

# RZ10 Lux Integrated Processor

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Hardware Reference



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# Table of Contents

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## **RZ10 Lux Integrated Processor**

RZ10 Overview	4
Power and Communication	5
Software Control	5
RZ10 Features	6
DSP Status Lights	6
Front Panel Display Screen	6
Fiber Optic Port	7
Legacy Fiber Optic Port	7
Onboard Analog Inputs	7
Digital I/O	8
LED Indicators	8
UDP Ethernet Interface	9
Specialized DSP/Optical Interface Boards	10
Onboard Lux I/O	10
RZ10 Technical Specifications	10
BNC Channel Mapping	11
DB25 Digital I/O Pinout	12

# RZ10 Lux Integrated Processor



## RZ10 Overview

The RZ10 platform includes light driving/sensing capabilities for lock-in amplification fiber photometry setups. The RZ10x model has twice as many light driving/sensing ports for running multiple subjects or to add optogenetic stimulation, and includes fiber optic connections for integrated multi-channel neurophysiology.

The RZ10 Lux Integrated Processor has a single 400 MHz Sharc digital signal processor (DSP). It includes one bank of integrated **Lux light drivers and photosensors**. The RZ10x model (shown above) has three DSPs and two Lux banks standard. Both models are expandable to up to four DSPs.

Each Lux bank has 3 output drivers and 2 inputs. Each output port can have either a Lux LED, an M8 connector to drive an external LED, or a BNC connector to control a voltage signal. Each input port can have either a Lux PS1 or PS2 photosensor, a Lux PM1 power meter, or a BNC connector to measure a voltage input. The components are interchangeable by the user.

The RZ10 includes one additional analog input channel. The RZ10x includes two additional analog input channels. The RZ10x fiber optic input port can acquire up to 32 channels of neurophysiological signals from a PZ amplifier at up to ~50 kHz for real-time processing synchronized to your fiber photometry data and/or optogenetic stimulation.

The RZ10 and RZ10x both feature 24-bits of digital I/O (four bits are accessible on the front panel BNC connectors) and a legacy fiber optic port to acquire neurophysiological signals from a Medusa4Z, RA8GA, or RA16PA preamplifier.

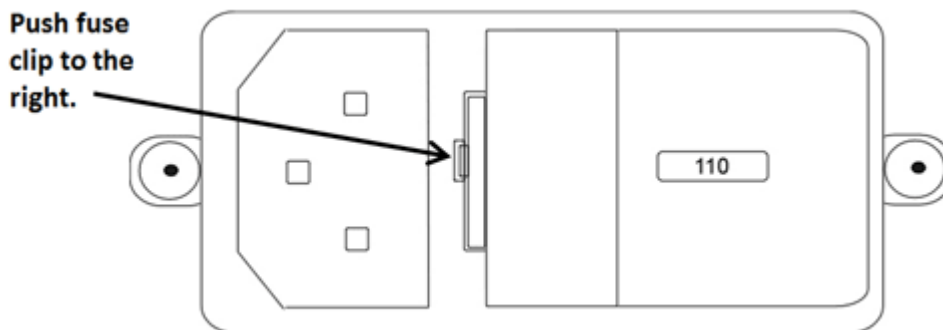
This manual provides hardware information for the RZ10. For a full application guide specific to fiber photometry using the RZ10, see the [Fiber Photometry User Guide](#).

## Power and Communication

The RZ10's Optibit optical interface connects to a [PO5](#), [PO5e](#), [PO5c](#), or [UZ3](#) computer interface card for fast and reliable data transfer from the RZ2 to the PC. Connectors on the back panel are color coded for correct wiring.

The RZ10's integrated power supply is shipped from TDT configured for the end user's regional voltage setting (110 V or 220 V). If you need to change the voltage setting:

1. Turn off the RZ10
2. Use a small flathead screwdriver to gently push the clip along the left side of the fuse plate to the right to remove it.



3. Remove the white AC voltage selector and rotate it until the desired voltage is displayed, then reinsert it and put the fuse plate back on.

The RZ10 is UL compliant, see the [RZ10 Operator's Manual](#) for power and safety information.

## Software Control

TDT's [Synapse](#) software controls the RZ10 and provides users a high level interface for device configuration.

