

**Preliminary**

**EconoPIM™3 module with TRENCHSTOP™ IGBT7 and Emitter Controlled 7 diode and NTC**

**Features**

- Electrical features
  - $V_{CES} = 1200\text{ V}$
  - $I_{C\text{nom}} = 150\text{ A} / I_{CRM} = 300\text{ A}$
  - TRENCHSTOP™ IGBT7
  - Overload operation up to  $175^\circ\text{C}$
  - Low  $V_{CEsat}$
- Mechanical features
  - Integrated NTC temperature sensor
  - Solder contact technology
  - Copper base plate
  - $\text{Al}_2\text{O}_3$  substrate with low thermal resistance



Typical appearance

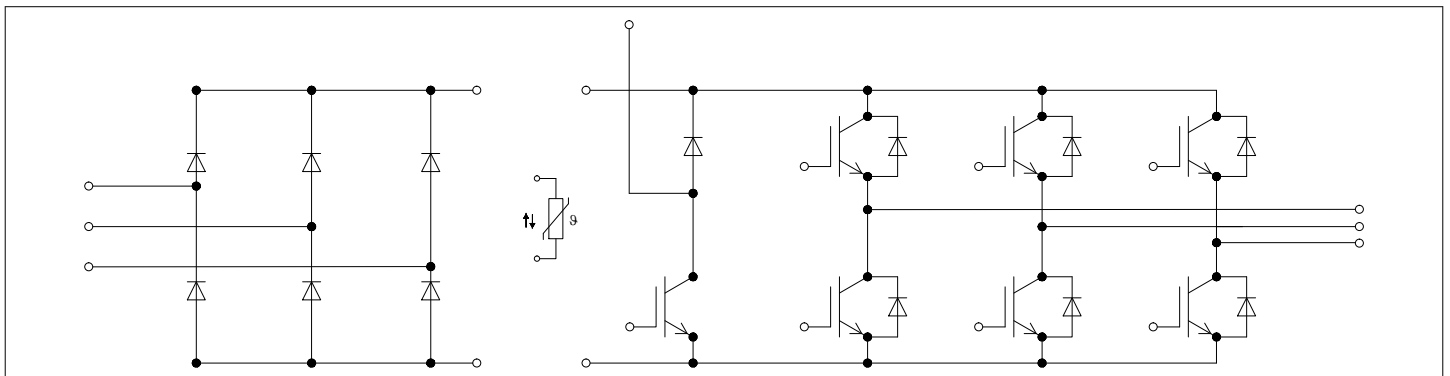
**Potential applications**

- Auxiliary inverters
- Motor drives
- 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, $f = 50$ Hz, $t = 1$ 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	
RTI Elec.	$RTI$	housing	140	°C

**Table 2 Characteristic Values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	$L_{SCE}$			25		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25^\circ C$ , per switch		1.1		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ C$ , per switch		1.6		mΩ
Storage temperature	$T_{stg}$		-40		125	°C
Mounting torque for modul mounting	$M$	- Mounting according to valid application note	3		6	Nm
Weight	$G$			300		g

## 2 IGBT, Inverter

**Table 3 Maximum Rated Values**

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	$V_{CES}$	$T_{vj} = 25^\circ C$	1200	V
Continous DC collector current	$I_{CDC}$	$T_{vj\ max} = 175^\circ C$ $T_C = 80^\circ C$	150	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1$ 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	TBD	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		$\mu C$	
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		1		$\Omega$	
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)	$t_{don}$	$I_C = 150\ A,$ $V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V,$ $R_{Gon} = 3.3\ \Omega$		$T_{vj} = 25\ ^\circ C$	0.172		$\mu s$
				$T_{vj} = 125\ ^\circ C$	0.183		
				$T_{vj} = 175\ ^\circ C$	0.189		
Rise time (inductive load)	$t_r$	$I_C = 150\ A,$ $V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V,$ $R_{Gon} = 3.3\ \Omega$		$T_{vj} = 25\ ^\circ C$	0.072		$\mu s$
				$T_{vj} = 125\ ^\circ C$	0.077		
				$T_{vj} = 175\ ^\circ C$	0.080		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 150\ A,$ $V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V,$ $R_{Goff} = 3.3\ \Omega$		$T_{vj} = 25\ ^\circ C$	0.331		$\mu s$
				$T_{vj} = 125\ ^\circ C$	0.414		
				$T_{vj} = 175\ ^\circ C$	0.433		

**Table 4** Characteristic Values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	$t_f$	$I_C = 150\text{ A}$ , $V_{CE} = 600\text{ V}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Goff} = 3.3\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C}$ $T_{vj} = 125\text{ }^\circ\text{C}$ $T_{vj} = 175\text{ }^\circ\text{C}$		0.103	$\mu\text{s}$
					0.198	
					0.262	
Turn-on energy loss per pulse	$E_{on}$	$I_C = 150\text{ A}$ , $V_{CE} = 600\text{ V}$ , $L_\sigma = 35\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Gon} = 3.3\ \Omega$ , $di/dt = 1700\text{ A}/\mu\text{s}$ ( $T_{vj} = 175\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$ $T_{vj} = 125\text{ }^\circ\text{C}$ $T_{vj} = 175\text{ }^\circ\text{C}$		16.6	mJ
					24.9	
					29.6	
Turn-off energy loss per pulse	$E_{off}$	$I_C = 150\text{ A}$ , $V_{CE} = 600\text{ V}$ , $L_\sigma = 35\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Goff} = 3.3\ \Omega$ , $dv/dt = 3200\text{ V}/\mu\text{s}$ ( $T_{vj} = 175\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$ $T_{vj} = 125\text{ }^\circ\text{C}$ $T_{vj} = 175\text{ }^\circ\text{C}$		10.4	mJ
					15.9	
					19.9	
SC data	$I_{SC}$	$V_{GE} \leq 15\text{ V}$ , $V_{CC} = 800\text{ V}$ , $V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 8\ \mu\text{s}$ , $T_{vj} = 150\text{ }^\circ\text{C}$ $t_p \leq 7\ \mu\text{s}$ , $T_{vj} = 175\text{ }^\circ\text{C}$		520	A
					490	
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			0.290	K/W
Thermal resistance, case to heatsink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$			0.0680	K/W
Temperature under switching conditions	$T_{vj\ op}$			-40	175	$^\circ\text{C}$

