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TO-LL: the latest evolution in SMD power packages

STPOWER MOSFET SJ MDmesh M6 and DM6

TO-LL the new space-saving and thermally efficient package

The new STPOWER MOSFET Super-junction MDmesh* M6 and MDmesh DM6 series in the space-saving and thermally efficient TO-LL leadless package allows more compact and space-saving power converters. Thanks to the additional Kelvin-source lead, designers can achieve better efficiency due to reduced turn-on / turn-off switching losses.

KEY FEATURES

- Reduced space on board
- Distributed heat sinks
- Additional Kelvin source
- Reduced thickness (2.3 mm)
- High creepage (distance 2.7 mm)

MAIN BENEFITS

- Increased power density
- Competitive thermal dissipation
- Improvement in Turn-on / Turn-off efficiency

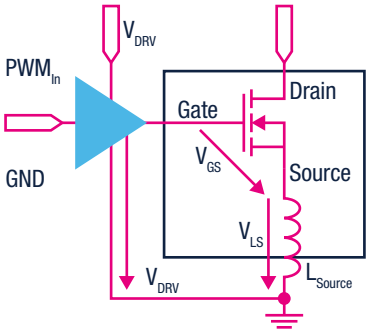
KEY APPLICATIONS

- Servers
- Telecom 5G SMPS
- Solar Microinvertes

Note: * is a registered and/or unregistered trademark of STMicroelectronics International NV or its affiliates in the EU and/or elsewhere

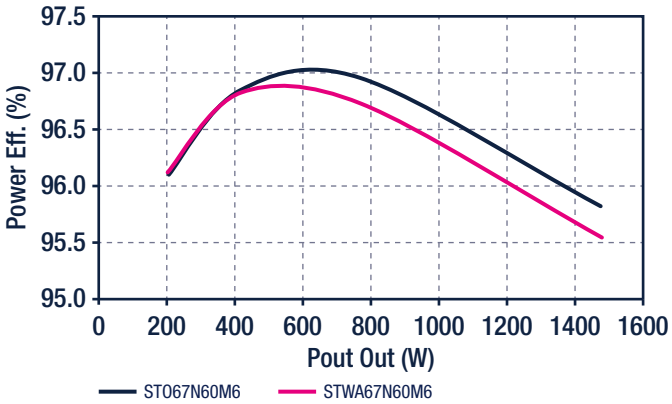
TO-LL WITH STPOWER MOSFET MDmesh M6 AND MDmesh DM6 SERIES

The TO-Leadless (TO-LL) package solution was tested against the TO-247 in the PFC and LLC sections of a 1.5 kW SMPS to compare their respective thermal performance and efficiency. The additional Kelvin-source lead generates significant efficiency gains in the PFC section at full load with high current levels, thanks to the reduction of the inductive effect on the turn-on commutation. The efficiency in the LLC section remains identical for both packages.



Power efficiency in PFC section

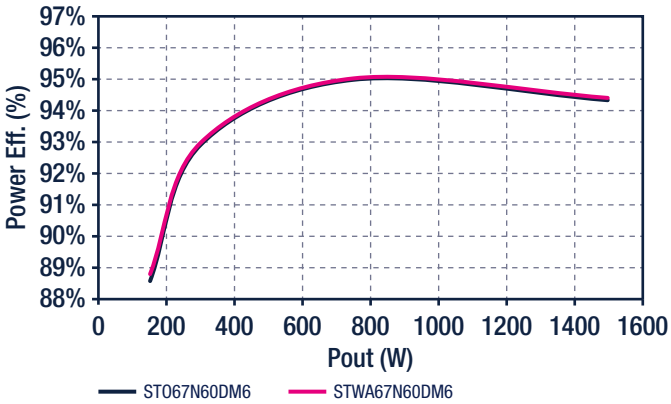
System Power Efficiency



The Kelvin-pin on the TO-LL package delivers better efficiency than the conventional TO-247 package, especially at full load.

