1. Introduction

Modern electronic systems demand high performance power semiconductors that can be easily mounted to the Printed Circuit Board in a mass production environment while also allowing efficient heat extraction. This has always been a challenge with surface-mounted devices but now, with the TSPAK package from WeEn Semiconductors, those thermal challenges have been eased markedly.

TSPAK allows higher current and higher power dissipation from a surface-mounted device while allowing the maximum heat extraction from its internal structure via top-side cooling. Intended applications are automotive, industrial and anywhere where high thermal performance from compact surface-mount assemblies is required.

This Application Note provides the TSPAK specifications, describes its benefits and explains how best to design it into your system for best long-term reliability.

2. Package description

TSPAK is a surface-mountable power semiconductor package with epoxy plastic encapsulation and exposed large-area heatsink pad, where the plastic body sits next to the PCB and the heatsink pad faces away from the PCB to allow heat to be extracted into a heatsink. Dimensionally it is based on the TO-263 (D^2PAK) outline and corresponds with other products on the market. The internal power semiconductor dies (or dice if more than one) is die-bonded directly to the heatsink pad to provide the lowest possible thermal resistance. The heatsink pad is non-isolated. Electrical connections are wire-bonded using aluminium wires. Bond wire diameter, the number of bond wires and their bonding method are designed for maximum surge current handling. The heatsink pad and legs are tin-plated (Sn).

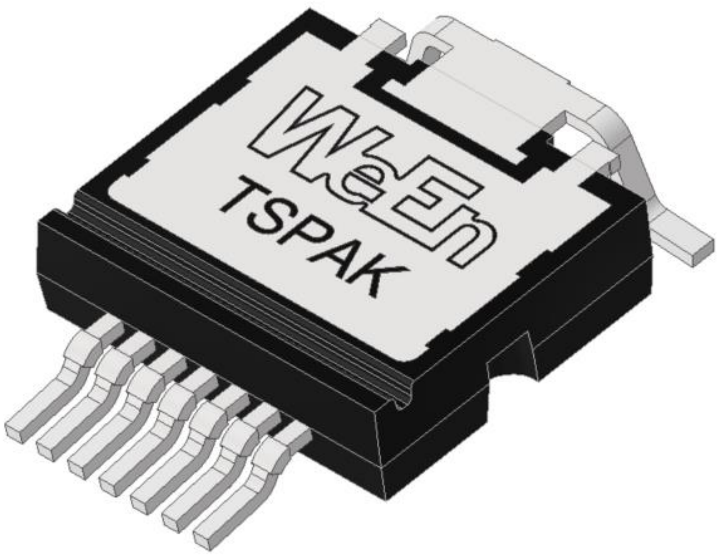
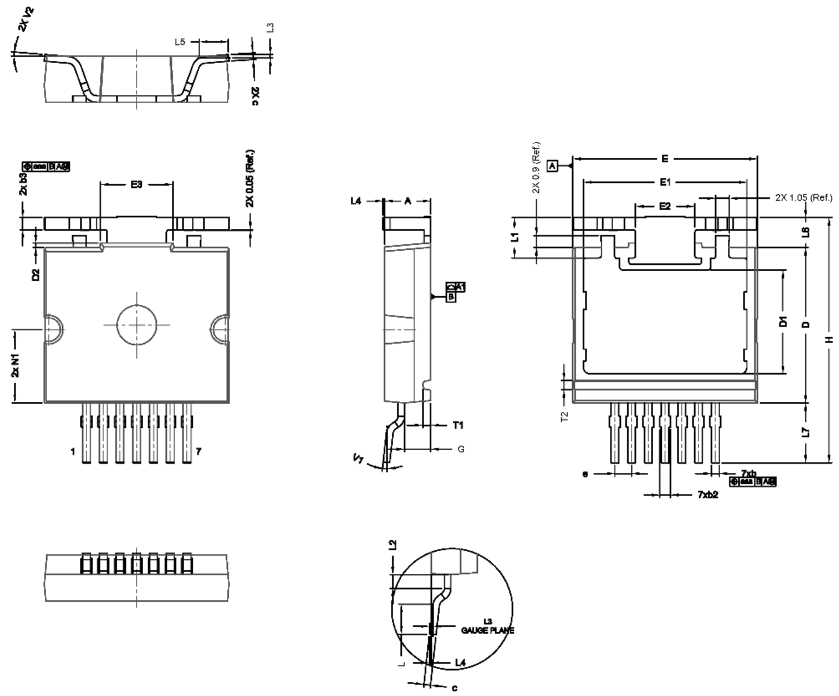
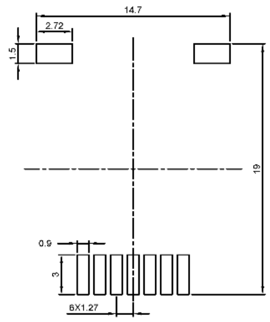


Fig. 1. The TSPAK package.

3. Package outline drawing



SYMBOL	DIMENSIONS MILLIMETER			SYMBOL	DIMENSIONS MILLIMETER		
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.
A	3.40	3.50	3.60	H	18.00	18.58	19.00
A1		0.05		L	2.185	2.285	2.385
b	0.50	0.60	0.70	L1		3.04	
b2	0.70	0.80	0.90	L2	0.90	1.00	1.10
b3	0.80	0.90	0.98	L3		0.26	
c	0.40	0.50	0.60	L4	0.075	0.125	0.175
D	11.70	11.80	11.90	L5	2.10	2.20	2.30
D1	7.78	7.88	7.98	L6	2.14	2.24	2.34
D2	0.24	0.34	0.44	L7	4.44	4.54	4.64
E	13.90	14.00	14.10	N1	5.46	5.56	5.66
E1	12.30	12.40	12.50	T1		0.6(Ref)	
E2	4.45	4.50	4.55	T2		0.7(Ref)	
E3	5.45	5.50	5.55	V1	0°		8°
e		1.27		V2	0°		8°
G	1.90	2.00	2.10	aaa		0.1	



Footprint(Only for reference)

NOTES.
1. DIMENSION AND TOLERANCE CONFORM TO ASME Y14.5M
2. CONTROLLING DIMENSIONS : MILLIMETER. CONVERTED INCH. DIMENSION ARE NOT NECESSARILY EXACT.
3. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

Fig. 2. TSPAK outline drawing.

4. Moisture sensitivity

If there is moisture trapped inside a package and the package is exposed to a reflow temperature profile, the moisture may turn into steam, which expands rapidly. This may cause damage to the inside of the package (delamination) and it may result in a cracked semiconductor package body (the popcorn effect). A package's sensitivity to moisture, or Moisture Sensitivity Level (MSL), depends on the package characteristics and on the temperature, it is exposed to during reflow soldering.

The MSL of semiconductor packages can be determined through standardised tests in which the packages are moistened to a predetermined level and then exposed to a temperature profile. The temperature is measured at the top of the package body. Depending on the damage after this test, an MSL of 1 (not sensitive to moisture) to 6 (very sensitive to moisture) is assigned. TSPAK is assigned MSL level 1, so no special environmental precautions are required.

