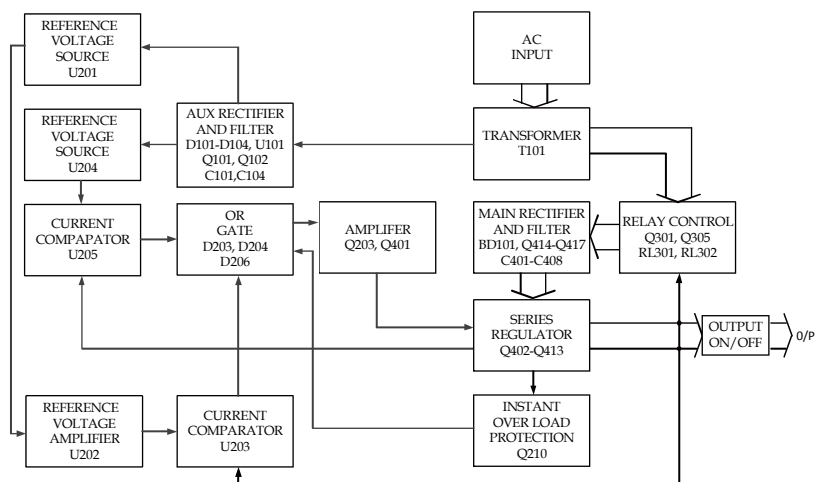
### Background

- The power supply can be divided into the following blocks: (1) AC input circuit, (2) transformer, (3) bias supply consisting of a rectifier and filter providing a reference voltage source, (4) main regulator circuit consisting of the main rectifier and filter, (5) series regulator, (6) current comparator, (7) voltage comparator, (8) reference voltage amplifier and (9) transistor driver consisting of rectifier and filter.
- The circuit elements consist of several integrated circuit (U201~U205, U101).
- The circuit is described in the block diagram on next page.
- Single phase input power is applied to the transformer through the input circuit.
- Auxiliary rectifier D101-D104 provides a bias voltage filtered by capacitor C101~ C104 for the pre-regulator U101, Q101 and Q102.
- The bias voltage is provided by auxiliary rectifier (D302~D305) to turn the transistor (Q303~Qn) on.
- The main rectifier is made by rectifiers and filters and then regulated via a series regulator and delivered to the output.
- U204 provides a reference voltage for U205 which acts as a current limiter. When the current is over rating, it is activated to decrease the current. U201 provides a reference voltage for U202, which is an inverter amplifier. U205 is

a comparator amplifier. It may be used to compare the reference voltage and the feedback voltage to calibrate the input voltage to Q202 and Q203.

- The output voltage is controlled by the output switch

Fig. 2 Block diagram (more than 100V)



# G GETTING STARTED

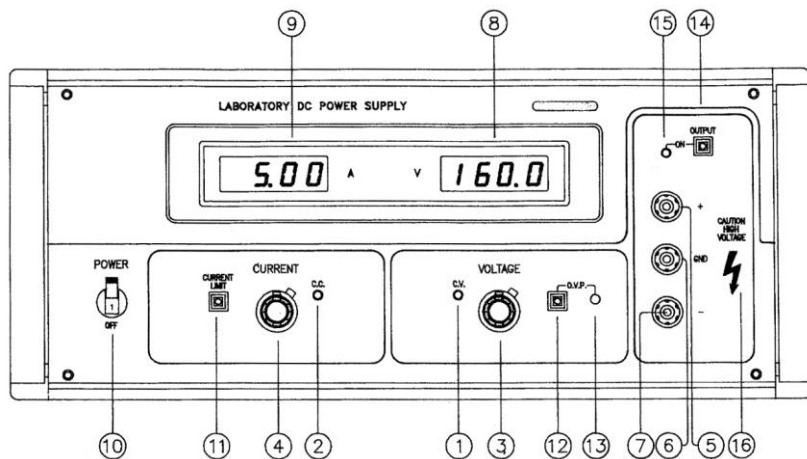
## Product Introduction

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- Description
- The regulated DC power supplies GPR-U series and GPR-Super series have been designed to cover the most often required applications in laboratories, schools and production lines.
  - The output voltage can be adjusted from 0 to the rated voltage in one single range by coarse and fine potentiometer. The load current can be varied from 0 to the rated current by coarse and fine potentiometer. Both outputs can be accurately read on the integrated voltmeter and ammeter.
  - Both stability and ripple are at high standard and meet the requirements of modern circuit design. The unit can be used as either constant voltage or constant current source. The various mode of operation are described in greater details in the Operation Instructions Section.

