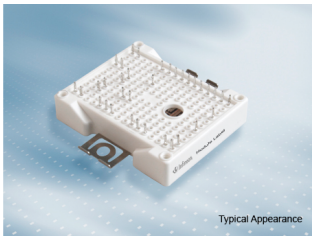
Preliminary datasheet
EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / NTC

Features



- Electrical features
  - V_{DSS} = 1200 V
  - I_{DN} = 100 A / I_{DRM} = 200 A
  - Increased DC-link voltage
  - High current density
  - Low switching losses
- Mechanical features
  - Rugged mounting due to integrated mounting clamps
  - PressFIT contact technology
  - Integrated NTC temperature sensor

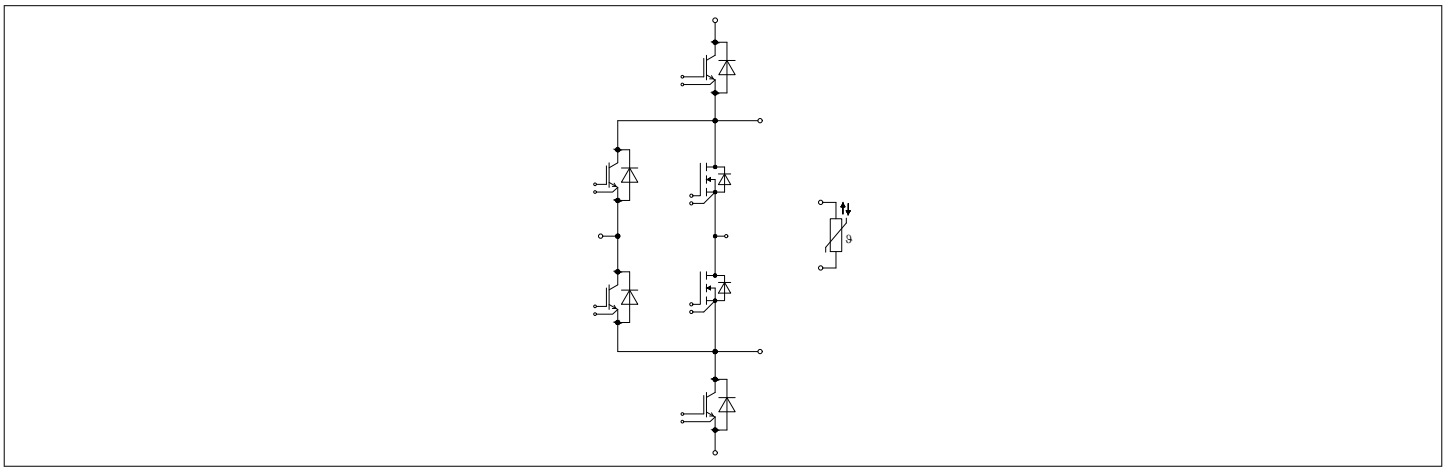
Potential applications

- Three-level applications
- High-frequency switching application
- Solar applications

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	3.0	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}			15		nH
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 25 A rms per connector pin.

2 MOSFET

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	1200	V
Implemented drain current	I_{DN}			100	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 15 V	T_H = 65 °C	85	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		200	A
Gate-source voltage, max. transient voltage	V_{GS}	*D* < 0.01		-10/23	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	I_D = 100 A	V_{GS} = 15 V, T_{vj} = 25 °C		11.3		mΩ
			V_{GS} = 15 V, T_{vj} = 125 °C		14.8		
			V_{GS} = 15 V, T_{vj} = 150 °C		16.5		
Gate threshold voltage	$V_{GS(th)}$	I_D = 40 mA, V_{DS} = V_{GS}, T_{vj} = 25 °C, (tested after 1ms pulse at V_{GS} = +20 V)		3.45	4.5	5.15	V
Total gate charge	Q_G	V_{DD} = 800 V, V_{GS} = -5/15 V			0.277		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			2		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS} = 800 V, V_{GS} = 0 V	T_{vj} = 25 °C		8.8		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS} = 800 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.42		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS} = 800 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.028		nF
C_{OSS} stored energy	E_{OSS}	V_{DS} = 800 V, V_{GS} = -5/15 V, T_{vj} = 25 °C			176		µJ
Drain-source leakage current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = -5 V	T_{vj} = 25 °C		0.4	380	µA
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V, T_{vj} = 25 °C	V_{GS} = 20 V			400	nA
Turn-on delay time (inductive load)	$t_{d\,on}$	I_D = 100 A, R_{Gon} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		45.1		ns
			T_{vj} = 125 °C		43.9		
			T_{vj} = 150 °C		42		
Rise time (inductive load)	t_r	I_D = 100 A, R_{Gon} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		25.5		ns
			T_{vj} = 125 °C		25.3		
			T_{vj} = 150 °C		24.4		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 100 A, R_{Goff} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		84.2		ns
			T_{vj} = 125 °C		86.7		
			T_{vj} = 150 °C		87.5		
Fall time (inductive load)	t_f	I_D = 100 A, R_{Goff} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		32.2		ns
			T_{vj} = 125 °C		35.5		
			T_{vj} = 150 °C		37.3		
Turn-on energy loss per pulse	E_{on}	I_D = 100 A, V_{DD} = 600 V, L_σ = 35 nH, V_{GS} = -5/15 V, R_{Gon} = 3.9 Ω, di/dt = 4.5 kA/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1		mJ
			T_{vj} = 125 °C		1.15		
			T_{vj} = 150 °C		1.24		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_D = 100 A, V_{DD} = 600 V, L_σ = 35 nH, V_{GS} = -5/15 V, R_{Goff} = 3.9 Ω, dv/dt = 21 kV/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1.62		mJ
			T_{vj} = 125 °C		1.85		
			T_{vj} = 150 °C		1.93		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET			0.58		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: The selection of positive and negative gate-source voltages impacts losses and the long-term behavior of the MOSFET and body diode. The design guidelines described in Application Note AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.

3 Body diode

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	T_{vj} = 175 °C, V_{GS} = -5 V	T_H = 20 °C	32	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 100 A, V_{GS} = -5 V	T_{vj} = 25 °C		4.6	5.65	V
			T_{vj} = 125 °C		4.35		
			T_{vj} = 150 °C		4.3		

4 IGBT, 3-Level

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	1200	V
Implemented collector current	I_{CN}			100	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	60	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		200	A

(table continues...)

