

Amphenol Aerospace

CF-020400-065

Thermal Analysis

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Electronic Cooling Solutions Inc.

Objectives

1. To determine that the critical components on the CF-020400-065 board are within their thermal limits for the following case:
 - a) **85°C at sea level**
 - b) **-40°C at sea level**

At 2 different power levels (predicted and worst case):

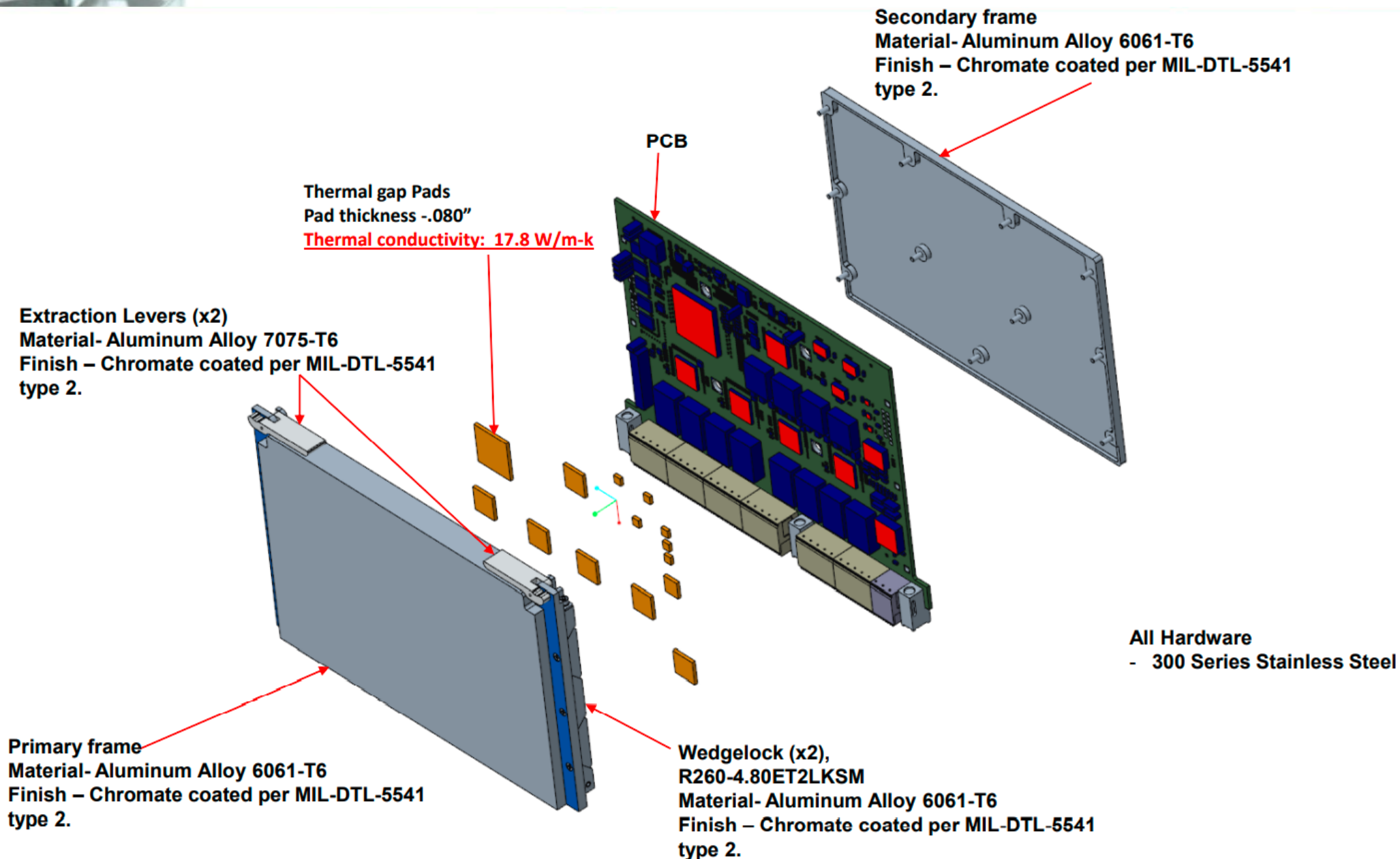
- a) **Predicted Case** – Total Power of 30.09 W
- b) **Worst Case** – Total Power of 40.99 W

Approach

1. This analysis was done using FloTHERM XT V2021.1 CFD software.
2. The updated thermal model was created from the cf-020400-065m_asm file provided for thermal analysis.
3. It was assumed that no neighboring devices were producing or sinking heat.
4. Thermal gap pad used for the components : Thermal conductivity of 17.8 W/m-K.
5. The critical components were modeled as 2-resistor networks with thermal resistance values found in the Thermal Analysis document provided by Amphenol Aerospace

Thermal Model Setup

Thermal Model Setup – Overview



Thermal Data

CF-065 Components			Power Cases		Thermal Resistance (C/W)	
Part	Desc.	Quantity	Predicted (W)	Worst Case (W)	R _{JC}	R _{JB}
BCM53570	U18	1	15.61	22.9	0.3	0.6
BCM84894	U2	1	6.02	7.52	1.26	2.38
LTM4650	U8	1	1.55	2.29	3.7	1.5
BCM54240	U14-17	4	1.52	1.82	9.8	10.3
MAXM17515	U46	1	0.32	0.4	6	1.5
MPM3686	U11	1	0.29	0.36	13	2.5
MPM3810	U32	1	0.08	0.09	13	11.5
MAXM17515	U47	1	0.07	0.08	6	1.5
MPM3810	U34	1	0.05	0.05	13	11.5
MAXM17515	U45	1	0.02	0.02	6	1.5
MPM3810	U33	1	0	0	13	11.5
Total			30.09	40.99		

Note: Thermal resistances from junction to case (R_{JC}) and from junction to board (R_{JB}) and thermal limits were taken from the documents given in “Parts Thermal Characteristics”.

