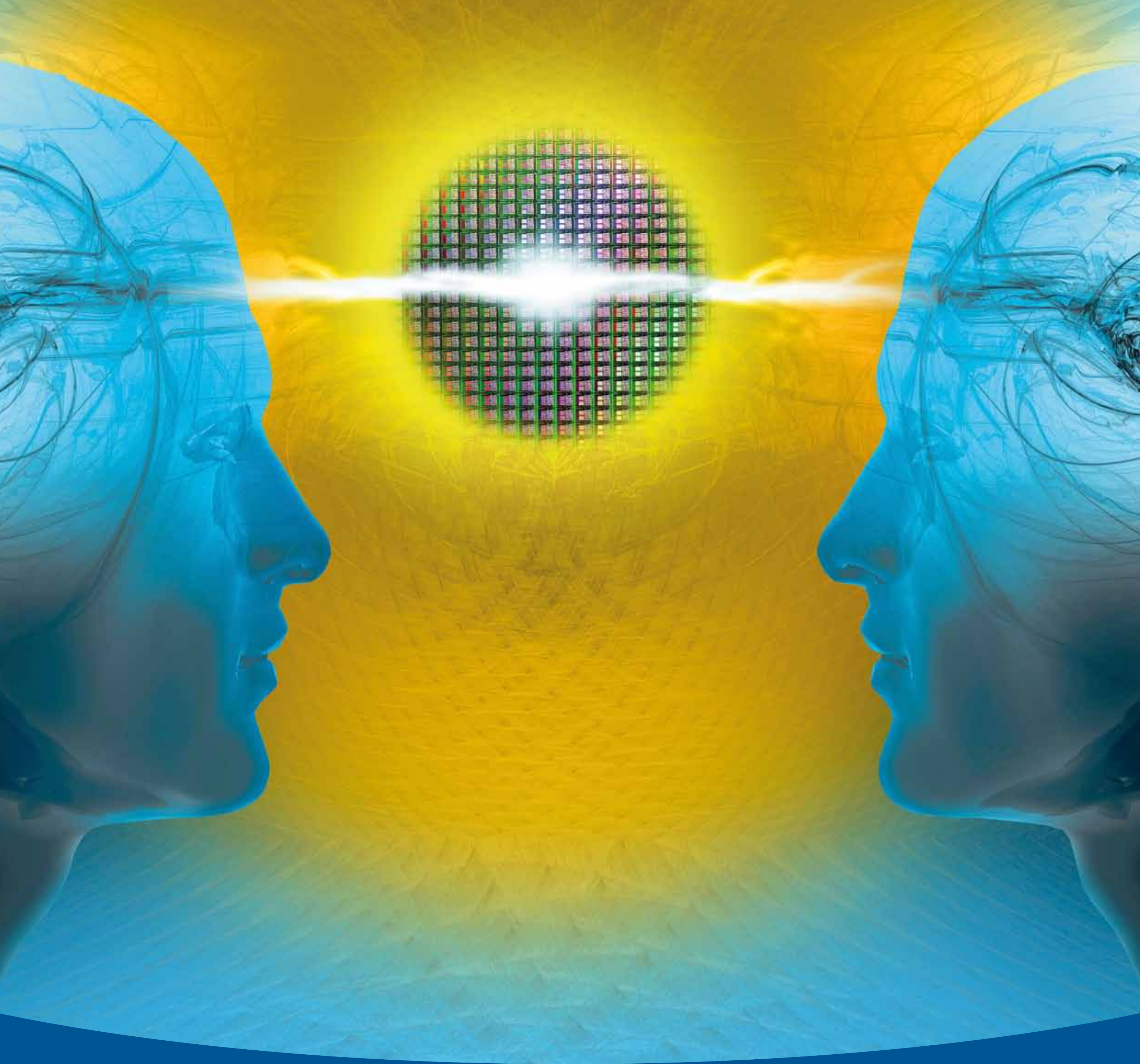
DATASHEET

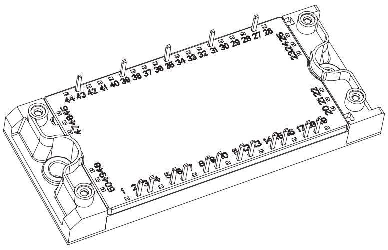
GENESIS

IGBT Module with SiC diodes for residential photovoltaic inverters



May 2011

BOOST SINGLE PHASE INVERTER, 50 A



ECONO2

PRODUCT SUMMARY	
V_{CES}	600 V
$V_{CE(on)}$ (typical) at 50 A	1.65 V
t_{sc} at T_J = 150 °C	5 µs
I_C at T_C = 95 °C	50 A

