HybridPACK™ Drive G2 for Traction Inverter

Infineon Technologies AG

May 2024

Infineon offers all components for Traction Inverters
The one-stop shop for competitive application solutions

Functional Safety

- Complementing and interoperable chip set
- ISO26262 compliance
- Harmonized Documentation

Traction Inverter

- Overview
- Products
- Documents
- Videos
- Training
- Support

Products

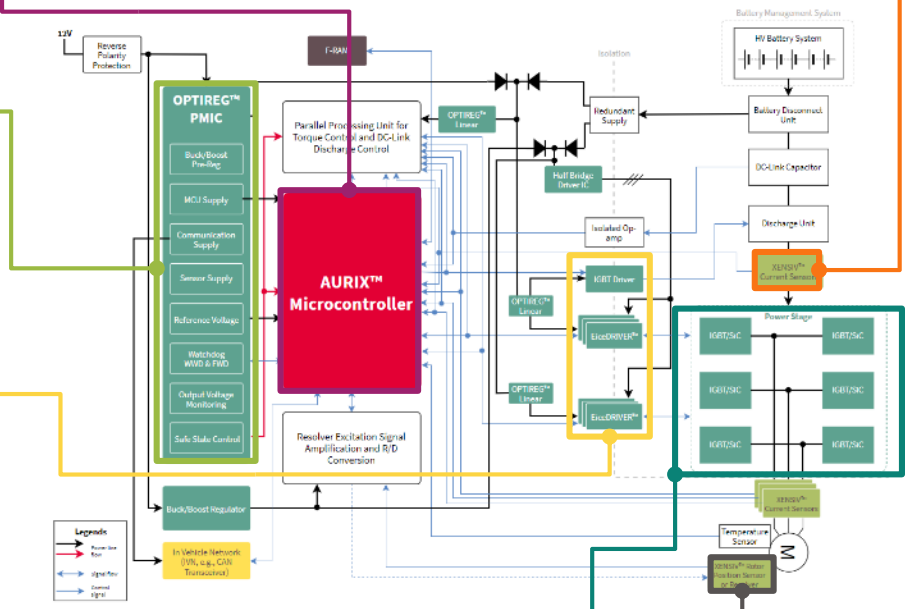
- Microcontroller
- Driver Stage
- PMIC
- CAN Transceiver
- Memory
- IGBT Modules / SiC Modules
- Position Sensor

Microcontrollers	IFX product offering
AURIX™	Multi-core device Safety & security Scalable across xEV

Power Supply	IFX product offering
OPTIREG™ PMIC	Functional Safety OPTIREG™ PMIC TLF35584 – for safety relevant applications

Gate Driver	IFX product offering
EiceDRIVER™	Increase system efficiency and lifetime Reduction of system cost

Current sensors	IFX product offering
XENSIV™	AC current measurement ADC interface Standalone sensor



Power Switches	IFX product offering
Modules, Discretes, Bare Dies	Broad product family WBG: Si, SiC High volume experience

Current Sensor
Highly accurate & core-less Enables compact designs Module from partner Swoboda in development

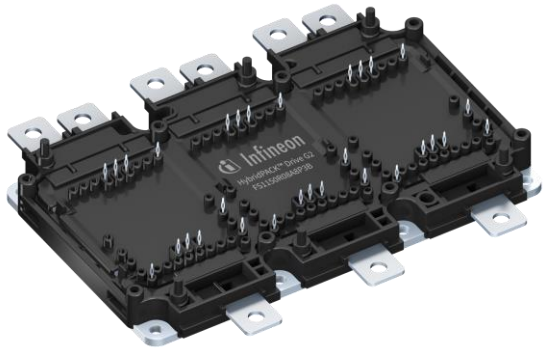
Position sensors	IFX product offering
XENSIV™	Integrated end-of-shaft rotor position sensing solution More compact design

Target Application: Traction Inverter
Infineon's latest development for Automotive Power Modules

HybridPACK™ Drive G2
Higher power density with Infineon's latest IGBT and SiC technologies

eMobility

Traction inverter



Motivation

– A clear trend in the traction inverter application, globally, is the increased demand for efficiency and performance, which translates into higher inverter power, lower losses, reduced cooling effort and a better power to cost ratio.

