Preliminary datasheet

EasyPACK™ 模块 采用 CoolSiC™ Trench MOSFET 带有 PressFIT 压接管脚和温度检测 NTC / TIM

特性


Typical appearance

- 电气特性
  - V_{DSS} = 1200 V
  - I_{DN} = 75 A / I_{DRM} = 150 A
  - 高电流密度
  - 低开关损耗
- 机械特性
  - 集成的安装夹使安装坚固
  - 集成 NTC 温度传感器
  - PressFIT 压接技术
  - 预涂导热介质

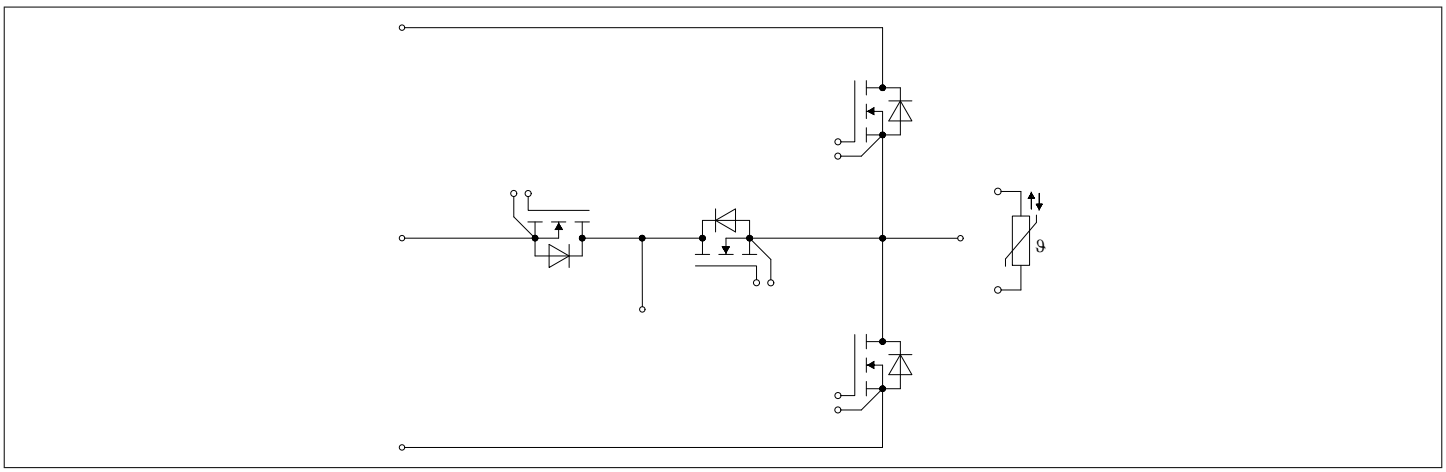
可选应用

- 太阳能应用
- 三电平应用
- 电动车直流充电

产品认证

- 根据 IEC 60747、60749 和 60068 标准的相关测试，符合工业应用的要求。

描述



内容

1 封装

表 1 绝缘参数

特征参数	代号	标注或测试条件	数值	单位
绝缘测试电压	V_{ISOL}	RMS, f = 50 Hz, *t* = 1 min	3.0	kV
内部绝缘		基本绝缘 (class 1, IEC 61140)	Al_2O_3	
爬电距离	d_{Creep}	端子至散热器	11.5	mm
爬电距离	d_{Creep}	端子至端子	6.3	mm
电气间隙	d_{Clear}	端子至散热器	10.0	mm
电气间隙	d_{Clear}	端子至端子	5.0	mm
相对电痕指数	*CTI*		> 200	
相对温度指数 (电)	*RTI*	封装	140	°C

表 2 特征值

特征参数	代号	标注或测试条件	数值			单位
			最小值	典型值	最大值	
杂散电感,模块	L_{sCE}			21		nH
模块引线电阻,端子-芯片	$R_{CC'+EE'}$	T_H=25°C, 每个开关		1.5		mΩ
储存温度	T_{stg}		-40		125	°C
最高基板工作温度	T_{BPmax}				125	°C
Mounting force per clamp	*F*		40		80	N
重量	*G*			39		g

注: 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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表 3 最大标定值

特征参数	代号	标注或测试条件		数值	单位
漏源极电压	V_{DSS}		T_{vj} = 25 °C	1200	V
植入漏极电流	I_{DN}			75	A
连续漏极直流电流	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 65 °C	65	A
漏极重复峰值电流	I_{DRM}	verified by design, t_p limited by T_{vjmax}		150	A
栅-源瞬态最大电压	V_{GS}	*D* < 0.01		-10/23	V

(待续)

表 3　　(续) 最大标定值

特征参数	代号	标注或测试条件	数值	单位
栅-源稳态最大电压	V_{GS}		-7/20	V

表 4　　推荐值

特征参数	代号	标注或测试条件	[ZH]Values	单位
通态栅极电压	$V_{GS(on)}$		15...18	V
断态栅极电压	$V_{GS(off)}$		-5...0	V

表 5　　特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
漏源通态电阻	$R_{DS(on)}$	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		
栅极阈值电压	$V_{GS(th)}$	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
栅极电荷	Q_G	V_{DS}=800 V, V_{GS} = -3/18 V			0.223		µC
内部栅极电阻	R_{Gint}	T_{vj}=25 °C			2.7		Ω
输入电容	C_{ISS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		6.6		nF
输出电容	C_{OSS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.315		nF
反向传输电容	C_{rss}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.021		nF
C_{OSS} 存储能量	E_{OSS}	V_{DS}=800 V, V_{GS} = -3/18 V, T_{vj}=25 °C			129		µJ
漏源泄漏电流	I_{DSS}	V_{DS}=1200 V, V_{GS}=-3 V	T_{vj}=25 °C		0.045	300	µA
栅极漏电流	I_{GSS}	V_{DS} = 0 V, T_{vj}=25 °C	V_{GS}=20 V			400	nA
开通延迟时间(感性负载)	$t_{d\,on}$	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		
上升时间(感性负载)	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		

(待续)

表 5 (续) 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
关断延迟时间(感性负载)	$t_{d\,off}$	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		
下降时间(感性负载)	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		
开通损耗能量 (每脉冲)	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		
关断损耗能量 (每脉冲）	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		
结－散热器热阻	R_{thJH}	每个 MOSFET , Valid with IFX pre-applied Thermal Interface Material				0.758	K/W
允许开关的温度范围	$T_{vj\,op}$			-40		175	°C

注: *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.

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表 6 最大标定值

特征参数	代号	标注或测试条件		数值	单位
体二极管正向直流电流	I_{SD}	T_{vj} = 175 °C, V_{GS} = -3 V	T_H = 65 °C	24	A

表 7 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
正向电压	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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表 8 最大标定值

特征参数	代号	标注或测试条件		数值	单位
漏源极电压	V_{DSS}		T_{vj} = 25 °C	1200	V
植入漏极电流	I_{DN}			75	A
连续漏极直流电流	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 65 °C	55	A
漏极重复峰值电流	I_{DRM}	verified by design, t_p limited by T_{vjmax}		150	A
栅-源瞬态最大电压	V_{GS}	D < 0.01		-10/23	V
栅-源稳态最大电压	V_{GS}			-7/20	V

表 9 推荐值

特征参数	代号	标注或测试条件	[ZH]Values	单位
通态栅极电压	$V_{GS(on)}$		15...18	V
断态栅极电压	$V_{GS(off)}$		-5...0	V

表 10 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
漏源通态电阻	$R_{DS(on)}$	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		
栅极阈值电压	$V_{GS(th)}$	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
栅极电荷	Q_G	V_{DS}=800 V, V_{GS} = -3/18 V			0.223		µC
内部栅极电阻	R_{Gint}	T_{vj}=25 °C			2.7		Ω
输入电容	C_{ISS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		6.6		nF
输出电容	C_{OSS}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.315		nF
反向传输电容	C_{rss}	f = 100 kHz, V_{DS}=800 V, V_{GS}=0 V	T_{vj}=25 °C		0.021		nF
C_{OSS} 存储能量	E_{OSS}	V_{DS}=800 V, V_{GS} = -3/18 V, T_{vj}=25 °C			129		µJ
漏源泄漏电流	I_{DSS}	V_{DS}=1200 V, V_{GS}=-3 V	T_{vj}=25 °C		0.045	300	µA
栅极漏电流	I_{GSS}	V_{DS} = 0 V, T_{vj}=25 °C	V_{GS}=20 V			400	nA

(待续)

表 10　　(续) 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
开通延迟时间(感性负载)	$t_{d\,on}$	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		
上升时间(感性负载)	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		
关断延迟时间(感性负载)	$t_{d\,off}$	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		
下降时间(感性负载)	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		
开通损耗能量 (每脉冲)	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		
关断损耗能量 (每脉冲）	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		
结－散热器热阻	R_{thJH}	每个 MOSFET , Valid with IFX pre-applied Thermal Interface Material				0.998	K/W
允许开关的温度范围	$T_{vj\,op}$			-40		175	°C

注: *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.

