Dancer Design
INNOVATION IN ELECTRONICS

Custom solutions for Neuroscience and Psychology Research

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TactAmp 4.2 tactor drive amplifier and experiment interface User Guide

The TactAmp is a four-channel amplifier unit designed to drive tactor vibrotactile stimulators from Dancer Design. For added versatility in running experiments it contains four outputs capable of driving LEDs or triggering external equipment and four inputs which may be wired to a digital signal or a switch or response button.

The drive signal for each amplifier may be a digital pulse train on one of the pins of the parallel input connector, which connects directly to a standard PC parallel (printer or LPT) port, or it may be an analog signal such as the output of a sound card.

Front view of TactAmp

Rear view of TactAmp

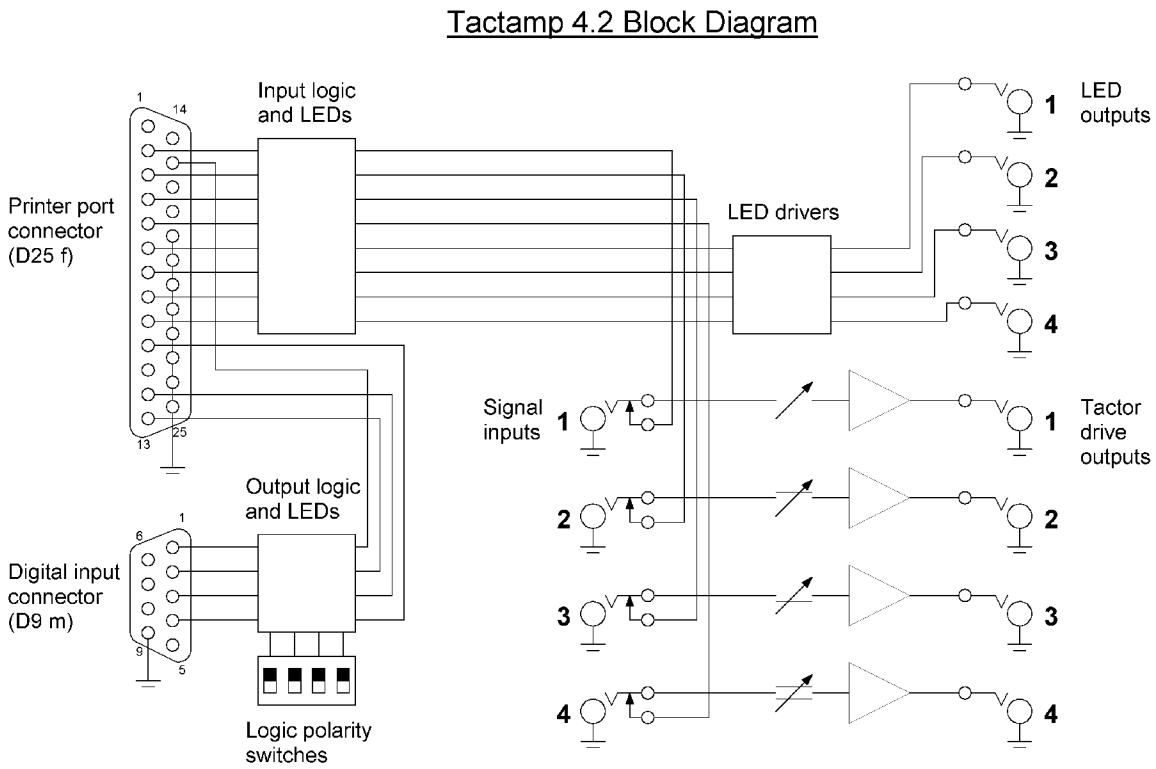


Table 1 – Digital pin assignment
(Direction is input to or output from the PC. Address is the physical port address assuming the common LPT base address of 378 hexadecimal)

Function	D25 pin	D9 pin	Direction	LPT name	Address / bit
Tactor 1 signal	2	-	Out	Data 0	378 / 0
Tactor 2 signal	3	-	Out	Data 1	378 / 1
Tactor 3 signal	4	-	Out	Data 2	378 / 2
Tactor 4 signal	5	-	Out	Data 3	378 / 3
LED 1 control	6	-	Out	Data 4	378 / 4
LED 2 control	7	-	Out	Data 5	378 / 5
LED 3 control	8	-	Out	Data 6	378 / 6
LED 4 control	9	-	Out	Data 7	378 / 7
Input 1	15	1	In	Error	379 / 3
Input 2	13	2	In	Select	379 / 4
Input 3	12	3	In	Paper out	379 / 5
Input 4	10	4	In	Ack	379 / 6
Digital ground	18 - 25	9	-	Gnd	-

Description

Amplifiers

Each amplifier is a DC-coupled audio frequency amplifier capable of delivering 1.35 watts (RMS sine wave) into an 18 ohm load. When no jack is plugged into the corresponding signal input socket the input signal for the amplifier comes from one of the digital lines 0 to 3 (pins 2 to 5) on the parallel port connector. In this case the signal is AC coupled and only frequencies above 0.15 Hz will be passed by the amplifier. This is because digital lines are often held at a constant DC voltage, and if the amplifier was DC coupled this would cause the tactor to draw current continually which could cause it to get hot and reduce its life.

