

MASTER Portable Amplifier System

- MPAS -

Hardware Documentation

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Overview

The MASTER portable amplifier system (MPAS) is a battery-powered portable audiometric assessment system. The stimuli are provided by two amplified PC-generated audio signals, presented via a set of headphones or ear inserts. A subject's EEG is recorded, filtered, and digitized in hardware, and analyzed by MASTER software. This system makes use of a National Instruments PCI or PCMCIA digital acquisition and control card, which interfaces with a laptop or desktop personal computer.

The MPAS comes with a two-year warranty on parts and labor. We will perform any required maintenance for free and pay for shipping to the customer. The warranty does not cover battery performance and battery life, which may vary, based upon usage and charging routines chosen by the user. The warranty covers normal usage and does not cover damage that results from physical negligence (e.g., accidentally dropping the MPAS on the ground.) The MPAS can be returned for a refund within the first 60 days of shipping (10% restocking charge). After 60 days, all sales are final.

The MPAS is for research purposes only. We have compared its performance to other commercially available EEG and audio amplifier systems and have found its performance to be comparable. The system is sold "as is," in its current form. Any parts and labor associated with future upgrades of the MPAS will not be provided free of charge, unless by special exception. The MPAS should not be considered a clinical instrument. We take no responsibility for any use, misuse, or clinical uses of the MPAS system; nor for any quality of data, results, or for ensuring that the MPAS is being used in a correct manner. We make no claim or guarantee that the MASTER software can be used to accurately assess hearing function or hearing impairment. While we have built the MPAS to be in accordance (and surpass) generally accepted safety guidelines for medical instruments, and each unit is certified by the Canadian Standards Association as a Medical device, the MASTER software for the MPAS is not FDA approved (only the Biologic System Corp MASTER is FDA approved). The MPAS is only for use with a laptop computer. The MPAS does not include laptop, earphones, EEG electrodes, etc., unless this has been arranged by special order.

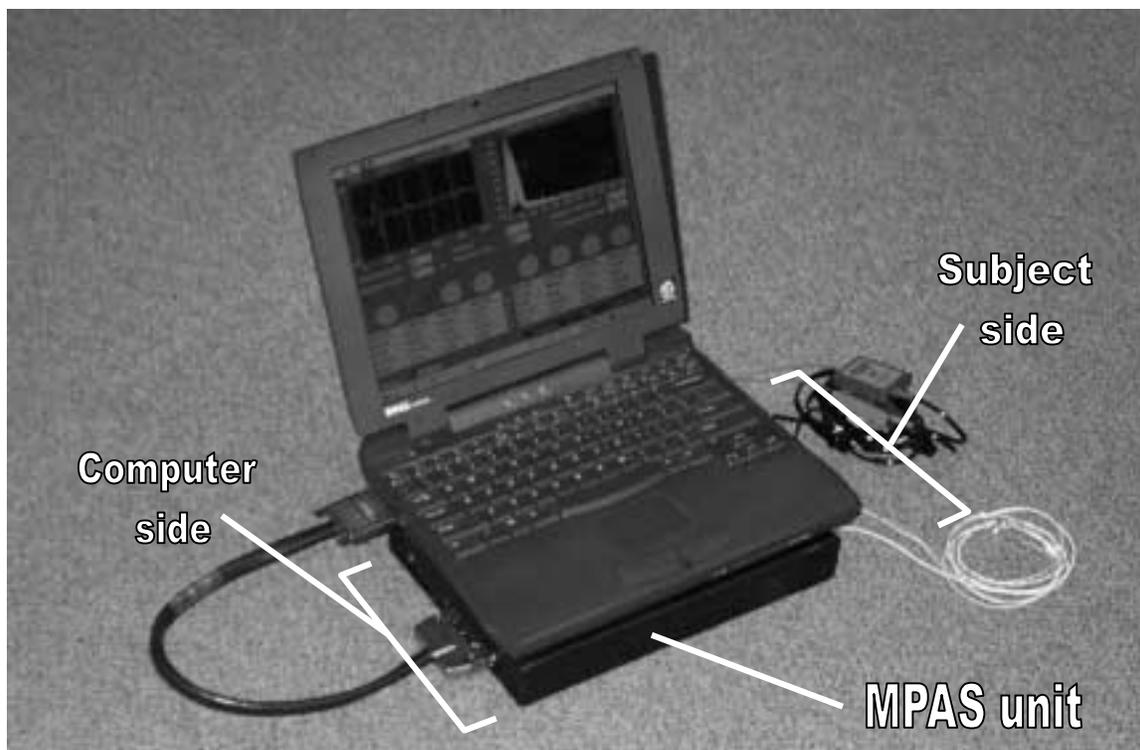


Fig. 1: The MASTER portable amplifier system (MPAS)

