Final datasheet

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

特性

- 电气特性
  - V_{DSS} = 2000 V
  - I_{DN} = 160 A / I_{DRM} = 320 A
  - 过载操作达 175°C
  - 可以从下面链接寻找适合的英飞凌驱动 IC https://www.infineon.com/gdfinder
- 机械特性
  - 集成 NTC 温度传感器
  - PressFIT 压接技术

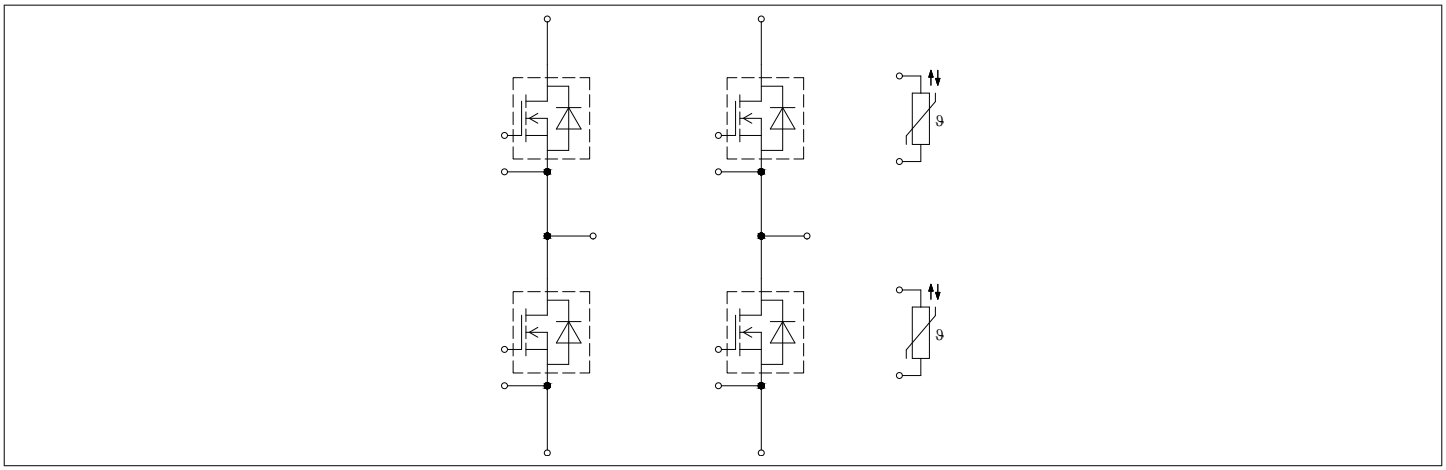
可选应用

- 电动汽车充电
- 储能系统（ESS）
- 太阳能应用
- DC/DC 变换器

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	3.2	kV
NTC 绝缘测试电压	$V_{ISOL(NTC)}$	RMS, f = 50 Hz, *t* = 1 min	3.2	kV
内部绝缘		基本绝缘 (class 1, IEC 61140)	Al_2O_3	
相对电痕指数	*CTI*		> 400	
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}				22		nH
模块引线电阻,端子-芯片	$R_{CC'+EE'}$	T_H = 25 °C, 每个开关			1.4		mΩ
储存温度	T_{stg}			-40		125	°C
模块安装的安装扭距	*M*	根据相应的应用手册进行安装	M5, 螺丝	1.3		1.5	Nm
重量	*G*				78		g

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

2 MOSFET, T1-T4

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	2000	V
植入漏极电流	I_{DN}			160	A
连续漏极直流电流	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 18 V	T_H = 65 °C	135	A
漏极重复峰值电流	I_{DRM}	verified by design, t_p limited by T_{vjmax}		320	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 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...-2	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 = 160 A	V_{GS} = 18 V, T_{vj} = 25 °C		5.1	8.1	mΩ
			V_{GS} = 18 V, T_{vj} = 125 °C		10.9		
			V_{GS} = 18 V, T_{vj} = 175 °C		15.4		
			V_{GS} = 15 V, T_{vj} = 25 °C		5.6		
栅极阈值电压	$V_{GS(th)}$	I_D = 112 mA, V_{DS} = V_{GS}, (tested after 1ms pulse at V_{GS} = +20 V), T_{vj} = 25 °C		3.45	4.3	5.15	V
栅极电荷	Q_G	V_{DD} = 1200 V, V_{GS} = -3 V, T_{vj} = 25 °C			0.78		µC
内部栅极电阻	R_{Gint}	T_{vj} = 25 °C			1.8		Ω
输入电容	C_{ISS}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		24.1		nF
输出电容	C_{OSS}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.563		nF
反向传输电容	C_{rss}	f = 100 kHz, V_{DS} = 1200 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.041		nF
C_{OSS} 存储能量	E_{OSS}	V_{DS} = 1200 V, V_{GS} = -3/18 V, T_{vj} = 25 °C			508		µJ
漏源泄漏电流	I_{DSS}	V_{DS} = 2000 V, V_{GS} = -3 V	T_{vj} = 25 °C		0.04	378	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 = 160 A, R_{Gon} = 4.3 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V, t_{dead} = 1000 ns, 0.1 V_{GS} to 0.1 I_D	T_{vj} = 25 °C		70		ns
			T_{vj} = 125 °C		69		
			T_{vj} = 175 °C		69		
上升时间(感性负载)	t_r	I_D = 160 A, R_{Gon} = 4.3 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V, t_{dead} = 1000 ns, 0.1 I_D to 0.9 I_D	T_{vj} = 25 °C		29		ns
			T_{vj} = 125 °C		29		
			T_{vj} = 175 °C		29		
关断延迟时间(感性负载)	$t_{d\,off}$	I_D = 160 A, R_{Goff} = 0.51 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V, 0.9 V_{GS} to 0.9 I_D	T_{vj} = 25 °C		107		ns
			T_{vj} = 125 °C		113		
			T_{vj} = 175 °C		119		

(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	
下降时间(感性负载)	t_f	I_D = 160 A, R_{Goff} = 0.51 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V, 0.9 I_D to 0.1 I_D	T_{vj} = 25 °C		33		ns
			T_{vj} = 125 °C		36		
			T_{vj} = 175 °C		38		
开通损耗能量 (每脉冲)	E_{on}	I_D = 160 A, V_{DD} = 1200 V, L_σ = 15 nH, V_{GS} = -3/18 V, R_{Gon} = 4.3 Ω, di/dt = 4.5 kA/µs (T_{vj} = 175 °C), t_{dead} = 1000 ns	T_{vj} = 25 °C		10.8		mJ
			T_{vj} = 125 °C		12.5		
			T_{vj} = 175 °C		15.1		
开通损耗能量 (每脉冲), 优化条件下	$E_{on,o}$	I_D = 160 A, V_{DD} = 1200 V, L_σ = 15 nH, V_{GS} = -3/18 V, $R_{Gon,o}$ = 2.4 Ω, di/dt = 6 kA/µs (T_{vj} = 175 °C), t_{dead} = 100 ns	T_{vj} = 25 °C		7.6		mJ
			T_{vj} = 125 °C		7.9		
			T_{vj} = 175 °C		8.7		
关断损耗能量 (每脉冲）	E_{off}	I_D = 160 A, V_{DD} = 1200 V, L_σ = 15 nH, V_{GS} = -3/18 V, R_{Goff} = 0.51 Ω, dv/dt = 38.5 kV/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.7		mJ
			T_{vj} = 125 °C		3		
			T_{vj} = 175 °C		3.1		
结－散热器热阻	R_{thJH}	每个 MOSFET, λ_{grease} = 3.3 W/(m·K)			0.238		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 detailed specifications, please refer to AN 2018-14.