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表 11　　最大标定值

特征参数	代号	标注或测试条件		数值	单位
体二极管正向直流电流	I_{SD}	T_{vj} = 175 °C, V_{GS} = -3 V	T_H = 65 °C	24	A

表 12 特征值

特征参数	代号	标注或测试条件		数值			单位
				最小值	典型值	最大值	
正向电压	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		

6 负温度系数热敏电阻

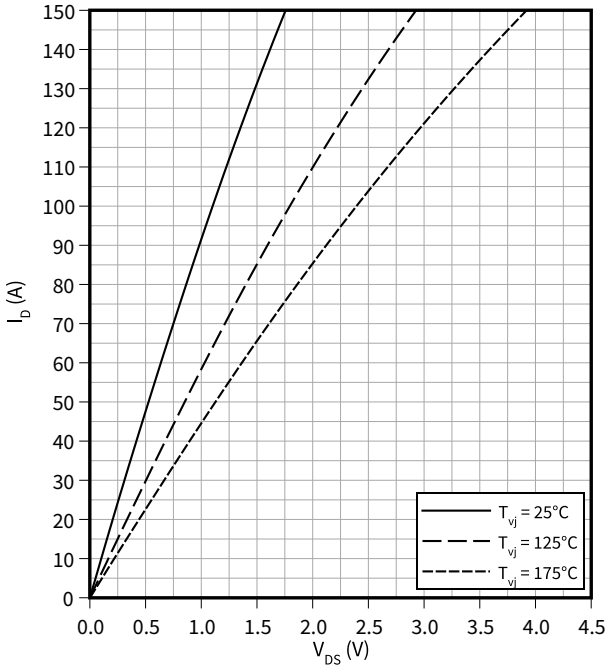
表 13 特征值

特征参数	代号	标注或测试条件	数值			单位
			最小值	典型值	最大值	
额定电阻值	R_{25}	T_{NTC} = 25 °C		5		kΩ
R_{100} 偏差	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
耗散功率	P_{25}	T_{NTC} = 25 °C			20	mW
B-值	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2-1/(298,15\ K))]$		3375		K
B-值	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2-1/(298,15\ K))]$		3411		K
B-值	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2-1/(298,15\ K))]$		3433		K

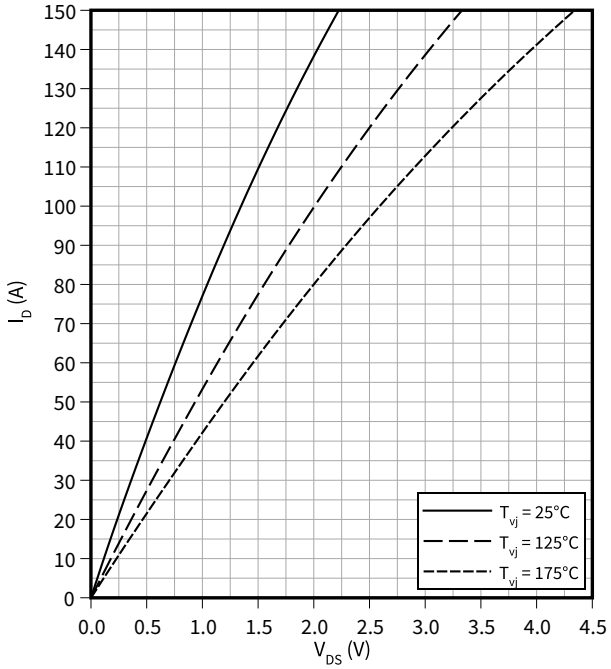
注: 根据应用手册标定

7 特征参数图表

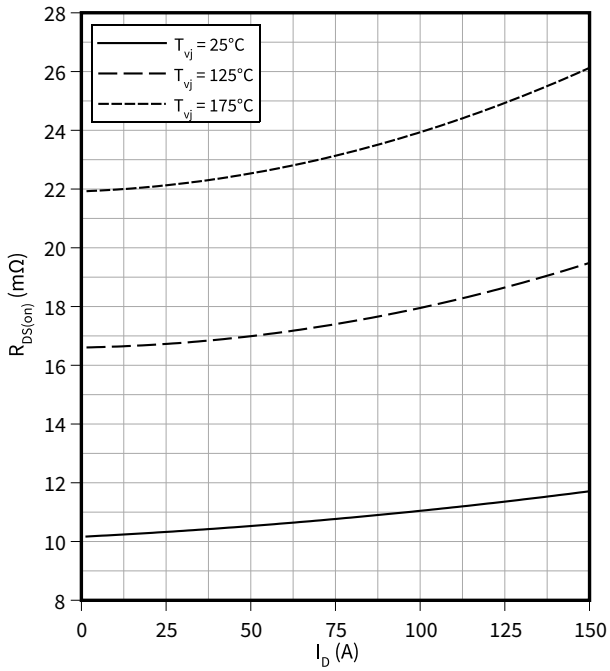
输出特性 （典型), MOSFET, T1 / T4
$I_D = f(V_{DS})$
V_{GS} = 18 V



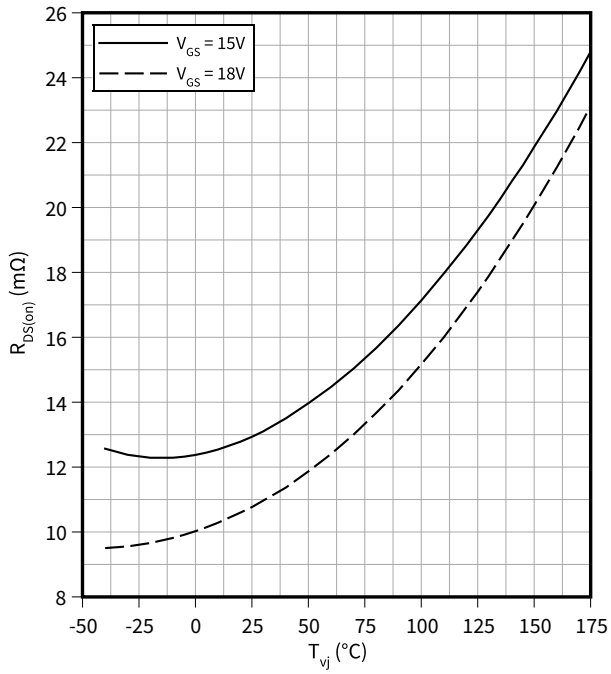
输出特性 （典型), MOSFET, T1 / T4
$I_D = f(V_{DS})$
V_{GS} = 15 V



