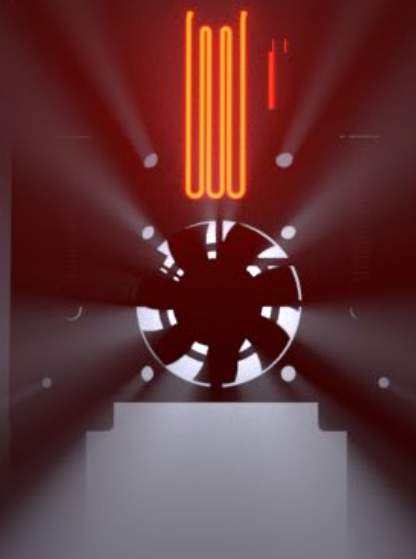
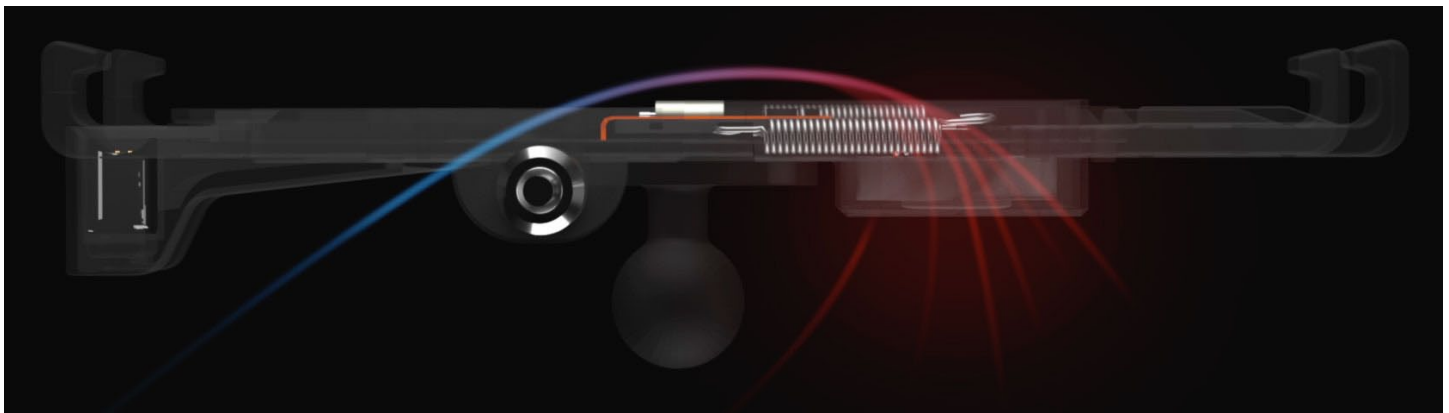


Atmos TCS

Introducing the world's first temperature control system
designed specifically for vehicle-mounted tablets.



Atmos TCS (Temperature Control System) has been designed to alleviate extreme overheating or freezing of the Samsung Galaxy 8" Tab E which may cause the battery to stop charging or the tablet to crash. These tablets are installed on fleet vehicles for a myriad of purposes. When the tablet or battery experiences overheating or extreme cooling, the batteries will stop charging, which prevents the driver from logging into their software and continue or start their routes. The design features a fan and heating system that will alleviate the cooling and heating issues by either maintaining the battery at a stable temperature range adequate for continuous charging or by greatly reducing the wait time to heat or cool the tablet in order to allow the battery to charge.



Goal

The goal of Atmos TCS is to maintain optimal battery temperature in order to achieve constant and reliable tablet operation in various climates.

