Preliminary datasheet

EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / pre-applied thermal interface material

Features

- Electrical features
  - V_{DSS} = 1200 V
  - I_{DN} = 50 A / I_{DRM} = 100 A
  - Low switching losses
  - High current density
  - Low inductive design
- Mechanical features
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - Rugged mounting due to integrated mounting clamps

Typical appearance

Potential applications

- Welding
- DC charger for EV
- DC/DC converter
- High-frequency switching application

Product validation

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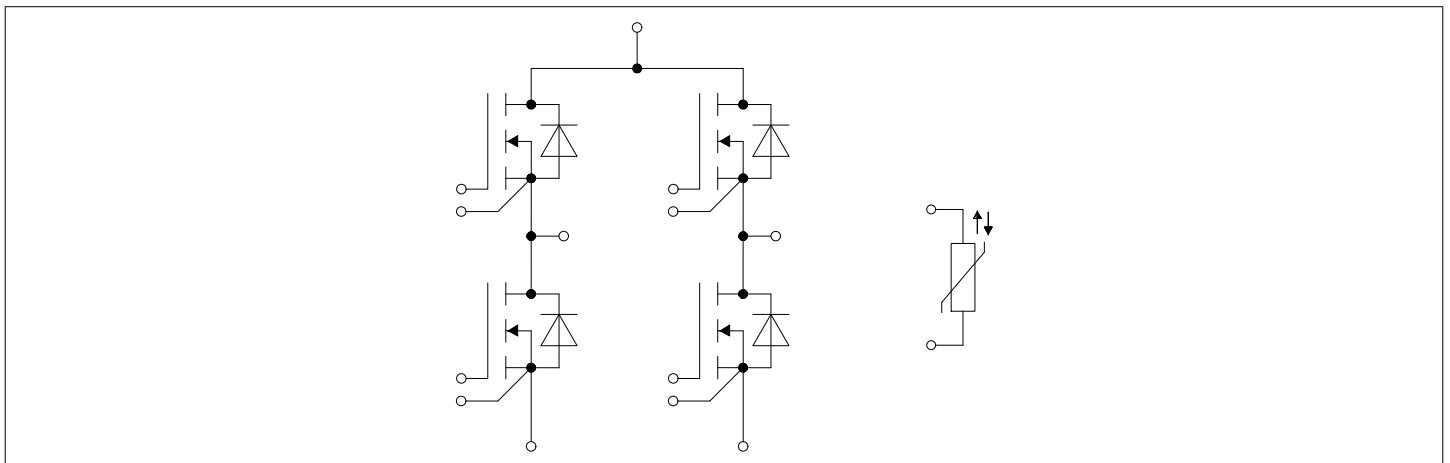
Description

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	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}			14		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch		2.6		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting force per clamp	F		20		50	N
Weight	G			24		g

Note: The current under continuous operation is limited to 25 A rms per connector pin.

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 °C	1200	V
Implemented drain current	I_{DN}			50	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 65 °C	45	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		100	A
Gate-source voltage, max. transient voltage	V_{GS}	D < 0.01		-10/23	V

(table continues...)

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

Parameter	Symbol	Note or test condition	Values	Unit
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	$V_{GS(on)}$		15...18	V
Off-state gate voltage	$V_{GS(off)}$		-5...0	V

Table 5 **Characteristic values**

Parameter	Symbol	Note or test condition		Min.	Typ.	Max.	Unit
Drain-source on-resistance	$R_{DS(on)}$	$I_D = 50$ A	$V_{GS} = 18$ V, $T_{vj} = 25$ °C		16.2		mΩ
			$V_{GS} = 18$ V, $T_{vj} = 125$ °C		26.1		
			$V_{GS} = 18$ V, $T_{vj} = 175$ °C		34.7		
			$V_{GS} = 15$ V, $T_{vj} = 25$ °C		19.4		
Gate threshold voltage	$V_{GS(th)}$	$I_D = 20$ 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	$V_{DD} = 800$ V, $V_{GS} = -3/18$ V			0.149		µC
Internal gate resistor	R_{Gint}	$T_{vj} = 25$ °C			4.1		Ω
Input capacitance	C_{ISS}	$f = 100$ kHz, $V_{DS} = 800$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		4.4		nF
Output capacitance	C_{OSS}	$f = 100$ kHz, $V_{DS} = 800$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		0.21		nF
Reverse transfer capacitance	C_{rss}	$f = 100$ kHz, $V_{DS} = 800$ V, $V_{GS} = 0$ V	$T_{vj} = 25$ °C		0.014		nF
C_{OSS} stored energy	E_{OSS}	$V_{DS} = 800$ V, $V_{GS} = -3/18$ V, $T_{vj} = 25$ °C			86		µJ
Drain-source leakage current	I_{DSS}	$V_{DS} = 1200$ V, $V_{GS} = -3$ V	$T_{vj} = 25$ °C		0.03	210	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)	$t_{d\,on}$	$I_D = 50$ A, $R_{Gon} = 5.1$ Ω, $V_{DD} = 600$ V, $V_{GS} = -3/18$ V	$T_{vj} = 25$ °C		36		ns
			$T_{vj} = 125$ °C		34		
			$T_{vj} = 175$ °C		34		

