

HiRange Series

HRG-6010

Programmable DC Power Supply



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
1. Important Safety Instructions

1.1 General

This chapter contains important safety instructions for fully utilizing the HiRange Series DC Power Supply. It is important that this manual is read and understood by all persons prior to transporting, installing, operating, servicing, or maintaining the product..

1.2 Symbols & Messages

The following symbols mainly appear in this chapter and may be found in other chapters and on the product itself.



	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury
	Indicates a potentially hazardous situation which, if not avoided, may result in death or serious injury
	Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury
	Electrical shock risk
	Fire risk
	Attention
	EMI risk
	High temperature
	Condensation
	Earth terminal

1.3 Safety Instructions



1.3.1 Transportation

When transporting the product, please ensure that the original packaging is used to prevent damage to the product.


1.3.2 Ambient Conditions

	<ul style="list-style-type: none"> •The product is designed for indoor use. •Condensation may occur after the product was shipped, or subject to a sudden change in an atmosphere of temperature or humidity. Do not use the product for at least two hours to ensure it is dry before turning it on.
	<ul style="list-style-type: none"> •Do not place the product in high humidity area. •Do not expose the product to direct sunlight or any heat source. •Do not block the ventilation openings at the enclosure of the product. •Do not place any heavy objects on the product.






1.3.3 Installation The product

	<p>The product is constructed to Protection Class I. Connect the product to an earthed wall receptacle with a power cord approved by relevant International Standards.</p>
	<p>The product is rated at AC input 85~264V, 47~63Hz mains.</p>

1.3.4 Operation

	<p>⚠ DANGER</p> <p>Be careful! A change from open circuit to short circuit could result in high current sparks and cause injury to eyes. An instantaneous power circuit change from short to open may induce high voltage and arcing, causing shock and injury to eyes.</p>
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1.3.5 Service & Maintenance

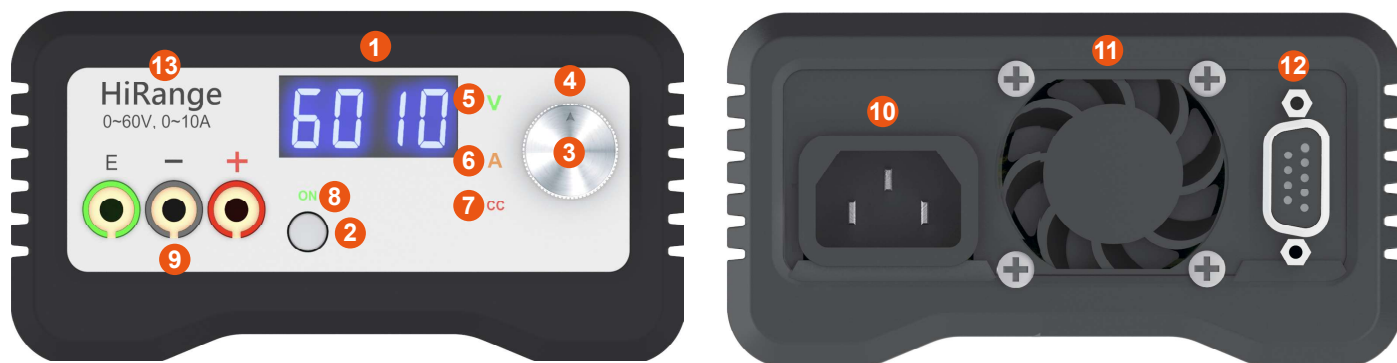
	<p>⚠ DANGER</p> <p>The product operates at hazardous high voltage (near DC 380V or AC 267V). Only qualified personnel can carry out servicing or maintenance.</p>
	<p>⚠ WARNING</p> <p>Always use a properly rated voltage sensing device to confirm that all power is off.</p>
	<p>⚠ WARNING</p> <p>Before attempting any service, disconnect the product from all power supply and ensure that no harmful residual voltage remains at the terminals of bulk capacitors.</p>
	<p>Replace the fuse only with the same amperage and voltage ratings to avoid risk of fire.</p>
	<ul style="list-style-type: none"> • This is a Class A device which may cause RF interference within the home. • The product should only be operated when the case is securely closed, with all screws tightened. • While operating the product, the wearing of metal or other conducting jewelry such as chains, bracelets, rings, etc. is not recommended.

1.3.6. Storage

- Location: Indoor
- Relative Humidity: <80%
- Temperature: -10°C ~ 70 °C

2. Get Acquainted with HiRange Series

2.1 Knowing about front / rear panel



1	7-segment LED module	4-digit meter measures and displays values of voltage and current. Also for auxiliary purpose of system parameters setup.
2	Output key	Press to turn the output on/off.
3	Knob enter key	Modes selection and input termination
4	Knob cw/ccw	Input increment/decrement
5	V-LED	Green "V" denotes unit = " VOLT" for meter display. Lit state : shows meter display in Reading mode. Blinking : shows meter display in Setting mode.
6	A-LED	Orange "A" denotes unit = " AMPERE" for meter display. Lit state : shows meter display in Reading mode. Blinking : shows meter display in Setting mode.
7	cc-LED	Red symbol "cc" . Off state : denotes output in constant voltage (CV) mode. Lit state: denotes output in constant current (CC) mode.
8	Output LED	Green symbol "ON" . Off state : denotes output Off. Lit state : denotes output On.
9	DC output	'Earth' terminal, '-' terminal and '+' terminal
10	AC input	IEC male socket
11	Cooling fan	Temperature control DC fan
12	Comm. port	RS-232 interface
13	Series & specifications	Series name / Output ratings

2.2 Models & Output Ratings

HiRange Series consists of 1 model and its ratings as listed below:

