Extended Temperature Testing On 3A99150C: 15.1" ULTRA 5-Wire Armoured Resistive Touch Screen

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Contents

1 – Executive Summary

The report describes the test procedure used to verify the functional and linear performance of a 15.1” ULTRA touchscreen when operated at 70°C and -25°C. A sample set of twenty working sensors were each operationally tested after having been heated and frozen in an environmental chamber at these two extreme temperatures. Also, one working sensor was tested over the course of 7 hours in order to test for linearity. This was done by comparing reference points taken at room temperature, 70°C and -25°C. Results showed that all sensors continued to operate without any significant degradation in performance or linearity. Although resistive sensors tend to be rated between -10°C and 55°C, the tests demonstrate that the 15.1” ULTRA 5-wire sensor will operate at these steady extreme temperatures.

2 – Introduction

This document details the experiment procedure and results of the testing performed on a series of A D Metro ULTRA touchscreens for basic functionality and linearity at temperatures extended beyond their published specifications.

3 – Test Subjects and Equipment

3.1 – Samples for High Temperature Functionality Testing

Twenty sensors, part number 3A99150C: A D Metro 5-wire resistive 15.1” ULTRA touchscreen with glass armouring on clear polyester, with FFC cable.

3.2 – Samples for Low Temperature Functionality Testing

Twenty sensors, part number 3A99150C: A D Metro 5-wire resistive 15.1” ULTRA touchscreen with glass armouring on clear polyester, with FFC cable.

3.3 – Samples for Linearity Testing

One sensor, part number 3A99150C: A D Metro 5-wire resistive 15.1” ULTRA touchscreen with glass armouring on clear polyester, with FFC cable.

3.4 – Environmental Test Chamber

The chamber used is a Tenney Environmental T30C-SPL using a Watlow series 942 quad output temperature regulator and profile editor. The chamber can achieve a temperature spread of -75°C to 200°C in a 36”x36”x39” interior.

3.5 – Computer Setup

Computer running Windows XP and Touchkit Software, connected to an EETI touch controller via USB, all positioned close to the environmental test chamber.

4 – Testing Description

To determine functionality of a sensor, the touchscreen is placed through a simple set of tests. First a 9-point calibration is performed on a functioning 15.1" touchscreen. This tells the controller how to translate touch activations to their proper locations. All subsequent touchscreens to be tested are connected to the controller and several points are touched and shapes drawn on the touchscreen using the Draw utility of the software. These tests check for malfunctions, such as constant touch output as well as any disconnected cable pins or other irregularities. An example of a normally functioning touchscreen test is shown in Figure 1, whereas a sample of a malfunctioning touchscreen with a disconnected pin is shown in Figure 2.