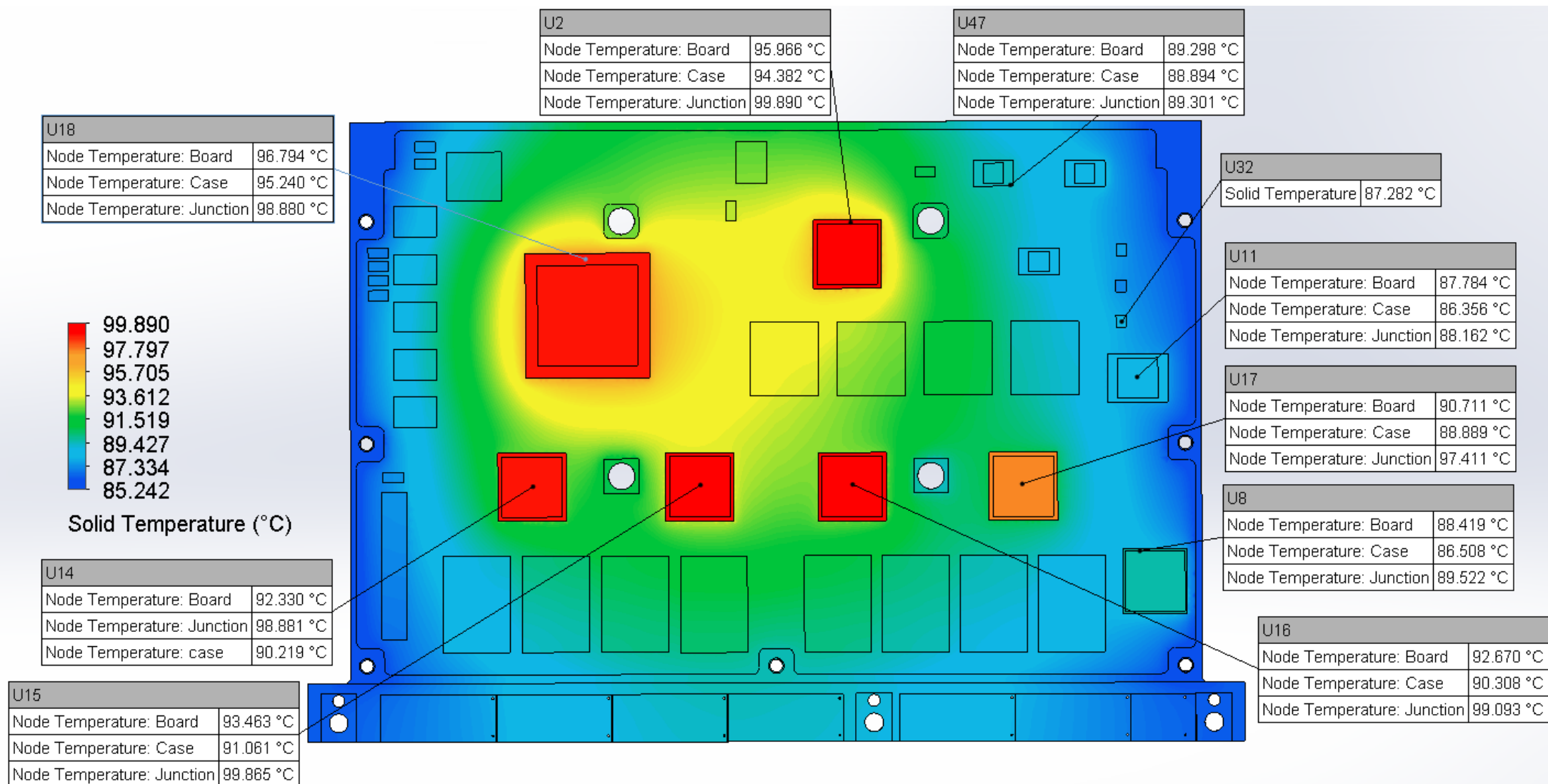
Thermal Analysis

**85 C Ambient,
Predicted Power – Sim 1**

Parameters				Sim 1		
Power Scenario				Predicted		
Cooling Rail Temperature °C				85		
Ambient Temp., °C				85		
Elevation, ft				0		
RESULTS						
Component	Desc.	Max. Limit, °C	Limit Type	Power, W	Result, °C	Margin, °C
BCM53570	U18	110	Junction	15.61	99.9	10.1
BCM84894	U2	110	Junction	6.02	99.9	10.1
LTM4650	U8	125	Junction	1.55	89.5	35.5
BCM54240	U14	110	Junction	1.52	90.2	19.8
BCM54241	U15	110	Junction	1.52	99.9	10.1
BCM54242	U16	110	Junction	1.52	99.1	10.9
BCM54243	U17	110	Junction	1.52	97.4	12.6
MAXM17515	U46	125	Junction	0.32	88.9	36.1
MPM3686	U11	125	Junction	0.29	88.2	36.8
MPM3810	U32	125	Junction	0.08	88.1	36.9
MAXM17515	U47	125	Junction	0.07	89.3	35.7
MPM3810	U34	125	Junction	0.05	87.6	37.4
MAXM17515	U45	125	Junction	0.02	88.8	36.2
MPM3810	U33	125	Junction	0	87.1	37.9

Sim 1 - Components Temperature Plot

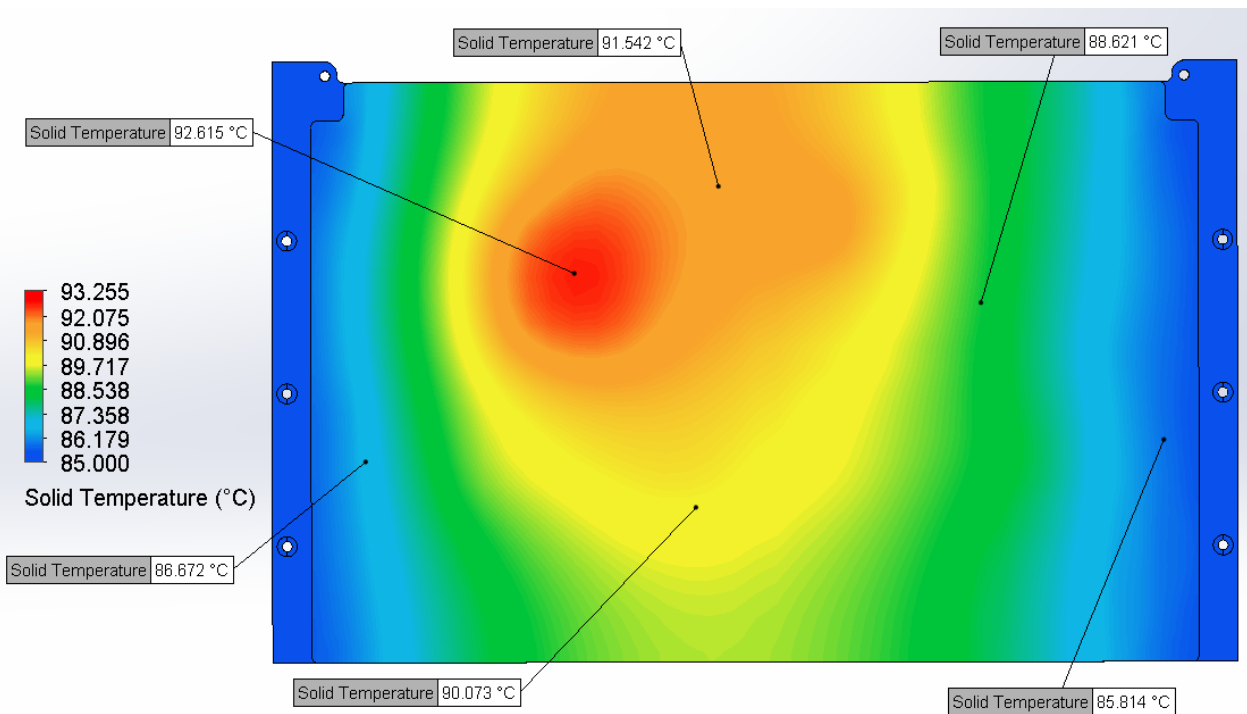
85°C , sea level



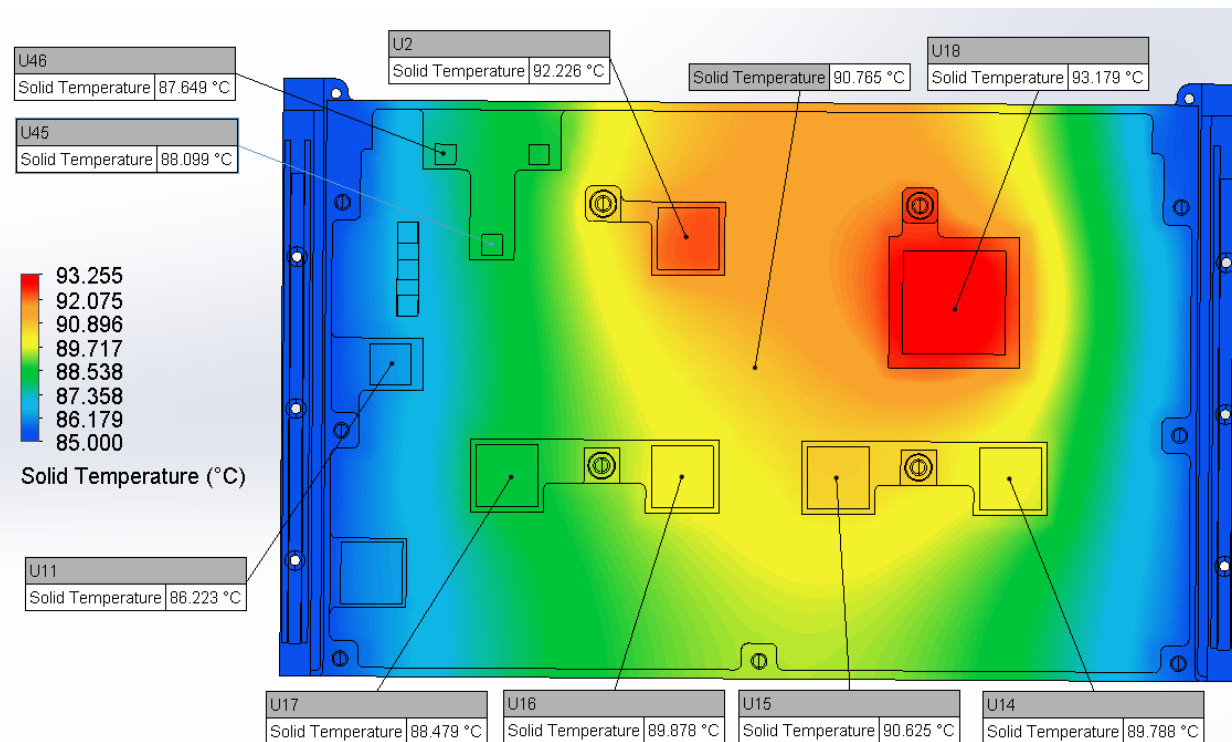
Note: only worst case MAXM17515 and MPM3810 components are probed

