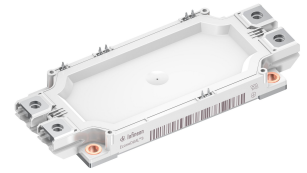


EconoDUAL™3 module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1700\text{ V}$
 - $I_{C\text{ nom}} = 900\text{ A} / I_{CRM} = 1800\text{ A}$
 - Integrated temperature sensor
 - High current density
 - Low $V_{CE,sat}$
 - Overload operation up to 175°C
 - TRENCHSTOP™ IGBT7
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - High power density
 - Isolated base plate
 - PressFIT contact technology
 - Standard housing



Potential applications

- High-power converters
- Medium-voltage converters
- Motor drives
- Wind turbines

Product validation

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

Description

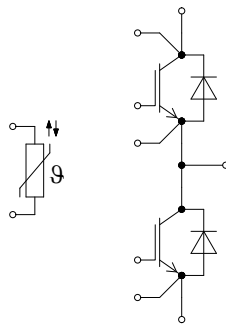


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al2O3	
Creepage distance	d_{Creep}	terminal to heatsink	15.0	mm
Creepage distance	d_{Creep}	terminal to terminal	13.0	mm
Clearance	d_{Clear}	terminal to heatsink	12.5	mm
Clearance	d_{Clear}	terminal to terminal	10.0	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}			20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T=25^{\circ}\text{C}$, per switch		0.8		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
Terminal connection torque	M	- Mounting according to valid application note	M6, Screw	3	6	Nm
Weight	G			345		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CES}	$T_{vj} = 25^{\circ}\text{C}$	1700	V
Continuous DC collector current	I_{CDC}	$T_{vj\max} = 175^{\circ}\text{C}$ $T_C = 80^{\circ}\text{C}$	900	A
Maximum RMS module DC-terminal current	I_{tRMS}	$T_{\text{Terminal}} = 90^{\circ}\text{C}$, $T_C = 90^{\circ}\text{C}$	580	A
		$T_{\text{Terminal}} = 105^{\circ}\text{C}$, $T_C = 90^{\circ}\text{C}$	565	

(table continues...)
 Datasheet

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	$t_P = 1 \text{ ms}$	1800	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	$V_{CE \text{ sat}}$	$I_C = 900 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	1.70	1.85	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$	1.95		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	2.05		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	2.10		
Gate threshold voltage	V_{GEth}	$I_C = 18.8 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25 \text{ }^\circ\text{C}$	5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15 \text{ V}, V_{CE} = 900 \text{ V}$		8.59		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25 \text{ }^\circ\text{C}$		0.28		Ω
Input capacitance	C_{ies}	$f = 100 \text{ kHz}, T_{vj} = 25 \text{ }^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		93.8		nF
Reverse transfer capacitance	C_{res}	$f = 100 \text{ kHz}, T_{vj} = 25 \text{ }^\circ\text{C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		0.33		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1700 \text{ V}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$			100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 900 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.33 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.174		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.195		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	0.202		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.207		
Rise time (inductive load)	t_r	$I_C = 900 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.33 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.054		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.060		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	0.061		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.065		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 900 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 3 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.738		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.828		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	0.850		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.865		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	t_f	$I_C = 900 \text{ A}$, $V_{CE} = 900 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 3 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.202		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.432		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	0.504		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.573		
Turn-on energy loss per pulse	E_{on}	$I_C = 900 \text{ A}$, $V_{CE} = 900 \text{ V}$, $L_\sigma = 25 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Gon} = 0.33 \Omega$, $di/dt = 12300 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	54.6		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	138		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	172		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	205		
Turn-off energy loss per pulse	E_{off}	$I_C = 900 \text{ A}$, $V_{CE} = 900 \text{ V}$, $L_\sigma = 25 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 3 \Omega$, $dv/dt = 3800 \text{ V}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	163		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	245		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	271		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	297		
SC data	I_{SC}	$V_{GE} = 15 \text{ V}$, $V_{CC} = 1000 \text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 8 \mu\text{s}$, $T_{vj} = 150 \text{ }^\circ\text{C}$	3000		A
			$t_p \leq 6 \mu\text{s}$, $T_{vj} = 175 \text{ }^\circ\text{C}$	2900		
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.0460	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$		0.0270		K/W
Temperature under switching conditions	T_{vjop}		-40		175	$^\circ\text{C}$

Note: $T_{vjop} > 150 \text{ }^\circ\text{C}$ 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}	$T_{vj} = 25 \text{ }^\circ\text{C}$	1700	V
Continuous DC forward current	I_F		900	A
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$	1800	A

(table continues...)

