



## DP-P / DP-PH Series User's Manual

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## 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.

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: $I = (\text{maximum power of the device} / 230) + 2$
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: $I = (\text{maximum power of the device} / 115) + 4$

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: $I = ((\text{maximum power of the device} / 400) / 1,73) + 2$

## 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.

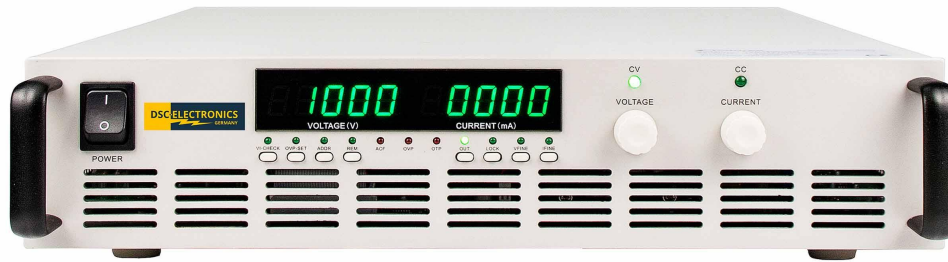
## 3. Product Description

The DP-P and DP-PH series are high power/voltage output laboratory DC power supplies, with rated power of 1200W and 2400W (DP-P Series) and 600W and 1200W (DP-PH Series). The DP-P and DP-PH series adopt ZVZCS PWM technology, which greatly reduces switching consumption and therefore facilitates switching function with high efficiency and high stability.

The DP-P and DP-PH series are manufactured in a 2U 19-inch standard chassis. The maximum rated voltage is 6V to 600V for DP-P series and 1kV to 12kV for DP-PH series, while the maximum rated current is 2A to 300A for DP-P series and 50mA to 5A for DP-PH series depending on the model. RS232, RS485 and RS422 communication interfaces are integrated in the standard configuration, providing multiple communication choices for a digital control.

## 4. Panel Controls and Indicators

### 4.1 Front Panel Illustration



DP-P/DP-PH Series Front panel

No	Name	Description
1	Power switch	Power ON/OFF the device.
2	<b>Function buttons</b>	
	VI-CHECK	Press to display the preset voltage and current limits. Use voltage and current knobs to set voltage and current limits.
	OVP-SET	Press to enter OVP setting mode. Use voltage knob to set OVP value.
	ADDR	Press to enter remote address setting mode.
	REM	Press to switch from remote control mode to local control mode.
	OUT	Press to turn on/off the output.
	VFINE	Press to switch between voltage fine adjustment and coarse adjustment.
	LOCK	Press to lock the panel.
	IFINE	Press to switch between current fine adjustment and coarse adjustment.
3	<b>Indicators</b>	
	VI-CHECK	Indicates preset mode.
	OVP-SET	Indicates OVC setting mode.
	ADDR	Indicates remote address setting mode.
	REM	Indicates remote control mode.
	ACF	Indicates AC input fault protection mode (Input voltage out of range).
	OVP	Indicates over voltage protection mode.
	OTP	Indicates over temperature protection mode.
	OUT	Indicates output ON.
	LOCK	Indicates that buttons and knobs are disabled/locked.
	VFINE	Indicates voltage fine adjustment mode.
	IFINE	Indicates current fine adjustment mode.
4	Voltage display	Displays voltage value.
5	Current display	Displays current value.
6	Voltage knob	Voltage adjustment.
7	Current knob	Current adjustment.
8	CV indicator	Indicates constant voltage mode.
9	CC indicator	Indicates constant current mode.
10	Precharge switch	Enables precharging of the output stage. (DP-PH Power Supplies only)

## 4.2 Rear Panel Illustration



DP-P Series Rear Panel



DP-PH Series Rear Panel



DP-PH Series Rear Panel (potential free version)

- |                        |                    |                               |
|------------------------|--------------------|-------------------------------|
| 1. RS485/422 interface | 2. RS232 interface | 3. Remote sensing terminal    |
| 4. Output terminal     | 5. Cooling fan     | 6. Power socket / fuse socket |

## 6. Operation Instructions

The QUICK START section gave you an overview over the basic functionality of the power supply. This section will provide detailed operation instructions.

