PsychRP Manual

PsychRP Manual – Version 1.06

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Before You Begin

System Requirements

PsychRP requires the following minimal hardware configuration:

1. RP2.1 real-time processor mounted in a ZB1PS device chassis with an USB interface device, such as the UZ2.*

2. Button response box configured for the RP2.1 digital I/O port, such the four button RBOX-RP2 or eight button BBOX.

3. Stimulus amplifier and transducer, such as the SA1 and a loudspeaker, the HB7 and earphones, or the MS2.

4. Desktop or laptop PC with a USB port and operating system that supports USB communication, such as Microsoft Windows 98 or later.

5. PsychRP and TDT ActiveX controls.

*Note: PsychRP also supports the Gigabit and Optibit interfaces.

Optional equipment includes:

1. Attenuator(s), such as the PA5.

2. Calibration microphone or sound level meter.

3. Signal mixer, such as the SM5.

Setting Up Your System

Install Software

If you haven't done so, install the most current versions of each of the following on your PC: TDT Drivers, RPvdsEx, PsychRP, and ActiveX. Instructions for installing the TDT Drivers software and setting up your system can be found in the TDT System 3 Installation Guide document.

Test Communication

Test to ensure that your PC is correctly communicating with the RP2.1 using the zBUSmon program (found in the C:\TDT\zDrv3 directory, for default installations). The zBUSmon display should show a map of your TDT System 3 devices, including your RP2.1. Check the **Show Version** check box to ensure that the version displayed for the RP2.1 matches the version number shown in the RPvdsEx Help | About menu. If not, reprogram the RP2.1 microcode following the instructions found in the System 3 Manual.
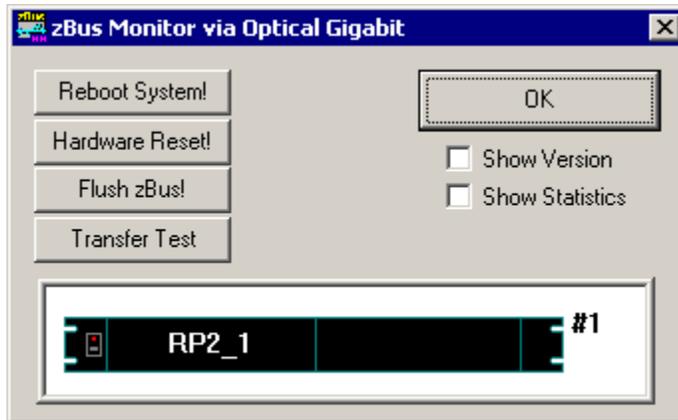
Hardware

Connect the RBOX cable to the 25 pin connector on the front panel of the RP2.1, shown below in the leftmost red circle. To send the signal directly to an amplifier and speaker, connect a BNC cable to the output of the RP2.1 labeled OUT-1, shown in the diagram below in the rightmost circle, then connect the cable to the input of an appropriate amplifier for your acoustic signal.

This might be the SA1 speaker amplifier and a free-field speaker, the HB7 headphone buffer and a set of headphones, the MS2 monitor speaker, or to a third-party amplifier of your choice. If you wish to attenuate, mix or otherwise modify the PsychRP output signal before presenting it to the subject, simply insert the appropriate device in line on this output connection.

Introduction

PsychRP is a flexible psychoacoustic software application for System 3 hardware. PsychRP offers the choice of three different adaptive tracking paradigms:

- Bekesy-type tracking (hereafter referred to as *Bekesy*)
- Modified Method of Limits (*MMOL*)
- n Alternative Forced-Choice (*nAFC* with up to 8 intervals)

In each of these paradigms, PsychRP monitors the subject's response through a response box and adjusts the value of a *dynamic variable* based on these responses. The dynamic variable controls stimulus level by default, but can also control user-defined parameters, such as modulation frequency or gap duration.

Reversals in dynamic variable value are tracked and used to calculate a threshold for the *trial*, a preset number of reversals or stimuli at a given *independent variable*, e.g. frequency. PsychRP can be used to determine threshold for a single independent variable, or automatically determine threshold for a set of user-defined independent variables. Advancing between trials can be controlled by the subject, the experimenter or automatically.

The pre-configured stock stimuli in PsychRP are pure tone bursts or band-limited noise bursts. By default, the dynamic stimulus variable is signal level and the independent variable is the center frequency of the tone or noise bursts. The default PsychRP configuration can be used to easily determine a psychophysical audiogram to stock stimuli using one of the three available paradigms.

The hardware engine upon which PsychRP runs is TDT's RP2.1 Real-Time Processor. User responses are entered through a four-button response box connected to the digital I/O port of the RP2.1. A calibration routine is included for *stock* stimuli, tone or noise bursts, so that presentation levels can be set and threshold determined in terms of dB SPL.

PsychRP can take advantage of the flexibility of TDT's RPvdsEx, a graphical programming interface for TDT's real-time processing hardware. The stock stimuli are generated by RPvdsEx processing chains for each of the three available paradigms and these processing chains are controlled through ActiveX controls by PsychRP. The RPvdsEx processing chain for each of these default paradigms is included in your installation and can be used as a framework to generate custom stimuli of the user's design. The user-defined RPvdsEx processing chains would then serve to generate and control the custom carrier stimulus in any of the three available psychoacoustic paradigms. Examples of custom processing chains are provided on page 35.

Data and settings for each trial are stored in a PsychRP data file, a tab delimited text file that is easily imported into third-party analysis programs.

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Starting PsychRP

In most installations, PsychRP.exe will appear in the directory:

C:\TDT\PsychRP\PsychRP.exe

The shortcut to PsychRP should also appear in the start menu:

Start->Programs->TDT Sys3->PsychRP->PsychRP.exe

Run PsychRP by double-clicking the shortcut icon ![RP icon], or clicking the listing of PsychRP.exe from the Windows Start menu.

Upon opening PsychRP, the following window will appear. (Subjects should not have access to this window during the course of the experiment). As you acquire data in PsychRP, the leftmost *Trial* plot will show the data as it is acquired within an individual trial, e.g. a Bekesy trial for a single frequency. The rightmost *Threshold* plot, will show the calculated threshold for each trial (e.g. for each frequency). The thresholds are plotted from left to right in the order in which they were acquired, without regard for the independent variable values. In the initial screen a single random data point is shown in each plot.
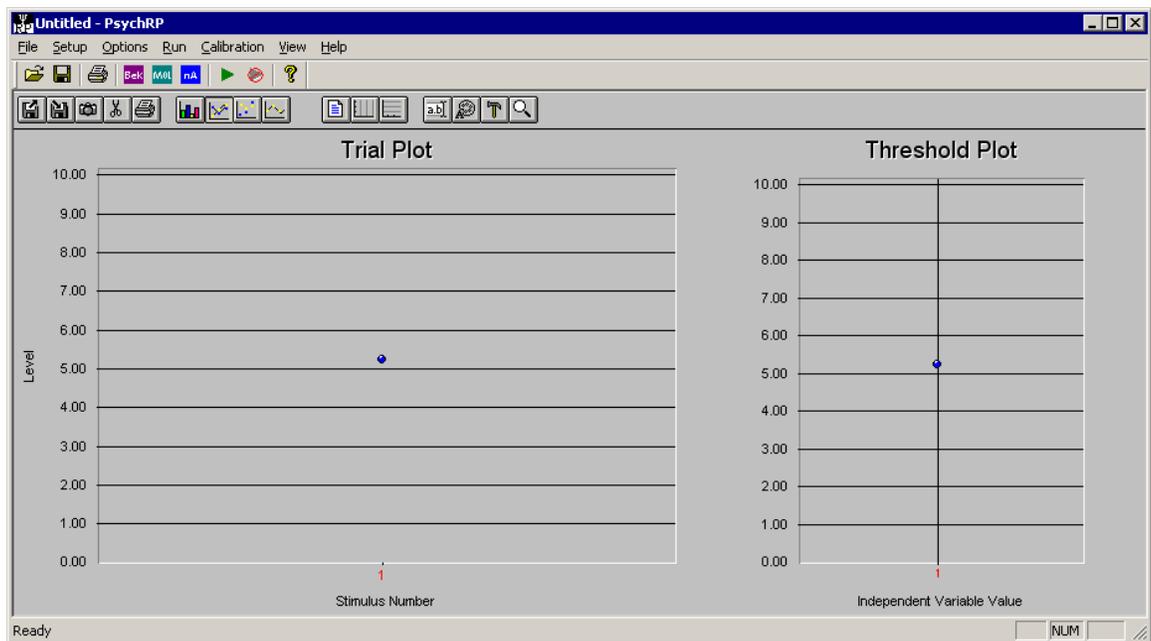
Running Your First Trial

PsychRP is configured by default to run a Bekesy tracking paradigm with pure tone burst stimuli. To run this default paradigm, select the **Run** option from the **Run** menu, or click the green **Run** icon ![run icon] in the tool bar.

or

Results File

PsychRP requires access to a file in which to store the acquired data. If you have not specified an output file, PsychRP will prompt you to do so before running the trial. PsychRP data files are simple text files that use a *.dat extension by default.

Running the Bekesy Paradigm

In the default Bekesy tracking paradigm, the subject should press and hold RBOX button #1 while the stimulus is audible. This will instruct the PsychRP software to decrease the stimulus level. When the stimulus level has decreased below the audible level, the subject should release the response button, an instruction for PsychRP to increase the stimulus level. The actual psychophysical threshold level should be somewhere between the levels that were just *audible* to the subject (peaks in the stimulus level) and the levels that were just *inaudible* to the subject (troughs in the stimulus level.)