MASTER portable amplifier system (MPAS)

The MPAS unit contains:

- A two-channel audio amplifier with independent volume and mute controls for each channel (which go to left and right ears). When used with a set of Telephonics TDH-50P headphones or 3A inserts, the output levels can be set from +10 dB SPL to +110 dB SPL. Measurements were made at 1kHz;
- A single channel differential EEG amplifier (active, reference, ground) with software-selectable gains of 2,000x, 6,000x, or 10,000x and calibration loop-back mode;
- Programmable EEG signal filters:
 - 1) High Pass 12 dB/octave, with software-selectable cutoff frequencies of 1Hz, or in the range of 5Hz to 300Hz;
 - 2) Low Pass 24 dB/octave, with bypass option, and software-selectable cutoff frequencies in the range of 150Hz to 3kHz;
- A two-cell internal battery fast-charger with discharge capability; and
- Two multi-cell nickel metal-hydride rechargeable batteries.

System requirements

The following equipment is required:

- The Master Portable Amplifier System unit;
- MASTER software with hardware key for use on one machine; and
- An external switching power supply and IEC mains power cord.

To be supplied by End User:

- Laptop with at least 10 Gig hard drive, 128 MB memory;
- A set of Telephonics™ TDH-50P headphones or Etymotic Research™ ER-3A/50 50-Ω inserts; and

The following may be supplied with your MPAS system depending upon your order.

- A set of three electrodes with IEC-60601 / DIN 42-802 1.5mm “touch proof” (shrouded) female connectors
- A National Instruments DAQcard (6062E or PCI equivalent,) and NI-DAQ software (shipped with DAQcards at no additional cost;)
- A 0.5-m 68-pin VHDCI to HD National Instruments cable. Use N.I. part # 186838C-OR5 if the PCMCIA card is in the upper slot of your laptop, or # 187406A-OR5 if the card is in the lower PCMCIA slot (using the correct cable will prevent your spare PCMCIA slot from being obstructed by the cable.) For a desktop computer with PCI acquisition card, the 184749A-01 1-meter cable is required;

Operational features

General:

- The MPAS unit will only power up if connected to the host PC, under software control;
- Software controlled volume, software mute, and hardware disconnect for each audio channel;
- Software monitoring of battery levels, charging status, and audio output line signals;
- Software controlled EEG gain, EEG filter cutoff frequencies, and calibration mode;
- PC link status LED (this is lit when connection is good between PC and MPAS); and
- EEG power status LED.

Charger and Batteries:

- Charger LEDs indicating discharge, charging and charge complete for each of the 2 batteries.

Safety features

EEG amplifier:

- The EEG amplifier employs 1.5mm “touch proof” (shrouded) male electrode connectors;
- A 3500-Vrms magnetic and optical isolation barrier act to isolate the EEG amplifier of the MPAS system from power, calibration signal, control signals, and the computer;
- Audio and EEG functions are shut down when the batteries are being charged, independently of whether the system is connected to a PC;

MPAS unit:

- Warnings are provided if the MASTER software is executed while the MPAS batteries are being charged and the software will not run;
- Warnings are provided if the MASTER software is executed while the laptop batteries are being charged and the software will not run;
- Four fuses protect the MPAS circuitry; and
- Batteries protected for charge over-current/over-heat and load over-current/over-heat.