Background

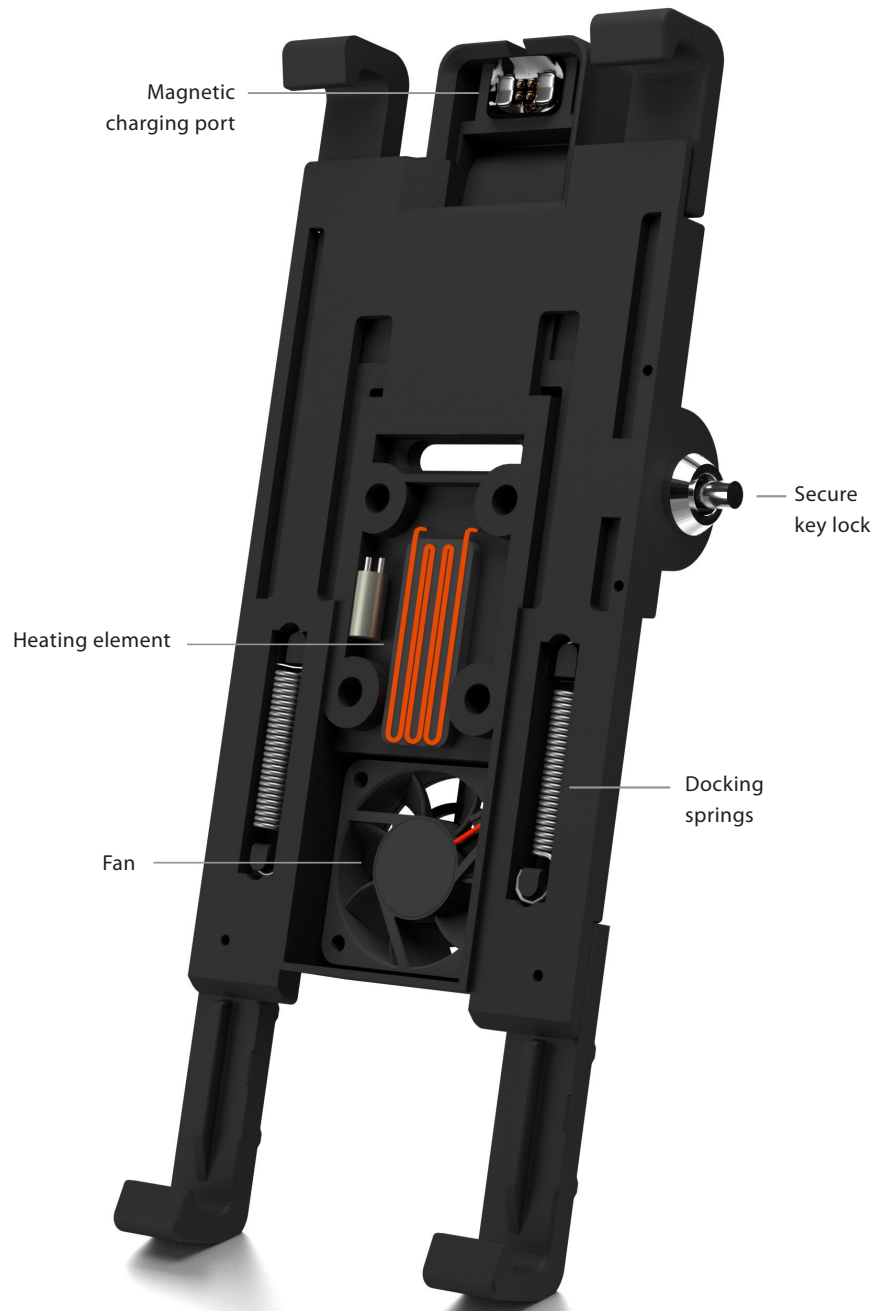
Fleet trucks utilize tablet computers with dispatch software, logging software, telematics, navigation, etc. During hot seasons, the tablets in use can overheat, reaching temperatures above 45 °C (114 °F) which causes the battery to stop charging and the tablet to often crash. During cold seasons, the tablets will experience temperatures below -1 °C (30 °F), which causes the battery to stop charging as well. This inconvenience often causes drivers to wait 13–20 minutes while the tablet either cools or warms up to a temperature appropriate for charging.

