

GPS Receiver Thermal Test Studies
Daniel Brandt
for
HEA Group (Covault)
CWRU
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Information below comprises that of the “Summertest”. Reporting on further data and/or elaboration of the subject below is freely available.

Summertest: A thermal test cycle designed to “match” near-worst-case thermal cycling at Malargue based on actual Auger SD temperature data collected during austral summers (monitoring archive)

Properties of the test:

- Duration: 25 hours
- Method of Experimentation: Two GPS receivers (one reference receiver with the ID CA0550 and various CC test receivers) are connected to a Xilinx XC2XL PLD logic board, which in turn is connected to a laptop running LabView 6.0 real-time as real-time difference values are measured between the receivers over the test’s duration. Data is continuously written to a txt file during real time, and information for each data point (taken each second) is stored in a column. Time in Modified Julian Date format is recorded in the 1st column, while the real time difference is recorded in the rightmost (10th) column.
- Oven Used: ESPEC Platinous K ESL-3CA
- Humidity was not considered in this test, only temperature!

Test Steps (based on SD temperature history):

- Oven temperature initially ramped down to 17.7 degrees C.
- Oven temperature held at 17.7 degrees C for 4 hours.
- Oven temperature decreased from 17.7 degrees C to 0.5 degrees C over a duration of 2 hours.
- Oven temperature held at 0.5 degrees C for 4 hours.
- Oven temperature increased from 0.5 degrees C to 17.7 degrees C over a duration of 2 hours.
- Oven temperature held at 17.7 degrees C for 4 hours.
- Oven temperature increased from 17.7 degrees C to 35 degrees C over a duration of 2 hours and 21 minutes.
- Oven temperature held at 35 degrees C for 4 hours.
- Oven temperature decreased from 35 degrees C to 20 degrees C over a duration of 1 hour and 26 minutes.

- Oven temperature held at 20 degrees C for 30 minutes (allows adjusted to room temperature to prevent dew formation).

Rationale on temperature range, speed of ramps, etc:

- The lowest temperature, 0.5 degrees C, was set to where it was because it was the lowest temperature in Malargüe last summer as obtained from the Weather Underground website.
- The highest temperature, 35 degrees C, was set to where it was because it was the highest temperature in Malargüe last summer as obtained from the Weather Underground website.
- The rate of temperature change on the ramps (excluding the initial ramp down to 17.7 degrees C and the final ramp at the end of the test down to 20 degrees C), which had a value of 7.29 degrees C/hour was set to that particular value, as it corresponds to the fastest recorded rate of temperature change using data from the Auger monitoring website.

The Summertest was performed on twenty of the “CC” receivers (new version 2014) with the following ID numbers:

- 3357, 3362, 3377, 3379, 3380, 3383, 3387, 3388, 3395, 3396, 3400, 3401, 3403, 3407, 3408, 3412, 3414, 3415, 3416, 3427

In each graph, the temperature as a function of time and the real-time difference as a function of time are plotted on the same graph, with the former in blue and the latter in red.

Important values after testing each receiver are below in the table:
(next page)

TABLE 1: Statistics on Real-Time Difference Values relative to reference GPS (all in nanoseconds) for “Summertest” thermal test cycle:

M12M GPS Receiver ID	Mean Offset relative to Reference (ns)	Standard Deviation (ns)
3357	12.47	3.93
3362	2.25	4.01
3377	-1.42	4.05
3379	2.60	4.09
3380	4.17	3.89
3383	-0.54	3.82
3387	4.43	3.86
3388	13.18	4.07
3395	-2.31	4.11
3396	4.08	4.01
3400	-5.71	4.04
3401	9.63	4.13
3403	5.33	3.94
3407	5.21	4.22
3408	2.30	3.82
3412	10.94	4.00
3414	7.95	4.41
3415	0.19	3.87
3416	-1.64	4.05
3427	2.73	4.14

