Application of Top-Side-Cooling Package in Power Semiconductor

Hunan Sanan Semiconducotr

Chen Yao

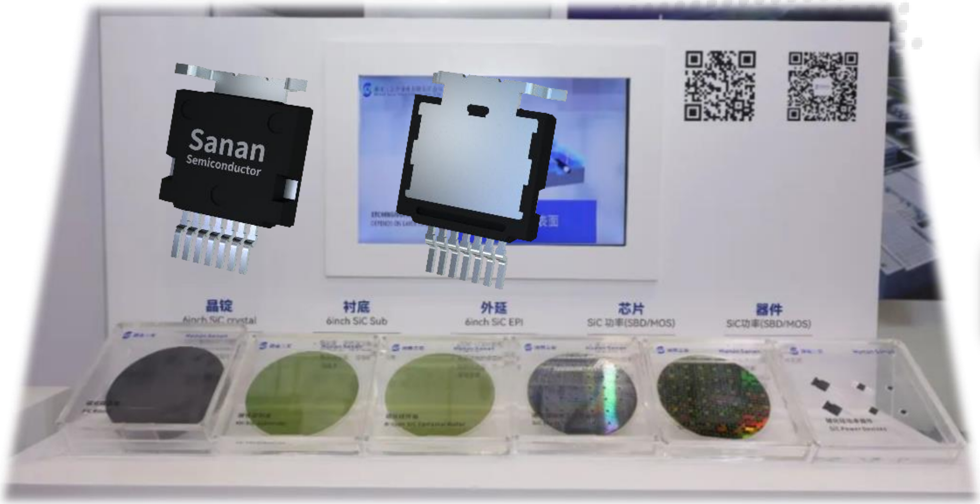
Yapo XU Jianshan Zhang

AN2025-P01 Rev1.1

2025/03/20

Source:Tesla Model 3

TSC & System



目 录

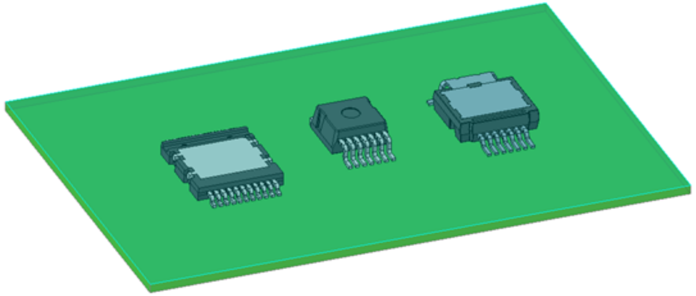
01 TSC Package Solution for Power Devices

San'an

1、Advantages and Disadvantages of SMD

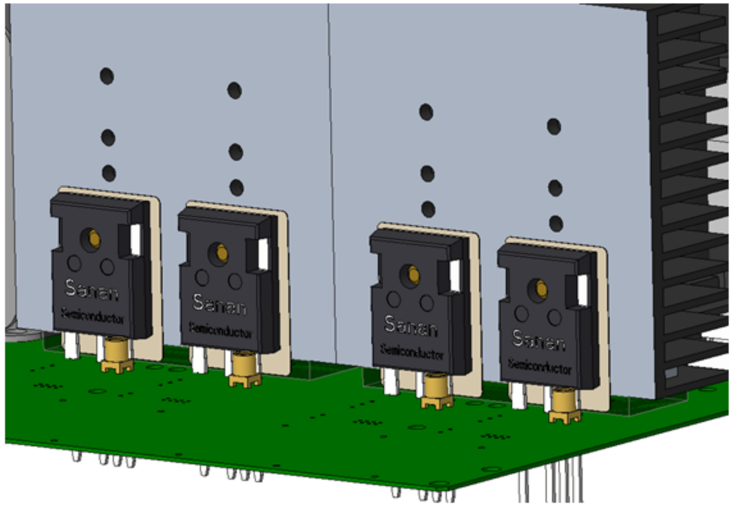
1. **Classification.** Device can generally through the SMT (Surface Mount Technology) or THT (Through-Hole Technology) be soldered to the PCB board. So we call them SMD (Surface Mount Device) and THD (Through-Hole Device) respectively.
2. **Difference in assembly.** SMD devices are characterized by their pins directly welded to the surface of the PCB, without the need to insert through the hole into the PCB.
3. **Advantages.** SMD has a smaller size, higher density and higher reliability,what’s more,facilitating the efficient automation of the SMT production line, thereby improving production efficiency and reducing costs.
4. **Disadvantages.** Traditional SMD devices are generally dissipated the power loss through the pins, the pads on the PCB or the addition of copper blocks.In the field of high-power, high-temperature may be difficult to meet the demand.

TO263-7L



SMD installation figure

TO247-4L



THD installation figure

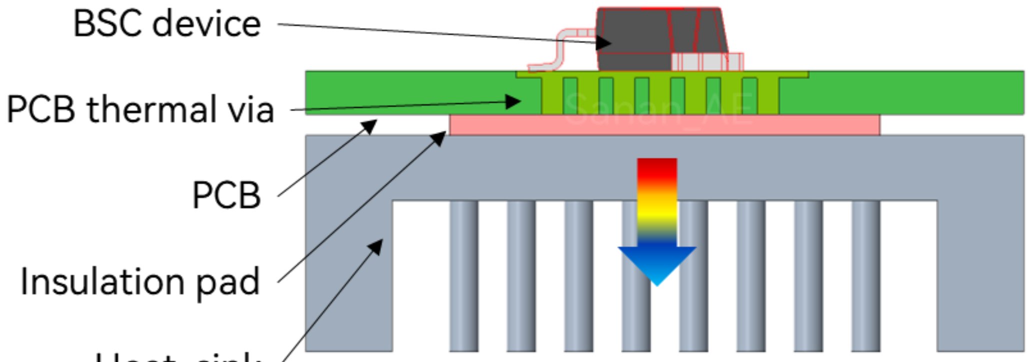
2、TSC Device of SMD

HOW TO

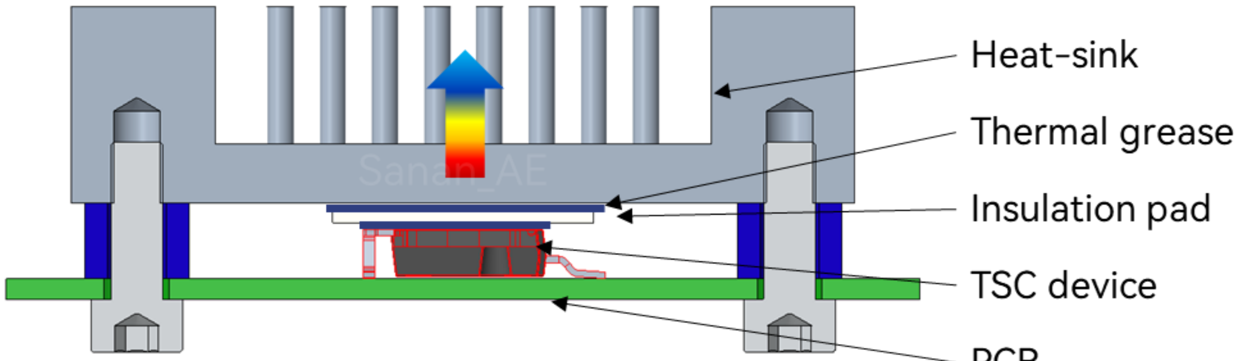
Keep the efficient assembly advantages of traditional SMD + Break through the limitations of PCB cooling capacity

Decoupling design

Change its main heat dissipation path, the back of the copper lead frame carrying the chip is changed from the bottom side to the top side, and contacts with the heat-sink, so that the direction of heat transfer is opposite to the PCB board, completely getting rid of the impact of low thermal conductivity of the PCB material. The top mounted heat-sink can be implemented in a variety of heat dissipation modes, such as natural cooling, forced air-cooling, liquid cooling, and phase change cooling. At the same time TSC devices flip the pins for the connection with PCB pads, inheriting advantages of SMD.



Traditional Bottom-Side Cooling (BSC) SMD figure



Advance Top-Side Cooling (TSC) SMD figure

3、Examples of Typical TSC Applications

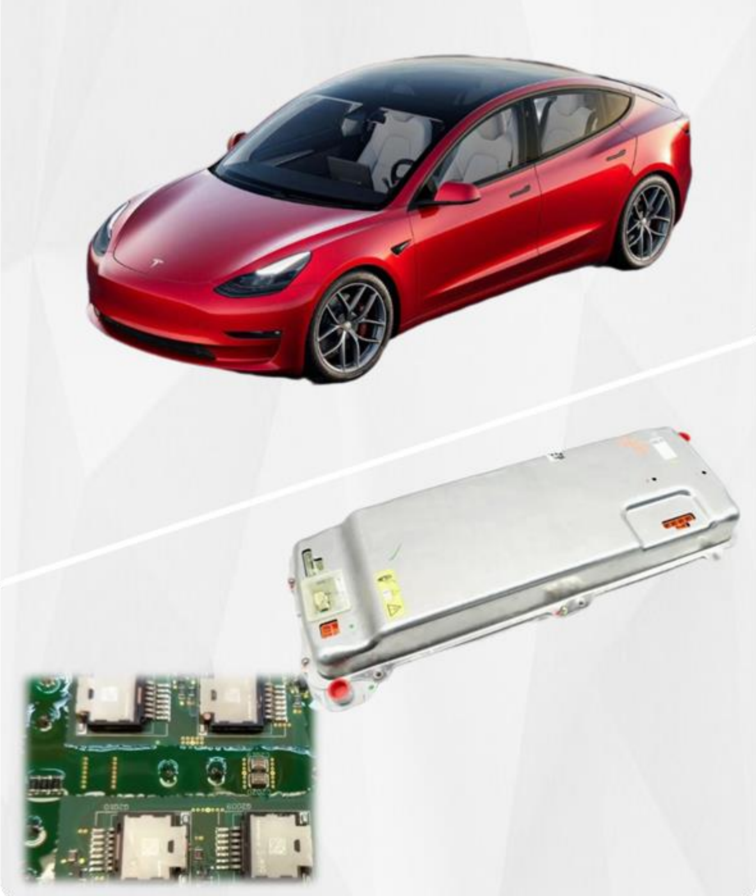
Desktop computer

High-power CPU cooled by cooling tower

Air conditional power

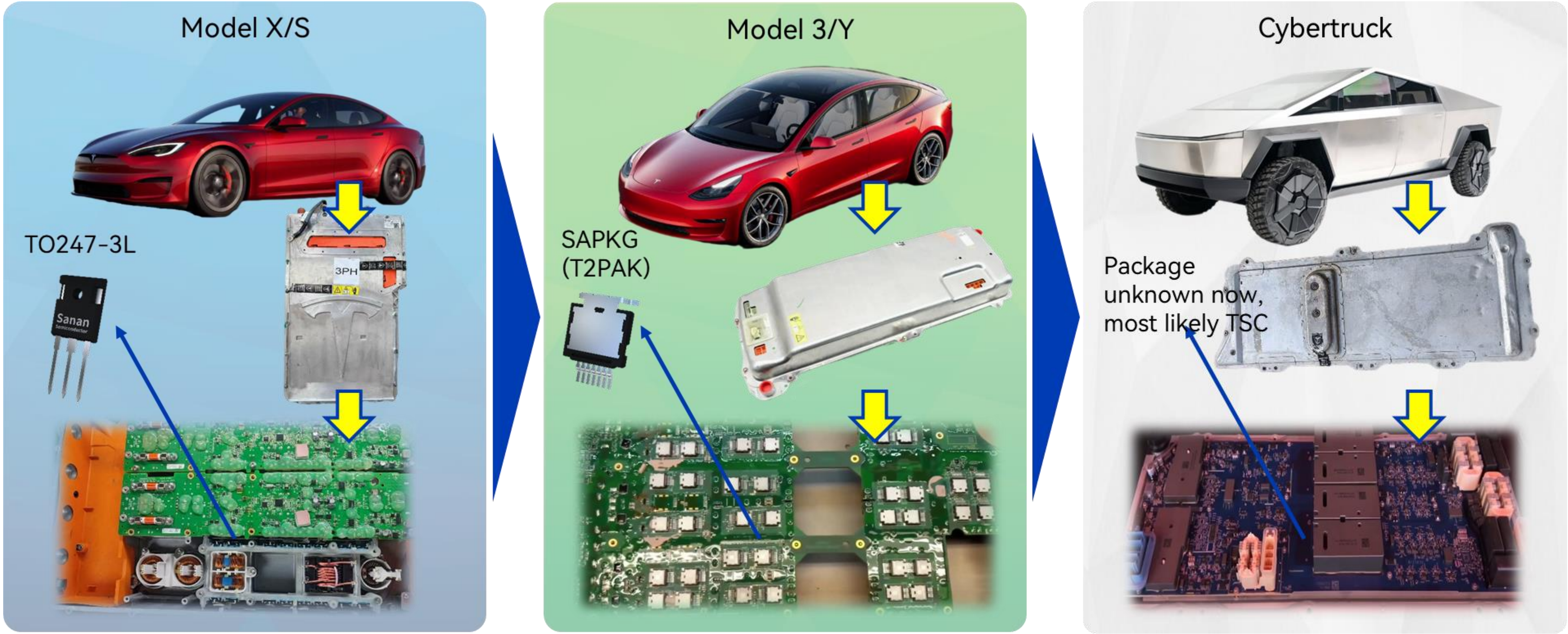
Air Conditional inverter IPM module with aluminum heat-sink

Automotive electrical system



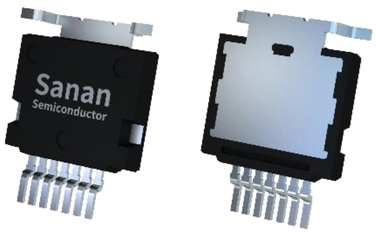
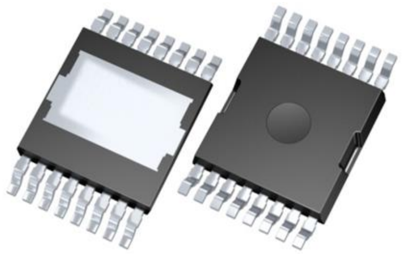
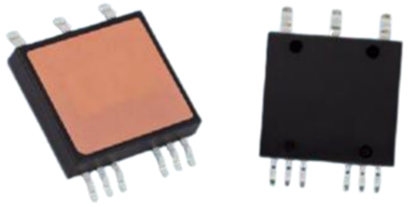
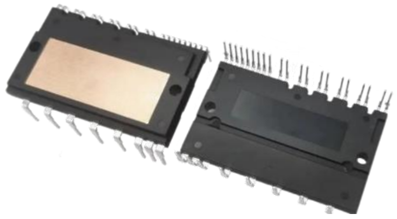
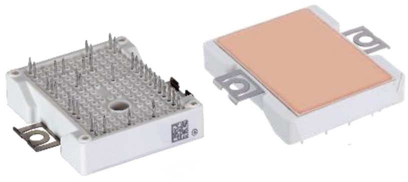
OBC and DC/DC appliaction in Tesla EV

4、Evolution of Tesla Power Conversion System



5、Several Types of TSC Devices

TSC devices are widely used in high current, high power density power converters. Both SMD and THD are available in TSC packages.

