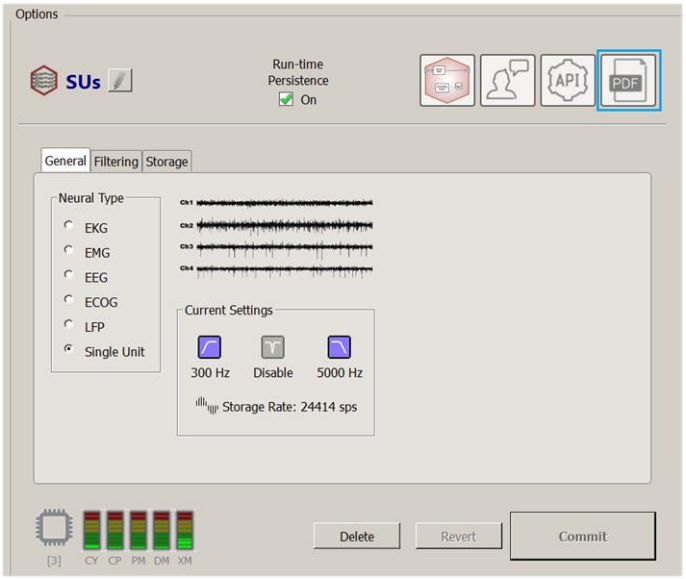
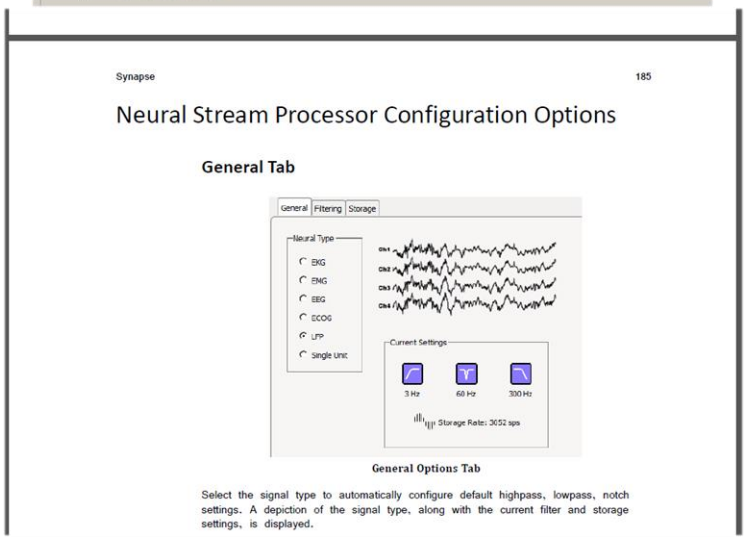
Gizmo Resources

Synapse Manual, Gizmo Slides and Cheat Sheets

TDT provides users with several information resources for learning about gizmos. The most in depth resource is the Synapse Manual, which users can access directly within Synapse by clicking the PDF icon shown in the Options icon bar of any gizmo.





Synapse 185

Neural Stream Processor Configuration Options

General Tab

General Options Tab

Select the signal type to automatically configure default highpass, lowpass, notch settings. A depiction of the signal type, along with the current filter and storage settings, is displayed.

TDT has developed new Gizmo Slides and Gizmo Cheat Sheet resources to further help users understand the features and use cases for individual gizmos. The Gizmo Slides are accessed from Synapse and provide specific information about a gizmo's function, inputs and outputs, and provides examples on how to use it and access important gizmo parameters in Run-Time or via the API. The Gizmo Cheat Sheets are useful as a high-level overview of gizmo categories and the use cases for any gizmo within a category.

Gizmo Slides

What are Gizmo Slides?

Gizmo Slides are a new user help tool in Synapse.

Gizmo Slides can be access directly within Synapse.

Each Gizmo Slide has specific information about a gizmo's function, inputs and outputs, and provides examples on how to use it and access important gizmo parameters in Run-Time or via the API.

How Can I Access Gizmo Slides?