Note:  $T_{vj\ op} > 150\text{ }^\circ\text{C}$  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

**Table 5 Maximum Rated Values (continued)**

Parameter	Symbol	Note or test condition	Values	Unit	
Continuous DC forward current	$I_F$		150	A	
Repetitive peak forward current	$I_{FRM}$	$t_P = 1 \text{ ms}$	300	A	
$I^2t$ - value	$I^2t$	$t_P = 10 \text{ ms},$ $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	2700	A <sup>2</sup> s
			$T_{vj} = 175 \text{ °C}$	2250	

**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	TBD	V
				$T_{vj} = 125 \text{ °C}$	1.59		
				$T_{vj} = 175 \text{ °C}$	1.52		
Peak reverse recovery current	$I_{RM}$	$V_R = 600 \text{ V},$ $I_F = 150 \text{ A},$ $V_{GE} = -15 \text{ V},$ $-di_F/dt = 1700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ )		$T_{vj} = 25 \text{ °C}$	65.3		A
				$T_{vj} = 125 \text{ °C}$	91.8		
				$T_{vj} = 175 \text{ °C}$	107		
Recovered charge	$Q_r$	$V_R = 600 \text{ V},$ $I_F = 150 \text{ A},$ $V_{GE} = -15 \text{ V},$ $-di_F/dt = 1700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ )		$T_{vj} = 25 \text{ °C}$	10.3		$\mu\text{C}$
				$T_{vj} = 125 \text{ °C}$	21.7		
				$T_{vj} = 175 \text{ °C}$	28.6		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V},$ $I_F = 150 \text{ A},$ $V_{GE} = -15 \text{ V},$ $-di_F/dt = 1700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ )		$T_{vj} = 25 \text{ °C}$	3.27		mJ
				$T_{vj} = 125 \text{ °C}$	7.32		
				$T_{vj} = 175 \text{ °C}$	9.88		
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.463		K/W
Thermal resistance, case to heatsink	$R_{thCH}$	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$			0.0698		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 Diode, Rectifier

**Table 7** Maximum Rated Values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} = 25\text{ °C}$	1600	V	
Maximum RMS forward current per chip	$I_{FRMSM}$	$T_C = 100\text{ °C}$	150	A	
Maximum RMS current at rectifier output	$I_{RMSM}$	$T_C = 100\text{ °C}$	150	A	
Surge forward current	$I_{FSM}$	$t_p = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	1600	A
			$T_{vj} = 150\text{ °C}$	1400	
$I^2t$ - value	$I^2t$	$t_p = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	12800	A <sup>2</sup> s
			$T_{vj} = 150\text{ °C}$	9800	

**Table 8** Characteristic Values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$V_F$	$I_F = 150\text{ A}$ $T_{vj} = 150\text{ °C}$		0.97		V
Reverse current	$I_r$	$T_{vj} = 150\text{ °C}$ , $V_R = 1600\text{ V}$		1		mA
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.333	K/W
Thermal resistance, case to heatsink	$R_{thCH}$	per diode, $\lambda_{grease} = 1\text{ W/(m}^2\text{K)}$		0.0670		K/W
Temperature under switching conditions	$T_{vj, op}$		-40		150	°C

## 5 IGBT, Brake-Chopper

**Table 9** 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	$I_{CDC}$	$T_{vj\ max} = 175\text{ °C}$ $T_C = 90\text{ °C}$	100	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1\text{ ms}$	200	A
Gate-emitter peak voltage	$V_{GES}$		±20	V

**Table 10**                      **Characteristic Values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 100\ A,$ $V_{GE} = 15\ V$		$T_{vj} = 25\ ^\circ C$	1.50	TBD	V
				$T_{vj} = 125\ ^\circ C$	1.64		
				$T_{vj} = 175\ ^\circ C$	1.72		
Gate threshold voltage	$V_{GEth}$	$I_C = 2.5\ mA,$ $V_{CE} = V_{GE},$ $T_{vj} = 25\ ^\circ C$	5.15	5.80	6.45	V	
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V,$ $V_{CE} = 600\ V$		1.8		$\mu C$	
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		1.5		$\Omega$	
Input capacitance	$C_{ies}$	$f = 100\ kHz,$ $T_{vj} = 25\ ^\circ C,$ $V_{CE} = 25\ V,$ $V_{GE} = 0\ V$		21.7		nF	
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz,$ $T_{vj} = 25\ ^\circ C,$ $V_{CE} = 25\ V,$ $V_{GE} = 0\ V$		0.076		nF	
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\ V,$ $V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$		0.01	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)	$t_{don}$	$I_C = 100\ A,$ $V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V,$ $R_{Gon} = 4.3\ \Omega$		$T_{vj} = 25\ ^\circ C$	0.169		$\mu s$
				$T_{vj} = 125\ ^\circ C$	0.180		
				$T_{vj} = 175\ ^\circ C$	0.187		
Rise time (inductive load)	$t_r$	$I_C = 100\ A,$ $V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V,$ $R_{Gon} = 4.3\ \Omega$		$T_{vj} = 25\ ^\circ C$	0.063		$\mu s$
				$T_{vj} = 125\ ^\circ C$	0.067		
				$T_{vj} = 175\ ^\circ C$	0.070		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 100\ A,$ $V_{CE} = 600\ V,$ $V_{GE} = \pm 15\ V,$ $R_{Goff} = 4.3\ \Omega$		$T_{vj} = 25\ ^\circ C$	0.310		$\mu s$
				$T_{vj} = 125\ ^\circ C$	0.390		
				$T_{vj} = 175\ ^\circ C$	0.410		