Model	HRG-6010
Voltage	0 - 60V
Current	0 - 10A
Power	200W

3. Operation

3.1 General

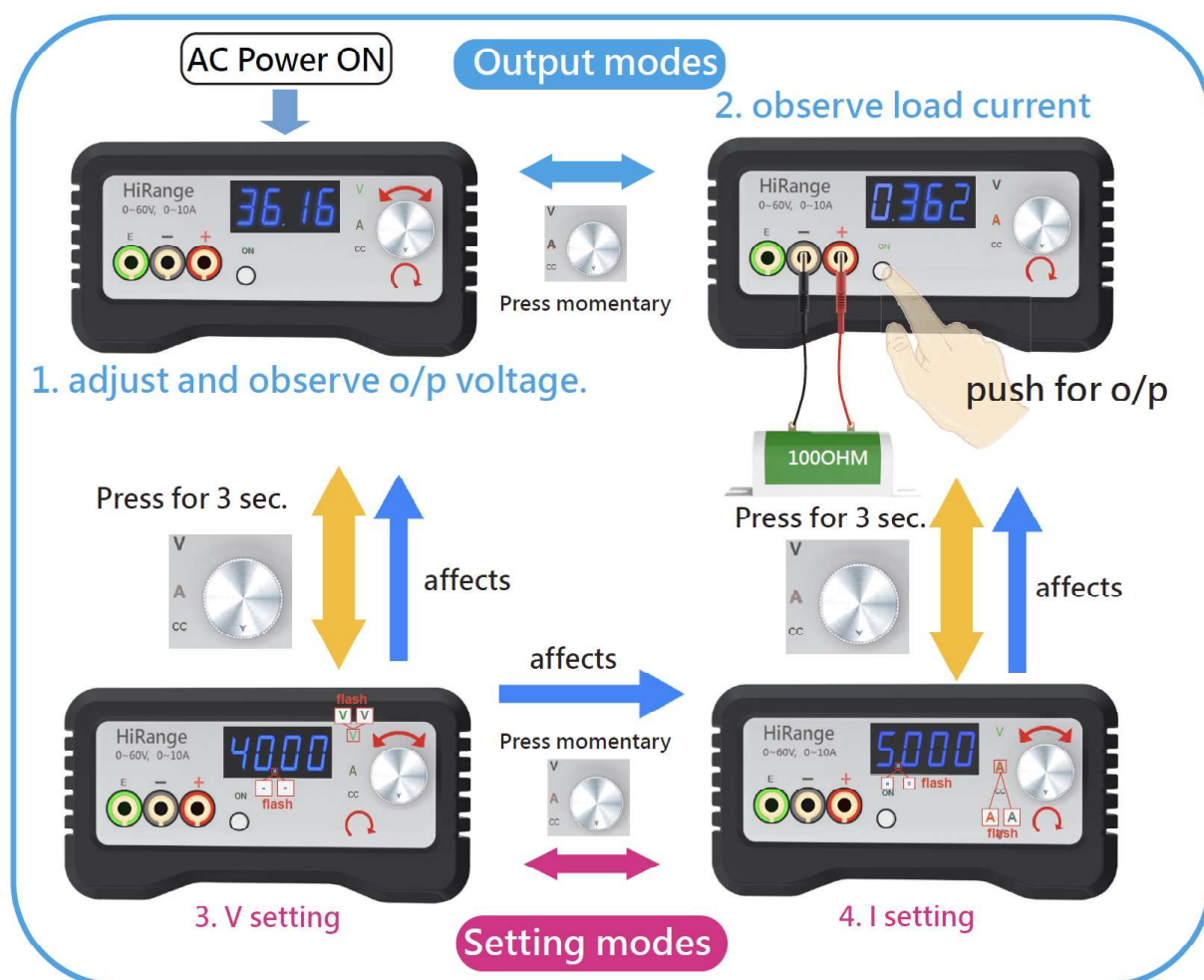
HiRange Series integrates actually two power supplies – constant voltage (CV) and constant current (CC). These two power supplies exclusively operate, and outputs do not exceed user-preset limits. CV or CC status is dependent on and limited by the comparison between load conditions and HiRange Series settings.

3.2 Description

A, Main Process Flow

Output modes	1, output V is adjustable & visible	2, output I is visible
Setting modes	3, V setting	4, I setting.

By pressing the knob for 3 seconds or momentarily, you can switch between the 2 modes. The following chart explains the main flows of the operation in the HiRange. According to the limit of $I \times V = 200W$ max, v setting could affect the other modes, esp. the I setting but I setting never affects V setting. I setting could also affect the max. output I.



B, AC power on to start (Output mode)

When AC power turns on, system enters into Output mode in which you can adjust and observe the output V. By ‘press the knob momentarily’ , a mechanical click is heard. You can choose ‘V’ OR ‘A’ indicator by using the contents of the 7-segment display, you can adjust and observe the output V OR observe the output I (if the output terminals are connected to a load or short circuit). For example, output is 36.16V once connected to ac power (as per the previous status saved when turning off)



1, Adjust and observe the output V
‘Press momentarily’ on the knob to show V indicator at the 7- segment display. Turning the knob clockwise or anti-clockwise to increase/decrease the number in the 7- segment display that represents output voltage. Suggest to connect a DVM to the output terminals and press the output switch to ON to observe the voltage. For example, the previous output voltage was 36.16V can adjust to 24V, 9V etc.



2, Observe the output I
‘Press momentarily’ on the knob to select A indicator at the 7- segment display. The system will show the current if connect to any load and the output switch is ON.

There are many possibilities as there are varied load and output conditions. For example,

1, no load	2, loading	3, over load	4, short circuit	5, Load conditions
output switch off OR no load	normal load (100 ohm/200W)	low resistance load (2 ohm/10W and I setting was 5A)	short circuit (I setting was 5A)	Output status and settings
0000	0362	5000	5000	Output current
36.16	36.16	1000	026	Output voltage
		"CC" lit	"CC" lit	CC indicator

Note, if output over load or short circuit, the "CC" will be lit on to show the system has entered into constant current status

C, Setting mode

Setting mode is to protect users from over voltage and over current damage to their load. How to set? 'Press 3 sec' on the knob until hear of a beep sound, select blinking " VV" or " AA" when the 7- segment display show **4000** or **5000** which means enters the setting mode.

3, V setting

The blinking " VV" shows V setting. Turn the knob CW/CCW to increase/decrease the number in the 7- segment display **4000** which represents V set point (default value is 40V).

If you press momentarily on the knob, system will only calculate the equation $I \leq 200W/V$, show the I value in the 7-segment display and will not save the new V and I but immediately change the I value to change the maximum output current, and then enter to 4, for I setting.