The MPAS unit

Side panels

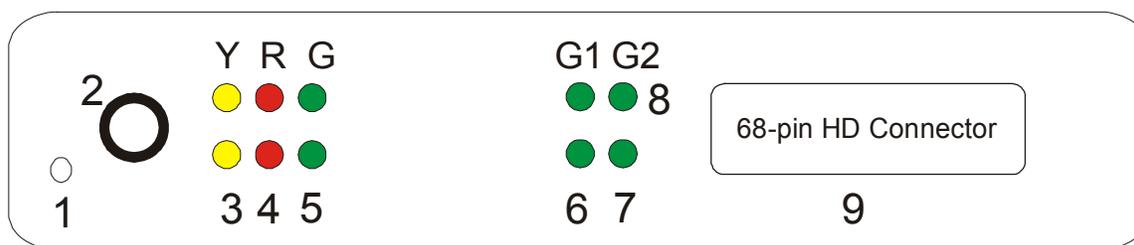


Fig. 2: Computer side of the MPAS unit

The MPAS indicator panel consists of several luminous indicators, connectors and controls. Figure 2 is a diagram of the subject side of the MPAS device.

From left to right, are:

- 1) Manual battery discharge pinhole (for manually initiating discharge;)
- 2) 15V DC, 1A charger power supply jack;
- 3) Discharge LEDs (yellow,) one for each battery cell*;
- 4) Charge LEDs (red,) one for each battery cell*;
- 5) Charge complete LEDs (green,) one for each battery*;
- 6) Battery status indicator LEDs (green,) one for each battery*;
- 7) PC link power indicator LED (green.) Indicates good connection between PC and MPAS;
- 8) EEG power indicator LED (green); and
- 9) 68-pin HD connector.

* top = battery A, bottom = battery B



Fig. 3: Subject side of the MPAS unit

The subject-side connectors (Fig. 3) are the following:

- 1) Active EEG electrode (yellow) 1.5mm "touch proof" male jack;
- 2) Reference EEG electrode (blue) 1.5mm "touch proof" male jack;
- 3) Ground EEG electrode (white) 1.5mm "touch proof" male jack;
- 4) Left headphone locking ¼" phone jack; and
- 5) Right headphone locking ¼" phone jack.

Subject isolation

All three EEG electrode jacks and the EEG amplifier are isolated from the remainder of the MPAS unit and the laptop by 3500-Volt RMS isolation.

The MPAS provides isolation that conforms to Risk Class 3 under CSA special inspection evaluation as per C22.2 No.125. However, the MPAS will not run while the laptop is plugged in and will only operate when the laptop runs off of battery power. Users are encouraged to purchase at least one additional battery for their laptop.

Charging the batteries

The MPAS unit is powered by two multi-cell NiMH battery packs. These must be charged every 4-8 hours of system use. Depending upon use, batteries may have to be replaced every 2-3 years. The MPAS batteries normally require about 2 to 4 hours to recharge.

