

关键参数

Key Parameters

V_{DS}		1200	V
$R_{DS(on)}$	Typ.	2.0	mΩ
I_D	Max.	720	A
I_{DM}	Max.	1440	A

典型应用

Typical Applications

- | | |
|-------------|----------------------------|
| ● 电动汽车 | Automotive Applications |
| ● 混合动力/纯电动车 | Hybrid/Electrical Vehicles |
| ● 电机驱动 | Motor Drives |

特点

Features

- | | |
|-------------------------------------|--|
| ● 低开关损耗 | Low Switching Losses |
| ● 转模封装 | Molded Package |
| ● 低感设计 | Low Inductive Design |
| ● Si ₃ N ₄ 衬板 | Si ₃ N ₄ AMB Substrate |

电路结构

Circuit Configuration

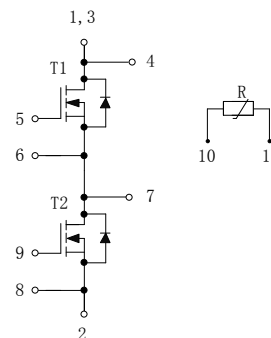


图 1.电路结构

Fig. 1 Circuit configuration

模块外形

Module Appearance

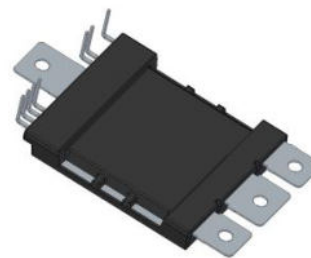


图 2. 模块外形

Fig. 2 Module appearance

模块标签说明

Module Label Code Instruction



数据位置 Data position	数据内容 Content of data
1--8	模块批次号 Module batch number
9--12	模块序列号 Module serial number

最大额定值
Absolute Maximum Ratings

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	数值 Value	单位 Unit
V_{DS}	漏源极电压 Drain-source voltage	$V_{GS} = 0V, T_C = 25\text{ }^{\circ}\text{C}$	1200	V
V_{GSmax}	栅源电压 Gate-source voltage	$T_C = 25\text{ }^{\circ}\text{C}$	-8/+22	V
V_{GSop}	栅源电压 Gate-source voltage	$T_C = 25\text{ }^{\circ}\text{C}$	-4/+18	V
I_D	额定漏极电流 Rating drain current	$T_F = 40\text{ }^{\circ}\text{C}, T_{vj\text{ max}} = 175\text{ }^{\circ}\text{C}$	720	A
I_{DM}	漏极峰值电流 Peak drain current	$t_P = 1\text{ms}$	1440	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_F = 65\text{ }^{\circ}\text{C}, T_{vj\text{ max}} = 175\text{ }^{\circ}\text{C}$	1350	W
I^2t	二极管 I^2t 值 Diode I^2t	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 175\text{ }^{\circ}\text{C}$	60	kA^2s
V_{isol}	绝缘电压(模块) Isolation voltage – per module	短接所有端子，端子与基板间施加电压 (Connected terminals to baseplate), $\text{RMS}, f = 0\text{ Hz}, t = 1\text{ sec}, T_C = 25\text{ }^{\circ}\text{C}$	4200	V

热和机械数据
Thermal & Mechanical Data

参数 Symbol	说明 Explanation	值 Value	单位 Unit
爬电距离 Creepage distance	端子-散热器 Terminal to heatsink	7.3	mm
	端子-端子 Terminal to terminal	7.3	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	7.3	mm
	端子-端子 Terminal to terminal	4	mm
相对漏电起痕指数 CTI (Comparative tracking index)		>400	

热和机械数据

Thermal & Mechanical Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$R_{th(J-F)}$ MOSFET	MOSFET 热阻 Thermal resistance –MOSFET	冷却液: 50%乙二醇溶液; $\Delta V/\Delta t=2.67 \text{ dm}^3/\text{min}$; $T_F = 65^\circ\text{C}$ Cooling Fluid: 50% water / 50% ethylene glycol; $\Delta V/\Delta t=2.67 \text{ dm}^3/\text{min}$; $T_F = 65^\circ\text{C}$		83.5		K / kW
ΔP	冷却液流阻 Pressure drop in cooling circuit	冷却液: 50%乙二醇溶液; $\Delta V/\Delta t=2.67 \text{ dm}^3/\text{min}$; $T_F = 25^\circ\text{C}$ Cooling Fluid: 50% water / 50% ethylenglycol; $\Delta V/\Delta t=2.67 \text{ dm}^3/\text{min}$; $T_F = 25^\circ\text{C}$		68		mbar
P	冷却液最大压力 Maximum pressure in cooling circuit				2.5	bar
$T_{vj\text{ op}}$	工作结温 Operating junction temperature		-40		175	$^\circ\text{C}$
T_{stg}	存储温度 Storage temperature range		-40		125	$^\circ\text{C}$
M	安装力矩 Screw torque	电路互连用– M5 Electrical connections – M5	3		6	Nm

