DP-D Gen2 Series
High Power Laboratory Power Supplies
User's Manual

by DSC-Electronics Germany • Georgstraße 36 • 53111 Bonn

1. Connection

Our devices are pre-configured to the power grid chosen with order (if not specified otherwise, our devices are manufactured for the EU power grid 230V 50Hz / 400V 50Hz). Subsequent adjustment after delivery is not possible. Connecting the device to an unsuitable power source will void any warranty.

Note: Devices of the DP-D series in the performance class 4.000W - 9.000W can cause a high starting current when switched on. Therefore, the use of circuit breakers of classes C, D or K is recommended.

1 Phase / EU Power Grid	
Voltage (Recommended)	230V ± 10% AC
Voltage (Max.)	250V AC
Frequency	50Hz - 60Hz
Circuit breaker minimum requirements	The maximum current of the device shall be determined as follows: I = (maximum power of the device / 230) + 2
1 Phase / American Power Grid	
Voltage (Recommended)	115V ± 10% AC
Voltage (Max.)	130V AC
Frequency	50Hz - 60Hz
Circuit breaker minimum requirements	The maximum current of the device shall be determined as follows: I = (maximum power of the device / 115) + 4

3 Phase / EU Power Grid (TN-S Network)	
Voltage (Recommended)	380V - 410V
Voltage (Max.)	430V
Frequency	50Hz
Circuit breaker Minimum requirements	The maximum phase current of the device shall be determined as follows: I = ((maximum power of the device / 400) / 1,73) + 2

2. General

Please read through and understand this Operation Manual before operating the product. After reading always keep the manual nearby so that you may refer to it as needed. When moving the product to another location, be sure to bring the manual as well.

Calibration

Before shipment, the instrument has been calibrated carefully in our factory. The calibration procedures and standards are compliant to the national regulations and standards for electronic calibration. If you have requested a certificate with your order, this is enclosed with your device. With ordered off-site calibration (DaKKS) the calibration was not performed in-house, please refer to the laboratory calibration protocol for details.

Warranty

We guarantee that the instrument has undergone a strict quality test before shipment and has passed all prescribed functional tests. We provide our customers with a warranty period of three years from receipt of the device. During the warranty period, all repairs, as well as spare parts are always free of charge. The warranty is void in the case of defects which have been caused by user's fault, or in case of unauthorized opening.

2.1 Safety instructions

This chapter contains important safety instructions that you must follow when operating the instrument and when keeping it in storage. Read the following before any operation to insure your safety and to keep the device in a proper condition.

Safety symbols

The following safety symbols may appear in this manual or on the instrument:

	**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 instrument or to other properties.
	**DANGER**	High Voltage
	**ATTENTION**	Refer to the Manual
		Protective Earth (PE)
		Earth (Ground)

2.2 Safety guidelines

Please follow the safety guidelines when using and putting the device into operation in order to prevent safety risks and to ensure the correct operation of the product.

- **Before connecting the device to the local power supply, make sure that the device is switched off.**
- **Check if the product is compatible with the local power supply before connecting it.**
- **Be careful on the correct earthing of the device (PE connection)**
- **Do not use the product in humid environments**
- **Do not touch the output terminals of the product with unprotected hands while it is switched on.**
- **Do not use the device in extremely dusty rooms**
- **Do not use the device outside the parameters specified in the data sheet**

2.3 Unpacking and examination

Our products are delivered carefully packed in cardboard boxes or in wooden crates, depending on place of destination and the type of the device (dimensions, weight). We pay attention to the environmental compatibility of the upholstery and packaging materials used and ask you to dispose the filling material correctly if present.

Please unpack the device and check the packaging as well as the product for transport damage. Should you notice any damage to the packaging or the device, we ask you to log it with photos and inform us immediately.

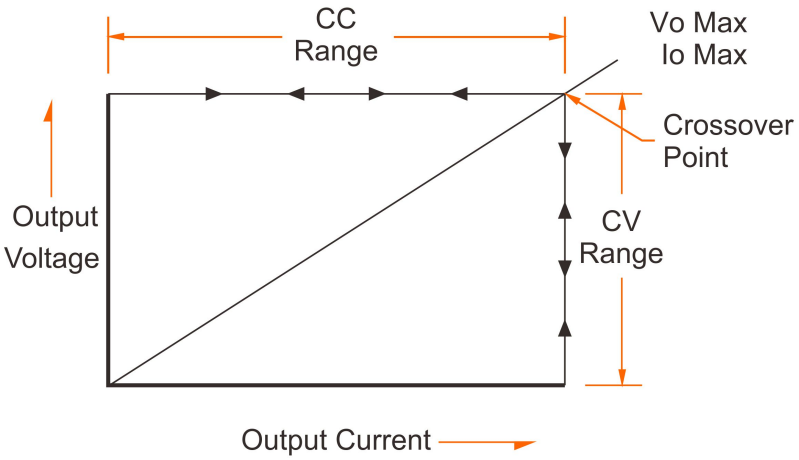
ATTENTION: If the device has been delivered in a wooden box, please do not dispose it as it can be used for eventual return transport for service procedures. Also the packaging material of smaller devices can be stored in order to be used if necessary for a return transport.

3. Product description

The DP-D Gen2 power supply can operate in constant voltage (CV) or constant current (CC) mode within the rated output range. This allows continuous switching between the modes in response to the load change.

In CV mode, a regulated output voltage is provided. The output voltage remains constant as the load increases while the output current changes in response to the load changes, until the preset current limit is reached. At that point, the output current becomes constant and the output voltage drops in proportion to the further increases in load. The current mode is indicated on the front panel display in area 12.

Similarly in CC mode switching from CC to CV mode automatically occurs from a decrease of the load. A regulated output current is provided. The output current remains constant as the load decreases while the output voltage changes in response to the load changes.



3.1 Capacitive load

Note: Can be ignored for devices with optional capacitive reverse current protection.

In the basic version, power supplies of the DP-D Gen2 series are not protected against reverse currents, which can lead to a reverse current from the capacitive load after switching off the output voltage of the power supply. Never connect pre-charged capacities to the power supply unit unless you have connected a serial protection diode between the load and the power supply. The protection diode is always recommended for operation with large capacities, please pay attention to a correct dimensioning.

3.2 Pulse load

Even if the peak current of the load is within the output power of the power supply, a high pulse load can cause voltage fluctuations. To compensate these voltage fluctuations, expand your circuit by a serial induction. For low currents, you can add a capacity in parallel for an even better result (1000uF / 1A).

3.3 Inductive load

Note: Can be ignored for devices with optional inductive reverse current protection.

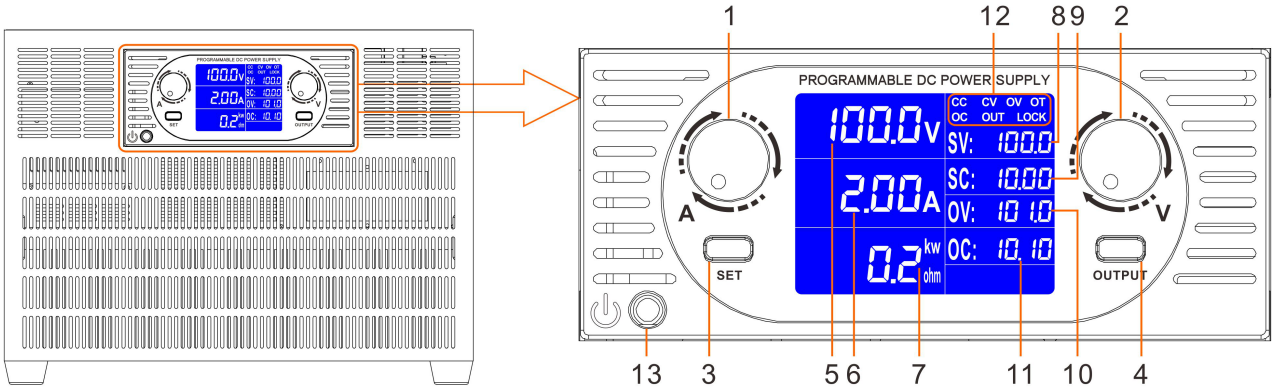
If the power supply is used with large inductive loads, voltage spikes with an amplitude of up to 5 times the output voltage can occur, this may damage the power supply or lead to unstable operation. To protect the power supply from damage, a freewheeling diode has to be used in parallel with the load.

3.4 Switches

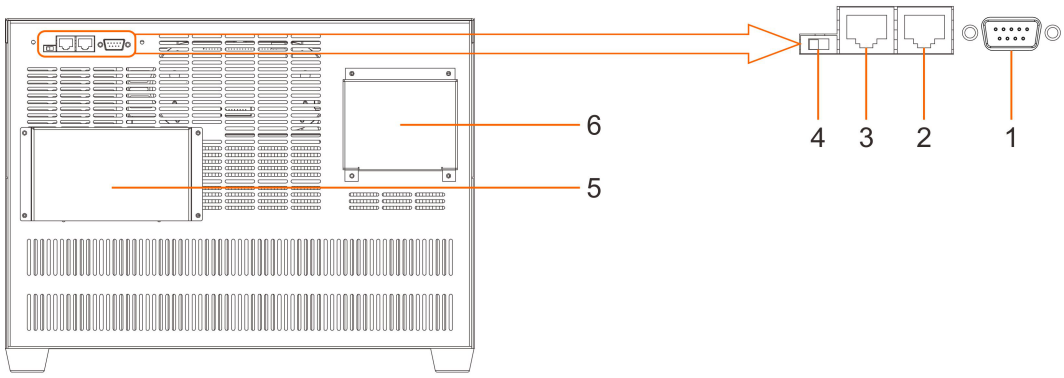
If a mechanic switch is used to connect or disconnect the power supply from the load, electric discharge can occur during switching on currents over 100A. This may cause unstable output. To prevent this behaviour, connect a RC circuit to the switch contact point.