Table 5 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
I^2t - value	I^2t	$t_p = 10 \text{ ms}$, $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	A^2s
			$T_{vj} = 175 \text{ °C}$	
			40200	
			27000	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 900 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		2.35	V
			$T_{vj} = 125 \text{ °C}$		2.25	
			$T_{vj} = 150 \text{ °C}$		2.20	
			$T_{vj} = 175 \text{ °C}$		2.10	
Peak reverse recovery current	I_{RM}	$V_R = 900 \text{ V}$, $I_F = 900 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 12900 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$		992	A
			$T_{vj} = 125 \text{ °C}$		1130	
			$T_{vj} = 150 \text{ °C}$		1140	
			$T_{vj} = 175 \text{ °C}$		1170	
Recovered charge	Q_r	$V_R = 900 \text{ V}$, $I_F = 900 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 12900 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$		119	μC
			$T_{vj} = 125 \text{ °C}$		210	
			$T_{vj} = 150 \text{ °C}$		240	
			$T_{vj} = 175 \text{ °C}$		272	
Reverse recovery energy	E_{rec}	$V_R = 900 \text{ V}$, $I_F = 900 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 12900 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$		86	mJ
			$T_{vj} = 125 \text{ °C}$		141	
			$T_{vj} = 150 \text{ °C}$		159	
			$T_{vj} = 175 \text{ °C}$		176	
Thermal resistance, junction to case	R_{thJC}	per diode			0.0885	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}^*\text{K})$		0.0370		K/W
Temperature under switching conditions	T_{vjop}		-40		175	°C

Note: $T_{vjop} > 150 \text{ °C}$ 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}	$T_{NTC} = 25\text{ °C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100\text{ °C}, R_{100} = 493\text{ Ω}$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25\text{ °C}$			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

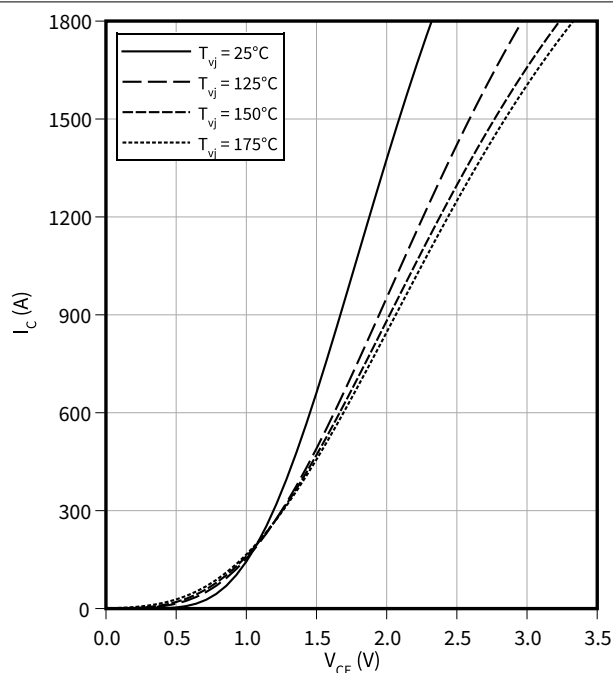
Note: Specification according to the valid application note.

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

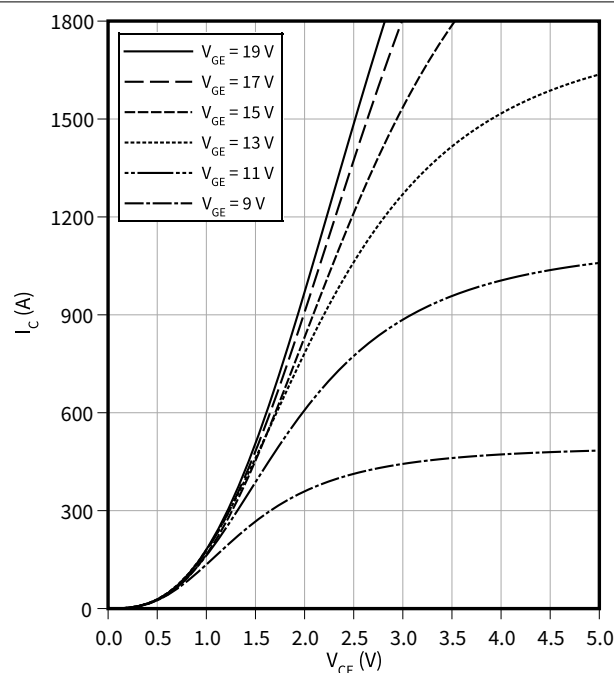
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