Table 1 shows the different MSLs with their respective storage and ambient conditions. "Floor life" is the elapsed time after removal from the sealed dry bag.

MSL	**Floor life**	**Ambient condition**
1	Unlimited	≤ 30 °C/85 % RH
2	1 year	≤ 30 °C/60 % RH
2a	4 weeks	≤ 30 °C/60 % RH
3	168 hours	≤ 30 °C/60 % RH
4	72 hours	≤ 30 °C/60 % RH
5	48 hours	≤ 30 °C/60 % RH
5a	24 hours	≤ 30 °C/60 % RH
6	6 hours	≤ 30 °C/60 % RH

Table 1. TSPAK is rated MSL1.

5. Mounting to the Printed Circuit Board

This Application Note presents information that is specific to TSPAK. More detailed information on reflow soldering in general can be found in WeEn Application Note 013 – Surface Mount Reflow Soldering.

The TSPAK surface-mounting process consists of the following:

- Solder stencilling
- Adhesive spotting (if required) *
- Component placement
- Component levelling (if required) *
- Glue curing (if required) *
- Reflow soldering
- Cleaning (if required)
- Inspection

*Asterisked processes may be required to fix multiple devices at the same angle and level prior to clamping to a common heatsink. The devices will be coplanar. Ensuring coplanarity after soldering will ensure the best and equal thermal contact between devices and heatsink.

5.1 PCB material

Any PCB type will function but the most commonly used glass-fibre FR4 material is ideal. A good degree of mechanical stiffness is required for heatsink assembly, which would mandate a minimum PCB thickness. Due to its lower mechanical and thermal robustness, Synthetic Resin-Bonded Paper PCB material is not recommended.

5.2 PCB copper

The higher than usual current loadings made possible by TSPAK require a greater thickness of copper to minimise resistive losses in the PCB. A copper thickness of 68 microns (2 ounces per square foot) is suggested, although 136 microns (3oz/ft^2) is also possible in very demanding applications. 68 microns is twice the thickness for most applications.

5.3 TSPAK footprint

The suggested footprint appears as part of Figure 2 but it is reproduced in greater detail in Figure 3 for easier reading. There is no big mounting base in contact with the PCB, so all solder connections are to device legs only.

Because heat is extracted away from the PCB via the top heatsink pad, the footprint design and PCB copper will exert little influence on the thermal performance of the system. However, there will still be heating of the PCB assembly. As good design practice, the amount of copper on both sides of the PCB should be balanced as far as possible to minimise warping and mechanical stress to solder connections during thermal cycling as the assembly ages.

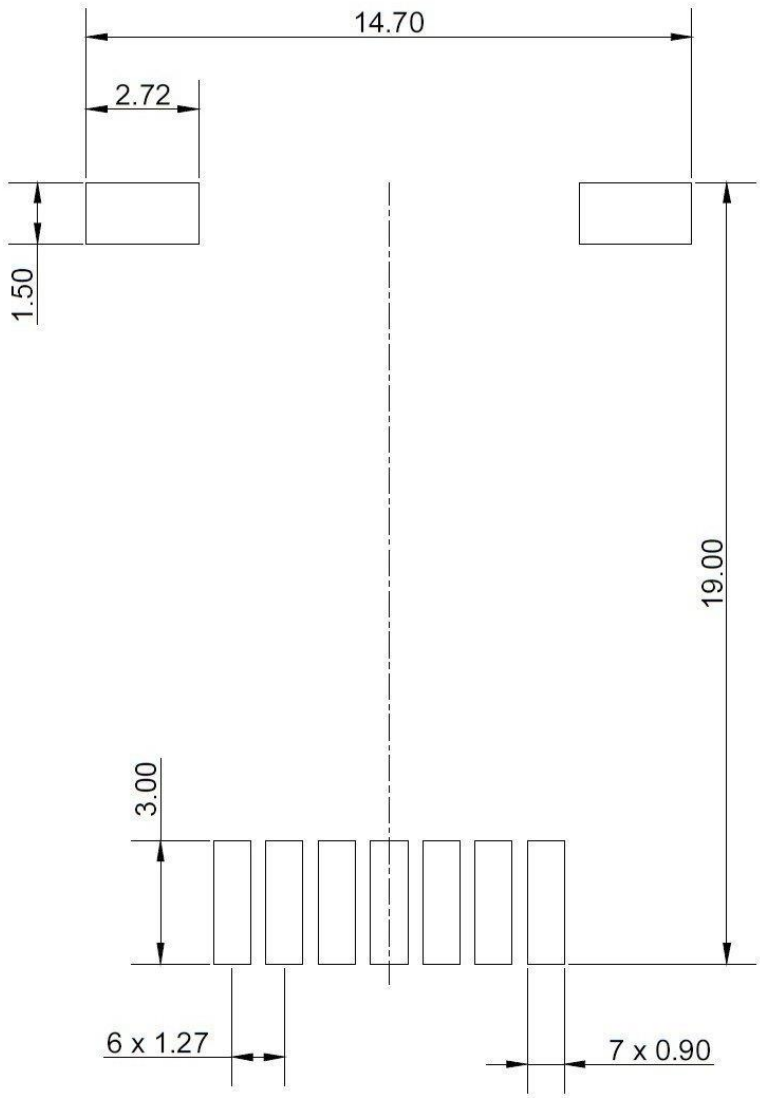


Fig. 3. TSPAK footprint (for reference only).

5.4 Pad metallisation

Normal rules for surface-mounted devices are well established to promote good wetting and solder flow. Pad metallisation requirements for TSPAK are the same as for other surface-mounted devices. Important is that the metallisation should be uniform and free of impurities to allow complete wetting as the parts being soldered reach solder flow temperature.

5.5 Solder masking

Accurate positioning is important to ensure the legs are correctly centralised within their respective pads. For the most accurate alignment during reflow soldering, Non Solder Mask Defined pads are recommended. This is where the solder mask (also known as solder resist) stops outside the metallised areas and allows the pad dimensions to control the positioning. To avoid the risk of the mask encroaching onto the solder pad area, the gap between mask and pad should be 50 – 75µm.

The alternative to NSMD is Solder Mask Defined, where the solder mask overlaps the periphery of the pads to control the positioning. However, the solder mask window alignment is much less precise than the solder pad alignment, so by definition, Solder Mask Defined alignment is also less precise.

