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Thermal Testing of Dallas/Maxim iButton Temperature Logger, Model DS1922L, for Flight Qualification on Captive Flight Test Unit-1B (CFTU-1B)

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Test Number 001

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1. Introduction

This report documents the flight qualification testing of the Dallas/Maxim iButton temperature logger, model DS1922L, for internal mounting to the W80 Air Launched Cruise Missile (ALCM). A single thermal test was performed utilizing a Thermotron Model S-1.2V, S/N 20330-S, Environmental Chamber, an Agilent 34970A Data Acquisition/Switch unit, S/N MY44002670, with a Agilent 34901A 20 channel multiplexer, S/N MY41038424, and a single J type thermocouple. Start, stop, chamber temperature and temperature profile control of the Themotron was accomplished using a custom LabView VI. Additional chamber thermal data from the Agilent unit, for comparison with the Thermtron thermocouple, was captured using Agilent BenchLink software. The thermal test was performed in Building 131, Room 2273, at Lawrence Livermore National Laboratory, Livermore, California. One hundred twenty eight (128) DS1922L temperature loggers were setup and tested simultaneously.

The test consisted of the thermal profile shown in table 1.1 and Figure 1.1

Table 1.1
Thermal Test Profile

Function	Time, Hours	Temperature, °C
Hold	2	25
Ramp	1	80
Hold	2	80
Ramp	1	25
Hold	2	25
Ramp	1	-65
Hold	2	-65
Ramp	1	25
Hold	2	25
Ramp	Machine limited	80
Hold	2	80
Ramp	Machine limited	25
Hold	2	25
Ramp	Machine limited	-65
Hold	2	-65
Ramp	Machine limited	25
Hold	2	25