Table 7 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Gate-emitter peak voltage	V_{GES}		±20	V

Table 8 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_{CC} = 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} = 25 °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_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 1.8 Ω	T_{vj} = 25 °C		0.153		µs
			T_{vj} = 125 °C		0.166		
			T_{vj} = 175 °C		0.174		
Rise time (inductive load)	t_r	I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 1.8 Ω	T_{vj} = 25 °C		0.033		µs
			T_{vj} = 125 °C		0.037		
			T_{vj} = 175 °C		0.040		
Turn-off delay time (inductive load)	t_{doff}	I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1.8 Ω	T_{vj} = 25 °C		0.283		µs
			T_{vj} = 125 °C		0.368		
			T_{vj} = 175 °C		0.421		
Fall time (inductive load)	t_f	I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1.8 Ω	T_{vj} = 25 °C		0.149		µs
			T_{vj} = 125 °C		0.221		
			T_{vj} = 175 °C		0.273		
Turn-on energy loss per pulse	E_{on}	I_C = 100 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 1.8 Ω, di/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.75		mJ
			T_{vj} = 125 °C		9.8		
			T_{vj} = 175 °C		11.5		

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_C = 100 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 1.8 Ω, dv/dt = 2700 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.6		mJ
			T_{vj} = 125 °C		10.2		
			T_{vj} = 175 °C		12.7		
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		370		A
			t_P ≤ 7 µs, T_{vj} ≤ 175 °C		350		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT			0.920		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: Tvj op > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14

5 Diode, 3-Level

Table 9 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			100	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		200	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	970	A^2s
			T_{vj} = 175 °C	860	

Table 10 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		

(table continues...)

Table 10 (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 = 100 A, V_{GE} = -15 V, -di$_F$/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		95.5		A
			T_{vj} = 125 °C		119		
			T_{vj} = 175 °C		134		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 100 A, V_{GE} = -15 V, -di$_F$/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		8.64		µC
			T_{vj} = 125 °C		15.1		
			T_{vj} = 175 °C		20		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 100 A, V_{GE} = -15 V, -di$_F$/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.13		mJ
			T_{vj} = 125 °C		5.83		
			T_{vj} = 175 °C		7.58		
Thermal resistance, junction to heat sink	R_{thJH}	per diode			1.03		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

Note: Tvj op > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

6 NTC-Thermistor

Table 11 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

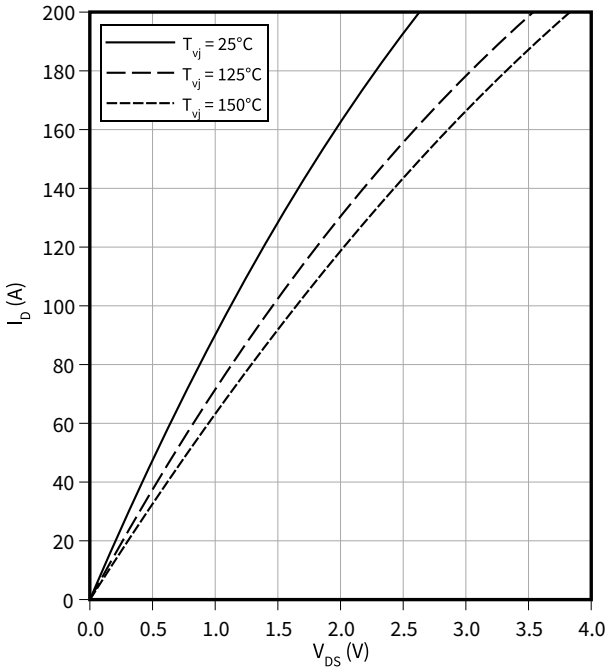
Note: Specification according to the valid application note.