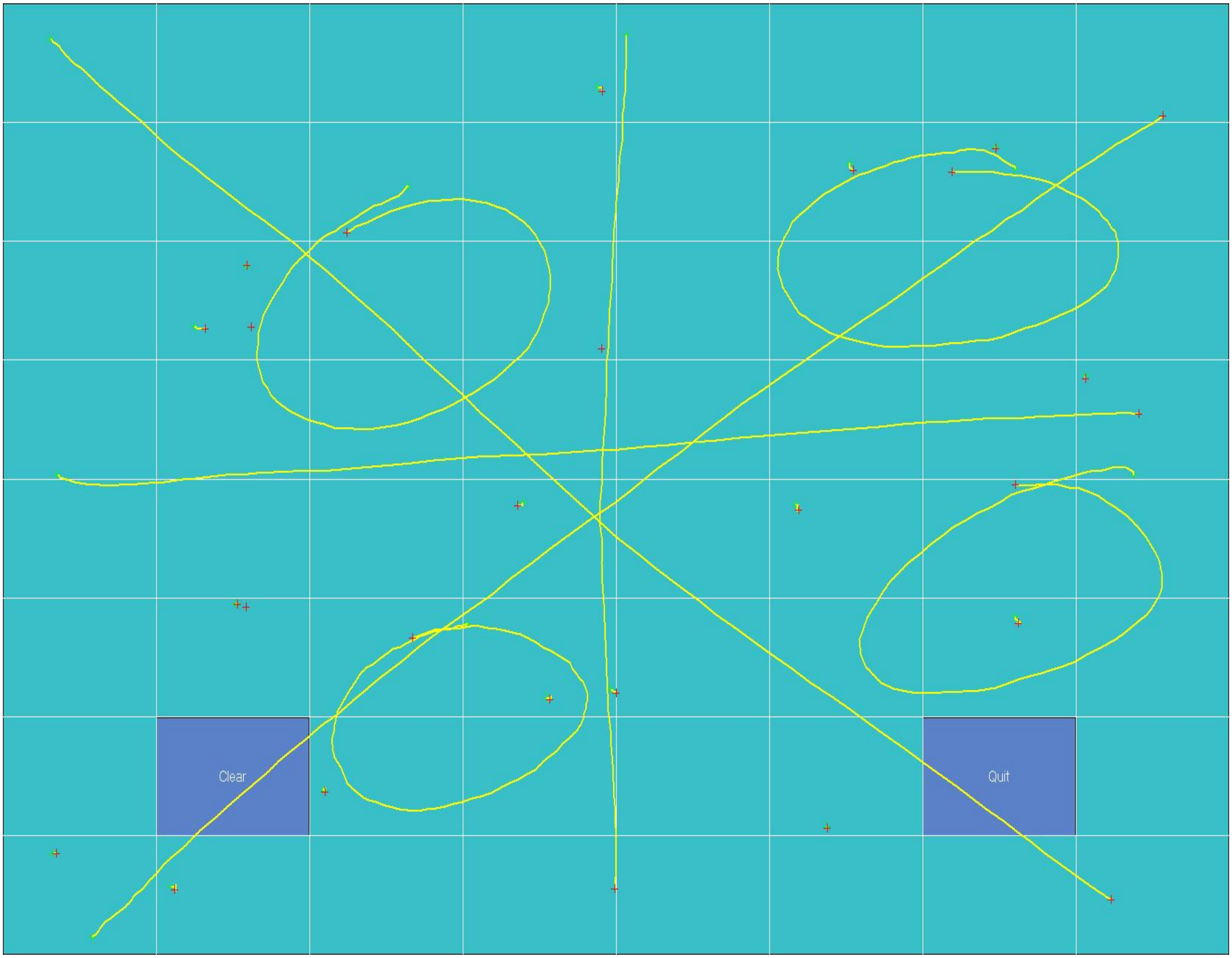

Figure 1 – A touchscreen functioning normally

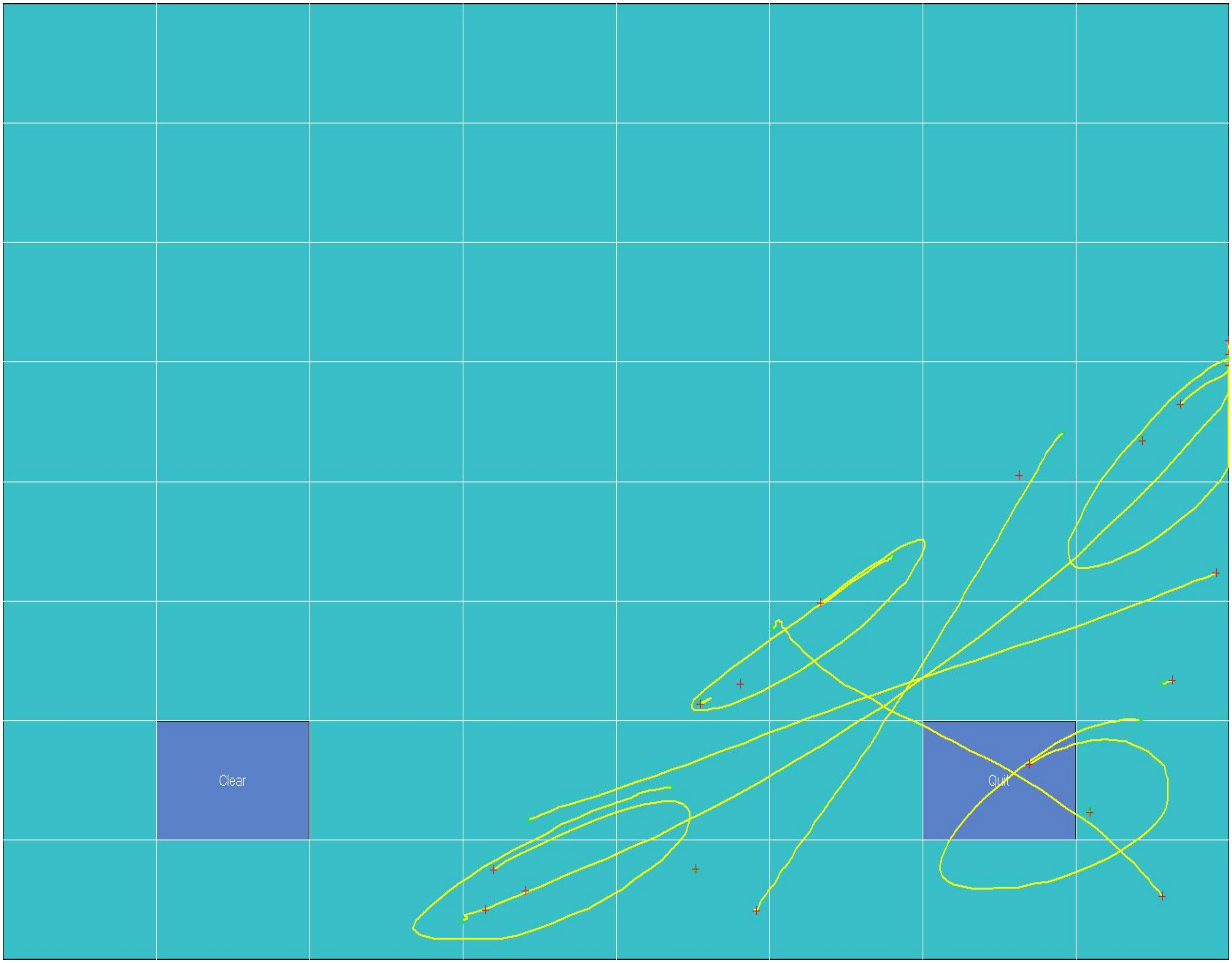

Figure 2 – A malfunctioning touchscreen due to a disconnected cable pin

5 – Experiment Procedure

5.1 – Extended High Temperature Functionality Procedure

First the touch controller was calibrated using a sensor at room temperature and all twenty samples were tested to ensure that they functioned properly prior to testing. After verifying this, the sensors were loaded into the environmental chamber, and the chamber profile was started.

The test as specified does not take into consideration performance under thermal shock. As such, the chamber's profile was set to a slow ramp up from room temperature (22°C) to

+70°C over an hour at a rate of approximately 0.8°C/min. Once at 70°C, the temperature was held there for 2 hours to allow the sensors to achieve thermal equilibrium and be fully heated.

Once finished soaking for 2 hours, the chamber continued to run in order to keep the sensors heated while they were removed one by one and tested individually. The results are tabulated in section 6.1.

The touch controller remained outside the test chamber for the duration of the test, as the touch controller is not rated to perform reliably at temperatures outside of its temperature range specifications.

5.2 – Extended Low Temperature Functionality Procedure

A similar test was used for testing the lower extreme. The same samples used in part 1 were allowed to return to room temperature overnight. Again, the touch controller was calibrated using a sensor at room temperature and all twenty samples were tested to ensure that they functioned properly prior to testing. The sensors were then loaded into the environmental chamber, and the chamber profile was started.

The chamber's profile was set to a slow ramp up from room temperature (22°C) to -25°C over an hour at a rate of approximately 0.79°C/min. Once at -25°C, the temperature was held there for 2 hours to allow the sensors to achieve thermal equilibrium and be fully frozen.

Once finished soaking for 2 hours, the chamber continued to run in order to keep the sensors frozen while they were removed one by one and tested individually. The results are tabulated in section 6.2.

As before, the touch controller remained outside the test chamber for the duration of the test.