When a signal source is connected to the amplifier by plugging a jack plug into the signal input socket the digital line is automatically disconnected. In this case the amplifier acts as a DC coupled audio amplifier with a gain of 10 (with the level control set to maximum). The amplifier is essentially linear from DC to well above the audio range.

The output current of each amplifier is limited to 500 mA by a self-resetting fuse inside the TactAmp. This provides short-circuit protection for the amplifier and it also limits the current that can be delivered into a load under fault conditions to a safe level, to prevent overheating.

A logic '1' on a digital input line 0 to 3 lights the corresponding Tactor LED on the front panel. This is provided as a confirmation that a signal is present on that line. Note that when driving the TactAmp with an external audio signal the corresponding Tactor LED will not light.

The amplifiers may be used to drive small loudspeakers for creating audio stimuli or prompts. They will deliver around 2 watts into an 8 ohm speaker.

Amplifier input and output connectors are 3.5mm mono jack sockets.

LED drive outputs

Lines 4 to 7 (pins 6 to 9) on the parallel port connector control the four LED drive outputs. Each LED output contains an internal current-limiting resistor which limits the current through a typical red, yellow or green LED to about 15 mA, which is sufficient to light most low power LEDs.

Each LED output is also a TTL-compatible logic level signal which means that it may be connected to a TTL-compatible input on another piece of equipment. A common example of this would be a trigger input line on an EEG machine.

LED drive output connectors are 2.5mm mono jack sockets.

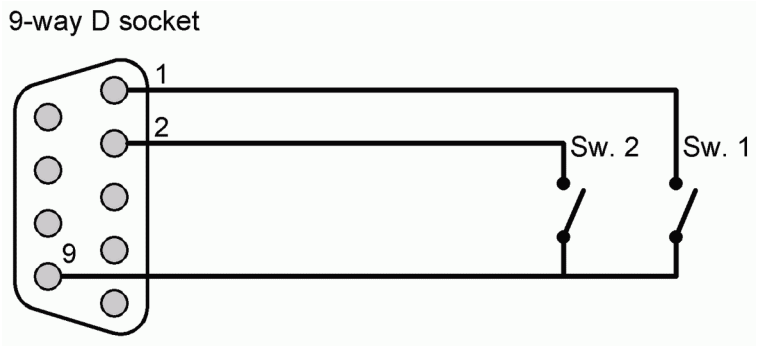
Digital / switch inputs

The 9-pin D-type connector on the rear panel allows four digital inputs to be connected to the TactAmp. The four inputs are routed to four status lines on the parallel port (see Table 1).

Each input may be set to true logic (high voltage = logic '1') or inverted logic (high voltage = logic '0') / switch-to-ground. Selection of the input polarity is by means of 4 small switches accessible on the rear panel.

True logic **Inverted logic / switch**

When set to true logic, a high voltage (>2V) on the input appears as a logic '1' on the corresponding bit in the status port in the computer. When set to inverted logic, a low voltage (<0.8V) on the input appears as a logic '1' on the corresponding bit. In inverted logic mode a switch connected across the input will create a logic '1' when it is closed. This can be useful for connecting response buttons, as shown below.



Connecting switches to digital inputs

Setting up and using the TactAmp

Amplifiers

When using the external signal inputs the amplifiers behave much like any other audio amplifier. When setting up a set of tactors it is a good idea to start with the level controls set to minimum, start the external signal running, and adjust the level for the desired amplitude of stimulation.

One important difference between the TactAmp and most audio amplifiers is that the TactAmp amplifiers are DC-coupled when using the signal input connectors. This means that a DC (constant) voltage fed into the input will be converted to a DC voltage on the output. This can be useful if you want a tactor produce a static indentation of the skin, but be aware that at DC the tactor coil is drawing current continuously even though the probe is not moving, so care should be taken that tactors are not driven for long periods with high voltages which may cause the coils to burn out due to overheating.

Using a parallel port

The TactAmp is designed to be used with hardware-mapped printer port (LPT port) which is still commonly found on desktop PCs. The port hardware resides at a range of addresses in the computer's memory space, but for the TactAmp use only two addresses are important: the base address, which is also the address of the data port, and base address +1, which is the address of the status port. The data port is used for output (tactors and LEDs); the status port is used for input.

Some versions of Microsoft Windows restrict access to addresses in the I/O range where the parallel port resides, but most of the programs commonly used for neuroscience and psychology research have drivers which get around this restriction. Examples are LabVIEW, MATLAB, Presentation and E-Prime.