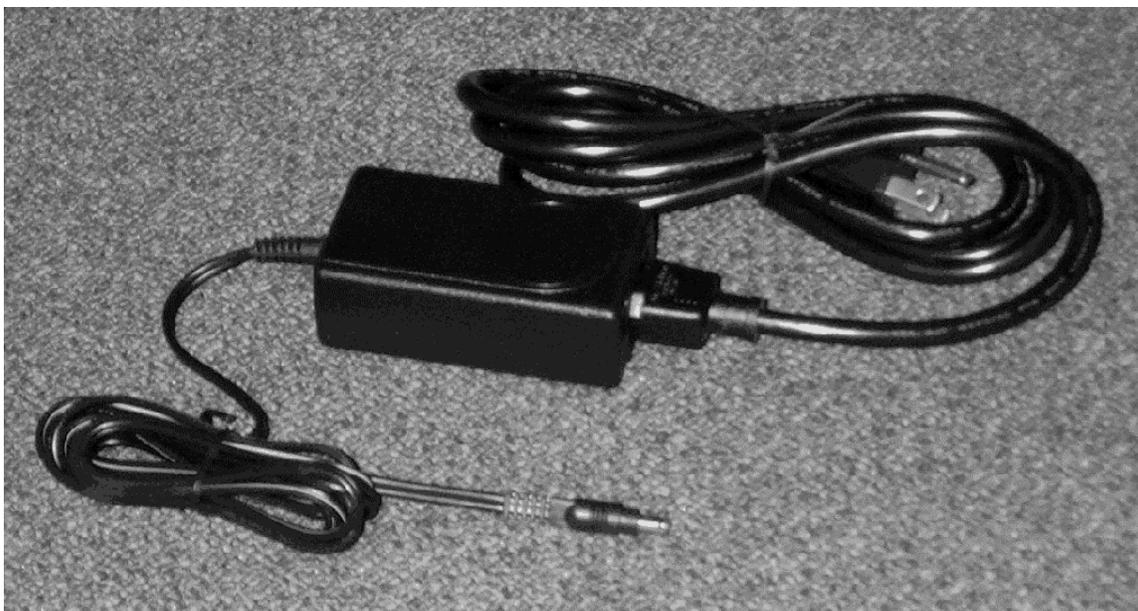


Fig. 4: Charger power supply

Charge is initiated by plugging the charger power supply (Fig. 4) into the MPAS unit's charger supply jack (Fig. 2, 2.) All audio and EEG functions are defeated during a charge.

A normal charge sequence consists of: charge of battery B, charge of battery A, and finally an indefinite trickle-charge maintenance mode. If discharge is selected (discussed below,) this sequence is preceded with a discharge phase, after which a normal charge sequence occurs.

Looking at figure 2, the top three LEDs (yellow – “discharge status,” red – “charge status,” and green – “charge complete.”) indicate battery A status. The lower three LEDs indicate battery B status.

Discharge-before-charging of the batteries is recommended once out of every three or four charges to extend battery life. If discharge is selected, the two discharge indicators will light once charger supply power is applied. One or both of the charge LEDs (red) will also be active. Once discharging (if selected) is complete, a normal charge sequence begins.

A normal charge sequence starts with charging of battery B. During this phase, the battery B red “charge status” indicator will be lit. Also, the battery A red charge indicator will be flashing to indicate that charge is pending. Once battery B is fully charged, its red charging indicator will turn off, and the “charge complete” (green) LED will light. At this point battery A will begin charging, indicated by a solidly lit red “charge status” LED.

When both charge complete LEDs are lit, charging is complete and both batteries are placed into a trickle-charge mode to maintain battery charge. The charger power supply can then be disconnected and the MPAS is ready for use.

→ The batteries should not be partially charged by interrupting the charge sequence before completion. This is because both batteries are needed to power the MPAS. Fully charging battery B will not help if battery A is low. Do not disconnect the charger power supply until both “charge complete” LEDs are on. If the power supply is accidentally disconnected, then reconnect and finish charge prior to use.

→ Trickle charge (both charge complete LEDs on) is not intended for indefinite use. Please disconnect the charger power supply within a day of starting a charge sequence.

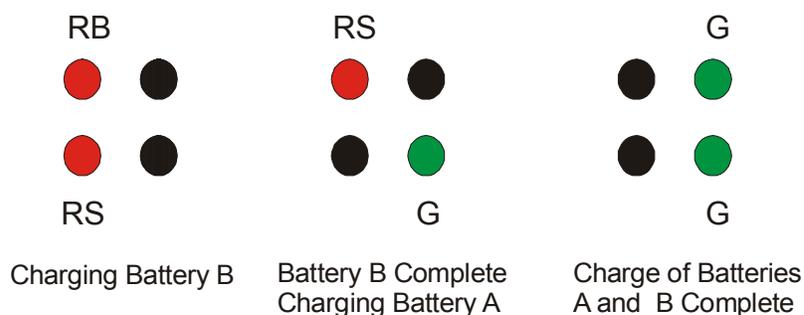


Figure 5: Charging the Batteries,
 RS = Red stable, RB = Red blinking, G = Green (stable.)
 Bottom row indicates battery B status; top row refers to battery A.

Discharging the batteries

→ Discharge before charging of the batteries is recommended once out of every three or four charges to extend battery life. A full discharge and recharge may take up to 5 hours.

Discharge can be initiated by MASTER software command or by depressing the discharge button (Fig. 2,1) with a pin or straightened paperclip. Once discharging is complete, a normal charging sequence will commence.

→ The preferred method for discharge initiation is to depress and hold the discharge button (Fig. 2, 1) as power is applied to the before should only be initiated within the first 2 minutes after power is applied to the charger supply jack (Fig. 2, 2.)

