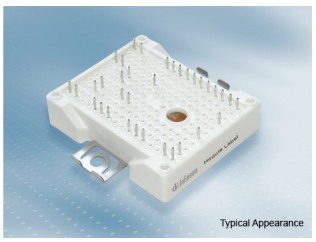
Preliminary datasheet

EasyPIM™ module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC



Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 50 A / I_{CRM} = 100 A
  - TRENCHSTOP™ IGBT7
  - Overload operation up to 175°C
  - Low $V_{CE,sat}$
- Mechanical features
  - Al_2O_3 substrate with low thermal resistance
  - Solder contact technology
  - High power density
  - Compact design
  - 2.5 kV AC 1 minute insulation

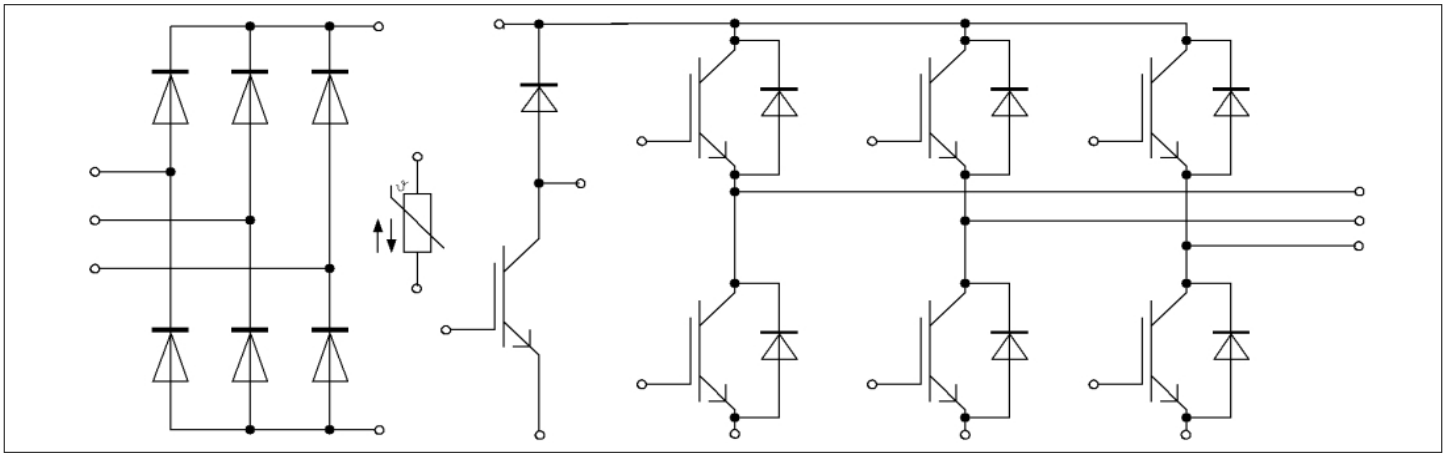
Potential applications

- Air conditioning
- Auxiliary inverters
- Motor 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
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	11.5	mm
Creepage distance	d_{Creep}	terminal to terminal	6.3	mm
Clearance	d_{Clear}	terminal to heatsink	10.0	mm
Clearance	d_{Clear}	terminal to terminal	5.0	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}			30		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_H = 25 °C, per switch		6		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H = 25 °C, per switch		5		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting force per clamp	*F*		40		80	N
Weight	*G*			39		g

Note: The current under continuous operation is limited to 30 A rms per connector pin. $T_{vj\ op}$ > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

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
Continuous DC collector current	I_{CDC}	$T_{vj\ max}$ = 175 °C	T_H = 80 °C	50	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		100	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 = 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
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 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, V_{GE} = 0 V	T_{vj} = 25 °C			0.008	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_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C		0.051		µs
			T_{vj} = 125 °C		0.054		
			T_{vj} = 175 °C		0.055		
Rise time (inductive load)	t_r	I_C = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C		0.027		µs
			T_{vj} = 125 °C		0.028		
			T_{vj} = 175 °C		0.029		
Turn-off delay time (inductive load)	t_{doff}	I_C = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.265		µs
			T_{vj} = 125 °C		0.335		
			T_{vj} = 175 °C		0.382		
Fall time (inductive load)	t_f	I_C = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.111		µs
			T_{vj} = 125 °C		0.185		
			T_{vj} = 175 °C		0.277		
Turn-on energy loss per pulse	E_{on}	I_C = 50 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω, di/dt = 1700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.24		mJ
			T_{vj} = 125 °C		4.49		
			T_{vj} = 175 °C		5.21		
Turn-off energy loss per pulse	E_{off}	I_C = 50 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω, dv/dt = 2900 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.84		mJ
			T_{vj} = 125 °C		5.54		
			T_{vj} = 175 °C		6.63		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
SC data	I_{SC}	$V_{GE} \le 15$ V, $V_{CC} = 800$ V, $V_{CEmax}=V_{CES}-L_{sCE}*di/dt$	$t_P \le 8$ µs, $T_{vj}=150$ °C		190		A
			$t_P \le 7$ µs, $T_{vj}=175$ °C		180		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, $\lambda_{grease} = 1$ W/(m·K)			0.910		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

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
Continuous DC forward current	I_F			50	A
Repetitive peak forward current	I_{FRM}	$t_P = 1$ ms		100	A
I^2t - value	I^2t	$t_P = 10$ ms, $V_R = 0$ V	$T_{vj} = 125$ °C	300	A^2s
			$T_{vj} = 175$ °C	250	