4. Front panel description

4.1 DP-D Gen2 front and rear panel

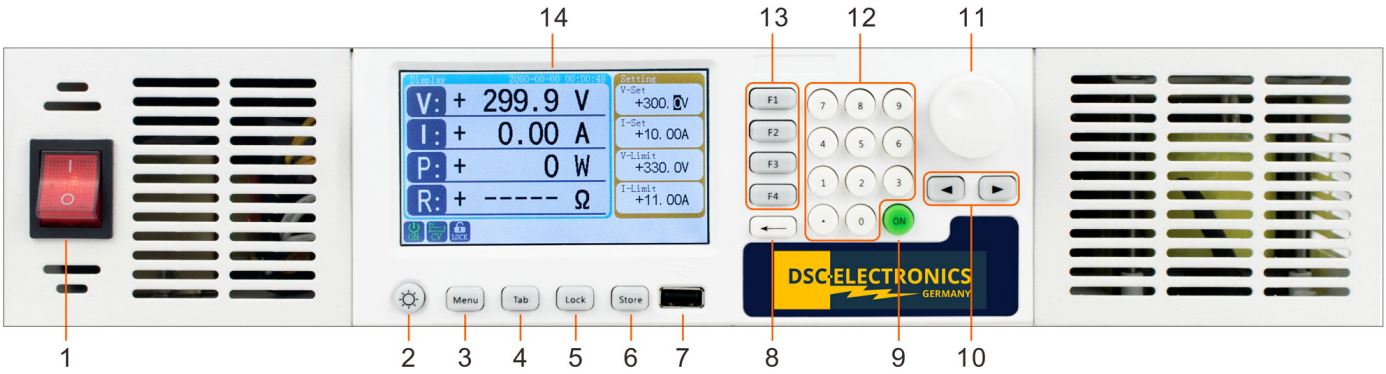


No.	Name	Description
1	Current knob	Adjustment of the current limit value.
2	Voltage knob	Adjustment of the voltage limit value.
3	SET button	Switching between SETUP and DISPLAY modes.
4	OUTPUT button	Enabling the output.
5	Voltmeter	Displaying the real output voltage.
6	Ammeter	Displaying the real output current.
7	Power / Resistance meter	Displaying the real output power and resistance of the load.
8	Set Voltage display	Displaying the set voltage value.
9	Set Current display	Displaying the set current value.
10	Over voltage setting	Displaying the set over voltage setting.
11	Over current setting	Displaying the set over current value.
12	Status display	Displaying the status of the power supply.
	CC	Constant current operation mode.
	CV	Constant voltage operation mode.
	OV	Over voltage protection triggered.
	OT	Over temperature protection triggered.
	OC	Over current protection triggered.
	OUT	Output enabled.
	LOCK	Panel locked.
13	Power switch	Powering on the power supply.

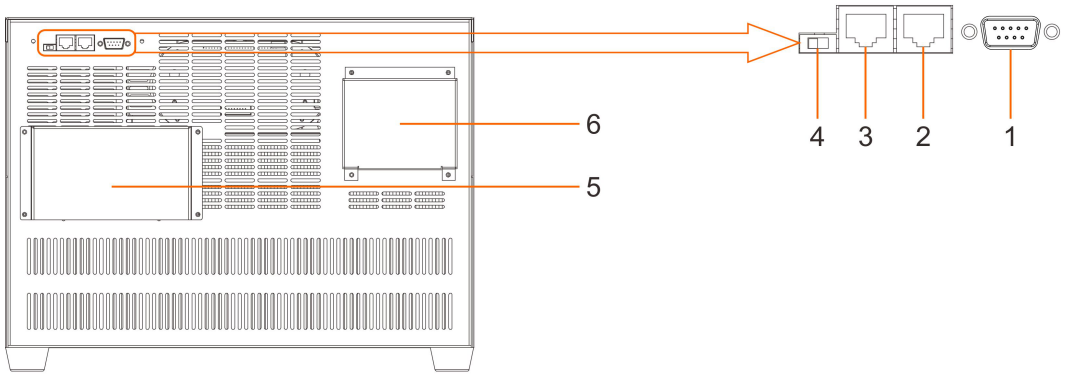


No.	Name	Description
1	RS-232 Interface	Standard interface.
2	RS-485 Interface	Standard interface.
3	RS-485-Interface	Standard interface.
4	Analog control switch	Enable / Disable external analog control (Optional).
5	Output terminals	Positive and negative output terminals.
6	AC input terminals	AC mains connection.

4.2 DP-G Gen2 front and rear panel with option [Y]



No.	Name	Description
1	Power switch	Power supply power ON/OFF.
2	Screen ON/OFF key	Press to enable or disable the front sceen. While the front screen is turned off, no inputs over the front panel are possible (locked), remote control remains active.
3	Menu button	Press to enter system settings menu. Short press is again to select a sub-menu.
4	Tab key	Cycle through tabs in the menu section.
5	Lock key	Press to lock front panel and remote control to the currently set state. Inputs either through the front panel, or remote control, will be discarded.
6	Store button	Save a screen shot of the curent display to the attached USB Stick.
7	USB Host port	Can handle USB sticks with FAT-32/16 and Ex-FAT format.
8	← key	Backspace.
9	Output ON/OFF key	Press to turn ON/OFF the output of the power supply.
10	< > keys	Cursor keys. Press to move cursor to the left or right.
11	Rotary knob	Turn anti-clockwise to increase a value, or clockwise to decrease a value. After the value is set, make a short press on the knob to save the setup and exit setup mode.
12	Numeric keypad	Input keys for numbers 1 to 9 and decimal point.
13	Function keys F1-F4	Press the key to select its corresponding parameter.
14	LCD display screen	-



No.	Name	Description
1	RS-232 Interface	Standard interface.
2	RS-485 Interface	Standard interface.
3	RS-485-Interface	Standard interface.
4	Analog control switch	Enable / Disable external analog control (Optional).
5	Output terminals	Positive and negative output terminals.
6	AC input terminals	AC mains connection.

5. Operation instructions for devices without option [Y]

The DP-D Gen2 power supply can be optionally equipped with external analog control and feedback connections, which allow to regulate and measure the set and real output values of the power supply externally. At the same time, either external analog control or digital and the front panel controls can be used, thus make sure to select your desired control method with the switch 4 on the rear panel before operation.

Caution: Always check that the output is switched off and the capacitors are discharged before connecting the load to the power supply.

5.1 SET Button operation

1. Turn on the power and check that the output is off.
2. Press the SET button to enter SETTING mode.
3. Now adjust the output voltage and current with the voltage and current knobs.
4. Press the SET button once again to select the over voltage and over current settings.
5. Now adjust the over voltage and over current protection values.
6. Press the SET button once again to save all settings.
7. Turn on the output by pressing the OUTPUT button.

5.2 CV Constant voltage operation

NOTE: Pressing the voltage or current knob shortly switches between coarse and fine tuning.

1. Turn on the power and check that the output is off.
2. Press the SET button and set the desired voltage and current limit according to point 5.2.
4. Turn on the output by pressing the OUTPUT button.
5. The CV indicator lights up.
6. The power supply is now operating in constant voltage mode (CV).

The output voltage remains stable while the current is adjusted automatically. If the current exceeds the maximum limit set, the power supply switches to CC mode and reduces the voltage not to exceed the maximum current limit.

5.3 Constant current operation

NOTE: Pressing the voltage or current knob shortly switches between coarse and fine tuning.

1. Turn on the power and check that the output is off.
2. Press the SET button and set the desired voltage and current limit according to point 5.2.
4. Turn the output on by pressing the OUTPUT button.
5. The CC indicator lights up as soon as the output current reaches the current limit set.

The power supply now operates in constant current mode (CC). The output current remains stable while the voltage is being adjusted automatically.

5.4 Locking the front panel

Press the current knob for 3 seconds to lock or unlock the front panel. The current and voltage knob as well as the SET button are not operational when the front panel is locked.

6. Operation instructions for devices with option [Y]

The DP-D Gen2 power supply can be optionally equipped with external analog control and feedback connections, which allow to regulate and measure the set and real output values of the power supply externally. At the same time, either external analog control or digital and the front panel controls can be used, thus make sure to select your desired control method with the switch 4 on the rear panel before operation.

Caution: Always check that the output is switched off and the capacitors are discharged before connecting the load to the power supply.

6.1 Set voltage

Press **[F1]** key to enter voltage setup mode (V-Set), now the cursor appears on voltage value position. The voltage value can be set up in two ways:

- Adjust voltage value by rotary knob
- Input voltage value through the keypad

Press < > keys to move the cursor to the position that you would like to adjust, this also works with the rotary knob. When the voltage value is adjusted to the desired value, short press the rotary knob to store the value and exit setup mode.

