62 mm C-Series module with CoolSiC™ Trench MOSFET

Features

- Electrical features
  - V_{DSS} = 2000 V
  - I_{DN} = 300 A / I_{DRM} = 600 A
  - Low switching losses
  - High current density
- Mechanical features
  - 4 kV AC 1 min insulation

Potential applications

- UPS systems
- DC/DC converter
- High-frequency switching application
- Solar applications

Product validation

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

Description

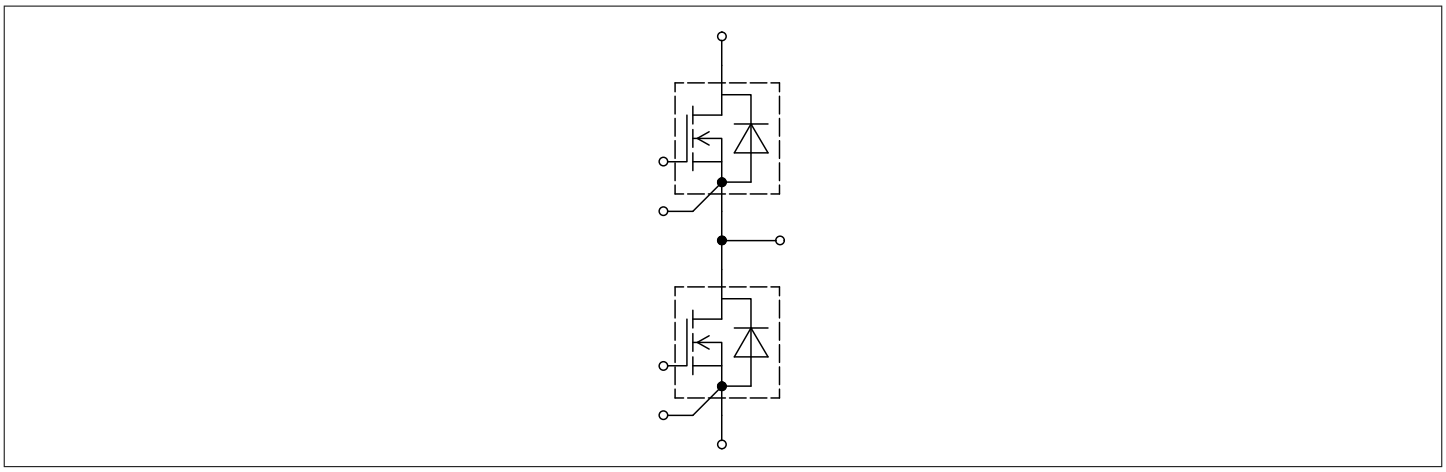


Table of contents

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	4.0	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	29.0	mm
Creepage distance	d_{Creep}	terminal to terminal	23.0	mm
Clearance	d_{Clear}	terminal to heatsink	23.0	mm
Clearance	d_{Clear}	terminal to terminal	11.0	mm
Comparative tracking index	*CTI*		> 400	
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 °C, per switch			0.475		mΩ
Storage temperature	T_{stg}			-40		125	°C
Mounting torque for module mounting	*M*	- Mounting according to valid application note	M6, Screw	3		6	Nm
Terminal connection torque	*M*	- Mounting according to valid application note	M6, Screw	2.5		5	Nm
Weight	*G*				340		g

2 MOSFET, T1 / T2

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	2000	V
Implemented drain current	I_{DN}			300	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_C = 25 °C	280	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		600	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Gate-source voltage, max. transient voltage	V_{GS}	$D < 0.01$	-10/23	V
Gate-source voltage, max. static voltage	V_{GS}		-7/20	V

Table 4 Recommended values

Parameter	Symbol	Note or test condition	Values	Unit
On-state gate voltage	$V_{GS(on)}$		18	V
Off-state gate voltage	$V_{GS(off)}$		-3	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	I_D = 300 A	V_{GS} = 18 V, T_{vj} = 25 °C		3.5	5.3	mΩ
			V_{GS} = 18 V, T_{vj} = 125 °C		7.3		
			V_{GS} = 18 V, T_{vj} = 175 °C		10.4		
Gate threshold voltage	$V_{GS(th)}$	I_D = 168 mA, V_{DS} = V_{GS}, T_{vj} = 25 °C, (tested after 1ms pulse at V_{GS} = +20 V)		3.45	4.3	5.15	V
Total gate charge	Q_G	V_{DD} = 1200 V, V_{GS} = -3/18 V			1.17		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.2		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		36.1		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.845		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.061		nF
C_{OSS} stored energy	E_{OSS}	V_{DS} = 1200 V, V_{GS} = -3/18 V, T_{vj} = 25 °C			1520		µJ
Drain-source leakage current	I_{DSS}	V_{DS} = 2000 V, V_{GS} = -3 V	T_{vj} = 25 °C		0.06	527	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 = 300 A, R_{Gon} = 7.1 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		204		ns
			T_{vj} = 125 °C		187		
			T_{vj} = 175 °C		181		

(table continues...)