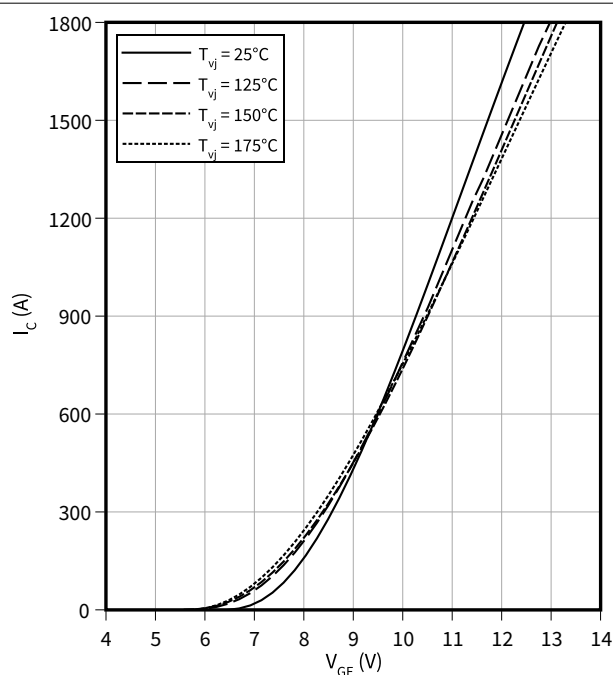
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

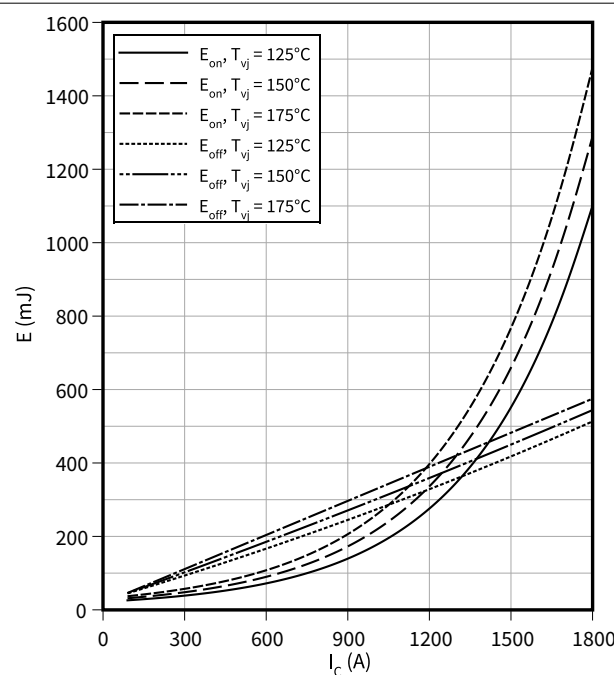
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 3 \text{ } \Omega, R_{Gon} = 0.33 \text{ } \Omega, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