热敏电阻数据

PTC-Thermistor Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
R	额定电阻值 Rated resistance	$T_C = 0^\circ\text{C}$	997.7	1000	1002.3	Ω
		$T_C = 150^\circ\text{C}$	1565.4	1573.3	1581.1	Ω
TC_R	温度系数 Temperature coefficient			0.385		%/K
T_{SH}	自发热 Self heating	$T_C = 0^\circ\text{C}$ $I_m=0.1\ldots0.3\text{mA}$		0.4		K/mW

电特性值
Electrical Characteristics

 除非特别声明，否则 $T_C = 25\text{ }^{\circ}\text{C}$
 $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise stated

符号 Symbol	参数名称 Parameter	条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
I_{DSS}	零栅压漏极电流 Zero gate voltage drain current	$V_{GS} = 0V, V_{DS} = V_{DSS}$			100	μA
		$V_{GS} = 0V, V_{DS} = V_{DSS}, T_{vj} = 150\text{ }^{\circ}\text{C}$			500	μA
		$V_{GS} = 0V, V_{DS} = V_{DSS}, T_{vj} = 175\text{ }^{\circ}\text{C}$			1000	μA
I_{GSS}	栅极漏电流 Gate leakage current	$V_{GS} = -8/+22V, V_{DS} = 0V$			500	nA
$V_{GS(th)}$	栅极-源极阈值电压 Gate threshold voltage	$I_D = 80mA, V_{GS} = V_{DS}$	2	2.7	3.4	V
$R_{DS(on)}^{(*1)}$	漏极-源极通态电阻 Drain-source on-state resistance	$V_{GS} = 18V, I_D = 720A$		2.00		m Ω
		$V_{GS} = 18V, I_D = 720A, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.70		m Ω
		$V_{GS} = 18V, I_D = 720A, T_{vj} = 175\text{ }^{\circ}\text{C}$		3.07		m Ω
g_{fs}	跨导 Forward transconductance	$V_{DS} = 20V, I_D = 720A$		380		S
$V_{SD}^{(*1)}$	二极管正向电压 Diode forward voltage	$I_{SD} = 720A, V_{GS} = -4V$		5.90		V
		$I_{SD} = 720A, V_{GS} = -4V, T_{vj} = 150\text{ }^{\circ}\text{C}$		5.54		V
		$I_{SD} = 720A, V_{GS} = -4V, T_{vj} = 175\text{ }^{\circ}\text{C}$		5.46		V
I_{SC}	短路电流 Short circuit current	$T_{vj} = 175\text{ }^{\circ}\text{C}, V_{DD} = 800V,$ $V_{GS} \leq 18V, t_p \leq TBD\mu s,$ $V_{DS(max)} = V_{DSS} - L^{(*2)} \times di/dt,$ IEC 60747-8		TBD		A

注意: 1. (*1) 表示该参数的测试点为辅助母排端子 (*1) indicates it is measured at the auxiliary busbar terminal),
Note: 2. (*2) 表示 L 是电路杂散电感加上 L_{SDS} (*3) indicates L is the circuit stray inductance plus L_{SDS}).



TM720HF12L5-F3A01

半桥型 SiC MOSFET 模块 Half bridge SiC MOSFET Module

产品数据手册 Product Datasheet 版本 Ver 24. 03

初版 Preliminary

电特性值

Electrical Characteristics

除非特别声明，否则 $T_C = 25\text{ }^{\circ}\text{C}$ $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise stated

符号 Symbol	参数名称 Parameter	条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
C_{iss}	输入电容 Input capacitance	$V_{DS} = 600V, V_{GS} = 0V,$ $f = 100kHz$		31		nF
Q_g	栅极电荷 Gate charge	-4/+18V		1.47		μC
C_{rss}	反向传输电容 Reverse transfer capacitance	$V_{DS} = 600V, V_{GS} = 0V, f$ $=100kHz$		0.11		nF
L_{sDS}	模块电感 Module inductance			6.0		nH
$R_{DD'+SS'}$	模块引线电阻，端子-芯片 Module lead resistance, terminal-chip			0.5		m Ω
R_{Gint}	内部栅极电阻 Internal gate resistor			0.6		Ω

