

Preliminary datasheet

62 mm C-Series module with CoolSiC™ Trench MOSFET and pre-applied thermal interface material

Features

- Electrical features
 - $V_{DS} = 1200\text{ V}$
 - $I_{DN} = 420\text{ A}$ / $I_{DRM} = 840\text{ A}$
 - High current density
 - Low switching losses
- Mechanical features
 - 4 kV AC 1 min insulation
 - Pre-applied thermal interface material

Potential applications

- UPS systems
- Solar applications
- DC/DC converter
- High-frequency switching application
- Energy storage systems
- DC charger for EV

Product validation

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

Description

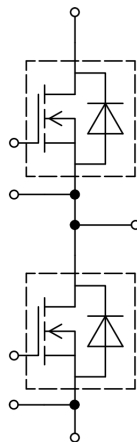


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 60 \text{ s}$	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	$R_{CC'+EE'}$	$T_H = 25\text{ }^{\circ}\text{C}$, per switch			0.475		mΩ
Storage temperature	T_{stg}			-40		125	°C
Maximum baseplate operation temperature	T_{BPmax}					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

Note: Storage and shipment of modules with TIM => see AN2012-07.

2 MOSFET

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Drain-source voltage	V_{DSS}	$T_{vj} = 25 \text{ °C}$	1200	V
Implemented drain current	I_{DN}		420	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Continuous DC drain current	I_{DDC}	$T_{\text{vj}} = 175\text{ °C}$, $V_{\text{GS}} = 18\text{ V}$	$T_{\text{H}} = 65\text{ °C}$	350	A
Repetitive peak drain current	I_{DRM}	verified by design, t_{p} limited by T_{vjmax}		840	A
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	$V_{\text{GS(on)}}$		15...18	V
Off-state gate voltage	$V_{\text{GS(off)}}$		-5...0	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{\text{DS(on)}}$	$I_{\text{D}} = 420\text{ A}$	$V_{\text{GS}} = 18\text{ V}$, $T_{\text{vj}} = 25\text{ °C}$		1.96		mΩ
			$V_{\text{GS}} = 18\text{ V}$, $T_{\text{vj}} = 125\text{ °C}$		3.17		
			$V_{\text{GS}} = 18\text{ V}$, $T_{\text{vj}} = 175\text{ °C}$		4.21		
			$V_{\text{GS}} = 15\text{ V}$, $T_{\text{vj}} = 25\text{ °C}$		2.36		
Gate threshold voltage	$V_{\text{GS(th)}}$	$I_{\text{D}} = 168\text{ mA}$, $V_{\text{DS}} = V_{\text{GS}}$, $T_{\text{vj}} = 25\text{ °C}$, (tested after 1ms pulse at $V_{\text{GS}} = +20\text{ V}$)		3.45	4.3	5.15	V
Total gate charge	Q_{G}	$V_{\text{DD}} = 800\text{ V}$, $V_{\text{GS}} = -3/18\text{ V}$			1.2		μC
Internal gate resistor	R_{Gint}	$T_{\text{vj}} = 25\text{ °C}$			1.3		Ω
Input capacitance	C_{ISS}	$f = 100\text{ kHz}$, $V_{\text{DS}} = 800\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	$T_{\text{vj}} = 25\text{ °C}$		36.3		nF
Output capacitance	C_{OSS}	$f = 100\text{ kHz}$, $V_{\text{DS}} = 800\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	$T_{\text{vj}} = 25\text{ °C}$		1.8		nF
Reverse transfer capacitance	C_{rss}	$f = 100\text{ kHz}$, $V_{\text{DS}} = 800\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	$T_{\text{vj}} = 25\text{ °C}$		0.118		nF
C_{OSS} stored energy	E_{OSS}	$V_{\text{DS}} = 800\text{ V}$, $V_{\text{GS}} = -3/18\text{ V}$, $T_{\text{vj}} = 25\text{ °C}$			709		μJ
Drain-source leakage current	I_{DSS}	$V_{\text{DS}} = 1200\text{ V}$, $V_{\text{GS}} = -3\text{ V}$	$T_{\text{vj}} = 25\text{ °C}$		0.24	527	μA

(table continues...)

Table 5 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Gate-source leakage current	I_{GSS}	$V_{DS} = 0 \text{ V}$, $T_{vj} = 25 \text{ }^{\circ}\text{C}$	$V_{GS} = 20 \text{ V}$			400	nA
Turn-on delay time (inductive load)	t_{don}	$I_D = 420 \text{ A}$, $R_{Gon} = 4.7 \text{ } \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		143		ns
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		132		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		130		
Rise time (inductive load)	t_r	$I_D = 420 \text{ A}$, $R_{Gon} = 4.7 \text{ } \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		153		ns
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		142		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		127		
Turn-off delay time (inductive load)	t_{doff}	$I_D = 420 \text{ A}$, $R_{Goff} = 1.5 \text{ } \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		150		ns
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		162		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		169		
Fall time (inductive load)	t_f	$I_D = 420 \text{ A}$, $R_{Goff} = 1.5 \text{ } \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		33		ns
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		33		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		34		
Turn-on energy loss per pulse	E_{on}	$I_D = 420 \text{ A}$, $V_{DD} = 600 \text{ V}$, $L_{\sigma} = 10 \text{ nH}$, $V_{GS} = -3/18 \text{ V}$, $R_{Gon} = 4.7 \text{ } \Omega$, $di/dt = 5.2 \text{ kA}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^{\circ}\text{C}$)	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		17.2		mJ
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		16.8		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		17.2		
Turn-off energy loss per pulse	E_{off}	$I_D = 420 \text{ A}$, $V_{DD} = 600 \text{ V}$, $L_{\sigma} = 10 \text{ nH}$, $V_{GS} = -3/18 \text{ V}$, $R_{Goff} = 1.5 \text{ } \Omega$, $dv/dt = 14.2 \text{ kV}/\mu\text{s}$ ($T_{vj} = 175 \text{ }^{\circ}\text{C}$)	$T_{vj} = 25 \text{ }^{\circ}\text{C}$		7.5		mJ
			$T_{vj} = 125 \text{ }^{\circ}\text{C}$		8		
			$T_{vj} = 175 \text{ }^{\circ}\text{C}$		8.4		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, Valid with IFX pre-applied Thermal Interface Material				0.14	K/W
Temperature under switching conditions	$T_{vj\text{ op}}$			-40		175	$^{\circ}\text{C}$