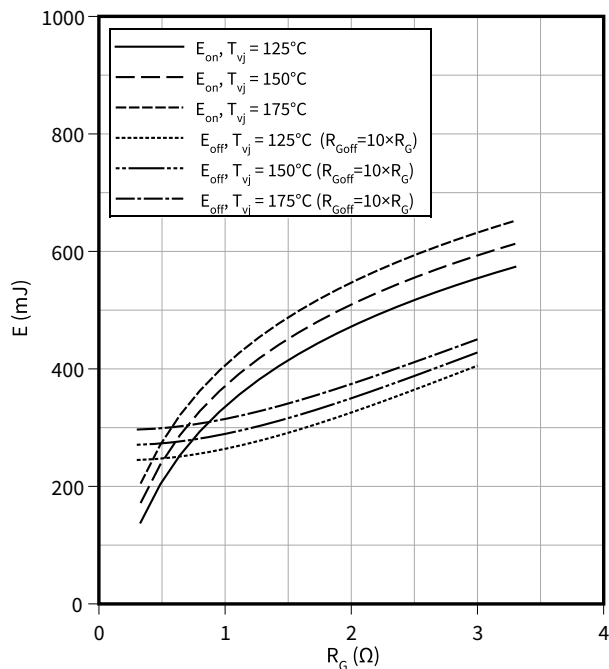


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

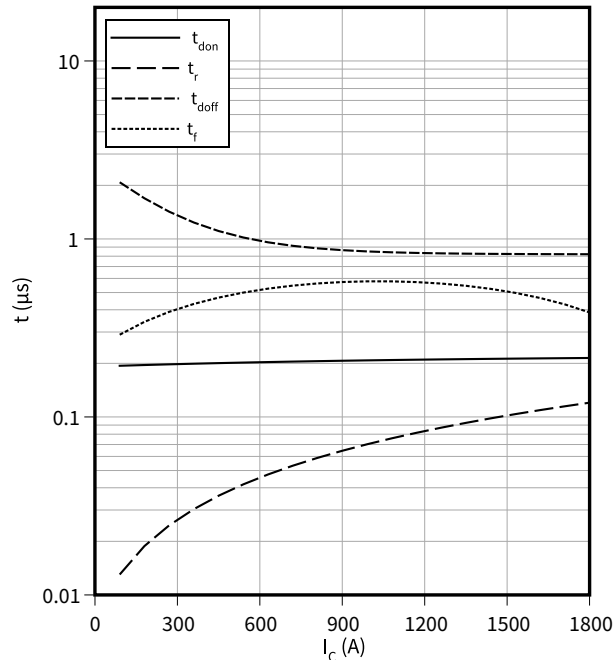
$I_C = 900\text{ A}$, $V_{CE} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

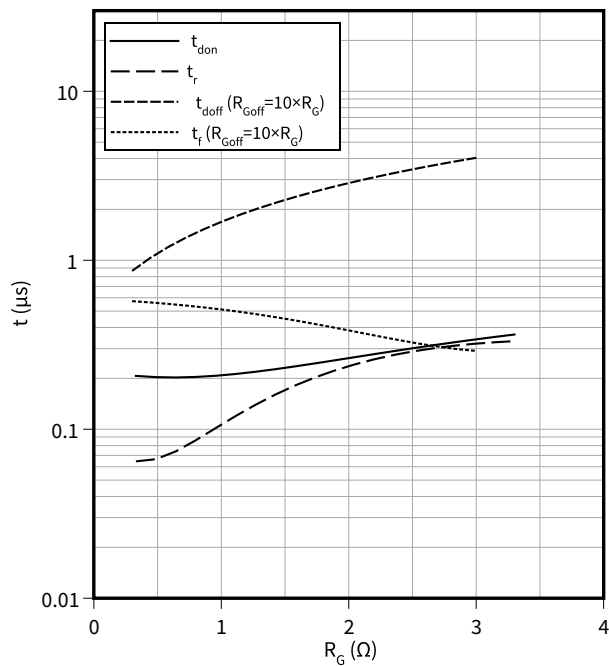
$R_{Goff} = 3\text{ }\Omega$, $R_{Gon} = 0.33\text{ }\Omega$, $V_{CE} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

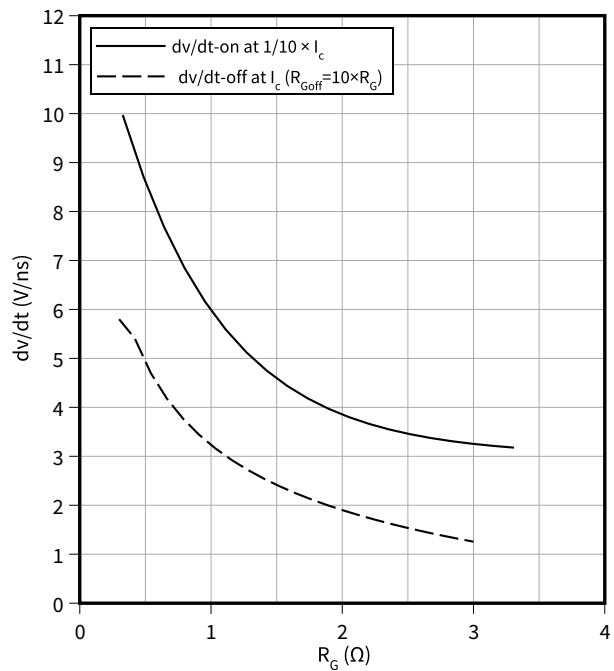
$I_C = 900\text{ A}$, $V_{CE} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