Table 5 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Rise time (inductive load)	t_r	I_D = 300 A, R_{Gon} = 7.1 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		219		ns
			T_{vj} = 125 °C		195		
			T_{vj} = 175 °C		194		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 300 A, R_{Goff} = 4.3 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		256		ns
			T_{vj} = 125 °C		282		
			T_{vj} = 175 °C		296		
Fall time (inductive load)	t_f	I_D = 300 A, R_{Goff} = 4.3 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		80.3		ns
			T_{vj} = 125 °C		82.1		
			T_{vj} = 175 °C		84.2		
Turn-on energy loss per pulse	E_{on}	I_D = 300 A, V_{DD} = 1200 V, L_σ = 25 nH, V_{GS} = -3/18 V, R_{Gon} = 7.1 Ω, di/dt = 3.4 kA/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		45.5		mJ
			T_{vj} = 125 °C		46.5		
			T_{vj} = 175 °C		50.5		
Turn-off energy loss per pulse	E_{off}	I_D = 300 A, V_{DD} = 1200 V, L_σ = 25 nH, V_{GS} = -3/18 V, R_{Goff} = 4.3 Ω, dv/dt = 11.4 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		23.7		mJ
			T_{vj} = 125 °C		24.5		
			T_{vj} = 175 °C		25.2		
Thermal resistance, junction to case	R_{thJC}	per MOSFET				0.119	K/W
Thermal resistance, case to heat sink	R_{thCH}	per MOSFET, λ_{grease}= 1 W /(m*K), λ_{grease} = 1 W/(m·K)			0.0380		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°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 Notes AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.

$T_{vj,op}$ > 150 °C is allowed for operation at overload conditions for MOSFET and body diode. For detailed specifications, please refer to AN 2021-13.

3 Body diode (MOSFET, T1 / T2)

Table 6 Maximum rated values

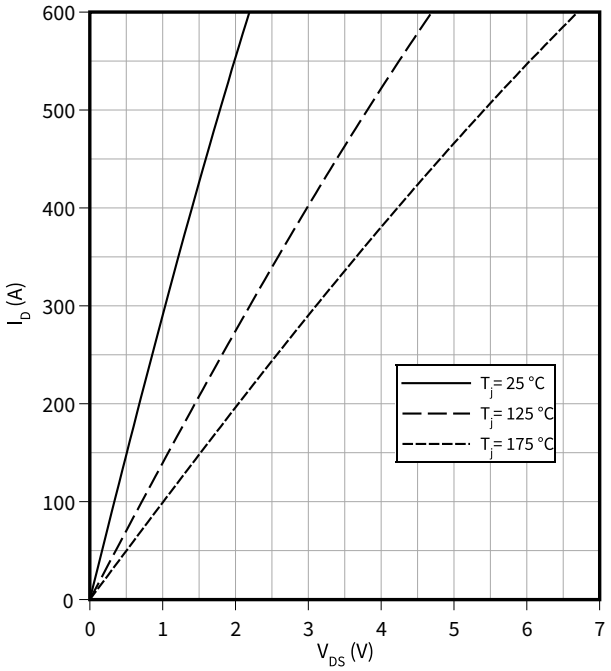
Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	T_{vj} = 175 °C, V_{GS} = -3 V	T_C = 25 °C	235	A