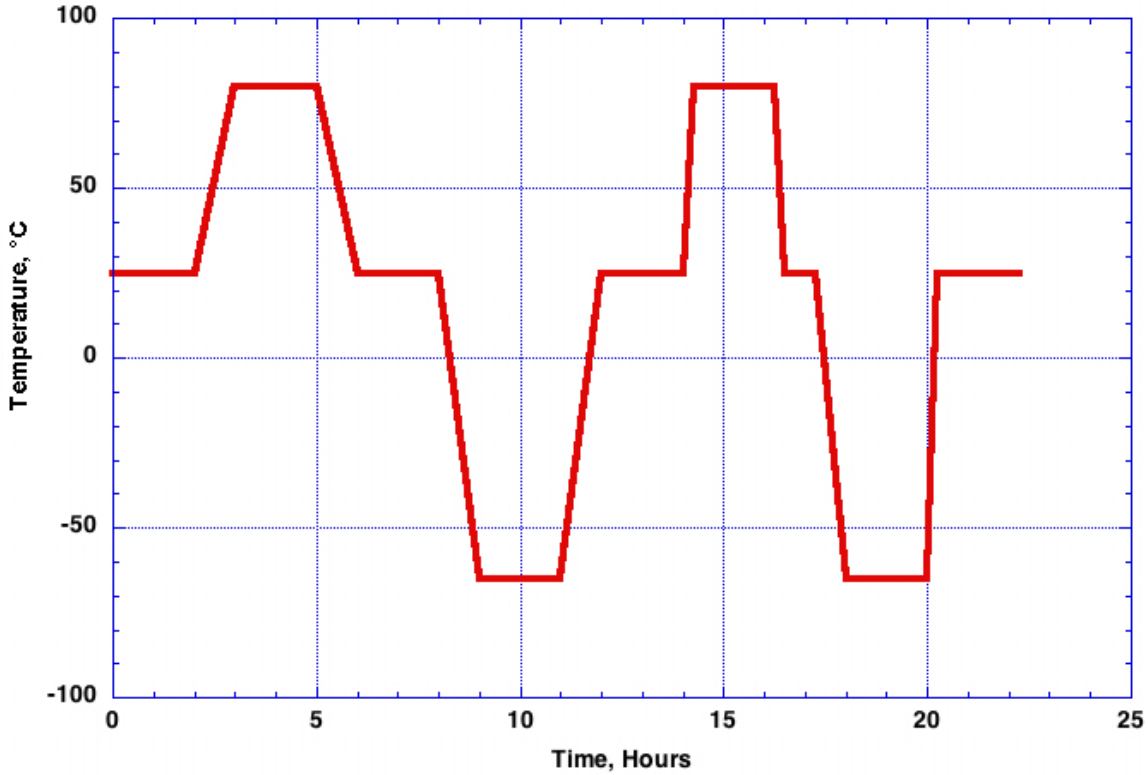


Figure 1.1 – Graph of Thermal Test Profile

2. Test Setup and Procedure

One hundred twenty eight (128) DS1922L temperature data loggers were assembled using orange halo tags, Dallas/Maxim model DS9106L-OG, and halo lock rings, Dallas/Maxim model DS9093RA. The halo tags were labeled using a black, fine-point, Sharpie permanent marker with their serial number for easy reading, figure 2.1.

Figure 2.1 – DS1922L, halo tag and lock ring

The DS1922Ls were configured using ThermoTrack software from Proges-Plus. Due to the large number of DS1922Ls being programmed, 16 mission profiles were created in ThermoTrack. The difference in the profiles was the start delay, which varied from 29 minutes to 59 minutes in 2-minute increments. This was necessary since one can only program 7 DS1922Ls in 1 minute, and we were wanted the one hundred twenty eight (128) DS1922Ls to start within one minute of each other.

Therefore, the parameters of the mission were a start delay from 59 minutes to 29 minutes, 0.5° C resolution, and a 160- second sampling rate. The 160-second sampling rate allows the DS1922L to acquire 8129, 8-bit readings for 15 days 4 Hours 5 minutes. The 23.5-hour test requires a minimum of 529 samples, which is easily accommodated by the DS1922L.

The one hundred twenty eight (128) DS1922Ls were loaded into the environmental chamber upon a perforated aluminum sheet. A J-type thermocouple, connected to the Agilent 34970A, was inserted into the chamber through the chamber feed-through port on the left side of the chamber, Figures 2.2 and 2.3.

Five minutes before the DS1922Ls were programmed to start, the Agilent 34970A was started, and began capturing data at 10-second intervals. A status check of five (5) DS1922Ls picked at random was performed ~8 minutes after the scheduled start time to verify they were acquiring data.