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 50$ 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}	$V_{CC} = 600$ V, $I_F = 50$ A, $V_{GE} = -15$ V, $-di_F/dt = 1700$ A/µs ($T_{vj} = 175$ °C)	$T_{vj} = 25$ °C		48.2		A
			$T_{vj} = 125$ °C		65.5		
			$T_{vj} = 175$ °C		77.8		
Recovered charge	Q_r	$V_{CC} = 600$ V, $I_F = 50$ A, $V_{GE} = -15$ V, $-di_F/dt = 1700$ A/µs ($T_{vj} = 175$ °C)	$T_{vj} = 25$ °C		4.36		µC
			$T_{vj} = 125$ °C		7.52		
			$T_{vj} = 175$ °C		9.82		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 1700 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.57		mJ
			T_{vj} = 125 °C		2.95		
			T_{vj} = 175 °C		3.95		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 1 W/(m·K)			1.20		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

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 = 90 °C		50	A
Maximum RMS current at rectifier output	I_{RMSM}	T_H = 90 °C		50	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	450	A
			T_{vj} = 150 °C	370	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	1010	A^2s
			T_{vj} = 150 °C	685	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 50 A	T_{vj} = 150 °C		1.09		V
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V			0.18		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 1 W/(m·K)			1.24		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 °C	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 90 °C	35	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		70	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 = 35 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.60	TBD	V
			T_{vj} = 125 °C		1.74		
			T_{vj} = 175 °C		1.82		
Gate threshold voltage	V_{GEth}	I_C = 0.75 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_{CC} = 600 V			0.548		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			6.62		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.023		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.005	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 = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.6 Ω	T_{vj} = 25 °C		0.043		µs
			T_{vj} = 125 °C		0.046		
			T_{vj} = 175 °C		0.048		
Rise time (inductive load)	t_r	I_C = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.6 Ω	T_{vj} = 25 °C		0.036		µs
			T_{vj} = 125 °C		0.038		
			T_{vj} = 175 °C		0.039		
Turn-off delay time (inductive load)	t_{doff}	I_C = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.6 Ω	T_{vj} = 25 °C		0.240		µs
			T_{vj} = 125 °C		0.310		
			T_{vj} = 175 °C		0.340		
Fall time (inductive load)	t_f	I_C = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.6 Ω	T_{vj} = 25 °C		0.120		µs
			T_{vj} = 125 °C		0.210		
			T_{vj} = 175 °C		0.270		

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on energy loss per pulse	E_{on}	I_C = 35 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 5.6 Ω, di/dt = 590 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.84		mJ
			T_{vj} = 125 °C		3.38		
			T_{vj} = 175 °C		3.61		
Turn-off energy loss per pulse	E_{off}	I_C = 35 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 5.6 Ω, dv/dt = 3000 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.31		mJ
			T_{vj} = 125 °C		3.84		
			T_{vj} = 175 °C		4.28		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 8 µs, T_{vj}=150 °C		110		A
			t_P ≤ 7 µs, T_{vj}=175 °C		100		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 1 W/(m·K)			1.09		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

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
Continuous DC forward current	I_F			25	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		50	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	72.5	A^2s
			T_{vj} = 175 °C	63	

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	TBD	V
			T_{vj} = 125 °C		1.70		
			T_{vj} = 175 °C		1.63		

(table continues...)

Table 12 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 25 A, -di$_F$/dt = 570 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		22.2		A
			T_{vj} = 125 °C		29.2		
			T_{vj} = 175 °C		33.9		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 25 A, -di$_F$/dt = 570 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.63		µC
			T_{vj} = 125 °C		3.44		
			T_{vj} = 175 °C		4.59		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 25 A, -di$_F$/dt = 570 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.38		mJ
			T_{vj} = 125 °C		1.25		
			T_{vj} = 175 °C		1.88		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 1 W/(m·K)			2.02		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

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	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298{,}15\ K))]$		3433		K

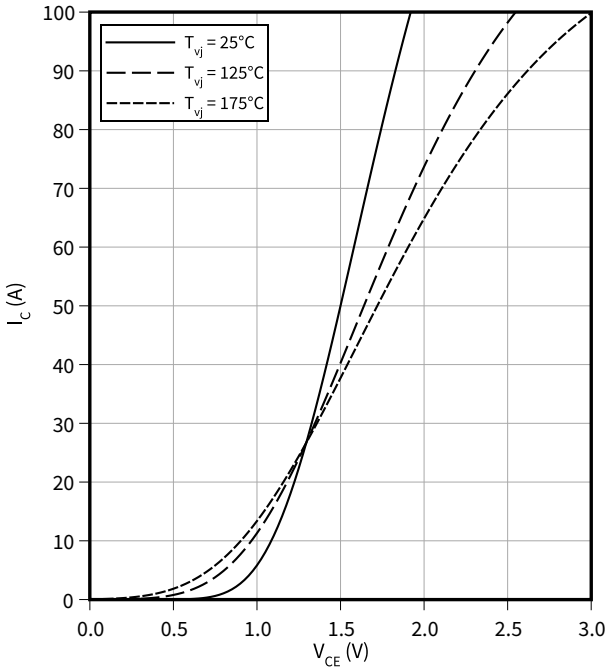
Note: Specification according to the valid application note.