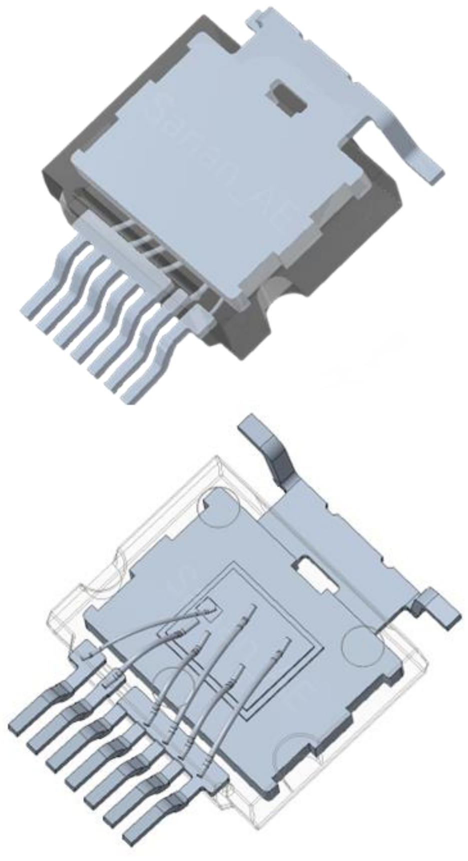
Top-Side-Cooling in SMD			THD Top-Side-Cooling in THD	
SAPKG-9L(Sanan) T2PAK(Tesla) HU3PAK(ST) TO263-9-1(Infineon)	MO-332A（JEDEC) TOLT(Infineon)	SMIT	Three Phase IPM	Easy1B/2B/3B
				

San'an

1、Structure and Dimensions of The Package

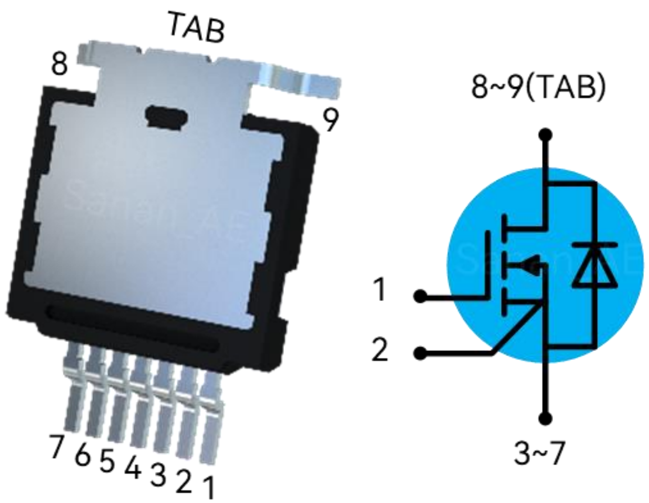
Take SAPKG-9L as an example, which is wildly used in automotive applications.

3D figure



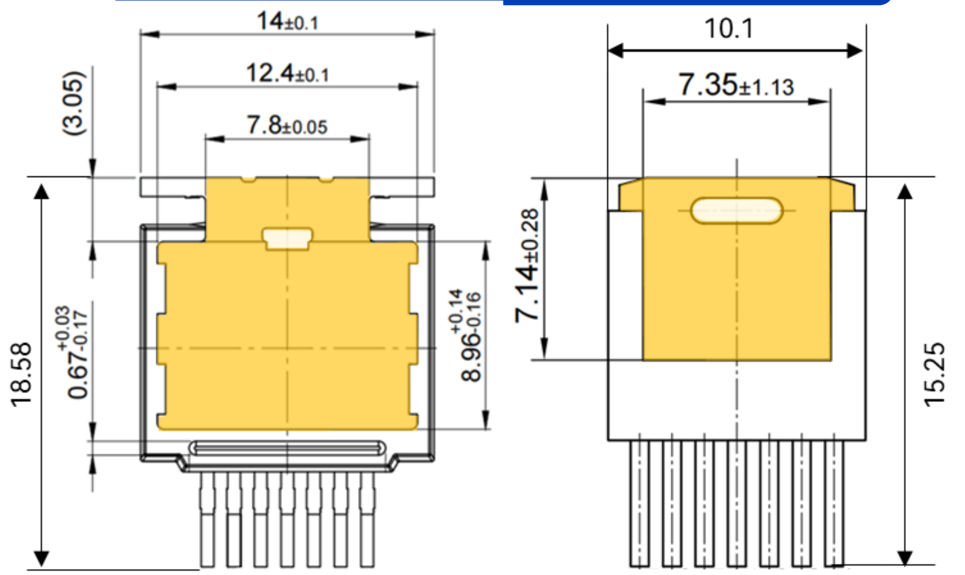
PS: Product maybe some different

Pin definitions



Pin Num.	Definition
1	Gate
2	Kelvin Source
3~7	Source
8~9(TAB)	Drain

Metal surface area on the top

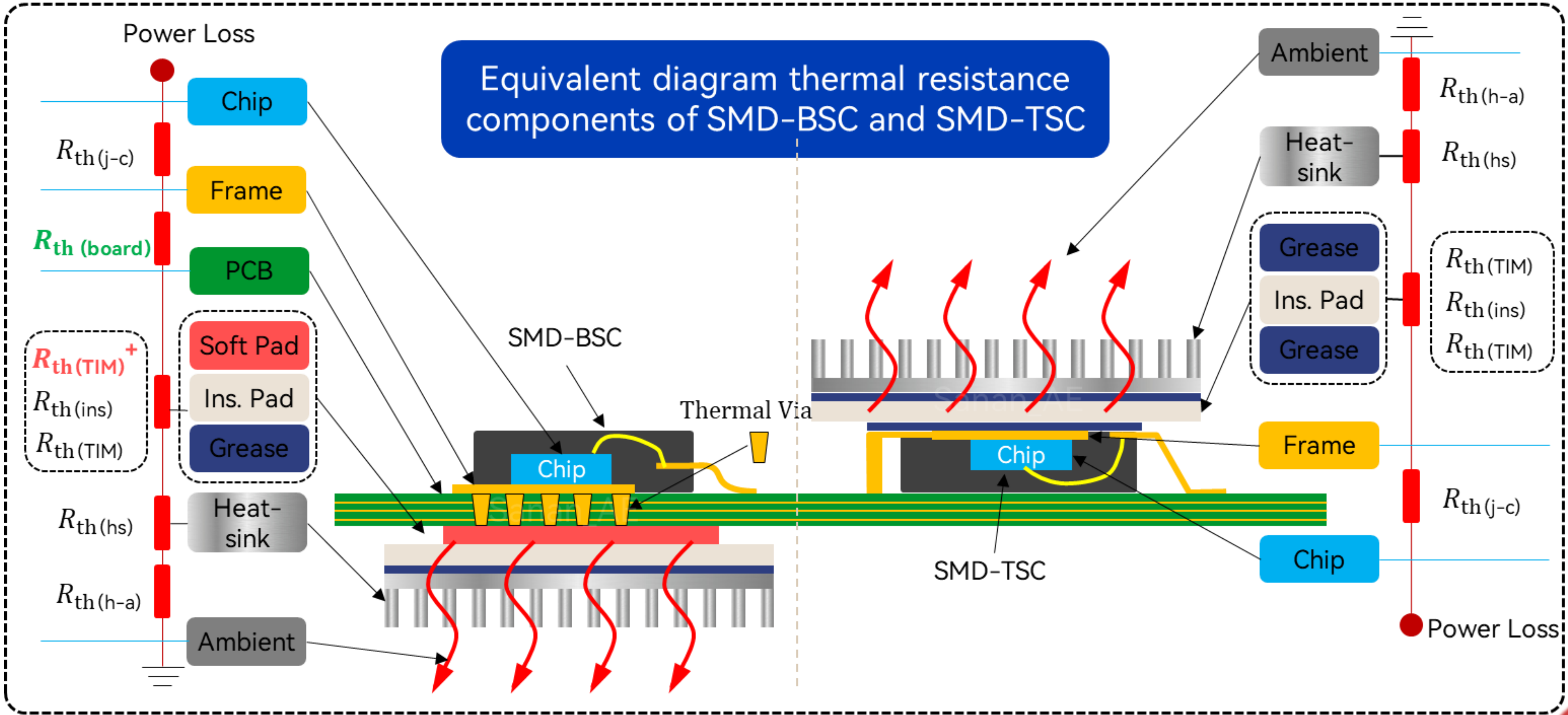


PS: Product maybe some different

Type	SAPKG-9L	TO263-7L	Comparison
Length and Width of Package	18.58x14mm	15.25x10.1mm	≈1.7x
Heat Dissipation Area	45.2mm²	23.8mm²	≈2x

San'an

2、Heat Dissipation Enhancement



Change the heat transfer path

Avoid PCB heat blocking

High-performance package expands applications

PCB design | Thermal management

$R_{th(j\text{-}a)}$ rduced

Performance

$R_{th(j-a)}$ Improved 20%

$R_{th(j-h)}$ Improved 50%

Thermal resistance components of SMD-BSC	$R_{th(j-a)} = R_{th(j\text{-}c)} + R_{th(board)} + R_{th(TIM)}^{+} + R_{th(ins)} + R_{th(TIM)} + R_{th(hs)} + R_{th(h\text{-}a)}$
Thermal resistance components of SMD-TSC	$R_{th(j-a)} = R_{th(j\text{-}c)} + R_{th(TIM)} + R_{th(ins)} + R_{th(TIM)} + R_{th(hs)} + R_{th(h\text{-}a)}$

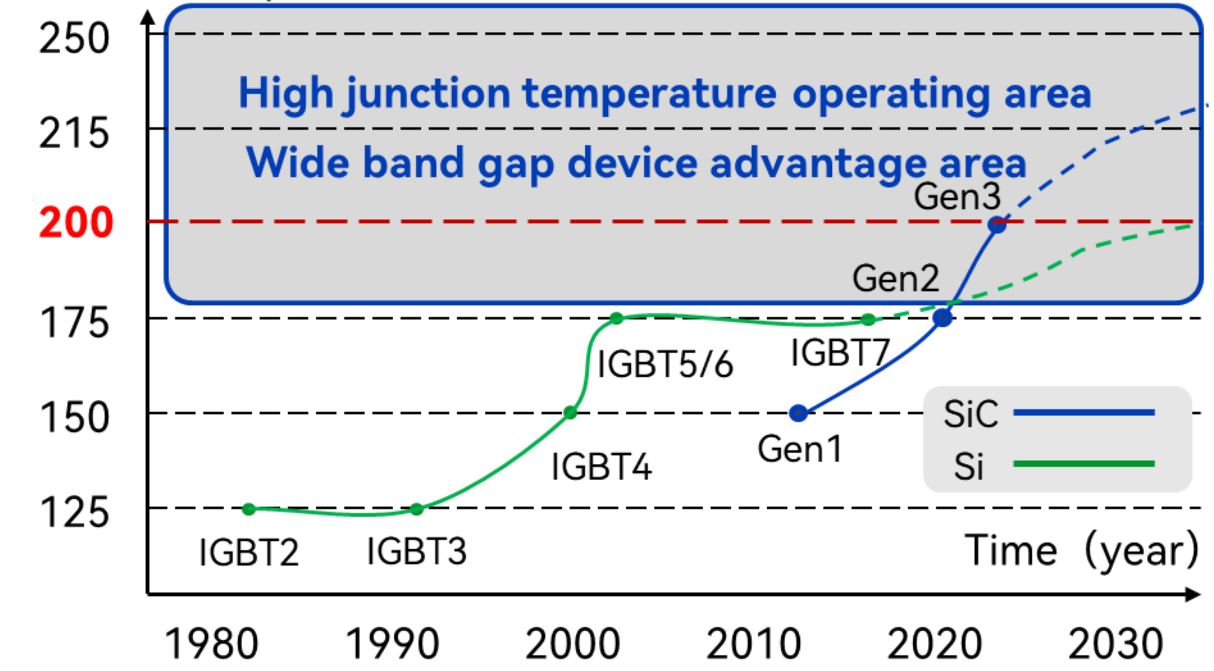
02 Application Advantages of TSC Devices

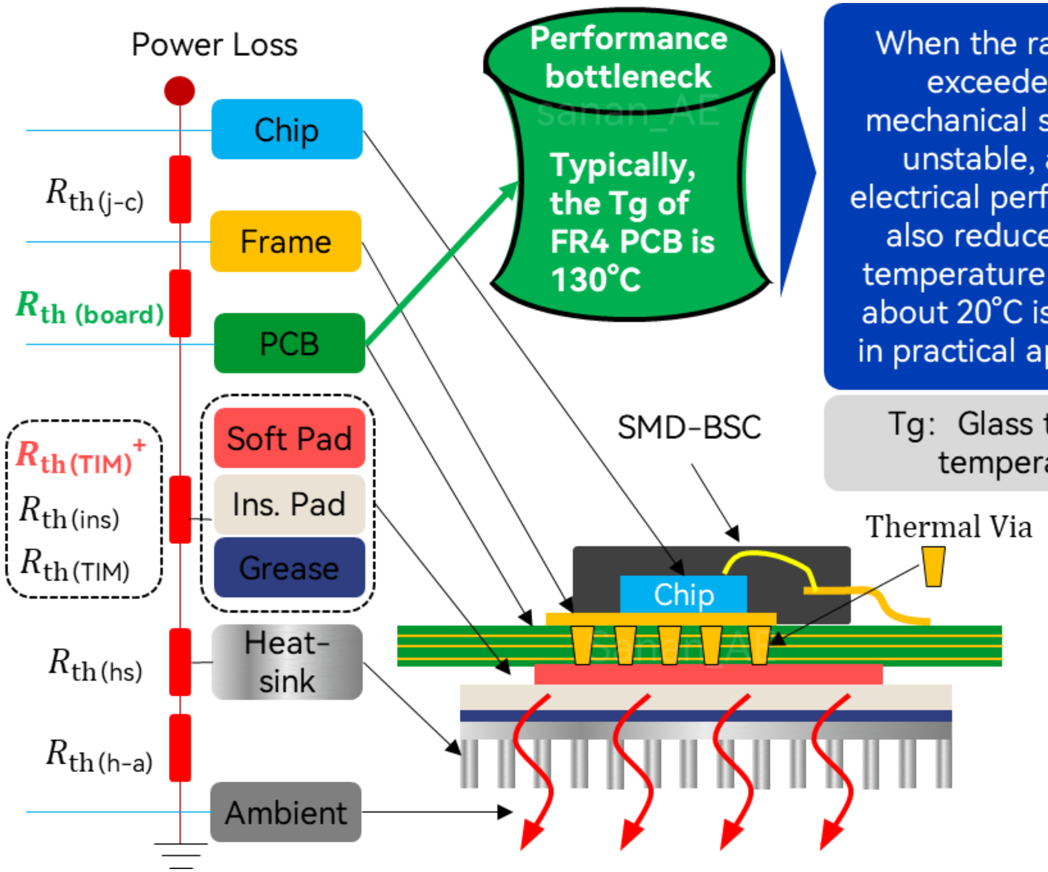
San'an

3、Make Full Performance of SiC Die

As the 3rd semiconductor material, it can operation at high junction temperature .(Theoretical 400℃ or more)

