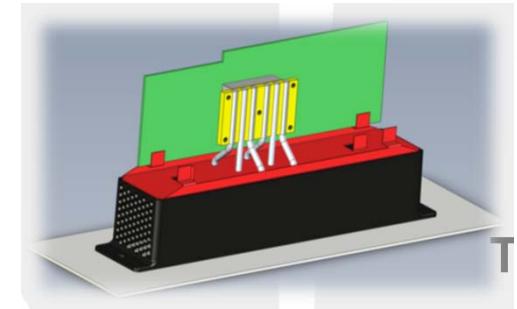


# Thermal Solution Test

## for AM company, Australia



Thermal-Design Team: Bryan Lin,  
Ken Chen  
Steven Hsiao

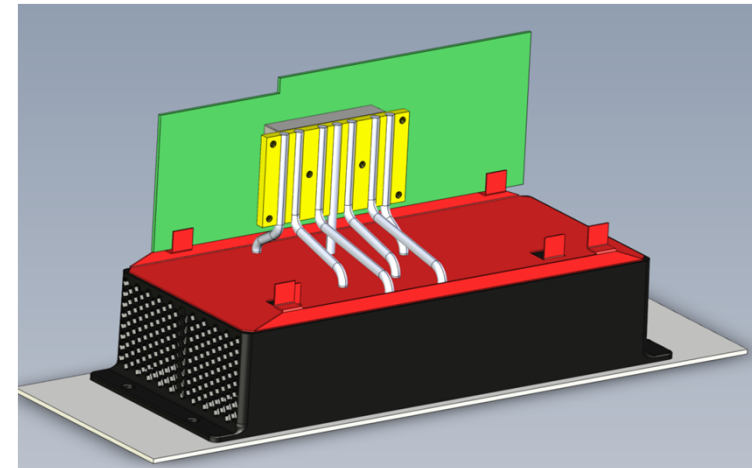
Date: Nov 25<sup>th</sup>, 2020

## Purpose:

To satisfy the thermal demand of IGBT in 200W & 430W by using the current space limitation from the layout provided by AM company.

## Conditions:

1. TDP = 200W/ 430W
2.  $T_a = 45^{\circ}\text{C}$
3.  $T_c = 80^{\circ}\text{C}$
4. Thermal Module
  - Fan : 9WL0624P4S001
  - Contact Plate : Copper
  - Heat pipe x 6pcs/ 7pcs : Copper
  - Base : Aluminum
  - Stacked Fins : Aluminum
  - Fan cover : stainless steel



## Methods:

To compare and adjust the key elements, including fin pitch, thickness and heat pipe q'ty & locations.

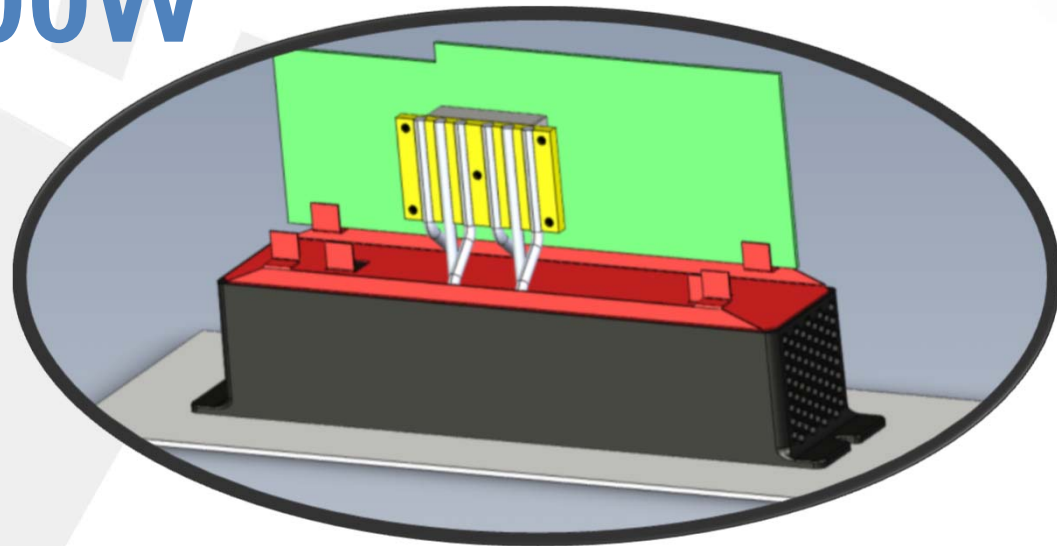
## Tests A (for 200W):

1. Pitch = 2.2mm, t = 0.3mm (A1)
2. Pitch = 2.0mm, t = 0.4mm (A2)
3. Pitch = 2.2mm, t = 0.3mm, location change of Heat pipe (A3)
4. Pitch = 2.0mm, t = 0.4mm, optimization of components combination (A4)

## Tests B (for 430W):

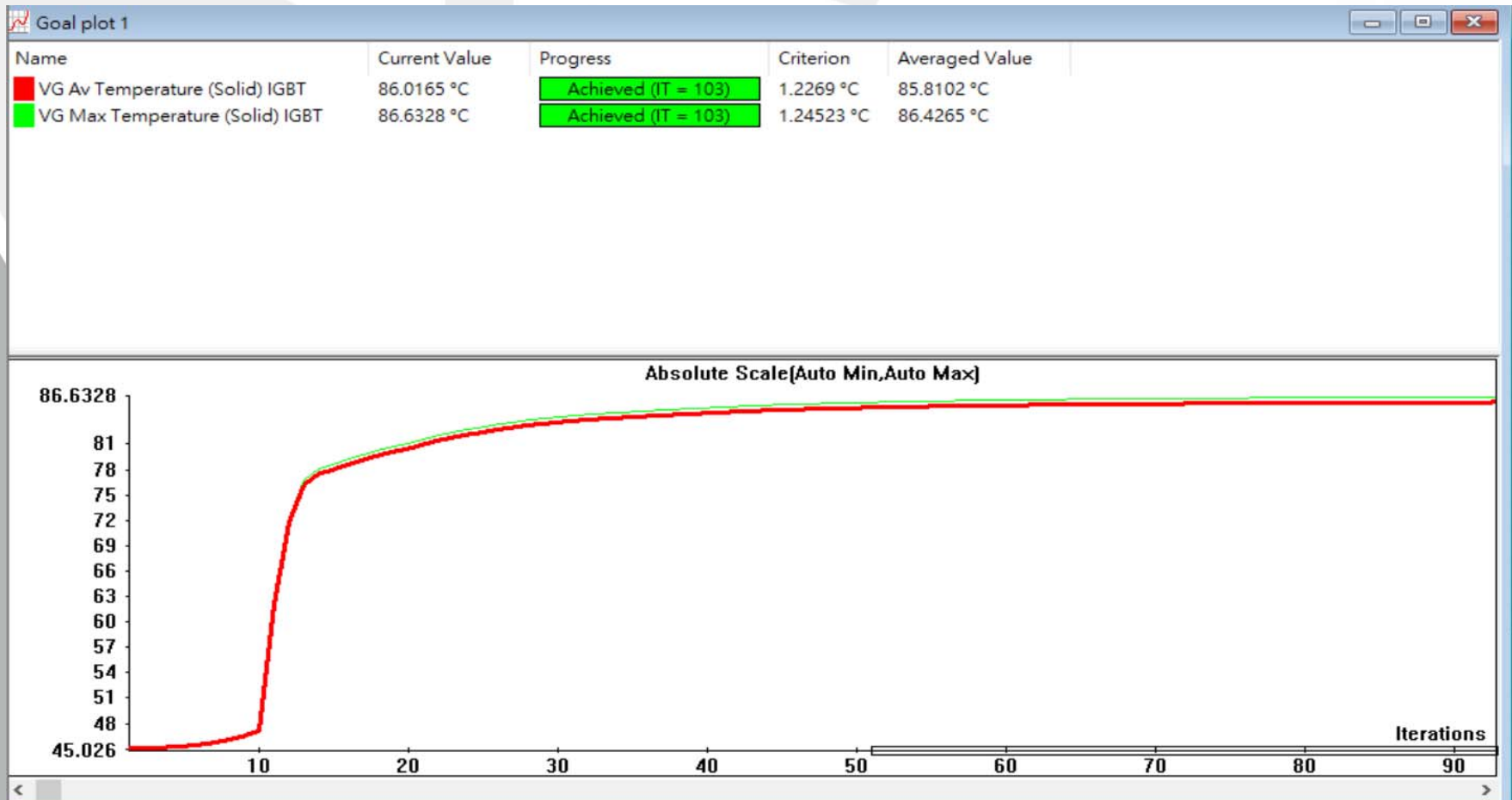
1. Pitch = 2.2mm, t = 0.3mm (B1)
2. Pitch = 2.0mm, t = 0.4mm (B2)
3. Pitch = 2.2mm, t = 0.3mm, location change of Heat pipe (B3)
4. Pitch = 2.0mm, t = 0.4mm, optimization of components combination (B4)