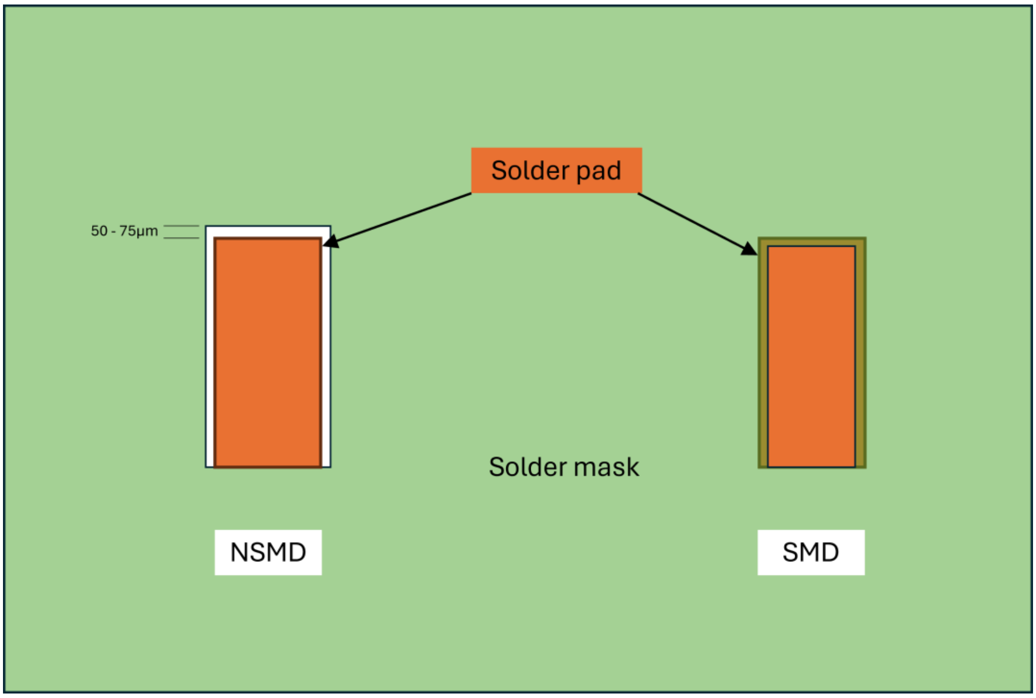


Fig. 4. Non-Solder Mask Defined pads allow for more accurate positioning after reflow.

5.6 Solder stencilling

The solder paste is screen-printed onto the pads through a metal stencil (stainless steel is preferred). The recommended stencil thickness is 150µm. The stencil apertures should be 25µm smaller than the solder pads on all sides and they should be tapered slightly (narrower at the top) to reduce the risk of smearing the paste outside the pad area as the stencil is slowly lifted away.

For solder paste specification, Type 3 or higher is recommended, with particle size of 45µm or lower. A suggested lead-free solder would be a tin (Sn) – silver (Ag) – copper (Cu) alloy, with 3 – 4% Ag content and less than 1% Cu content.

5.7 Component placement

For production environments, only automatic pick-and-place machines should be used to position TSPAK due to their placement accuracy and their avoidance of asymmetrical downforce, which otherwise might cause the device to sit at an angle. The surface tension of the molten solder may result in further centring of legs on pads for final positioning accuracy.

If two reflow processes are required for both sides of the PCB, TSPAK should be on the final reflow. If it is not, it will detach itself from the PCB during the second reflow process.

If SMT adhesive is used to hold devices in position, the positioning accuracy of the pick-and-place machine is critical, since the molten solder will no longer be able to dictate the final positioning.

Manual placement is not recommended other than for laboratory and prototyping situations, where extra care can be exerted and remedial action taken if misalignment should occur.

5.8 Component levelling (optional)

In cases where multiple TSPAK devices are to be cooled by a common heatsink, due to small tolerances in the manufacturing process, the heatsink pads may not lie on the same plane (they may be at different angles and levels) after reflowing, so heat transfer will be compromised. Heat transfer pads are available that can compress to accommodate variations in air gap between devices and heatsink, but thermal resistance will increase and, possibly more critically, it may vary from device to device. The option of glueing the devices into position will allow all heatsink pads to be pressed against a planar surface to normalise their levels prior to glue-curing and soldering. This will ensure better coplanarity of all devices after reflowing.

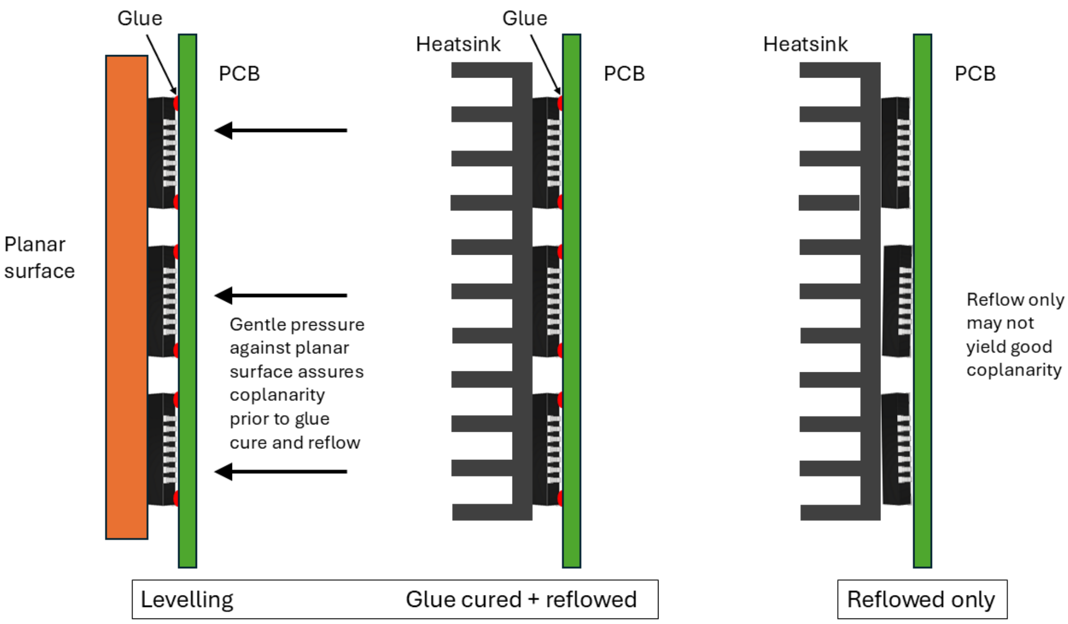


Fig. 5. How to ensure coplanarity of multiple devices prior to reflow soldering.

5.9 SMT adhesive application

Where multiple devices are cooled on a common heatsink it may be necessary to fix their positions before reflow soldering. This may require the dispensing of a spot of Surface Mount Technology (SMT) adhesive onto the PCB in the four corners of the package outline before accurate placement. Considering the working process and the heating cycle in reflow stage, here we recommend a 2-component glue to do the device boning operation. As the glue curing takes about 4~5 minutes, it will leave enough time for devices aligning to the stiff lining plate to achieve a better coplanarity. The 2-component glue can cure under normal room temperature, don't need other additional physical treatment, which will be very friendly to the already applied solder paste before the reflow process. Fig 6 shown the key parameter of two component glue as example.