8 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

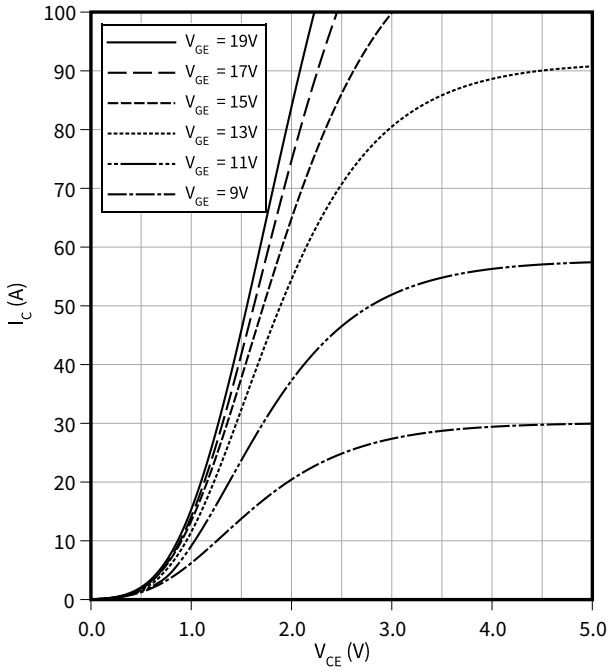
$V_{GE} = 15$ V



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

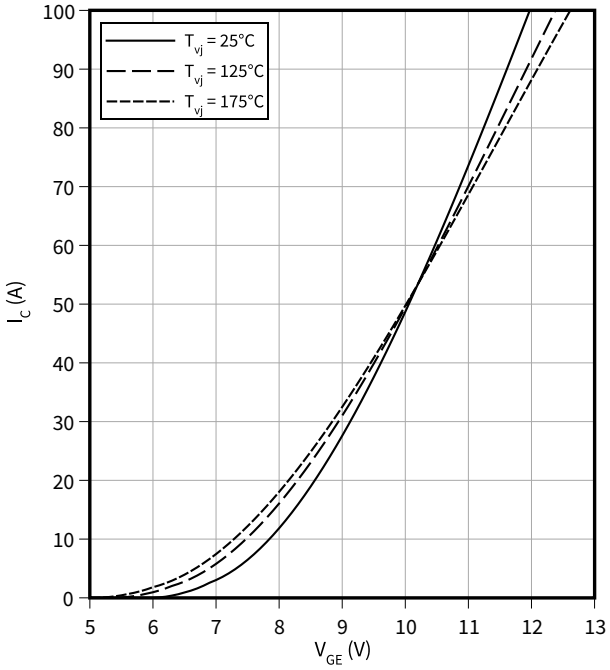
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

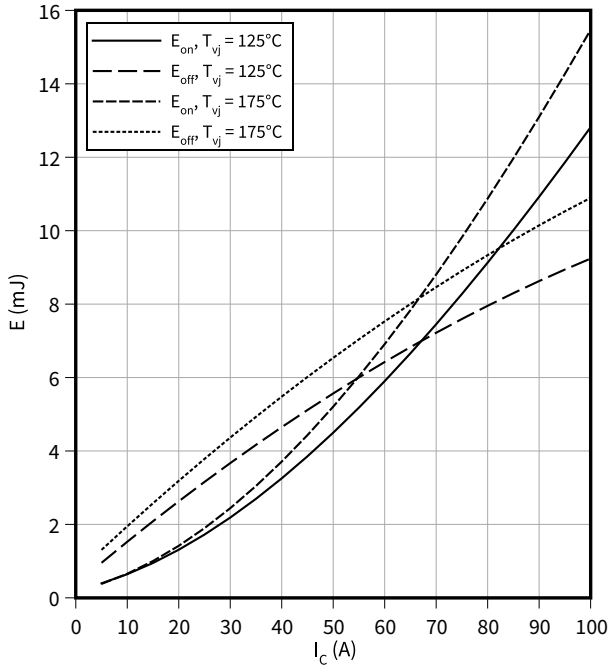
$V_{CE} = 20$ V



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

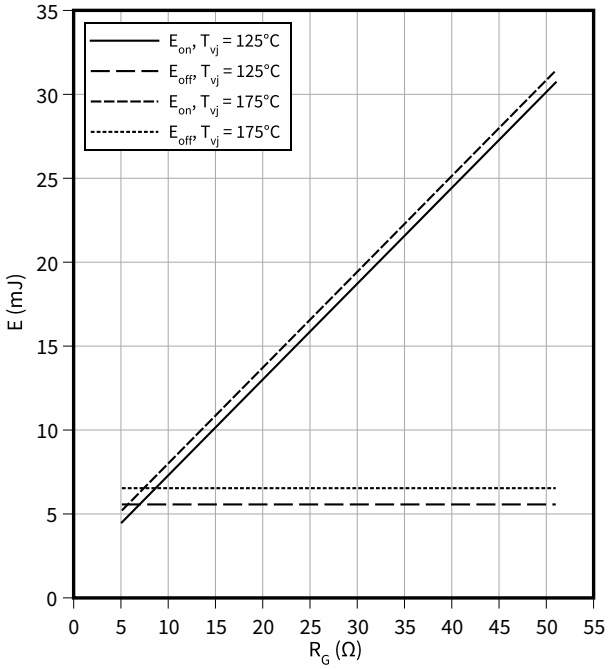
$R_{Goff} = 5.1\ \Omega$, $R_{Gon} = 5.1\ \Omega$, $V_{CC} = 600$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

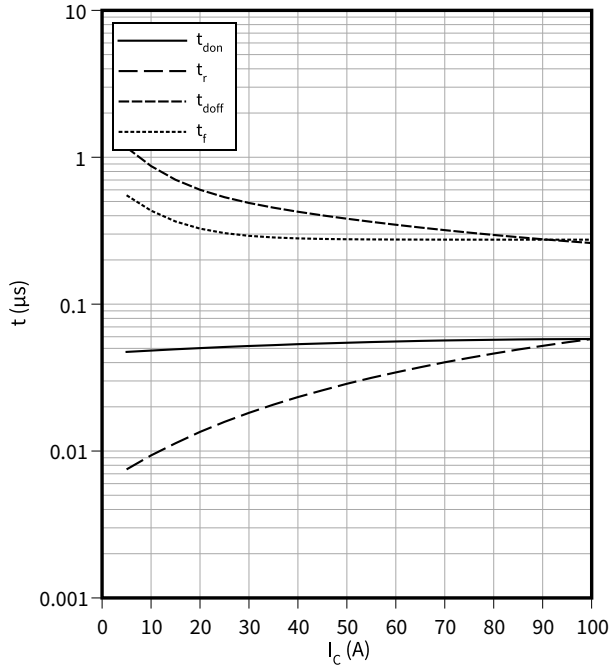
$I_C = 50\ A$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