Test Equipment

- Samsung Galaxy Tab E 8"
- GPSLockbox Flex Case
- GPSLockbox Atmos Cradle
- Environmental testing chamber
- Thermometer
- Timer

Design

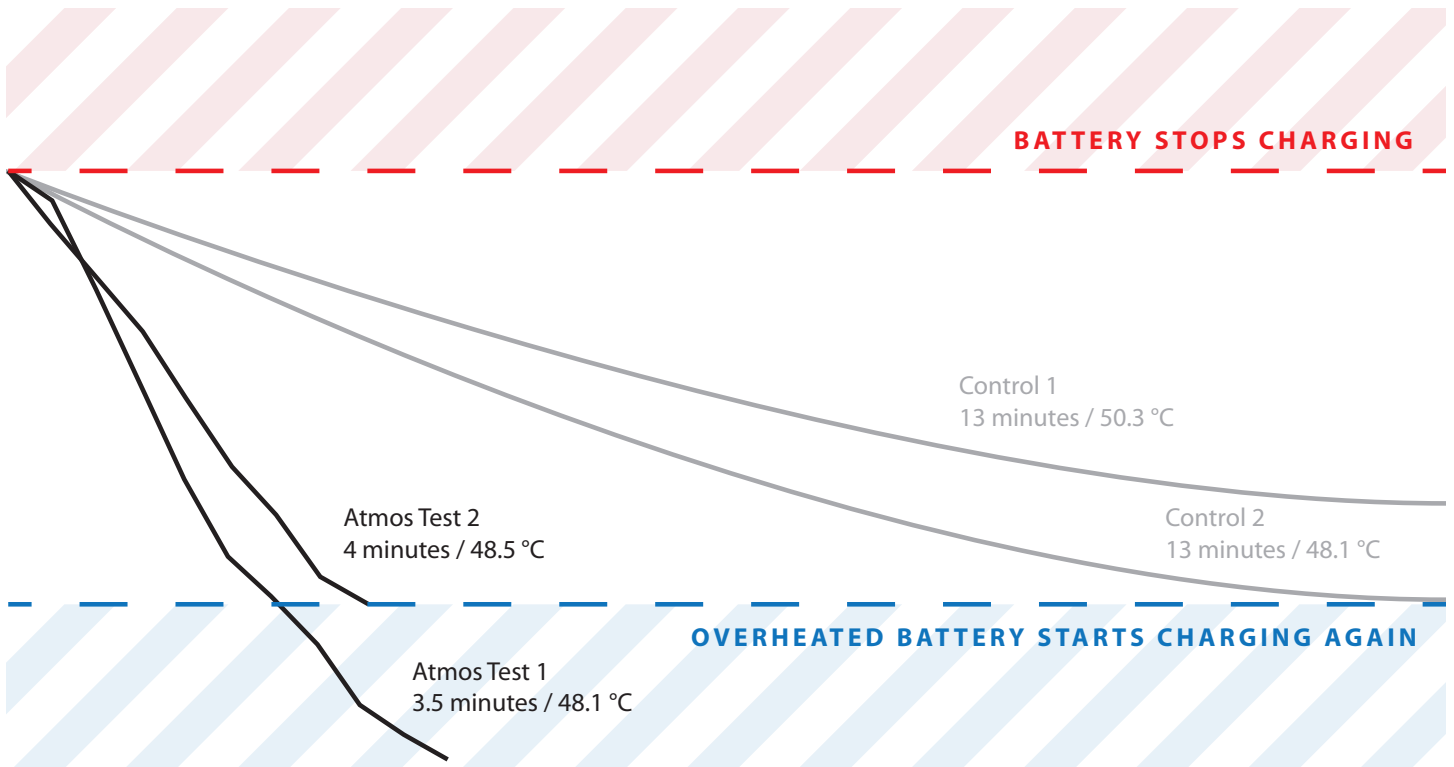
Atmos TCS features an integrated thermostat that will allow the cradle to respond appropriately to the temperature conditions of the battery via a heater, fan, and a custom control system. Atmos is designed to pull cool air from within or even outside the cab in order to optimize the cooling effects of the air on the tablet. The directed airflow within Atmos is designed for optimal heat dissipation.