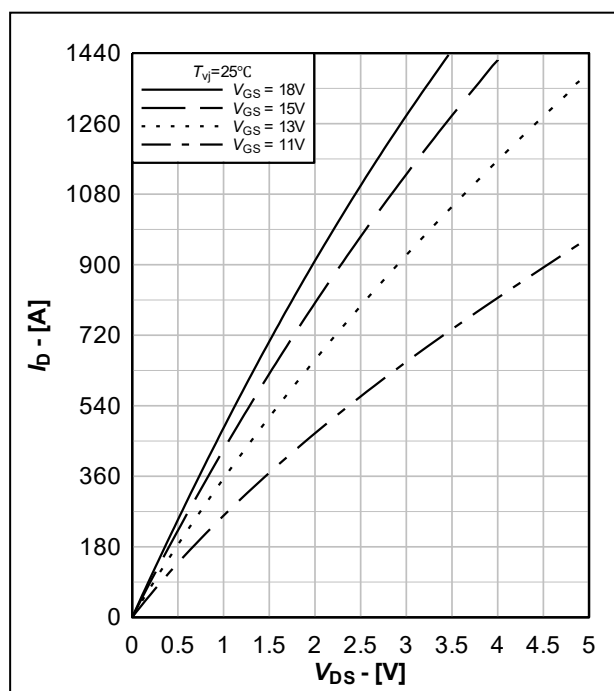
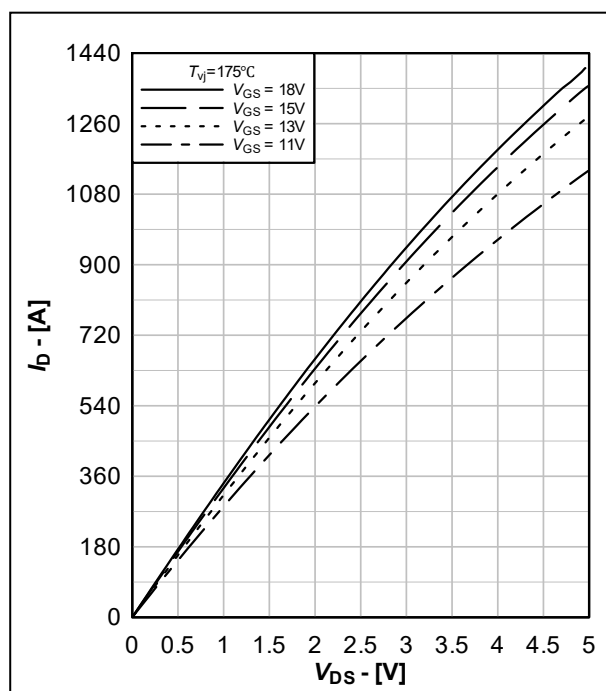
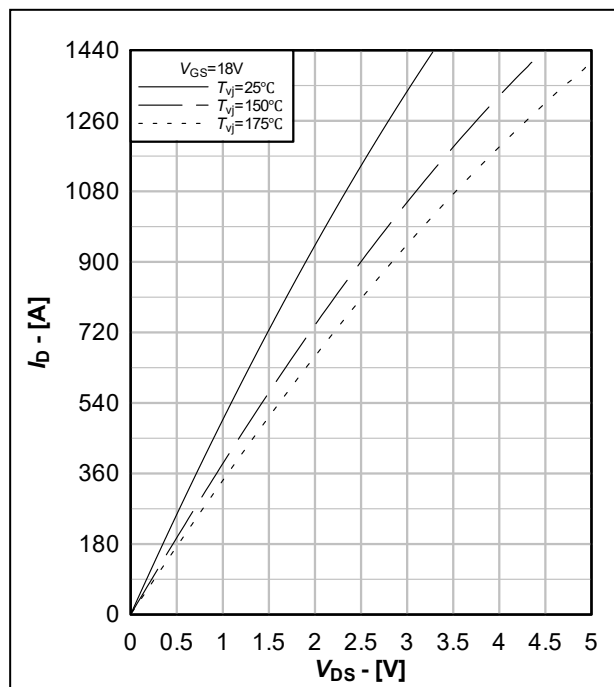
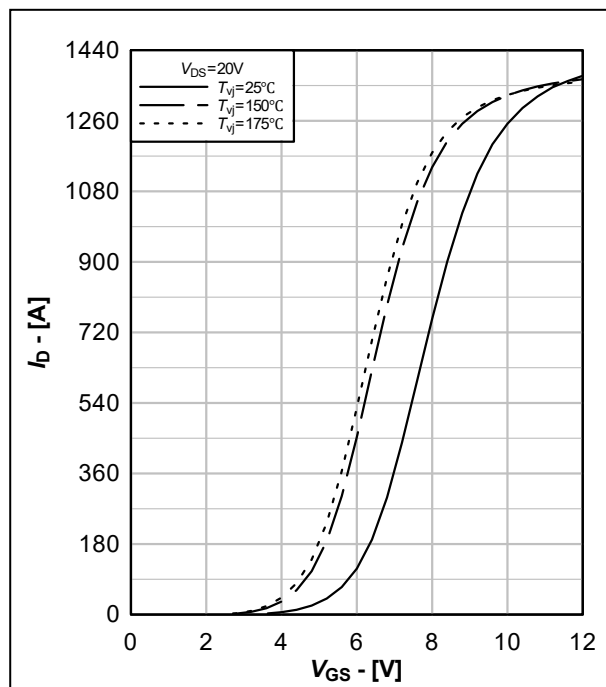
Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