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.

$T_{vj,op} > 150^{\circ}\text{C}$ 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)

Table 6 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	$T_{vj} = 175\text{ °C}$, $V_{GS} = -3\text{ V}$	$T_H = 65\text{ °C}$	190	A

Table 7 Characteristic values

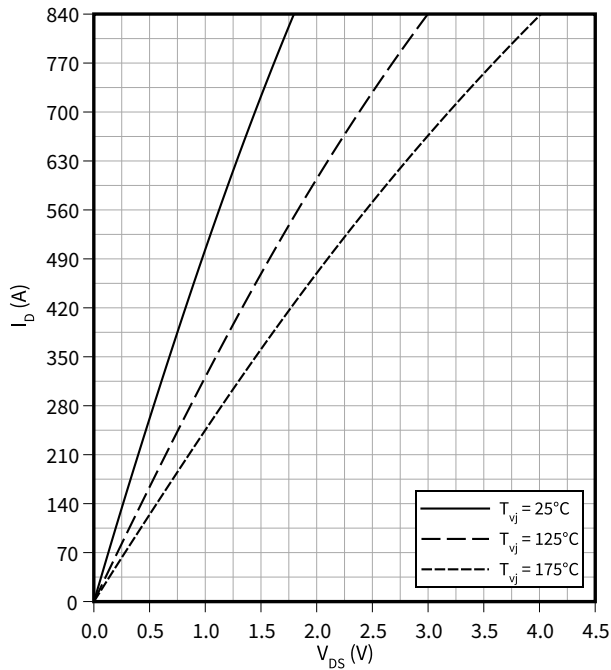
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	$I_{SD} = 420\text{ A}$, $V_{GS} = -3\text{ V}$	$T_{vj} = 25\text{ °C}$		4.22	5.59	V
			$T_{vj} = 125\text{ °C}$		3.95		
			$T_{vj} = 175\text{ °C}$		3.85		