3 Body diode (MOSFET, T1-T4)

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	100	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} = 160 A, V_{GS} = -3 V	T_{vj} = 25 °C		4.4	5.95	V
			T_{vj} = 125 °C		4		
			T_{vj} = 175 °C		3.85		
反向恢复峰值电流	I_{rrm}	I_{SD} = 160 A, di_s/dt = 4.5 kA/µs, V_{DD} = 1200 V, V_{GS} = -3 V, t_{dead} = 1000 ns	T_{vj} = 25 °C		88		A
			T_{vj} = 125 °C		118		
			T_{vj} = 175 °C		162		
恢复电荷	Q_{rr}	I_{SD} = 160 A, di_s/dt = 4.5 kA/µs, V_{DD} = 1200 V, V_{GS} = -3 V, t_{dead} = 1000 ns	T_{vj} = 25 °C		4.3		µC
			T_{vj} = 125 °C		5.9		
			T_{vj} = 175 °C		8.8		
反向恢复损耗（每脉冲）	E_{rec}	I_{SD} = 160 A, di_s/dt = 4.5 kA/µs (T_{vj} = 175 °C), V_{DD} = 1200 V, V_{GS} = -3 V, t_{dead} = 1000 ns	T_{vj} = 25 °C		3.5		mJ
			T_{vj} = 125 °C		4.3		
			T_{vj} = 175 °C		5.4		
反向恢复损耗（每脉冲），优化条件下	$E_{rec,o}$	I_{SD} = 160 A, di_s/dt = 6 kA/µs (T_{vj} = 175 °C), V_{DD} = 1200 V, V_{GS} = -3 V, t_{dead} = 100 ns	T_{vj} = 25 °C		2.5		mJ
			T_{vj} = 125 °C		2.8		
			T_{vj} = 175 °C		4.1		

4　负温度系数热敏电阻

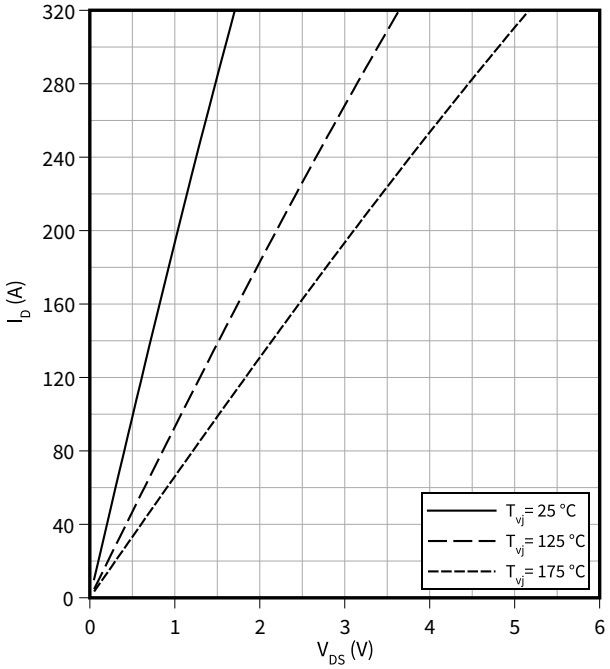
表 8　　特征值

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

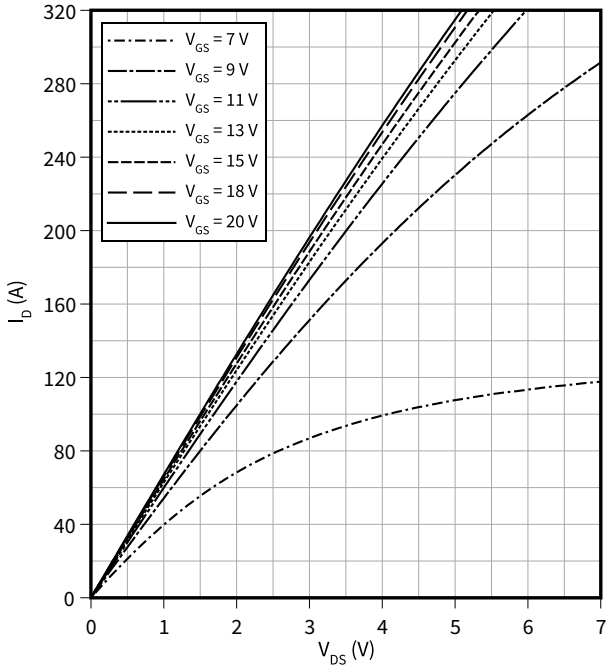
注:　NTC 的具体参数分析请见 AN2009-10, 第 4 章

5 特征参数图表

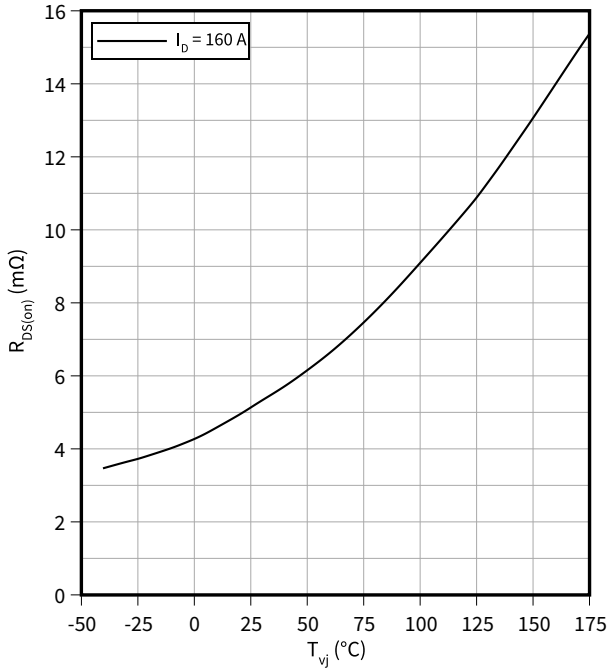
输出特性 （典型), MOSFET, T1-T4
$I_D = f(V_{DS})$
V_{GS} = 18 V