Gizmo Slides can be accessed in two simple steps

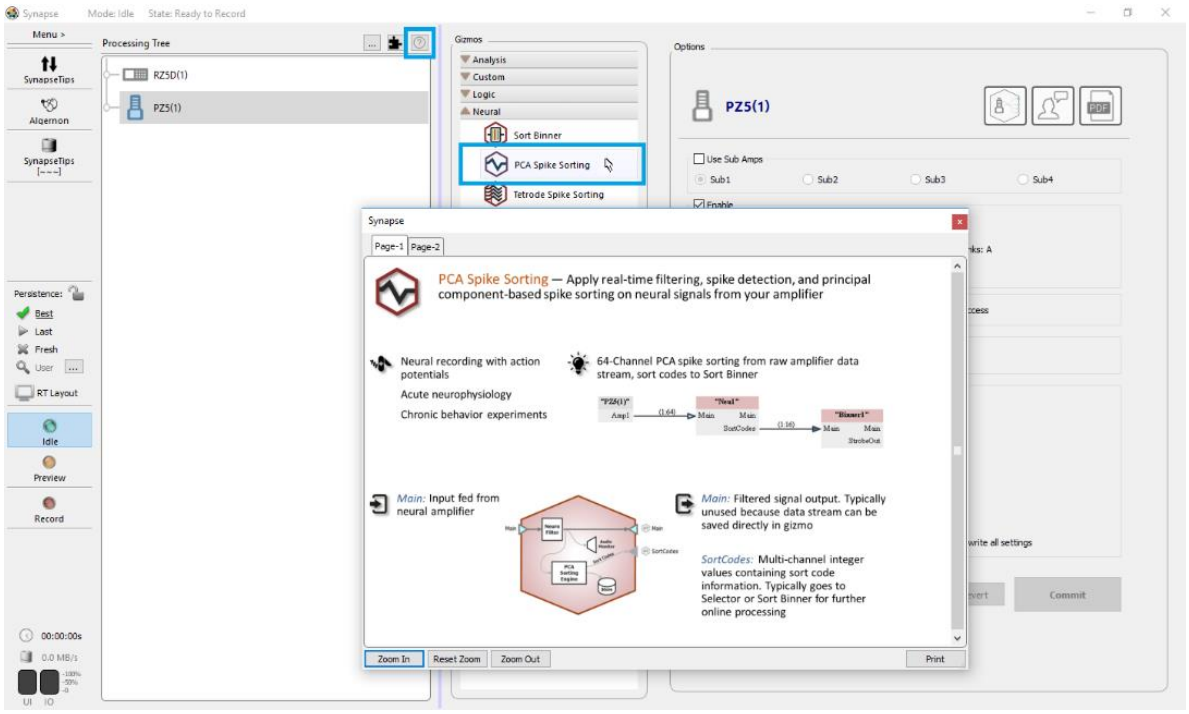
1. Click on the '?' icon above the processing tree.

   This will generate a pop-up window for the gizmo slides.

2. Select a gizmo whose slides you wish to view.

   The Gizmo Slides pop-up will automatically update for the selected gizmo.

   This function can be accessed with Gizmos already in the Processing Tree. Available Gimzos to highlight are pruned based on connection compatibility with the selected item in the Processing Tree.



Gizmo Cheat Sheet – Analysis Gizmos

Perform powerful real-time analysis on incoming signals

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Signal Accumulator**	Collect a sum of an incoming signal over a user-defined window. Optionally compute the average as well. Can also perform thresholding of accumulated signal for further processing	Use this gizmo to calculate the total power of a signal over a specified time span, or to compute average signal power over many trials	Any single or multi-channel data stream The sum of the accumulated signal and optionally the average.

Gizmo Cheat Sheet – Logic Gizmos

Combine logical signals originating from external hardware or other gizmos into meaningful logic states

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **State Maker**	State Maker is an interface for performing logical tests on single-channel inputs and combining results into output states for storage and controlling/ triggering other gizmos for further signal processing	Use this gizmo when receiving bit codes from external devices, and to make decisions/ process gizmo output values. Used often to trigger store events or strobing other gizmos	Digital I/O inputs from RZ gizmo, or inputs from other gizmos, such as integer values from a Selector reading sort codes Output variable duration logic triggers based on a combination of keys and marks
 **Timer**	Measures time between or duration of logical events from primary and secondary inputs	Use this gizmo to calculate event frequency or time logical events. Can be used to measure response time to stimuli, calculate heart rate, and time other physiologic intervals	Any logic signals Output smoothed or instantaneous measurements of period or frequency
 **Pulse Generator**	Creates user-defined pulse trains based on milliseconds or Hz. Control duty cycle, period, number of pulses, and trigger pulse trains internally or from other gizmos	Use this gizmo for directly controlling optogenetic stimulation or driving the timing of other connected gizmos or devices	Logic strobe signal for other gizmos or digital I/O Output TTL or floating-point pulses to be routed to other gizmos or I/O
 **User Input**	Create dynamic stores and logic outputs based on inputs from digital I/O bits or a software button	Use this gizmo to store I/O inputs with values defined by user or another gizmo and create fixed-duration, toggled, or edge logic outputs based	Input from digital I/O bits or software button Output logic as an edge, fixed-duration TTL pulse, or toggled output. Output can be a counter, a user-set value, or gizmo input