If you 'press 3 sec' on the knob, there will be a beep sound and similarly, system will implement the equation $I = 200W/V$, save the V and I, and exit the present setting mode to enter to the Output mode. It will not allow any output voltage > the V setting in the future.

Although $I \times V$ could be < 200W, system will never increase the I setting but could have decreased it as well.

4, I setting

The blinking " AA" shows I setting. Rotate the knob clockwise or anti-clockwise to increase/decrease the number in the 7 segment display **5000** which is the I setting (the default value is 5A). It will not allow any output current > the I setting in the future.

If you 'press momentarily' on the knob, system will not save any new value but enter into 3, for V setting.

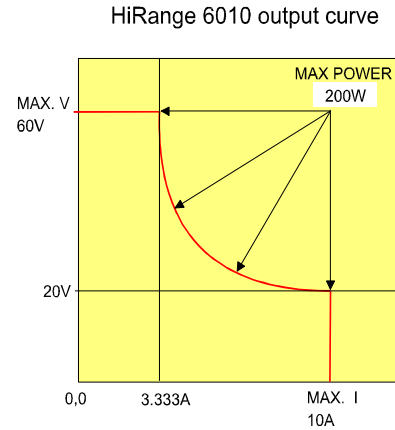
If you 'press 3 sec' on the knob, there will be a beep sound and system will save the new I and exit the present setting mode to enter to the Output mode. I setting never affects the V setting by following the equation of $I \leq 200W/V$.

4-1 Adjustable current source by I setting

When system enters into CC mode (CC indicator lit), I setting will reflect the output current immediately, similar to Output mode, the output voltage is adjustable (CV mode). If there is a current load, the system can be a current source.

D, Automatically set the system in 200W max.

The max. output rating of the HiRange 6010 is $I \times V = 200W$. Any operation and setting to I and V should never be more than 60V, 9.990A and 200W. There is no parameter to designate the max. power but the system will monitor V and decrease I to make sure it will not be more than 200W.



E, Output switch and ON indicator

- 'Press momentarily' or 'press 3 sec' on the knob until system goes back to the Output mode as " V " indicator at 7-segment display.
 - Turn the knob to a desired output voltage on the 7-segment LED display.
 - Connect a load to the output terminals.
 - 'Press momentarily' on the knob to select " A " indicator.
 - Press output switch to "ON" and hear a beep sound.
 - Now the 7 -segment LED display shows the load current.
 - 'Press momentarily' on the knob to select " V " indicator.
- 7 -segment displays the load voltage again.

F, V, I relationships in output mode and setting mode.

A, Output modes

- Under the threshold of V setting, the output voltage can be adjusted and observed.
- Output current can be observed.

If you want to adjust output current in the CC mode, please refer to the following NOTE of 4, I setting.

B, Setting modes:

There are V setting and I setting in setting modes.

The two settings must be complied to the following table,

	Conditions for setting
a	$I \leq 9.990A$
b	$V \leq 60$
c	$I \times V \leq 200W$
d	I setting never affects V setting.
e	V setting could decrease the I setting.
f	Users can increase I setting acc. to $I \leq 200W/V$.

3, V setting.

After complete V setting, 'press 3 sec' on the knob, you will hear of a beep sound and system will implement the equation $I=200W/V$, save the V and I, and exit the present setting mode to go to the Output mode. Output voltage will not allow any value higher than the setting voltage in the future.

If $V \times I \leq 200W$, system will not affect the I setting value.

If $V \times I > 200W$, system will decrease the I setting value to meet 200W.

4, I setting.

After complete I setting, 'press 3 sec' on the knob, system will save the new I then enter into output mode. It will not allow any value bigger than setting current in the future.

I setting ranges in $I \leq 200W/V$. Even if $I \times V < 200W$, I setting never affects the V setting.

NOTE : When system works in CC mode, the I setting operation can control the output current directly like an adjustable current source.

4. Keys: Special Functions

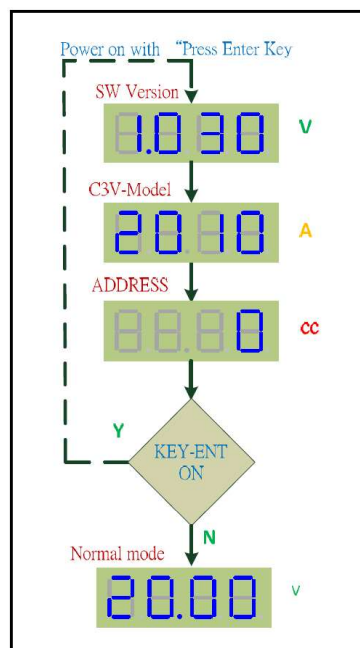
Some keys are programmed with special functions.

4.1 Normal Operations

Output key	<ul style="list-style-type: none"> • Press to toggle the output on / off (refer to 4.3 for default AC power setting).
Knob as Enter key	<ul style="list-style-type: none"> • Press for 3 seconds to select between Output (Reading) Mode and Setting Mode. • Momentary press to select V or A. • Please refer to V-LED and A-LED on the panel.
Knob as Up key	<ul style="list-style-type: none"> • Turn cw for input increments. • The faster to turn cw the more to increase. • Please refer to the Display Meter on the panel.
Knob as Down key	<ul style="list-style-type: none"> • Turn ccw for input decrements. • The faster to turn ccw the more to decrease. • Please refer to the Display Meter on the panel.

4.1 Special Functions

Query on firmware version / model number / RS-485 address	<p>Hold down the Enter key and turn on AC power. You will find:</p> <ul style="list-style-type: none"> • V-LED: firmware version • A-LED: model number • CC-LED: RS-485 address <p>Release the Enter key to resume normal operations. Refer to the graphic below.</p>
Set up RS-485 address	<p>Press and hold the Output key for 10 seconds until it beeps. The LED will display the address. Press the Up and Down key to set the address and press the Enter key to confirm.</p>



4.3 Default Output State (ON / OFF)

Output state when the unit is powered on:

JP12 on MCU card	Default state at AC power on
OPEN	Output ON
SHORT	Output OFF(Default)

Note: User modification not recommended.

