OptiMOS™ power MOSFETs in TOLx family

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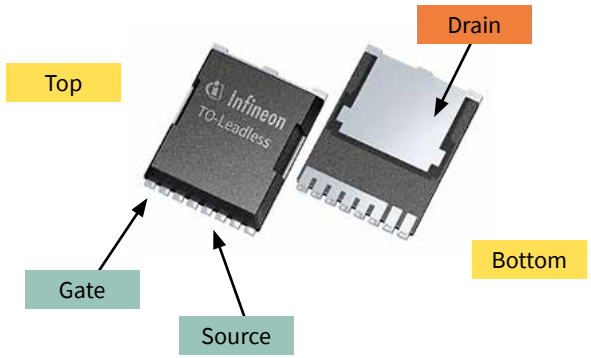
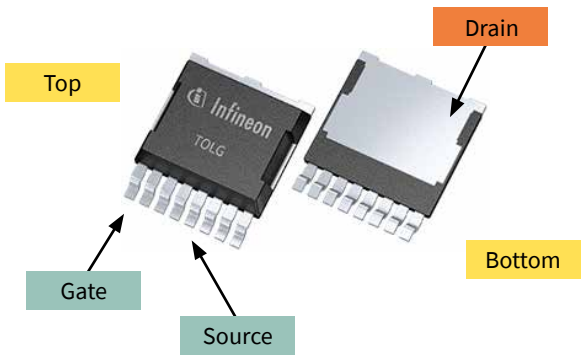
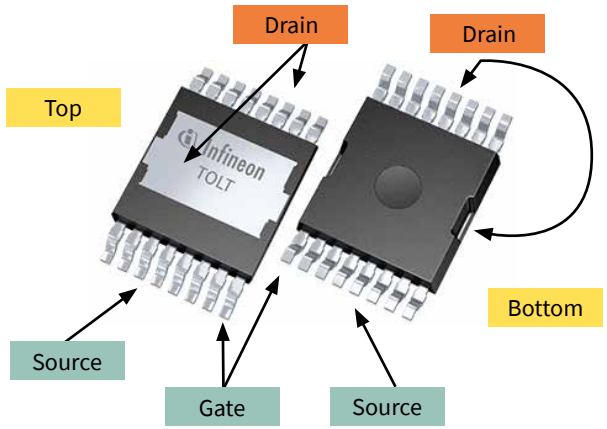
Three different packages addressing different requirements







TOLL	TOLG	TOLT
TO-Leadless	TO-Leaded with **gullwing**	TO-Leaded **top-side cooling**
Optimized for high-power applications	Optimized for better thermal cycling on board (TCoB) robustness	Optimized for superior thermal performance

TO-Leadless

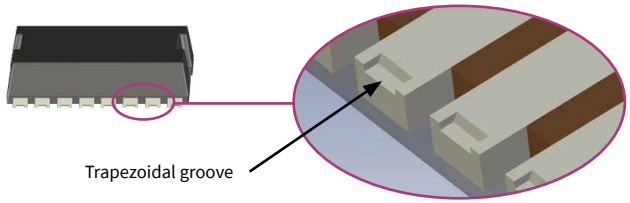
TO-Leadless offers the industry's lowest on-state resistance $R_{DS(on)}$ together with high current capability. This enables a reduction in the number of paralleled MOSFETs in high-power applications and increases power density. Additionally, 60 percent board space reduction is achievable compared to D²PAK 7-pin.

Voltage class [V]	Sales name	$R_{DS(on)}$ max. @ 10 V [mΩ]	Current rating [A]
30 V	IPT004N03L	0.40	300
40 V	IRL40T209	0.72	586
60 V	IPT007N06N	0.70	486
	IPT009N06NM5*	0.90	427
	IPT012N06N	1.20	313
80 V	IPT010N08NM5	1.05	425
	IPT012N08N5	1.20	400
	IPT012N08NF2S	1.23	351
	IPT014N08NM5	1.40	331
	IPT019N08N5	1.90	247
	IPT029N08N5	2.90	169
100 V	IPT014N10N5*	1.40	362
	IPT015N10N5	1.50	300
	IPT015N10NF2S	1.50	315
	IPT017N10NF2S	1.75	294
	IPT020N10N5	2.00	260
	IPT022N10NF2S	2.25	236
	IPT026N10N5	2.60	202
120 V	IPT030N12N3	3.00	237
150 V	IPT039N15N5	3.90	190
	IPT044N15N5	4.40	174
	IPT054N15N5	5.40	143
	IPT063N15N5	6.30	122
200 V	IPT111N20NFD	11.0	96
250 V	IPT210N25NFD	21.0	59

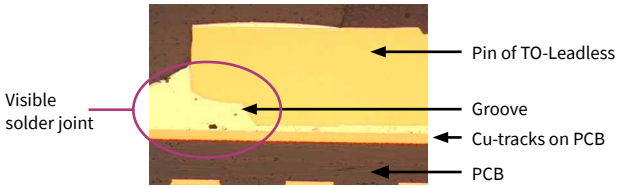
*coming soon

Furthermore, TO-Leadless has a 50 percent larger solder contact area compared to the D²PAK 7-pin, enabling lower current density, avoiding electromigration at high current levels and temperatures, resulting in improved reliability. TO-Leadless is a package without leads allowing the possibility of optical inspection due to tin plated grooved gate and source contacts.