漏源通态电阻 （典型), MOSFET, T1 / T4
$R_{DS(on)} = f(I_D)$
V_{GS} = 18 V

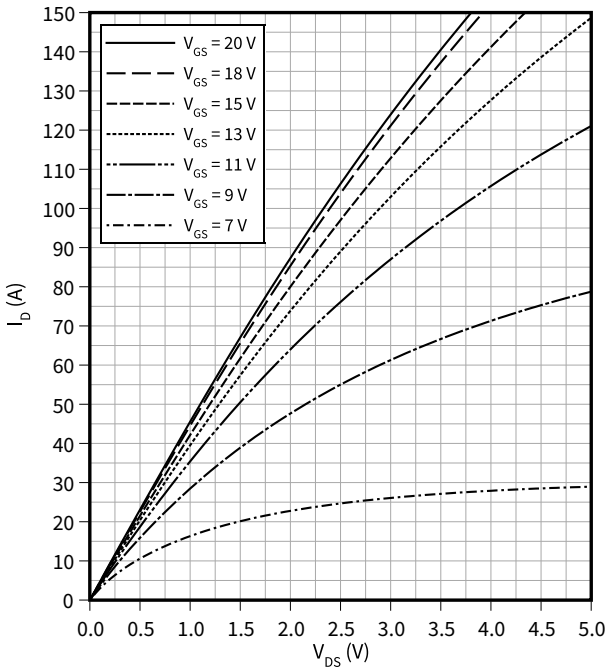


漏源通态电阻 （典型), MOSFET, T1 / T4
$R_{DS(on)} = f(T_{vj})$
I_D = 75 A



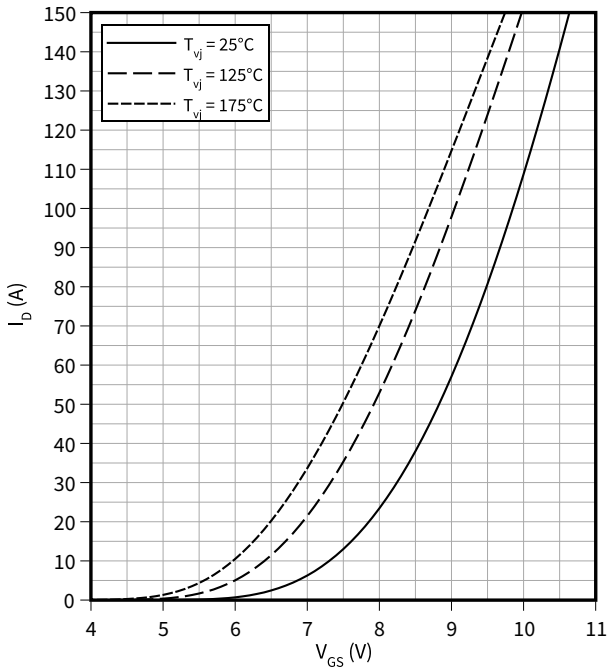
输出特性 （典型), MOSFET, T1 / T4

$I_D = f(V_{DS})$
$T_{vj} = 175\ °C$



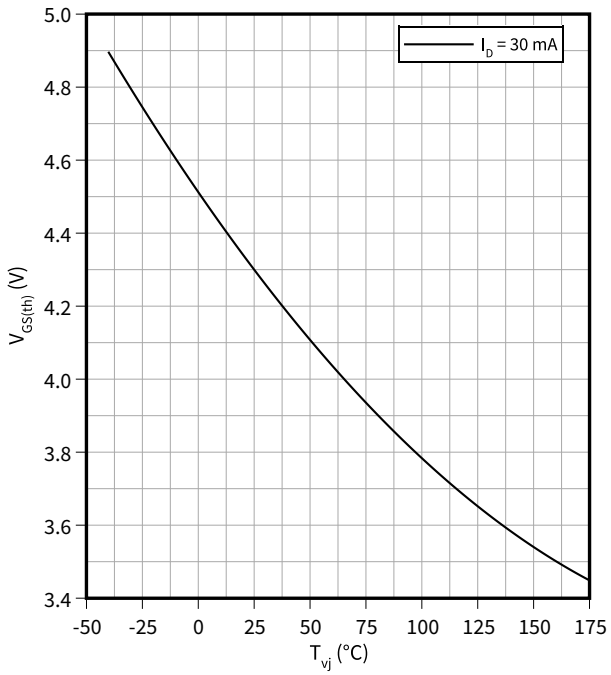
传输特性 （典型), MOSFET, T1 / T4

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



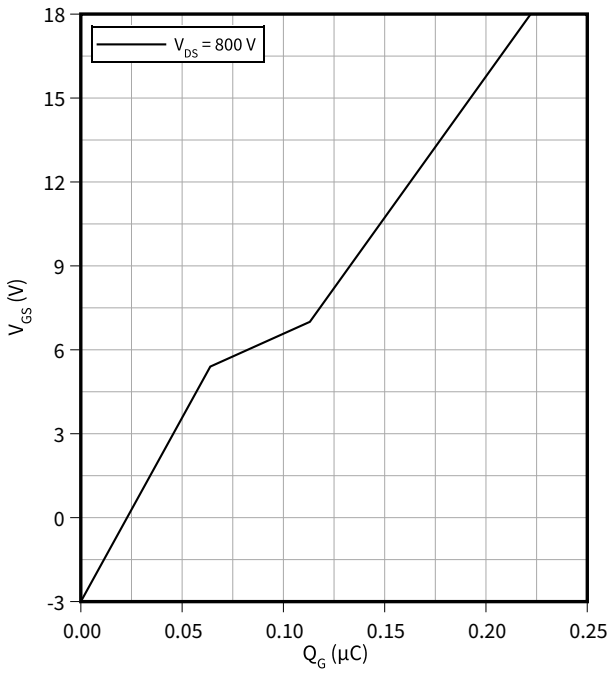
栅-源阀值电压（典型）, MOSFET, T1 / T4

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



栅极电荷特性 （典型), MOSFET, T1 / T4

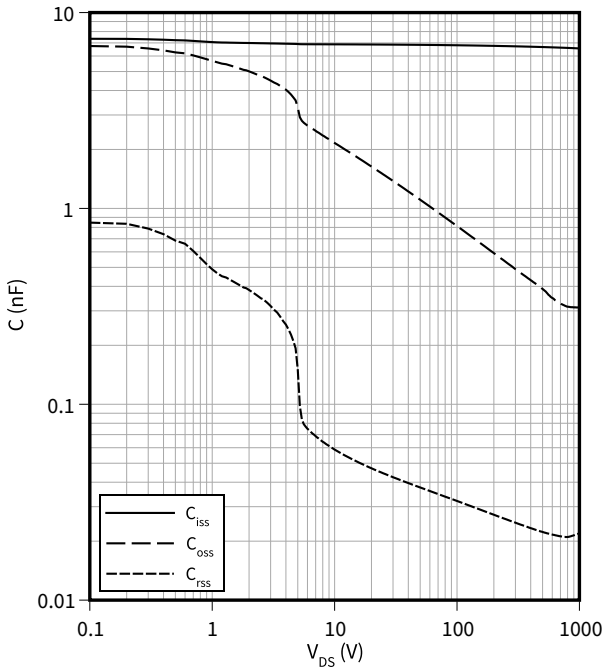
$V_{GS} = f(Q_G)$
$I_D = 75\ A,\ T_{vj} = 25\ °C$



电容特性 （典型), MOSFET, T1 / T4

$C = f(V_{DS})$

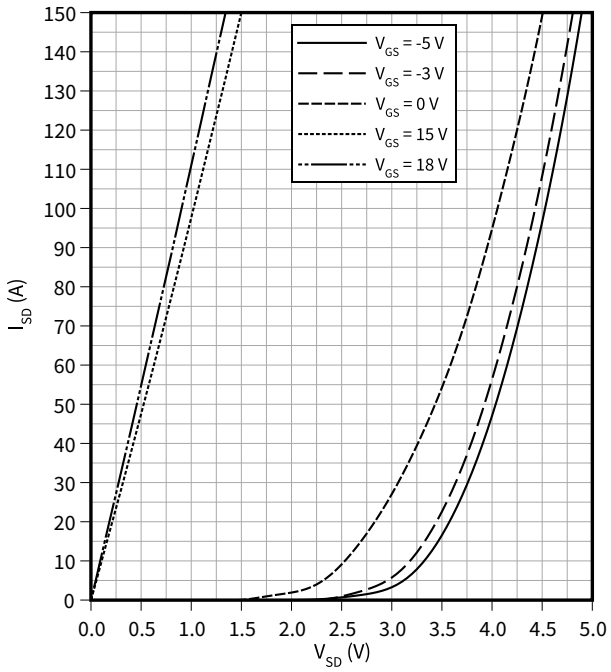
$f = 100\ kHz, T_{vj} = 25\ °C, V_{GS} = 0\ V$



正向特性 体二极管（典型), MOSFET, T1 / T4

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

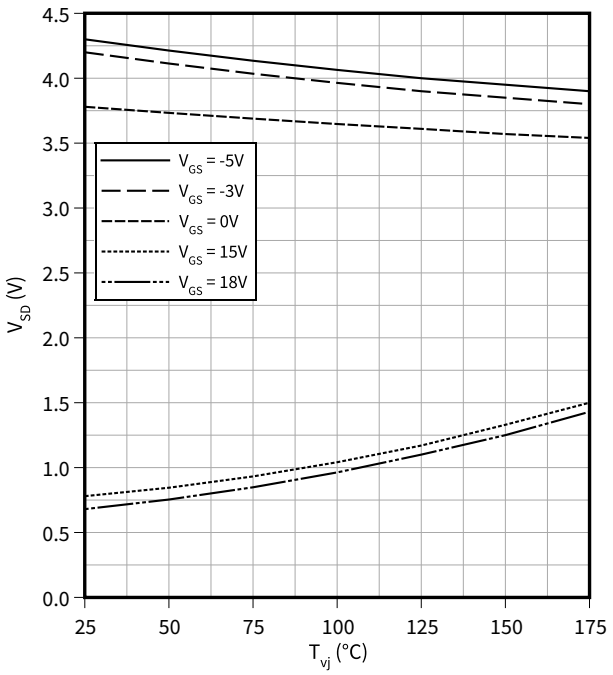
$T_{vj} = 25\ °C$



体二极管正向压降（典型), MOSFET, T1 / T4

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

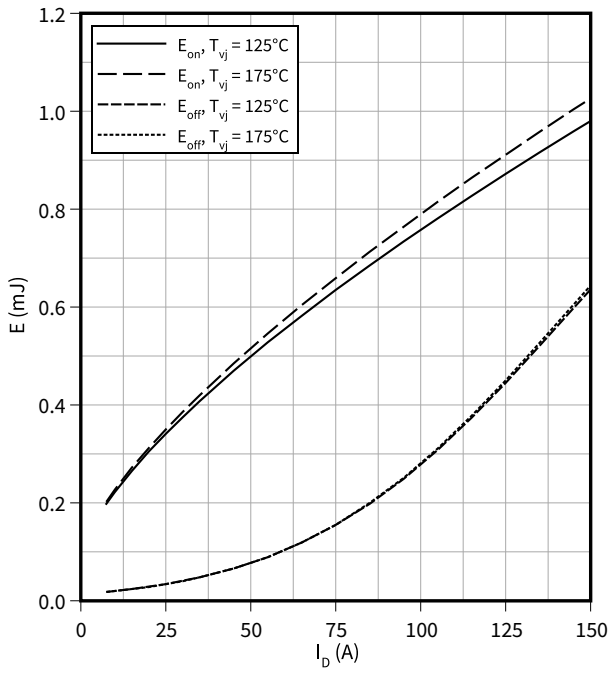
$I_{SD} = 75\ A$



开关损耗 （典型), MOSFET, T1 / T4

$E = f(I_D)$

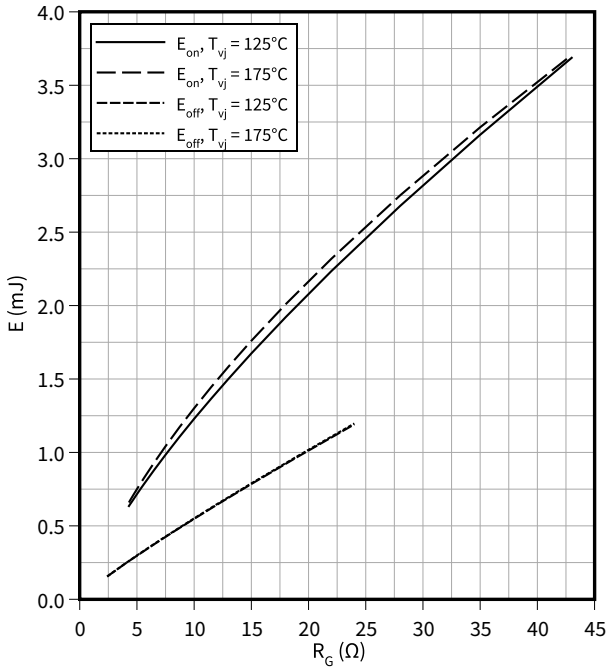
$R_{Goff} = 2.4\ \Omega, R_{Gon} = 4.3\ \Omega, V_{DS} = 400\ V, V_{GS} = -3/18\ V$



