

EconoPACK™3 module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 150\text{ A} / I_{CRM} = 300\text{ A}$
 - LOW $V_{CE,sat}$
 - Overload operation up to 175°C
 - TRENCHSTOP™ IGBT7
- Mechanical features
 - Integrated NTC temperature sensor
 - High power and thermal cycling capability
 - Solder contact technology
 - Al_2O_3 substrate with low thermal resistance
 - Copper base plate



Potential applications

- Motor drives
- Auxiliary inverters
- Servo drives

Product validation

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

Description

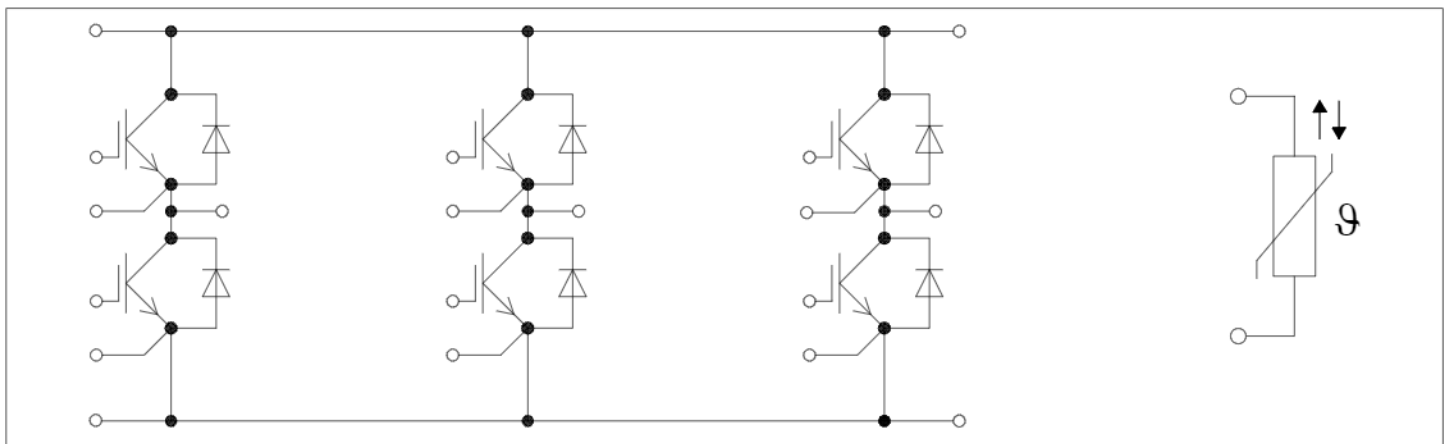


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	2.5	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	10.0	mm
Clearance	d_{Clear}	terminal to heatsink	7.5	mm
Comparative tracking index	CTI		>200	
Relative thermal index (electrical)	RTI	housing	140	°C

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	L_{sCE}			34		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$, per switch		1.6		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	3	6	Nm
Weight	G			300		g

Note: The current under continuous operation is limited to 50 A rms per connector pin.

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175^\circ\text{C}$	$T_C = 85^\circ\text{C}$	150	A
Repetitive peak collector current	I_{CRM}	$t_p = 1 \text{ ms}$		300	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	$V_{CE\ sat}$	$I_C = 150\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.55	1.80	V
			$T_{vj} = 125\ ^\circ C$		1.69		
			$T_{vj} = 175\ ^\circ C$		1.77		
Gate threshold voltage	V_{GEth}	$I_C = 3.5\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$			2.5		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			1		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			30.1		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.105		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			0.012	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.175		μs
			$T_{vj} = 125\ ^\circ C$		0.189		
			$T_{vj} = 175\ ^\circ C$		0.213		
Rise time (inductive load)	t_r	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.064		μs
			$T_{vj} = 125\ ^\circ C$		0.069		
			$T_{vj} = 175\ ^\circ C$		0.070		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.323		μs
			$T_{vj} = 125\ ^\circ C$		0.409		
			$T_{vj} = 175\ ^\circ C$		0.443		
Fall time (inductive load)	t_f	$I_C = 150\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.094		μs
			$T_{vj} = 125\ ^\circ C$		0.205		
			$T_{vj} = 175\ ^\circ C$		0.275		
Turn-on energy loss per pulse	E_{on}	$I_C = 150\ A, V_{CE} = 600\ V, L_G = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 3.6\ \Omega, di/dt = 1680\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		20.5		mJ
			$T_{vj} = 125\ ^\circ C$		26.9		
			$T_{vj} = 175\ ^\circ C$		30.9		
Turn-off energy loss per pulse	E_{off}	$I_C = 150\ A, V_{CE} = 600\ V, L_G = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 3.6\ \Omega, dv/dt = 3200\ V/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		9.95		mJ
			$T_{vj} = 125\ ^\circ C$		16.5		
			$T_{vj} = 175\ ^\circ C$		19.9		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 8\ \mu s, T_{vj} = 150\ ^\circ C$		530		A
			$t_P \leq 7\ \mu s, T_{vj} = 175\ ^\circ C$		500		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.290	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		0.0680		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		175	°C