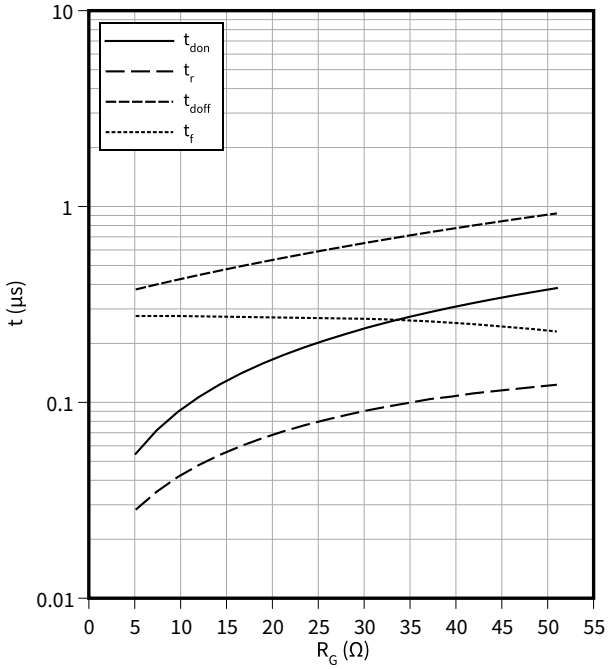
$R_{Goff} = 5.1\ \Omega$, $R_{Gon} = 5.1\ \Omega$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

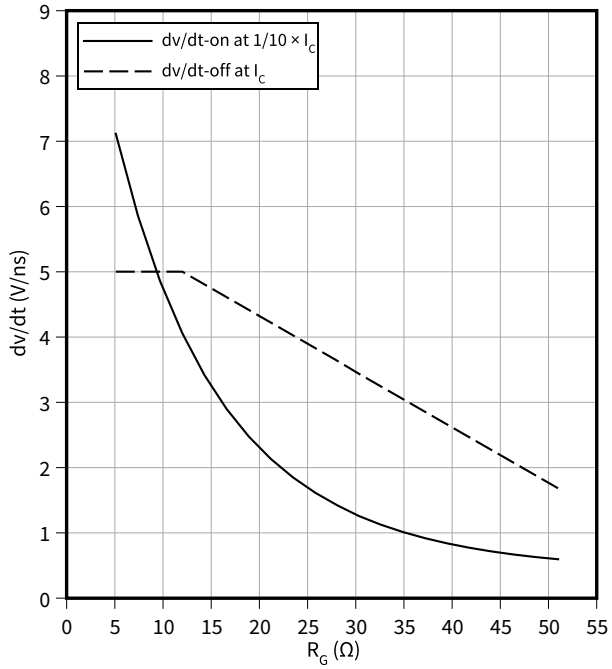
$I_C = 50\ A$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Voltage slope (typical), IGBT, Inverter

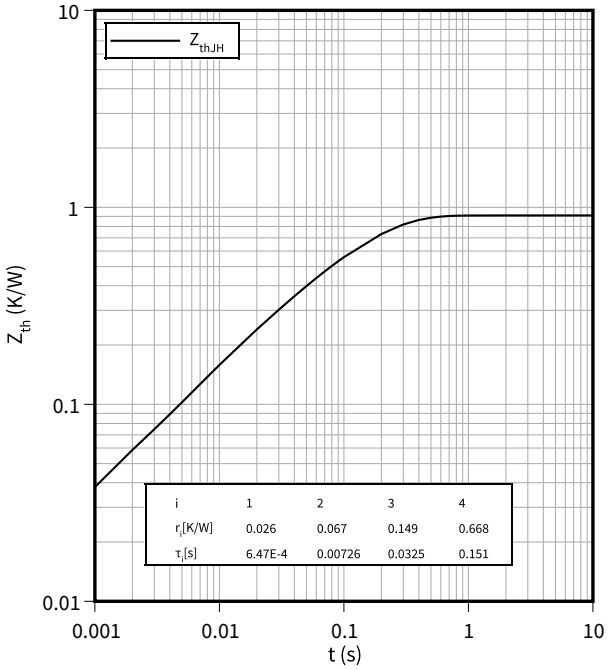
$dv/dt = f(R_G)$

$I_C = 50\ A$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 25\ °C$



Transient thermal impedance , IGBT, Inverter

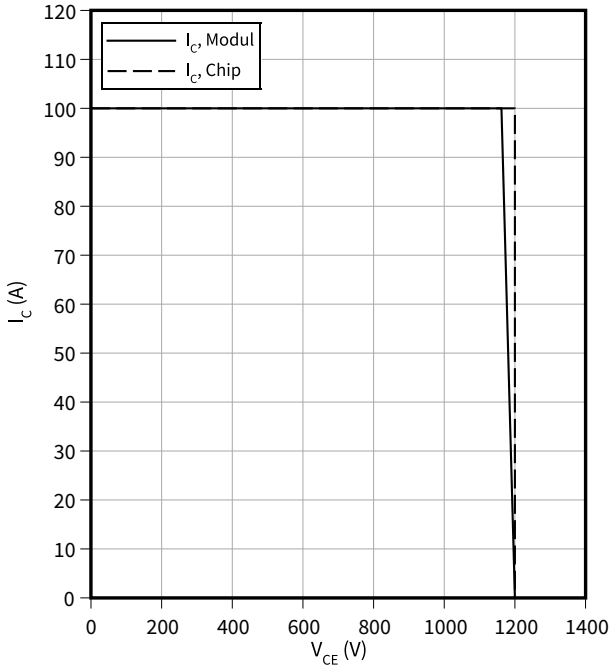
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

