

Final datasheet

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

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 750\text{ A} / I_{CRM} = 1500\text{ A}$
 - Integrated temperature sensor
 - TRENCHSTOP™ IGBT7
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - PressFIT contact technology
 - Standard housing
 - Isolated base plate
 - High power density



Potential applications

- Commercial agriculture vehicles
- High-power converters
- Motor drives
- Servo drives
- UPS systems

Product validation

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

Description

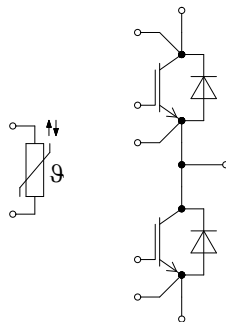


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1 Package

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)	Al_2O_3	
Creepage distance	$d_{Creep \text{ nom}}$	terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0)	> 15	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0)	14.7	mm
Creepage distance	$d_{Creep \text{ nom}}$	terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0)	12.1	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0)	11.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to baseplate, nom.	> 12.5	mm
Clearance	$d_{Clear \text{ min}}$	terminal to baseplate, min.	12.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to terminal, nom.	10.0	mm
Clearance	$d_{Clear \text{ min}}$	terminal to terminal, min.	9.6	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	$R_{CC'+EE'}$	$T_C = 25 \text{ °C}$, 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}		$T_{vj} = 25\text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\text{ max}} = 175\text{ °C}$	$T_C = 90\text{ °C}$	750	A
Maximum RMS module DC-terminal current	I_{tRMS}		$T_{\text{Terminal}} = 90\text{ °C},$ $T_C = 90\text{ °C}$	580	A
			$T_{\text{Terminal}} = 105\text{ °C},$ $T_C = 90\text{ °C}$	565	
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\text{ op}}$		1500	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	$V_{CE\text{ sat}}$	$I_C = 750\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.50	1.75	V
			$T_{vj} = 125\text{ °C}$		1.65		
			$T_{vj} = 175\text{ °C}$		1.75		
Gate threshold voltage	V_{GEth}	$I_C = 15\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25\text{ °C}$		5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\text{ V}, V_{CC} = 600\text{ V}$			12		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$			0.5		Ω
Input capacitance	C_{ies}	$f = 100\text{ kHz}, T_{vj} = 25\text{ °C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$			115		nF
Reverse transfer capacitance	C_{res}	$f = 100\text{ kHz}, T_{vj} = 25\text{ °C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$			0.58		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			45	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_{vj} = 25\text{ °C}$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 750\text{ A}, V_{CC} = 600\text{ V},$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 0.5\text{ Ω}$	$T_{vj} = 25\text{ °C}$		0.300		μs
			$T_{vj} = 125\text{ °C}$		0.320		
			$T_{vj} = 175\text{ °C}$		0.340		
Rise time (inductive load)	t_r	$I_C = 750\text{ A}, V_{CC} = 600\text{ V},$ $V_{GE} = \pm 15\text{ V}, R_{Gon} = 0.5\text{ Ω}$	$T_{vj} = 25\text{ °C}$		0.079		μs
			$T_{vj} = 125\text{ °C}$		0.086		
			$T_{vj} = 175\text{ °C}$		0.090		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off delay time (inductive load)	t_{doff}	$I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_{\text{Goff}} = 0.5 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.470		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.550		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.600		
Fall time (inductive load)	t_f	$I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_{\text{Goff}} = 0.5 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.110		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.240		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	0.350		
Turn-on energy loss per pulse	E_{on}	$I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $L_\sigma = 25 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{\text{Gon}} = 0.5 \Omega$, $di/dt = 7000 \text{ A}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	53		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	86		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	107		
Turn-off energy loss per pulse	E_{off}	$I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $L_\sigma = 25 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{\text{Goff}} = 0.5 \Omega$, $dv/dt = 3100 \text{ V}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	65		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	97.5		
			$T_{vj} = 175 \text{ }^\circ\text{C}$	121		
SC data	I_{SC}	$V_{GE} \leq 15 \text{ V}$, $V_{CC} = 800 \text{ V}$, $V_{\text{CEmax}} = V_{\text{CES}} - L_{\text{sCE}} \cdot di/dt$	$t_p \leq 8 \mu\text{s}$, $T_{vj} = 150 \text{ }^\circ\text{C}$	2900		A
			$t_p \leq 6 \mu\text{s}$, $T_{vj} = 175 \text{ }^\circ\text{C}$	2800		
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.0520	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m} \cdot \text{K})$		0.0260		K/W
Temperature under switching conditions	$T_{vj \text{ op}}$		-40		175	$^\circ\text{C}$

