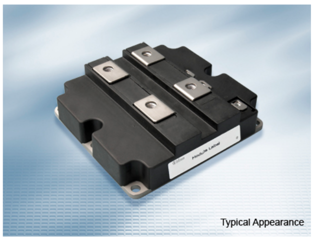
WINSOURCE ELECTRONICS

THE DATASHEET OF

FZ1000R33HE3C1NOSA1

IHM-B module with fast Trench/Fieldstop IGBT3 and emitter controlled 3 diode



Features

- Electrical features
  - V_{CES} = 3300 V
  - $I_{C\ nom}$ = 1000 A / I_{CRM} = 2000 A
  - Unbeatable robustness
  - High DC stability
  - High short-circuit capability
  - Low switching losses
  - Low $V_{CE,sat}$
  - $T_{vj,op}$ = 150°C
  - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
  - AlSiC base plate for increased thermal cycling capability
  - Package with CTI > 600
  - IHM B housing
  - Isolated base plate

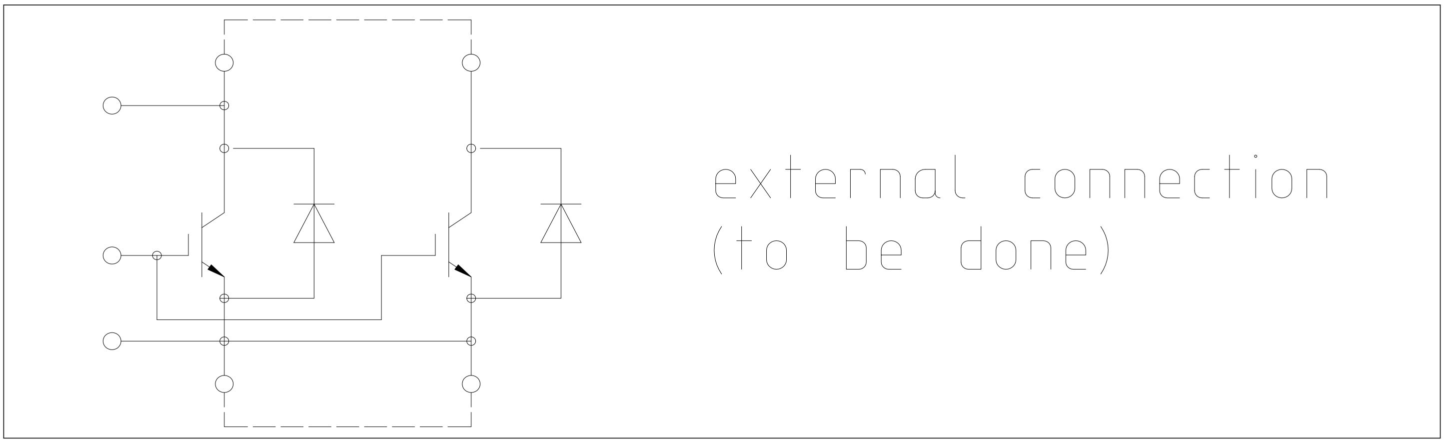
Potential applications

- Chopper applications
- Medium-voltage converters
- Motor drives
- Traction drives
- UPS systems
- Wind turbines

Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

Description



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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 1 min	6.0	kV
Partial discharge extinction voltage	V_{isol}	RMS, f = 50 Hz, Q_{PD} ≤ 10 pC	2.6	kV
DC stability	$V_{CE(D)}$	T_{vj}=25°C, 100 Fit	2100	V
Material of module baseplate			AlSiC	
Creepage distance	d_{Creep}	terminal to heatsink	32.2	mm
Clearance	d_{Clear}	terminal to heatsink	19.1	mm
Comparative tracking index	*CTI*		>600	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Stray inductance module	L_{sCE}				9		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.19		mΩ
Storage temperature	T_{stg}			-40		150	°C
Mounting torque for module mounting	*M*	- Mounting according to valid application note	M6, Screw	4.25		5.75	Nm
Terminal connection torque	*M*	- Mounting according to valid application note	M4, Screw	1.8		2.1	Nm
			M8, Screw	8		10	
Weight	*G*				800		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = -40 °C	3300	V
			T_{vj} = 150 °C	3300	
Continuous DC collector current	I_{CDC}	$T_{vj\ max}$ = 150 °C	T_C = 95 °C	1000	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		2000	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C = 1000 A, V_{GE} = 15 V	T_{vj} = 25 °C		2.55	3.10	V
			T_{vj} = 125 °C		3.00	3.45	
			T_{vj} = 150 °C		3.15		
Gate threshold voltage	V_{GEth}	I_C = 48 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.20	5.80	6.40	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 1800 V			28		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.63		Ω
Input capacitance	C_{ies}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			190		nF
Reverse transfer capacitance	C_{res}	f = 1000 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			4		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 3300 V, V_{GE} = 0 V	T_{vj} = 25 °C			5	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				400	nA
Turn-on delay time (inductive load)	t_{don}	I_C = 1000 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Gon} = 0.71 Ω, C_{GE} = 220 nF	T_{vj} = 25 °C		0.350		µs
			T_{vj} = 125 °C		0.380		
			T_{vj} = 150 °C		0.380		
Rise time (inductive load)	t_r	I_C = 1000 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Gon} = 0.71 Ω, C_{GE} = 220 nF	T_{vj} = 25 °C		0.350		µs
			T_{vj} = 125 °C		0.380		
			T_{vj} = 150 °C		0.380		
Turn-off delay time (inductive load)	t_{doff}	I_C = 1000 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Goff} = 2.3 Ω, C_{GE} = 220 nF	T_{vj} = 25 °C		3.000		µs
			T_{vj} = 125 °C		3.200		
			T_{vj} = 150 °C		3.200		
Fall time (inductive load)	t_f	I_C = 1000 A, V_{CE} = 1800 V, V_{GE} = ±15 V, R_{Goff} = 2.3 Ω, C_{GE} = 220 nF	T_{vj} = 25 °C		0.300		µs
			T_{vj} = 125 °C		0.350		
			T_{vj} = 150 °C		0.350		
Turn-on time (resistive load)	t_{on_R}	I_C = 500 A, V_{CE} = 2000 V, V_{GE} = ±15 V, R_{Gon} = 0.71 Ω, C_{GE} = 220 nF	T_{vj} = 25 °C	1.30			µs
Turn-on energy loss per pulse	E_{on}	I_C = 1000 A, V_{CE} = 1800 V, $L_σ$ = 85 nH, V_{GE} = ±15 V, R_{Gon} = 0.71 Ω, C_{GE} = 220 nF, di/dt = 3000 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1250		mJ
			T_{vj} = 125 °C		1700		
			T_{vj} = 150 °C		1950		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values Min.	Values Typ.	Values Max.	Unit
Turn-off energy loss per pulse	E_{off}	I_C = 1000 A, V_{CE} = 1800 V, L_σ = 85 nH, V_{GE} = ±15 V, R_{Goff} = 2.3 Ω, C_{GE} = 220 nF, dv/dt = 2100 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1050		mJ
			T_{vj} = 125 °C		1400		
			T_{vj} = 150 °C		1550		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 2500 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj}=150 °C		4200		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				11.1	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease}= 1 W/(m*K)			14.5		K/kW
Temperature under switching conditions	$T_{vj\ op}$			-40		150	°C

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = -40 °C	3300	V
			T_{vj} = 150 °C	3300	
Continuous DC forward current	I_F			1000	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		2000	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	260	kA^2s
			T_{vj} = 150 °C	245	
Maximum power dissipation	P_{RQM}	T_{vj} = 150 °C		1600	kW
Minimum turn-on time	t_{onmin}			10	µs

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values Min.	Values Typ.	Values Max.	Unit
Forward voltage	V_F	I_F = 1000 A, V_{GE} = 0 V	T_{vj} = 25 °C		3.10	3.85	V
			T_{vj} = 125 °C		2.75	3.25	
			T_{vj} = 150 °C		2.65		