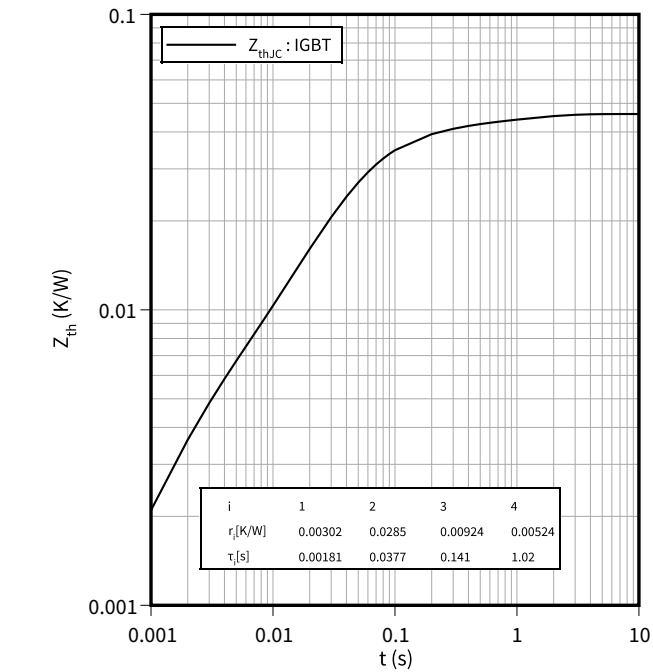
$I_C = 900\text{ A}$, $V_{CE} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 25\text{ }^\circ\text{C}$



5 Characteristics diagrams

Transient thermal impedance , IGBT, Inverter

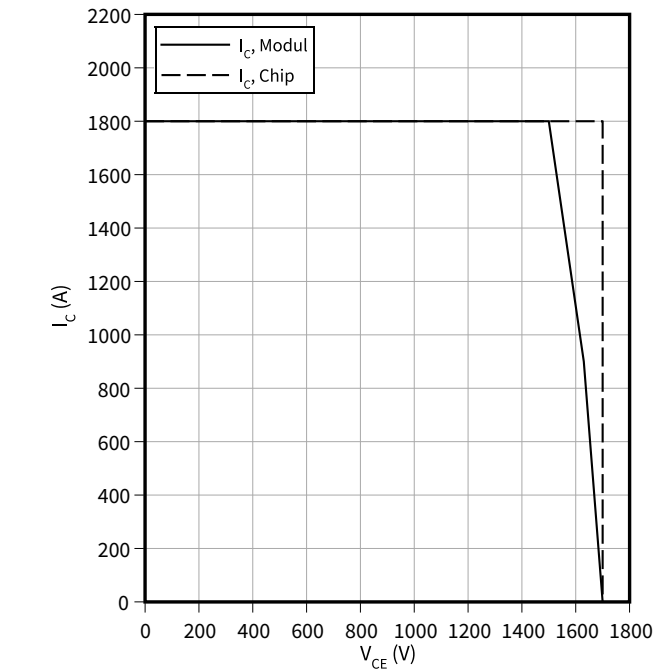
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

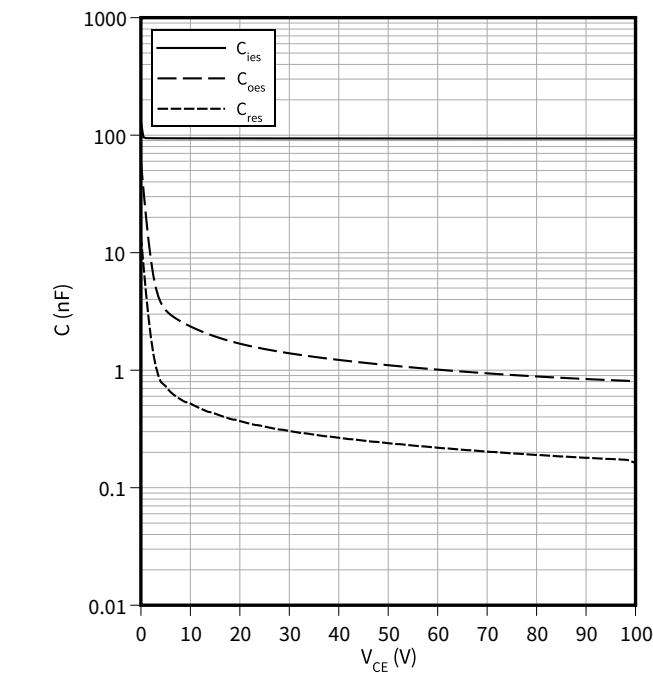
$R_{Goff} = 3 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