Sim 1 – Top Housing Surface Temperature Plot

85°C , sea level



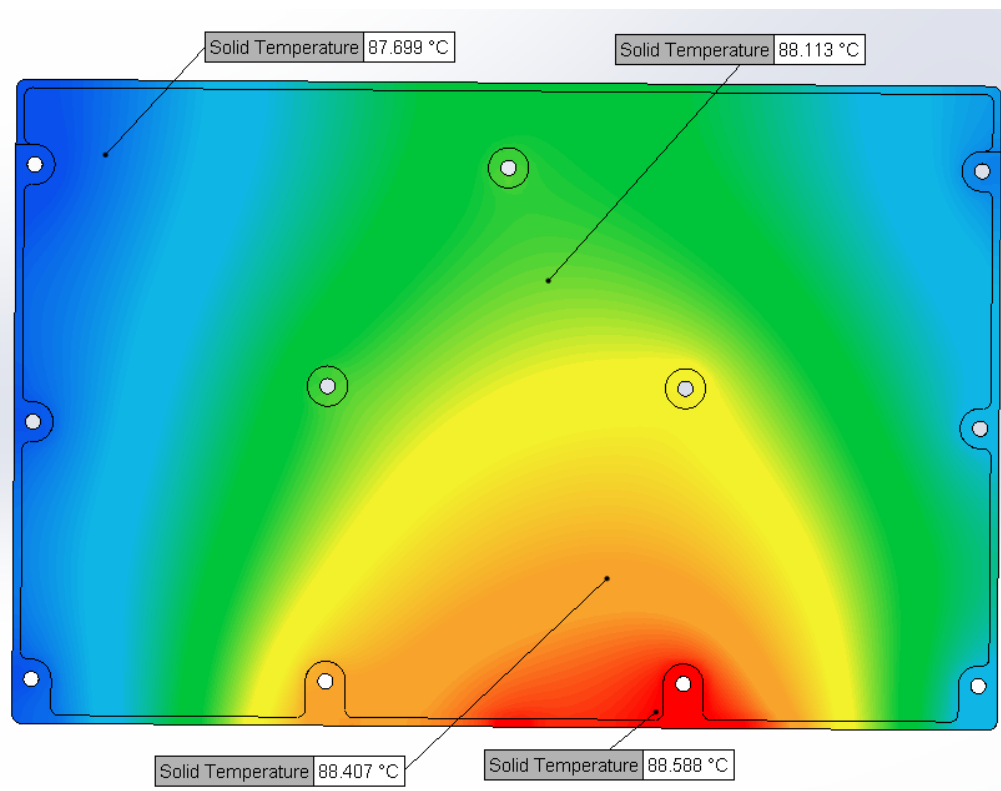
Top Side



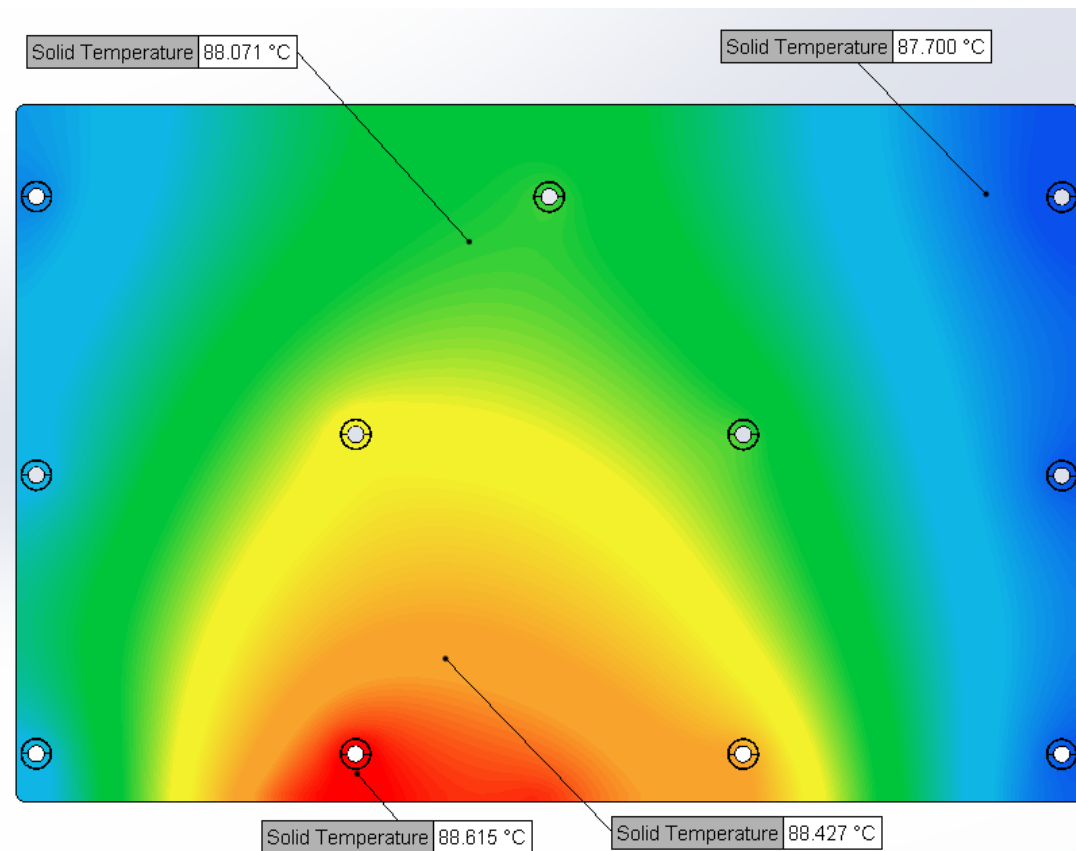
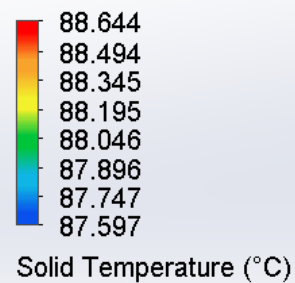
Bottom Side

Sim 1 - Rear Cover Temperature Plot

85°C , sea level



Top Side



Bottom Side

85 C Ambient, Worst Case Power – Sim 2

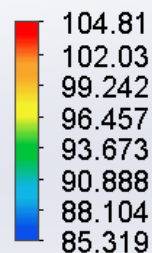
Parameters				Sim 2		
Power Scenario				Worst Case		
Cooling Rail Temperature °C				85		
Ambient Temp., °C				85		
Elevation, ft				0		
RESULTS						
Component	Desc.	Max. Limit, °C	Limit Type	Power, W	Result, °C	Margin, °C
BCM53570	U18	110	Junction	22.9	104.8	5.2
BCM84894	U2	110	Junction	7.52	104.1	5.9
LTM4650	U8	125	Junction	2.29	89.8	35.2
BCM54240	U14	110	Junction	1.82	102.5	7.5
BCM54241	U15	110	Junction	1.82	103.7	6.3
BCM54242	U16	110	Junction	1.82	102.6	7.4
BCM54243	U17	110	Junction	1.82	100.3	9.7
MAXM17515	U46	125	Junction	0.4	90.0	35.0
MPM3686	U11	125	Junction	0.36	89.1	35.9
MPM3810	U32	125	Junction	0.09	88.9	36.1
MAXM17515	U47	125	Junction	0.08	90.6	34.4
MPM3810	U34	125	Junction	0.05	87.7	37.3
MAXM17515	U45	125	Junction	0.02	89.9	35.1
MPM3810	U33	125	Junction	0	87.7	37.3

Sim 2- Components Temperature Plot

85°C , sea level

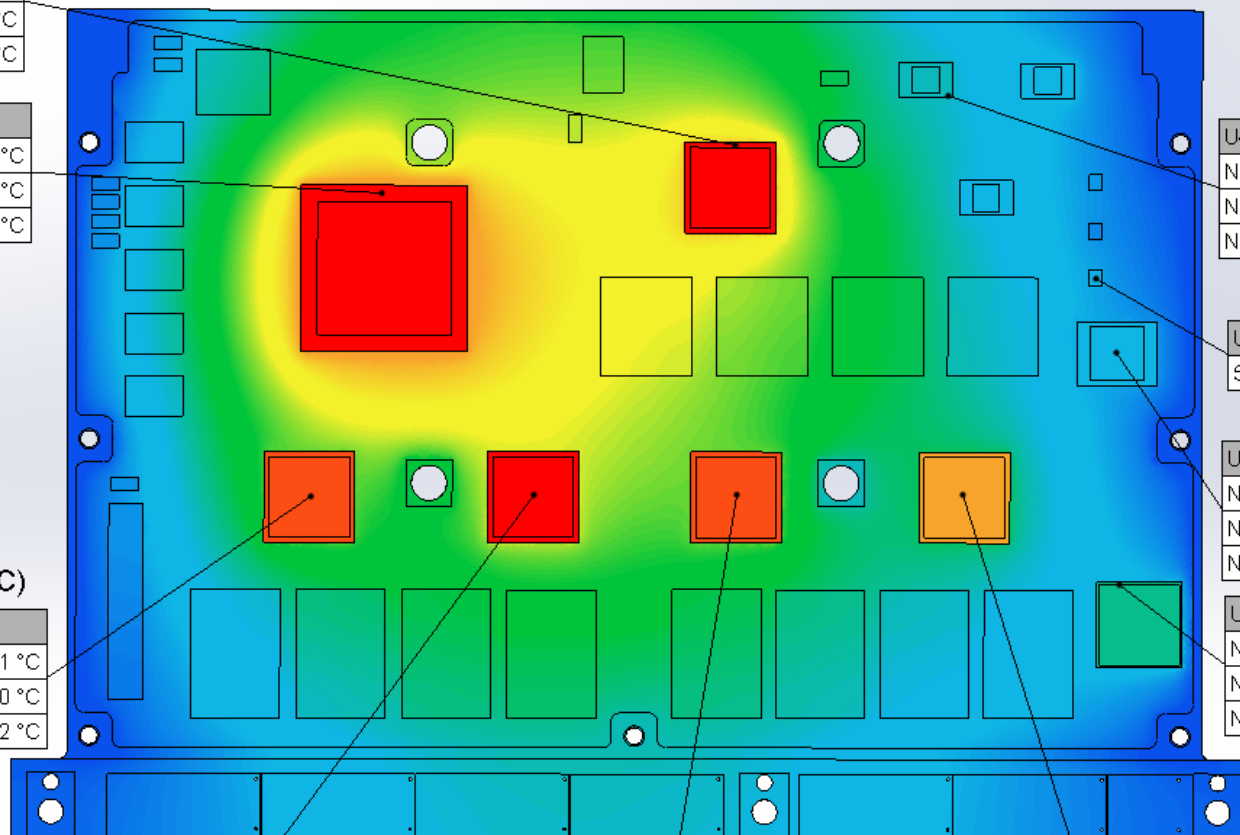
U2	
Node Temperature: Board	99.110 °C
Node Temperature: Case	97.187 °C
Node Temperature: Junction	104.05 °C

U18	
Node Temperature: Board	101.70 °C
Node Temperature: Case	99.494 °C
Node Temperature: Junction	104.81 °C



Solid Temperature (°C)

U14	
Node Temperature: Board	94.781 °C
Node Temperature: Junction	102.50 °C
Node Temperature: case	92.022 °C



U47	
Node Temperature: Board	90.636 °C
Node Temperature: Case	90.121 °C
Node Temperature: Junction	90.629 °C

U32	
Solid Temperature	87.919 °C

U11	
Node Temperature: Board	88.601 °C
Node Temperature: Case	86.779 °C
Node Temperature: Junction	89.062 °C

