

## Continually Self Calibrated - No User Calibration Required

The Arbiter Systems' GPS Satellite Controlled clocks with the Power System Time, Frequency, and Phase Monitor option (Option 28) do not operate like a typical transducer. The clocks are primary sources receiving a GPS satellite timing signal that is traceable to NIST and meet the requirement of BAL-005, R17 when locked to GPS. All time and frequency measurements made are within the specified accuracy of the individual models. This information applies to the entire GPS satellite controlled clock including Option 28.

Model	Accuracy
1093A/B/C	500 nanoseconds
1084A/B/C	100 nanoseconds
1088B	100 nanoseconds

System frequency measurements are made by determining the rate of change of phase angle with respect to time. Errors in the phase measurement cancel since this measurement is made as a difference measurement. Time errors also cancel since the measurement of time is a difference as well.

$$\text{SysFreq} = \Delta\Phi / \Delta T.$$

Similarly, the accumulated system time error is measured by accumulating the difference in phase angle relative to UTC time. Calibration errors of phase, or offsets of time, drop out of the measurement.

$$\text{SysTimeError} = \sum(\Delta\Phi) / (360 * \text{SysFreq})$$

where SysFreq is constant, 50 or 60 Hz.

Therefore, so long as the clock stays locked to GPS it is continually calibrated using GPS time transfer directly traceable to UTC-USNO and the measurements of system frequency and time are directly traceable to NIST, meeting BAL-005, R17. No calibration is necessary or possible. In the event that the clock loses lock, frequency errors of a few parts per million are likely, as is drift of the system time offset. When the clock regains lock, it will reset the time offset to the nearest value (+/- half a cycle of 60 Hz). If the loss of lock has been sustained and the drift has exceeded a half cycle, the system time error would be off by an integer number of cycles. In this event we would recommend resetting the system time error to the actual known value, if available. In any event, these errors, due to loss of lock, cannot be corrected for or calibrated by any direct means.