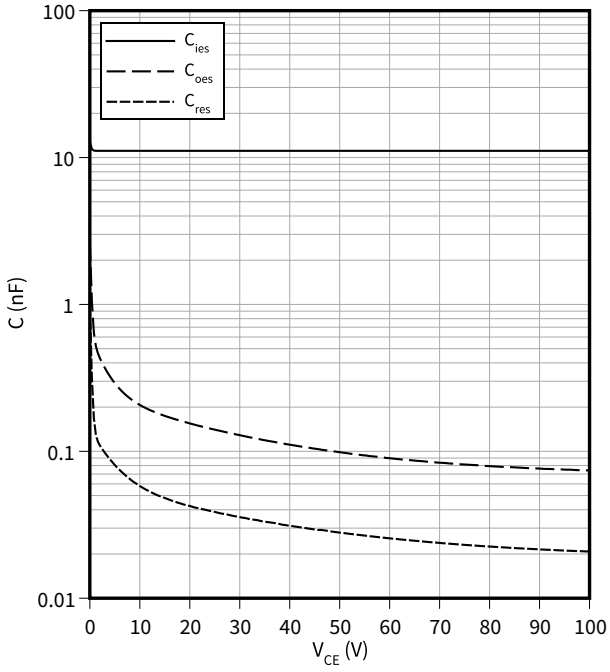
$R_{Goff} = 5.1\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

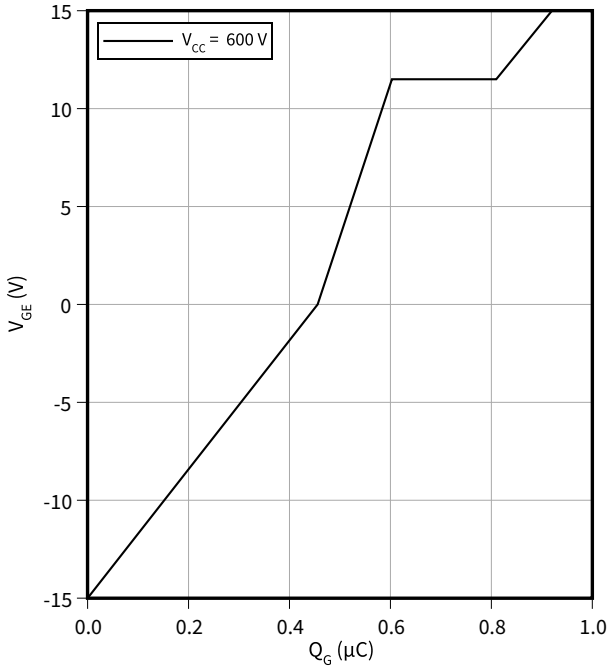
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

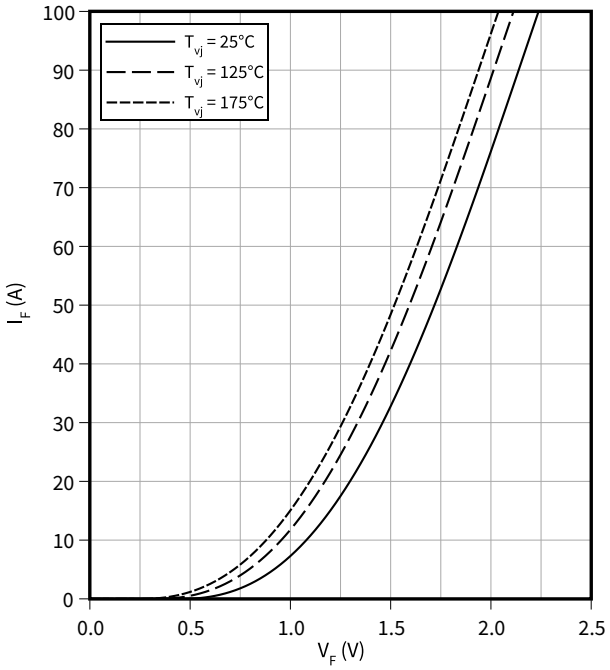
$V_{GE} = f(Q_G)$

$I_C = 50$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

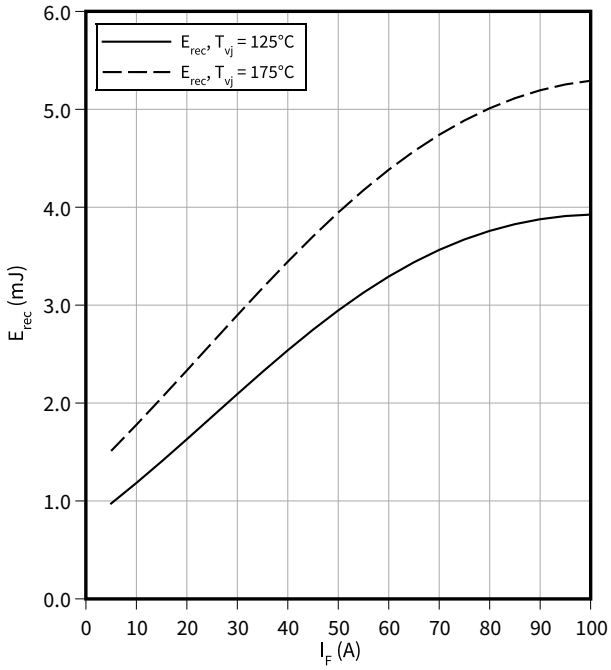
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

