

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

### Features

- Electrical features
  - $V_{DS} = 2000\text{ V}$
  - $I_{DN} = 300\text{ A} / I_{DRM} = 600\text{ A}$
  - Low switching losses
  - High current density
- Mechanical features
  - 4 kV AC 1 min insulation
  - Pre-applied thermal interface material



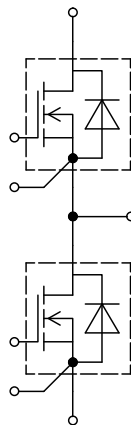
### Potential applications

- 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



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## 1 Package

**Table 1** Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	$V_{ISOL}$	RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$	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	$R_{CC'+EE'}$	$T_C = 25 \text{ °C}$ , 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, T1 / T2

**Table 3** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Drain-source voltage	$V_{DSS}$	$T_{vj} = 25 \text{ °C}$	2000	V
Implemented drain current	$I_{DN}$		300	A

(table continues...)

**Table 3 (continued) Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit
Continuous DC drain current	$I_{\text{DDC}}$	$T_{\text{vj}} = 175\text{ °C}$ , $V_{\text{GS}} = 18\text{ V}$ $T_{\text{H}} = 25\text{ °C}$	245	A
Repetitive peak drain current	$I_{\text{DRM}}$	verified by design, $t_{\text{p}}$ limited by $T_{\text{vjmax}}$	600	A
Gate-source voltage, max. transient voltage	$V_{\text{GS}}$	$D < 0.01$	-10/23	V
Gate-source voltage, max. static voltage	$V_{\text{GS}}$		-7/20	V

**Table 4 Recommended values**

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

**Table 5 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Drain-source on-resistance	$R_{\text{DS(on)}}$	$I_{\text{D}} = 300\text{ A}$	$V_{\text{GS}} = 18\text{ V}$ , $T_{\text{vj}} = 25\text{ °C}$	3.5	5.3	mΩ
			$V_{\text{GS}} = 18\text{ V}$ , $T_{\text{vj}} = 125\text{ °C}$	7.3		
			$V_{\text{GS}} = 18\text{ V}$ , $T_{\text{vj}} = 175\text{ °C}$	10.4		
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	$Q_{\text{G}}$	$V_{\text{DD}} = 1200\text{ V}$ , $V_{\text{GS}} = -3/18\text{ V}$		1.17		μC
Internal gate resistor	$R_{\text{Gint}}$	$T_{\text{vj}} = 25\text{ °C}$		1.2		Ω
Input capacitance	$C_{\text{ISS}}$	$f = 100\text{ kHz}$ , $V_{\text{DS}} = 1200\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$ $T_{\text{vj}} = 25\text{ °C}$		36.1		nF
Output capacitance	$C_{\text{OSS}}$	$f = 100\text{ kHz}$ , $V_{\text{DS}} = 1200\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$ $T_{\text{vj}} = 25\text{ °C}$		0.845		nF
Reverse transfer capacitance	$C_{\text{rSS}}$	$f = 100\text{ kHz}$ , $V_{\text{DS}} = 1200\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$ $T_{\text{vj}} = 25\text{ °C}$		0.061		nF
$C_{\text{OSS}}$ stored energy	$E_{\text{OSS}}$	$V_{\text{DS}} = 1200\text{ V}$ , $V_{\text{GS}} = -3/18\text{ V}$ , $T_{\text{vj}} = 25\text{ °C}$		1520		μJ
Drain-source leakage current	$I_{\text{DSS}}$	$V_{\text{DS}} = 2000\text{ V}$ , $V_{\text{GS}} = -3\text{ V}$ $T_{\text{vj}} = 25\text{ °C}$		0.06	527	μA
Gate-source leakage current	$I_{\text{GSS}}$	$V_{\text{DS}} = 0\text{ V}$ , $T_{\text{vj}} = 25\text{ °C}$ $V_{\text{GS}} = 20\text{ V}$			400	nA