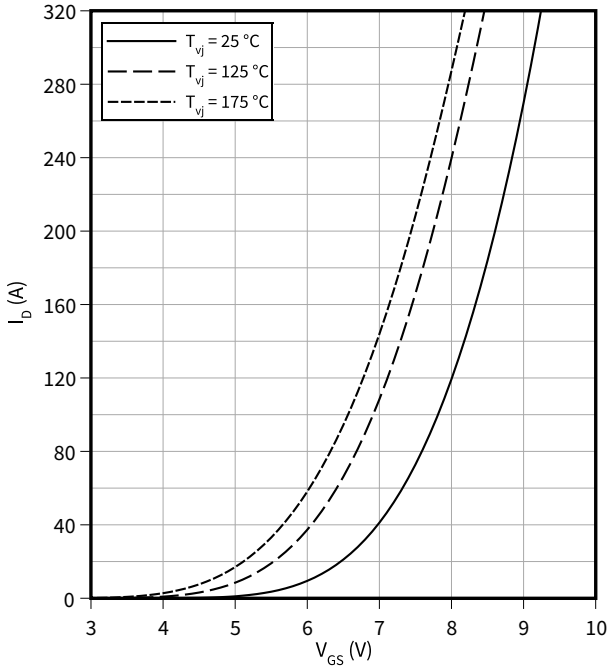
输出特性 （典型), MOSFET, T1-T4
$I_D = f(V_{DS})$
T_{vj} = 175 °C



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

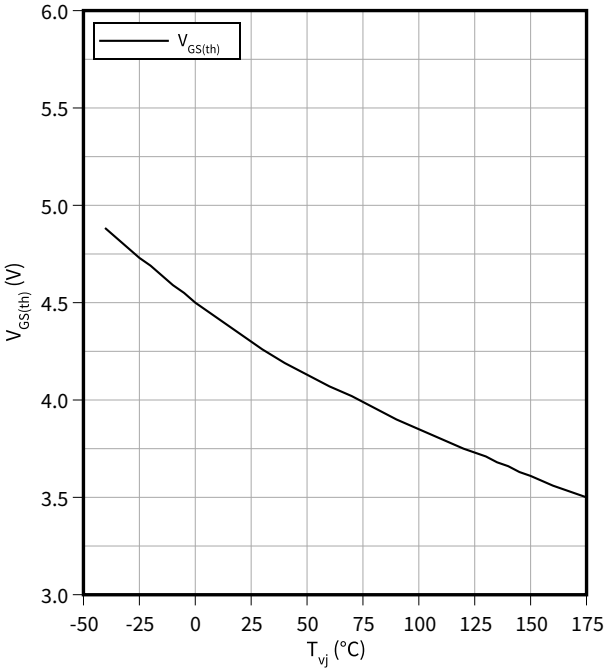


传输特性 （典型), MOSFET, T1-T4
$I_D = f(V_{GS})$
V_{DS} = 20 V



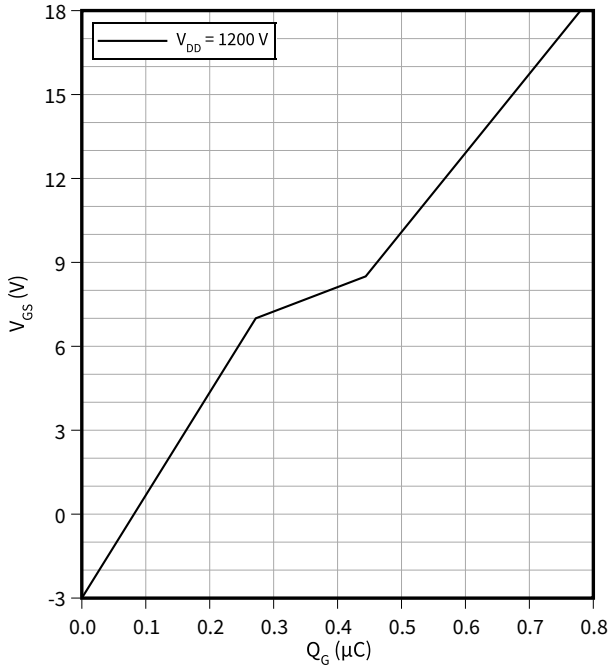
栅-源阀值电压（典型）, MOSFET, T1-T4

$V_{GS(th)} = f(T_{vj})$
$I_D = 112$ mA, $V_{GS} = V_{DS}$



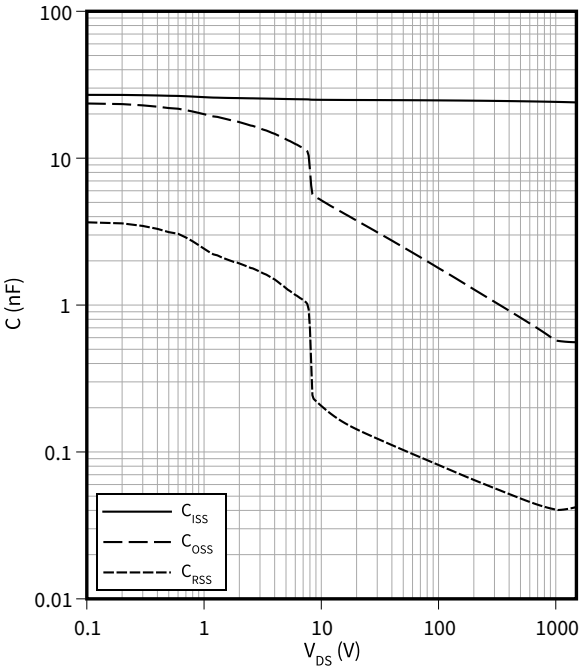
栅极电荷特性 （典型), MOSFET, T1-T4

$V_{GS} = f(Q_G)$
$I_D = 160$ A, $T_{vj} = 25$ °C



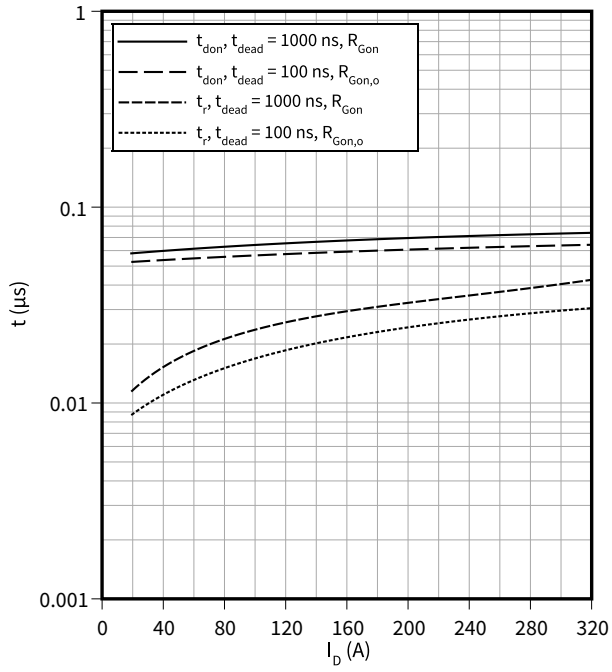
电容特性 （典型), MOSFET, T1-T4

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



开关时间 （典型), MOSFET, T1-T4

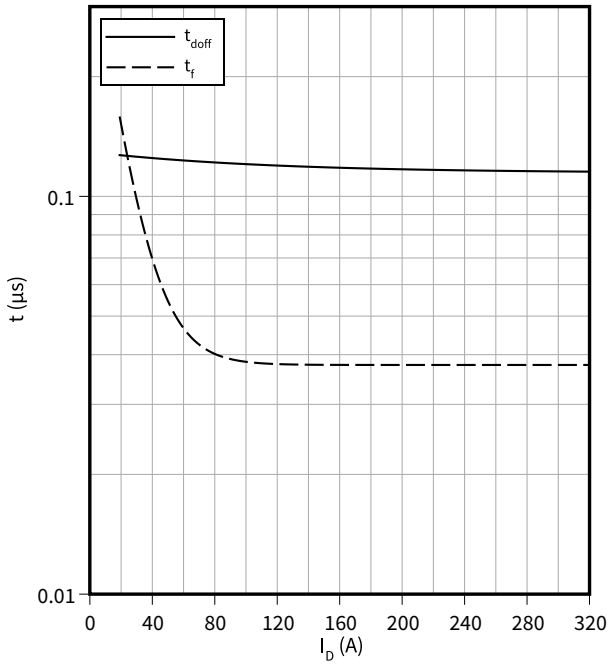
$t = f(I_D)$
$V_{DD} = 1200$ V, $R_{Gon} = 4.3\ \Omega$, $R_{Gon,o} = 2.4\ \Omega$, $T_{vj} = 175$ °C, $V_{GS} = -3/18$ V