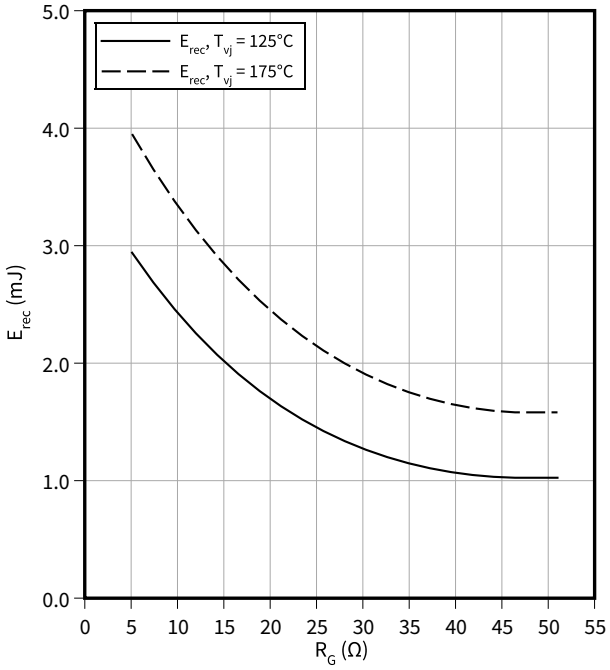
$R_{Gon} = 5.1\ \Omega$, $V_{CC} = 600\ V$



Switching losses (typical), Diode, Inverter

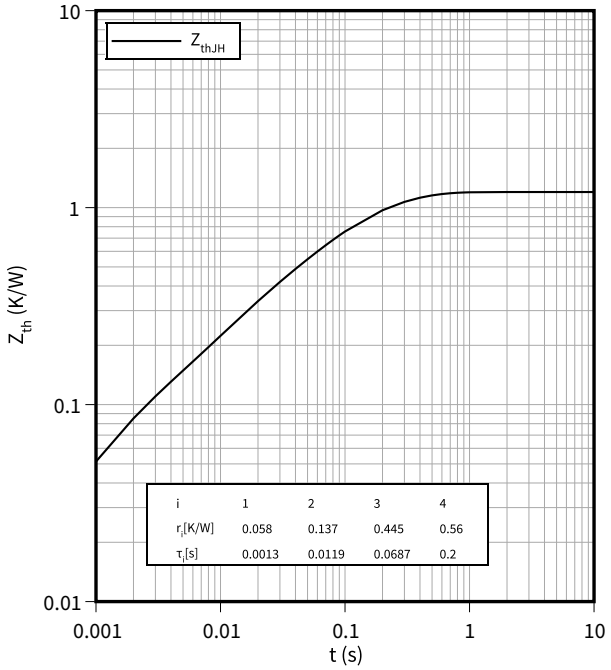
$E_{rec} = f(R_G)$

$I_F = 50\ A$, $V_{CC} = 600\ V$



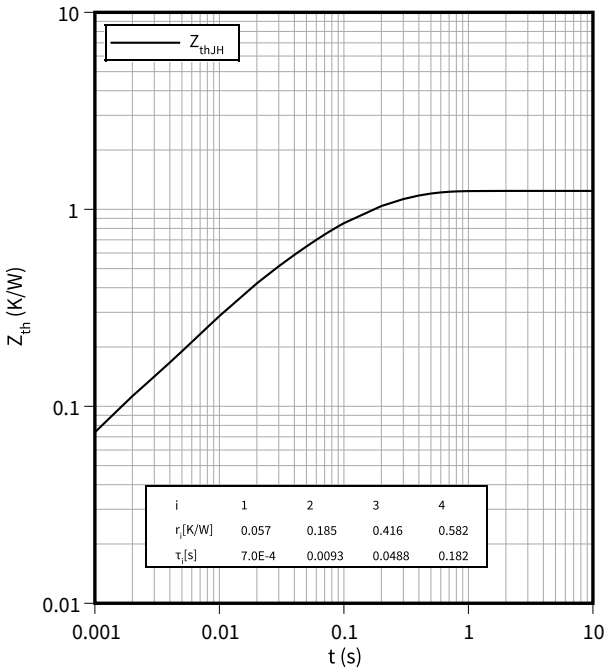
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



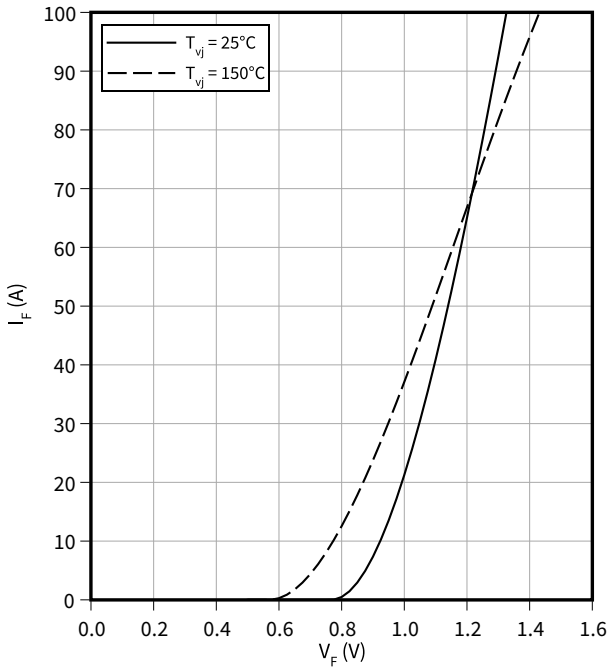
Transient thermal impedance, Diode, Rectifier