**Table 10** Characteristic Values (continued)

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Fall time (inductive load)	$t_f$	$I_C = 100\text{ A}$ , $V_{CE} = 600\text{ V}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Goff} = 4.3\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C}$ $T_{vj} = 125\text{ }^\circ\text{C}$ $T_{vj} = 175\text{ }^\circ\text{C}$		0.110		$\mu\text{s}$
					0.190		
					0.250		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 100\text{ A}$ , $V_{CE} = 600\text{ V}$ , $L_\sigma = 35\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Gon} = 4.3\ \Omega$ , $di/dt = 1100\text{ A}/\mu\text{s}$ ( $T_{vj} = 175\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$ $T_{vj} = 125\text{ }^\circ\text{C}$ $T_{vj} = 175\text{ }^\circ\text{C}$		7.12		mJ
					11.7		
					14.5		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 100\text{ A}$ , $V_{CE} = 600\text{ V}$ , $L_\sigma = 35\text{ nH}$ , $V_{GE} = \pm 15\text{ V}$ , $R_{Goff} = 4.3\ \Omega$ , $dv/dt = 2800\text{ V}/\mu\text{s}$ ( $T_{vj} = 175\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$ $T_{vj} = 125\text{ }^\circ\text{C}$ $T_{vj} = 175\text{ }^\circ\text{C}$		6.93		mJ
					10.6		
					13.3		
SC data	$I_{SC}$	$V_{GE} \leq 15\text{ V}$ , $V_{CC} = 800\text{ V}$ , $V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 8\ \mu\text{s}$ , $T_{vj} = 150\text{ }^\circ\text{C}$ $t_p \leq 7\ \mu\text{s}$ , $T_{vj} = 175\text{ }^\circ\text{C}$		370		A
					350		
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			0.373		K/W
Thermal resistance, case to heatsink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$			0.0680		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	$^\circ\text{C}$

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

## 6 Diode, Brake-Chopper

**Table 11** 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

**Table 11 Maximum Rated Values (continued)**

Parameter	Symbol	Note or test condition	Values	Unit	
Continuous DC forward current	$I_F$		50	A	
Repetitive peak forward current	$I_{FRM}$	$t_P = 1 \text{ ms}$	100	A	
$I^2t$ - value	$I^2t$	$t_P = 10 \text{ ms},$ $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	220	A <sup>2</sup> s
			$T_{vj} = 175 \text{ °C}$	200	

**Table 12 Characteristic Values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 50 \text{ A},$ $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$ $T_{vj} = 125 \text{ °C}$ $T_{vj} = 175 \text{ °C}$		1.72	TBD	V
					1.59		
					1.52		
Peak reverse recovery current	$I_{RM}$	$V_R = 600 \text{ V},$ $I_F = 50 \text{ A},$ $V_{GE} = -15 \text{ V},$ $-di_F/dt = 550 \text{ A}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ )	$T_{vj} = 25 \text{ °C}$ $T_{vj} = 125 \text{ °C}$ $T_{vj} = 175 \text{ °C}$		37.3		A
					44.3		
					49.6		
Recovered charge	$Q_r$	$V_R = 600 \text{ V},$ $I_F = 50 \text{ A},$ $V_{GE} = -15 \text{ V},$ $-di_F/dt = 550 \text{ A}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ )	$T_{vj} = 25 \text{ °C}$ $T_{vj} = 125 \text{ °C}$ $T_{vj} = 175 \text{ °C}$		3.86		$\mu\text{C}$
					7.05		
					10.1		
Reverse recovery energy	$E_{rec}$	$V_R = 600 \text{ V},$ $I_F = 50 \text{ A},$ $V_{GE} = -15 \text{ V},$ $-di_F/dt = 550 \text{ A}/\mu\text{s}$ ( $T_{vj} = 175 \text{ °C}$ )	$T_{vj} = 25 \text{ °C}$ $T_{vj} = 125 \text{ °C}$ $T_{vj} = 175 \text{ °C}$		1.13		mJ
					2.34		
					3.23		
Thermal resistance, junction to case	$R_{thJC}$	per diode			0.909	K/W	
Thermal resistance, case to heatsink	$R_{thCH}$	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$			0.109	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.

## 7 NTC-Thermistor

**Table 13** 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 $R_{100}$	$\Delta R/R$	$T_{NTC} = 100\text{ °C}$ , $R_{100} = 493\ \Omega$	-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

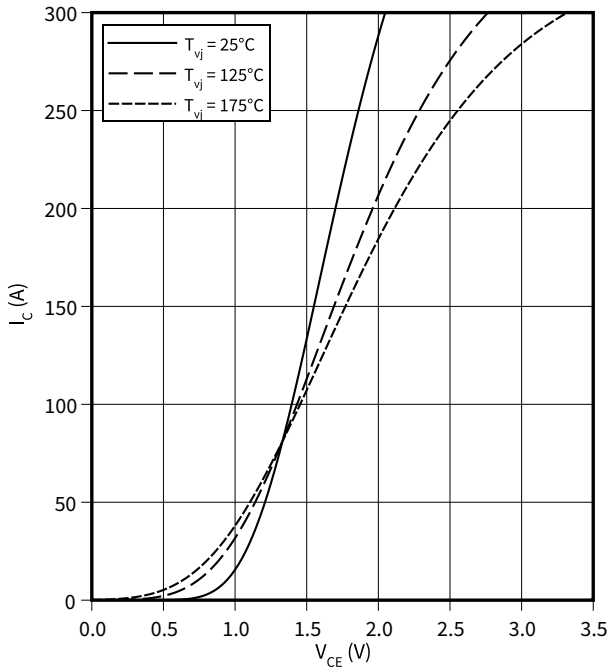
Note: Specification according to the valid application note.