Product description

– Incorporating Infineon's latest IGBT and SiC technologies (EDT3 and CoolSiC™ G2 options) and maximizing chip size inside the well established HybridPACK™ Drive form factor, the HybridPACK™ G2 offers higher power with a better power to cost ratio and benchmark power cycling capability compared to its first generation.

HybridPACK™ product families cover the full performance spectrum

~ Power Class*	Medium		High			Ultra High		
	60 kW	90 kW	120 kW	150 kW	180 kW	200 kW	250 kW	>300 kW

● Production
● Development

HybridPACK™ Drive G2

1200V


● **FS410**


● **FS520**


● **FS03MR12 SiC**


● **FS02MR12 SiC**


● **FS01MR12 SiC**

750V


● **FS1000**


● **FS1150**


● **FS01MR08 SiC**

HybridPACK™ Drive G1

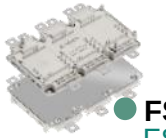
1200V

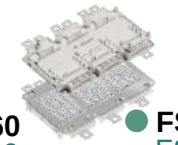

● **FS380**
FS380

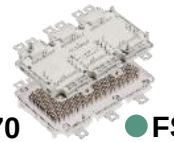

● **FS05 SiC**
FS05

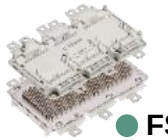

● **FS03 SiC**
FS03

750V


● **FS660**
FS660


● **FS770**
FS770


● **FS820**
FS820


● **FS950**
FS950

HybridPACK™ DC6

705/750V


● **HP DC6**
FS400R07A3E3


● **HP DC6 Wave**
FS400R07A3E3_H6


● **HP DC6i**
FS650

HybridPACK™ 1

650V


● **HP Light**
FS200R07A5E3_S6


● **HP1**
FS200R07A1E3
FS400R07A1E3
FS400R07A1E3_S7 (Enhanced)

750V


● **HP 2**
FS900R08A2P2_B31
FS900R08A2P2_B32

* Inverter power depends on individual system design of our customers

HybridPACK™ G2
Power your inverter with most scalable portfolio across Si & SiC

Subject to change

	750 V	1200 V		
SiC G2		1.1mΩ	2.9mΩ	2.2mΩ	1.5mΩ
		FS01	FS03	FS02	FS01
IGBT EDT3	~ 750 A_{rms}	~900 A_{rms}	~ 315 A_{rms}	~395 A_{rms}
	FS1000	FS1150	FS410	FS520

SOP Sample

HybridPACK™ Drive G2 Si IGBT 1200V / 750V
Portfolio Overview

Subject to change

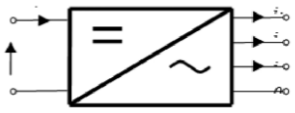
HybridPACK™ G2

Picture

Timeline

	EES	ES	QS	SOP
FS1000	●	●	Q2/24	Q4/24
FS1150	●	●	Q1/24	Q2/24
FS410	●	●	Q3/24	Q3/24
FS520	●	●	Q2/24	Q2/24

Key Applications



Traction Inverter

Features

- New EDT3 750V and EDT(1) 1200V technologies with improved thermal stacks
- Long AC tabs optional, to enable current sensing
- Lower AC contact resistance and increased tabs thickness (1,5mm)
- Improved pin rivet ensuring high robustness over entire temperature range
- PinFin baseplate for direct cooling
- Die attach technology with sintering

Portfolio Overview

Products	Voltage	Arms	Substrate Variant	AC Tab Thickness
FS1150	750	900	SiN (A8)	1.5mm
FS1000	750	750	Al_2O_3 (A7)	1.0mm
FS520	1200	395	SiN (A8)	1.5mm
FS410	1200	315	Al_2O_3 (A7)	1.0mm