Junction Temperature (℃) **(Trend of some competitors)**

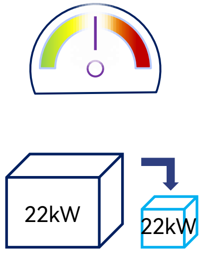




When the rated Tg is exceeded, the mechanical strength is unstable, and the electrical performance is also reduced, and a temperature margin of about 20°C is allocated in practical applications

Tg: Glass transition temperature

Now
200℃
Maximum Tj

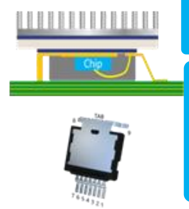


Increased overload capability

Higher power density

PCB board
≈110℃
Long-term limit

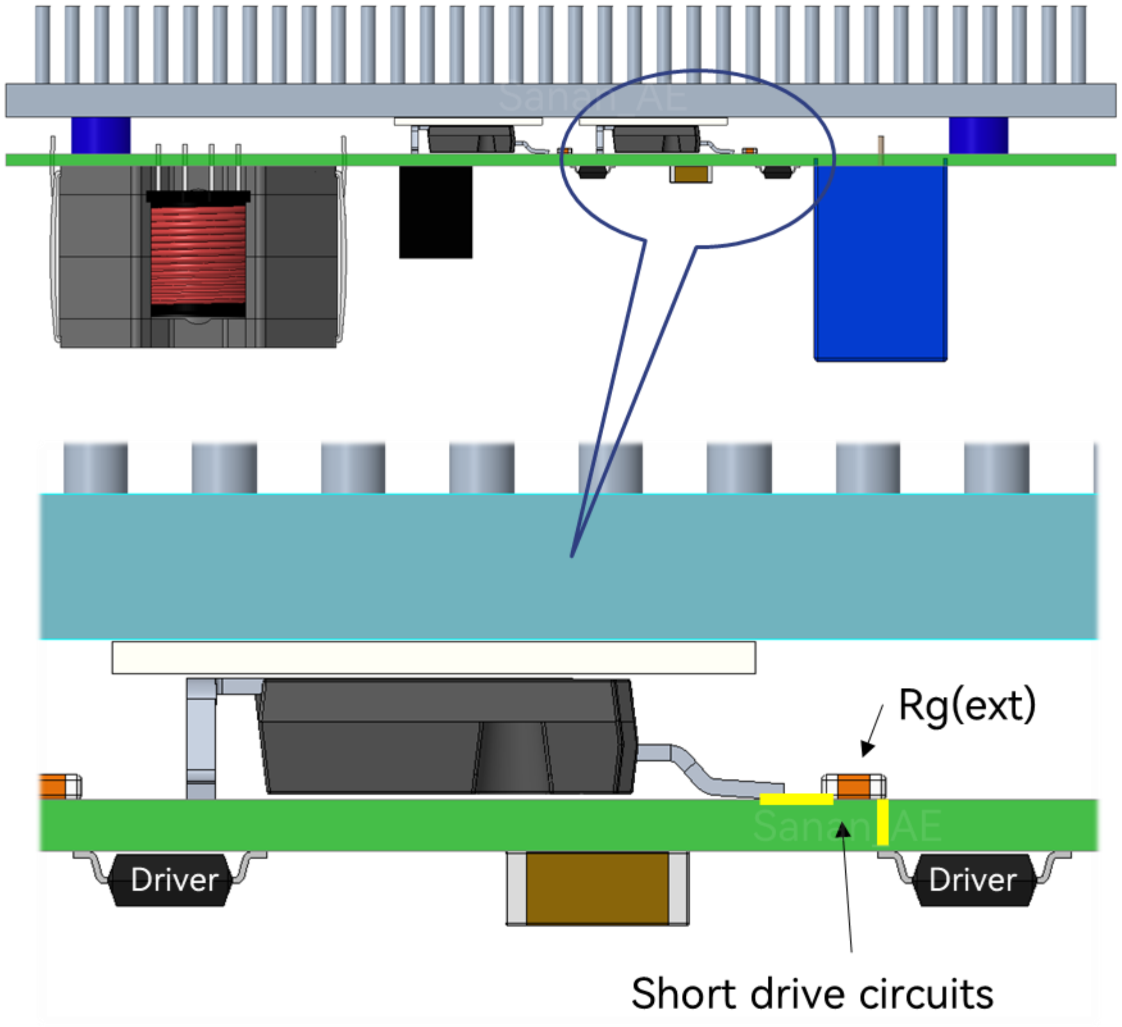
TSC Option

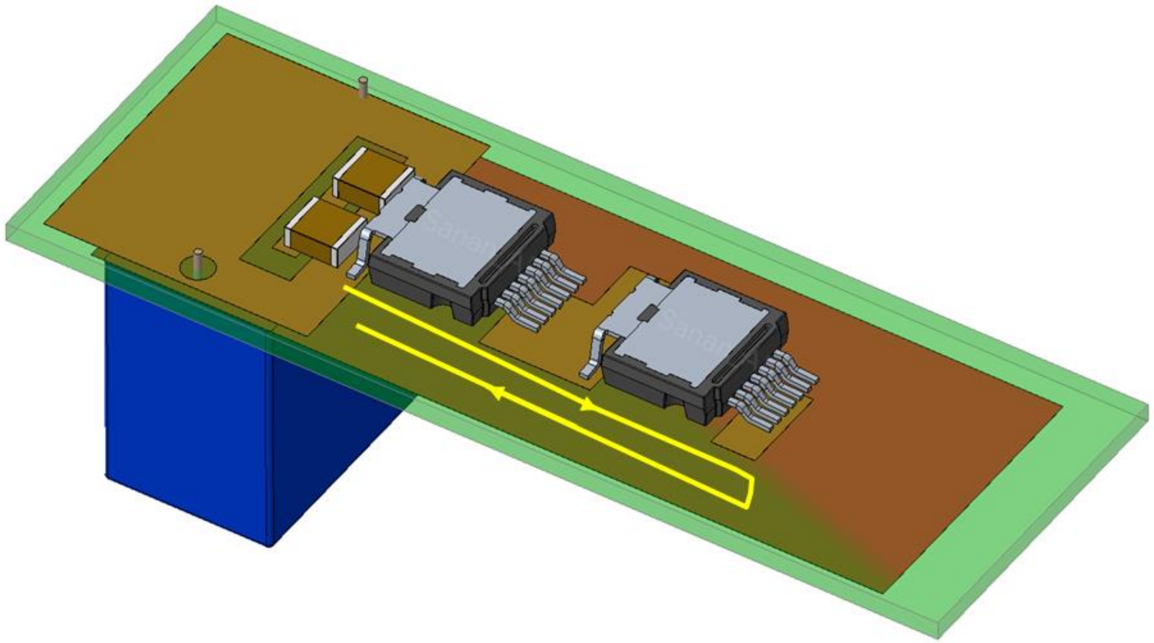


Break through bottleneck limit to make full performance of SiC die current capacity

Cancle the need for high-performance die to reduce the cost of power device

4、Short Drive Circuits, Double-sided PCB Layout, Small Power Circuit Inductance





The current return path in the bottom PCB copper layer to achieve the positive and negative bus lamination effect. Reduce the parasitic inductance of the loop and smooth the voltage spike during switching.

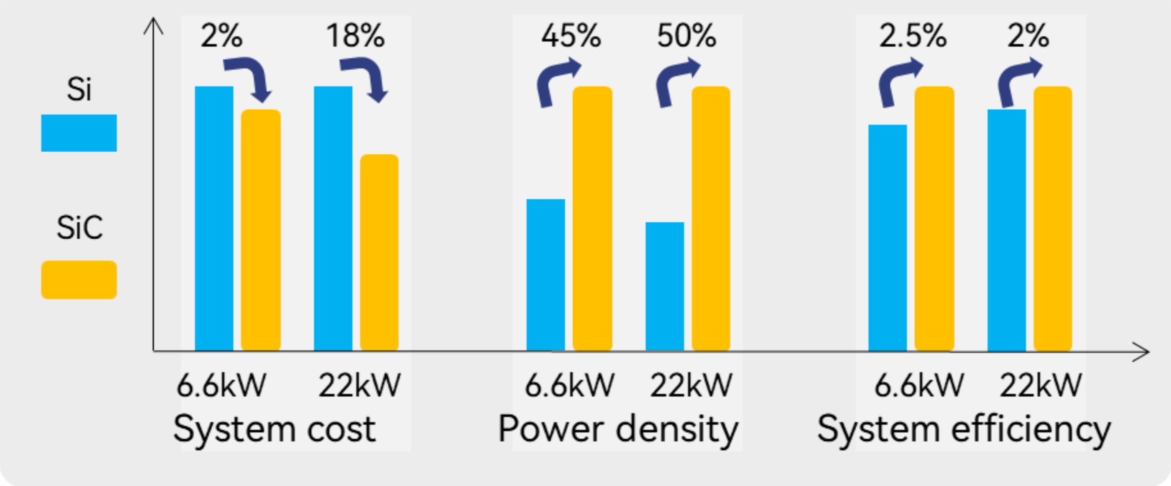
5、High Integration, High Power Density

OBC

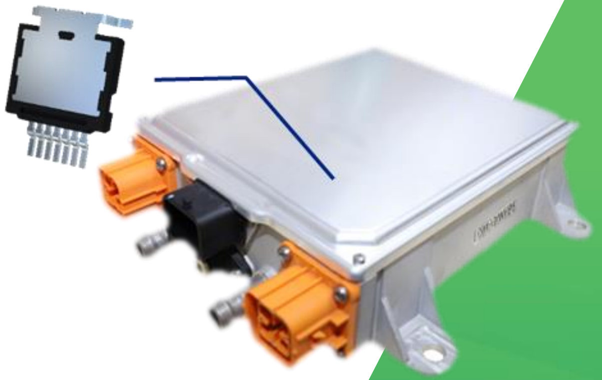
Development Trend

Power level increasing	Higher power density	Higher efficiency
3→6.6→11→22kW	22kW → 22kW	Maximum >97%

Bidirection	Support 400/800V voltage platform
V2X (V2H、V2G、V2V...)	400V & 800V



Final goal of power electronics
Higher efficiency
Higher power density



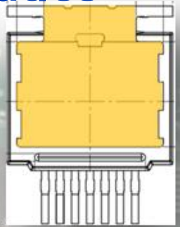
Reasonable cost
Keep product competitiveness

Solve the problem of heat Dissipation of devices in compact space

San'an

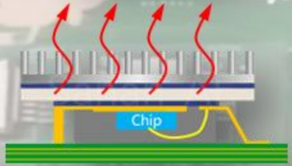
6、Summary of Advantages

2x VS TO263-7
Big or more chips



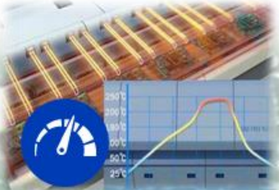
Performance

$R_{th(j-a)}$ improved 20%
$R_{th(j-h)}$ improved 50%

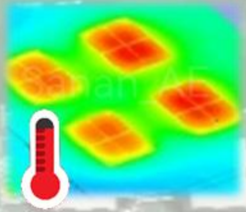


Max.operating junction temperature of SiC chip is 175~200℃

- Bigger thermal pad longer creepage distance
- Inherit efficient production of SMD
- Change the heat direction
- Make full use of layout space
- Eliminate the thermal effects of other parts
- No PCB limitation break the bottleneck
- lower Tg PCB can be used