开关时间 （典型), MOSFET, T1-T4

$t = f(I_D)$

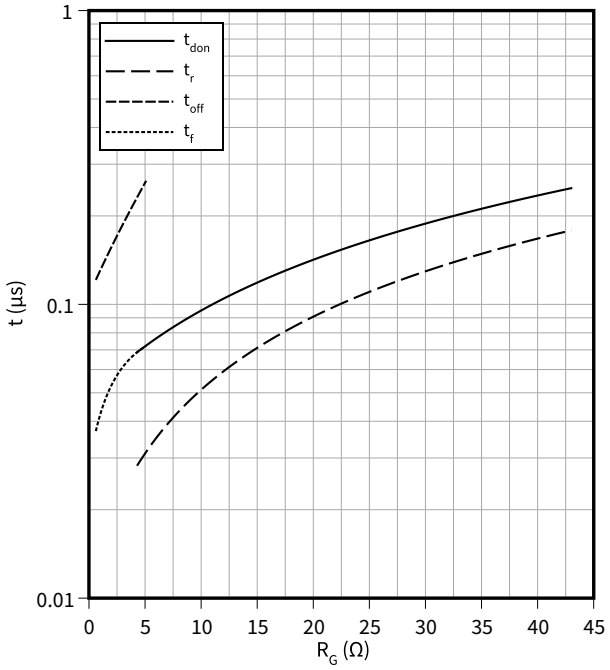
R_{Goff} = 0.51 Ω, V_{DD} = 1200 V, T_{vj} = 175 °C, V_{GS} = -3/18 V



开关时间 （典型), MOSFET, T1-T4

$t = f(R_G)$

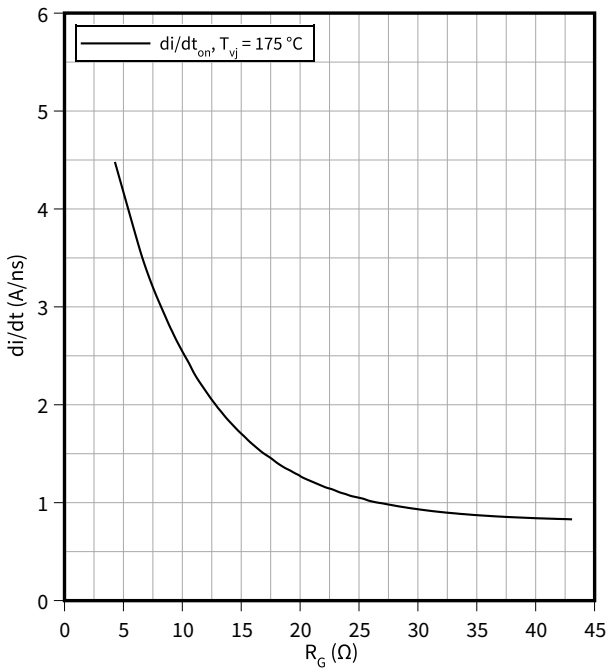
V_{DD} = 1200 V, t_{dead} = 1000 ns, I_D = 160 A, T_{vj} = 175 °C, V_{GS} = -3/18 V



电流变化斜率 （典型), MOSFET, T1-T4

$di/dt = f(R_G)$

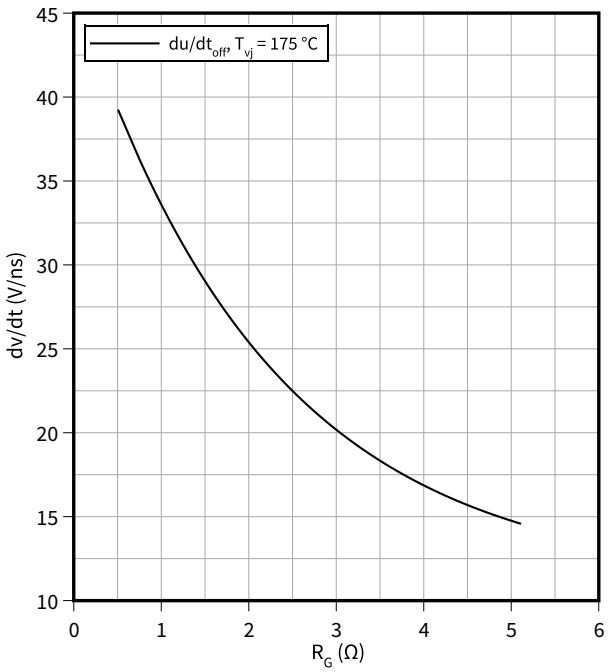
V_{DD} = 1200 V, I_D = 160 A, V_{GS} = -3/18 V



电压变化斜率 （典型), MOSFET, T1-T4

$dv/dt = f(R_G)$

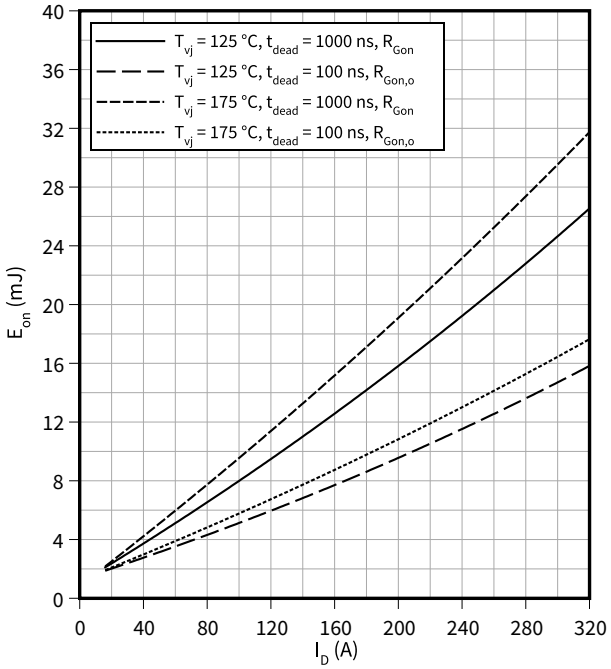
V_{DD} = 1200 V, I_D = 160 A, V_{GS} = -3/18 V



