

## NRI Management

Use this window to:

**Create New NRI Measurement**

Click on the New button.

**Open Existing Measurements**

Double-click on an NRI row or click on the View button.

**Delete Measurements**

Highlight a row, and then click on Delete.

**Hide/Show tNRI**

Highlight a row, and then click on Hide/Show tNRI. Displays tNRI marker(s) on program window.

**Edit/Add Notes**

Highlight a row, and then click on Notes.

Each row in the NRI window represents a saved NRI measurement.

ID	Stim. Elec.	Rec. Elec.	Start (CU)	End (CU)	Steps	Averages	tNRI (CU)	Show	Creation Date	Notes
10	14	12	76	375	10	128	267.9	No	11/29/2005	
9	14	12	76	375	10	128	283.0	Yes	11/29/2005	
8	12	10	76	375	10	128	131.3	Yes	11/29/2005	
7	7	5	76	375	10	128	154.9	Yes	11/29/2005	
6	3	1	76	399	10	128	79.8	Yes	11/29/2005	
5	13	11	452	80	10	128	53.3	Yes	11/29/2005	

Buttons: Help, Edit Notes, Show tNRI, Delete, View, New, Close

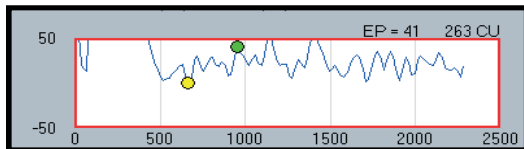
**Close Window**

Click on the Close button to return to programming.

## NRI Troubleshooting

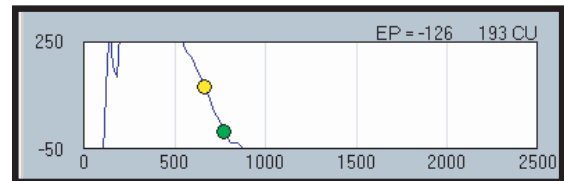
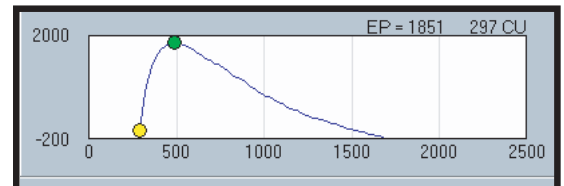
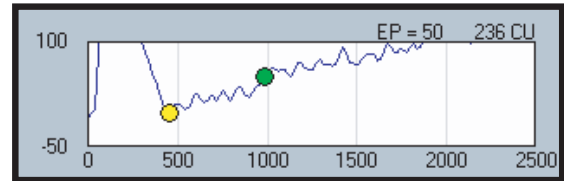
### Managing Noise

Response should be larger than the noise floor represented in the time window beyond 1000mS. Increase number of averages using the NRI options screen, or try another recording electrode (+1 apical or -2 basal). Should the random fluctuations be as large as the amplitude selected for the neural response, eliminate that point from the tNRI calculation.



### Managing Artifact

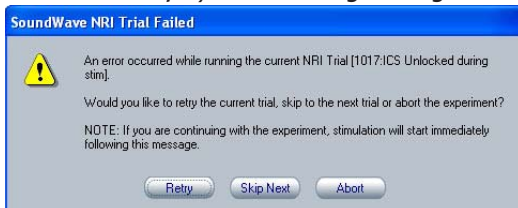
Examples of artifact. Note atypical response amplitude (too large or negative typically indicates artifact). Try another recording electrode (+1 apical or -2 basal).



### Manual Averaging

- Use NRI options to set Samples to 128.
- Use the space bar to stop the measurement once desired response is observed (no need to gather all 128 Samples if not required)

SoundWave displays the following message.



- Use **Skip Next** to continue building an I/O function.
- Use **Abort** if you have gathered enough responses and you want to end the measurement

Note: This message also displays if lock is lost or stimulation is stopped during NRI measurement.

Note: Do not use electrodes with out of range impedance or shorts for recording or stimulating an NRI measurement.

## Looking for NRI

NRI consists of a negative peak (N1) followed by a positive peak (P2). N1 latency is typically between 200 - 500 micro seconds. P2 is typically less robust with a latency before approximately 1ms. Amplitude of the response is measured between N1 and P2 in uV and varies across individuals from typically 20-1500uV.

The scale of each NRI plot is automatically set based on the largest response in the series. To verify the presence of a response it may be necessary for you to adjust the scaling by clicking on a plot (SoundWave highlights a selected plot in red) and then using the up or down arrow keys to adjust the scale. Adjustments can be made during or after measurements are run.