## 8 Characteristics diagrams

### output characteristic (typical), IGBT, Inverter

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

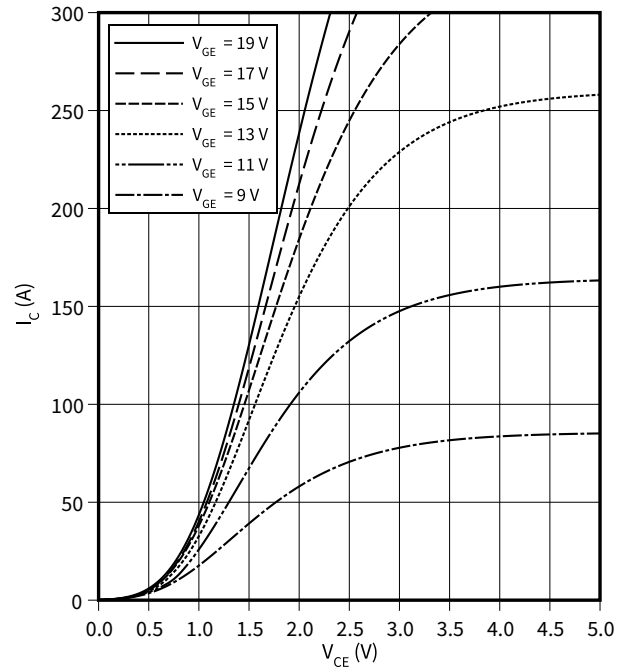
$$V_{GE} = 15 \text{ V}$$



### output characteristic (typical), IGBT, Inverter

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

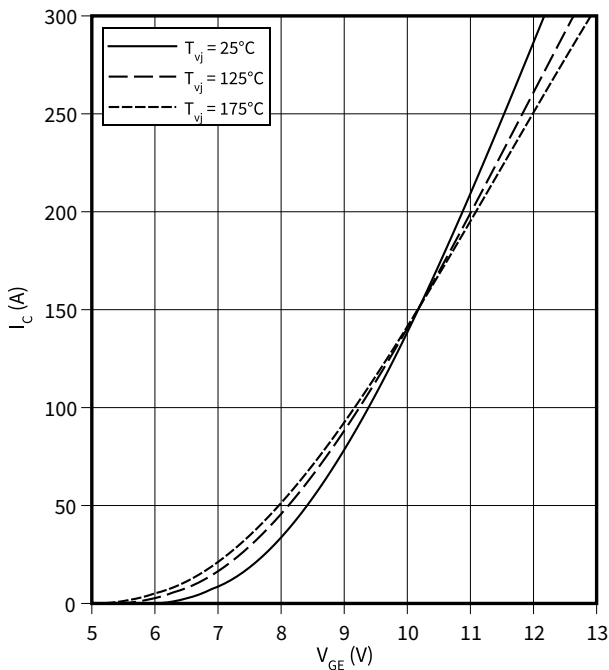
$$T_{vj} = 175 \text{ °C}$$



### transfer characteristic (typical), IGBT, Inverter

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

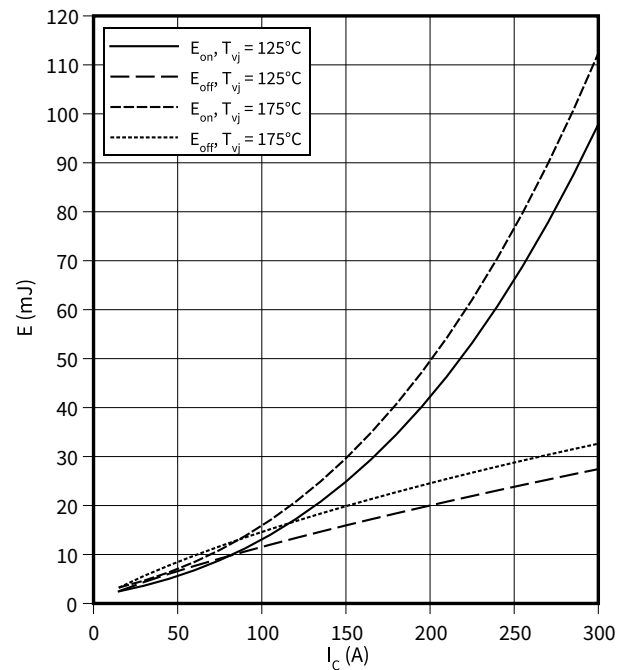
$$V_{CE} = 20 \text{ V}$$



### switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 3.3 \text{ } \Omega, R_{Gon} = 3.3 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

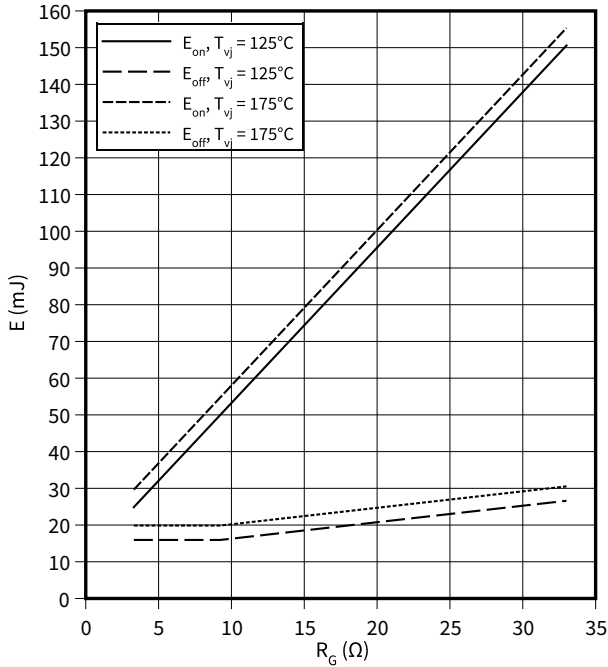


8 Characteristics diagrams

**switching losses (typical), IGBT, Inverter**

$E = f(R_G)$

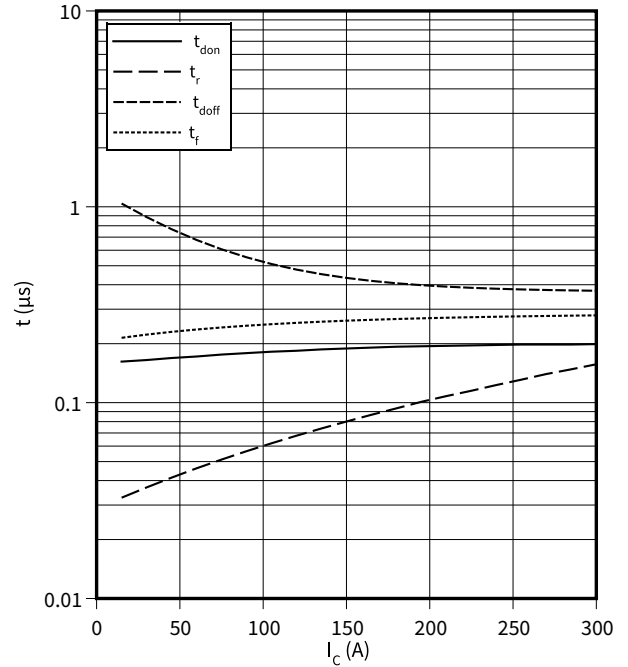
$I_C = 150 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$