开关损耗 （典型), MOSFET, T1-T4

$E_{on} = f(I_D)$

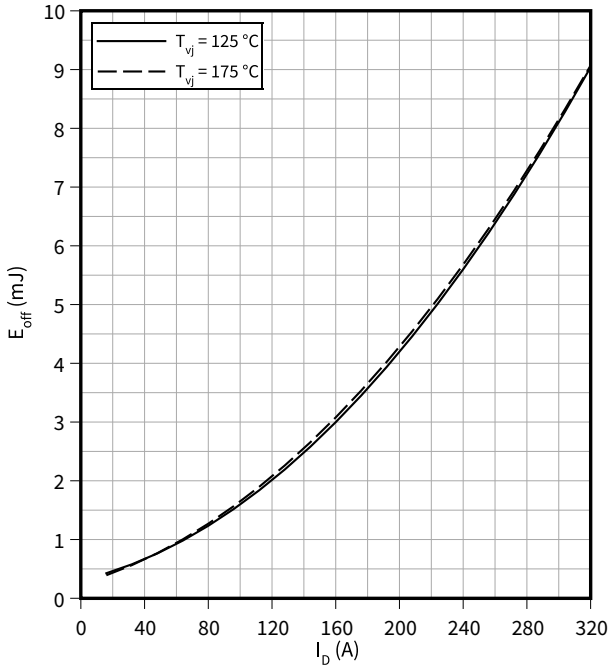
V_{DD} = 1200 V, R_{Gon} = 4.3 Ω, $R_{Gon,o}$ = 2.4 Ω, V_{GS} = -3/18 V



开关损耗 （典型), MOSFET, T1-T4

$E_{off} = f(I_D)$

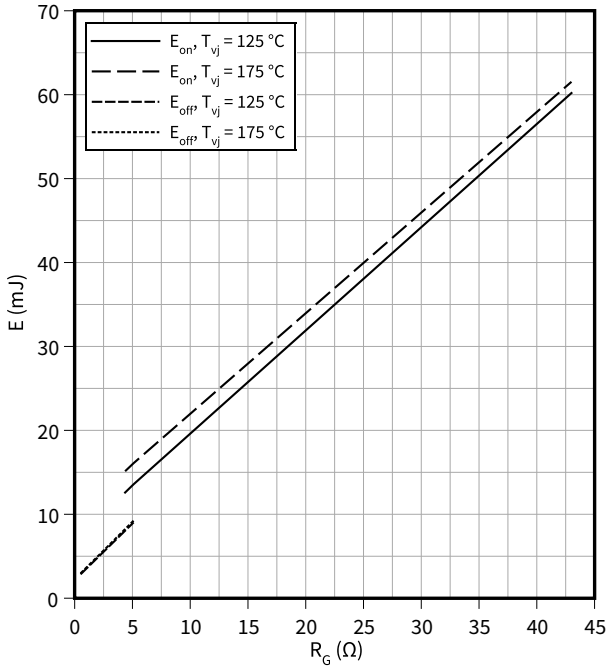
R_{Goff} = 0.51 Ω, V_{DD} = 1200 V, V_{GS} = -3/18 V



开关损耗 （典型), MOSFET, T1-T4

$E = f(R_G)$

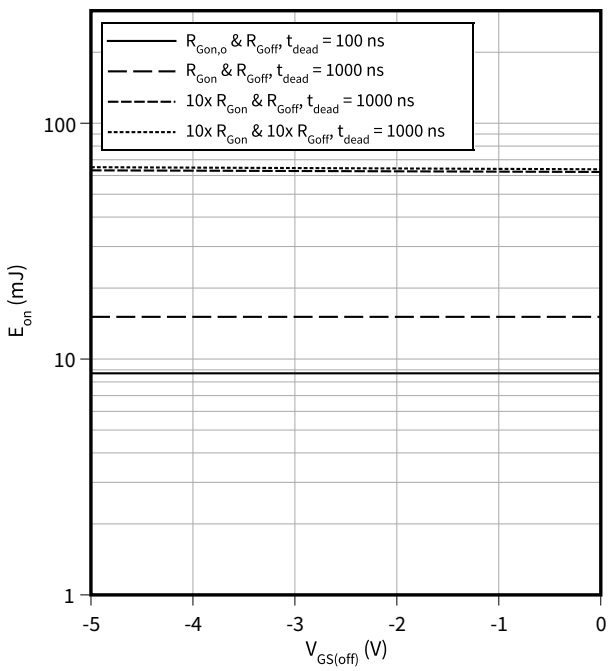
V_{DD} = 1200 V, t_{dead} = 1000 ns, I_D = 160 A, V_{GS} = -3/18 V



开关损耗 （典型), MOSFET, T1-T4

$E_{on} = f(V_{GS(off)})$

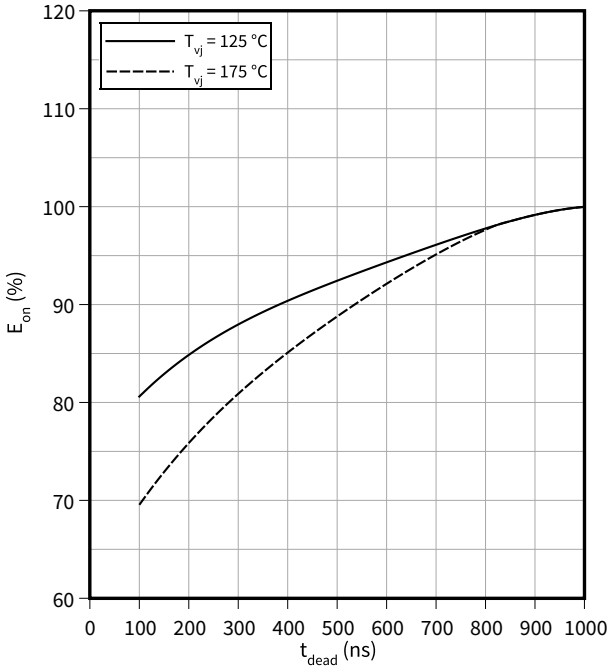
R_{Goff} = 0.51 Ω, V_{DD} = 1200 V, R_{Gon} = 4.3 Ω, $V_{GS(on)}$ = 18 V, I_D = 160 A, $R_{Gon,o}$ = 2.4 Ω, T_{vj} = 175 °C



开关损耗 （典型), MOSFET, T1-T4

$E_{on} = f(t_{dead})$

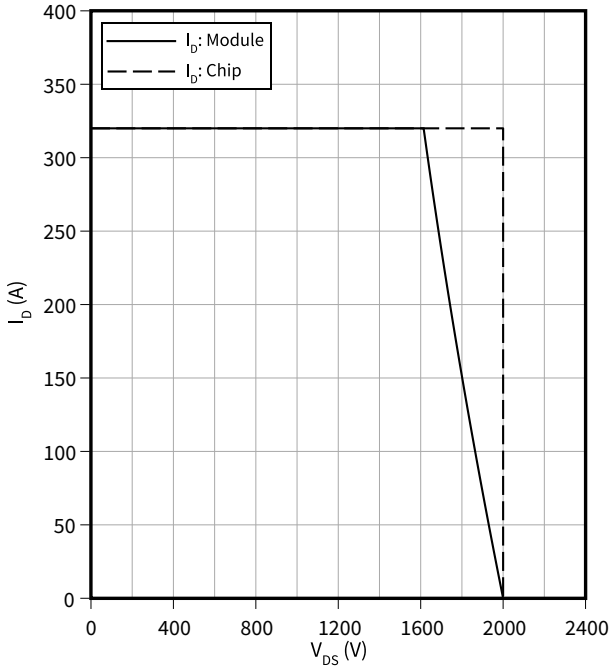
R_{Gon} = 4.3 Ω, I_D = 160 A, V_{DD} = 1200 V, V_{GS} = -3/18 V