Figure 2.2 – Thermotron Environmental Chamber

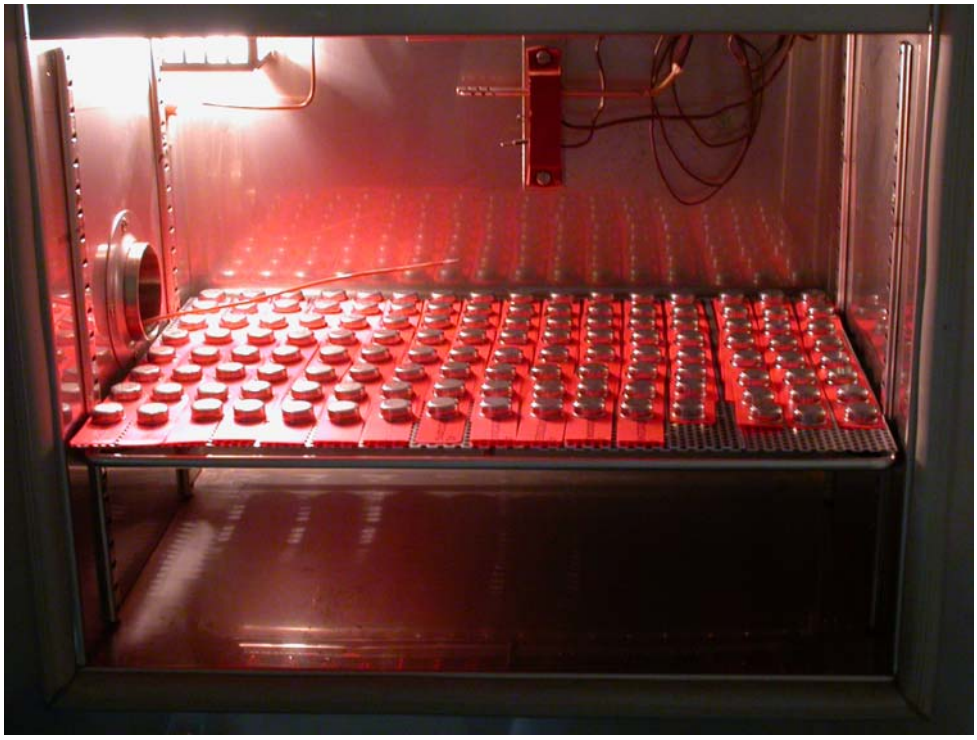


Figure 2.3 – DS1922Ls Loaded in Chamber with J-type Thermocouple Inserted

The LabView program controlling the Thermotron was started at 9:12:32 AM on 4/26/2005 and ran the programmed temperature profile until 7:12:31 AM on 4/27/2005. After the temperature profile was run, the Thermotron shut off and the chamber temperature was left to drift.

While the VI was running, temperature data was captured from the Thermotron at 10-second intervals. Thermal data continued to be captured by both the Agilent 34970A and the LabView VI until they were stopped at 8:25:25 AM and 8:31:32 AM, respectively. The temperature profiles were saved as .txt files.

At the end of the test period, a status check of the DS1922Ls was performed to verify functionality and data acquisition was then stopped. The data was then downloaded to a laptop, archived and exported to an Excel format file.

3. Test Results

Figure 3.1 shows the temperature profile of the Thermotron Environmental Chamber captured by the LabView VI. Figure 3.2 shows the chamber temperature as recorded by the Agilent 34970A J-type thermocouple. As can be seen when comparing the two figures, the temperature in figure 3.1 is a smoothed, averaged signal whereas; the temperature in figure 3.2 is a true representation of the chamber temperature. Figure 3.3 shows a representative temperature profile recorded by the DS1922Ls. The temperature plot in figure 3.2 is similar to the temperature plot in figure 3.3. Figure 3.2 has better resolution due to the 10-second sampling rate versus the 160-second sample rate of figure 3.3.