Note: $T_{vj\text{ op}} > 150 \text{ °C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC forward current	I_F			150	A
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		300	A
I^2t - value	I^2t	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	3240	A^2s
			$T_{vj} = 175 \text{ °C}$	2660	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.72	2.10	V
			$T_{vj} = 125 \text{ °C}$	1.59		
			$T_{vj} = 175 \text{ °C}$	1.52		
Peak reverse recovery current	I_{RM}	$V_R = 600 \text{ V}, I_F = 150 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1680 \text{ A/}\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	64.2		A
			$T_{vj} = 125 \text{ °C}$	86		
			$T_{vj} = 175 \text{ °C}$	98.9		
Recovered charge	Q_r	$V_R = 600 \text{ V}, I_F = 150 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 1680 \text{ A/}\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	9.61		μC
			$T_{vj} = 125 \text{ °C}$	20.1		
			$T_{vj} = 175 \text{ °C}$	27.7		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}$, $I_F = 150 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 1680 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	2.62		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	6.07		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	8.86		
Thermal resistance, junction to case	R_{thJC}	per diode			0.464	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$		0.0700		K/W
Temperature under switching conditions	$T_{vj op}$		-40		175	$^\circ\text{C}$

Note: $T_{vj op} > 150 \text{ }^\circ\text{C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ }^\circ\text{C}$, $R_{100} = 493 \text{ } \Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

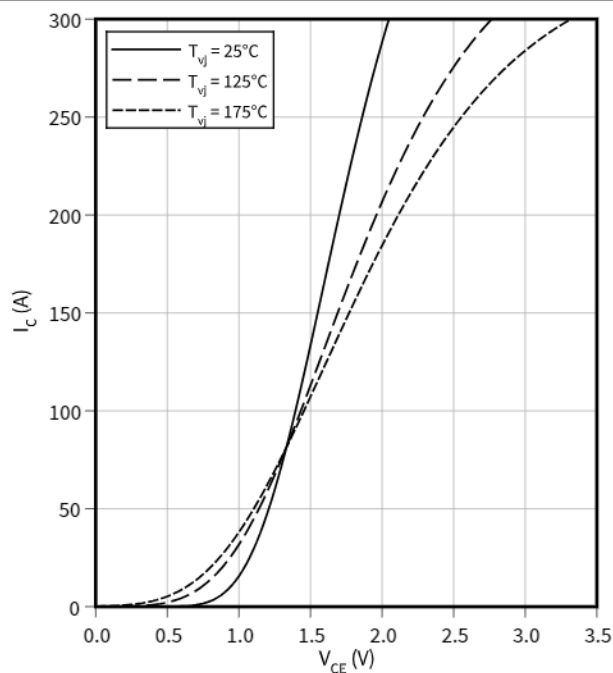
Note: Specification according to the valid application note.