Gizmo Cheat Sheet – Neural Gizmos

Neural gizmos combine all your real-time neurophysiology processing tasks

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Box Spike Sorting**	Real-time filtering, spike detection, and discrimination of neural signals using time-voltage windows	Use this gizmo to sort neuronal spikes on individual channels using time-voltage discrimination windows	Input any multi-channel neural stream (raw amplifier stream) Output integer sort codes
 **Tetrode Spike Sorting**	Real-time filtering, cross-channel tetrode spike detection and classification in a fully customizable 2D feature projection	Use this gizmo for sorting spikes using tetrodes. Commonly used for cell isolation, tetrode sorting provides high spatial localization of nearby units	Any multi-channel neural stream (raw amplifier stream), often from a mapper to organize tetrode channels Output integer sort codes
 **PCA Spike Sorting**	Real-time filtering, spike detection, and principal component-based spike sorting with selectable algorithms	This is the most common method for spike sorting. Cluster units in PCA space and identify spikes automatically or manually cut	Input any multi-channel neural stream (raw amplifier stream) Output integer sort codes
 **Sort Binner**	Compress sort code output from spike sorting gizmos for fast viewing and further processing. Optionally output to RZ UDP interface for external processing	Use this gizmo to count the number of sort codes that occur on specific channels within a user-specified time window	Input from sort code outputs of spike sorting gizmos Output 32-bit integer words that are a count of sort codes per channel
 **Neural Signal Referencer**	Digitally subtract common signals from multi-channel stream. Single or multi-channel referencing on all channels or independent sub-groups of channels	Use this gizmo to eliminate common mode noise across channels or to perform digital re-referencing. Multi-channel referencing won't create artificial waveforms on your signal	Input any multi-channel neural stream (typically pre-filtered) Output multi-channel re-referenced signal, and save reference signal itself
 **Neural Stream Processor**	Easily visualize, filter and store real-time multichannel neurophysiology signals. Includes built in, optimized settings for the most common biologic signal types	Use this gizmo for easy filtering and storage of common signal types: LFP, EEG, EMG, Single-Unit, EKG	Input any neural stream (typically the raw signal) Outputs filtered signal, and also saves the filtered signal by default

Gizmo Cheat Sheet – Specialized Gizmos

Specialized gizmos encapsulate a specific application all in one gizmo

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Fiber Photometry**	Real-time control and acquisition of demodulated locked-in amplification signal from any combination of up to 4 light drivers and 2 photosensors	This is the primary gizmo used in fiber photometry setups. Record up to 8 demodulated signals with raw photosensor output too	Input from DAC channels to drive LEDs Output demodulated Driver x Sensor signals
 **MRI Recording Processor**	Suppress MRI recording artifacts using controllable signal gate. Titrate gating tightly around artifact to clean up online signals	Use this gizmo to eliminate gradient switching artifact in an MRI recording environment. Can automatically detect artifacts or be triggered using timing signal from the magnet	Input any multi-channel neural stream Output multi-channel filtered and artifact-free single unit and LFP signals
 **Calcium Image Processor**	Use this gizmo in combination with an endoscope to capture and process calcium imaging data in real-time	Freely-behaving in vivo calcium imaging	Miniscope camera feed Signal strength in ROI

Gizmo Cheat Sheet – Routing Gizmos

Work with single or multi-channel signals in the Synapse framework

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Mapper**	Create user-defined channel maps to reroute electrode sites to different amplifier channels	Use this when you want to create ordered spatial maps with unordered electrode sites	Any multi-channel stream, typically right from the amplifier Output a reordered multi-channel stream
 **Selector**	Pick off individual channels from a multi-channel stream, or isolate specific channel and sort code combinations from Sort Binner	Use this gizmo for routing individual channels for monitoring or further processing, or for reading Sort Binner outputs of single channel + sort code information	Any multi-channel signal or Sort Binner Output the isolated channel for further processing or the Sort Binner count of sort code occurrences on the specified channel
 **Merger**	Combine up to eight single or multi-channel streams into a single multi-channel stream	Use this gizmo to send separate data into a single multi-channel stream for processing in other gizmos or storage	Two or more single or multi-channel data streams. Must be of the same single or multi-channel type Output the merged data streams
 **Injector**	Insert a single channel input into a multi-channel data stream at specific user-specified channels	Choose a channel for electrical stimulation. Can also be used to route audio signal to a speaker array (channel in DAC Montage).	A single channel input such as eStim or aStim Output into a multi-channel signal with channel routing information
 **Delay**	Adds a fixed or dynamic delay to any input signal	This gizmo is useful for triggering optogenetic, auditory, or other stimuli a programmed time after an event of interest occurs	Input from any signal Output the same signal at a specified time later
 **Parameter Manifold**	Control multiple stimulation gizmo parameters simultaneously	Use this gizmo when needing to share parameters between multiple stimulation gizmos, such as duration or pulse count. Often used in conjunction with Parameter Sequencer	Strobe signal input from other gizmos Output shared parameter values to multiple gizmos