Note: $T_{vj \text{ op}} > 150 \text{ }^\circ\text{C}$ is 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}	$T_{vj} = 25 \text{ }^\circ\text{C}$	1200	V
Continuous DC forward current	I_F		750	A
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$	1500	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
			$T_{vj} = 175 \text{ °C}$	
			28700	
			20500	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 750 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		1.80	V
			$T_{vj} = 125 \text{ °C}$		1.70	
			$T_{vj} = 175 \text{ °C}$		1.60	
Peak reverse recovery current	I_{RM}	$V_{CC} = 600 \text{ V}, I_F = 750 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 7000 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		400	A
			$T_{vj} = 125 \text{ °C}$		485	
			$T_{vj} = 175 \text{ °C}$		561	
Recovered charge	Q_r	$V_{CC} = 600 \text{ V}, I_F = 750 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 7000 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		48	μC
			$T_{vj} = 125 \text{ °C}$		84	
			$T_{vj} = 175 \text{ °C}$		131	
Reverse recovery energy	E_{rec}	$V_{CC} = 600 \text{ V}, I_F = 750 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 7000 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		20	mJ
			$T_{vj} = 125 \text{ °C}$		32	
			$T_{vj} = 175 \text{ °C}$		53	
Thermal resistance, junction to case	R_{thJC}	per diode			0.101	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		0.0380		K/W
Temperature under switching conditions	$T_{vj op}$		-40		175	°C

Note: $T_{vj op} > 150 \text{ °C}$ is 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

(table continues...)

Table 7 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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

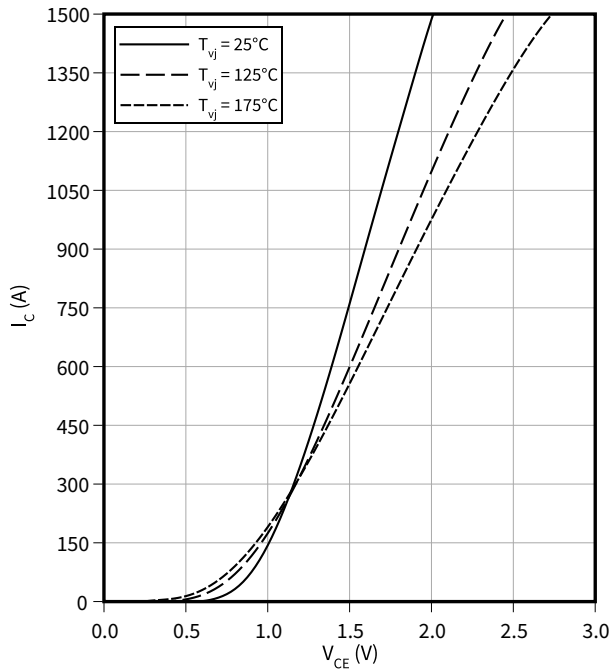
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

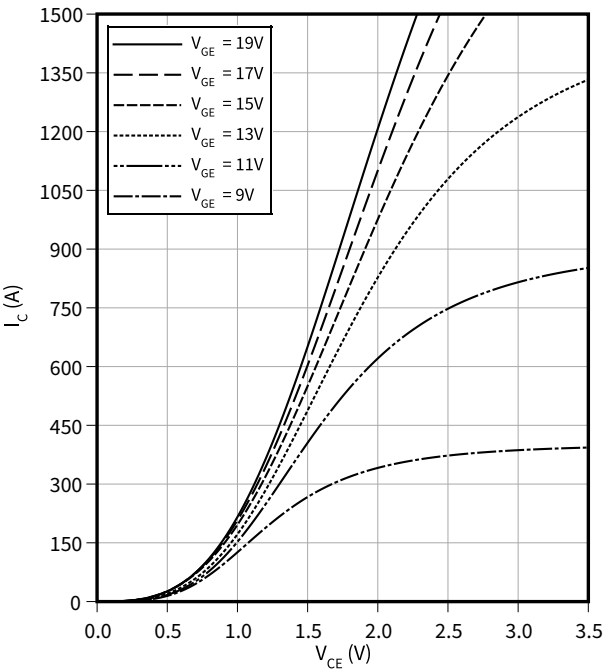
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