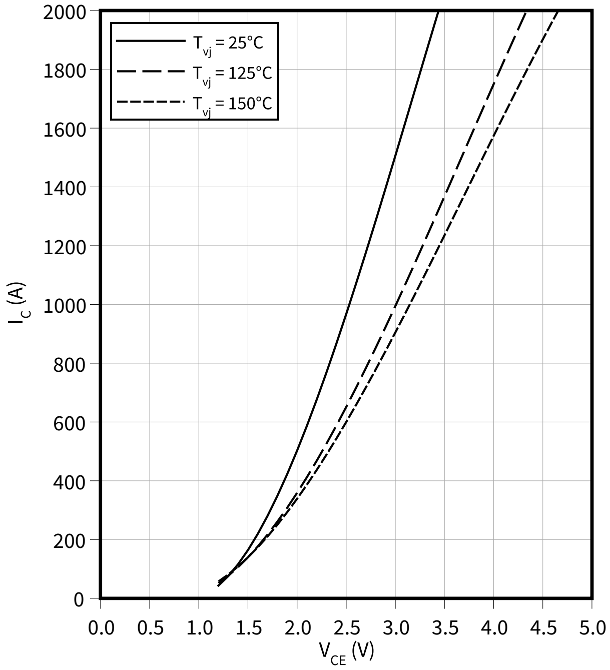
(table continues...)

Table 6 **(continued) Characteristic values**

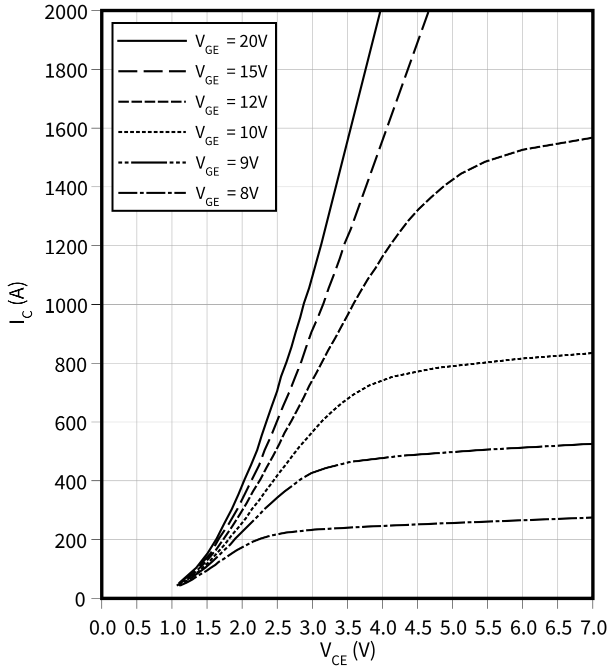
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_R = 1800 V, I_F = 1000 A, V_{GE} = -15 V, -di$_F$/dt = 3000 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1000		A
			T_{vj} = 125 °C		1200		
			T_{vj} = 150 °C		1250		
Recovered charge	Q_r	V_R = 1800 V, I_F = 1000 A, V_{GE} = -15 V, -di$_F$/dt = 3000 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		450		µC
			T_{vj} = 125 °C		900		
			T_{vj} = 150 °C		1050		
Reverse recovery energy	E_{rec}	V_R = 1800 V, I_F = 1000 A, V_{GE} = -15 V, -di$_F$/dt = 3000 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		450		mJ
			T_{vj} = 125 °C		1100		
			T_{vj} = 150 °C		1300		
Thermal resistance, junction to case	R_{thJC}	per diode				19.8	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)			16.5		K/kW
Temperature under switching conditions	$T_{vj\ op}$			-40		150	°C

