



GENESIS

**Boost-Bridge IGBT Module with SiC Diodes
for Efficient Inverters**

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GENESIS

BOOST-BRIDGE IGBT MODULE WITH SiC DIODES FOR EFFICIENT INVERTERS

Genesis is a complete power stage integrated on a module for single phase photovoltaic inverters. With 50 Amps and 600 V ratings is targeted for residential applications (2.5 to 6 KVA).

Best in class semiconductors are integrated inside the module: Trench IGBTs for best compromise between conduction and switching losses, Silicon Carbide diodes to reduce switching losses and improve the EMI signature and FRED silicon diodes for boost bypass at high input voltages and protection against reverse panel string connection.

Genesis is implementing a flexible, proven and easy to use power topology: a boost stage that supports the Maximum Power Point Tracking of the photovoltaic string followed by a single phase bridge for the DC to AC power conversion.

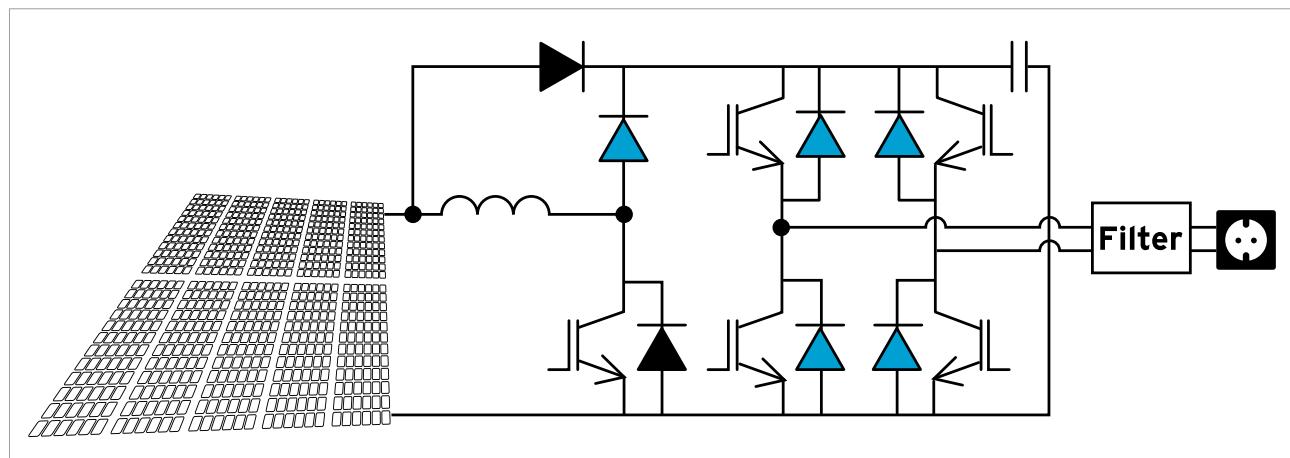
Designers can avoid mounting and thermal issues of discrete semiconductors using the Genesis module with improvements in reliability, performance and manufacturing time. Genesis is using the popular Econo2 package. That's a standard package with copper base plate widely accepted with proven reliability in thousands



PRODUCT SUMMARY

V_{CES}	600 V
$V_{CE(on)}$ (typical) at 50 A	1.65 V
t_{sc} at $T_J = 150^\circ\text{C}$	5 μs
I_C at $T_C = 95^\circ\text{C}$	50 A

of industrial applications. With state of the art semiconductors integrated using low stray inductance design techniques, Genesis is offering a simple upgrade migration path for customers already using sixpack econo modules in single phase inverters that will benefit of the increase in efficiency and lower EMI.



Simplified Application Circuit: MPPT Boost + DC/AC Inverter

ABOUT EBV ELEKTRONIK

EBV Elektronik, an Avnet (NYSE:AVT) company, was founded in 1969 and is the leading specialist in European semiconductor distribution. EBV maintains its successful strategy of personal commitment to customers and excellent services. 230 Technical Sales Specialists provide a strong focus on a selected group of long-term manufacturing partners. 120 continuously trained Application Specialists offer extensive application know-how and design expertise. Warehouse operations, complete logistics solutions and value-added services such as programming, taping & reeling and laser marking are fulfilled by Avnet Logistics, EBV's logistical backbone and Europe's largest service centre. EBV operates from 60 offices in 27 countries throughout EMEA (Europe – Middle East – Africa). For more information about EBV Elektronik, please visit ebv.com.