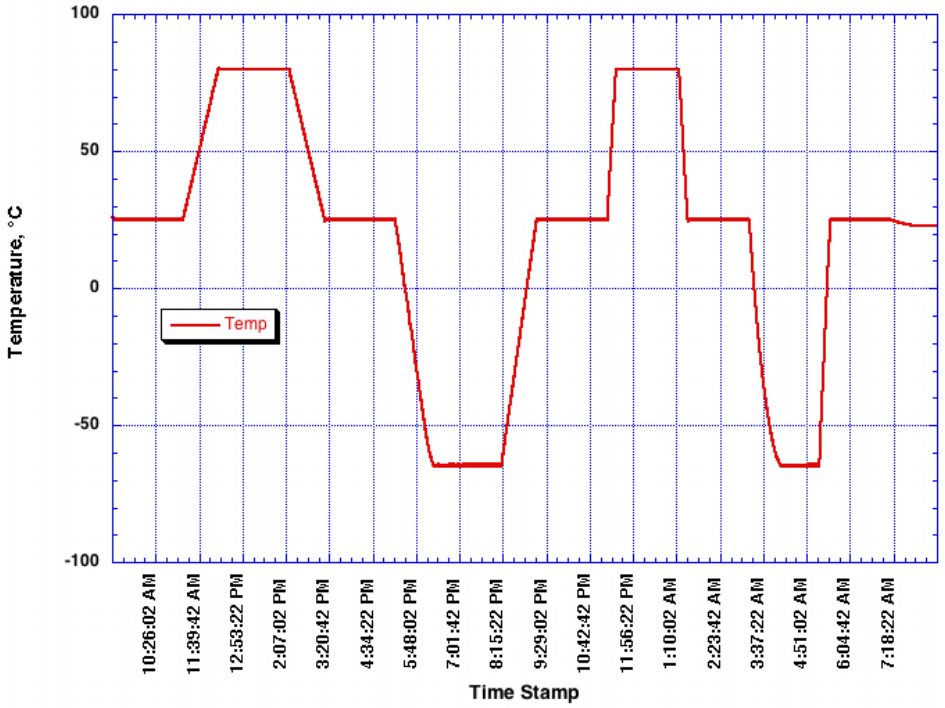


Figure 3.1 – Thermotron Temperature Recorded by LabView VI

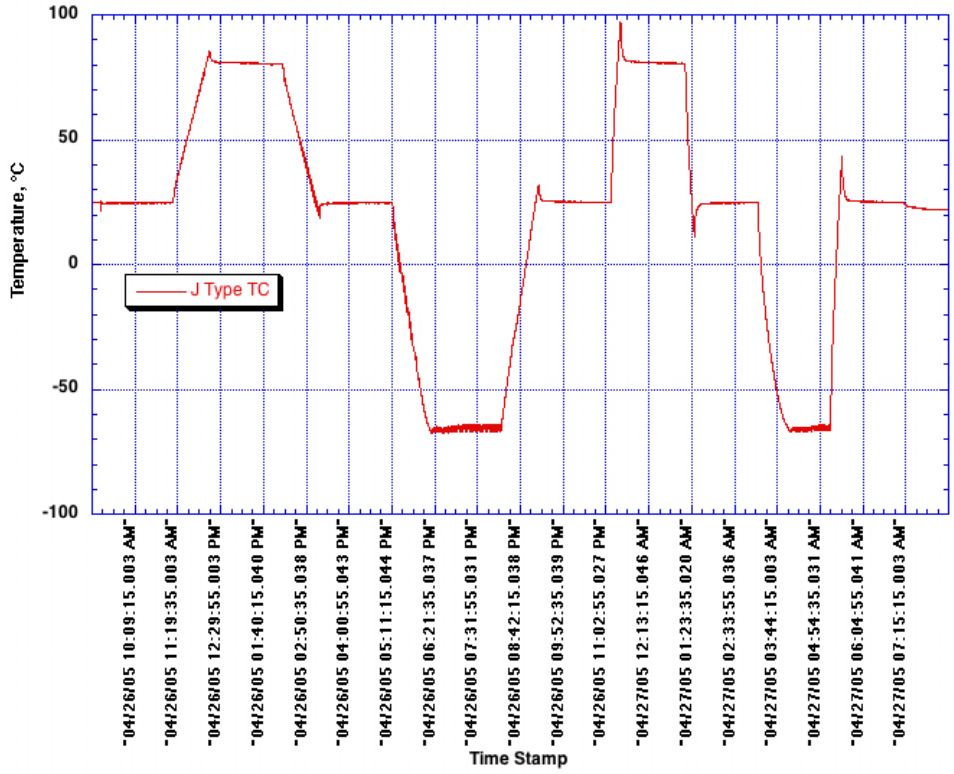


Figure 3.2 – Chamber Temperature Recorded by Agilent 34970A

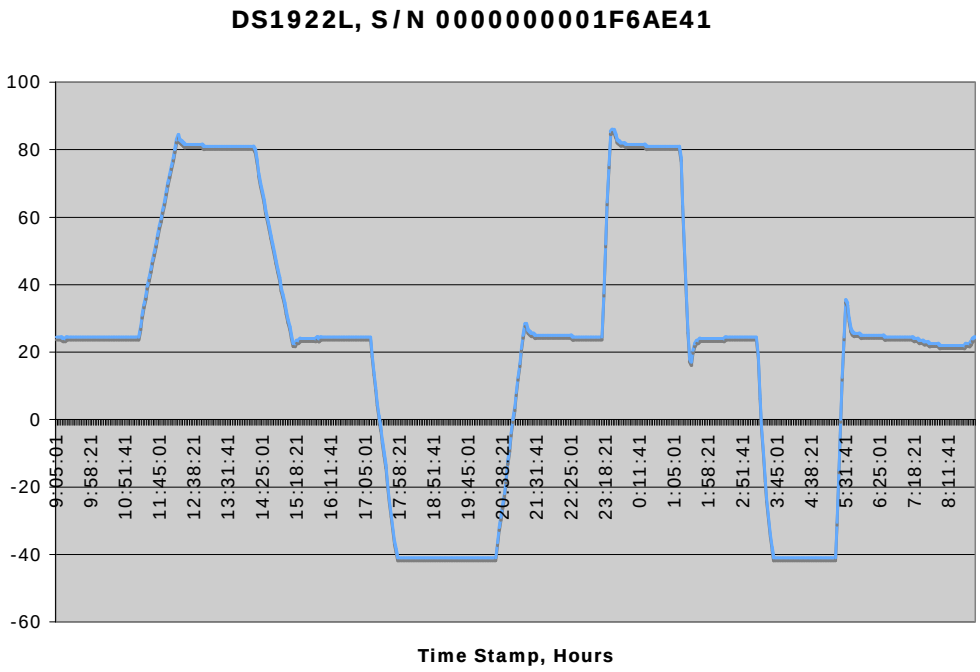


Figure 3.3 – Chamber Temperature Recorded by DS1922L Temperature Logger

Of the 128 DS1922L temperature loggers tested, only one failed to mission properly, S/N 4600000001F4FB41. This was from a batch of 20 spare