反偏安全工作区 （RBSOA）, MOSFET, T1-T4

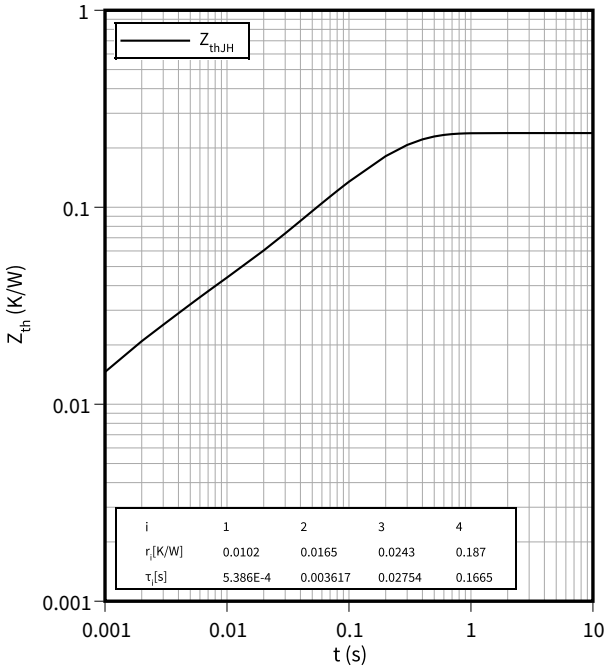
$I_D = f(V_{DS})$

R_{Goff} = 0.51 Ω, T_{vj} = 175 °C, V_{GS} = -3/18 V



瞬态热阻抗, MOSFET, T1-T4

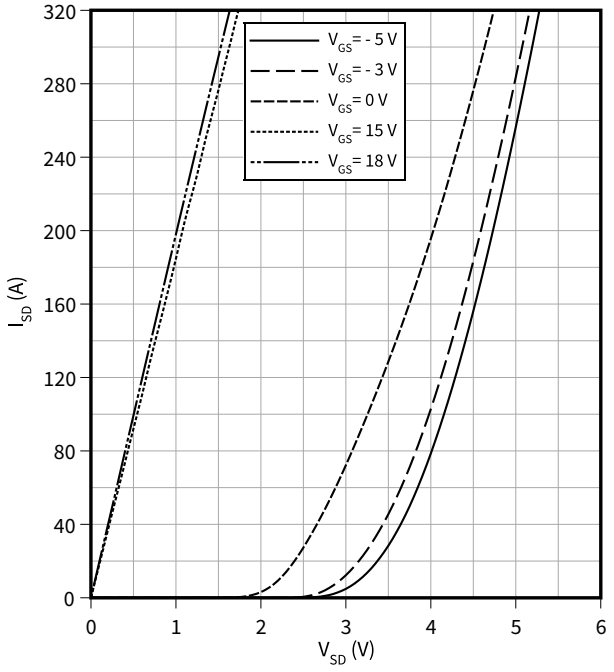
$Z_{th} = f(t)$



正向特性 体二极管（典型), MOSFET, T1-T4

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

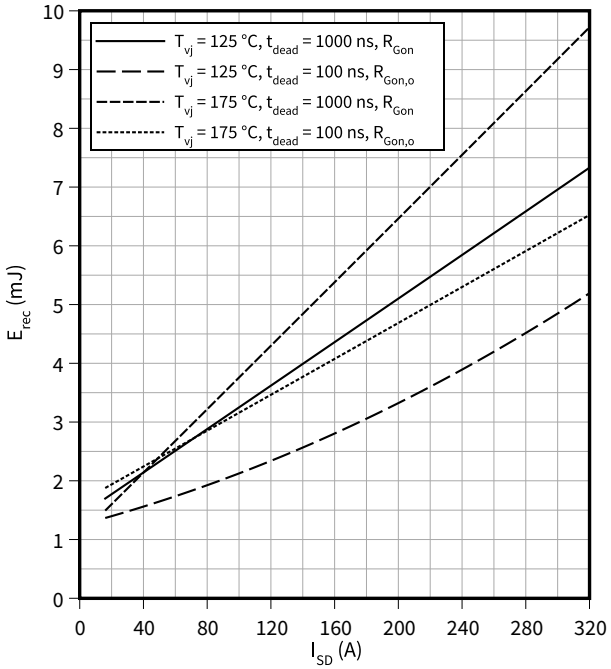
T_{vj} = 25 °C



开关损耗 体二极管（典型), MOSFET, T1-T4

$E_{rec} = f(I_{SD})$

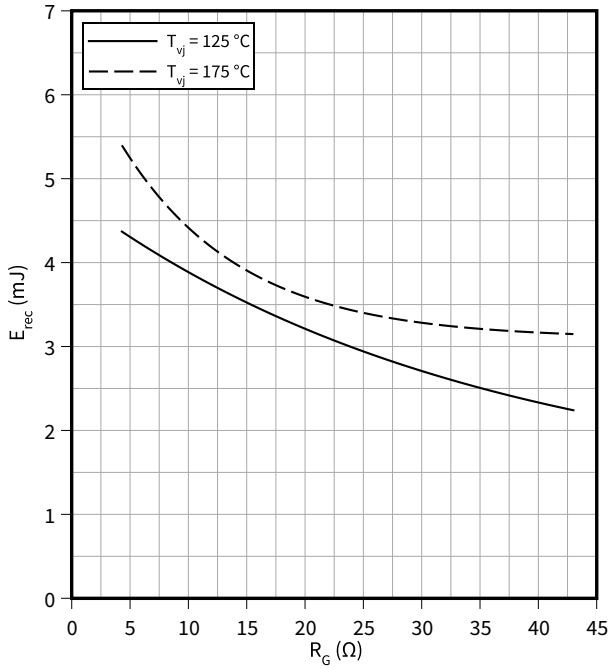
$R_{Gon} = 4.3\ \Omega$, $R_{Gon,o} = 2.4\ \Omega$, $V_{DD} = 1200$ V



