Preliminary

EasyPIM™ module with TRENCHSTOP™IGBT7 and Emitter Controlled 7 diode and PressFIT / NTC

Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 100 A / I_{CRM} = 200 A
  - TRENCHSTOP™ IGBT7
  - Low V_{CEsat}
  - Overload operation up to 175°C
- Mechanical features
  - High power density
  - Compact design
  - Al_2O_3 substrate with low thermal resistance
  - 2.5 kV AC 1 min insulation
  - PressFIT contact technology

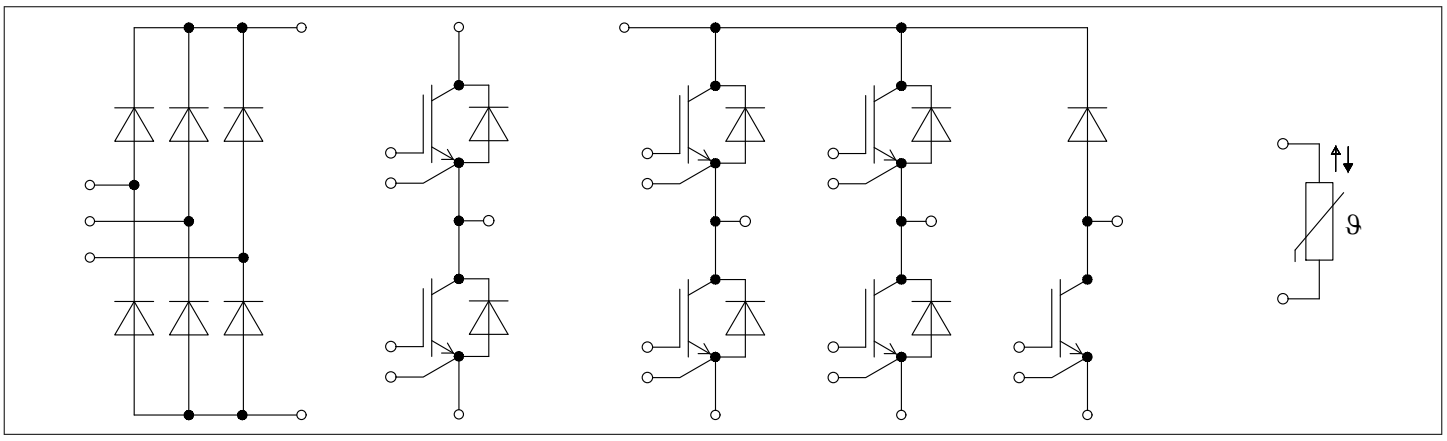
Potential applications

- Air conditioning
- Auxiliary inverters
- 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

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
Internal Isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	11.2	mm
Creepage distance	d_{Creep}	terminal to terminal	6.8	mm
Clearance	d_{Clear}	terminal to heatsink	9.4	mm
Clearance	d_{Clear}	terminal to terminal	5.5	mm
Comperative tracking index	*CTI*		> 400	
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}			35		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_H=25°C, per switch		2.8		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch		2.2		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for modul mounting	*M*	- Mounting according to valid application note M5, Screw	1.3		1.5	Nm
Weight	*G*			78		g

Note: The current under continuous operation is limited to 25 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 °C	1200	V
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	100	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		200	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 = 100 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	TBD	V
			T_{vj} = 125 °C		1.64		
			T_{vj} = 175 °C		1.72		
Gate threshold voltage	V_{GEth}	I_C = 2.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			1.8		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.5		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			21.7		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °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} = 125 °C			0.009	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
Turn on delay time (inductive load)	t_{don}	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C		0.163		µs
			T_{vj} = 125 °C		0.184		
			T_{vj} = 175 °C		0.193		
Rise time (inductive load)	t_r	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C		0.054		µs
			T_{vj} = 125 °C		0.056		
			T_{vj} = 175 °C		0.057		
Turn off delay time (inductive load)	t_{doff}	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		0.328		µs
			T_{vj} = 125 °C		0.410		
			T_{vj} = 175 °C		0.459		

Table 4 Characteristic Values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Fall time (inductive load)	t_f	I_C = 100 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.114 0.197 0.258		µs
Turn-on energy loss per pulse	E_{on}	I_C = 100 A, V_{CE} = 600 V, L_σ = 35 nH, di/dt = 1900 A/µs (T_{vj} = 175 °C), V_{GE} = ±15 V, R_{Gon} = 3.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		9.5 12.6 14.3		mJ
Turn-off energy loss per pulse	E_{off}	I_C = 100 A, V_{CE} = 600 V, L_σ = 35 nH, du/dt = 3000 V/µs (T_{vj} = 175 °C), V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		6.85 10.3 12.6		mJ
SC data	I_{SC}	V_{CC} = 800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	$t_P \leq$ 8 µs, T_{vj} = 150 °C $t_P \leq$ 7 µs, T_{vj} = 175 °C		370 350		A
Thermal resistance, junction to heatsink	R_{thJH}	per IGBT, λ_{grease}= 3.3 W/(m*K)			0.510		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: $T_{vj\,op}$ > 150°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 °C	1200	V
Continous DC forward current	I_F			100	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		200	A

Table 5 Maximum Rated Values (continued)

Parameter	Symbol	Note or test condition		Values	Unit
I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms	T_{vj} = 125 °C	970	A^2s
			T_{vj} = 175 °C	860	