devices whose overlaid temperature profiles are shown in figure 3.4. The failed device is the ramp plot.

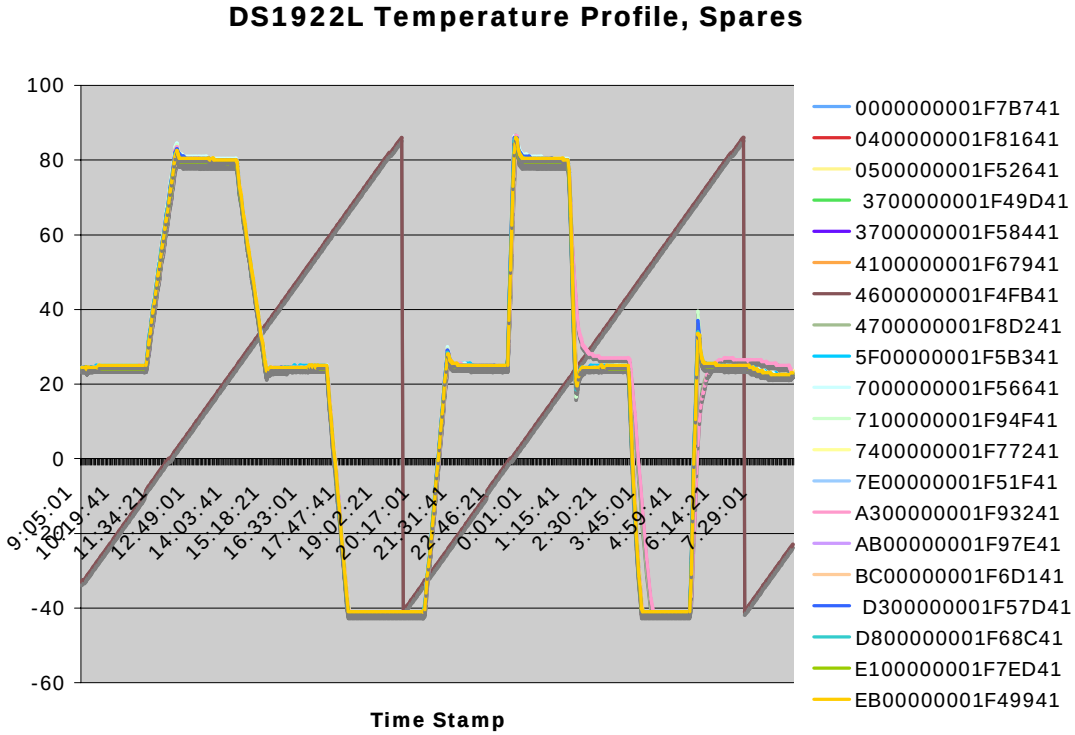


Figure 3.4 –Temperature Profile for 20 Spare DS1922Ls

The temperature accuracy of the DS1922L, Figure 3.5, is from the Dallas Semiconductor/Maxim DS1922L data sheet. Temperature accuracy is essentially the same for 8-bit data. The difference is in the resolution, 0.0625°C for 11-bit versus 0.5°C for 8-bit.