4 Characteristics diagrams

Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

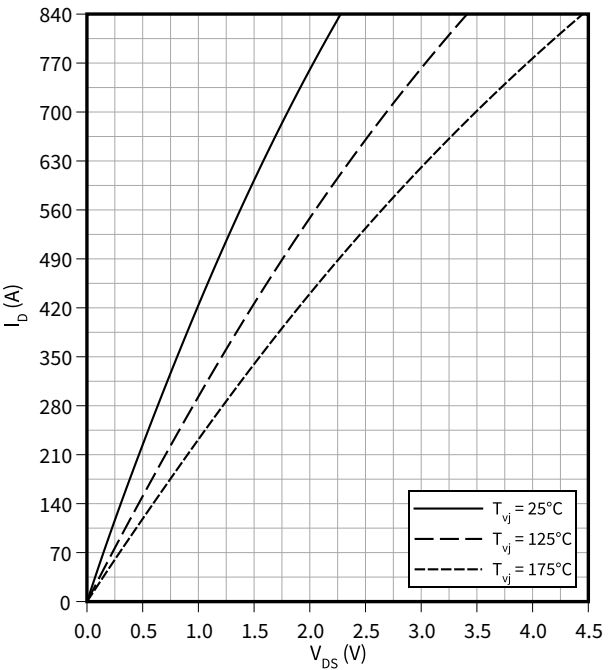
$V_{GS} = 18\text{ V}$



Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

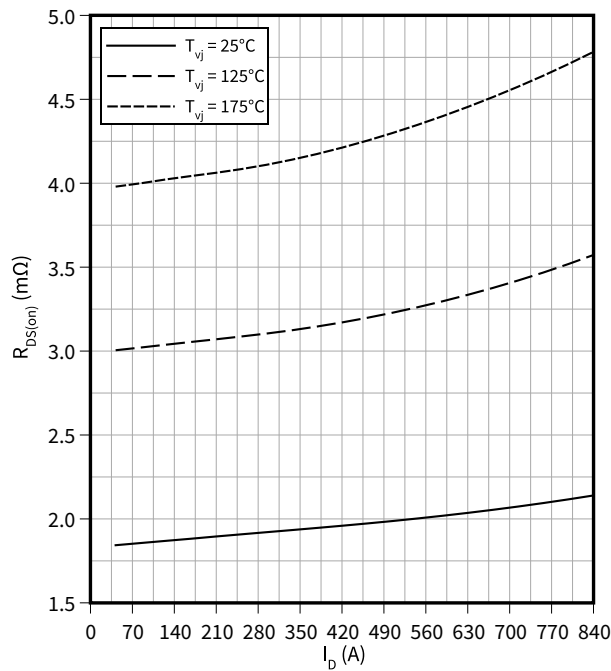
$V_{GS} = 15\text{ V}$



Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(I_D)$

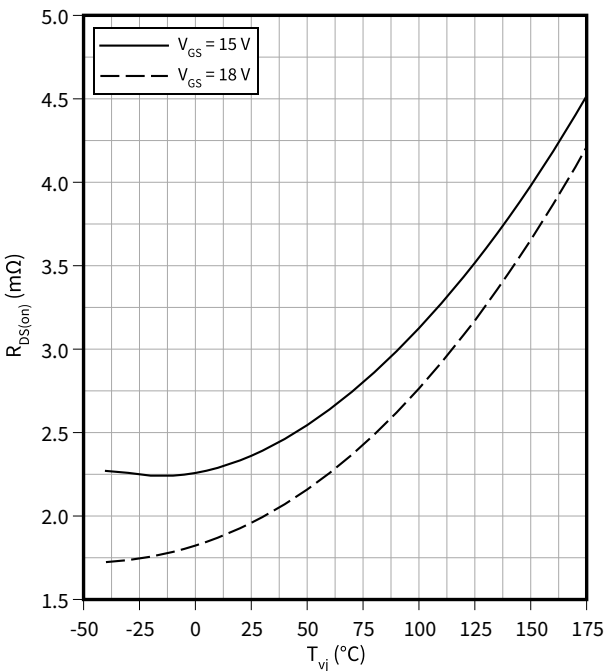
$V_{GS} = 18\text{ V}$



Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(T_{vj})$

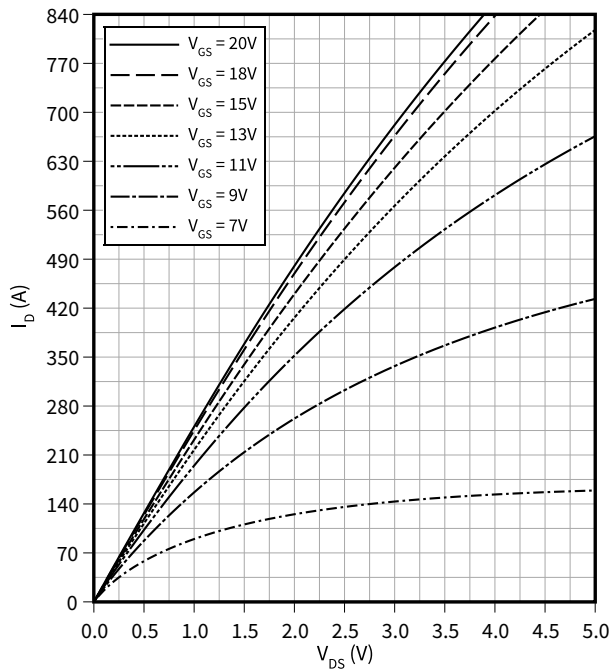
$I_D = 420\text{ A}$



4 Characteristics diagrams

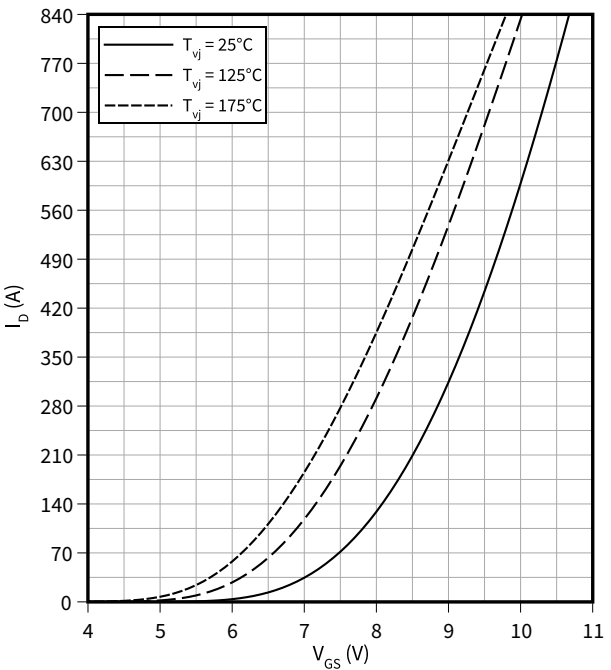
Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$
 $T_{vj} = 175\text{ }^{\circ}\text{C}$



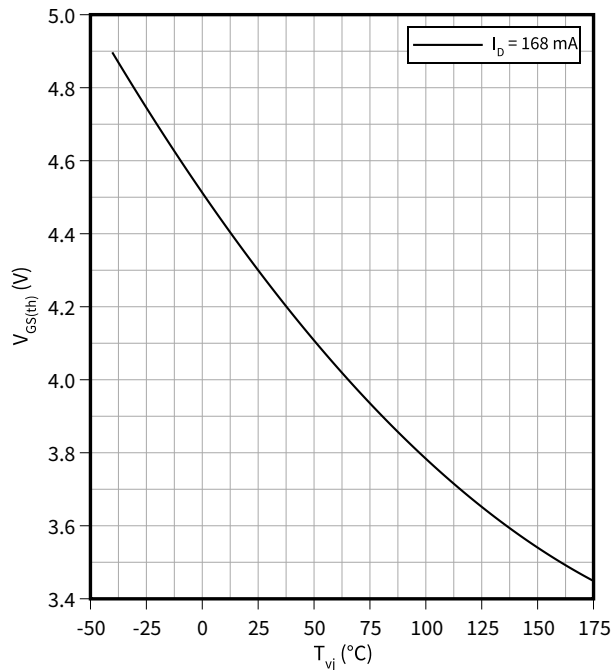
Transfer characteristic (typical), MOSFET