U8	
Node Temperature: Board	89.826 °C
Node Temperature: Case	87.089 °C
Node Temperature: Junction	91.481 °C

U15	
Node Temperature: Board	96.134 °C
Node Temperature: Case	93.105 °C
Node Temperature: Junction	103.72 °C

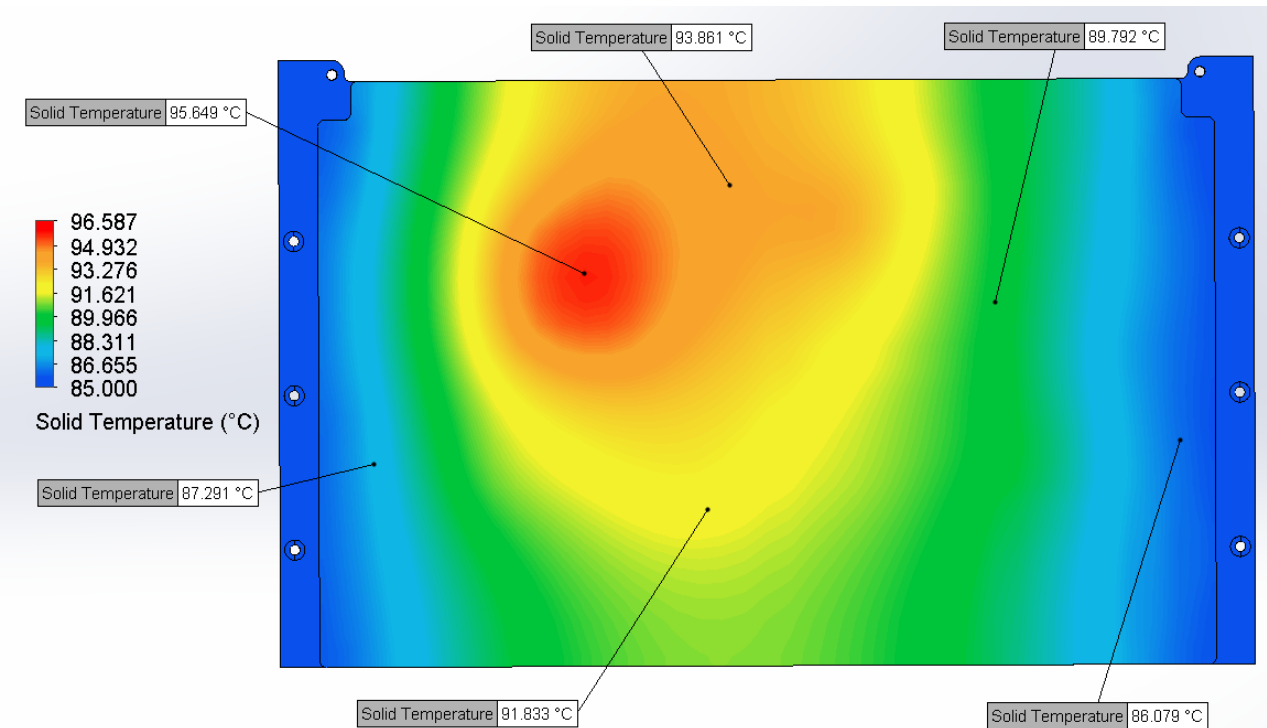
U16	
Node Temperature: Board	94.913 °C
Node Temperature: Case	91.978 °C
Node Temperature: Junction	102.55 °C

U17	
Node Temperature: Board	92.324 °C
Node Temperature: Case	90.061 °C
Node Temperature: Junction	100.30 °C

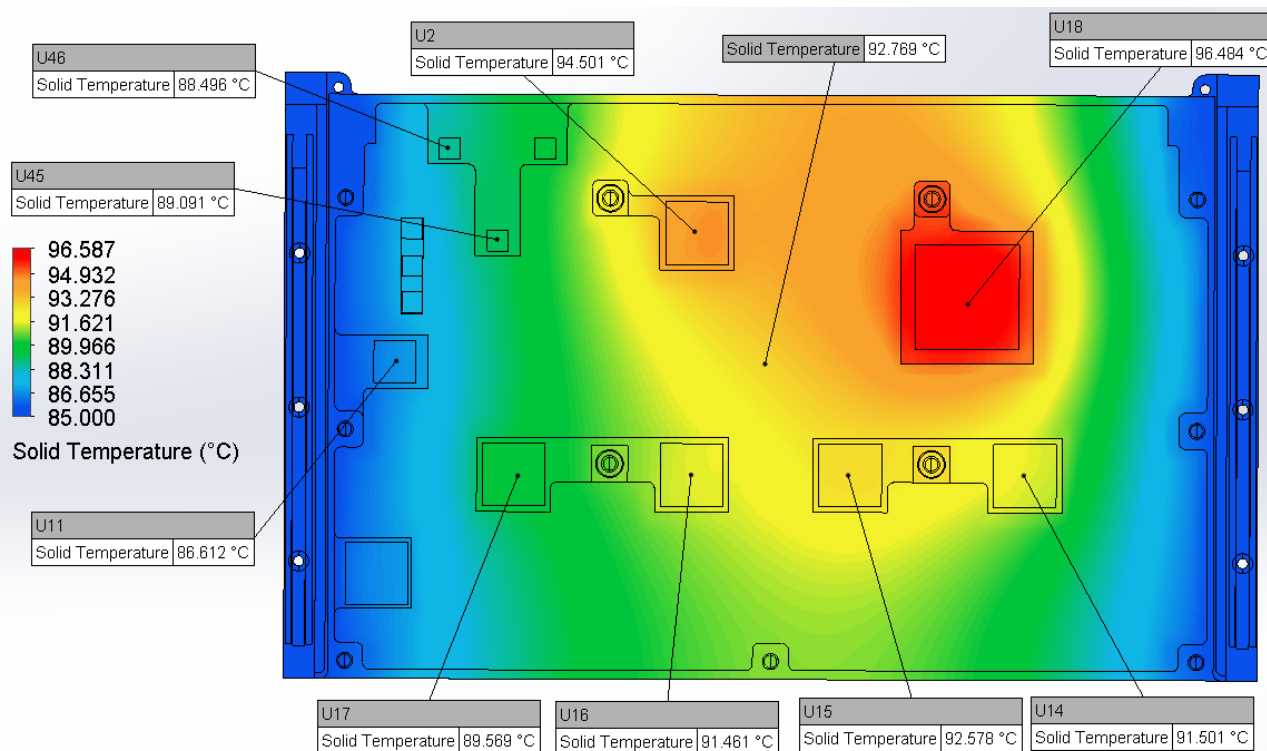
Note: only worst case MAXM17515 and MPM3810 components are probed

