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

Features


Typical appearance

- Electrical features
  - V_{DSS} = 1200 V
  - I_{DN} = 75 A / I_{DRM} = 150 A
  - High current density
  - Low switching losses
- Mechanical features
  - Rugged mounting due to integrated mounting clamps
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - Pre-applied thermal interface material

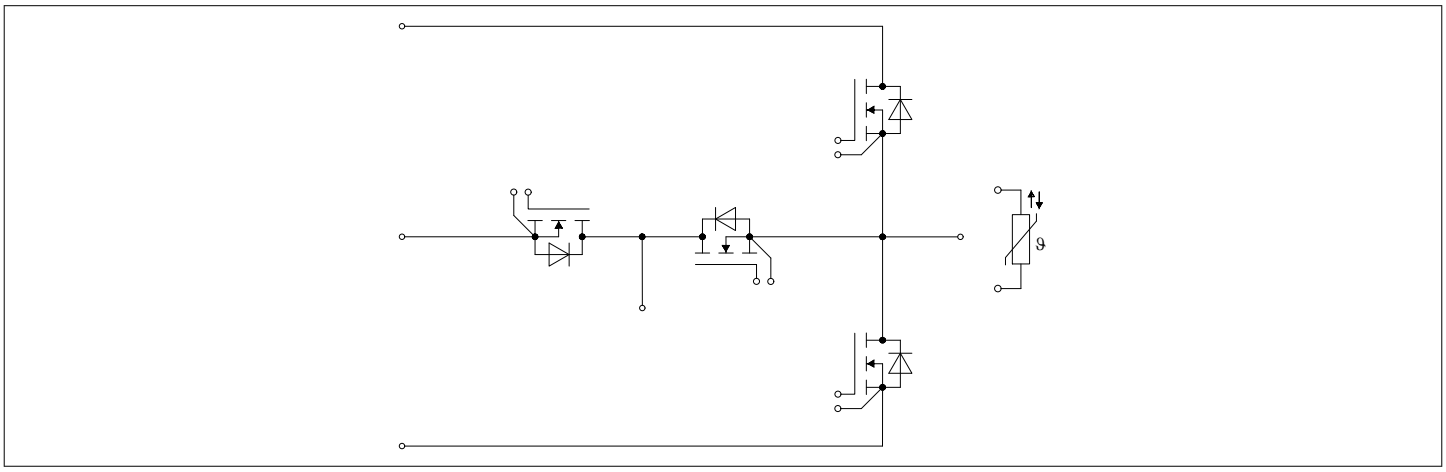
Potential applications

- Solar applications
- Three-level applications
- 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 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}			21		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch		1.5		mΩ
Storage temperature	T_{stg}		-40		125	°C
Maximum baseplate operation temperature	T_{BPmax}				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.
Storage and shipment of modules with TIM => see AN 2012-07.
Chapters 2 and 3 describe MOSFET T1/T4 and the corresponding body diode. Chapters 4 and 5 describe MOSFET T2/T3 and the corresponding body diode.

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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}			75	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 65 °C	65	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}	150	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	$V_{GS(on)}$		15...18	V
Off-state gate voltage	$V_{GS(off)}$		-5...0	V

Table 5 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	I_D = 75 A	V_{GS}=18 V, T_{vj}=25 °C		10.8	16	mΩ
			V_{GS}=18 V, T_{vj}=125 °C		17.4		
			V_{GS}=18 V, T_{vj}=175 °C		23.1		
			V_{GS}=15 V, T_{vj}=25 °C		12.9		
Gate threshold voltage	$V_{GS(th)}$	I_D = 30 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_{DS}=800 V, V_{GS} = -3/18 V			0.223		µC
Internal gate resistor	R_{Gint}	T_{vj}=25 °C			2.7		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		6.6		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.315		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.021		nF
C_{OSS} stored energy	E_{OSS}	V_{DS}=800 V, V_{GS} = -3/18 V, T_{vj}=25 °C			129		µJ
Drain-source leakage current	I_{DSS}	V_{DS}=1200 V, V_{GS}=-3 V	T_{vj}=25 °C		0.045	300	µA
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V, T_{vj}=25 °C	V_{GS}=20 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 = 75 A, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		34		ns
			T_{vj} = 125 °C		34		
			T_{vj} = 175 °C		34		
Rise time (inductive load)	t_r	I_D = 75 A, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		37		ns
			T_{vj} = 125 °C		40		
			T_{vj} = 175 °C		41		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 75 A, R_{Goff} = 2.4 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		61		ns
			T_{vj} = 125 °C		66		
			T_{vj} = 175 °C		69		
Fall time (inductive load)	t_f	I_D = 75 A, R_{Goff} = 2.4 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		12.5		ns
			T_{vj} = 125 °C		12.5		
			T_{vj} = 175 °C		12.5		
Turn-on energy loss per pulse	E_{on}	I_D = 75 A, V_{DS} = 400 V, L_σ = 35 nH, V_{GS} = -3/18 V, R_{Gon} = 4.3 Ω, di/dt = 4.09 kA/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.582		mJ
			T_{vj} = 125 °C		0.635		
			T_{vj} = 175 °C		0.659		
Turn-off energy loss per pulse	E_{off}	I_D = 75 A, V_{DS} = 400 V, L_σ = 35 nH, V_{GS} = -3/18 V, R_{Goff} = 2.4 Ω, dv/dt = 25.6 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.154		mJ
			T_{vj} = 125 °C		0.155		
			T_{vj} = 175 °C		0.155		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, Valid with IFX pre-applied Thermal Interface Material				0.758	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	24	A

Table 7 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 75 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		

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Table 8 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}			75	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 65 °C	55	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		150	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 9 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 10 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	I_D = 75 A	V_{GS}=18 V, T_{vj}=25 °C		10.8	16	mΩ
			V_{GS}=18 V, T_{vj}=125 °C		17.4		
			V_{GS}=18 V, T_{vj}=175 °C		23.1		
			V_{GS}=15 V, T_{vj}=25 °C		12.9		
Gate threshold voltage	$V_{GS(th)}$	I_D = 30 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_{DS}=800 V, V_{GS} = -3/18 V			0.223		µC

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Internal gate resistor	R_{Gint}	T_{vj}=25 °C			2.7		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		6.6		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.315		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.021		nF
C_{OSS} stored energy	E_{OSS}	V_{DS}=800 V, V_{GS} = -3/18 V, T_{vj}=25 °C			129		µJ
Drain-source leakage current	I_{DSS}	V_{DS}=1200 V, V_{GS}=-3 V	T_{vj}=25 °C		0.045	300	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 = 75 A, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		34		ns
			T_{vj} = 125 °C		34		
			T_{vj} = 175 °C		34		
Rise time (inductive load)	t_r	I_D = 75 A, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		43		ns
			T_{vj} = 125 °C		46		
			T_{vj} = 175 °C		47		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 75 A, R_{Goff} = 2.4 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		60		ns
			T_{vj} = 125 °C		65		
			T_{vj} = 175 °C		68		
Fall time (inductive load)	t_f	I_D = 75 A, R_{Goff} = 2.4 Ω, V_{DS} = 400 V, V_{GS} = -3/18 V	T_{vj} = 25 °C		12.6		ns
			T_{vj} = 125 °C		12.6		
			T_{vj} = 175 °C		12.6		
Turn-on energy loss per pulse	E_{on}	I_D = 75 A, V_{DS} = 400 V, L_σ = 35 nH, V_{GS} = -3/18 V, R_{Gon} = 4.3 Ω, di/dt = 4.11 kA/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.586		mJ
			T_{vj} = 125 °C		0.642		
			T_{vj} = 175 °C		0.679		
Turn-off energy loss per pulse	E_{off}	I_D = 75 A, V_{DS} = 400 V, L_σ = 35 nH, V_{GS} = -3/18 V, R_{Goff} = 2.4 Ω, dv/dt = 25.4 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.168		mJ
			T_{vj} = 125 °C		0.174		
			T_{vj} = 175 °C		0.177		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET, Valid with IFX pre-applied Thermal Interface Material				0.998	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.

5 Body diode

Table 11 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	24	A

Table 12 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 75 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		

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Table 13 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

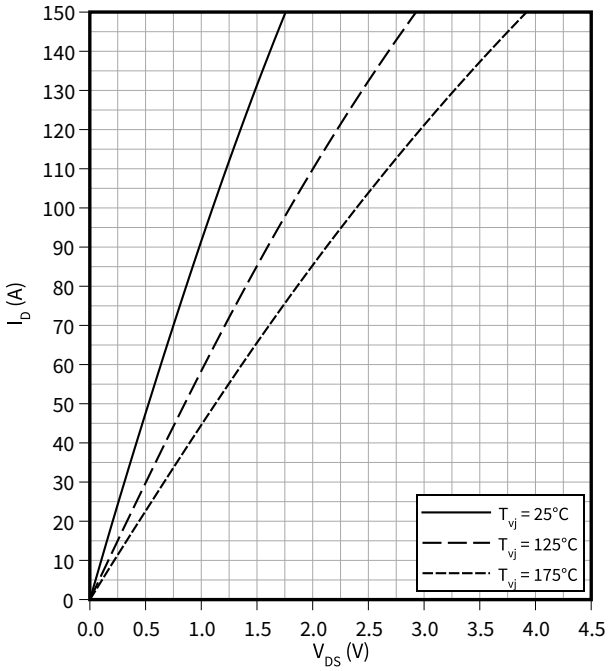
Note: Specification according to the valid application note.