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Rectifier

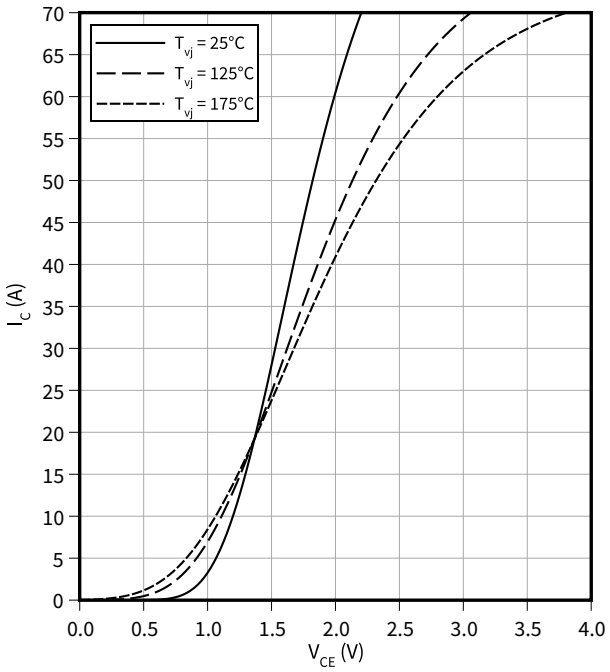
$I_F = f(V_F)$



Output characteristic (typical), IGBT, Brake-Chopper

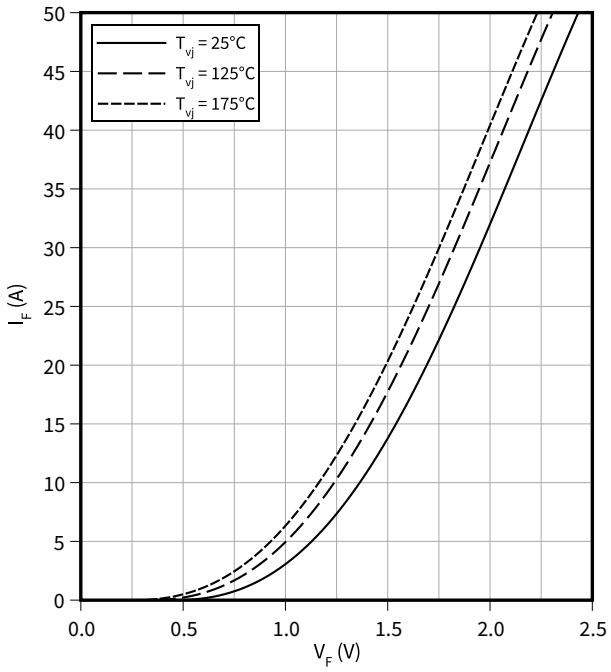
$I_C = f(V_{CE})$

$V_{GE} = 15\ V$



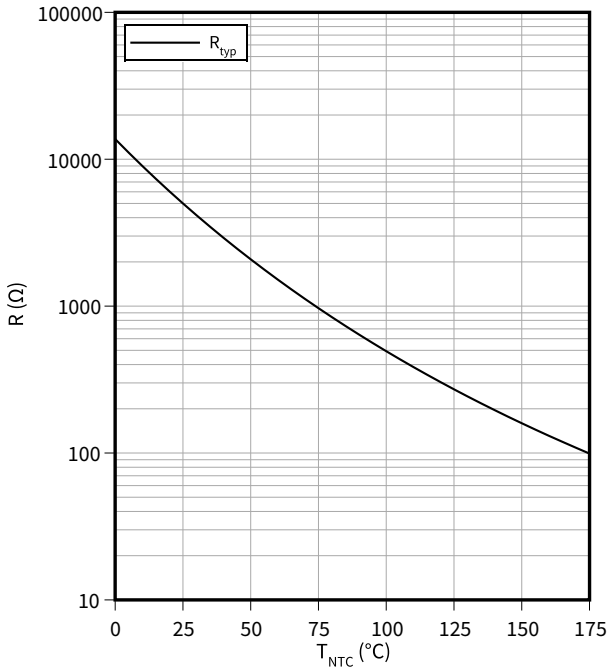
Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