Sim 2 – Top Housing Surface Temperature Plot

85°C , sea level



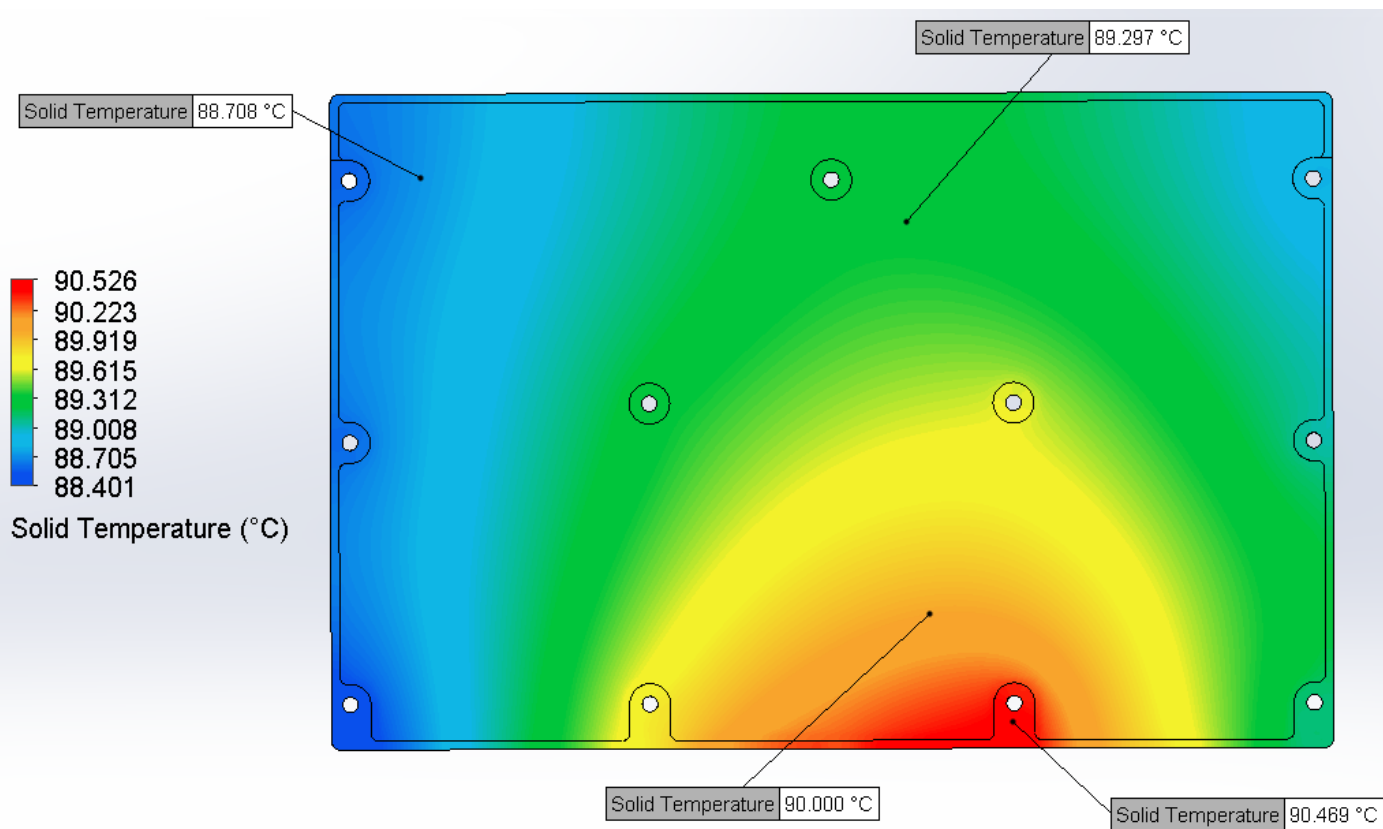
Top Side



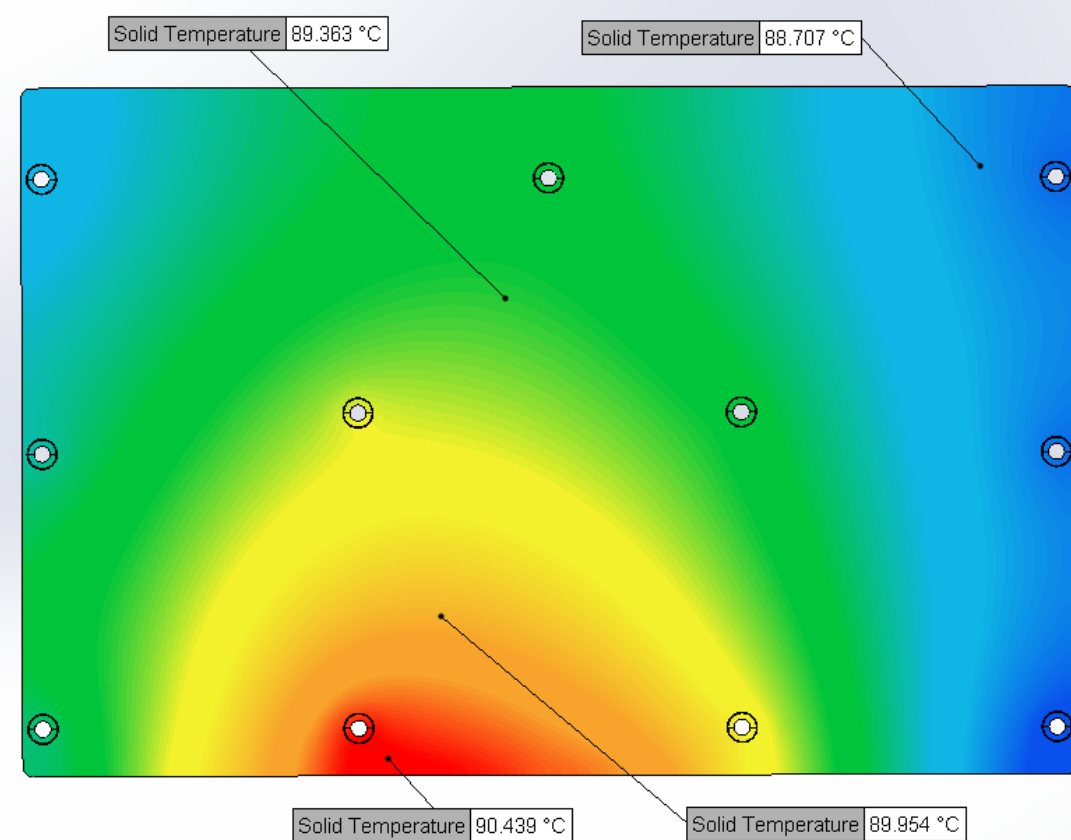
Bottom Side

Sim 2 - Rear Cover Temperature Plot

85°C , sea level



Top Side



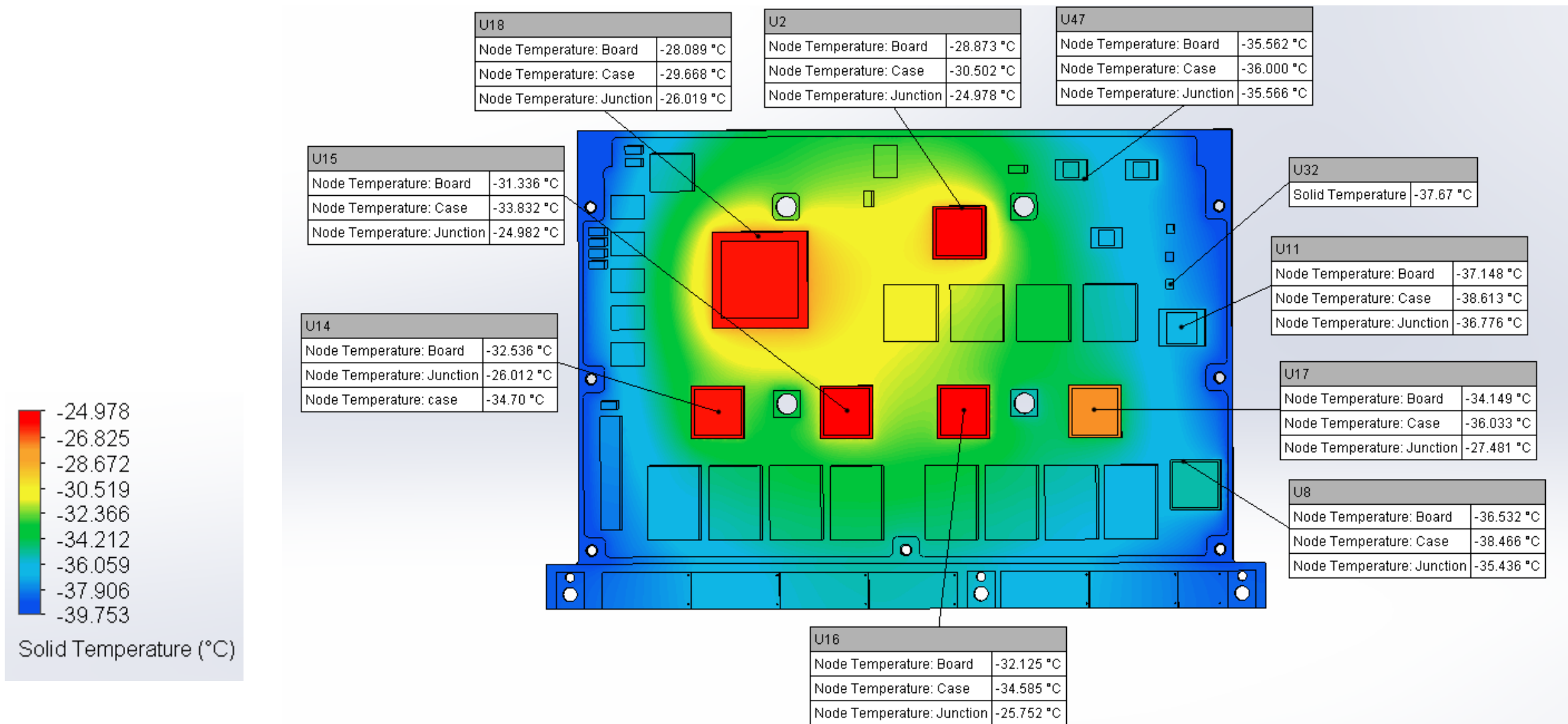
Bottom Side

**-40 C Ambient,
Predicted Power – Sim 3**

Parameters					Sim 3		
Power Scenario					Predicted		
Cooling Rail Temperature °C					-40		
Ambient Temp., °C					-40		
Elevation, ft					0		
RESULTS							
Component	Desc.	Min. Limit, °C °C	Max. Limit, °C	Limit Type	Power, W	Result, °C	Margin from Min, °C
BCM53570	U18	-40	110	Junction	15.61	-26.0	-14
BCM84894	U2	-40	110	Junction	6.02	-24.9	-15.1
LTM4650	U8	-40	125	Junction	1.55	-35.4	-4.6
BCM54240	U14	-40	110	Junction	1.52	-34.7	-5.3
BCM54241	U15	-40	110	Junction	1.52	-24.9	-15.1
BCM54242	U16	-40	110	Junction	1.52	-25.7	-14.3
BCM54243	U17	-40	110	Junction	1.52	-27.4	-12.6
MAXM17515	U46	-40	125	Junction	0.32	-37.2	-2.8
MPM3686	U11	-40	125	Junction	0.29	-36.7	-3.3
MPM3810	U32	-40	125	Junction	0.08	-37.6	-2.4
MAXM17515	U47	-40	125	Junction	0.07	-35.5	-4.5
MPM3810	U34	-40	125	Junction	0.05	-37.8	-2.2
MAXM17515	U45	-40	125	Junction	0.02	-36.8	-3.2
MPM3810	U33	-40	125	Junction	0	-38.0	-2