Table 6 Characteristic Values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 100 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.72	TBD	V
			T_{vj} = 125 °C		1.59		
			T_{vj} = 175 °C		1.52		
Peak reverse recovery current	I_{RM}	V_R = 600 V, V_{GE} = -15 V, $-di_F/dt$ = 1900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		68.3		A
			T_{vj} = 125 °C		84.6		
			T_{vj} = 175 °C		92.8		
Recovered charge	Q_r	V_R = 600 V, V_{GE} = -15 V, $-di_F/dt$ = 1900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		9.38		µC
			T_{vj} = 125 °C		14.9		
			T_{vj} = 175 °C		19.1		
Reverse recovery energy	E_{rec}	V_R = 600 V, V_{GE} = -15 V, $-di_F/dt$ = 1900 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.02		mJ
			T_{vj} = 125 °C		5.18		
			T_{vj} = 175 °C		6.5		
Thermal resistance, junction to heatsink	R_{thJH}	per diode, λ_{grease}= 3.3 W/(m*K)			0.870		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: $T_{vj\,op}$ > 150°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 °C	1600	V
Maximum RMS forward current per chip	I_{FRMSM}	T_H = 100 °C	100	A
Maximum RMS current at rectifier output	I_{RMSM}	T_H = 100 °C	100	A

Table 7 Maximum Rated Values (continued)

Parameter	Symbol	Note or test condition		Values	Unit
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	1150	A
			T_{vj} = 150 °C	880	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	6610	A^2s
			T_{vj} = 150 °C	3870	

Table 8 Characteristic Values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	T_{vj} = 150 °C, I_F = 100 A		1.02		V
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V		1		mA
Thermal resistance, junction to heatsink	R_{thJH}	per diode, λ_{grease} = 3.3 W /(m*K)		0.700		K/W
Temperature under switching conditions	$T_{vj, op}$		-40		150	°C

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Table 9 Maximum Rated Values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	1200	V
Continous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 80 °C	50	A
Repetitive peak collector current	I_{CRM}	t_P = 1 ms		100	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 = 50 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	TBD	V
			T_{vj} = 125 °C		1.64		
			T_{vj} = 175 °C		1.72		
Gate threshold voltage	V_{GEth}	I_C = 1.28 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V

Table 10 Characteristic Values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			0.92		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			11.1		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.039		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V	T_{vj} = 25 °C			1	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
Turn on delay time (inductive load)	t_{don}	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.045 0.047 0.048		µs
Rise time (inductive load)	t_r	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.031 0.034 0.035		µs
Turn off delay time (inductive load)	t_{doff}	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.255 0.340 0.382		µs
Fall time (inductive load)	t_f	I_C = 50 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		0.107 0.195 0.255		µs

Table 10 Characteristic Values (continued)

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy loss per pulse	E_{on}	I_C = 50 A, V_{CE} = 600 V, L_σ = 35 nH, di/dt = 1200 A/µs (T_{vj} = 175 °C), V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		3.21 4.03 4.46		mJ
Turn-off energy loss per pulse	E_{off}	I_C = 50 A, V_{CE} = 600 V, L_σ = 35 nH, du/dt = 2900 V/µs (T_{vj} = 175 °C), V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 175 °C		3.23 5.22 6.45		mJ
SC data	I_{SC}	V_{CC} = 800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	$t_P \leq$ 8 µs, T_{vj} = 150 °C $t_P \leq$ 7 µs, T_{vj} = 175 °C		190 180		A
Thermal resistance, junction to heatsink	R_{thJH}	per IGBT, λ_{grease}= 3.3 W /(m*K)			0.850		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: $T_{vj\,op}$ > 150°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 °C	1200	V
Continous DC forward current	I_F			25	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		50	A
I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms	T_{vj} = 125 °C T_{vj} = 175 °C	72.5 63	A^2s

Table 12 Characteristic Values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 25 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.83		V
			T_{vj} = 125 °C		1.70		
			T_{vj} = 175 °C		1.63		
Peak reverse recovery current	I_{RM}	V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 1100 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		27.4		A
			T_{vj} = 125 °C		31.2		
			T_{vj} = 175 °C		34.1		
Recovered charge	Q_r	V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 1100 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.93		µC
			T_{vj} = 125 °C		3.51		
			T_{vj} = 175 °C		4.51		
Reverse recovery energy	E_{rec}	V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 1100 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.74		mJ
			T_{vj} = 125 °C		1.42		
			T_{vj} = 175 °C		1.85		
Thermal resistance, junction to heatsink	R_{thJH}	per diode, λ_{grease}= 3.3 W /(m*K)			1.86		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: $T_{vj\,op}$ > 150°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 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3433		K

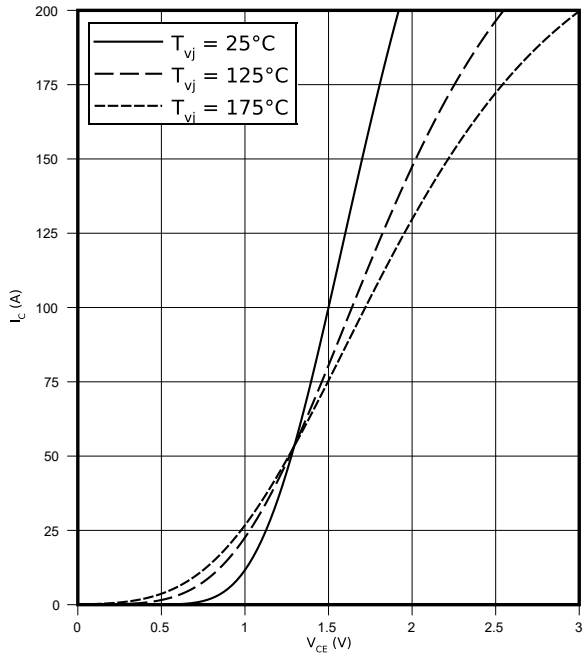
Note: Specification according to the valid application note.