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BOOST SINGLE PHASE INVERTER, 50 A

FEATURES

- Low $V_{CE(on)}$ Trench IGBT technology
- Silicon carbide diode technology
- FRED Pt® 1.0 diode
- 5 μ s short circuit capability
- Square RBSOA
- Positive VCE(on) temperature coefficient
- Low stray inductance design
- Speed 4...30 kHz
- Compliant to RoHS Directive 2002/95/EC
- Designed and qualified for industrial market

BENEFITS

- Benchmark efficiency for power converter
- Rugged transient performance
- Low EMI, requires less snubbing
- Direct mounting to heatsink
- PCB solderable terminals
- Low junction to case thermal resistance

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Single Phase Inverter Q1 to Q4, D1 to D4	Maximum operating junction temperature	T_J		175	°C
	Storage temperature range	T_{Stg}		- 40 to + 175	
	Isolation voltage	V_{ISOL}	AC (1 min)	2500	V
	Collector to emitter voltage	V_{CES}		600	V
	Gate to emitter voltage	V_{GES}		± 20	
	Continuous collector current	I_C	$T_C = 25$ °C	75	A
			$T_C = 80$ °C	56	
	Pulsed collector current	I_{CM}		192	A
	Clamped inductive load current	I_{LM}		192	A
Boost QB, DB, D1b	Power dissipation (IGBT)	P_D	$T_C = 25$ °C	200	W
			$T_C = 80$ °C	127	
	AP diode continuous forward current	I_F	$T_C = 25$ °C	27	A
			$T_C = 80$ °C	19	
	Collector to emitter voltage	V_{CES}		600	V
	Gate to emitter voltage	V_{GES}		± 20	
	Continuous collector current	I_C	$T_C = 25$ °C	75	A
			$T_C = 80$ °C	56	
	Pulsed collector current	I_{CM}		192	A
	Clamped inductive load current	I_{LM}		192	A
Capacitor	Power dissipation (IGBT)	P_D	$T_C = 25$ °C	200	W
			$T_C = 80$ °C	127	
	Repetitive peak reverse voltage boost diode DB	V_{RRM}		600	V
	Continuous forward current boost diode DB	I_F	$T_C = 25$ °C	40	A
			$T_C = 80$ °C	29	
	Continuous forward current anti parallel diode D1b	I_F	$T_C = 25$ °C	76	A
			$T_C = 80$ °C	50	
	Maximum DC voltage	$V_{max.}$		500	V
By Pass Diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Continuous forward current	I_F	$T_C = 25$ °C	65	A
			$T_C = 80$ °C	40	



ABOUT VISHAY

Vishay Intertechnology, Inc., a Fortune 1,000 Company listed on the NYSE (VSH), is one of the world's largest manufacturers of discrete semiconductors (diodes, rectifiers, MOSFETs, optoelectronics, and selected ICs) and passive electronic components (resistors, inductors, and capacitors). Vishay Intertechnology components are used in virtually all types of electronic devices and equipment, in the industrial, computer, automotive, consumer, telecommunications, military, aerospace, power supplies, and medical markets. Vishay Intertechnology's global footprint includes manufacturing facilities in China and four other Asian countries, Israel, Europe, and the Americas, as well as sales offices around the world.

Vishay's product innovations, successful acquisition strategy, and 'one-stop shop' service have made it a global industry leader. Vishay can be found on the Internet at vishay.com.