**switching times (typical), IGBT, Inverter**

$t = f(I_C)$

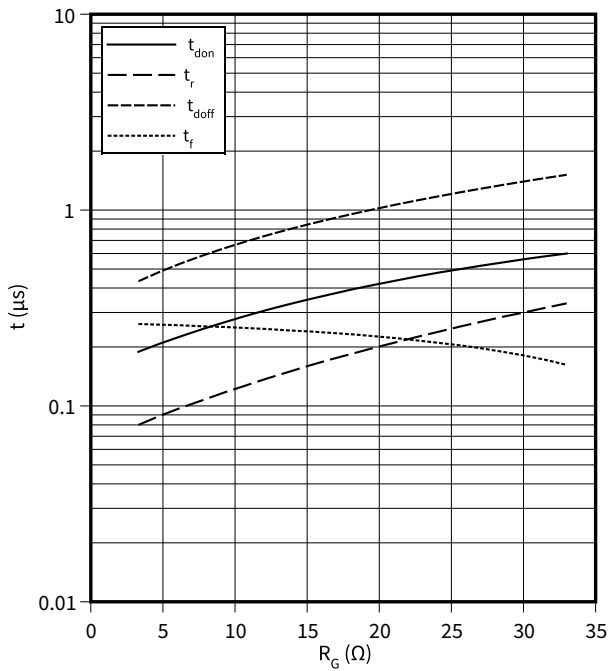
$R_{Goff} = 3.3 \text{ } \Omega, R_{Gon} = 3.3 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ } ^\circ\text{C}$



**switching times (typical), IGBT, Inverter**

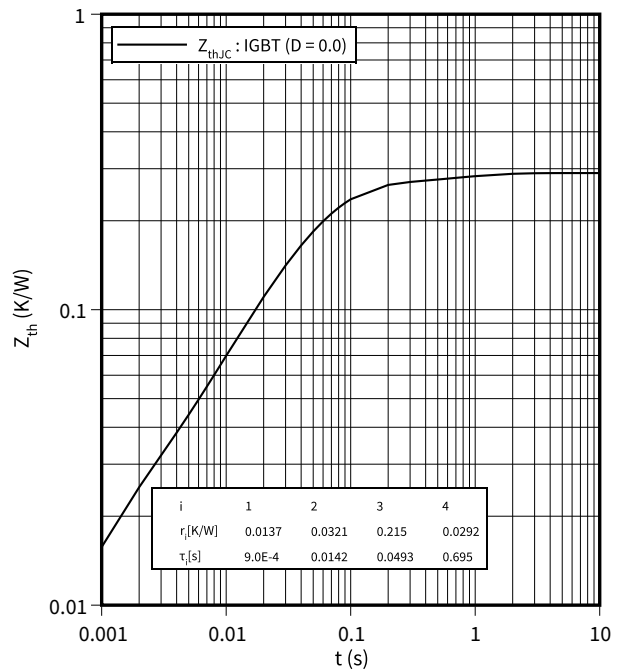
$t = f(R_G)$

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



**transient thermal impedance, IGBT, Inverter**

$Z_{th} = f(t)$

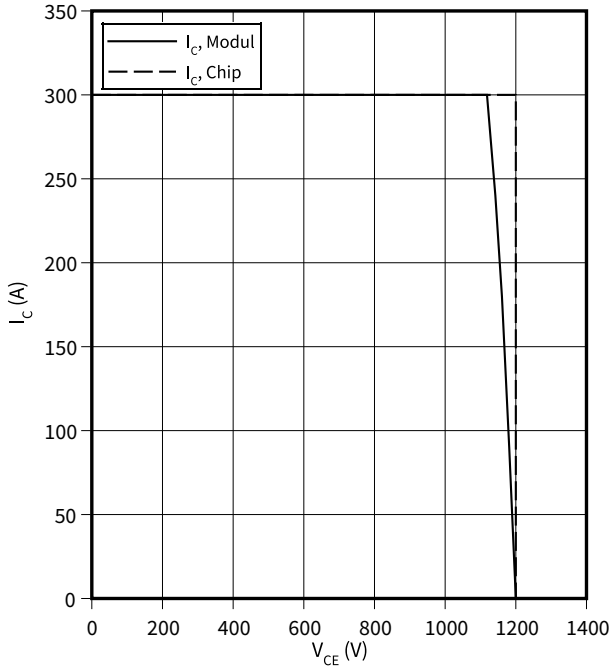


8 Characteristics diagrams

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

$I_C = f(V_{CE})$

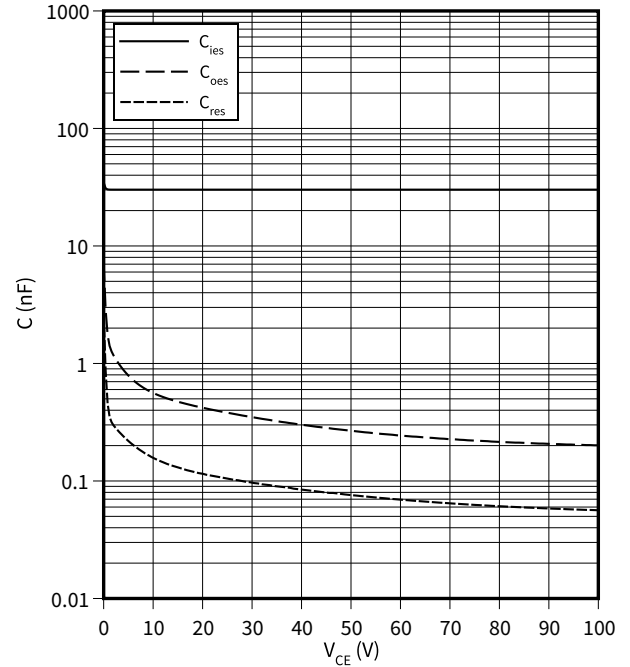
$R_{Goff} = 3.3 \Omega, V_{GE} = 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