**FOR 200W**



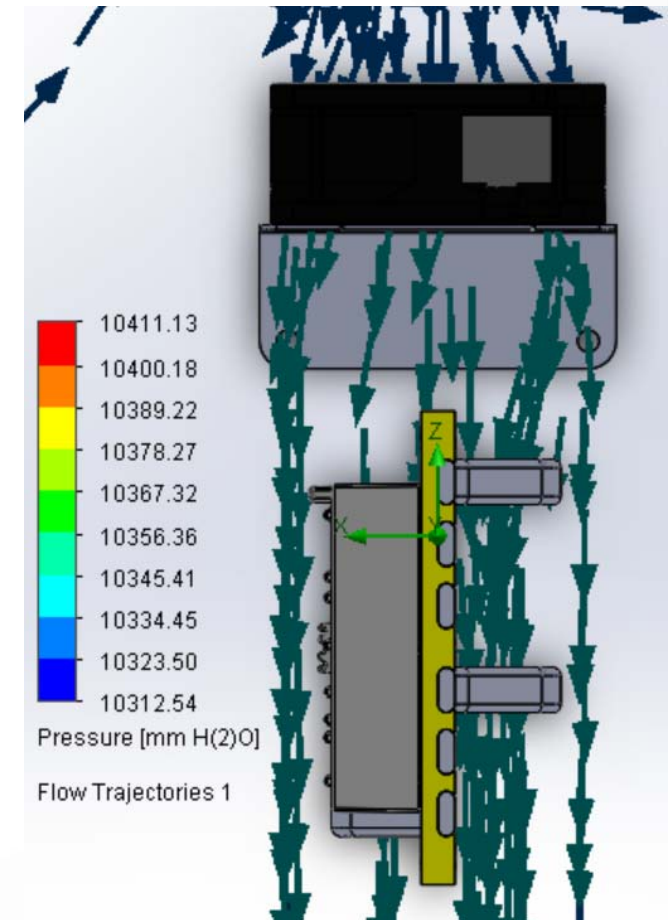
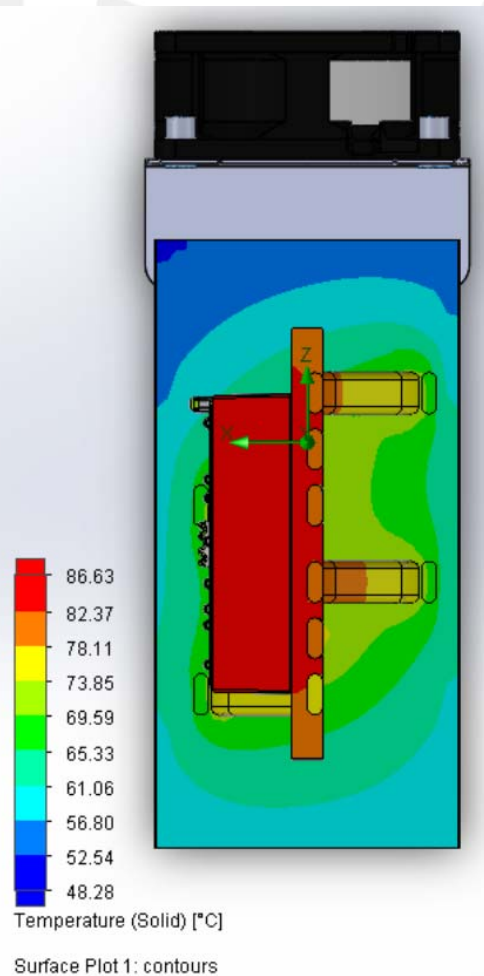
# Analysis – Temp Profile (A1)

The stabilized maximum temp is  $> 80^{\circ}\text{C}$  , FAILURE .



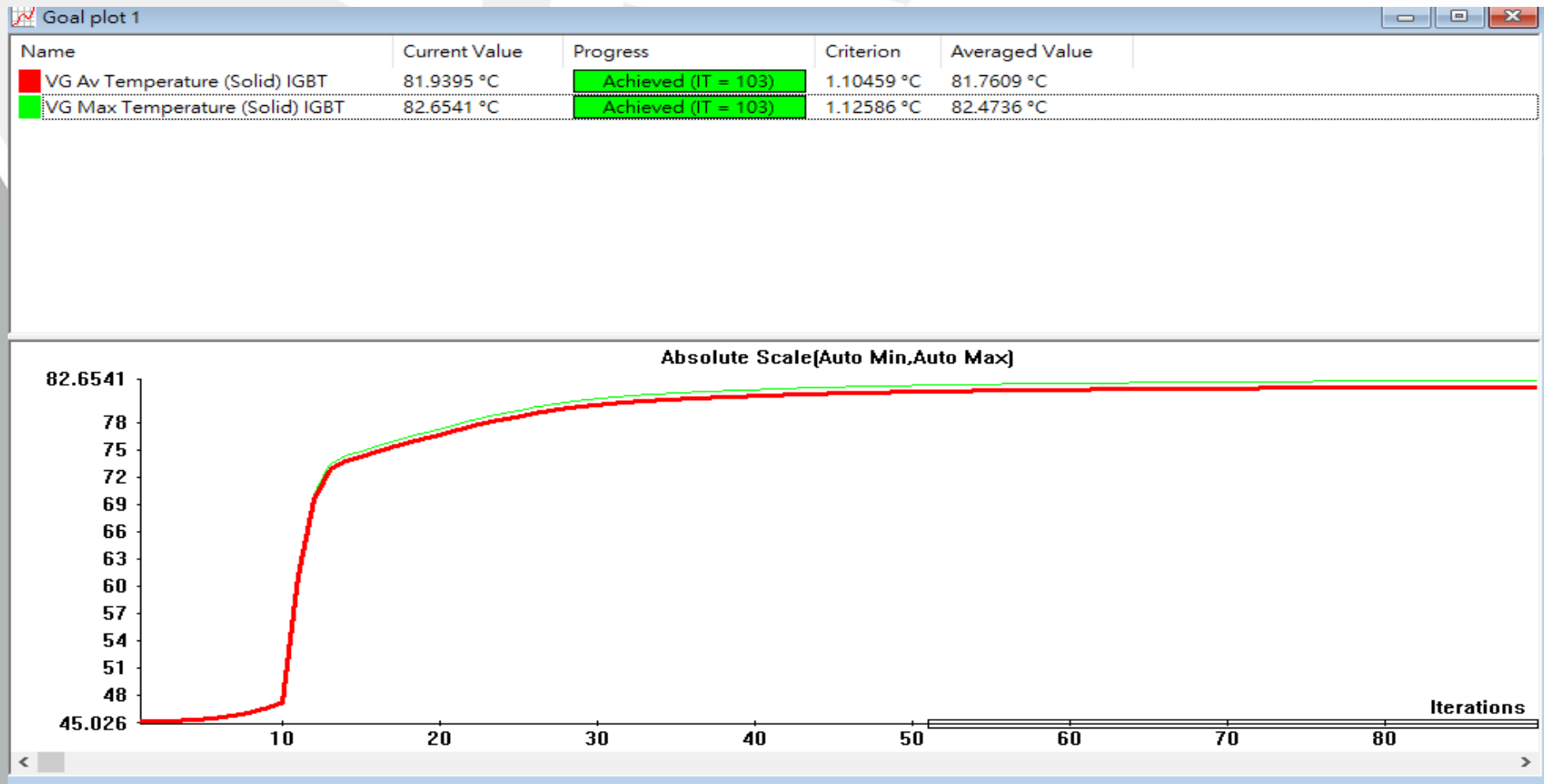
# Analysis – Thermal Ranging (A1)

▲ Maximum temp = 86.60°C.