Tinned trapezoidal grooves on the tips of gate and source contacts



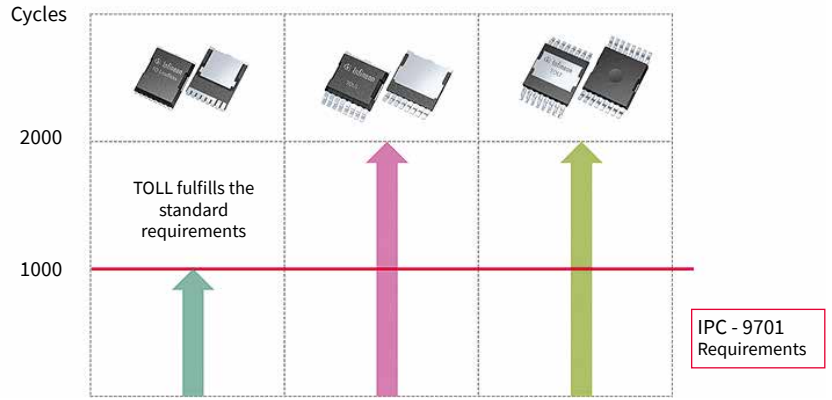
Visible solder meniscus allows a simple and inexpensive automatic optical inspection



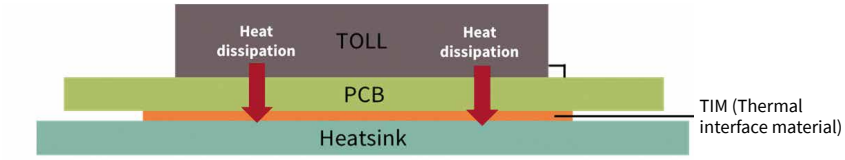
TOLG – TO-Leaded with gullwing

TOLG is the package encompassing the best features from both TO-Leadless and D²PAK 7-pin. It has the same footprint and excellent electrical performance as TOLL. The advantage of TOLG is the flexibility enabled by the gullwing leads, which offer better joint reliability on the Aluminum-IMS board. Thanks to this feature TOLG achieves two times better thermal cycling on board (TCoB) performance compared to IPC-9701 standard requirements.

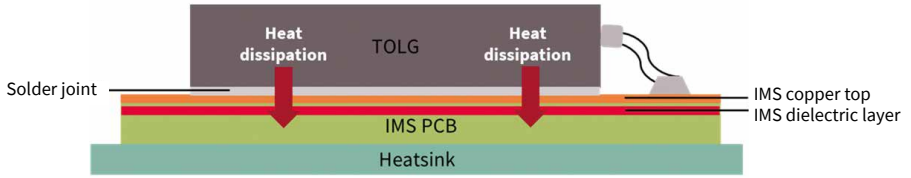
Voltage class [V]	Part number	$R_{DS(on)}$ max. @ 10 V [mΩ]	I_D [A]
60	IPTG007N06NM5	0.75	454
80	IPTG011N08NM5	1.10	408
	IPTG018N08NM5	1.80	253
	IPTG025N08NM5	2.50	184
100	IPTG014N10NM5	1.40	366
	IPTG018N10NM5	1.80	273
	IPTG025N10NM5	2.50	206
150	IPTG039N15NM5	3.90	190
	IPTG044N15NM5	4.40	174
	IPTG054N15NM5	5.40	143
	IPTG063N15NM5	6.30	122
200	IPTG111N20NM3FD	11.10	77
250	IPTG210N25NM3FD	21.00	108



Thermal cycling on board (TCoB) performance on Al-IMS board



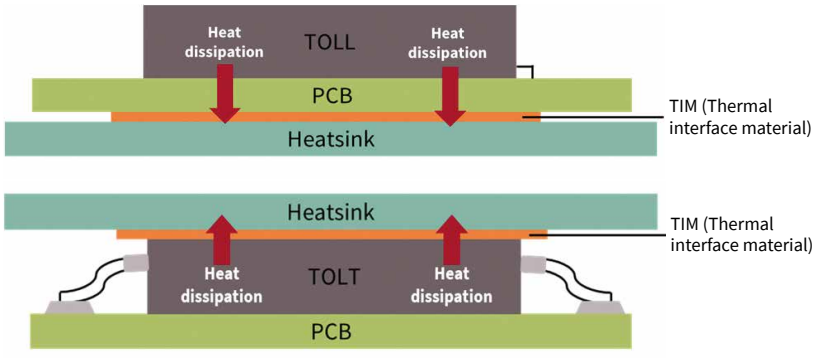
TOLL is recommended for FR4 and Cu-based IMS board