开关损耗 体二极管（典型), MOSFET, T1-T4

$E_{rec} = f(R_G)$

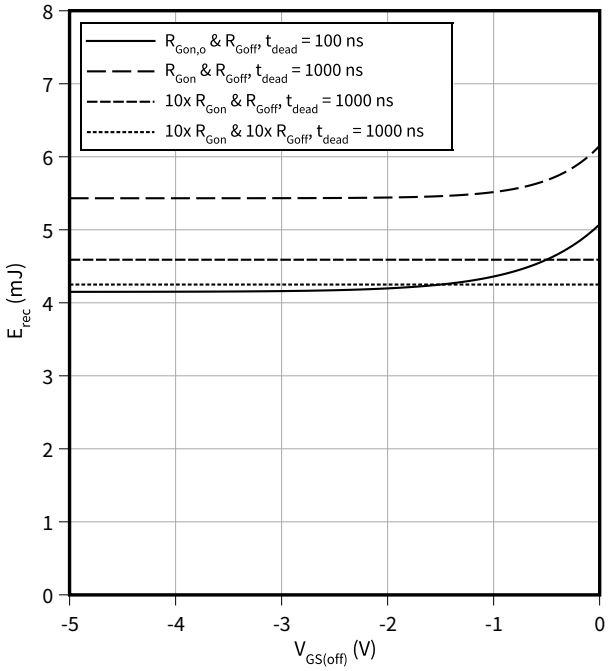
$t_{dead} = 1000$ ns, $I_{SD} = 160$ A, $V_{DD} = 1200$ V



开关损耗 体二极管（典型), MOSFET, T1-T4

$E_{rec} = f(V_{GS(off)})$

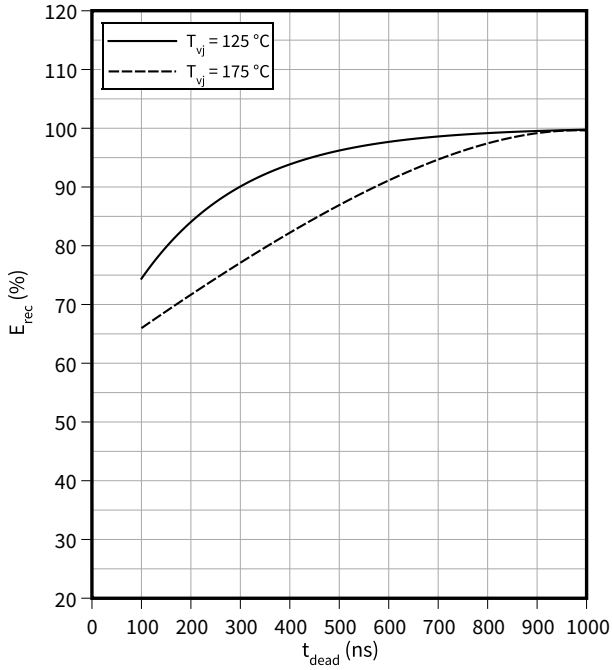
$R_{Goff} = 0.51\ \Omega$, $R_{Gon} = 4.3\ \Omega$, $V_{GS(on)} = 18$ V, $I_{SD} = 160$ A, $R_{Gon,o} = 2.4\ \Omega$, $V_{DD} = 1200$ V, $T_{vj} = 175$ °C