7 Characteristics diagrams

Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

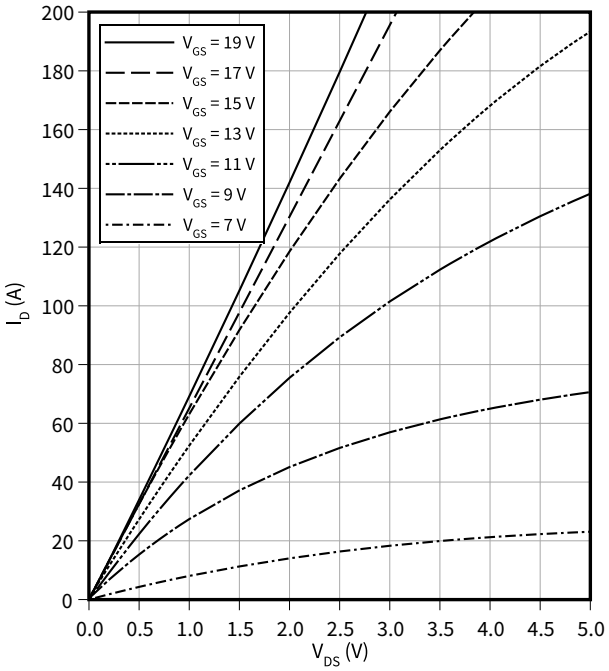
$V_{GS} = 15$ V



Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$

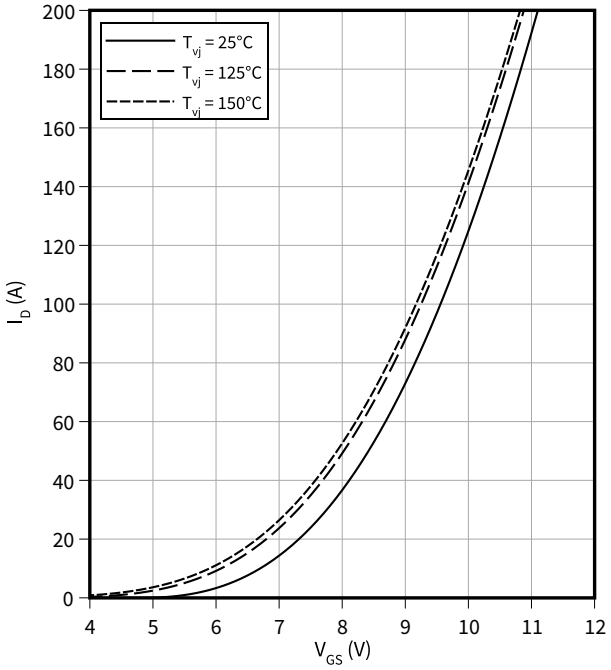
$T_{vj} = 150$ °C



Transfer characteristic (typical), MOSFET

$I_D = f(V_{GS})$

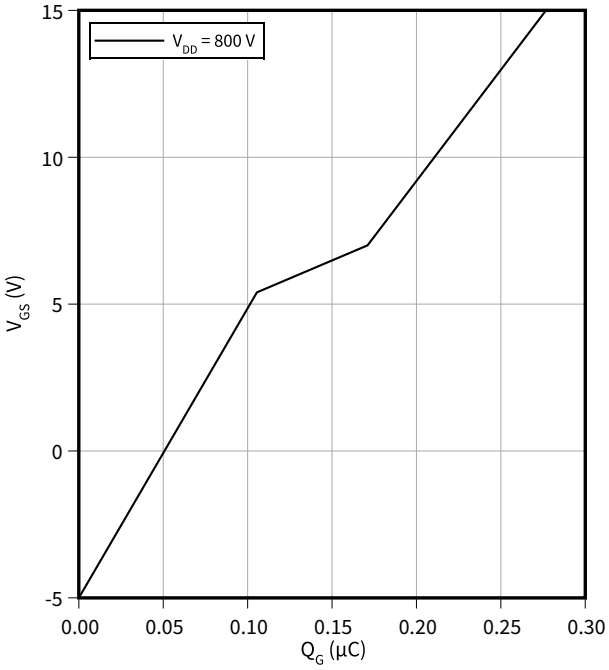
$V_{DS} = 20$ V



Gate charge characteristic (typical), MOSFET

$V_{GS} = f(Q_G)$

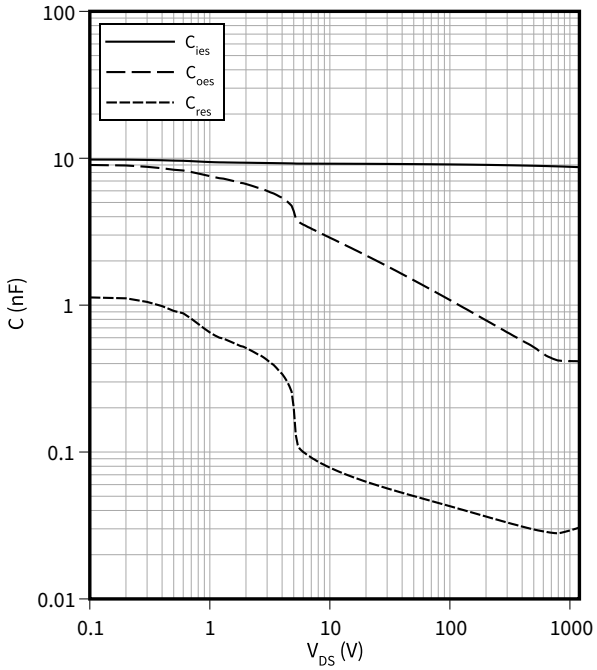
$I_D = 100$ A, $T_{vj} = 25$ °C



Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

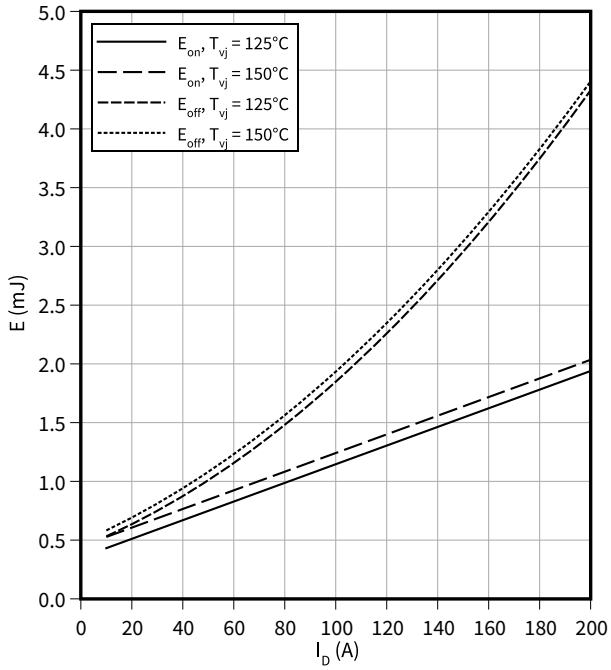
$f = 100\ kHz, T_{vj} = 25\ °C, V_{GS} = 0\ V$



Switching losses (typical), MOSFET

$E = f(I_D)$

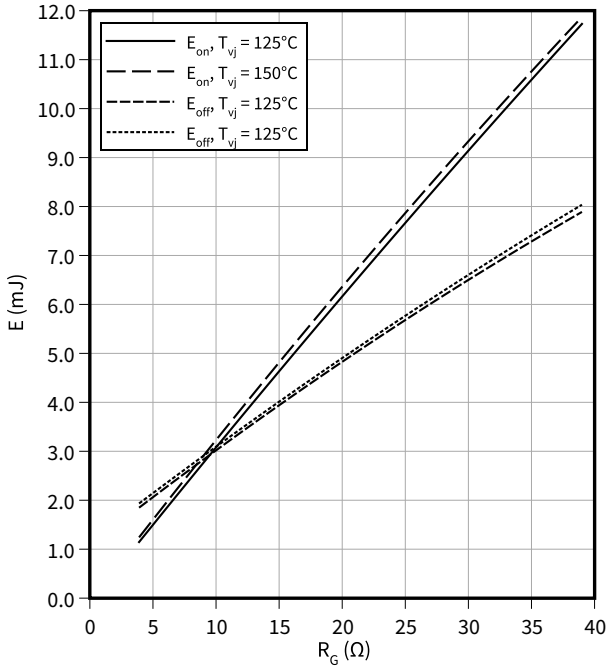
$R_{Goff} = 3.9\ \Omega, R_{Gon} = 3.9\ \Omega, V_{DS} = 600\ V, V_{GS} = -5/15\ V$



Switching losses (typical), MOSFET

$E = f(R_G)$

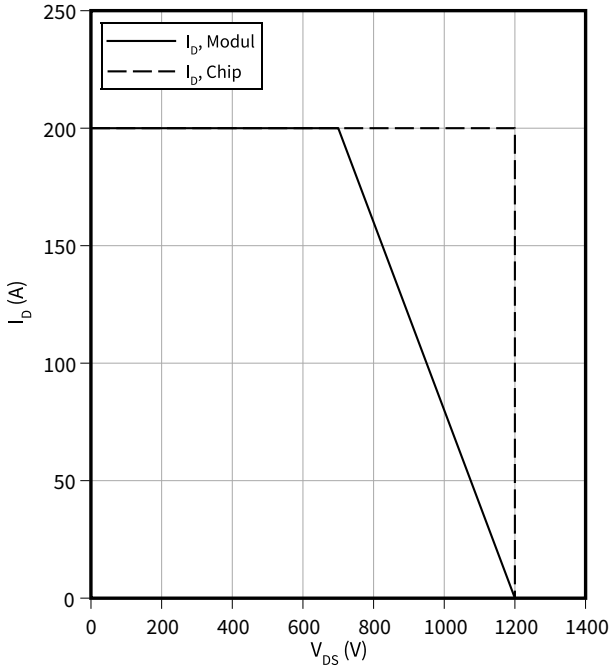
$V_{DS} = 600\ V, I_D = 100\ A, V_{GS} = -5/15\ V$