注意：该器件对静电敏感，用户须采取 ESD 防护措施。

电特性值

Electrical Characteristics

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$t_{d(off)}$	关断延迟时间 Turn-off delay time	I_D =720A, V_{DS} = 800V, V_{GS} = -4/+18V, $R_{G(Off)}$ = 3.3 Ω , L_S = 19nH, dv/dt =11700V/ μ s (T_{vj} = 175 $^{\circ}$ C).	T_{vj} = 25 $^{\circ}$ C		298		ns
			T_{vj} = 150 $^{\circ}$ C		385		
			T_{vj} = 175 $^{\circ}$ C		400		
t_f	下降时间 Fall time		T_{vj} = 25 $^{\circ}$ C		50		ns
			T_{vj} = 150 $^{\circ}$ C		56		
			T_{vj} = 175 $^{\circ}$ C		56		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj} = 25 $^{\circ}$ C		48		mJ
			T_{vj} = 150 $^{\circ}$ C		47		
			T_{vj} = 175 $^{\circ}$ C		45		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	T_{vj} = 25 $^{\circ}$ C		72		ns	
		T_{vj} = 150 $^{\circ}$ C		29			
		T_{vj} = 175 $^{\circ}$ C		23			
t_r	上升时间 Rise time	T_{vj} = 25 $^{\circ}$ C		96		ns	
		T_{vj} = 150 $^{\circ}$ C		76			
		T_{vj} = 175 $^{\circ}$ C		72			
E_{ON}	开通损耗 Turn-on energy loss	T_{vj} = 25 $^{\circ}$ C		60		mJ	
		T_{vj} = 150 $^{\circ}$ C		44			
		T_{vj} = 175 $^{\circ}$ C		42			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	T_{vj} = 25 $^{\circ}$ C		2		μ C	
		T_{vj} = 150 $^{\circ}$ C		8			
		T_{vj} = 175 $^{\circ}$ C		10			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	T_{vj} = 25 $^{\circ}$ C		113		A	
		T_{vj} = 150 $^{\circ}$ C		215			
		T_{vj} = 175 $^{\circ}$ C		263			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	T_{vj} = 25 $^{\circ}$ C		0.9		mJ	
		T_{vj} = 150 $^{\circ}$ C		4.8			
		T_{vj} = 175 $^{\circ}$ C		5.1			

图 3. MOSFET 输出特性典型曲线, $I_D = f(V_{DS})$ Fig.3 Typical MOSFET output characteristics, $I_D = f(V_{DS})$ 图 4. MOSFET 输出特性典型曲线, $I_D = f(V_{DS})$ Fig.4 Typical MOSFET output characteristics, $I_D = f(V_{DS})$ 图 5. MOSFET 输出特性典型曲线, $I_D = f(V_{DS})$ Fig.5 Typical MOSFET output characteristics, $I_D = f(V_{DS})$ 图 6. MOSFET 传输特性典型曲线, $I_D = f(V_{GS})$ Fig.6 Typical MOSFET transfer characteristics, $I_D = f(V_{GS})$