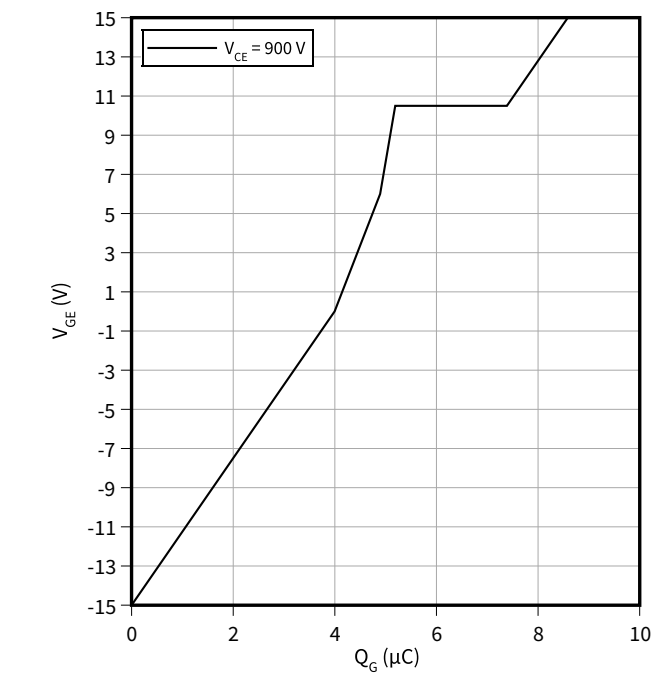
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

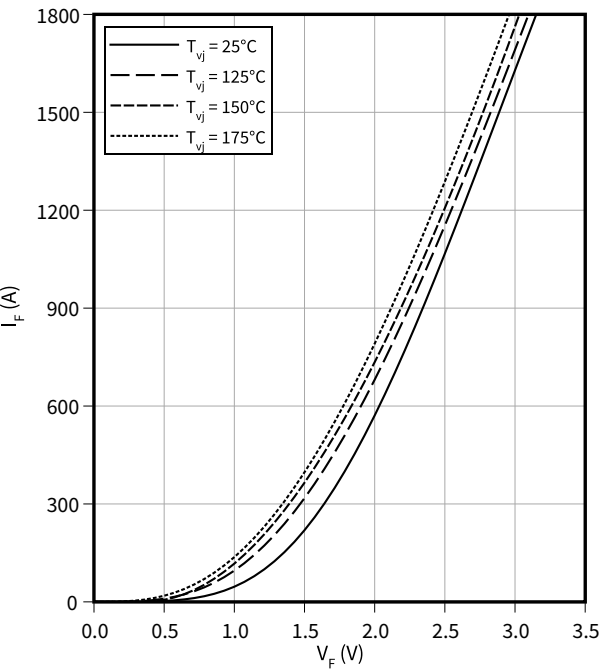
$I_C = 900 A, T_{vj} = 25 \text{ }^\circ\text{C}$



5 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

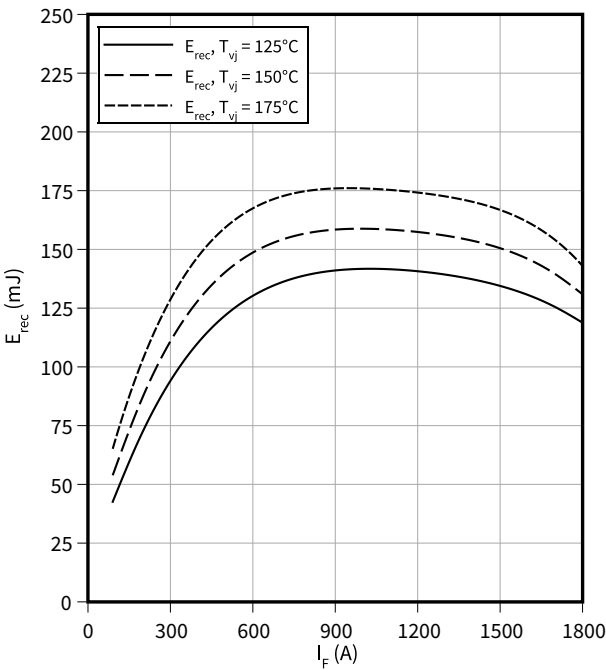
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