Reverse bias safe operating area (RBSOA), MOSFET

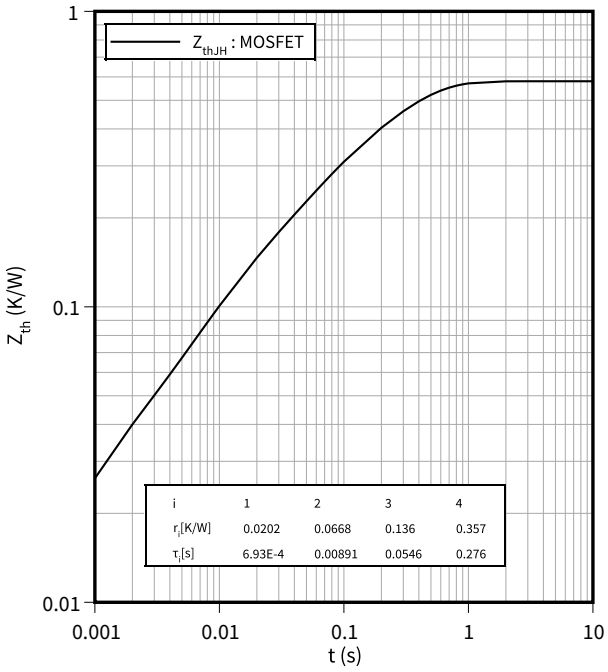
$I_D = f(V_{DS})$

$R_{Goff} = 3.9\ \Omega, T_{vj} = 150\ °C, V_{GS} = -5/15\ V$



Transient thermal impedance , MOSFET

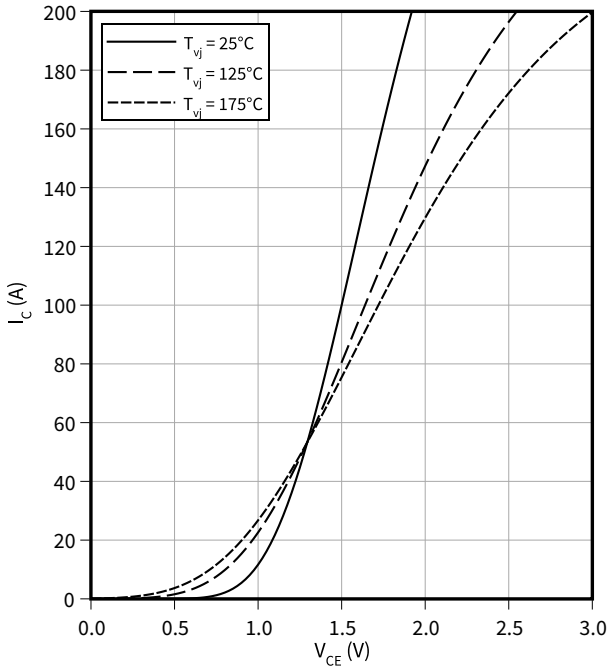
$Z_{th} = f(t)$



Output characteristic (typical), IGBT, 3-Level

$I_C = f(V_{CE})$

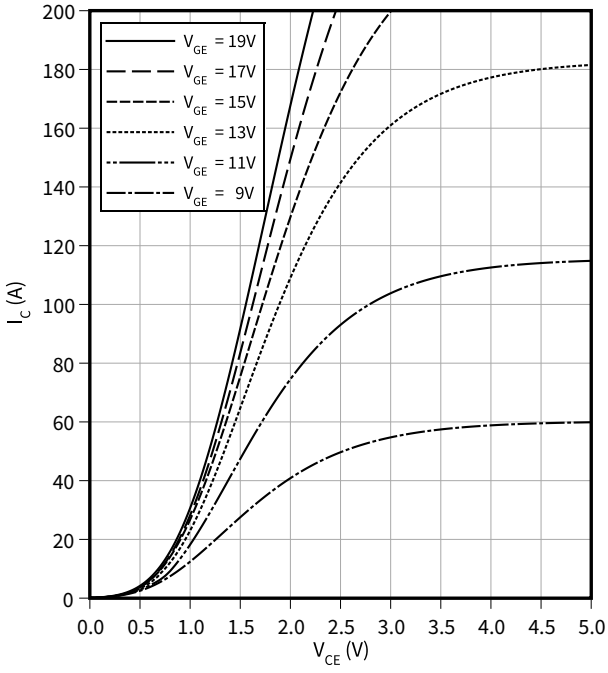
$V_{GE} = 15$ V



Output characteristic field (typical), IGBT, 3-Level

$I_C = f(V_{CE})$

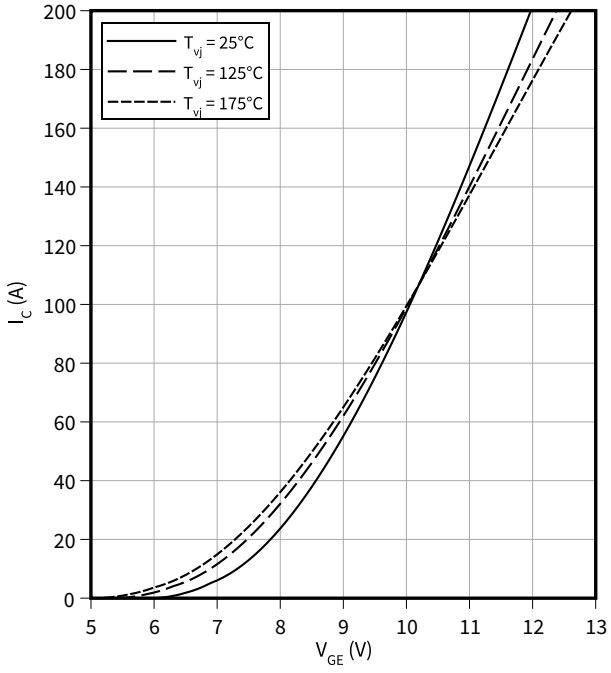
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, 3-Level

