



# **DP-D Series High Power Laboratory Power Supplies 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.

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

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

## 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-D power supply can operate in constant voltage (CV), constant current (CC) or constant power (CP) (optional) 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 by the front panel LED indicators.

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.

If your device is equipped with a constant power (CP) mode, the power supply will regulate the output Voltage and Current to stay under/on the power limit set if operating in CP mode.

### 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 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

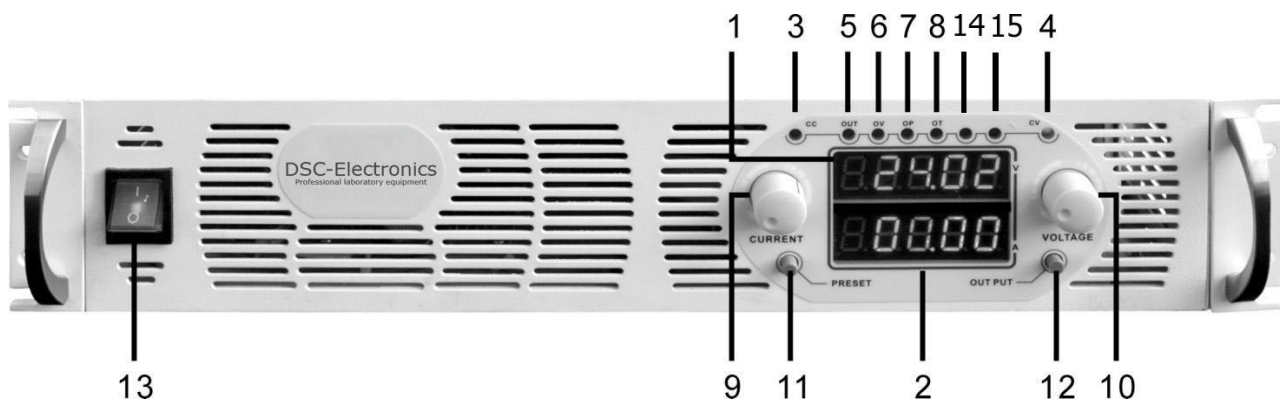
**Note:** Can be ignored for devices with optional inductive reverse current protection.

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



| No. | Name             | Description   |
|-----|------------------|---|
| 1   | Voltage          | Displays the output voltage                             |
| 2   | Current          | Displays the output current                             |
| 3   | C.C indicator    | Constant Current mode indicator                         |
| 4   | C.V indicator    | Constant Voltage mode indicator                         |
| 5   | Output indicator | Output status indicator                                 |
| 6   | OV indicator     | Over Voltage protection ON                              |
| 7   | OL indicator     | Overload protection ON                                  |
| 8   | OT indicator     | Over temperature protection ON                          |
| 9   | Current setting  | Adjusts the current setting                             |
| 10  | Voltage setting  | Adjusts the voltage setting                             |
| 11  | Preset key       | Press this button to set voltage and current preset     |
| 12  | Output ON/OFF    | Use this key to turn on or off the output               |
| 13  | Power switch     | Use this switch to turn on or off the power supply      |
| 14  | PR indicator     | PRESET Mode ON (Digital devices only)                   |
| 15  | FI Indicator     | Voltage / Current fine tune mode (Digital devices only) |

## 5. Operation Instructions

**Note:** The DP-D power supply is manufactured with digital or analog control. The digital control is installed in devices with digital connection (RS232, RS485, USB), all other devices are controlled analogously. There are generally two differences in operation:

Analog control

- Press and hold the PRESET button
- No fine adjustment is possible by pressing the voltage regulator

Digital control

- Press the PRESET button to enter the values, press again to save the values.
- By pressing the voltage regulator fine adjustment of the output values is possible.

**Caution:** Always check that the output is switched off and the capacitors are discharged before connecting the load to the power supply. The load can be connected either after or before the power supply is switched on - but always before the output is switched on!

### 5.1 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.
4. Press / Hold the PRESET button, set the current to maximum and the voltage to 0V.
5. Press the OUTPUT button to turn on the output of the power supply. The CV indicator lights up while the CC indicator is off.
6. Now turn the voltage regulator to maximum, the display will show the maximum voltage.
7. Now switch off the output of the power supply by pressing the OUTPUT button again.
8. Press / Hold PRESET, set the current to minimum.
9. CAUTION: Check that the output is switched off.
10. Short the output of the power supply (Attention: the cable must be able to withstand the maximum power of the power supply for at least 10 seconds.)
11. Switch on the output of the device again. The CC indicator lights up while the CV indicator is off.
12. Now increase the current to maximum. The maximum current is displayed.

