

PWS3.x (SCR Based) / HS-PWS (IGBT Based) Eddy Current Power Supply with Current Control



Contents

SportDevices End User License & Warranty Disclaimer.....	2
General Safety Instructions.....	3
SAFETY: When Working Inside Your Device.....	4
SAFETY: General Power Safety.....	4
SAFETY: If Your Device Gets Wet.....	4
SAFETY: If You Drop or Damage Your Equipment.....	5
Protecting Against Electrostatic Discharge.....	5
Technical Specs.....	6
Connections for Brake Power Supply PWS3.1 (GEN 3) (FW1.11).....	7
Configuration Procedure.....	7
Connections for Brake Power Supply PWS3.2 (GEN 3).....	8
Configuration Procedure.....	8
HS-PWS High Speed Power Supply (IGBT @ 1KHz).....	9
Jumpers for HS-PWS.....	9

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This Product License Warranty Disclaimer supersedes all prior warranty statements. Inquiries concerning this Product Warranty Disclaimer should be directed to:

SportDevices

Cami del Port 145, 46470 Catarroja, Spain

General Safety Instructions

Use the following safety guidelines to help ensure your own personal safety and to help protect your equipment and working environment from potential damage.

SAFETY: General Safety

When setting up the equipment for use:

- Place the equipment on a hard, level surface. If the equipment is installed in a closed-in wall unit, ensure that there is enough ventilation.
- Avoid placing objects on top of this equipment to permit the airflow required for proper ventilation. Restricting airflow can damage the equipment.
- Keep your device away from radiators and heat sources.
- Keep your equipment away from extremely hot or cold temperatures to ensure that it is used within the specified operating range. (check technical parameters section)
- Keep your equipment away from Electromagnetic emitting devices like CDI ignition, or electric motors / VFD (Variable Frequency Drive)
- Do not push any objects into the air vents or openings of your equipment. Doing so can cause fire or electric shock by shorting out interior components.
- Ensure that nothing rests on your equipment's cables and that the cables are not located where they can be stepped on or tripped over.

When operating your equipment:

- Do not use your equipment in a wet environment, for example, in a wet basement.
- Do not use AC powered equipment during an electrical storm.
- Do not spill food or liquids on your equipment.
- Before you clean your equipment, disconnect it from the electrical outlet. Clean your device with a soft cloth dampened with water. Do not use liquids or aerosol cleaners, which may contain flammable substances.
- Clean the display with a soft, clean cloth and water. Apply the water to the cloth, then stroke the cloth across the display in one direction, moving from the top of the display to the bottom. Remove moisture from the display quickly and keep the display dry.
- Long-term exposure to moisture can damage the display. Do not use a commercial window cleaner to clean your display.



CAUTION: Do not operate your equipment with any cover(s) removed.

- If your equipment does not operate normally - in particular, if there are any unusual sounds or smells coming from it - unplug it immediately and contact an authorized dealer or service center.



WARNING: To prevent the spread of fire, keep open flames away from this product at all times.

SAFETY: When Working Inside Your Device

Do not attempt to service the equipment yourself, except as explained in your documentation or in instructions otherwise provided to you by SportDevices. Always follow installation and service instructions closely.

The only user configurable parts in this device are: jumpers and wiring.

All parts in this equipment are powered to grid, even the low voltage parts as LCD, switches, jumpers, BT dongle (when present), etc, are directly connected to grid. Do not touch any of the electrical parts unless the circuit breaker is OFF.

SAFETY: General Power Safety



By default, if other values are not specified, all SportDevices equipment are rated for **230 VAC / 50 Hz**. (115 VAC units will have a specific label for that)



All parts in this equipment are powered to grid, even the low voltage parts as LCD, switches, jumpers, BT dongle (when present), etc, are directly connected to grid. Do not touch any of the electrical parts unless **the circuit breaker is OFF**.

Observe the following guidelines when connecting your equipment to a power source:

- Check the voltage rating before you connect the equipment to the grid to ensure that the required voltage and frequency match the available power source.
- This equipment is designed to have a permanent installation to the grid through a circuit breaker.
- Ensure both power lines (L and N) are correctly connected to the 230 V input connector, and ground cables are correctly connected to ground screws.
- Connection can also be made through a power cord, but ensure the power cord rating is suitable for the brake application (typically 16 Amp or higher), and ground is correctly connected from the equipment to building Ground.

SAFETY: If Your Device Gets Wet



CAUTION: Before you begin any of the procedures in this section, see the **SAFETY: General Safety** section of this document.