Table 7 Characteristic values

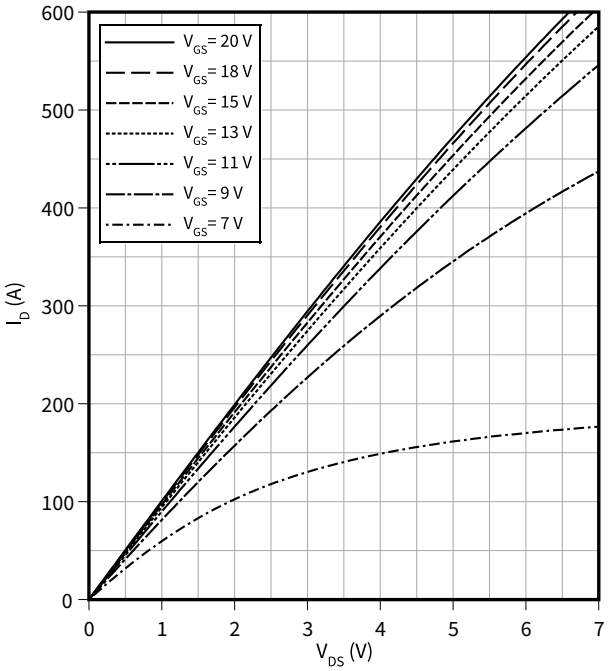
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 300 A, V_{GS} = -3 V	T_{vj} = 25 °C		4.6	6.15	V
			T_{vj} = 125 °C		4.15		
			T_{vj} = 175 °C		4		

4 Characteristics diagrams

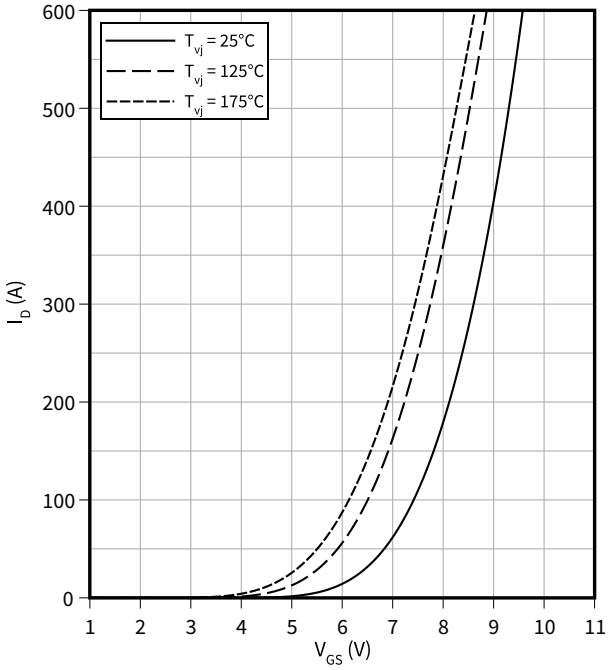
Output characteristic (typical), MOSFET, T1 / T2
$I_D = f(V_{DS})$
$V_{GS} = 18$ V



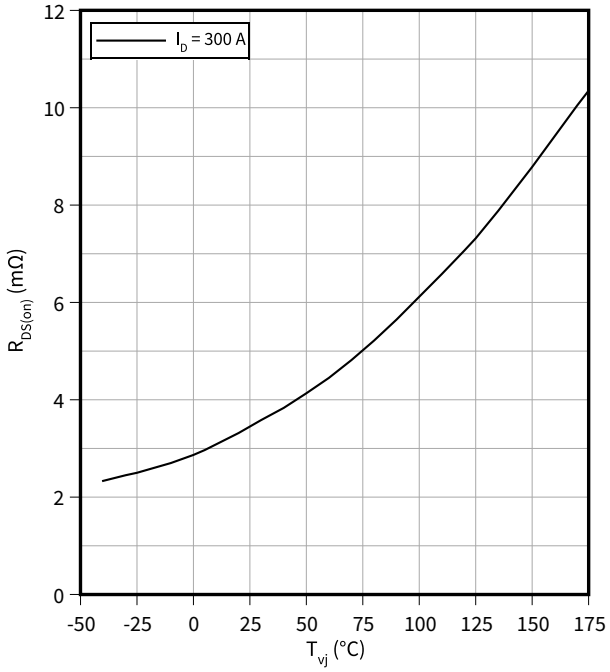
Output characteristic field (typical), MOSFET, T1 / T2
$I_D = f(V_{DS})$
$T_{vj} = 175$ °C



Transfer characteristic (typical), MOSFET, T1 / T2
$I_D = f(V_{GS})$
$V_{DS} = 20$ V