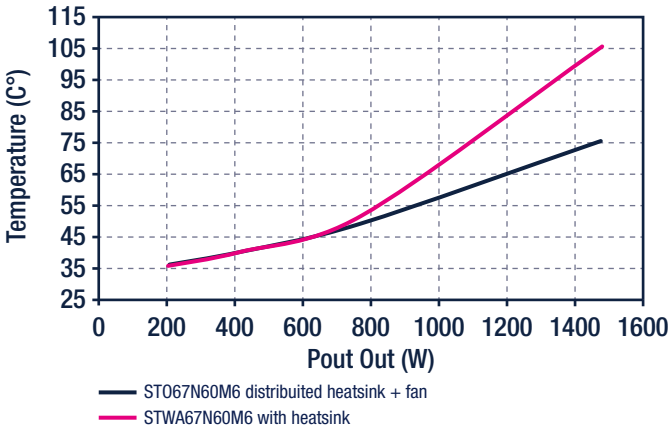
Power efficiency in LLC section

System Power Efficiency



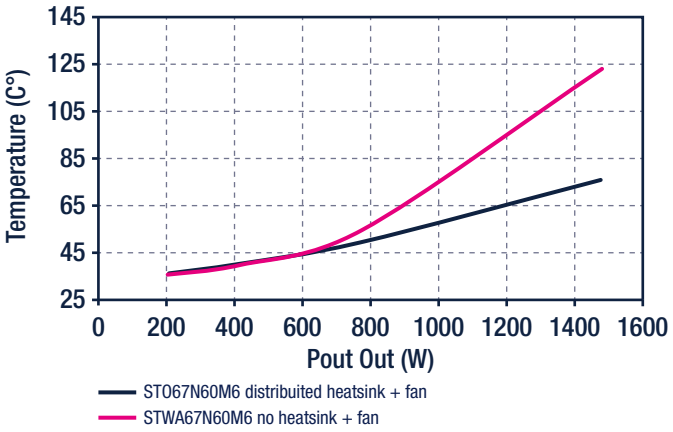
The power efficiency in the LLC is the same for both SMD and THD solutions. The Kelvin-pin does not impact efficiency because current at turn-off is very low and turn-on losses are zero due to ZVS.

Thermal comparison with same $R_{thj\text{-}amb}$



Thermal comparison beetween TO-LL and TO-247 at the same $R_{thj\text{-}amb}$ in 1.5 kW PFC.

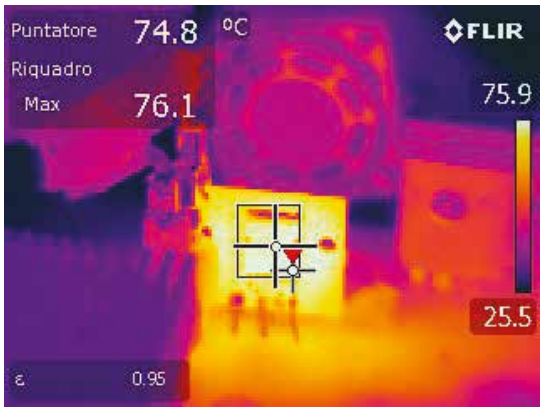
Thermal comparison with same fan



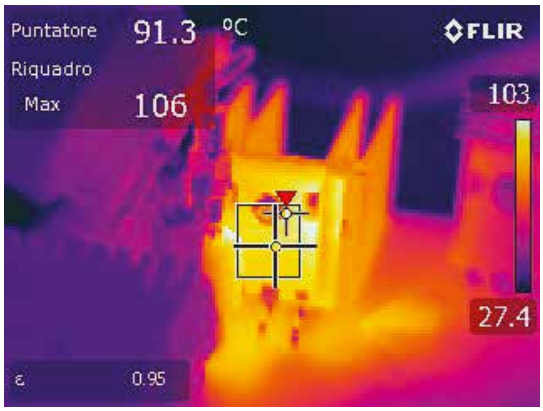
Thermal comparison beetween TO-LL and TO-247 with the same fan in 1.5 kW PFC