8 Characteristics diagrams

output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

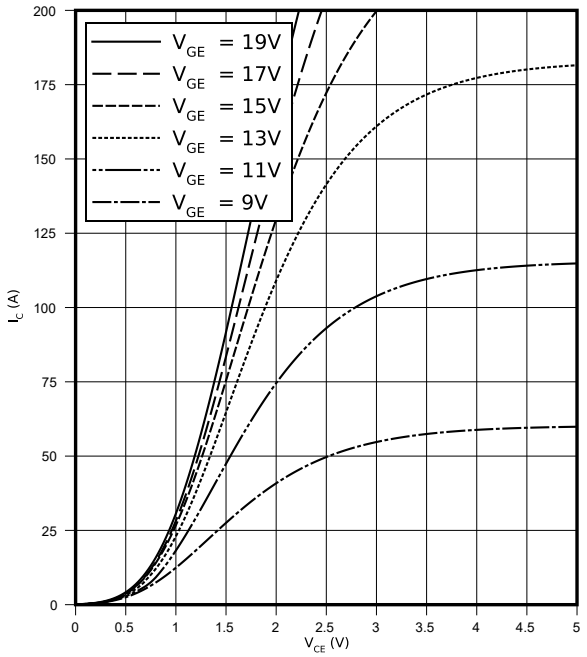
V_{GE} = 15 V



output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

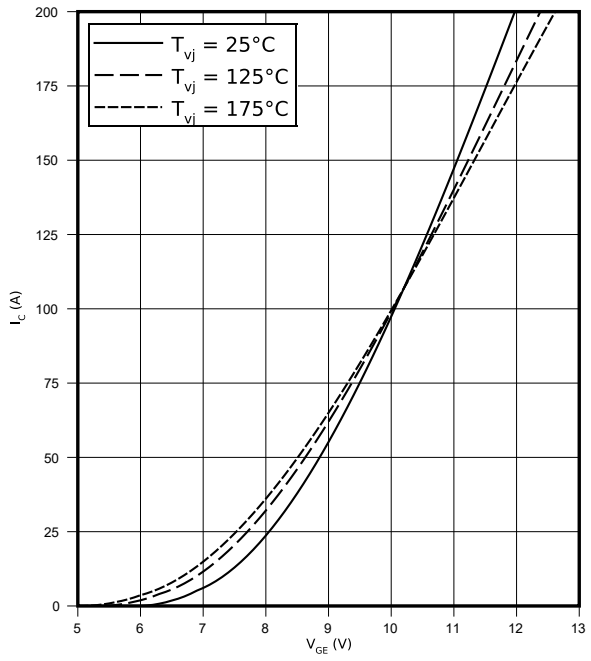
T_{vj} = 175 °C



transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

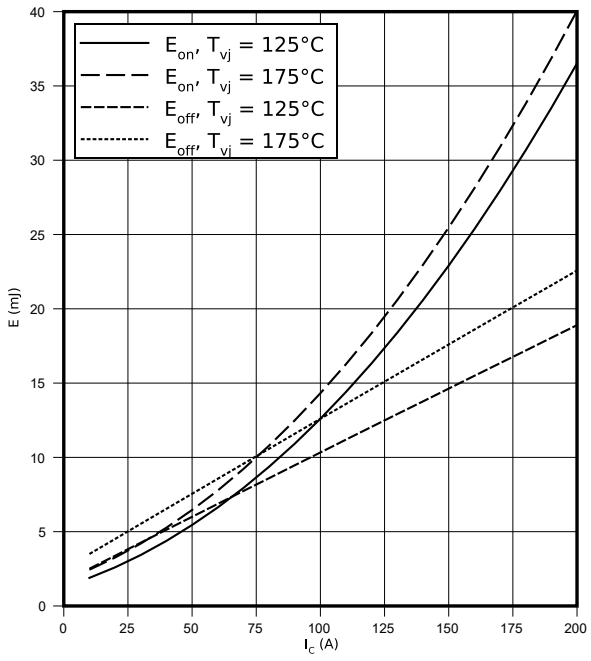
V_{CE} = 20 V



switching losses (typical), IGBT, Inverter

$E = f(I_C)$

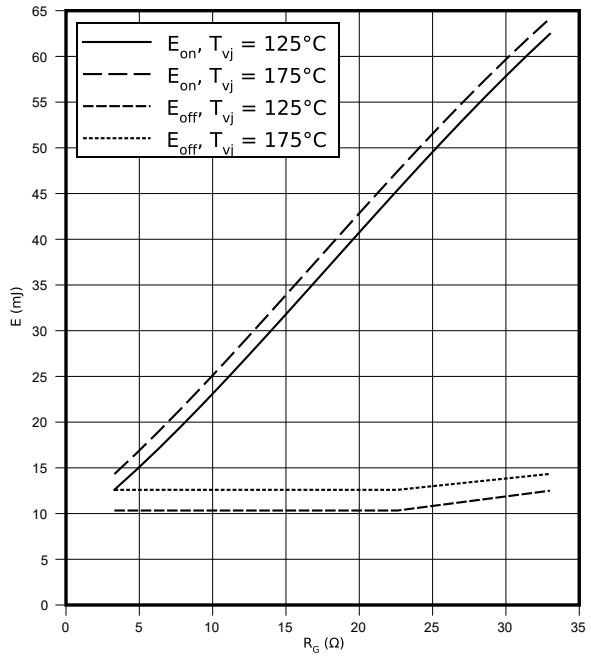
R_{Goff} = 3.3 Ω, R_{Gon} = 3.3 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V