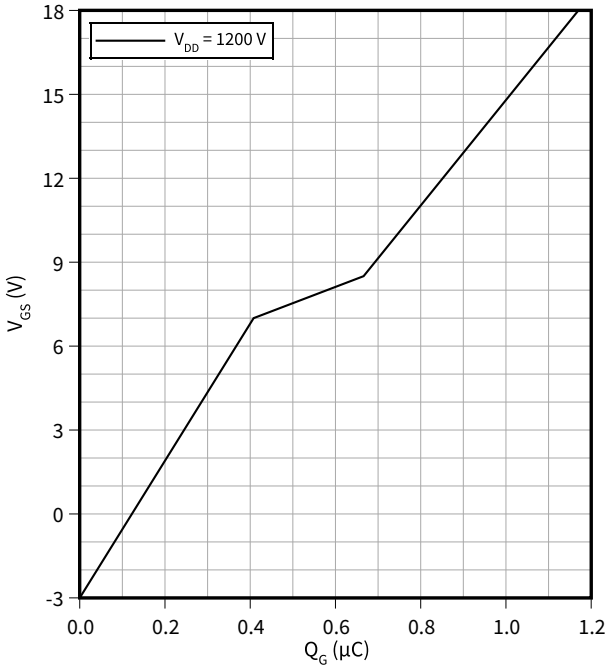


Drain source on-resistance (typical), MOSFET, T1 / T2
$R_{DS(on)} = f(T_{vj})$
$V_{GS} = 18$ V



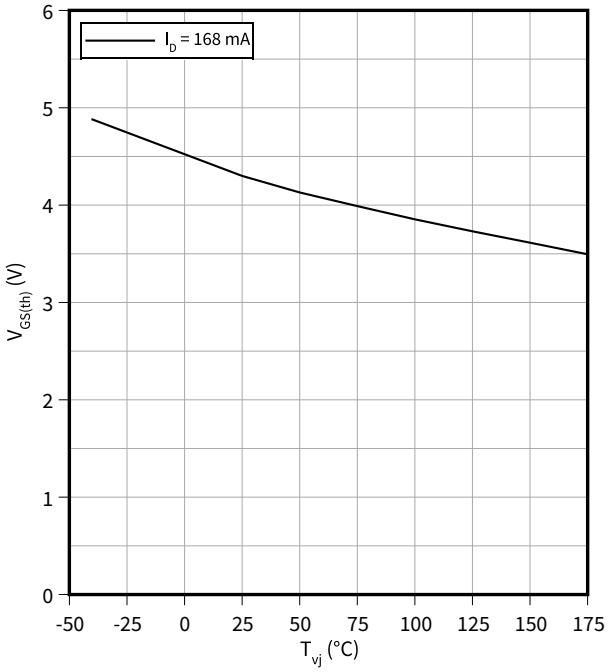
Gate charge characteristic (typical), MOSFET, T1 / T2

$V_{GS} = f(Q_G)$
$I_D = 300\ A$, $T_{vj} = 25\ °C$



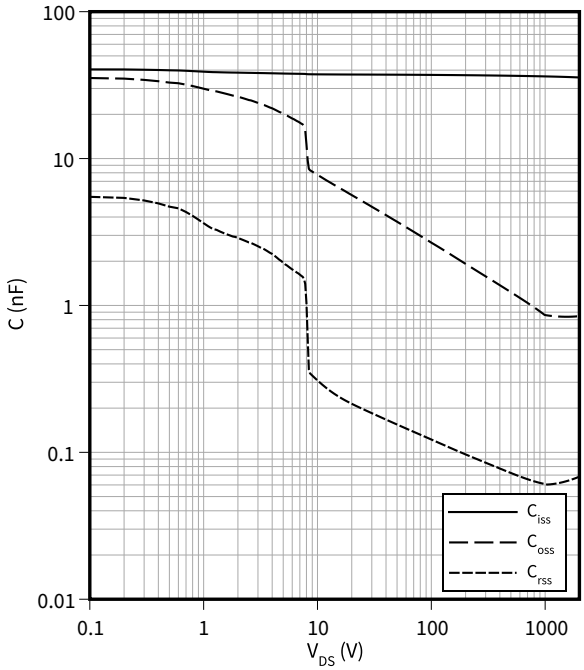
Gate-source threshold voltage (typical), MOSFET, T1 / T2