(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 = 50 A, R_{Gon} = 5.1 Ω, V_{DD} = 600 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		35		ns
			T_{vj} = 125 °C		36		
			T_{vj} = 175 °C		38		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 50 A, R_{Goff} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		63		ns
			T_{vj} = 125 °C		66		
			T_{vj} = 175 °C		68		
Fall time (inductive load)	t_f	I_D = 50 A, R_{Goff} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		18		ns
			T_{vj} = 125 °C		18		
			T_{vj} = 175 °C		18		
Turn-on energy loss per pulse	E_{on}	I_D = 50 A, V_{DD} = 600 V, L_σ = 35 nH, V_{GS} = -3/18 V, R_{Gon} = 5.1 Ω, di/dt = 3.08 kA/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.773		mJ
			T_{vj} = 125 °C		0.955		
			T_{vj} = 175 °C		1.06		
Turn-off energy loss per pulse	E_{off}	I_D = 50 A, V_{DD} = 600 V, L_σ = 35 nH, V_{GS} = -3/18 V, R_{Goff} = 3.9 Ω, dv/dt = 26.67 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.186		mJ
			T_{vj} = 125 °C		0.19		
			T_{vj} = 175 °C		0.197		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, Valid with IFX pre-applied Thermal Interface Material				1.09	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

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_H = 65 °C	16	A

Table 7	Characteristic values							
Parameter	**Symbol**	**Note or test condition**			**Values**			**Unit**
				Min.	**Typ.**	**Max.**	
Forward voltage	V_{SD}	I_{SD} = 50 A, V_{GS} = -3 V	T_{vj} = 25 °C		4.2	5.35	V
			T_{vj} = 125 °C		3.9		
			T_{vj} = 175 °C		3.8		

4 NTC-Thermistor

Table 8	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.

5 Characteristics diagrams

Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

$V_{GS} = 18\ V$
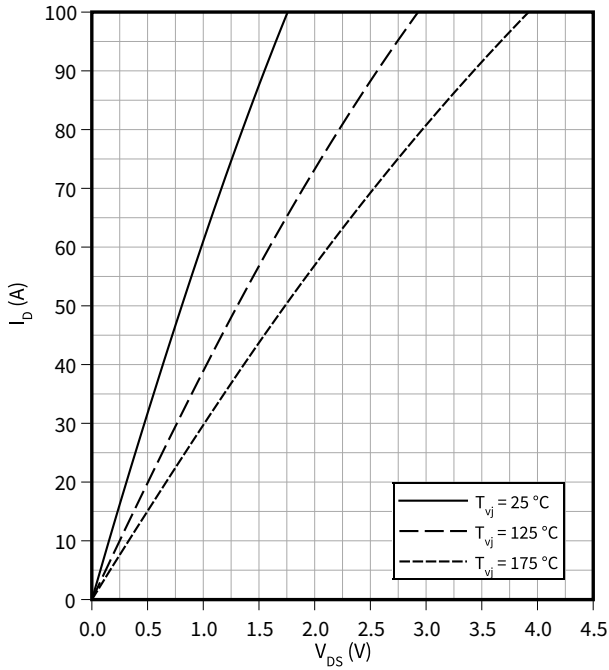
Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

$V_{GS} = 15\ V$
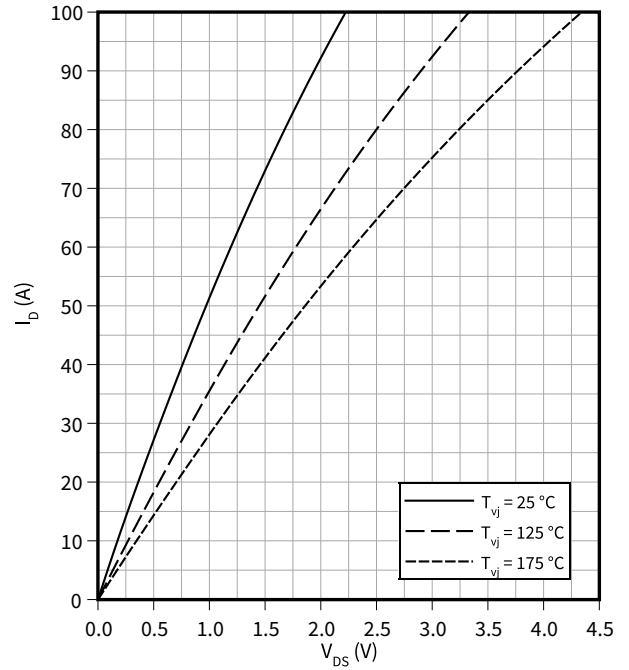
Drain source on-resistance (typical), MOSFET