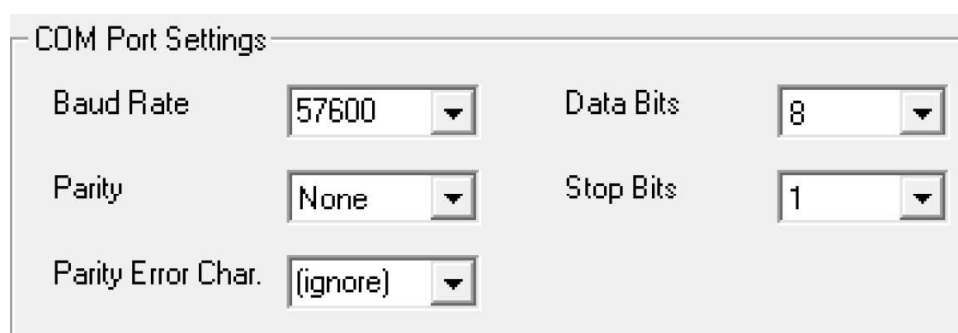
5. HiRange Series Communication Interfaces

HiRange Series provides three isolated communication interfaces: RS232, USB and RS485. The selected interface must be confirmed before shipping and cannot be modified after delivery.

5.1 Communication Data Rate

Data rate: 57600/N/8/1

- Baud Rate: 57600
- Parity: None
- Data Bit: 8
- Stop Bit: 1
- Flow Control: None



COM Port Settings

Baud Rate	57600	Data Bits	8
Parity	None	Stop Bits	1
Parity Error Char.	(ignore)		

5.2 HiRange Series with RS232 Interface

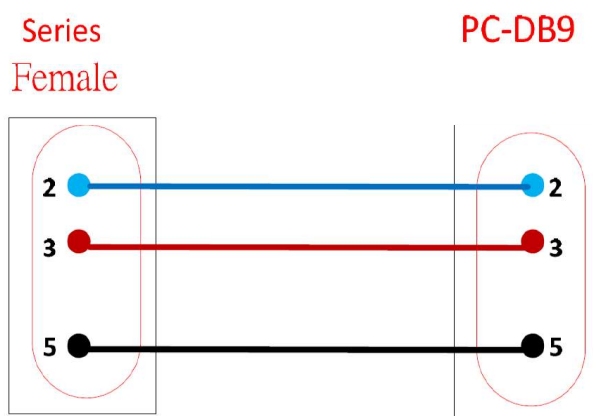
Uses standard female DB9 connector.

RS232 pin assignment:

Pin No.	Signal Name	Description	DTE In/Out
1	DCD	Data Carrier Detect	Input
2	RX	Receive Data	Input
3	TX	Transmit Data	Output
4	DTR	Data Terminal Ready	Output
5	SGND	Signal Ground	-
6	DSR	Data Set Ready	Input

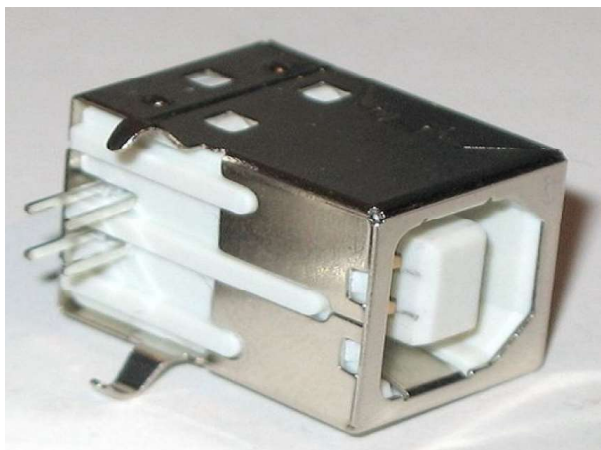
Pin No.	Signal Name	Description	DTE In/Out
7	RTS	Request To Send	Input
8	CTS	Clear To Send	Input
9	RI	Ring Indicator	Output