switching losses (typical), IGBT, Inverter

$E = f(R_G)$

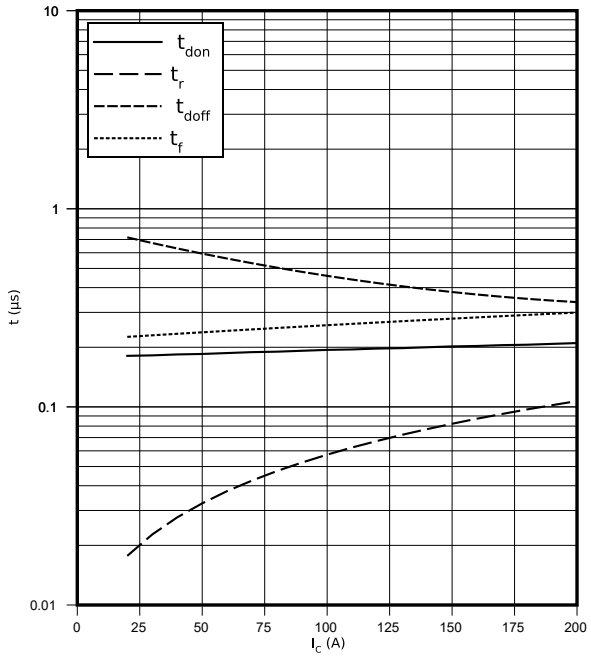
$I_C = 100\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$



switching times (typical), IGBT, Inverter

$t = f(I_C)$

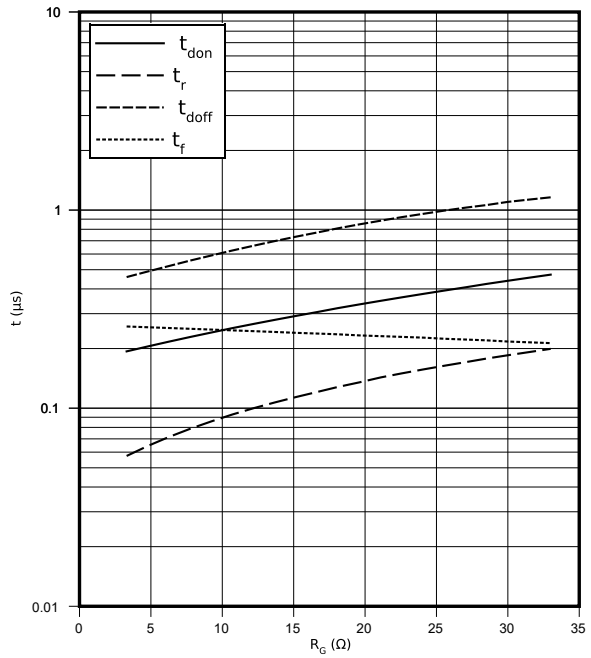
$R_{Goff} = 3.3\ \Omega$, $R_{Gon} = 3.3\ \Omega$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



switching times (typical), IGBT, Inverter

$t = f(R_G)$

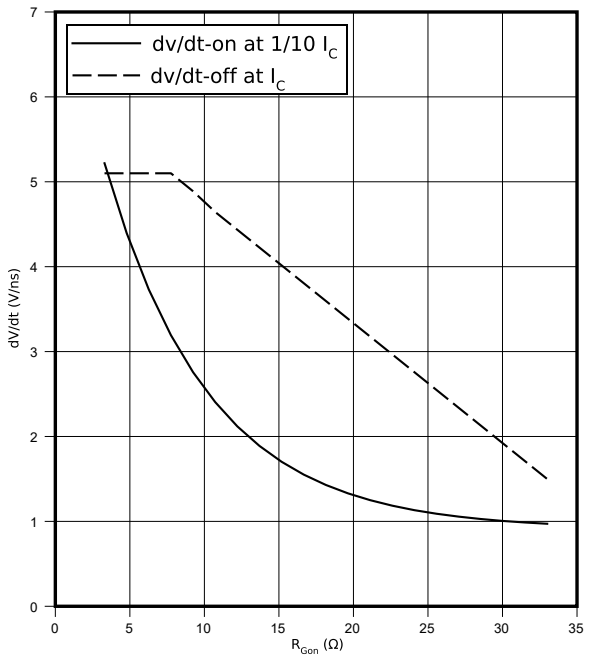
$I_C = 100\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