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

$V_{GS} = 18\ V$
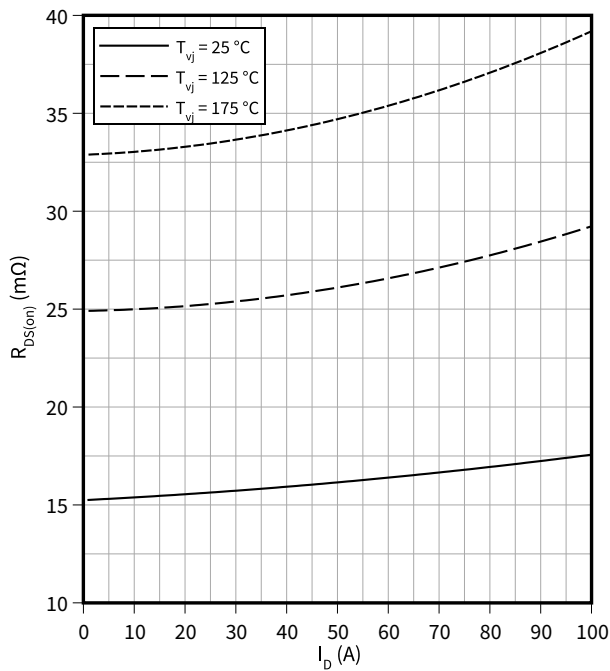
Drain source on-resistance (typical), MOSFET

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

$I_D = 50\ A$

Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$

$T_{vj} = 175\ °C$
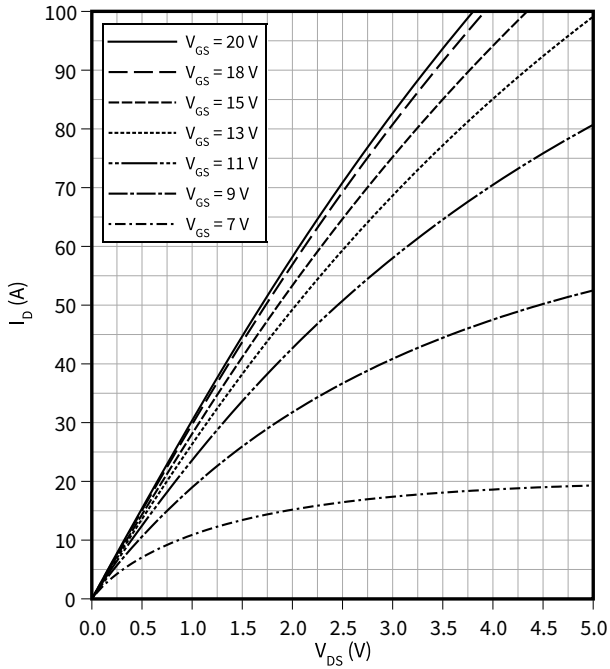
Transfer characteristic (typical), MOSFET

$I_D = f(V_{GS})$

$V_{DS} = 20\ V$
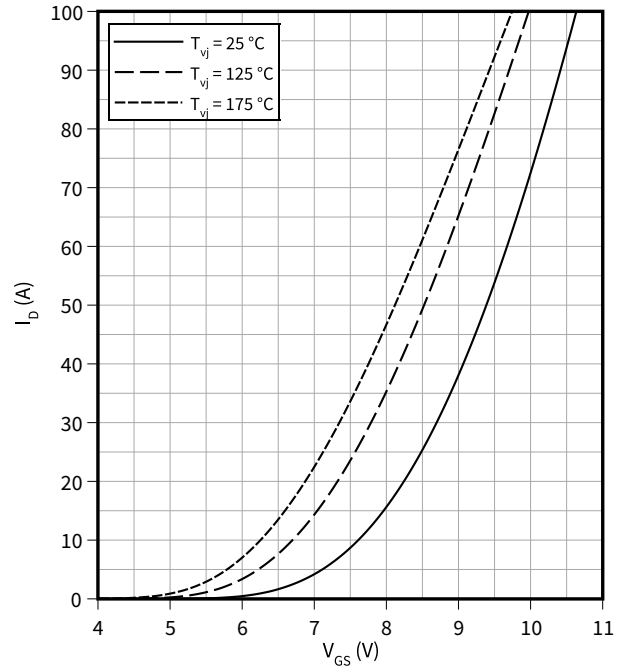
Gate-source threshold voltage (typical), MOSFET

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

$V_{GS} = V_{DS}$
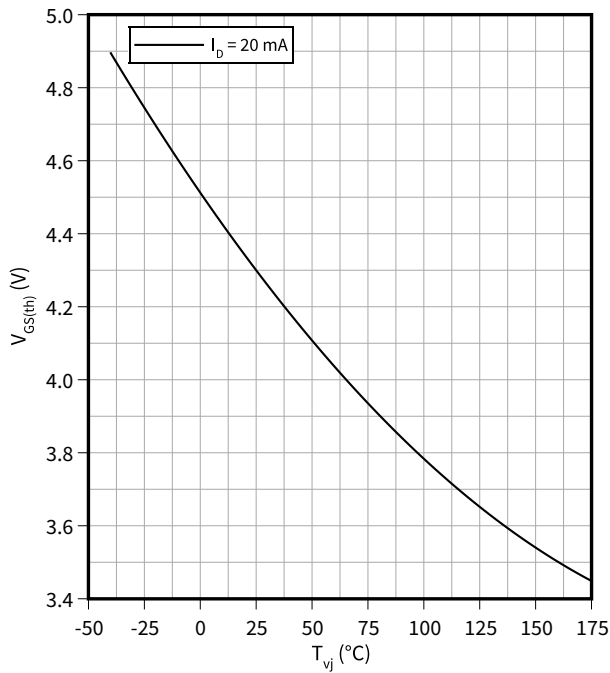
Gate charge characteristic (typical), MOSFET