7 Characteristics diagrams

Output characteristic (typical), MOSFET, T1 / T4

$I_D = f(V_{DS})$

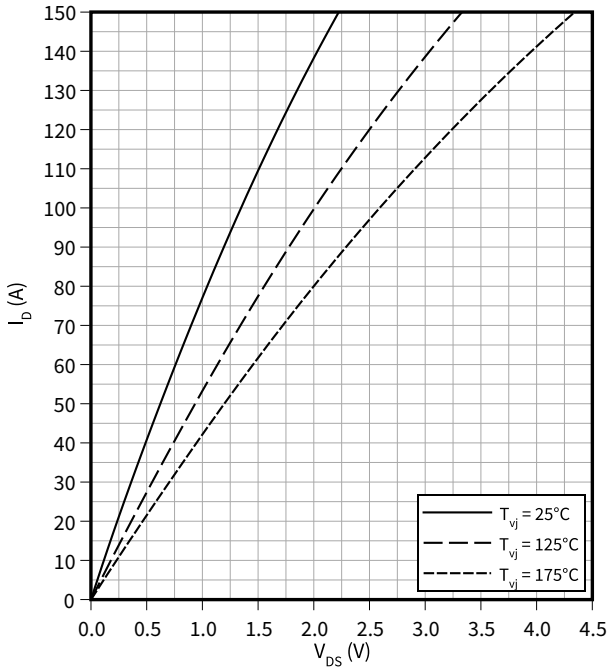
V_{GS} = 18 V



Output characteristic (typical), MOSFET, T1 / T4

$I_D = f(V_{DS})$

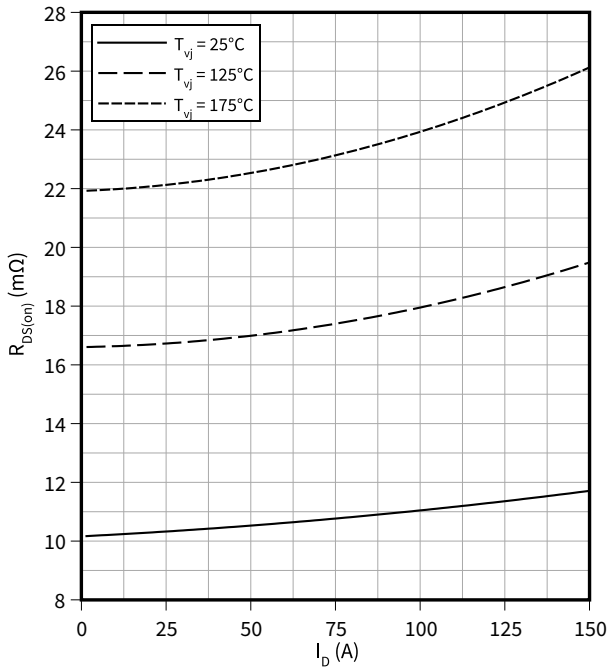
V_{GS} = 15 V



Drain source on-resistance (typical), MOSFET, T1 / T4

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

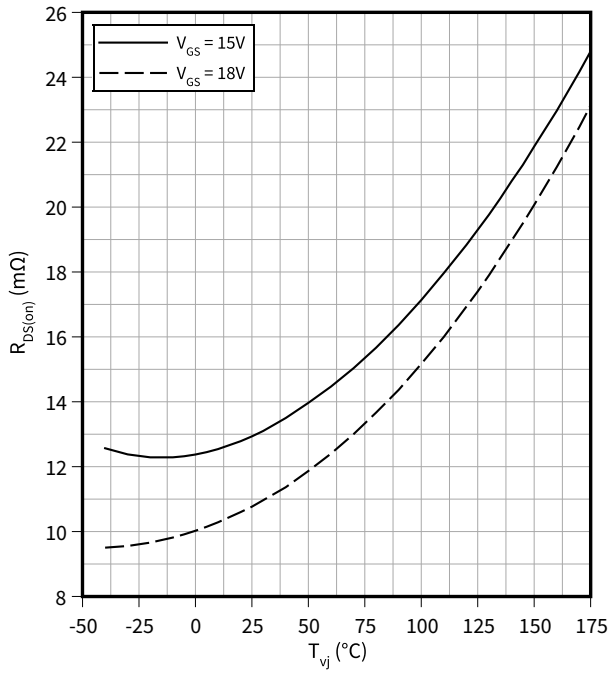
V_{GS} = 18 V



Drain source on-resistance (typical), MOSFET, T1 / T4

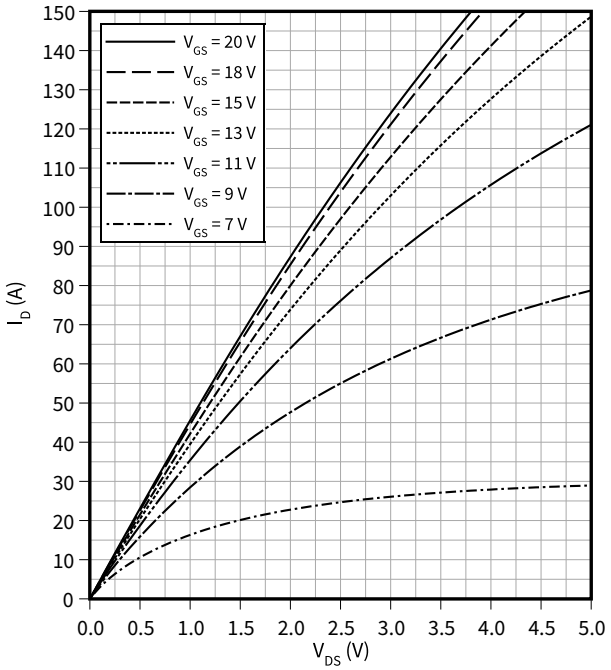
$R_{DS(on)} = f(T_{vj})$

I_D = 75 A



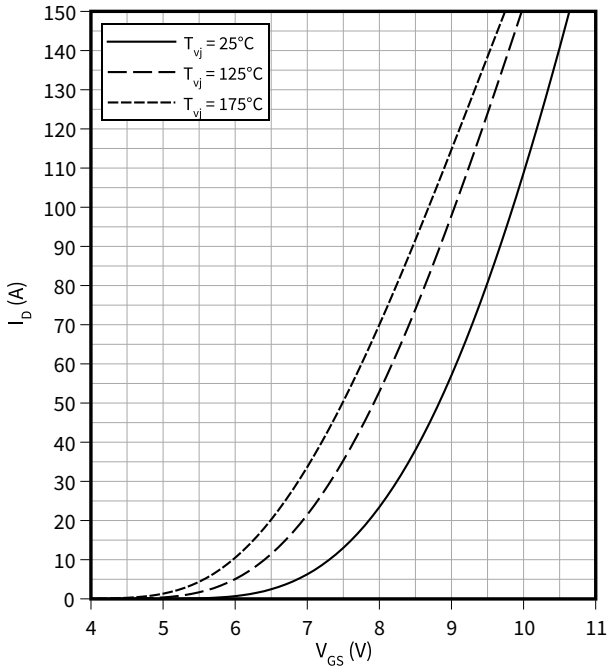
Output characteristic field (typical), MOSFET, T1 / T4

$I_D = f(V_{DS})$
$T_{vj} = 175\ °C$



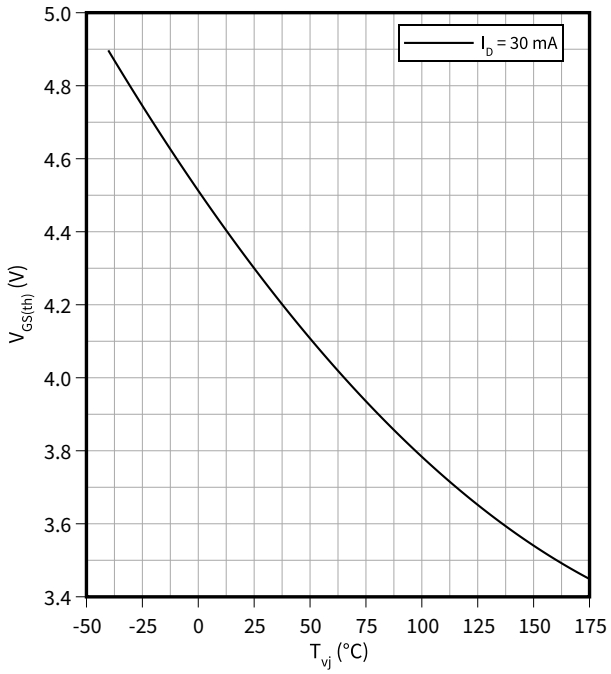
Transfer characteristic (typical), MOSFET, T1 / T4