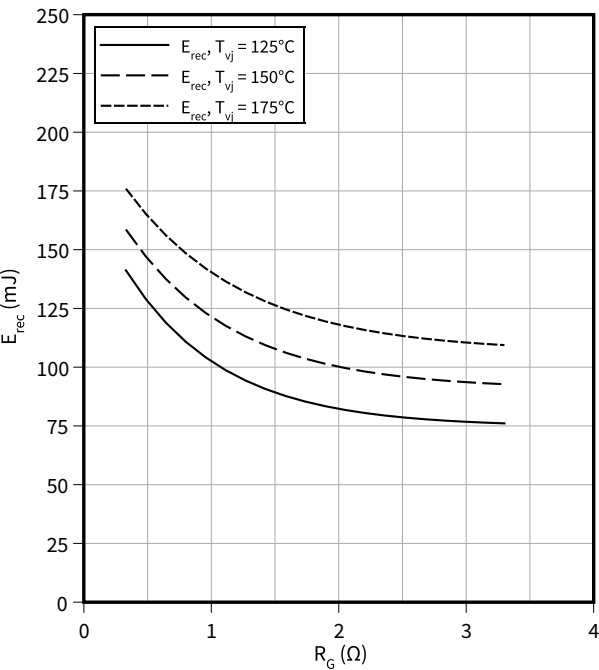
$R_{Gon} = 0.33 \Omega$, $V_{CE} = 900 \text{ V}$