开关损耗 （典型), MOSFET, T1 / T4

$E = f(R_G)$

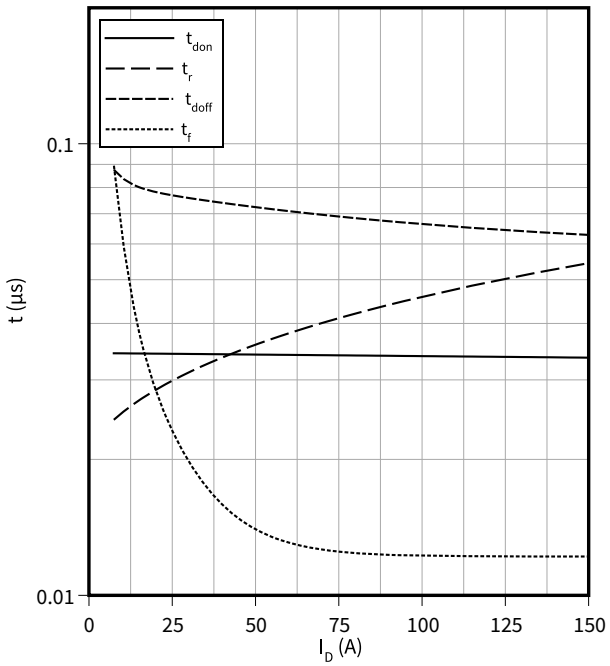
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



开关时间 （典型), MOSFET, T1 / T4

$t = f(I_D)$

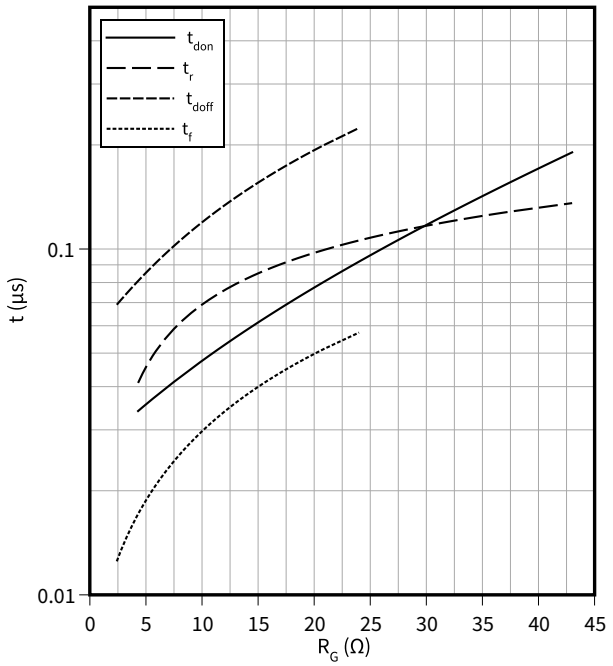
R_{Goff} = 2.4 Ω, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



开关时间 （典型), MOSFET, T1 / T4

$t = f(R_G)$

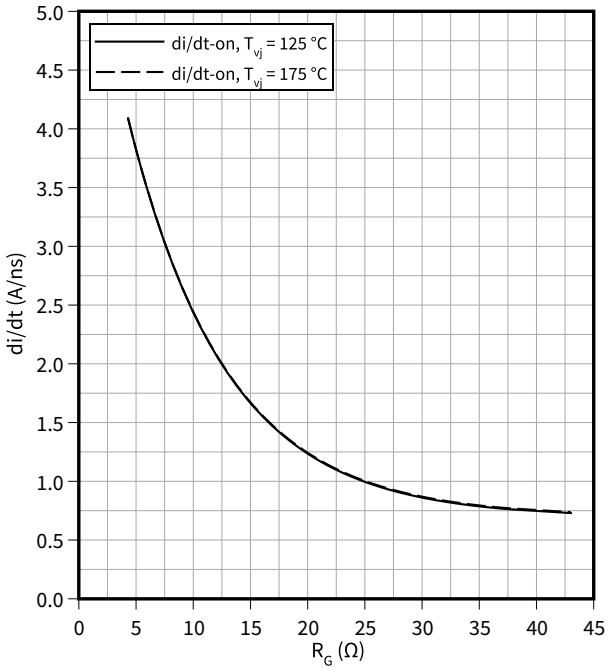
V_{DS} = 400 V, I_D = 75 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



电流变化斜率 （典型), MOSFET, T1 / T4

$di/dt = f(R_G)$

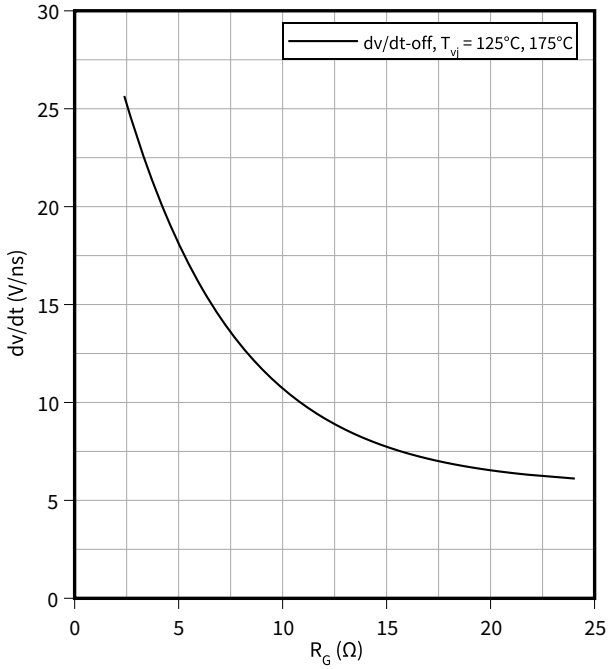
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



电压变化斜率 （典型), MOSFET, T1 / T4

$dv/dt = f(R_G)$

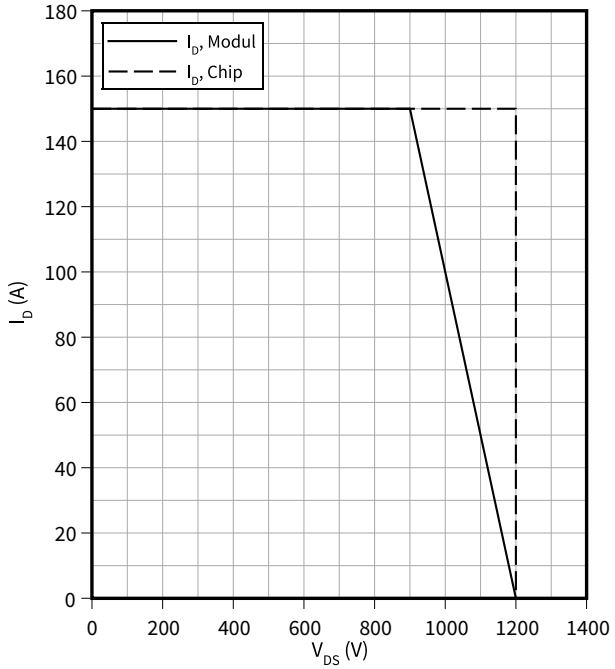
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