$V_{GS(th)} = f(T_{vj})$
$V_{GS} = V_{DS}$



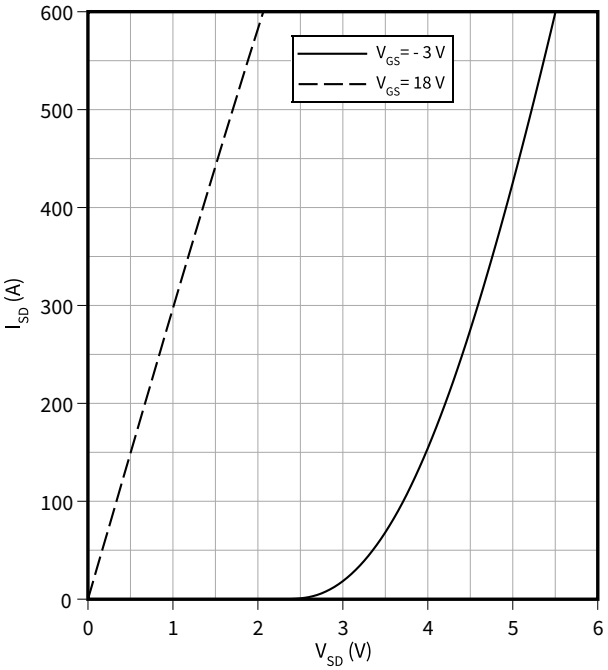
Capacity characteristic (typical), MOSFET, T1 / T2

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



Forward characteristic body diode (typical), MOSFET, T1 / T2

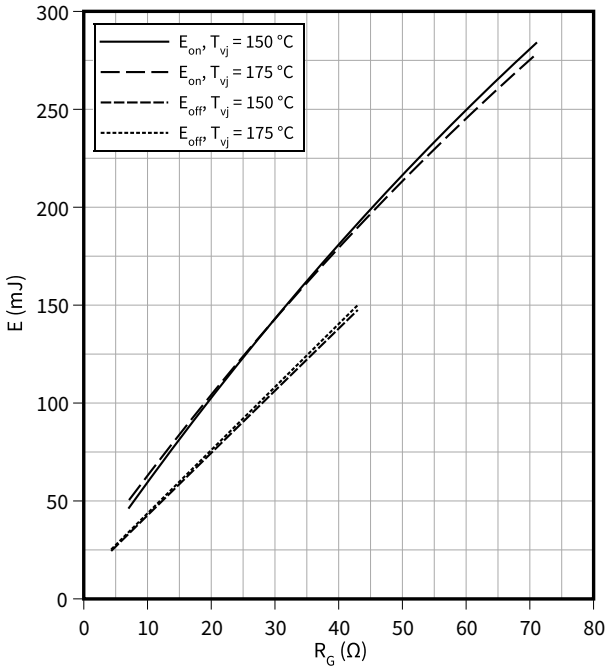
$I_{SD} = f(V_{SD})$
$T_{vj} = 25\ °C$



Switching losses (typical), MOSFET, T1 / T2

$E = f(R_G)$

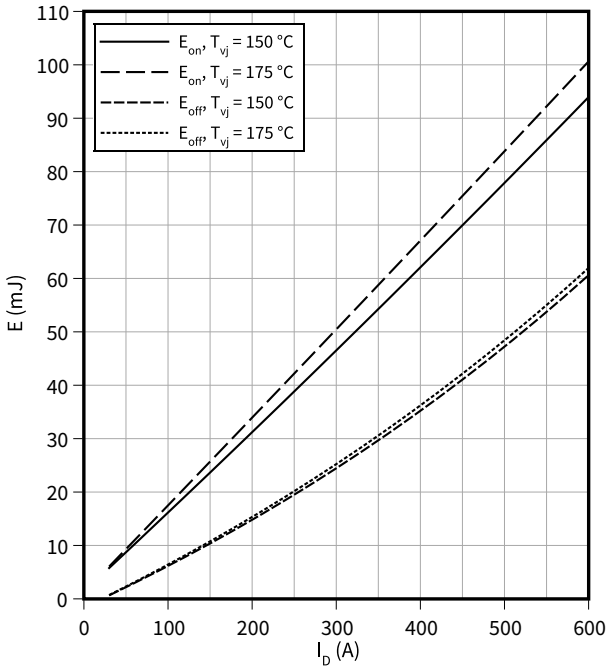
V_{DD} = 1200 V, I_D = 300 A, V_{GS} = -3/18 V