Gizmo Cheat Sheet – Signal Conditioning Gizmos

Perform signal conditioning and processing on incoming data

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Unary Processor**	Implement series of mathematical operations to incoming signals	Use this gizmo to perform interesting signal processing on incoming data, such as power in band, RMS, or scaling. Can also perform complex thresholding or type conversion on signals	Any single or multi-channel data stream Outputs the processed data stream or a converted signal type
 **General Purpose Filter**	Create filters with user-defined parameters that include high/ low pass corners up to 8th order and notches with varying cut depths and bandwidths	Use this gizmo to design a filter with higher orders or more notches than the Neural Stream Processor can provide	Any single or multi-channel data stream Outputs the filtered data stream
 **Artifact Blocker**	Suppress artifacts associated with triggered events. Includes gate timing parameters for control of gate shape	Use this gizmo to remove large artifacts during events like electrical stimulation or motion artifact	Any single or multi-channel data stream Outputs the same signal, but with the data removed around the artifact event

Gizmo Cheat Sheet – Stimulation Gizmos

Stimulation gizmos generate precisely sequenced audio, electrical, or optical stimulation

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Parameter Sequencer**	Control stimulus parameters with complex timing and presentation sequences (rolling, repeated, random, manual)	High-level parameter control and stimulus presentation	Root or strobe input from another gizmo Outputs Parameter value and strobing logic
 **Audio Stimulation**	Generate fully customizable tone, noise, and other audio stimulation types	Use this gizmo for audio neurophysiology, stimulus-response protocols, hearing screening protocols, and psychoacoustics	Strobe inputs; parameter inputs from Parameter Sequencer Output the audio signal and a stim sync logic signal
 **Electrical Stim Driver**	Create up to four stimulation voices for single-ended or bipolar stimulations outputs on a target device, such as an IZ2 or IZV. Create monophasic or biphasic waveforms with charge balancing options.	Use this gizmo for design of interesting electrical stimulation waveforms	Strobe inputs; parameter inputs from Parameter Sequencer Output voices to target stimulation devices
 **File Stimulation**	Play custom waveforms from a list of files on disk, which includes WAV files and MAT files	Use this for speech studies, psychoacoustics, or for custom audio or electrical stimulus presentations	Strobe inputs; parameter inputs from Parameter Sequencer Output stimuli and a stim sync signal
 **Ultrasonic Stimulation**	A streamlined version of Audio Stimulation for creating stimuli at ultrasonic frequencies	This gizmo is useful for audio neurophysiology and stimulus response protocols for animals that can hear in the ultrasonic frequency range	Strobe inputs; parameter inputs from Parameter Sequencer Output the audio signal and a stim sync logic signal

Gizmo Cheat Sheet – Storage Gizmos

Precisely timestamp and store any type of real-time data to disk

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Stream Data Storage**	A general-purpose gizmo used to store single or multi-channel data streams. Includes data formatting and scaling options	Use this gizmo to store raw data directly from your amplifier. Use on the output of other gizmos that do not have storage options, like Unary Processor	Any single or multi-channel data stream No outputs
 **Strobed Data Storage**	Store single values or short segments of data (including pre-trigger data). Includes heat maps and bar plots	Use this gizmo to store streaming data asynchronously or store values/ segments of data around events of interest	Any single or multi-channel data stream and a strobe input No outputs
 **Epoch Data Storage**	Timestamp and store single or multi-channel data when triggered	Use this gizmo to capture behavioral inputs or stimulus parameters to filter and align neurophysiological data	Any data input and a strobe input No outputs

Gizmo Cheat Sheet – Visualization Gizmos

View incoming signals in dynamic ways and perform interesting processing on them

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **Oscilloscope**	Has all the functionality of a hardware oscilloscope and more. View up to four channels at user-defined ranges and domains, and perform complex signal testing for creating trigger outputs	Use this gizmo to visualize signals on a more refined time scale, or to perform thresholding or hysteresis tests for complex triggering paradigms like phase-locked stimulation off LFPs	Any single-channel signal Outputs logical triggers and delayed signal

Gizmo Cheat Sheet – Custom Gizmos

Create your own custom real-time signal processing function

Gizmo	About this Gizmo	When to Use	Common Inputs & Outputs
 **User Gizmo**	Use the RPvdsEx coding environment to make a custom gizmo with any component in the RPvdsEx library	When you can't find a standard gizmo to do what you want	Any single or multi-channel data stream