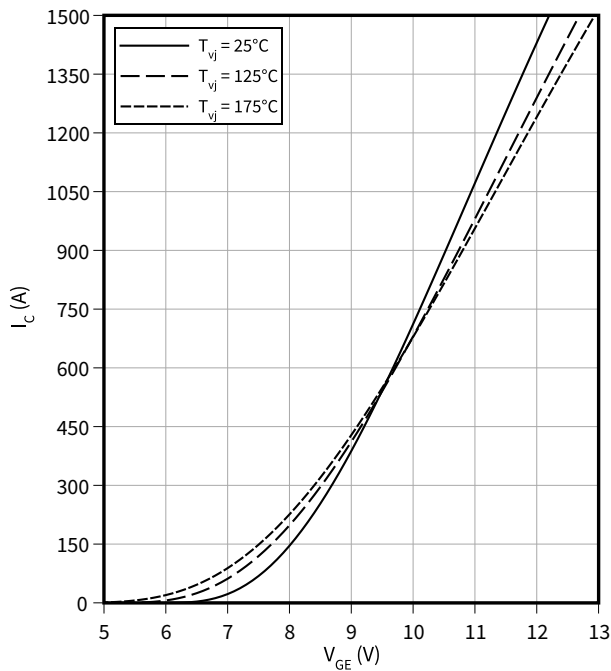
$T_{vj} = 175^\circ\text{C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

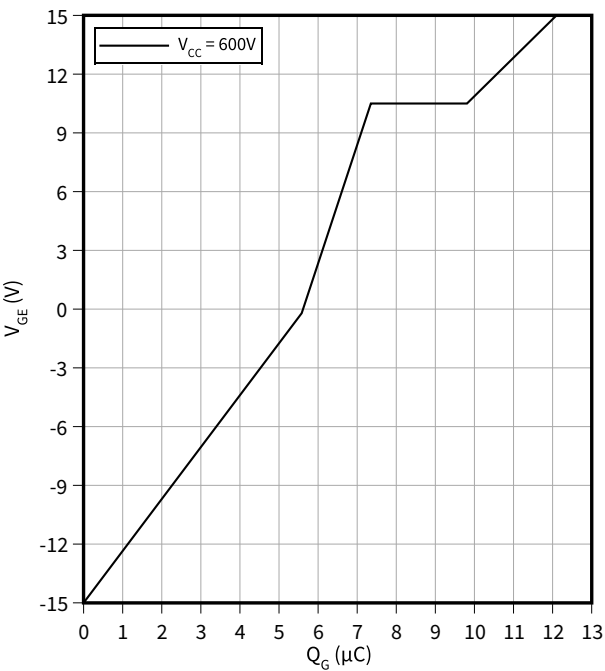
$V_{CE} = 20\text{ V}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

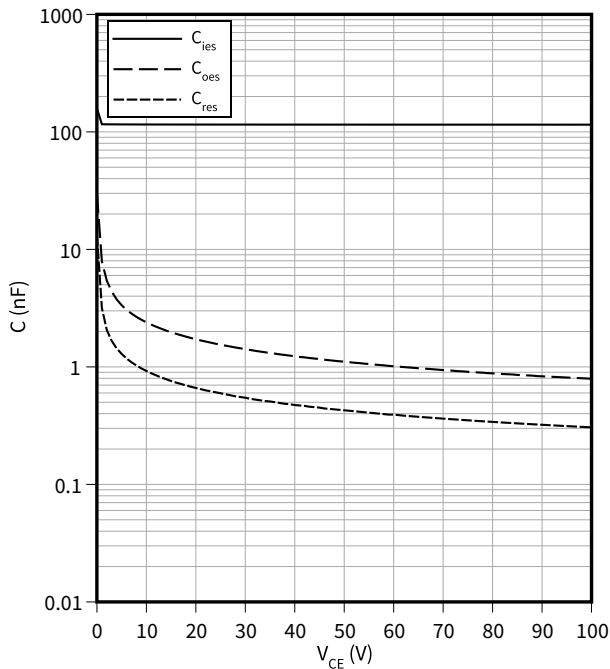
$I_C = 750\text{ A}, T_{vj} = 25^\circ\text{C}$