In PsychRP, a curve similar to that shown here might be recorded to the Bekesy paradigm, where the average of these reversal points was at a stimulus level of about 1.75 Volts. Using the calibration routines described elsewhere, the sound pressure level at this voltage can be calculated, and the threshold described in terms of dB SPL.
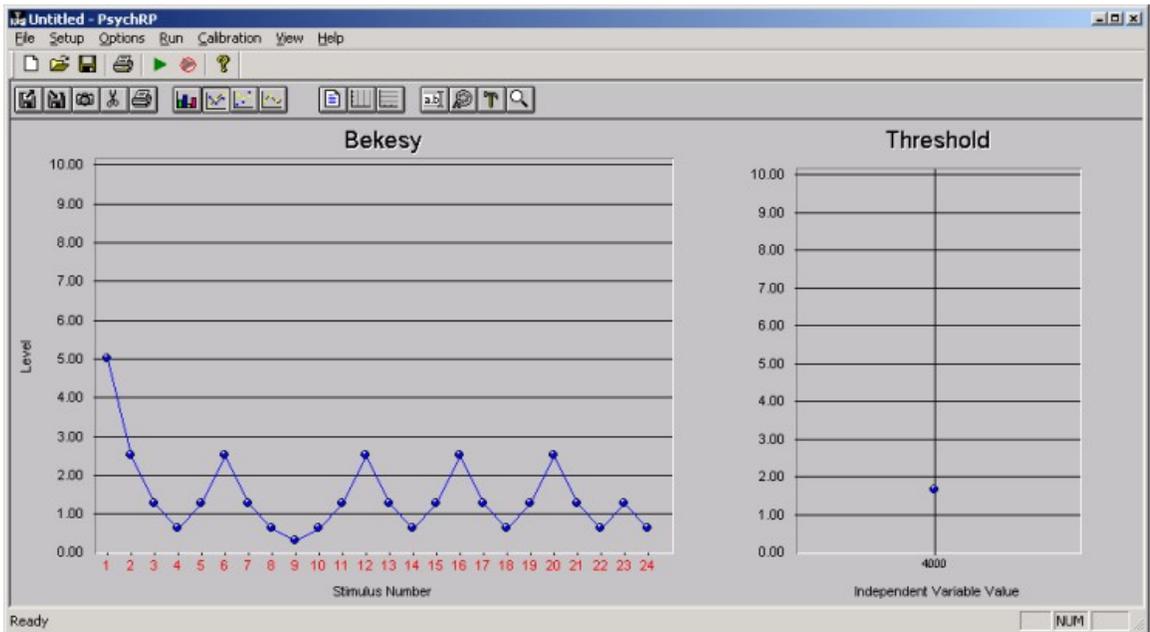
Note that the data in the trial window is not displayed until the response to a given stimulus has been obtained, thus this plot will lag behind the actual stimulus presentation.

Paradigms

PsychRP offers the choice of three different adaptive tracking paradigms: Bekesy, Modified Method of Limits, and n Alternative Forced-Choice. The setups for each paradigm are stored individually so that different paradigms with different settings could be run in the same experimental session without re-configuring.

In each paradigm, the subject's task is to use a response box to indicate whether a target stimulus was detected. On the subsequent stimulus presentation, the value of the dynamic variable is adjusted up or down based on the subject's response. Generally the dynamic variable, e.g. stimulus level, would be decreased until it is undetectable to the subject, at which point it would be increased until it is again detectable.

The points at which the dynamic variable changes direction are termed *reversals*. The psychophysical threshold level should be somewhere between the positive reversals, where the dynamic variable changed from increasing to decreasing, and the negative reversals, where the dynamic variable changed from decreasing to increasing.

Stock stimuli for each paradigm are either pure tone bursts or band-limited noise bursts. Custom .rco files can be created with dynamic variables other than stimulus level. These custom dynamic variables can also be tracked using one of the standard paradigms. For example, the dynamic variable might be used to control gap duration which could be adjusted using the Bekesy-type tracking paradigm.

Bekesy Type Tracking

The Bekesy type tracking paradigm presents stimuli at a fixed Interstimulus Onset Interval (ISOI). The subject responses are entered through Response Box button #1. Subjects should generally be instructed to press and hold this button as long as the target stimuli are detectable.

The response is determined at the end of the ISOI. If the response button is pressed at this time, PsychRP logs as a positive response to the preceding stimulus.

Details for setting up the Bekesy paradigm can be found on page 10.

Modified Method of Limits

The Modified Method of Limits is similar to the Bekesy-Type tracking paradigm in that it is a staircase paradigm, alternating between ascending and descending series. However, in the modified method of limits, the Interstimulus Onset Interval is random, occurring within a user-specified range. Moreover, the subject is required to indicate that the stimulus was detected by pressing and releasing response box button #1 within a temporal response window specified by the experimenter.

Details for setting up the MMOL paradigm can be found on page 15.

n *Alternative Forced-Choice*

In the n Alternative Forced-Choice paradigm, the subject is presented with between one and eight stimuli in a set. One of the stimuli in the set is the *target* stimulus; the remaining stimuli are *standard* stimuli. The target and standard stimuli differ in the value of stimulus parameter that is controlled by the dynamic variable. For standard stimuli, this parameter remains constant throughout the trial, for target stimuli this value is adjusted adaptively.

The values for the target and standards are specified in the Setup nAFC menu. The temporal order in which the target and standards appear within the set is random.

The subject should be instructed to depress and release the button on the response box that corresponds to the position of the target in the set. If the subject does not correctly identify the position of the target stimulus, the dynamic variable is adjusted in the default direction. If the subject correctly identifies the target stimulus, the dynamic variable is adjusted opposite the default direction. The subject must respond before the next stimulus will be presented. A correct response is indicated by all LEDs on the response box being simultaneously lit.
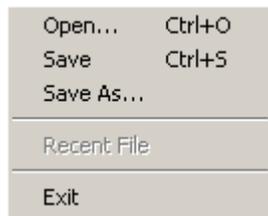
Details for setting up the nAFC paradigm can be found on page 20.

Menus

The PsychRP menus provide access to a variety of tasks. However, most common tasks will be preformed using the PsychRP toolbars.
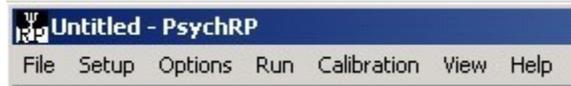

File Menu

The settings for all PsychRP menu options can be saved and later recalled using the File menu. Using this feature, any number of experimental setups can be saved and recalled without having to manually re-configure each setting from within PsychRP for each experimental session. The configuration file extension is *.prp. The configuration files are binary, and can not be edited.

Setup Menu

The Setup menu is divided into three major sections.
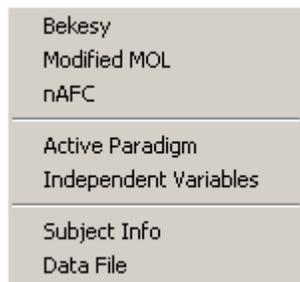
The top section contains the submenus used to configure the Bekesy, Modified Method of Limits and nAFC paradigms.

The middle section contains the submenus to select the currently Active Paradigm, and to setup the Independent Variables file.

The bottom section of the Setup Menu contains the submenus to enter Subject Information and to select the Data File which will be used to store experimental data.

Setup Bekesy

The Setup | Bekesy Menu contains groups of controls for Stimulus Parameters, Paradigm Settings, Threshold Calculation and Calibrated Output.

Bekesy Stimulus Parameters

Center/Tone Frequency (Hz)

Specifies the carrier frequency for Tone stimuli or the center frequency for Noise stimuli. For tones, frequencies between about 20 Hz and 20 kHz can be generated. For noise, the same frequency restrictions apply. However, the acceptable center frequencies for noise stimuli are affected by the Noise Bandwidth setting. For example, setting the Noise Bandwidth to 1 octave and the center frequency to 5 kHz would create an acceptable passband of ~3.5 kHz to ~7.0 kHz. However, if the center frequency were adjusted to 15 kHz, the resulting 1 octave passband would be ~10.6 kHz to ~21.2 kHz, beyond the 20 kHz upper frequency limit of PsychRP. The upper frequency will automatically be adjusted back to about 20 kHz, regardless of setting.

Noise Bandwidth (Octaves)

Used in concert with the Center Frequency setting specifies the low-pass corner frequency and high-pass corner frequency for noise stimuli based on the following calculation:

$$HP = \text{center frequency} * 2^{-bandwidth/2}$$
$$LP = \text{center frequency} * 2^{bandwidth/2}$$

The noise stimulus is a Gaussian white noise stimulus, filtered to the desired pass band using 4th order Butterworth IIR filters set to the user-specified cutoffs.

Duration (ms)

The envelope of the stock stimuli is created using a linear gate with a user-specified duration as discussed below. The duration specified here refers to the total duration of tone or noise burst, including the rise and fall times. The plateau of the stimulus = duration - 2 * R/F time.

ISOI (ms between Onsets)

Sets the approximate Interstimulus Onset Interval (ISOI). The ISOI should be long enough that the subject has time to process and respond to a given stimulus before the next one is presented. To maintain the Interstimulus Onset Interval, PsychRP periodically checks the RP2.1 to ensure that the ISOI has expired. The Windows operating system limits how fast this polling can occur to ~55 ms or longer, depending on system usage. Thus, the actual ISOI will always be longer than specified.

Rise/Fall (ms)

Duration of the linear gate applied to beginning and end of the carrier signal. Since the rise and fall times are included in the overall stimulus duration, R/F should be set to less than half of the overall duration.

Stimulus

Select from pure tone burst, Gaussian white noise burst, or a custom stimulus specified by a user-defined .rco file.

Bekesy Paradigm Settings

Number of Reversals

The desired number of reversals for a given trial. The point beginning the first non-default direction of stimulus change would be defined as the first reversal in the trial. Thus, if the subject responds to the first stimulus in the trial, this point would count as a reversal. The last point in the trial is always a reversal.

Maximum Repetitions

PsychRP will continue presenting stimuli until the desired number of reversals or the maximum number of stimuli have been reached.

Default Direction

The direction in which the dynamic variable will change in the absence of a response.

If the default direction is set to *increasing*, the value of the dynamic variable will increase if the subject did not respond to the stimulus. A response to the stimulus will cause a decrease in the dynamic variable. In most cases, a larger dynamic variable will increase the detectability of that stimulus (e.g. greater stimulus level, gap duration, modulation depth) and a smaller dynamic variable will decrease detectability.

If the default direction is instead set to *decreasing*, the value of the dynamic variable will decrease if there was no response from the subject. In most cases, this would reverse the logic of the button presses such that the subject would need to depress the response button to make the stimulus more detectable, and release the button to make the stimulus less detectable.

The decreasing default direction could also be used with standard logic for dynamic variables with values inversely related to detectability.

n To Step

The number of consecutive responses required to change the value of the dynamic variable.

The value in the *n Correct* box indicates how many consecutive stimuli must be detected before the dynamic value is adjusted by one step (in the direction opposite the default direction).

The value in the *n Incorrect* box indicates how many consecutive stimuli must go undetected before the dynamic value is adjusted by one step (in the default direction).

Starting Value

The value of the dynamic variable on the first stimulus in a trial. For stock stimuli, the dynamic variable controls the output voltage of the signal. For tones, the dynamic variable sets the peak voltage of the sine wave, while for noise; the dynamic variable controls the RMS level of the noise.