**(table continues...)**

**Table 5** (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on delay time (inductive load)	$t_{d\ on}$	$I_D = 300\ A, R_{Gon} = 7.1\ \Omega, V_{DD} = 1200\ V, V_{GS} = -3/18\ V$	$T_{vj} = 25\ ^\circ C$	204		ns
			$T_{vj} = 125\ ^\circ C$	187		
			$T_{vj} = 175\ ^\circ C$	181		
Rise time (inductive load)	$t_r$	$I_D = 300\ A, R_{Gon} = 7.1\ \Omega, V_{DD} = 1200\ V, V_{GS} = -3/18\ V$	$T_{vj} = 25\ ^\circ C$	219		ns
			$T_{vj} = 125\ ^\circ C$	195		
			$T_{vj} = 175\ ^\circ C$	194		
Turn-off delay time (inductive load)	$t_{d\ off}$	$I_D = 300\ A, R_{Goff} = 4.3\ \Omega, V_{DD} = 1200\ V, V_{GS} = -3/18\ V$	$T_{vj} = 25\ ^\circ C$	256		ns
			$T_{vj} = 125\ ^\circ C$	282		
			$T_{vj} = 175\ ^\circ C$	296		
Fall time (inductive load)	$t_f$	$I_D = 300\ A, R_{Goff} = 4.3\ \Omega, V_{DD} = 1200\ V, V_{GS} = -3/18\ V$	$T_{vj} = 25\ ^\circ C$	80.3		ns
			$T_{vj} = 125\ ^\circ C$	82.1		
			$T_{vj} = 175\ ^\circ C$	84.2		
Turn-on energy loss per pulse	$E_{on}$	$I_D = 300\ A, V_{DD} = 1200\ V, L_\sigma = 25\ nH, V_{GS} = -3/18\ V, R_{Gon} = 7.1\ \Omega, di/dt = 3.4\ kA/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	45.5		mJ
			$T_{vj} = 125\ ^\circ C$	46.5		
			$T_{vj} = 175\ ^\circ C$	50.5		
Turn-off energy loss per pulse	$E_{off}$	$I_D = 300\ A, V_{DD} = 1200\ V, L_\sigma = 25\ nH, V_{GS} = -3/18\ V, R_{Goff} = 4.3\ \Omega, dv/dt = 11.4\ kV/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	23.7		mJ
			$T_{vj} = 125\ ^\circ C$	24.5		
			$T_{vj} = 175\ ^\circ C$	25.2		
Thermal resistance, junction to heat sink	$R_{thJH}$	per MOSFET, Valid with IFX pre-applied Thermal Interface Material			0.153	K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	$^\circ C$

*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.

$T_{vj,op} > 150\ ^\circ C$  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	$I_{SD}$	$T_{vj} = 175\ ^\circ C, V_{GS} = -3\ V$ $T_H = 25\ ^\circ C$	180	A

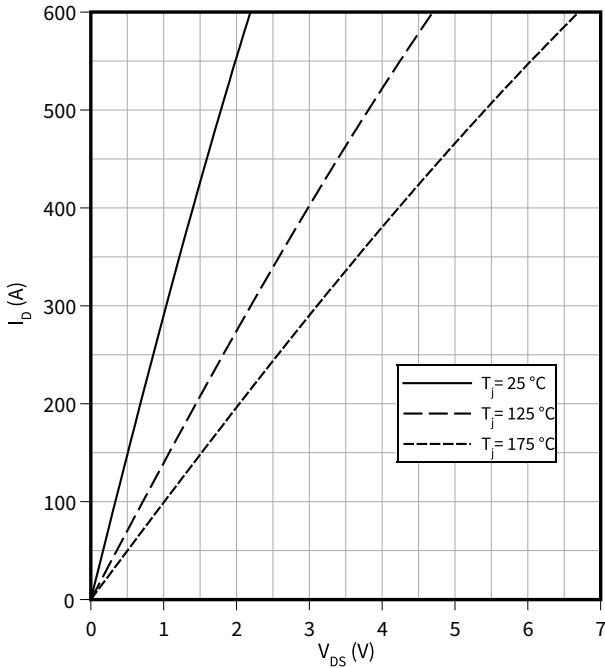
**Table 7**                    **Characteristic values**

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

## 4 Characteristics diagrams

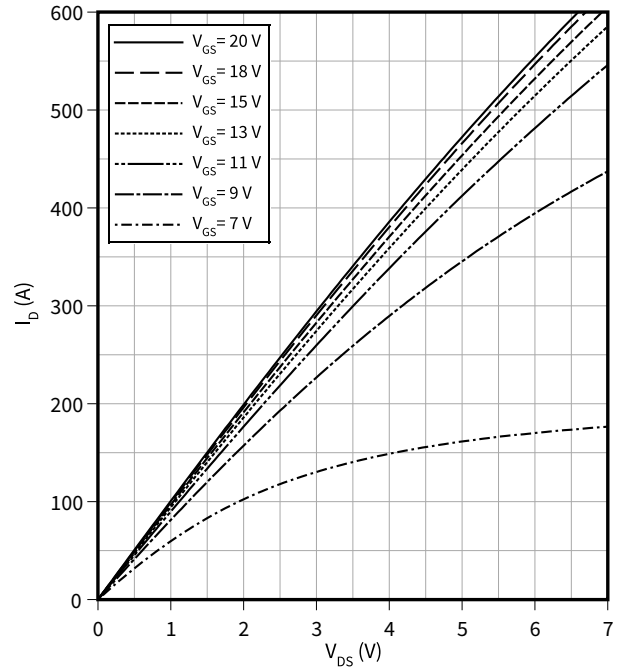
**Output characteristic (typical), MOSFET, T1 / T2**