6.2 Set current

Press **[F2]** key to enter current setup mode (I-Set), now the cursor appears on current value position. Perform the current setup the same way as described in the voltage setup section above.

6.3 Set OVP

Press **[F3]** key to enter over voltage protection (OVP) limit setup mode (V-Limit). The cursor appears on voltage limit value position. Perform the current setup the same way as described in the voltage setup section above.

6.4 Set OCP

Press **[F4]** key to enter over current protection (OCP) limit setup mode (I-Limit). The cursor appears on current limit value position. Perform the current setup the same way as described in the voltage setup section above.

6.5 Set output On/Off

After power on, the power supply output status is defaulted to OFF. Output has to be turned on by pressing the on/off key. Short press the **[ON]** key to turn on the output. The "ON" icon appears on the lower left corner of the LCD screen when output is turned on. Short press the **[ON]** key again to turn off output. The "Off" icon appears on the lower left corner of the LCD screen when the output is off.

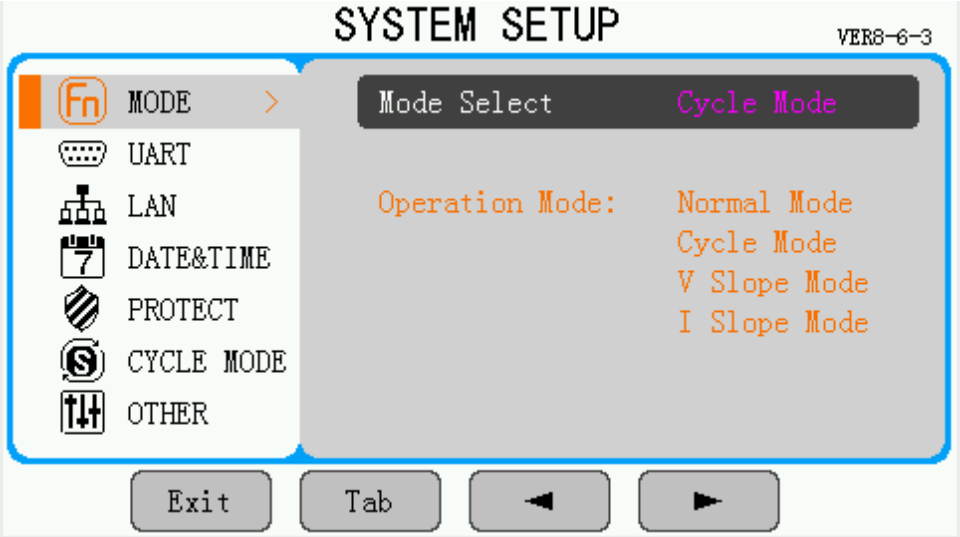
6.6 Panel lock

The panel lock function is designed to avoid inputs by mistake.

Short press **[Lock]** key to lock operations of front panel keys and knobs. The "Lock" icon appears the lower left corner of the LCD screen when the front panel is locked. Inputs of all keys and knobs are invalid, except operation of the **[ON]** key. If output is on during panel lock, the **[ON]** key can be pressed to turn off the output. However, output cannot be turned on again by pressing the **[ON]** key while the panel is locked. The front panel can be unlocked by pressing the **[Lock]** key again.

6.7 System setup

Press the **[Menu]** button for two times to select "System Setup" mode.



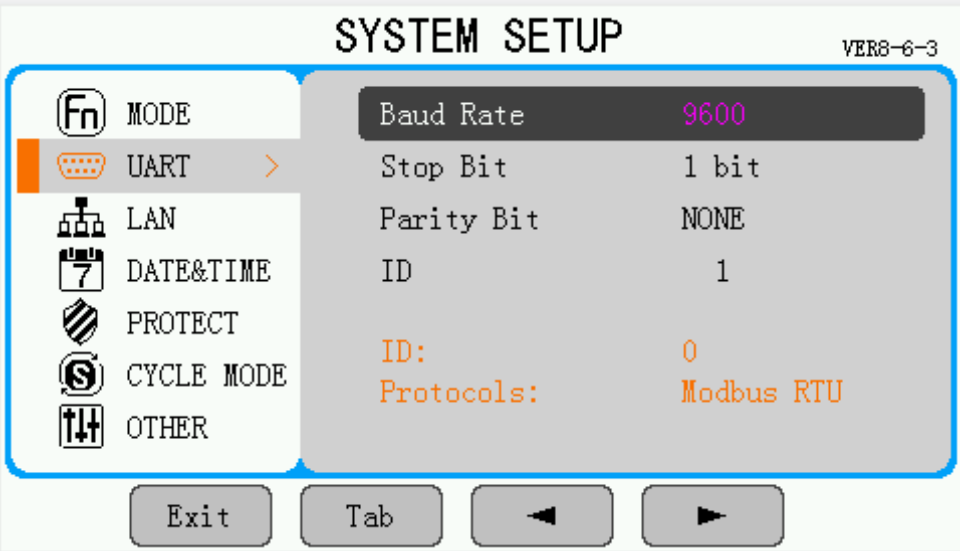
6.7.1 Set output mode

There are four output modes to be chosen from. Press the **[Tab]** button to select the "MODE" menu. Use the rotary knob to select an output mode from the "Mode Select" setting.

Normal mode: In this mode, output voltage and current is set up by manual configuration on front panel or through external interfaces.
Cycle mode: In this mode, maximum 999999 steps can be set into one automatic running cycle. Output voltage, current and time can be set up in each step.
V Slope mode: In this mode, voltage rise/fall time can be adjusted.
I-Slope mode: In this mode, current rise/fall time can be adjusted.

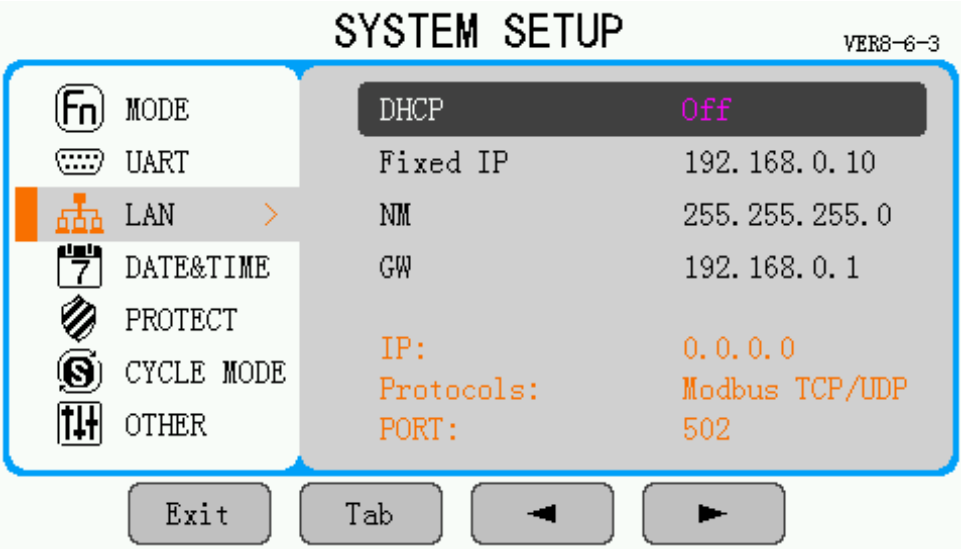
Depending on the mode chosen, the sixth tab in the main menu gets replaced by the appropriate configuration utility for the mode chosen.

6.7.2 Serial communication



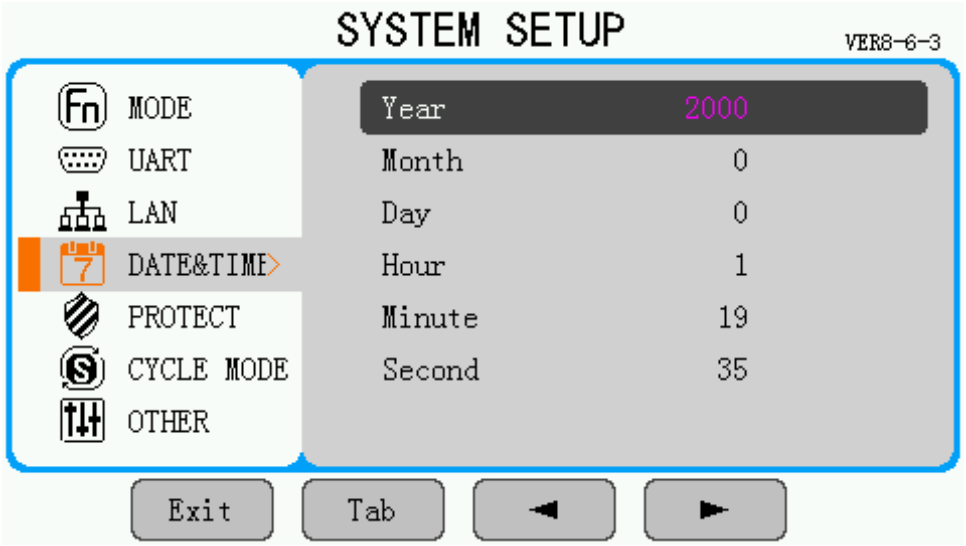
Press the **[Tab]** button to select the "UART" menu. In this menu, parameters of baud rate, stop bit, parity bit and communication ID can be adjusted. Press < > keys to move the cursor to select a parameter, and then use the rotary knob to set the value. Communication ID defaults to 0.