The I/O Function plots the NRI amplitude against Clinical Unit (CU) level. Typically, the I/O contains a low amplitude noise floor and a linear portion of response growth. Be sure to obtain 4 well spaced points on the linear portion of the I/O function for calculation of tNRI. tNRI is the threshold for the neural response derived by fitting a linear regression line through the I/O function. When response amplitudes are low (<100 uV) and I/O function slope is shallow use 1st NRI (visual) instead of tNRI. 1st NRI is the level that you can first visually detect a neural response with an amplitude of 20-50 uV.

Artifact (normal)

Left side displays individual NRI plots for a given CU level.

Click once to select N1 (yellow circle) or P2 (green circle) and use the left or right arrow keys on your keyboard to change the point selected.

Set using arrow keys or typing in the fields.

Impedances:  
Yellow - Open  
Purple - Short  
Green - Normal  
Blue - Stimulation Level exceeds compliance

Right side displays I/O plot (amplitude of N1 to P2).

tNRI

Click to select a point in the graph and exclude/include it from the tNRI calculation. Click again to include it.

- indicates a response that is excluded from the tNRI calculation, points < 20 mV will automatically be excluded.
- indicates a response that is included in the tNRI calculation

Note: You can use the Space Bar on the keyboard to stop the measurement at anytime.

## Using NRI

### Step 1: Set tNRI Recording Settings

#### Stimulating Electrode:

- Run on the 3rd electrode of each speech burst band (3,7,11,15).

#### Recording Electrode:

- Use default (2 apical unless at the end of the array) to start  
*Note: Do not use extracochlear contacts or out-of-range*

#### Stimulation Level:

- Set Start Level to behavioral M level (from program) if < 200CU.
- If behavioral M level > 200 CU or not reached by 300CU start at 200CU.
- Set End Level to 50 CU

#### Points:

- Set number of points to achieve an increment step size of 10-20 CU.

#### Averages:

- Use default of 128 averages and use manual averaging.  
*Note: Use Space Bar to "Abort" CU level once response is observed (no need to complete all 128 averages if not required).*

### Step 2: Run Measurement

- If a response is > is obtained, verify tNRI calculation from I/O and save.
- If response is not present or is < 100uV, record at increased stimulation level *within behavioral comfort limits*, but do not exceed compliance limit for an electrode.
  - If you can obtain a neural response with an amplitude >100uV after increasing level, verify tNRI calculation from I/O and save.
  - If you can only measure a neural response <100uV use 1st NRI instead of tNRI from I/O.
  - If you cannot measure a neural response repeat run with a different recording/stimulating electrode.

### Creating Programs based on tNRI

You can use the following recommendations for creating programs using the data obtained using NRI.

#### If tNRI is <200CU:

- Program 1: M levels set to tNRI.
- Program 2: M levels set to 20% above tNRI.
- Program 3: M levels set to 40% above tNRI.

#### If tNRI is between 200-300CU:

- Program 1: M levels set to NRI.
- Program 2: M levels set to 10% above tNRI.
- Program 3: M levels set to tNRI 15% above.

*Note: You may initially set M levels 10-20% below NRI and/or use volume to monitor performance*

#### If tNRI or M levels are >300CU:

- Measure ESRT with Speech Bursts.
- Program 1: M levels set 20% below ESRT.
- Program 2: M levels set 10% below ESRT.
- Program 3: M levels set to ESRT.

*Note: For very young children initially select only one strategy.*

*Patient may be comfortable with any of these programs, no need to encourage to try each unless progression is necessary for comfort level or based on performance.*

*Monitor progress with program with objective speech perception measures as well as subjective report.*

#### If Behavioral M level is significantly Higher or Lower than tNRI/ESRT:

Create programs with gradually adjusted M levels (set to level of ESRT or NRI) volume control set -50/0% and monitor performance.

#### If you cannot measure tNRI or ESRT:

- Set M to behavioral levels obtained with Live Speech
- If no reliable behavioral measures, contact Advanced Bionics for assistance.

## Measuring NRI in the Operating Room

#### NRI Measurement Template for the OR:

Starting Level:	<b>400CU</b>
Ending Level:	<b>50CU</b>
Increments:	<b>15</b>
Averages:	<b>128</b> (use manual averaging)
Stimulating Electrodes:	<b>7/5, 3/1, 11/9, 15/13</b>

If time permits, measure in the above order; exclude extracochlear contacts and out-of-range impedances from stimulating or recording.

Due to time restrictions and the potential for post-operative changes in the neural-tissue interface, seeking 1st NRI is not recommended in the OR.

It is recommended to repeat measures at the initial stimulation to apply to programming. If measures cannot be repeated at the initial stim, **reduce programming recommendations by 1/3 to be conservative.**