Maximum Value

The maximum allowable value for the dynamic variable. For stock tones, this value should be set to 10.0 or less, the maximum peak output voltage of the RP2.1.

For noise, the actual peak output level depends on the bandwidth of the filters, the center frequency of the noise band, and the setting of the dynamic variable. In all cases, a value of less than 2.2 Vrms should be sufficient to avoid clipping of the output signal. If this value does not produce sufficient signal levels, the maximum RMS level that will avoid clipping (producing a signal level of > 10.0 Vp) should be determined empirically.

Minimum Value

The minimum allowable value for the dynamic variable.

Step

The amount by which the dynamic variable will change between each stimulus. Two step sizes are available. Generally, a larger *Initial Step* size would be used for the first few reversals, followed by a smaller *Final Step* size for the remaining reversals. For a logarithmic progression, the dB scale can be used. The default Initial Step setting is 6.02 dB, which would double the dynamic variable for increasing values, or halve the dynamic variable for decreasing values. A linear step is also available.

Bekesy Threshold and Calibration

Threshold Calculation

The threshold calculation is simply an average of the values of the dynamic variable at the reversal points.

Since the initial value of the dynamic variable is often purposely set well above threshold, those reversals at the beginning of a trial may not provide meaningful estimates of threshold. Accordingly, the first *n* reversals in each trial can be ignored for the purpose of threshold estimation. All data points are displayed in the trial plot and stored in the data file regardless of this setting.

Calibrated Output

For use with stock stimuli only, after running a calibration or loading a calibration file. Used to specify the stimulus level of stock stimuli in dB SPL instead of as the voltage of the output signal. The calibration routine will suggest values for Starting SPL, Maximum SPL and Minimum SPL based on the settings of the dynamic variable. These recommendations should generally be adhered to. Calibration is described in more detail on page 28.

Setup MMOL

The Setup | Modified Method of Limits Menu contains groups of controls for Stimulus Parameters, Paradigm Settings, Threshold Calculation and Calibrated Output.

MMOL Stimulus Parameters

Center/Tone Frequency (Hz)

Specifies the carrier frequency for Tone stimuli or the center frequency for Noise stimuli. For tones, frequencies between about 20 Hz and 20 kHz can be generated. For noise, the same frequency restrictions apply. However, the acceptable center frequencies for noise stimuli are affected by the Noise Bandwidth setting. For example, setting the Noise Bandwidth to 1 octave and the center frequency to 5 kHz would create an acceptable passband of ~3.5 kHz to ~7.0 kHz. However, if the center frequency were adjusted to 15 kHz, the resulting 1 octave passband would be ~10.6 kHz to ~21.2 kHz, beyond the 20 kHz upper frequency limit of PsychRP. The upper frequency will automatically be adjusted back to about 20 kHz, regardless of setting.

Noise Bandwidth (Octaves)

In concert with the Center Frequency setting, specifies the low-pass corner frequency and high-pass corner frequency for Noise stimuli based on the following calculation:

$$HP = \text{center frequency} * 2^{-\text{bandwidth}/2}$$
$$LP = \text{center frequency} * 2^{\text{bandwidth}/2}$$

The noise stimulus is a Gaussian white noise stimulus, filtered to the desired pass band using 4th order Butterworth IIR filters set to the user-specified cutoffs.

Duration (ms)

The envelope of the stock stimuli is created using a linear gate with a user-specified duration as discussed below. The duration specified here refers to the total duration of tone or noise burst, including the rise and fall times. The plateau of the stimulus = duration - 2 * R/F time.

Rise/Fall (ms)

Duration of the linear gate applied to beginning and end of the carrier signal. Since the rise and fall times are included in the overall stimulus duration, R/F should be set to less than half of the overall duration.

Stimulus

Select from pure tone burst, Gaussian white noise burst, or a custom stimulus specified by a user-defined .rco file.

MMOL Paradigm Settings

Number of Reversals

The desired number of reversals for a given trial. The point beginning the first non-default direction of stimulus change would be defined as the first reversal in the trial. Thus, if the subject responds to the first stimulus in the trial, this point would count as a reversal. The last point in the trial is always a reversal.

Maximum Repetitions

PsychRP will continue presenting stimuli until the desired number of reversals or the maximum number of stimuli have been reached.

Default Direction

The direction in which the dynamic variable will change in the absence of a response.

If the default direction is set to *increasing*, the value of the dynamic variable will increase if the subject did not respond to the stimulus. A response to the stimulus will cause a decrease in the dynamic variable. In most cases, a larger dynamic variable will increase the detectability of that stimulus (e.g. greater stimulus level, gap duration, modulation depth) and a smaller dynamic variable will decrease detectability.

If the default direction is instead set to *decreasing*, the value of the dynamic variable will decrease if there was no response from the subject. In most cases, this would reverse the logic of the button presses such that the subject would need to depress the response button to make the stimulus more detectable, and release the button to make the stimulus less detectable.

The decreasing default direction could also be used with standard logic for dynamic variables with values inversely related to detectability.

n To Step

The number of consecutive responses required to change the value of the dynamic variable.

The value in the *n Correct* box indicates how many consecutive stimuli must be detected within the MMOL response window before the dynamic value is adjusted by one step (in the direction opposite the default direction).

The value in the *n Incorrect* box indicates how many consecutive stimuli must go undetected within the MMOL response window before the dynamic value is adjusted by one step (in default direction).

Starting Value

The value of the dynamic variable on the first stimulus in a trial. For stock stimuli, the dynamic variable controls the output voltage of the signal. For tones, the dynamic variable sets the peak voltage of the sine wave, while for noise; the dynamic variable controls the RMS level of the noise.

Maximum Value

The maximum allowable value for the dynamic variable. For stock tones, this value should be set to 10.0 or less, the maximum peak output voltage of the RP2.1.

For noise, the actual peak output level depends on the bandwidth of the filters, the center frequency of the noise band, and the setting of the dynamic variable. In all cases, a value of less than 2.2 Vrms should be sufficient to avoid clipping of the output signal. If this value does not produce sufficient signal levels, the maximum RMS level that will avoid clipping (producing a signal level of > 10.0 Vp) should be determined empirically.

Minimum Value

The minimum allowable value for the dynamic variable.

Step

The amount by which the dynamic variable will change between each stimulus. Two step sizes are available. Generally, a larger *Initial Step* size would be used for the first few reversals, followed by a smaller *Final Step* size for the remaining reversals. For a logarithmic progression, the dB scale can be used. The default Initial Step setting is 6.02 dB, which would double the dynamic variable for increasing values, or halve the dynamic variable for decreasing values. A linear step is also available.

Response Window Duration (ms)

In the Modified Method of Limits paradigm, the subject must indicate that the target stimulus was detected by depressing and releasing Response Box button #1 within this user-defined temporal window. The window is defined as number of milliseconds after stimulus onset that the subject has to respond. If no response is entered in the response window, the preceding stimulus is considered to be undetected by PsychRP.

Minimum ISOI (ms between Onsets)

Sets the approximate minimum Interstimulus Onset Interval.

In the MMOL paradigm, PsychRP will present stimuli at random time intervals somewhere between the Minimum and Maximum ISOIs. PsychRP determines whether the specified ISOI has expired by polling a register on the RP2.1. Because of this polling, the actual ISOI will always be somewhat longer than specified.

Maximum ISOI (ms between Onsets)

Sets the approximate maximum Interstimulus Onset Interval.

MMOL Threshold and Calibration

Threshold Calculation

The threshold calculation is simply an average of the values of the dynamic variable at the reversal points.

Since the initial value of the dynamic variable is often purposely set well above threshold, those reversals at the beginning of a trial may not provide meaningful estimates of threshold. Accordingly, the first *n* reversals in each trial can be ignored for the purpose of threshold estimation. All data points are displayed in the trial plot and stored in the data file regardless of this setting.

Calibrated Output

For use with stock stimuli only, after running a calibration or loading a calibration file. Used to specify the stimulus level of stock stimuli in dB SPL instead of as the voltage of the output signal. The calibration routine will suggest values for Starting SPL, Maximum SPL and Minimum SPL based on the settings of the dynamic variable. These recommendations should generally be adhered to. Calibration is described in more detail on page 28.

Setup nAFC

The Setup | nAFC Menu contains groups of controls for Stimulus Parameters, Paradigm Settings, Threshold Calculation and Calibrated Output