4 Characteristics diagrams

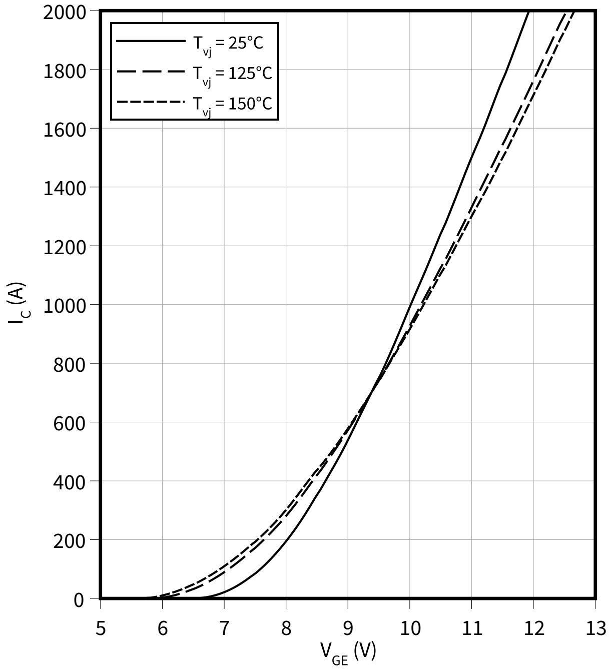
output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



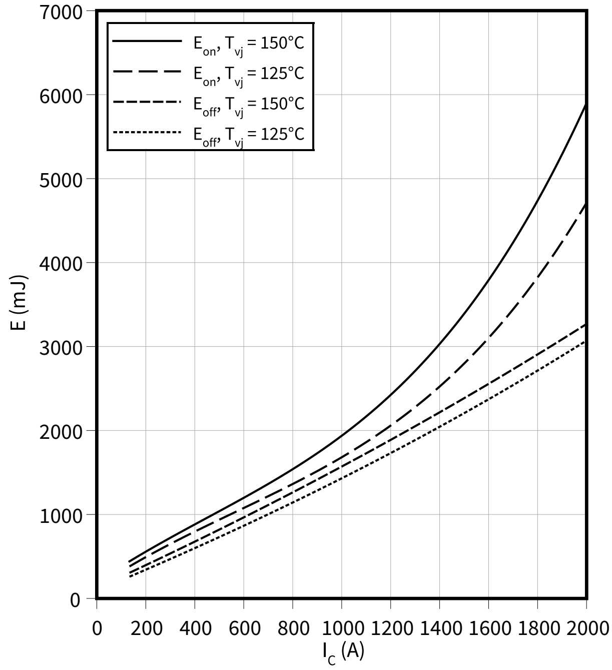
output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 150$ °C



transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



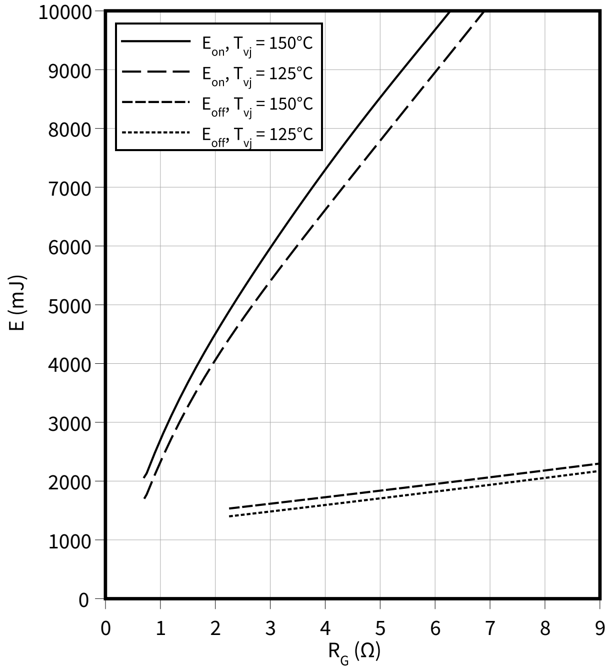
switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 2.3\ \Omega$, $R_{Gon} = 0.71\ \Omega$, $C_{GE} = 220$ nF, $V_{CE} = 1800$ V, V_{GE} = -15 / 15 V