6.7.3 LAN Communication



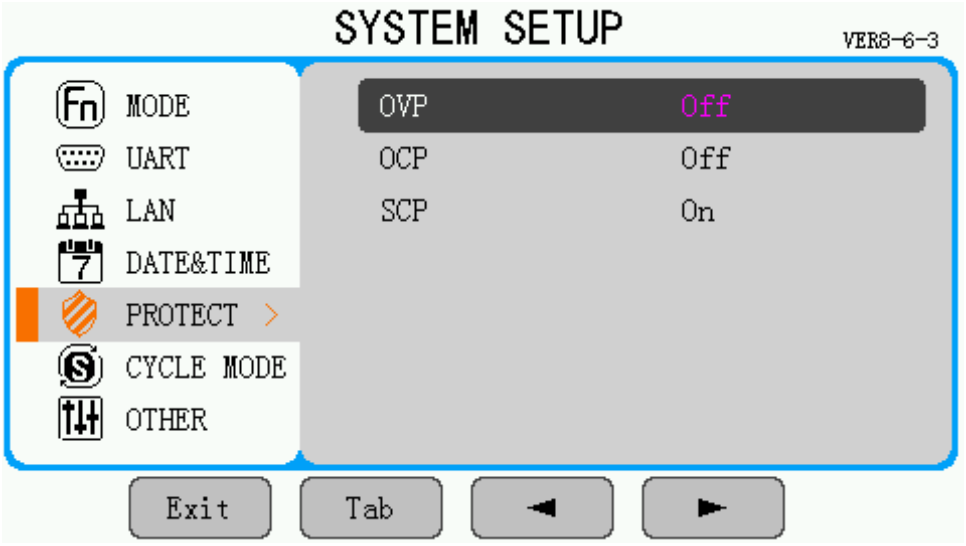
Press the **[Tab]** button to select the "LAN" menu. LAN communication settings include automatic IP address allocation "DHCP" and fixed IP address settings "Fixed IP", as well as subnet mask settings "NM" and default gateway settings "GW". Also the currently assigned IP address and communication protocol is displayed. The host port number defaults to 502.

6.7.4 Date and time



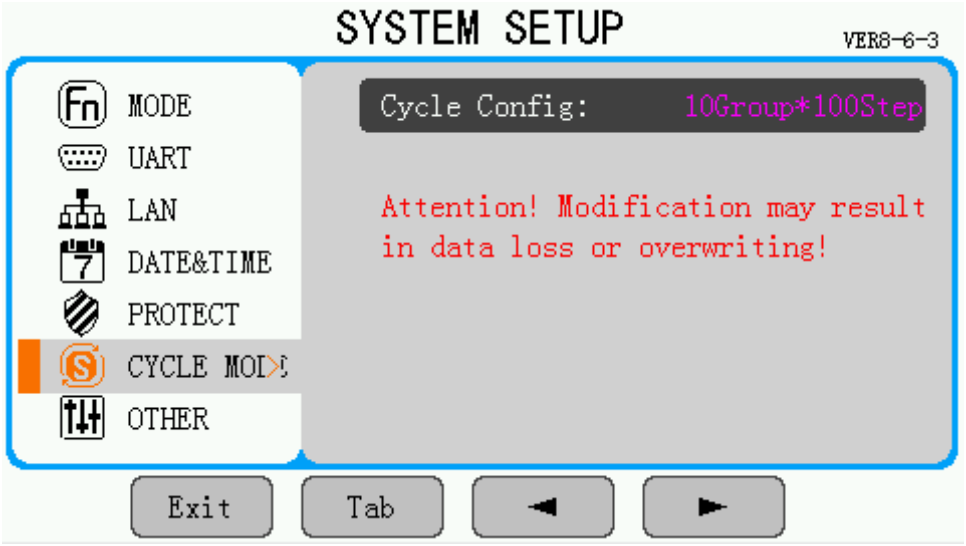
Press the **[Tab]** button to select the "DATE & TIME" menu. Press the < > keys to move cursor to select a parameter, and then use rotary knob to set the value.

6.7.5 Protection settings



Press the **[Tab]** button to select the "PROTECT" menu. The over voltage protection and over current protection functions can be turned on and off depending on the settings here. Press the < > keys to move the cursor to select a protection mode, and then use the rotary knob to switch between on and off.

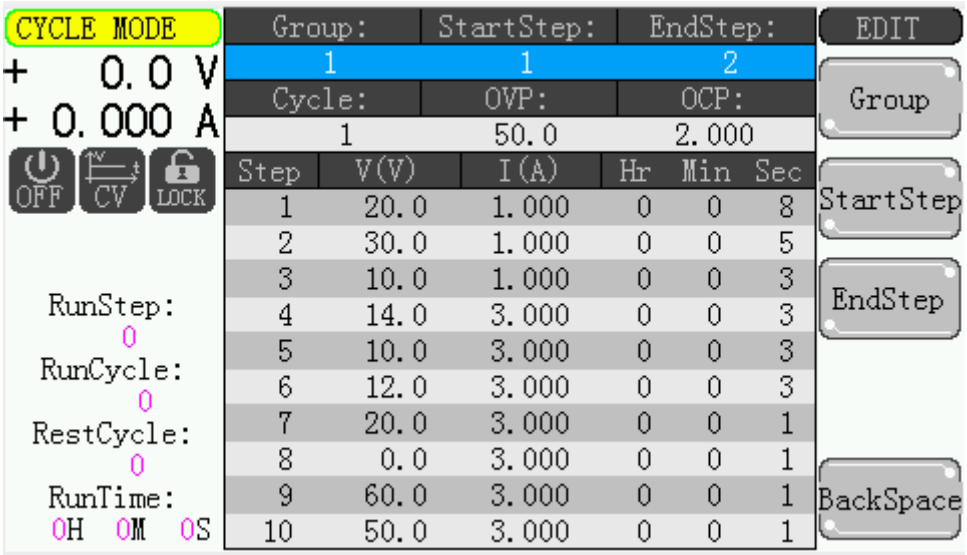
6.7.6 Cycle mode settings



Press the **[Tab]** button to select the "CYCLE MODE" menu.
There are 4 cycle configuration options:

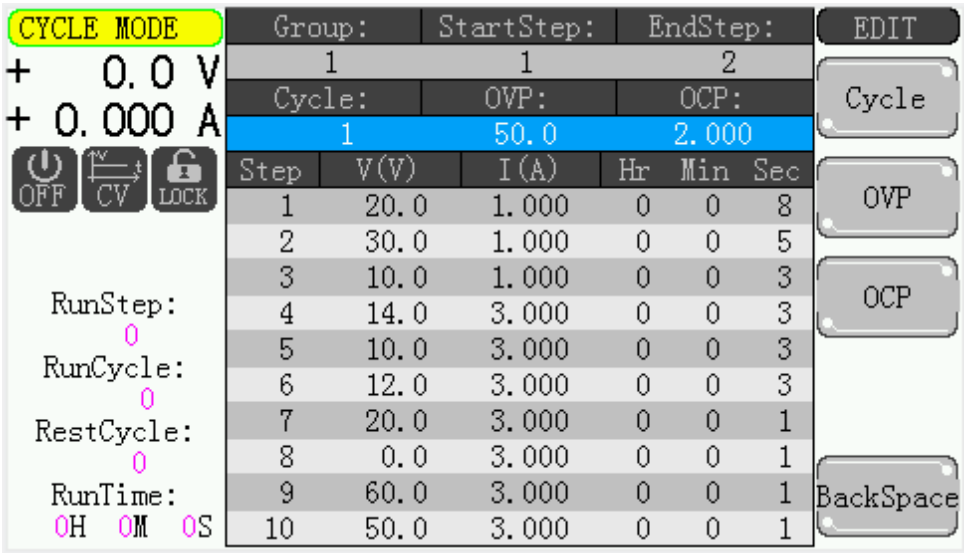
10 group * 100 item (100 steps in each group, in total 10 groups)
20 group * 50 item (50 steps in each group, in total 20 groups)
50 group * 20 item (20 steps in each group, in total 50 groups)
100 group * 10 item (10 steps in each group, in total 100 groups)

Press the < > keys to move the cursor and select a cycle configuration.



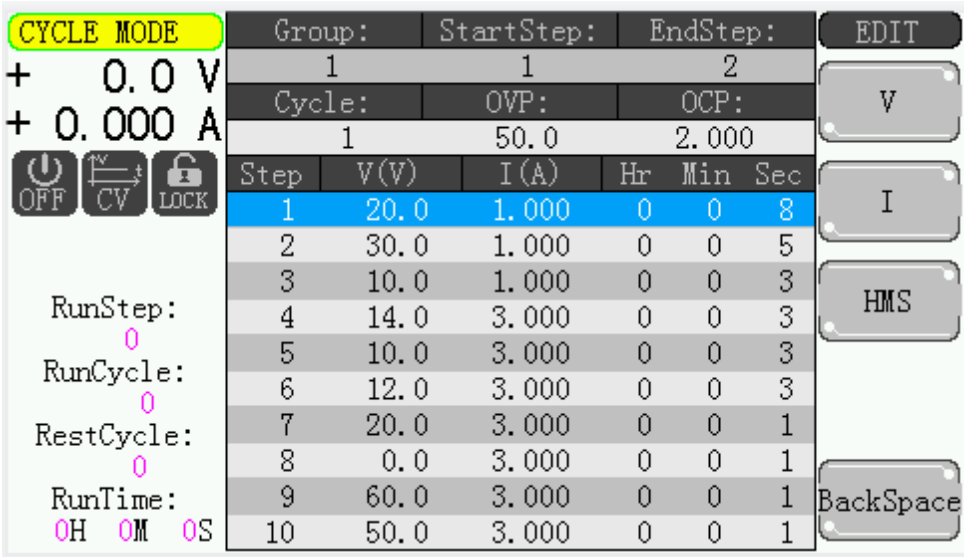
Press the < > keys or turn the rotary knob to move the cursor to the row entitled as "Group:, StartStep:, EndStep:", the cursor position is highlighted in blue as above.