Customer Benefits

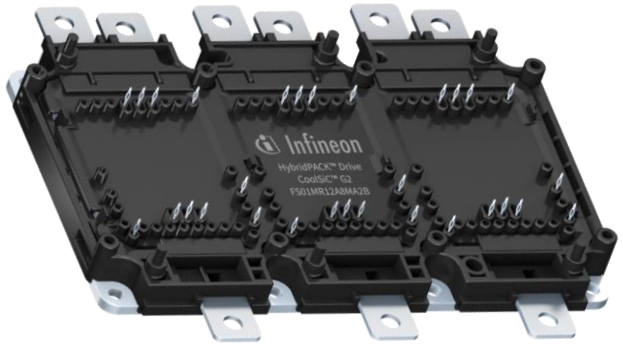
- High robustness over entire temperature range
- Supports continuous operating temperature @175°C and Peak@185°C (FS1150, FS1300)
- >900Arms continuos possible (Gen1 ~550 Arms)
- Improved thermal conductivity
- Increased durability especially in harsh environment

HybridPACK™ Drive G2 SiC 1200V / 750V Portfolio Overview

Subject to change

HybridPACK™ G2

Module



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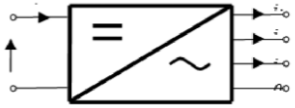


Traction Inverter

Features

- ATV CoolSiC™ Trench MOSFET Gen2
- Enhanced Package (sintered, performance ceramic)
- PinFin baseplate for direct cooling
- Supports continuous operating temperature at 175°C
- Supports peak operating temperatures at 190°C
- Improved Pin Rivet. High robustness over entire temperature range
- Long AC tabs optional, to enable current sensing
- Lower AC contact resistance and lower tab temperature

Portfolio Overview

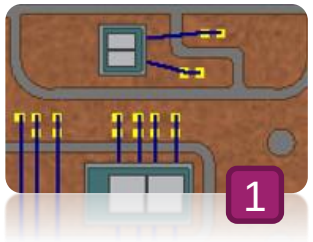
Products	Voltage	R_{DSon}*	Status	ES	QS	SOP
FS01MR08	750V	1.1 mOhm	In production			Production
FS01MR12	1200V	1.5 mOhm	In development	●		Q4/2024
FS02MR12	1200V	2.2 mOhm	In production			Production
FS03MR12	1200V	2.9 mOhm	In development		●	Q3/2024

Customer Benefits

- Superior gate oxide and cosmic ray reliability
- Enable scalable inverter platform development
- Reduces inverter losses by 2/3rd vs. state of the art IGBT solutions
- Operation up to 900Arms peak current with enhanced products

*TYP RDSON at 25°C [mΩ],
For peak current, please refer to performance curve

HybridPACK™ Drive G2 package enhancements

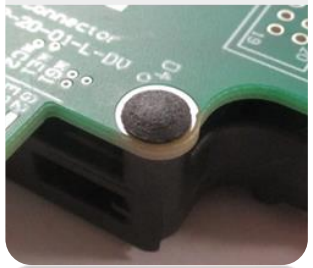


Sintered:

- Temperature sensor
- Automotive Si/SiC 1200 V / 750 V various population options