$I_C = f(V_{GE})$

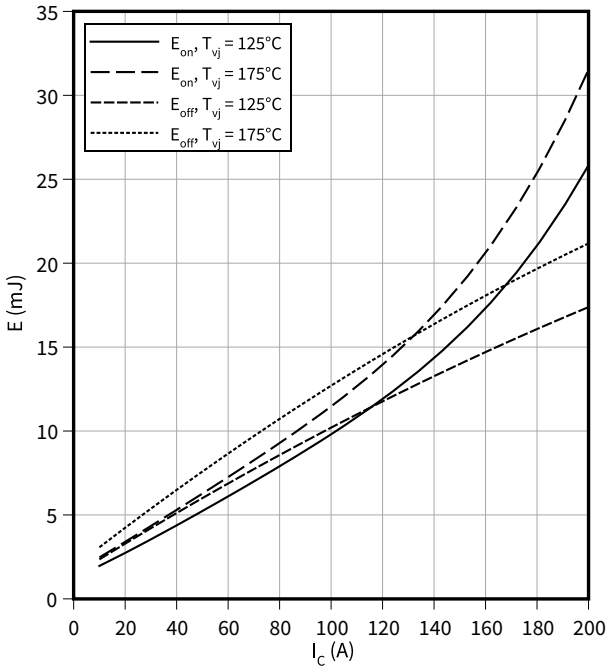
$V_{CE} = 20$ V



Switching losses (typical), IGBT, 3-Level

$E = f(I_C)$

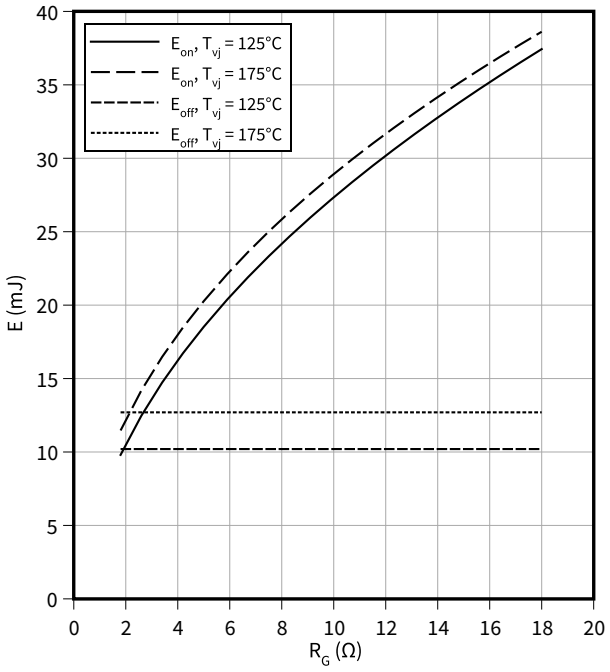
$R_{Goff} = 1.8\ \Omega$, $R_{Gon} = 1.8\ \Omega$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$



Switching losses (typical), IGBT, 3-Level

$E = f(R_G)$

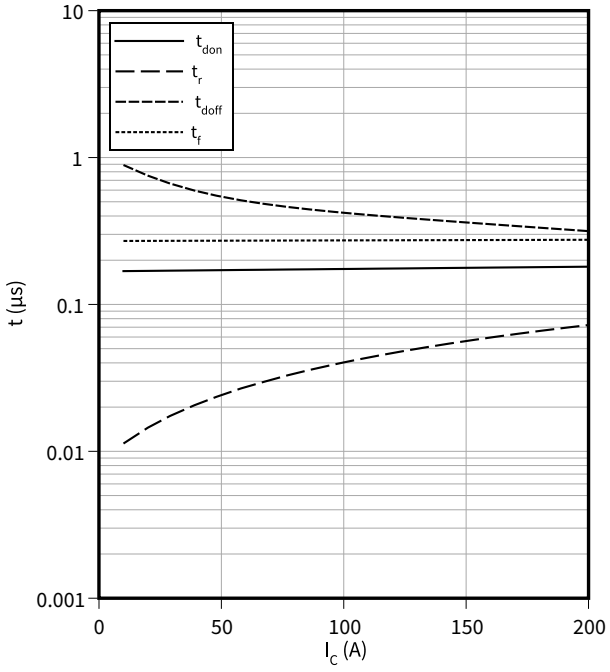
$I_C = 100\ A$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$



Switching times (typical), IGBT, 3-Level

$t = f(I_C)$

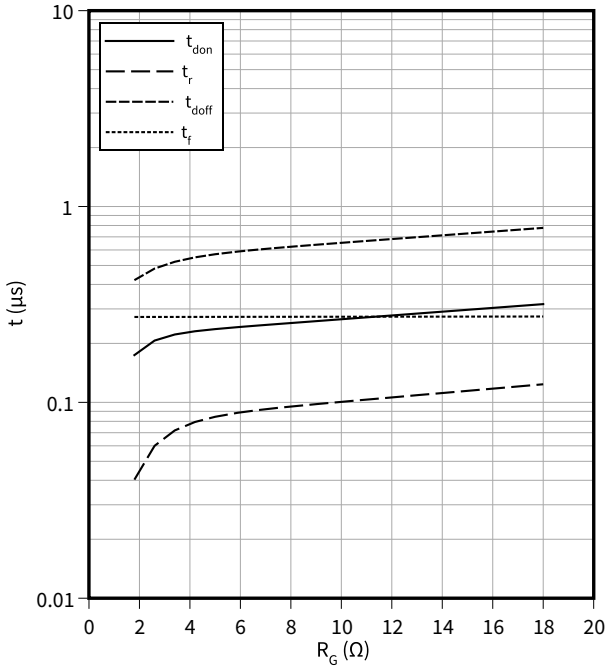
$R_{Goff} = 1.8\ \Omega$, $R_{Gon} = 1.8\ \Omega$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Switching times (typical), IGBT, 3-Level

$t = f(R_G)$

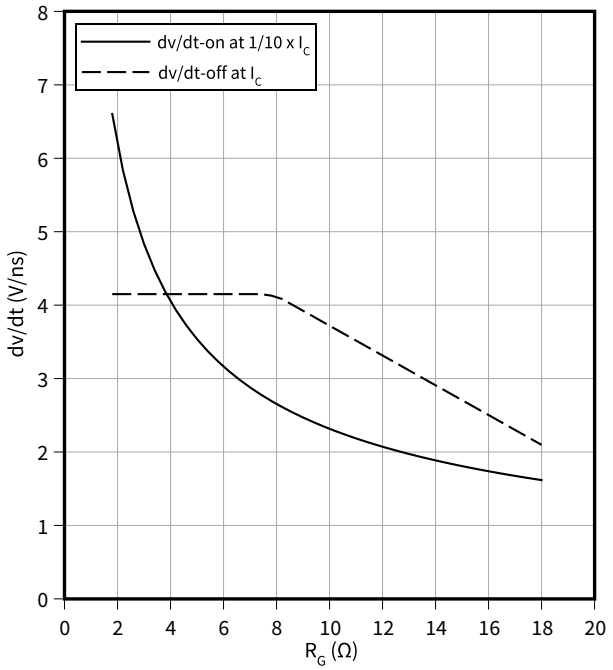
$I_C = 100\ A$, $V_{CC} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Voltage slope (typical), IGBT, 3-Level