Function keys F1-F4 now correspond to Group No. **[Group]**, Start Step No. **[StartStep]**, End Step No. **[EndStep]** and **[BackSpace]** key respectively. Press F1-F4 keys to select a parameter. Input a new parameter via keypad or rotary knob, and make a short press on the rotary knob to confirm input.



Press the < > keys or turn the rotary knob to move the cursor to the row entitled as "Cycle:, OVP:, OCP:", the cursor position is highlighted in blue as above.

Function keys F1-F4 now correspond to Cycle No. **[Cycle]**, OVP value **[OVP]**, OCP value **[OCP]** and **[BackSpace]** key respectively. Press F1-F4 keys to select a parameter. Input a new parameter via keypad or rotary knob, and make a short press on the rotary knob to confirm input.

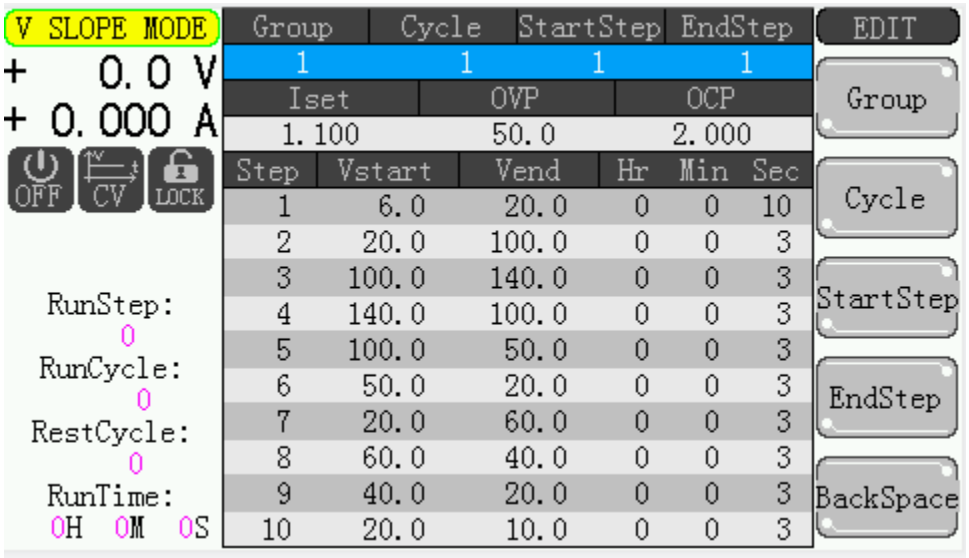


Press the < > keys or turn the rotary knob to move the cursor to the first row of the table, the cursor position is highlighted in blue as above.

Function keys F1-F4 now correspond to Step No. **[Step]**, Voltage value **[V (V)]**, Current value **[I(A)]**, time value **[Hr Min Sec]** and **[BackSpace]** key respectively. Press F1-F4 keys to select a parameter. Input a new parameter via keypad or rotary knob, and make a short press on the rotary knob to confirm input.

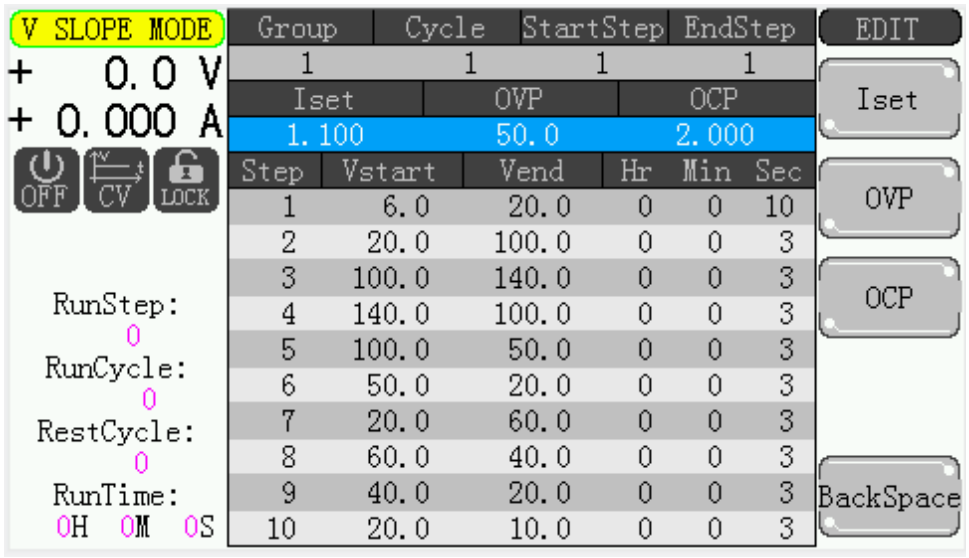
6.7.7 V Slope mode

In voltage slope mode, the output voltage rise time or fall time can be adjusted. After setting up rise time or fall time, the output voltage rises or falls gradually within the preset time. Otherwise, the output voltage rises or falls at the maximum speed. The rise or fall time can be adjusted to max 99999 seconds.



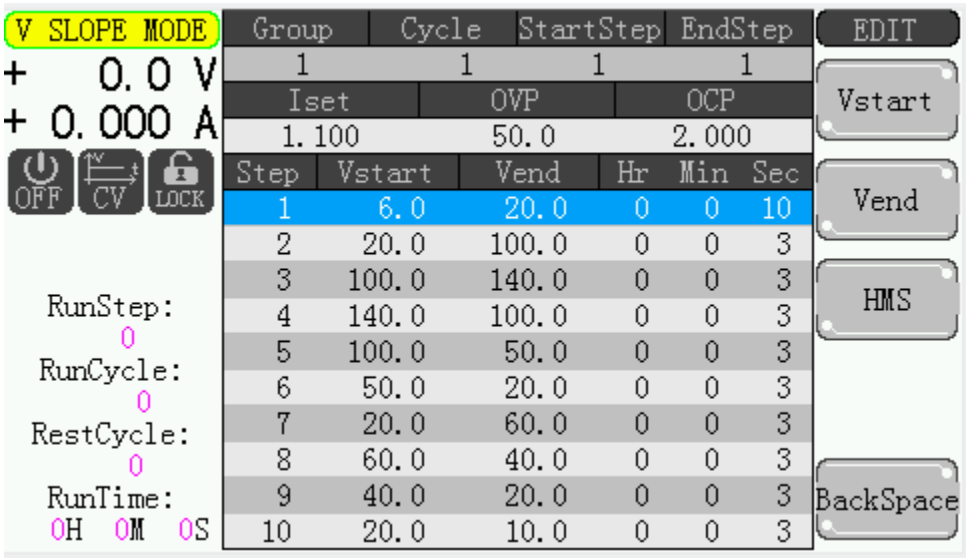
Press the < > keys or turn the rotary knob to move the cursor to the row entitled as "Group:, StartStep:, EndStep:", the cursor position is highlighted in blue as above.

Function keys F1-F4 now correspond to Group No. **[Group]**, Cycle No. **[Cycle]**, Start Step No. **[StartStep]**, End Step No. **[EndStep]** and **[BackSpace]** key respectively. Press F1-F4 keys to select a parameter. Input a new parameter via keypad or rotary knob, and make a short press on the rotary knob to confirm input.



Press the < > keys or turn the rotary knob to move the cursor to the row entitled as "Iset:, OVP:, OCP:", the cursor position is highlighted in blue as above.

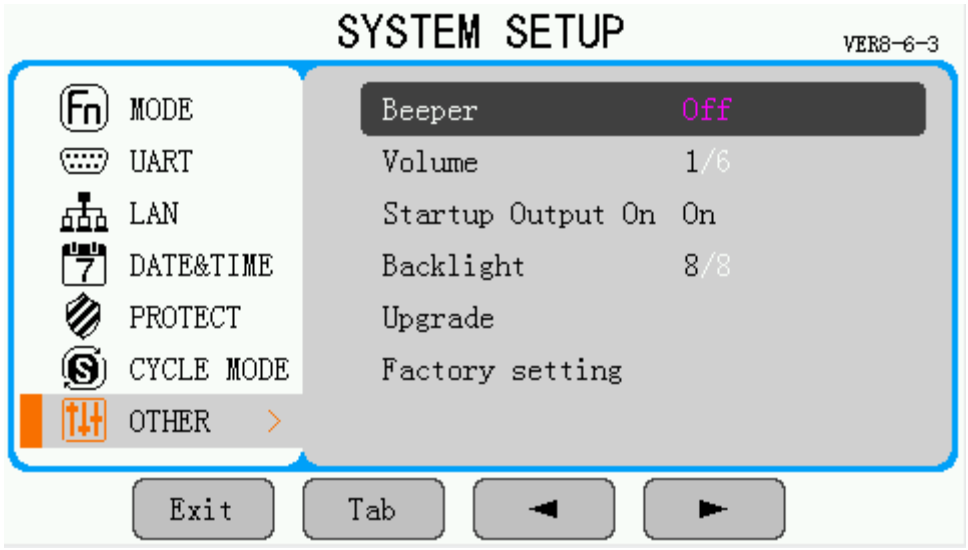
Function keys F1-F4 now correspond to OVP value **[OVP]**, OCP value **[OCP]** and **[BackSpace]** key respectively. Press F1~F4 keys to select a parameter. Input a new parameter via keypad or rotary knob, and make a short press on the rotary knob to confirm input.