Switching losses (typical), MOSFET, T1 / T2

$E = f(I_D)$

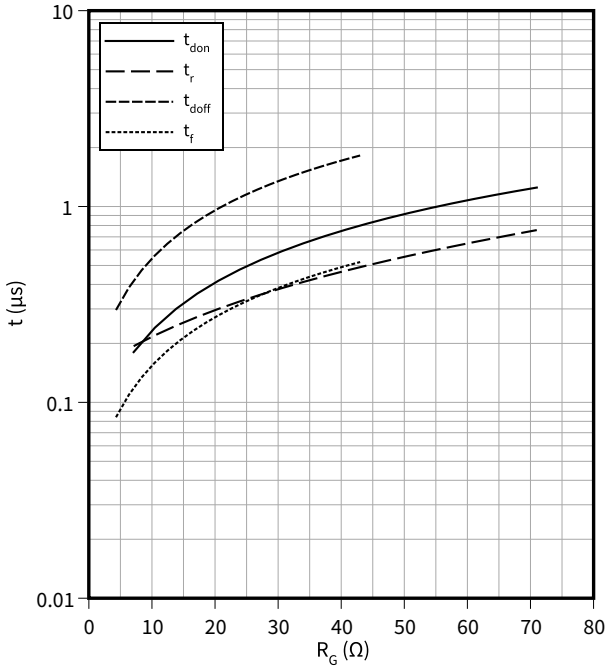
R_{Goff} = 4.3 Ω, R_{Gon} = 7.1 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V



Switching times (typical), MOSFET, T1 / T2

$t = f(R_G)$

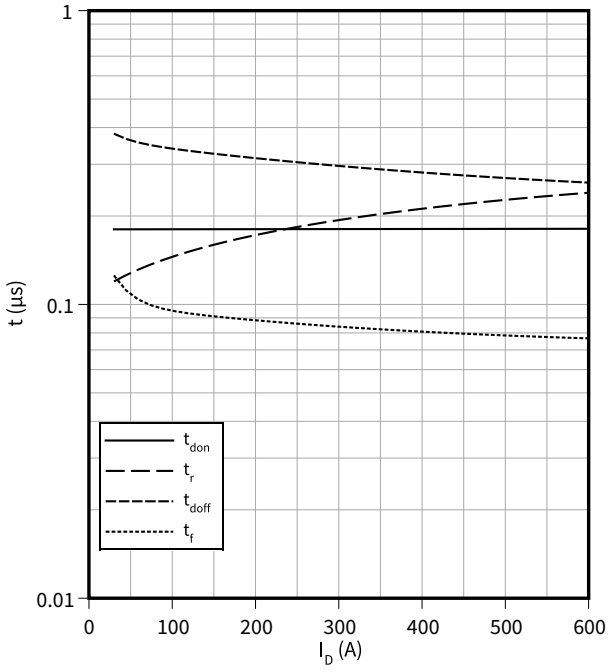
V_{DD} = 1200 V, I_D = 300 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



Switching times (typical), MOSFET, T1 / T2

$t = f(I_D)$

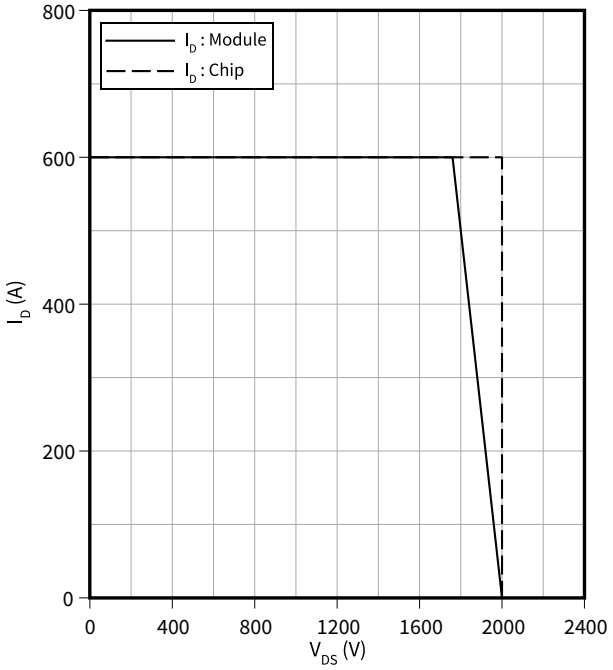
R_{Goff} = 4.3 Ω, R_{Gon} = 7.1 Ω, V_{DD} = 1200 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