5 Characteristics diagrams

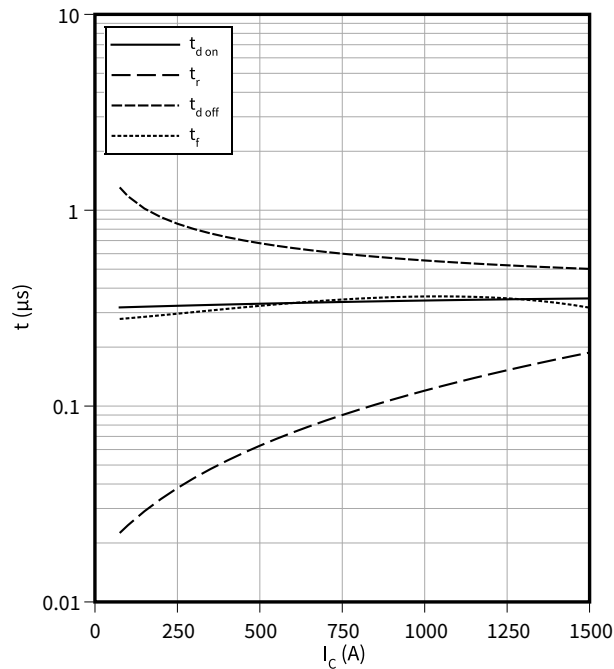
Capacity characteristic (typical), IGBT, Inverter

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



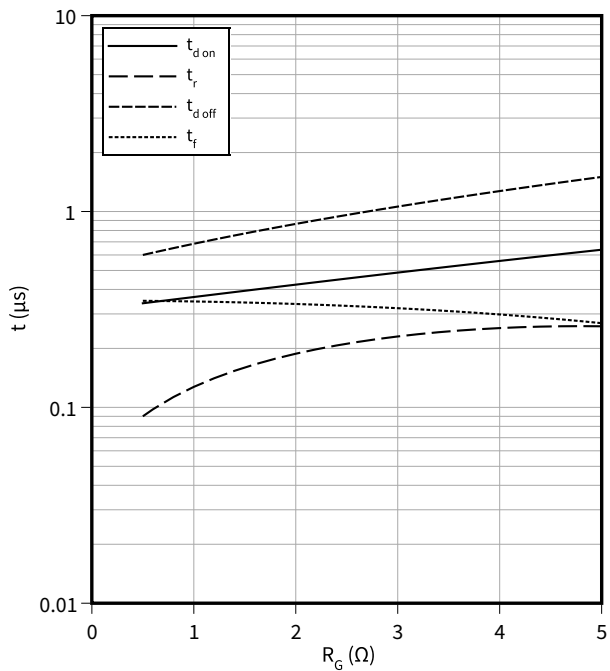
Switching times (typical), IGBT, Inverter

$t = f(I_C)$
 $R_{Goff} = 0.5 \text{ } \Omega$, $R_{Gon} = 0.5 \text{ } \Omega$, $V_{GE} = \pm 15 \text{ V}$, $V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^{\circ}\text{C}$



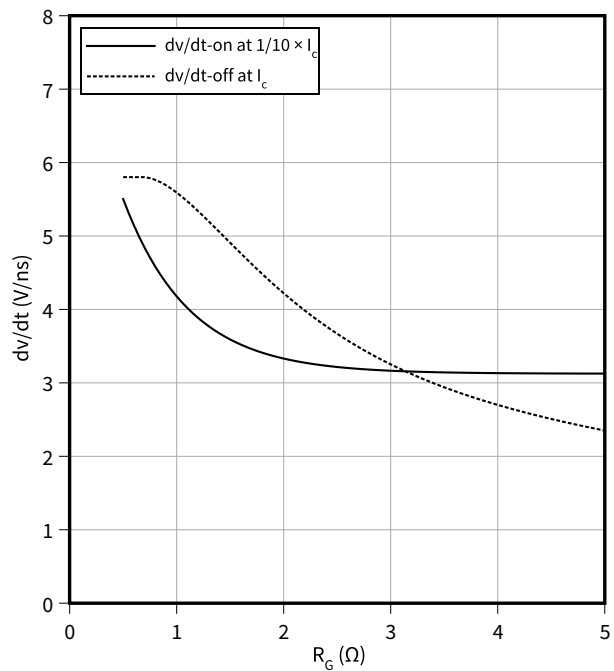
Switching times (typical), IGBT, Inverter