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



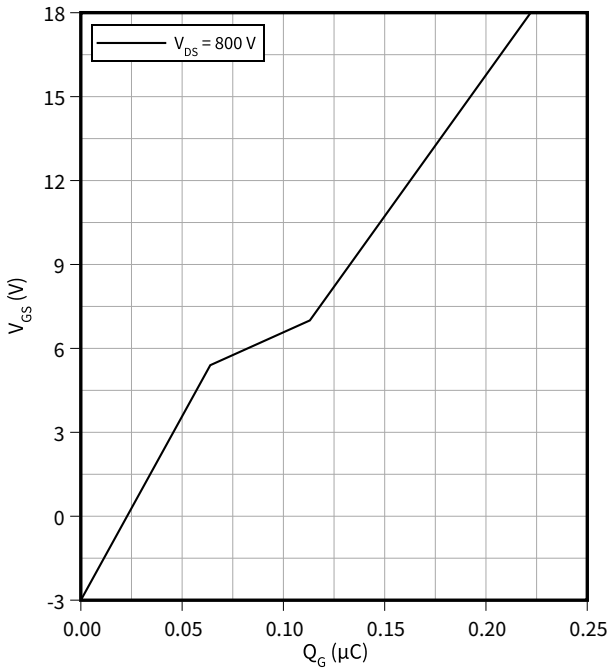
Gate-source threshold voltage (typical), MOSFET, T1 / T4

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



Gate charge characteristic (typical), MOSFET, T1 / T4

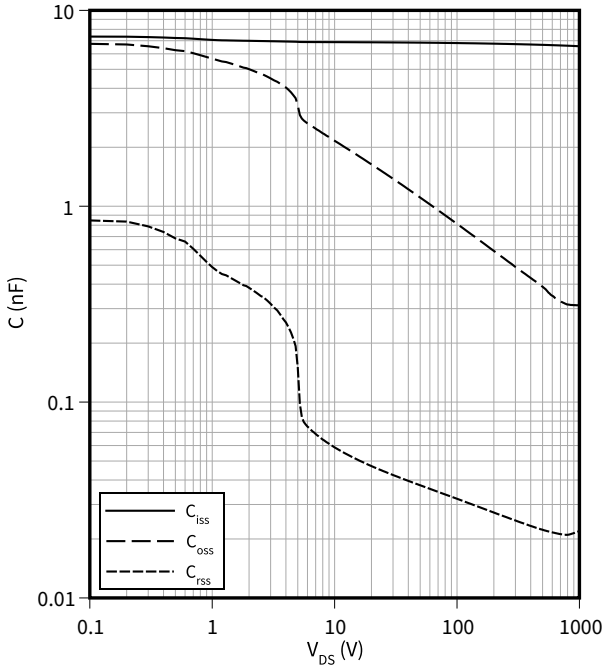
$V_{GS} = f(Q_G)$
$I_D = 75\ A,\ T_{vj} = 25\ °C$



Capacity characteristic (typical), MOSFET, T1 / T4

$C = f(V_{DS})$

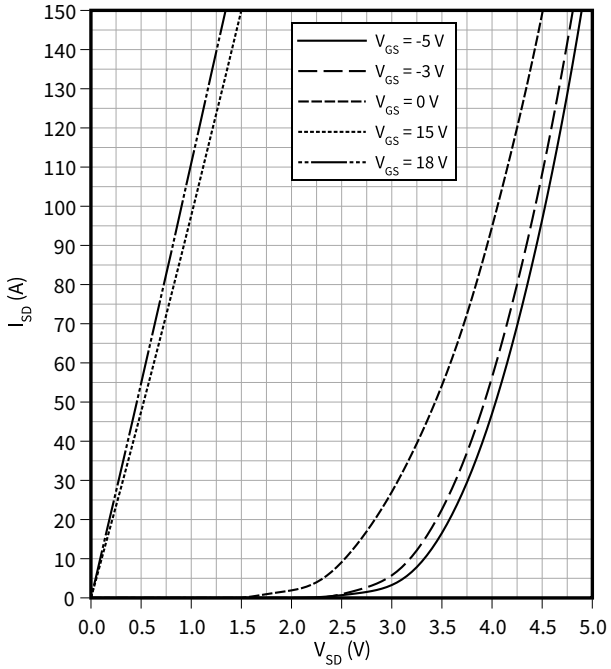
$f = 100\ kHz, T_{vj} = 25\ °C, V_{GS} = 0\ V$



Forward characteristic body diode (typical), MOSFET, T1 / T4

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

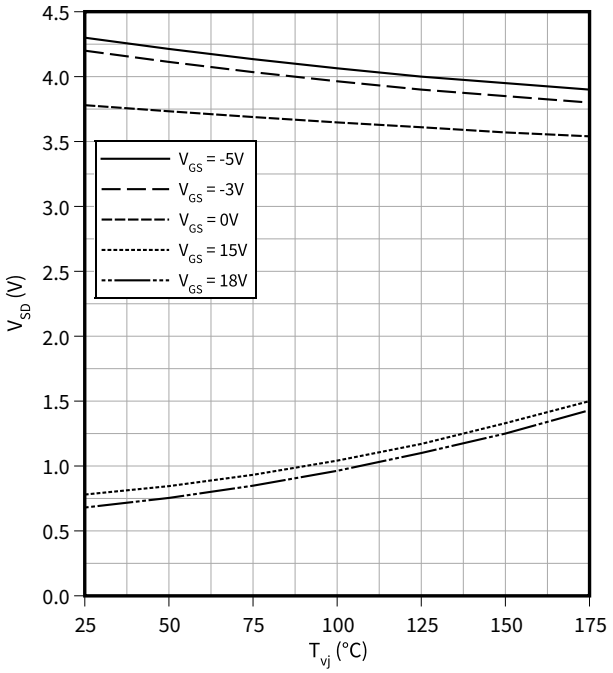
$T_{vj} = 25\ °C$



Forward voltage of body diode (typical), MOSFET, T1 / T4

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

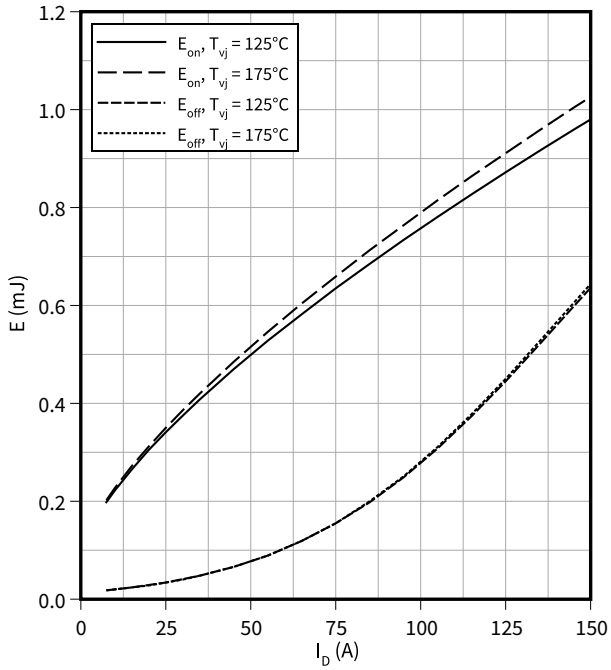
$I_{SD} = 75\ A$



Switching losses (typical), MOSFET, T1 / T4

$E = f(I_D)$

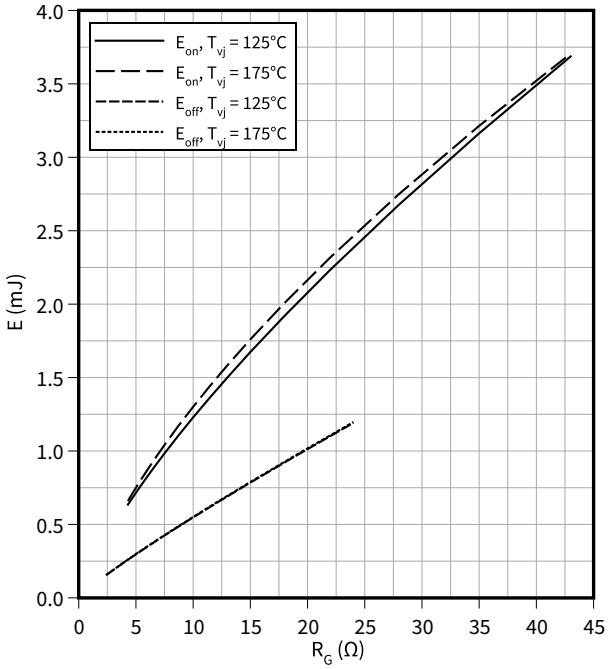
$R_{Goff} = 2.4\ \Omega, R_{Gon} = 4.3\ \Omega, V_{DS} = 400\ V, V_{GS} = -3/18\ V$



