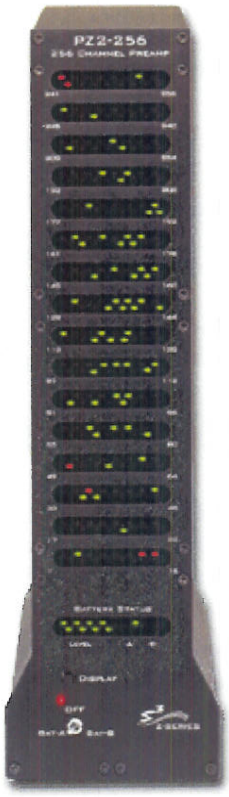
PZ2 Preamplifier

Overview



The PZ2 is a high channel count preamplifier suitable for extracellular recordings. The PZ2 preamplifier features a custom 18-bit hybrid A/D architecture that offers the advantages of Sigma-Delta converters at significantly lower power and a fast fiber optic connection capable of simultaneously transferring up to 256 channels. The extended bandwidth offered by this connection supports sampling rates up to ~50 kHz and improves signal fidelity, spike discrimination, sorting, and analysis. Used exclusively with Z-Series base stations, PZ2 preamplifiers are available in 32, 64, 128, or 256-channel models.

Note: When sampling at a rate of ~50 kHz only the first 128 amplifier channels will be available.

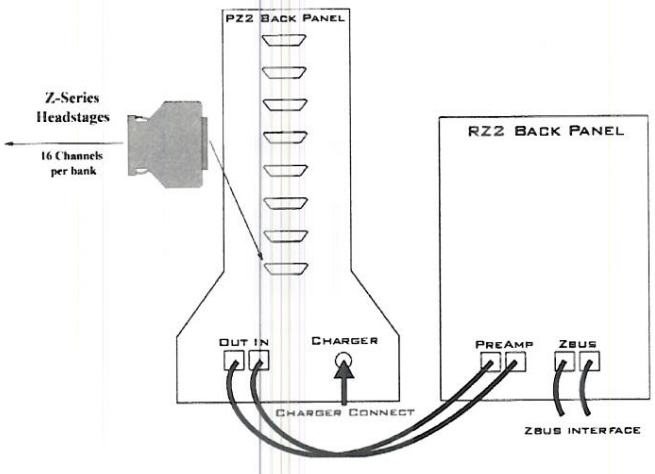
System Hardware

All PZ2 channels are organized into groups of 16 channel ***banks*** with each bank corresponding to a rear panel headstage connector and front panel LED display. Recorded signals are digitized, amplified, and transmitted to the RZ2 base station via a single fiber optic connection for further processing. In addition, configuration information is sent from the RZ2 to the PZ2 preamplifier across the fiber optic connection.

A standard configuration for neurophysiology recordings includes electrodes (chronic or acute), one or more Z-Series high impedance headstages, a PZ2 preamplifier, and an RZ2 base station.

Hardware Set-up

The diagram below illustrates the connections necessary for PZ2 preamplifier operation.



One or more Z-Series headstages can be connected to the input connectors on the PZ2 back panel.

A 5-meter paired fiber optic cable is included to connect the preamplifier to the base station. The connectors are color coded and keyed to ensure proper connections.

The PZ2 battery charger connects to the round female connector located on the back panel of the PZ2 preamplifier.

Important!: To avoid introducing EMF noise, DO NOT connect the charger to the PZ2 while collecting data.

Powering ON

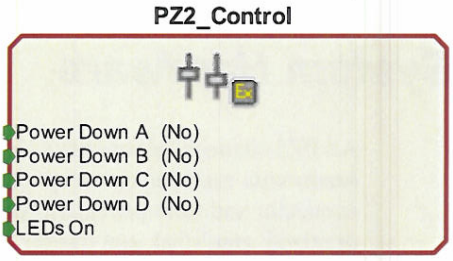
- To turn the preamplifier on, move the three position battery switch located on the front panel of the PZ2, to either the Bat-A or Bat-B position.