Inheritance efficiency, High stability



Minimize thermal coupling

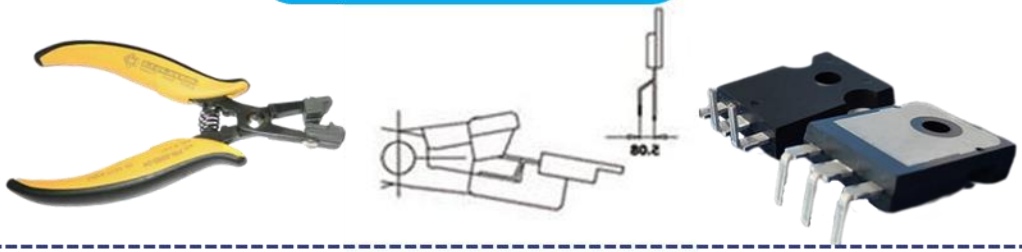
Alternative PCB Tg≈130 ℃

High productivity! High power density!
High product competitiveness

7、How to Convert Traditional THD to TSC

The device pins were bent 90°

TO220
TO247
TO251
KBP、KBL…



Applications of device pins were bent

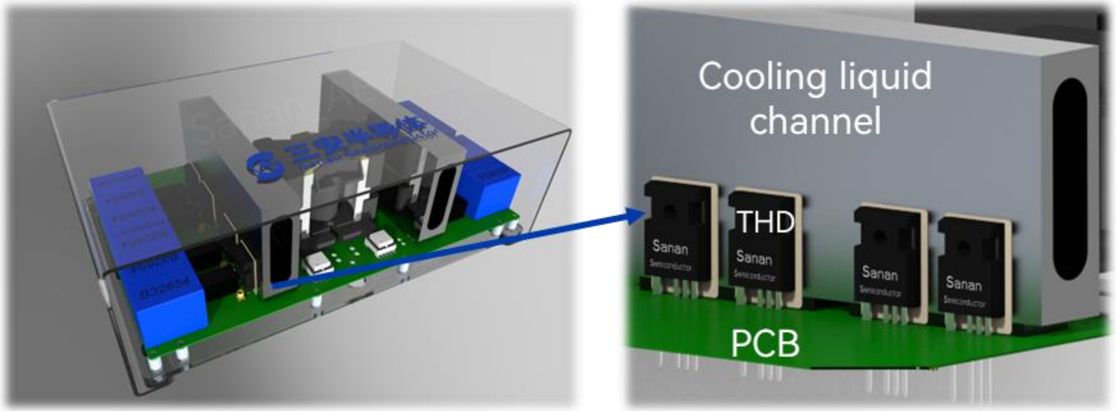
Source:Tesla Model S Gen1

EV traction inverter

Photovoltaic inverter

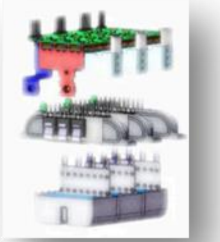
Air conditional PFC

Cooling channel or heat-sink vertical to PCB



Application where the devices were inserted vertically into the cooling wall

Source: Tesla Gen2



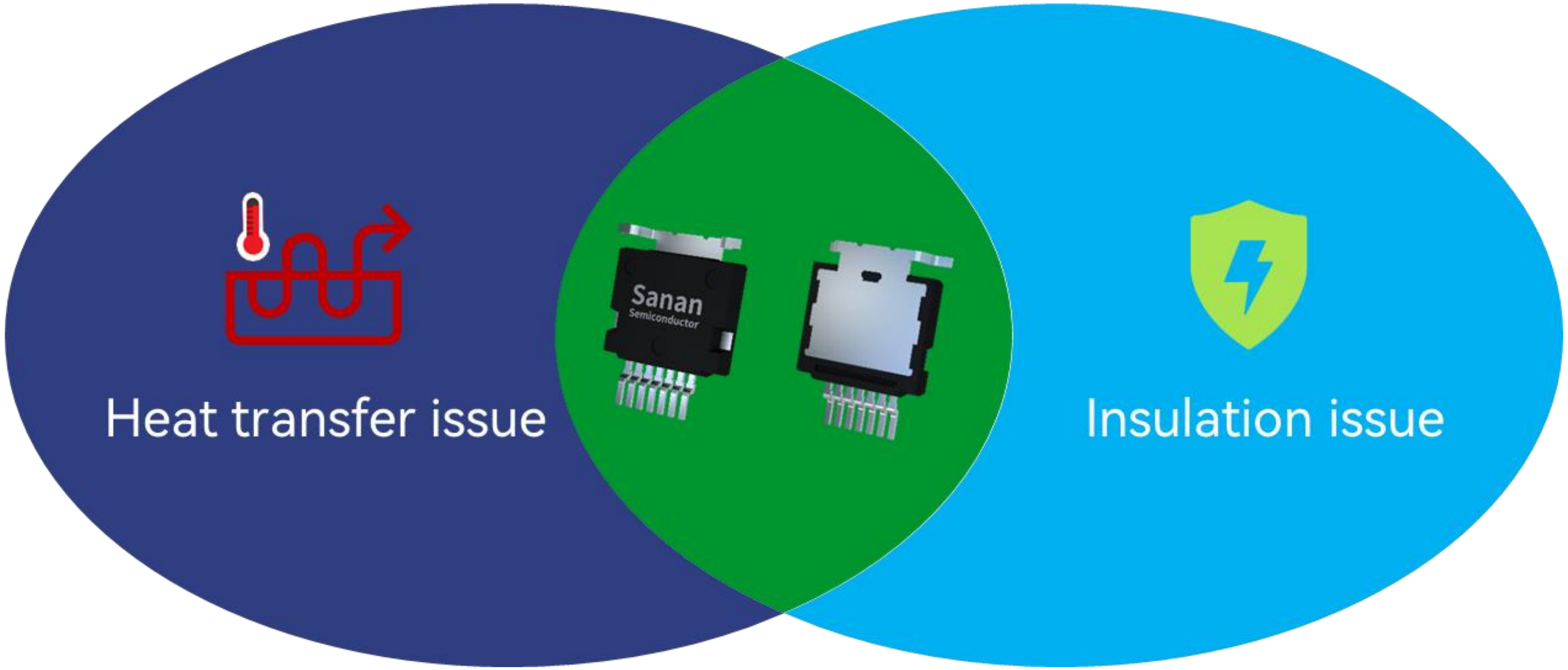
Source: Enpower

EV traction inverter

Source: Vmax

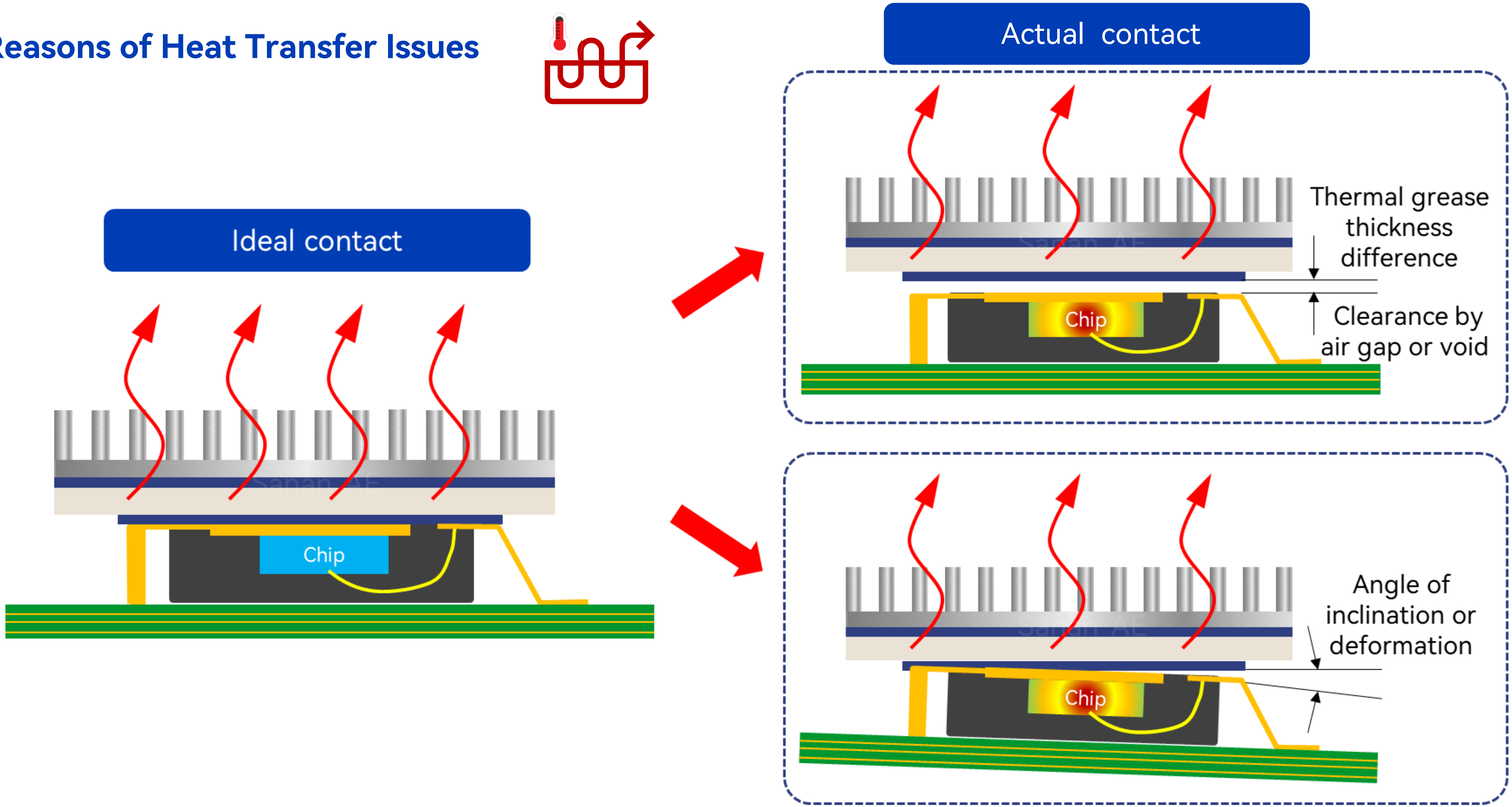
OBC or DC/DC

1、Why the Emphasis on Ensuring Reliable Application



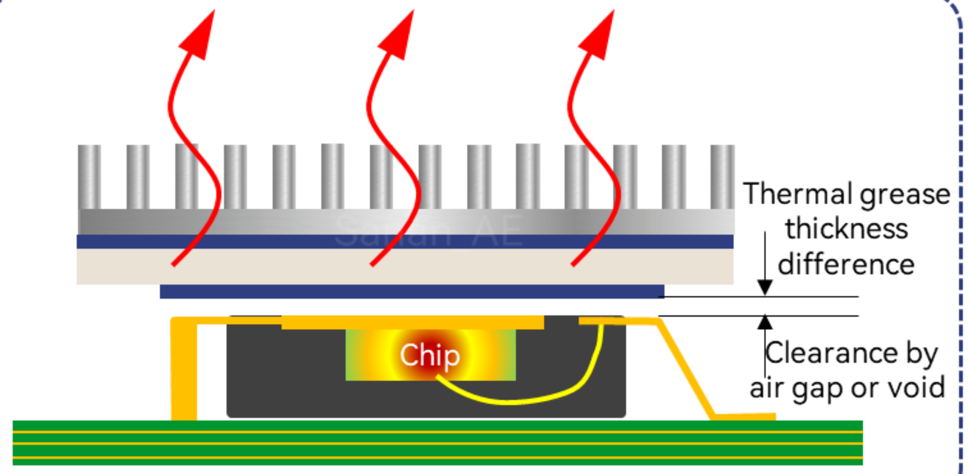
There are two issues that need to be focused on during the actual product application

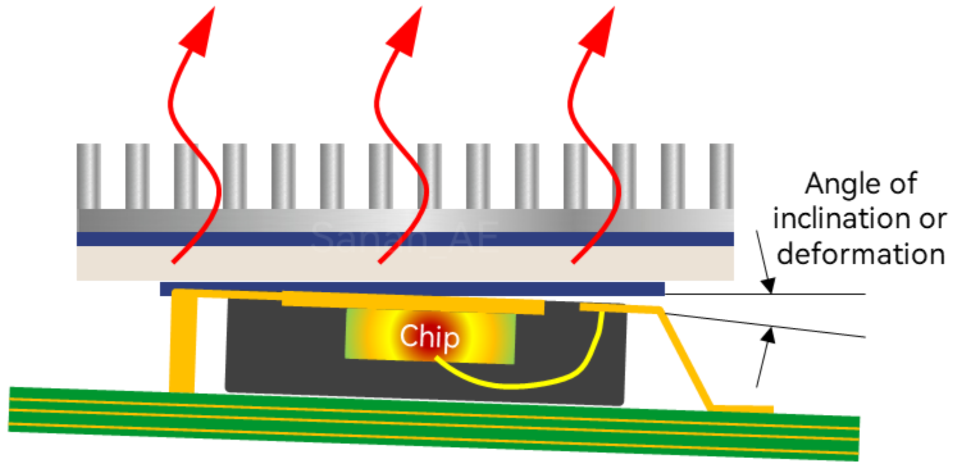
2、Reasons of Heat Transfer Issues



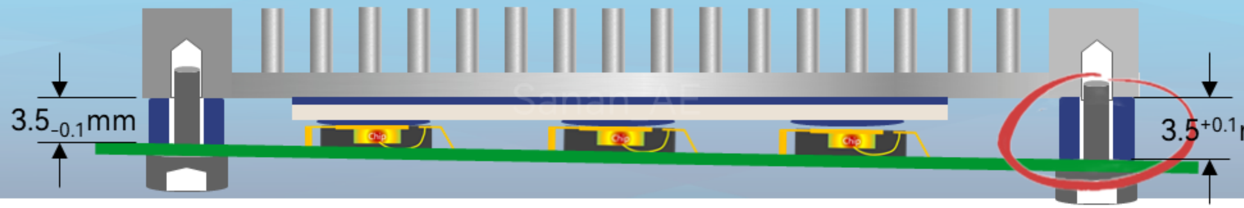
03 How to Ensure Reliable Application of TSC

2、Reasons of Heat Transfer Issues

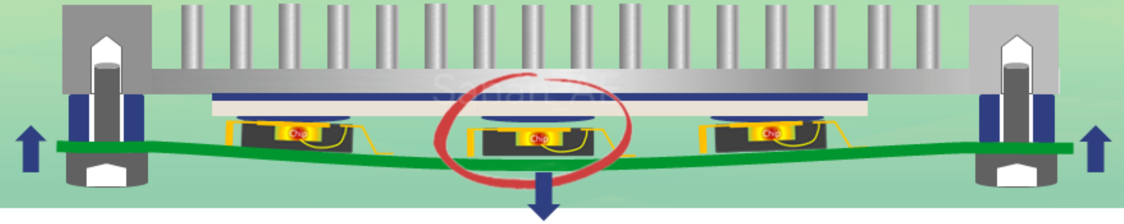




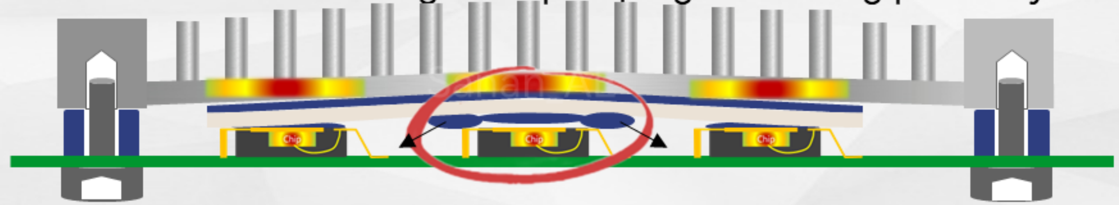
Reflow soldering and secondary assembly to fit the heat dissipation surface, makeing cumulative dimensional tolerances of each component lead to poor contact.



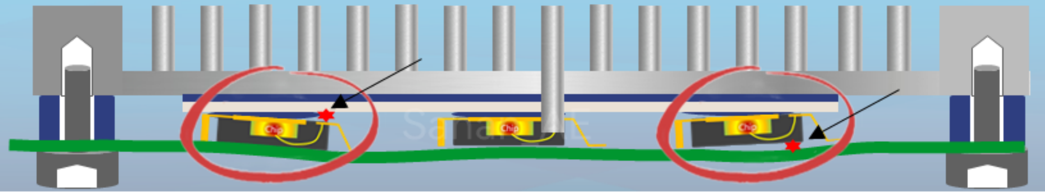
In order to keep the device close to the heat dissipation surface, the screws used to fasten the PCB will cause it to deform and bend.