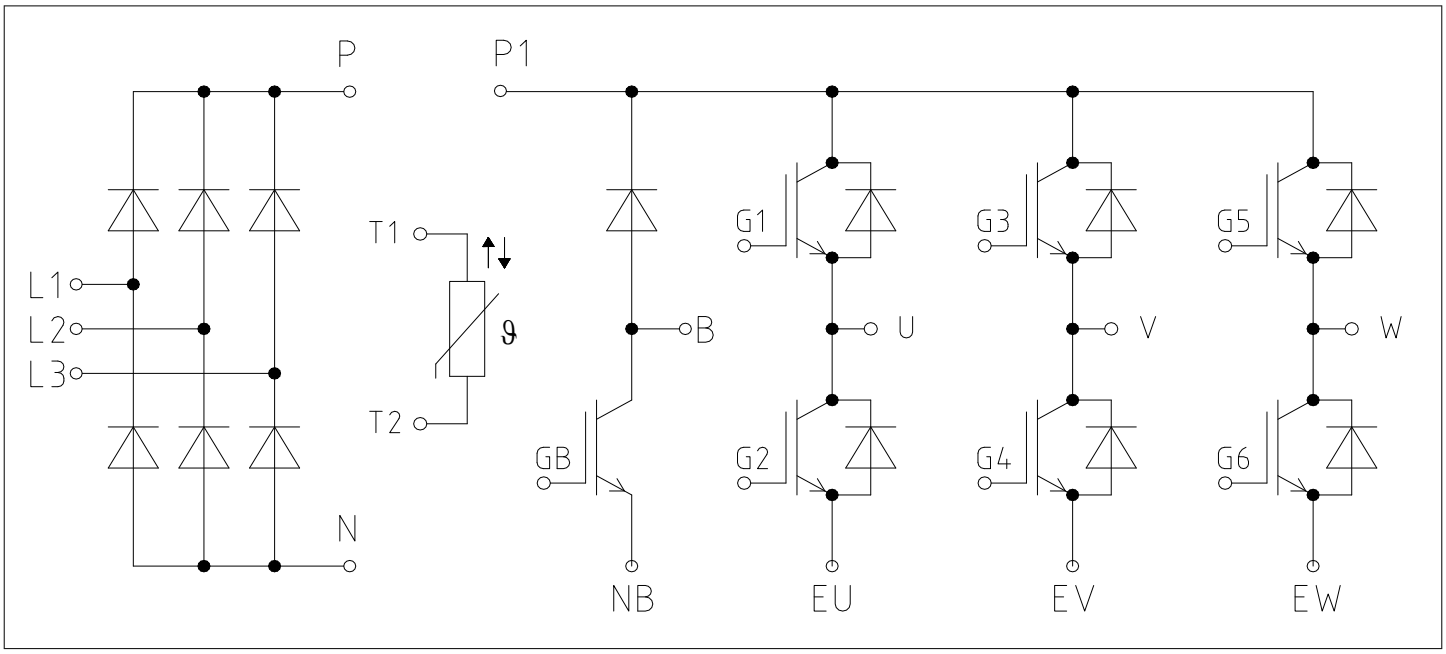


Figure 1

10 Package outlines

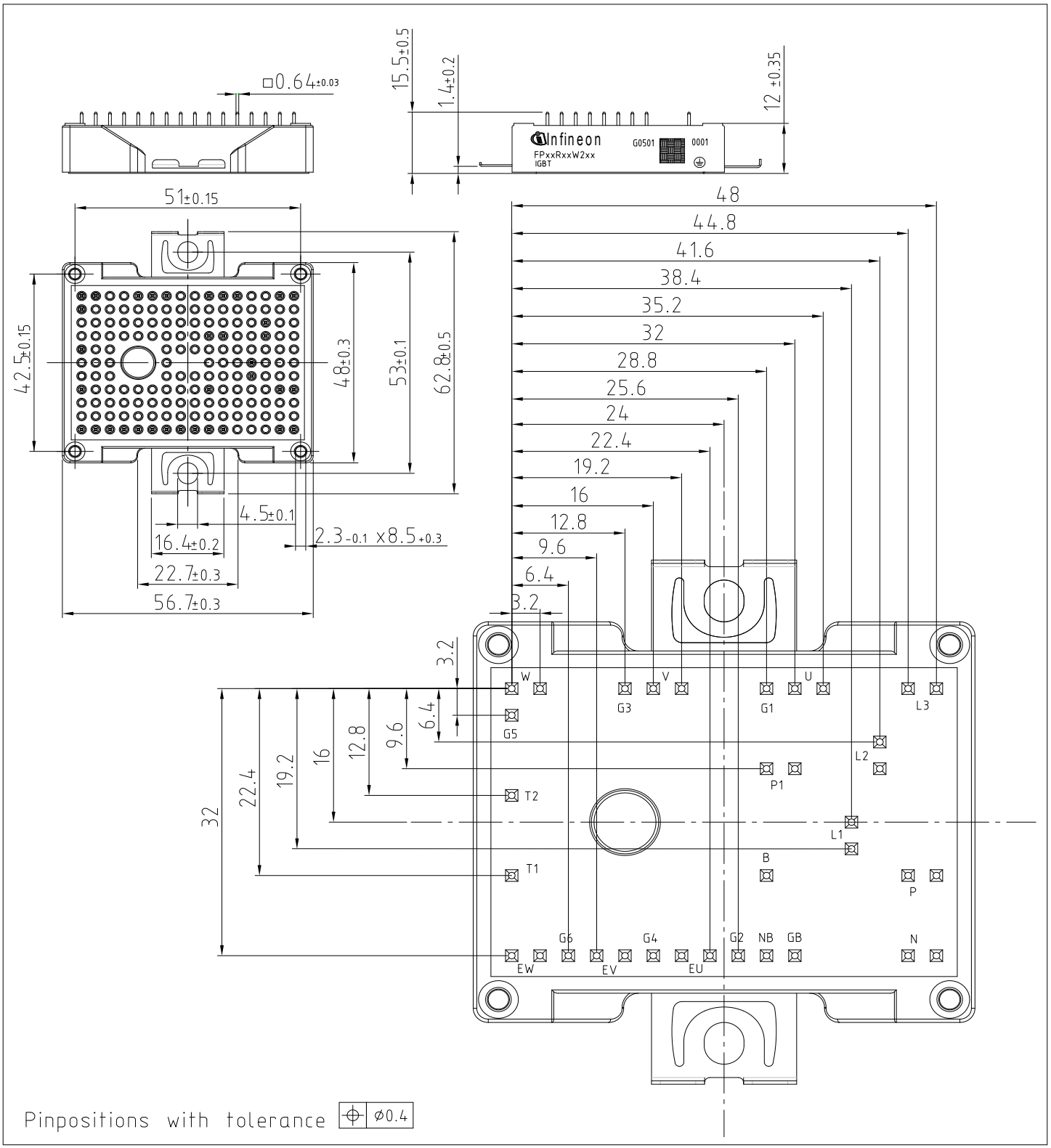


Figure 2

11 Module label code

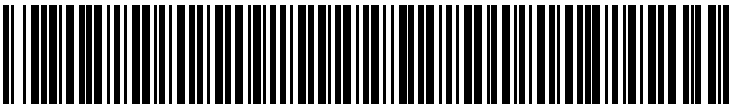
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 715491428465505499115 30		 715491428465505499115 30

Figure 3

Revision history

Document revision	Date of release	Description of changes
V2.0	2020-05-08	Preliminary 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
0.20	2023-02-14	Preliminary datasheet