Opening the MPAS unit

The MPAS unit is not intended for user servicing, unauthorised modifications or adjustments void the warantee. Should the unit fail and you are instructed to replace a fuse, please follow these insructions.

- 1) Disconnect all cables from the MPAS unit
- 2) Lay the unit upside-down on a flat surface
- 3) Completely unscrew the two **recessed** screws with a #1 Philips screwdriver
- 4) While holding the cover firmly in place, flip the unit over, making sure not to loose the two screws which will fall out of their openings
- 5) Lift the cover off of the unit

Note that the batteries may fall out and cause damage to the circuitry or cabling if the unit is tilted while the cover is not being firmly held in place. Please refer to the next section for fuse locations.

When reassembling the unit, be sure to replace the cover in the proper orientation. The foam strips, found on the inside of the cover, should contact the batteries when the unit is closed. Also be sure to hold the cover firmly in place when flipping the unit over to replace the screws.

MPAS portable unit internals

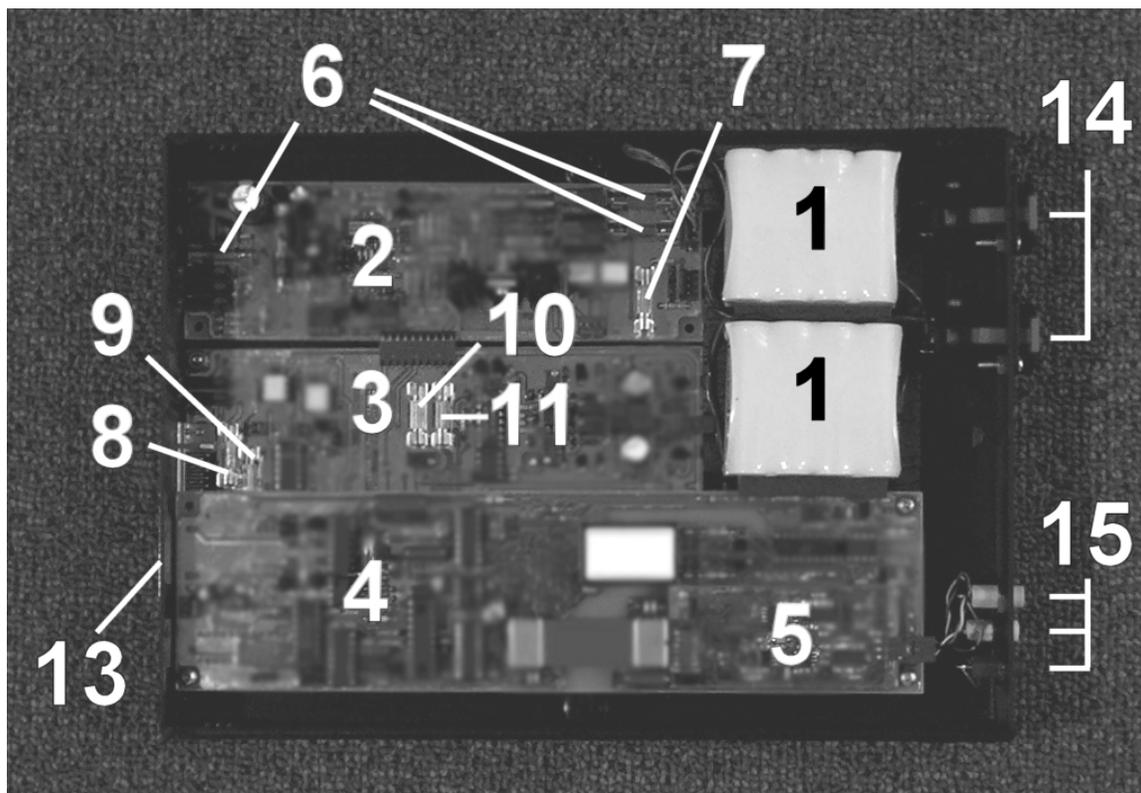


Fig. 6 MPAS unit internals

The main parts in the MPAS unit are the following (refer to Fig. 6.)

