

# Control Box - manual

## 1 Front panel

The Control box converts low-power control signals from the PCI DIO-24 parallel output card in the PC into high power signals. On the front panel, several groups of controls can be found :

- **Power** – turns the device On and Off
- **Ground Switch** – switches grounds to enable electrophysiological recordings in paradigms using shock
- **Arena Motor control** – controls the rotation of the DC motor in the Rotating Arena
- **Animal LED brightness adjustment** – adjusts the brightness of the LED on the subject (if it is used)
- **Noise Generator** – provides a white noise signal for an optional loudspeaker



Figure 1 : Control Box – front view

Let's talk about each part in more detail.

### 1.1 Ground Switch

When recording electrophysiological signals during behaviours that use shock as a stimulus, one can use two electrical grounds. One ground is from the Current Source used to shock the subject. The second ground is supplied by the user and can be for example the ground of the buffering and/or main amplifiers.

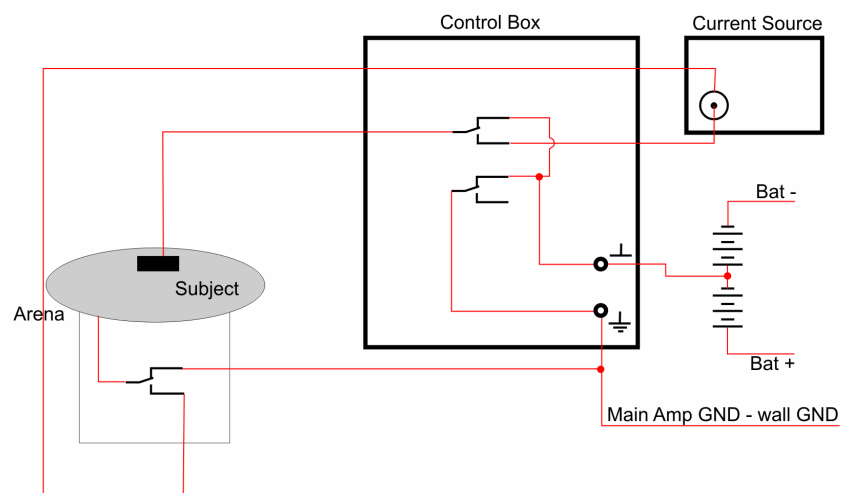


Figure 2 : Ground switch

The reason for the two grounds is that for shocking the current should pass from the shock electrode through the subject to ground at the contact of the paws. If there is another ground (e.g. through the buffering amplifiers), current will flow to ground bypassing the high impedance path through the paws. The main voltage drop across these low impedance contacts will be rather small, so the subject will not feel the shock and more importantly neural tissue and possibly the recording electronics will be damaged.

Activating the PC Ground switch control at the Control Box causes a relay switch to toggle between the two grounds. When the shock is enabled, the Current Source ground is connected to the Arena. When the shock is off, the user supply ground is connected to the Arena. By connecting the preamplifier ground to the metal arena, the arena acts as a shield for the electromagnetic noise generated by the DC motor.

The Ground Switch can be activated by the **PC Ground Switch Control**. In this case, relays are controlled by the computer, when the Ground Switch is off, relays connect the user supply grounds and the arena.

**Note** : optional grounding of the shocking cable ("live" wire coming from the Current Source) can be disabled by the switch inside the Control Box. See chapter **3.2** for more details.

## 1.2 Arena Motor

When the control signals for Arena motor are present, the status LED is active. The **Error** LED signals that too large current flows to the DC motor. This can happen when the Arena is blocked from rotation and the motor is stopped by the force. To prevent overheating the motor, control mechanism is activated, which temporarily stops delivery of current to the motor. Two other LEDs **CW** and **CCW** identify the direction of the Arena rotation.

## 1.3 Arena LED brightness

There are two possible sources for powering the Subject LED, which can be used for tracking – internal power supply or external batteries. Using an external battery can reduce ambient electromagnetic noise in electrophysiological recordings. Those options can be selected by the **LED power source** switch. For each mode, a separate amplitude adjustment knob is provided. The status LED is connected in series with the Subject LED, so it is active only when the Subject LED is active.

## 1.4 Noise Generator

The white noise generator can be used to mask environmental sounds, which can be potentially used by the subject for orienting. You may turn on and off the generator by the switch. You may also increase and decrease the volume by the adjustment knob. The status LED indicates the generator is active.

## 1.5 Ext. Battery

An External battery or isolated power supply is usually used to power buffering amplifiers for electrophysiological recordings. In this case, it is advantages to power the subject LED from this source. You should also connect the battery common ground to the Ground Switch.

# 2 Control Box connections

On the back, several connectors are provided to connect the Control Box with the PC and external devices.