反偏安全工作区 （RBSOA）, MOSFET, T1 / T4

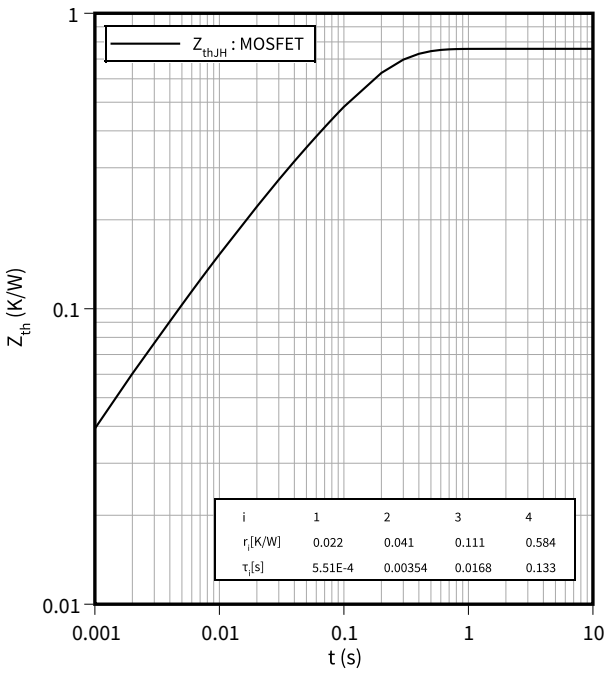
$I_D = f(V_{DS})$

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



瞬态热阻抗 , MOSFET, T1 / T4

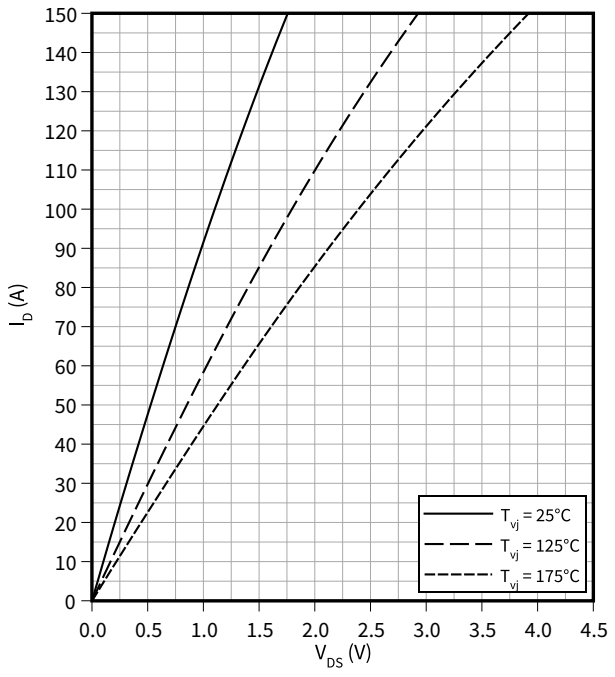
$Z_{th} = f(t)$



输出特性 （典型), MOSFET, T2 / T3

$I_D = f(V_{DS})$

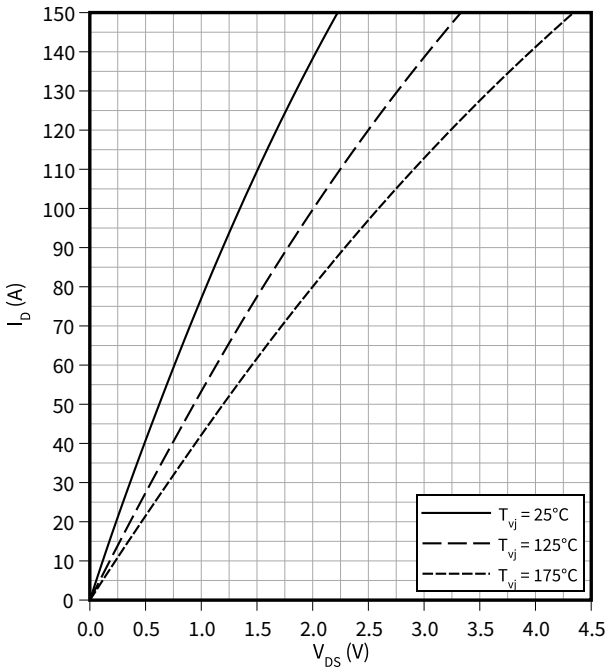
V_{GS} = 18 V



输出特性 （典型), MOSFET, T2 / T3

$I_D = f(V_{DS})$

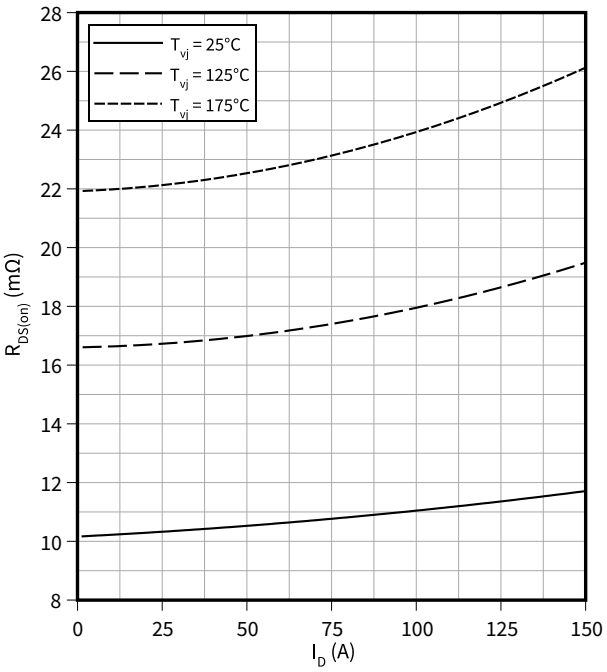
$V_{GS} = 15$ V



漏源通态电阻 （典型), MOSFET, T2 / T3

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

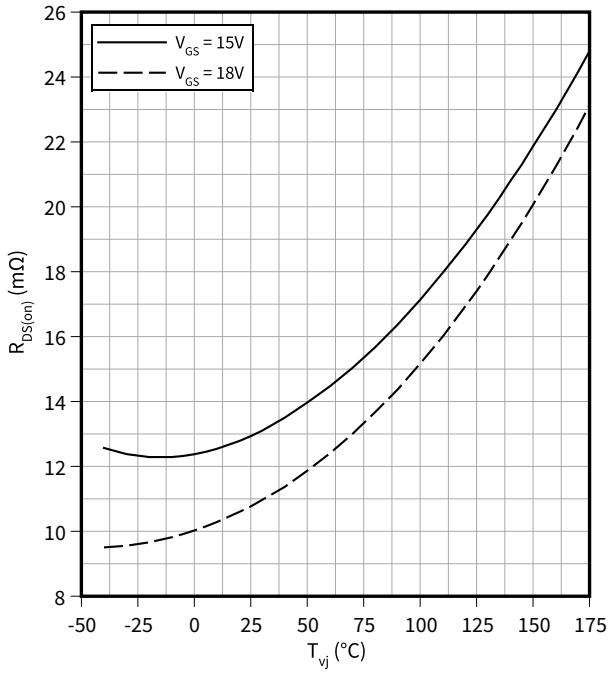
$V_{GS} = 18$ V



漏源通态电阻 （典型), MOSFET, T2 / T3

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

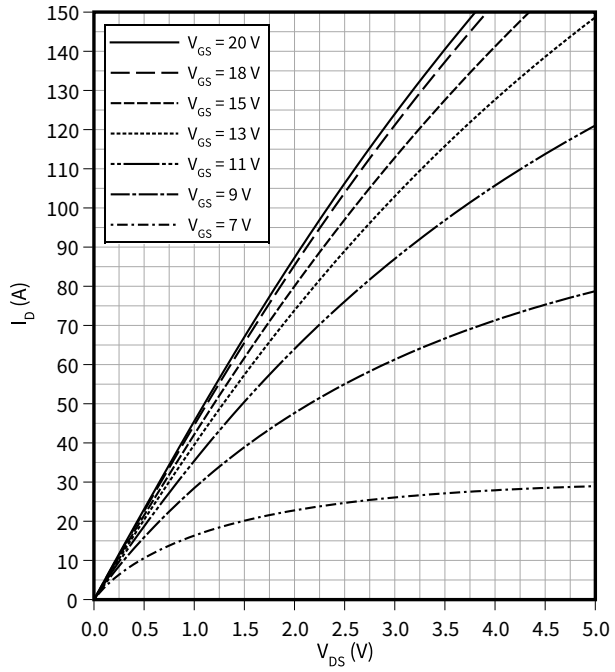
$I_D = 75$ A



输出特性 （典型), MOSFET, T2 / T3

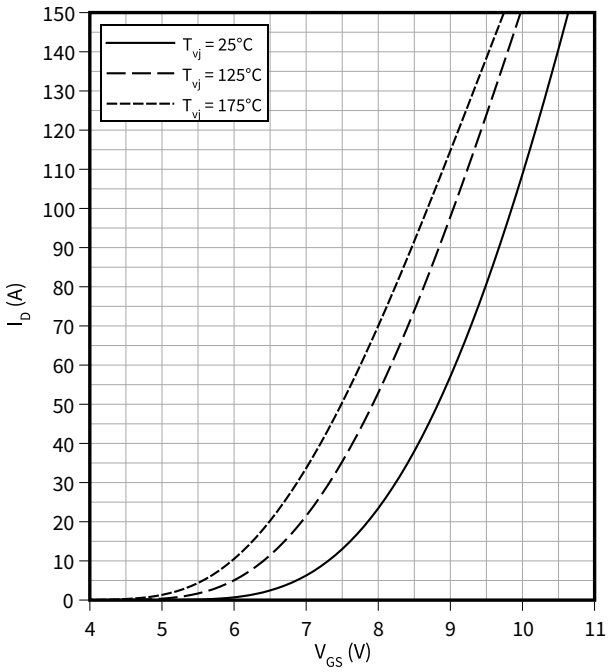
$I_D = f(V_{DS})$

$T_{vj} = 175$ °C



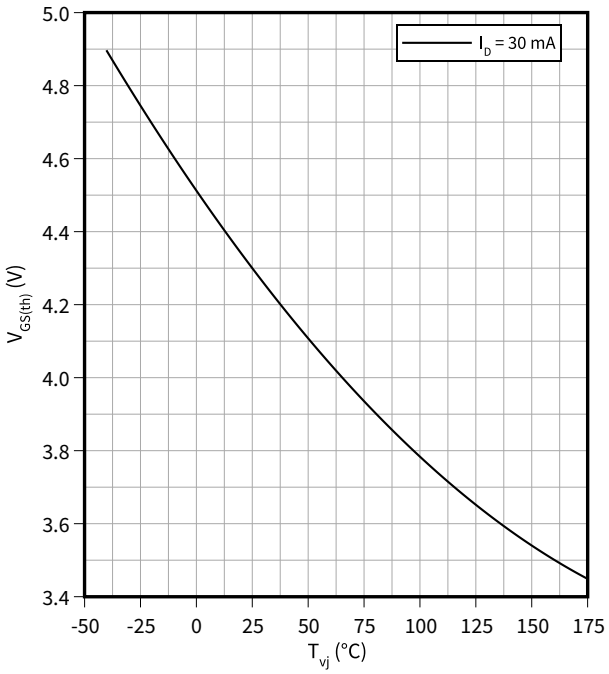
传输特性 （典型), MOSFET, T2 / T3