$V_{GS} = f(Q_G)$

$I_D = 50\ A,\ T_{vj} = 25\ °C$

Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

$T_{vj} = 25 \ °C$, $V_{GS} = 0 \ V$, $f = 100 \ kHz$
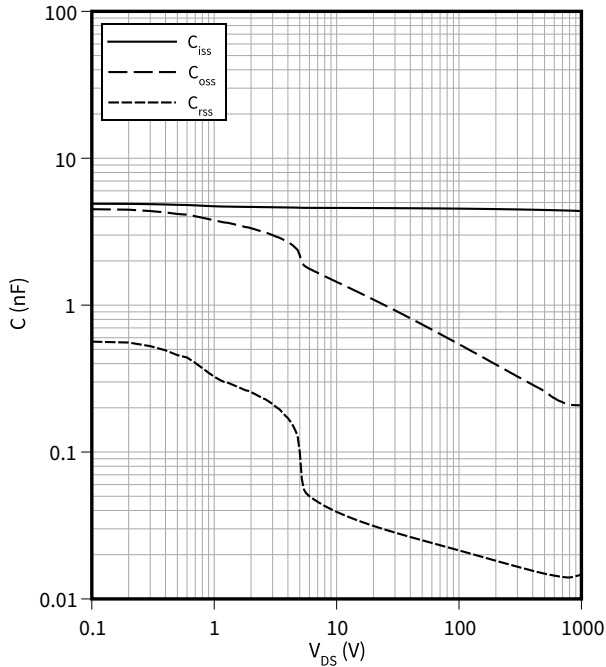
Forward characteristic body diode (typical), MOSFET

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

$T_{vj} = 25 \ °C$
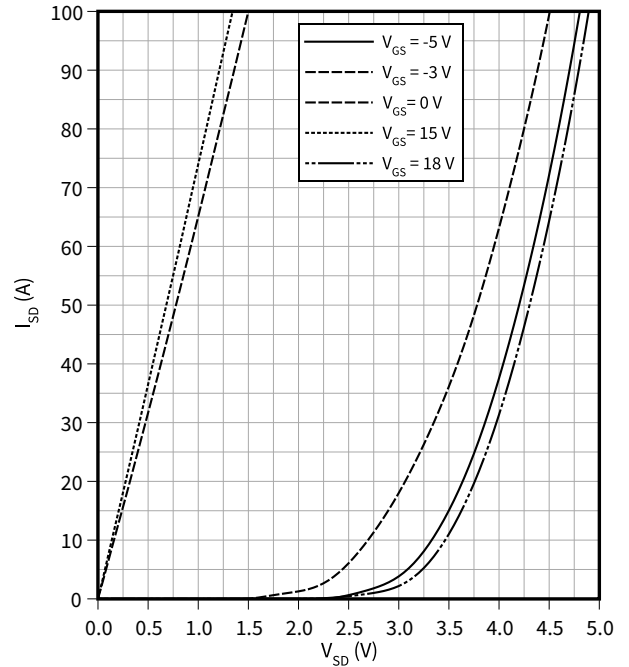
Forward characteristic body diode (typical), MOSFET

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

$I_{SD} = 50 \ A$
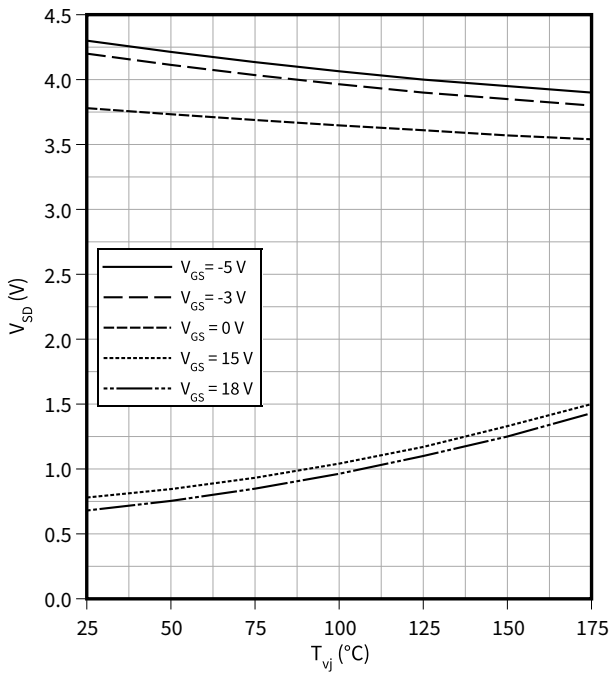
Switching losses (typical), MOSFET