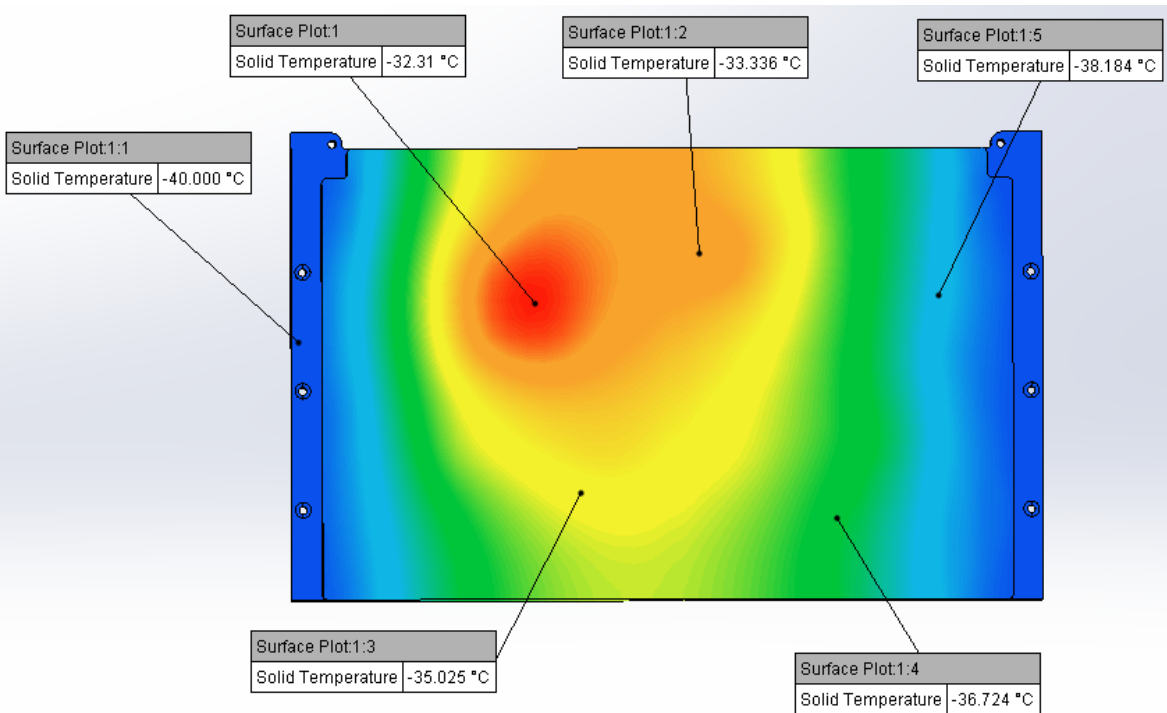
Sim 3 - Components Temperature Plot

-40°C , sea level

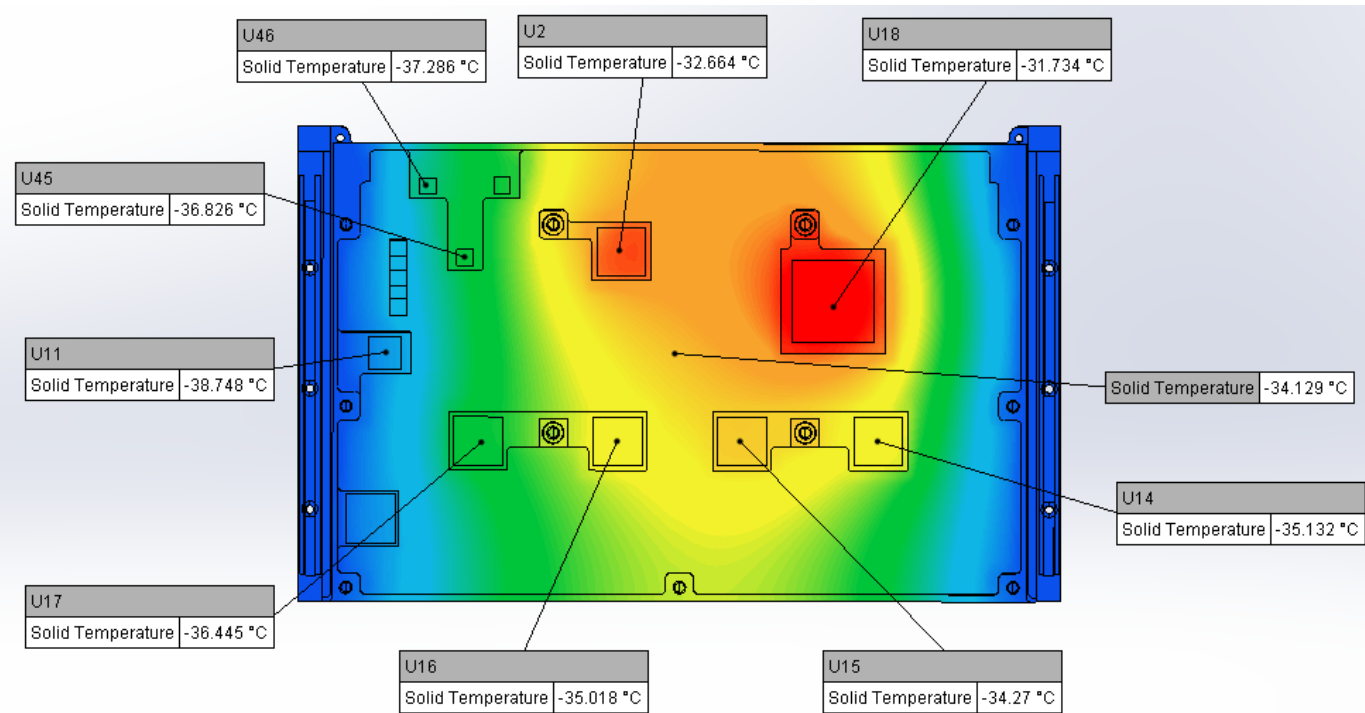


Note: only worst case MAXM17515 and MPM3810 components are probed

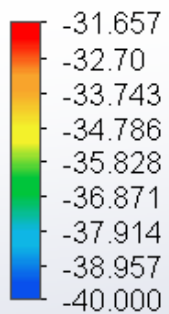
-40°C , sea level



Top Side



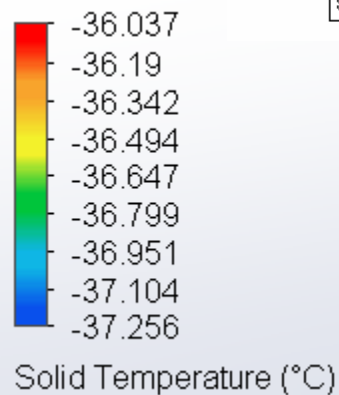
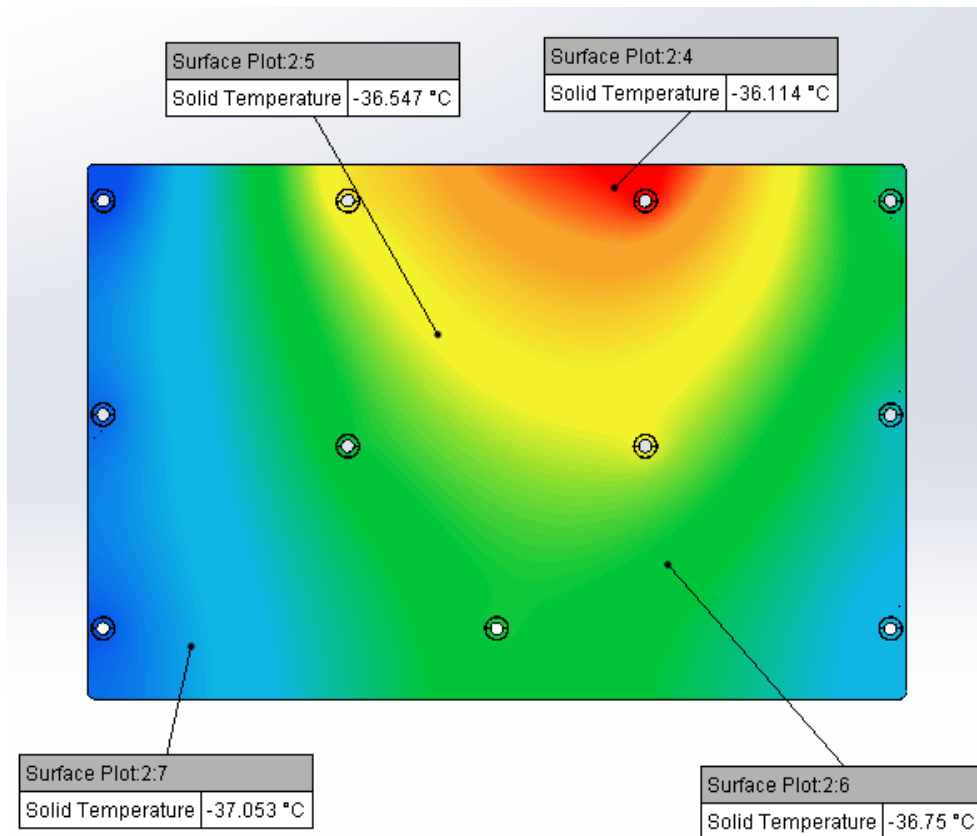
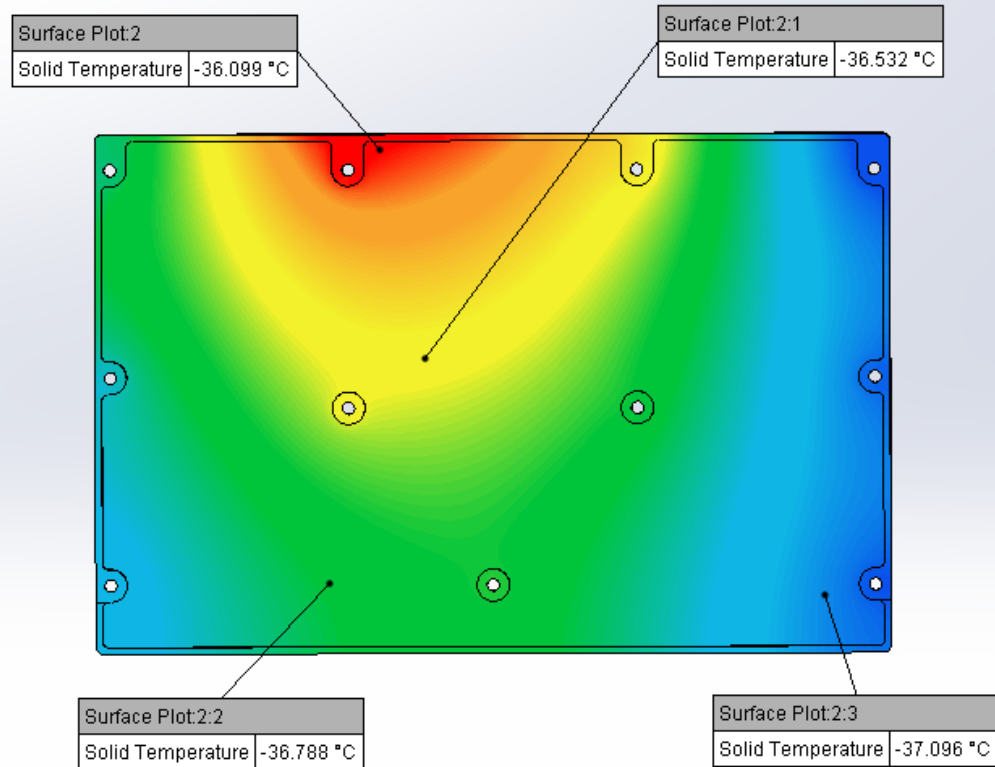
Bottom Side