$t = f(R_G)$
 $V_{GE} = \pm 15 \text{ V}$, $I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $T_{vj} = 175 \text{ }^{\circ}\text{C}$



Voltage slope (typical), IGBT, Inverter

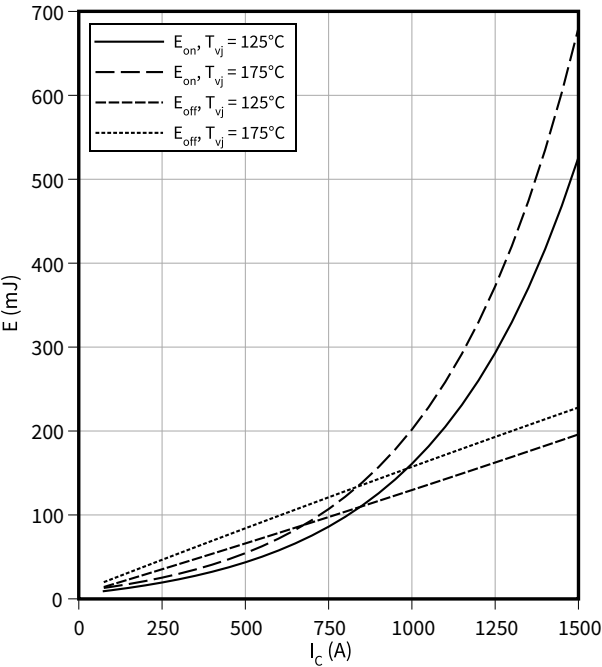
$dv/dt = f(R_G)$
 $I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$



5 Characteristics diagrams

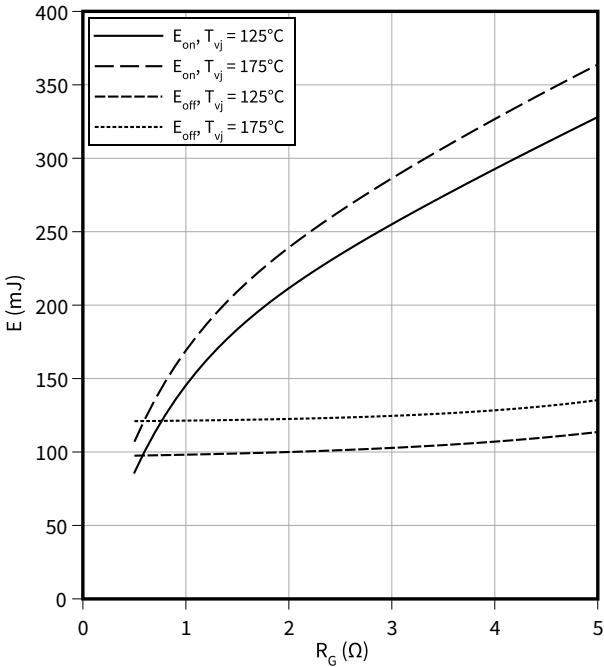
Switching losses (typical), IGBT, Inverter

$E = f(I_C)$
 $R_{Goff} = 0.5 \Omega, R_{Gon} = 0.5 \Omega, V_{CC} = 600 \text{ V}, V_{GE} = -15 / 15 \text{ V}$



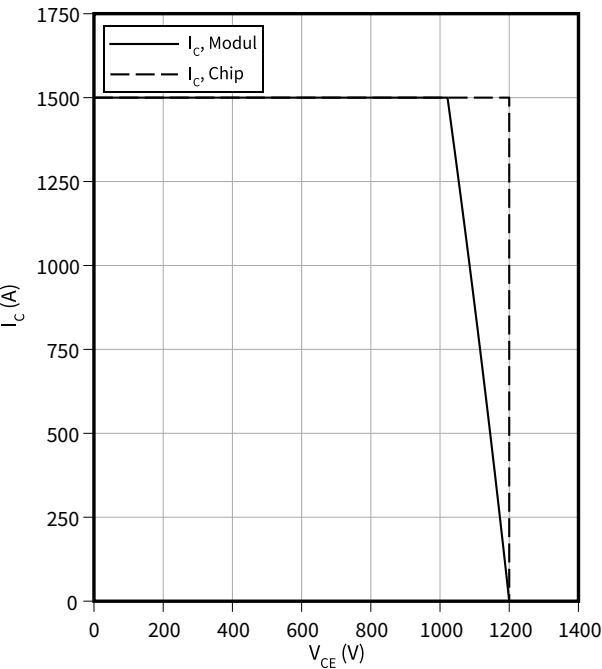
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $I_C = 750 \text{ A}, V_{CC} = 600 \text{ V}, V_{GE} = -15 / 15 \text{ V}$