$E = f(I_D)$

$R_{Goff} = 3.9 \ \Omega$, $R_{Gon} = 5.1 \ \Omega$, $V_{DD} = 600 \ V$, $V_{GS} = -3/18 \ V$
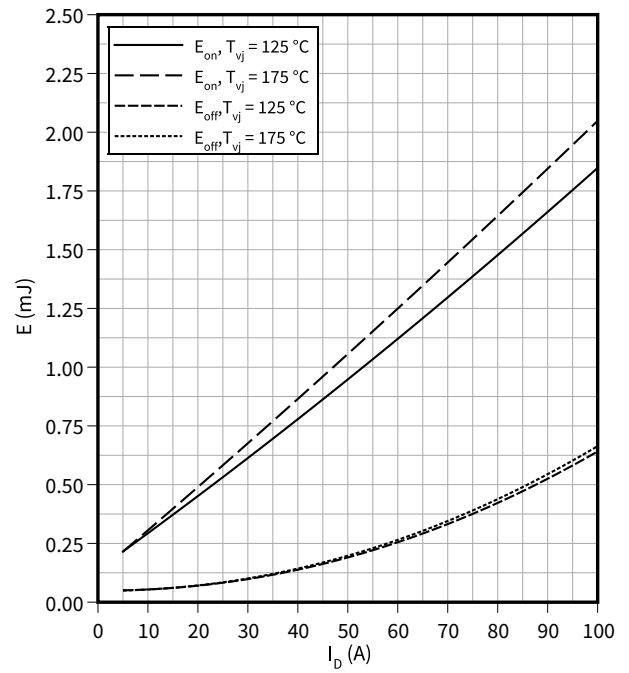
Switching losses (typical), MOSFET

$E = f(R_G)$

$V_{DD} = 600$ V, $I_D = 50$ A, $V_{GS} = -3/18$ V
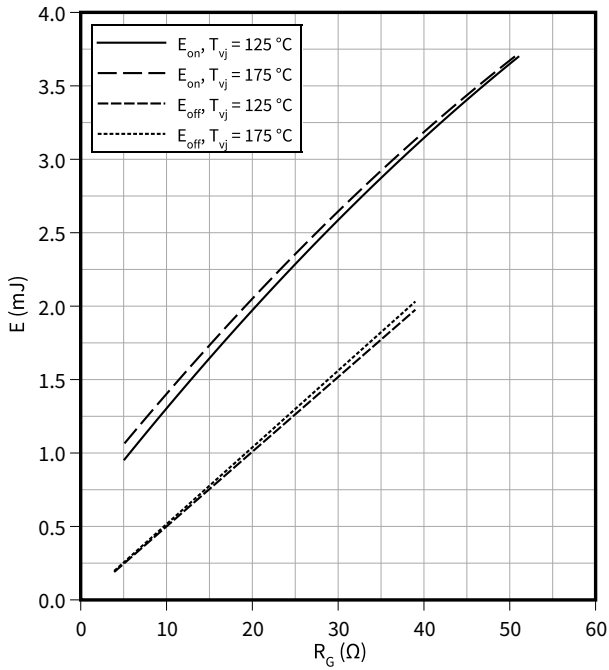
Switching times (typical), MOSFET

$t = f(I_D)$

$R_{Goff} = 3.9$ Ω, $R_{Gon} = 5.1$ Ω, $V_{DD} = 600$ V, $T_{vj} = 175$ °C, $V_{GS} = -3/18$ V
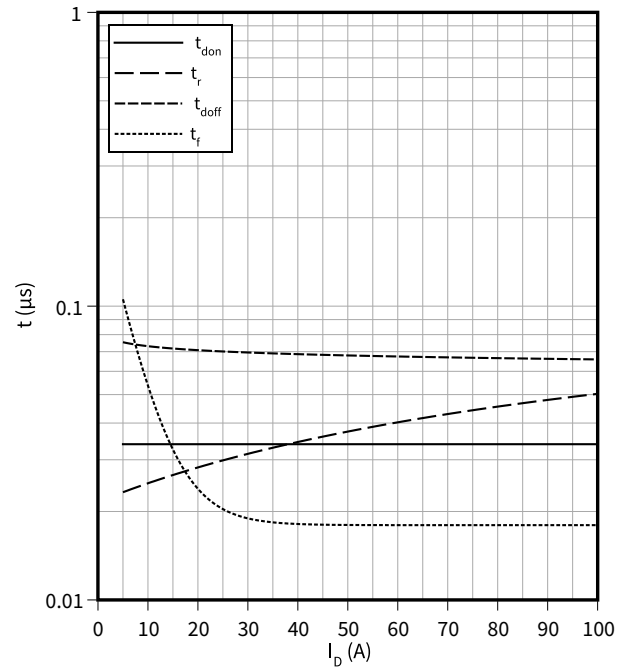
Switching times (typical), MOSFET