## Front Panel Overview

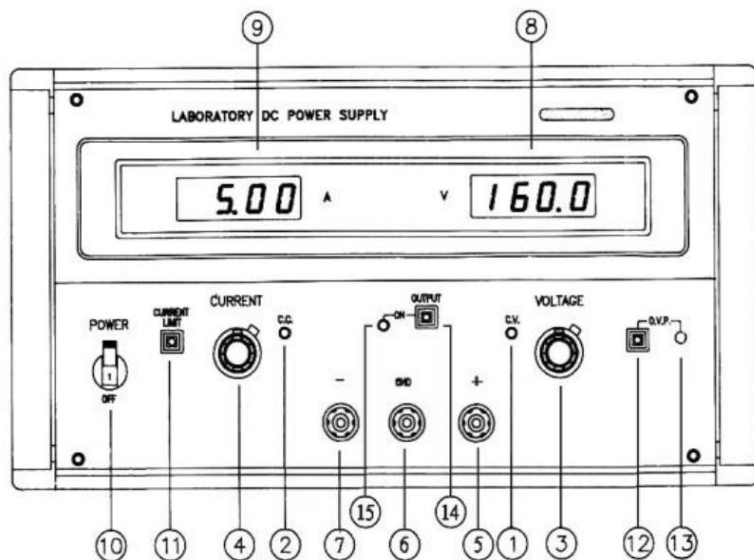
### GPR-U Series



No.	Name	Description
1	CV Indicator	Lights when the power is on and in constant voltage operation.
2	CC Indicator	Lights when the device is in constant current operation.
3	Voltage	Coarse and fine voltage control knob.
4	Current	Coarse and fine current control knob.
5	“+” output terminal	Positive polarity, load current (Red).
6	“GND” terminal	Earth and chassis ground (Green).
7	“-” output terminal	Negative polarity (Black).
8	Voltmeter	Indicates the output voltage.
9	Ammeter	Indicates the output current.
10	Power control	Unit On/Off switch with overvoltage and overcurrent tripped crowbar.

- 11 Current limit switch When the current limit switch is pushed, the Ammeter indicates the value of the current limit setting.
- 12 O.V.P. switch When the O.V.P. switch is pushed, the Voltmeter indicates the value of the over voltage protection setting.
- 13 O.V.P. adjust For the O.V.P. adjustment of the over voltage protection setting value.
- 14 Output switch Turns on / off the output.
- 15 Output indicator Lights when the output switch is turned on.
- 16  Caution high voltage  
Caution, potential of 100V or more may be present on the terminals.

GPR-Super Series



No.	Name	Description
1	CV Indicator	The indicator lights when the device is powered on and in constant voltage operation.
2	CC Indicator	The indicator lights when the device is in constant current operation.
3	Voltage	Coarse and fine voltage control knob.
4	Current	Coarse and fine current control knob.
5	"+" Output Terminal	Output terminal of positive polarity (10A Max. This output terminal is not a major output terminal).
6	"GND" terminal	Output terminal for grounding (10A Max. This output terminal is not a major output terminal).

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7	"-" Output Terminal	Output terminal of negative polarity (10A Max. This output terminal is not a major output terminal).
8	Voltmeter	Indicates the output voltage (Digital power meter).
9	Ammeter	Indicates the output current (Digital power meter).
10	Power control	Unit On/Off switch with overvoltage and overcurrent tripped crowbar.
11	Current limit switch	When the current limit switch is pushed, the Ammeter indicates the value of the current limit setting.
12	O.V.P. switch	When the O.V.P. switch is pushed, the Voltmeter indicates the value of the over voltage protection setting.
13	O.V.P. adjust	For the O.V.P. adjustment of the over voltage protection setting value.
14	Output switch	Turns on/off the output.
15	Output indicator	The indicator lights when the output voltage switch is turned on.