Thermal deformation of PCB or heat-sink due to device or magnet heat generation, which can also lead to grease pumping out during power cycle.



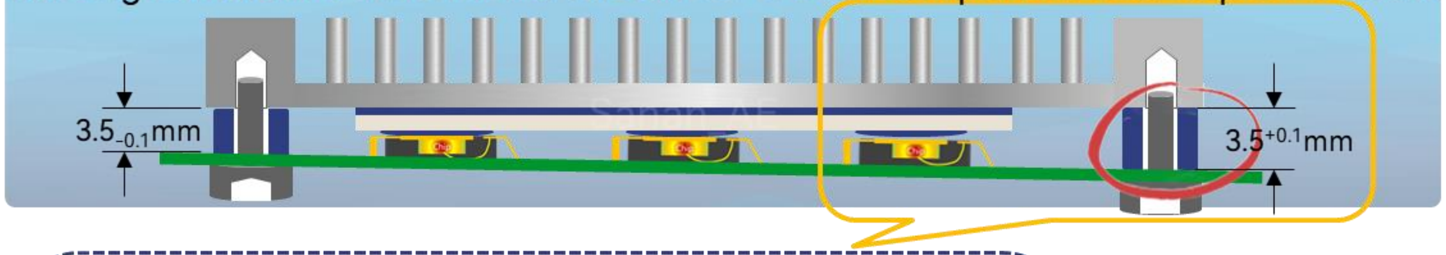
Device Inclination due to large particles of dirt on device reflow or thermal conductive contact surfaces.



San'an

3、Methods to Overcome Heat Transfer Issues

Reflow soldering and secondary assembly to fit the heat dissipation surface, makeing cumulative dimensional tolerances of each component lead to poor contact.

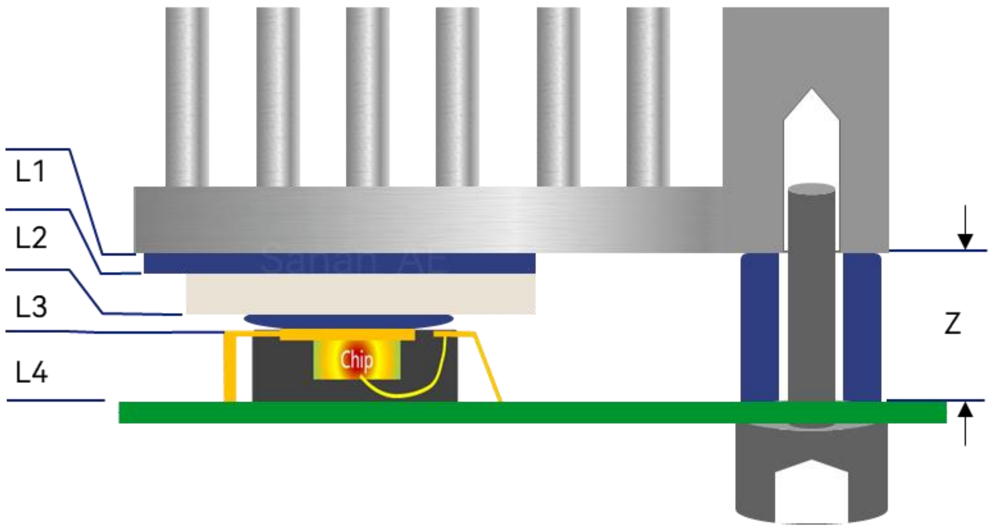


Target

Management and minimization of mechanical tolerances for excellent thermal performance.

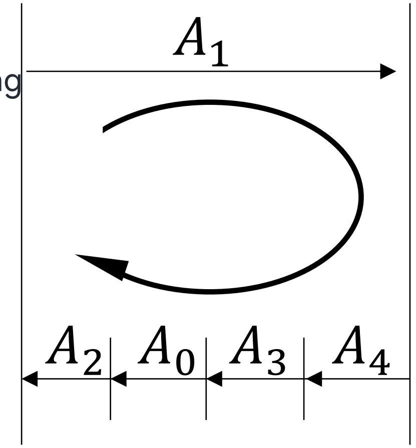
Key parts tolerance control and dimension chain calculation

Build dimension chain → Analyse dimension chain → Calculate dimension chain → Deal with dimension chain



L1-Thickness of grease 1, L2-Thickness of insulation ceramic,
L3-Thickness of grease 2
L4-Thickness of device, Z-Hight of spacer

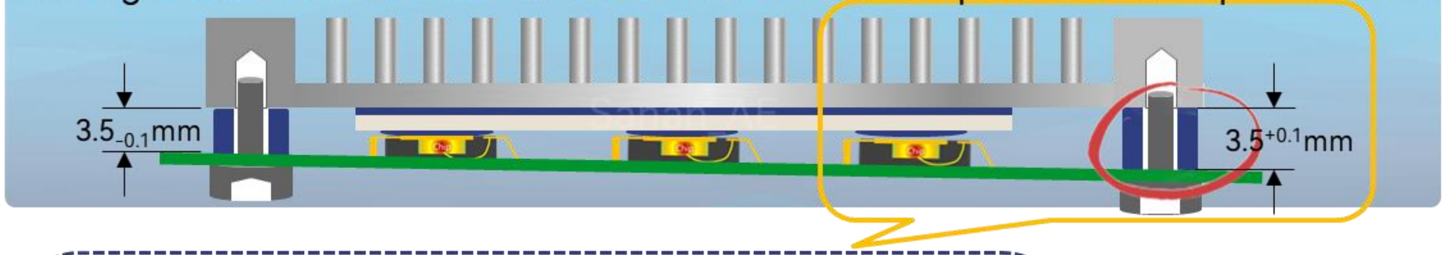
Definition. It is a closed dimensions ring formed by a group of interconnected dimensions.In engineering design and manufacturing often use the dimensional chain to make size conversion, control the tolerance of key dimensions, so as to ensure the manufacturing accuracy of the product.

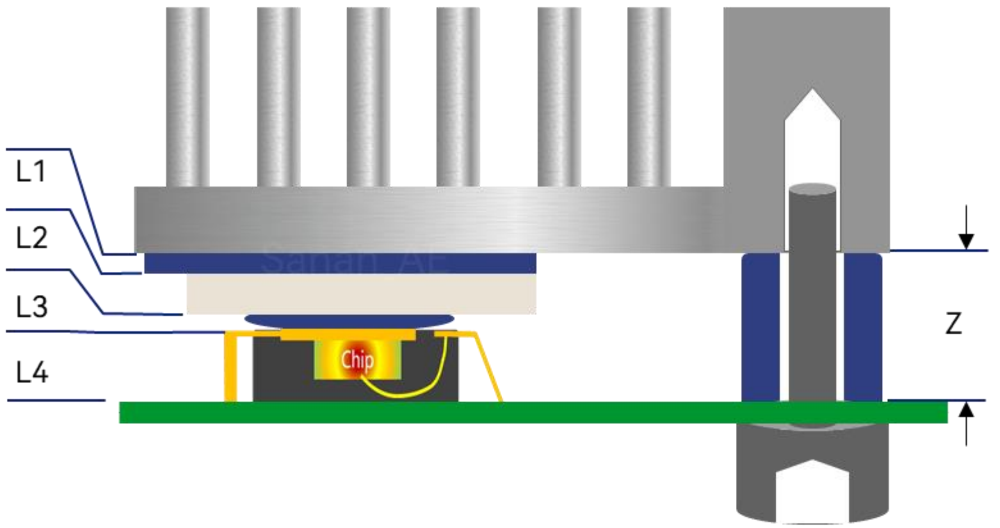


Ring . Each dimension in the chain is called a ring.
Closed-ring. The final dimension naturally formed during machining or assembly is called a closed-ring , and is noted as A_0。 Determining closed-ring is an important step in chain analysis.
Component-ring. Rings other than the closed-ring are called Component-rings and are divided into increasing-ring and decreasing-ring,which depends on their effect on the closed-ring.
Increasing-ring. The Component-ring that changes in the same direction as the closed-ring is called the increasing-ring.It means that , the one ring increases, and the size of the closed-ring increases accordingly, and is noted as $\vec{A}$ 。
Decreasing-ring. The Component-ring that changes in the opposite direction as the closed-ring is called the decreasing-ring.It means that , the one ring increases, and the size of the closed-ring decreases accordingly, and is noted as $\overleftarrow{A}$ 。

3、Methods to Overcome Heat Transfer Issues

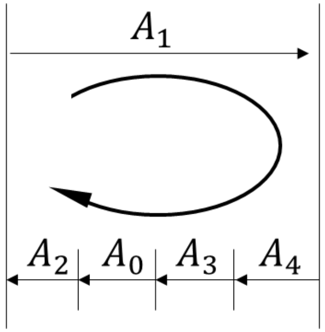
Reflow soldering and secondary assembly to fit the heat dissipation surface, makeing cumulative dimensional tolerances of each component lead to poor contact.





L1-Thickness of grease 1， L2-Thickness of insulation ceramic，
L3-Thickness of grease 2
L4-Thickness of device， Z-Hight of spacer

Tolerance control and dimensional chain calculation for key parts.



$$\text{Basic Dimension of Closed} - \text{ring}, A_0 = \sum_{i=1}^{m} \overrightarrow{A_i} - \sum_{i=1}^{n} \overleftarrow{A_i}$$

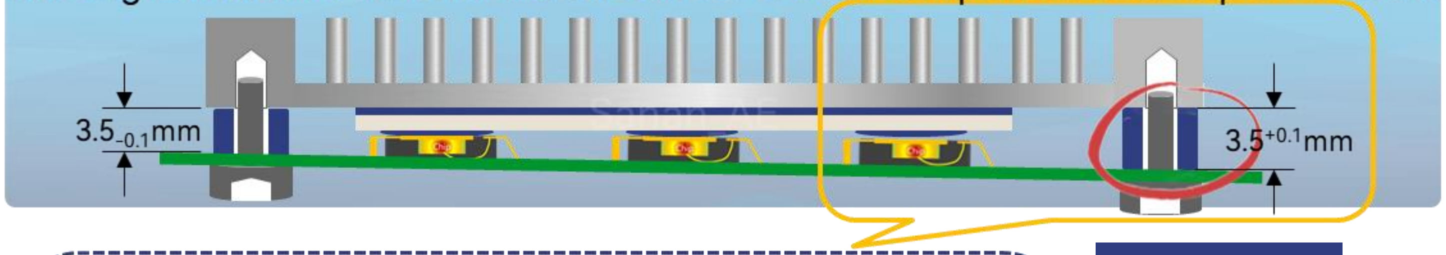
$$\text{Max. Dimension of Closed} - \text{ring}, A_{0max} = \sum_{i=1}^{m} \overrightarrow{A_{imax}} - \sum_{i=1}^{n} \overleftarrow{A_{imin}}$$

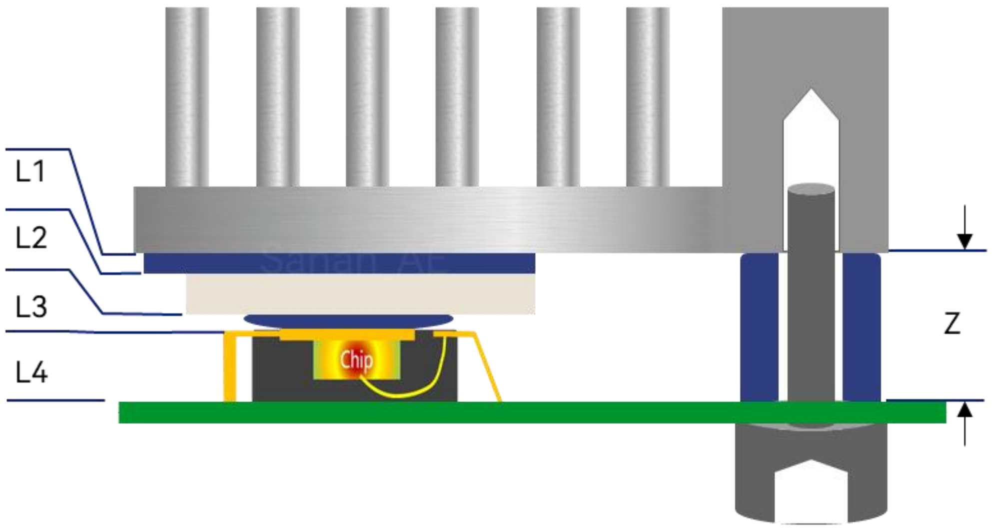
$$\text{Min. Dimension of Closed} - \text{ring}, A_{0min} = \sum_{i=1}^{m} \overrightarrow{A_{imin}} - \sum_{i=1}^{n} \overleftarrow{A_{imax}}$$

m→Represent the number of Increasing-ring
n → Represent the number of decreasing-ring

3、Methods to Overcome Heat Transfer Issues

Reflow soldering and secondary assembly to fit the heat dissipation surface, makeing cumulative dimensional tolerances of each component lead to poor contact.





L1-Thickness of grease 1，L2-Thickness of insulation ceramic,
L3-Thickness of grease 2
L4-Thickness of device，Z-Hight of spacer

Tolerance control and dimensional chain calculation for key parts.

Definition. It is a closed dimensions ring formed by a group of interconnected dimensions.In engineering design and manufacturing often use the dimensional chain to make size conversion, control the tolerance of key dimensions, so as to ensure the manufacturing accuracy of the product.

Ring judgment

A_0 Closed-ring is L3,thickness of grease 2.
$\overrightarrow{A}$ Increasing-ring is Z,hight of spacer.
$\overleftarrow{A}$ decreasing-ring are L1, L2 and L4.