USB to parallel adaptors are available but they may not be suitable for use with the TactAmp for two reasons. The first is that the USB device may not allow software access to individual input and output lines. The second reason is that

there is an inherent delay in accessing any USB device. The delay is unpredictable and may be several milliseconds, so accurate timing and rapid port manipulation will be impossible.

Most modern laptop PCs do not have parallel ports, but parallel port adaptors are available which plug into the PC card or Express card slot. These appear as a hardware-mapped device and can be used exactly like the original printer port.

It may be necessary to set up the parallel port as a standard parallel port in order to use it. To do this, boot the PC and enter the BIOS settings control panel. There should be an option to change the operating mode of the parallel port (also known as printer or LPT port). Choose SPP mode, save the BIOS settings and exit. The BIOS settings are retained after the computer is switched off so it should not be necessary to change the setting more than once.

Some versions of Microsoft Windows periodically access the parallel port to check for devices attached to it. This causes the port state to change for no apparent reason. This odd behaviour can be stopped by making a change to the Windows registry. Contact Dancer Design for instructions if you are experiencing this problem.

An alternative to using a PC parallel port is to use any device which acts as a digital input / output port. An example is the NI USB-6501 card from National Instruments. The Tactamp test program now supports this. A suitable adapter cable must be assembled. Dancer Design can supply a suitable cable or can give instructions on how to make one.

Using parallel port lines 0-3 to drive the amplifiers

To use one of the lines on the parallel port to drive an amplifier simply connect the parallel port connector on the TactAmp to the printer port of the PC. Leave the corresponding signal input unconnected.

Signals are created by changing the state of the port line in software. If the line is set to a static logic '1', this will create a "tap" from the tactor, as shown below. Note that when the port line is reset to logic '0' there will be another "tap" as the tactor core moves in the opposite direction. If you require the sensation of a single tap use a pulse that lasts only a few ms.

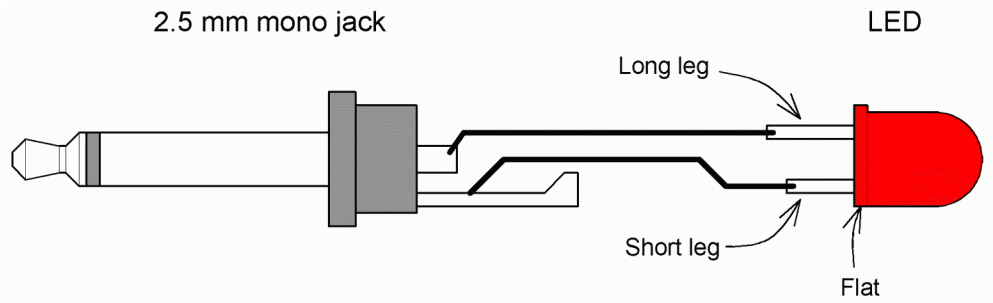
For a vibratory stimulus the port line must output a repetitive pulse waveform which can be achieved by rapidly changing the state of the port line in software.

Using parallel port lines 4-7 to drive the LED outputs

Bits 4 – 7 on the parallel port map directly to LED outputs 1 – 4. Setting a bit state to logic '1' lights the corresponding LED.

LEDs should be wired to the jack plug as shown below.

LED wiring



The barrel of the LED output connector is electrically connected to the TactAmp case and 0V of the power supply.

Accessories

Power supply	Friwo GPP18 or MPP15, 18V, 2.1mm connector, centre positive
Tactors	Dancer Design tactors
Parallel cable	D25 male – male, all lines connected 1:1 NI USB-6501 adapter cable
Cable for sound card	'Y' cable - stereo 3.5mm plug to 2x mono 3.5mm plug
LEDs	Any standard red, green or yellow LED. White or blue LEDs may require additional drive circuits
Connectors for LEDs	2.5mm mono jack plug. Recommended part is Lumberg KLS10 (RS Components 505-1277)

For further information or advice on using the TactAmp, contact Dancer Design.

Contact Details

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Specifications

General

Dimensions (mm)	170 (w) x 55 (h) x 191 (d)
Weight	0.94 kg
Power input	18 V, 1A
Power connector	2.1 mm coaxial, 9.5mm long, centre positive
Current consumption	quiescent ~110 mA maximum ~1A (limited by power supply)

Safety (when used with recommended power supply)

Isolation from mains	to IEC 60601-1
Leakage current	< 10 µA @ 240 V
Equipment type	Class II

Amplifiers

Gain	10x max.
Input impedance	50 kΩ
Frequency range	
(digital inputs)	0.15 Hz to >20 kHz
(analog inputs)	DC to >20 kHz
Output voltage max.	+/- 7V
Output current limit	500 mA per channel (resettable fuses)

LED outputs

Output voltage, logic 1	no load: 4.4 V
Current limiting resistor	180 Ω
Output voltage, logic 0	0.49 V @ 100 µA