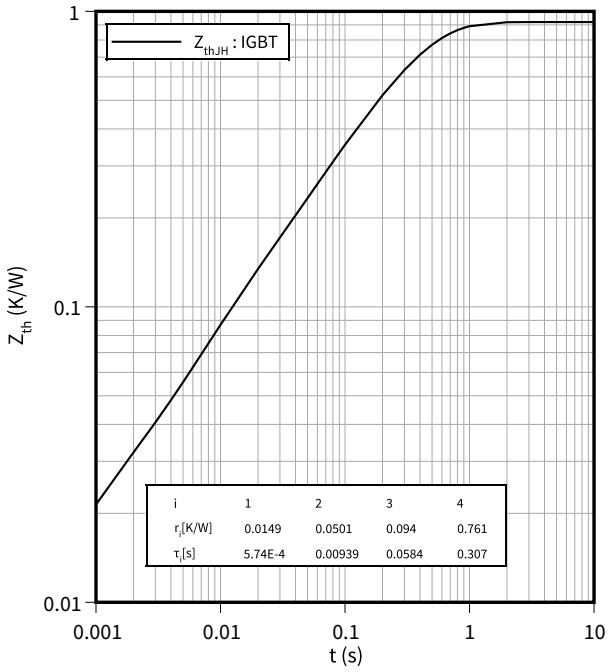
$dv/dt = f(R_G)$

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



Transient thermal impedance , IGBT, 3-Level

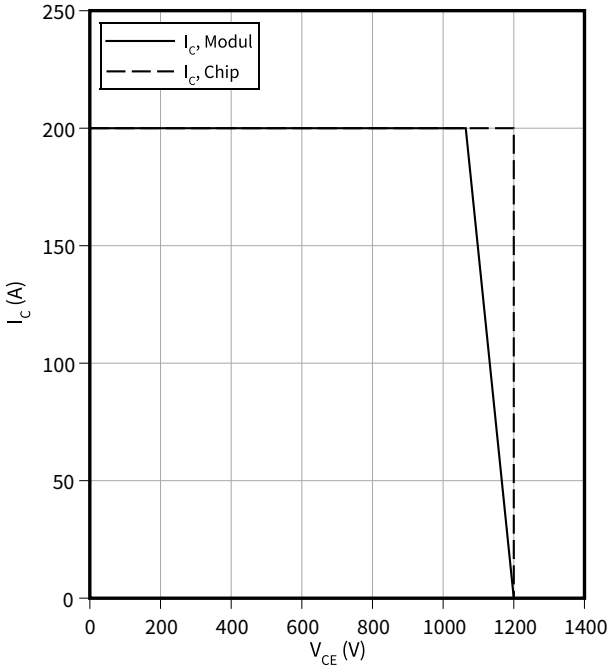
$Z_{th} = f(t)$



Reverse bias safe operating area (RBSOA), IGBT, 3-Level

$I_C = f(V_{CE})$

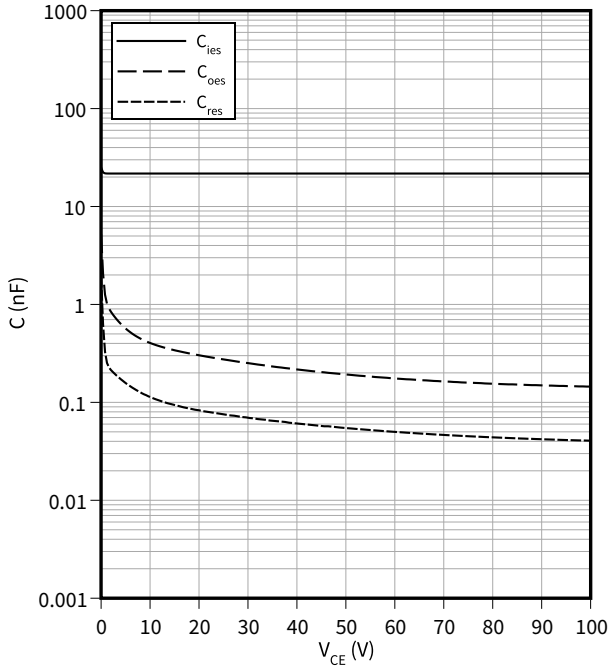
$R_{Goff} = 1.8\ \Omega$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



Capacity characteristic (typical), IGBT, 3-Level

$C = f(V_{CE})$

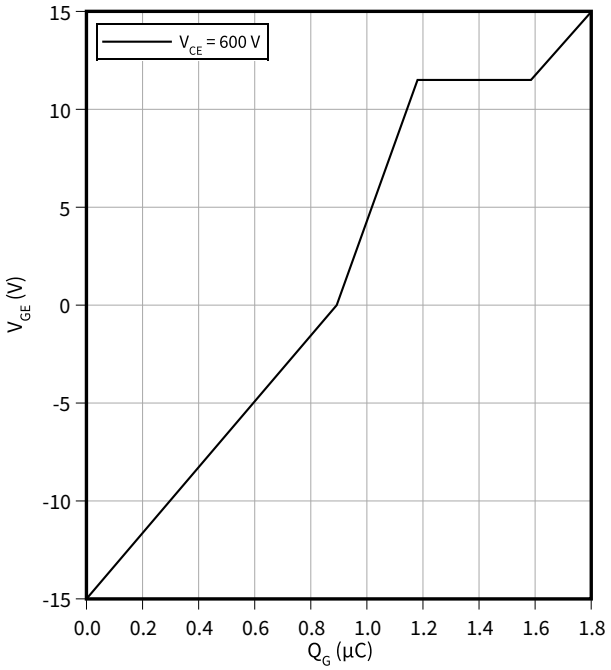
$f = 100\ kHz$, $V_{GE} = 0\ V$, $T_{vj} = 25\ °C$