dv/dt (typical), IGBT, Inverter

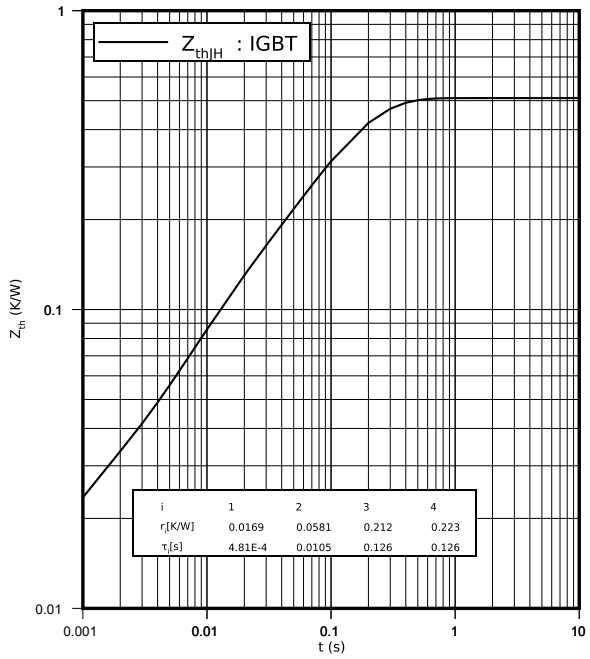
$dV/dt = f(R_{Gon})$

$I_C = 100\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 25\ °C$



transient thermal impedance , IGBT, Inverter

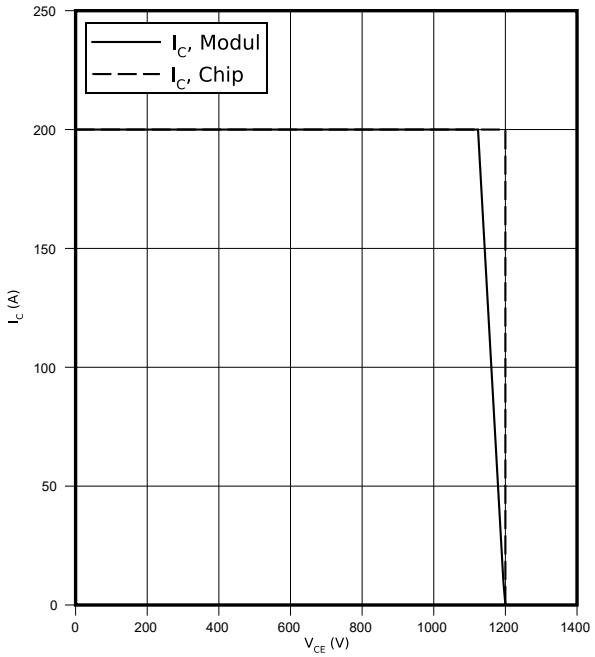
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

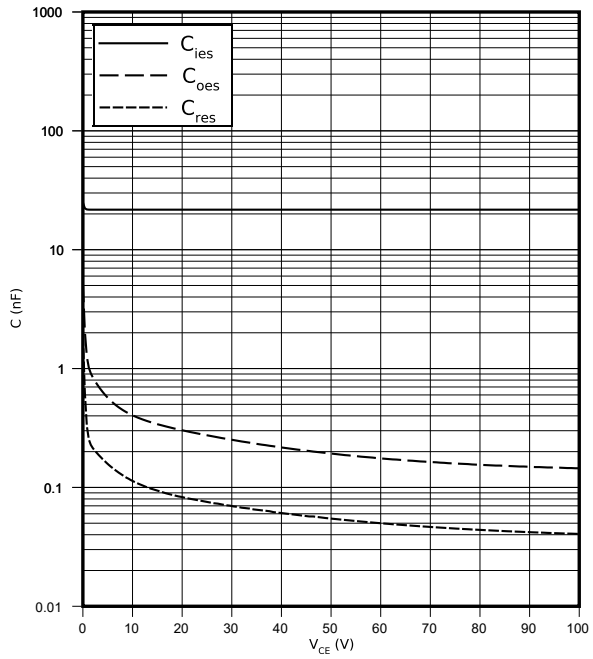
$R_{Goff} = 3.3\ \Omega$, $V_{GE} = \pm 15.0$ V, $T_{vj} = 175$ °C



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

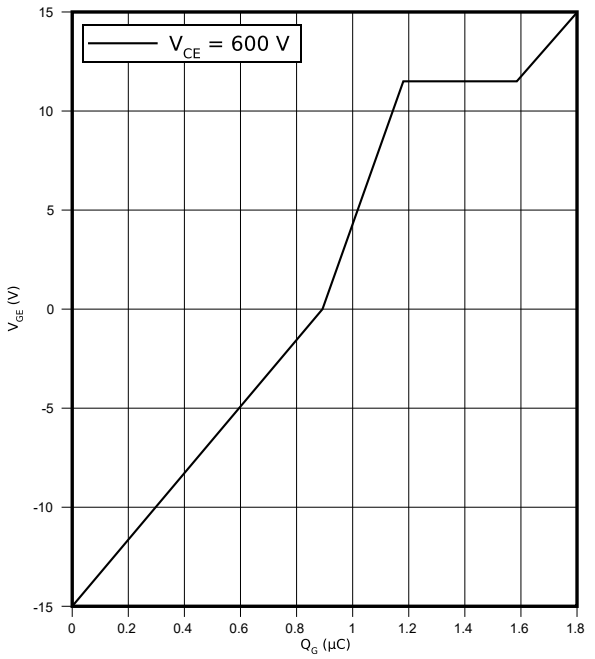
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

