User Manual - evaluation board

650 V TRENCHSTOP™ 5 D2Pak IGBT on insulated metal substrate (IMS)

About this document

Scope and purpose

The evaluation board for the 650 V TRENCHSTOP™ 5 D2Pak IGBT on insulated metal substrate enables an easy and rapid test setup for evaluation of D2Pak IGBTs on an IMS solution.

Specifically, the evaluation board consists of a new D2Pak 40 A 650 V TRENCHSTOP™ 5 IGBT, co-packed with a 40 A diode, assembled on IMS in a half-bridge configuration.

Two versions, 40 A and 80 A, are available featuring a single D2Pak IGBT or 2 x D2Pak IGBTs in parallel per switch.

The evaluation board provides pin lead connections for IGBT gate signals, collector and emitter power signals, and additional NTC sensor signals to monitor the IMS temperature performance.
The evaluation board design allows for an evaluation of the operating performance of the D^2Pak IGBT and co-packed diode in topologies such as half-bridge, buck, and boost converter or merely as a single switch.

In summary, the evaluation board for the 650 V TRENCHSTOP™ 5 D2Pak IGBT on insulated metal substrate saves the user time and effort by providing a quick board solution to evaluate D2Pak IGBTs on an IMS solution.

Intended audience

This application note is intended for all technical specialists working with the 650 V TRENCHSTOP™ 5 D2Pak IGBT on IMS.

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1 Evaluation board specifications

1.1 40 A evaluation board general specifications, layout and dimensions

Parameter	Test conditions	Unit	Value
Thermal conductivity	ASTM D5470	W/m-K	2.0
Thermal resistance	ASTM D5470	°C/W	0.55
Thermal stress	288°C, solder dipping	s	120
Peel strength	IPC-TM-650, 2.4.8	N/mm	1.5
Volume resistivity	IPC-TM-650, 2.5.17	MΩ-cm	108
Surface resistivity	IPC-TM-650, 2.5.17	MΩ-cm	107
Dielectric constant	IPC-TM-650, 2.5.5.3, 1MHz	-	4.9
Dissipation factor	IPC-TM-650, 2.5.5.3, 1MHz	-	≤ 0.02
Breakdown voltage	ASTM D149	kV DC	3
Flammability	UL94	class	V-0
CTI	IEC60112	V	600
TG	DSC	°C	130
Halogen	Cl, Br	ppm	≤ 900
	Cl, +Br	ppm	≤ 1500

Figure 1.1. Specifications of 40 A evaluation board

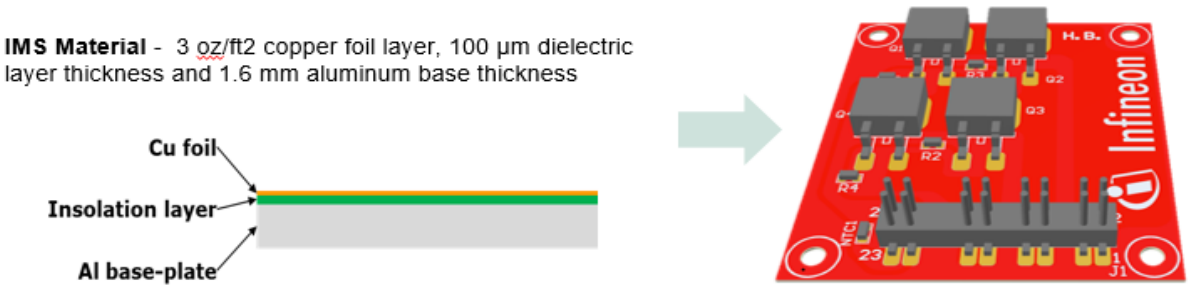
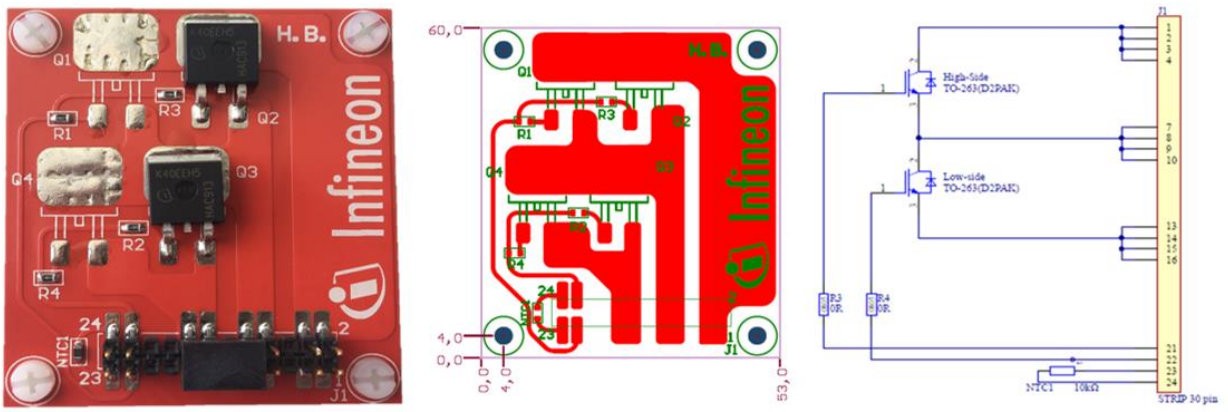