Powering OFF

- To turn the preamplifier off, move the three position battery switch located on the front panel of the PZ2, to the OFF position.

Important Note: Channels are grouped by 16-channel banks and each bank will only power up when a headstage is connected. This design helps to increase battery life.

PZ2 Software Control



The preamplifier's hardware operation (power options and indicator LEDs) can be configured using the ***PZ2_Control*** macro within the RPvdsEx control circuits running on the RZ2 base station.

Double-clicking the macro in RPvdsEx displays the macro properties and allows users to easily configure the macro. Additional information on using the macro is available in the macro properties dialog box.

This macro is not required for preamplifier operation but is recommended if the user requires more control over the amplifier power/up or power/down status or front panel LEDs. See the relevant sections below for more information about these features.

PZ2 Features

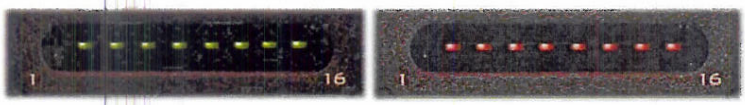
Clip Warnings and Activity Display

256 front panel LEDs can be used to indicate spike activity and/or clip warning depending on display mode and configuration. See *Display Button and Status LED* below for more information.

Recording Channel LEDs:

LED meanings:

When enabled, LEDs for each channel may be lit green to indicate activity or red to indicate a clip warning.



Green: Activity | Red: Clip Warning

Clip Warning When the input to a channel is greater than -3dB from the preamplifier's maximum voltage input the LED for the corresponding channel is lit red indicating clipping may occur.

Activity Whenever a unit (spike) occurs (the sensitivity threshold can be configured with the PZ2_Control macro) the LED for the corresponding channel is lit green.

Note: The LED Indicators are also mirrored on the RZ2 LCD display.

Display Button:

The Display button located on the front panel of the PZ2 toggles the clip warning and activity display LEDs between software control and standard operation.

To toggle between display modes:

- Press the **Display** button.

Status LED:

When recording, the **status LED** located below the Display button indicates the current display mode of the LED Indicators.

Green Software Control of LEDs

Use the PZ2_Control macro to configure LED Indicators. LEDs are turned off until enabled through software control.

Orange LEDs enabled for standard operation

In this mode, LEDs are automatically enabled for default activity and clip warning display as described above.

Battery Overview

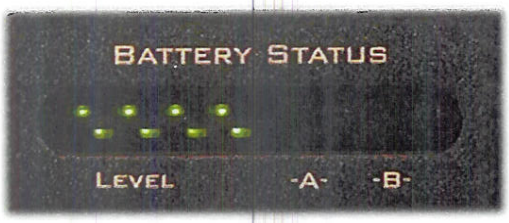
The PZ2 preamplifier features two Lithium ion batteries to allow for longer record times. A three-position switch selects the active battery between Bank-A, Bank-B, or both banks off.

Maximizing Battery Life

To increase battery life, individual banks of channels will only power up when a headstage is connected to the corresponding input.

The PZ2_Control macro can also be added to the circuit running on the RZ2 to further specify how PZ2 channel banks are powered. When a headstage is connected, banks may be powered on or off statically through the **Power Control** options within the macro or dynamically by using the **PZ2_Control macro** inputs. See the internal macro help for more information.

Battery Status LEDs



Battery Level: Eight LEDs indicate the voltage level of the selected battery. These LEDs can be found on the front of the PZ2 preamplifier by the heading Level. When the battery is fully charged, all eight LEDs will light green. When the battery voltage is low, only one green LED will be lit. If the voltage is allowed to drop further, the last LED will flash red. TDT recommends charging the battery before this flashing low-voltage indicator comes on. While charging, the Level LEDs will flash green.

Status	Description
8 Green	Fully Charged
1 Green, 7 Unlit	Low Voltage
1 Flashing Red	Low Voltage - Charge Immediately!
8 Green Flashing	Charging in Progress

Charging the Batteries

Operate the preamplifier with the charging cable disconnected. Connecting the PZ2 charger will simultaneously charge both batteries. TDT recommends putting the three-position switch in the **OFF** (middle) position while charging the PZ2.