Heating Test

The heating elements on Atmos TCS have been tested throughout the winter in the states of MN and NY where the tablets often experience freezing temperatures below 0 °C. During these conditions, the tablets would cease to charge or completely shut down. The heating portion of Atmos TCS was installed on these units in order to regulate the temperature of the battery. Once the temperatures of the battery dropped under 5 °C (41 °F) the heating element would warm up the battery and prevent the temperature from dropping further. The prototype units have thus far been successful at regulating the battery temperature in two separate markets.





Cooling Tests

1 CONTROL

The Tab E was first placed in the tablet case and connected to power in order for the battery to charge. Then, the encased tablet was placed inside an environmental test chamber without Atmos. The temperature chamber was set to 60 °C (140 °F) in order to determine the temperature at which the battery would cease to charge. Once the battery stopped charging, the environmental test chamber was shut off and the battery was allowed to cool at room temperature until the battery resumed charging, which occurred at approximately 49 °C (120 °F). The battery ceased to charge at roughly 56 °C (132.8 °F). It took approximately 13 minutes to cool the battery from 56 °C to its charging temperature (48.1 °C [118.5 °F] for trial 1 and 50.3 °C [122.5 °F] for trial 2).

2 TABLET WITH ATMOS

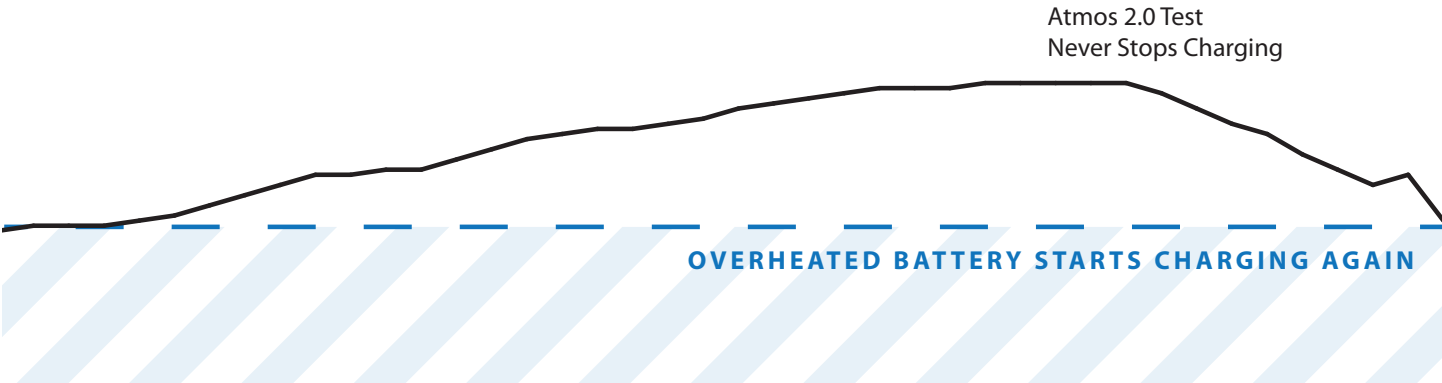
The Tab E, within the tablet case, was placed in the temperature chamber with Atmos. The tablet was provided power in order for the battery to charge. The environmental test chamber was set to 60 °C (140 °F) in order to determine the same parameters as test 1. Temperature readings were taken every 30 seconds.

For trial 1, the maximum temperature at which the battery stopped charging was 56.2 °C (133.1 °F). The temperature chamber was shut off and the tablet was allowed to cool at ambient temperature (23 °C / 74 °F) to simulate turning on the cab AC or opening a window. With Atmos, the battery took approximately 2.5 minutes to cool down and resumed charging at 50.7 °C (123.2 °F).

For trial 2, the temperature at which the battery stopped charging was 56 °C (132.8 °F). The temperature chamber was shut off and the tablet was allowed to cool at the same ambient temperature as trial 1. The battery took approximately the same amount of time as trial 1 (2.5 minutes) to cool down and resume charging.