5.3 – Extended Temperature Linearity Testing

In order to determine if the linearity of the sensor remains largely unaffected while being at temperatures outside of the printed specifications, a different test was required. A single touchscreen was selected at random and used as a test subject. Five reference points were drawn on the surface of the sensor and the reference points were touched and its resulting touch locations recorded on a computer with Touchkit software. The sensor was then placed in the environmental chamber and was kept connected to the computer for the entire duration of the test.

To achieve a slow ramp again and long soak times, the following ramping profile was used:

1) Soak at room temperature for 5 minutes.

2) Ramp up to 70°C over 1 hour (approx. 0.8°C/min)
3) Soak at 70°C for 2 hours
4) Ramp down to -25°C over 2 hours (approx. 0.79°C/min)
5) Soak at -25°C for 2 hours
6) Ramp up to room temperature over 1 hour (approx. 0.79°C/min)

In the middle of steps 3 and 5, the chamber was quickly opened and the 5 reference points were each pressed and their touch locations recorded in Touchkit. By comparing and measuring on the computer's display the distance between locations of the touches when frozen and heated to the locations of the touches at room temperature, the maximum percent linearity deviation can be determined for both high and low temperatures. For the results see section 6.3 and Figure 3 below.

6 – Results

6.1 – Extended High Temperature Functionality Test Results

All sensors exited the environmental chamber working as expected (for normal function, refer to Figure 1).

Sample	Condition Before Test	Condition After Test
1	Normal Function	Normal Function
2	Normal Function	Normal Function
3	Normal Function	Normal Function
4	Normal Function	Normal Function
5	Normal Function	Normal Function
6	Normal Function	Normal Function
7	Normal Function	Normal Function
8	Normal Function	Normal Function
9	Normal Function	Normal Function
10	Normal Function	Normal Function
11	Normal Function	Normal Function
12	Normal Function	Normal Function
13	Normal Function	Normal Function
14	Normal Function	Normal Function
15	Normal Function	Normal Function
16	Normal Function	Normal Function
17	Normal Function	Normal Function
18	Normal Function	Normal Function
19	Normal Function	Normal Function
20	Normal Function	Normal Function

6.2 – Extended Low Temperature Functionality Test Results

All sensors exited the environmental chamber working as expected (for normal function, refer to Figure 1).

Sample	Condition Before Test	Condition After Test
1	Normal Function	Normal Function
2	Normal Function	Normal Function
3	Normal Function	Normal Function
4	Normal Function	Normal Function
5	Normal Function	Normal Function
6	Normal Function	Normal Function
7	Normal Function	Normal Function
8	Normal Function	Normal Function
9	Normal Function	Normal Function
10	Normal Function	Normal Function
11	Normal Function	Normal Function
12	Normal Function	Normal Function
13	Normal Function	Normal Function
14	Normal Function	Normal Function
15	Normal Function	Normal Function
16	Normal Function	Normal Function
17	Normal Function	Normal Function
18	Normal Function	Normal Function
19	Normal Function	Normal Function
20	Normal Function	Normal Function

6.3 – Extended Temperature Linearity Test Results

R = Reference point at room temperature (21°C)
H = Reference point at high temperature (70°C)
L = Reference point at low temperature (-25°C)
D = Diagonal of display used for test = 17" = 431.8mm

Point #	R to H Deviation	R to L Deviation
1 (top left)	1.5mm	2mm
2 (top right)	1mm	2mm
3 (bottom left)	2mm	1mm
4 (bottom right)	0mm	2mm
5 (middle)	2mm	3.5mm

Maximum percent linearity deviation = Max(R to H deviation) / D = 0.46%
Maximum percent linearity deviation = Max(R to L deviation) / D = 0.81%