CAUTION: Perform this procedure only after you are certain that it is safe to do so. If the device is connected to an electrical outlet, turn off the AC power at the circuit breaker, if possible, before attempting to remove the power cables from the electrical outlet. Use the utmost caution when removing wet cables from a live power source.

1. Disconnect the AC cord from the electrical outlet, and then, if possible, disconnect the AC cord from the device.
2. Turn off any attached external devices, then disconnect them from their power sources, and then from the device.
3. Contact SportDevices support (info@sportdevices.com)

⚠ **Limited Warranties:** warranty is limited to normal usage of the device, any fault caused by inappropriate usage or accident will not be covered

SAFETY: If You Drop or Damage Your Equipment

⚠ **CAUTION:** Before you begin any of the procedures in this section, see the **SAFETY: General Safety and Power Safety** sections of this document.

4. **CAUTION:** If any internal components can be seen through damaged portions, or if smoke or unusual odors are detected, disconnect the device from the electrical outlet and contact SportDevices support (info@sportdevices.com)

1. Save and close any open files, exit any open programs, and shut down the computer.
2. Turn off the device and disconnect from the power source, and then disconnect from the computer.
3. Turn off any attached external devices, and disconnect them from their power sources and then from the computer.
4. Connect the device to the power source and turn on the device.
5. If the device does not start, or if and smoke or unusual odors are detected, or you cannot identify the damaged components, contact SportDevices support.

Protecting Against Electrostatic Discharge

⚠ **CAUTION:** Disconnect product from mains power source in accordance with product specific safety information located on the “Safety Information” section of this website.

Electrostatic discharge (ESD) events can harm electronic components inside your device. Under certain conditions, ESD may build up on your body or an object, such as a peripheral, and then discharge into another object, such as your device. To prevent ESD damage, you should discharge static electricity from your body before you interact with any of your device’s internal electronic components, like the Bluetooth plug-in.

You can protect against ESD and discharge static electricity from your body by touching a metal grounded object (such as an unpainted metal surface on your device) before you interact with anything electronic.

You can also take the following steps to prevent damage from electrostatic discharge:

- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component. Just before unwrapping the antistatic package, be sure to discharge static electricity from your body.
- When transporting a sensitive component, first place it in an antistatic container or packaging.
- Handle all electrostatic sensitive components in a static-safe area. If possible, use antistatic floor pads and work bench pads.

Technical Specs

Input:

- Supply Voltage 230 Vac / 50-60 Hz. Single phase. **For PWS3.x: Max one Power Supply per phase, use different phases for AWD operation.**
- Power Consumption: 16 Amp brake: max 3.2 KW, 23 Amp brake: max 4.6 KW

Output:

- **Max Brake Voltage:** 200 VDC, 100 VDC, 70 VDC, 50 VDC
- **Max Brake Current:** 23A, 20A, 16A, 12A, 9A, 7A

PWS3.x

- Modulation Method: Phase Angle Control (SCRs) @ 100 Hz
- Inductive Load Control: Flywheel diode (passive discharge)

HS-PWS

- Modulation Method: PWM (IGBTs) @ 1000 Hz
- Inductive Load Control: Flywheel diode (passive discharge)

HS-PWS-Discharge

- Modulation Method: PWM (partial H-bridge topology) @ 1000 Hz
- Inductive Load Control: Regenerative discharge (-200VDC) + Overvoltage Control