ELECTRICAL SPECIFICATIONS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Single Phase Inverter IGBT	Collector to emitter breakdown voltage	$\text{BV}_{(\text{CES})}$	$V_{\text{GE}} = 0 \text{ V}, I_C = 500 \mu\text{A}$	600	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{(\text{BR})\text{CES}/\Delta T_J}$	$V_{\text{GE}} = 0 \text{ V}, I_C = 1 \text{ mA}$ (25°C to 175°C)	-	0.3	-	$\text{V}/^\circ\text{C}$
	Collector to emitter voltage	$V_{\text{CE}(\text{on})}$	$I_C = 25 \text{ A}, V_{\text{GE}} = 15 \text{ V}$	-	1.35	-	V
			$I_C = 50 \text{ A}, V_{\text{GE}} = 15 \text{ V}$	-	1.65	-	
			$I_C = 25 \text{ A}, V_{\text{GE}} = 15 \text{ V}, T_J = 125^\circ\text{C}$	-	1.50	-	
			$I_C = 50 \text{ A}, V_{\text{GE}} = 15 \text{ V}, T_J = 125^\circ\text{C}$	-	2.05	-	
	Gate threshold voltage	$V_{\text{GE}(\text{th})}$	$V_{\text{CE}} = V_{\text{GE}}, I_C = 250 \mu\text{A}$	4.0	-	6.5	
	Threshold voltage temperature coefficient	$\Delta V_{\text{GE}(\text{th})/\Delta T_J}$	$V_{\text{CE}} = V_{\text{GE}}, I_C = 1 \text{ mA}$ (25°C to 175°C)	-	6.0	-	$\text{mV}/^\circ\text{C}$
	Zero gate voltage collector current	I_{CES}	$V_{\text{GE}} = 0 \text{ V}, V_{\text{CE}} = 600 \text{ V}$	-	1.0	150	μA
			$V_{\text{GE}} = 0 \text{ V}, V_{\text{CE}} = 600 \text{ V}, T_J = 125^\circ\text{C}$	-	450	-	
	Gate to emitter leakage current	I_{GES}	$V_{\text{GE}} = \pm 20 \text{ V}$	-	-	± 200	nA
	Total gate charge (turn-on)	Q_G	$I_C = 50 \text{ A}$ $V_{\text{CC}} = 400 \text{ V}$ $V_{\text{GE}} = 15 \text{ V}$	-	95	-	nC
	Gate to emitter charge (turn-on)	Q_{GE}		-	28	-	
	Gate to collector charge (turn-on)	Q_{GC}		-	35	-	
	Turn-on switching loss	E_{on}	$I_C = 50 \text{ A}, V_{\text{CC}} = 400 \text{ V}$ $V_{\text{GE}} = 15 \text{ V}, R_g = 10 \Omega$ $L = 200 \mu\text{H}, T_J = 25^\circ\text{C}$ (1)	-	0.3	-	mJ
	Turn-off switching loss	E_{off}		-	1.3	-	
	Total switching loss	E_{tot}		-	1.6	-	
	Turn-on switching loss	E_{on}	$I_C = 50 \text{ A}, V_{\text{CC}} = 400 \text{ V}$ $V_{\text{GE}} = 15 \text{ V}, R_g = 10 \Omega$ $L = 200 \mu\text{H}, T_J = 125^\circ\text{C}$ (1)	-	0.8	-	mJ
	Turn-off switching loss	E_{off}		-	1.65	-	
	Total switching loss	E_{tot}		-	2.45	-	
	Turn-on delay time	$t_{\text{d}(\text{on})}$	$I_C = 50 \text{ A}, V_{\text{CC}} = 400 \text{ V}$ $V_{\text{GE}} = 15 \text{ V}, R_g = 10 \Omega$ $L = 200 \mu\text{H}, T_J = 125^\circ\text{C}$	-	55	-	ns
	Rise time	t_r		-	45	-	
	Turn-off delay time	$t_{\text{d}(\text{off})}$		-	165	-	
	Fall time	t_f		-	45	-	
	Input capacitance	C_{ies}	$V_{\text{GE}} = 0 \text{ V}$ $V_{\text{CC}} = 30 \text{ V}$ $f = 1 \text{ MHz}$	-	3025	-	pF
	Output capacitance	C_{oes}		-	245	-	
	Reverse transfer capacitance	C_{res}		-	90	-	
	Reverse bias safe operating area	RBSOA	$T_J = 175^\circ\text{C}, I_C = 192 \text{ A}$ $R_g = 27 \Omega, V_{\text{GE}} = 15 \text{ V to } 0 \text{ V}$	Fullsquare			
	Short circuit safe operating area	SCSOA	$V_{\text{CC}} = 400 \text{ V to } V_P = 600 \text{ V}$ $R_g = 10 \Omega, V_{\text{GE}} = 15 \text{ V to } 0 \text{ V}$	5	-	-	μs
Single Phase Inverter Diode	Reverse recovery parameters	I_{rr}	$T_J = 125^\circ\text{C}$ $V_{\text{CC}} = 200 \text{ V}, I_F = 20 \text{ A}$ $dI/dt = 200 \text{ A}/\mu\text{s}$	-	2.1	-	A
		t_{rr}		-	43	-	ns
		Q_{rr}		-	46	-	nC
	Diode forward voltage drop	V_{FM}	$I_F = 20 \text{ A}$	-	1.4	-	V
			$I_F = 20 \text{ A}, T_J = 125^\circ\text{C}$	-	1.67	-	
Capacitor	C value	C	$T_J = 25^\circ\text{C}$	59.4	66	72.6	nF
By Pass Diode	Diode forward voltage drop	V_{FM}	$I_F = 30 \text{ A}$	-	1.1	-	V
			$I_F = 30 \text{ A}, T_J = 125^\circ\text{C}$	-	1.0	-	
	Breakdown voltage	V_{BR}	$I_{\text{rr}} = 100 \mu\text{A}$	600	-	-	
	Leakage current	I_{RM}	$V_{\text{RR}} = 600 \text{ V}$	-	-	0.05	mA
			$V_{\text{RR}} = 600 \text{ V}, T_J = 125^\circ\text{C}$	-	-	1.0	