$I_D = f(V_{DS})$   
 $V_{GS} = 18\text{ V}$



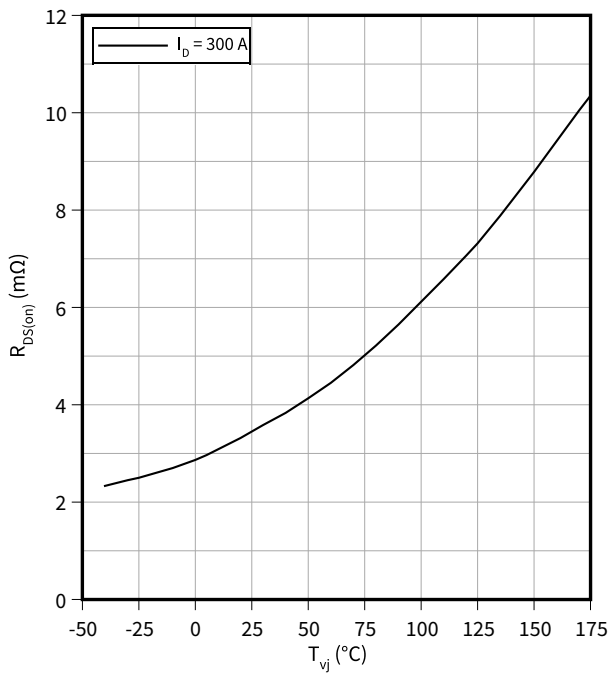
**Output characteristic field (typical), MOSFET, T1 / T2**

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



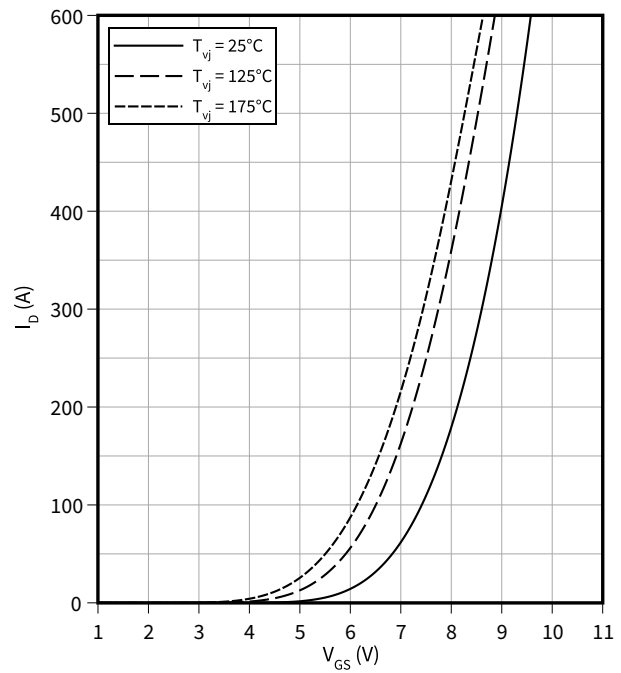
**Drain source on-resistance (typical), MOSFET, T1 / T2**