nAFC Stimulus Parameters

```
┌─ Stimulus Settings ─────────────────────────────────────────┐
│                                            ┌─ Stimulus ──┐   │
│   Center/Tone Frequency (Hz)  [4000]       │  ○ Noise    │   │
│   Noise Bandwidth (Octaves)   [0.33]       │  ● Tone     │   │
│   Stimulus Duration (ms)      [250]        │  ○ Custom   │   │
│   Interstimulus Interval (ms) [500]        │ [Select Custom *.rco] │
│   Rise/Fall Time              [10]         │ [            ]│   │
│                                            └─────────────┘   │
└─────────────────────────────────────────────────────────────┘
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Center/Tone Frequency (Hz)

Specifies the carrier frequency for Tone stimuli or the center frequency for Noise stimuli. For tones frequencies between about 20 Hz and 20 kHz can be generated. For noise, the same frequency restrictions apply. However, the acceptable center frequencies for noise stimuli are affected by the Noise Bandwidth setting. For example, setting the Noise Bandwidth to 1 octave and the center frequency to 5 kHz would create an acceptable passband of ~3.5 kHz to ~7.0 kHz. However, if the center frequency were adjusted to 15 kHz, the resulting 1 octave passband would be ~10.6 kHz to ~21.2 kHz, beyond the 20 kHz upper frequency limit of PsychRP. The upper frequency will automatically be adjusted back to about 20 kHz, regardless of setting.

Noise Bandwidth (Octaves)

In concert with the Center Frequency setting, specifies the low-pass corner frequency and high-pass corner frequency for Noise stimuli based on the following calculation:

$HP = \text{center frequency} * 2^{-\text{bandwidth}/2}$
$LP = \text{center frequency} * 2^{\text{bandwidth}/2}$

The noise stimulus is a Gaussian white noise stimulus, filtered to the desired pass band using 4th order Butterworth IIR filters set to the user-specified cutoffs.

Duration (ms)

The envelope of the stock stimuli is created using a linear gate with a user-specified duration as discussed below. The duration specified here refers to the total duration of tone or noise burst, including the rise and fall times. The plateau of the stimulus = duration - 2 * R/F time.

Interstimulus Interval (ms)

Sets the interval between the onsets of stimuli in a set. The Interstimulus Onset Interval (ISOI) should be long enough that the subject has time to process and respond to a given stimulus before the next one is presented. To maintain the Interstimulus Onset Interval, PsychRP periodically checks the RP2.1 to ensure that the ISOI has expired. The Windows operating system limits how fast this polling can occur to ~55 ms or longer, depending on system usage. Thus, the actual ISOI will always be longer than specified.

Rise/Fall (ms)

Duration of the linear gate applied to beginning and end of the carrier signal. Since the rise and fall times are included in the overall stimulus duration, R/F should be set to less than half of the overall duration.

Stimulus

Select from pure tone burst, Gaussian white noise burst, or a custom stimulus specified by a user-defined .rco.

nAFC Paradigm Settings

Number of Reversals

The desired number of reversals for a given trial. The point beginning the first non-default direction of stimulus change would be defined as the first reversal in the trial. Thus, if the subject responds to the first stimulus in the trial, this point would count as a reversal. The last point in the trial is always a reversal.

Maximum Repetitions

PsychRP will continue presenting stimuli until the desired number of reversals or the maximum number of stimuli have been reached.

Number of Intervals

The number of stimuli that will be presented in a single stimulus set. One of these will be the target stimulus presented in a random order within the remaining n-1 intervals.

Default Direction

The direction in which the dynamic variable will change in the absence of a response.

If the default direction is set to *increasing*, the value of the dynamic variable will increase if the subject did not respond to the stimulus. A response to the stimulus will cause a decrease in the dynamic variable. In most cases, a larger dynamic variable will increase the detectability of that stimulus (e.g. greater stimulus level, gap duration, modulation depth) and a smaller dynamic variable will decrease detectability.

If the default direction is instead set to *decreasing*, the value of the dynamic variable will decrease if there was no response from the subject. In most cases, this would reverse the logic of the button presses such that the subject would need to depress the response button to make the stimulus more detectable, and release the button to make the stimulus less detectable.

The decreasing default direction could also be used with standard logic for dynamic variables with values inversely related to detectability.

n To Step

The number of consecutive responses required to change the value of the dynamic variable.

The value in the *n Correct* box indicates how many consecutive target stimuli must be correctly assigned to their proper interval before the dynamic value is adjusted by one step (in the direction opposite the default direction).

The value in the *n Incorrect* box indicates how many consecutive target stimuli must be assigned to the incorrect interval before the dynamic value is adjusted by one step (in default direction).

Starting Target Value

The value of the dynamic variable on the first stimulus in a trial. For stock stimuli, the dynamic variable controls the output voltage of the signal. For tones, the dynamic variable sets the peak voltage of the sine wave, for noise, the dynamic variable controls the RMS level of the noise.

Maximum Target Value

The maximum allowable value for the dynamic variable. For stock tones, this value should be set to 10.0 or less, the maximum peak output voltage of the RP2.1.

For noise, the actual peak output level depends on the bandwidth of the filters, the center frequency of the noise band, and the setting of the dynamic variable. In all cases, a value of less than 2.2 Vrms should be sufficient to avoid clipping of the output signal. If this value does not produce sufficient signal levels, the maximum RMS level that will avoid clipping (producing a signal level of > 10.0 Vp) should be determined empirically.

Minimum Target Value

The minimum allowable value for the dynamic variable.

Standard Value

Value for the same variable as controlled by the dynamic variable for the target stimuli. All standards in all stimulus sets will maintain this value and serve as comparisons for the target.

Step

The amount by which the dynamic variable will change between each stimulus. Two step sizes are available. Generally, a larger *Initial Step* size would be used for the first few reversals, followed by a smaller *Final Step* size for the remaining reversals. For a logarithmic progression, the dB scale can be used. The default Initial Step setting is 6.02 dB, which would double the dynamic variable for increasing values, or halve the dynamic variable for decreasing values. A linear step is also available.

Minimum Feedback Duration

The minimum duration of user feedback (in ms) after the subject enters a response. By default, all LEDs on the button box are lit after a correct response. No LEDs are lit after an incorrect response.

nAFC Threshold and Calibration

Threshold Calculation

The threshold calculation is simply an average of the values of the dynamic variable at the reversal points.

Since the initial value of the dynamic variable is often purposely set well above threshold, those reversals at the beginning of a trial may not provide meaningful estimates of threshold. Accordingly, the first *n* reversals in each trial can be ignored for the purpose of threshold estimation. All data points are displayed in the trial plot and stored in the data file regardless of this setting.

Calibrated Output

For use with stock stimuli only, after running a calibration or loading a calibration file. Used to specify the stimulus level of stock stimuli in dB SPL instead of as the voltage of the output signal. The calibration routine will suggest values for Starting SPL, Maximum SPL and Minimum SPL based on the settings of the dynamic variable. These recommendations should generally be adhered to. Calibration is described in more detail on page 28.

Active Paradigm

Use this menu to select whether the Bekesy, MMOL or nAFC paradigm will be run when the Run option is selected. Click one of the icons below to set the Active Paradigm directly from the toolbar.
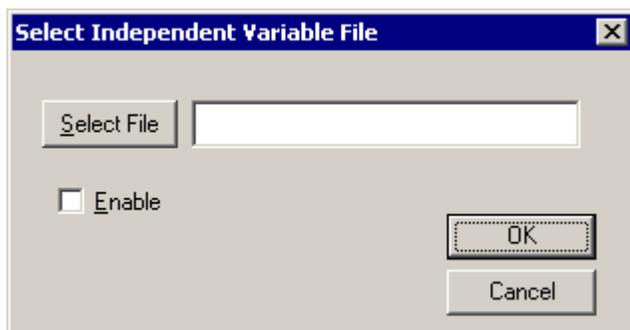
 Bekesy

 MMOL

 nAFC

Each paradigm is setup independently, and has a separate setup dialog box and calibration.

For instance, if you run a calibration while Bekesy is the Active Paradigm, and then switch to the MMOL paradigm, you will have to run a new calibration or load a previously stored calibration file for the MMOL paradigm.

Independent Variables

Use to select a pre-configured list of independent variable values. At this writing, the Independent Variable File (*.IVF) can be used to control the center frequency of stock stimuli only. The IVF is a simple text file that can be created with any text editor (e.g. WordPad) with floating point values for each desired frequency on a separate line. In this example:

1000.0
2000.0
4000.0
8000.0
16000.0

selecting *Run* or *Run Calibration* will run a trial or present a calibration stimulus at each frequency: 1, 2, 4, 8, and 16 kHz.

Subject Info
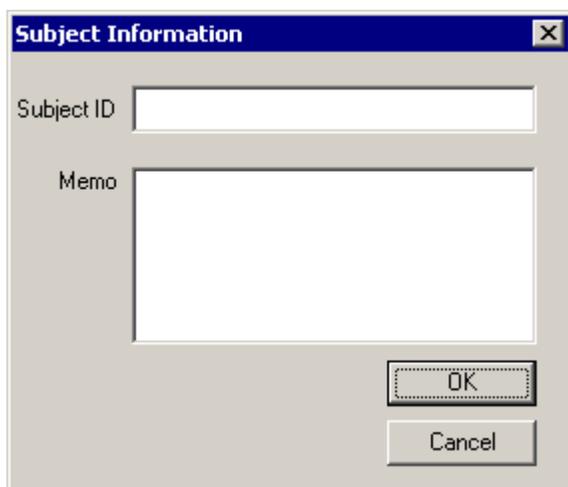
Type in *Subject ID* and any other desired information here. As with all settings, the subject info is saved to the Data File at the beginning of each trial so that any changes entered in the subject info between trials will be saved.

Data File
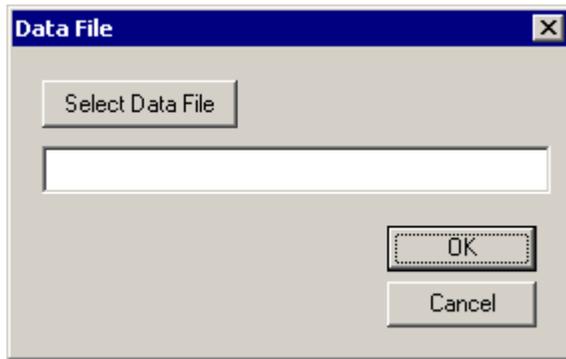
Select file name for output data file. Selecting an existing file name will append, not overwrite the existing data file. The data file is a text file stored with a .dat extension. For each set of trials, a header with the stimulus parameters for the active paradigm are stored, along with subject information, calibration information, etc. The header is followed by the setting of the Independent Variable, in this case, stimulus frequency, and the value of the dynamic variable on each stimulus presentation. The contents of any user-defined buffers will be stored. Finally, a listing of the thresholds calculated for each independent variable is included. The data files are tab-delimited and easily imported into other analysis packages (e.g. Microsoft Excel).

Example output is shown for a run with two Bekesy trials:

```
------------------------------
Subject ID: JM032601-pt
Notes:Re-test of 01/22/01
Paradigm: BEKESY
StimDur: 250.0000
ISOI: 1000.000000
R/F Time: 10.0000
Revsls: 6
MaxReps: 1000
DefaultDir: INCREASING
StartVal: 5.0000
MinVal: 0.0000
MaxVal: 10.0000
StepSize: 6.0206
Rco file: C:\tdt\RPvds\RCOs\BekPdgm
Stimulus: TONE
Calibration: OFF
IgnoreInThold: 2
IndVar: FREQ
--
IndVar: 1000.000000
5.0000
10.0000
5.0000
2.5000
1.2500
0.6250
1.2500
2.5000
1.2500
2.5000
1.2500
```
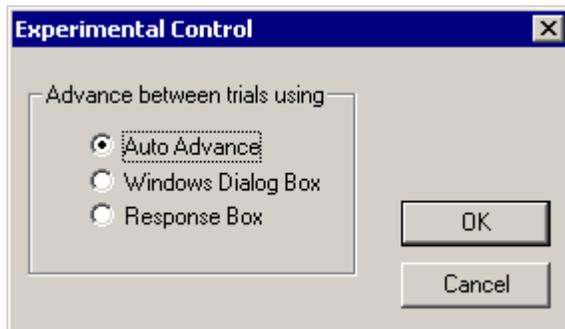
0.6250
--
IndVar: 2000.000000
5.0000
2.5000
1.2500
0.6250
1.2500
0.6250
0.3125
0.6250
1.2500
0.6250
0.3125
--
Thresholds
1000.0000: 1.7188
2000.0000: 0.7813

Options Menu

The Options menu contains the experimental control configuration.

Experimental Control

The experimental control options control how PsychRP controls advancing between trials (i.e. Independent variables).

Auto Advance

A trial for each member of the Independent Variable File is run automatically after the previous trial is complete. The first trial in the series is begun as soon as the Run button is clicked.

Windows Dialog Box:

The following message box appears before each trial.
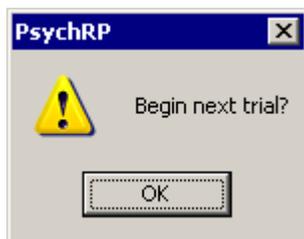
The trial does not begin until the experimenter has responded. This might be useful if the experimenter wishes to ascertain that the subject is ready to begin before advancing to the next trial.

Response Box

In this mode the subject is presented with a sequence of lights flashing from left to right across the response box LEDs. When this pattern is displayed, the subject must initiate the start of the next trial by simultaneously depressing the response box buttons #1 and #4.

Run Menu

The Run menu has selections for *Run* and *Abort*. Both of these functions can be accessed icons in the tool bar.

Run

The *Run* command runs the currently active paradigm using the settings from that paradigm Setup menu. If an Independent Variable File has been loaded and enabled, a series of trials will be run for that paradigm, one for each variable in the *.ivf.

Abort

The *Abort* command will stop the acquisition currently in progress. The Data file will contain header information for the trial or series and the data points for any trials completed in the series before the Abort command was issued. A message indicating *Acquisition aborted* will appear in the data file for the aborted trial.

Calibration Menu
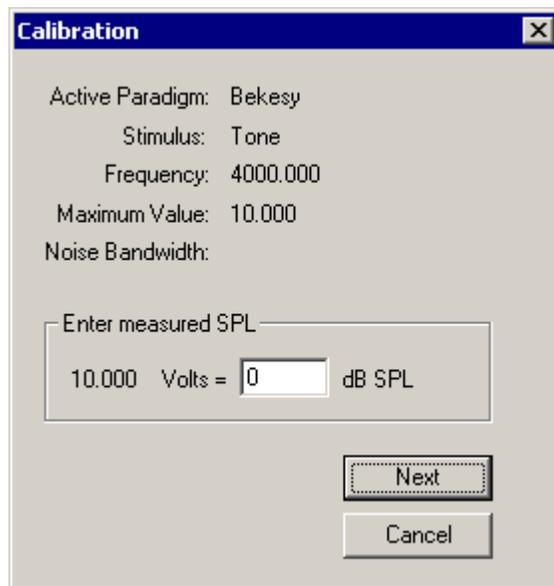
Calibrated output is available for stock stimuli using the calibration routine.

Run calibration

The *Run Calibration* command will present the currently selected stimulus settings for the currently active Paradigm.

If an Independent Variable File is enabled, the Run Calibration routine will step through each of the independent variables (frequencies). Calibration stimuli are presented at the voltage level specified in the *Maximum Value* setup menu item for the active paradigm.

For each frequency, the dialog box shown below will be displayed and the calibration stimulus for that variable will be presented continuously until the *Next* button is selected (or 1 hour has passed). A calibrated microphone or sound level meter is necessary to measure the sound pressure level at the location of the subject.

 Once this measurement has been obtained and the SPL value entered into the dialog box, select the *Next* button to advance to the next calibration stimulus.

For noise stimuli, the Run Calibration menu could also be used for a *dry run*. Here, the experimenter could ensure that the selected frequencies, noise bandwidth and Maximum Value settings are optimized to produce a signal that does not exceed 10 Volts peak at any frequency, but is sufficiently loud for the experiment.

After entering the final calibration value, a menu to specify a calibration *.cal file will appear. The calibration file is an editable text file with the following format: a header indicating the paradigm, stock stimulus type, Voltage used to generate the calibration stimuli, and noise bandwidth precedes a bracketed listing of the sound pressure levels for each of the independent variables. An example is shown below.