Thermal comparison with same $R_{thj\text{-}amb}$ in 1.5 kW PFC

TO-LL T_{case} at 1.5 kW



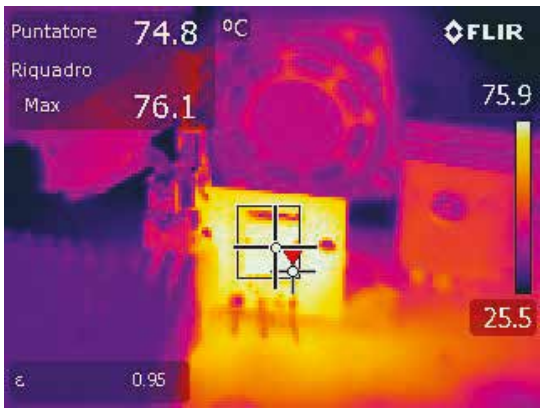
TO-247 T_{case} at 1.5 kW



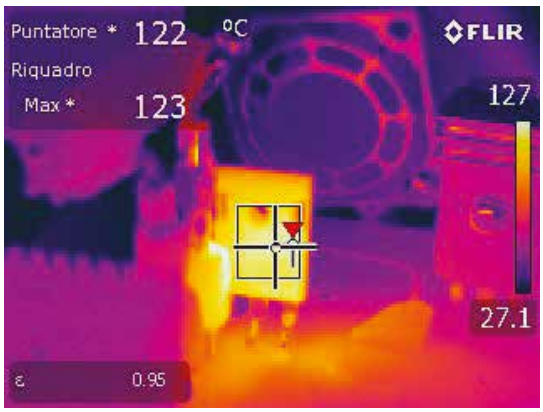
The TO-LL package generates less heat than the TO-247 option for an equivalent $R_{thj\text{-}amb}$ (in this case about 3.75 °C/W). To maintain a constant thermal resistance, we used a cooling fan for the TO-LL package, and a heatsink for the TO-247.

Thermal comparison with same fan

TO-LL T_{case} at 1.5 kW

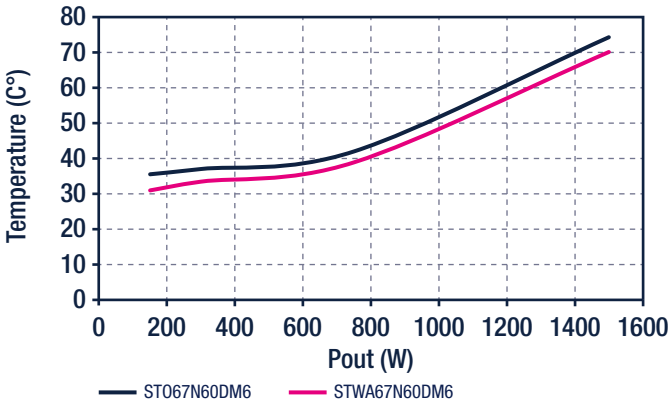


TO-247 T_{case} at 1.5 kW



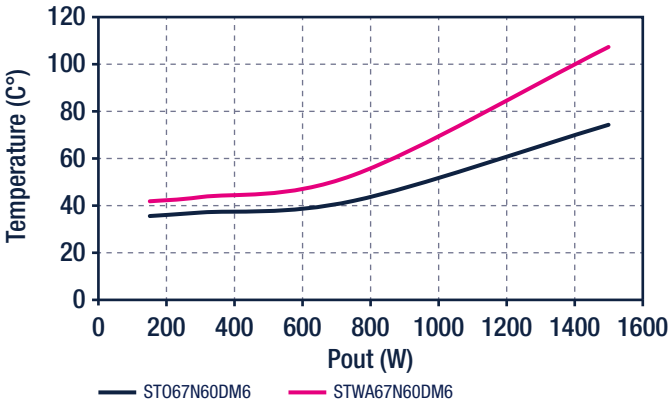
When we remove the heatsink from the TO-247 and use the same fan cooling system for both packages, the thermal performance of the TO-LL does not degrade like the TO-247.