$R_{DS(on)} = f(T_{vj})$   
 $V_{GS} = 18\text{ V}$



**Transfer characteristic (typical), MOSFET, T1 / T2**

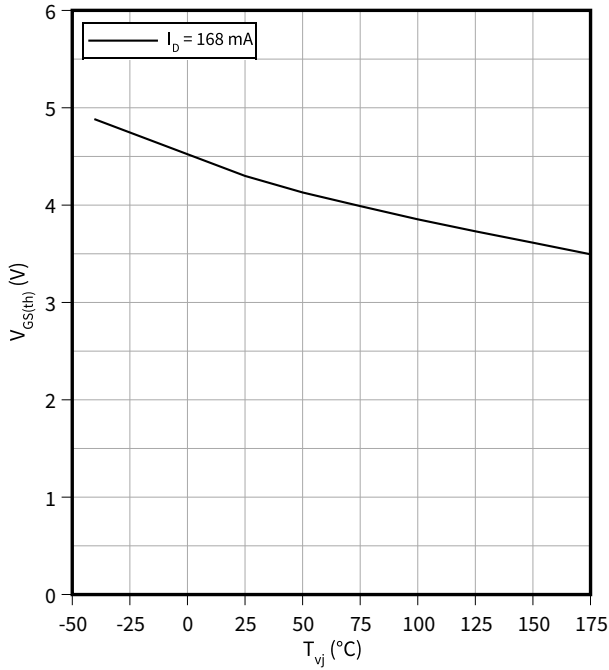
$I_D = f(V_{GS})$   
 $V_{DS} = 20\text{ V}$



4 Characteristics diagrams

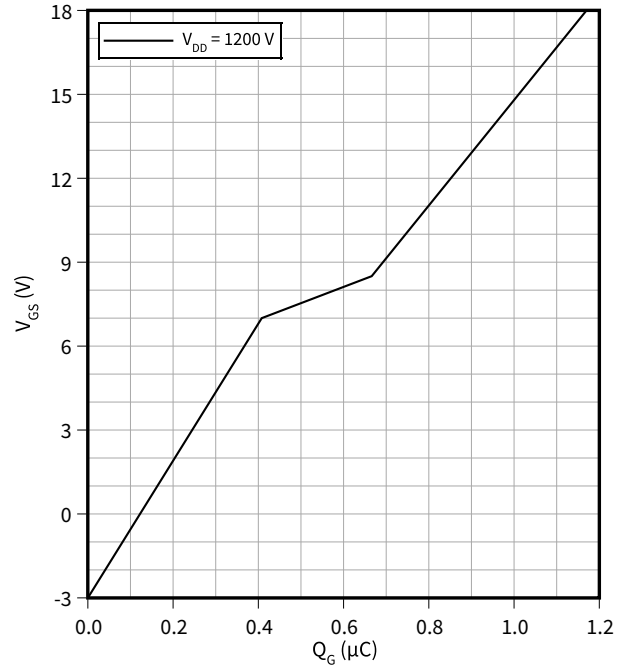
**Gate-source threshold voltage (typical), MOSFET, T1 / T2**

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



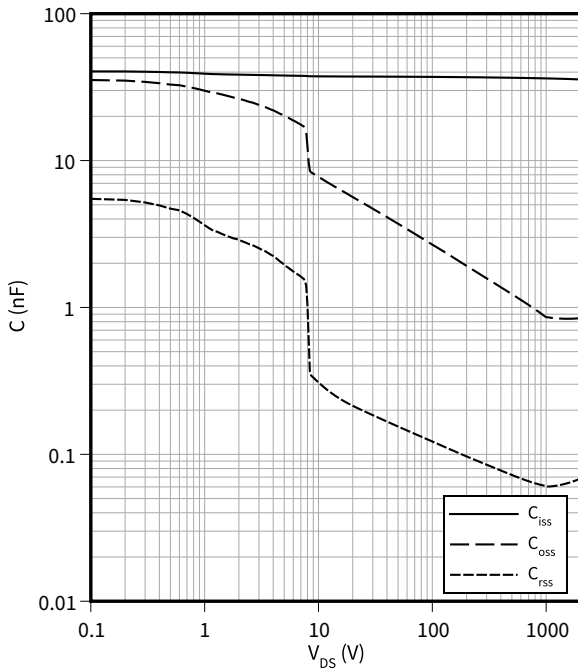
**Gate charge characteristic (typical), MOSFET, T1 / T2**

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



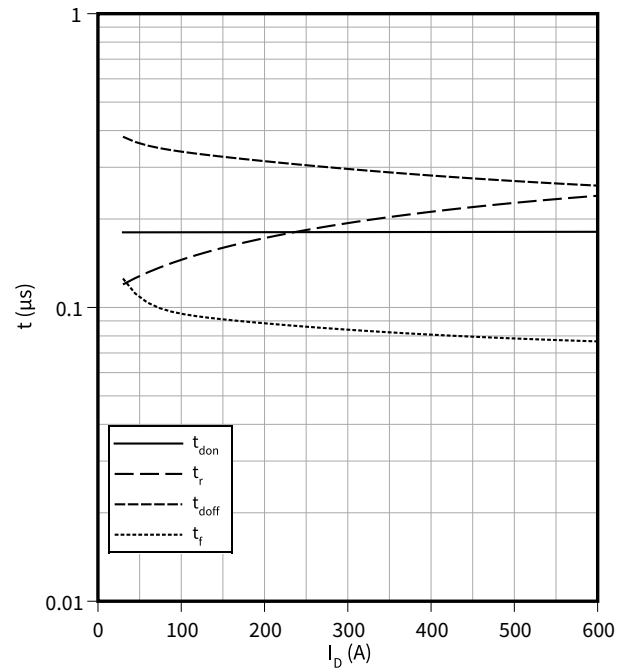
**Capacity characteristic (typical), MOSFET, T1 / T2**