$I_D = f(V_{GS})$
 $V_{DS} = 20\text{ V}$



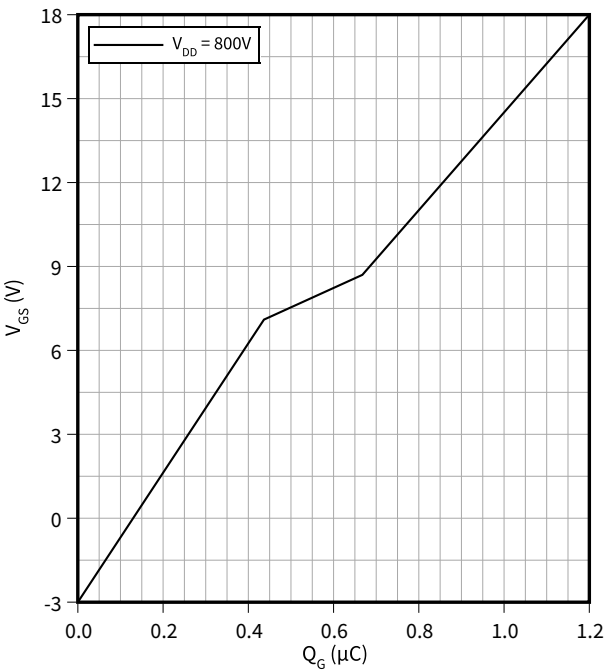
Gate-source threshold voltage (typical), MOSFET

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



Gate charge characteristic (typical), MOSFET

$V_{GS} = f(Q_G)$
 $I_D = 420\text{ A}, T_{vj} = 25\text{ }^{\circ}\text{C}$

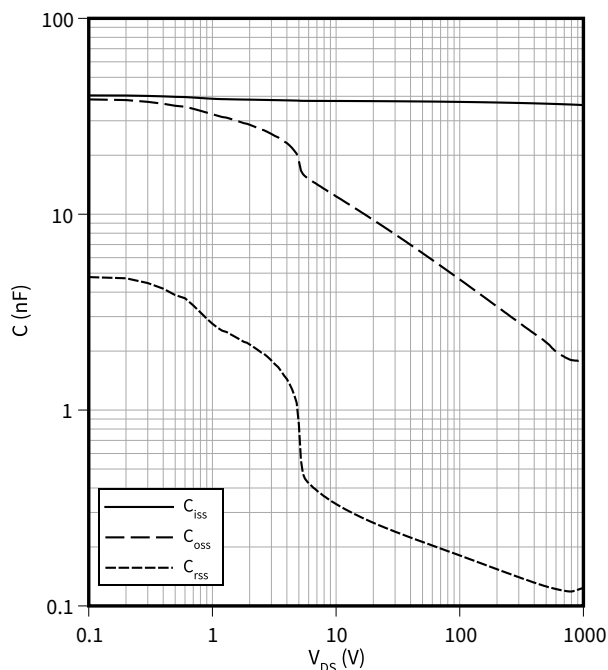


4 Characteristics diagrams

Capacity characteristic (typical), MOSFET

$$C = f(V_{DS})$$

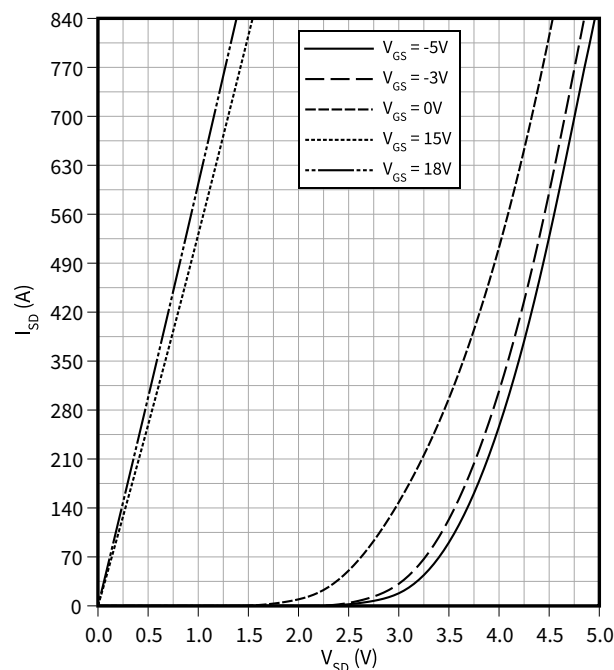
$f = 100 \text{ kHz}$, $T_{vj} = 25^\circ\text{C}$, $V_{GS} = 0 \text{ V}$