Figure 1.2. Description of the IMS material

General parameters	
Product name	EVAL-IGBT-D2PAK-40A
Product description	2 x 40 A 650 V D2Pak IGBT assembled on IMS
Configuration	Half-bridge
Maximum DC collector current per switch (D2Pak Tcase = 100°C)	46.0 A
Maximum power dissipation per switch (D2Pak Tcase = 100°C)	125 W
Dimensions	60 mm x 53 mm x 1.8 mm
Target application	PV solar inverters Industrial power supplies (UPS, SMPS) Welding converters Energy storage EV chargers

Figure 1.3. General parameters of 40 A evaluation board



a) IMS assembly b) IMS layout and dimensions c) IMS schematic

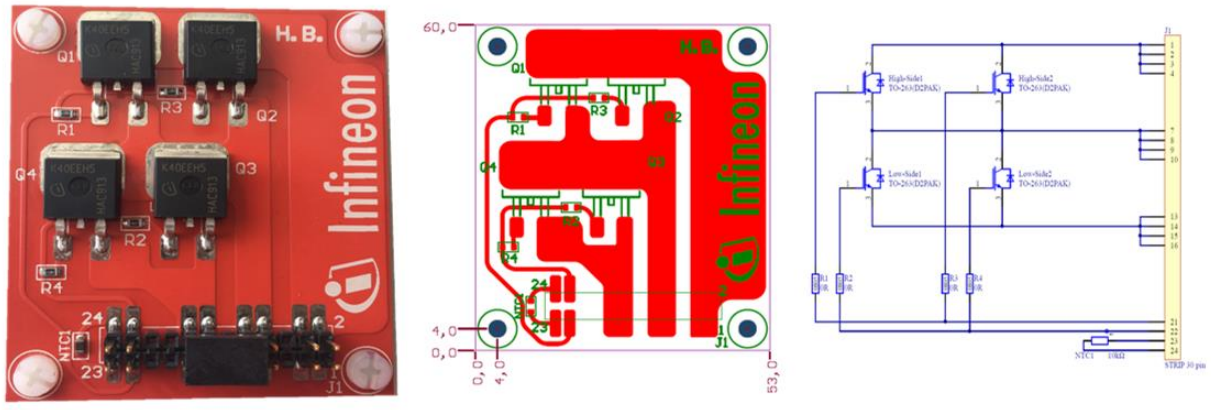
- 1 phase, half--bridge topology
- **2x** IKB40N65EH5 TRENCHSTOP™ 5 D2Pak
- **2x** Rg (gate resistor) with the value of 22 Ω ±1%, package 0805, 200mW
- NTC thermistor with the value of 10 kΩ, part number - Murata NCP21XV103J03RA
- Dimensions: 60 x 53 x 18 mm^3

Figure 1. 4. Image and description of 40 A evaluation board

1.2 General specifications, layout and dimensions of 80 A evaluation board

General parameters	
Product name	EVAL-IGBT-D2PAK-80A
Product description	4 x 40 A 650 V D2Pak IGBT assembled on IMS
Configuration	Half-bridge with 2 x D2Pak IGBT in parallel per switch
Maximum DC collector current per switch, 2 x IGBT in parallel (D2Pak Tcase = 100°C)	92.0 A
Maximum power dissipation per switch, 2 x IGBT in parallel (D2Pak Tcase = 100°C)	250 W
Dimensions	60 mm x 53 mm x 1.8 mm
Target application	PV solar inverters Industrial power supplies (UPS, SMPS) Welding converters Energy storage EV chargers

Figure 1.5. General parameters of 40 A evaluation board



a) IMS assembly b) IMS layout and dimensions c) IMS schematic

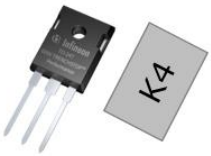
- 1 phase, half-bridge topology
- **4x** IKB40N65EH5 TRENCHSTOP™ 5 D2Pak
- **4x** Rg (gate resistor) with the value of 22 Ω ±1%, package 0805, 200mW
- NTC thermistor with the value of 10 kΩ, part number - Murata NCP21XV103J03RA
- Dimensions: 60 x 53 x 18 mm^3