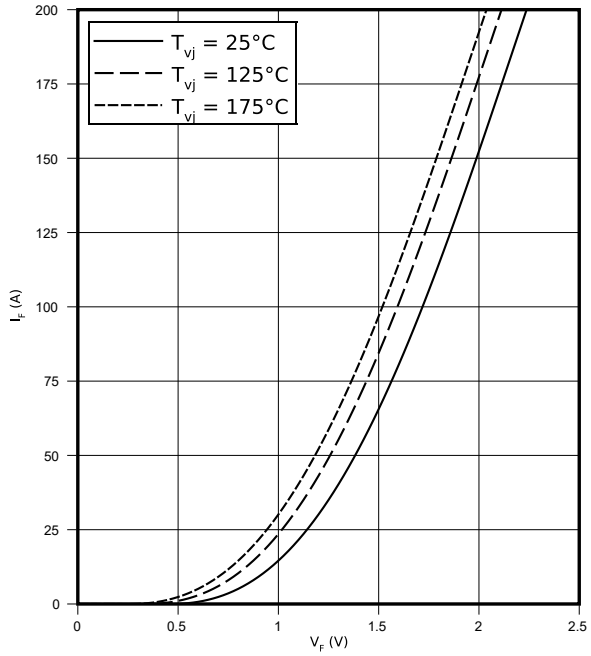
$V_{GE} = f(Q_G)$

$I_C = 100$ A, $T_{vj} = 25$ °C



forward characteristic (typical), Diode, Inverter

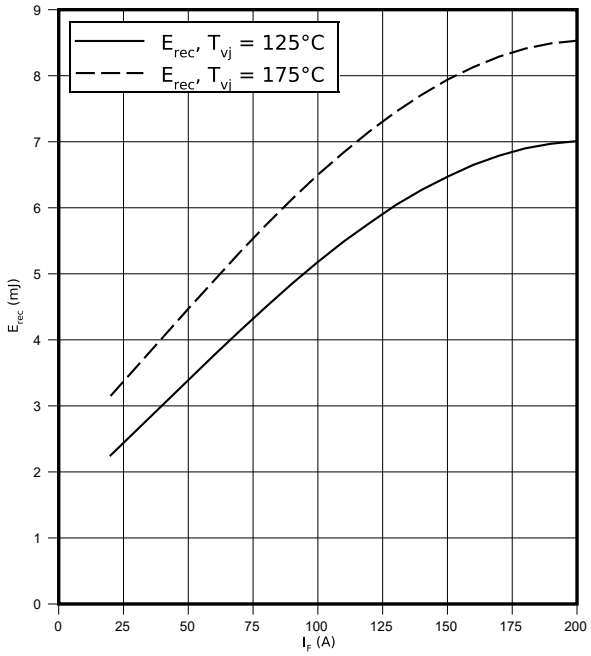
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

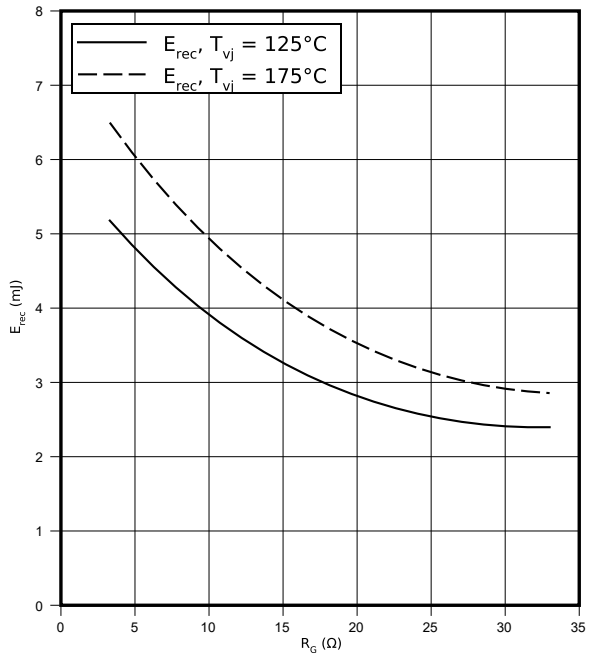
$V_{CE} = 600\ V$, $R_{Gon} = R_{Gon(IGBT)}$



switching losses (typical), Diode, Inverter

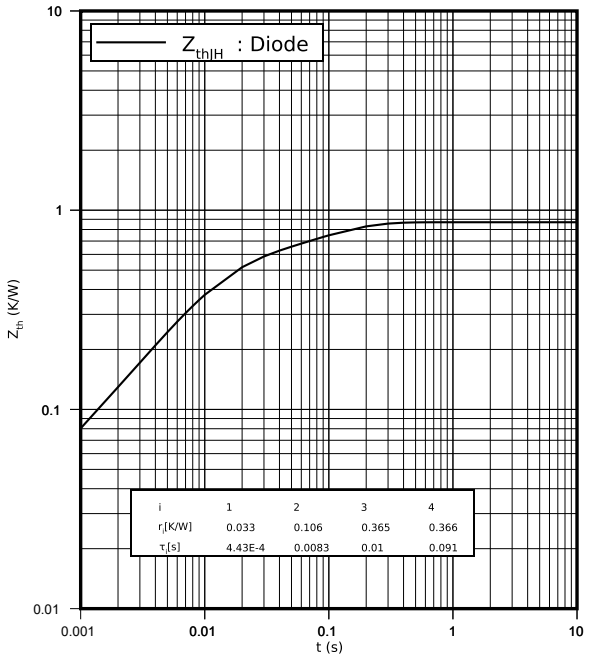
$E_{rec} = f(R_G)$

$V_{CE} = 600\ V$, $I_F = 100\ A$



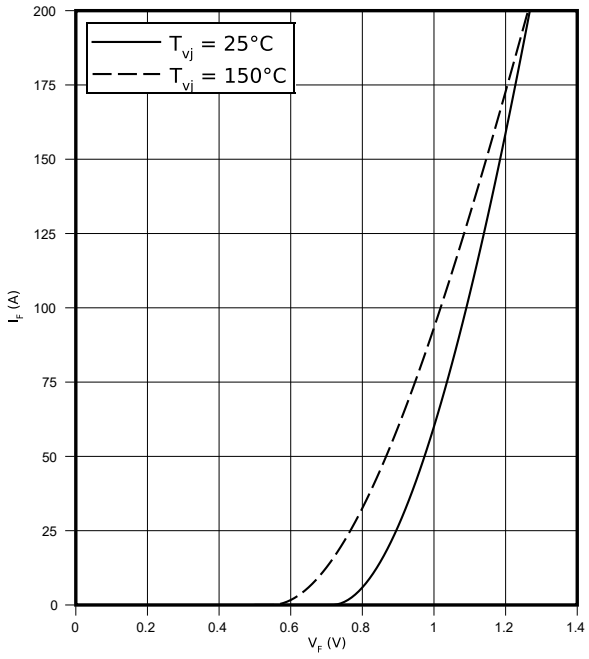
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$