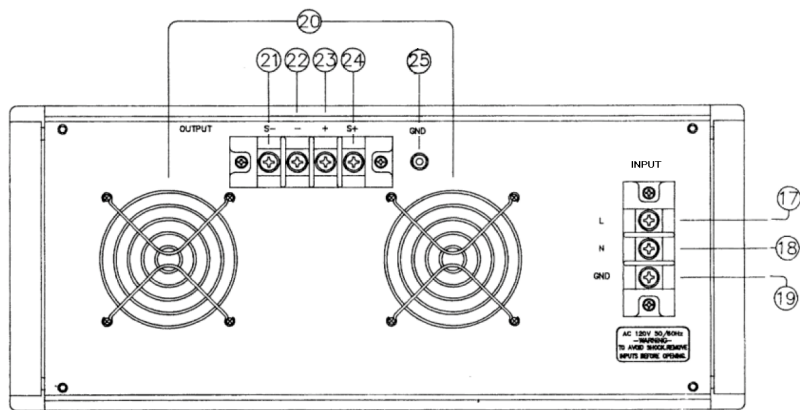
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**WARNING**

Warning: Do not touch the output terminal after power is on to avoid electrical shock.

# Rear Panel

## GPR-U Series



No.	Name	Description
17	“L” terminal	AC. Live input terminal.
18	“N” terminal	AC. Neutral input terminal
19	GND terminal	Earth and chassis ground.
20	Cooling fan	Ventilates the hot air out.
21	“S-” terminal	Negative polarity sense terminal.
22	“-” terminal	Negative polarity output terminal.
23	“+” terminal	Positive polarity output terminal.
24	“S+” terminal	Positive polarity sense terminal.
25	GND terminal	Earth and chassis ground.

**NOTE**

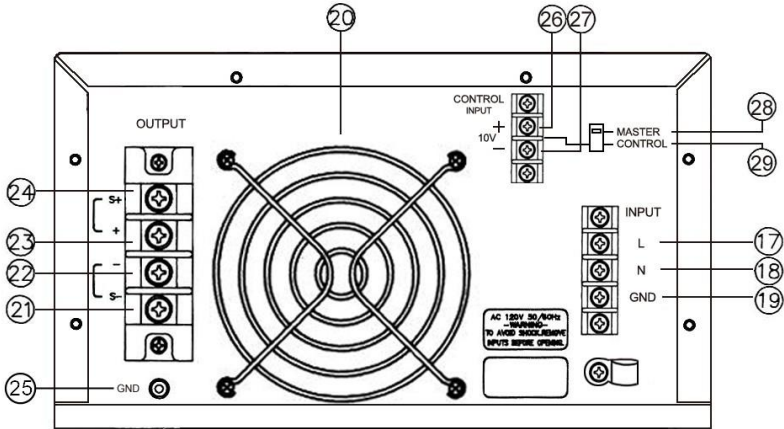
If the load current is greater than 10A, then the rear panel terminals (21 to 25) must be used.

**WARNING**

Warning: Do not touch the output terminal after power is on to avoid electrical shock.



GPR-Super Series



No.	Name	Description
17	“L” terminal	AC. Live input terminal.
18	“N” terminal	AC. Neutral input terminal
19	GND terminal	Earth and chassis ground.
20	Cooling fan	Ventilates the hot air out.
21	“S-” terminal	Negative polarity sense terminal.
22	“-” terminal	Negative polarity output terminal.
23	“+” terminal	Positive polarity output terminal.
24	“S+” terminal	Positive polarity sense terminal.
25	GND terminal	Earth and chassis ground.
26	Control input “+” terminal	The positive polarity +10V input terminal of external control
27	Control input “-” terminal	The negative polarity -10V input terminal of external control
28	Master	When the switch is in this position, the voltage and current settings are controlled by the front panel control knobs.

29 Control When the switch is in this position, the voltage and current settings can be controlled remotely via the control input 10V terminals.