Reverse bias safe operating area (RBSOA), MOSFET, T1 / T2

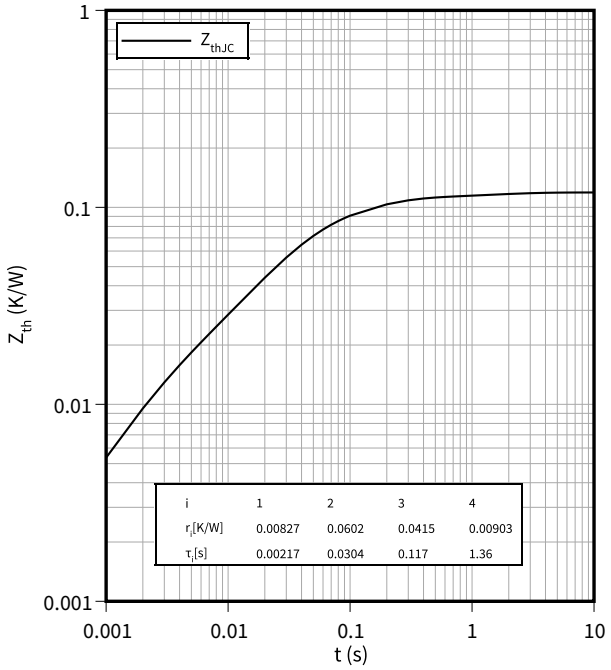
$I_D = f(V_{DS})$

$R_{Goff} = 4.3\ \Omega$, $T_{vj} = 175\ °C$, $V_{GS} = -3/18\ V$



Transient thermal impedance , MOSFET, T1 / T2

$Z_{th} = f(t)$



5 Circuit diagram

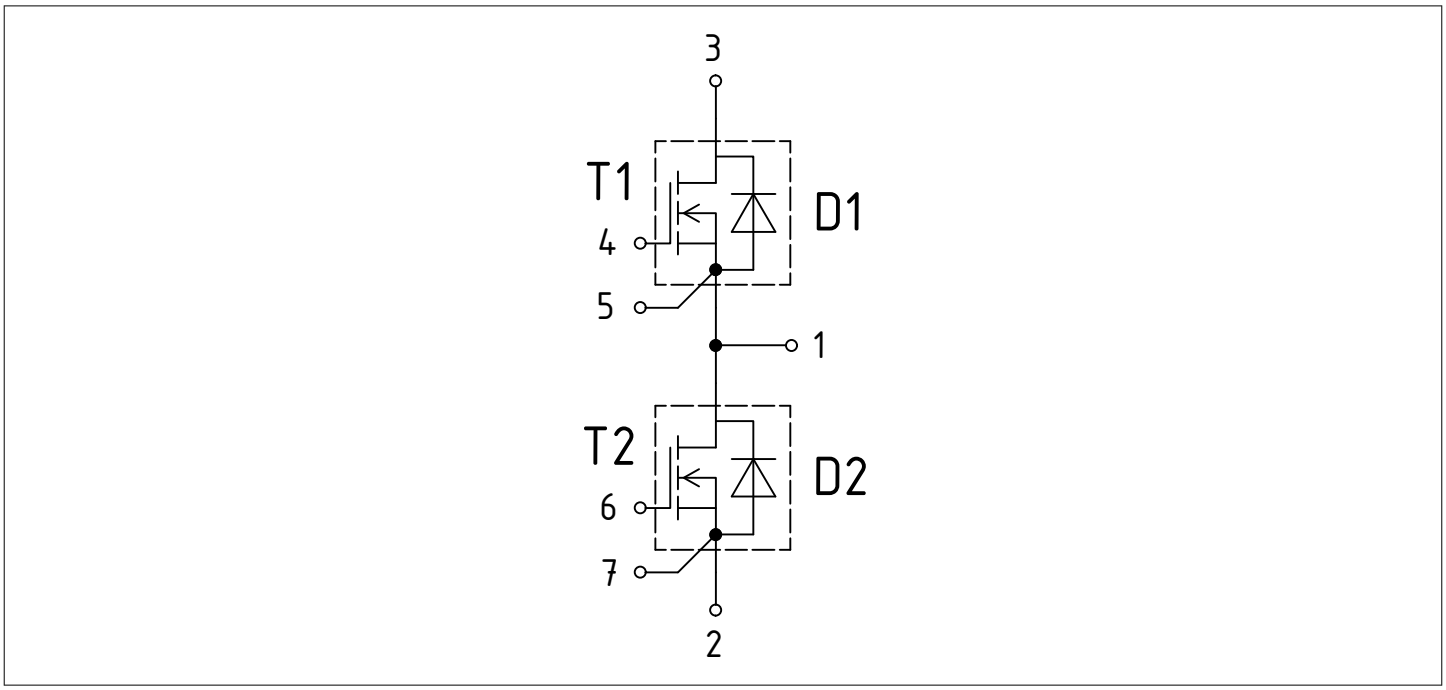


Figure 1

6 Package outlines