Gate charge characteristic (typical), IGBT, 3-Level

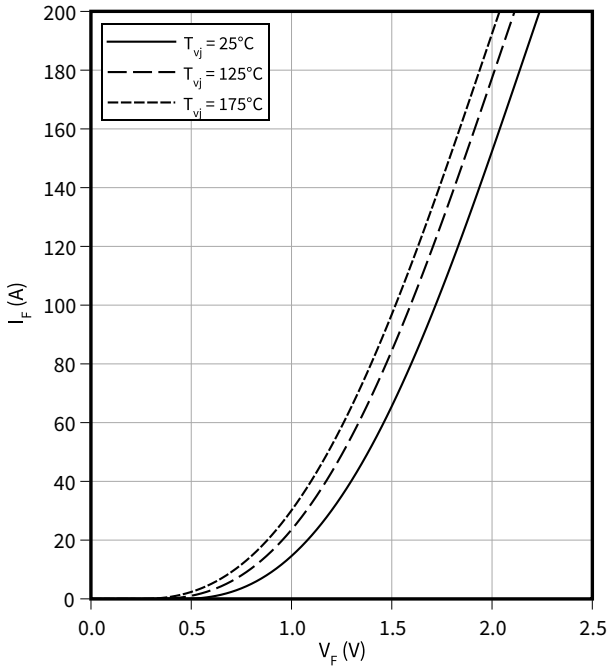
$V_{GE} = f(Q_G)$

$I_C = 100\ A$, $T_{vj} = 25\ °C$



Forward characteristic (typical), Diode, 3-Level

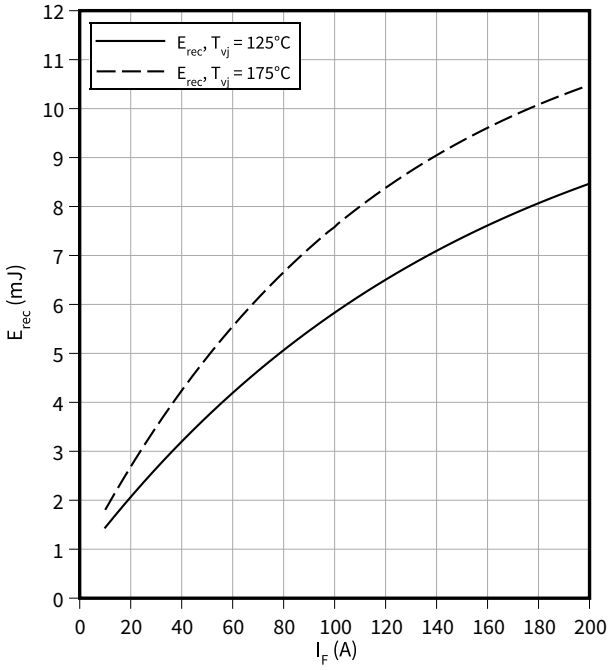
$I_F = f(V_F)$



Switching losses (typical), Diode, 3-Level

$E_{rec} = f(I_F)$

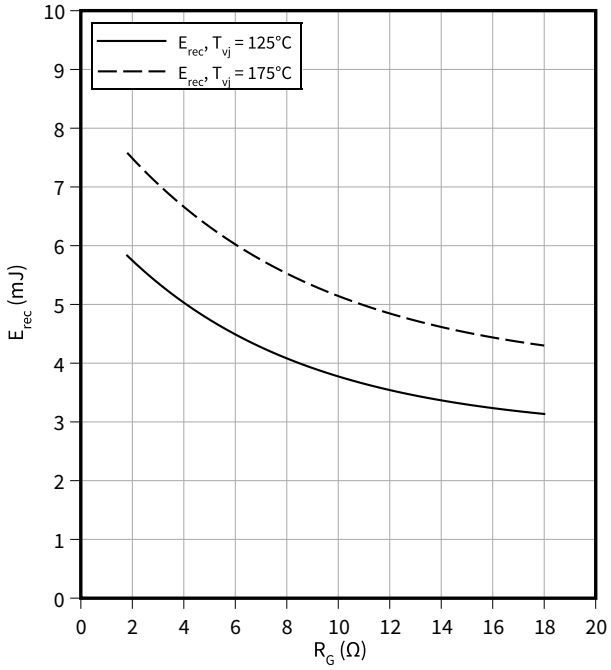
$R_{Gon} = 1.8\ \Omega$, $V_{CC} = 600\ V$



Switching losses (typical), Diode, 3-Level

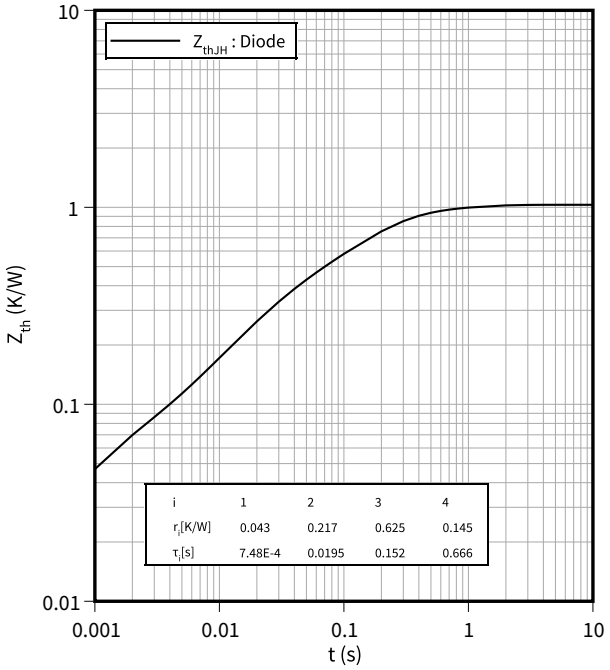
$E_{rec} = f(R_G)$

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



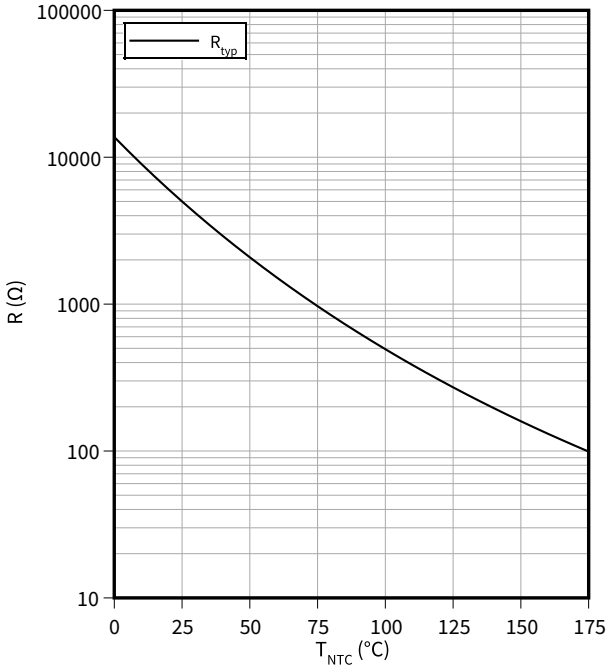
Transient thermal impedance, Diode, 3-Level