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



**Switching times (typical), MOSFET, T1 / T2**

$t = f(I_D)$   
 $R_{Goff} = 4.3 \text{ } \Omega, R_{Gon} = 7.1 \text{ } \Omega, V_{DD} = 1200 \text{ V}, T_{vj} = 175 \text{ °C}, V_{GS} = -3/18 \text{ V}$



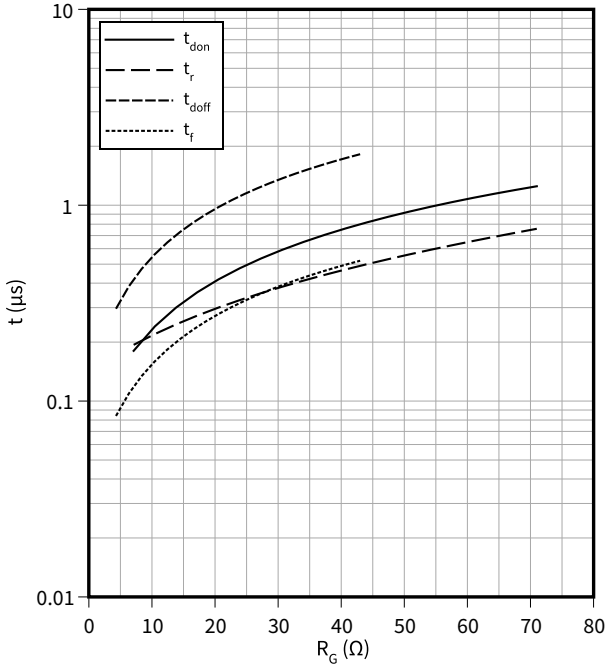


4 Characteristics diagrams

**Switching times (typical), MOSFET, T1 / T2**

$t = f(R_G)$

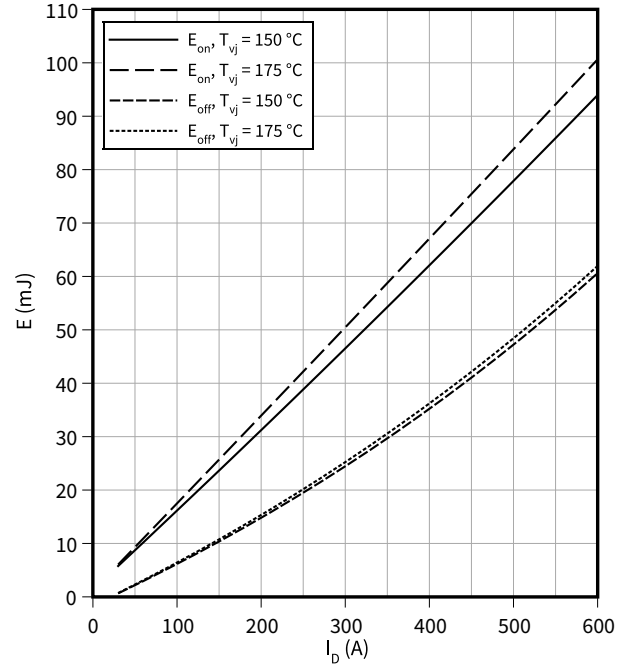
$V_{DD} = 1200\text{ V}$ ,  $I_D = 300\text{ A}$ ,  $T_{vj} = 175\text{ }^\circ\text{C}$ ,  $V_{GS} = -3/18\text{ V}$