	TEST 1	TEST 2
0 s	56.2 °C	56.0 °C
30 s	55.5 °C	55.0 °C
60 s	54.0 °C	54.1 °C
90 s	52.2 °C	53.1 °C
120 s	50.7 °C	52.0 °C
150 s	49.5 °C	50.8 °C
180 s	48.6 °C	50.0 °C
210 s	47.9 °C	48.8 °C
240 s	47.0 °C	48.5 °C
270 s	46.5 °C	
300 s	45.9 °C	
330 s	45.2 °C	
360 s	44.4 °C	
390 s	43.9 °C	
420 s	43.4 °C	
450 s	42.7 °C	

BATTERY STOPS CHARGING

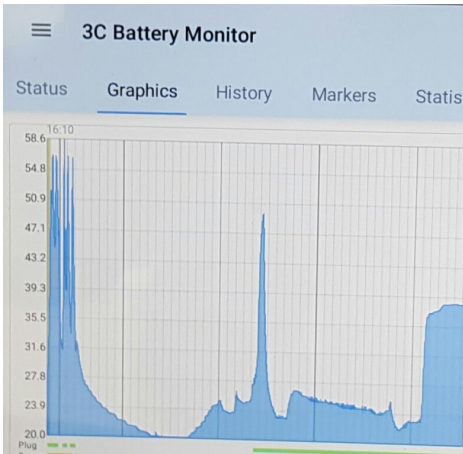
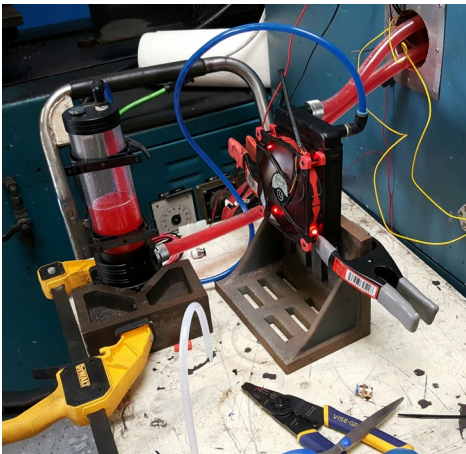


Cooling Test with Advanced Radiator System

An external radiator for Atmos TCS is currently being developed and has begun preliminary testing. Atmos with External Radiator was submitted to the same conditions as Test 2. The maximum battery temperature was 49.6 °C (121.3 °F). As a result, the tablet did not overheat and charging was never interrupted. Atmos with External Radiator would be designed to maintain the battery within the manufacturer’s specifications regardless of the extreme atmospheric temperature.

Note: there are no plans to produce this design at this time.

0 min	46.7 °C	11 min	49.2 °C
1 min	46.8 °C	12 min	49.4 °C
2 min	46.9 °C	13 min	49.5 °C
3 min	47.0 °C	14 min	49.6 °C
4 min	47.4 °C	15 min	49.6 °C
5 min	47.8 °C	16 min	49.6 °C
6 min	47.9 °C	17 min	49.1 °C
7 min	48.1 °C	18 min	48.6 °C
8 min	48.5 °C	19 min	47.9 °C
9 min	48.7 °C	20 min	47.8 °C
10 min	48.9 °C		



Conclusion

Currently, tablets nationwide are overheating and/or freezing, causing major inconveniences and ultimately increasing costs. During hot seasons, Atmos is able to reduce the waiting time or possibly even eliminate it. This translates to approximately to a 2.5-minute wait time (80% reduction) based on the test conditions. For extremely cold conditions, Atmos TCS will be able to warm the battery and allow the tablet to continue charging without interruptions.

Atmos TCS is currently in production and will be available as early as August, 2017. The goal of Atmos TCS is to maintain optimal battery temperature in order to achieve constant, safe, and reliable tablet operation. As an addition to the GPSLockbox product lineup, Atmos TCS will make a significant impact for fleet operators, dispatchers, and drivers.