FEATURES

- Low $V_{CE(on)}$ Trench IGBT technology
- Silicon carbide diode technology
- FRED Pt® 1.0 diode
- 5 µs short circuit capability
- Square RBSOA
- Positive $V_{CE(on)}$ temperature coefficient
- Low stray inductance design
- Speed 4 kHz to 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
	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
Single Phase Inverter Q1 to Q4, D1 to D4	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
	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	
Boost QB, DB, D1b	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
	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	
Capacitor	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	

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

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)

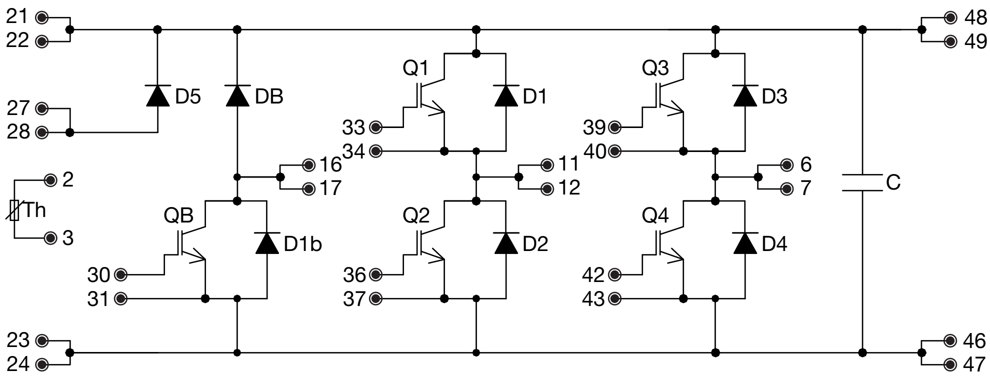
	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Boost IGBT	Collector to emitter breakdown voltage	$BV_{(CES)}$	V_{GE} = 0 V, I_C = 500 µA	600	-	-	
	Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 1 mA (25 °C to 175 °C)	-	0.3	-	V/°C
	Collector to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

Note

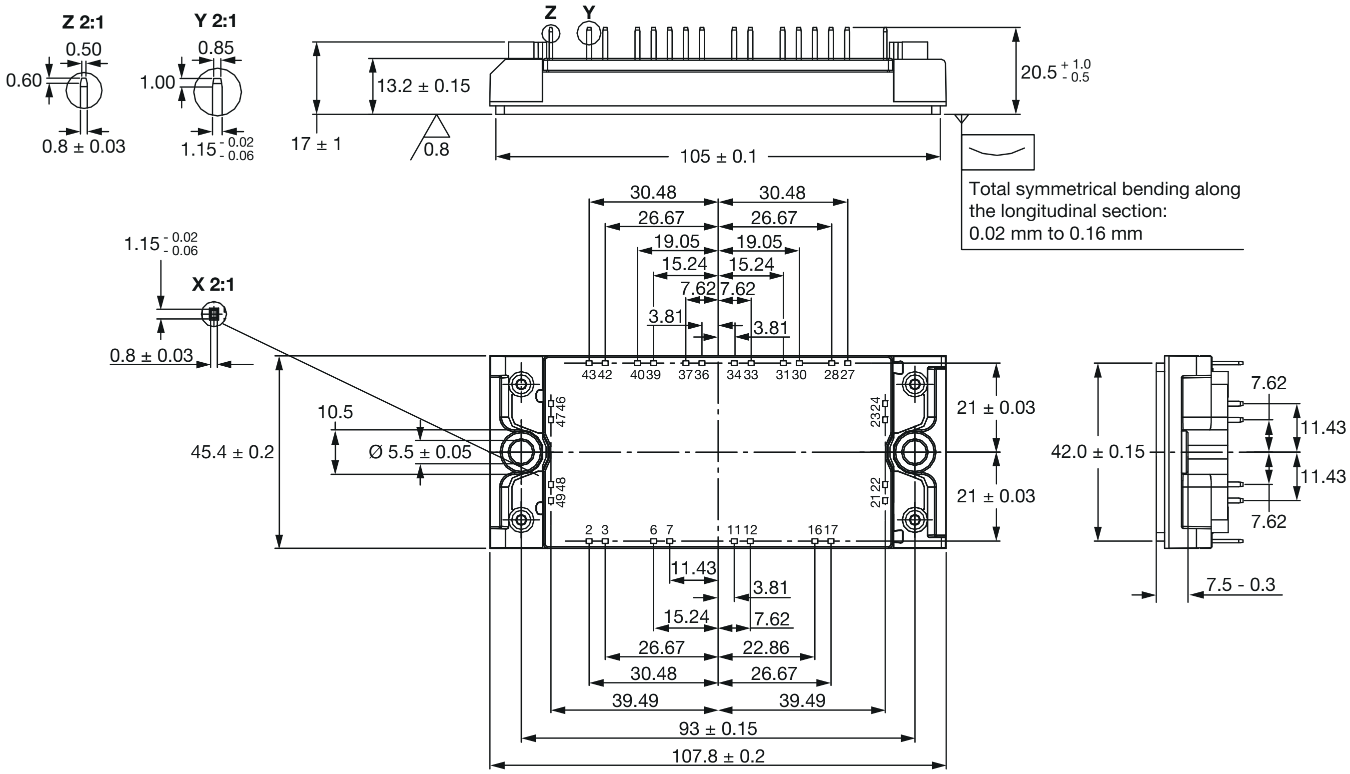
(1) Energy losses include "tail" and diode reverse recovery