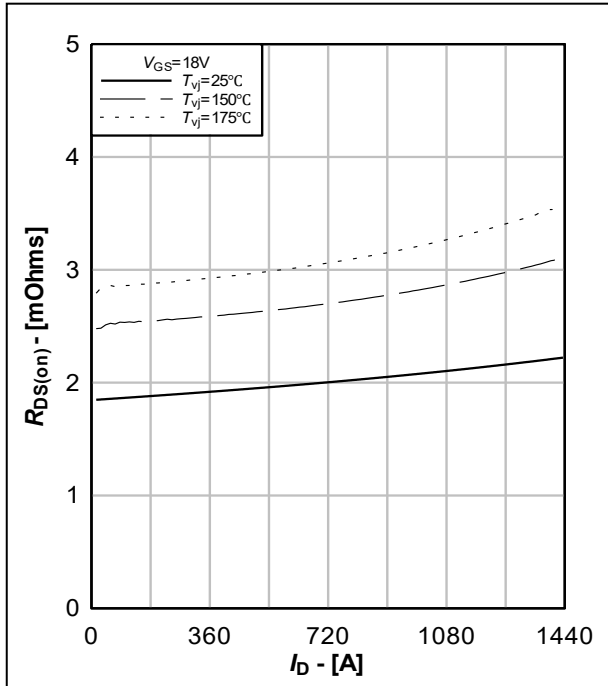

图 7. 导通电阻典型曲线, $R_{DS(on)} = f(I_D)$

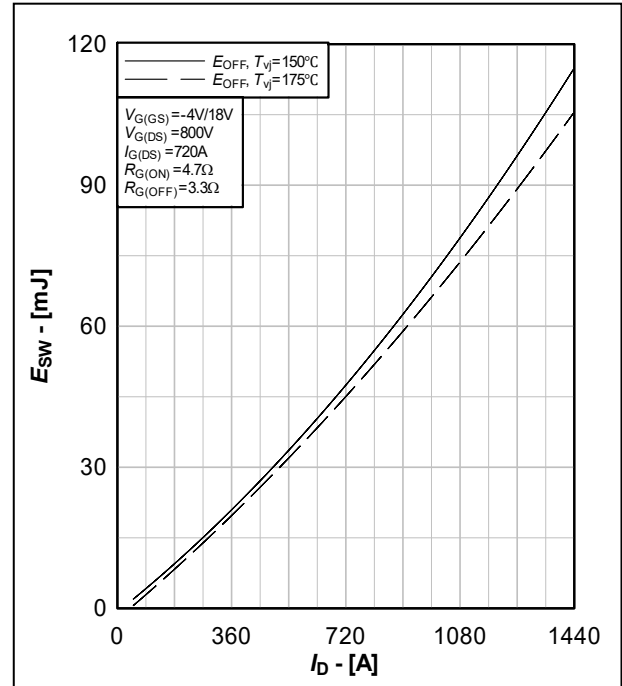
Fig.7 Typical On-Resistance characteristics, $R_{DS(on)} = f(I_D)$

图 8. MOSFET 开关损耗典型曲线, $E_{off} = f(I_C)$

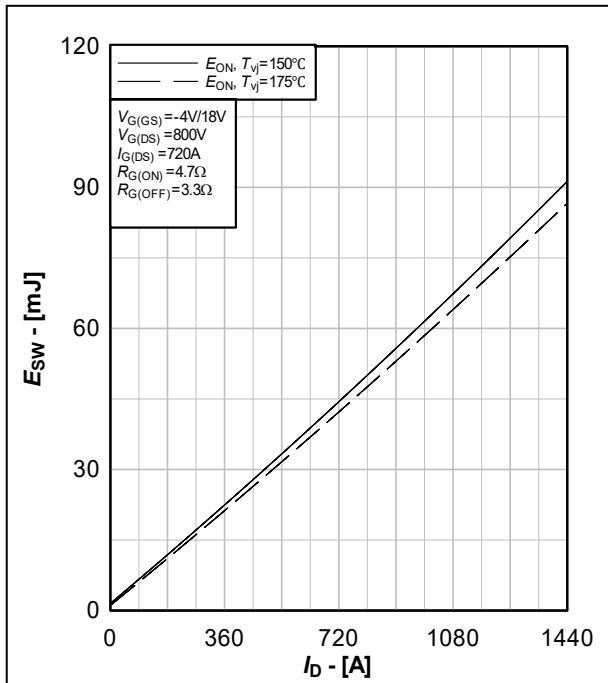
Fig.8 Typical MOSFET switching energy, $E_{off} = f(I_C)$