Switching losses (typical), MOSFET, T1 / T4

$E = f(R_G)$

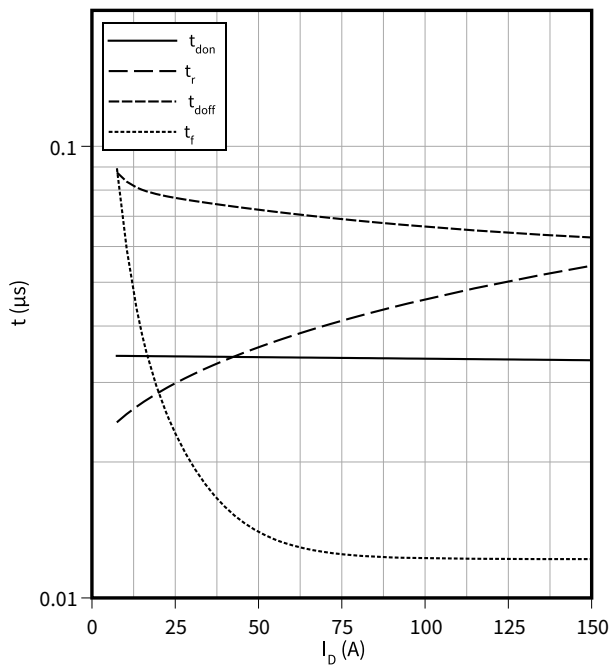
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



Switching times (typical), MOSFET, T1 / T4

$t = f(I_D)$

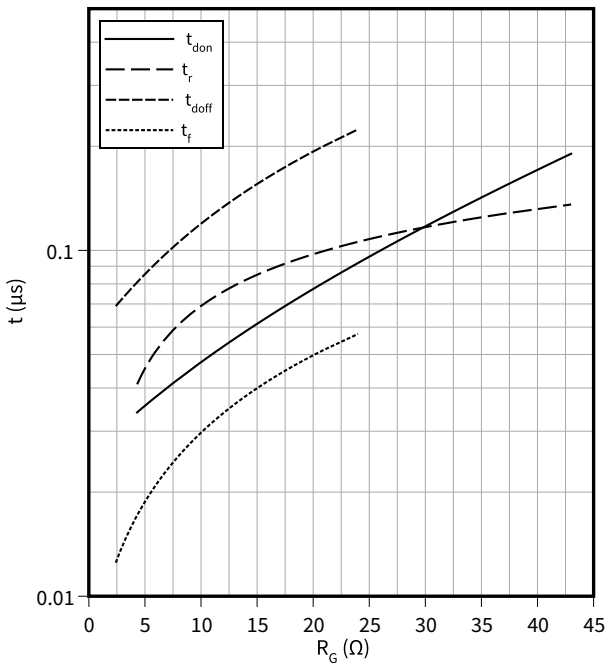
R_{Goff} = 2.4 Ω, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



Switching times (typical), MOSFET, T1 / T4

$t = f(R_G)$

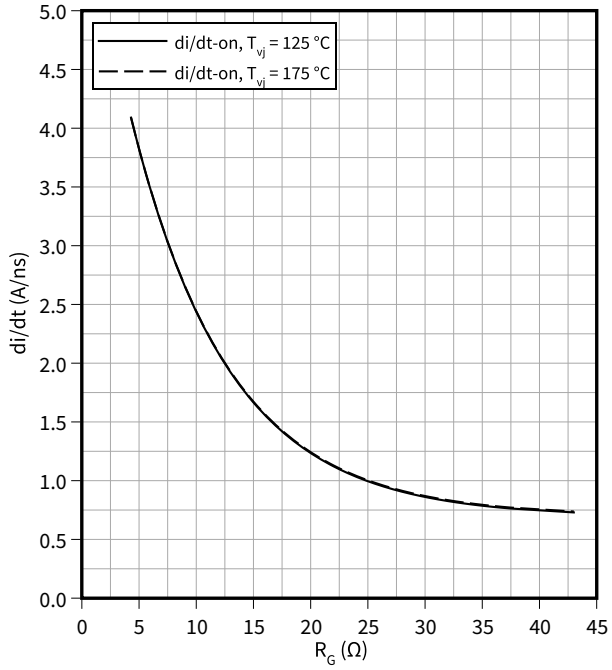
V_{DS} = 400 V, I_D = 75 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



Current slope (typical), MOSFET, T1 / T4

$di/dt = f(R_G)$

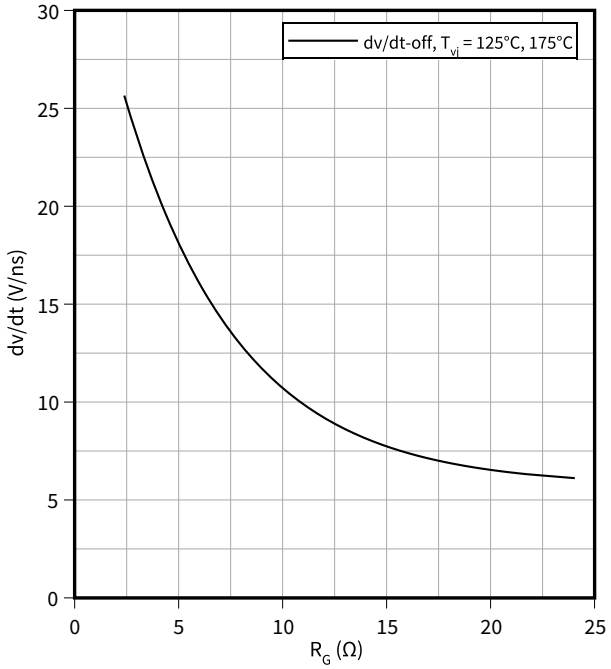
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



Voltage slope (typical), MOSFET, T1 / T4

$dv/dt = f(R_G)$

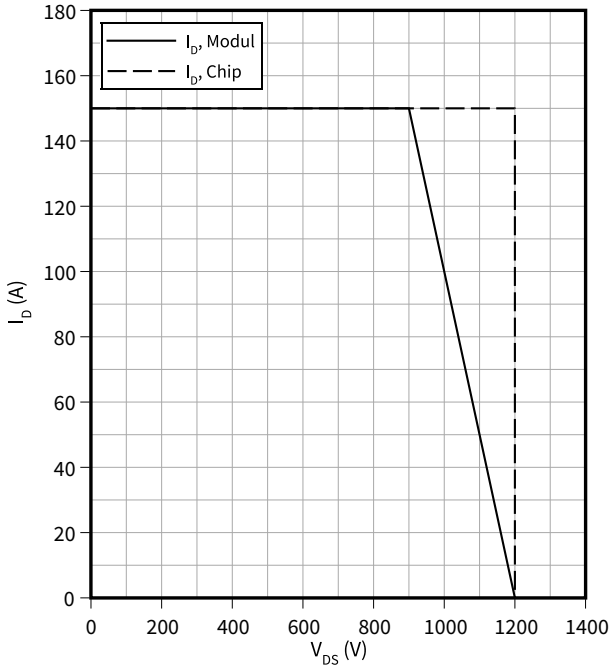
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