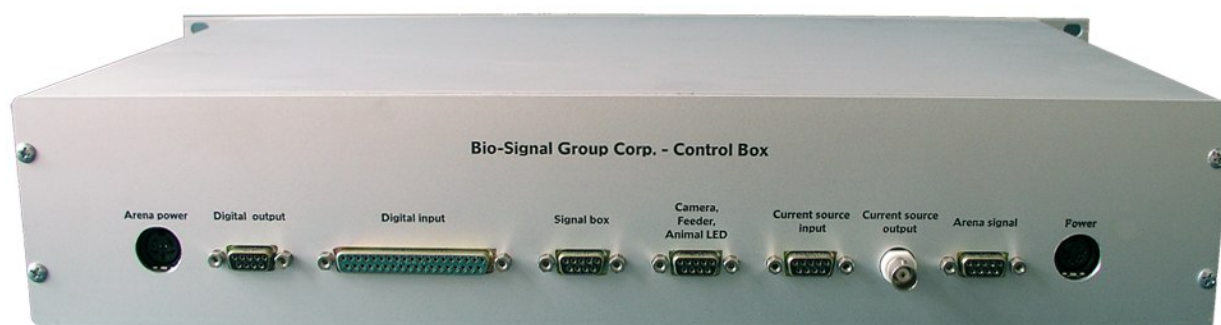


Figure 3 : Control Box – back view

## 2.1 Arena Power

Provides a high power connection for the Bio-Signal Group Rotating Arena.

Pin	Assignment
2,5	Motor GND
1,3	Motor +12V
4	Repro +
6	Repro -

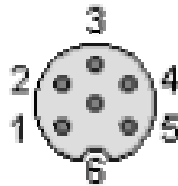


Figure 4 : Arena Power DIN 6 connector

## 2.2 Digital Output

Provides 8 bits for the optional control of the external devices ( port A on the DIO-24 card).

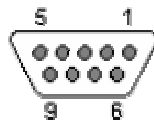


Figure 5 : Digital Output connector

Pin	Assignment
1	A, bit 7
2	A, bit 6
3	A, bit 5
4	A, bit 4
5	A, bit 3
6	A, bit 2
7	A, bit 1
8	A, bit 0
9	GND

## 2.3 Digital Input

Connects the PC's DIO-24 card and the Control Box.

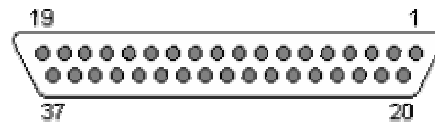


Figure 5 : Digital Input connector

1	External Interrupt
2	External Interrupt Enable (active low)
3	B, bit 3 MOTOR
4	B, bit 2 MOTOR
5	B, bit 1 MOTOR
6	B, bit 0 MOTOR L/R
7	B, bit 3 Optional
8	B, bit 2 Optional
9	B, bit 1 Optional
10	B, bit 0 Optional
11	Ground GND SW
12	-5V
13	Ground FEEDER
14	-12V
15	Ground MOTOR
16	+12V
17	Ground
18	+5V
19	Ground DIGITAL OUT
20	+5V
21	Ground SIGNAL BOX
22	C, bit 7 SYNC
23	C, bit 6 Signal Box
24	C, bit 5 Signal Box
25	C, bit 4 Signal Box
26	C, bit 3 FEEDER
27	C, bit 2 SHOCK
28	C, bit 1 SHOCK
29	C, bit 0 SHOCK
30	A, bit 7 DIGITAL OUT
31	A, bit 6 DIGITAL OUT
32	A, bit 5 DIGITAL OUT
33	A, bit 4 DIGITAL OUT
34	A, bit 3 DIGITAL OUT
35	A, bit 2 DIGITAL OUT
36	A, bit 1 DIGITAL OUT
37	A, bit 0 DIGITAL OUT

## 2.4 Signal Box

Provides optional 3 bits for controlling external devices (pins 1, 2, 3, 9), extracts even/odd field pulses from any video signal connected, gates the even/odd signal when the experiment starts and provides external +12V power for the optional video splitter.

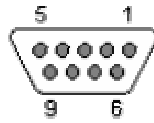


Figure 6 : Signal Box connector

Pin	Assignment	Description
1	Signal Box bit 4	Optional Control Signal bit 0
2	Signal Box bit 5	Optional Control Signal bit 1
3	Signal Box bit 6	Optional Control Signal bit 2
4	Sync	Active high when experiment starts
5	Video input	Video input signal for separating even/odd field signal
6	even/odd signal ENABLED	Even/Odd video signal enabled by the experiment start
7	+ 12V video splitter	+12V power for the optional video splitter
8	GND video splitter	GND for the optional video splitter
9	Signal Box GND	Optional Control Signal GND

## 2.5 Camera, Feeder, Animal LED

Provides power for the analog camera, optional Feeder, subject LED; TTL control signal for triggering the Feeder and connects the “live” Current Source wire to the subject to deliver the shock.