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



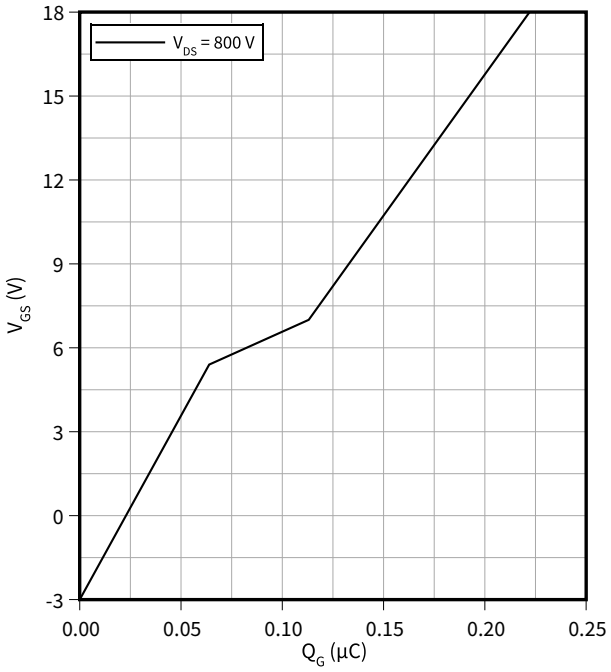
栅-源阀值电压（典型）, MOSFET, T2 / T3

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



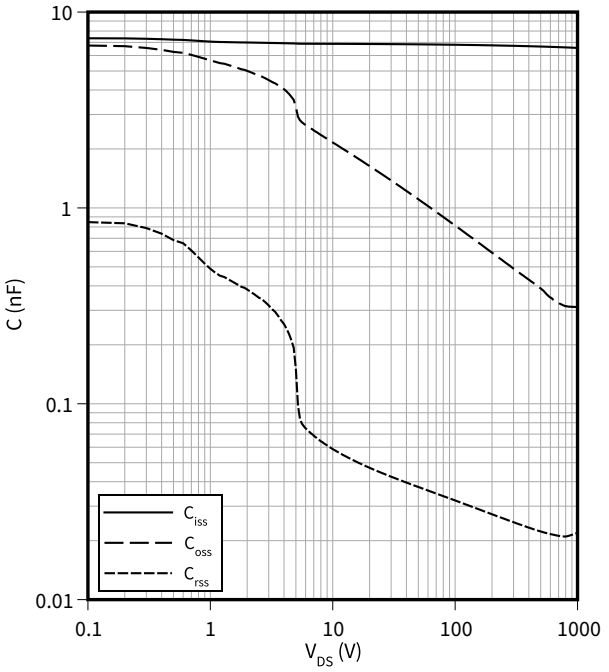
栅极电荷特性 （典型), MOSFET, T2 / T3

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



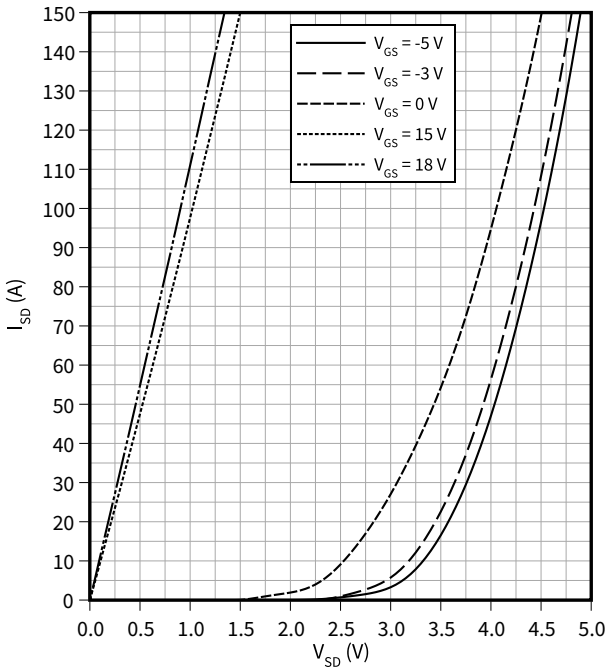
电容特性 （典型), MOSFET, T2 / T3

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



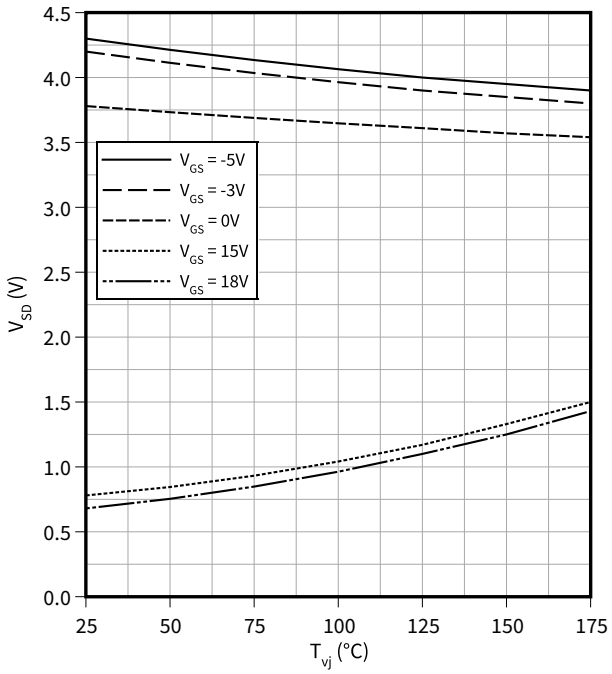
正向特性 体二极管（典型), MOSFET, T2 / T3

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



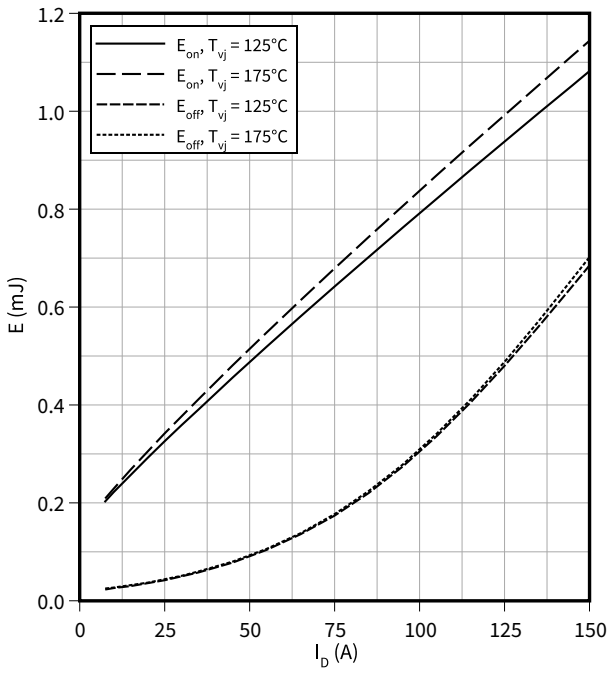
体二极管正向压降（典型), MOSFET, T2 / T3

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



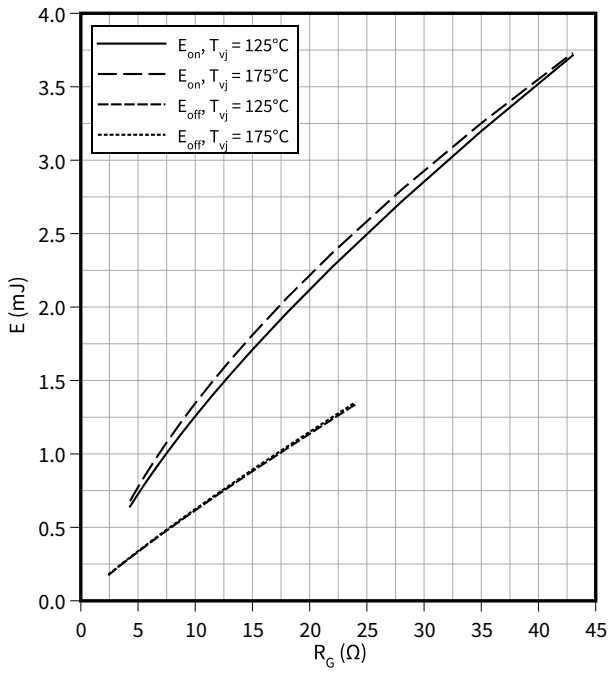
开关损耗 （典型), MOSFET, T2 / T3

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



开关损耗 （典型), MOSFET, T2 / T3

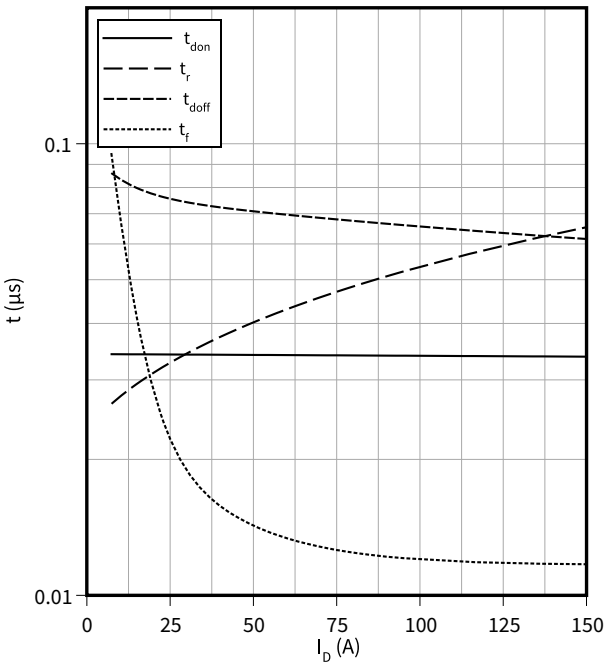
$E = f(R_G)$
$V_{DS} = 400\ V$, $I_D = 75\ A$, $V_{GS} = -3/18\ V$