图 9. MOSFET 开关损耗典型曲线, $E_{on} = f(I_C)$

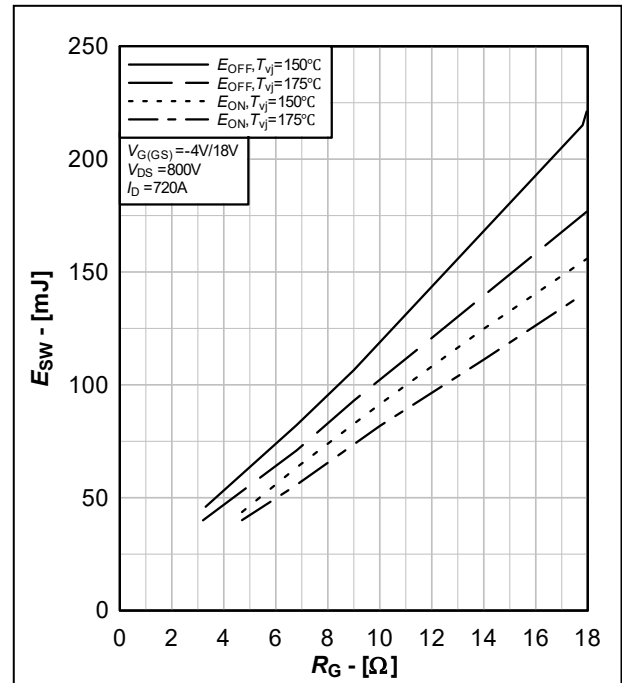
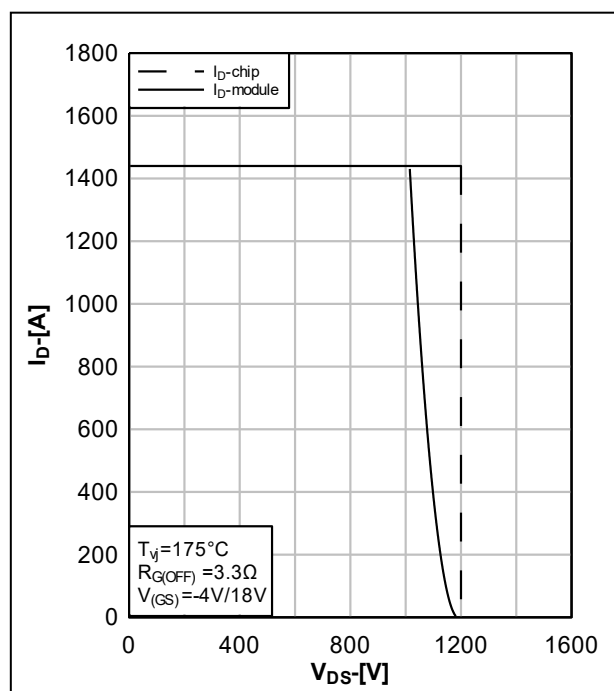
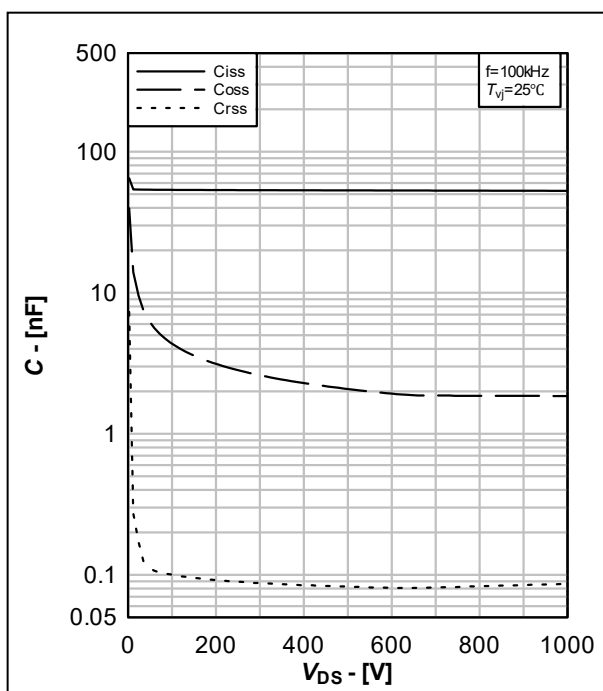