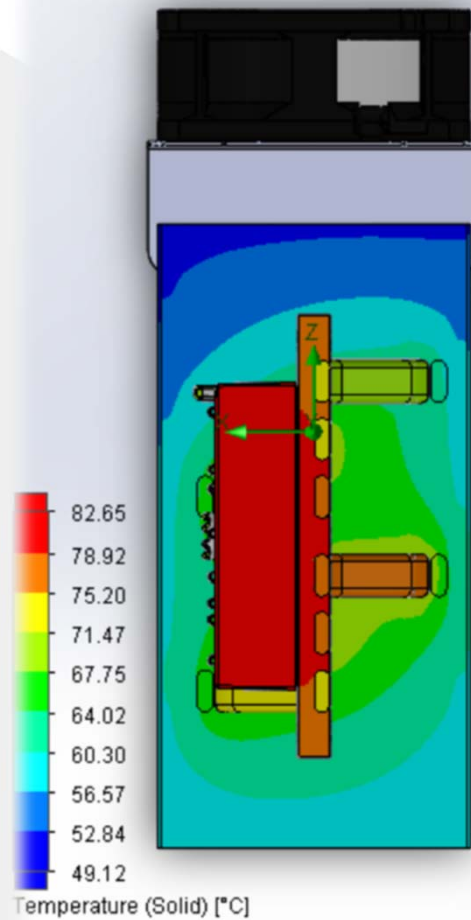
# Analysis – Temp Profile (A2)

The stabilized maximum temp is  $> 80^{\circ}\text{C}$  , FAILURE .

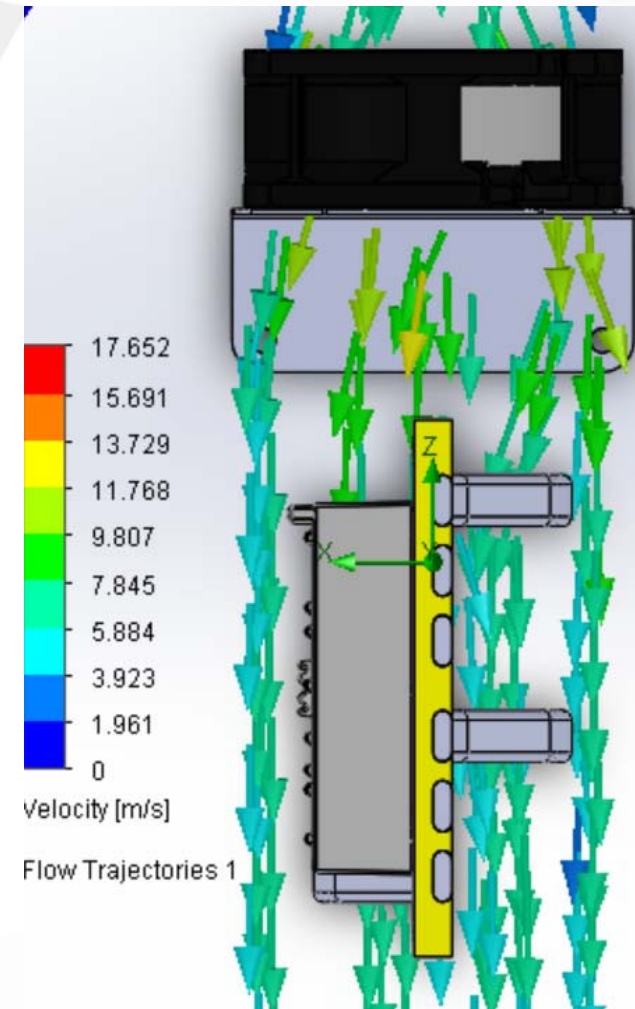


# Analysis – Thermal Ranging (A2)

▲ Maximum temp = 82.60°C.



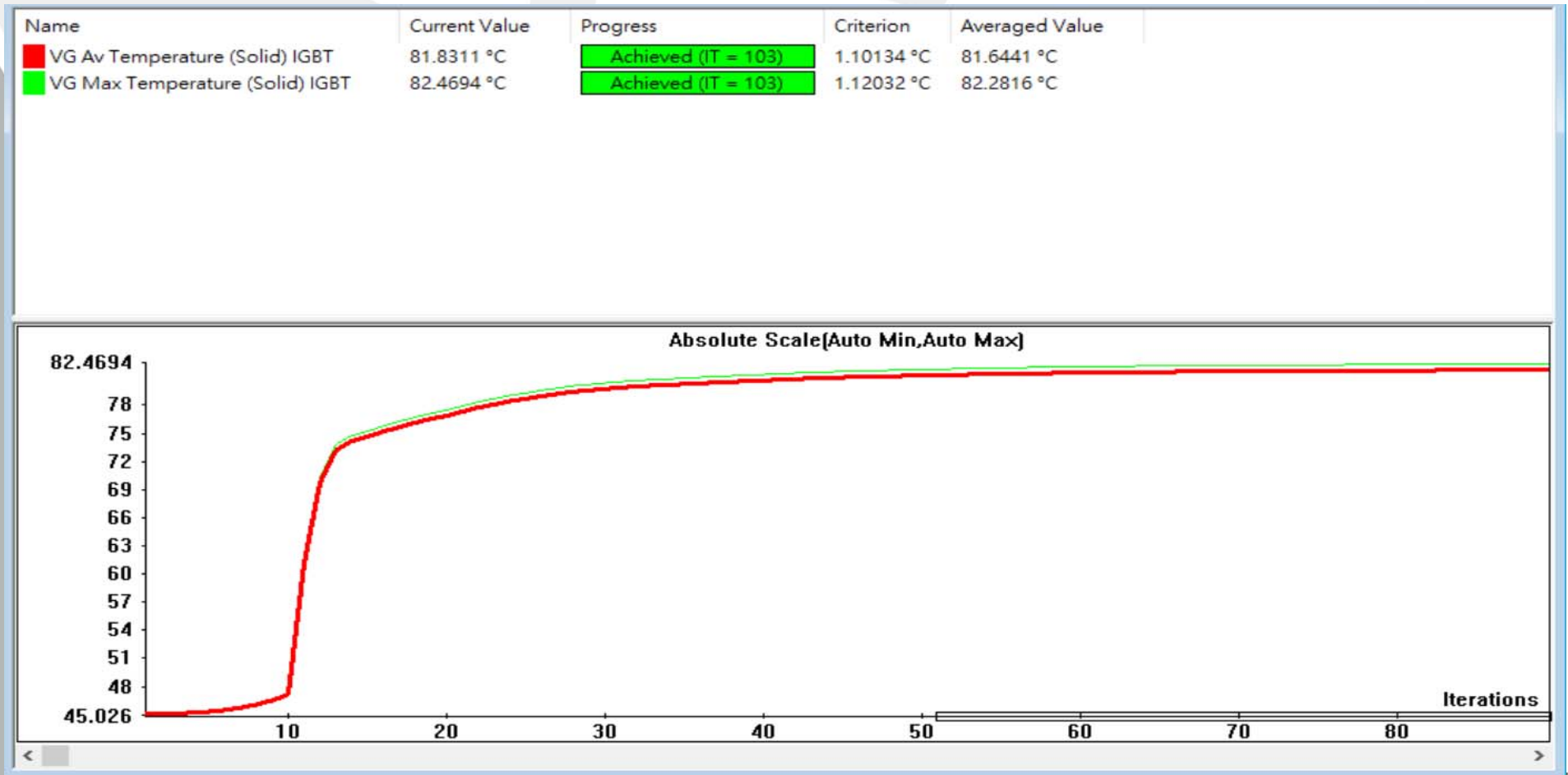
Surface Plot 1: contours





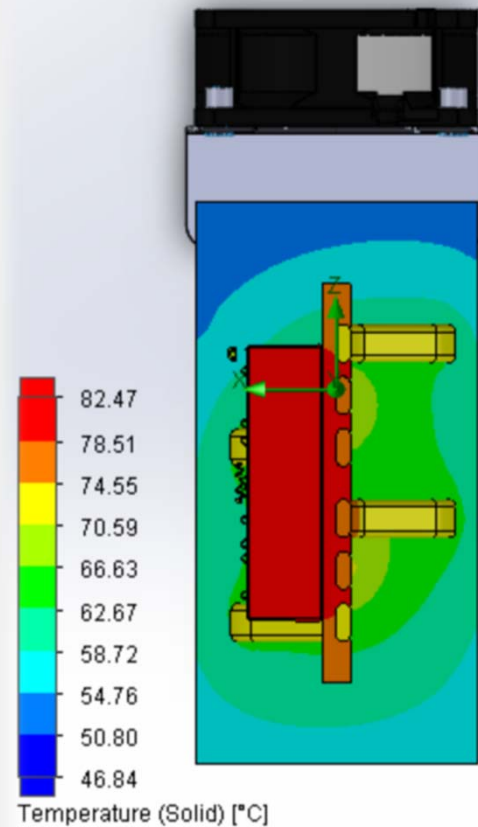
# Analysis – Temp Profile (A3)

The stabilized maximum temp is > 80°C , **FAILURE** .

