Calibration of the SolarTrak® Real-time Clock/Calendar

The crystal that provides timing pulses to the clock chip on the SolarTrak® has two modes of deviation that must be accounted for in order to provide accurate time over long periods. The first is operating temperature variation and the second is variation of fabrication within published tolerances for the part.

Temperature is accounted for through the integration of operating temperature applied to a formula provided by the part manufacturer. The SolarTrak® is equipped with an onboard thermistor-based device mounted adjacent to the crystal that allows operating temperature to be sampled once per minute. The time adjustment is applied once per day at midnight.

The fabrication variation issue must be dealt with using essentially empirical methods. The required correction can be reduced to a daily and weekly operation if the overall time is kept within twenty seconds of the correct universal time, corresponding to about one-tenth of a degree of sun motion.

The basic computation for determining the correction is simply the number of days since the clock was set exactly on universal time divided into the number of seconds of observed deviation over that time frame. If that value is applied to the current clock value by the processor once per day, the time will remain accurate.

Since the time is not kept in fractional parts within the clock calendar device, the correction is broken into two parts, seconds-per-day deviation plus seconds-per-week. Seconds per month might be applicable but there are space constraints associated with internal storage for both parameters and program code that makes the addition less than optimal.

The PC Interface software (F9 then F3) and the User Interface Board (Set Controller to UIB time) both provide an automated method for performing this calibration provided that the operation is performed with the respective clocks on those devices set to precisely universal time. The SolarTrak® stores the last time-set date as an internal, non-volatile parameter and performs the required calculation at each time-set operation, reducing the overall deviation to an update of the seconds-per-day and seconds-per-week in integer (whole numbers) rather that fractional form.

This operation can be done by hand using several iterations by performing the following steps.

1. Set the clock/calendar to universal time. Note the day it was set.
2. Progressively extend the time between time-set operations from a few days to a few months over three or four iterations.
3. Note the time deviation (in seconds) for the lapsed time (in days), divide out to produce seconds per day and add that deviation (using only the integer part with the sign convention + was running slow, - was running fast) to any previously computed value.

4. Take the remaining seconds of deviation not accounted for by step three and divide by the number of lapsed weeks, adding that integer value to the seconds-per-week parameter using the same sign convention.

5. Repeat steps 1-4 three or four times.

The same progressive time lapse between operations should be applied to the automated methods as well.

Proper calibration of the clock/calendar will produce clock error within the twenty-second window over as long as a year without further updates.