5.2.1 RS232 Connection with PC RS232 to PC



5.3 HiRange Series with USB Interface

USB Type B Connector as shown below

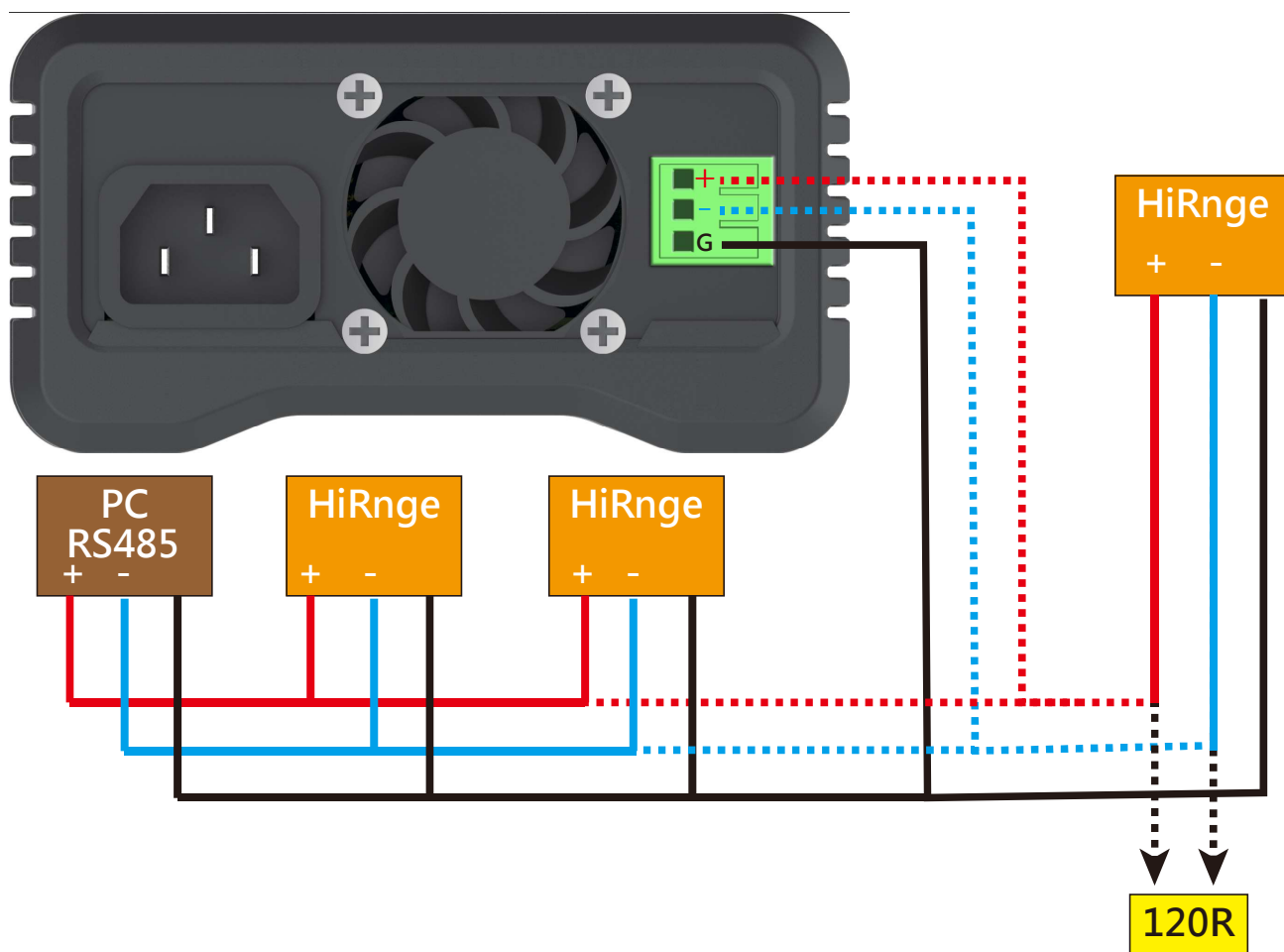


5.4 HiRange Series with RS485 Interface

The RS485 address needs to be set up before communication. Each HiRange Series must have a unique address ranging from 1 to 32. The address "0" is reserved for RS-232 and USB interface. Up to 32 units can be connected in parallel.

5.4.1 RS485 Termination Resistor (120R) Installation & Wiring

When installing, please connect a 120Ω termination resistor to the “+/-” terminals of the green terminal block of the final parallel unit of HiRange Series.



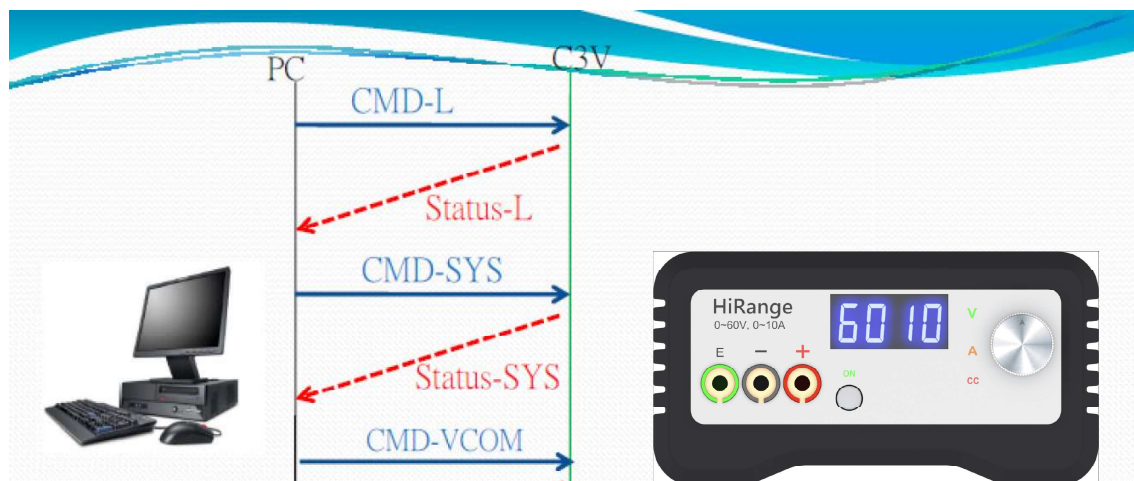
5.4.2 RS485 Address

The RS485 address must be set from 1 to 32 and cannot duplicated. USB & RS232 interface do not require set up as default value "0" is already factory preset.

Refer to Chapter 4 for instructions on the RS485 address setup and query.

6. HiRange Series Communication Protocol

Commands can be written in either ASCII or hexadecimal codes. HiRange Series **never** sends messages till it receives the CMD from the PC.



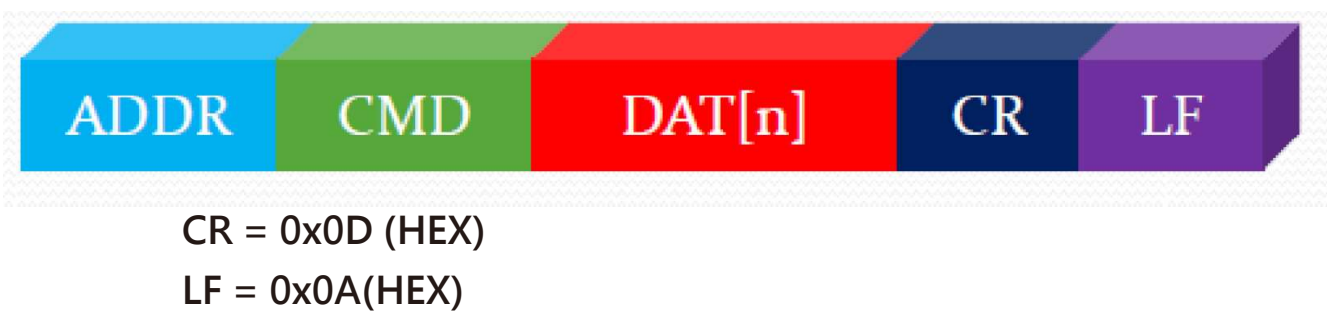
6.1 Communication between PC and HiRange Series

As shown below:

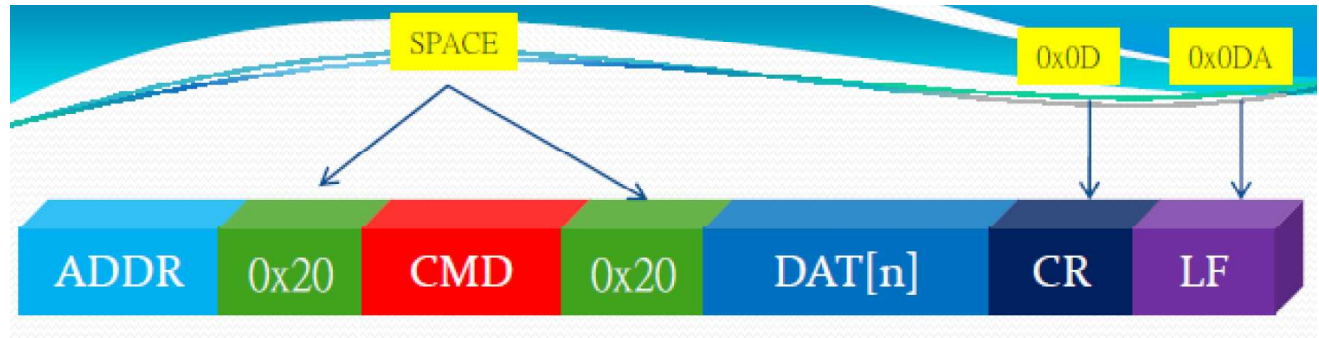
- PC sends "CMD-L" – HiRange Series replies "Status-L"
- PC sends "CMD-VCOM" – HiRange Series replies "Status-OK"



6.2 Message Terminator of Protocol: CR LF



6.3 Data format (PC to HiRange)



6.3.1 ADDR (PC to HiRange Series)

This field is the address code of the protocol. If this code is correct, HiRange Series will receive commands. Every HiRange Series unit can be set with an address from 1 to 32. When using the RS485 interface, you must set a unique address code for each power supply. Refer to 4.2

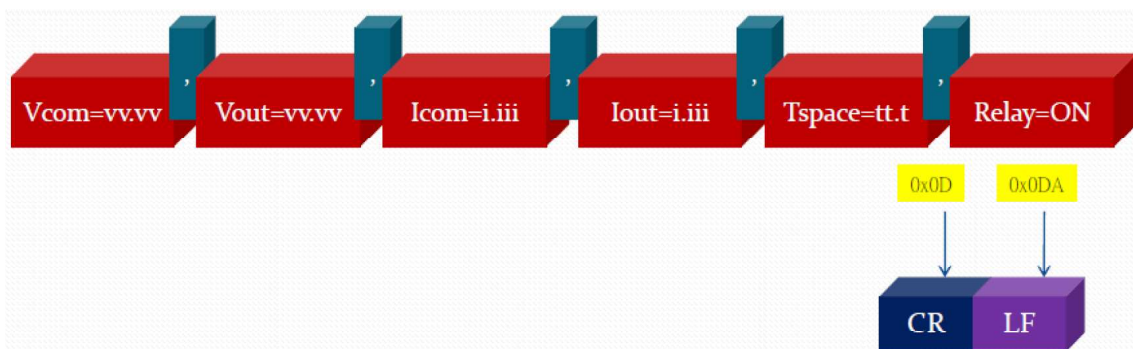
ADD	Description	Interface
HiRange series 00	This is a universal code. HiRange series will execute commands after receiving the code.	RS232, USB and RS485 (single unit)
HiRange series 01	When the HiRange series receives and decodes the code (address), it will execute the received command.	RS485 (multiple units)
HiRange series 02	
HiRange series 03	

Command Set (PC to HiRange Series)

This field is the command code of the protocol.

CMD	Function Description
L	<p>The L query returns all HiRange series statuses: Reply:Status-L HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=On <CR><LF></p>
SYS	<p>The SYS query returns the model and firmware version of the HiRange series: HiRange series 00 SYS <CR><LF> HiRange series -405@1.01 <CR><LF></p>
VCOM	<p>VCOM sets output voltage level : Reply : Status-OK HiRange series 00 VCOM 20 <CR><LF> OK <CR><LF></p>
ICOM	<p>ICOM sets the output current limit : HiRange series 00 ICOM 3.5 <CR><LF> OK <CR><LF></p>
ON	<p>ON turns the output on : Reply : Status-OK HiRange series 00 ON <CR><LF> OK <CR><LF></p>
OFF	<p>OFF turns the output on : Reply : Status-OK HiRange series 00 OFF <CR><LF> OK <CR><LF></p>

Data Format CMD-L (HiRange Series to PC)



Status-L (HiRange Series to PC)

This field is the command code of this protocol.

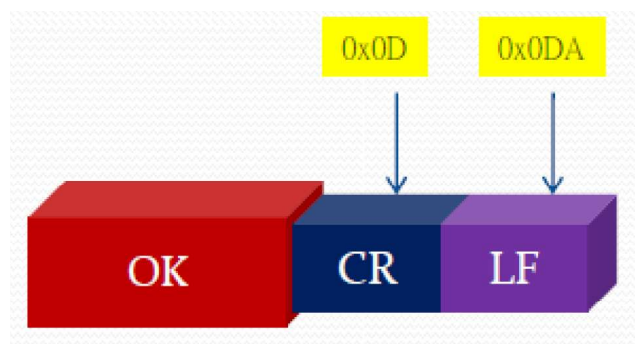
Status	Function Description
Vcom	Reply voltage value of setting : HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=ON <CR><LF>
Vout	Reply output voltage value : HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=ON <CR><LF>
Icom	Reply rurrent limit setting : HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=ON <CR><LF>
Iout	Reply output rurrent value : HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=ON <CR><LF>
Relay	Reply RELAY status : HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=ON <CR><LF>
Tspac	Reply heat sink temperature value : HiRange series 00 L<CR><LF> Vcom=20.00, Vout=1.35 Icom=3.500, Iout=0.000 Tspace=30.8, Relay=ON <CR><LF>

Status-SYS (HiRange Series to PC)

Status-SYS	Function Description
SYS	Reply model and software version of HiRange series : HiRange series SYS HiRange series-405@1.01

Status-OK (HiRange Series to PC)

Status-OK	Function Description
OK	Reply OK HiRange series ON OK



7. Automatic Fan Speed vs Temperature Control

7.1 PWM Fan Speed Control

HiRange Series uses PWM to control the fan speed and temperature. The MCU senses the internal temperature of the unit and adjusts the fan speed automatically. This extends the fan lifespan and reduces mechanical noise when there is no output. If the output current exceeds one half of the maximum current, the fan will be set at full speed automatically.