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**NOTE**

If the load current is greater than 10A, then the rear panel terminals (21 to 25) must be used.

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**WARNING**

Warning: Do not touch the output terminal after power is on to avoid electrical shock.

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# PERATION

# INSTRUCTIONS

## Precaution

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AC input	AC input should be within the range of line voltage $\pm 10\%$ at 50/60Hz.
Installation	Avoid using the power supply in a place where ambient temperature exceeds 40°C. The heat sink locate at the rear of the power supply must have sufficient air space for radiation.
Output voltage overshoot	Voltage between output terminals never exceeds the preset value when the power is turned on or off.

## Setting Current Limit

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- Procedure
1. Determine the maximum safe current for the device to be powered.
  2. Push the current limit switch.
  3. Rotate the Coarse Voltage Control Knob away from zero sufficiently for the CC indicator to light.
  4. Adjust the current limit to the desired value by rotating the Current Control Knob. You can read the current value on the Ammeter.
  5. The current limit (overload protection) has now been preset. Do not change the Current Limit setting after this step.
  6. Release the current limit switch.

## Constant Voltage / Constant Current Characteristics

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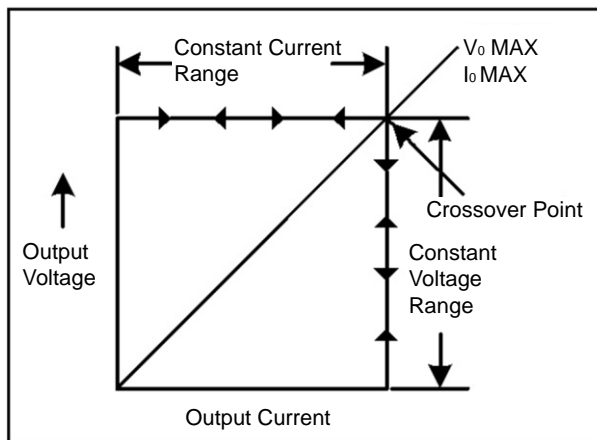
### Background

The regulated DC power supplies GPR-U series and GPR-Super series are Constant Voltage / Constant Current automatic crossover type of power supplies. This allows continuous operation during transition from constant current to constant voltage modes in response to the load change. The intersection point of constant voltage and constant current modes is called the crossover point. Fig.3 shows the relationship between this crossover point and the load.

For example, if the load is such that the power supply is operating in constant voltage mode, a regulated output voltage is provided. The output voltage remains constant as the load increases, up until the point where the preset current limit is reached. At that point, the output current becomes constant and the output voltage will start to drop in proportion to further increase in load. The crossover point is indicated by the front panel LED indicators. The crossover point in that case is reached when the CV indicator turns off and the CC indicator turns on.

Similarly, crossover from constant current to constant voltage mode automatically occurs from a decrease in load. A good example of this would be seen when charging a 12 volt battery. Initially, the open circuit voltage of the power supply may be preset for 13.8 volts. A low battery will place a heavy load on the power supply and it will operate in constant current mode, which may be adjusted for a 1 amp charging rate. As the battery becomes charged, and its voltage approaches 13.8 volts, its load decreases to the point where it no longer demands the full 1 amp charging rate. This is the crossover point where the power supply goes into constant voltage mode.

Fig. 3 Constant Voltage/Constant Current Characteristic



# APPENDIX

## Specifications

All specifications are applicable only when the rear panel terminals are used. If the front panel terminals are used or if operating with long cables, remote sense must be connected to the terminals.

The specifications apply when the device is powered on for at least 30 minutes under +20°C~+30°C.