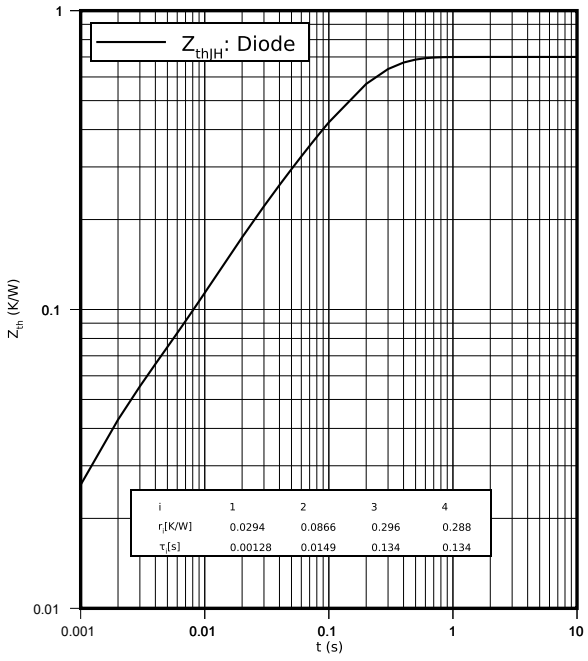
forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$



transient thermal impedance , Diode, Rectifier

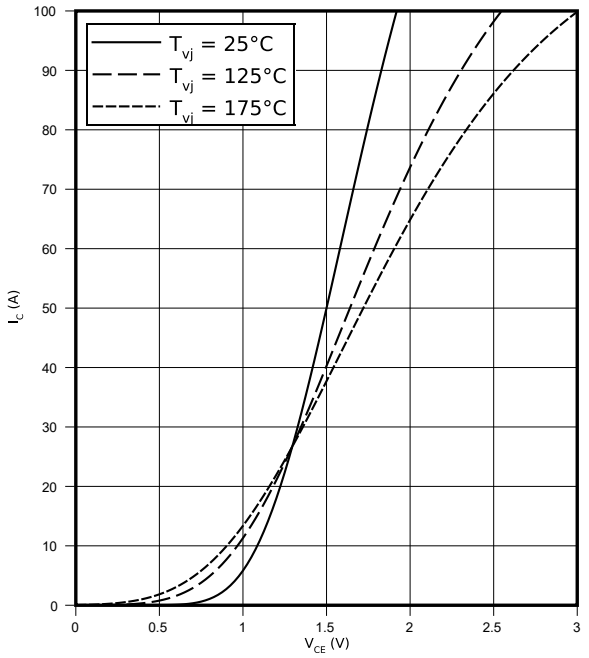
$Z_{th} = f(t)$



output characteristic (typical), IGBT, Brake-Chopper

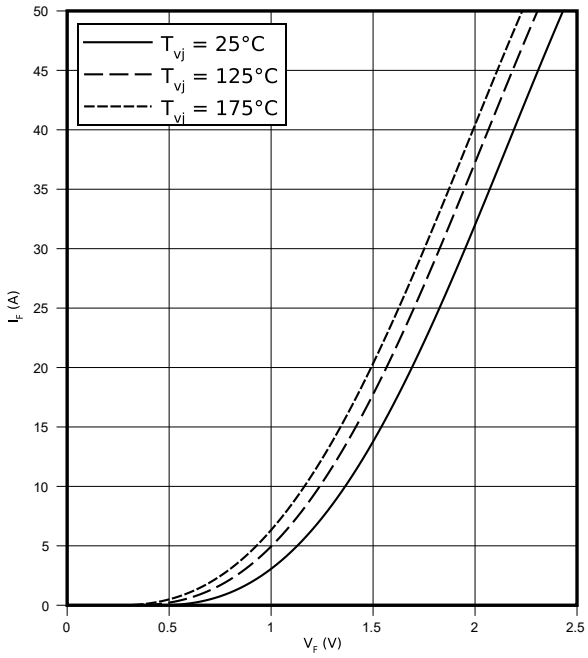
$I_C = f(V_{CE})$

$V_{GE} = 15\ V$



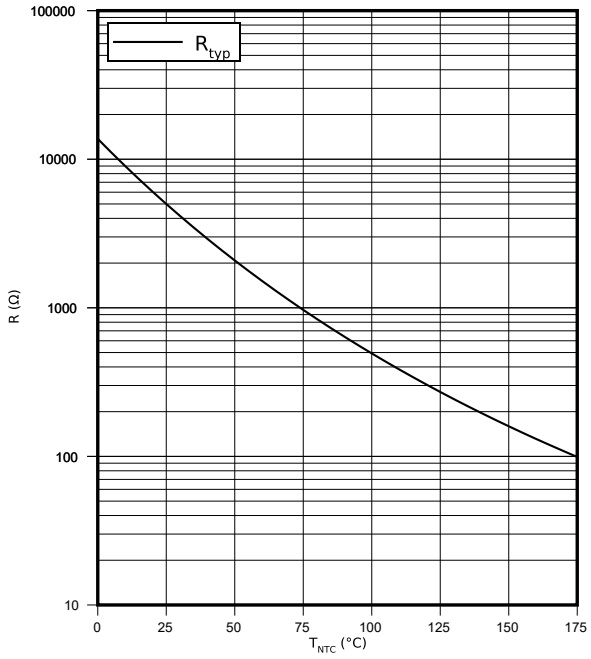
forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