7.2 Over Temperature Protection (OTP) Alarm

When the temperature of the secondary heat sink is high ($> 85\text{ }^{\circ}\text{C}$), it will turn off the output automatically and generate an acoustic alarm.

8. Wiring and Connections.

8.1 All Connections

The following table shows the types of connection to the unit:

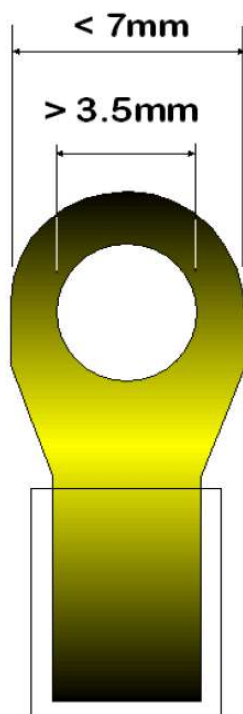
1. AC input
2. DC output
3. Communication interfaces.

	To be connected and fixed at HiRange series.	Connection with external wires(cable)
AC input (Rear panel)	IEC male	IEC (female) cord
	Terminal board	Y or O type terminal with wires
DC output (Front panel)	Banana jack	Banana plug with wires
	Terminal board	Y or O type terminal with wires
Communication Interface (Rear panel)	USB type B connector	USB male connector
	RS-485 terminal block	Twisted wire pair
	RS-232 female D-sub	RS-232 male D-sub

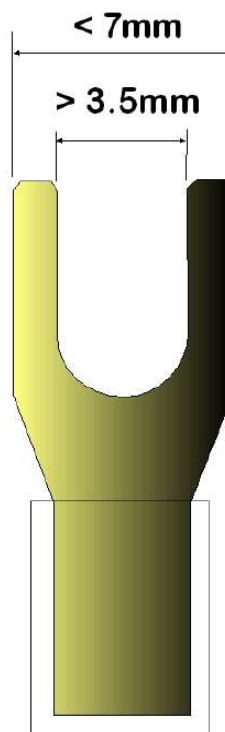
8.2 Special Connectors to Prepare

"O" or "Y" type terminal

"O" type terminal



"Y" type terminal



8.3 Wire Size Table

The following table suggests some applicable sizes for DC output lead wire where the maximum current and minimum DC resistance are considered.

Gauge	Diameter (mm)	Rated Current (A)	Ω /meter
AWG #12	2.06	26	.005211
AWG #14	1.63	16	.008286
AWG #16	1.30	10	.01317
AWG #18	1.02	6	.02095
AWG #20	0.81	4	.03331

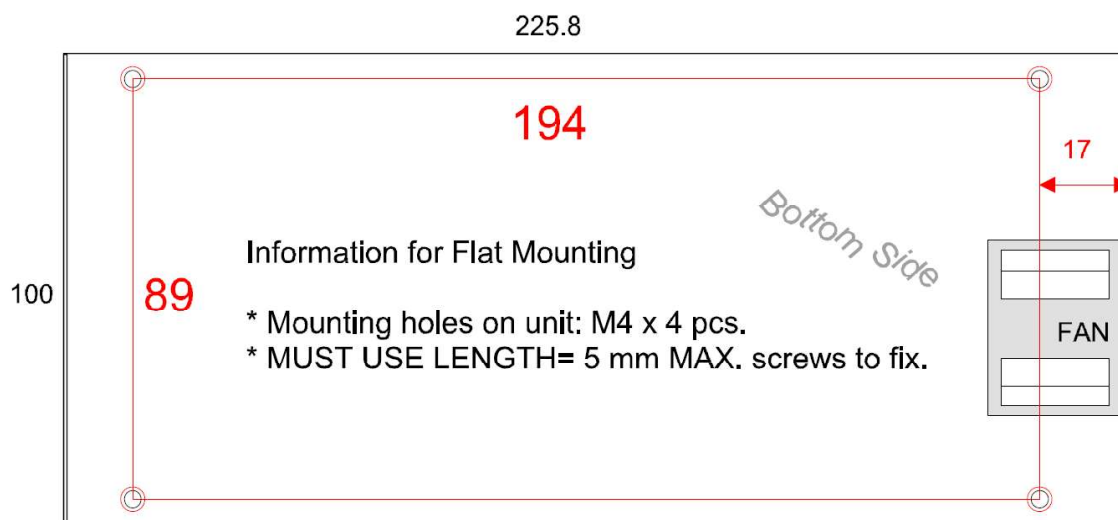
9. Mountings and Ventilations

We suggest flat mount or erect mount when installation the HiRange Series. Note that both mounting methods require clear ventilation paths. Please keep the ventilation paths free of blockings and obstacles.

9.1 Flat Mount and Ventilation



Illustration for the flat mount and the associated ventilation flows



Position reference for flat mounting



Caution: Using a screw longer than 5mm may penetrate the circuit board and cause product failure.