### 6.1 General

Before putting the device into operation, you need to learn the functionality of the front panel and meanings of the indicators. After turning on the **POWER** switch, the power supply enters the standby mode.

The power supply can be switched between internal control through the front panel or remote control via the digital connections. In remote control mode, the REM indicator lights on, and only the **REM** button is active while all other buttons and knobs are locked. The device enters remote control mode automatically, as soon as a connection is established but you can switch to internal control by pressing the **REM** button any time.



## 6.2 Precharge (DP-PH series power supplies only)

The DP-PH series high voltage power supplies may have a short (ms) overshoot of around 150V at the output while enabling the output at low voltage settings (under 50% of the voltage range) before the output voltage reaches the set value. The overshoot is caused by the output stage if it is not charged at the moment when the output is enabled. To prevent this the power supply is equipped with an output stage precharge function, which charges the output stage before the output is enabled completely. By doing this the overshoot is completely eliminated.

The output of the power supply is under voltage and has a very high impedance when the precharge function is enabled but the output disabled, thus a high voltage may be measurable at the output but it will fall almost to 0V if a load is connected to the output.

To precharge the output stage, set the PRECHARGE switch from OFF to PRECHARGE after you connected the load to the power supply. You will see that the output Voltage rises from 0V to a higher value (depending on the load connected). After doing this, the power supply can be operated as usual (set the desired voltage and enable the output). The PRECHARGE function can also be used while operating the power supply remotely.

**CAUTION:** Please do not touch the power supply output when the PRECHARGE function is enabled !

## 6.3 Front Panel Operation

### 6.3.1 Buttons and their functionality

#### VI-CHECK

Press the **POWER** switch to turn on the power supply. The power supply enters the standby mode. Press the **VI-CHECK** button to display the preset voltage and current limits. Use the **CURRENT** knob to adjust the set current limit to the desired value and the **VOLTAGE** knob to set the output voltage value. Press the **VI-CHECK** button again to return to the output voltage and current display. During operation, if the actual output current exceeds the preset current limit, the power supply enters CC mode and adjusts the output voltage according to the load change to keep the current at the set current limit. Setting a proper current limit value can protect connected equipment from damages by over current. If the current drops under the set current limit while the power supply works in the CC mode, the device enters the CV mode automatically and keeps the output voltage steady at the set value while the output current is adjusted automatically depending on the load change.

#### OVP-SET

Press the **POWER** switch to turn on the power supply. The power supply enters the standby mode. Press **OVP-SET** to display the OVP value. Use the **VOLTAGE** knob to adjust the set OVP limit to the desired value. Press **OVP-SET** button again to return to output voltage and current display. When the actual output voltage exceeds the set OVP value, the OVP circuit will be activated and the output will be shut down immediately.

#### ADDR

Press the **POWER** switch to turn on the power supply. The power supply enters standby mode. Press **ADDR** button to display the present address. Use the **VOLTAGE** knob to set the communication address to the desired value. Press **ADDR** button again to return to output voltage and current display.

#### REM

Use the **REM** button to switch between remote control and internal control. In remote control mode, only the REM button is enabled, which can switch the power supply back to internal control (front panel control). All other buttons and knobs are disabled. In internal control mode, all buttons and knobs are enabled.

## OUT

During operation of the power supply, use the **OUT** button to turn off the output. The OUT indicator lights off. Press the **OUT** button again to re-enable the output, the OUT indicator lights on again. If using the **VOLTAGE** knob to adjust the output voltage while the output is active, the **VOLTAGE** knob may generate a short voltage overshoot under some circumstances that could exceed the preset OVP limit. In this case the OVP protection is activated and the OVP indicator lights on. Turn the **VOLTAGE** knob anti-clockwise half a turn, and then press the **OUT** button. The output will recover. If the output still does not recover, lower the **VOLTAGE** a bit more and try again.