开关时间 （典型), MOSFET, T2 / T3

$t = f(I_D)$

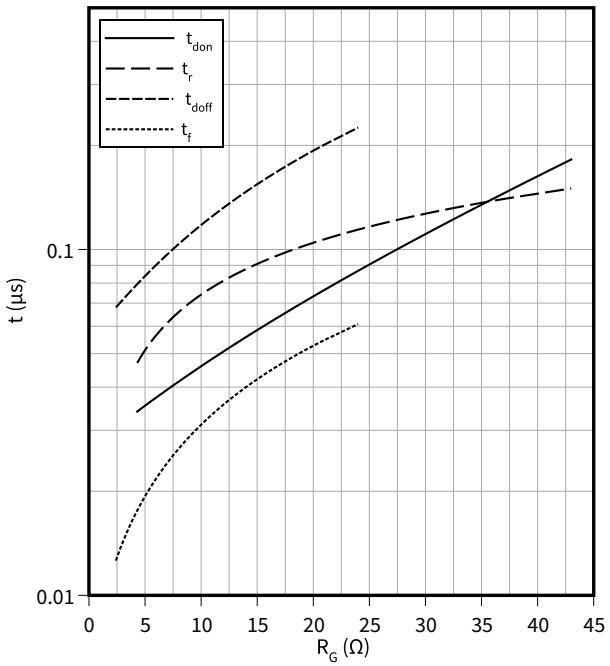
R_{Goff} = 2.4 Ω, R_{Gon} = 4.3 Ω, V_{DS} = 400 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



开关时间 （典型), MOSFET, T2 / T3

$t = f(R_G)$

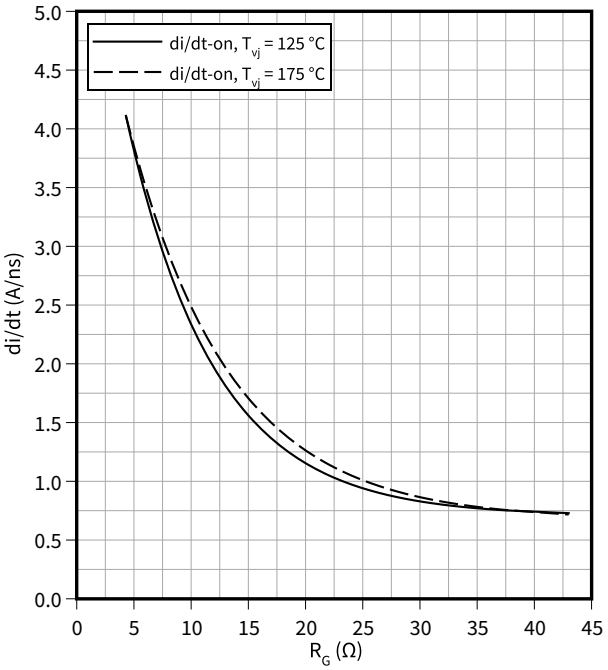
V_{DS} = 400 V, I_D = 75 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



电流变化斜率 （典型), MOSFET, T2 / T3

$di/dt = f(R_G)$

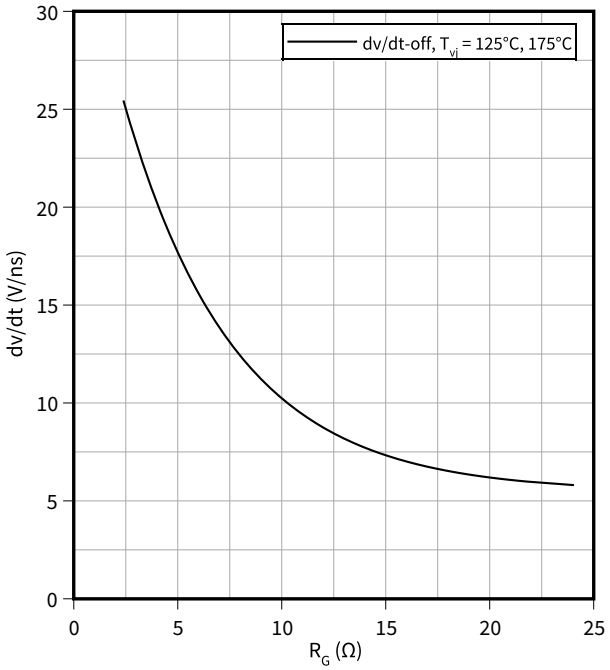
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



电压变化斜率 （典型), MOSFET, T2 / T3

$dv/dt = f(R_G)$

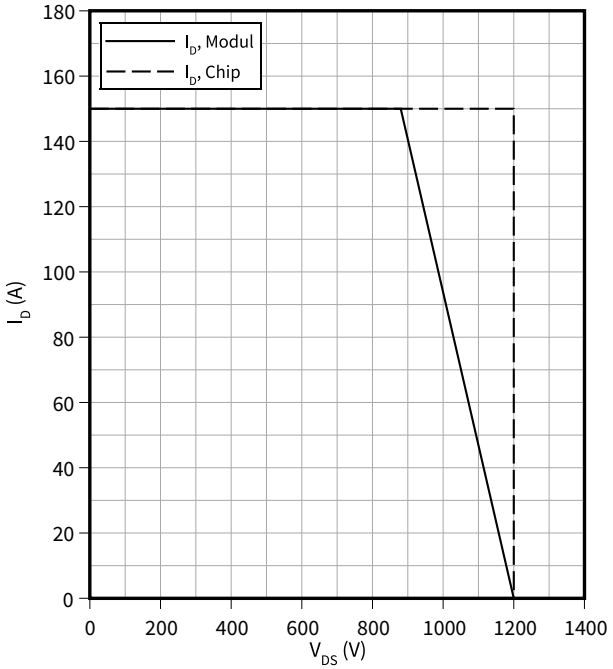
V_{DS} = 400 V, I_D = 75 A, V_{GS} = -3/18 V