TOLG is recommended for Al-IMS board

TOLT – TO-Leaded top-side cooling

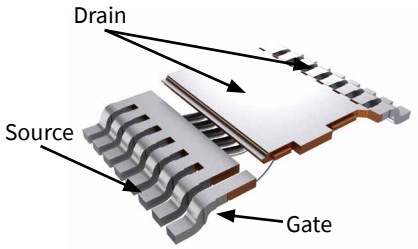
TOLT package offers the same high current low profile benefits as the TOLL package with the additional advantage of top-side cooling for optimum thermal performance.



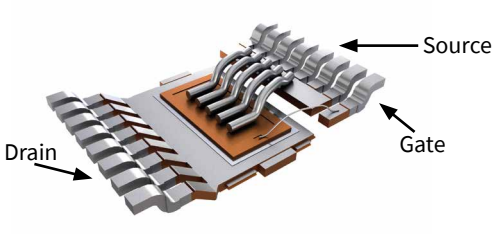
With bottom-side cooling packages, like the TOLL or the D²PAK, the heat is dissipated via the PCB to the heatsink resulting in high power losses. With top-side cooling, the drain is exposed at the surface of the package allowing the heat to be dissipated directly to the heatsink, achieving 20 percent better RthJA and 50 percent improved RthJC compared to the TOLL package.

Voltage class [V]	Part number	$R_{DS(on)}$ max. @ 10 V [mΩ]	I_D [A]
60	IPTC007N06NM5*	0.75	454
	IPTC012N06NM5*	1.2	311
80	IPTC011N08NM5	1.1	408
	IPTC014N08NM5	1.4	330
100	IPTC014N10NM5	1.4	365
	IPTC019N10NM5	1.9	279
150	IPTC039N15N5	3.9	190
	IPTC044N15N5	4.4	174
	IPTC054N15N5	5.4	163
	IPTC063N15N5	6.3	139

*coming soon

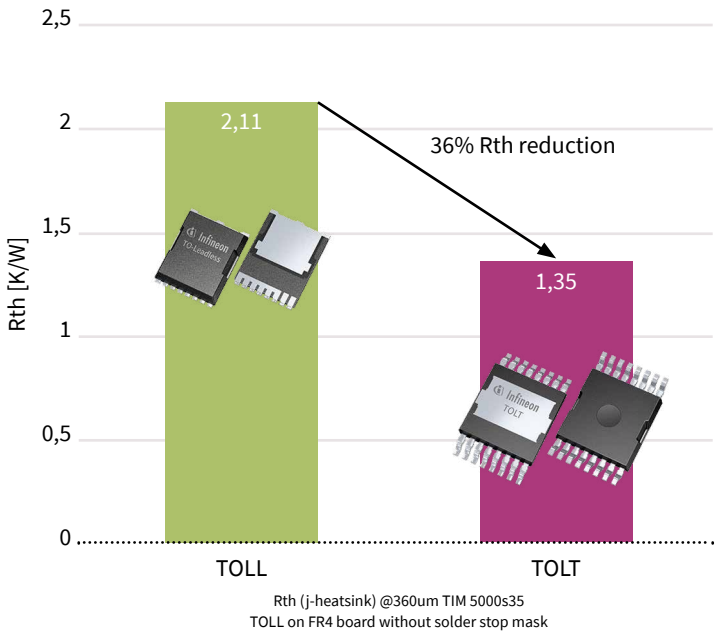


Top view w/o mould compoud



Bottom view w/o mould compoud

TOLT vs. TOLL - Thermal comparison



Rth (j-heatsink) @360um TIM 5000s35
TOLL on FR4 board without solder stop mask

To meet the same current handling as the bottom side cooling package, it is possible to significantly reduce the heatsink size with TOLT package achieving lower system cost.

Package	TOLx family features	TOLx family benefits	Package key features	Package key benefits	Target applications
TOLL	Low $R_{DS(on)}$ High current rating Lower ringing and voltage overshoot compared to D^2PAK	Reduction in conduction losses High power density, system efficiency and extended lifetime Higher efficiency by lower switching losses and lower EMI	60% board space reduction compared to D^2PAK 7pin	High power density	Light electric vehicles E-scooter E-bikes Battery management system Hotswap Power and gardening tools Drones Robotics
TOLG			Gullwing leads	Superior thermal cycling on board (TCoB) capability	
TOLT			Top side cooling Negative stand-off	Superior thermal performance Minimize thermal resistance to heatsink	