**capacity characteristic (typical), IGBT, Inverter**

$C = f(V_{CE})$

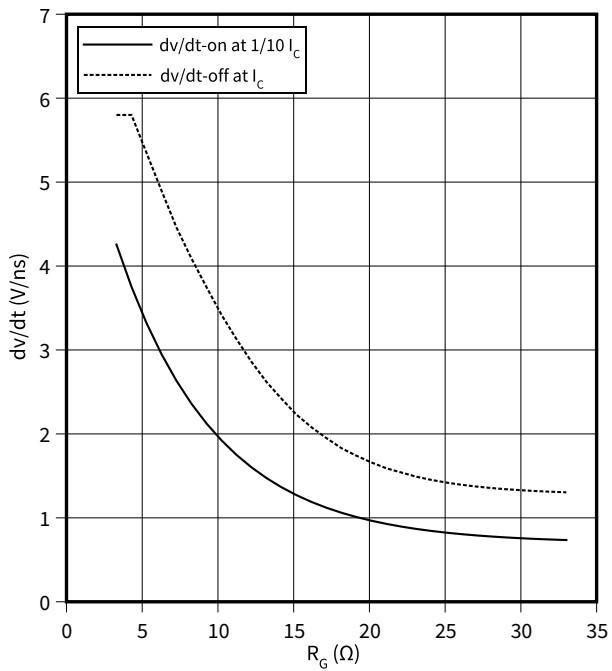
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



**Voltage slope (typical), IGBT, Inverter**

$dv/dt = f(R_G)$

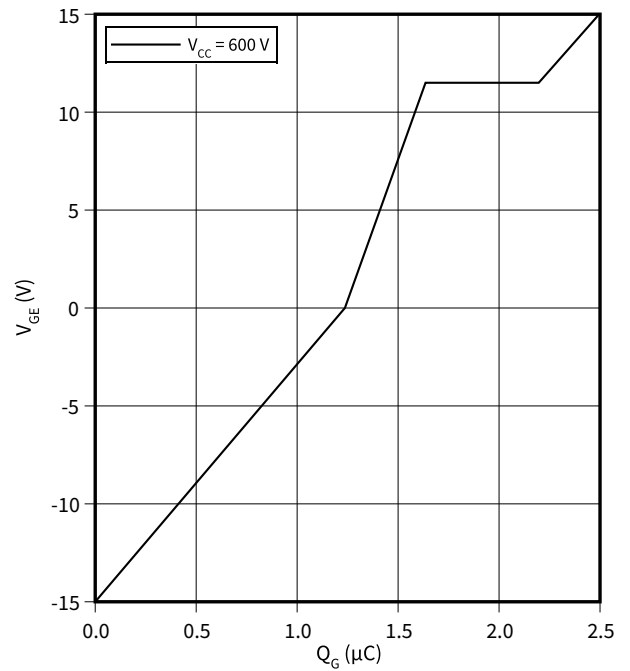
$I_C = 150 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



**gate charge characteristic (typical), IGBT, Inverter**

$V_{GE} = f(Q_G)$

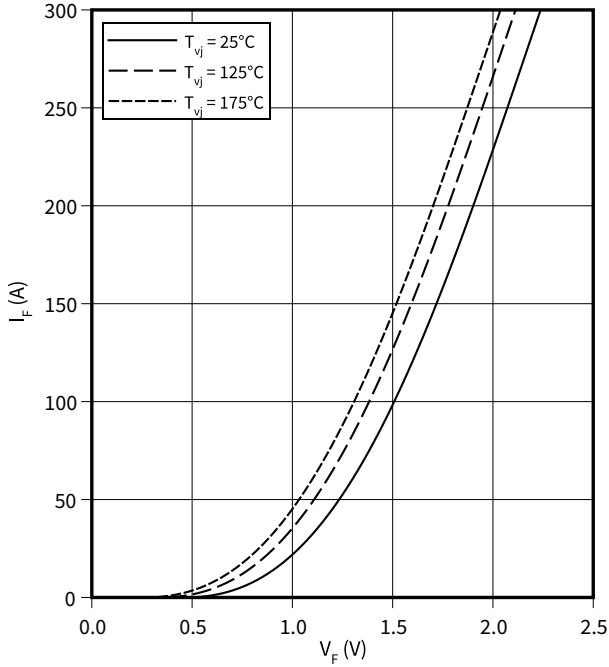
$I_C = 150 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