ELECTRICAL SPECIFICATIONS ($T_J = 25^\circ\text{C}$ unless otherwise noted)							
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Boost IGBT	Collector to emitter breakdown voltage	$\text{BV}_{(\text{CES})}$	$V_{\text{GE}} = 0 \text{ V}, I_C = 500 \mu\text{A}$	600	-	-	
	Temperature coefficient of breakdown voltage	$\Delta V_{(\text{BR})\text{CES}/\Delta T_J}$	$V_{\text{GE}} = 0 \text{ V}, I_C = 1 \text{ mA}$ (25 °C to 175 °C)	-	0.3	-	V/°C
	Collector to emitter voltage	$V_{\text{CE}(\text{on})}$	$I_C = 25 \text{ A}, V_{\text{GE}} = 15 \text{ V}$	-	1.35	-	V
			$I_C = 50 \text{ A}, V_{\text{GE}} = 15 \text{ V}$	-	1.65	-	
			$I_C = 25 \text{ A}, V_{\text{GE}} = 15 \text{ V}, T_J = 125^\circ\text{C}$	-	1.50	-	
			$I_C = 50 \text{ A}, V_{\text{GE}} = 15 \text{ V}, T_J = 125^\circ\text{C}$	-	2.05	-	
	Gate threshold voltage	$V_{\text{GE}(\text{th})}$	$V_{\text{CE}} = V_{\text{GE}}, I_C = 250 \mu\text{A}$	4.0	-	6.5	
	Threshold voltage temperature coefficient	$\Delta V_{\text{GE}(\text{th})/\Delta T_J}$	$V_{\text{CE}} = V_{\text{GE}}, I_C = 1 \text{ mA}$ (25 °C to 175 °C)	-	-6.0	-	mV/°C
	Zero gate voltage collector current	I_{CES}	$V_{\text{GE}} = 0 \text{ V}, V_{\text{CE}} = 600 \text{ V}$	-	1.0	150	μA
			$V_{\text{GE}} = 0 \text{ V}, V_{\text{CE}} = 600 \text{ V}, T_J = 125^\circ\text{C}$	-	450	-	
	Gate to emitter leakage current	I_{GES}	$V_{\text{GE}} = \pm 20 \text{ V}$	-	-	±200	nA
	Total gate charge (turn-on)	Q_G	$I_C = 50 \text{ A}$	-	95	-	nC
	Gate to emitter charge (turn-on)	Q_{GE}	$V_{\text{CC}} = 400 \text{ V}$	-	28	-	
	Gate to collector charge (turn-on)	Q_{GC}	$V_{\text{GE}} = 15 \text{ V}$	-	35	-	
	Turn-on switching loss	E_{on}	$I_C = 50 \text{ A}, V_{\text{CC}} = 400 \text{ V}$	-	0.3	-	mJ
	Turn-off switching loss	E_{off}	$V_{\text{GE}} = 15 \text{ V}, R_g = 10 \Omega$	-	1.3	-	
	Total switching loss	E_{tot}	$L = 200 \mu\text{H}, T_J = 25^\circ\text{C}$ (1)	-	1.6	-	