- 1) Batteries (top = A, bottom = B;)
- 2) Power Module (MPM;)
- 3) Main board (MMB;)
- 4) EEG Isolation, Filtering, and Control Module (MIFCM;)
- 5) EEG High Gain Module (MHGM;)
- 6) Charge fuses (1.0 A, 3 pcs.;)
- 7) Spare charge fuse;
- 8) Control fuse (200 mA;)
- 9) EEG fuse (200 mA;)
- 10) Spare control fuse;
- 11) Spare EEG fuse;
- 13) 68-pin N.I. connector;
- 14) Audio output Phone jacks; and
- 15) EEG electrode shrouded 1.5mm connectors (3.)

Fuses are included with spares as one of the measures to protect the MPAS circuitry.

→ Only use fuse replacements with current ratings identical to the originals.

Specifications:	MPAS1
Model:	MASTER portable amplifier system 1
Safety inspection:	Certified as a class 3 Medical device under CSA special inspection for Electromedical Equipment (C22.2 No. 125). This is obtained even though MPAS is run off of a laptop computer.
Physical:	
Dimensions:	286 x 200 x 49 mm
Weight:	1.5 kg / 3.3 lb (MPAS unit only)
Audio Amplifier:	MMB R5.4
Volume control:	+10 to +110 dB SPL in 1 dB with 50-Ω load at 1 kHz with Telephonics™ TDH-50P headphones
THD:	< 0.6% from 250 Hz to 8 kHz with TDH-50P transducers < 1.3% from 250 Hz to 8 kHz with EAR-3A transducers includes distortion generated in DAQ card, transducers, and test equipment (artificial ear, microphone amplifier, and spectrum analyser) Exceeds ANSI S3.6 1989 THD performance specification
Crosstalk:	> 70 dB of channel separation from 250 Hz to 8 kHz both channels at maximum output and unmuted
Connector:	Two (2) locking mono ¼" phone jacks
Drive capacity:	50-Ω load impedance
Audio Loop-back:	National Instruments DAQ00OUT, DAQ10OUT, as well amplified audio output lines are fed back to DAQ card digital inputs for signal check
EEG amplifier:	MHGM R1.1
Type:	1 channel differential (active, reference, ground)
Gain settings:	2,000x, 6,000x, and 10,000x, software-selected National Instruments DAQ cards provide additional gains of 1, 2, 5, 10, 20, 50, and 100 x
Input range:	± 2.5-mV at 2,000 x ± 830-μV at 6,000 x ± 500-μV at 10,000 x
Input impedance:	> 10 x 10 ⁶ Ω
Common mode rejection:	> 48 dB at 100 Hz
Noise:	1.3 μV _{rms} from 1 Hz to 10 kHz with input grounded
Frequency response:	8 Hz to 4 kHz (-3 dB bandwidth) A single-pole 8 Hz high-pass filter is designed-in
Connectors:	Three (3) IEC-60601/DIN 42-802 1.5mm shrouded male jacks
Calibration mode:	PC-generated 10 V _{peak} signal, attenuated by 10 ⁵ :1, software controlled
Isolation:	Sink test exceeds CSA Risk class 3 requirement under C22.2 No.125
EEG filters:	MIFCM R2.1
Low-pass filter slope:	24 dB/oct.
Low-pass filter cutoff frequency:	150Hz to 3kHz, software-selectable, with defeat option
High-pass filter slope:	12 dB/oct.
High-pass filter cutoff frequency:	1Hz, or 5Hz to 300Hz, software-selectable ¹
Mains frequency filter:	[optional] Frequency is 50 or 60 Hz (factory set) with on/off software control
Battery charger:	MPM R2.4
Type:	Internal, dual-cell NiMH
Supply Power:	15 VDC, 1.0 A max.
Supply Connector:	2.5mm centre-positive power jack
Approved Adapter:	Protek Electronics™ PMP30-13-B2
Adapter input:	100-240 VAC, 0.8A max., 47-63 Hz
Leakage current:	< 100-μA risk-leakage current under CSA special inspection for Electromedical Equipment (C22.2 No.125) with approved adapter ²
Notes:	¹ Frequency response is limited by the EEG amplifier's DC (8 Hz) high-pass characteristic ² Risk-leakage current is only tested at 125 VAC input, unless specially requested to be tested at 240 VAC.