

New Automotive Grade 1200 V SiC MOSFET-based Intelligent Power Module for Auxiliary Motor Drive Applications on BEVs

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Introduction

The rapid electrification in battery electric vehicles (BEVs) is driving the demand for compact, highly efficient, and automotive-qualified auxiliary motor drive systems. Conventional Si-based IPMs have been adopted; however, increasing switching frequency, power density, and thermal requirements have exposed the limitations of silicon technology.

To overcome these challenges,

- Infineon has developed a **new automotive-grade 1200 V CoolSiC™ MOSFET-based CIPOS™ Maxi IPM**.
- The module integrates **second-generation (G2) CoolSiC™ MOSFETs**, a 6-channel SOI gate drive IC, an NTC thermistor, and high-performance DCB substrate in a compact transfer-molded DIP package.

The proposed solution provides high efficiency, high power density, and superior thermal performance while meeting automotive qualification requirements. This poster presents the module architecture and thermal performance for BEV auxiliary motor drive applications.

Key features

- **AQG324 qualified module**
- **1200 V CoolSiC™ trench-type MOSFET technology**
- **1200 V 6-channel SOI single gate driver IC**
 - Rugged SOI gate driver technology with stability against transient and negative voltages
 - Integrated bootstrap functionality
 - Overcurrent shutdown
 - Undervoltage lockout at all channels
 - Multifunctional RFE pin
 - All six switches turn off during protection events
 - Allowable negative V_S potential of up to -11 V for signal transmission at $V_{BS} = 15\text{ V}$
- Built-in NTC thermistor for temperature monitoring
- Low-side emitter pins accessible for phase current sensing (open emitter type)
- Fully isolated, dual-in-line molded DCB package

Product overview

Product lineup

Product	$R_{DS(on)}$	Applications
AIM12S25EB1	25 mΩ	Automotive auxiliary inverter such as eCCs, HV oil pumps, and fans
AIM12S36EB1	36 mΩ	
AIM12S54EB1	54 mΩ	
AIM12S83EB1	83 mΩ	
AIM12S112EB1	112 mΩ	

Package overview

Internal block diagram

Package

Internal structure

Insulation distance

Heatsink design guidelines

Electrical characteristics (Static)

Static characteristics (AIM12S25EB1, 1200 V, 25 mΩ)

(a) MOSFET Drain-source voltage, V_{DS} [V]

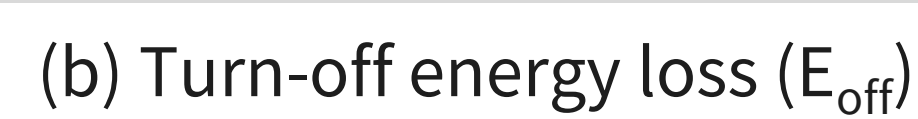
(b) Source-drain voltage, V_{SD} [V]

- Low $V_{DS(on)}$ minimizes conduction loss, contributing to reduced junction temperature
- Stable reverse-conduction characteristics improve thermal performance under inverter operation

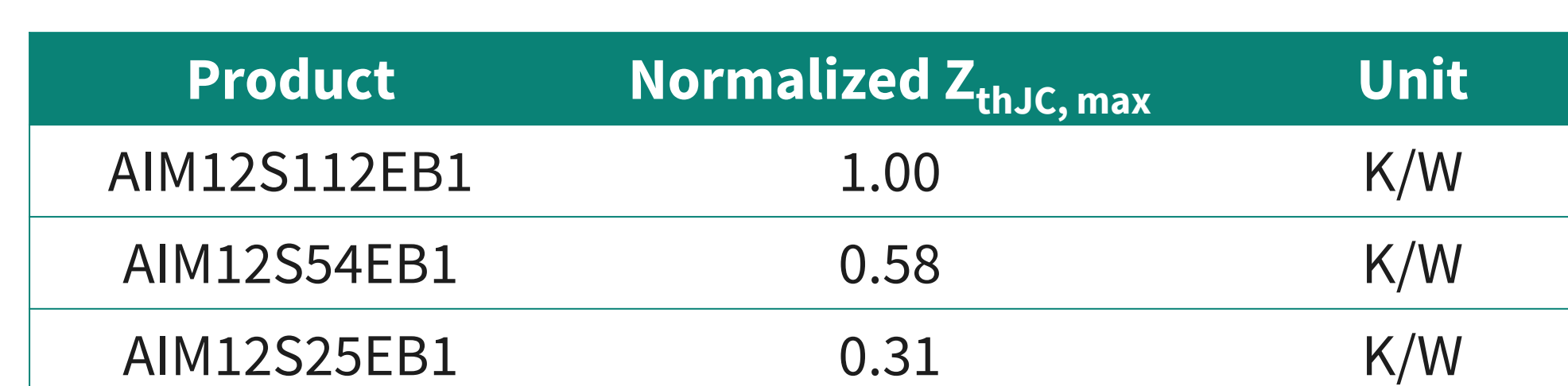
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Dynamic characteristics (AIM12S25EB1, 1200 V, 25 mΩ)



Normalized transient thermal impedance



Thermal performance environment

Technical drawing of the top view of the mould. The drawing shows a rectangular mould with an 'Adaptor plate' at the top. Dimensions are indicated: a total width of 81.3 mm, an internal width of 74.0 mm, a top edge thickness of 3.2 mm, a top edge height of 4.4 mm, and a distance of 11.5 mm from the top edge to the start of the internal cavity.