Press the < > keys or turn the rotary knob to move the cursor to the first row of the table, the cursor position is highlighted in blue as above.

Function keys F1-F4 now correspond to Step No. **[Step]**, Voltage value **[V(V)]**, Current value **[I(A)]**, time value **[Hr Min Sec]** and **[BackSpace]** key respectively. Press F1-F4 keys to select a parameter. Input a new parameter via keypad or rotary knob, and make a short press on the rotary knob to confirm input.

6.7.8 Other settings



Beeper: Beeper alarm can be turn on and off.
Volume: Beeper volume can be set from low to high in 6 steps. Volume defaults to lowest range 1.
Startup Output on: The output defaults to off after startup, but can be set to on.
Backlight: The brightness of the LCD backlight can be set from low to high in 8 steps. Brightness defaults to the lowest step 1.
Upgrade: Begin firmware upgrade from an external USB stick.
Keep only one (the latest) BIN file on the USB flash drive that is used for firmware upgrade. If there is more than a single firmware file, the system cannot identify which file to use for this particular upgrade.

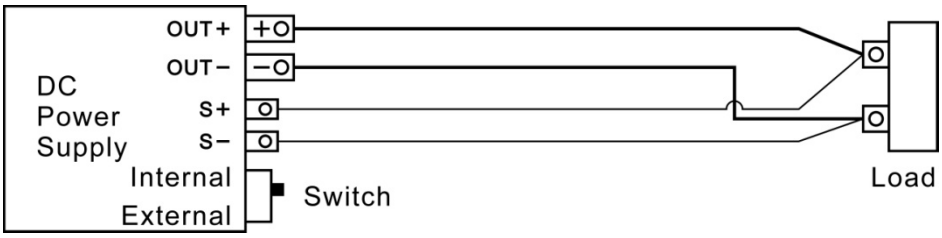
Plug in the USB flash drive with the .bin firmware file after startup and select "Upgrade" in the "OTHER" tab. To avoid accidential firmware modifications, you will have to confirm the firmware upgrade by turning the rotary knob to increase the counter to "5/5". The power supply will start to read the BIN file and begin automatic upgrade. Please under no circumstances power off the power supply during the upgrade.

Factory setting: Resets the power supply configuration to factory settings.

7. Optional features

7.1 Remote sensing

The power supply is optionally equipped with remote sensing terminals, which can read the voltage at the load and therefore compensate losses. Refer to below figure on how to connect the load to remote sensing terminals. The remote sensing input can be connected optionally, and is automatically deactivated if not connected.



WARNING: In case you physically disconnect the output leads from the load, also disconnect the remote sensing leads at the same time.

7.2 External „Output ON/OFF" Control & Interlock

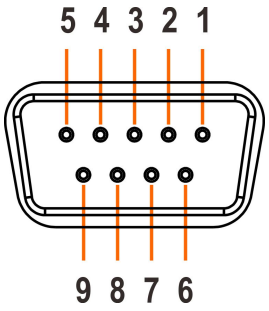
Input for controlling the status of the output of the laboratory power supply (on / off), switchable as "Interlock" or external control. This input is configured as a two pin connection, a „true" state is triggered by shorting the two pins and a „false" state is triggered by removing any connection between the two pins of the input.

This option can be configured as either an interlock input, which disables the output of the power supply if the state is false, or as an external output status control which enables or disables the output of the power supply depending on the control signal state (true = on/false = off) if the „Output On/Off" switch of the power supply is always in the ON position.

8. Digital control

8.1 RS-232 Interface

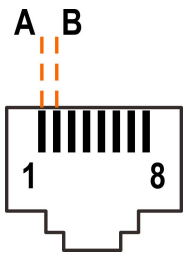
Following the pin description of the RS-232 interface of the DP-D Gen2 Series.



Pin	Pin out definition	Function
1	NC	Blank
2	TXD	Send
3	RXD	Receive
4	NC	Blank
5	GND	Ground
6	NC	Blank
7	NC	Blank
8	NC	Blank
9	NC	Blank

8.2 RS-485 Interface

Following the pin description of the RS-485 interface of the DP-D Gen2 Series.



Pin	Pin out definition	Function
1	A (D+)	-
2	B (D-)	-
3	NC	-
4	NC	-
5	NC	-
6	NC	-
7	NC	-
8	NC	-

Space for your notes:

9. Communication Protocol for DSC-Electronics DP-D Gen2 Series power supplies

Interface: RS-232 / RS-485 (Profibus DB) / LAN (Only with option[Y])
Command format: Asynchronous, 1 start bit, 8 data bits, 1 stop bit
UART baud rate: 1200; 2400; 4800; (9600 default); 14400; 19200; 38400; 43000; 57600; 76800; 115200; 128000
Communicationmode: Master-Slave mode

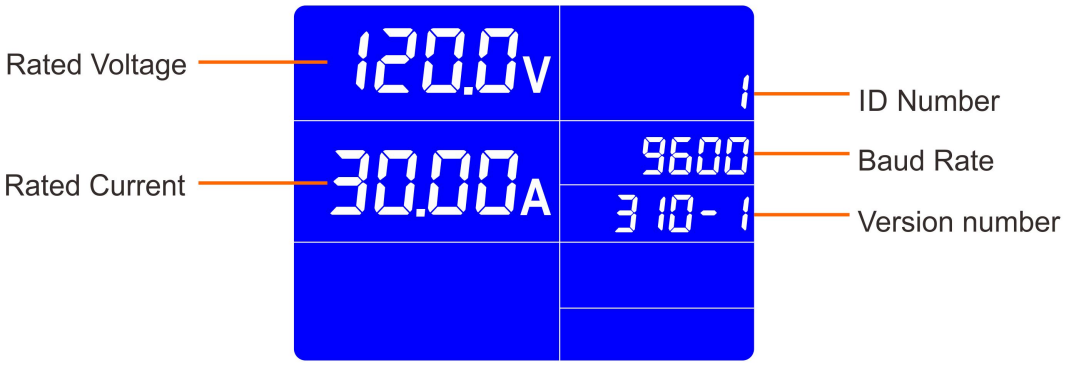
Command Format

1st part: ID number of the DC power supply, 1-16 (If the ID number is 0, all devices will respond)
2nd part: Control command
3rd part: Data length (how many values are supplied to the device in this command)
Data part: 16-bit data, high bit in the front
CRC part: MODBUS format, low byte in the front

Feedback Command Format

1st part: ID number of the DC power supply, 1-16
2nd part: control command
3rd part: data length (how many values are supplied to the device in this command)
Data part: 16-bit data, high bit in the front
CRC check: MODBUS format, low byte in the front

The power supply automatically switches to remote operation mode as soon as contacted through one of the digital interfaces. The below information is displayed while the device is in remote operation mode (not on devices with the [Y] option).



9.1 Command Examples

9.1.1 Output ON/OFF

Control command:

ID	Function Code	Register Address	Data (On/Off)	CRC Check Code
01	05	0085	FF00	9DD3
01	05	0085	0000	DC23

Feedback: Equal to command.

9.1.2 Read Output Status

Control command:

ID	Function Code	Address of Start Register	Numbers of Registers	CRC Check Code
01	01	0085	0001	EC23

Feedback:

ID	Function Code	Address of First Register	Output Status (On/Off)	CRC Check Code
01	01	01	01	9048
01	01	01	00	5188

9.1.3 Read Output Voltage Value

Control command:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	04	0064	0001	7015

Feedback:

ID	Function Code	Bytes	Output Voltage	CRC Check Code
01	04	02	0283	F9F1

Voltage: 0x0283 in decimal equals to 643.
643 divided by 10 (1 decimal point) is 64.3, thus a voltage value of 64.3V.

9.1.4 Read Output Voltage and Current Value

Control command:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	04	0064	0002	7015

Feedback:

ID	Function Code	Bytes	Output Voltage	Output Current	CRC Check Code
01	04	02	0283	0001	CA14

Voltage: 0x0001 in decimal equals to 1.
1 divided by 100 is (2 decimal points) 0.01, thus a current value of 0.01A.

9.1.5 Read Output Power Value

Control command:

Register	Type	Function	Address (Decimal)	Address (Hex)	Target	Function Code 04 (Read)
3	Read	Output power (feedback value)	102	0x0066	Byte	√

This is an optional command and is not available in standard configurations.

Below commands are used to read output power value in standard configuration devices.