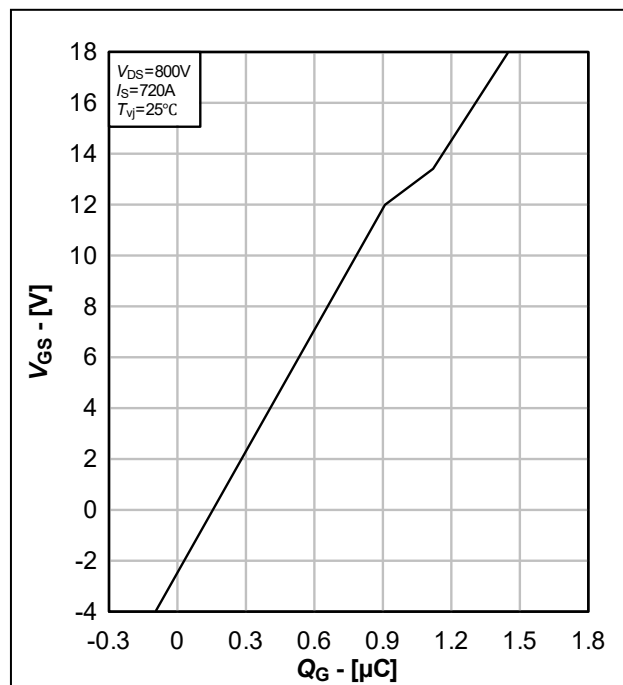
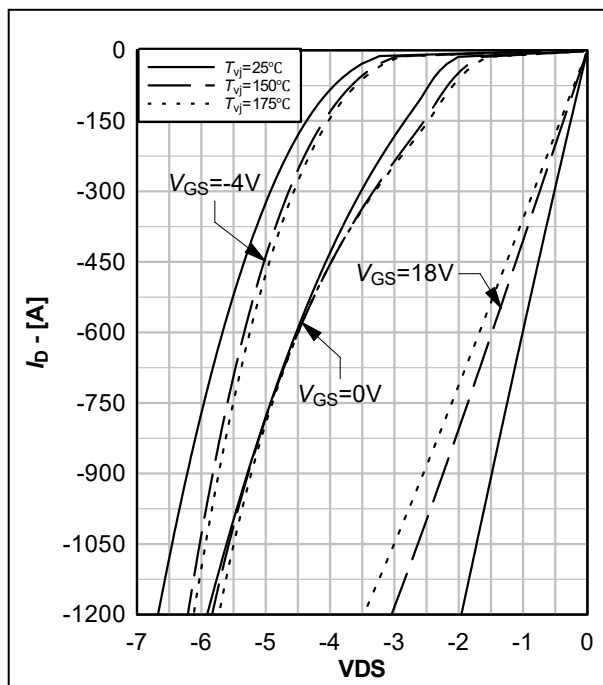
Fig.9 Typical MOSFET switching energy, $E_{on} = f(I_C)$