	Turn-on switching loss	E_{on}	$I_C = 50 \text{ A}, V_{\text{CC}} = 400 \text{ V}$	-	0.8	-	
	Turn-off switching loss	E_{off}	$V_{\text{GE}} = 15 \text{ V}, R_g = 10 \Omega$	-	1.65	-	
	Total switching loss	E_{tot}	$L = 200 \mu\text{H}, T_J = 125^\circ\text{C}$ (1)	-	2.45	-	
	Turn-on delay time	$t_{\text{d}(\text{on})}$	$I_C = 50 \text{ A}, V_{\text{CC}} = 400 \text{ V}$ $V_{\text{GE}} = 15 \text{ V}, R_g = 10 \Omega$ $L = 200 \mu\text{H}, T_J = 125^\circ\text{C}$	-	55	-	ns
	Rise time	t_r		-	45	-	
	Turn-off delay time	$t_{\text{d}(\text{off})}$		-	165	-	
	Fall time	t_f		-	45	-	
	Input capacitance	C_{ies}	$V_{\text{GE}} = 0 \text{ V}$	-	3025	-	pF
	Output capacitance	C_{oes}	$V_{\text{CC}} = 30 \text{ V}$	-	245	-	
	Reverse transfer capacitance	C_{res}	$f = 1 \text{ MHz}$	-	90	-	
	Reverse bias safe operating area	RBSOA	$T_J = 175^\circ\text{C}, I_C = 192 \text{ A}$ $R_g = 27 \Omega, V_{\text{GE}} = 15 \text{ V to } 0 \text{ V}$	Fullsquare			
	Short circuit safe operating area	SCSOA	$V_{\text{CC}} = 400 \text{ V to } V_P = 600 \text{ V}$ $R_g = 10 \Omega, V_{\text{GE}} = 15 \text{ V to } 0 \text{ V}$	5	-	-	μs
AP Diode of Boost IGBT	Diode forward voltage drop	V_{FM}	$I_F = 50 \text{ A}$	-	1.91	-	V
			$I_F = 50 \text{ A}, T_J = 125^\circ\text{C}$	-	1.49	-	
	Reverse recovery parameters	I_{rr}	$T_J = 125^\circ\text{C}$	-	18	-	A
		t_{rr}	$V_{\text{CC}} = 200 \text{ V}, I_F = 50 \text{ A}$	-	115	-	ns
		Q_{rr}	$dI/dt = 500 \text{ A}/\mu\text{s}$	-	1100	-	nC
Boost Diode	Breakdown voltage	V_{BR}	$I_{\text{rr}} = 100 \mu\text{A}$	600	-	-	V
	Leakage current	I_{RM}	$V_{\text{rr}} = 600 \text{ V}$	-	-	100	μA
	Diode forward voltage drop	V_{FM}	$I_F = 30 \text{ A}$	-	1.4	-	V
			$I_F = 30 \text{ A}, T_J = 125^\circ\text{C}$	-	1.67	-	
	Reverse recovery parameters	I_{rr}	$T_J = 125^\circ\text{C}$	-	3.6	-	A
		t_{rr}	$V_{\text{CC}} = 200 \text{ V}, I_F = 30 \text{ A}$	-	26	-	ns
		Q_{rr}	$dI/dt = 500 \text{ A}/\mu\text{s}$	-	46	-	nC