9.2 Erect Mount and Ventilation

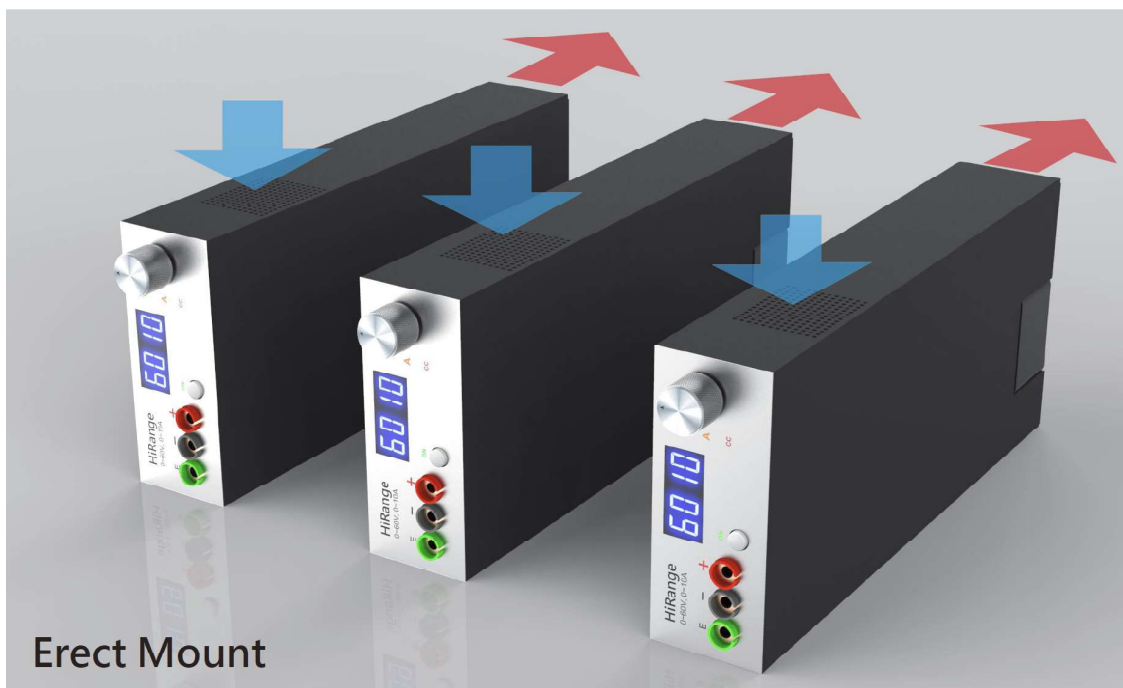
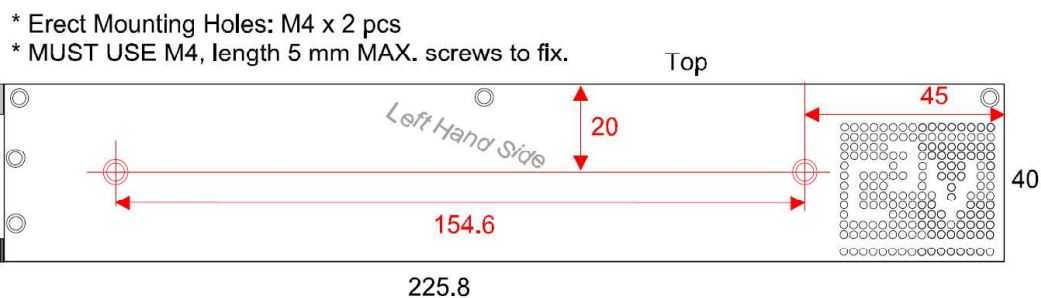


Illustration for the erect mount and the associated ventilation flows.



Positioning reference for erect mounting.



Caution: Using a screw longer than 7mm may penetrate the circuit board and cause product failure.

10.HiRange Series Specifications

HiRange series	HRG-6010
ELECTRIC	
AC input rating	
Power, Watt	200W max
Voltage, Volt	85~264VAC
Current, Amp	2.4A max./115VAC , 1.2A max./230VAC
Frequency, Hz	47~63Hz
Inrush, Amp	22A max./115VAC , 46A max./230VAC
Power factor	PF>0.95/230VAC , PF>0.99/115VAC
ELECTRONIC	
DC output rating	
Voltage, Volt	0-60V
Current, Amp	0-9.99A
Power, Watt	200W
Line regulation	
CV, mV	$\leq 10\text{mV}$
CC, mA	$\leq 5\text{mA}$
Load regulation	
CV, mV	$\leq 10\text{mV}$
CC, mA	$\leq 10\text{mA}$
Ripple / Noise (*1)	
CV, mVp-p	$\leq 30\text{mVpp}$
CV, mVrms	$\leq 10\text{mV}$
CC, mArms	$\leq 10\text{mV}$

MEASUREMENT	
Panel setting resolution	
Voltage,mV	20mV
Current, mA	5mA
Programming resolution	
Voltage,mV	20mV
Current, mA	5mA
Programming accuracy	
Voltage, %	0.05 % + 7 cnt
Current, %	0.2% + 10 cnt
Measurement resolution	
Voltage,mV	20mV
Current, mA	5mA
Measurement accuracy	
Voltage %	0.05 % + 7 cnt
Current %	0.2% + 10 cnt
Temperature coefficient	
Voltage %/°C	0.001%/°C
Current %/°C	0.005%/°C
PROTECTIONS	
OVP	yes
OCP	yes
OTP	yes

COMMUNICATION

Interface: only 1 option

RS232	DB9
RS485	terminal block
USB	type-B

Protocol

Data rate, B/s	57600/N/8/1
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NORMS

EMC EMISSION	EN61000-3-2,-3
EMC IMMUNITY	EN61000-4-2,3,4,5,6,8,1
SAFETY\FET	EN60950-1

ENVIRONMENT

Operating temp. °C	0°C~50 °C
R. humidity, no condensed, %	20%~85%
Storage temp. °C	-20°C~70 °C
R. humidity, no condensed, %	<90%

PHYSICAL

Dimensions mm cubic	W*D*H = 100mm*250mm*40mm(<1U)
Weight, kg	1.3kg

*1: From output terminals, running a 25cm twisted wire pair terminated with a 0.1uf CC & 10uF EC. Observe voltage across the capacitors under 20 MHz BW at full resistive load.



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Eof.

11. Appendix:

Ordering and options details:

Neutral format of order code :

HRG-vvii-FT-RT-C

Options in details:

6010: 0~60V, 0~10A	FT: Front DC output terminals tb: terminal board output bn: banana jack output	RT: Rear AC input connections tb: terminal board input ec: IEC input.	C: Comm types N: not applied U: USB, type B 2: RS-232 5: RS-485
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For example:

If a **"HRG-6010-BN-EC - 2 "**is ordered, the real product will be looking as followed