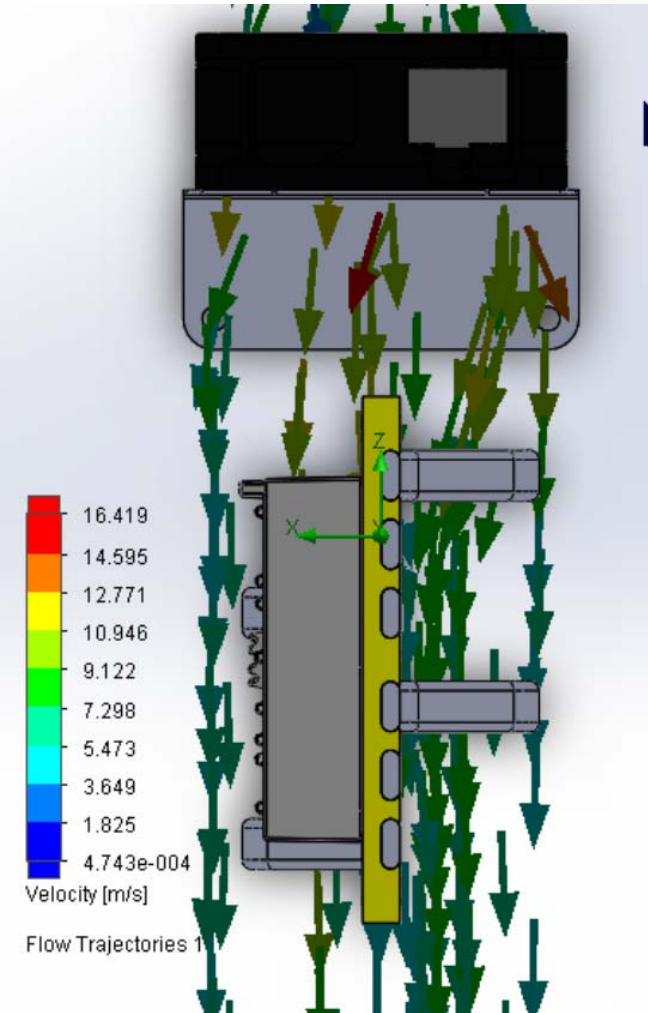


# Analysis – Thermal Ranging (A3)

▲ Maximum temp = 82.50°C.



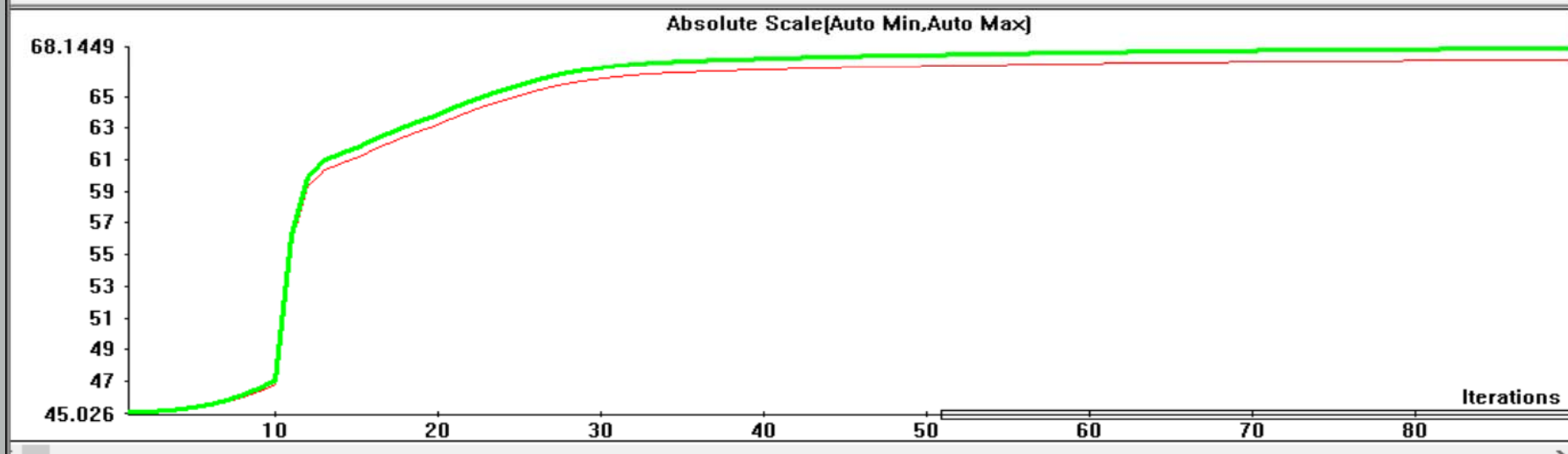
Surface Plot 1: contours



# Analysis – Temp Profile (A4)

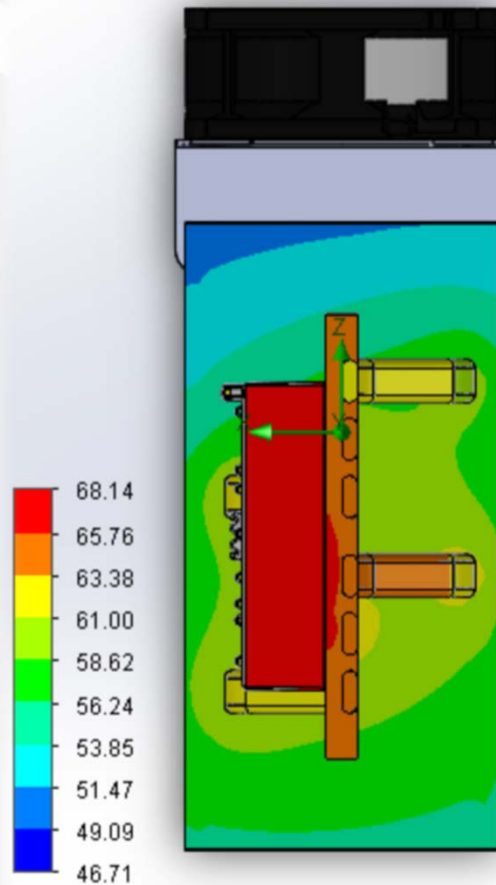
The stabilized maximum temp is  $< 80^{\circ}\text{C}$  , **PASSED** .

Name	Current Value	Progress	Criterion	Averaged Value
VG Av Temperature (Solid) IGBT	67.4219 °C	Achieved (IT = 103)	0.669066 °C	67.2691 °C
VG Max Temperature (Solid) IGBT	68.1449 °C	Achieved (IT = 103)	0.690589 °C	67.9885 °C



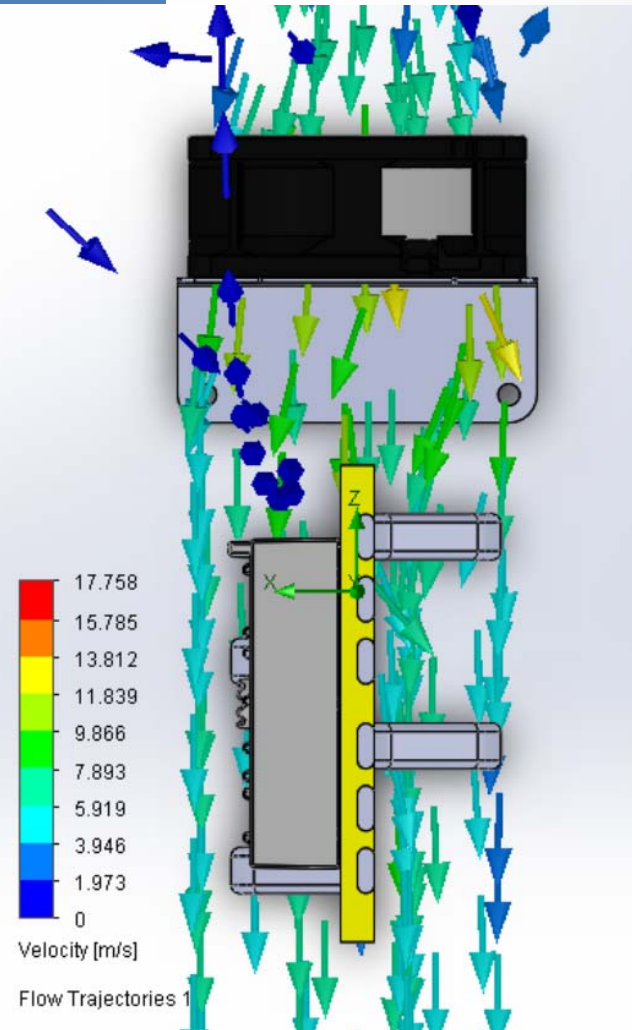
# Analysis – Thermal Ranging (A4)

▲ Maximum temp = 68.10°C.