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

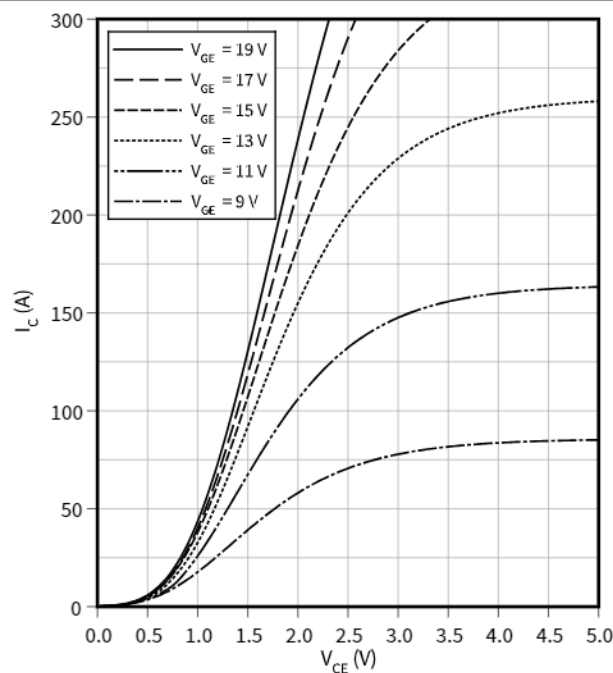
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

$$I_C = f(V_{CE})$$

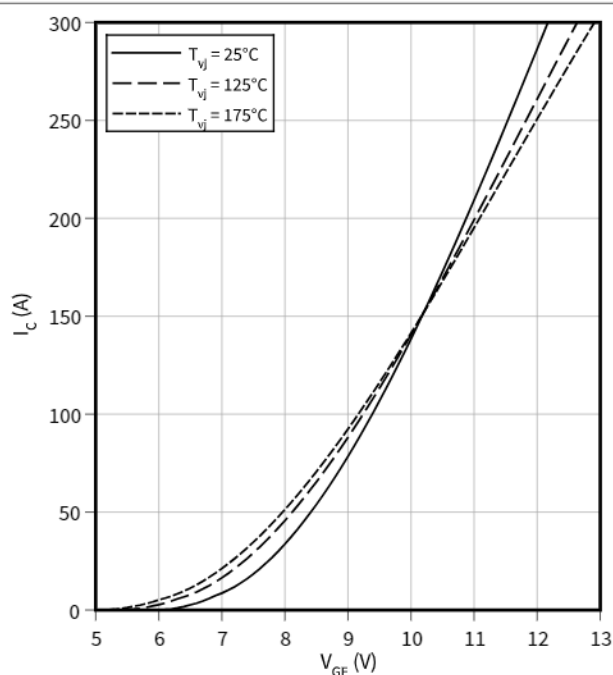
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

$$I_C = f(V_{GE})$$

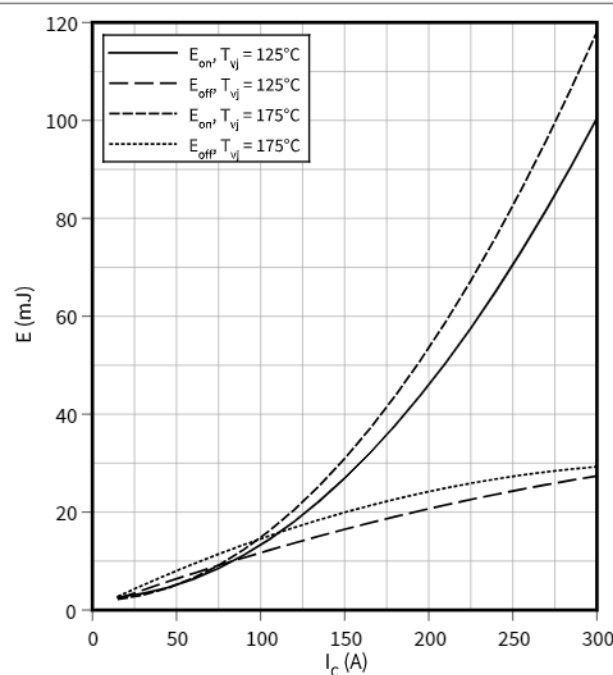
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