PRODUCT DESCRIPTION
LOCTITE HHD 8190R provides the following product characteristics:

Technology	Acrylic
Appearance - Part A	Amber
Appearance - Part B	Blue
Appearance - Mixed	Green
Components	Two components - requires mixing
Mix Ratio by volume, Part A:Part B	10 : 1
Cure	Room temperature cure after mixing
Product Benefits	• Superior impact and peel strength • Little or no surface preparation • Rapid room temperature cure • Excellent environmental resistance • Halogen free
Application	Device assembly, Structural bonding

Fig. 6. Example of the key parameter of two component glue

5.10 Reflow

This process combines glue curing (where applicable) with soldering. If SMT adhesive has been applied, it will cure first to fix the position of TSPAK as the temperature rises during the reflow process.

The peak temperature required to flow the solder and wet the joints correctly is very much higher than the worst-case operating temperature. It can be highly stressful for the device being soldered if not done correctly. The temperature profile must be carefully controlled to minimise the duration at high temperature yet achieve full solder flow and wetting, while at the same time minimising the rate of change of temperature to minimise temperature differentials within the device structure, which otherwise would allow thermal stresses to occur. Figure 7 shows the recommended reflow temperature profile and Table 2 gives the specifications for tin-lead and lead-free processes. Unless special dispensation is in force – e.g. automotive applications, the lead-free process is assumed. Peak temperature is 245°C, where the melting point of the Sn-Ag-Cu solder paste is around 217°C.

Figure 8 shows the actual temperature profile deployed in test reflow processes for TSPAK.

[Please note that wave soldering should not be used for TSPAK for the following reasons:

1. It cannot be guaranteed to achieve correct wetting of all joints due to solder shadows (the package body can hide some solder pads from the solder flow)
2. Closely spaced pads may be shorted out by solder bridges
3. Larger leg + pad combinations may not be sufficiently heated to full wetting
4. The cooling pad will be contaminated by solder and will no longer be flat, so effective heatsinking will be impaired.]

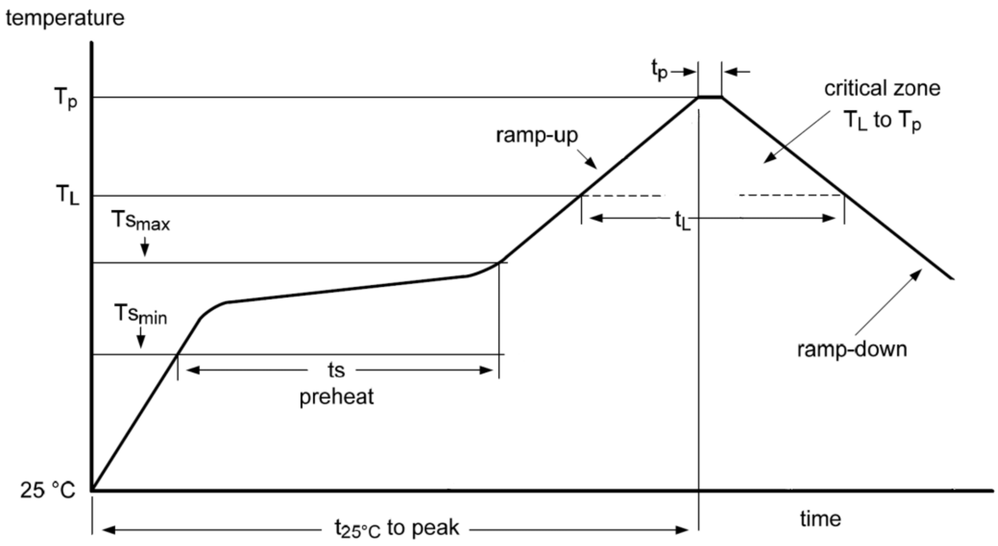


Fig. 7. Reflow soldering temperature profile.

Profile Feature	SnPb eutectic assembly	Pb-free assembly
Average ramp-up rate (**$T_{S\,max}$** to **T_P**)	max 3°C/s	max 3°C/s
Preheat Temperature minimum (**$T_{S\,min}$**) Temperature maximum (**$T_{S\,max}$**) Time (**$t_{s\,min}$** to **$t_{s\,max}$**)	 100°C 150°C 60 - 120s	 150°C 200°C 60 - 180s
Time maintained above Temperature (**T_L**) Time (**t_L**)	 183°C 60 - 150s	 217°C 60 - 150s
Peak Temperature (**T_P**)	220°C	245°C
Number of allowed reflow cycles	3	3
Time within 5°C of actual peak temperature (**t_P**)	10 - 30s	20 - 40s
Ramp-down rate	6°C/s maximum	6°C/s maximum
$t_{25°C}$ to peak temperature	6 minutes maximum	8 minutes maximum

Table 2. Recommended reflow temperatures and durations.

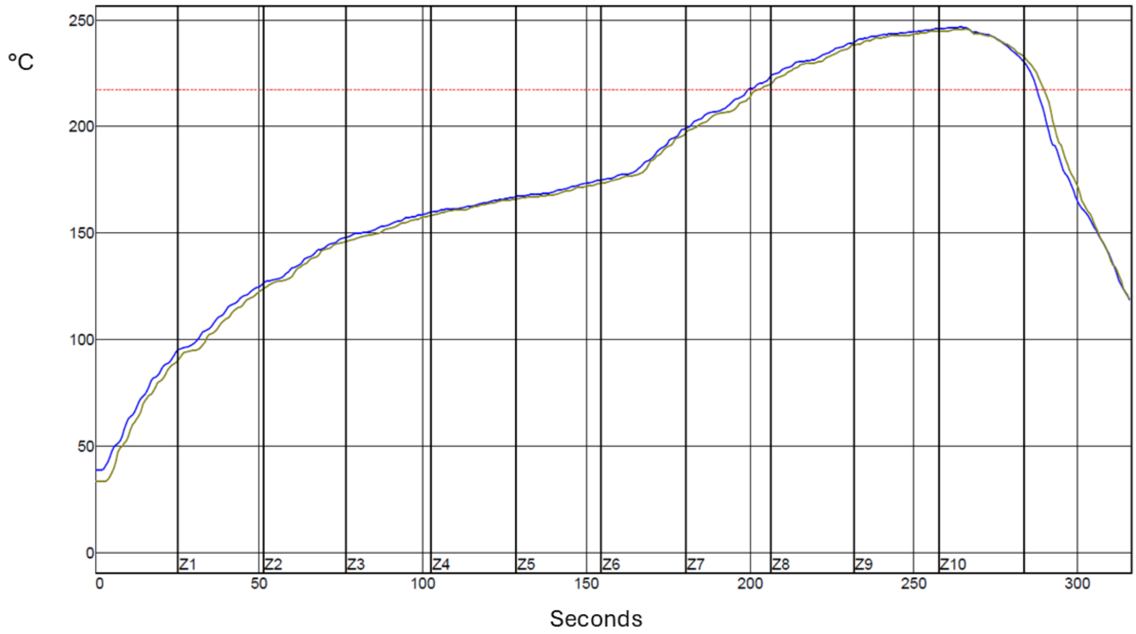


Fig. 8. Reflow soldering temperature profile (real life testing).