Forward characteristic body diode (typical), MOSFET

$$I_{SD} = f(V_{SD})$$

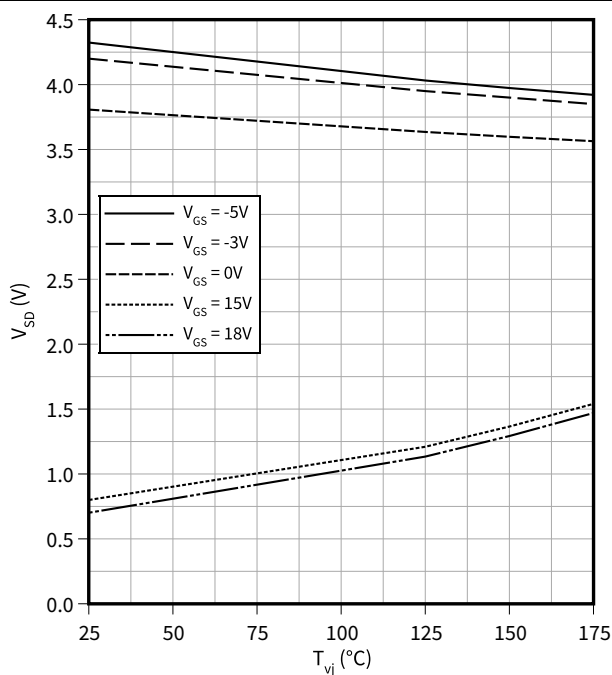
$T_{vj} = 25^\circ\text{C}$



Forward voltage of body diode (typical), MOSFET

$$V_{SD} = f(T_{vj})$$

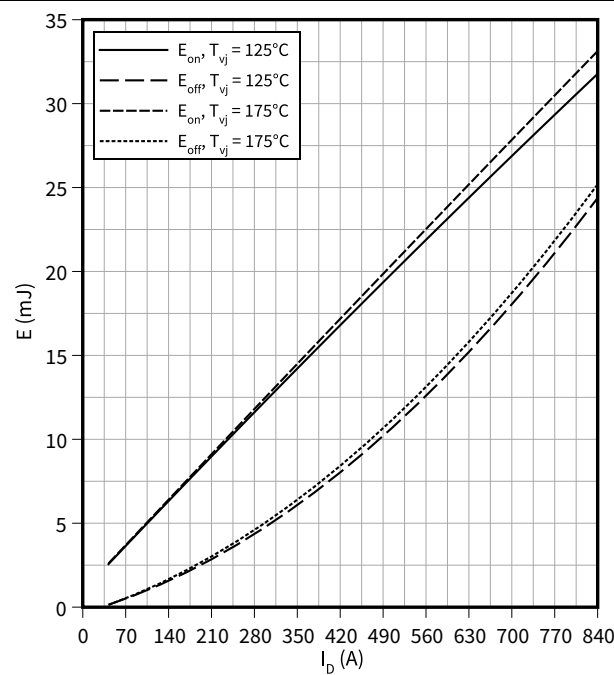
$I_{SD} = 420 \text{ A}$



Switching losses (typical), MOSFET

$$E = f(I_D)$$

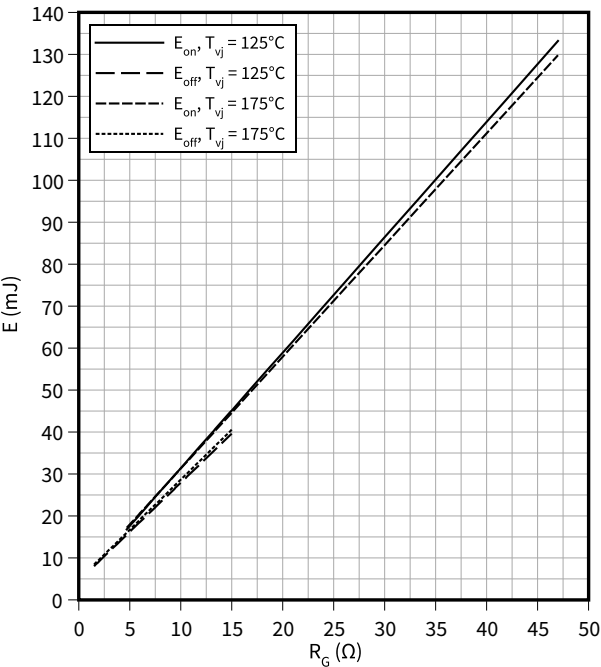
$R_{Goff} = 1.5 \Omega$, $R_{Gon} = 4.7 \Omega$, $V_{DD} = 600 \text{ V}$, $V_{GS} = -3/18 \text{ V}$



4 Characteristics diagrams

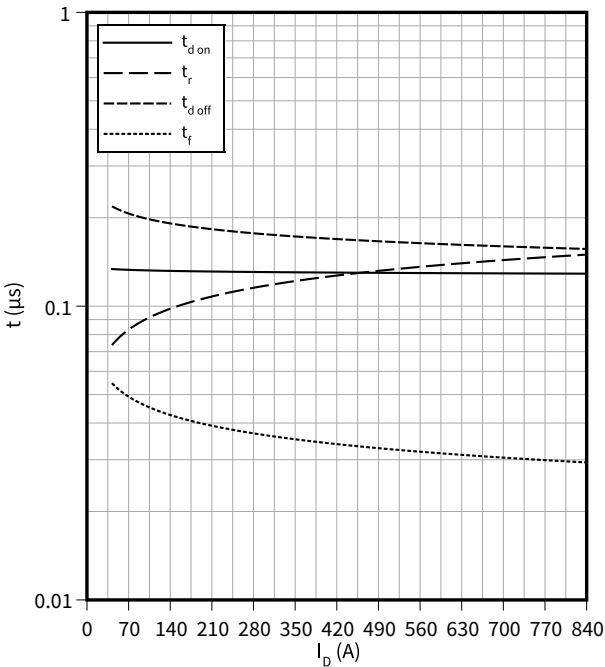
Switching losses (typical), MOSFET

$E = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 420\text{ A}$, $V_{GS} = -3/18\text{ V}$