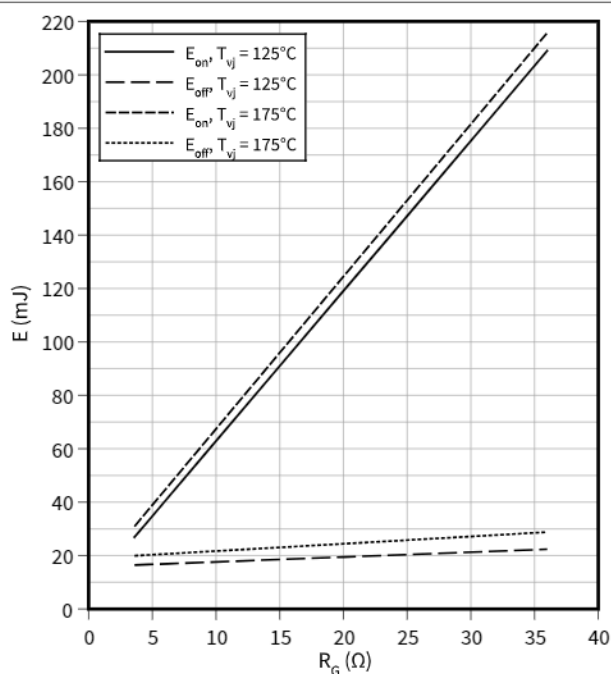
$$R_{Goff} = 3.6 \text{ } \Omega, R_{Gon} = 3.6 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(R_G)$$

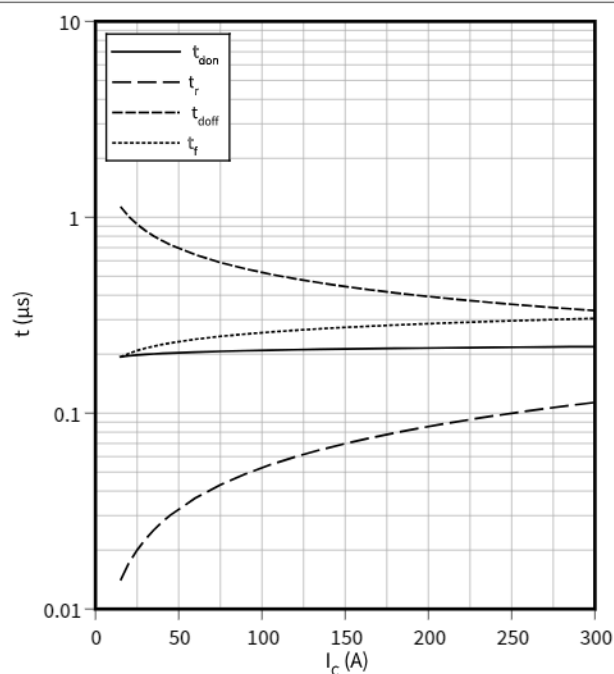
$I_C = 150 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$



Switching times (typical), IGBT, Inverter

$$t = f(I_C)$$

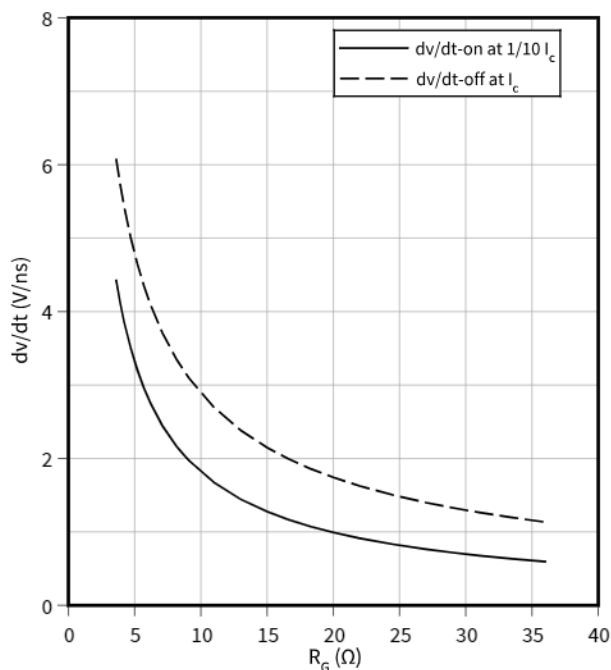
$R_{Goff} = 3.6 \Omega$, $R_{Gon} = 3.6 \Omega$, $V_{CE} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 175^\circ \text{C}$