Thermal comparison with same $R_{thj-amb}$



Thermal comparison beetween TO-LL and TO-247 at the same $R_{thj-amb}$ in 1.5 kW LLC.

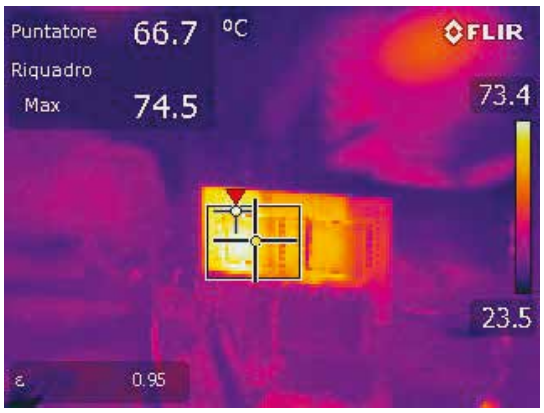
Thermal comparison with same fan



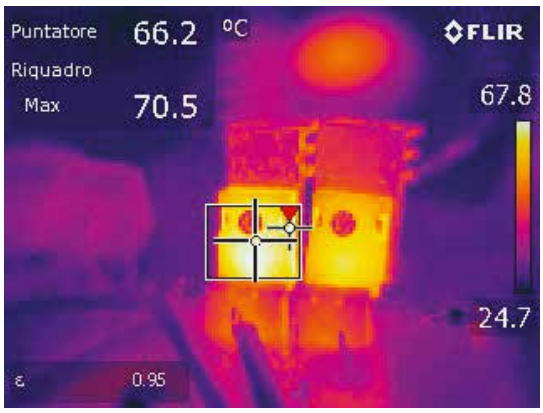
Thermal comparison beetween TO-LL and TO-247 with the same fan in 1.5 kW LLC.

Thermal comparison with same $R_{thj-amb}$ in 1.5 kW LLC

TO-LL T_{case} at 1.5 kW



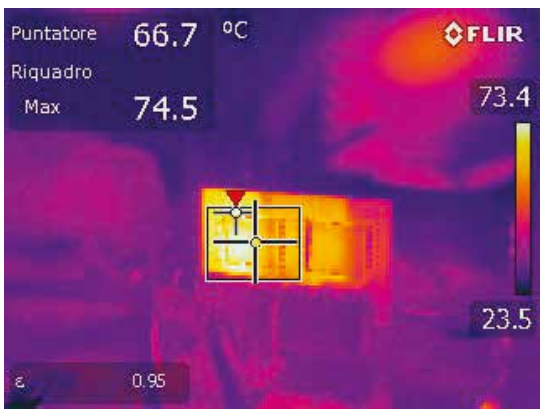
TO-247 T_{case} at 1.5 kW



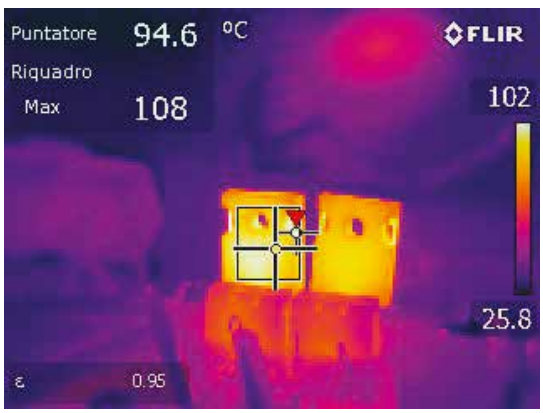
The TO-LL solution allows almost the same temperature respect the TO-247 when we use the same $R_{thj-amb}$, approximately 12.5 °C/W.
To maintain a constant thermal resistance, we used a cooling fan for the TO-LL package, and a heatsink for the TO-247.