Generally，The basic dimensions and tolerances of each ring are next,
L1 → 0.075±0.025mm
L2 → 1±0.1mm
L4 → 3.5±0.1mm
Z → 4.725±0.05mm

Basic dimension of closed-ring

$$L3 = A_0 = \sum_{i=1}^{m} \overrightarrow{A_i} - \sum_{i=1}^{n} \overleftarrow{A_i} = 0.15\mathrm{mm}$$

$$\text{Max. Dimension of closed} - \text{ring}, A_{0max} = \sum_{i=1}^{m} \overrightarrow{A_{imax}} - \sum_{i=1}^{n} \overleftarrow{A_{imin}} = 0.425\mathrm{mm}$$

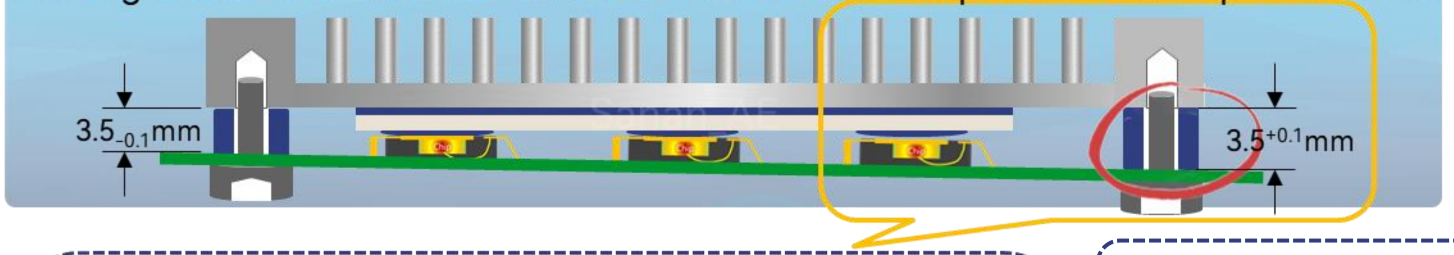
$$\text{Min. Dimension of closed} - \text{ring}, A_{0min} = \sum_{i=1}^{m} \overrightarrow{A_{imin}} - \sum_{i=1}^{n} \overleftarrow{A_{imax}} = -0.125mm$$

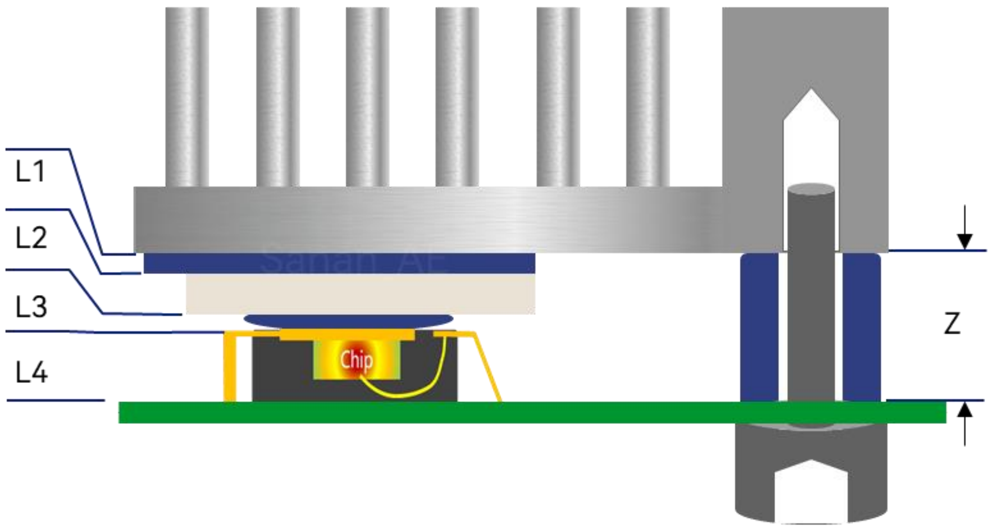
Negative dimensions appear and it is clear that the tolerance control in the general case is wrong.

San'an

3、Methods to Overcome Heat Transfer Issues

Reflow soldering and secondary assembly to fit the heat dissipation surface, makeing cumulative dimensional tolerances of each component lead to poor contact.





L1-Thickness of grease 1，L2-Thickness of insulation ceramic，
L3-Thickness of grease 2
L4-Thickness of device，Z-Hight of spacer

Tolerance control and dimensional chain calculation for key parts.

Definition. It is a closed dimensions ring formed by a group of interconnected dimensions.In engineering design and manufacturing often use the dimensional chain to make size conversion, control the tolerance of key dimensions, so as to ensure the manufacturing accuracy of the product.

If **enhance** rings tolerances control:
L1 → 0.075±0.025mm
L2 → 1±**0.05**mm
L4 → 3.5±**0.06**mm
Z → 4.725±**0.02**mm

$$A_{0max} = \sum_{i=1}^{m} \overrightarrow{A_{imax}} - \sum_{i=1}^{n} \overleftarrow{A_{imin}} = 0.295\text{mm}$$

$$A_{0min} = \sum_{i=1}^{m} \overrightarrow{A_{imin}} - \sum_{i=1}^{n} \overleftarrow{A_{imax}} = 0.005\text{mm}$$

Extremum method → L3-Thickness of grease 2=$0.15_{-0.145}^{0.145}$mm

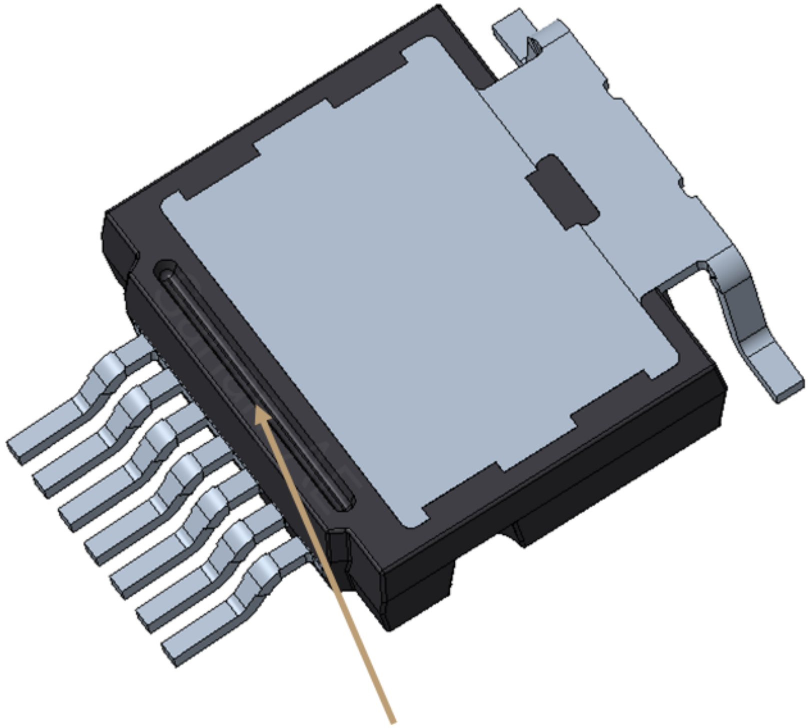
If adopt **probabilistic method,** Confidence level set at 99.73%（±3δ）"almost certain".

L3-Thickness of grease 2 =$0.15_{-0.0826}^{0.0826}$mm

In the calculation of the actual size, the height difference between the surface copper foil and the solder mask and other dimensional rings that affect the height direction should also be considered.

Q: How thick does the actual grease need to be to ensure good heat transfer?

3、Methods to Overcome Heat Transfer Issues



The groove also need to be filled with about 7.2mg

Totally at least 137.2mg,about 0.043mL，
As the size of a mung bean.
PS： In the actual application, there will be a little margin, so It's usually greater than that.

Calculation the amount of grease

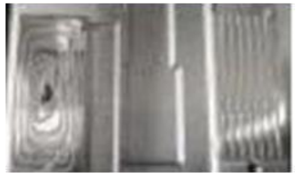
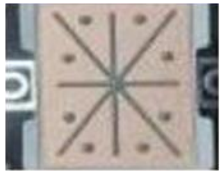
- $M_{TIM}=S_{TIM} \times T_{TIM} \times \rho_{TIM}$ (Shin-Etsu Silicones G-777 for example)
- Weight of graese=Area x Thinkness x Density
- $130mg=1.72cm^2 x 0.02326cm x 3.2g/cm^3$

Heat-sink roughness and flatness requirements

- ✓ RoughnessRa<10um （Half finish-milling)
- ✓ FlatnessFZ <10um/100mm

Reference:
2022 Electronic Intelligent Manufacturing Academic Technology Symposium.

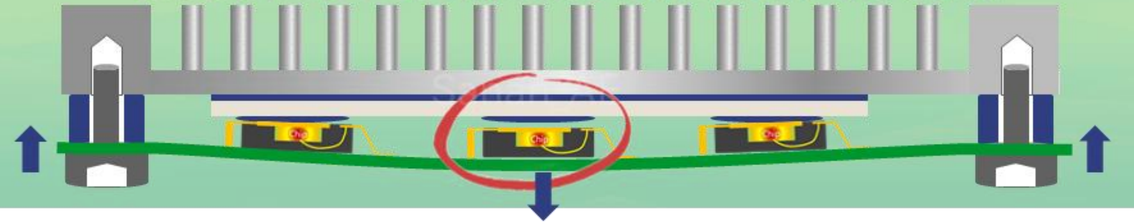
Glue dispenser comparison

	Neumatic dispensing valve	Plunger valve	Screw valve	Quantitative plunger valve
Dispensing effect				
Characteristic	Air pressure quantification, easy to plug the glue nozzle	Air pressure quantification, low accessories loss	Terminal quantification, expensive valves and high accessories loss	Terminal quantification, expensive valves and low accessories loss

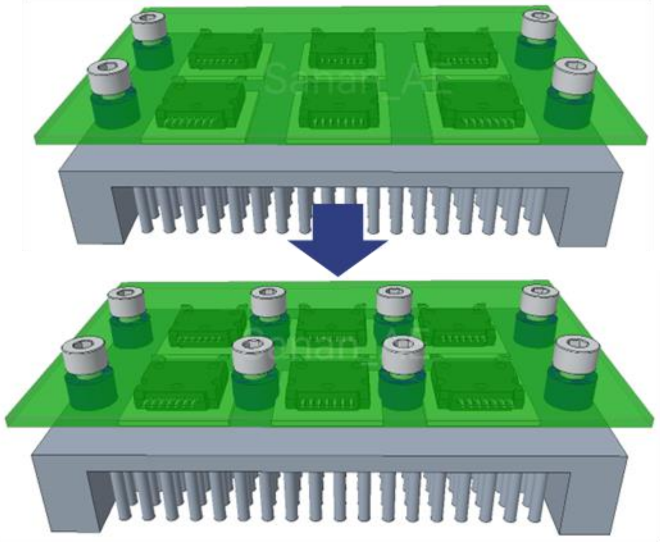
03 How to Ensure Reliable Application of TSC

3、 Methods to Overcome Heat Transfer Issues

In order to keep the device close to the heat dissipation surface, the screws used to fasten the PCB will cause it to deform and bend.

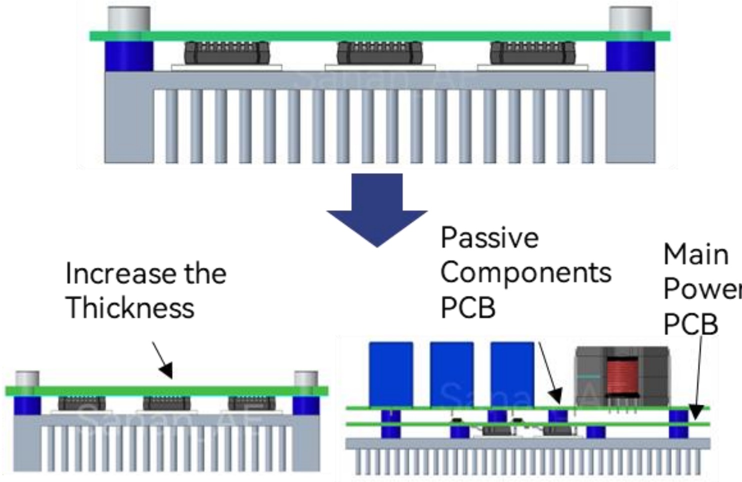


Screws are arranged to distribute the force.



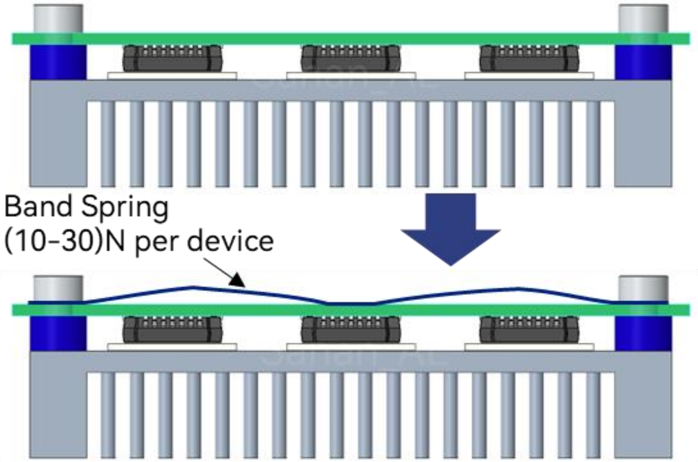
Advantage →The force on each device is uniform.
Disadvantage → Complex structure, occupy space.

Increase the thickness of the PCB board or double layer PCB layout to improve the stiffness.

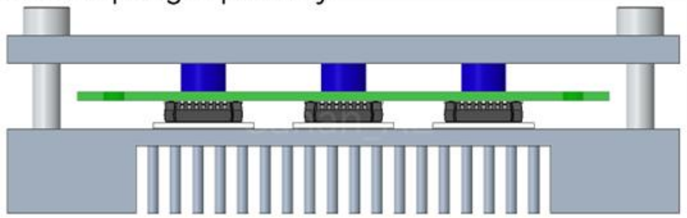


Advantage →Saves space and facilitates layout.
Disadvantage →Cost increaseing, and double-layer requirements for system layout capabilities

Set the reverse support on the other side of the device.



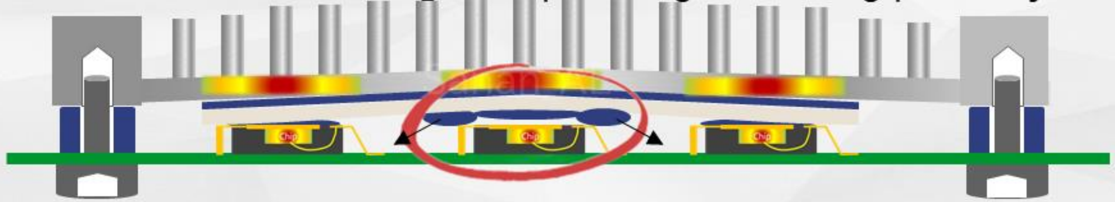
Advantage →Reduce bending and ensure a tight contact.
Disadvantage → Complex structure, occupy space. It is necessary to design and calculate the size and stiffness of the band spring separately.