switching losses (typical), IGBT, Inverter

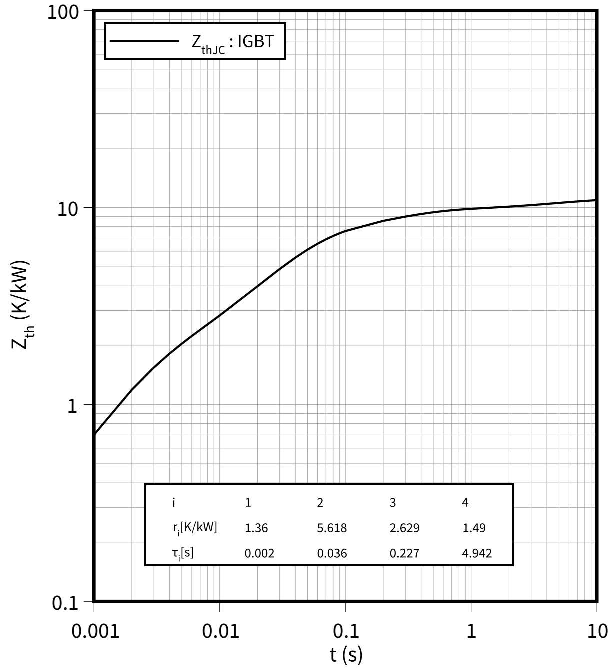
$E = f(R_G)$

$I_C = 1000$ A, $C_{GE} = 220$ nF, $V_{CE} = 1800$ V, $V_{GE} = -15 / 15$ V



transient thermal impedance , IGBT, Inverter

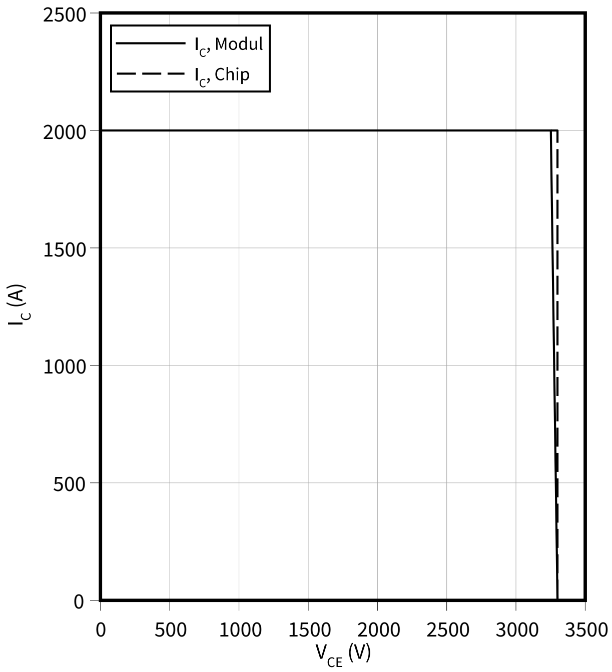
$Z_{th} = f(t)$



reverse bias safe operating area (RBSOA), IGBT, Inverter

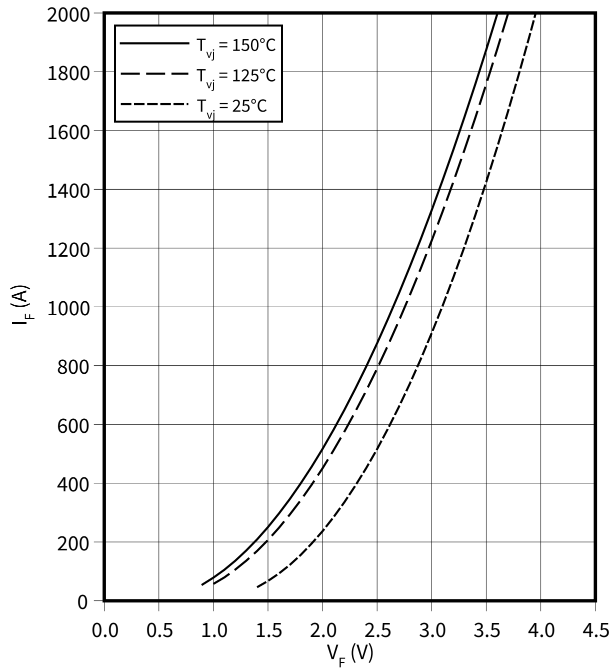
$I_C = f(V_{CE})$

$T_{vj} = 150$ °C, $R_{Goff} = 2.3$ Ω, $V_{GE} = \pm15$ V, $C_{GE} = 220$ nF