Register	Type	Function	Address (Decimal)	Address (Hex)	Target	Function Code 04 (Read)
11	Read	Output power KW*1	110	0x006E	Byte	√
12	Read	Output power W*1	111	0x006F	Byte	√
13	Read	Output power mW*1	112	0x0070	Byte	√

Control command:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	04	006E	0003	DID6

Feedback:

ID	Function Code	Bytes	KW	W	mW	CRC Check Code
01	04	06	0000	007F	02E8	F9F1

KW: 0x0000 = 0kW
W: 0x007F = 127W
Mw: 0x02E8 = 744mW
Output power: 0+127+0.744 = 127.744W

The power value is calculated from the voltage and current readback value, so the digits of the read power value may be two decimal points longer than the digits displayed by the power supply.

9.1.6 Read Rated Voltage Value

Control command:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	04	0067	0001	8015

Feedback:

ID	Function Code	Bytes	Output Voltage	CRC Check Code
01	04	02	03E8	B98E

Voltage: 0x03E8 into decimal system is 1000.
1000 divided by 10 is (1 decimal point) 100.0, thus the voltage value is 100.0V.

9.1.7 Set Output Voltage Value

Control command:

ID	Function Code	Register Address	Data	CRC Check Code
01	06	0095	01F4	99F1

Feedback:

ID	Function Code	Register Address	Data	CRC Check Code
01	06	0095	01F4	99F1

Set output voltage to 50V. There is 1 decimal point for voltage value (50.0).The value should be 500 in the decimal system. 500 into hex is 0x01F4.

9.1.8 Set Output Voltage and Current Value

Control command:

ID	Function Code	Address of First Register	Numbers of Registers	Bytes	Voltage	Current	CRC Check Code
01	10	0095	0002	04	0190	01F4	3B3A

Feedback:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	10	0095	0002	51E4

9.1.9 Set Cycle Mode

1) Change Operation Mode of the Power Supply

Control command:

ID	Function Code	Register Address	Data	CRC Check Code
01	06	00A0	0000 (Normal mode)	89E8
01	06	00A0	0001 (Cycle mode)	4828

Feedback: Equal to command.

2) Set Voltage Value of Sequence Number 1 to X

For example, set voltage values of sequence number 1, 2 and 3 at 2.4V, 3.4V and 5.4V respectively.

ID	Function Code	Address of First Register	Numbers of Registers	Bytes	#1	#2	#3	CRC Check Code
01	10	03E9	0003	06	0018	0022	0036	3DA3

Feedback data:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	10	03E9	0003	51B8

3) Set Current Value of Sequence Number 1 to X

For example, set current values of sequence number 1, 2 and 3 at 10.00A.

ID	Function Code	Address of First Register	Numbers of Registers	Bytes	#1	#2	#3	CRC Check Code
01	10	044D	0003	06	03E8	03E8	03E8	8074

Feedback:

ID	Function Code	Address of First Register	Numbers of Registers	CRC Check Code
01	10	044D	0003	112F

4) Set Running Time Value of Sequence Number 1 to X

For example, set running time values of sequence number 1, 2 and 3 at 15s, 10s, and 5s respectively.

ID	Function Code	Address of First Register	Numbers of Registers	Bytes	#1	#2	#3	CRC Check Code
01	10	04B1	0003	06	000F	000A	0005	1162

Feedback:

ID	Function Code	Start Address of Register Address	Numbers of Registers	CRC Check Code
01	10	04B1	0003	D11F

9.1.10 Set Cycle Numbers

Control command:

ID	Function Code	Register Address	Data	CRC Check Code
01	06	00A4	0004	082A

Feedback: Equal to command.

Remarks:

1) While the output is ON, the power supply operating mode cannot be changed, nor can the voltage, current, or time values be changed.
2) In cycle mode, the voltage, current, and time under each sequence number must be set. If the voltage and current are set to 0, the power output is 0. If the time is set to 0, this sequence number is not run.

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9.2 Command Frame

9.2.1 Function Code

Below function codes are supported.

Function Code	Function Code HEX	Description	Bit Operation / Byte Operation	Numbers of Operation
01	0x01	Read cycle status	Bit Operation	Single or multiple
02	0x02	Read discrete input status	Bit Operation	Single or multiple
03	0x03	Read holding register	Byte Operation	Single or multiple
04	0x04	Read input register	Byte Operation	Single or multiple
05	0x05	Write single cycle	Bit Operation	Single
06	0x06	Write single holding register	Byte Operation	Single
15	0x0f	Write multiple cycles	Bit Operation	Multiple
16	0x10	Write Multiple holding register	Byte Operation	Multiple

Bit operation: Read/write cycle, read/write data bit by bit.
Byte Operation: Read/write register, read/write data byte by byte.

Space for your notes:

9.2.2 Register Definition

Input Register						
No	Type	Description	Address (Decimal)	Address (Hex)	Target	Function Code 04 (Read)
1	Read	Output voltage (feedback value)	100	0x0064	Byte	√
2	Read	Output current (feedback value)	101	0x0065	Byte	√
3	Read	Output power (feedback value)	102	0x0066	Byte	√
4	Read	Rated voltage	103	0x0067	Byte	√
5	Read	Rated current	104	0x0068	Byte	√
6	Read	Reserved	105	0x0069		
7	Read	Voltage decimal point	106	0x006a	Byte	√
8	Read	Current decimal point	107	0x006b	Byte	√
9	Read	Reserved	108	0x006c		
10	Read	Reserved	109	0x006d		
11	Read	Output power-KW*1	110	0x006e	Byte	√
12	Read	Output power-W*1	111	0x006f	Byte	√
13	Read	Output power-mW*1	112	0x0070	Byte	√
14	Read	Load resistance-Kohm*1	113	0x0071	Byte	√
15	Read	Load resistance-ohm*1	114	0x0072	Byte	√
16	Read	Load resistance-mohm*1	115	0x0073	Byte	√
17	Read	Reserved	116	0x0074	Byte	√
18	Read	Reserved	117	0x0075	Byte	√
19	Read	Reserved	118	0x0076	Byte	√
20	Read	Reserved	119	0x0077	Byte	√
21	Read	Reserved	120	0x0078	Byte	√
22	Read	Reserved	121	0x0079	Byte	√
23	Read	Reserved	122	0x007a	Byte	√
24	Read	Reserved	123	0x007b	Byte	√
25	Read	The running sequence number in cycle mode	124	0x007c	Byte	√
26	Read	The run cycle numbers in cycle mode	125	0x007d	Byte	√
27	Read	The running time in cycle model (hour)	126	0x007e	Byte	√
28	Read	The running time in cycle model (minute)	127	0x007f	Byte	√
29	Read	The running time in cycle model (second)	128	0x0080	Byte	√
30	Read	Total number of cycles in cycle mode	129	0x0081	Byte	√
31	Read	Total numbers of sequences in each cycle	130	0x0082	Byte	√
32	Read	Reserved	131	0x0083	Byte	√
33	Read	Reserved	132	0x0084	Byte	√
34	Read	Reserved	133	0x0085	Byte	√
35	Read	Reserved	134	0x0086	Byte	√
36	Read	Reserved	135	0x0087	Byte	√
37	Read	Reserved	136	0x0088	Byte	√
38	Read	Reserved	137	0x0089	Byte	√
39	Read	Reserved	138	0x008a	Byte	√
40	Read	Reserved	139	0x008b	Byte	√
41	Read	Reserved	140	0x008c	Byte	√
42	Read	Reserved	141	0x008d	Byte	√

Discrete Input Status						
No	Type	Description	Address (Decimal)	Address (Hex)	Target	Function Code
						02 (Read)
1	Read	Constant Current mode (CC)	116	0x0074	Bit	√
2	Read	Constant Voltage mode (CV)	117	0x0075	Bit	√
3	Read	Reserved	118	0x0076		
4	Read	Reserved	119	0x0077		
5	Read	Over Voltage Protection (OVP)	120	0x0078	Bit	√
6	Read	Over Current Protection (OCP)	121	0x0079	Bit	√
7	Read	Over Temperature Operation (OTP)	122	0x007a	Bit	√
8	Read	Reserved	123	0x007b		
9	Read	Reserved	124	0x007c		
10	Read	Reserved	125	0x007d		
11	Read	Reserved	126	0x007e	Bit	√

Cycle								
No	Type	Description	Address (Decimal)	Address (Hex)	Target	Function Code		
						01 (Read)	05 (Write single)	15 (Write multiple)
1	R/W	Reserved	132	0x0084				
2	R/W	Output switch	133	0x0085	Bit	√	√	√
3	R/W	Lock	134	0x0086	Bit	√	√	√
4	R/W	Reserved	135	0x0087				
5	R/W	OVP allowed	136	0x0088	Bit	√	√	√
6	R/W	OCP allowed	137	0x0089	Bit	√	√	√
7	R/W	Reserved	138	0x008a				
8	R/W	Reserved	139	0x008b				
9	R/W	Reserved	140	0x008c				
10	R/W	Reserved	141	0x008d				
11	R/W	Save output status	142	0x008e	Bit	√	√	√
12	R/W	Reserved	143	0x008f	Bit	√	√	√

Space for your Notes:

Holding Register								
No	Type	Description	Address (Decimal)	Address (Hex)	Target	Function Code		
						03 (Read)	06 (Write single)	16 (Write multiple)
1	R/W	ID	148	0x0094	Byte	√	√	√
2	R/W	Voltage setup value	149	0x0095	Byte	√	√	√
3	R/W	Current setup value	150	0x0096	Byte	√	√	√
4	R/W	Power setup value (optional)	151	0x0097	Byte	√	√	√
5	R/W	Line resistance (optional)	152	0x0098	Byte	√	√	√
6	R/W	Low bit of PWM frequency (optional)	153	0x0099	Byte	√	√	√
7	R/W	High bit of PWM frequency (optional)	154	0x009a	Byte	√	√	√
8	R/W	PWM duty cycle (optional)	155	0x009b	Byte	√	√	√
9	R/W	Baud rate*2	156	0x009c	Byte	√	√	√
10	R/W	OVP value	157	0x009d	Byte	√	√	√
11	R/W	OCP value	158	0x009e	Byte	√	√	√
12	R/W	OPP value (optional)	159	0x009f				
13	R/W	Operation mode*3	160	0x00a0	Byte	√	√	√
14	R/W	Running cycle number in cycle mode	161	0x00a1	Byte	√	√	√
15	R/W	The 1st sequence number in cycle mode	162	0x00a2	Byte	√	√	√
16	R/W	The last sequence number in cycle mode	163	0x00a3	Byte	√	√	√
17	R/W	Total number of cycles in cycle mode	164	0x00a4	Byte	√	√	√
18	R/W	Reserved	165	0x00a5	Byte	√	√	√
19	R/W	Reserved	166	0x00a6	Byte	√	√	√
20	R/W	Reserved	167	0x00a7	Byte	√	√	√
21	R/W	Reserved	168	0x00a8	Byte	√	√	√
22	R/W	Running cycle number of V-Slope mode.	169	0x00a9	Byte	√	√	√
23	R/W	Current setup value in V-Slope mode	170	0x00aa	Byte	√	√	√
24	R/W	Start step in V Slope mode	171	0x00ab	Byte	√	√	√
25	R/W	End step in V Slope mode	172	0x00ac	Byte	√	√	√
26	R/W	Cycle numbers in V-Slope mode	173	0x00ad	Byte	√	√	√
27	R/W	Reserved	174	0x00ae	Byte	√	√	√
28	R/W	Reserved	175	0x00af	Byte	√	√	√
29	R/W	Reserved	176	0x00b0	Byte	√	√	√
30	R/W	Reserved	177	0x00b1	Byte	√	√	√
31	R/W	Running cycle number of I-Slope mode.	178	0x00b2	Byte	√	√	√
32	R/W	Voltage setup in I-Slope mode	179	0x00b3	Byte	√	√	√

Holding Register								
No	Type	Description	Address (Decimal)	Address (Hex)	Target	Function Code		
						03 (Read)	06 (Write single)	16 (Write multiple)
33	R/W	Start step in I-Slope mode	180	0x00b4	Byte	√	√	√
34	R/W	End step in I-Slope mode	181	0x00b5	Byte	√	√	√
35	R/W	Cycle numbers in I-Slope mode	182	0x00b6	Byte	√	√	√
36	R/W	Reserved	183	0x00b7	Byte	√	√	√
37	R/W	Reserved	184	0x00b8	Byte	√	√	√
38	R/W	Reserved	185	0x00b9	Byte	√	√	√
39	R/W	Reserved	186	0x00ba	Byte	√	√	√
40	R/W	Year	187	0x00bb	Byte	√	√	√
41	R/W	Month	188	0x00bc	Byte	√	√	√
42	R/W	Date	189	0x00bd	Byte	√	√	√
43	R/W	Time	190	0x00be	Byte	√	√	√
44	R/W	Minute	191	0x00bf	Byte	√	√	√
45	R/W	Second	192	0x00c0	Byte	√	√	√
46	R/W	LAN DHCP switch (optional)	193	0x00c1	Byte	√	√	√
47	R/W	LAN IP part1 (optional)	194	0x00c2	Byte	√	√	√
48	R/W	LAN IP part2 (optional)	195	0x00c3	Byte	√	√	√
49	R/W	LAN IP part3 (optional)	196	0x00c4	Byte	√	√	√
50	R/W	LAN IP part4 (optional)	197	0x00c5	Byte	√	√	√
51	R/W	LAN subnet mask part1 (optional)	198	0x00c6	Byte	√	√	√
52	R/W	LAN subnet mask part2 (optional)	199	0x00c7	Byte	√	√	√
53	R/W	LAN subnet mask part3 (optional)	200	0x00c8	Byte	√	√	√
54	R/W	LAN subnet mask part4 (optional)	201	0x00c9	Byte	√	√	√
55	R/W	LAN default gateway part1	202	0x00ca	Byte	√	√	√
56	R/W	LAN default gateway part2	203	0x00cb	Byte	√	√	√
57	R/W	LAN default gateway part3	204	0x00cc	Byte	√	√	√
58	R/W	LAN default gateway part4	205	0x00cd	Byte	√	√	√
59	R/W	Voltage of sequence 1 in Cycle Mode	1001	0x03e9	Byte	√	√	√
60	R/W	Voltage of sequence X in Cycle Mode	1000+X		Byte	√	√	√
61	R/W	Voltage of sequence 100 in Cycle Mode	1100	0x044c	Byte	√	√	√
62	R/W	Current of sequence 1 in Cycle Mode	1101	0x044d	Byte	√	√	√
63	R/W	Current of sequence X in Cycle Mode	1100+X		Byte	√	√	√
64	R/W	Current of sequence 100 in Cycle Mode	1200	0x04b0	Byte	√	√	√
65	R/W	Running time of sequence 1 in Cycle Mode	1201	0X04B1	Byte	√	√	√

Holding Register								
No	Type	Description	Address (Decimal)	Address (Hex)	Target	Function Code		
						03 (Read)	06 (Write single)	16 (Write multiple)
66	R/W	Running time of sequence X in Cycle Mode	1200+X		Byte	√	√	√
67	R/W	Running time of sequence 100 in Cycle Mode	1300	0X0514	Byte	√	√	√
68	R/W	Start voltage of step 1 in V-Slope Mode	1301	0x0515	Byte	√	√	√
69	R/W	End voltage of step 1 in V-Slope Mode	1302	0x0516	Byte	√	√	√
70	R/W	End voltage of step X in V-Slope Mode	1301+X		Byte	√	√	√
71	R/W	End voltage of step 50 in V-Slope Mode	1351	0x0547	Byte	√	√	√
72	R/W	Running time of step 1 in V-Slope Mode	1401	0x0579	Byte	√	√	√
73	R/W	Running time of step X in Voltage Slope Mode	1400+X		Byte	√	√	√
74	R/W	Running time of step 50 in V-Slope Mode	1450	0x05aa	Byte	√	√	√
75	R/W	Start current of step 1 in I-Slope Mode	1501	0x05dd	Byte	√	√	√
76	R/W	End current of step 1 in I- Slope Mode	1502	0x05de	Byte	√	√	√
77	R/W	End current of step X in I- Slope Mode	1501+X		Byte	√	√	√
78	R/W	End current of step 50 in I-Slope Mode	1551	0x060f	Byte	√	√	√
79	R/W	Running time of step 1 in I-Slope Mode	1601	0x0641	Byte	√	√	√
80	R/W	Running time of step X in I-Slope Mode	1600+X		Byte	√	√	√
81	R/W	Running time of step 50 in I-Slope Mode	1650	0x0672	Byte	√	√	√

Space for your notes:

Note: Registers marked yellow are only available on devices with option [Y].

Remark 1:
The output power and load resistance are calculated from the voltage and current readback values.
To get the present output power, you need to read the data of three addresses of kilowatts (KW), watts (W), and milliwatts (mW) at one time. Set the three address data to A, B, and C. The output power value follows the following formula:

$$Power(W) = A \times 10^{3} + \mathrm{B} + C \times 10^{-3}$$

Apply the same method to calculate load resistance value.

Remark 2:
Supported baud rates: 1200; 2400; 4800; 9600; 14400; 19200; 38400; 43000; 57600; 76800; 115200; 128000
Due to the limitation of single register data range (0~65535), the baud rate needs to be divided by 10, that is, remove a 0 at the end and write it.

Remark 3:

Operation Mode	
Register Value	Operation Mode
0	Normal mode
1	Cycle mode

10. Device Check

NOTE: The device check should only be performed for troubleshooting purposes.

1. Make sure that the device is correctly connected to the power grid.
2. Please do not connect any loads to the power supply during self-test.
3. Turn on the power, set the preset current to the highest possible value and the voltage to 0V.
4. Set the over current and over voltage protection limits to their maximum values.
5. Turn on the output and check the output voltage to be equal to the maximum voltage of the power supply model. The power supply should be working in CV mode now.
6. Turn off the output, wait till the capacitors are discharged and the output voltage reaches 0V.
7. Set the preset current to 0A and leave the voltage at the maximum value.
8. Shorten the output terminals of the power supply with an appropriate cable or copper bar, which is able to withstand the maximum current of the power supply for at least 30 seconds.
9. Turn on the output, slowly turn the output current up until you reach the maximum possible value. Check whether the output current is equal to the maximum current of the power supply.
10. Turn off the output, turn off the power supply, disconnect the cable from the output terminals.