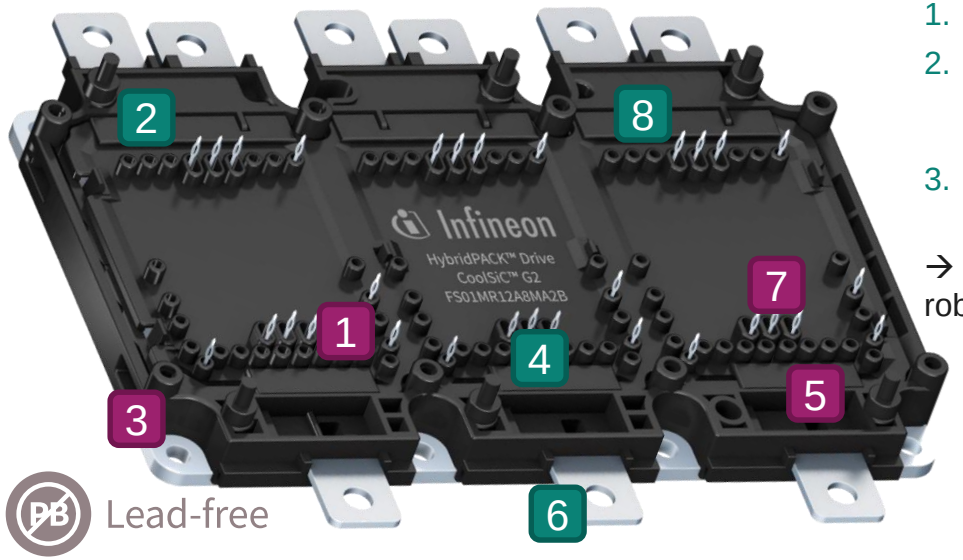
6x Heat stake Dome. **Reduced system BOM.** More effective PCB area.

Backup Ejot screws are also available.

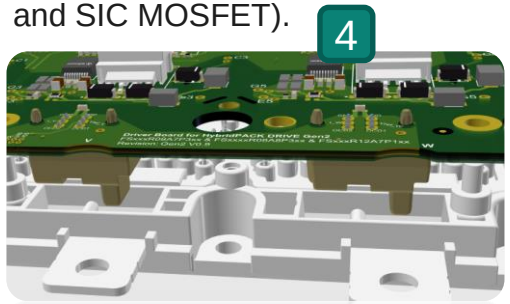


HPD Si & SiC G1/G2

Well known PinFin Baseplate



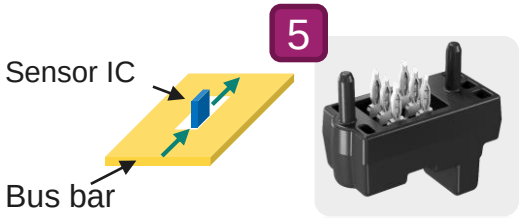
Sensor Module: 100% vertical mounting. No core. High accuracy. One Sensor fits all Drive G2 (IGBT and SIC MOSFET).



Enhanced Robustness

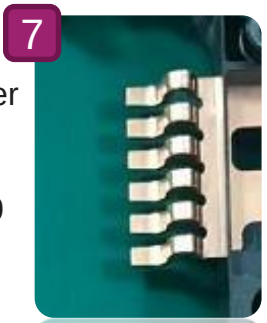
1. G2 Pin Rivet Connection
2. Sintered die attach
   Further improvement of Power Cycling capability by factor 5
3. Enhanced bond wire technology

→ Significant achievement in robustness (TST, PCB, Pcsec)



Tab slot to enable differential HALL sensors & current sensor from Swoboda-IFX with core-less sensing technology

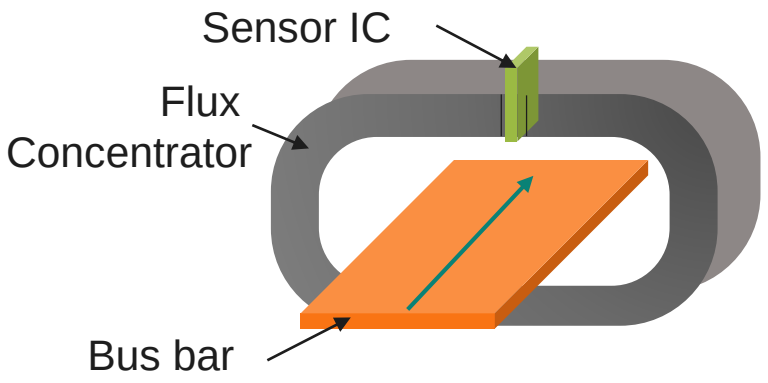
Lower AC contact resistance and lower tab temperature. Continuous **currents up to 900 Arms** with enhanced products



Short and Long AC Tabs.