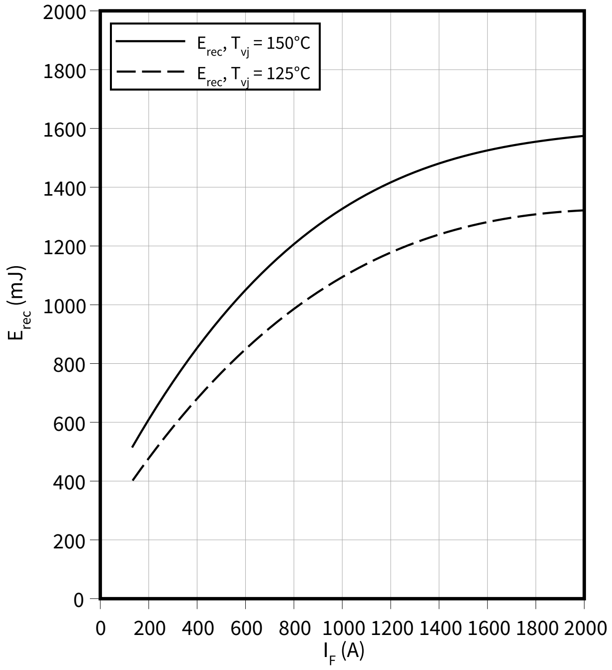


forward characteristic (typical), Diode, Inverter

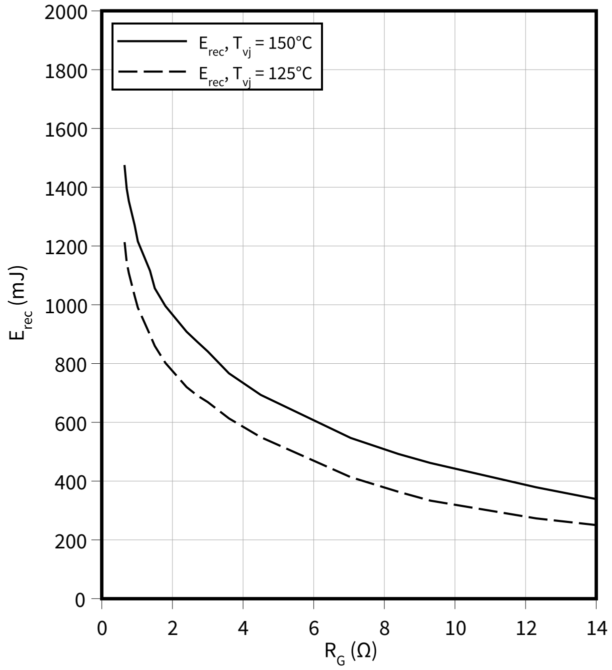
$I_F = f(V_F)$



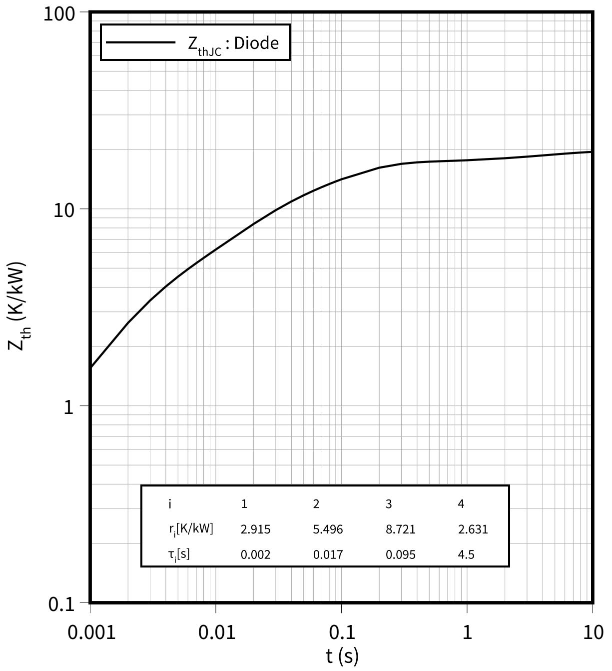
switching losses (typical), Diode, Inverter
$E_{rec} = f(I_F)$
$V_{CE} = 1800$ V, $R_{Gon} = R_{Gon}$(IGBT)



switching losses (typical), Diode, Inverter
$E_{rec} = f(R_G)$
$V_{CE} = 1800$ V, $I_F = 1000$ A