$t = f(R_G)$

$V_{DD} = 600$ V, $I_D = 50$ A, $T_{vj} = 175$ °C, $V_{GS} = -3/18$ V
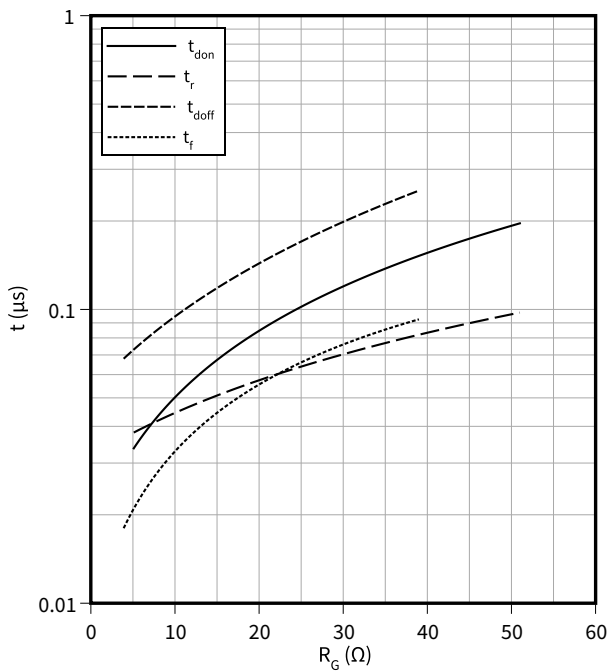
Current slope (typical), MOSFET

$di/dt = f(R_G)$

$V_{DD} = 600$ V, $I_D = 50$ A, $V_{GS} = -3/18$ V

Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$

$V_{DD} = 600$ V, $I_D = 50$ A, $V_{GS} = -3/18$ V
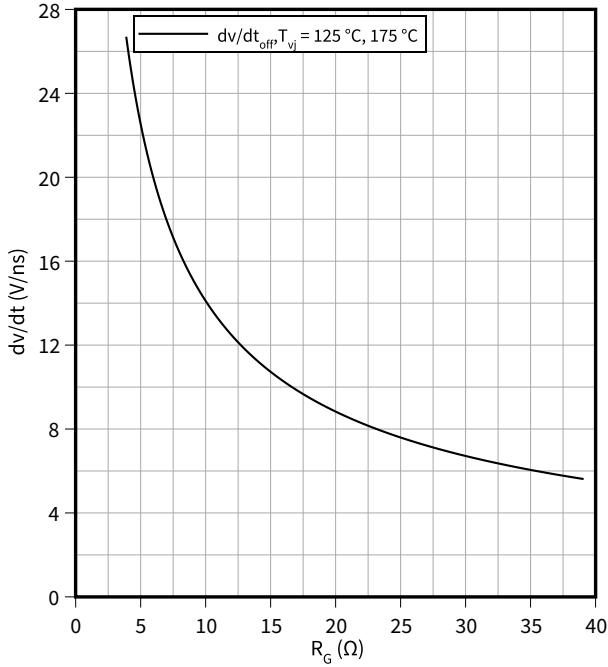
Reverse bias safe operating area (RBSOA), MOSFET

$I_D = f(V_{DS})$

$R_{Goff} = 3.9$ Ω, $T_{vj} = 175$ °C, $V_{GS} = -3/18$ V
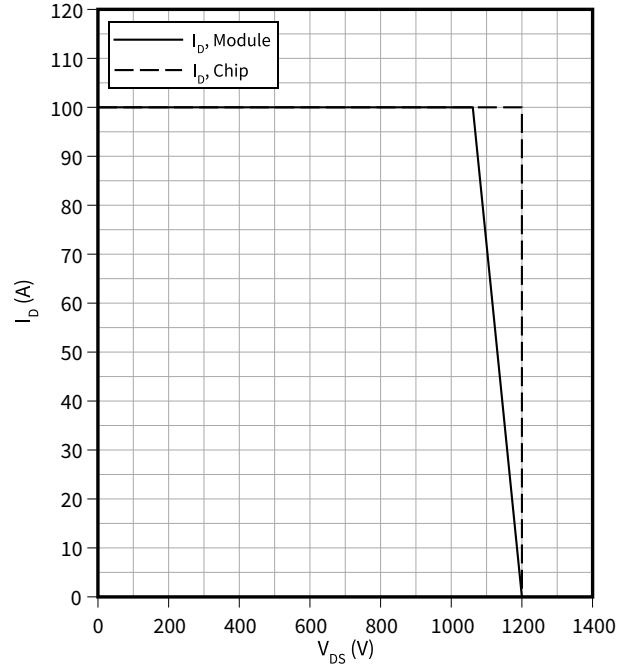
Transient thermal impedance , MOSFET