Turn off the power supply's output, turn off the power, and disconnect all connection cables.

### 5.2 Voltage and Current (PRESET)

1. Turn on the power and check that the output is off.
2. Press / Hold the PRESET button, adjust the voltage and current.
3. Turn on the output by pressing the OUTPUT button.

### 5.3 CV Constant Voltage Operation

1. Turn on the power and check that the output is off.
2. Press / Hold PRESET and set the desired voltage and current limit.
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.

## 5.4 Constant Current Operation

1. Turn on the power and check that the output is off.
2. Press / hold PRESET and set the desired current and voltage.
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.

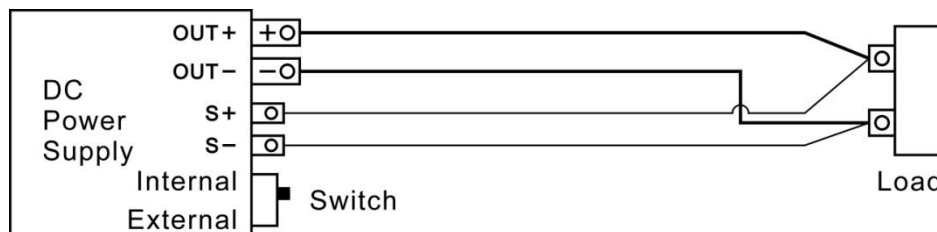
## 5.5 Optional: Constant Power Operation

1. Turn on the power and check that the output is off.
2. Press / Hold PRESET and set the desired maximum voltage, current and power.
4. Now turn the output on by pressing the OUTPUT button.

The device now regulates the output voltage as a function of the load in order to remain at the maximum limit (current / power) reached as the first.

## 5.6 Optional: 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.



## 5.7 Optional: Timer

Power supplies of the DP-D series can be equipped with an integrated timer to control the output status. The Panasonic Timer Model LT4HW-AC240VS can be set to two time periods, T1 and T2. The operation sequence is started with the toggle switch "START" or stopped "STOP".

Working modes of the timer

Pu-A:

When the toggle switch is set to "START", the timer starts counting down at T1 (output OFF) until the time set for T1 has expired and then changes to the second state T2 (output ON). This state is retained until the time set for T2 elapses, the output then returns to the original state (output Off) and ends the process.

Pu-B:

When the toggle switch is set to "START", the timer starts counting down at T1 (output OFF) until the time set for T1 has expired and then changes to the second state T2 (output ON). This condition is retained until the time set for T2 elapses, the output then returns to the original state T1 (output Off) and starts the procedure from the beginning.

Pu-C:

When the toggle switch is set to "START", the timer starts counting down at T1 (output On) until the time set for T1 has expired and then changes to the second state T2 (output Off). This state is retained until the time set for T2 elapses, the output then returns to the original state T1 (output On) and starts the process from the beginning.

Switching the working modes

To switch between the working modes, press the first arrow key (up/down) from the right while holding "set / lock".

## a). Setting the T1 / T2 Time

Use the arrow keys below the time values to increase / decrease them.

## b). Resetting the timer

Set the toggle switch to the "STOP" position and press "Reset" to reset the timer.

## c). Lock

To lock the control panel, hold down "Lock" while pressing the last arrow (left).

## 5.8 Optional: 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.

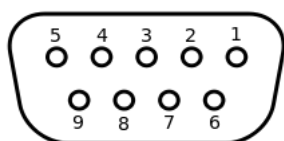
## 5.9 Optional: RS485 / RS232 / USB

DP-D series devices can be equipped with an RS485 connection to read/write output values in real time. Optionally the device can be shipped with a RS485 → RS232 adapter, or with both, a RS485 → RS232 and RS232 → USB adapter.

(Please see communication protocol at the end of this manual)

## 5.10 Optional: Analog Control Ports

The DP-D series devices can be equipped with analog connections to read / write output values. The analog connections can be accessed through the D-SUB connection on the rear side of the device. The pin-out is as follows:



Pin1: GND

Pin2: Voltage External Control +

Pin3: Current External Control +

Pin4: Power External Control +

Pin5: Voltage Feedback +

Pin6: Current Feedback +

Pin7: Power Feedback +

Pin8: External Output ON/OFF & Interlock

Pin9: (Reserved for custom options)

## 5.11 Optional: Adjustable Voltage Limit (OVP)

Devices of the DP-D series can optionally be equipped with an adjustable voltage limit, which can be addressed via the front panel as well as via one of the digital interfaces (optional). If a voltage limit is set, a higher output voltage can not be set either via the front panel nor via external interfaces.



