



Dancer Design
INNOVATION IN ELECTRONICS

Room 66, The I Centre, Back Gate, Ingleton, N. Yorks., LA6 3BT, UK
Tel: +44 7743 089056 Email: chris@dancerdesign.co.uk Web: www.dancerdesign.co.uk

Dancer Design Mini-PTS Description and User Instructions

IMPORTANT! Please read before unpacking the system...

The Mini-PTS stimulators are very delicate devices. The piezo bender element is sensitive to shocks and can easily be damaged by dropping it onto a hard surface. The casing is made of ceramic and should be handled carefully and secured in place when it is in use.

Sudden application or sudden removal of power to the stimulator device can cause excessive strain which can permanently damage the piezo bender. Because of this ***the cables between the amplifier and the stimulators should never be connected or disconnected with the amplifier switched on.*** This applies to the 12-way connectors on the back of the amplifier as well as the connectors on the filter, the head box and the stimulators themselves.

Once the stimulators are in position for the experiment the stimulator leads should be secured so that they do not trail and pull on the connector, and so that the chances of them being accidentally pulled out are minimised.

Power is applied to the stimulators even when they are not being driven with a signal. Therefore, if a stimulator or lead becomes damaged stop using it immediately.

The head box and stimulators are the only parts of the system that may be used close to the bore of an MRI scanner. The stimulators are safe for use in MRI scanners up to 7T.



System Overview

The Mini PTS system consists of a multi-channel amplifier (with 2, 5 or 10 channels), a power supply for the amplifier, a passive radio frequency filter, a headbox, and a number of stimulator devices.

The stimulators and headbox are MRI safe, ***the control unit and power supply are not.*** The filter is safe for use in the MRI scanner room but contains some small ferrous parts so should not be allowed close to the magnet. Normally it will be fitted into the penetration panel (see below).

Amplifier

The amplifier contains a bias voltage generator and a number of amplifier channels for driving the stimulators.

Level controls on the front panel allow manual adjustment of the stimulus intensity. The presence of signals going to the amplifiers is indicated by the yellow LEDs on the front panel.

The amplifier has analog voltage inputs, one per channel. Connection to these is made via BNC sockets on the rear panel. In addition a 15-way D-connector on the rear of the 10-way amplifier allows 10 analog inputs to be connected without using the BNC sockets. This is typically used in conjunction with a National Instruments NI9264 analog output card.

The recommended voltage to achieve maximum output at maximum setting of the front panel knob is 1V, or 2V peak-peak. This allows most sound cards to drive the amplifier. Only low voltage analog signals should be connected to the inputs.

Frequency range of the input signals is from 1Hz to 500Hz, but signals outside this range will not be harmful.

Use of Filter Unit

The RF filter is a feed-through capacitive filter. It is mainly intended to reduce the chances of noise from the amplifier electronics and other devices in the control room being conducted into the scanner room and causing interference which may result in image artifacts.

Ideally it should be securely bolted into the penetration panel of the MRI room, ensuring that the socket on the filter faces the scanner room and the plug faces the control room. Alternatively the filter may be used "free" with the cable passing through a waveguide in the penetration panel. If this is done the filter should be kept as close as possible to the penetration panel and the case of the filter should be electrically connected to the metal of the panel. The ideal way to do this is with a "jump lead" for vehicle batteries.

Setting Up Procedure (for fMRI)

- Connect the audio cables between the sound card or other signal source and the rear of the control unit. Normally sound card use stereo 3.5mm jack sockets. A suitable cable for connecting two channels is a 3.5mm stereo plug to two RCA phono plugs, fitted with two phono-to-BNC adapters.
- Connect the power supply to an outlet in the control room and connect its output cable to the power in socket on the back of the amplifier. Ensure that the amplifier is

- switched off and all level controls are set to zero.
- Connect the amplifier output (labelled "Stimulators") to the input of the filter via the short 12-way lead.
 - Connect the head box cable to the filter output.
 - Position the subject on the scanner bed.
 - Unpack the stimulators and position them appropriately on the subject. This can be done while the subject is still outside the scanner bore. Connect the stimulator leads to the stimulators and secure them to the subject or bed by means of clips, velcro, etc.
 - Connect the stimulator leads to the head box.
 - Slide the subject into the scanner bore, ensuring that the stimulator leads do not catch on anything.
 - Switch on the amplifier and check that the LED on the head box is lit.
 - Set the level controls to the desired setting (which should have been determined by experimentation beforehand).

The system should now be set up to deliver stimuli.

Packing-up is the reverse of this procedure, noting that ***the amplifier should be switched off before any parts are disconnected.***

Stimulators

Stimulators should be kept in the case supplied when not in use.

The small rectangular connector on the end of the stimulator cable fits into the hole in the base of the stimulator. It can only be inserted one way. When removing this connector take care not to pull or bend the cable.

To prevent damage to the piezo bender element avoid doing the following:

- Applying excessive force
- Dropping it onto a hard surface
- Driving it to excessive displacements causing the probe to hit the inner surface of the case. This is especially important when using it close to the resonant frequency ~180Hz.
- Connecting or disconnecting the stimulator while power is applied to the cable. If a headbox is used this also applies to the multipole connector (see below).

The mechanical load created by the skin will restrict the motion of the probe significantly, so a drive voltage which creates a displacement which is safe for the stimulator when it is contacting the skin may cause it to be damaged when it is in free air.

Ensure that the cables to the stimulator are not in a position where they may be pulled out accidentally. Using a bean-bag or velcro straps to hold the cables in place on the scanner bed or patient is a good idea. Using tape is not advisable because the process of pulling it off may damage the cable.

Stimulators may be cleaned with alcohol wipes.

The probe can be removed for cleaning using the tools provided. Use one tool to hold the rear brass washer still while you use the other to rotate the aluminium probe anti-clockwise. This should be done very carefully without stressing the bender element and preferably with the stimulator casing held in place. A foam block with a slot in it is ideal for holding the case vertical while removing or refitting the probe.

Refitting is the opposite of this procedure, taking care not to over-tighten the parts.

For stimulation of the fingers stimulators may be attached to a block or flat surface with adhesive velcro, or using the rubber strips provided (see separate document detailing this).

Specifications

Stimulator properties

Stimulator case: 68 x 20 x 5mm

Probe diameter: 6mm

Probe aperture diameter: 8mm

Weight (without cable): 13.3g

Case material: Machined ceramic (Macor)

Probe material: Aluminium

Other materials: Titanium (screws), brass, piezoceramic, resin bonded glass fibre, copper, epoxy resin, polystyrene, RTV silicone, traces of gold and nickel.

Standard connecting cable length: 1.5m

Useful frequency range: ~1Hz to 400Hz (amplitude rolls off above 180Hz)

Power supply

Medically isolated to IEC 60601

Output: 12V DC @ 2A (2 channel) / 3A (5 channel) / 4A (10 channel)

Input: 110 – 240V AC 50 / 60Hz

Amplifier

Input voltage for maximum displacement: 2V pk-pk

Input impedance: ~10k

Output impedance: 220 ohms

Channel gain: 30

Bias voltages for stimulators: +/-30V

All information correct at date of publication – 29/11/2022