Solid Temperature (°C)

Sim 3 - Rear Cover Temperature Plot

-40°C , sea level

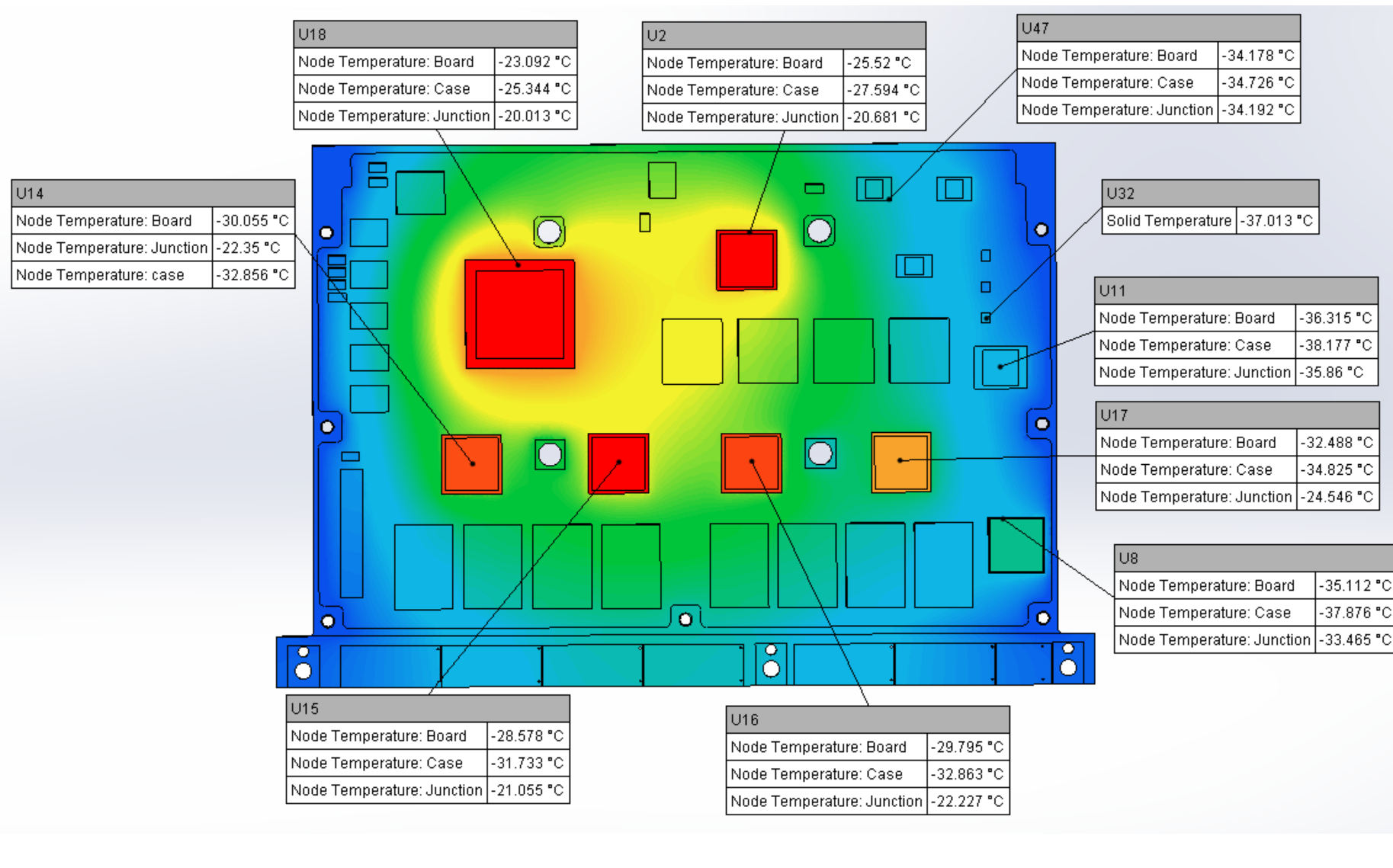


-40 C Ambient, Worst Case Power – Sim 4

Parameters					Sim 4		
Power Scenario					Worst Case		
Cooling Rail Temperature °C					-40		
Ambient Temp., °C					-40		
Elevation, ft					0		
RESULTS							
Component	Desc.	Min. Limit, °C	Max. Limit, °C	Limit Type	Power, W	Result, °C	Margin from Min, °C
BCM53570	U18	-40	110	Junction	22.9	-20.0	-20
BCM84894	U2	-40	110	Junction	7.52	-20.6	-19.4
LTM4650	U8	-40	125	Junction	2.29	-33.4	-6.6
BCM54240	U14	-40	110	Junction	1.82	-32.8	-7.2
BCM54241	U15	-40	110	Junction	1.82	-21.0	-19
BCM54242	U16	-40	110	Junction	1.82	-22.2	-17.8
BCM54243	U17	-40	110	Junction	1.82	-24.5	-15.5
MAXM17515	U46	-40	125	Junction	0.4	-37.2	-2.8
MPM3686	U11	-40	125	Junction	0.36	-35.8	-4.2
MPM3810	U32	-40	125	Junction	0.09	-37.0	-3
MAXM17515	U47	-40	125	Junction	0.08	-34.1	-5.9
MPM3810	U34	-40	125	Junction	0.05	-37.2	-2.8
MAXM17515	U45	-40	125	Junction	0.02	-36.8	-3.2
MPM3810	U33	-40	125	Junction	0	-37.4	-2.6