Temperature (Solid) [°C]

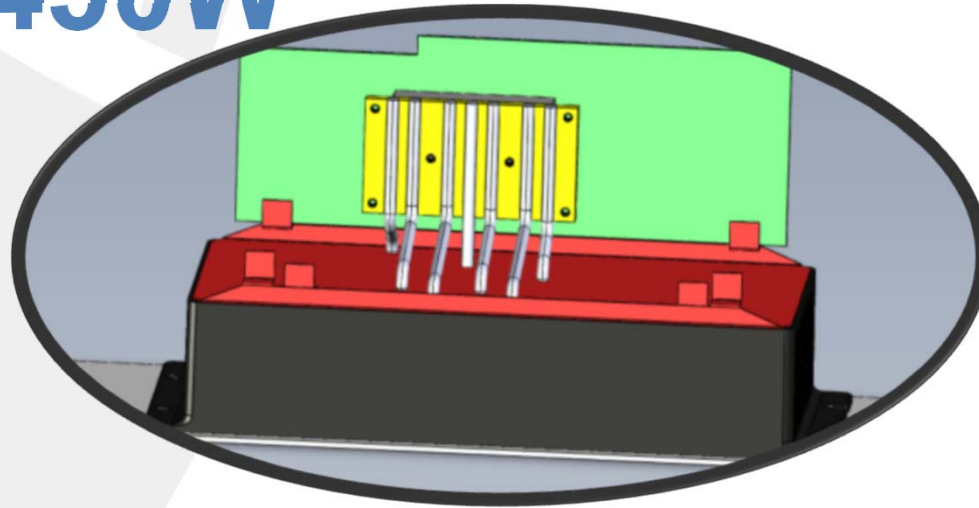
Surface Plot 1: contours



Velocity [m/s]

Flow Trajectories 1

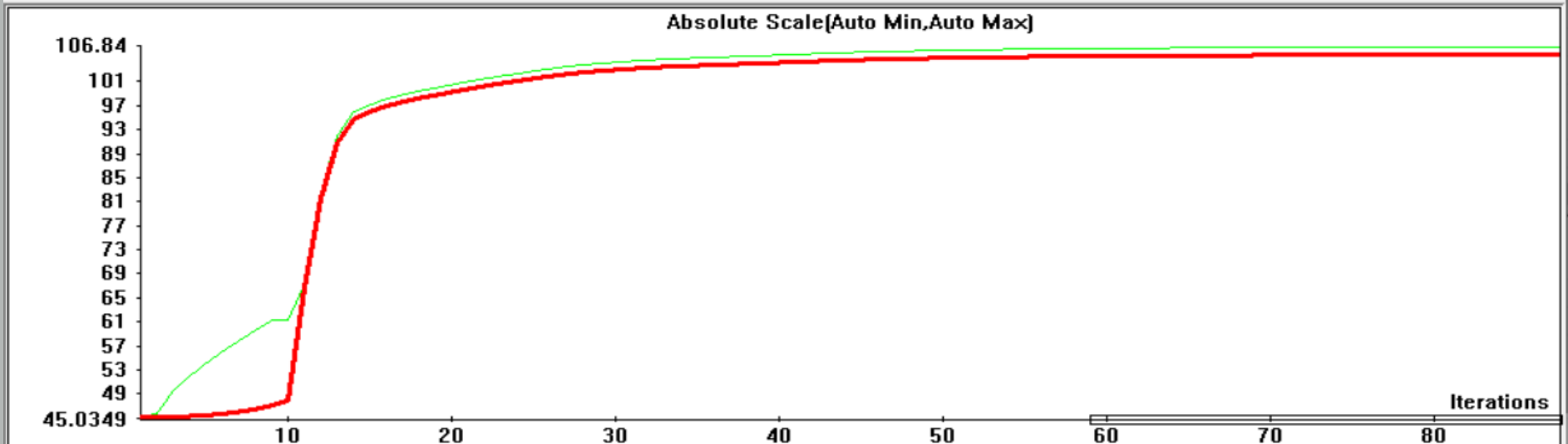
**FOR 430W**



# Analysis – Temp Profile (B1)

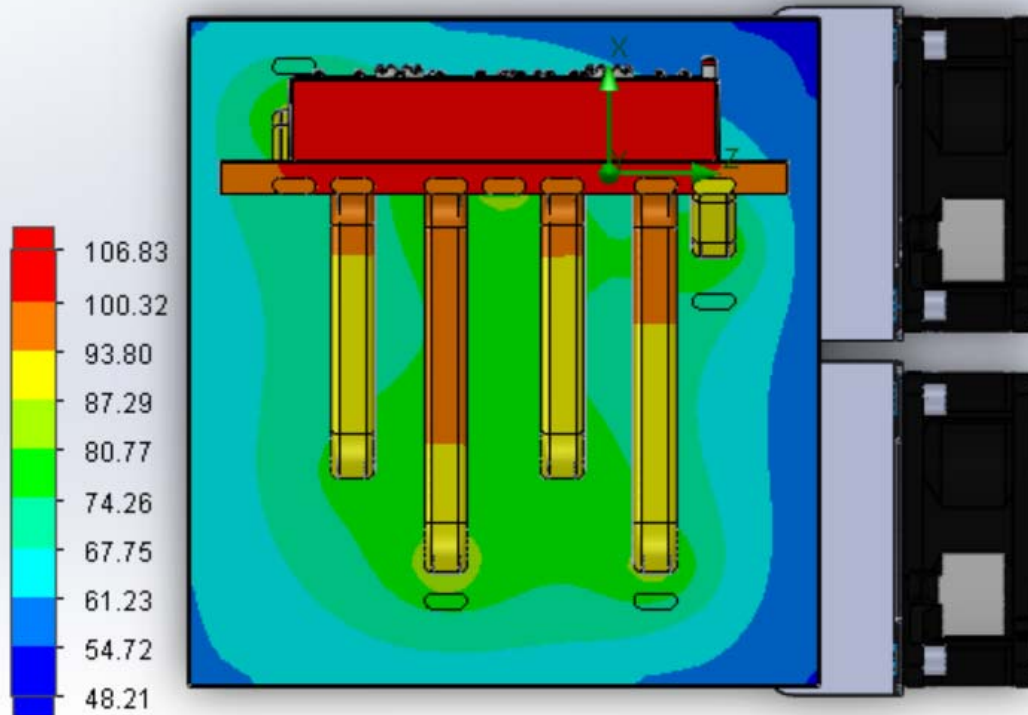
The stabilized maximum temp is  $> 80^{\circ}\text{C}$  , **FAILURE** .

Name	Current Value	Progress	Criterion	Averaged Value
VG Av Temperature (Solid) IGBT	105.55 °C	Achieved (IT = 118)	1.81191 °C	105.48 °C
VG Max Temperature (Solid) IGBT	106.833 °C	Achieved (IT = 118)	1.72185 °C	106.763 °C



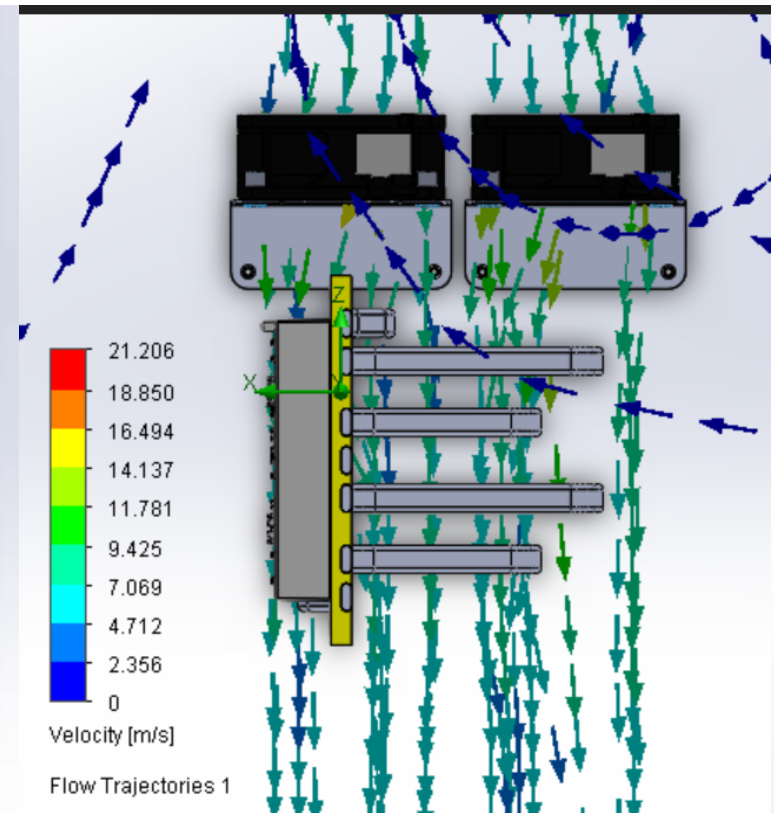
# Analysis – Thermal Ranging (B1)

▲ Maximum temp = 106.8°C.