Charging Indicators: When powered on the PZ2 battery status LEDs are also used for each battery to indicate which battery, if any, is charging. These LEDs are found next to the Level LEDs by the headings -A- and -B-. A green indicator denotes the battery bank is fully charged while a red indicator designates the battery is currently charging. When the device is in operation (charger is not connected) the -A- and -B- LEDs are not lit.

Status	Description
Red	Charging
Green	Fully Charged
Unlit	Operation Mode (charger not connected)

PZ2 Technical Specifications

Technical specifications for the PZ2 Z-Series Preamplifier.

A/D	Up to 256 channels, 18-bit hybrid
Maximum Voltage In	+/- 10 mV
Frequency Response	3 dB: 0.35 Hz – 7.5 kHz 6 dB: 0.2 Hz – 8.5 kHz
Anti-Aliasing Filter	4^{th} order Lowpass (24 dB per octave)
S/N (typical)	73 dB
Distortion (typical)	< 1%
A/D Sample Rate	Up to 48828.125 Hz*
Input Impedance	10^5 Ohms
Power Requirements	2 Lithium Ion cells at 10 AmpHours each
Battery	Eight hours to charge both batteries Battery life between charges per battery: 32 ch ~ 13 hrs 64 ch ~ 11 hrs 128 ch ~ 8 hrs 256 ch ~ 5 hrs
Charger	External 6VDC, 3A power supply
Indicator LEDs	Up to 256 status or clip warning, battery life, active battery bank
Input inferred noise	2µV rms typical 300- 7000Hz, 8µV peak typical
Fiber Optic Cable	5 meters standard, cable lengths up to 20 meters**

***Note:** When sampling at a rate of 48.828 kHz the PZ2 preamplifier is limited to a maximum of 128 channels.

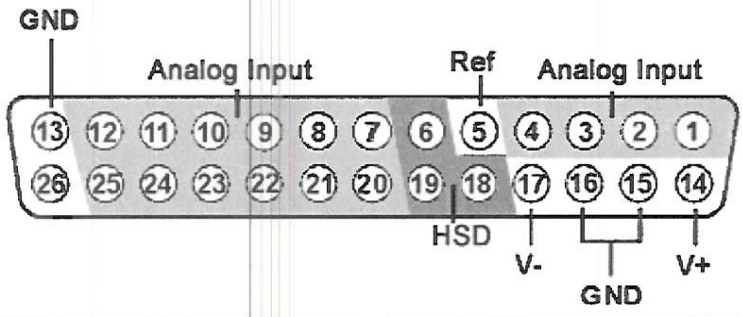
****Note:** If longer cable lengths are required, contact TDT.

Input Connectors

PZ2 Preamplifiers have up to 16, 26-pin headstage connectors on the back of the unit. A1 – A16 represent the 16 channels coming from each connected headstage. The PZ2 channels are marked next to the respective connector on the preamplifier. So, for the connector for channel 1 – 16, A1 is channel 1 while on the connector for channels 17 – 32, A1 is channel 17.

Important!: Each input connector uses its own unique ground and reference. When using multiple headstages, ground pins on all headstages should be connected together to form a single common ground. See the *Headstage Connection Guide*, page 5-33 for more information.

Pinout Diagram



Pin	Name	Description
1	A1	Analog Input Channels
2	A2	
3	A3	
4	A4	
5	Ref	Reference
6	HSD	Headstage Detect
7	A5	Analog Input Channels
8	A7	
9	A9	
10	A11	
11	A13	
12	A15	
13	GND	Ground

Pin	Name	Description
14	V+	Positive Voltage
15	GND	Ground
16	GND	
17	V-	Negative Voltage
18	HSD	Headstage Detect
19	HSD	
20	A6	Analog Input Channels
21	A8	
22	A10	
23	A12	
24	A14	
25	A16	
26	NA	Not Used

Note: Do not attempt to make any custom connections to pins 6, 18, or 19. These pins are intended for TDT use only.