Thermal comparison with same fan

TO-LL T_{case} at 1.5 kW



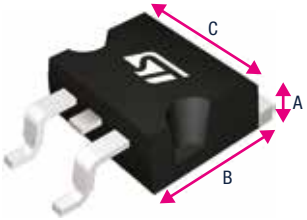
TO-247 T_{case} at 1.5 kW



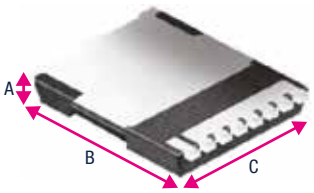
When we remove the heatsink from the TO-247 and use the same fan cooling system for both packages, the thermal performance of the TO-LL does not degrade like the TO-247.

TO-LL vs D²PAK

Size and thermal performance comparisons



D²PAK
Area on Board: 164.3 mm²



TO-LL
Area on Board: 115.6 mm²

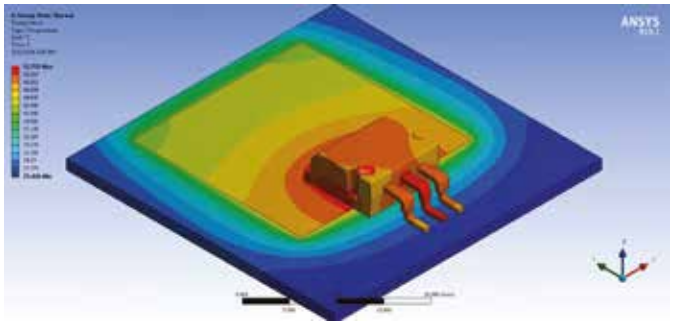
TO-LL: 30% Saved Area on Board vs D²PAK

Dimensions (mm)

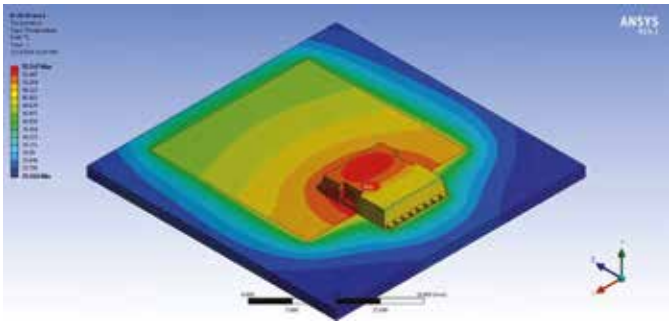
	A	B	C
D²PAK	4.6	15.8	10.4
TO-LL	2.3	11.7	9.9

TO-LL

Thermal performance comparisons



D²PAK using 1 inch² 70 µm thick Cu layer
$R_{thj\text{-}pcb}$ = 27.76 °C/W



TO-LL using 1 inch² 70 µm thick Cu layer
$R_{thj\text{-}pcb}$ = 30.55 °C/W

Product portfolio in TO-LL package

B_{VDSS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)	Q_g (nC)	Sales Type	Package	Technology
600	0.190	TBD	TBD	STO24N60M6	TO-LL	MDmesh M6
	0.125	30	38	STO33N60M6		
	0.099	34	47	STO36N60M6		
	0.080	40	57	STO47N60M6		
	0.054	38	80	STO67N60M6		
	0.078	TBD	61	STO65N60DM6*		MDmesh DM6
	0.076	40	65	STO52N60DM6**		
	0.054	38	80	STO67N60DM6		
650	0.059	34	80	STO68N65DM6		

Note: * coming soon by Q3 2020 ** coming soon by Q4 2020

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To explore the complete MDmesh M6 and MDmesh DM6 product portfolio, visit www.st.com or use our ST-MOSFET-Finder mobile app for Android and iOS.

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