```
-------------
Bekesy
Tone
10.000
0.33
{
108.000
97.400
92.300
95.900
85.200
}
-----------
```

A saved calibration file can be loaded at any time from the calibration menu.

After the calibration has been run or a calibration file loaded, the Setup menu for the active paradigm will appear as shown below. The Starting, Maximum and Minimum Value boxes will be grayed out. The Use Calibration box will be selected, and the Starting, Maximum, and Minimum SPL values will have new values.

These recommended values are calculated based on the entered SPLs and the Starting, Maximum and Minimum voltage settings. The maximum SPL value will be set to equal the lowest calibration SPL value at any of the frequencies tested.
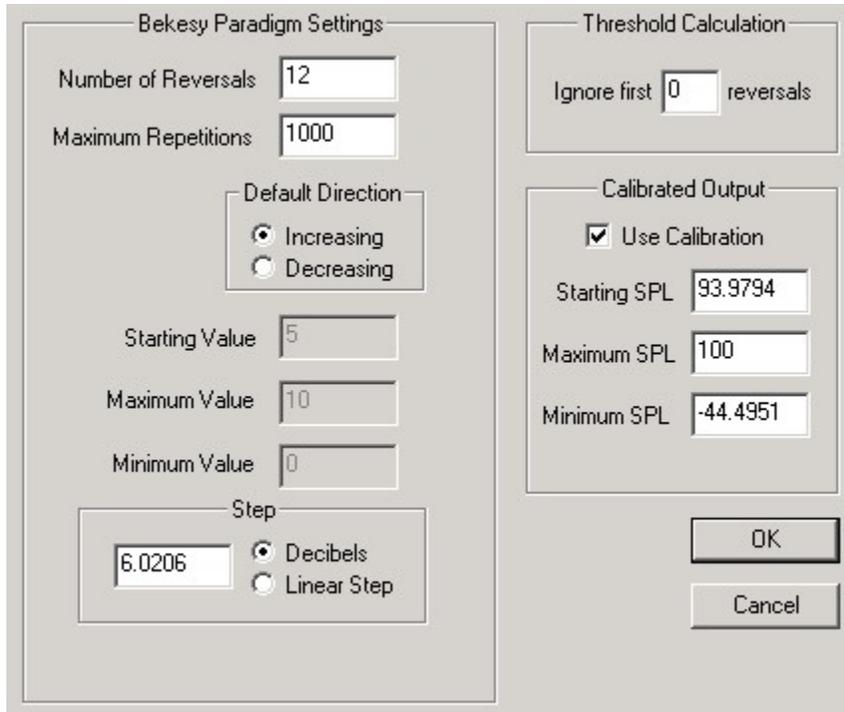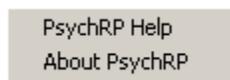
Important!: You should be certain that the calibration file matches the current stimulus parameters. Any change in stimulus parameters could cause a mismatch with the calibration parameters.

View Menu

The View menu can be used to view/hide the toolbar and status bars.

Help Menu

The Help menu can be used to access information about PsychRP. The PsychRP Help command will launch the documentation for PsychRP in HTML Help format. The About PsychRP command will display the current version and copyright information. For the latest version of the PsychRP documentation, open the PDF version from the Start menu. A printer friendly format (PDF) of the PsychRP Help can also be found online at www.TDT.com.

Trial Plot Toolbar

The toolbar at the top of the trial plot can be used to control the settings of this plot, view and print the trial plot data. Right-click the toolbar button for a tool tip.

The first group of tools allow the trial plots to be saved and read as graphics (.chf) files, saved as bitmaps, the data saved to the clipboard as text, and printed.

Import a chart from file (*.CHF)

Export the chart to a file (*.CHF)

Copy the chart to clipboard as a bitmap

Copy the chart to clipboard as text

Print the chart

The second group of tools changes the display format of the plot.

Display data as a column and bar chart

Display data as a line chart

Display data as a mark (point) chart

Display data as a fit to curve chart

The third group accesses the legend and grid options.

Show or hide the legend

Show or hide the vertical grid

Show or hide the horizontal grid

The fourth group allows editing of titles, fonts, raw data, and chart attributes such as axis minima and maxima.

Prompts the edit titles dialog box

Prompts the edit titles font menu

Prompts the tools menu

Prompts the view options dialog box

~

Customizing Stimuli

In addition to stock PsychRP stimuli, custom stimuli can also be created, allowing the threshold for carriers other than the stock tone and noise bursts to be measured. With custom stimuli, the dynamic variable can control stimulus parameters other than stimulus level, and the threshold for this parameter can measured using any of the three PsychRP paradigms.

At the heart of this flexibility is the ability for PsychRP to run custom processing chains built in the RPvdsEx programming language. If you are not yet familiar with RPvdsEx and control object (.rco) files, you should consult the RPvdsEx Manual before proceeding further.

The PsychRP stock stimuli are generated by one of three RPvdsEx processing chains: one for each of the three available paradigms. These processing chains (saved as .rco files) are loaded, run, and controlled by PsychRP via ActiveX controls. The RPvdsEx processing chain for each of these default paradigms (BekPdgm.rpd, MmolPdgm.rpd, and NafcPdgm.rpd) is included in your installation and can be used as a framework to generate custom stimuli of your own design.

Once the custom processing chain has been created in RPvdsEx, using this chain is simply a matter of creating an .rco file, and loading this file from the Paradigm menu. Several examples of custom processing chains are included on page 33. Please don't hesitate to contact us if these examples don't demonstrate the necessary techniques for your particular application.

Standard Processing Chains

One of three standard processing chains are used when generating stock stimuli. These chains are found in three Read-Only .rpd files in your C:\TDT\PsychRP\Files directory: BekPdgm.rpd, MmolPdgm.rpd and NafcPdgm.rpd. PsychRP loads and runs the component object (.rco) files built from these processing chains when the active paradigm is executed from the PsychRP **Run** menu.

Parameter Tags

Settings specified in PsychRP are then loaded into that processing chain via Parameter Tags and ActiveX controls. While is not necessary to fully understand ActiveX controls to customize processing chains, it will be necessary to use Parameter Tags in RPvdsEx circuits. For example, the value of the dynamic variable is calculated before each stimulus presentation by PsychRP according to the settings specified in the Setup Menu for each paradigm and the user's response. This value is loaded into the Parameter Tag labeled "DynamicVar" in the processing chain.


The dynamic variable can be used to control stimulus level, as in the standard paradigms, or any other stimulus parameter you specify in your custom processing chain. Other stimulus variables in the standard processing chains set with parameter tags (e.g. "RFTime", "StimFreq", "HPCorner", "LPCorner") can also be used to control variables in custom PsychRP chains.

The standard .rpd files should be used as a template for creating custom stimuli. The top portion generally consists of the tone and noise generation, gating and timing components, and D/A conversion. A multiplexer is used to route either the tone or noise carrier to the gate. This section can be edited or replaced as desired. The bottom section of these chains should not be edited. A warning message delimits the editable from non-editable sections of code.

Timing

Two software triggers are used to control timing in the standard circuits. The trigger labeled "Soft1" triggers filter coefficient generators before stimulus presentation commences and can be used to trigger any other triggered setup functions you wish to add.

[1:1,0]

Src=Soft1
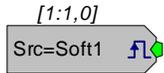
A "Soft2" trigger initiates each stimulus presentation until the trial is complete (in the nAFC paradigm, the Soft2 triggers a group of *n* stimuli). Since all stimulus and acquisition timing is relative to the Soft2 trigger, any time-critical custom programming will likely use timing derived from the Soft2 trigger.

[1:1,0]

Src=Soft2
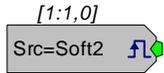
Reading User Buffers

In some experiments, you might want to record other data in addition to whether the subject responded to a given stimulus. PsychRP allows you to customize standard processing chains to retrieve and store data of particular interest. For example, you might want to store the reaction times in an MMOL trial or the number of the interval that was selected for each nAFC stimulus. To read data back from the processing chain, you'll first modify your processing chain to store the data of interest into a user-defined buffer. PsychRP can then access these data at the end of the trial and store them to the output file through parameter tags containing preset identification characters.

Up to 1000 floating point numbers can be stored into a buffer in an RP2.1 processing chain. User buffers should be numbered sequentially, counting from one up to a maximum of 100. Two parameter tags are required to access data from user buffers, the first points to the data contained in the buffer, the second points to the index of the buffer. These parameter tags must use the following the naming conventions:

- The first three characters in the tag must be "UB_", indicating that they point to a user buffer
- The tag pointing to the data should have a "D" as the fourth character