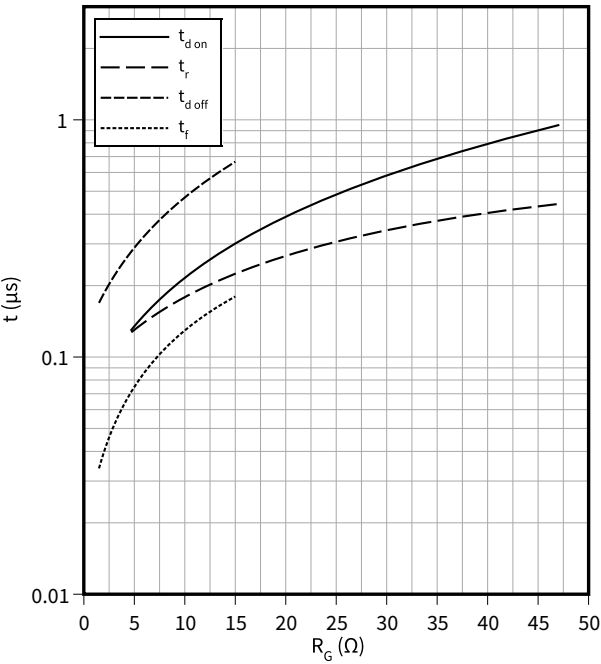
Switching times (typical), MOSFET

$t = f(I_D)$
 $R_{Goff} = 1.5\text{ }\Omega$, $R_{Gon} = 4.7\text{ }\Omega$, $V_{DD} = 600\text{ V}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



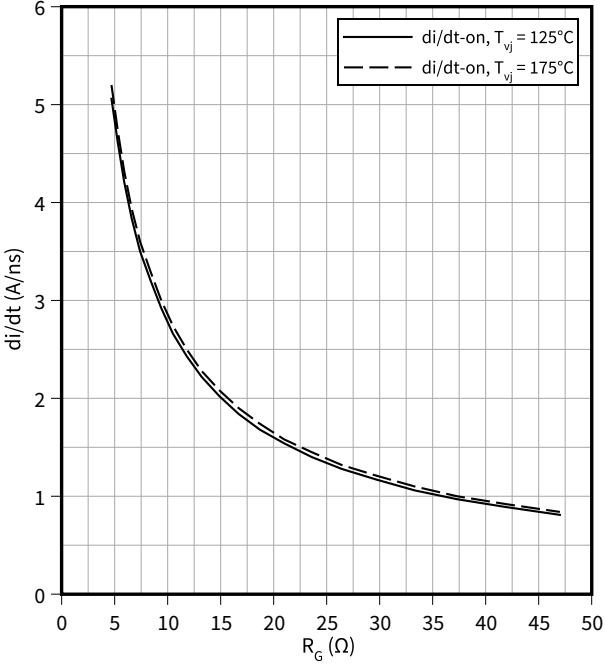
Switching times (typical), MOSFET

$t = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 420\text{ A}$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



Current slope (typical), MOSFET

$di/dt = f(R_G)$
 $V_{DD} = 600\text{ V}$, $I_D = 420\text{ A}$, $V_{GS} = -3/18\text{ V}$