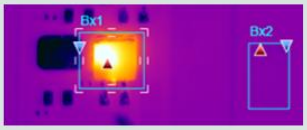
Figure 1.6. Image and description of 80 A evaluation board

2 Thermal performance

2.1 D2Pak on IMS vs. TO-247 with Sil-Pad K-4 insulation foil

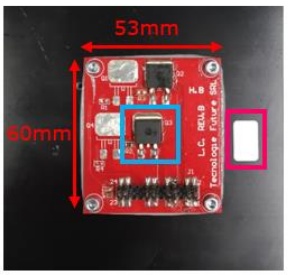


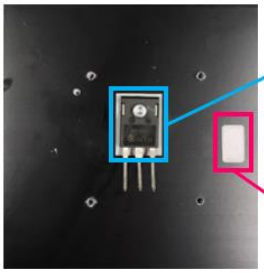


	D2PAK on IMS	TO-247 with Sil-Pad K-4
IR camera picture (same scale for all pictures)		
IGBT Case temperature T_{case} [°C]	148.4	148.9
Heat sink temperature $T_{heatsink}$ [°C]	62.4	74.2
Temperature difference ΔT [°C]	86.0	74.7
Power P [W]	78.0	57.9
Thermal resistance $Rth_{case\text{-}heatsink}$ [K/W]	**1.10**	**1.29**

Test set-up

- Same heatsink size
- Same 40 A 650 V IGBT die in D2Pak on IMS and TO-247 with insulation foil





T_{case} – max temp of this area

$T_{heatsink}$ – max temp of this area

Figure 2.1. Test results comparing 40 A duopack TRENCHSTOP™ 5 IGBT in D2Pak vs TO-247-3 using 40 A evaluation board

3 Summary - Improving system designs performance using 650 V TRENCHSTOP™ 5 D2Pak IGBT on IMS

The recently released TRENCHSTOP™ 5 IGBT in a surface-mounted D2Pak package, optimized for switching frequencies over 30 kHz, perfectly complements the previously released portfolio of TRENCHSTOP™ 5 IGBT in through-hole TO-247 packages.

The new TRENCHSTOP™ 5 IGBT in the D2Pak portfolio is a 40 A, 650 V IGBT, co-packed with a 40 A diode, the best-in-class and unique highest power density 650 V IGBT on the market in a D2Pak package.

The new TRENCHSTOP™ 5 IGBT in a D2Pak package enables designers to take advantage of the SMD package features for improving the performance and cost of system designs that typically use the TO-247 package IGBTs.

For instance, Infineon's 4 kW welding machine power supply demo board based on a half-bridge converter topology using SMD on an IMS solution demonstrates the improved efficiency of the power converter, delivering lower operating temperatures and reliable switching performance with lower turn-off voltage overshoot on IGBT.

In summary, the system's design with SMD IGBTs assembled on IMS provides not only improved electrical and thermal performance, but also reduces the system's size and weight.
For more information related to 650 V TRENCHSTOP™ 5 D2Pak IGBT on IMS application, please refer to Infineon's application note AN2018-23:
https://www.infineon.com/dgdl/Infineon-650V_TRENCHSTOP_5_D2Pak_IGBT-AN-v01_00-EN.pdf?fileId=5546d46265f064ff0166435041e50bab

4 References

[1] AN2018-23 - 650 V TRENCHSTOP™ 5 D2Pak IGBT - Improving performance of a portable welding machine power supply using SMD on IMS https://www.infineon.com/dgdl/Infineon-650V_TRENCHSTOP_5_D2Pak_IGBT-ApplicationNotes-v01_00-EN.pdf?fileId=5546d46265f064ff0166435041e50bab

[2] AN2019-10 - TO-247PLUS IGBT discrete device enhances power density in welding machines extending the range of use of discrete IGBTs to power levels typically achieved by standard IGBT modules https://www.infineon.com/dgdl/Infineon-TO-247PLUS_IGBT_discrete_device_enhances_power_density_in_welding_machines-ApplicationNotes-v01_00-EN.pdf?fileId=5546d4626b2d8e69016bacf10e2c2515

Note: All listed reference materials are available for download on Infineon's website www.infineon.com/.

5 Revision History

Major changes since the last revision

Page or Reference	Description of change
	Revision 1.0 – First Release – Blaz Klobucar / Jorge Cerezo / Tetiana Kolosenko

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