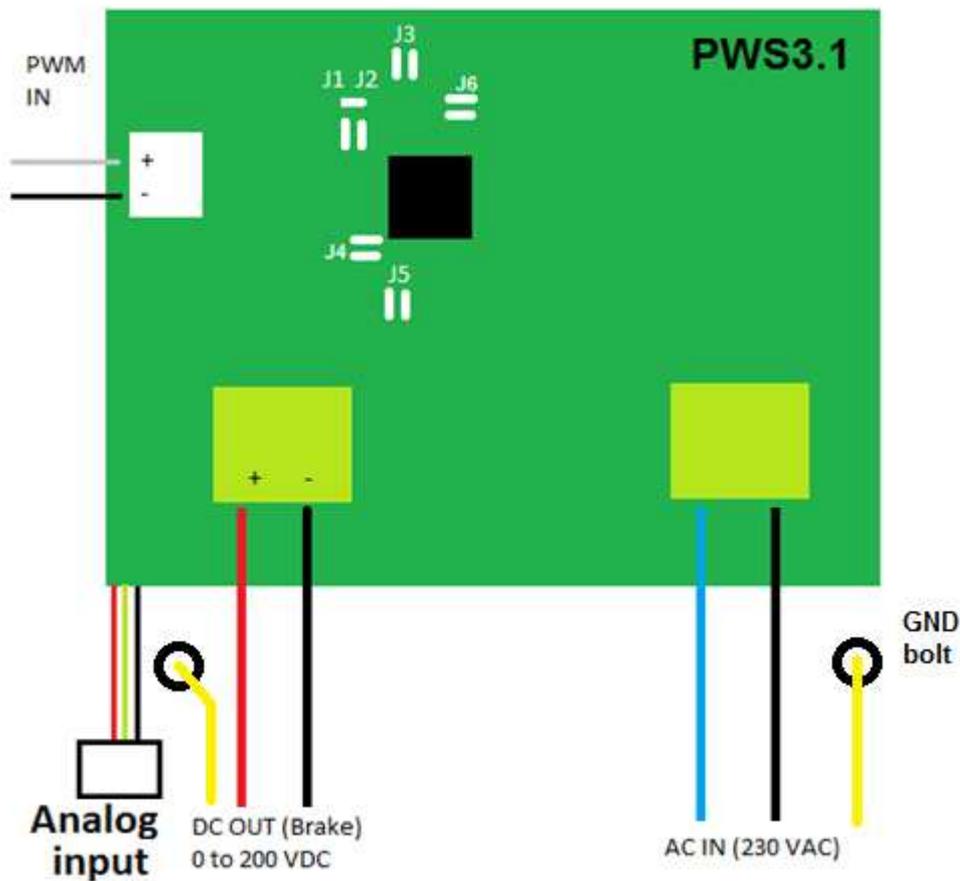
Control lines:

- **PWM input:** PWM 0 to 5 Volt, 2.4 Khz. ISOLATED:
 - + Brake output (SP4/SP5)
 - - GND
- **Analog input (* optional):** 0 to 5 Volt. ISOLATED:
3 pin connector
 - Pin 1: GND
 - Pin 2: Analog in
 - PIN 3: 5V (low current for potentiometer)

Other:

- Working Conditions: Temperature: -10°C to 40°C, humidity < 90%
- Storage Conditions: Temperature: -20°C to 80°C, humidity < 80%
- Current Control: P.I. regulator (Proportional Integral)

Connections for Brake Power Supply PWS3.1 (GEN 3) (FW1.11)



Configuration Procedure

- Disconnect PWS3.1 from grid
- Remove Plastic box screws (4)
- Remove LCD display nuts and washers (2 + 2), and then LCD Display
- Locate solder Jumpers (J1 to J5)

Voltage	J1 (half)	J2 (half)	Current)	J3	J4	J5
200 VDC	OFF	OFF	29 Amp (not available)	OFF	OFF	OFF
100 VDC	ON	OFF	23 Amp	ON	OFF	OFF
70 VDC	OFF	ON	20 Amp	OFF	ON	OFF
50 VDC	ON	ON	16 Amp	ON	ON	OFF
			12 Amp	OFF	OFF	ON
			9 Amp	ON	OFF	ON
			7 Amp	OFF	ON	ON
			4 Amp*	ON	ON	ON

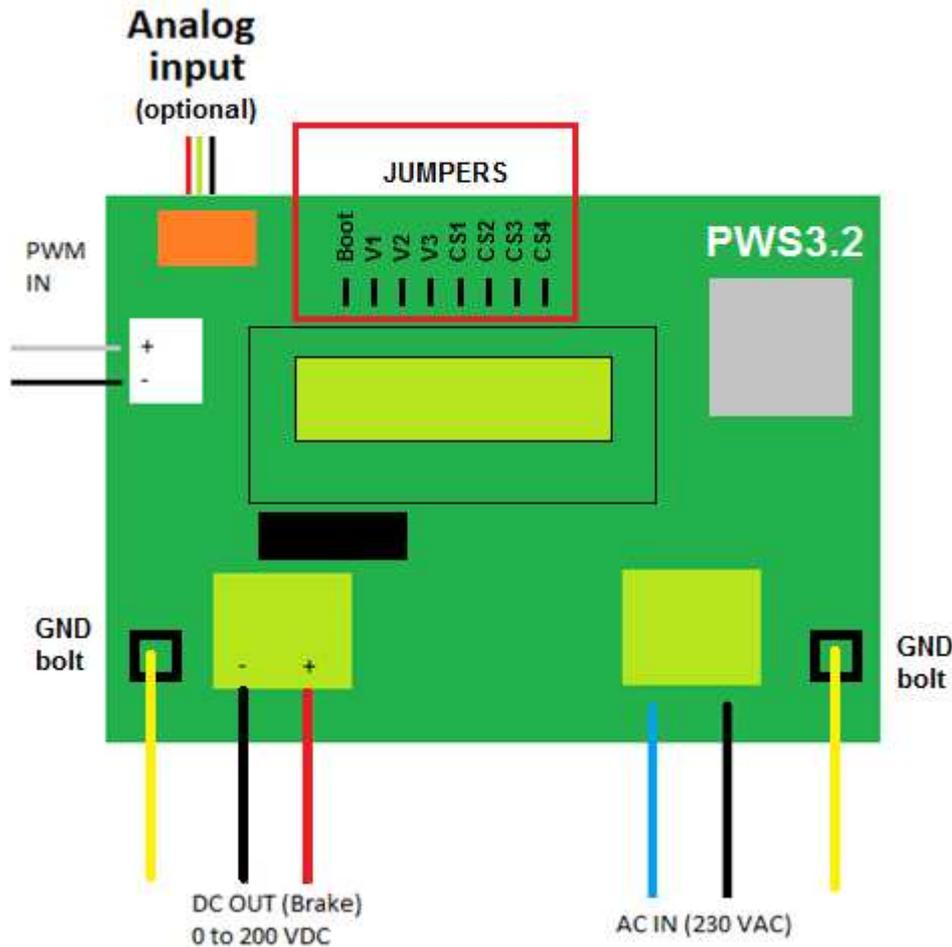
Note 1: jumpers are ON by placing a solder drop, and OFF when empty