- The tag pointing to the index should have an "I" as the fourth character
- The next characters should be the number of the buffer
- An optional set mnemonic characters may be included in the data tag pointer after the buffer number to indicate the contents of the buffer

The example below shows the parameter tags used to access a serial buffer. The tag numbering indicates that this is User Buffer number one and the optional mnemonic at the end of the data tag indicate that this buffer contains information regarding frequency.

[1:1,0]

SerialBuf

Size=1000
Rst=0
AccEnab=1
Write=1
Index=0   UB_I1
NBlks=0

UB_D1_Freq   {>Data}
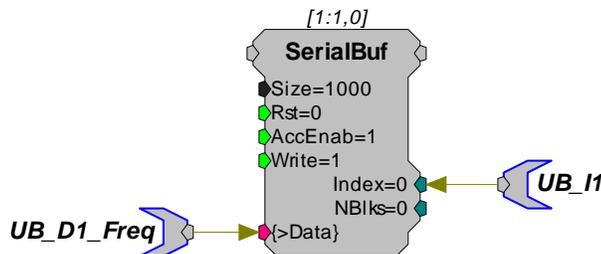
Parameter tags following this naming convention will be recognized by PsychRP as pointing to user buffers. The contents of these buffers will be stored at the end of each trial to the output file.

A specific example using User Buffers is found in the Storing Reaction Time example on page 39.

Examples

Several examples of custom processing chains are described for the custom circuits provided with PsychRP.

Sinusoidal AM Carrier

A common application for using a custom PsychRP stimulus would be to determine the level threshold, as if using a stock stimulus, but substituting a custom carrier for the stock tone or noise bursts.

Part of the standard circuit for generating the stock tone carrier is shown below.
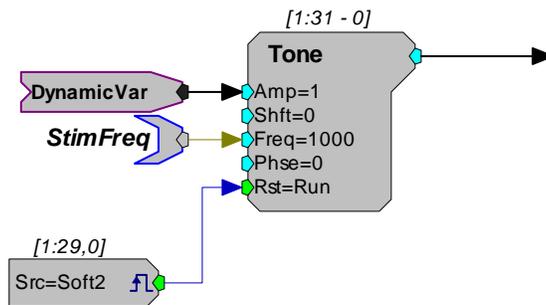
The component labeled "DynamicVar" is used to control stimulus level, the carrier frequency is controlled by the "StimFreq" parameter tag, and the phase of the tone carrier is reset to 0 at the start of each tone burst by the "Soft2" trigger. The output of the Tone component would then be passed to a multiplexer, gate and DacOut (not shown).

To generate sinusoidal amplitude modulated stimuli, the stock processing chain could be replaced by the chain shown below.
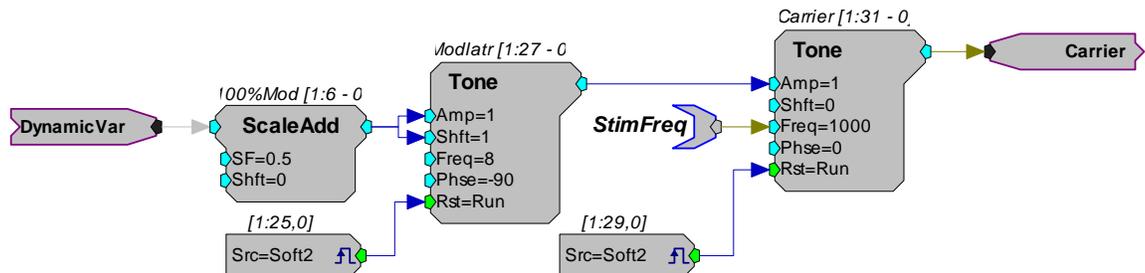
Here, the frequency and phase of the carrier tone are controlled with the "StimFreq" and "Soft2" components as for the stock stimulus. However, the amplitude of the carrier tone is controlled by a modulating sinusoid, labeled here as "Modlatr". This modulator component causes the amplitude of the carrier to vary sinusoidally between the maximum and minimum output levels of the modulator. The peak amplitude of the SAM stimulus is set to the value of the dynamic variable and the minimum amplitude set to 0 (100% modulation depth). This is accomplished by setting the modulator amplitude to 50% of the dynamic variable value, and shifting this sine wave up by 50%.

This example can be run by selecting the *Custom* stimulus option from the Bekesy Setup Menu and loading the included BekPdgmSam.rco file. The .rco and the complete processing chain for this example are included with PsychRP and can be found on your disk as C:\TDT\PsychRP\Files\BekPdgmSAM.*.

Important!: Example chains are for illustration purposes only. They should be thoroughly tested to be sure they match your specifications before using them.
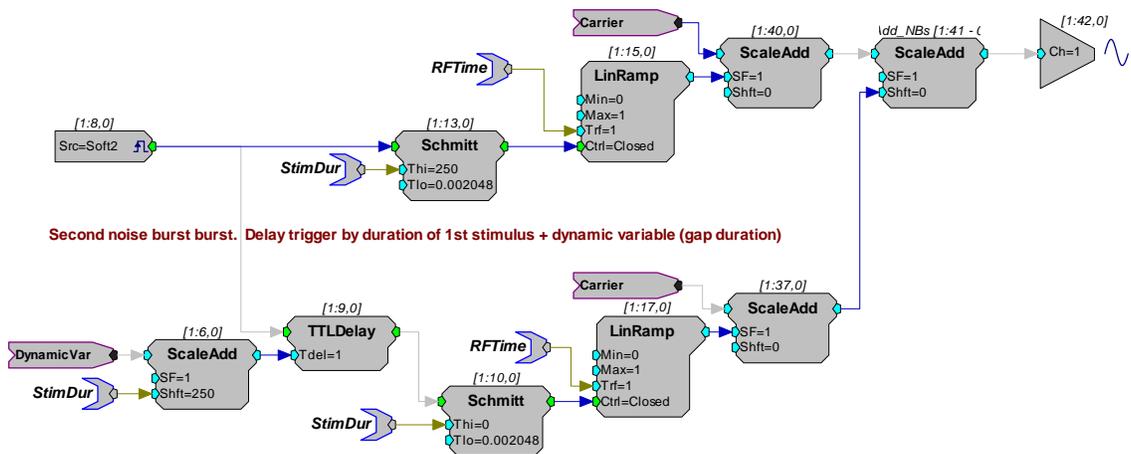
Gap Detection

Instead of controlling stimulus level, the dynamic variable can be used as input to any floating point input in your custom processing chain. This example, found in C:\TDT\PsychRP\Files\BekPdgmGap.*., presents a pair of noise bursts at a fixed level but varies the duration of a silent gap between the noise bursts. When the stimulus gap is detectable, the subject depresses and holds RBOX button #1, causing a decrease in the dynamic variable: the duration of the silent gap. Bekesy paradigm menu selections such as center frequency, noise bandwidth, stimulus duration, ISOI and rise/fall time are used in this example processing chain and thus, are still controlled through the setup menu.

The stimulus carrier is much the same as the stock noise burst carrier, except that stimulus level remains fixed at 1 Vrms. Briefly, the output from the Gaussian Noise component is filtered with 4th order Biquad filters which have High-Pass and Low-Pass corner frequencies specified by the setup menu entries. The coefficient generators are triggered by a software trigger.
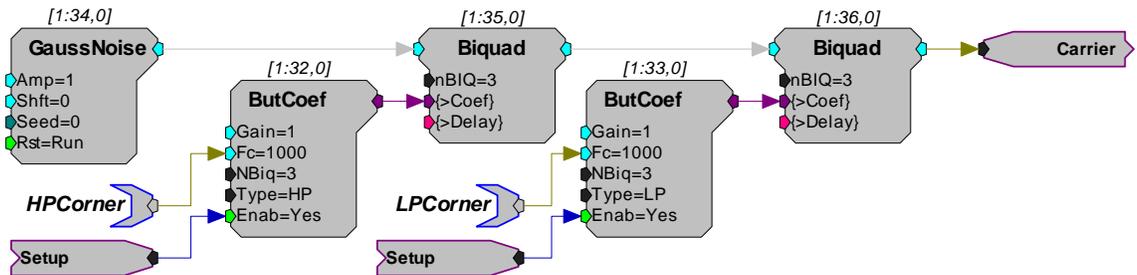
This carrier signal is then gated into two noise bursts with a variable length silent gap between them. The duration and R/F time of both noise bursts is controlled from the setup menu. The software trigger controlling the onset of the second noise burst is delayed by a TTLDelay component with a delay equal to the duration of the first stimulus plus the duration of the dynamic variable, in this case, the gap duration.

The range and step size of the gap duration would also be controlled through the Bekesy setup menu. The results of the Bekesy trial and the calculated threshold would be displayed in terms of milliseconds of gap duration.

This example can be run by selecting the *Custom* stimulus option from the Bekesy Setup Menu and loading the included BekPdgmGap.rco file.

The .rco and the complete processing chain for this example are included with PsychRP and can be found on your disk as C:\TDT\PsychRP\Files\BekPdgmGap.*.

Important!: Example chains are for illustration purposes only. They should be thoroughly tested to be sure they match your specifications before using them.

FM Threshold

In this example, the dynamic variable is used to control the depth of a frequency modulated stimulus. The component labeled "Modulator" in the processing chain shown below controls the frequency of a second tone component labeled "Carrier". The modulation frequency varies sinusoidally between "StimFreq" + "StdOrTgt" and "StimFreq" – "StdOrTgt" at a rate of 8 times per second.
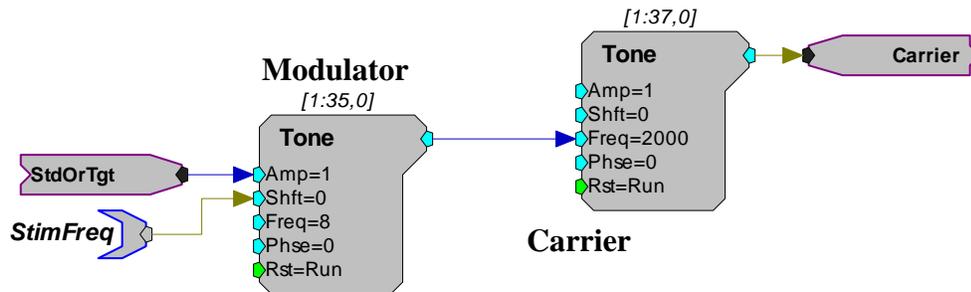
Since the paradigm is an nAFC, the modulation depth assumes either the value: A) specified for the standard target or B) specified by the dynamic variable. The task for the subject is to identify which interval contained the target stimulus (with the non-standard modulation depth) by depressing the corresponding response box button. The nAFC paradigm menu selections such as center frequency, stimulus duration, ISOI, and rise/fall time are used in this example processing chain and thus, are still controlled through the setup menu.

The part of the processing chain controlling the modulation depth is shown below. Before each stimulus set of n intervals, PsychRP sets the position of the target within the set through the "nTarget" parameter tag. The stimulus at this position within the set will output the *Target* modulation depth equal to the hop "DynamVar". All other stimuli in the set will output the *Standard* modulation depth equal to "StdVal". For example, in a four alternative forced-choice set with nTarget=2, stimuli 1, 3, and 4 have an nBrst != nTarget, which would result in "StdVal" being sent through the MuxIn component to the "Modulator" tone component above. The 2nd stimulus of the four stimulus set, where nBrst = nTarget would result in the modulation depth = DynamVar.
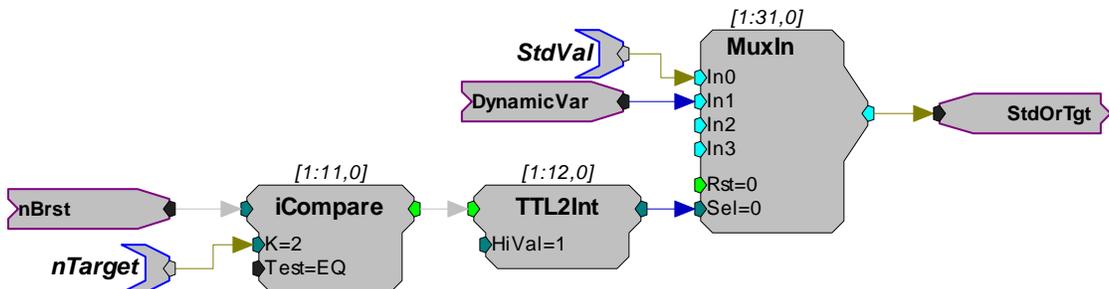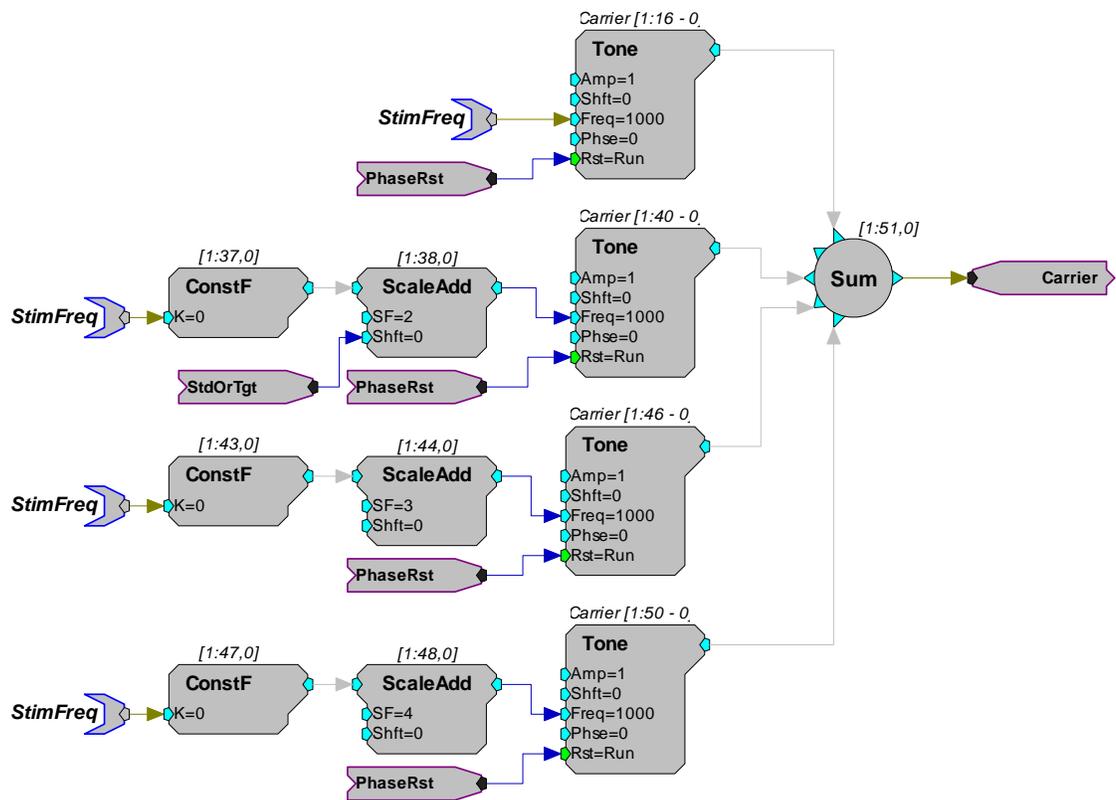

This example can be run by selecting the *Custom* stimulus option from the nAFC Setup Menu and loading the included nAFCPdgmSFM.rco file. The .rco and the complete processing chain for this example are included with PsychRP and can be found on your disk as C:\TDT\PsychRP\Files\nAFCPdgmSFM.*.

Important!: Example chains are for illustration purposes only. They should be thoroughly tested to be sure they match your specifications before using them.

Mistuned Harmonic

This example demonstrates a circuit for measuring the threshold for a mistuned harmonic embedded in a harmonic complex. The .rco and the complete processing chain for this example are included with PsychRP and can be found on your disk as C:\TDT\PsychRP\Files\nAFCPdgmMisTHarm.*