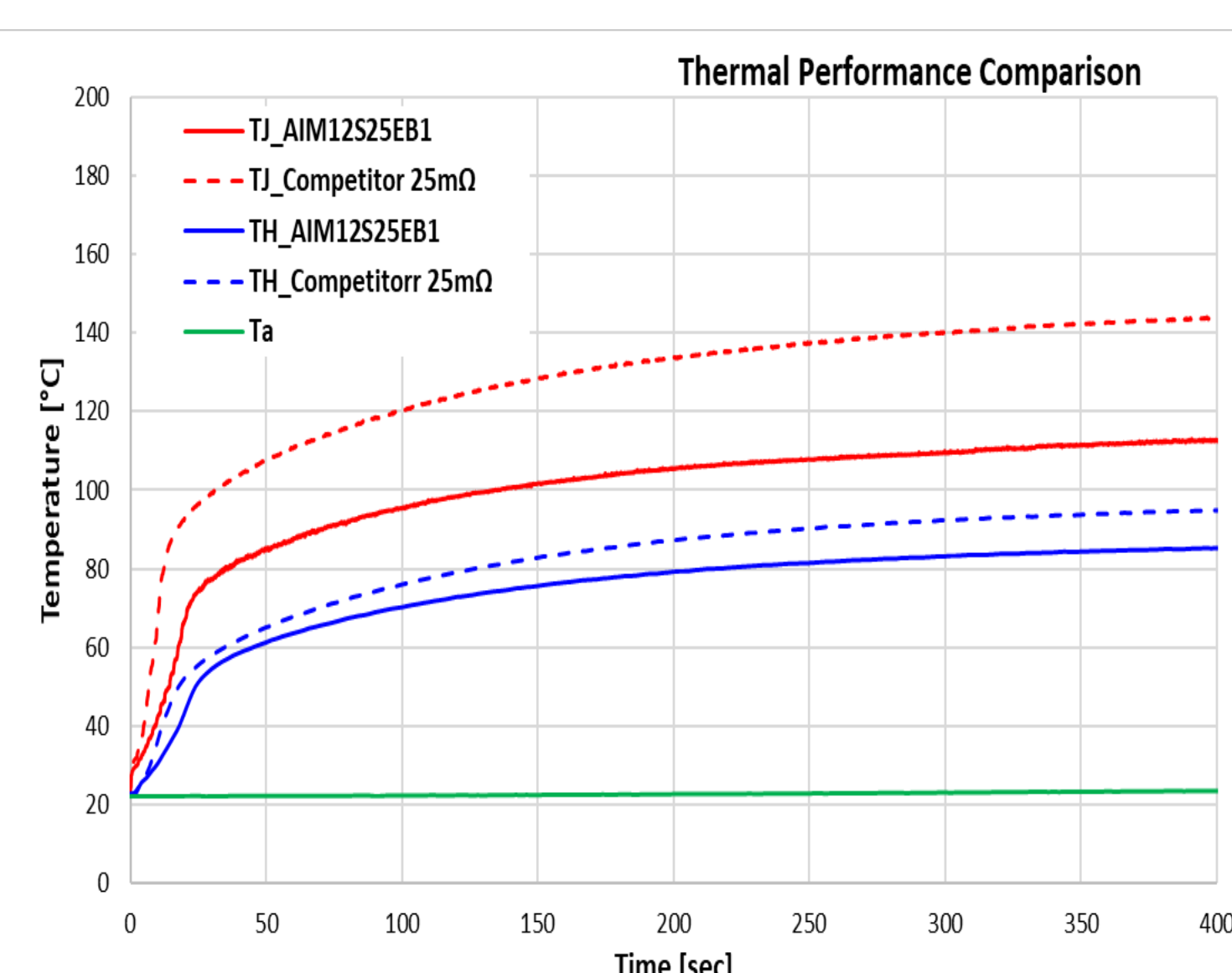
(a) Temperature measurement point

(b) Heatsink information

- Heatsink temperature: T_H / Ambient temperature: T_A / Junction temperature: T_J
- T_H and T_A were measured using a thermocouples

ΔT_{CA} measurement results for AIM12S25EB1 (1200 V, 25 m Ω)

Test conditions: $V_{DC-link} = 800$ V, $V_{DD} = 18$ V, SVPWM, P.F. = 0.9286, M.I. = 0.808, $I_0 = 30$ A_{peak}, $f_{SW} = 20$ kHz, $f_0 = 120$ Hz



f _{SW} = 20 kHz						
Product	T _J	T _H	T _A	ΔT _{JA}	Unit	Remark
AIM12S25EB1	112.6	85.2	23.4	89.3	°C	▼ 31.1°C
Competitor	143.8	94.8	23.5	120.4	°C	

This poster introduces an automotive-grade 1200 V SiC MOSFET-based IPM for BEV auxiliary motor drive applications. Experimental results demonstrate low electrical losses and improved thermal performance compared with a competing molded SiC IPM. The improved thermal characteristics confirm the effectiveness of the proposed DCB-based package architecture and its suitability for demanding automotive auxiliary inverter applications.