Temperature (Solid) [°C]

Surface Plot 1: contours



Velocity [m/s]

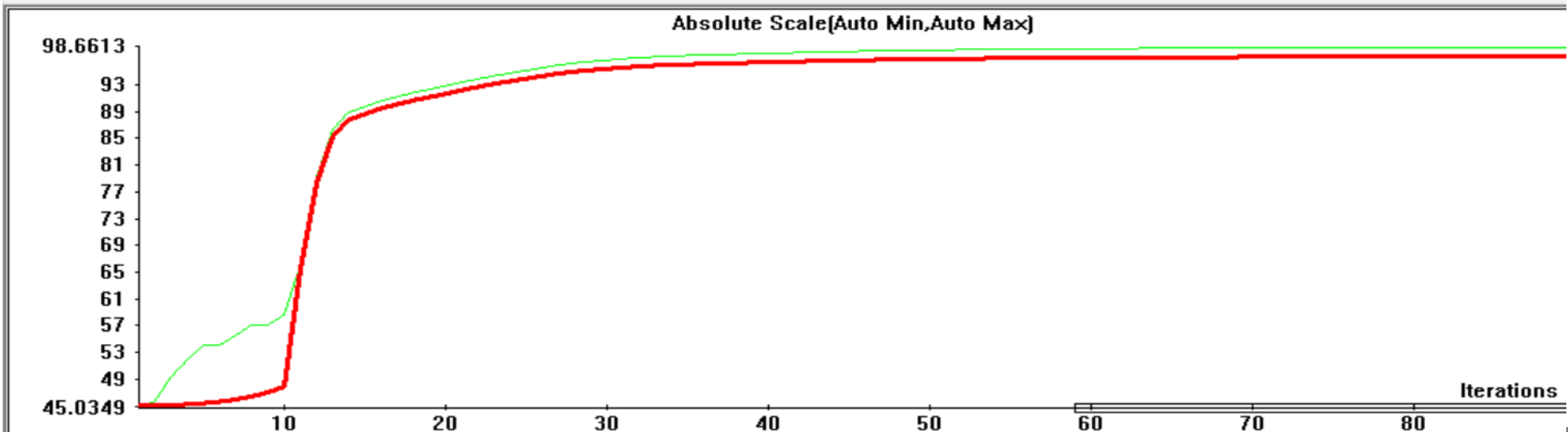
Flow Trajectories 1



# Analysis – Temp Profile (B2)

The stabilized maximum temp is  $> 80^{\circ}\text{C}$  , FAILURE .

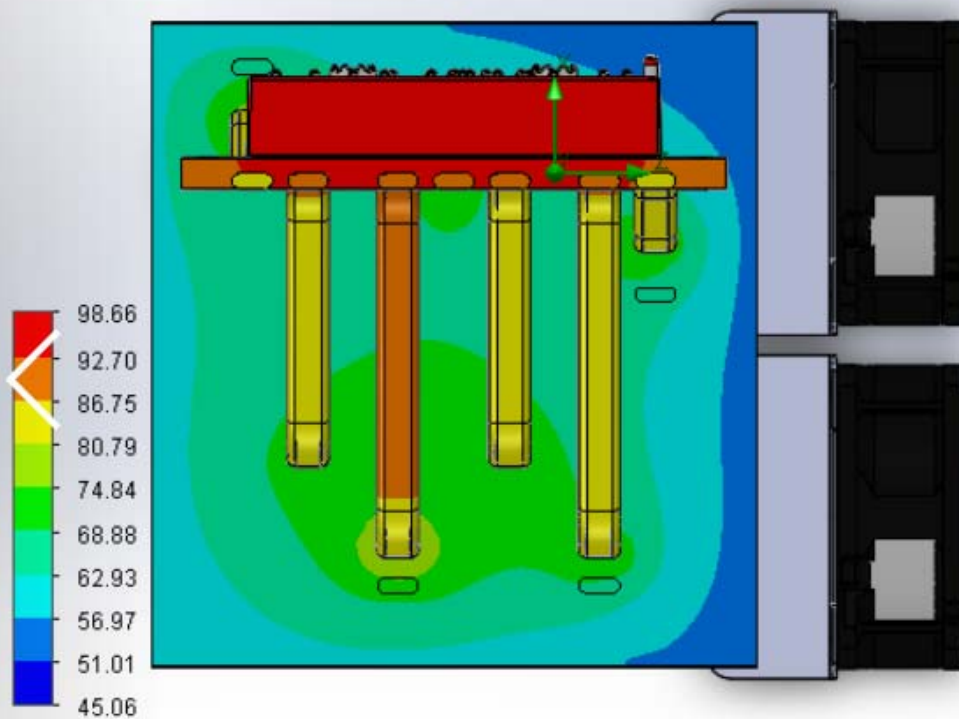
Name	Current Value	Progress	Criterion	Averaged Value
VG Av Temperature (Solid) IGBT	97.3181 °C	Achieved (IT = 118)	1.56481 °C	97.2558 °C
VG Max Temperature (Solid) IGBT	98.6575 °C	Achieved (IT = 118)	1.47644 °C	98.5944 °C





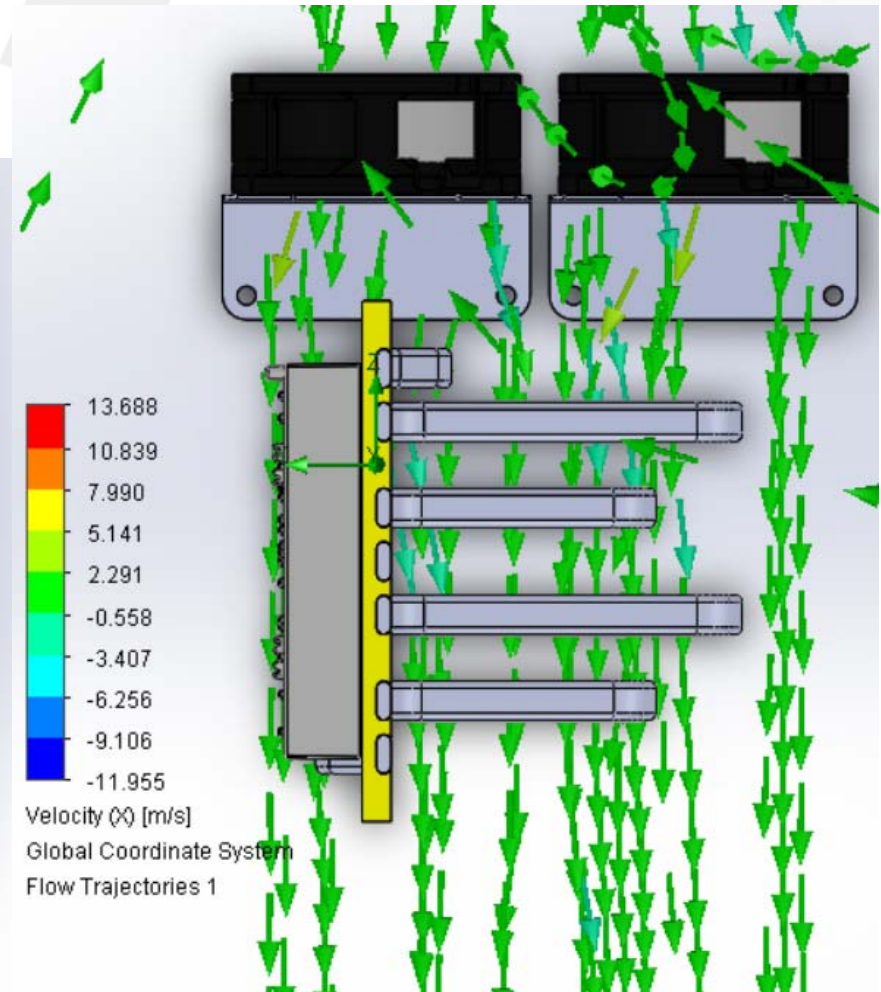
## Analysis – Thermal Ranging (B2)

▲ Maximum temp = 98.6°C.