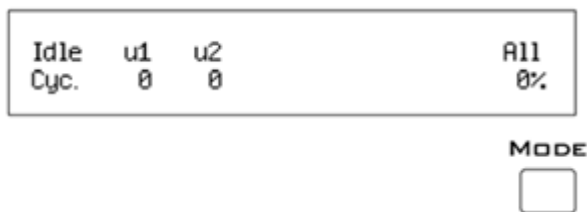
## RZ10 Features

### DSP Status Lights



These LEDs report the status of the multiprocessor's individual DSPs and will be lit solid green when the corresponding DSP is installed and running. The corresponding LED will be lit dim green if the cycle usage on a DSP is 0%. If the demands on a DSP exceed 99% of its capacity on any given cycle, the corresponding LED will flash red (~1 time per second). For QZDSPs, the LED indicates levels for the core with the highest cycle usage.

### Front Panel Display Screen



The front panel display screen reports detailed information about the status of the system. The top line reports the system mode, Run!, Idle, or Reset. The second line reports the user's choice of status indicators for each DSP followed by an aggregate value.

The user can cycle through the various status indicators using the Mode button to the bottom right of the display. Push and release the button to change the display or push and hold the button for one second then release to automatically cycle through each of the display options. The display screen may also report system status such as booting status (Reset).

#### Note

When burning new microcode or if the firmware on the RZ is blank, the display screen will report a cycle usage of 99% and the processor status lights will flash red.

Indicator	Description
Cyc	Cycle usage. For QZDSPs, the highest core cycle usage is shown
Bus%	Percentage of internal device's bus capacity used
I/O%	Percentage of data transfer capacity used
Opt	Connection (sync) status of legacy amplifier

## Fiber Optic Port

The fiber optical port next to the Digital I/O connector can be used with a Subject Interface, PZ5 amplifier, or iCon Behavioral Controller for up to 128 channels of electrical stimulation, 32 channels or neurophysiological recording, or behavior control. It is labeled 'M' or 'SI'.

### Note

RZ10x with serial number <2000 had a port labeled 'PZ' for PZ5 NeuroDigitizer support only.

## Legacy Fiber Optic Port

The RZ10 has one Legacy fiber optic ports labeled Legacy Amp to acquire digitized signals from the [Medusa4Z](#), [RA16PA](#), or [RA8GA](#). This port can read up to 16 channels at a maximum sampling rate of ~25 kHz.

## Onboard Analog Inputs

The [Onboard Lux I/O](#) is the primary analog I/O on the RZ10. However, the RZ10 model has an extra channel of 16-bit PCM A/D input accessible through the BNC marked 'ADC4'. The RZ10x model has an additional channel marked 'ADC8'. See the [Synapse Manual](#) for information on using these inputs.

## Digital I/O

The digital I/O ports include 24 bits of programmable I/O. The digital I/O is divided into three bytes (A, B, and C) as described in the chart below. All digital I/O lines are accessed via the 25-pin connector on the front of the RZ10 and bits 0 - 3 of byte C are available through BNC connectors on the front panel labeled Digital. See [RZ10 Technical Specifications](#) for the DB25 pinout.

The digital I/O is configured in the [Synapse RZn Hal](#).

Digital I/O	Description	DB25	BNCs	Notes
Byte A	bits 0 - 7	Yes	No	byte addressable
Byte B	bits 0 - 7	Yes	No	byte addressable
Byte C	bits 0 - 7	Yes	Yes*	bit addressable

\*Note: Byte C Bits 0 - 3 are available via front panel BNCs

The data direction for the Digital I/O is also configured in the [Synapse RZn Hal](#).

The RZ digital I/O ports have different voltage outputs and logic thresholds depending on the type. Below is a table listing the different voltage outputs and thresholds for both types.

Digital I/O Type	Output High	Output Low	Input High	Input Low
Port A & Port B	5 V	0 V	$\geq 2.5$ V	0-2.45 V
Port C	3.3 V	0 V	$\geq 1.5$ V	0-1.4 V

## LED Indicators

The RZ10 has 16 LED indicators for the analog and digital I/O located directly below the display screen and DSP status LEDs.



## Digital I/O

These LEDs indicate the state of the 8 bit-addressable I/O of byte C.

Light Pattern	Description
Dim Green	Bit is configured for output and is currently a logical low (0)
Solid Green	Bit is configured for output and is currently a logical high (1)
Dim Red	Bit is configured for input and is currently a logical low (0)
Solid Red	Bit is configured for input and is currently a logical high (1)

## Analog I/O

These LEDs indicate the state of the four ADC and four DAC channels.

Light Pattern	Description
Off	Analog I/O channel signal voltage is less than $\pm 100$ mV
Dim Green	Analog I/O channel signal voltage is less than $\pm 5$ V
Solid Green	Analog I/O channel signal voltage is between $\pm 5$ V to $\pm 9$ V
Solid Red	Analog I/O channel clip warning (voltage greater than $\pm 9$ V)

### Note

ADC channel 3 and DAC channel 4 are used internally while the RZ10 is actively running, so the ADC3 and DAC4 LEDs will flash  $\sim 1$  Hz during normal operation.