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



8 Circuit diagram

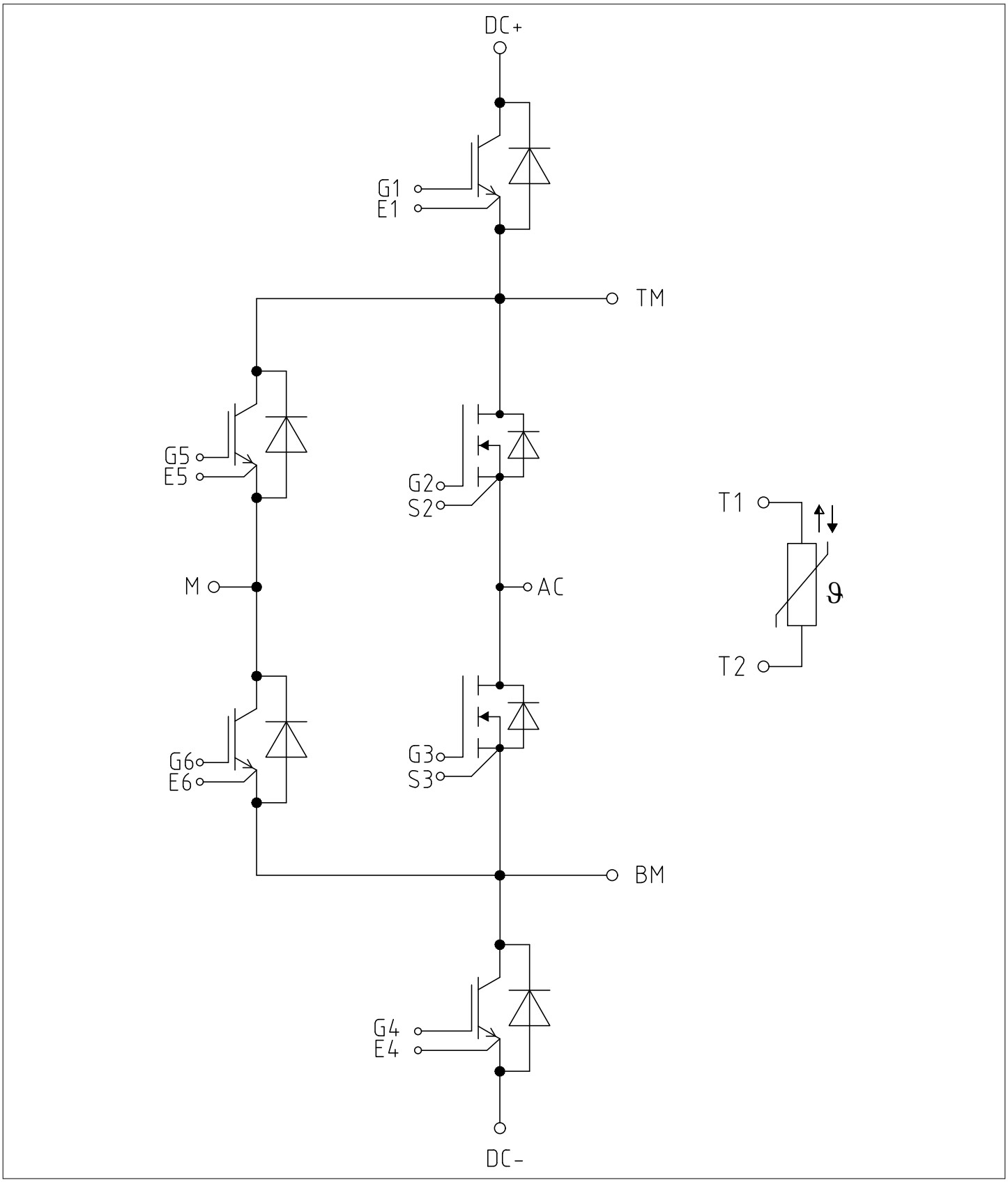


Figure 1

9 Package outlines

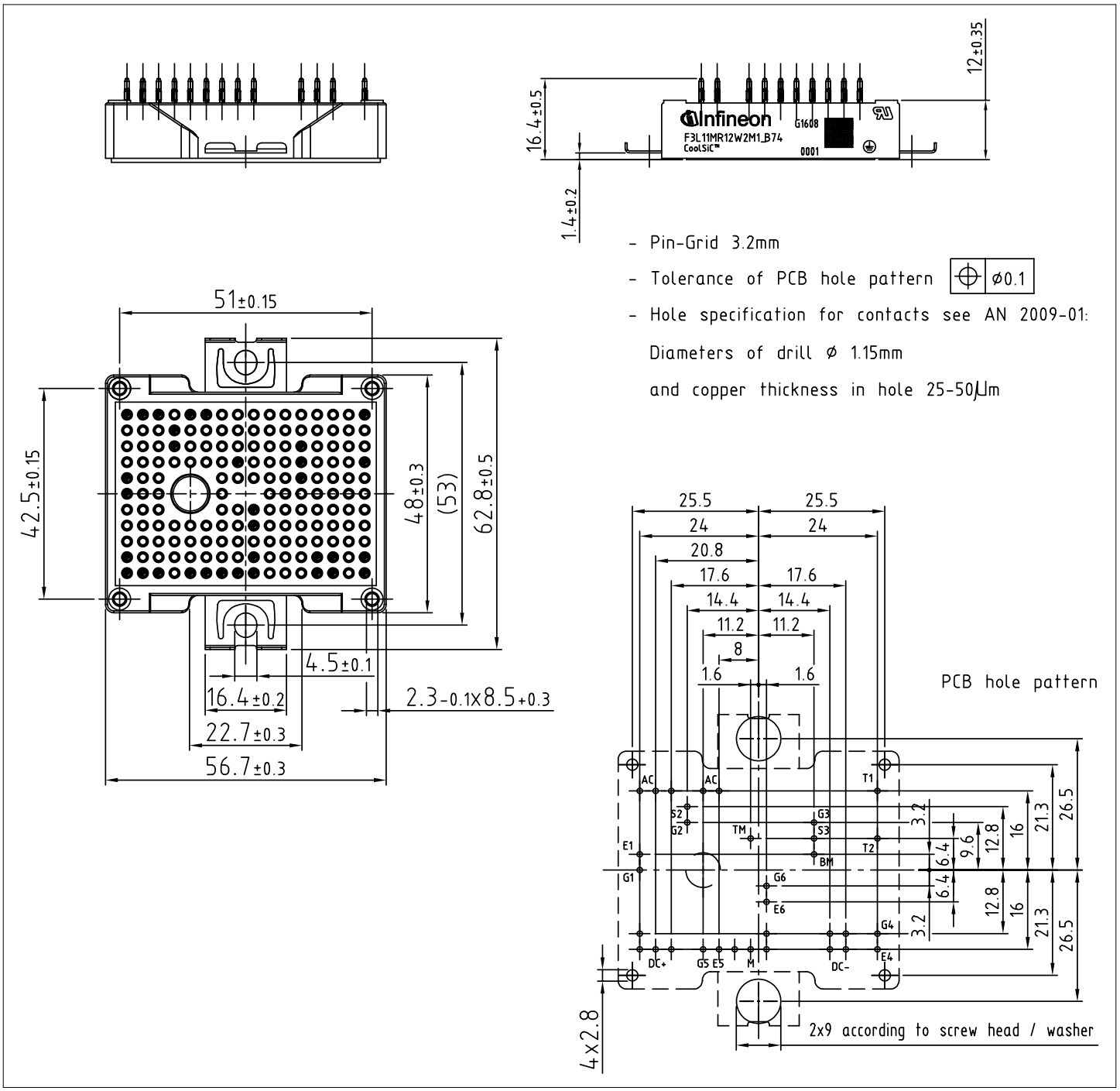


Figure 2

10 Module label code

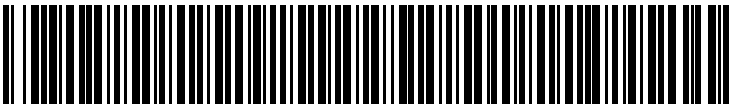
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 7154914284655054991530	 7154914284655054991530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2020-05-29	Target datasheet
V2.0	2020-09-04	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	2022-05-25	Preliminary datasheet

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