**Switching losses (typical), MOSFET, T1 / T2**

$E = f(I_D)$

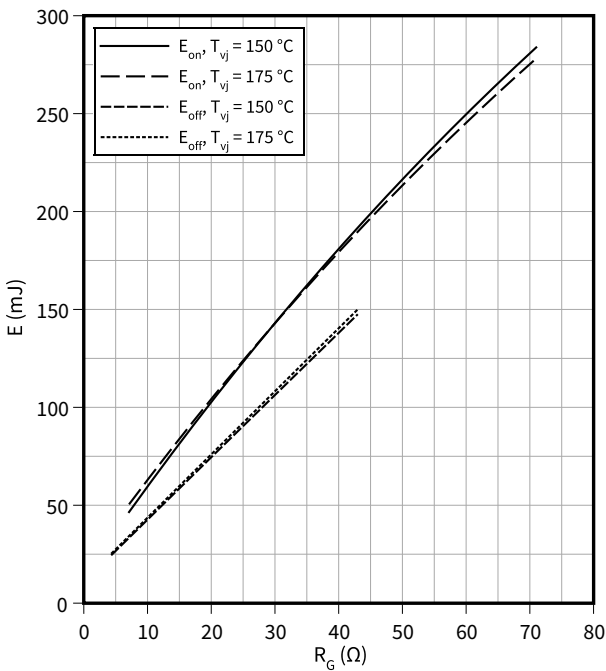
$R_{Goff} = 4.3\text{ } \Omega$ ,  $R_{Gon} = 7.1\text{ } \Omega$ ,  $V_{DD} = 1200\text{ V}$ ,  $V_{GS} = -3/18\text{ V}$



**Switching losses (typical), MOSFET, T1 / T2**

$E = f(R_G)$

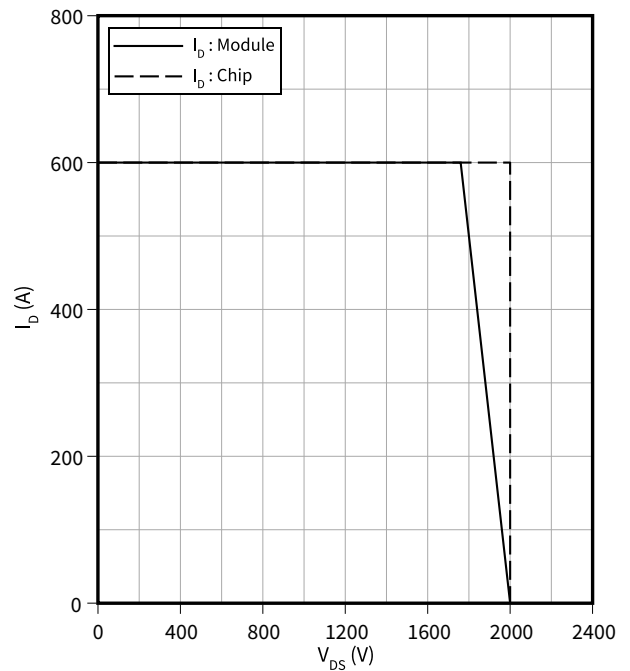
$V_{DD} = 1200\text{ V}$ ,  $I_D = 300\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$



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

$I_D = f(V_{DS})$

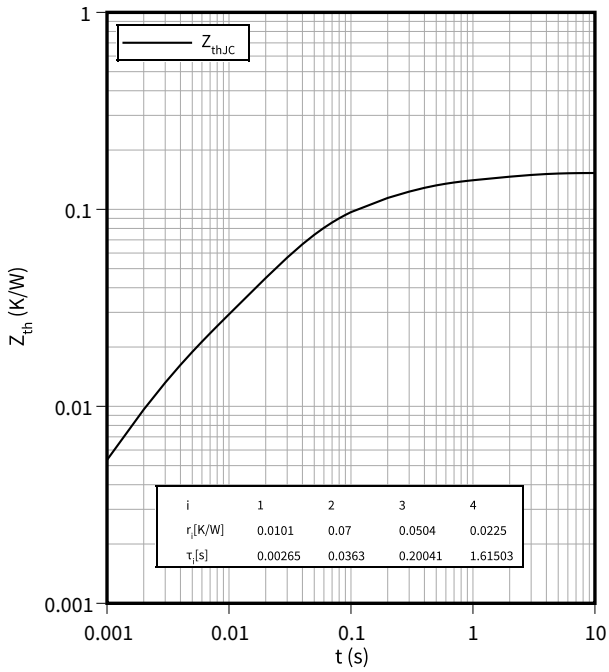
$R_{Goff} = 4.3\text{ } \Omega$ ,  $T_{vj} = 175\text{ }^\circ\text{C}$ ,  $V_{GS} = -3/18\text{ V}$