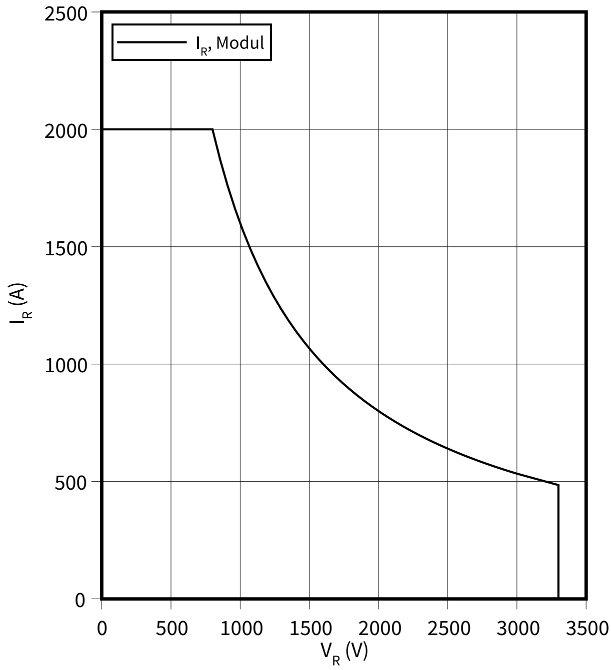


transient thermal impedance , Diode, Inverter
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/kW]	2.915	5.496	8.721	2.631
τ_i[s]	0.002	0.017	0.095	4.5