$Z_{th} = f(t)$

i	1	2	3	4
r_i[K/W]	0.04	0.112	0.244	0.694
τ_i[s]	6.1E-4	0.00695	0.0388	0.158
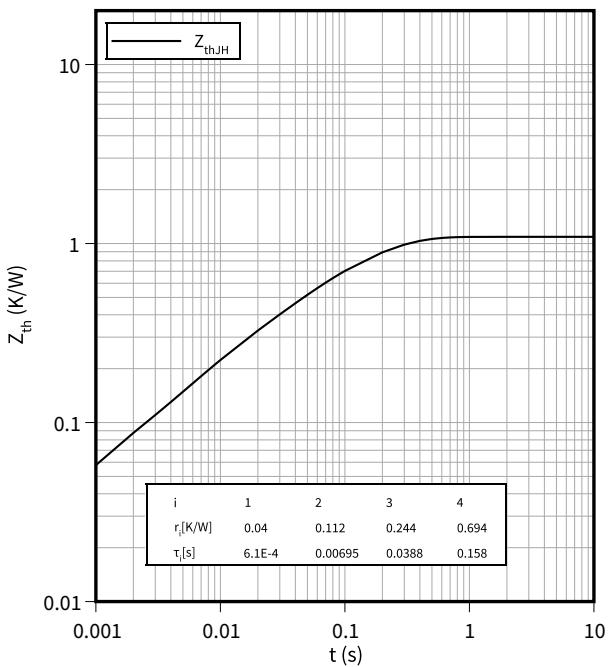
Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$
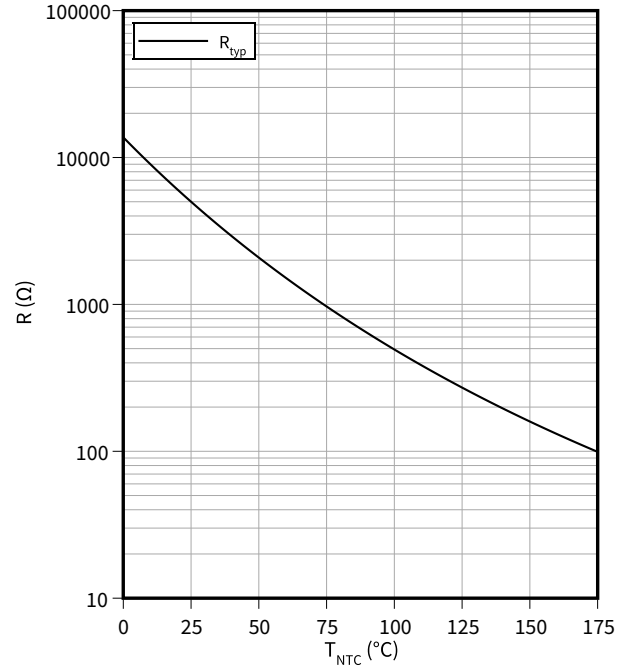
6 Circuit diagram
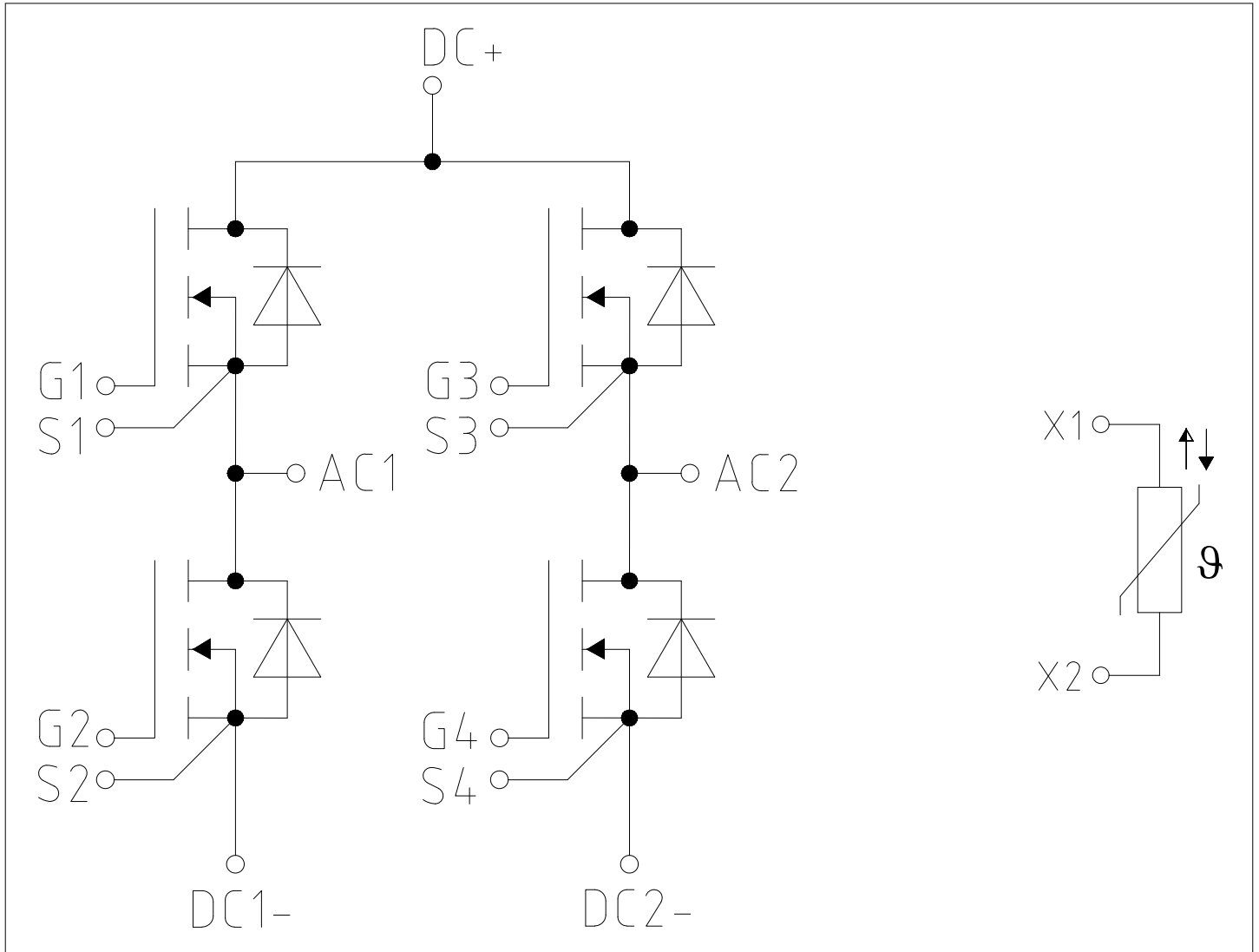
Figure 1