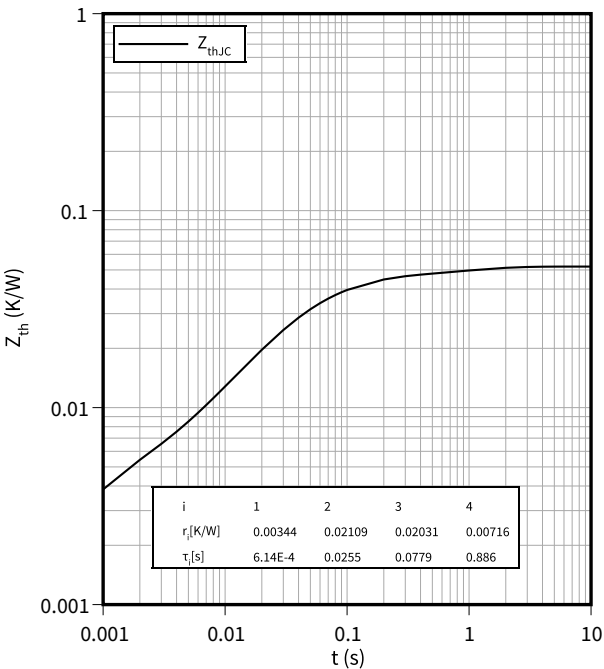
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 0.5 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



Transient thermal impedance, IGBT, Inverter

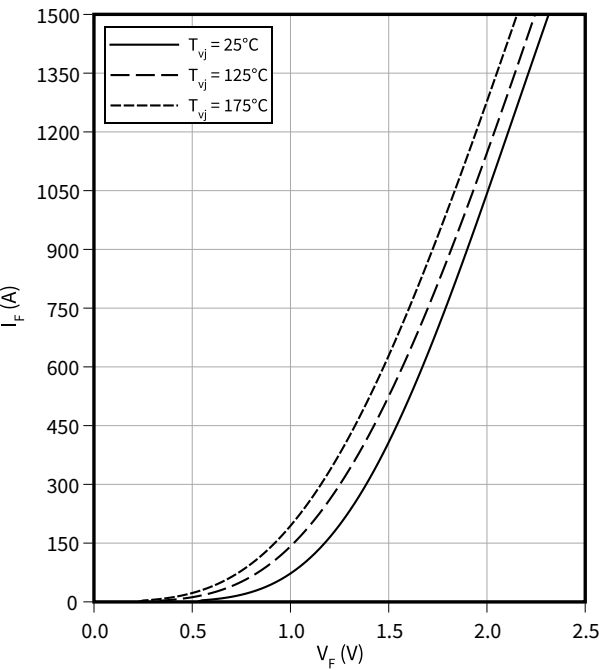
$Z_{th} = f(t)$



5 Characteristics diagrams

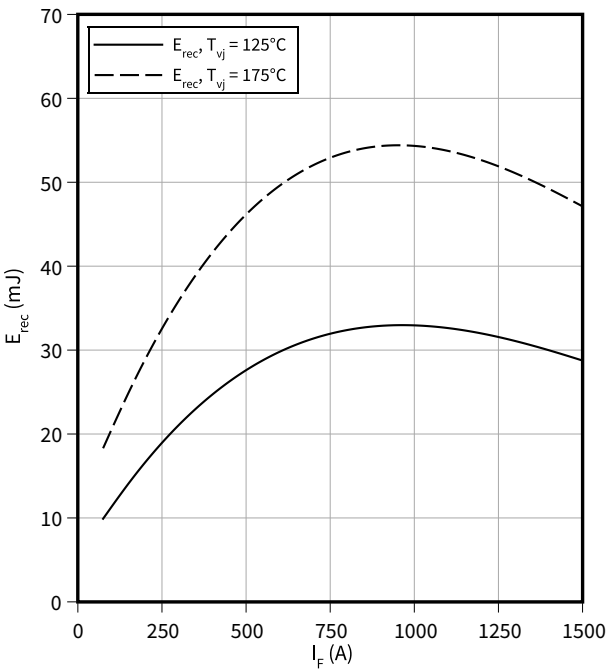
Forward characteristic (typical), Diode, Inverter