Reverse bias safe operating area (RBSOA), MOSFET, T1 / T4

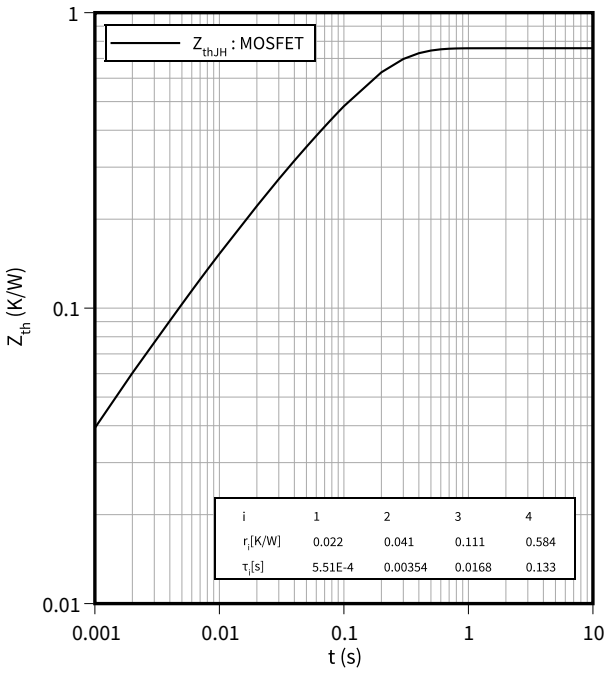
$I_D = f(V_{DS})$

R_{Goff} = 2.4 Ω, T_{vj} = 175 °C, V_{GS} = -3/18 V



Transient thermal impedance , MOSFET, T1 / T4

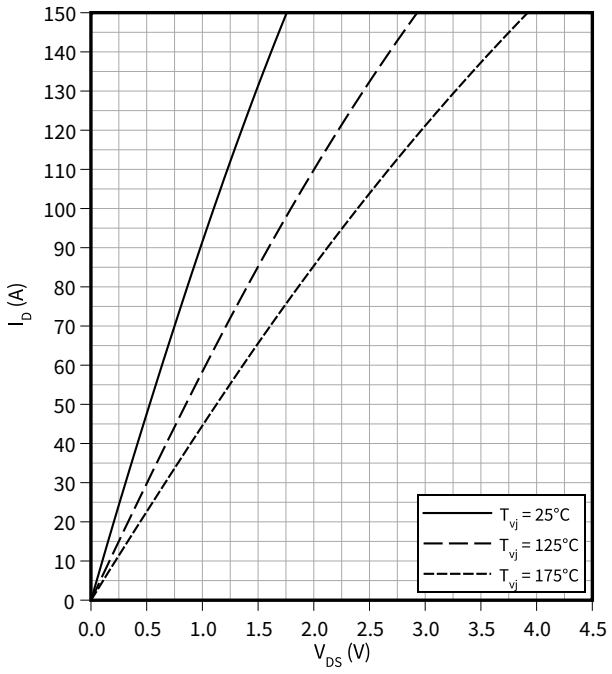
$Z_{th} = f(t)$



Output characteristic (typical), MOSFET, T2 / T3

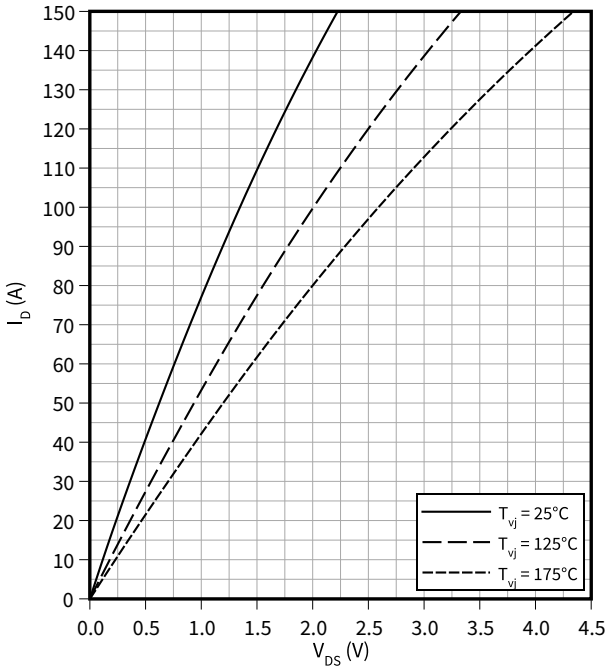
$I_D = f(V_{DS})$

V_{GS} = 18 V



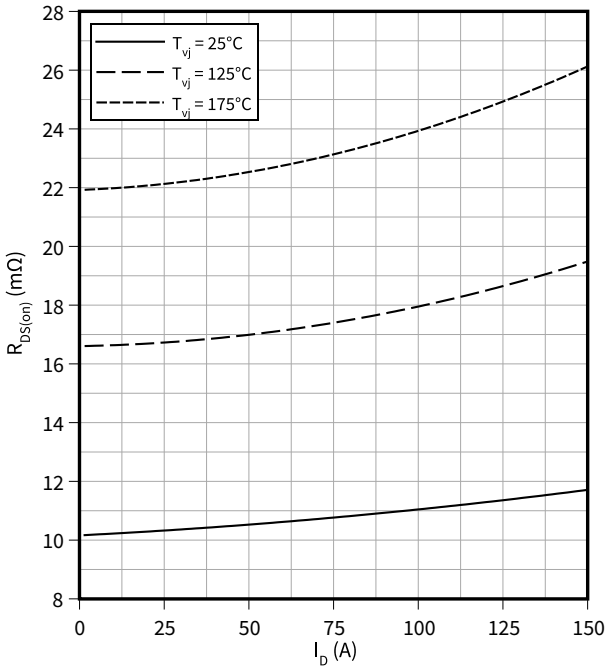
Output characteristic (typical), MOSFET, T2 / T3

$I_D = f(V_{DS})$
$V_{GS} = 15$ V



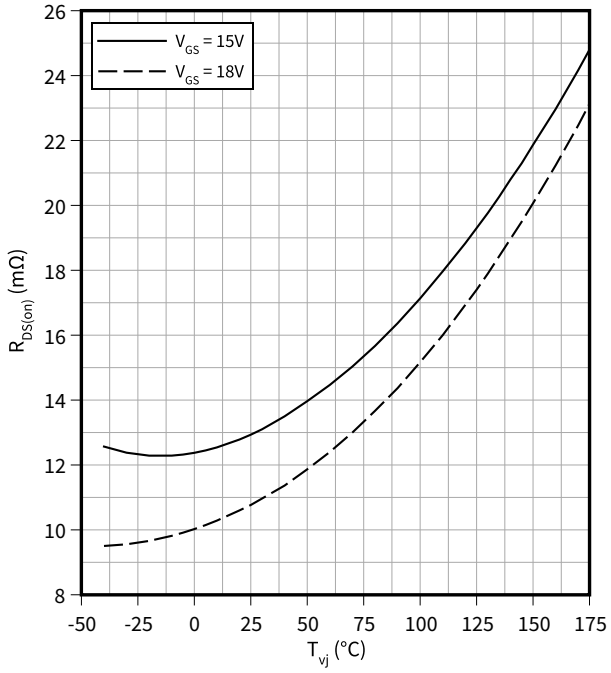
Drain source on-resistance (typical), MOSFET, T2 / T3

$R_{DS(on)} = f(I_D)$
$V_{GS} = 18$ V



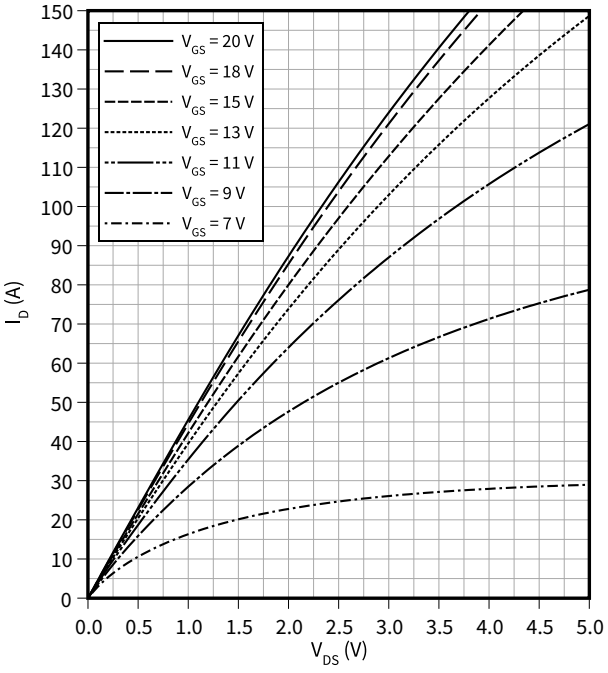
Drain source on-resistance (typical), MOSFET, T2 / T3

$R_{DS(on)} = f(T_{vj})$
$I_D = 75$ A



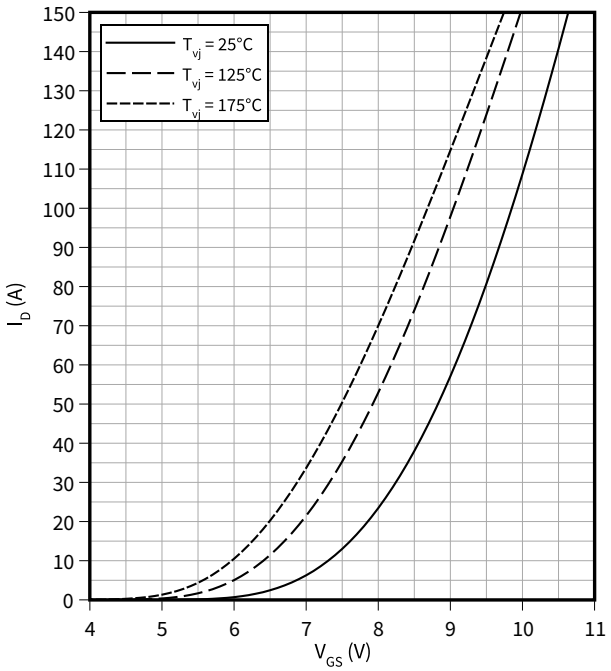
Output characteristic field (typical), MOSFET, T2 / T3

$I_D = f(V_{DS})$
$T_{vj} = 175$ °C



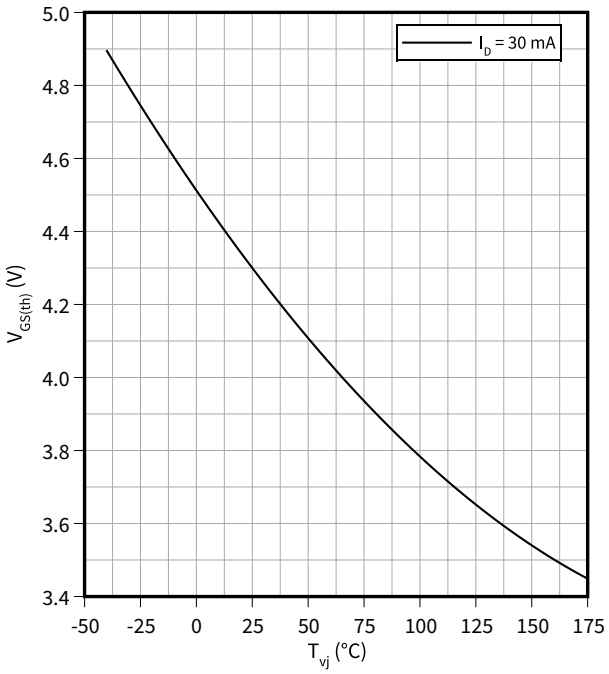
Transfer characteristic (typical), MOSFET, T2 / T3