## LOCK

Use the **LOCK** button to lock or unlock the front panel. Press the **LOCK** button to lock the front panel. The LOCK indicator lights on. Except the **LOCK** button, all buttons and knobs are disabled. Press the **LOCK** button again and the LOCK indicator lights off. The front panel is now unlocked.

## VFINE

Use **VFINE** button to switch between coarse and fine adjustment during OVP voltage or output voltage setting. If the VFINE indicator is off, the **VOLTAGE** knob operates in coarse adjustment. Press **VFINE** button and the VFINE indicator lights on. The **VOLTAGE** knob operates in fine adjustment now.

## IFINE

Use **IFINE** button to switch between coarse and fine adjustment during current setting. If the IFINE indicator is off, the **CURRENT** knob operates in coarse adjustment. Press **IFINE** button and the IFINE indicator lights on. The **CURRENT** knob operates in fine adjustment now.

### 6.3.2 Knobs

#### Voltage knob

Use the **VOLTAGE** knob to set the output voltage. Turn the knob clockwise to increase voltage, or anti-clockwise to decrease it. The output voltage can be set at any value between 0V to rated output voltage.

#### Current knob

Use the **CURRENT** knob to set the current limit. Turn the knob clockwise to increase the current limit or anti-clockwise to decrease it. The current limit can be set at any value between 0A to rated output current.

## 7. Powering on the power supply

Check the **PRECHARGE** switch to be in the OFF position. Connect the power supply to the local power grid and turn on the **POWER** switch, the power supply will enter into operation mode. The cooling fan starts to run, the LED display lights on, the buttons and rotary knobs on the front panel react to your actions.

### 7.1 Operation Example

Operation steps:

- 1) Connect the power supply to the local power grid.
- 2) Ensure the **PRECHARGE** switch is in position OFF.
- 3) Press the **POWER** switch to turn on the power. The LED display shows 00.00V and 00.00A. The OUT indicator and CV indicator light on. Other indicators remain off.
- 4) Press the **VI-CHECK** button to set the output voltage and current values and press the button again to save.
- 5) Connect the load to the power supply.
- 6) Optionally set the **PRECHARGE** switch to ON.
- 7) Power on the output by pressing **OUT**.



**WARNING** DO NOT forcefully press any button or knob on the front panel.



## 7.3 Output Check

The following steps are to check and ensure that the power supply can make maximum rated output and response to front panel operations correctly.

### → Check the Output Voltage

The following steps are needed to verify basic voltage functions without load.

- Turn on the **POWER** switch, the CV indicator lights on. Other indicators are off.
- Press **OVP-SET** button to display the preset OVP value. Adjust **VOLTAGE** knob to set OVP value to the maximum. Press **OVP-SET** button again to return to output voltage and current display.
- Press **OUT** button to turn on the output.
- Adjust **VOLTAGE** knob to set output voltage to the maximum. Current display shall be 0A at this moment.

### → Check the Output Current

The following steps are needed to verify basic current functions under load.

- Turn on the **POWER** switch, the CV indicator lights on. Other indicators are off.
- Press **VI-CHECK** button to display the preset current and voltage limit. Adjust **CURRENT** and **VOLTAGE** knob to set the current and voltage limit to the rated value. Press **VI-CHECK** button again to return to output voltage and current display.
- Connect a load rated according the set output values.
- Press **OUT** button to turn on the output.
- Check if the output current is in compliance with the output voltage and current settings.

## 7.4 Start Up Failure (Trouble-Shooting)

If the power supply is not able to start up properly, please follow these instructions.

- Check if the power cord is connected properly.  
Check if the AC input is in the range specified on the power supply.  
Check if the power switch is ON.
- Check if the OUT indicator is ON.
- Check if the ACF, OTP or OVP indicators light on.
- Press **VI-CHECK** button to check the preset voltage and current limits. If the preset voltage or current limit is set to zero, adjust the **VOLTAGE** or **CURRENT** knob to set voltage or current limit to the desired value. Press **VI-CHECK** button again to return to output voltage and current display.
- Press **OVP-SET** button to check OVP value. If the OVP value is set to zero, adjust **VOLTAGE** knob to set OVP value to the desired value. Press **OVP-SET** button again to return to output voltage and current display.