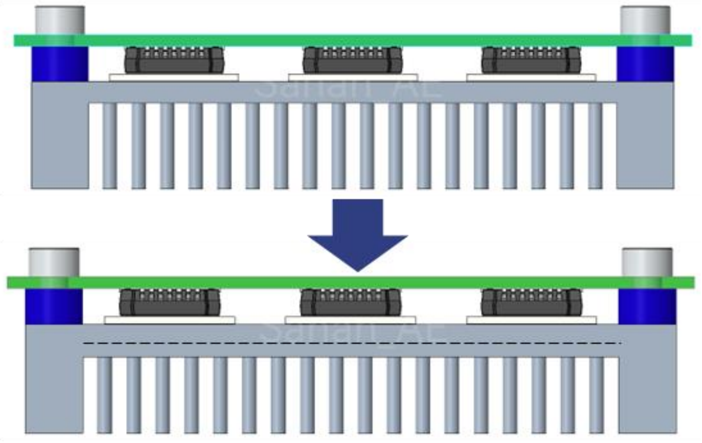
Advantage → The force on each device is uniform.
Disadvantage → Complex structure, occupy space. The support side needs to have good strength structure to against force.

3、Methods to Overcome Heat Transfer Issues

Thermal deformation of PCB or heat-sink due to device or magnet heat generation, which can also lead to grease pumping out during power cycle.

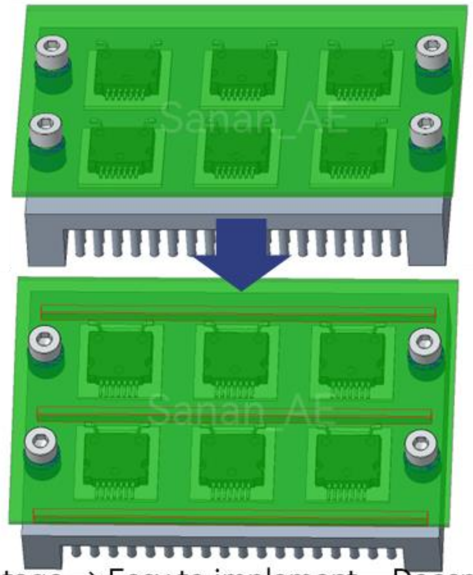


Improving the stiffness by increasing heat-sink base thickness



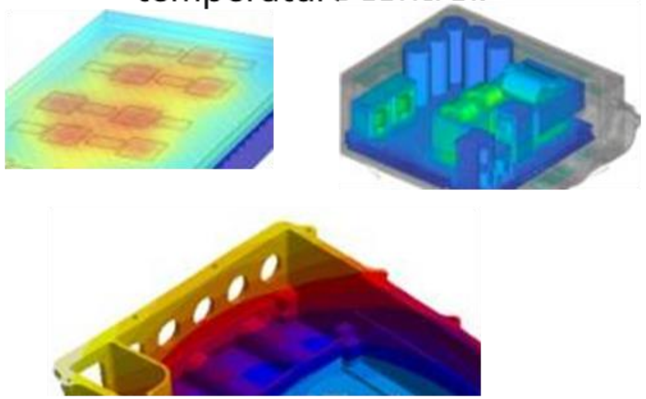
Advantage →Easy to implement,saves space and facilitates layout.
Disadvantage →The cost of heat-sink increases, and the heat dissipation effect decreases

Reinforcing ribs are added to form a skeleton



Advantage → Easy to implement， Doesn’t affect heat dissipation.
Disadvantage →Pay attention to insulation of ribs.

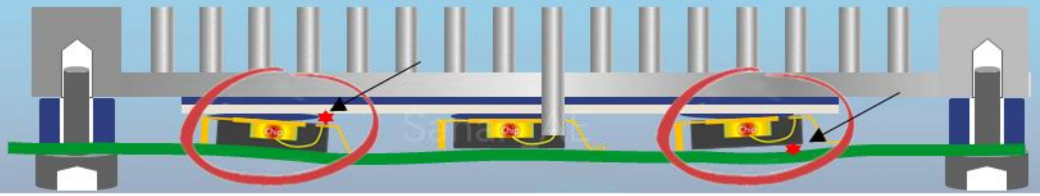
Finite element simulation is used to identify thermal deformation in advance and then optimize device distribution and temperature control.



Advantage →Forward design and optimization in advance, difficult to imitate, with technical threshold.
Disadvantage →Engineers are required to transfer loss and deformation control information to each other, and professional requirements are high.

3、Methods to Overcome Heat Transfer Issues

Device Inclination due to large particles of dirt on device reflow or thermal conductive contact surfaces.



Reflow and secondary assembly require 6S clean workshop.

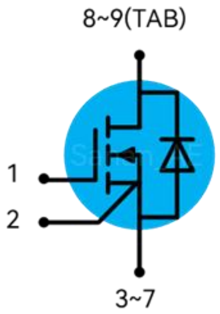
Vacuum cleaning and visual inspection of reflow or thermal contact surface in advance.

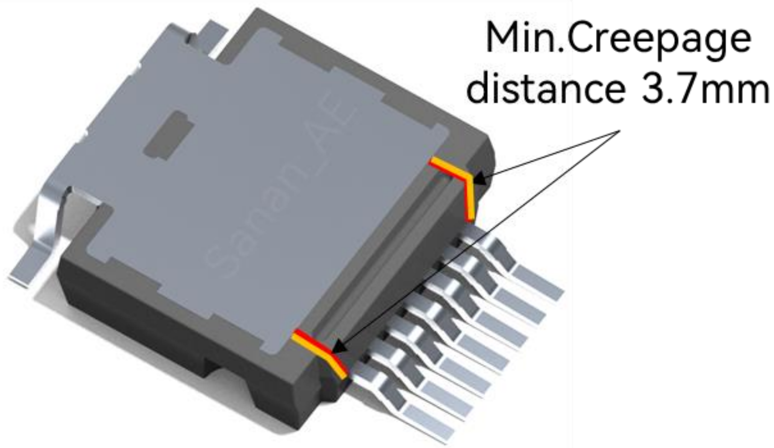
03 How to Ensure Reliable Application of TSC

San'an

4、Reasons of Insulation Issues

Creepage distance of SAPKG-9L





IEC 60664-1:2020 Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests.

Voltage RMS	Minimum creepage distance								
	Printed wiring material								
	Pollution degree								
	1	2	1	2			3		
	All material groups	All material groups, except IIIb	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0.025	0.04	0.08	0.4	0.4	0.4	1	1	1
12.5	0.025	0.04	0.09	0.42	0.42	0.42	1.05	1.05	1.05
16	0.025	0.04	0.1	0.45	0.45	0.45	1.1	1.1	1.1
20	0.025	0.04	0.11	0.48	0.48	0.48	1.2	1.2	1.2
25	0.025	0.04	0.125	0.5	0.5	0.5	1.25	1.25	1.25
32	0.025	0.04	0.14	0.53	0.53	0.53	1.3	1.3	1.3
40	0.025	0.04	0.16	0.56	0.8	1.1	1.4	1.6	1.8
50	0.025	0.04	0.18	0.6	0.85	1.2	1.5	1.7	1.9
63	0.04	0.063	0.2	0.63	0.90	1.25	1.6	1.8	2
80	0.063	0.1	0.22	0.67	0.95	1.3	1.7	1.9	2.1
100	0.1	0.16	0.25	0.71	1	1.4	1.8	2	2.2
125	0.16	0.25	0.28	0.75	1.05	1.5	1.9	2.1	2.4
160	0.25	0.4	0.32	0.8	1.1	1.6	2	2.2	2.5
200	0.4	0.63	0.42	1	1.4	2	2.5	2.8	3.2
250	0.56	1	0.56	1.25	1.8	2.5	3.2	3.6	4
320	0.75	1.6	0.75	1.6	2.2	3.2	4	4.5	5
400	1	2	1	2	2.8	4	5	5.6	6.3
500	1.3	2.5	1.3	2.5	3.6	5	6.3	7.1	8.0 (7.9)[4)]
630	1.8	3.2	1.8	3.2	4.5	6.3	8.0 (7.9)[4)]	9.0 (8.4)[4)]	10.0 (9.0)[4)]
800	2.4	4	2.4	4	5.6	8	10.0 (9.0)[4)]	11.0 (9.6)[4)]	12.5 (10.2)[4)]
1 000	3.2	5	3.2	5	7.1	10	12.5 (10.2)[4)]	14.0 (11.2)[4)]	16.0 (12.8)[4)]
1 250			4.2	6.3	9	12.5	16.0 (12.8)[4)]	18.0 (14.4)[4)]	20.0 (16.0)[4)]
1 600			5.6	8	11	16	20.0 (16.0)[4)]	22.0 (17.6)[4)]	25.0 (20 0)[4)]
2 000			7.5	10	14	20	25.0 (20.0)[4)]	28.0 (22.4)[4)]	32.0 (25.6)[4)]
2 500			10	12.5	18	25	32.0 (25.6)[4)]	36.0 (28.8)[4)]	40.0 (32 0)[4)]
3 200			12.5	16	22	32	40.0 (32.0)4)	45.0 (36.0)[4)]	50.0 (40.0)[4)]

According to IEC 60664-1:2020

If the pollution degree is 1.

↓

Voltage RMS 1000V

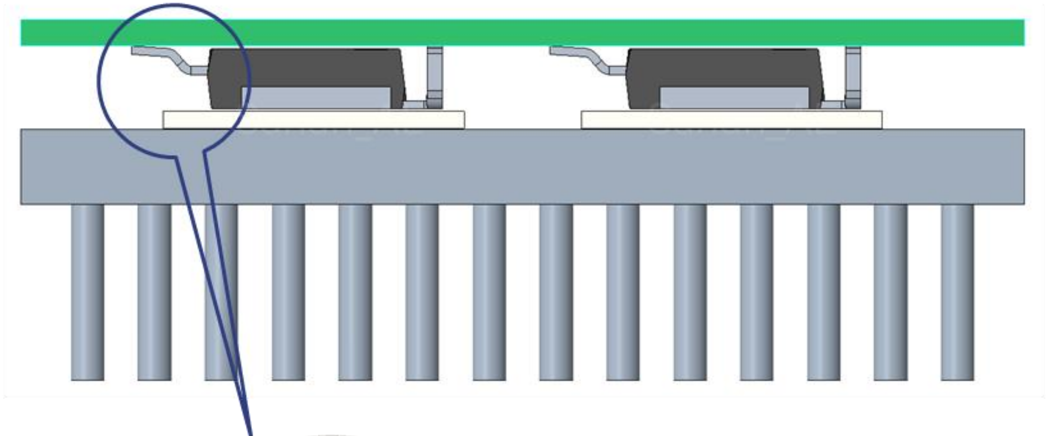
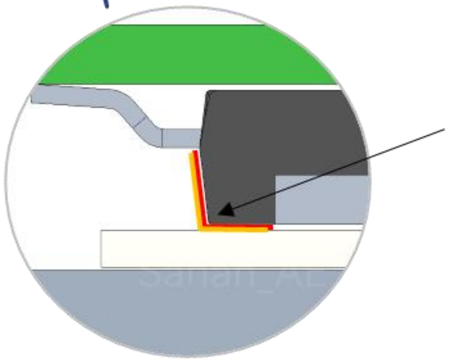
If the pollution degree is 1,and material group is II.

↓

Voltage RMS 500V

4、Reasons of Insulation Issues

In the case of grease material with uncemented properties

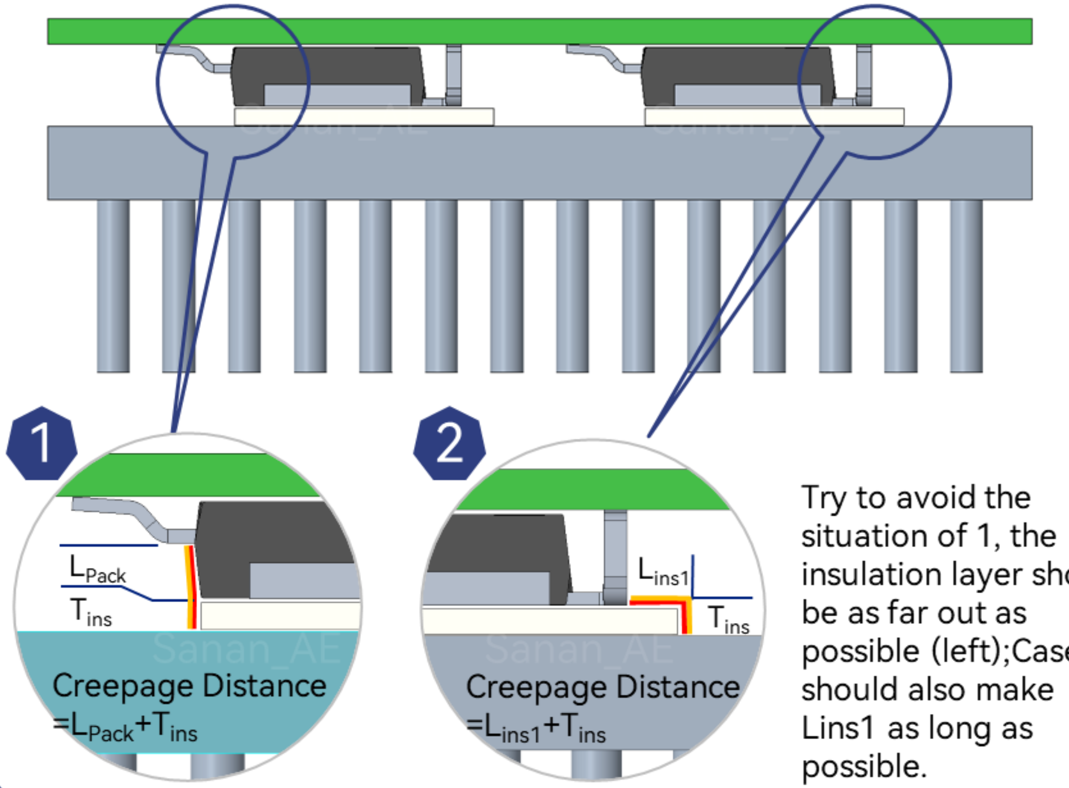
TIM may not fully fill and cover the heat dissipation surface of the package, and its minimum creepage distance is 3.7mm.

For liquid interfacial materials after curing


- The locking screws that hold the device to the cooling surface may shrink during curing and may need to be re-tightened to ensure good thermal contact.
- The case with band spring can be ignored because the pressure is automatically compensated.