Voltage slope (typical), IGBT, Inverter

$$dv/dt = f(R_G)$$

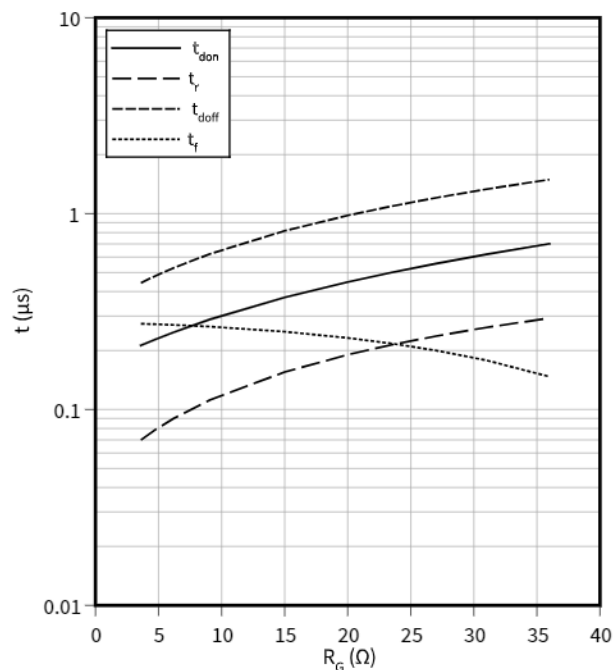
$I_C = 150 \text{ A}$, $V_{CE} = 25 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 25^\circ \text{C}$



Switching times (typical), IGBT, Inverter

$$t = f(R_G)$$

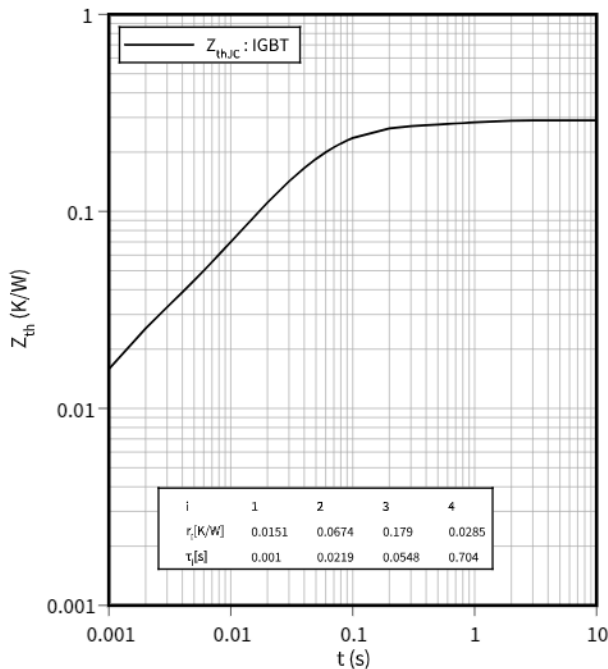
$I_C = 150 \text{ A}$, $V_{CE} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 175^\circ \text{C}$



5 Characteristics diagrams

Transient thermal impedance , IGBT, Inverter

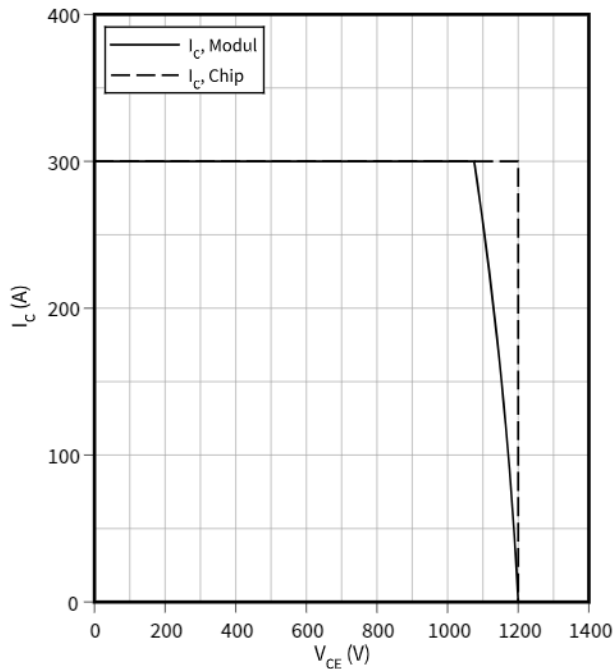
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