Switching losses (typical), Diode, Inverter

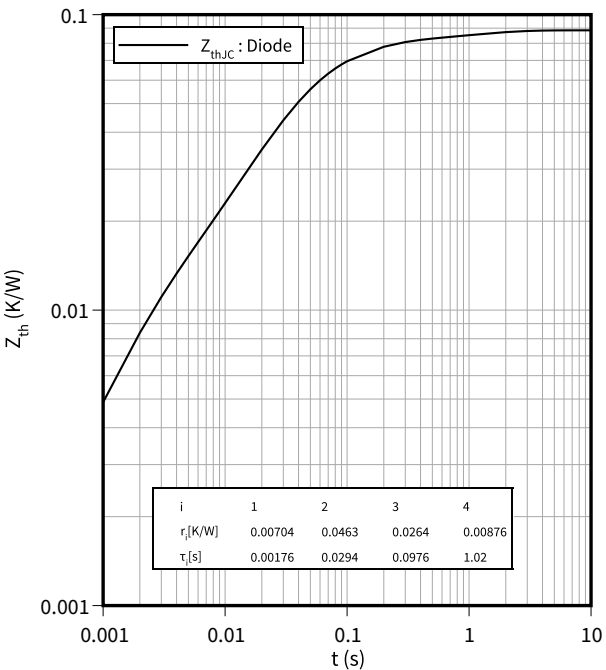
$E_{rec} = f(R_G)$

$V_{CE} = 900 \text{ V}$, $I_F = 900 \text{ A}$

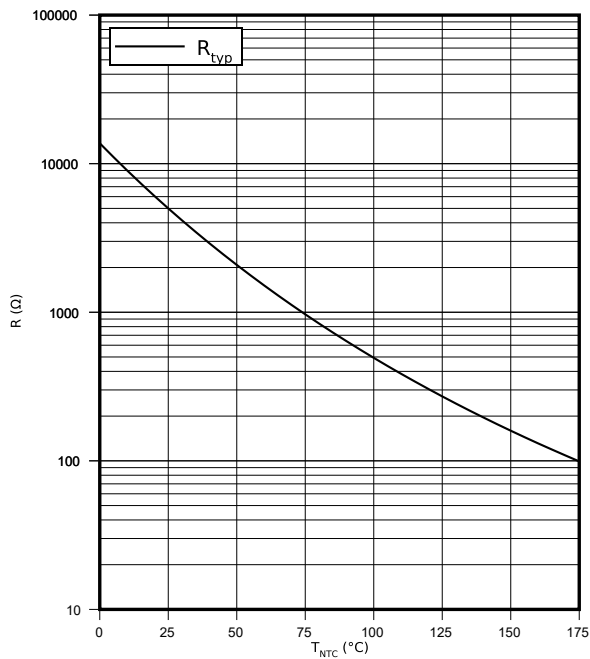


Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor
 $R = f(T_{NTC})$



6 **Circuit diagram**

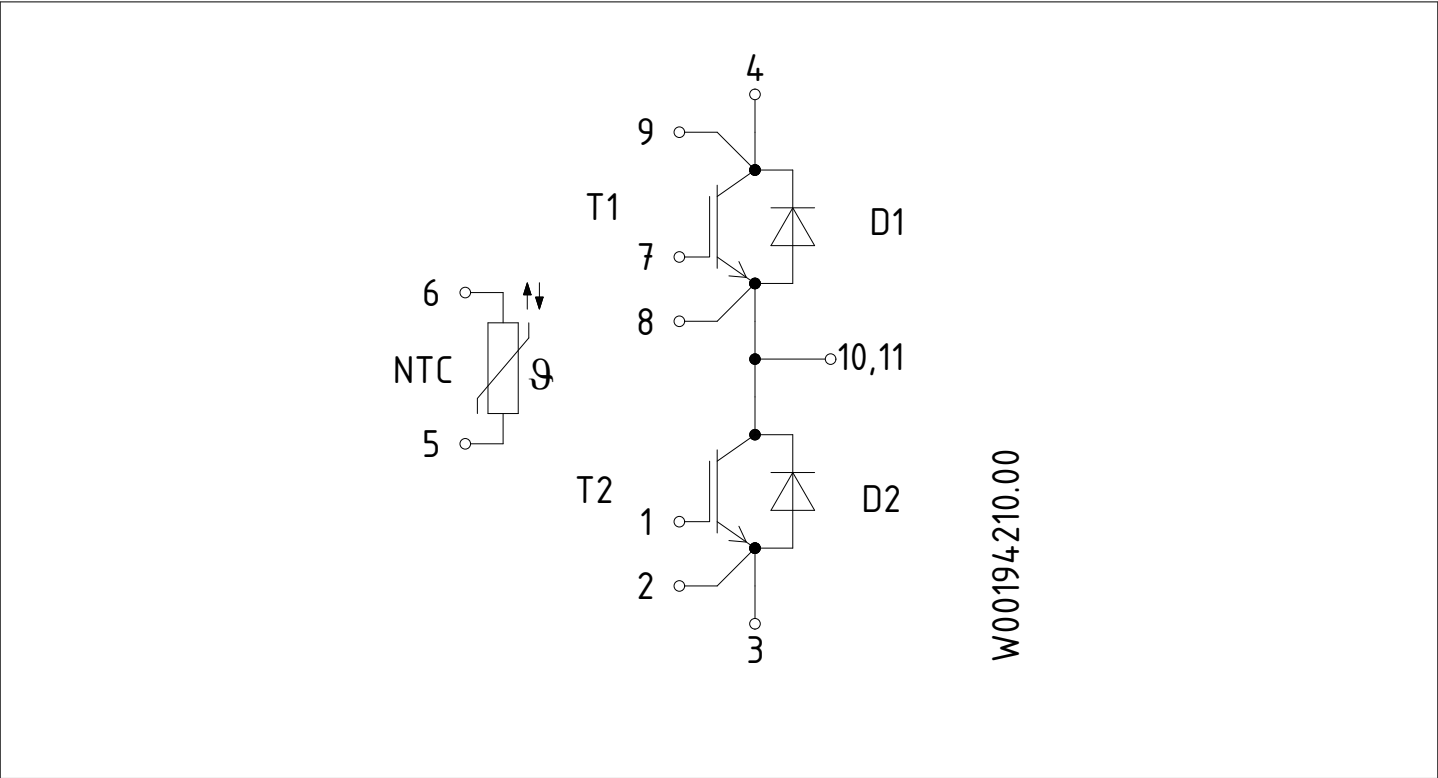


Figure 1



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	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	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
0.10	2020-11-12	Target datasheet
0.20	2021-01-14	Target datasheet
1.00	2022-02-01	Final datasheet

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