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



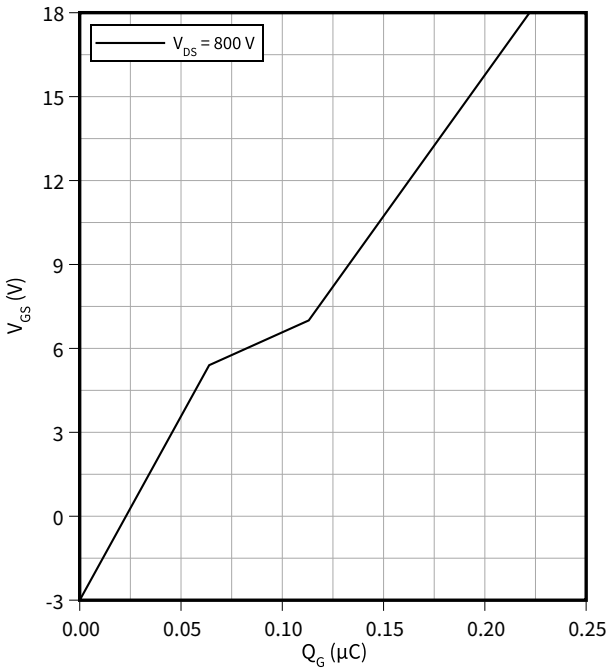
Gate-source threshold voltage (typical), MOSFET, T2 / T3

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



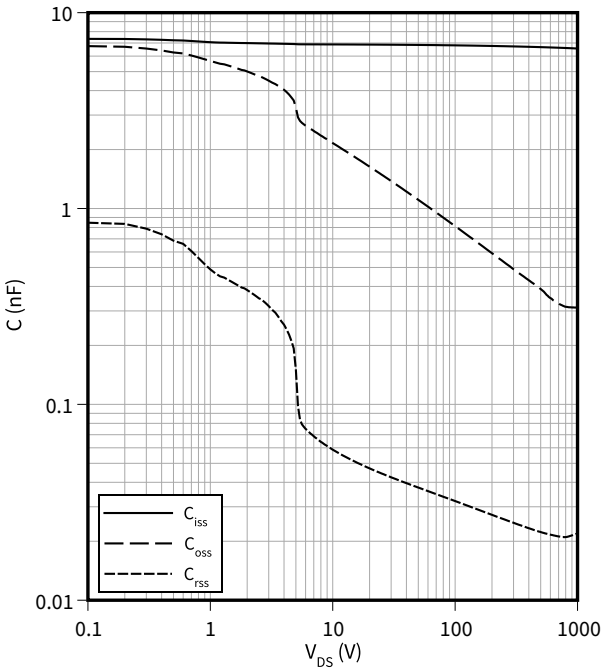
Gate charge characteristic (typical), MOSFET, T2 / T3

$V_{GS} = f(Q_G)$
$I_D = 75$ A, $T_{vj} = 25$ °C



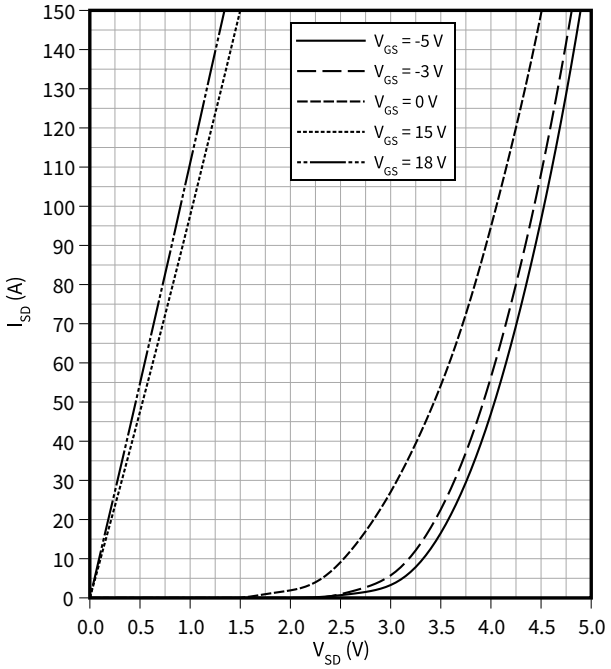
Capacity characteristic (typical), MOSFET, T2 / T3

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



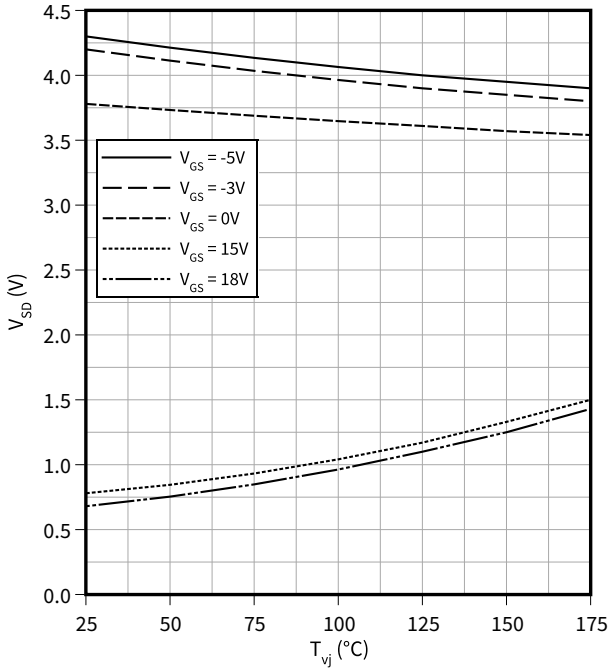
Forward characteristic body diode (typical), MOSFET, T2 / T3

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



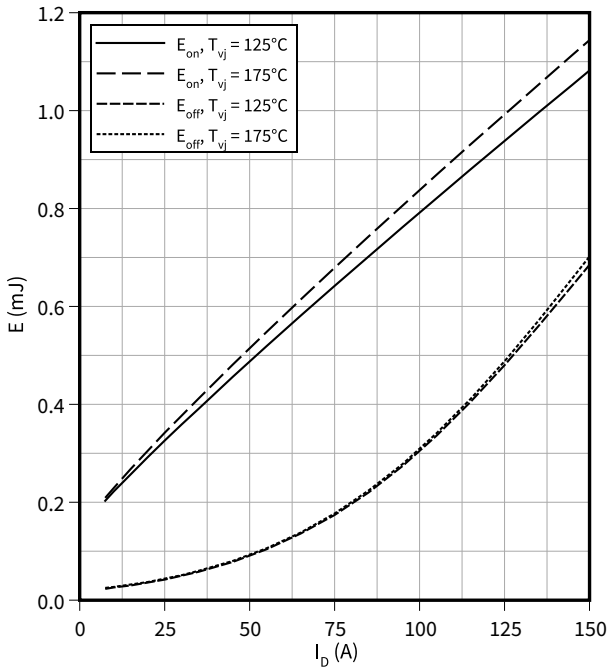
Forward voltage of body diode (typical), MOSFET, T2 / T3

$V_{SD} = f(T_{vj})$
$I_{SD} = 75\ A$



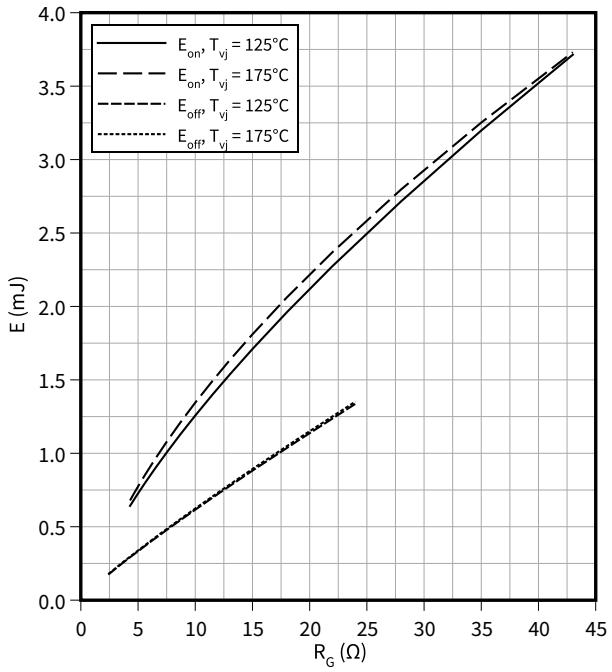
Switching losses (typical), MOSFET, T2 / T3

$E = f(I_D)$
$R_{Goff} = 2.4\ \Omega$, $R_{Gon} = 4.3\ \Omega$, $V_{DS} = 400\ V$, $V_{GS} = -3/18\ V$