反偏安全工作区 （RBSOA）, MOSFET, T2 / T3

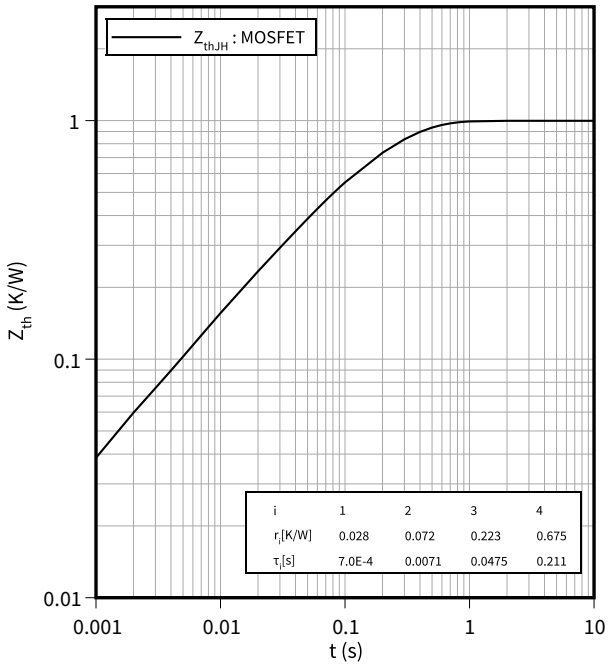
$I_D = f(V_{DS})$

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



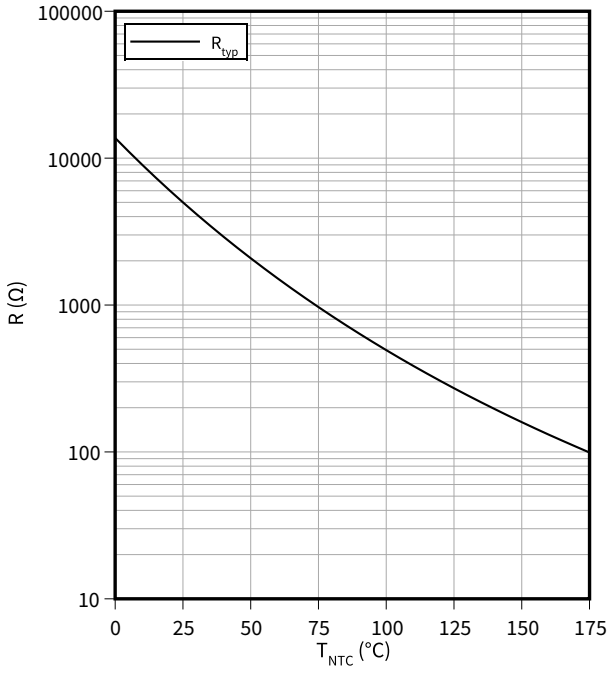
瞬态热阻抗 , MOSFET, T2 / T3

$Z_{th} = f(t)$



温度特性, 负温度系数热敏电阻

$R = f(T_{NTC})$



8 电路拓扑图

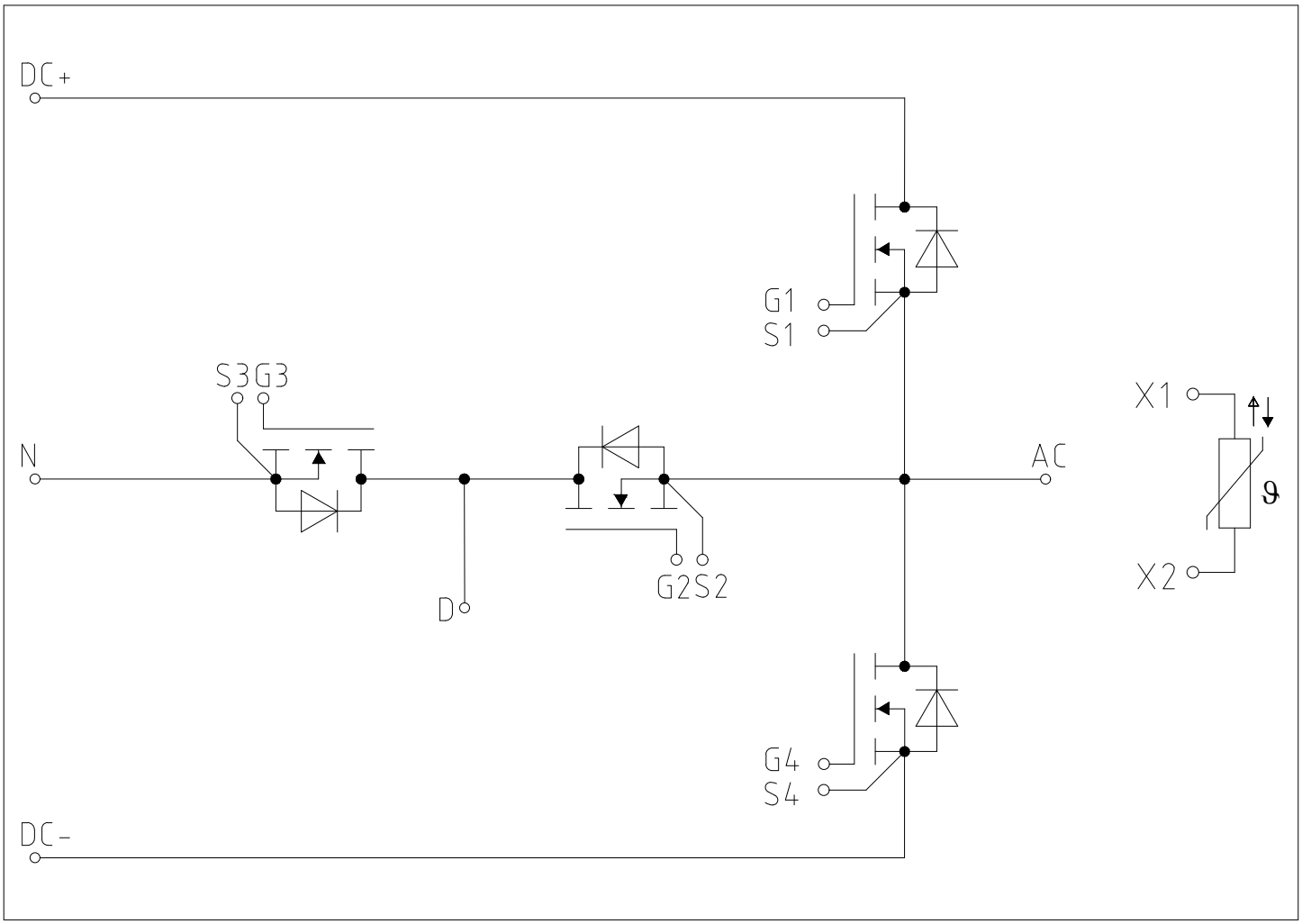


图 1

9 封装尺寸

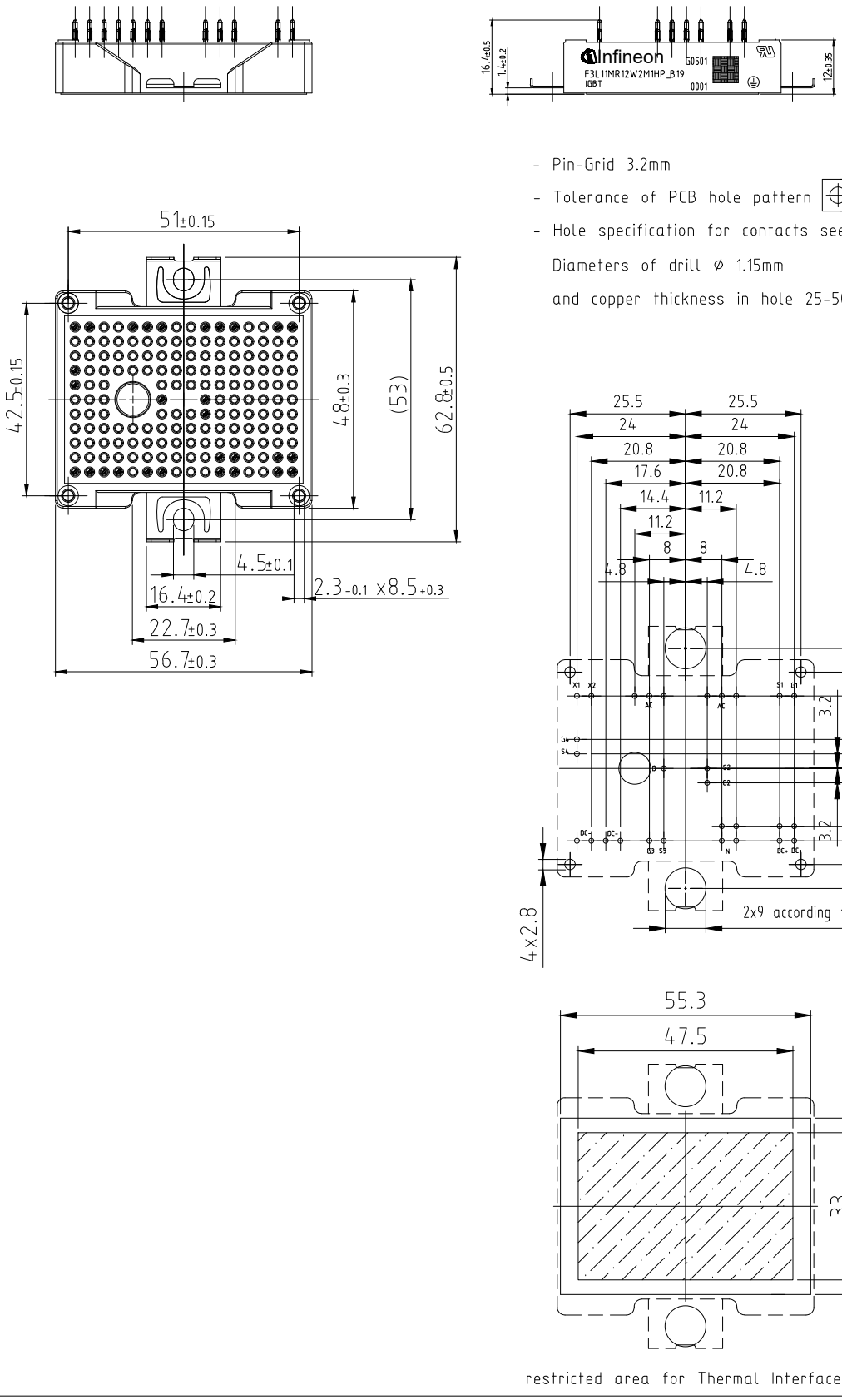

Infineon
F3L11MR12W2M1HP_B19
IGBT
- Pin-Grid 3.2mm
- Tolerance of PCB hole pattern ⌀0.1
- Hole specification for contacts see AN 2009-01:
Diameters of drill ⌀ 1.15mm
and copper thickness in hole 25-50µm
PCB hole pattern
2x9 according to screw head / washer
restricted area for Thermal Interface Material

图 2

10 模块标签代码

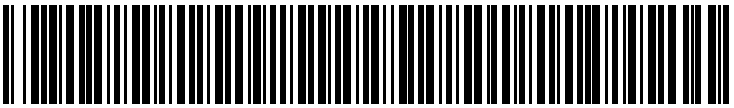
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 7154914284655054991530	 7154914284655054991530	

图 3

修订历史

修订版本	发布日期	变更说明
0.10	2022-02-23	Initial version
0.20	2022-06-01	Preliminary datasheet

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Edition 2022-06-01

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Document reference
IFX-ABC853-002

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