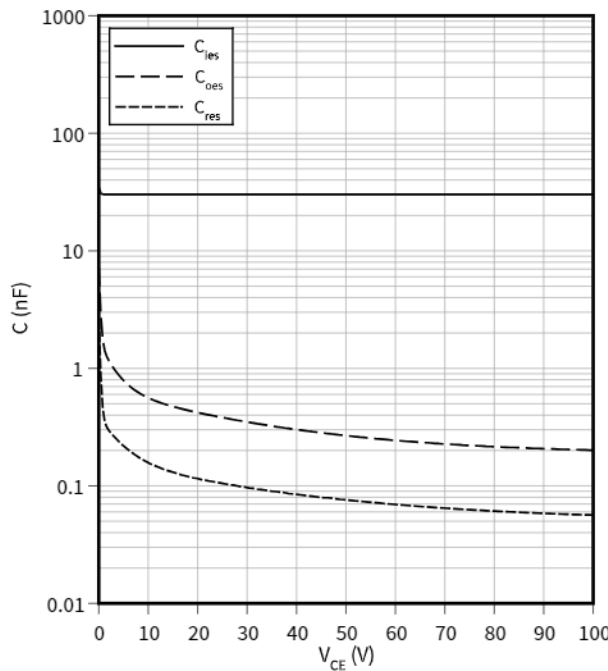
$R_{Goff} = 3.6 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

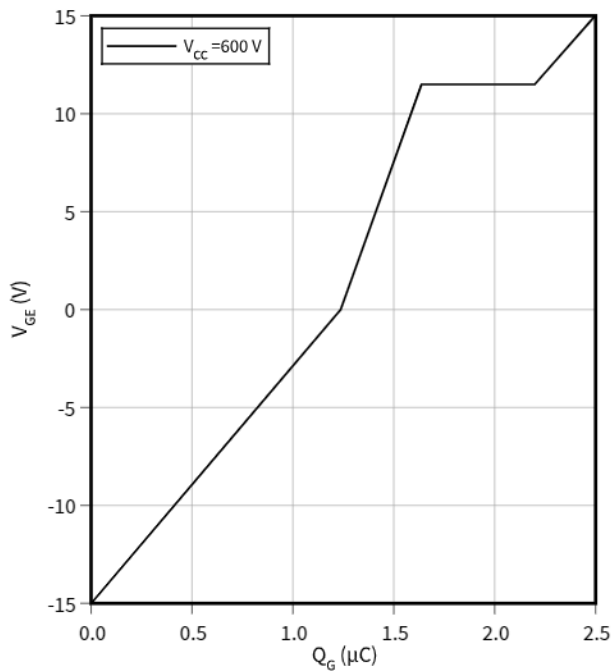
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

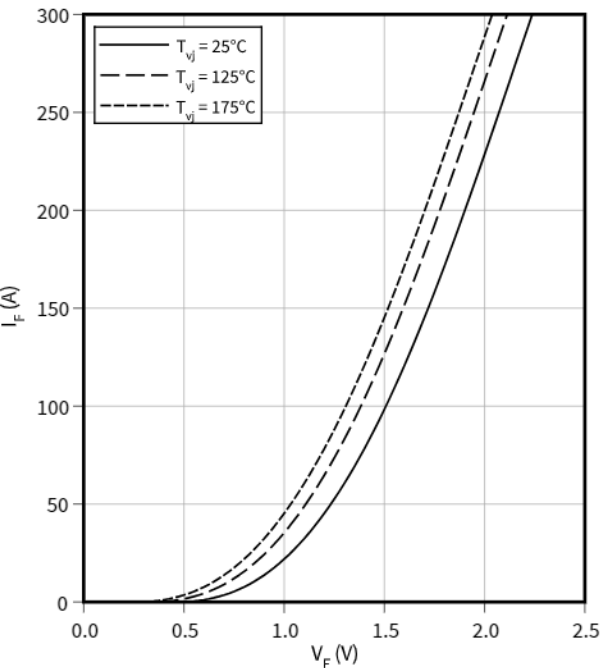
$I_C = 150 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