$I_F = f(V_F)$



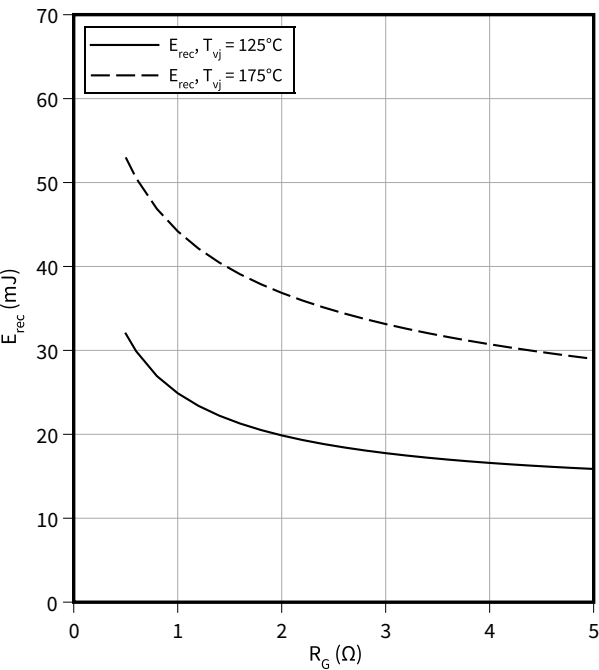
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $R_{Gon} = R_{Gon}(IGBT)$, $V_{CC} = 600\text{ V}$



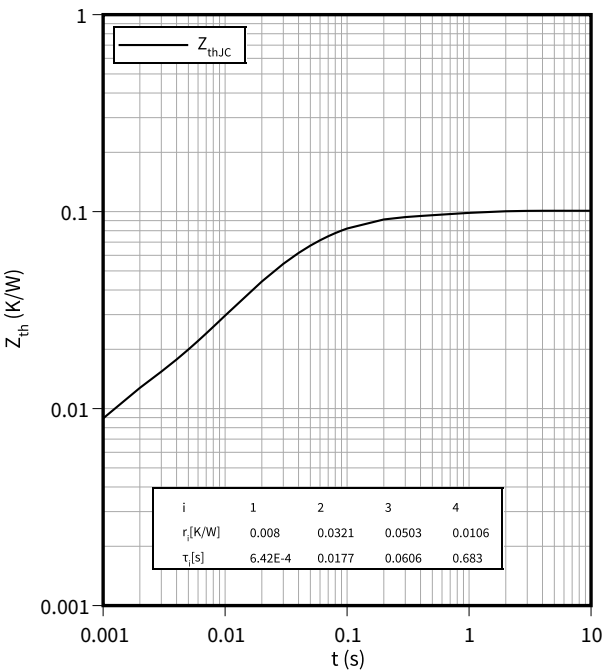
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $I_F = 750\text{ A}$, $V_{CC} = 600\text{ V}$