5.11 Cleaning (optional)

The preferred no-clean solder pastes are designed to leave minimal flux residue on the PCB after reflow soldering, so cleaning (de-fluxing) is not normally necessary. Some minor flux residues may remain visible, however. For demanding applications where this might be considered problematic, a suitable aqueous or solvent cleaning stage can be implemented.

5.12 Inspection

The assumed inspection method in large-scale production is automatic, where high resolution cameras and Artificial Intelligence can search for defects such as:

- Solder bridges between closely spaced pads
- Incomplete solder flow or wetting of joints
- Component legs misaligned on solder pads (might be caused by misaligned component or individual legs bent out of position through mishandling)
- Lifted component legs failing to contact solder pads (might be caused by legs bent upwards through mishandling)

6. Thermal Performance

6.1 Thermal Resistance

The thermal resistance of semiconductor assembly is the parameter that characterizes its resistance to the heat flow generated by the junction during operation. A temperature exceeding the maximum junction temperature curtails the electrical performance and may damage the device. Fig 9 shown the thermal resistance parameter in datasheet.

Table 6. Thermal & Mechanical characteristics

Symbol	Parameter	Conditions	Notes	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base			-	0.25	-	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air		-	40	-	K/W

Note: Device is ESD sensitive. Handling precautions are recommanded.

Fig. 9. Example of thermal characteristics.

$R_{th(j-mb)}$ is the thermal resistance of the device from junction to mounting base. Figure 10 gives a visual definition. Maximum steady-state thermal resistance values are given in the datasheet and are used to specify the device's current and power ratings. The average junction temperature rise for a given dissipation is the mathematical product of the average power dissipation and the thermal resistance:

$$\text{Delt } (T_j - T_{mb}) = P_D \times R_{th(j-mb)}$$

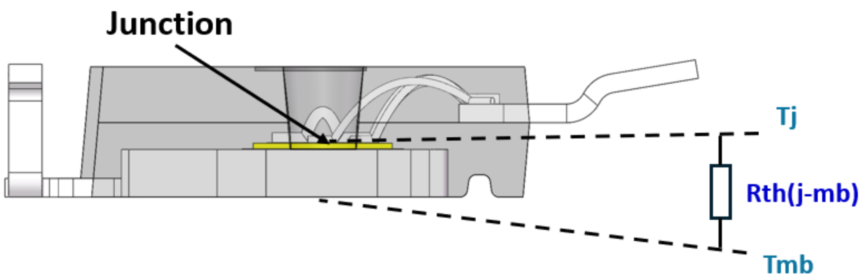


Fig. 10. Visual definition of $R_{th(j-mb)}$.

$R_{th(j-a)} = R_{th(j-mb)} + R_{th(mb-a)}$ is the thermal resistance of the device from junction to ambient. It assumes the device is mounted vertically on a PCB in free air without artificial air movement. Figure 11 shows a typical experimental setup for measuring $R_{th(j-a)}$. $R_{th(mb-a)}$ is the thermal resistance of the device from mounting base to ambient in free air, no wind flowing.

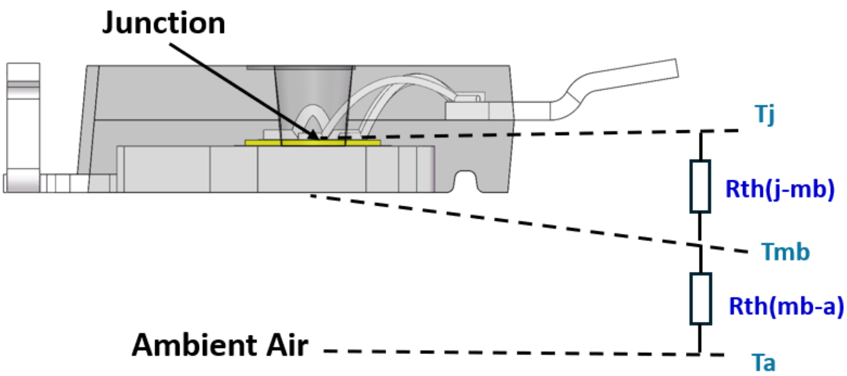


Fig. 11. Visual definition of $R_{th(j-a)}$

6.2 Thermal Path

The TSPAK package is designed to have a heat sink pad located on the top of the device, to connect to a heat sink. The TSPAK package is designed to ensure that the thermal path from the die junction (where the heat is generated) to the thermal pad is kept as highly thermally conductive as possible. The purpose of the heat sink is to keep the thermal path resistance from the device to the ambient environment that receives this heat (whether it is water or atmosphere), also as low as possible. So, the total resistance from junction to ambient is the sum of:

- The junction to mounting base resistance, defined by package design ($R_{th(j-mb)}$).
- The resistance of the thermal pad or compound used between the device and the heat sink ($R_{th(mb-h)}$)
- The resistance of the heat sink between thermal pad/compound and the ambient environment ($R_{th(h-a)}$)

[Note: 'mounting base' may be referred to as 'case' by other manufacturers. The corresponding temperature condition is T_c. T_{mb} and T_c may therefore be regarded as equivalents.]

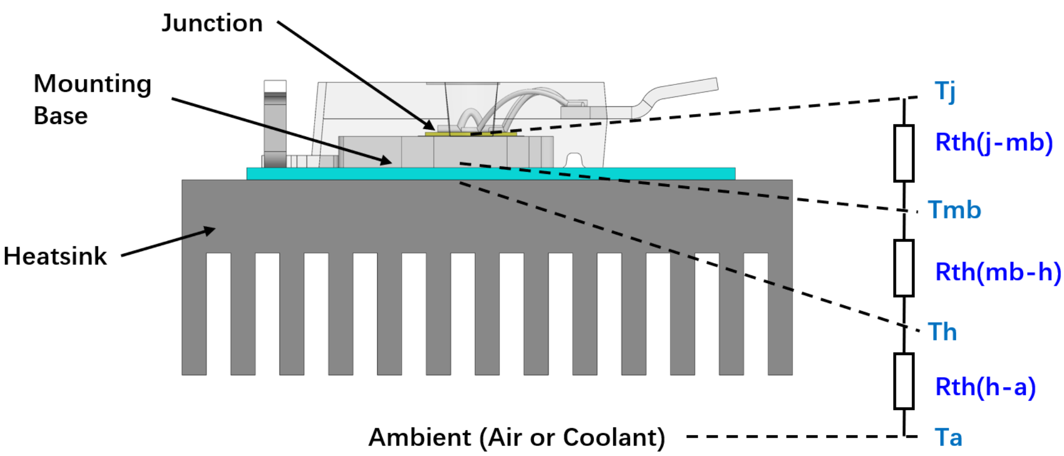


Fig. 12. Example of thermal path for TSPAK

For the TSPAK package, thermal grease should be used to fill the microscopic air gaps between the package and the heatsink. In many applications, the package must be electrically insulated from its mounting surface. This will add considerably to the $R_{th(mb-h)}$ because the insulation has a comparatively high thermal resistance, which raises junction operating temperatures. So how to reduce the value of $R_{th(mb-h)}$ is the key point in the system design. Boron Nitride (BN), Aluminium Nitride (AlN) and Alumina (Al2O3) are typical isolation materials commonly use in system applications.