8 Characteristics diagrams

**forward characteristic (typical), Diode, Inverter**

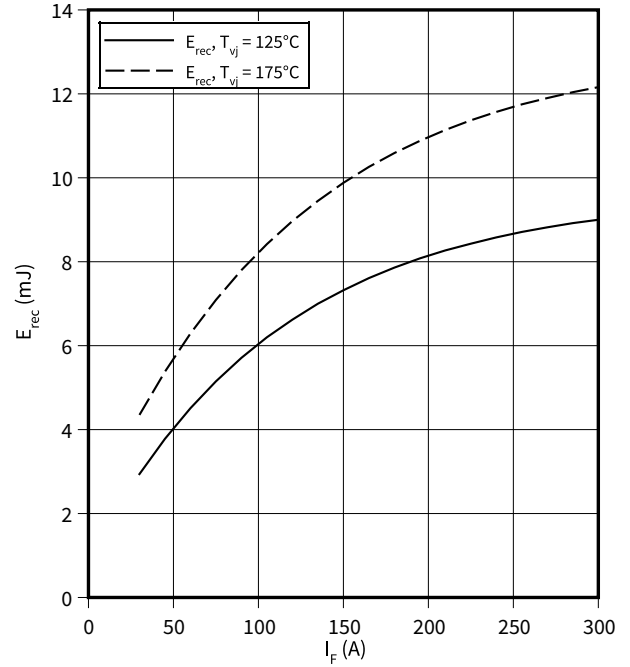
$I_F = f(V_F)$



**switching losses (typical), Diode, Inverter**

$E_{rec} = f(I_F)$

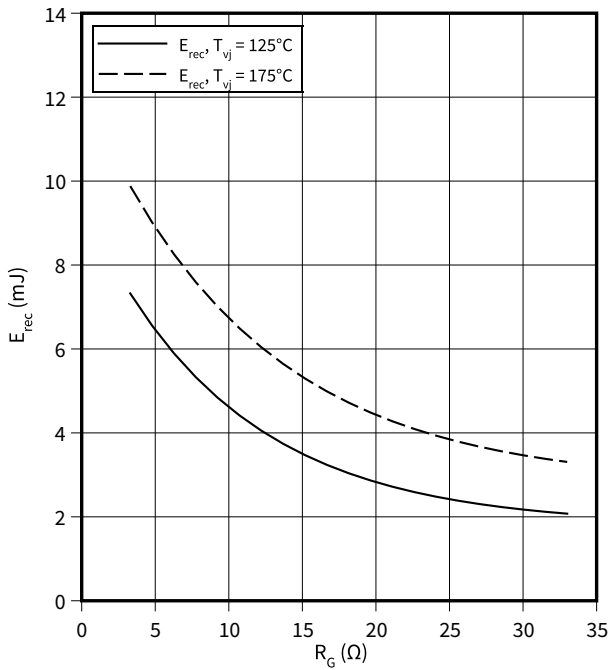
$R_{Gon} = 3.3 \Omega, V_{CE} = 600 V$



**switching losses (typical), Diode, Inverter**

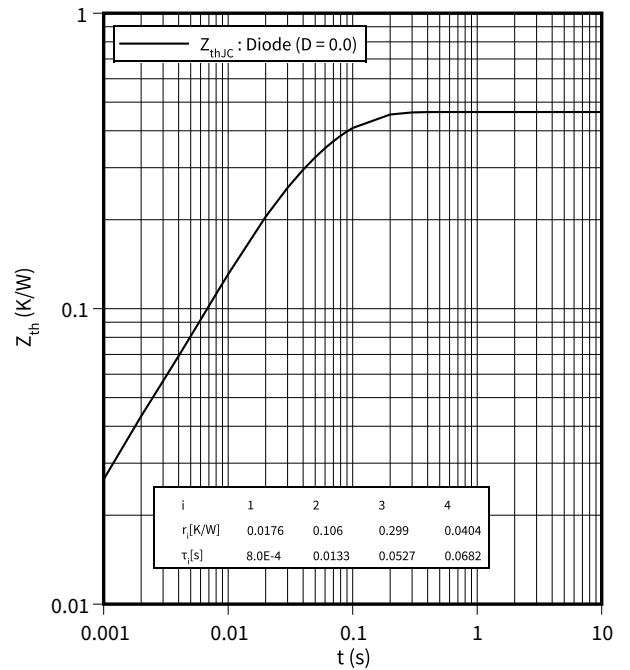
$E_{rec} = f(R_G)$

$V_{CE} = 600 V, I_F = 150 A$



**transient thermal impedance, Diode, Inverter**

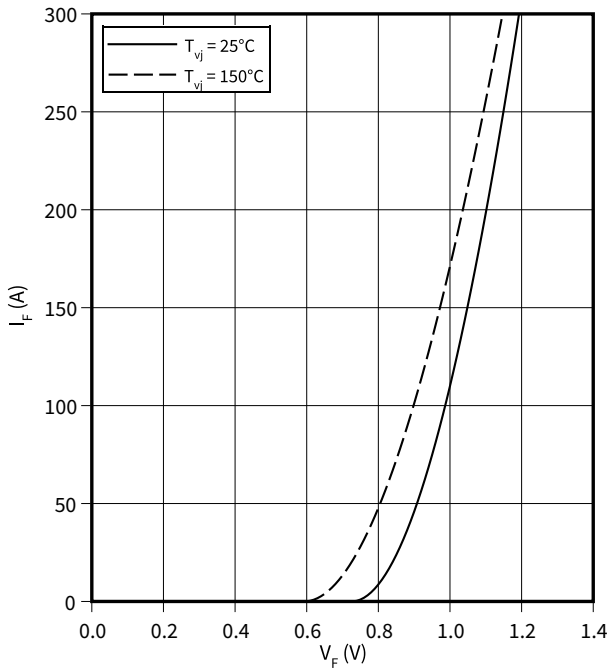
$Z_{th} = f(t)$



8 Characteristics diagrams

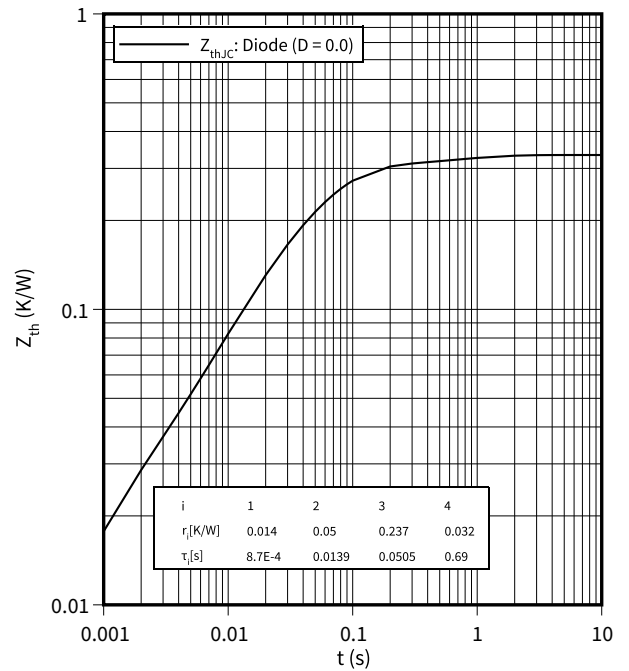
**forward characteristic (typical), Diode, Rectifier**