General	Main supply	AC120±10% 50/60Hz(Otherwise by order made)
	Rating, dimension and weight	See Table 1 and table2
Operation mode	Series Operation	
Operation Environment	Indoor use	
Operation Temperature & Humidity	0°C to 40°C, <80%.	
Storage Temperature & Humidity	-10°C to 70°C, < 70%.	
Accessories	<ul style="list-style-type: none"> <li>• Operation Manual</li> <li>• Test Lead: GTL-10(Current&lt;4A)*1, or GTL-104(Current≤10A)*1</li> </ul>	
	Note: No Test Lead included to the unit with its current greater than 10A or voltage greater than 600V.	
Constant Voltage Operation	Output Voltage ranges 0 to rating voltage adjustable continuously	
	Voltage regulation	line regulation ≤0.01%+3mV. load regulation ≤0.01%+5mV. load regulation ≤0.02%+5mV(≥10A).
	Recovery time	≤100μs (50% Load change, minimum load 0.5A)

	Ripple & Noise	$\leq 2mVrms$ (5Hz~1MHz).
	Temperature coefficient	$\leq 300ppm/^{\circ}C$
	OVP setting ranges from 15% to 105% of rate voltage continuously adjustable	
	Output current range 0 to rating current adjustable continuously	
Constant Current Operation	Current regulation	line regulation $\leq 0.2\%+3mA$ load regulation $\leq 0.2\%+5mA$
	Ripple	$\leq 5mArms$ ( $\leq 20A$ ) $\leq 20mArms$ ( $\leq 50A$ ) $\leq 100mArms$ ( $\leq 100A$ )
Indicator Meter	Display	3 1/2 Digits 0.5" Red LED display.
	Accuracy	$\pm(0.5\%$ of rdg + 2 digits)
	Voltage range	19.99V of full scale(rating voltage $\leq 18V$ ) 199.9V of full scale(rating voltage $\leq 180V$ ) 1999V of full scale(rating voltage $\leq 1800V$ )
	Current range	1.999A of full scale(rating current $\leq 1.8A$ ) 19.99A of full scale(rating current $\geq 18A$ ) 199.9A of full scale(rating current $\leq 180A$ )
Insulation	Between chassis and output terminal	100M $\Omega$ or above(DC1000V)
	Between Chassis and AC cord	100M $\Omega$ or above (DC1000V).

Table 1

GPR-U Model	Max. Rating		Dimensions (m/m)	Weight (Kg)
	Volts(V)	Amps(A)		
GPR-100H05D	1000	0.5	430(W) 178(H) 572(D)	28.5
GPR-60H15D	600	1.5		30.5
GPR-50H15D	500	1.5		29.5
GPR-35H20D	350	2		29.5
GPR-25H30D	250	3		29.5
GPR-16H50D	160	5		30.5
GPR-7510HD	75	10		29.5
GPR-6015HD	60	15		30.0
GPR-3520HD	35	20		29.5
GPR-1850HD	18	50		30.0





Note

1. Special order 8 volts to 1000 volts and 0.5 Amps to 75 Amps under 1kVA available. Rear-Panel Output for GPR-1850HD/3520HD/6015HD.
2. In addition to the specifications listed above, GW Instek can also manufacture GPR series power supplies with customized specifications.



Warning

When the voltage exceeds 60VDC, users might be in danger of electric shock. When connecting the power supplies in series, please be careful as the voltage between connection terminals and ground terminals may reach 60VDC or higher.

Table 2

GPR-Super Model	Max. Rating		Dimensions WxHxD(m/m)	Remote function	Weight Kg
	Volts(V)	Amps(A)		External 10V Remote control	
GPR-100H05DA	1000	0.5	300(W) 194(H) 558(D)	Without	26.5
GPR-60H15DA	600	1.5		Without	26.5
GPR-50H15DA	500	1.5		Without	26.5
GPR-35H20DA	350	2		Without	26.5
GPR-25H30DA	250	3		Without	26.5
GPR-16H50DA	160	5		Without	26.5
GPR-7510HDA	75	10		Without	26.5
GPR-6015HDA	60	15		Without	26.5
GPR-3520HDA	35	20		Without	26.5
GPR-7510HDC	75	10		With	26.5
GPR-6015HDC	60	15		With	26.5
GPR-3520HDC	35	20		With	26.5



Note

In addition to the specifications listed above, GW Instek can also manufacture GPR series power supplies with customized specifications.

**Warning**

When the voltage exceeds 60VDC, users might be in danger of electric shock. When connecting the power supplies in series, please be careful as the voltage between connection terminals and ground terminals may reach 60VDC or higher.