Switching losses (typical), MOSFET, T2 / T3

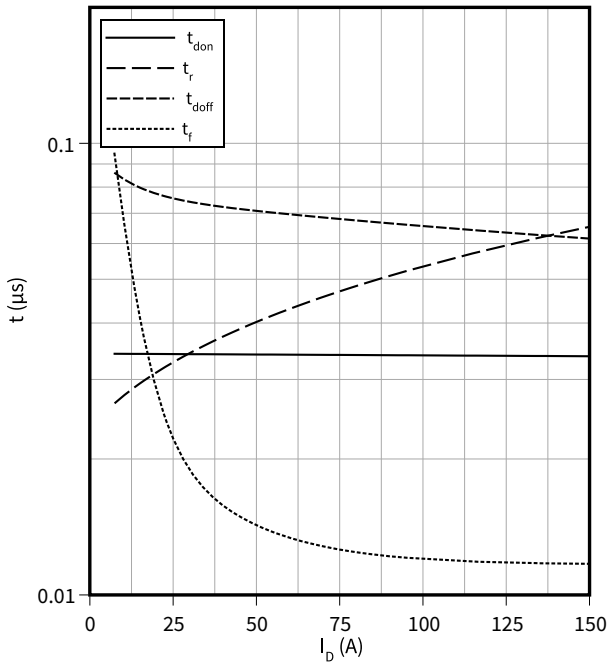
$E = f(R_G)$
$V_{DS} = 400\ V$, $I_D = 75\ A$, $V_{GS} = -3/18\ V$



Switching times (typical), MOSFET, T2 / T3

$t = f(I_D)$

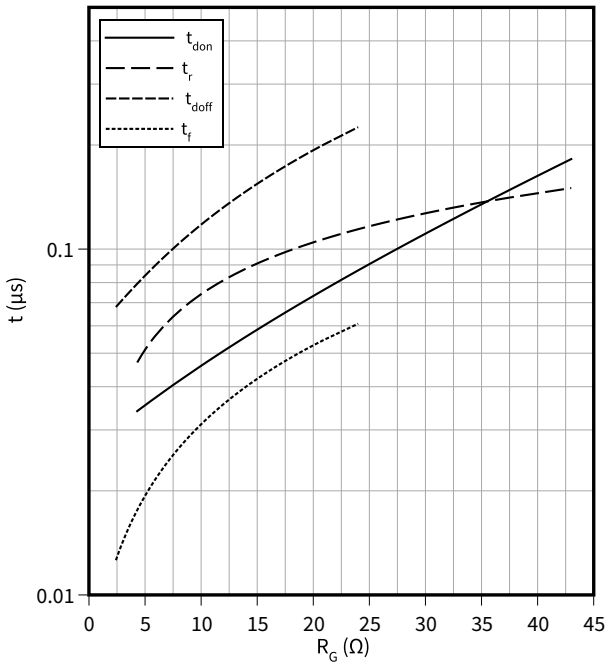
R_{Goff} = 2.4 Ω, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



Switching times (typical), MOSFET, T2 / T3

$t = f(R_G)$

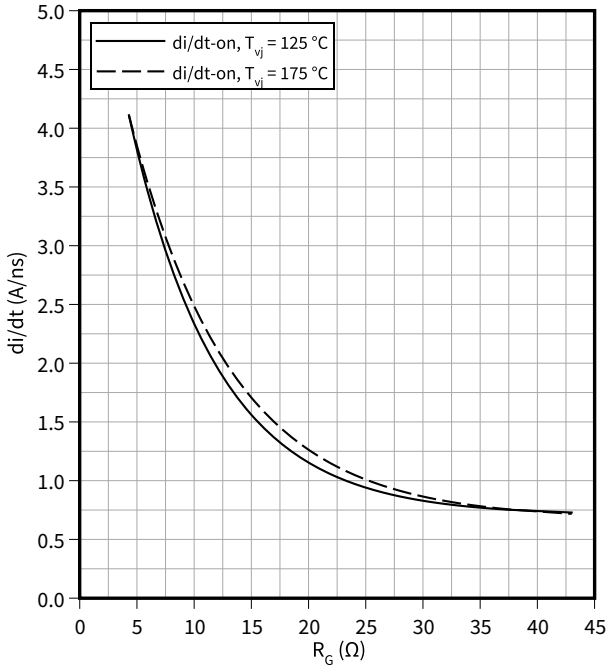
V_{DS} = 400 V, I_D = 75 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



Current slope (typical), MOSFET, T2 / T3

$di/dt = f(R_G)$

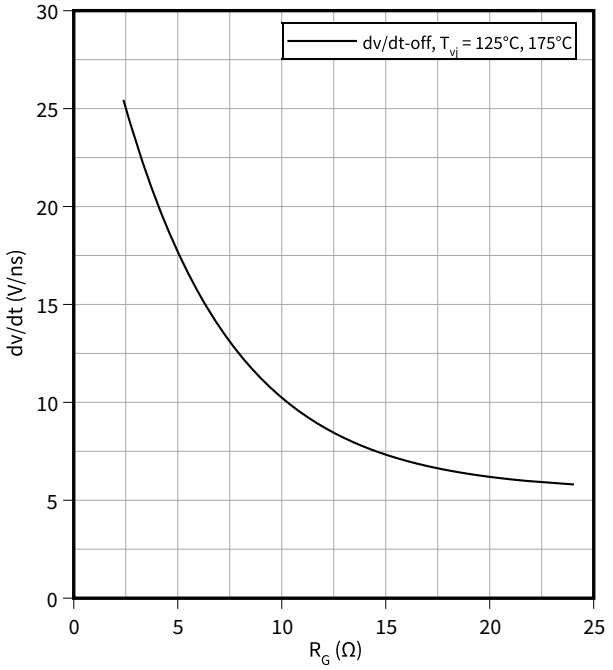
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



Voltage slope (typical), MOSFET, T2 / T3

$dv/dt = f(R_G)$

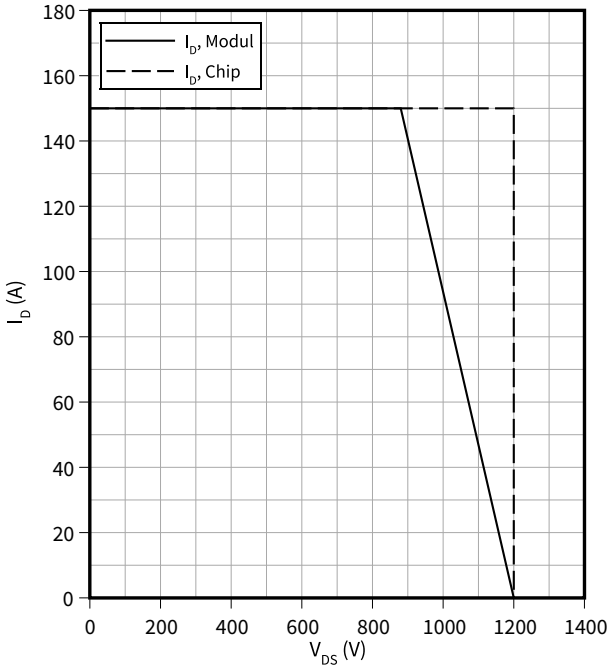
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



Reverse bias safe operating area (RBSOA), MOSFET, T2 / T3

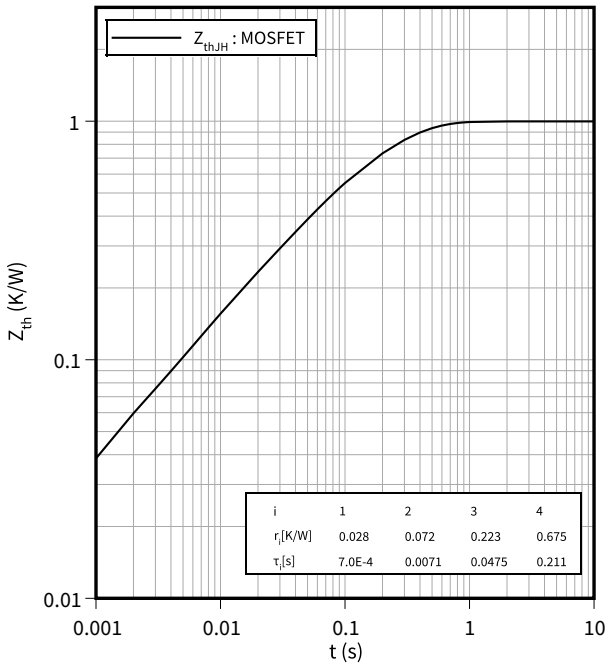
$I_D = f(V_{DS})$

R_{Goff} = 2.4 Ω, T_{vj} = 175 °C, V_{GS} = -3/18 V



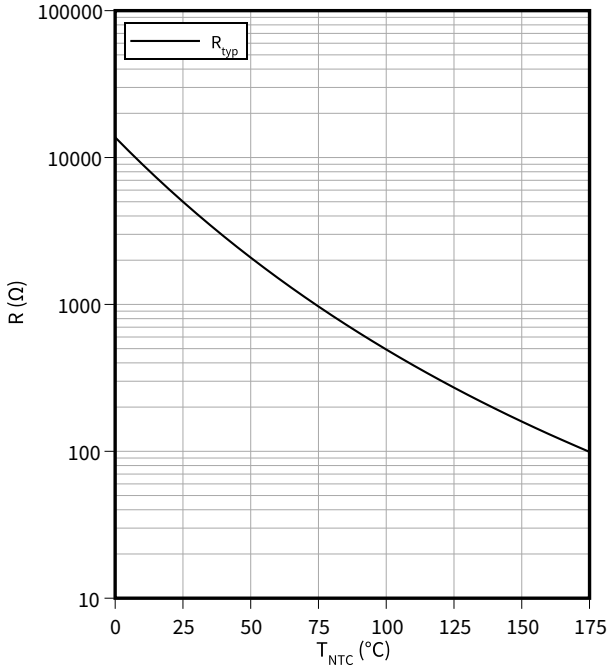
Transient thermal impedance , MOSFET, T2 / T3

