

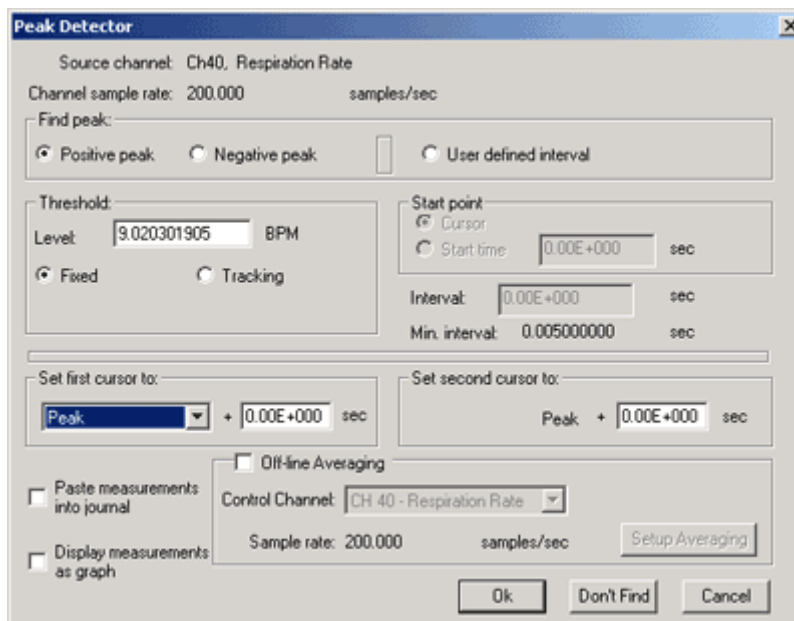
## Application Note 204 AcqKnowledge Peak Detector Operation

The AcqKnowledge Peak Detector is a software analysis tool used for the purposes of automatically performing specific measurements on data in an AcqKnowledge data file. The Peak Detector can perform automatic measurements on multiple channels simultaneously. The resultant measurements can be printed directly to the Journal or plotted, in graphical form, to a new channel in the AcqKnowledge data file.

**TIP** The **Analysis** menu contains many automated Peak/Cycle Detector functions; running peak detection through this dialog may not be required and/or may not be the most efficient—check the **Analysis** menu first.

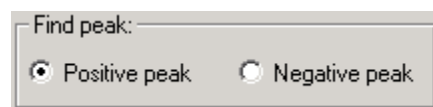
This Application Note details the major Peak Detector functions.

- For a guided example using Peak Detector functions, see the AcqKnowledge Software Guide section on how to detect the positive spike in the QRS complex.



### Peak Detector Measurement Modes

#### 1) Data Driven Measurements



In this mode, data is extracted from the waveform as mediated by the form of the data itself. In typical physiological recordings, data is often quite cyclic in nature. Data driven measurements are those which employ characteristics of the data cycles themselves to determine the interval over which the measurement is performed. When performing data driven measurements, the user can specify whether the software should look for positive or negative peaks in the record. If positive peaks are chosen, the Peak Detector will advance a master cursor, step-by-step, through all the positive peaks in the data file or selected area.

- A good example of a data driven measurement is the determination of R-R interval in an ECG recording. The Peak Detector will simply “hop” from the peak of one R-wave to the next and, in the process of doing so, will automatically extract all the cyclic R-R intervals present in the ECG recording.

## 2) User-Defined Measurements

In this mode, data is extracted from the waveform as mediated by a pre-defined time interval. The Peak Detector will simply “hop” to the next fixed point in time as indicated by the user-defined time interval. In all user-defined interval measurements, the Peak Detector will advance a master cursor, step-by-step, through specific (fixed) time intervals, until the end of the file or selected area is reached.

- A good example of a user defined interval measurement is the determination of mean blood pressure values over ongoing, consecutive, 1 minute intervals.