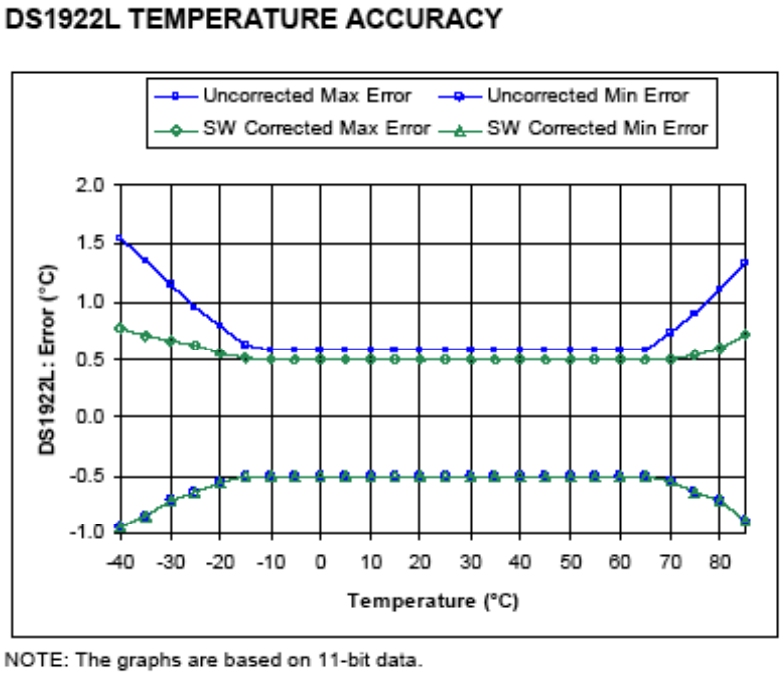
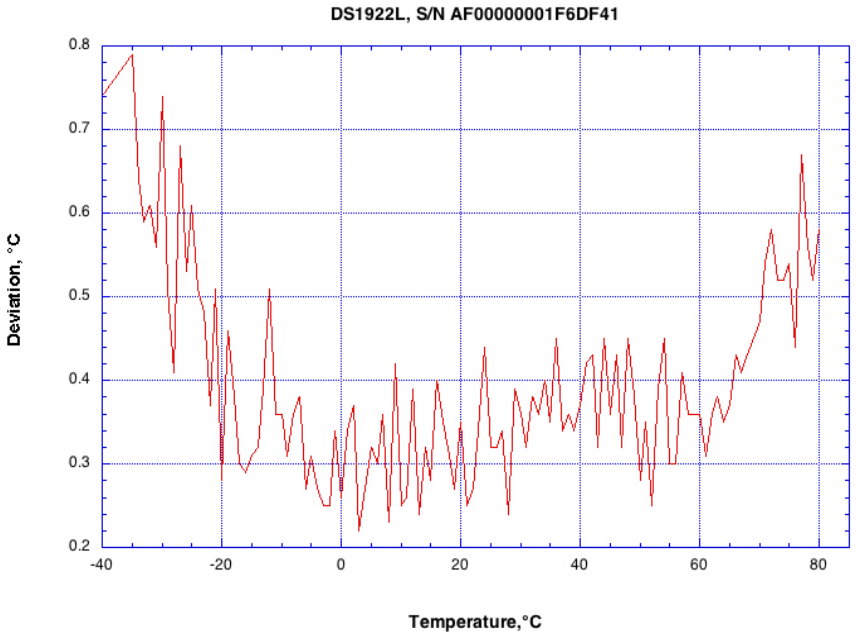


Figure 3.5 – DS1922L Temperature Accuracy

Typical temperature accuracy of the tested DS1922Ls, Figure 3.6, fall within the range of accuracy shown in Figure 3.5