Long tab for simultaneous LEM & diff Hall testing

Swoboda current sensor module scalable for complete HybridPACK™ Drive G2 portfolio



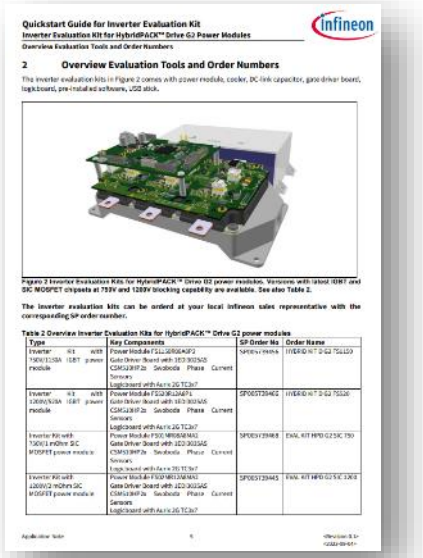
Easy platform migration

- Scalability cross whole HybridPACK™ Drive G2 portfolio
- Easy migration for preferred power segments

Less cost & complexity

- Eliminate long tab
- No magnetic concentrator
- Reduce assembly time

HybridPACK™ Drive G2 Inverter Evaluation Kit


Quickstart Guide for Inverter Evaluation Kit
Inverter Evaluation Kit for HybridPACK™ Drive G2 Power Modules
Overview Evaluation Tools and Order Numbers

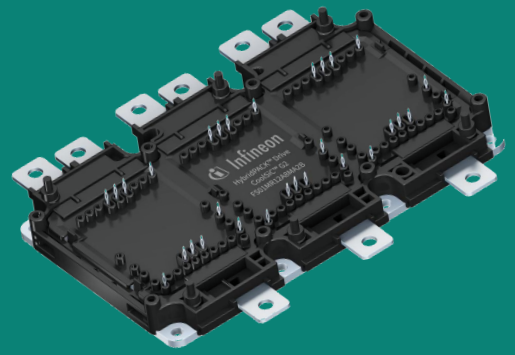
2 Overview Evaluation Tools and Order Numbers

Power Module	Driver	Sensor	Order code
IGBT 750V 1150A FS1150R08A8P3	1EDI3025AS	Swoboda CSM510HP2x	SP005739456 EV INV HPD2 SI FS1150 08
IGBT 1200V/520A FS520R12A8P1	1EDI3025AS	Swoboda CSM510HP2x	SP006038374 EV INV HPD2 SI FS520 12
SiC 750V/1 mOhm FS01MR08A8MA2	1EDI3035AS	Swoboda CSM510HP2x	SP005739468 EV INV HPD2 SIC FS01 08
SiC 1200V/2 mOhm FS02MR12A8MA2	1EDI3035AS	Swoboda CSM510HP2x	SP006056146 EV INV HPD2 SIC FS02 12

The inverter evaluation kits comes with two boards: power board & logic board.
- power board includes 1)power module 2) cooler 3)DC-link capacitor 4)gate driver
- logic board includes AURIX 2G TC3x7, pre-installed software, USB stick

Infineon offers the most scalable portfolio in a single footprint for traction inverter application

HybridPACK™ Drive package was invented by Infineon and with a track record of almost 8.5 units sold since 2017, it is Infineon's market leading power module family for electric vehicles	Market success
HybridPACK™ Drive G2 offers several package enhancements such as Rivet, Heat stake Domes, PinFin Baseplate, phase current sensors modules, and much more	G2 innovation
Infineon is the one-stop shop for Traction Inverters components. HybridPACK™ Drive G2 offers a seamless connection with EiceDRIVER™ and XENSIV™ current sensor	System solution



Summary


Infineon