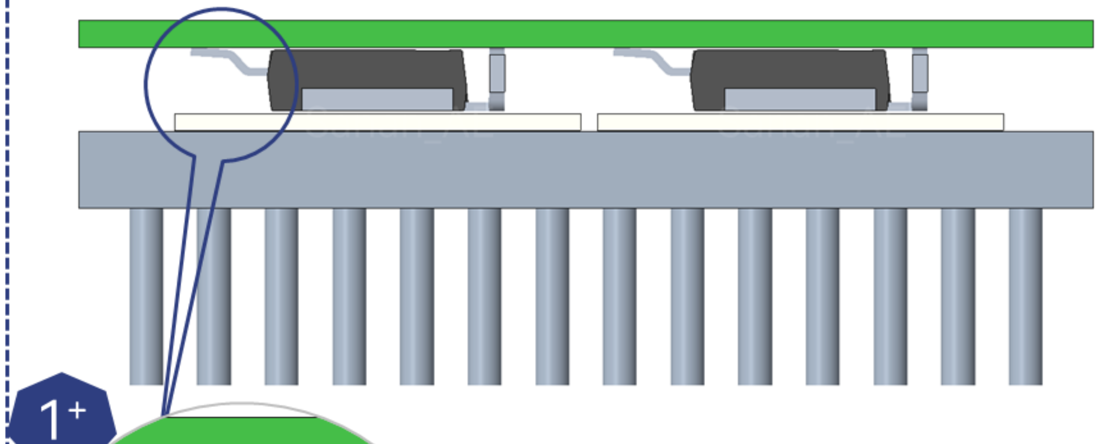
4、Reasons of Insulation Issues

In the case of grease material with cemented properties

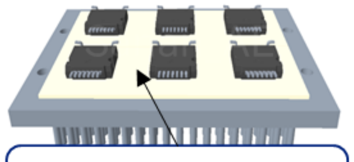


Try to avoid the situation of 1, the insulation layer should be as far out as possible (left);Case 2 should also make Lins1 as long as possible.

Increase creepage distance to increase insulation



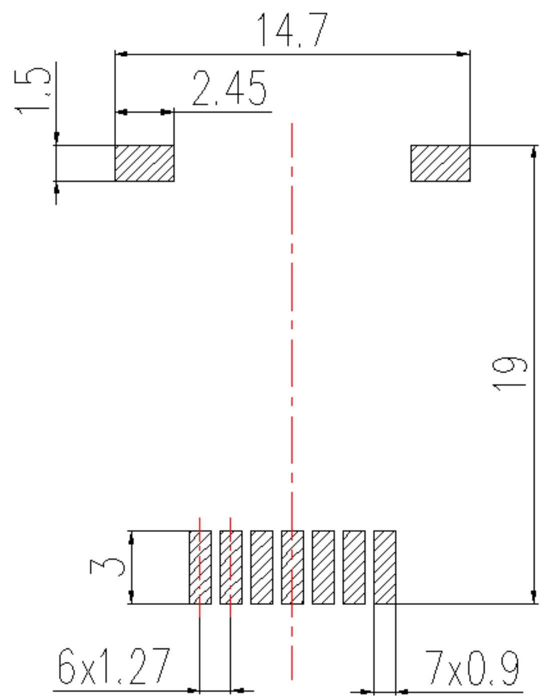
If you do not want to calculate so fine, Compatible with 400,800 and 1000V platforms. It can be covered a large area and a large plane to give sufficient margin.



A whole piece of insulationBut be careful to eliminate air void.

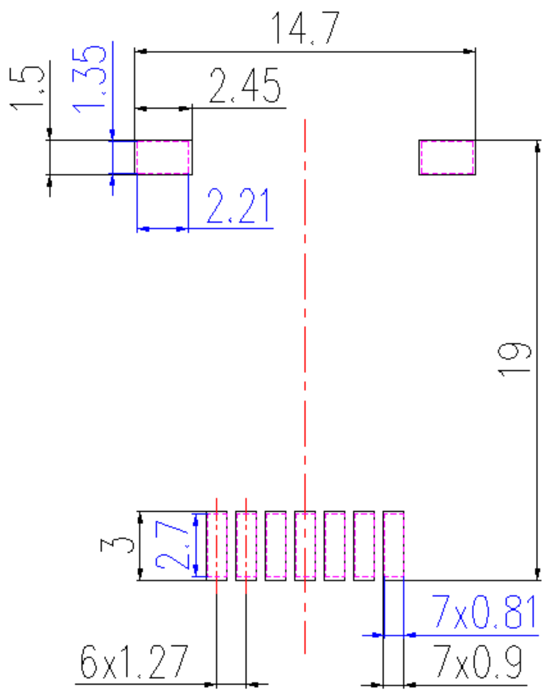
5、Notices for soldering the TSC

Recommended footprint
(dimensions in mm)



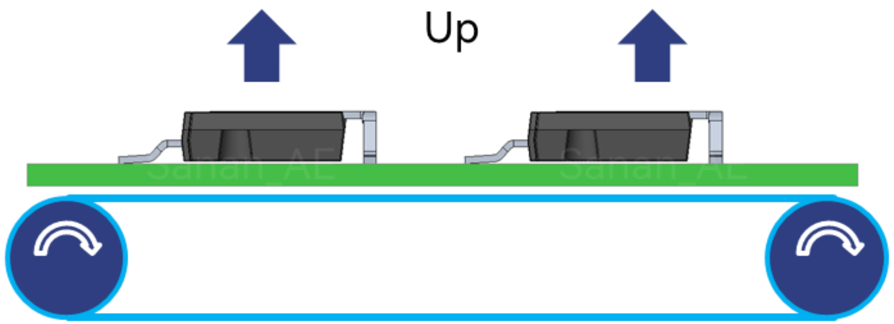
Also refer to datesheet

Stencil opening recommendation
(dimensions in mm)



150um thickness of stainless steel stencil can be used, and the opening is recommended to be 90% of the size of the footprint.

Double-side reflow sequence



- If the PCB board is designed with devices on both sides, reflow soldering must be performed on the side where SAPKG devices are installed at the last (second) time, otherwise secondary heating may cause slight displacement or even drop of the device, affecting the consistent performance of thermal contact.
- It is recommended to apply pre-adhesive red glue process to the parts that may fall off the bottom of the PCB during SAPKG soldering.
- For the SMD with a heat transfer surface on the top, it is not recommended to use wave soldering to avoid tin on surface that will influence on heat dissipation contact.

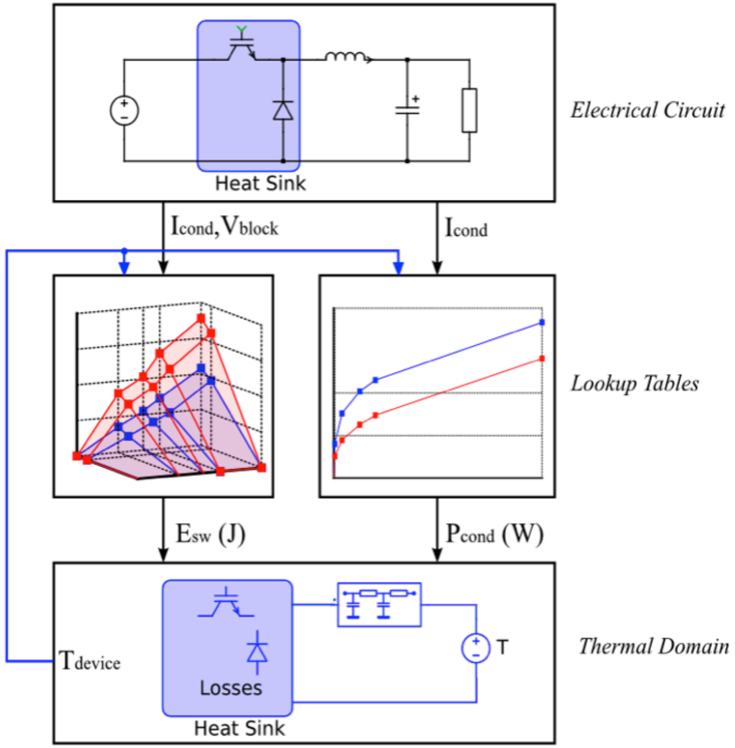
04 TSC Devices of Sanan

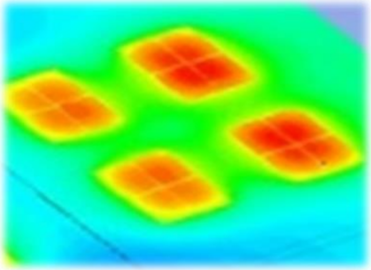
Num.	Type	Voltage	Current or Resistance	Package	Figure
1	ADS065J020V4	650V	20A	SAPKG-9L	
2	ADS120J050V3	1200V	50A		
3	AMS0650027V2	650V	27mΩ		
4	AMS0650035V	650V	35mΩ		
5	AMS0650050V2	650V	50mΩ		
6	AMS0750011V	750V	11mΩ		
7	AMS1200013V3	1200V	13mΩ		
8	AMS1200020V2	1200V	20mΩ		
9	AMS1200032V2	1200V	32mΩ		
10	AMS1200040V2	1200V	40mΩ		
11	AMS1200060V2	1200V	60mΩ		

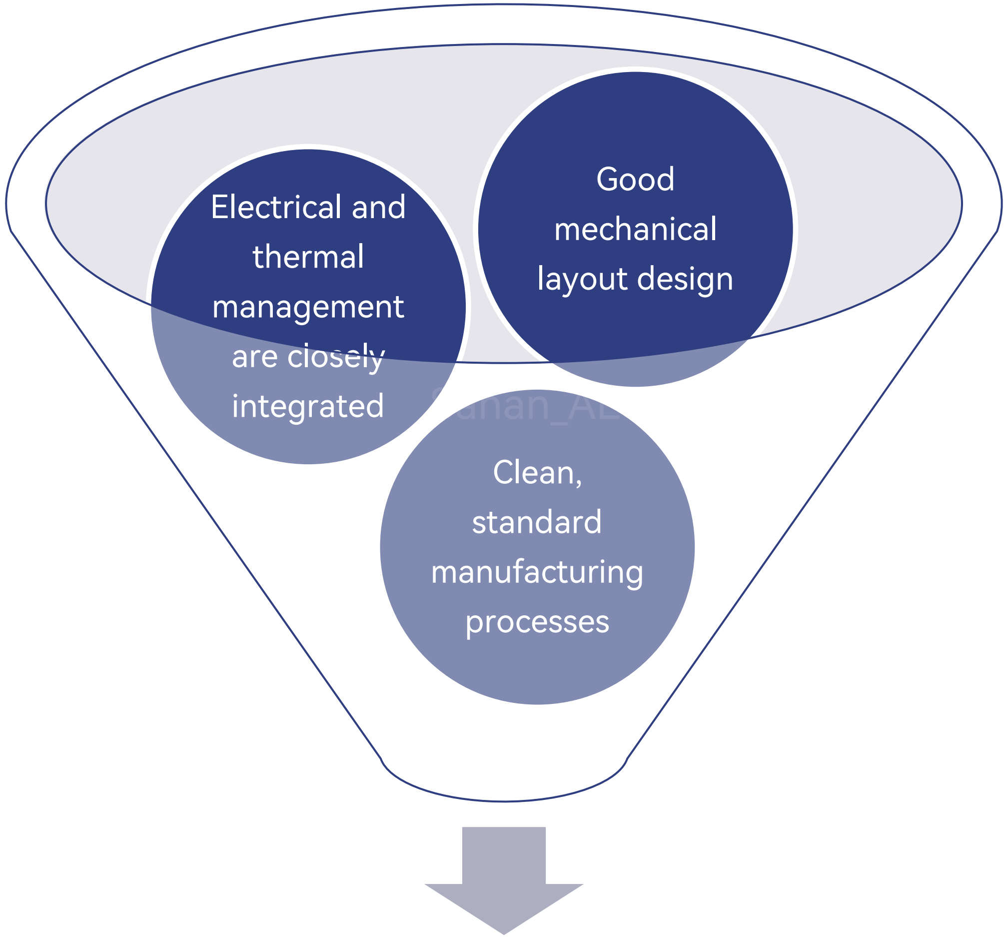
- In the continuous update, if necessary, please contact the sales of Sanan or login the official website to confirm.
- https://www.sanan-semiconductor.com/

05 Summary and Prospect

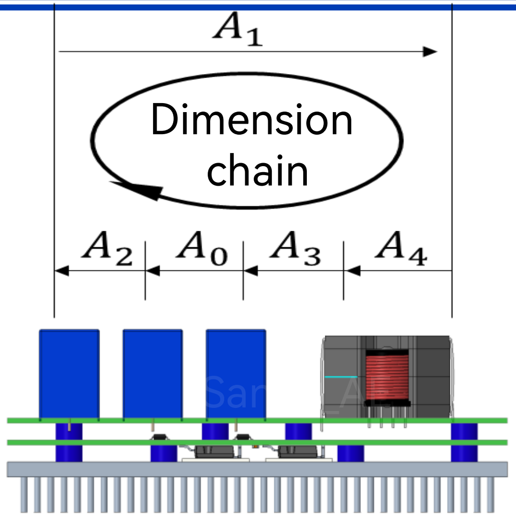
1、Summary







Successful TSC application design



San'an

2、Prospect

Materials and design innovation

- ✓ **Nano silver sintering.** Thermal resistance reduction of 40% (chip and copper lead frame， Copper lead frame with heat-sink).
- ✓ **Heat dissipation materials.** New materials with higher thermal conductivity have been developed for heat dissipation structures, such as diamond (theoretical thermal conductivity 2000W/mK), graphene (theoretical thermal conductivity 5000W/mK), and nanostructured heat dissipation coatings or fins are used to increase the heat dissipation area and heat dissipation effect.
- ✓ **Integration with advanced packaging technology.**Deep integration with advanced packaging technology such as 3D packaging and multi-chip integration. For example, by integrating the micro-channel heat dissipation structure and heat dissipation fins inside the package, the heat is quickly exported from the chip to meet the heat dissipation requirements of highly integrated and high-performance chips.

Intelligent thermal management

- ✓ **Embedded temperature sensor.**±1℃ accuracy, response time <10μs.
- ✓ **Ai-driven dynamic thermal control.** Automatically adjusts the heat dissipation policy according to the load, such as dynamically adjusting the speed of the heat dissipation fan, changing the flow rate of the heat dissipation channel, and thermal resistance. AI algorithms are used to implement intelligent thermal management policies to achieve the best balance between heat dissipation power and device loss.

Sanan

Please scan Sanan Wechat

Get planning and product updates

Thanks for your attention

Application of Top-Side-Cooling Package in Power Semiconductor

致力于成为世界级半导体研发、制造与服务平台

Chen Yao
Yapo XU Jianshan Zhang