If the problem can not be resolved by the solutions above, please contact our support.

## 8. Remote Control

The power supply is equipped with RS232, RS485 and RS422 interfaces, supporting the Modbus protocol.

### 8.1 Introduction

The following table lists the connection methods and options of each communication module.

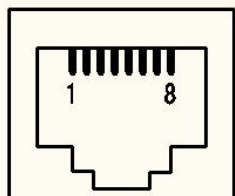
Connection	Connecting Method	Communication Mode	Communication Distance	Multi-unit Communication
RS232	RS232 cable	Full duplex	Short	NO
	USB-to-RS232 cable + RS232 cable	Full duplex	Short	NO
RS485	RS232-to-RS485 cable + RS485 cable	Half duplex	Long	YES
RS422	RS232-to-RS422 cable + RS422 cable	Full duplex	Long	YES

## 8.2 Interface Definition

### 8.2.1 Interface Definition of RS485 and RS422

User can choose between the RS485 or RS422 interface for communication. The pin out of the RS485 and RS422 interfaces is given as below.

Connector illustration:



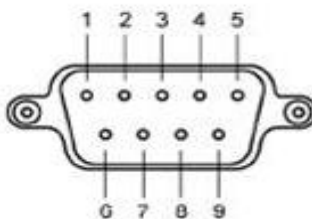
Pin out definition:

Pin	RS422 Pin out definition	RS485 Pin out definition
1	GND	GND
2	GND	GND
3	T+	A(D+)
4	T-	B(D-)
5	R+	NC
6	R-	NC
7	NC	NC
8	NC	NC

### 8.2.2 Interface Definition of RS232

Pin out of the RS232 interface is given as below.

Connector illustration:



Pin out definition:

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

## 9. Protocol (ModBus)

The data frame consists of four parts: device address, function code, data, error check.

To ensure reliability during communication, the time interval between each data frame shall be more than 3.5 times of a single byte character transmission time. For example, if the baud rate is 9600, the time interval between each data frame is more than  $11 \times 3.5 / 9600 = 0.004s$ .

The power supply uses Bidirectional asynchronous communication, with 1 start bit, 8 data bits and 1 stop bit. It supports four baud rates: 9600, 19200, 38400 and 57600.

### 9.1 Function Code

The following function codes (ModBus) are supported by the device:

Function code	Description
0x01	Read coils
0x05	Write single coil
0x03	Read holding registers
0x10	Write multiple registers

## 9.2 Error Check

The power supply uses the Cyclic Redundancy Check (CRC) checksum to prevent data corruption.

## 9.3 Function code descriptions

### Read Coils 01 (0x01)

Request frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x01
Starting address	2	0 to 0xFFFF
Quantity of coils	2	1 to 16
CRC	2	
Response frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x01
Byte count	1	1 to 2
Coil status	n	
CRC	2	
Error frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x81
Exception code	1	1 to 8
CRC	2	

### Example

The power supply's communication address: 1  
 Read the power supply's remote control status.  
 Coil address: 0x0500  
 Send request: 01 01 05 00 00 01 fd 06  
 Normal reply: 01 01 01 FF 90 48  
 Definition: FF is the response value, remote control is ON.

### Write Single Coil 05 (0x05)

Request frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x05
Start address	2	0 to 0xFFFF
Output value	2	0x0000 to 0xFF00
CRC	2	
Reply frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x01
Byte number	2	0 to 0xFFFF
Output value	2	0x0000 to 0xFF00
CRC	2	
Error frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x85
Exception code	1	1 to 8
CRC	2	

### Example

The power supply's communication address: 1  
 Enable the power supply remote control.  
 Coil address: 0x0500  
 Send request: 01 05 05 00 ff 00 8c f6  
 Normal reply: 01 05 05 00 ff 00 8c f6

## Read Holding Register 03 (0x03)

Request frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x03
Start address	2	0 to 0xFFFF
Register number	2	n=1-32
CRC	2	
Reply frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x03
Byte number	1	2*n
Register value	2*n	
CRC	2	
Exception frame	Byte length	Value
Device address	1	1 to 64
Function code	1	0x83
Exception code	1	1 to 8
CRC	2	

### Example

The power supply's communication address: 1

Read the power supply's output voltage VS.