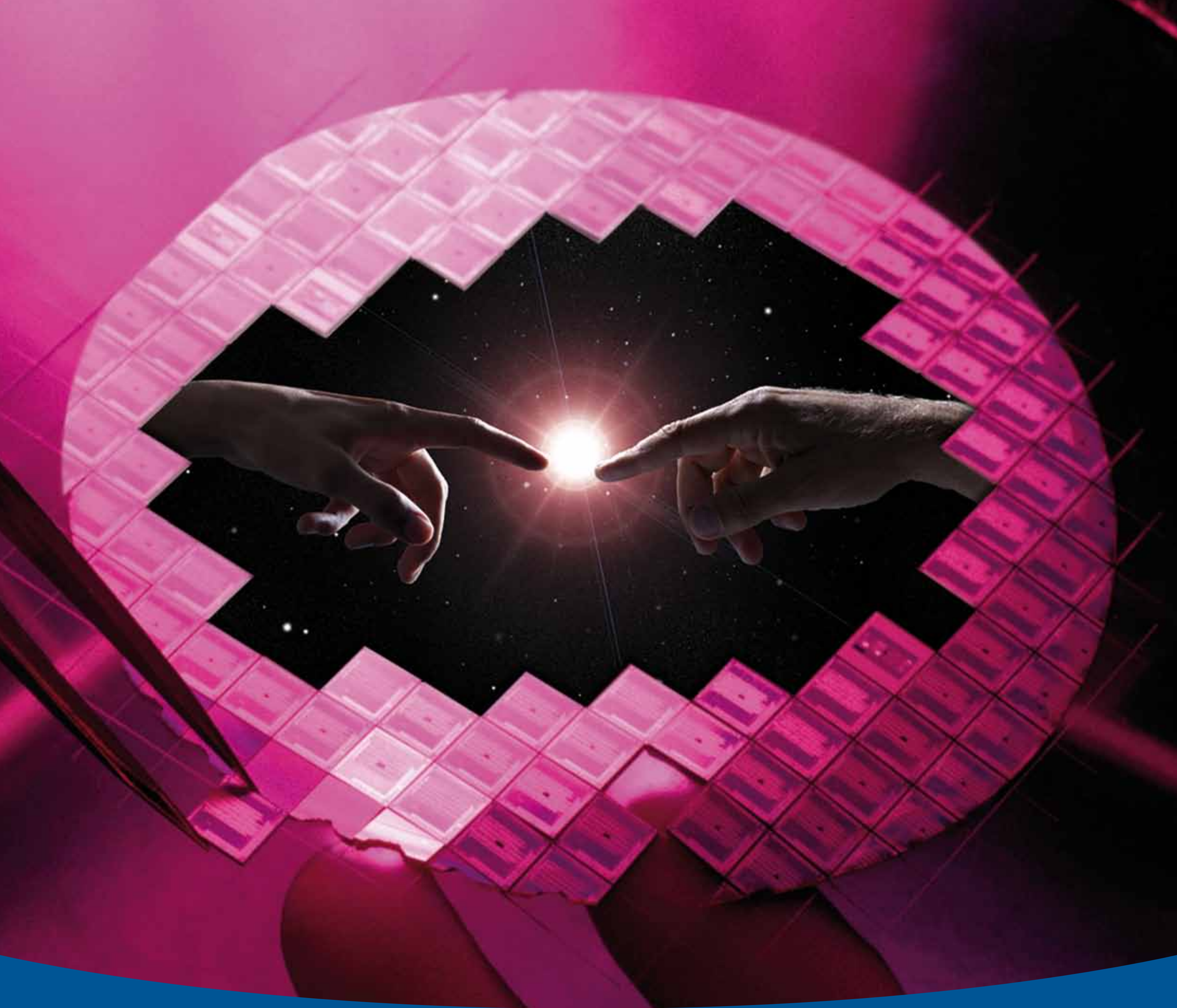
THERMAL AND MECHANICAL SPECIFICATIONS					
PARAMETER	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Junction to case single phase inverter IGBT thermal resistance	R_{thJC}	-	-	0.75	°C/W
Junction to case single phase inverter diode thermal resistance		-	-	2.71	
Junction to case boost diode thermal resistance		-	-	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)





GENESIS – Let there be Chips!

IGBT Module from Vishay and EBV for Use in Photovoltaic Systems in Private Homes

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