Operation via the front panel:

- 1). Switch to PRESET mode by pressing the PRESET button.
- 2). Press the CURRENT rotary encoder, the OV LED lights up.
- 3). Now set the maximum voltage by turning the VOLTAGE rotary encoder.
- 4). Confirm the entry by pressing the CURRENT rotary encoder.

Setting via digital interfaces:

The command 0x2d 0x02 directly addresses the voltage limitation. The command is an extension of the DP-D Series communication protocol and is structured as follows (XX YY YY ZZ ZZ AA AA) where X is the device ID, Y is the command, Z is the value and A is the CRC sum. The command to set the voltage limit to 5.11V would thus be for a device with the ID 01:

01 2D 02 01 FF F0 BC

ID: 01 / BEFEHL: 2D 02 / WERT: 01 FF / CRC: F0 BC

## Communication Protocol for DSC-Electronics DP-D Series power supplies

Interface: RS-232 / RS-485 (Profibus DB)

Command format: Asynchronous, 1 start bit, 8 data bits, 1 stop bit

Baud rate: 9600

Communication mode: Master-Slave mode

### Command Format

1st byte: ID number of the DC power supply, 1-16 (If the ID number is 0, all devices will response)

2nd byte: Control command

3rd byte: Data length (how many values are supplied to the device in this command)

Data byte: 16-bit data, high bit in the front

CRC check byte: MODBUS format, low byte in the front

### Feedback Command Format

1st byte: ID number of the DC power supply, 1-16

2nd byte: control command

3rd byte: data length (how many values are supplied to the device in this command)

Data byte: 16-bit data, high bit in the front

CRC check byte: MODBUS format, low byte in the front

- Devices with equal device ID's can not be connected to one controller
- The communication protocol includes commands for calibration, therefore please use only the commands specified in this User's Manual

## Output Status Control: 0x20

Command:

|                 |      |      |                                  |              |               |
|-----------------|------|------|----------------------------------|--------------|---------------|
| ID number: 1-16 | 0x20 | 0x01 | Output:<br>0x01: ON<br>0x00: OFF | CRC low byte | CRC high byte |
|-----------------|------|------|----------------------------------|--------------|---------------|

Device response:

|                 |      |      |                                  |              |               |
|-----------------|------|------|----------------------------------|--------------|---------------|
| ID number: 1-16 | 0x20 | 0x01 | Output:<br>0x01: ON<br>0x00: OFF | CRC low byte | CRC high byte |
|-----------------|------|------|----------------------------------|--------------|---------------|

## Voltage Setup: 0x21

Command:

|                 |      |      |                            |                           |              |               |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|
| ID number: 1-16 | 0x21 | 0x02 | High byte of voltage value | Low byte of voltage value | CRC low byte | CRC high byte |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|

Device response:

|                 |      |      |                            |                           |              |               |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|
| ID number: 1-16 | 0x21 | 0x02 | High byte of voltage value | Low byte of voltage value | CRC low byte | CRC high byte |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|

## Set up Current: 0x22

Command:

|                 |      |      |                            |                           |              |               |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|
| ID number: 1-16 | 0x22 | 0x02 | High byte of current value | Low byte of current value | CRC low byte | CRC high byte |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|

Device response:

|                 |      |      |                            |                           |              |               |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|
| ID number: 1-16 | 0x22 | 0x02 | High byte of current value | Low byte of current value | CRC low byte | CRC high byte |
|-----------------|------|------|----------------------------|---------------------------|--------------|---------------|

## Voltage and Current Setup: 0x23

Command:

|                 |      |      |                             |                           |                            |                            |              |               |
|-----------------|------|------|-----------------------------|---------------------------|----------------------------|----------------------------|--------------|---------------|
| ID number: 1-16 | 0x23 | 0x04 | High byte for voltage value | Low byte of voltage value | High byte of current value | Low byte for current value | CRC low byte | CRC high byte |
|-----------------|------|------|-----------------------------|---------------------------|----------------------------|----------------------------|--------------|---------------|

Device response:

|                 |      |      |                             |                           |                            |                            |              |               |
|-----------------|------|------|-----------------------------|---------------------------|----------------------------|----------------------------|--------------|---------------|
| ID number: 1-16 | 0x23 | 0x04 | High byte for voltage value | Low byte of voltage value | High byte of current value | Low byte for current value | CRC low byte | CRC high byte |
|-----------------|------|------|-----------------------------|---------------------------|----------------------------|----------------------------|--------------|---------------|

## Read Voltage and Current Feedback Data: 0x26

Command:

|                 |      |      |              |  |  |  |               |  |
|-----------------|------|------|--------------|--|--|--|---------------|--|
| ID number: 1-16 | 0x26 | 0x00 | CRC low byte |  |  |  | CRC high byte |  |
|-----------------|------|------|--------------|--|--|--|---------------|--|