7 Package outlines

- Pin-Grid 3.2mm
- Tolerance of PCB hole pattern ⊕ ⌀0.1
- Hole specification for contacts see AN 2009-01
- Diameters of drill ⌀ 1.15mm
  and copper thickness in hole 25-50μm

PCB hole pattern

2x9 according to screw head / washer

restricted area for Thermal Interface Material
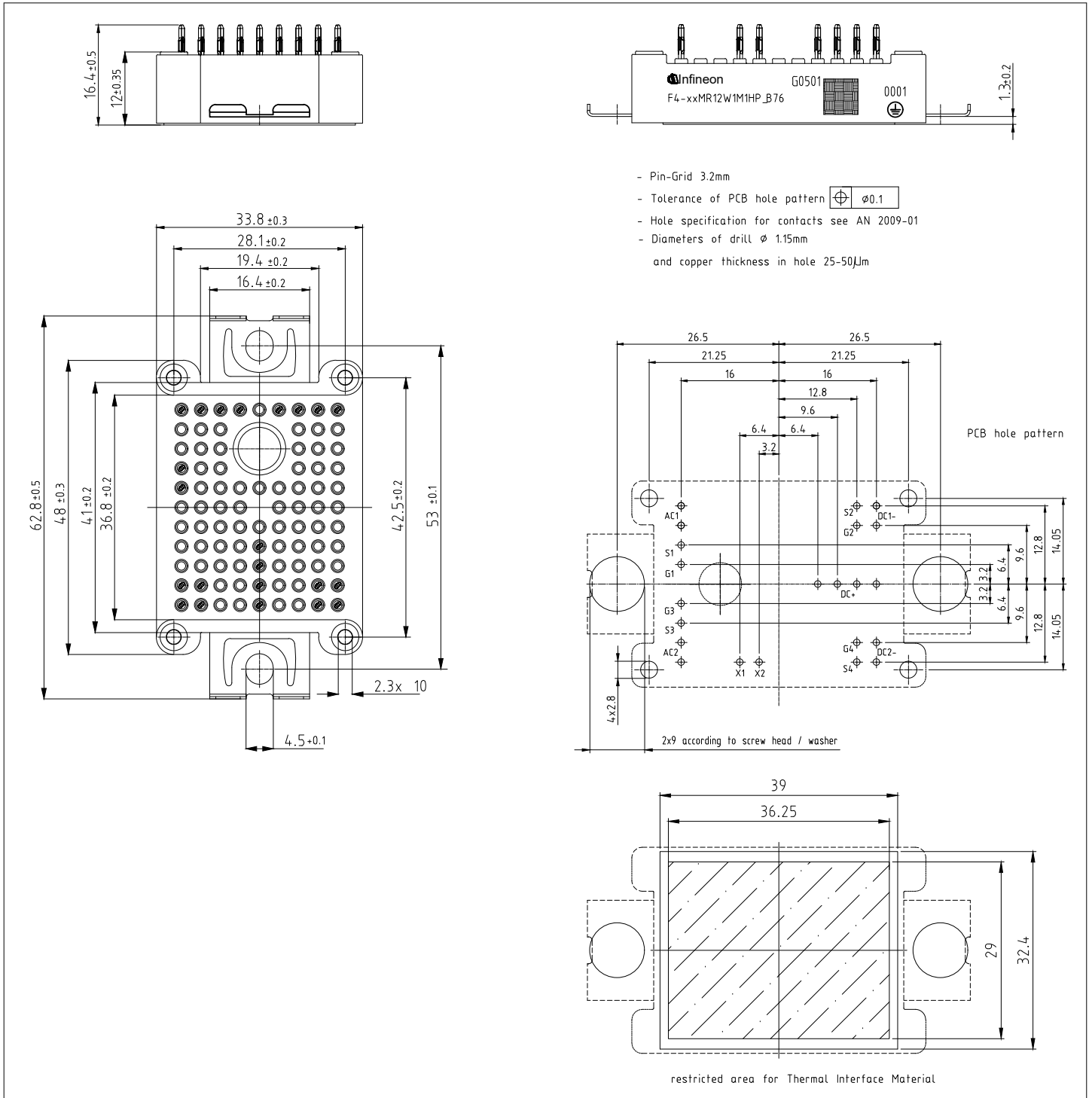
Figure 2

8   Module label code
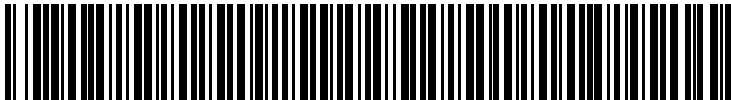
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production 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 version	Date of release	Description of changes
0.10	2022-09-09	Initial version

Trademarks

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