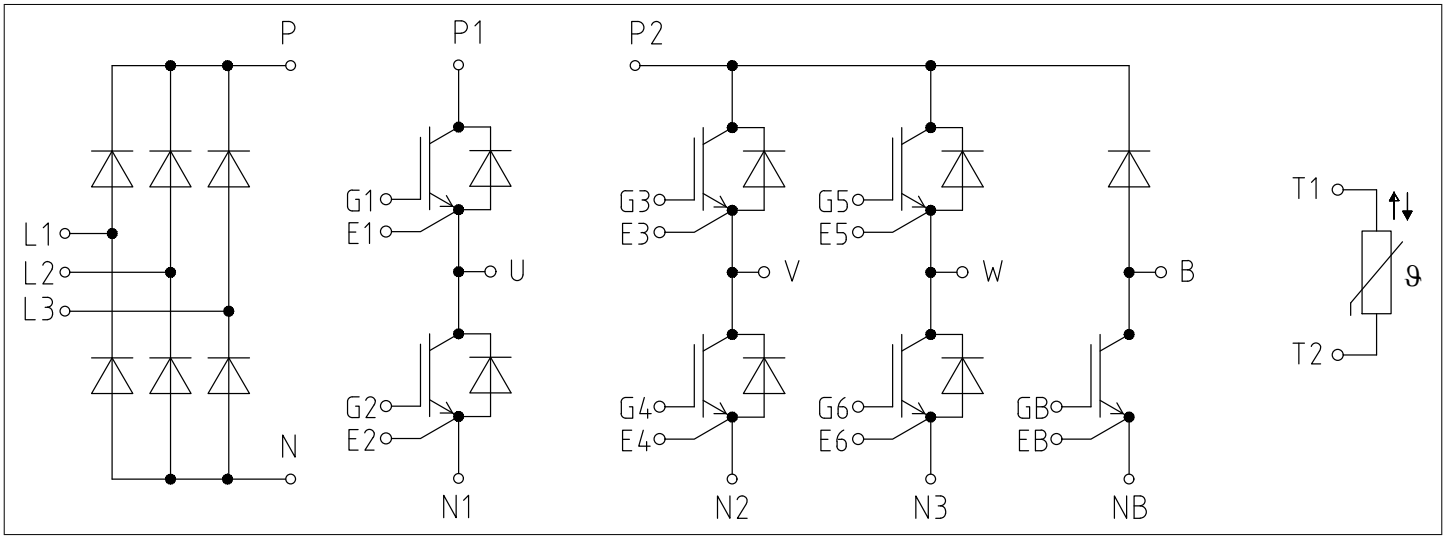


Figure 2

10 Package outlines

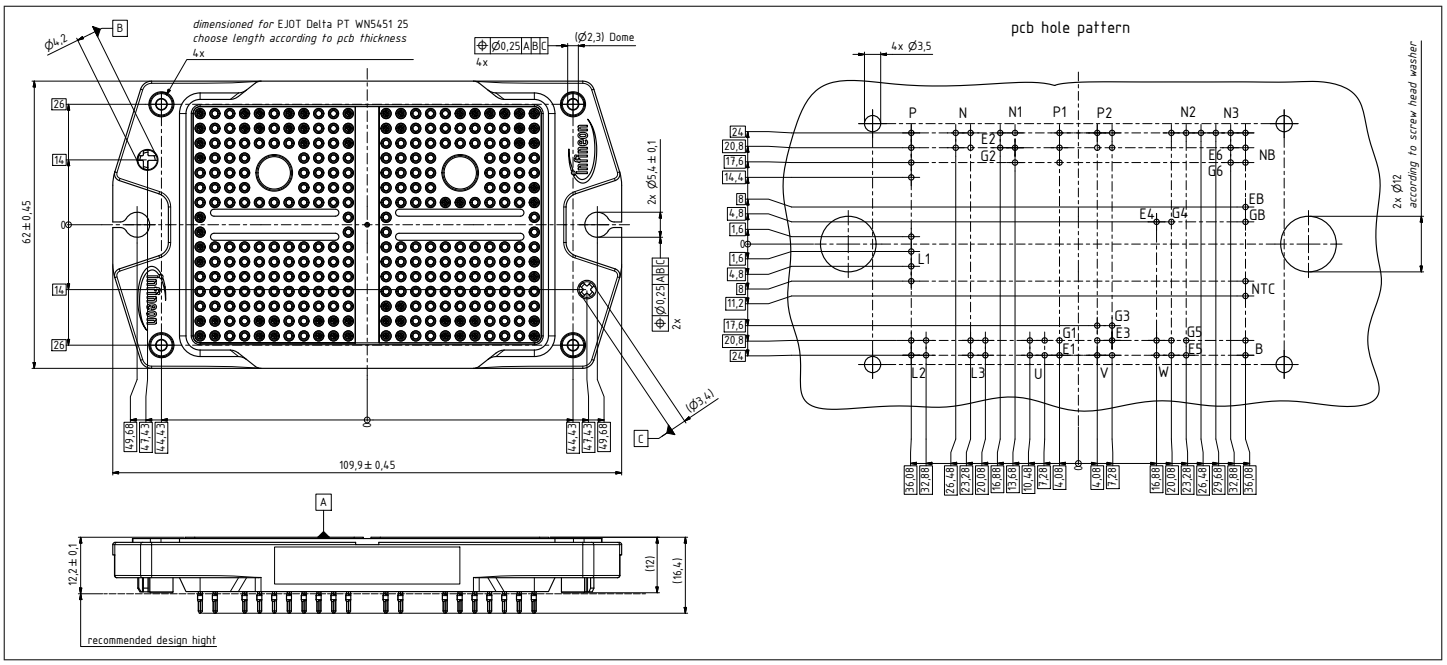


Figure 3

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