Parts of this example circuit are shown below. Individual harmonics are created by multiplying the tone frequency (set in the nAFC menu) by a constant which controls the frequency of a tone component. The harmonic complex is created by summing the individual harmonics. In this example, the frequency of the second harmonic has an additional offset equal to the value of the nAFC target (dynamic variable) or the fixed nAFC standard value.

The amount of mistuning in that harmonic depends on whether the stimulus interval is one of the standard stimuli or is the target stimulus. The circuit below illustrates that control. In a 4 AFC, when the 2nd interval is the target (nTarget=2), the iCompare below evaluates true on the second of the four intervals. This sends the value of the hop "DynamicVar" through the MuxIn component parameter (In1). On intervals 1, 3, and 4, the iCompare would evaluate false, and send the "StdVal" through the MuxIn component parameter (In0).
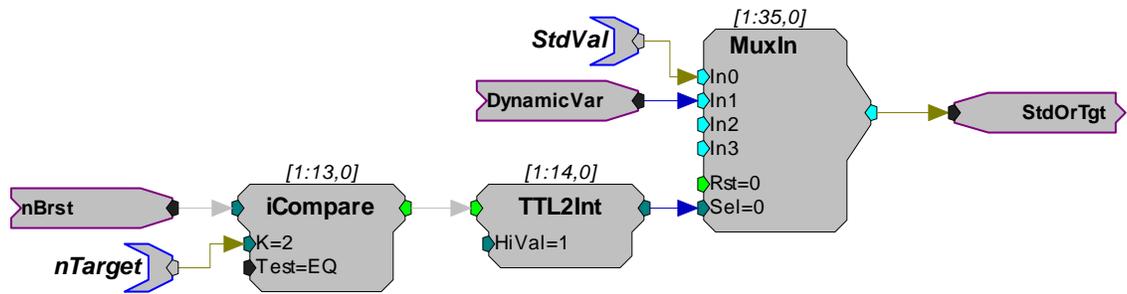
This example can be run by selecting the *Custom* stimulus option from the nAFC Setup Menu and loading the included nAFCPdgmMisTHarm.rco file. From the same menu, set the **Stimulus Frequency** to **1000 Hz**, and the **Starting** and **Maximum Target Values** both to **100 (Hz)**, and the **Standard Value** to **0 (Hz)**. The in the first stimulus, the second harmonic will be mistuned by 100 Hz in the target interval, with no mistuning in the standard intervals. The amount of mistuning in the target interval is then controlled by the subject's response.

Important!: Example chains are for illustration purposes only. They should be thoroughly tested to be sure they match your specifications before using them.

Storing Reaction Time

In addition to recording whether a subject responded correctly or incorrectly to a given stimulus, one might wish to record the latency of this response. This can be done by storing the reaction time into a user buffer. This example, found in C:\TDT\PsychRP\Files\MmolPdgmRxTime, stores the reaction time and interstimulus interval for each stimulus in a modified method of limits trial.

Triggering

As described for the Modified Method of Limits, user responses in the MMOL paradigm are accepted only during a finite acquisition window. This example therefore stores reaction time and ISOI for each stimulus at the end of this acquisition window. Timing is initiated by the SoftTrg2 and storage is triggered using the EndAcqnWind logic pulse created in the chain below.
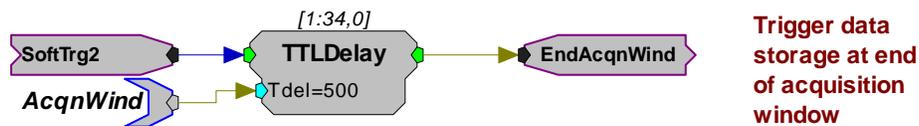

Storing ISOI

In the MMOL paradigm, the interstimulus onset interval (ISOI) is a random value between user-specified maxima and minima. To ascertain whether stimulus detection or reaction time is influenced by the ISOI, you would need to store the ISOI values for later analysis. The chain below first casts the value of the ISOI parameter tag into a floating point primary input type. It then stores this value into a serial buffer at the end of each acquisition window using the EndAcqnWind logic pulse to trigger storage. This serial buffer is then accessed by PsychRP at the end of the trial through parameter tags in the UB format and stored to the output file.

Store the (random) ISOI for each stimulus
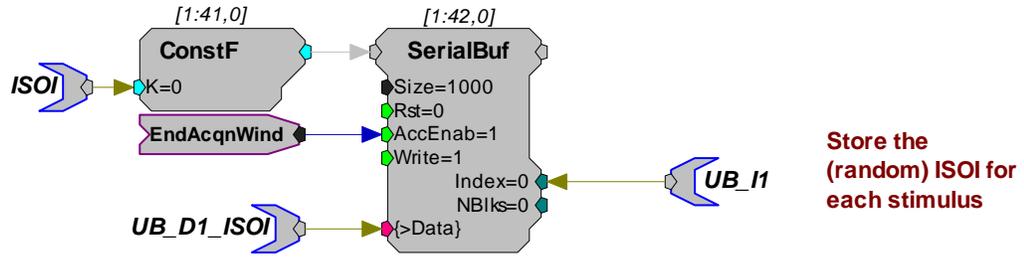
Storing Reaction Time

The timing, storage, and buffer access for storing the reaction time is identical to that for storing the ISOI. The example chain below shows how those reaction time measurements were created. At the onset of each stimulus, the timer (TSlope component) is reset to 0.0 and begins counting the number of milliseconds from this reset. To measure the reaction time, two values from the lower part of the processing chain were passed to this circuit using *hops*. The first is the "BtnRelease" logical pulse indicating when the response box button was released. This pulse triggers the latching of the time of the button release into the latch component. The second of these, the "RespInWindow" hop, sets the buffer input to 0 in the absence of a subject response within the acquisition window.

Store Button release if inside Acqn window, else 0
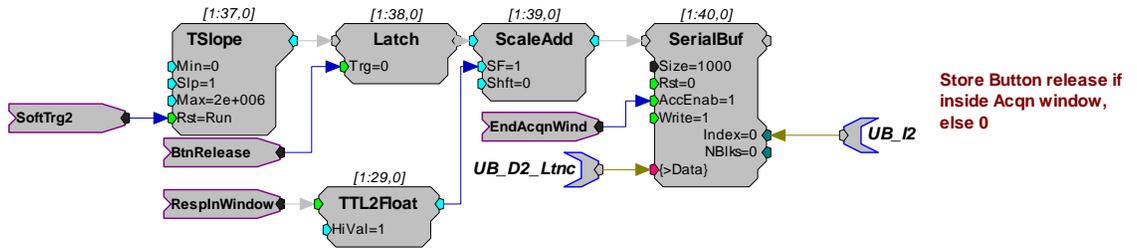
This example can be run by selecting the *Custom* stimulus option from the MMOL Setup Menu and loading the included MmolPdgmRxTime.rco file. The .rco and the complete processing chain for this example are included with PsychRP and can be found on your disk as C:\TDT\PsychRP\Files\MmolPdgmRxTime.*.

Important!: Example chains are for illustration purposes only. They should be thoroughly tested to be sure they match your specifications before using them.

Pre-Recorded Stimulus Files

For some experiments, you might play pre-recorded stimuli rather than generate them in the RPvdsEx processing chain. One way to do so is by using a *SourceFile* component in your custom processing chain, which stores stimulus file contents to a buffer. These buffers can then be played in one of the three standard paradigms.

The following example loads the contents of two .wav files into two serial buffers, playing one as the standard and one as the target in an nAFC paradigm.

The circuit below loads the standard signal from the file C:\TDT\PsychRp\Files\da50k.wav into a serial buffer. The target stimulus is loaded similarly into a second buffer with an output hop "TgtSignal". Both buffers should be large enough to hold the longer of the two files, in this case, 25000 points. The "PulseOn" hop resets the buffer index at the beginning of each stimulus interval, so that each stimulus is played from the top the buffer.
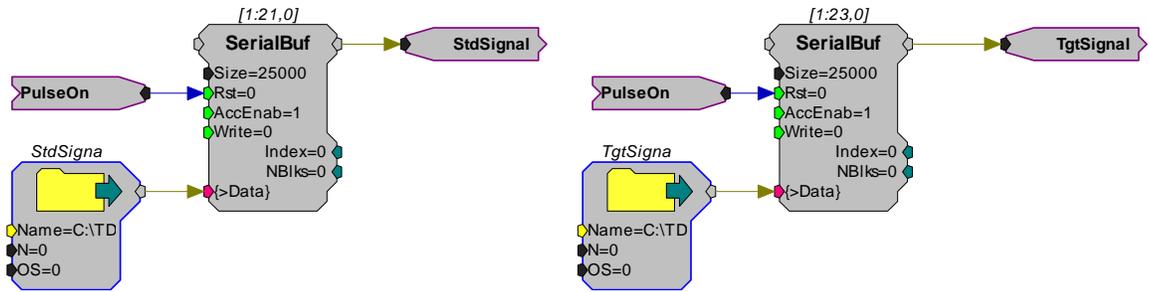
Once the signals are loaded into their respective buffers, it is necessary to direct the target signal to the D/A in the target interval, and the standard signal to the D/A the other (standard) intervals.

To do this we will tap into the nAFC control that switches between the standard and target variable values depending on the current interval (shown below). In a 4 AFC, when the 2nd interval is the target (*nTarget*=2), the iCompare below evaluates true on the second of the four intervals. This sends the value of the "DynamicVar" hop through the MuxIn component parameter (In1). On intervals 1, 3, and 4, the iCompare would evaluate false, and send the "StdVal" through the MuxIn component parameter (In0).
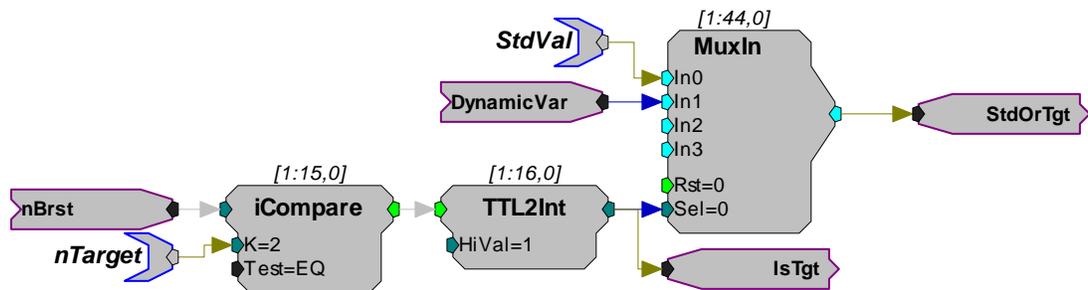
Adding the "IsTgt" hop to the standard circuit allows us to send either the standard or a target signal to the D/A in a similar fashion, as shown below.
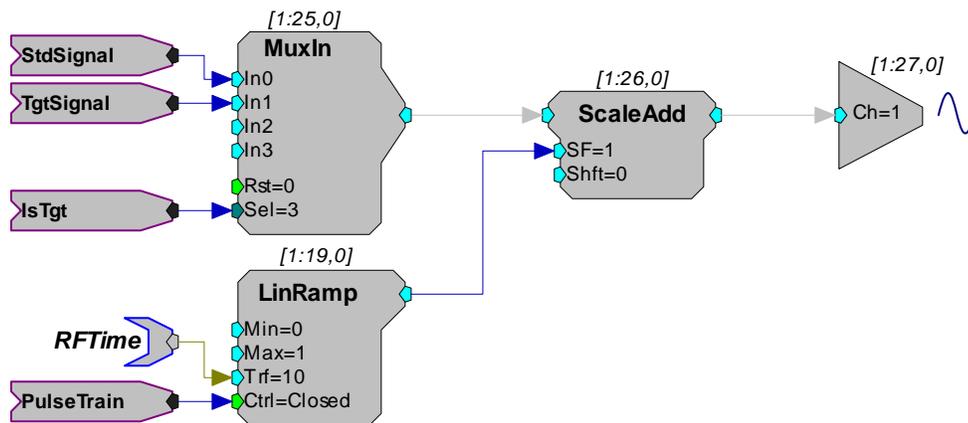
The standard gating using the LinRamp component is still in effect. Be sure to adjust the stimulus duration and interval in the nAFC menu to accommodate your own files in this paradigm.

The dynamic variable is not used in this example, but could be used to record 0.0 for an undetected target and 1.0 for a detected target.

This example can be run by selecting the *Custom* stimulus option from the nAFC Setup Menu and loading the included nAfcPdgmWav.rco file.

The .rco, complete processing chain, and example .wav files for this example are included with PsychRP and can be found on your disk as C:\TDT\PsychRP\Files\nAfcPdgmWav.*.

Important!: Example chains are for illustration purposes only. They should be thoroughly tested to be sure they match your specifications before using them.

Revision History

PsychRP Version 1.06

- Added support for Optibit and Gigabit interfaces
- nAFC paradigm supports up to 8 AFC using NafcPdgm8box.rco custom processing chain and 8 button BBOX

PsychRP Version 1.05

- PsychRP now supports reading User Buffers from custom .rco chains and storing these to the data file
- Support added for transformed Up-Down adaptive tracking methods
- A bug in the Stock Noise Bandwidth has been fixed
- The Customizing Stimuli section of this manual has been expanded and includes more example .rco code