VS address: 0x0B00

Send request: 01 03 0b 00 00 02 c6 2f

Normal reply: 01 03 04 40 AB 28 46 01 E1

Definition: 40 AB 28 46 is the voltage value, meaning floating point number 5.35V (Only two decimal digits remained)

## Write Multiple Registers 16 (0x10)

Request frame	Byte length	Value
Device Address	1	1 to 64
Function code	1	0x10
Start address	2	0 to 0xFFFF
Register number	2	n=1-32
Byte counting	1	2*n
Register value	2*n	
CRC	2	
Reply frame	Byte length	Value
Device Address	1	1 to 64
Function code	1	0x010
Start address	2	0 to 0xFFFF
Register number	2	n
CRC	2	
Exception frame	Byte length	Value
Device Address	1	1 to 64
Function code	1	0x90
Exception code	1	1 to 8
CRC	2	

### Example

The power supply's communication address: 1

Set the output voltage at 10V.

VSET address: 0x0A05

Send request: 01 10 0a 05 00 02 04 41 20 00 00 58 c6

Normal reply: 01 10 0A 05 00 02 52 11

Definition: 41 20 00 00 is the voltage value, meaning floating point number 10V

## 9.4 Coil and Register Address Assignments

### Coil byte register definition:

Name	Address	Byte	Attribute	Description
PC	0x0500	1	W/R	Remote control status byte: 1, front panel control is disabled.
ACF	0x0510	1	R	AC input fault: 1, ACF fault protection mode is on.
OTP	0x0511	1	R	1: OTP mode is activated.
OVP	0x0512	1	R	1: OVP mode is activated.
OFF	0x0513	1	R	Output on/off: 1=ON.
CC	0x0514	1	R	CC/CV status: 1=CC, 0=CV.

### RAM register definition:

Name	Address	Byte	Attribute	Description
CMD	0x0A00	1	W/R	Command register: 8 low bytes valid, 8 high bytes invalid.
VMAX	0x0A01	2	W/R	Max. voltage register, double type
IMAX	0x0A03	2	W/R	Max. current register, double type
VSET	0x0A05	2	W/R	Setting voltage register, double type
ISSET	0x0A07	2	W/R	Setting current register, double type
TMCVS	0x0A09	2	W/R	Voltage initiated timer setting register, double type
BAUDRATE	0x0A1b	1	W/R	Baud rate settings register, u16 type 1=9600, 2=19200, 3=38400, 4=57600 The new baud rate is valid after rebooting the power supply.
VS	0x0B00	2	R	Voltage register, double type
IS	0x0B02	2	R	Current register, double type
MODEL	0x0B04	1	R	Model number register, u16 type
EDITION	0x0B05	1	R	Software version register, u16 type

### CMD Register Definition

Definition	CMD value	Description
Voltage setting	1	To make the set voltage effective
Current setting	2	To make the set current effective
Voltage soft start setting	3	To make the set voltage effective. Turn on the voltage slowly.
Turn ON output	6	Enable the output
Turn OFF output	7	Shut down the output

## 9.5 Frequently Used Functions

### Setting up the remote control:

Operation	Register	Value	Description
Write cycle	PC	1	Required

### Disabling remote control:

Operation	Register	Value	Description
Write cycle	PC	0	Required

### Voltage setup:

Operation	Register	Value	Description
Write cycle	VSET	double	Optional
Write cycle	CMD	1	Required

### Current setup:

Operation	Register	Value	Description
Write cycle	ISSET	double	Optional
Write cycle	CMD	2	Required

### Voltage soft start setup:

Operation	Register	Value	Description
Write cycle	VSET	double	Optional
Write cycle	TMCVS	double	Optional
Write cycle	CMD	3	Required

### System setup:

Operation	Register	Value	Description
Write cycle	BAUDRATE	u16	Optional
Write cycle	CMD	6	Required