Temperature (Solid) [°C]

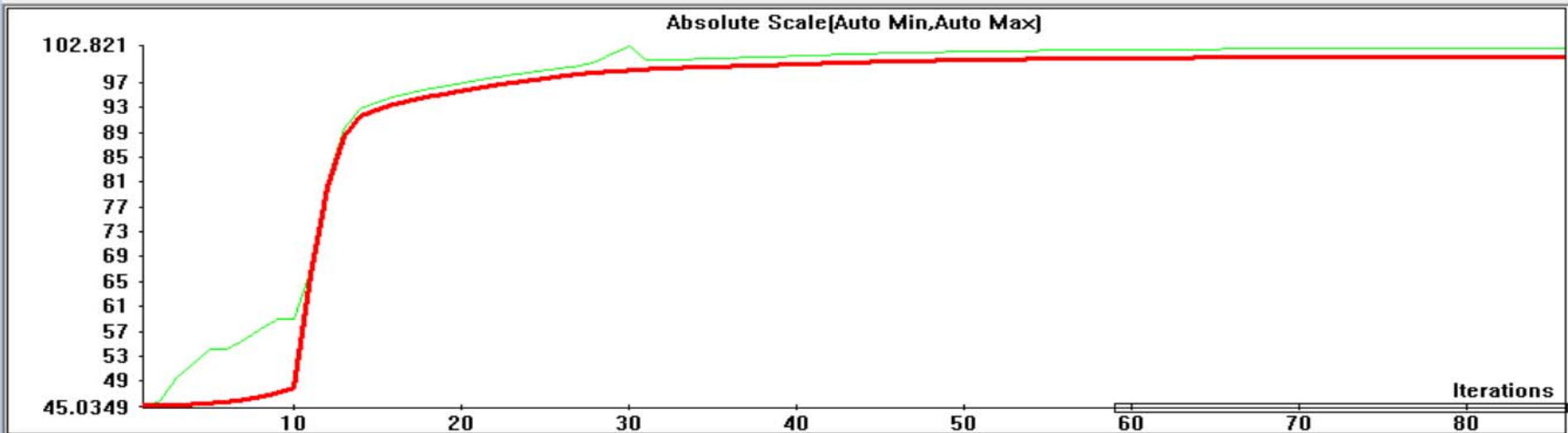
Surface Plot 1: contours



# Analysis – Temp Profile (B3)

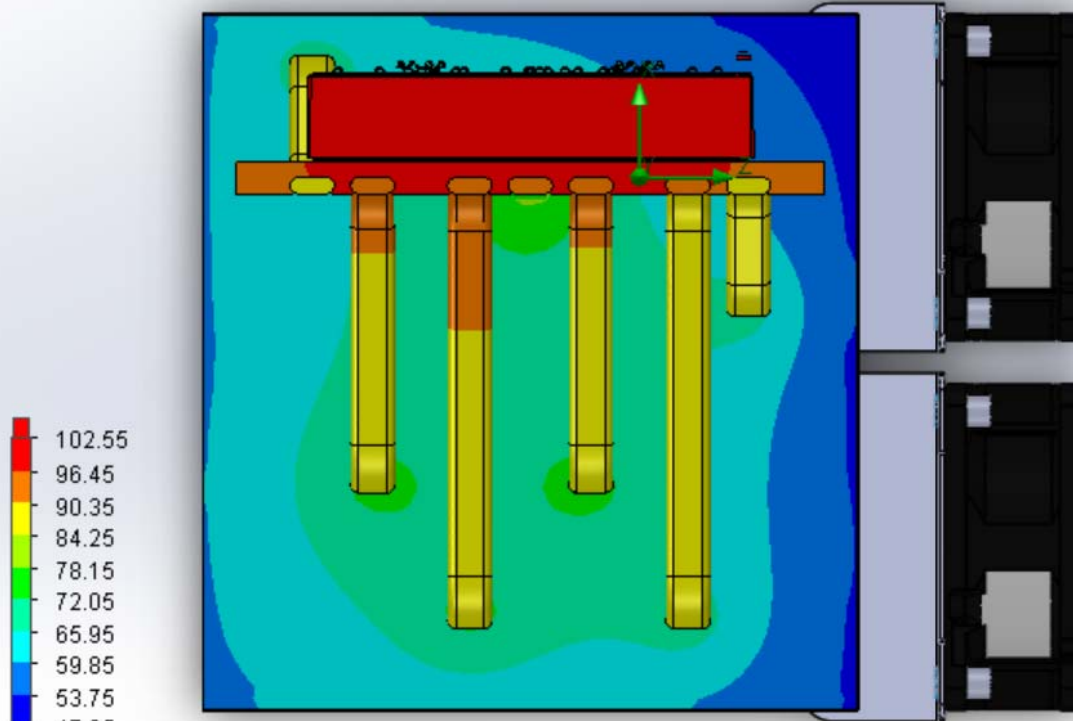
The stabilized maximum temp is  $> 80^{\circ}\text{C}$  , FAILURE .

Name	Current Value	Progress	Criterion	Averaged Value
VG Av Temperature (Solid) IGBT	101.203 °C	Achieved (IT = 118)	1.68138 °C	101.133 °C
VG Max Temperature (Solid) IGBT	102.561 °C	Achieved (IT = 118)	1.60121 °C	102.491 °C



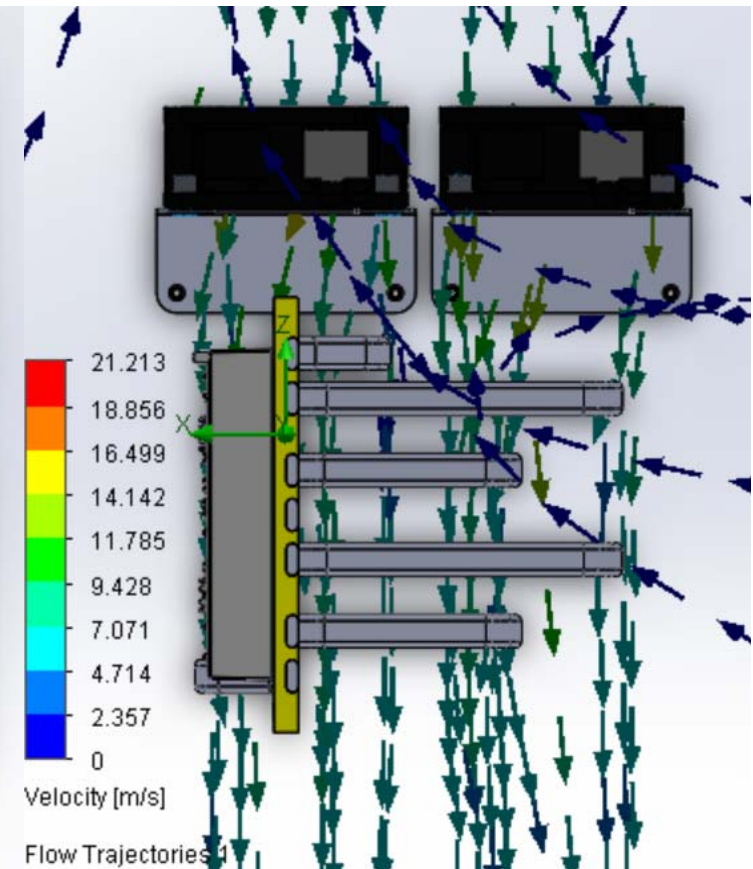
## Analysis – Thermal Ranging (B3)

▲ Maximum temp = 102.6°C.