开关损耗 体二极管（典型), MOSFET, T1-T4

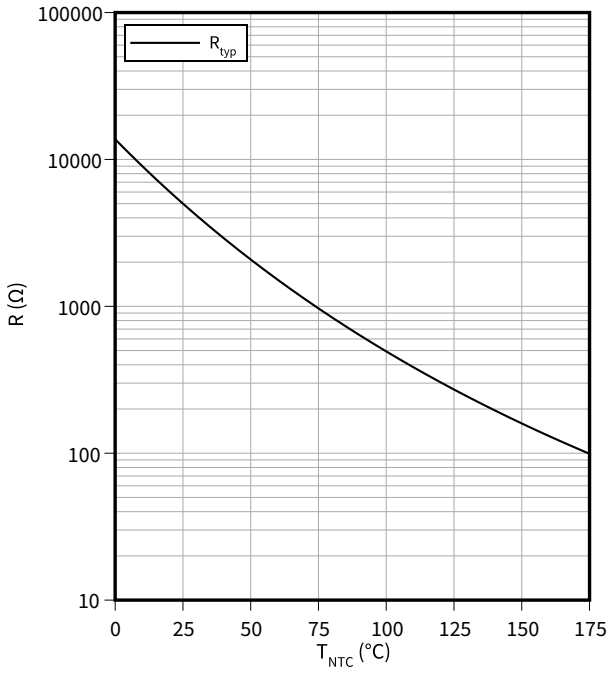
$E_{rec} = f(t_{dead})$

$R_{Gon} = 4.3\ \Omega$, $I_D = 160$ A, $V_{DD} = 1200$ V, $V_{GS} = -3/18$ V



温度特性, 负温度系数热敏电阻

$R = f(T_{NTC})$



6 电路拓扑图

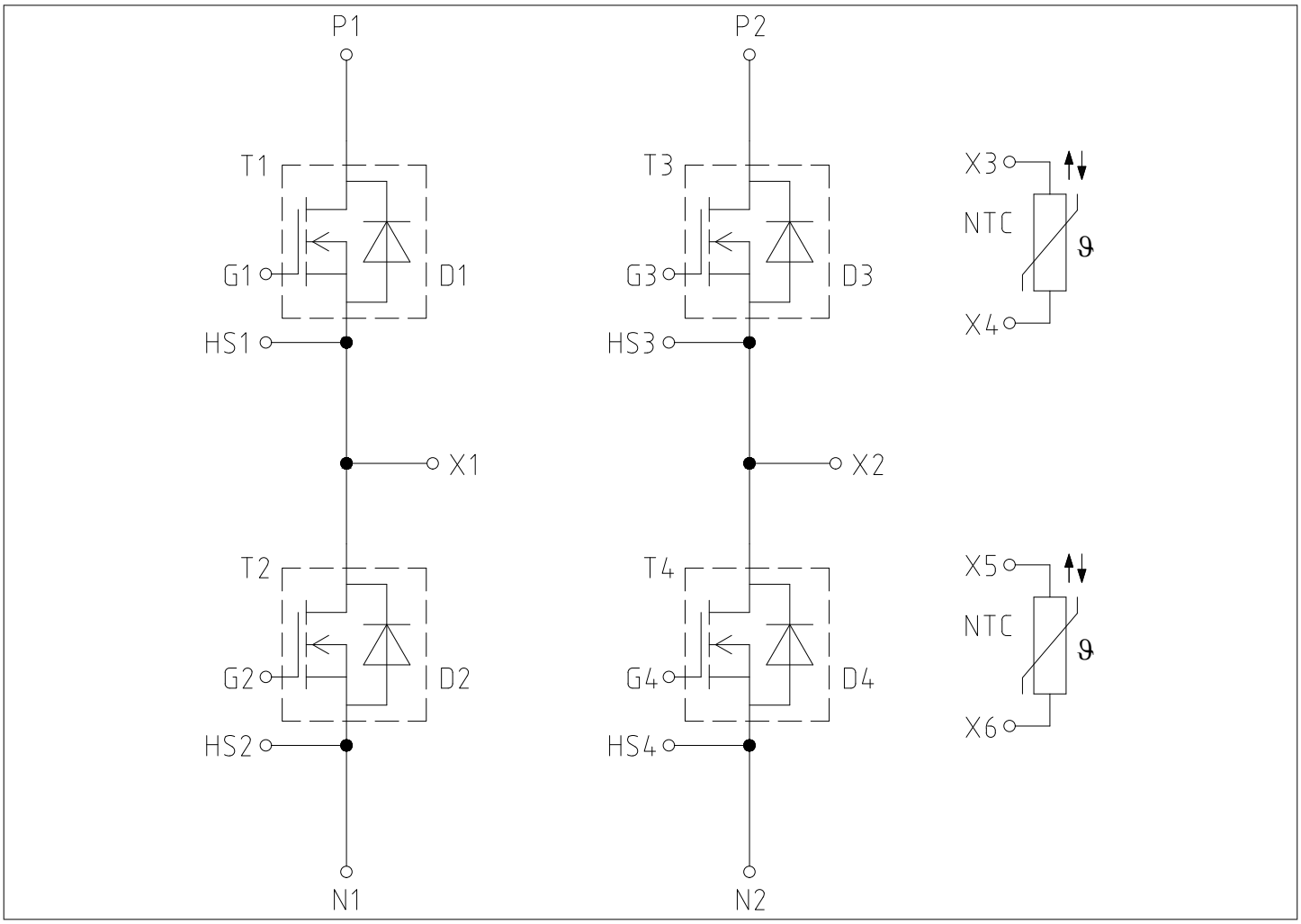

P1
P2
T1
T3
X3
NTC
G1
D1
G3
D3
HS1
HS3
X4
X1
X2
T2
T4
X5
NTC
G2
D2
G4
D4
HS2
HS4
X6
N1
N2

图 1

7 封装尺寸

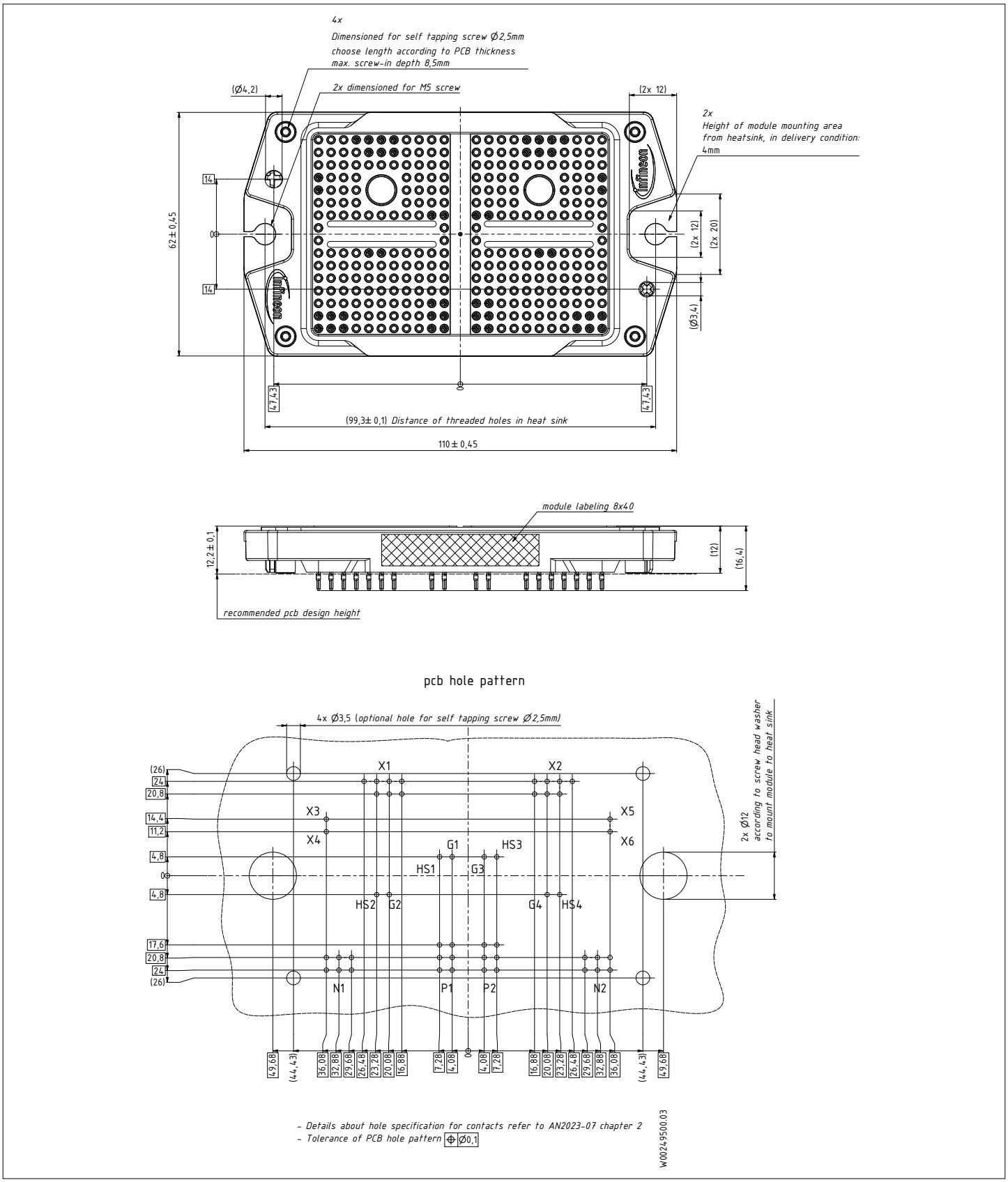

4x
Dimensioned for self tapping screw Ø2,5mm
choose length according to PCB thickness
max. screw-in depth 8,5mm
2x dimensioned for M5 screw
(Ø4,2)
(2x 12)
2x
Height of module mounting area
from heatsink, in delivery condition:
4mm
62 ± 0,45
14
0
14
(2x 12)
(2x 20)
(Ø3,4)
47,43
47,43
(99,3± 0,1) Distance of threaded holes in heat sink
110 ± 0,45
module labeling 8x40
12,2 ± 0,1
(12)
(16,4)
recommended pcb design height
pcb hole pattern
4x Ø3,5 (optional hole for self tapping screw Ø2,5mm)
2x Ø12
according to screw head washer
to mount module to heat sink
X1
X2
X3
X4
X5
X6
G1
G2
G3
G4
HS1
HS2
HS3
HS4
N1
P1
P2
N2
(26)
24
20,8
14,4
11,2
4,8
0
4,8
17,6
20,8
24
(26)
49,68
(44,43)
36,08
32,88
29,68
26,48
23,28
20,08
16,88
7,28
4,08
0
4,08
7,28
16,88
20,08
23,28
26,48
29,68
32,88
36,08
(44,43)
49,68
- Details about hole specification for contacts refer to AN2023-07 chapter 2
- Tolerance of PCB hole pattern ⌖ Ø0,1
W00249500.03

图 2

8 模块标签代码

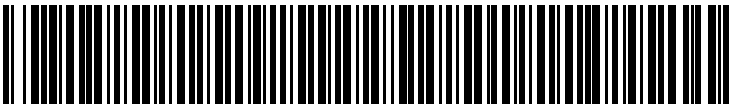
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production 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	2024-08-12	Initial version
1.00	2024-11-11	Final datasheet

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