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



8 Circuit diagram

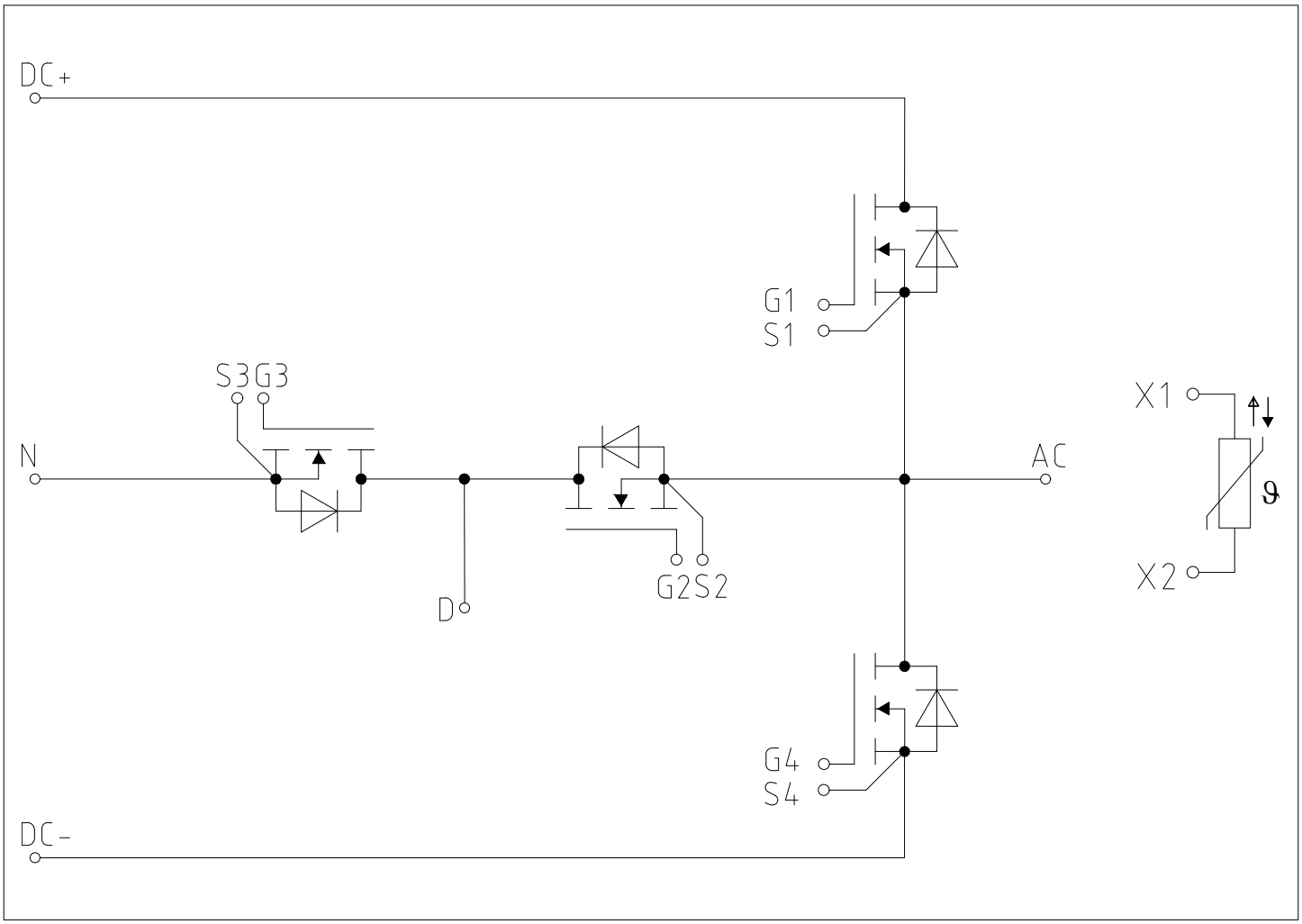


Figure 1

9 Package outlines

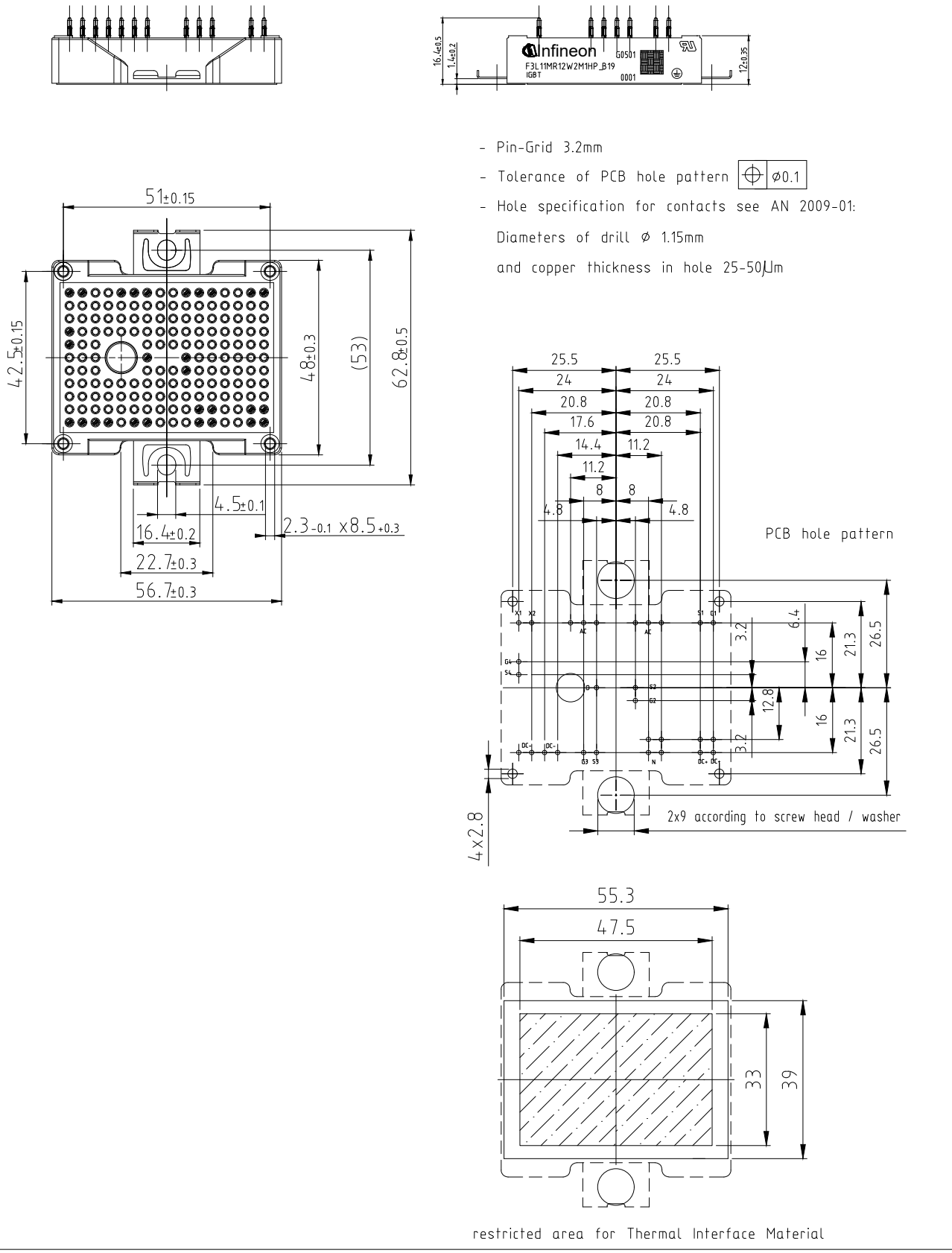


Figure 2

10 Module label code

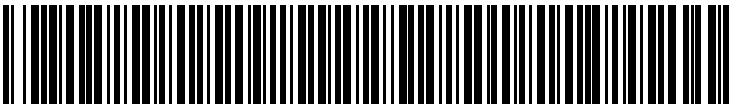
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 71549142846550549911530	 71549142846550549911530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
0.10	2022-02-23	Initial version
0.20	2022-06-01	Preliminary datasheet

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