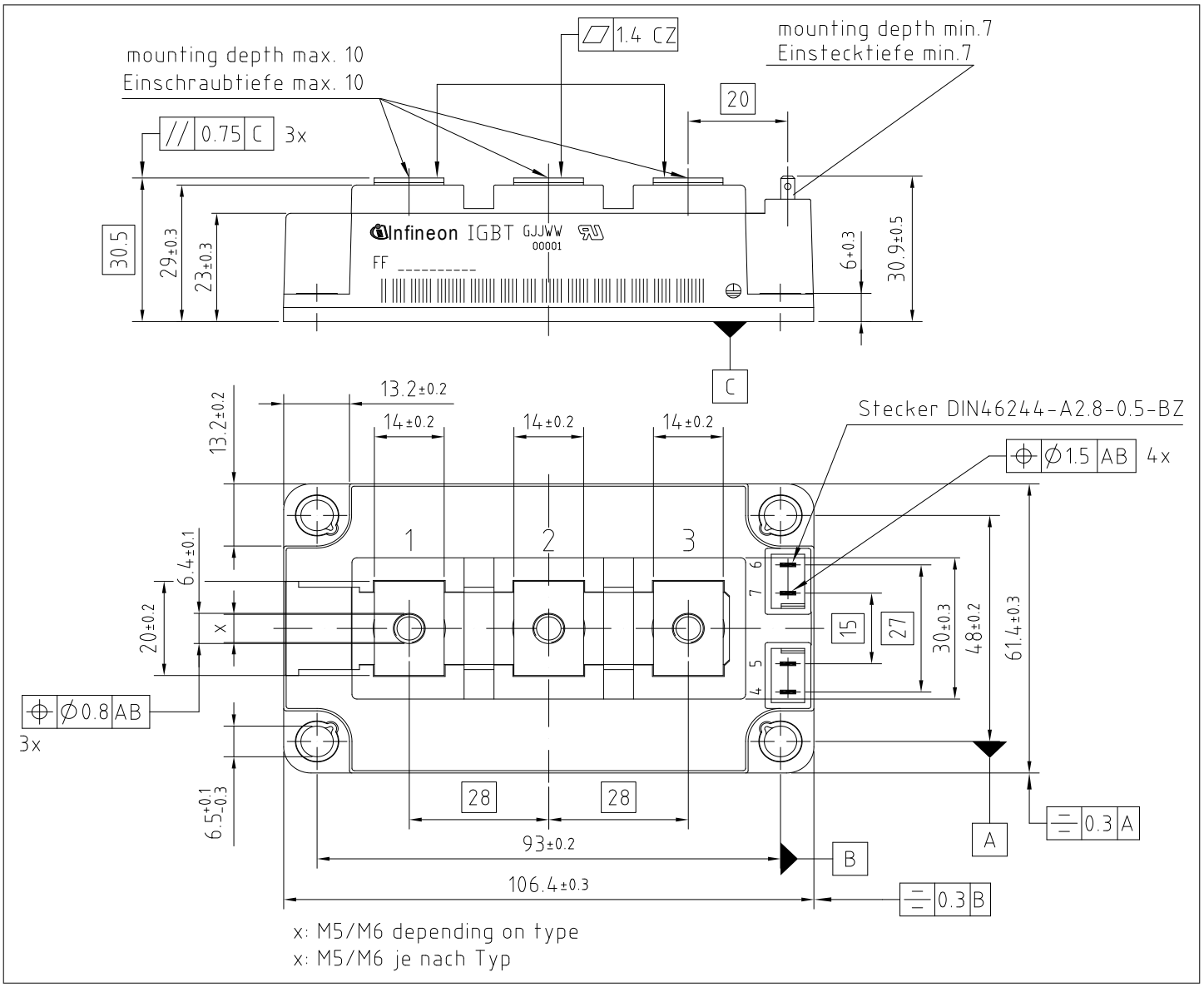


Figure 2

7 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	71549142846550549911530		71549142846550549911530

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2021-06-28	Initial version
0.20	2022-11-09	Target datasheet
1.00	2022-12-22	Final datasheet

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