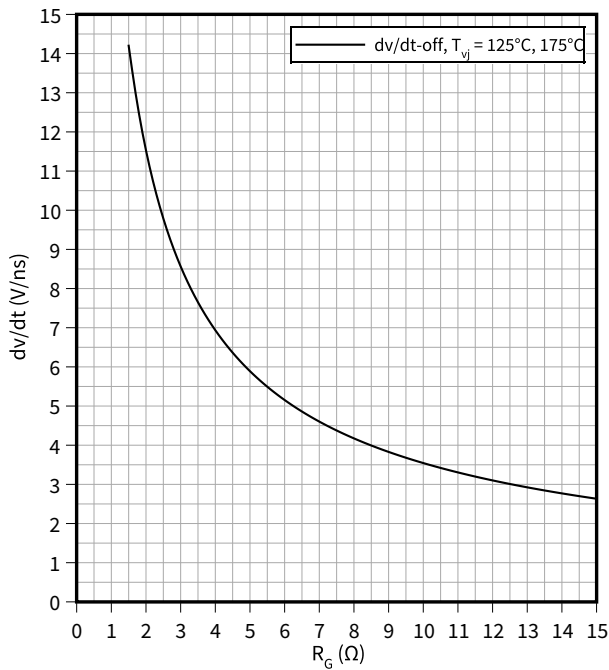


4 Characteristics diagrams

Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$

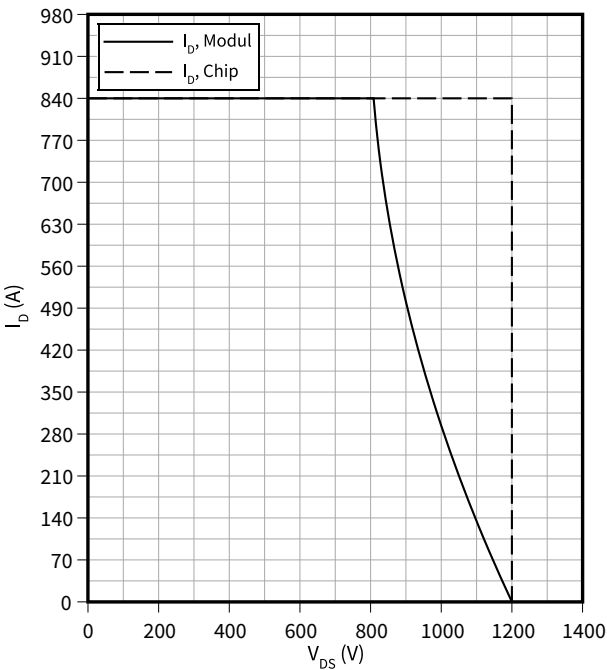
$V_{DD} = 600\text{ V}$, $I_D = 420\text{ A}$, $V_{GS} = -3/18\text{ V}$



Reverse bias safe operating area (RBSOA), MOSFET

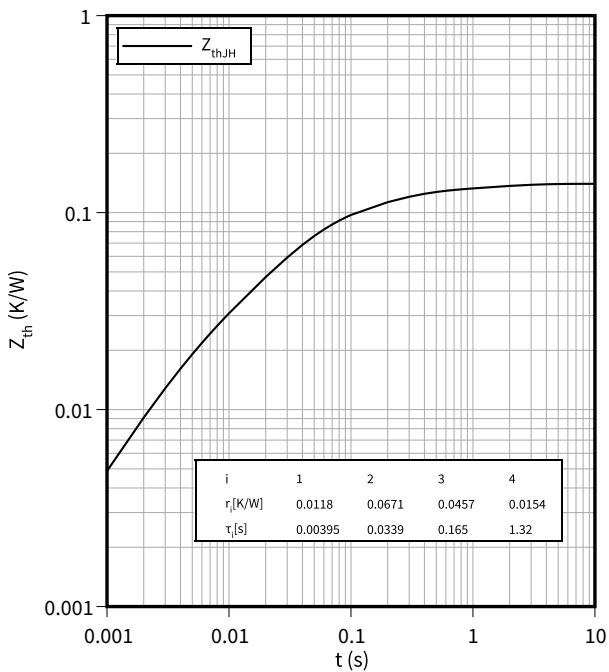
$I_D = f(V_{DS})$

$R_{Goff} = 1.5\text{ }\Omega$, $T_{vj} = 175\text{ }^\circ\text{C}$, $V_{GS} = -3/18\text{ V}$