5 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

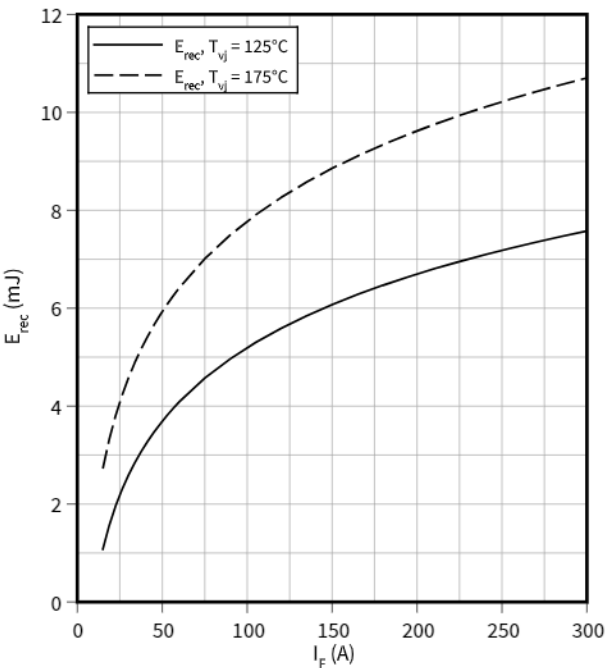
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

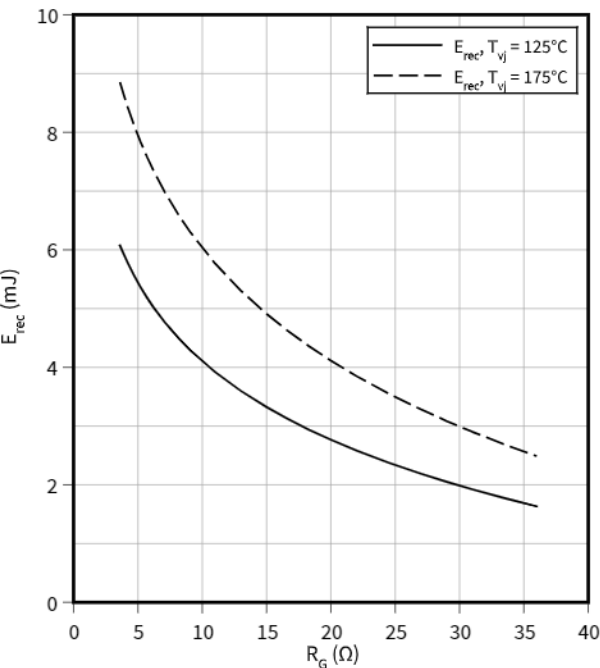
$R_{Gon} = 3.6\ \Omega, V_R = 600\ \text{V}$



