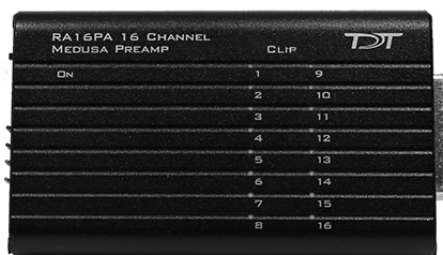


# RA16PA/RA4PA Medusa PreAmps



## Medusa Overview

The Medusa Preamplifiers are low noise digital bioamplifiers and are available with either PCM or Sigma-Delta As. The system amplifies and digitizes up to 16-channels of analog signal at a 24.414 kHz sampling rate. The amplified digital signal is sent to the base station via a noiseless fiber optic connector.

- Digitizes either four or 16 channels at acquisition rates of approximately 6, 12, or 25 kHz.
- Connects to the headstage via a DB25 connector.
- Powered by a Lithium-ion battery that provides 20 hours of continuous data acquisition in 16-channel mode and 30 hours of operation in 4-channel mode.
- Clip warning lights indicate when any signal is -3db from the preamplifier's maximum voltage input.

## Medusa Features

### Analog Acquisition Channels

The RA16PA and RA4PA standard Medusa Preamplifiers acquire signals using 16-bit PCM As, which provide quality acquisition with minimal delay. The RA16SD and RA4SD use Sigma-Delta As, which have several characteristics that improve signal quality. Oversampling of the signal before conversion removes aliasing of high frequency RF signals.

RA16SD testing indicates that signals greater than 150% of the Nyquist frequency are removed from the signal. This allows users to acquire at lower sampling rates (6 kHz) without worry of significant aliasing. In addition, each converter also has a two pole anti-aliasing filter (12 dB per Octave) at 7.5 kHz. However, the sigma-delta A's have a fixed group delay of 20 samples (compared to four samples for the RA16PA). When using the RA16SD this group delay must be taken into account

when the data is displayed or acquired (for example, adding a SampDelay to the RPvdsEx circuit).

## Clip Warning Lights

When the input to a channel is greater than -3db from the preamplifier's maximum voltage input, a light on the top of the amplifier is illuminated. The first column of lights corresponds to channels 1-8 and the second column corresponds to channels 9-16. The clip warning light indicator can be turned off by flipping a switch on the end of the amplifier.

## Power Light

The power light is in the top corner of the amplifier. It is illuminated when the device is on. It flashes quickly if the battery is low. It flashes slowly while the battery is charging.



## Headstage Connector

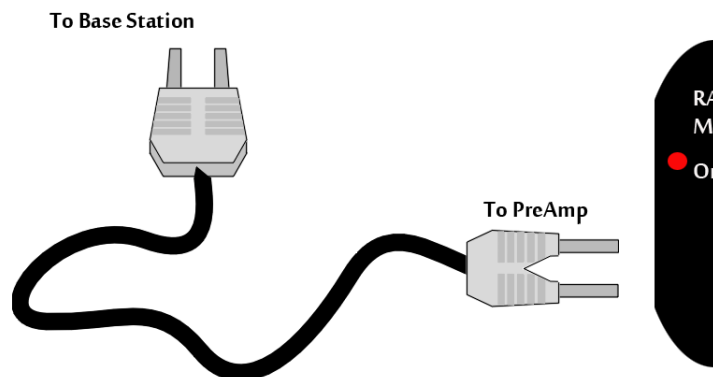
The headstage connector is a 25-pin (16-channel) connector. Information on the pin inputs is provided with the technical specifications.

## Base Station Connector - To Base

Use the provided fiber optic pair (white connectors) to connect the To Base port on the preamplifier to the optical input port on the base station.



The duplex fiber optic cable has identical one-piece connectors at each end. There is a V-shaped groove on one side of the connector and a raised rectangle on the other. As shown in the image above, plug the connector into the RZ6 port with the raised rectangle side up. Plug the connector into the preamplifier with the V-shaped groove up.



Medusa PreAmp Connection Diagram

## Power

A switch on the back powers up the amplifier. The fiber connector at the right will be illuminated when the amplifier is on.

## LEDs

This switch turns the clip warning lights on top of the amplifier on or off.

## Power Requirements

The Lithium-ion batteries charge in four hours. Keeping the battery charger connected to the amplifier does not affect the battery life. However, the charger will significantly increase the noise of the system if it is plugged in while an experiment is running. A 6 volt battery charger is included with the amplifier. The charger tip is center negative. If it is necessary to replace the charger make sure that the power supply has the correct polarity.

The Li-ion battery supplied with the system cannot be removed. If battery life longer than 30 hours is required, an external battery pack can be connected to the voltage inputs of the charger. TDT recommends a 6 (minimum) to 9 Volt (maximum) battery, such as lead acid batteries used for motorized wheel chairs. Contact TDT for more information.