7 Mounting to the heatsink

A safe and reliable method is needed to keep the thermal pad of TSPAK pressed against the heatsink. We mention 'safe' because the mounting method must not cause undue stress to any parts of the assembly, most notably the PCB, but in the meanwhile a proper and enough pressure between the thermal pad and the heatsink is necessary to conduct the heat effectively . The simplest method may be to use bolts screwed into threaded holes in the heatsink, but care is needed to avoid excessive force bending the PCB. Assuming the thickness of PCB is 1.6mm, the device local area warpage should be less than 0.7% to keep the PCB's application reliability.

Three possible assembly methods were recommended as shown below. On the first case, as mentioned above, the flexion of the PCB was forced using a short spacer. The tightening of the screw leads against the spacers to bend the PCB. The gap should be precisely controlled to create a 0.4%~0.7% PCB partial warpage to press the device to the heatsink. The pressing pressure, which will affect the thermal interface filling rate, could be adjusted by different warpage with different spacer height and screw span.

On the second case, the spacer used is in same height or bit longer than the assembly height and a pressure screw presses the package against the heat sink. This assembly forces the PCB to bend downward to press the device against the heatsink. The pressure should be fine controlled to ensure a proper thermal interface filling rate by managing the screw torque, and also the PCB warpage should not be over 0.7%. A permanent thread glue should be used to ensure a robust assembly state and the pressure maintenance.

The third case is a less stressful configuration, where the PCB is assembled with minimal bending. With an additional stiff backplate mounted onto the back of the PCB pressing the device against the heatsink, the partial warpage could be eliminated, and the pressure could be controlled by limiting the screw torque to ensure a proper thermal interface filling rate.

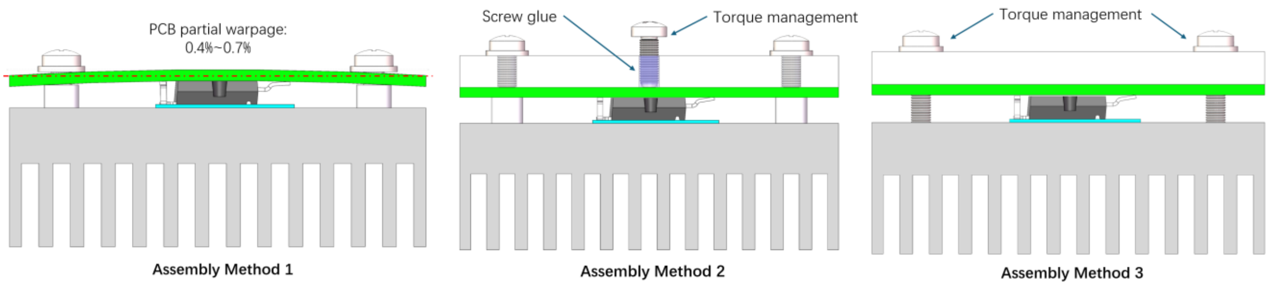


Fig. 13. Reference methods of mounting to the heatsink

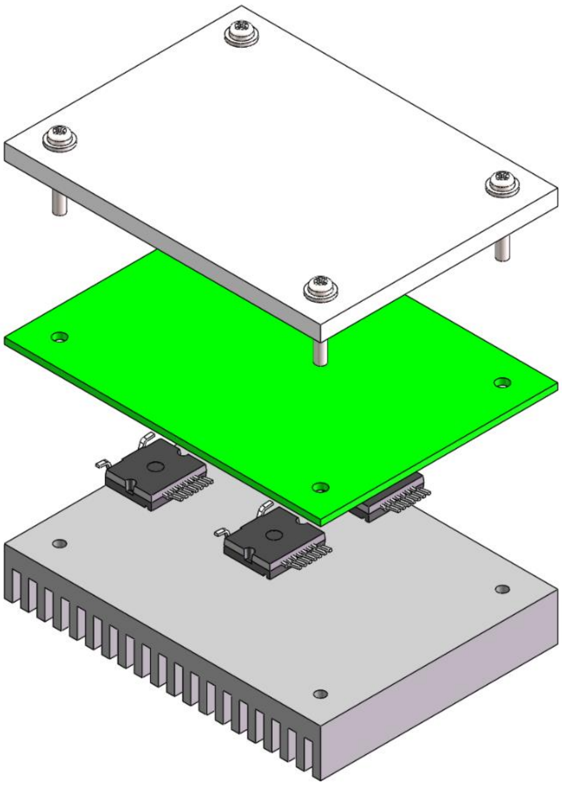


Fig. 14. Improved mounting to heatsink using a stiff backplate.

7.1 Thermal interface

The major benefit of top-side cooling is that there is no PCB in the thermal path (no large-area copper pads with vias linking them through the FR4 material). The only interface between the heatsink pad of the device and the heatsink is the heat transfer material or thermal pad, which has much higher thermal conductivity than the PCB. Junction-to-heatsink thermal resistance is therefore much lower.

If no electrical isolation is required and metal-to-metal contact is permitted, heatsink compound (thermal grease) may be used to aid heat transfer. However, electrically conductive thermal transfer pads may be preferred due to their improved cleanliness (no messy grease to contend with).

If electrical isolation is required (this is the assumed default condition), electrically isolating but thermally conductive pads must be used.

Non-isolating (electrically conductive) thermal pads are the thinnest and have the best thermal transfer properties. Their thermal performance may be comparable with thermal grease only.

Electrically non-conducting thermal pads will be thicker to achieve the necessary isolation or dielectric strength. They will have poorer thermal transfer properties.

If the surfaces are not well-matched – i.e. if they have not gone through the coplanarity process described earlier, thicker, compressible pads are available which can accommodate the variations in air gap. Their thermal transfer properties will be the poorest.

Thermal pads may also be self-adhesive. This may prove advantageous in accurate assembly to ensure the creepage distance is not compromised (see Section 6.2).

The thermal pads described above will be flexible and already impregnated to aid heat transfer, so no additional thermal grease is required. However, hard isolation materials are sometimes used which will require the application of heatsink compound to their upper and lower surfaces. The original such material is mica, but more modern materials are ceramic or alumina sheet.

The above examples involve many suppliers and cover a wide range of isolation and thermal conductivity properties. Local suppliers should be consulted for available products and their specifications.