## UDP Ethernet Interface

The RZ UDP Ethernet interface can transfer low bandwidth data directly to or from a PC. RZ devices equipped with a UDP interface have an additional Ethernet port and RS232 serial port located on the back panel. See [RZ-UDP Communications Interface](#) for more information.

## Specialized DSP/Optical Interface Boards

The RZ standard DSP boards can be replaced with specialized DSP boards which include an optical interface for communication and control of RZ compatible devices, such as the Subject Interface and RS4 Data Streamer. RZ devices equipped with one or more specialized DSP boards include an optical port for each card. The ports are located on the back panel and labeled for easy identification.

DSP	Supported Peripheral
RZDSP-I	I22 Stimulators
RZDSP-M	Subject Interface, PZ5 amplifier, iCon Behavioral Controller
RZDSP-P	PZ amplifier. It can be used to expand the number of channels that can be acquired on any RZ processor
RZDSP-S	RS4 Data Streamer, allowing the RZ device to stream data directly to the RS4's storage arrays
RZDSP-U	PO8e interface card, allowing the RZ device to stream data directly to client software
RZDSP-V	RV2 Video Tracking System
QZDSP_OPT	Supports all of the above devices

## Onboard Lux I/O

The RZ10 has one bank of integrated Lux components. Each Lux bank has three built-in current driver outputs for driving integrated LEDs directly, or external LEDs connected to an M8 cable. Each Lux bank also has two input slots for photosensors and/or power meters. The RZ10x includes a second full bank for Lux components.

See the [Lux hardware manual](#) for more information and technical specifications.

## RZ10 Technical Specifications

### Note

Specifications for amplifier A/D converters are found under the preamplifier's technical specifications.

DSP	Up to four standard DSPs and/or quad-core (QZDSP) DSP: 400 MHz DSPs, 2.4 GFLOPS peak per DSP QZDSP: Four 400 MHz DSPs, 2.4 GFLOPS per core
Memory	64 MB SDRAM per standard DSP 256 MB DDR2 RAM per core, four cores per QZDSP
Digital I/O	8 programmable bits: 3.3 V (5.0 V max input), 25 mA max load 2 programmable bytes (16 bits): 5.0 V (6.0 V max input), 35 mA max load
<b>A/D</b>	<b>1 channel, 16-bit PCM</b>
Sample Rate	Up to 48828.125 Hz
Frequency Response	DC - 7.5 kHz (3 dB corner, 2 <sup>nd</sup> order, 12 dB per octave)
Voltage In	±10.0 V
S/N (typical)	82 dB (20 Hz - 20 kHz at 9.9 V)
Input Impedance	10 kOhms
<b>Fiber Optic Ports</b>	
SI	RZ10x (serial >=2000): One connection for Subject Interface, PZ5, or iCon
PZ	RZ10x (serial <2000): One connection for PZ5 NeuroDigitizer
Legacy Amp (Medusa)	16-channel input, up to 24414.0625 Hz

## BNC Channel Mapping

Please note channel numbering is printed on the face of the device to minimize mis-wiring.



Maps To:  
Ch 4 Analog In



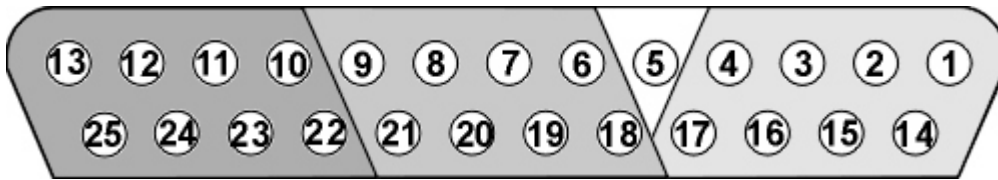
Ch 8 Analog In (RZ10x only)



Maps To:  
Port C Bits 0-3 Digital I/O



## DB25 Digital I/O Pinout



Pin	Name	Description	Pin	Name	Description
1	C0	Port C Bit Addressable	14	C1	Port C Bit Addressable
2	C2		15	C3	
3	C4		16	C5	
4	C6		17	C7	
5	GND	Digital I/O Ground	18	A0	Port A Word Addressable
6	A1	Port A Word Addressable	19	A2	
7	A3		20	A4	
8	A5		21	A6	
9	A7		22	B0	Port B Word Addressable
10	B1	Port B Word Addressable	23	B2	
11	B3		24	B4	
12	B5		25	B6	
13	B7				

If using a PP24 Patch Panel, see [PP24 to RZ10 Digital I/O](#).