Note 2: Table valid for FW version 1.11+

Note 3: *4 Amp only valid for special HW configuration (1 shunt instead 2 shunts)

- Assemble PWS3.1 again and Power It up, the starting message will show the current configuration (50, 70, 100, 200 V and selected current)

Connections for Brake Power Supply PWS3.2 (GEN 3)



Configuration Procedure

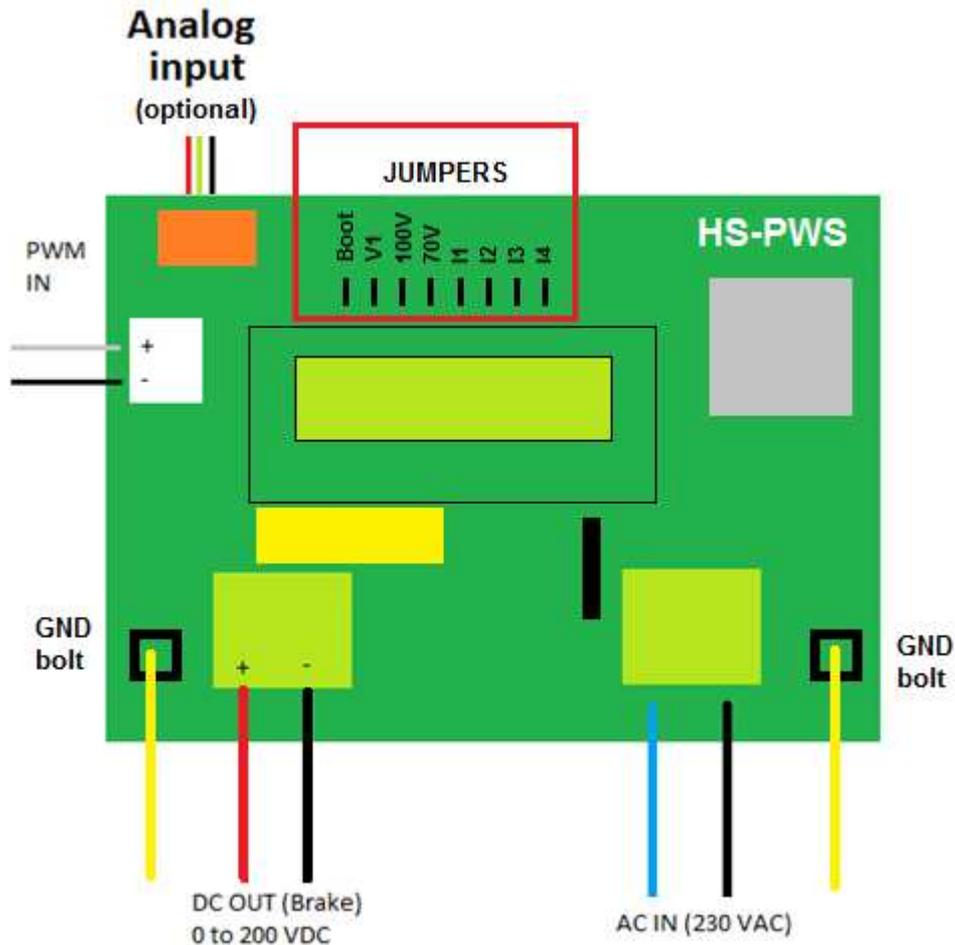
- Disconnect PWS3.2 from grid
- Remove Plastic box screws (4)
- Locate jumpers and set / remove jumpers according to this table:

Voltage	VS1	VS2	VS3	Current)	CS1	CS2	CS3	CS4
200 VDC	-	OFF	OFF	29 Amp (not available)	OFF	OFF	OFF	-
100 VDC	-	ON	OFF	23 Amp	ON	OFF	OFF	-
70 VDC	-	OFF	ON	20 Amp	OFF	ON	OFF	-
50 VDC	-	ON	ON	16 Amp	ON	ON	OFF	-
				12 Amp	OFF	OFF	ON	-
				9 Amp	ON	OFF	ON	-
				7 Amp	OFF	ON	ON	-
				4 Amp*	ON	ON	ON	-

Note 1: jumpers are ON by placing the jumper between pins, and OFF when is not set

- Assemble PWS3.2 again and Power It up, the starting message will show the current configuration (50, 70, 100, 200 V and selected current)

HS-PWS High Speed Power Supply (IGBT @ 1KHz)



HS-

PWS rectifies AC on a DC bus, and then DC is applied through an IGBT transistor to the eddy current brake changing duty cycle (PWM) at 1000 Hz which provides a slightly faster control than PWS3.x and less ripple on the current output.

Jumpers for HS-PWS

Voltage	"100V"	"70V"	Current)	I1	I2	I3
200 VDC	OFF	OFF	29 Amp	OFF	OFF	OFF
100 VDC	ON	OFF	23 Amp	ON	OFF	OFF
70 VDC	OFF	ON	21 Amp	OFF	ON	OFF
50 VDC	ON	ON	16 Amp	ON	ON	OFF
			12 Amp	OFF	OFF	ON
			8 Amp	ON	OFF	ON
			6 Amp	OFF	ON	ON
			4 Amp	ON	ON	ON

Notes: Table valid for FW version 1.05

Differences between PWS3.x and HS-PWS power supplies

Due to the high inductance of eddy current brakes, power supply provides a control based on current (higher voltages during transients). **Nevertheless, the first transient (say from 0A to 10A) is always slow as it is limited by the brake (up to 500 ms)**

Most power supplies feed the brake directly from grid using SCRs (thyristors) which actively rectify AC on DC for the brake. This topology has several advantages: robustness, simplicity, constant load on the AC grid (no current peaks). On the other hand, SCRs need to be synchronized with the grid frequency, this limits the control frequency to 100 Hz, this makes control performance slightly poorer than HS-PWS.

In HS-PWS, AC is rectified to DC and then it is applied to the brake using an IGBT transistor (PWM). Our HS-PWS operates at 1000 Hz to minimize interferences. This provides a faster control than PWS3.x

HS-PWS has several advantages: More linear output, low ripple current, more accurate and faster control on transients. On the other hand HW-PWS has the following disadvantages: more heat dissipation, more electric interferences on the load cell, audible operation.

To summarize: all power supplies have an initial delay caused by the brake, but HS-PWS provides more accurate control during small transients and clean current. Nevertheless, due to the lower interferences, PWS3.x are being improved to be able **replace HS-PWS**.

What is HS-PWS-D (discharge)? **[PROTOTYPE]** Power supplies can charge the brake fastly, but when the discharge is required they passively discharge the brake through a flywheel diode. Although discharge is fast from 100% to about 20% of brake range, **when 20% is reached discharge becomes extremely slow (up to 5 seconds)**. HS-PWS-D is able to regenerate the stored energy and dissipate the voltage excess using resistors. This consumes the brake energy very fast and provides an accurate control on brake de-energizing process.

When is this useful? Actually, for most dynamometers this is almost NOT noticeable as they normally operate in the recommended region (approx 20% to 80%) and especially on roller dynos, whose inertia minimizes the effect of the remaining brake torque. But for dynamometers with big brakes and small engines and lightweight inertia, it can make a difference as the brake can operate in the 0% to 20% range and remove the remaining torque very fast.

	PWS3.x	HS-PWS	HS-PWS-D (discharge)
Modulation Method	SCRs (synchronized with grid frequency)	IGBT with DC bus	IGBT, partial H-bridge
Control Frequency	100 Hz (Europe)	1000 Hz	1000 Hz
Voltage control	Not linear (AC input)	Linear	Linear
Inductive Load Control	Flywheel diode (passive discharge)	Flywheel diode (passive discharge)	Regenerative discharge + Overvoltage Control
Interferences Emission	Low (100 Hz rectified)	Medium (1000 Hz square wave)	Medium (1000 Hz square wave)