## Cursors

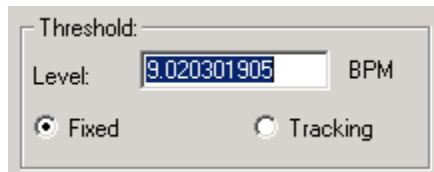
In both of the operational modes, the Peak Detector advances (step-by-step) a single **master cursor** forward in time. The time jumps made by this master cursor are determined by the operational mode chosen.

- In data driven mode, the master cursor jumps forward to the next point as defined by the data stream and the kind of feature (positive or negative peak) identified.
- In user-defined interval mode, the master cursor jumps forward by the pre-specified, user defined interval.

The Peak Detector also employs **sub-cursors**. The sub-cursors can be set to fixed positions in time, related to the master cursor.

- For example, the master cursor could be set up to move through the data at 30 second intervals, but the sub-cursors can be configured so that a data measurement can be performed several seconds before and several seconds after the location of each 30 second jump point.

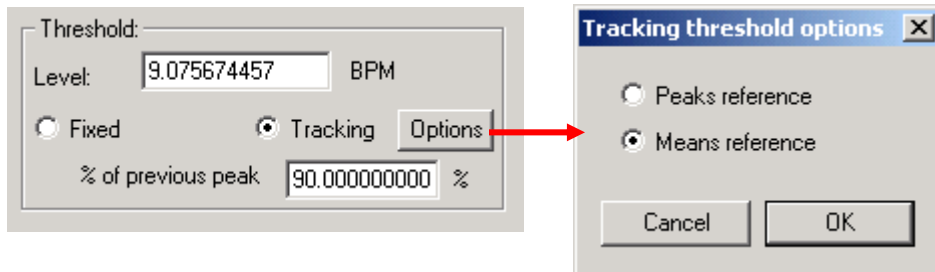
## Threshold



In data driven mode, the Peak Detector feature can be set up to look for positive or negative peaks. In the simplest mode of data driven operation, the user can identify a **Fixed threshold**.

- **Positive Peak:** If the data crosses the Fixed threshold, first positively and then negatively, the highest valued point in the data between these crossings is identified as a positive peak.
- **Negative peak:** If the data crosses the Fixed threshold, first negatively and then positively, the least valued point in the data between these crossings is identified as a negative peak.

The next simplest mode of data driven operation employs a **Tracking threshold**. The Tracking threshold simply adjusts the threshold level each time another peak (positive or negative) is found. When Tracking is selected, an **Options** button is activated, which generates the Tracking threshold options:



The default option for Tracking threshold operation employs a **Means reference**. This option will cause the software to determine the Mean Value of all the data between the sub-cursors. This Mean Value establishes a variable reference upon which the tracking threshold operates. The software will determine the new threshold as follows:

- For Positive Peaks:  $\text{New Threshold} = \text{Mean Value} + (\text{Positive Peak Value} - \text{Mean Value}) \times (\% \text{ factor})$
- For Negative Peaks:  $\text{New Threshold} = \text{Mean Value} - (\text{Mean Value} - \text{Negative Peak Value}) \times (\% \text{ factor})$

An alternate option for Tracking threshold operation employs a **Peaks reference**. This option will cause the software to determine the Positive Peak Value and Negative Peak Value of all the data between the sub-cursors. The Positive and Negative Peak Values establish a variable reference upon which the tracking threshold operates. The software will determine the new threshold as follows:

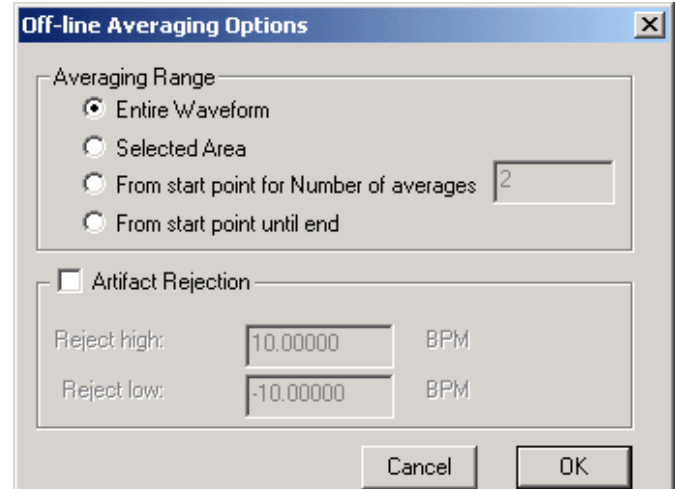
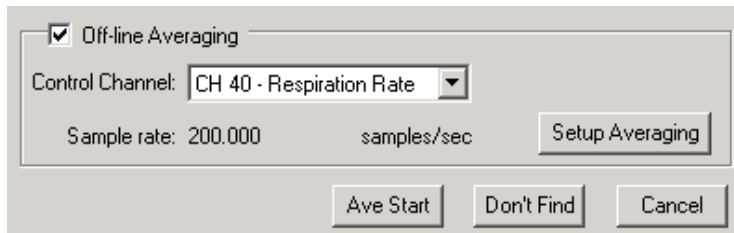
- For Positive Peaks:  $\text{New Threshold} = \text{Neg. Peak Value} + (\text{Pos. Peak Value} - \text{Neg. Peak Value}) \times (\% \text{ factor})$
- For Negative Peaks:  $\text{New Threshold} = \text{Pos. Peak Value} - (\text{Pos. Peak Value} - \text{Neg. Peak Value}) \times (\% \text{ factor})$

### Hints for Threshold Tracking...

- If the data has a very consistent cyclical nature, either Tracking Option will work fine.
- If the data has spurious positive or negative peak values present, the **Means** Tracking Option reference is probably a better choice.
- If the data has an erratic baseline, but consistently sized, positive and negative peaks, the **Peaks** Tracking Option reference is probably a better choice.

## Averaging

A special feature of the Peak Detector is the ability to perform **averages** of data when performing data driven or user defined measurements. A good example of this feature would be for the case of assembling a representative or average blood pressure cycle from a larger collection of cycles. In this example, the Peak detector would automatically identify the high (positive) or low (negative) points of a selected series of blood pressure cycles. The Peak Detector would be set up to look “before” and “after” each positive or negative blood pressure peak. After all the peaks are found, the software automatically assembles the identified data to create the averaged beat.



The **Control Channel** option lets you detect events in one channel while averaging the response from another channel. Using the Control Channel function, you can perform averaging on one data channel even though the master cursor is synchronized (controlled) by another channel. This means that the average value of one signal can be computed around events in another signal, which is useful for ERP and P300 studies.

- A good example of this feature revolves around **P300 measurements**, where two or more Control Channels are used to sequentially average data. [Using the SuperLab® presentation system](#), the average response can be determined based on when stimuli were presented to the subject. One Control Channel can correlate to stimulus A, and other Control Channels can correlate to stimuli B, C, D, etc. In this fashion, averaged responses to different types of sequentially presented stimuli can be compared and analyze.

## Display Measurements as Graph

This option will plot the measurements as a graph in a new channel. Each measurement is assigned its own channel. As each measurement is calculated, the results can be pasted to the Journal or displayed as a new channel. This function provides a powerful way to summarize large data files for further analysis. For instance, starting with a 24-hour recording, you could use the data reduction tools to take the Mean every 20 minutes and then display the Mean as a graph.

- Measurements are inserted for all Find Peak operations, including Find All Peaks and Find Next Peak.
- A new channel is created for the measurement when:
  - a measurement changes between successive Find Peak operations
  - the Source channel for a measurement changes between successive Find Peak operations
  - a measurement channel is removed from the graph (Edit> Remove waveform)
- Display Measurements as Graph is not available with Off-line Averaging.