safe operation area (SOA), Diode, Inverter
$I_R = f(V_R)$
$T_{vj} = 150$ °C



5 Circuit diagram

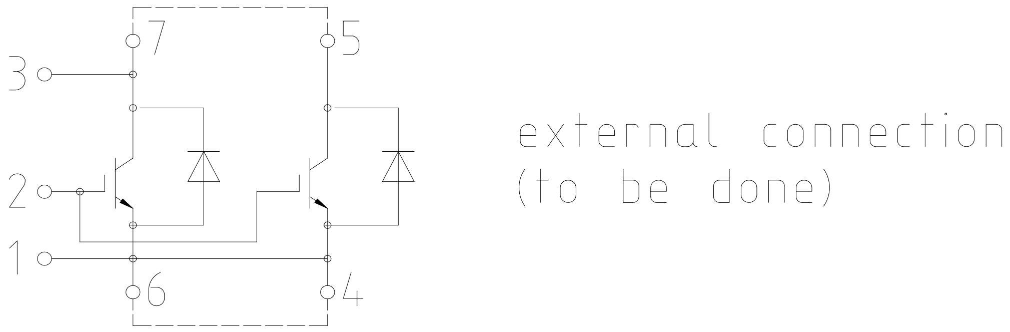


Figure 1

6 Package outlines

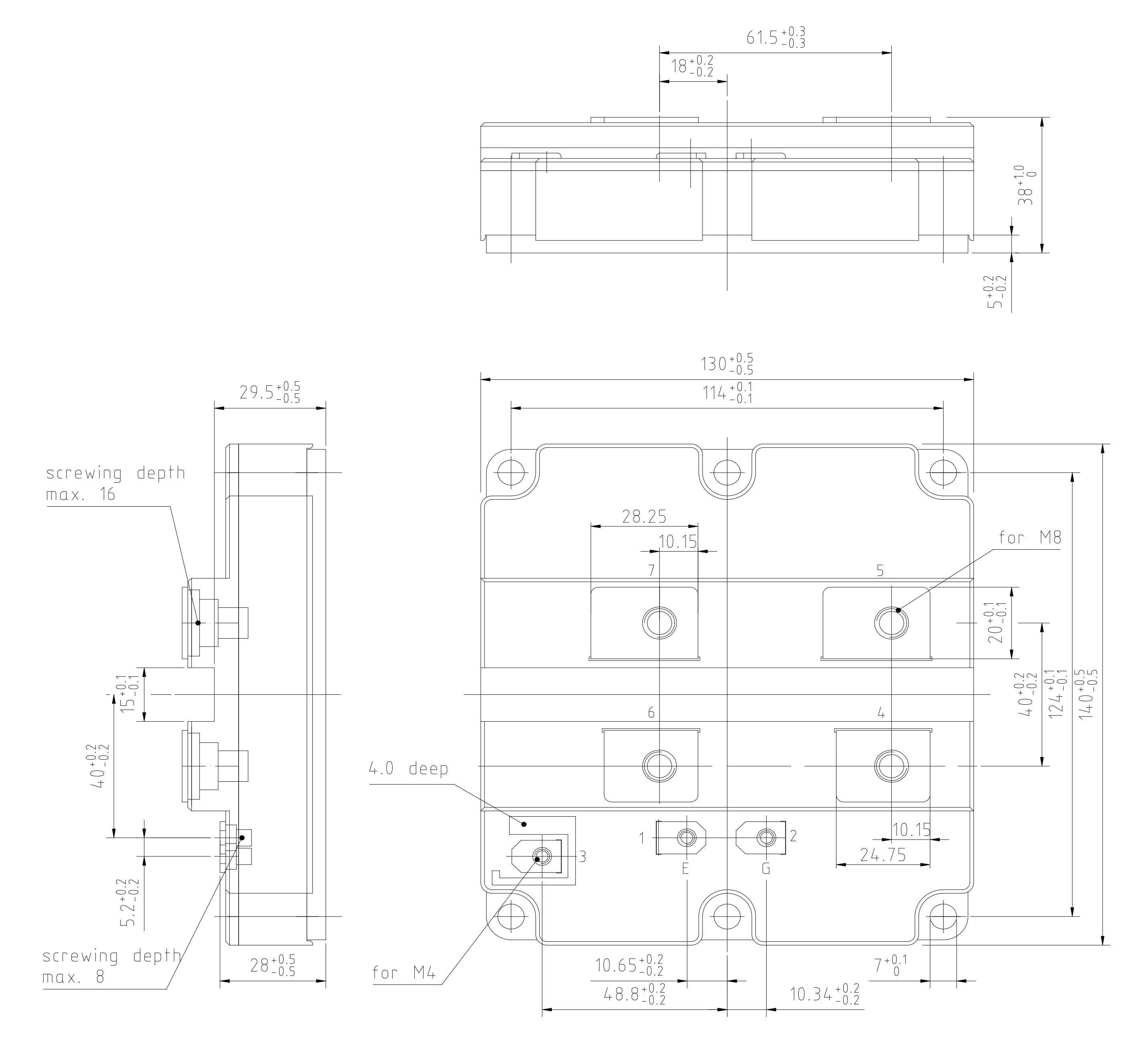


Figure 2

7 Module label code

Module label code		
Code format	Data Matrix	Barcode Code128
Encoding	ASCII text	Code Set A
Symbol size	16x16	23 digits
Standard	IEC24720 and IEC16022	IEC8859-1

Code content	*Content*	*Digit*	*Example*
	Module serial number	1 – 5	71549
	Module material number	6 - 11	142846
	Production order number	12 - 19	55054991
	Date code (production year)	20 – 21	15
	Date code (production week)	22 – 23	30
Example	71549142846550549911530		71549142846550549911530

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2007-10-11	Target datasheet
V1.1	2007-11-02	Target datasheet
V1.2	2008-02-06	Target datasheet
V2.0	2008-10-31	Preliminary datasheet
V2.1	2010-04-26	Preliminary datasheet
V2.2	2010-07-16	Preliminary datasheet
V3.0	2013-08-12	Final datasheet
V3.1	2013-12-11	Final datasheet
V3.2	2016-12-06	Final datasheet
V3.3	2018-07-12	Final datasheet
V3.4	2019-07-24	Final datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2021-10-22	Final datasheet

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