Device response:

|                 |      |      |                                |                              |                               |                               |              |               |
|-----------------|------|------|--------------------------------|------------------------------|-------------------------------|-------------------------------|--------------|---------------|
| ID number: 1-16 | 0x26 | 0x04 | High byte for voltage feedback | Low byte of voltage feedback | High byte of current feedback | Low byte for current feedback | CRC low byte | CRC high byte |
|-----------------|------|------|--------------------------------|------------------------------|-------------------------------|-------------------------------|--------------|---------------|

## Read Voltage and Current Feedback Data: 0x2a (including output status)

Command:

|                 |      |      |              |  |  |               |  |  |
|-----------------|------|------|--------------|--|--|---------------|--|--|
| ID number: 1-16 | 0x2a | 0x00 | CRC low byte |  |  | CRC high byte |  |  |
|-----------------|------|------|--------------|--|--|---------------|--|--|

Device response:

|                 |      |      |   |                               |                              |                               |                              |              |               |
|-----------------|------|------|---|-------------------------------|------------------------------|-------------------------------|------------------------------|--------------|---------------|
| ID number: 1-16 | 0x2a | 0x05 | Output status:<br>0x01: ON<br>0x00: OFF | High byte of voltage feedback | Low byte of voltage feedback | High byte of current feedback | Low byte of current feedback | CRC low byte | CRC high byte |
|-----------------|------|------|---|-------------------------------|------------------------------|-------------------------------|------------------------------|--------------|---------------|

## Read Maximum Voltage and Current: 0x27

Command:

|                 |      |      |              |               |
|-----------------|------|------|--------------|---------------|
| ID number: 1-16 | 0x27 | 0x00 | CRC low byte | CRC high byte |
|-----------------|------|------|--------------|---------------|

Device response:

|                 |      |      |                           |                          |  |                           |                          |  |              |               |
|-----------------|------|------|---------------------------|--------------------------|--|---------------------------|--------------------------|--|--------------|---------------|
| ID number: 1-16 | 0x27 | 0x06 | High byte of max. voltage | Low byte of min. voltage | Length of decimal point "n": all voltage data//10 <sup>n</sup> | High byte of max. current | Low byte of min. current | Length of decimal point "n": all current data//10 <sup>n</sup> | CRC low byte | CRC high byte |
|-----------------|------|------|---------------------------|--------------------------|--|---------------------------|--------------------------|--|--------------|---------------|

## Read Output Voltage & Current Setup Data: 0x28

Command:

|                 |      |      |              |               |
|-----------------|------|------|--------------|---------------|
| ID number: 1-16 | 0x28 | 0x00 | CRC low byte | CRC high byte |
|-----------------|------|------|--------------|---------------|

Device response:

|                 |      |      |   |                            |                           |                            |                           |              |               |
|-----------------|------|------|---|----------------------------|---------------------------|----------------------------|---------------------------|--------------|---------------|
| ID number: 1-16 | 0x28 | 0x05 | Output status:<br>0x01: ON<br>0x00: OFF | High byte of voltage value | Low byte of voltage value | High byte of current value | Low byte of current value | CRC low byte | CRC high byte |
|-----------------|------|------|---|----------------------------|---------------------------|----------------------------|---------------------------|--------------|---------------|

## Set ID Number: 0x29

Command:

|                 |      |      |                     |              |               |
|-----------------|------|------|---------------------|--------------|---------------|
| ID number: 0x00 | 0x29 | 0x01 | New ID number: 1-16 | CRC low byte | CRC high byte |
|-----------------|------|------|---------------------|--------------|---------------|

Device response:

|                 |      |      |                 |              |               |
|-----------------|------|------|-----------------|--------------|---------------|
| ID number: 1-16 | 0x29 | 0x01 | ID number: 1-16 | CRC low byte | CRC high byte |
|-----------------|------|------|-----------------|--------------|---------------|

## Reverse Output Polarity: 0x2b (optional)

### Command:

|                    |      |      |  |              |               |
|--------------------|------|------|--|--------------|---------------|
| ID number:<br>1-16 | 0x2b | 0x01 | Set direction:<br>0x00: disconnect<br>0x01: positive<br>0x02: negative | CRC low byte | CRC high byte |
|--------------------|------|------|--|--------------|---------------|

### Device response:

|                    |      |      |  |             |               |
|--------------------|------|------|--|-------------|---------------|
| ID number:<br>1-16 | 0x2b | 0x01 | Set direction:<br>0x00: disconnect<br>0x01: positive<br>0x02: negative | CRC low bit | CRC high byte |
|--------------------|------|------|--|-------------|---------------|