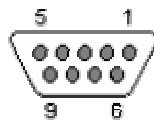


Figure 7 : Camera, Feeder, Animal LED connector

Pin	Assignment
1	+12V Feeder Power
2	+12V Camera Power
3	Subject LED + 12 V
4	GND Feeder Power
5	Current Source Shock
6	Feeder Data
7	Feeder Data GND
8	GND Camera Power
9	Subject LED GND

## 2.6 Current Source Input

Provides 3bit TTL parallel control signal for the Current Source.

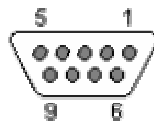


Figure 8 : Current Source Input connector

Pin	Assignment
1	Current Source BIT 0
2	Current Source BIT 1
3	Current Source BIT 2
9	Current Source GND

## 2.7 Current Source Output

Connects the Current Source output (Shock) to the Control Box, so it can be then separated and redistributed (“live” wire goes through the “Camera, Feeder, Animal LED” connector to the Subject and Current Source ground is connected to the Rotating Arena plate.

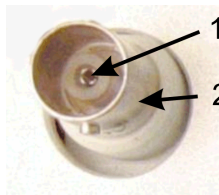


Figure 9 : Current Source Output connector

Pin	Assignment
1	Current Source SHOCK
2	Current Source GND

## 2.8 Arena Signal

Provides a low power signal for the Bio-Signal Group Rotating Arena – signal for switching the Arena Relay (switches between Current Source and Main Amplifier Ground), Arena LED and Current Source LED.

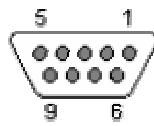


Figure 10 : Arena Signal connector

Pin	Assignment
1	Arena Relay
2	Arena Relay
3	Arena LED +
4	ARENA LED GND
5	Current Source GND
6	Optional
7	Optional
8	Optional
9	Optional

## 2.9 Power

Main Control Box power supply input for 12V / 11 A desktop power supply.



Figure 11 : Power connector

Pin	Assignment
1,2,4	GND
3,5	+12V

## 3 Internal adjustments

Some of the Control box functions can be adjusted inside the Control Box. Those functions are :

- Setting the rotation speed for the Rotating Arena
- Grounding of the “live” wire used for the shock delivery

### 3.1 Setting the rotation speed

Rotation speed of the Rotating Arena may be adjusted by 7 potentiometers inside the Control Box. Those potentiometers are marked R4-R10. Speed may be adjusted from 0 to approx 2.75 rpm. Following table shows recommended speed values for each motor level step (iTrack) with corresponding potentiometer.

Relative Motor Speed	Potentiometer	Recommended Speed (rpm)
0	-	0
1	R10	0.5
2	R9	0.75
3	R8	1
4	R7	1.5
5	R6	2
6	R5	2.5
7	R4	2.75

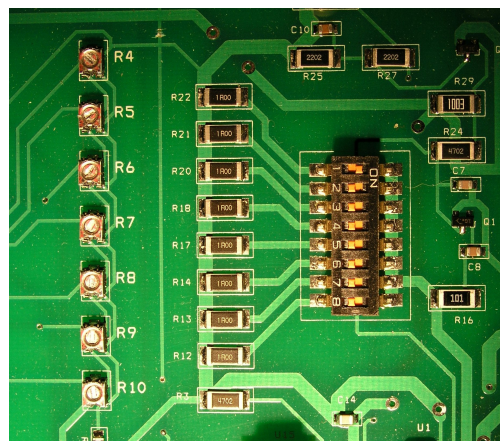


Figure 12 : Speed adjustment

### 3.2 Grounding the shocking cable



The wire, which is used for shocking the subject can be potentially grounded (when the shock is not delivered) to minimize noise in the electrophysiological recording. Move the switch in the upper position (ON) to ground the cable.

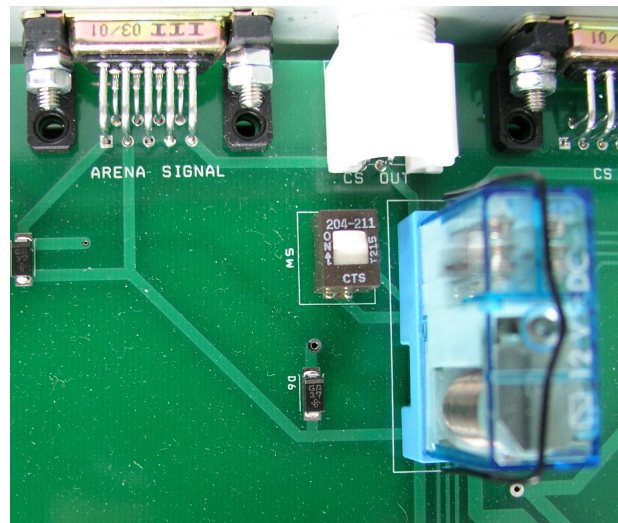


Figure 13 : grounding of the shocking wire