

Understanding the Differences in Ponemah Derived Parameter Calculations within Different Modes

Background:

Ponemah calculates and reports parameter data through three different modes: Acquisition, Replay, and Review. Depending on the mode the user is within, the parameter calculations may contain slight variations. The purpose of this document is to describe these variations and explain why they occur.

Comparing the Different Modes:

The calculated parameters Ponemah reports in Acquisition and Replay are consistent; assuming the Analysis Attributes have not changed and the Sampling Scheduler was not used. However, when comparing the reported values from Acquisition or Replay to Review, inconsistency may be seen. This variation will also apply to ODBC output from Ponemah (Excel and Access) when comparing a spreadsheet generated during Acquisition and Replay to the values seen in Review.

Causes

1. Signal Related:

- a. Signal values are very slightly different due data caching performed in Review. Review calculates presentation signals from the RAW data file through the application of filters and data processing. This results in a large quantity of data that needs to be saved temporarily for use by P3 during the Review session. In order to save disk space, a number of samples of the presentation signal are grouped together and quantized. There is a small loss of precision in this process, on average, is less than 0.05%. One of the consequences of this difference is seen with Calculated Marks. If, after opening a Review file, Review is prompted to recalculate a Calculated Mark, the mark may move with no change to the marks on which it depends. This is because the original placement of the Calculated Mark was based on the Replay data values; whereas, recalculation uses the data values present in Review.

2. Logging Method Related:

- a. Acquisition and Replay report Cycle information at different times than Review. Cycle information is logged in the Drx spreadsheet when the analysis module determines a valid cycle has been found; however, the exact time at which this occurs differs for each analysis module. In Review, a complex is defined as a valid cycle when the analysis module marks a specific complex characteristic and it is at this logging mark, defined in the Analysis user's manual, that cycle information is logged in the spreadsheet. For example, when the BP analysis module marks the Systolic Mark, it is considered a valid cycle and is reported to the spreadsheet, associating the derived parameters of the cycle to the time of the Systolic Mark. However, in Acquisition/Replay, a complex is fully defined once the next cycle is recognized by the analysis module, and it is at this time that the derived parameter data associated with the previous cycle is reported to the spreadsheet. For example, the BP analysis module will report the previous cycle upon clearing the Systolic Validation Time of the next cycle. The result of this will delay the logging of a cycle into Drx spreadsheet of Acquisition/Replay by a few tenths of a second, when compared to Review. This occurs because the software has the entire signal to consider when analyzing

- during a Review, while in Acquisition the signal is still being written. Ultimately, this will affect which cycles are included in the logging rate averages.
- b. Cycle Range, the points associated with the start and end of the cycle, is defined differently between Acquisition/Replay and Review.
 - i. Mean parameter values can be reported differently depending on where the Cycle Range is defined. In Review, the Cycle Range is more physiologically relevant since the software has the whole signal available when performing calculations. For example, in BP a point-by-point mean can be reported which in Acquisition/Replay reports the average of points from the end of one systolic validation time to the next; however, this does not have any physiological significance. In Review the Cycle Range is defined from end diastolic to end diastolic, which provides a more accurate interface between cycles and thereby provides a more valuable mean calculation. Since the Cycle Range is defined at different starting and ending points, the Mean parameter value will be calculated from a different set of points, thus resulting in different reported values.
 - ii. In Beat-to-Beat mode (Logging Rate = 1 Epoch), cycles get logged according to the user-defined trigger channel for a Group. Once a valid cycle is marked on the Group's trigger channel, Ponemah will report cycle information across all channels associated with the Group from the marks within the Cycle Range. Since the Cycle Ranges differ between Acquisition/Replay and Review, separate channel cycle marks and their derived parameters will be logged at different times. For example, if Group A has a BP and an ECG channel, with the BP channel defined as the trigger channel, and the ECG channel has marks between the Diastolic point of Cycle 1 and End Systolic Validation Time of Cycle 2, then in Acquisition/Replay those marks will be logged with Cycle 1, while in Review they will be logged with Cycle 2.
 - c. For any Analysis module where heart rate or breathing rate is determined, Review uses Harmonic Mean to calculate logging rate averages of the HR, BPM, RBpm (BPR module only), and Rate (MAP and PT modules only), while Acquisition and Replay use the Arithmetic Mean.
3. Parameter definition differences: The calculations of derived parameters are identical to those performed during acquisition and replay for most parameters, exceptions are noted for specific derived parameters by Analysis Module below:

Analysis Module	Parameter	Acquisition/Replay Calculation	Review Calculation
BP	+dP/dt	Calculated between two successive end of peak detection times	Calculated between the end diastolic point and the systolic point
	-dP/dt	Calculated between the point that clears Minimum Pulse Height to the end of peak detection time	Calculated between the peak and the end of the peak detection time
LVP	Min	Calculated between the previous cycles Min Slope and the current cycles LVEDP point	Calculated between the Min Slope mark and the following cycle's LVEDP mark
ECG	PH	P direction is determined by the shape of the P wave relative to the T-P segment	P direction is based on the shape of the P wave relative to the points at which the P start and P end are marked
PAF	TV	Reports the maximum volume over the entire cycle	Reports the volume at the start of expiration as the Tidal Volume
PCR	TV	Reports the maximum volume over the entire cycle	Reports the volume at the start of expiration

			as the Tidal Volume
PT	Avg	Calculated between the point after clearing Peak Validation time for the previous cycle to the point at which peak validation time is cleared for the current cycle	Calculated from the current cycle's Minimum mark to the point prior to the following cycles Minimum mark
	Rate	Calculated based on the interval between the completion of the previous cycles peak validation time and the current cycles peak validation time	Calculated off the duration between the previous cycle's Maximum mark and the current cycles Maximum Mark
	+d_/dt	Calculated between the Start Contraction Mark and the completion of Peak Validation Time	Calculated between the Minimum Mark and the Maximum Mark
	-d_/dt	Calculated between the Maximum Mark and the point that clears the minimum pulse height	Calculated between the Maximum Mark and the next cycle's Minimum Mark
	+dd/dt	Calculated between the Start Contraction point and the peak validation time	Calculated between the Minimum Mark and the Maximum Mark
	-dd/dt	Calculated between the maximum point and the point that clears the minimum pulse height	Calculated between the Maximum Mark and the next cycle's Minimum Mark
URP	MV	Averaged value calculated off of the averaged TV and averaged BPM values when running in a multiple epoch logging rate or time-based logging rate	Averages are calculated from individual epochs, cycles, being averaged
	MVadj	Averaged value calculated off of the averaged TVadj and averaged BPM values when running in a multiple epoch logging rate or second logging rate	Averages are calculated from individual epochs, cycles, being averaged