7.2 Creepage distance

To protect the components or the user from the effect of the operating voltage, a sufficient creepage distance is required. 'Creepage distance' is the shortest distance between two conductive materials along the surface of the insulator between them. The creepage distance between Drain and source can be seen as below picture for WeEn's TSPAK.

Fig. 15. Example of creepage distance between Drain and Source.

The isolating pad size and positioning is critical to achieve the necessary creepage distance between heatsink pad and heatsink. There is also the creepage distance between heatsink pad and the device legs to consider (Drain-to-Source in the case of a MOSFET). The package design already has its own creepage-maximising feature (a groove in the plastic moulding) between heatsink pad and legs. However, if a single isolating pad is used, it will bypass this groove and shorten the creepage distance by the difference between the groove path and direct path across the top of the groove (see Fig. 13 and Fig. 16). If the isolating pad is stopped before the groove to avoid this bypassing, it will then leave a very short creepage distance between heatsink pad and heatsink around the edge of the isolating pad (see Fig. 16).

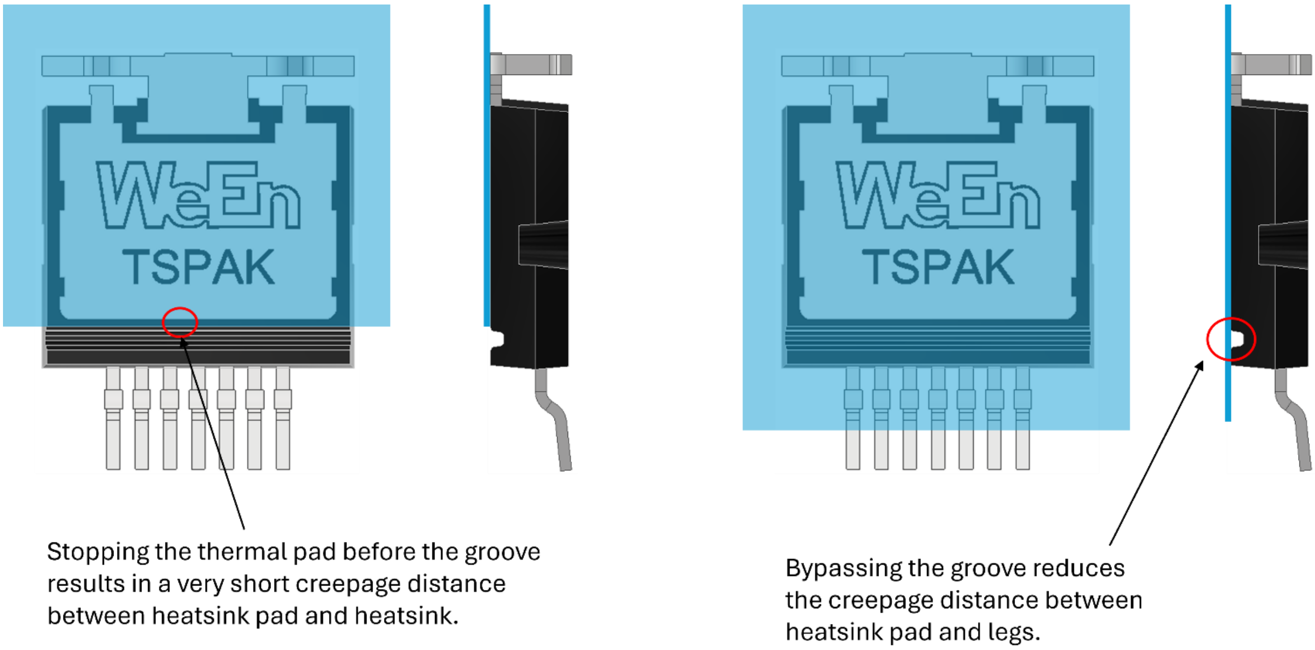


Fig. 16. A single isolating pad will shorten creepage distance.

A method is needed to mount the device without compromising either of these two creepage distances. One idea might be to use a profiled heatsink with a trough or groove to increase the creepage distance between heatsink pad and heatsink (see Fig. 17). However, this has several disadvantages:

1. The heatsink is more complicated so likely to be more expensive.
2. The heatsink is designed specifically for the PCB assembly, so any changes to the PCB layout which involve a change to the TSPAK positioning will not be possible without redesigning the heatsink as well.
3. Great precision will be needed when clamping the assembly to the heatsink to ensure correct alignment without compromising creepage distances.
4. The device must be mounted over the edge of the heatsink area, where only part of the heatsink, pad is being cooled. This would severely impact the heatsinking effectiveness.

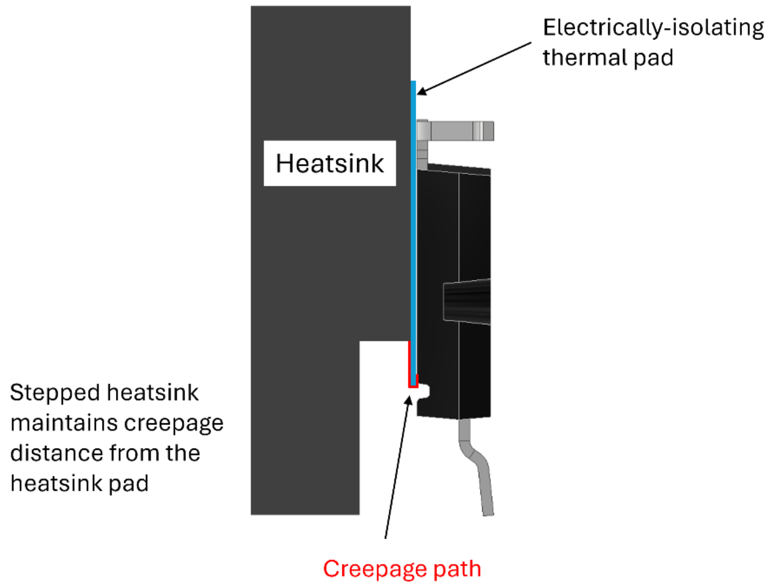


Fig. 17. Modified heatsink maintains both creepage distances.

A simpler assembly method that retains full creepage distances without compromising the thermal contact area and without the need for special heatsink profiling uses two thermal pads – one small, fixed pad on the TSPAK and a larger pad on the heatsink as normal to provide the electrical isolation (see Fig. 18). The small pad on the TSPAK will need to be positioned accurately and glued in place. It could even be electrically conductive to give the best possible thermal performance, since its only purpose is to lift the package body away from the heatsink to prevent the bypassing of the groove.