4 Characteristics diagrams

**Transient thermal impedance, MOSFET, T1 / T2**

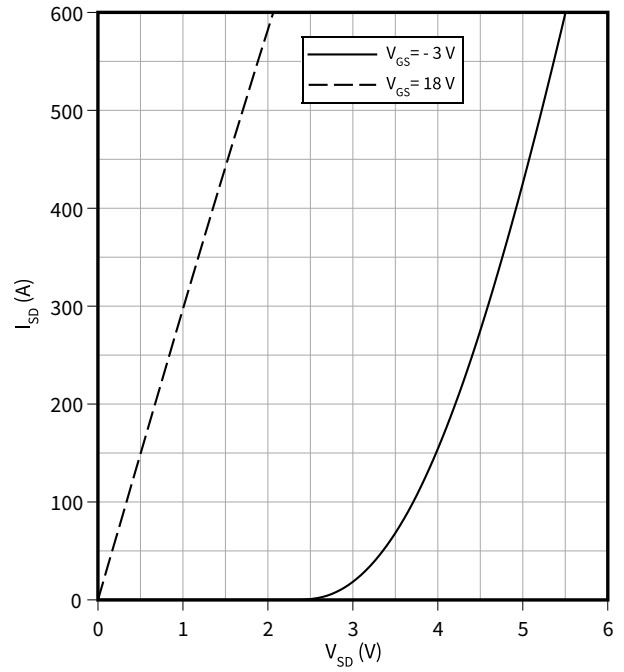
$Z_{th} = f(t)$



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

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

$T_{vj} = 25\text{ °C}$



## 5 Circuit diagram

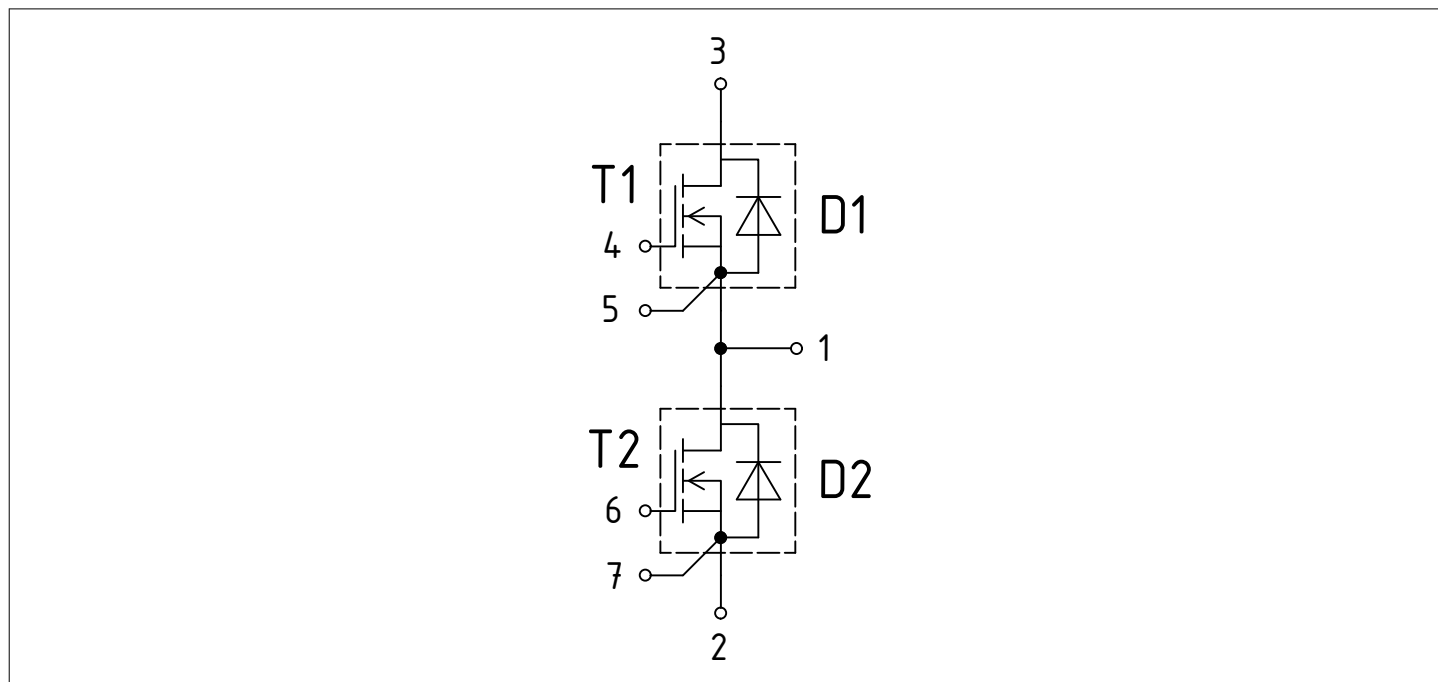
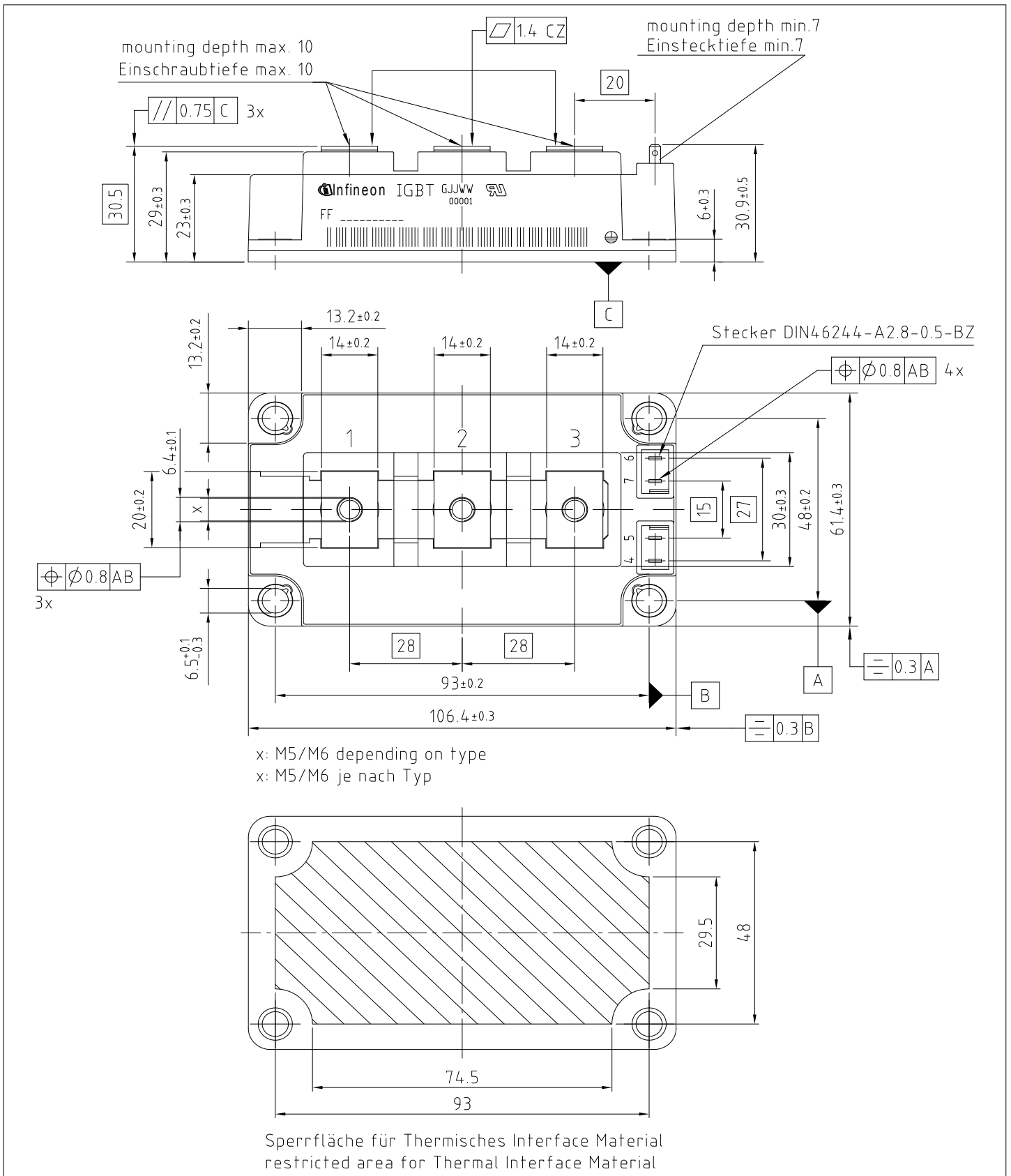


Figure 1

**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	<i>Content</i> Module serial number Module material number Production order number Date code (production year) Date code (production week)	<i>Digit</i> 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	<i>Example</i> 71549 142846 55054991 15 30
Example	 		
	71549142846550549911530		71549142846550549911530

**Figure 3**

## Revision history

Document revision	Date of release	Description of changes
1.00	2023-05-05	Initial version

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**Document reference**

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