Switching losses (typical), Diode, Inverter

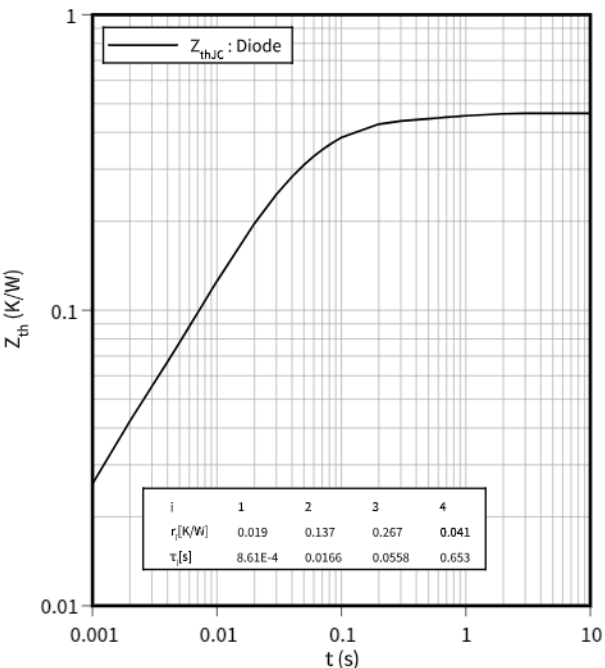
$E_{rec} = f(R_G)$

$I_F = 150\ \text{A}, V_R = 600\ \text{V}$



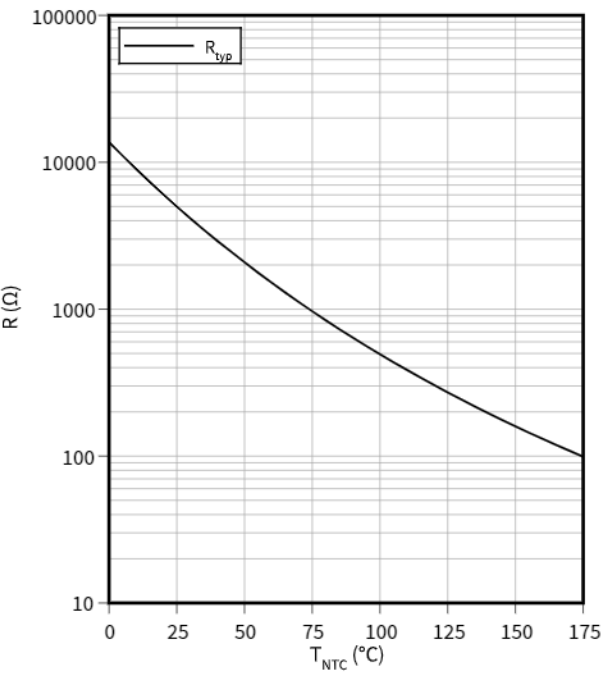
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



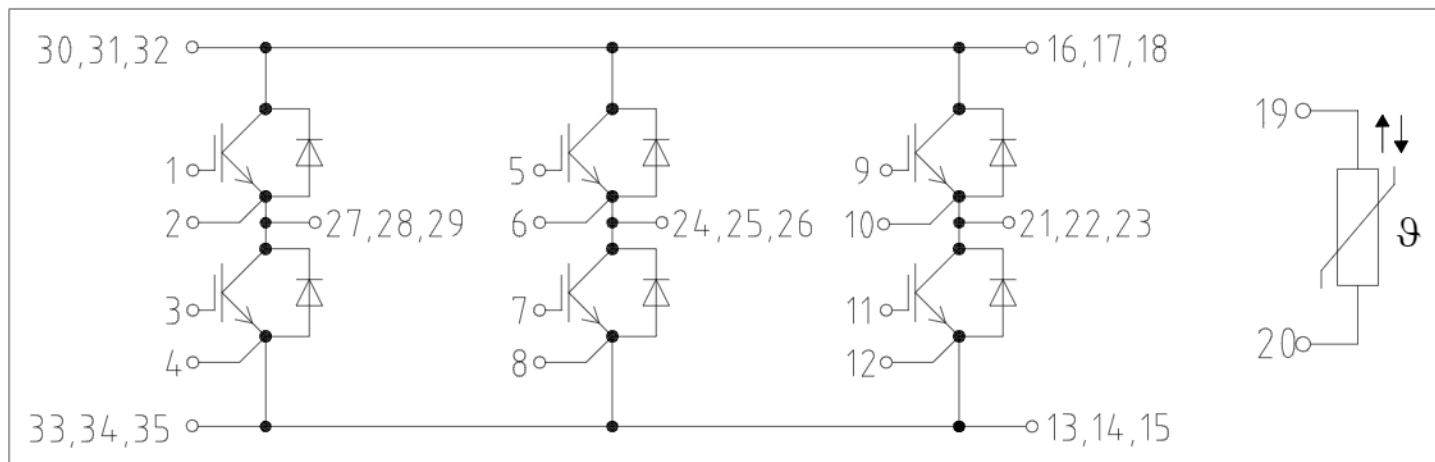


Figure 1



8 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
1.00	2022-01-31	Final datasheet

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