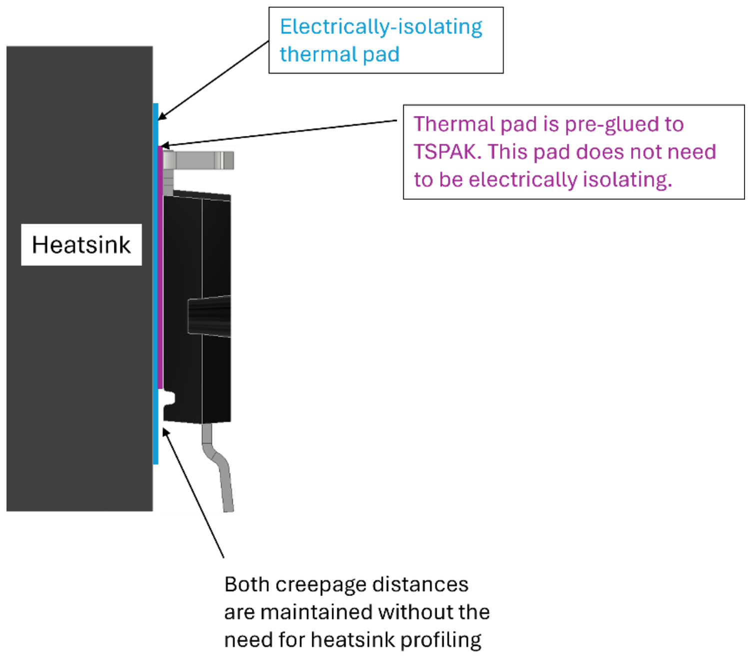
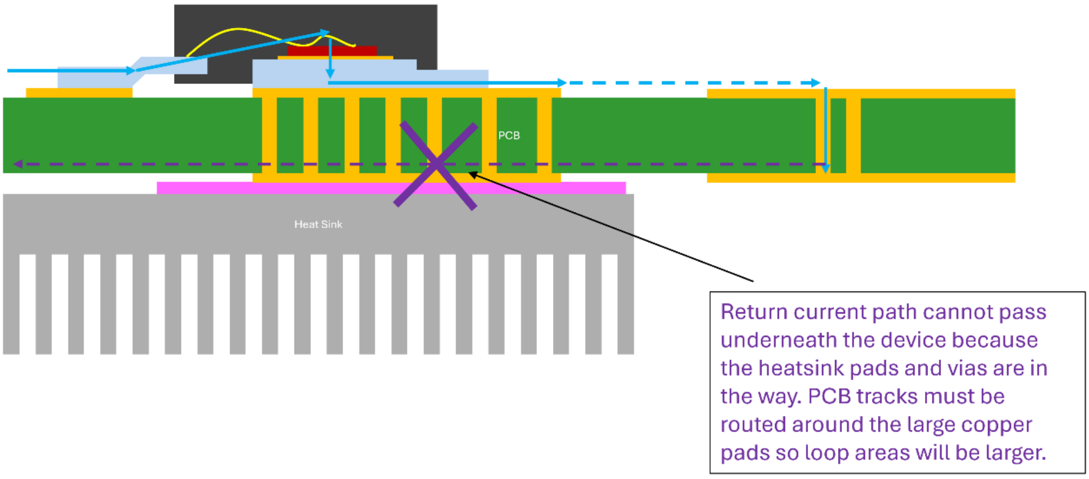


Fig. 18. Two pads allow a simpler assembly.

8 EMC benefits of TSPAK

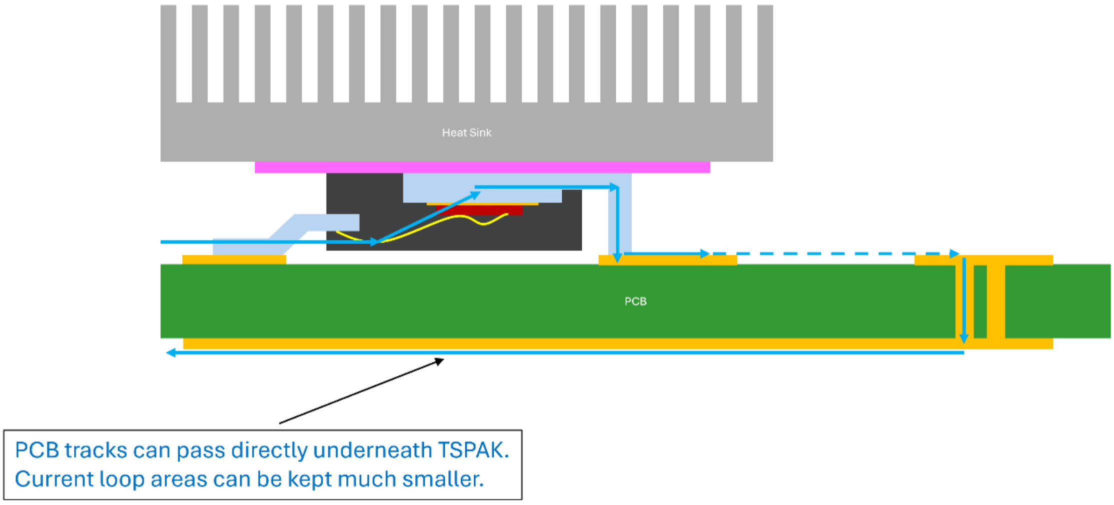
For traditional surface-mounted power packages – e.g. TO-263 (D^2PAK) – where the heat is extracted into the PCB, it is necessary to have a large area of copper on both sides of the PCB with vias between them to extract the heat into the heatsink. Any power tracks that carry the load current must be routed around those copper areas. This increases loop area and stray inductance. It will increase oscillation or 'ringing', risking dangerous voltage spikes and wasting power while compromising the performance of high frequency switching circuits. Electro Magnetic Interference will be increased.



Conventional bottom-cooled package – e.g. TO-263 (D^2PAK).

Fig. 19. Bottom-side cooling prevents compact layouts -> poor EMC.

A large benefit of topside-cooled power packages like TSPAK is that there is no need for large areas of copper on the PCB. The PCB can be used solely for current-carrying tracks near the power device, including immediately underneath it. This makes it possible to keep loop areas and stray inductances to the absolute minimum, thereby maximising the high frequency switching performance (see Fig. 16).



Improved top-side cooling with TSPAK.

Fig. 20. Top-side cooling allows compact layouts for improved EMC.

9 Conclusions

TSPAK is a top-side-cooled power package of similar size to TO-263 (D^2PAK). It is aimed at compact, high power, Surface Mount Technology designs in industrial and automotive applications. TSPAK has thermal advantages:

- No PCB in the thermal path so junction-to-heatsink thermal resistance is lower. More heat can be extracted for higher power dissipation
- Heat is extracted away from the PCB, so the PCB assembly runs cooler

It also has electrical advantages:

- Current-carrying PCB tracks can pass directly underneath the device without having to route around copper heatsink pads and vias. Current loop areas can be much smaller for better electromagnetic performance.

This WeEn Application Note has also provided guidance and suggestions on assembly of TSPAK to the PCB and heatsink for ease of production while achieving the best performance in the application.

Revision history

Rev	Date	Description
V.01	20241205	Initial version
V.02	20240116	Updated thermal and mounting to the heatsink diagram

Contact information

For more information and sales office addresses please visit: **http://www.ween-semi.com**

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