Transient thermal impedance, MOSFET

$Z_{th} = f(t)$



5 **Circuit diagram**

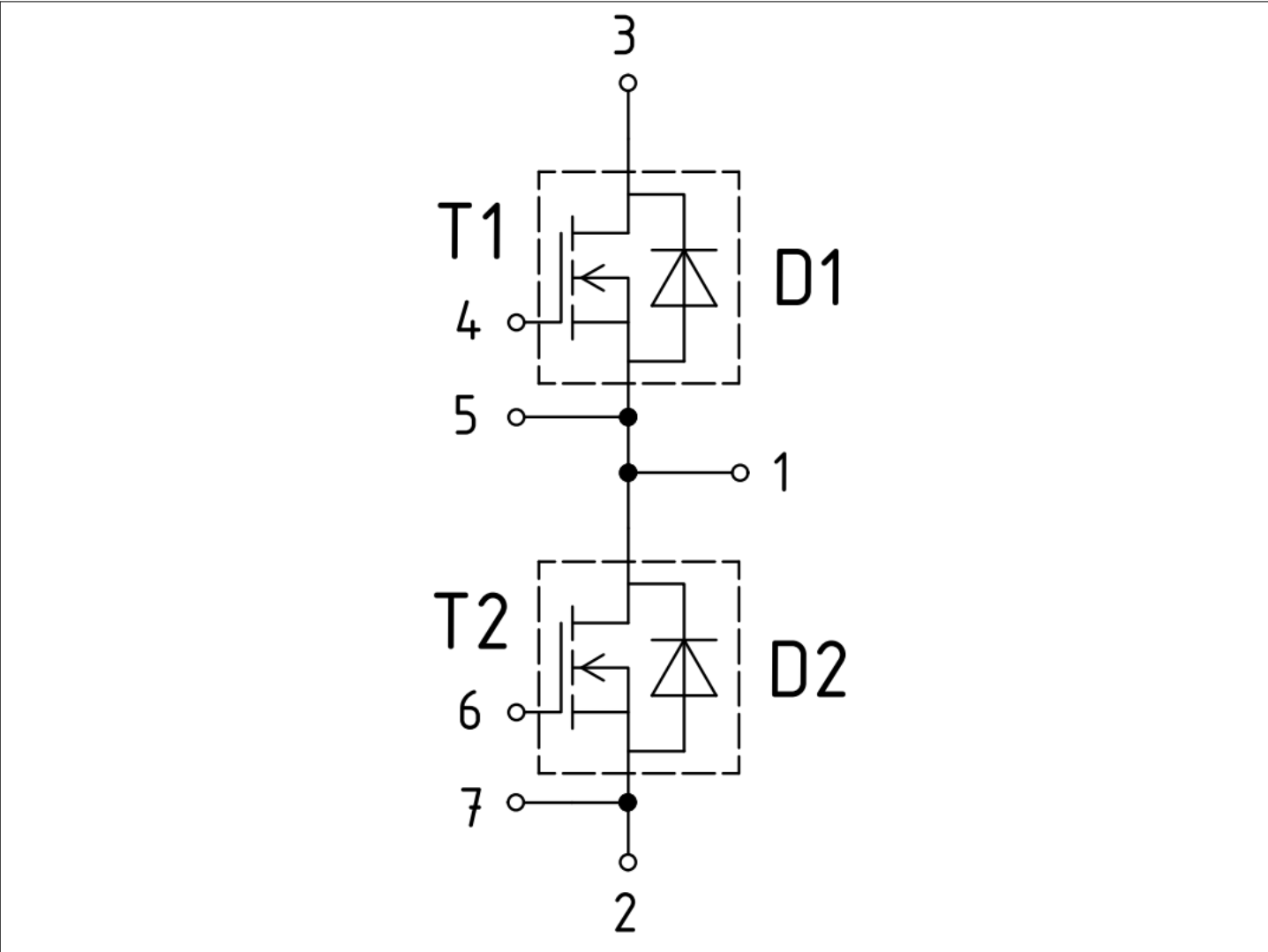


Figure 1

6 Package outlines

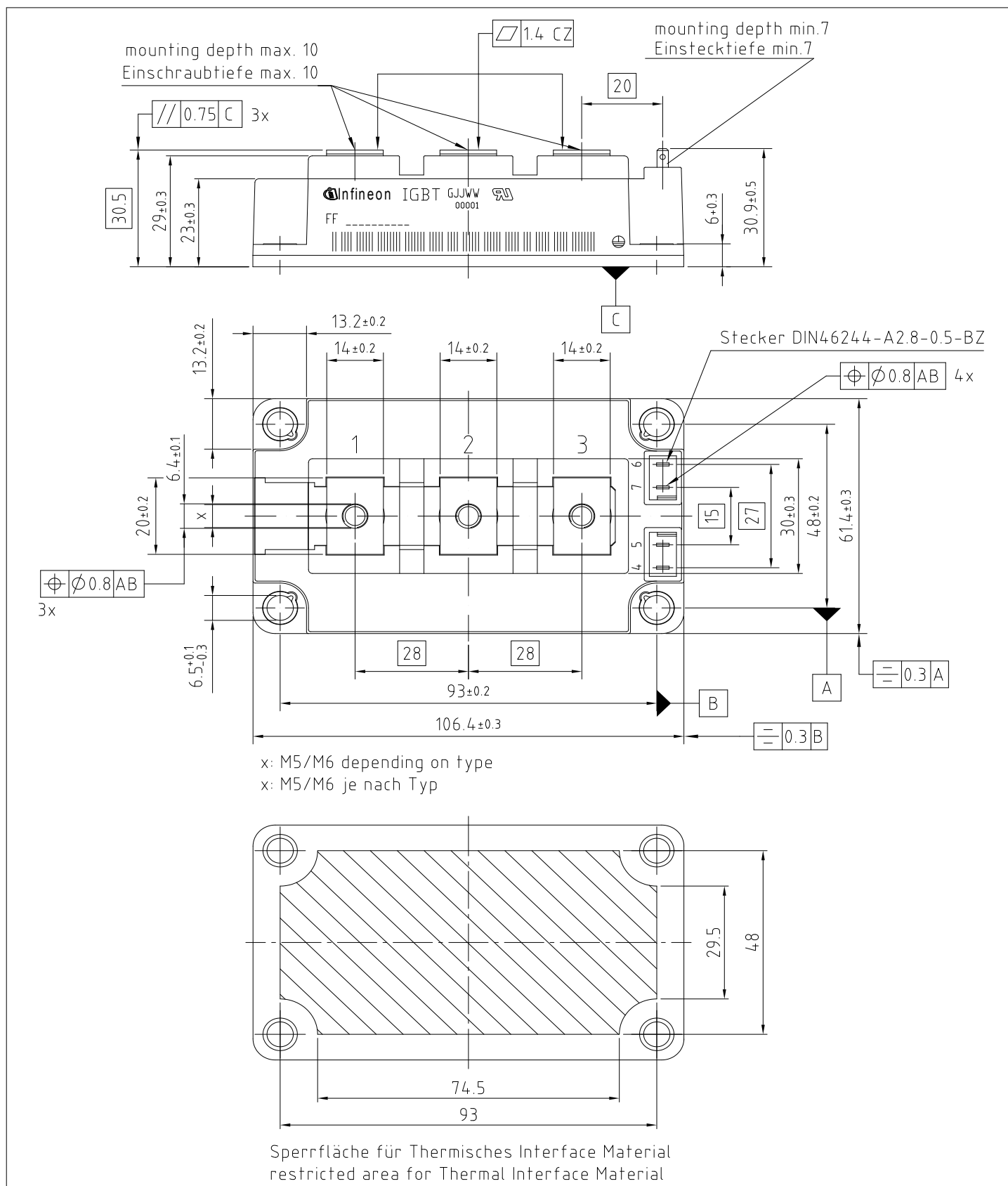


Figure 2

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	Digit	Example
	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	 7154914284655054991153071549142846550549911530		

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2023-01-20	Initial version
0.20	2023-03-03	Preliminary datasheet

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Edition 2023-03-03

Published by

Infineon Technologies AG
81726 Munich, Germany

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Document reference
IFX-ABG202-002

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