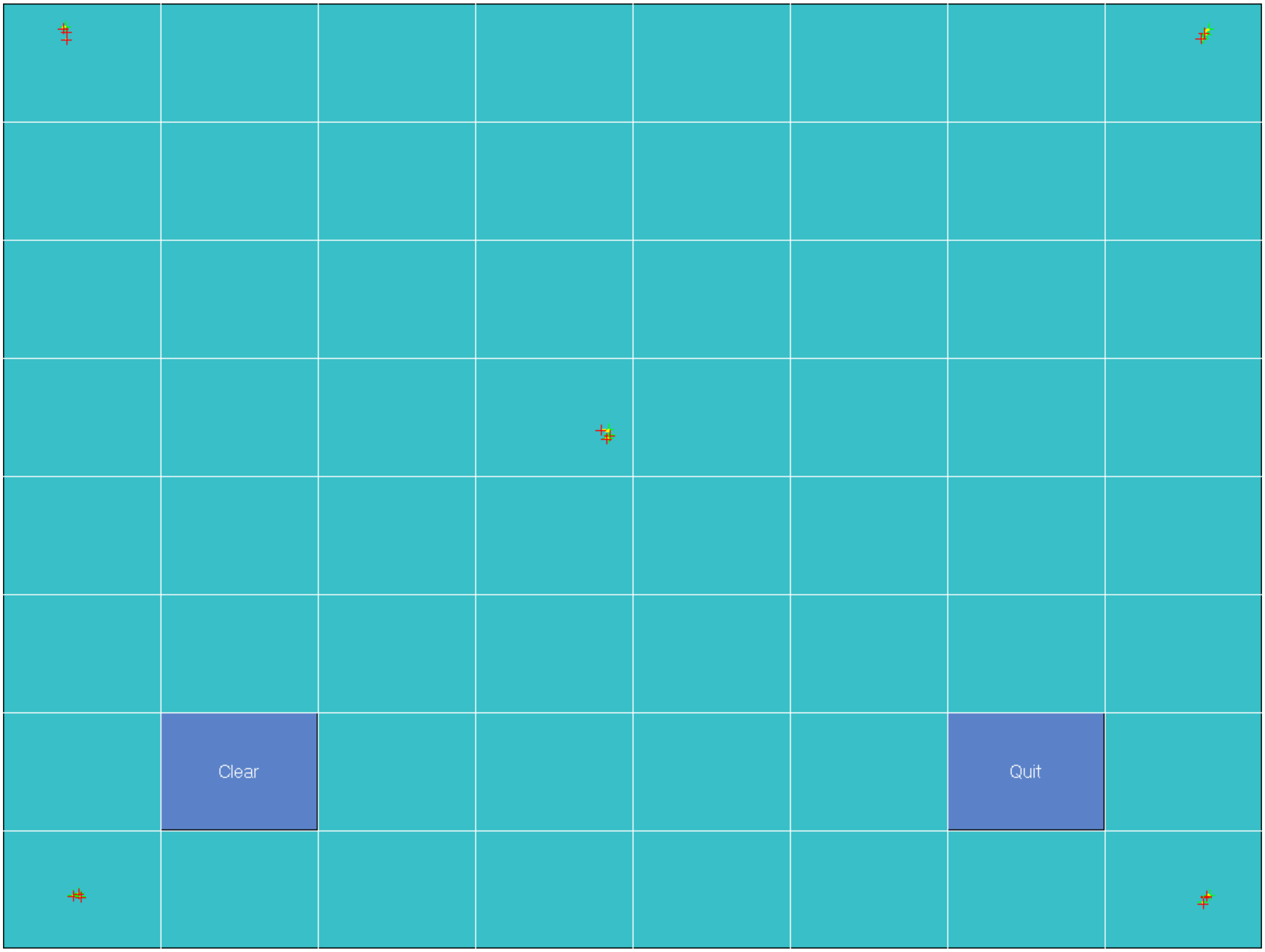

Figure 3 – Linearity deviations as seen in Touchkit Draw mode for Low and High Temperatures

7 – Conclusion and Comments

The test did not yield any evidence that ULTRA sensors malfunction when operating at 70°C and -25°C. In fact, it has shown that ULTRA sensors tend to continue functioning smoothly and accurately at these extreme temperatures, though with a small loss of linearity, particularly on the lower end. For further testing, the effect on the touchscreen of prolonged exposure to extreme temperatures would be worth being examined.

However, even though ULTRA sensors will function at extreme temperatures, the limiting factor in touch assemblies is often not the sensor itself but rather the touch controller and the LCD, as they are more sensitive to temperatures outside of their specified range.