4. Serial Numbers for Tested Dallas/Maxim iButton Temperature Logger, Model DS1922L

Sensor ID #	Pass	Fail
D800000001F68C41	X	
D300000001F57D41	X	
7E00000001F51F41	X	
EB00000001F49941	X	
4700000001F8D241	X	
BC00000001F6D141	X	
7400000001F77241	X	
3700000001F58441	X	
A300000001F93241	X	
0500000001F52641	X	
0000000001F7B741	X	
AB00000001F97E41	X	
0400000001F81641	X	
5F00000001F5B341	X	
7100000001F94F41	X	
3700000001F49D41	X	
7000000001F56641	X	
4100000001F67941	X	
9300000001F26041	X	
D900000001F26D41	X	
2200000001F4A641	X	
EF00000001F4BF41	X	
D600000001F4C741	X	
3F00000001F4D141	X	
2C00000001F4DF41	X	
2A00000001F4EA41	X	
4600000001F4FB41		X
AD00000001F4FE41	X	
9A00000001F4FF41	X	
2700000001F51C41	X	
3200000001F52741	X	
B500000001F53341	X	
2300000001F53A41	X	
D500000001F54841	X	
4100000001F55241	X	
F300000001F55441	X	
D700000001F55B41	X	

Sensor ID #	Pass	Fail
8800000001F56D41	X	
C000000001F57541	X	
5600000001F57A41	X	
BD00000001F57F41	X	
4A00000001F58841	X	
2400000001F58A41	X	
1300000001F58B41	X	
B000000001F59041	X	
0200000001F59641	X	
3500000001F59741	X	
CD00000001F59C41	X	
FA00000001F59D41	X	
9200000001F5AA41	X	
9000000001F5B941	X	
2200000001F5BF41	X	
8A00000001F65541	X	
9900000001F65B41	X	
3E00000001F66641	X	
D700000001F67041	X	
6500000001F67641	X	
AA00000001F67C41	X	
CB00000001F68241	X	
8100000001F68F41	X	
A700000001F69341	X	
2200000001F69441	X	
0000000001F6AE41	X	
7100000001F6C641	X	
C300000001F6CE41	X	
AF00000001F6DF41	X	
1B00000001F6EC41	X	
D600000001F6F541	X	
FF00000001F70C41	X	
1600000001F71A41	X	
A200000001F72941	X	
CC00000001F72B41	X	
9700000001F73B41	X	
6100000001F74941	X	
0F00000001F74B41	X	
9B00000001F75141	X	
5200000001F76E41	X	

Sensor ID #	Pass	Fail
2600000001F7AB41	X	
2400000001F7B841	X	
9600000001F7BE41	X	
2A00000001F7C141	X	
F600000001F7C541	X	
5700000001F7CD41	X	
F400000001F7D641	X	
AB00000001F7E041	X	
9E00000001F7F241	X	
EF00000001F81341	X	
CB00000001F81C41	X	
5900000001F83341	X	
9600000001F83941	X	
2400000001F83F41	X	
E500000001F84C41	X	
7100000001F85641	X	
8D00000001F87B41	X	
6600000001F87E41	X	
A400000001F89B41	X	
1600000001F89D41	X	
FB00000001F8AD41	X	
0100000001F8B541	X	
A000000001F8BD41	X	
E600000001F8DA41	X	
7600000001F8E641	X	
7400000001F8F541	X	
5000000001F8FA41	X	
1500000001F91241	X	
FE00000001F91741	X	
DA00000001F91841	X	
ED00000001F91941	X	
A100000001F92141	X	
CD00000001F93041	X	
BC00000001F95641	X	
C100000001F95A41	X	
A400000001F98241	X	
6B00000001F98841	X	
3200000001F98B41	X	
D900000001F98E41	X	
B000000001FB2541	X	

Sensor ID #	Pass	Fail
F200000001FB4F41	X	
2C00000001FB5841	X	
C100000001FB6841	X	
6300000002004541	X	
3A00000002004641	X	
FE00000002009641	X	
F20000000202CE41	X	
390000000202E241	X	
3C00000002041741	X	
1800000002041841	X	
E100000001F7ED41	X	

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