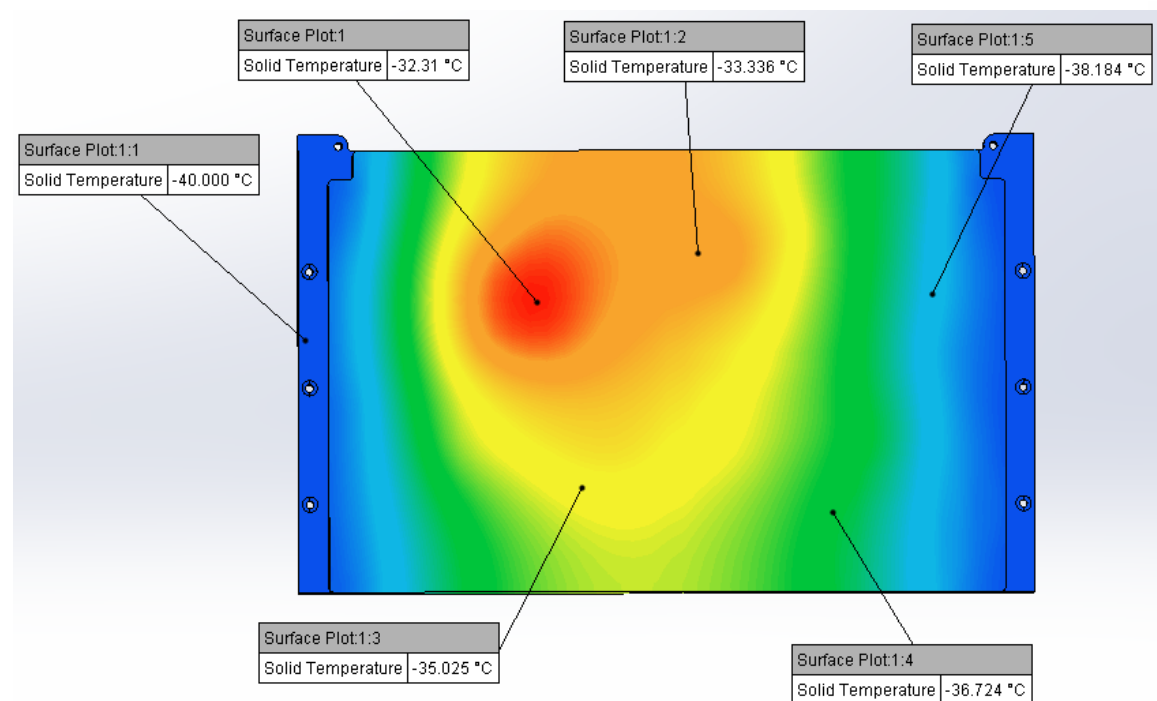
Sim 4 - Components Temperature Plot

-40°C , sea level

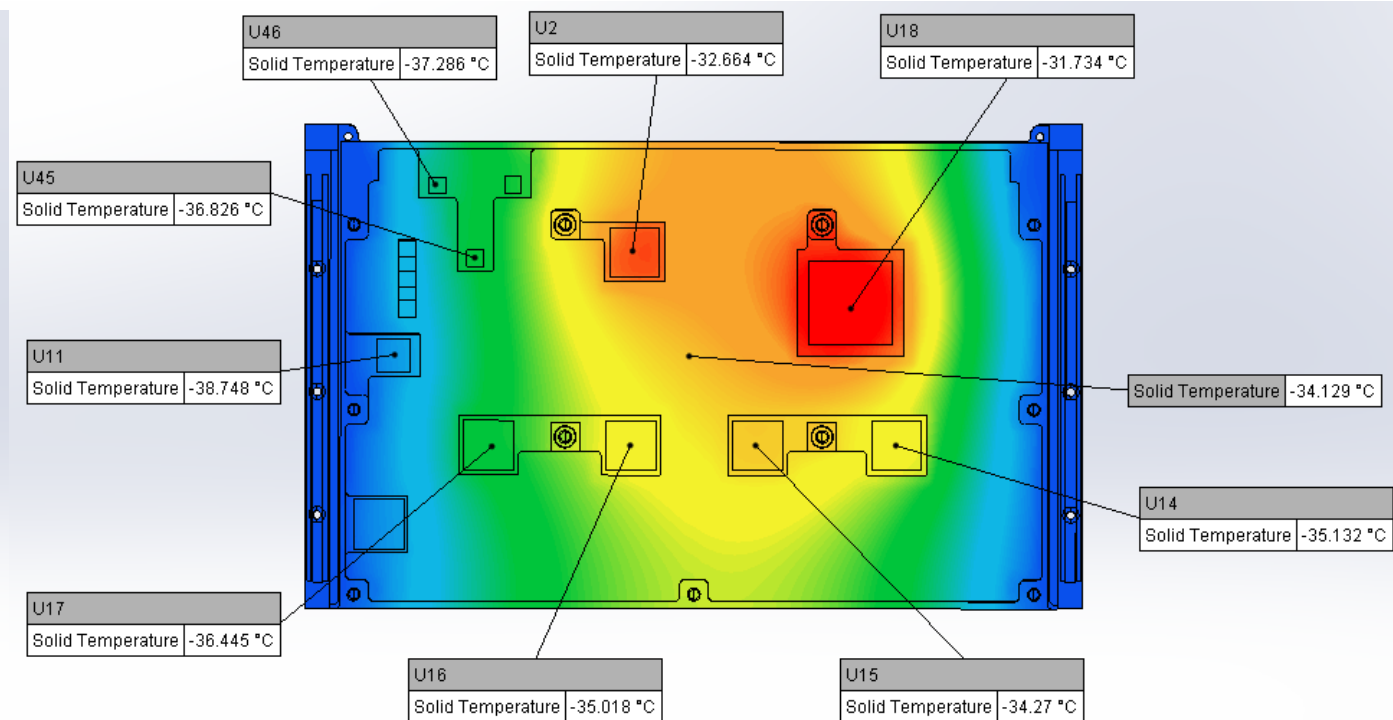


Note: only worst case MAXM17515 and MPM3810 components are probed

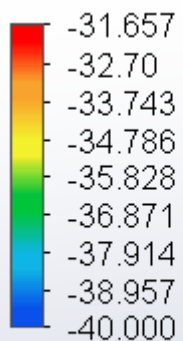
-40°C , sea level



Top Side



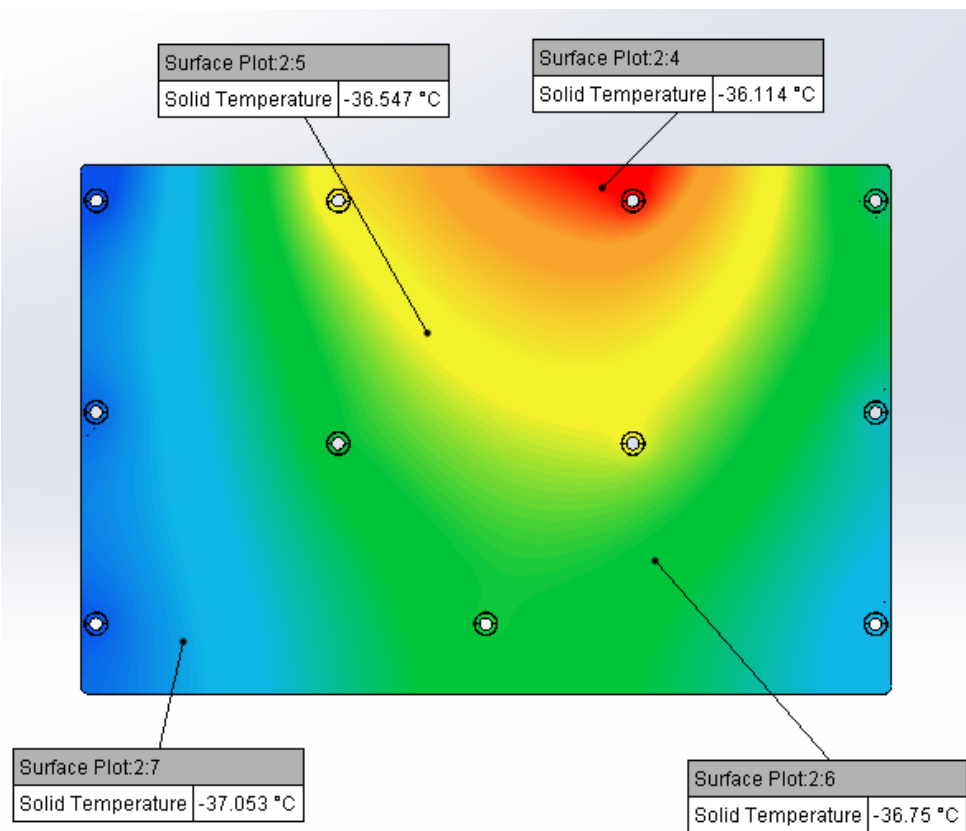
Bottom Side



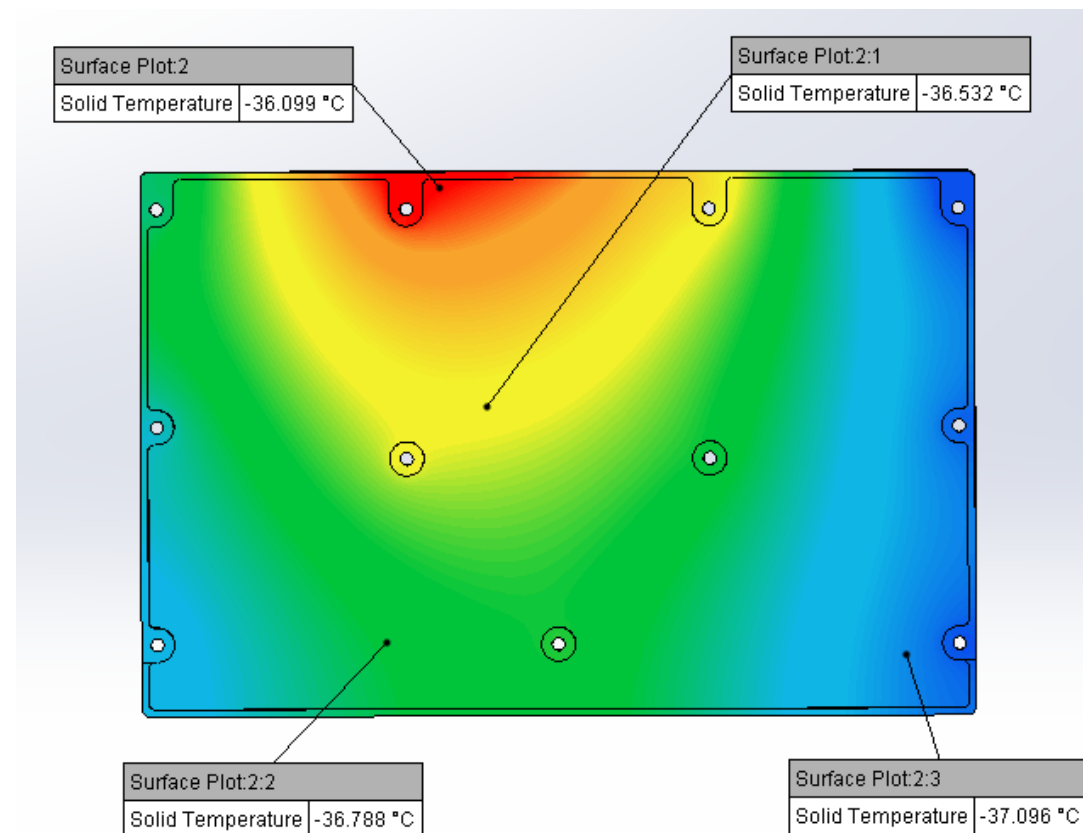
Solid Temperature (°C)

Sim 4 - Rear Cover Temperature Plot

-40°C , sea level



Top Side



Bottom Side