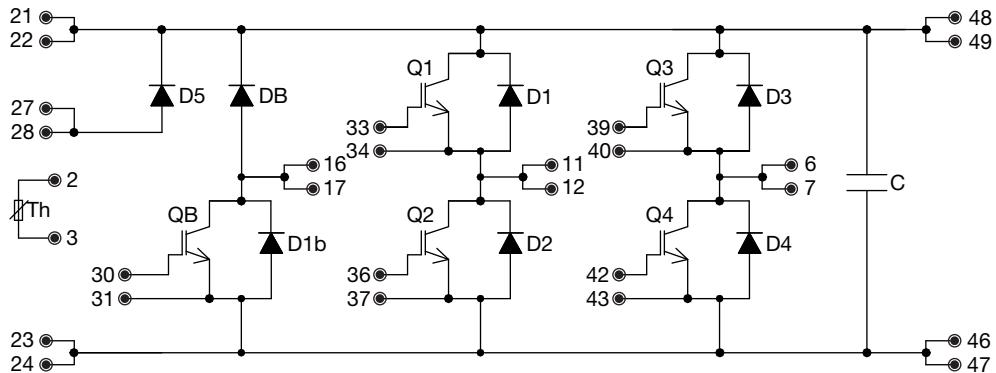
Note

(1) Energy losses include "tail" and diode reverse recovery

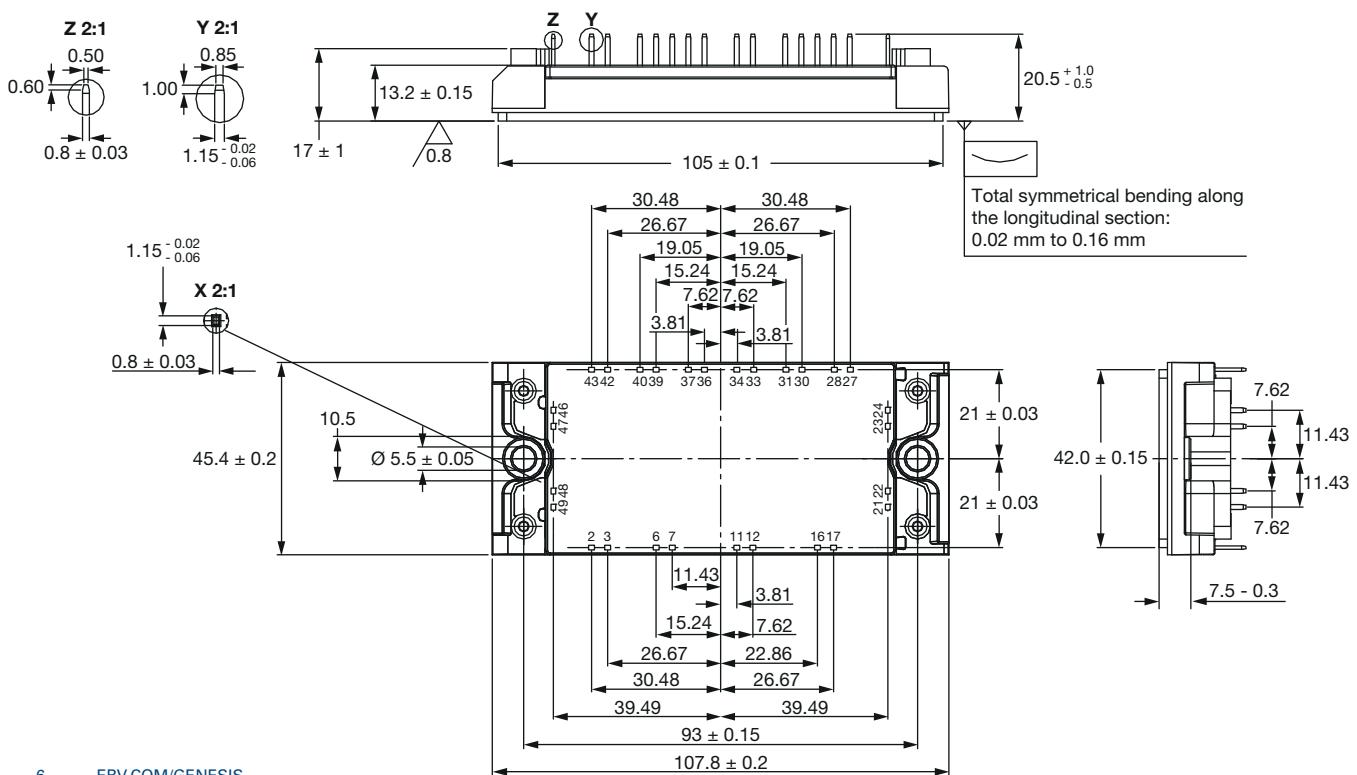
THERMAL AND MECHANICAL SPECIFICATIONS

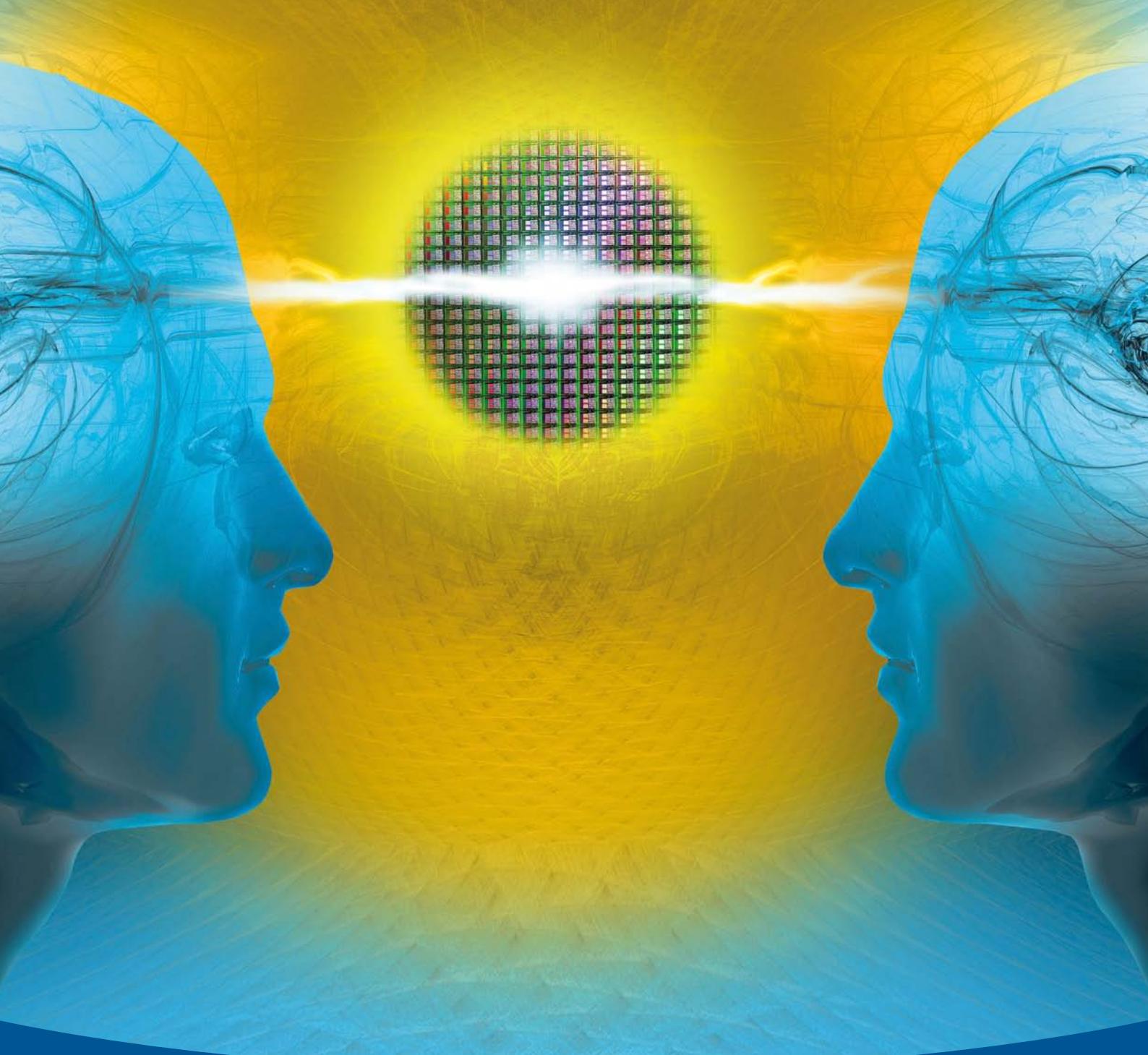
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Junction to case single phase inverter IGBT thermal resistance	R_{thJC}	-	-	0.75	°C/W
Junction to case single phase inverter diode thermal resistance		-	-	2.71	
Junction to case boost diode thermal resistance		-	-	1.8	
Junction to case anti parallel diode boost IGBT thermal resistance		-	-	0.87	
Junction to case boost IGBT thermal resistance		-	-	0.75	
Junction to case by pass diode thermal resistance		-	-	1.5	
Case to sink, flat, greased surface	R_{thCS}	-	0.05	-	
Mounting torque (M5)		2.7	-	3.3	Nm
Weight		-	170	-	g

CIRCUIT CONFIGURATION



DIMENSIONS (mm)





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