Temperature (Solid) [°C]

Surface Plot 1: contours



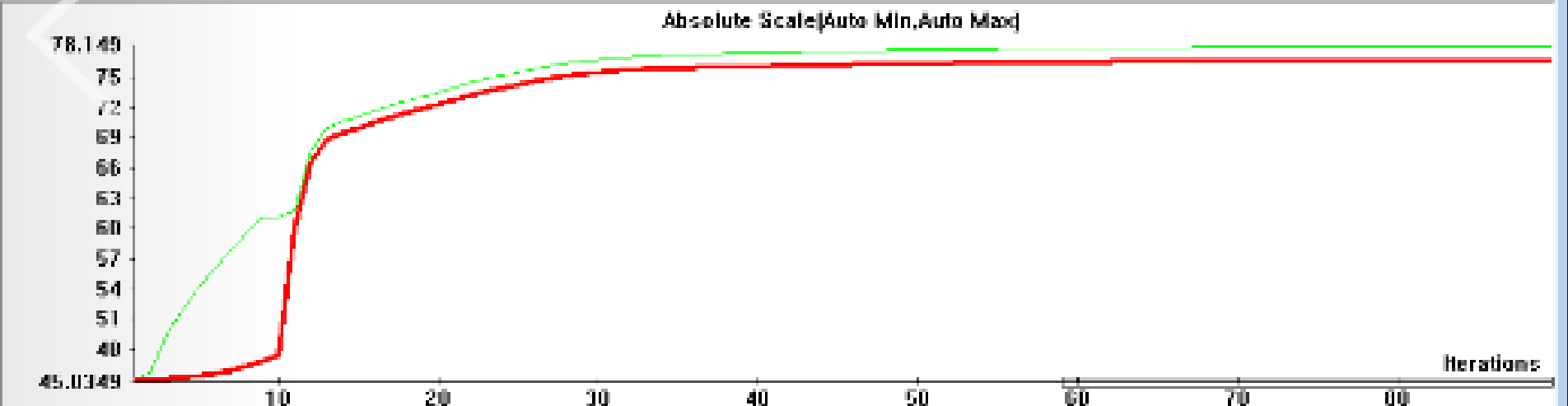
Velocity [m/s]

Flow Trajectories

# Analysis – Temp Profile (B4)

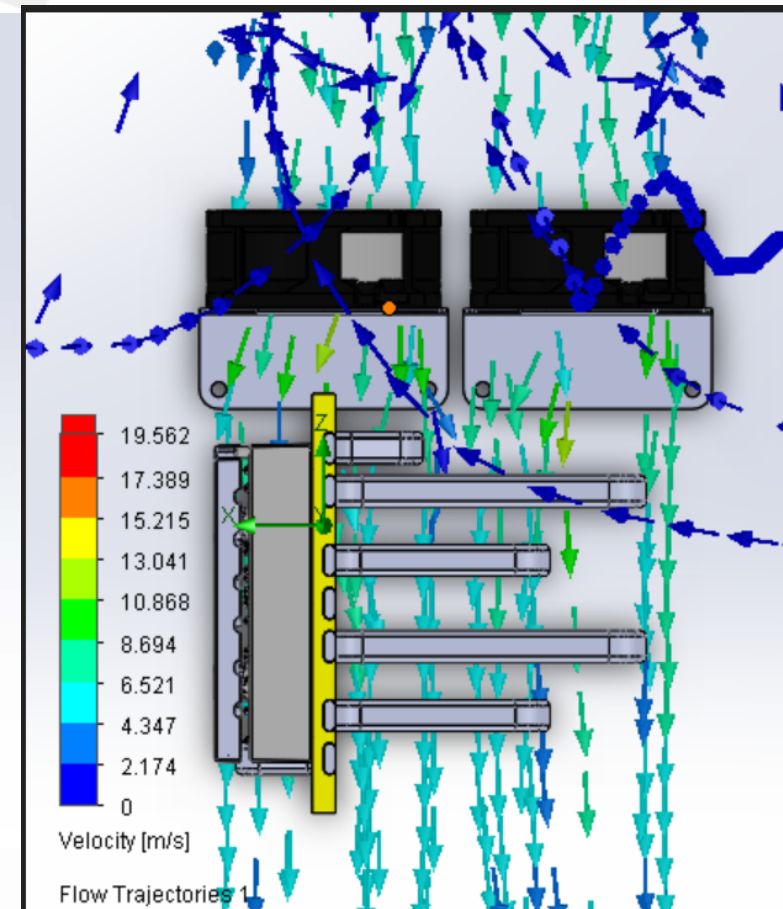
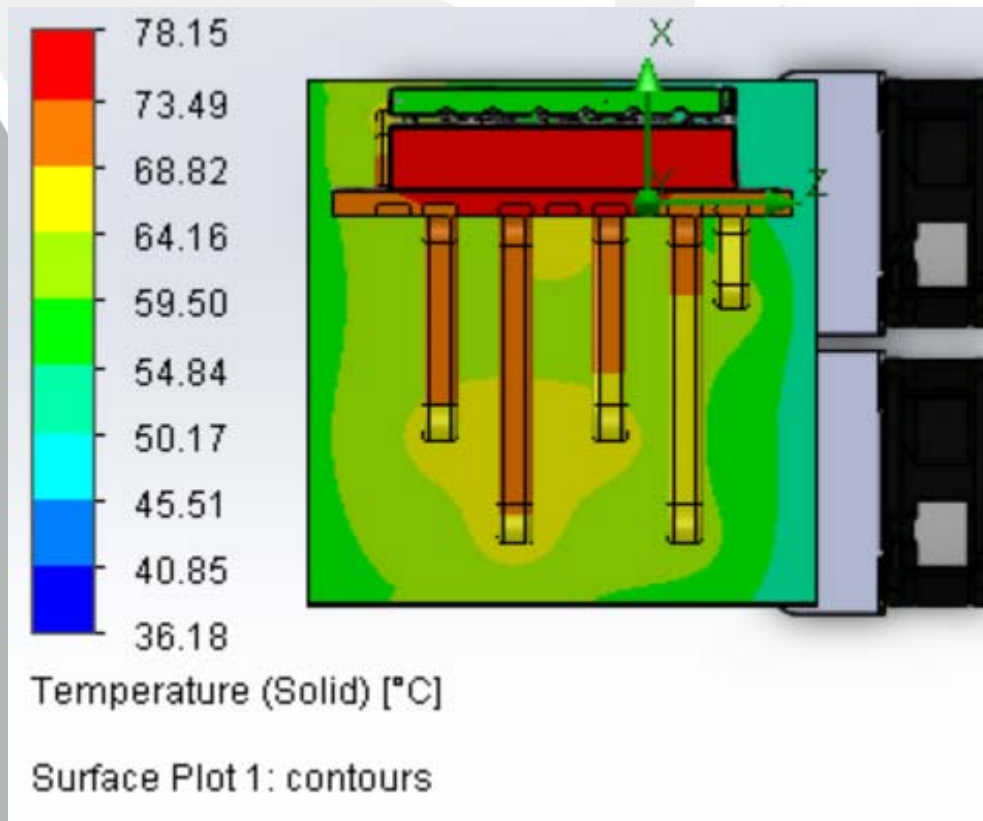
The stabilized maximum temp is  $< 80^{\circ}\text{C}$  , **PASSED** .

Name	Current Value	Progress	Criterion	Averaged Value
WG Av Temperature (Solid) IGBT	76.8218 °C	Achieved (T = 118)	0.948824 °C	76.7557 °C
WG Max Temperature (Solid) IGBT	78.149 °C	Achieved (T = 118)	0.851053 °C	78.0811 °C



## Analysis – Thermal Ranging (B4)

▲ Maximum temp = 78.10°C.



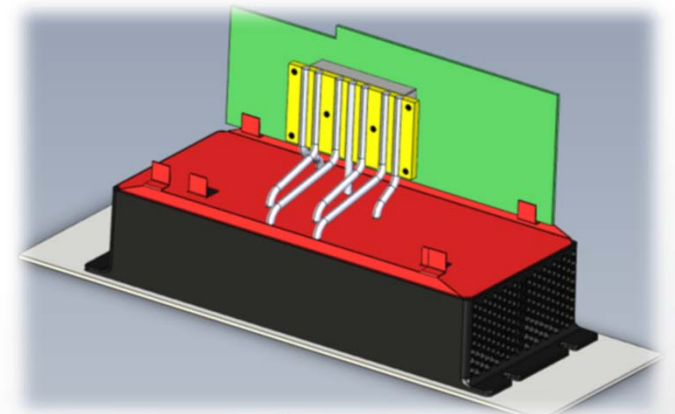
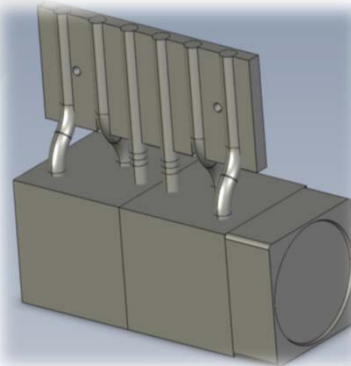


# Conclusion

After optimizing previous design we've proposed in the March of 2020, meanwhile considering resolving the additional request in 430W IGBT, it's sincerely suggested to consider the latest design as optimized (see more details as Test A4 & B4) to get the best thermal effect as you expect in Tcase and ambient temperature as needed.

Here's the kind reminder that each component in this module could more or less affect overall performance, but the key is how to perfectly integrate all parts into module in highest efficiency in heat dissipation. Generally, there'd be 20~25% difference between simulation and real products, but our simulations could make it no more than 20%, even less, based on preciseness of conditions been given.

Thank you.  
**REGO Thermal Design Team**





**THANK YOU!**  
OUR TEAM IS COMMITTED TO PROVIDE  
QUICK RESPONSE AND PRO-ACTIVELY  
ASSIST OUR CUSTOMERS

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