$I_F = f(V_F)$



**transient thermal impedance, Diode, Rectifier**

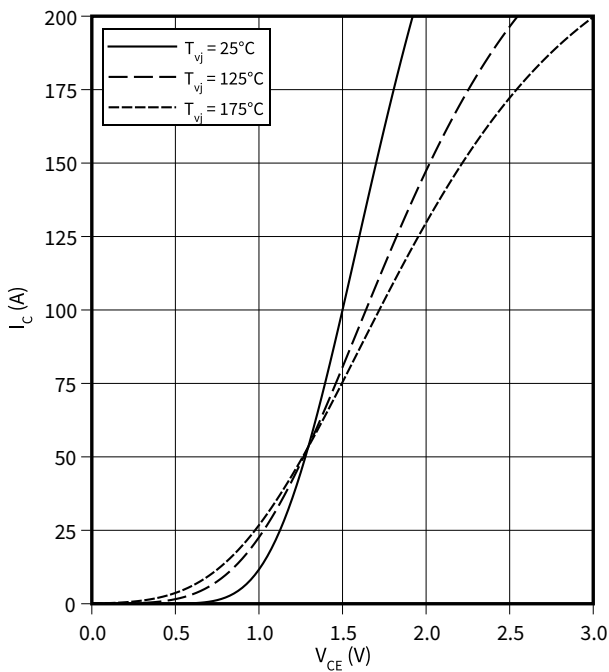
$Z_{th} = f(t)$



**output characteristic (typical), IGBT, Brake-Chopper**

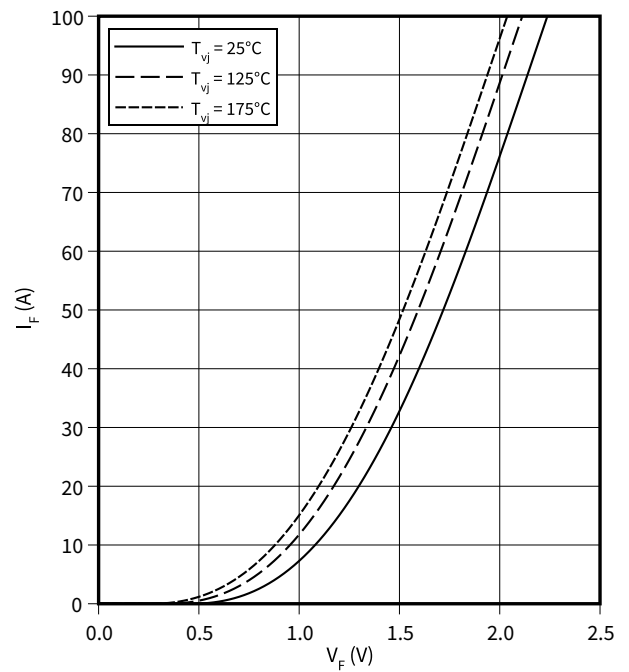
$I_C = f(V_{CE})$

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



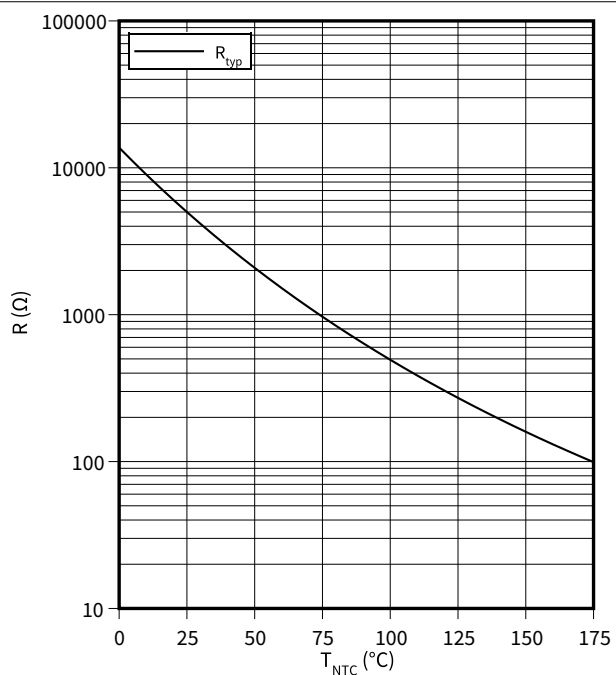
**forward characteristic (typical), Diode, Brake-Chopper**

$I_F = f(V_F)$

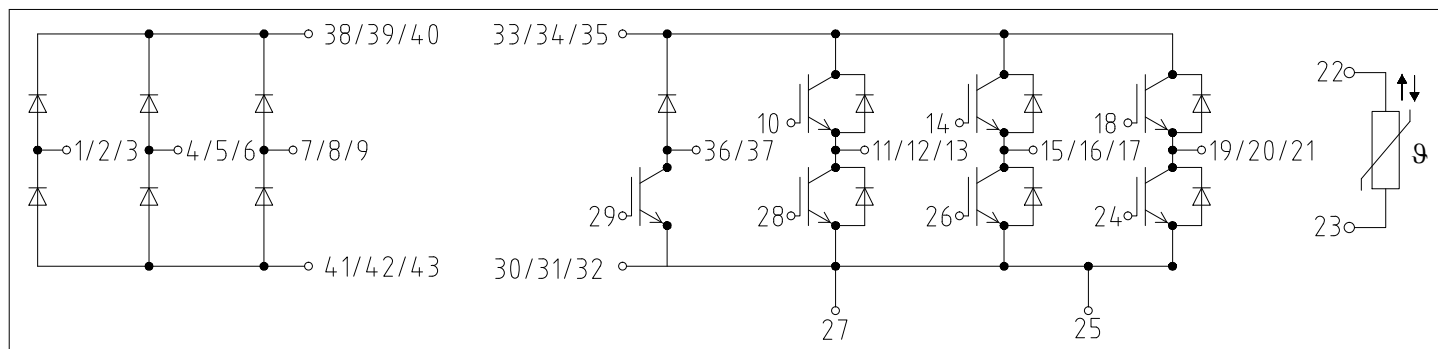


temperature characteristic (typical), NTC-Thermistor

$$R = f(T_{NTC})$$





**9**      **Circuit diagram**



**Figure 2**



## 11 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 4**

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