## RA16PA Medusa PreAmp Technical Specifications

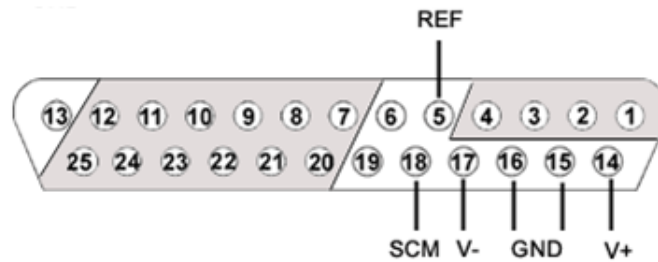
Includes specifications for the RA4PA, RA16PA, and RA16SD Medusa Preamplifiers.

|                                |                                                                                                                                   |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>A/D</b>                     | RA4PA: 4-channels 16-bit PCM<br>RA16PA: 16-channels 16-bit PCM<br>RA16SD: 16-channels 16-bit sigma-delta                          |
| <b>Sample Rate</b>             | 6, 12, or 25 kHz                                                                                                                  |
| <b>Maximum Voltage In</b>      | RA4PA and RA16PA: +/- 4 millivolts<br>RA16SD: +/- 5 millivolts                                                                    |
| <b>Frequency Response</b>      | 3 dB 2.2 Hz - 7.5 kHz                                                                                                             |
| <b>Highpass Filter</b>         | 2.2 Hz                                                                                                                            |
| <b>Anti-Aliasing Filtering</b> | RA4PA and RA16PA: 7.5 kHz (3 dB corner, 1st order, 6 dB per octave)<br>RA16SD: 7.5 kHz (3 dB corner, 2nd order, 12 dB per octave) |
| <b>S/N (typical)</b>           | RA4PA and RA16PA: 60dB                                                                                                            |
| <b>Input Referred Noise</b>    | rms 3 microvolts bandwidth 300 - 3000 Hz<br>6 microvolts bandwidth 30 - 5000 Hz                                                   |
| <b>Group Sample Delay</b>      | RA4PA and RA16PA: NA<br>RA16SD: 20 Samples                                                                                        |
| <b>Input Impedance</b>         | 10 <sup>5</sup> Ohms                                                                                                              |

|                           |                                                                                                      |
|---------------------------|------------------------------------------------------------------------------------------------------|
| <b>Power Requirements</b> | 500 mAmps while charging, 60 mAmps once charged                                                      |
| <b>Battery</b>            | Li-ion Battery 1950 mAh, 20-25 hours between charges. 1000 cycles of charging, not removable by user |
| <b>Charger</b>            | 6-9 Volts DC, greater than 500 mAmps, center negative                                                |
| <b>Fiber Optic Cable</b>  | 5 meters standard, maximum cable length 12 meters                                                    |

## Pinout Diagrams

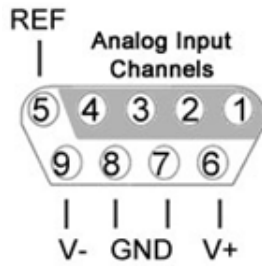
16/4-channel pinouts (all 16 and 4 channel models built after 2002):



| Pin | Name | Description                                                                 | Pin    | Name | Description                                                                                                                                                                                                                 |
|-----|------|-----------------------------------------------------------------------------|--------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | A1   | Analog Input Channel Number                                                 | 14     | V+   | Positive Voltage Headstage Power Source (1.4 V as measured in reference to ground)                                                                                                                                          |
| 2   | A2   |                                                                             | 15     | GND  | Ground                                                                                                                                                                                                                      |
| 3   | A3   |                                                                             | 16     | GND  | Ground                                                                                                                                                                                                                      |
| 4   | A4   |                                                                             | 17     | V-   | Negative Voltage Headstage Power Source (1.4 V as measured in reference to ground)                                                                                                                                          |
| 5   | REF  | Reference Pin                                                               | 18     | SCM  | Sixteen Channel Mode Indicator Pin<br>The status of pin 18 determines whether the preamplifier is in four or 16-channel mode. To use the preamplifier in 16-channel mode with a custom headstage, connect pin 18 to pin 17. |
| 6   | NA   | TDT Use Only<br>Pins 6, and 19 are for TDT use only and should not be used. | 19     | NA   | TDT Use Only<br>Pins 6, and 19 are for TDT use only and should not be used.                                                                                                                                                 |
| 7   | A5   | Analog Input Channel Number                                                 | 20     | A6   | Analog Input Channel Number                                                                                                                                                                                                 |
| 8   | A7   |                                                                             | 21     | A8   |                                                                                                                                                                                                                             |
| 9   | A9   |                                                                             | 22     | A10  |                                                                                                                                                                                                                             |
| 10  | A11  |                                                                             | 23     | A12  |                                                                                                                                                                                                                             |
| 11  | A13  |                                                                             | 24     | A14  |                                                                                                                                                                                                                             |
| 12  | A15  |                                                                             | 25     | A16  |                                                                                                                                                                                                                             |
| 13  | GND  |                                                                             | Ground |      |                                                                                                                                                                                                                             |

**Note:** Grounds (pins 13, 15, 16) are tied together.

## 4-Channel Pinout



A 4-Channel connector is found only on models shipped before January 2002. **Note:** Pins 7 & 8, tied together.

| Pin | Name | Description                             |
|-----|------|-----------------------------------------|
| 1   | A1   | Analog Input Channel Number             |
| 2   | A2   |                                         |
| 3   | A3   |                                         |
| 4   | A4   |                                         |
| 5   | REF  | Reference Pin                           |
| 6   | V+   | Positive Voltage Headstage Power Source |
| 7   | GND  | Ground                                  |
| 8   | GND  | Ground                                  |
| 9   | V-   | Negative Voltage Headstage Power Source |