Transient thermal impedance, Diode, Inverter

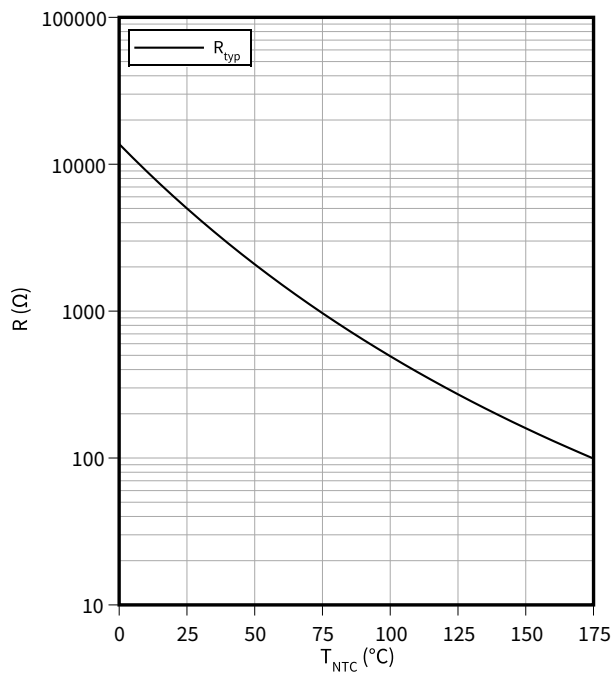
$Z_{th} = f(t)$



5 Characteristics diagrams

Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 **Circuit diagram**

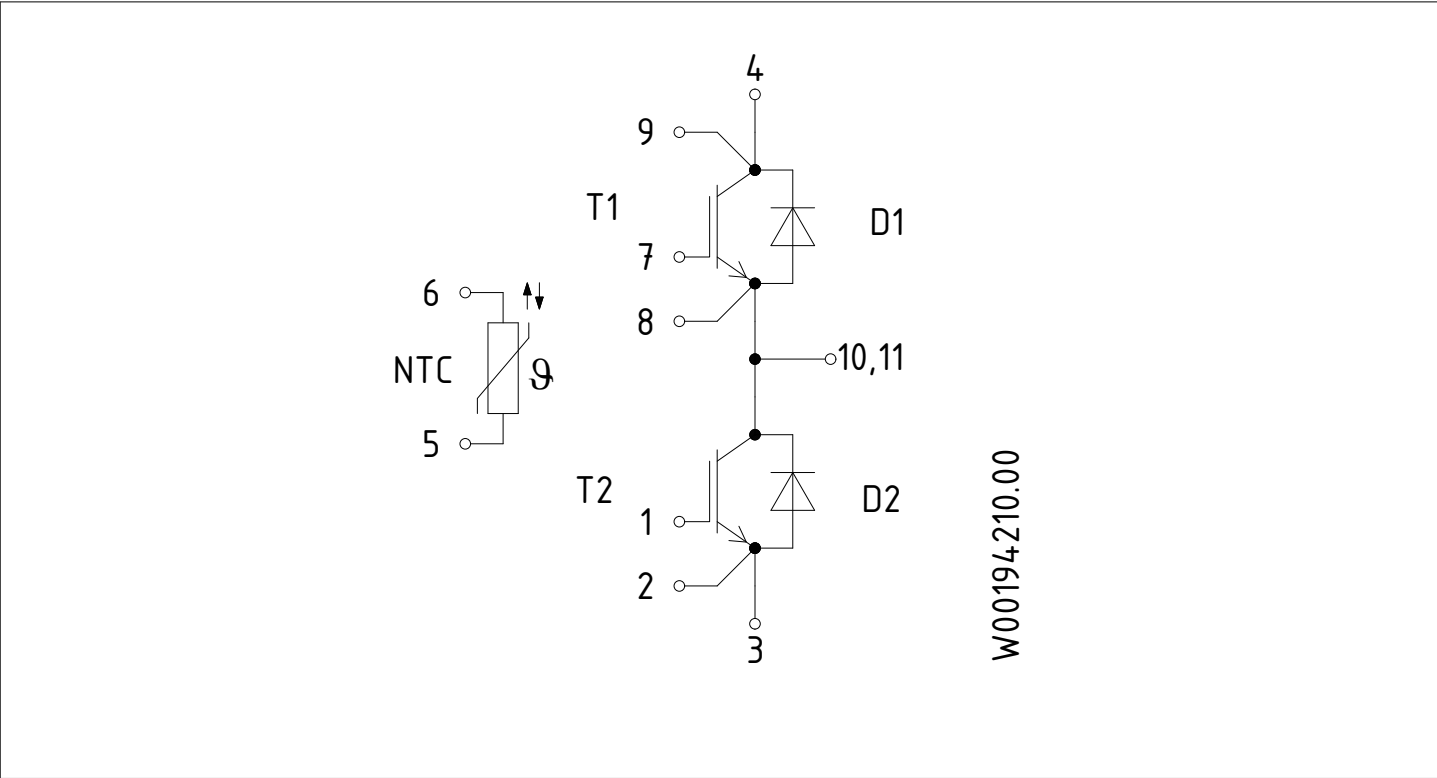


Figure 1

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
V1.0	2019-11-06	Target 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
0.11	2020-11-24	Target datasheet
1.00	2021-05-27	Final datasheet
1.10	2021-10-11	Final datasheet
1.20	2024-03-08	Final datasheet

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