图 10. MOSFET 开关损耗典型曲线, $E_{on} = f(R_G)$, $E_{off} = f(R_G)$

Fig.10 Typical MOSFET switching energy, $E_{on} = f(R_G)$, $E_{off} = f(R_G)$

图 11. MOSFET 反偏安全工作区, $I_D = f(V_{DS})$ Fig.11 Reverse bias safe operating area of MOSFET, $I_D = f(V_{DS})$ 图 12. 电容特性典型曲线, $C = f(V_{DS})$ Fig.12 Typical capacity characteristic, $C = f(V_{DS})$ 图 13. 栅极电荷特性典型曲线, $V_{GS} = f(Q_G)$ Fig.13 Typical gate charge characteristic, $V_{GS} = f(Q_G)$ 图 14. 体二极管及第三象限输出特性典型曲线, $I_D = f(V_{DS})$ Fig.14 Typical body diode output and 3rd quadrant characteristic, $I_D = f(V_{DS})$

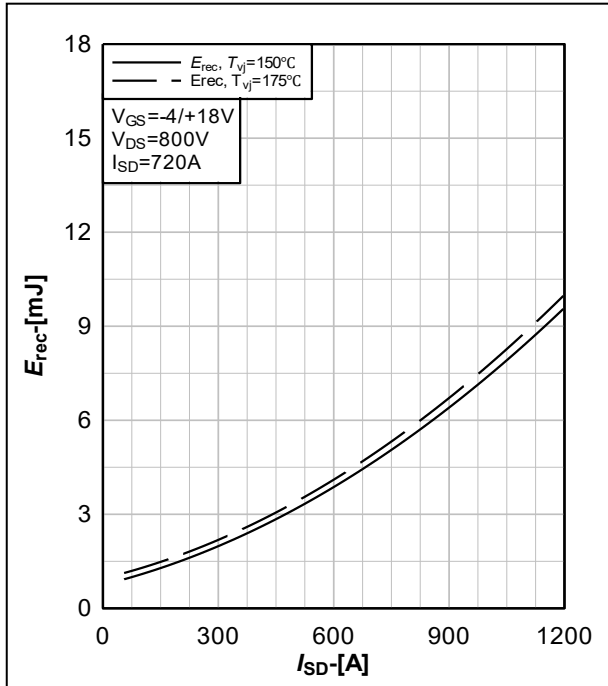


图 15. 体二极管反向恢复损耗典型曲线, $E_{rec}=f(I_{SD})$

Fig.15 Typical body diode switching loss E_{rec} $E_{rec}=f(I_{SD})$

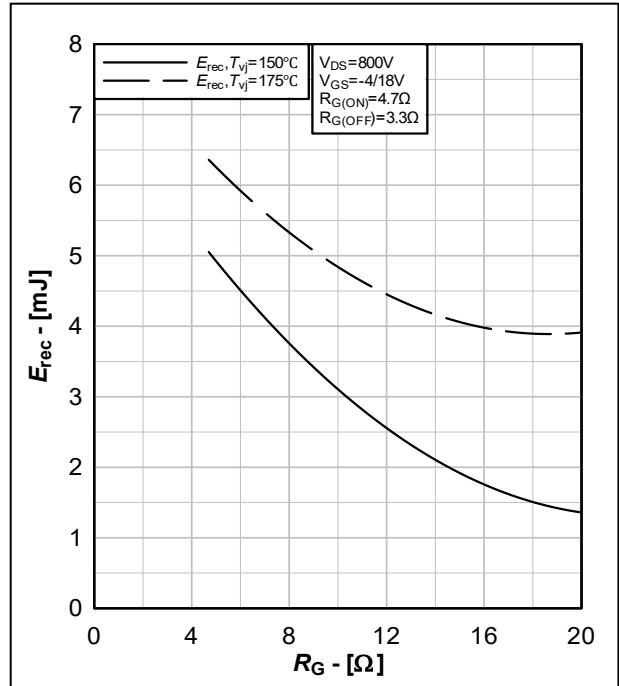


图 16. 体二极管反向恢复损耗典型曲线, $E_{rec}=f(R_G)$

Fig.16 Typical body diode switching loss E_{rec} $E_{rec}=f(R_G)$

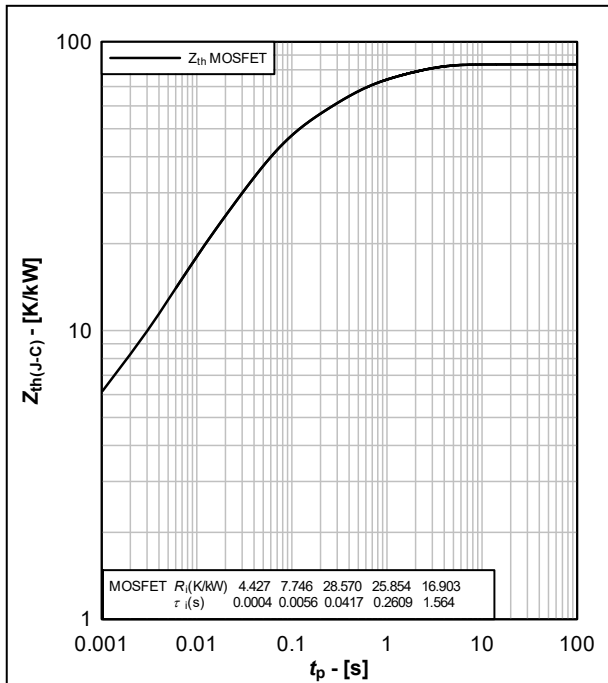


图 17. 瞬态热阻抗曲线, $Z_{th(J-F)} = f(t_p)$

Fig.17 Transient thermal impedance, $Z_{th(J-F)} = f(t_p)$

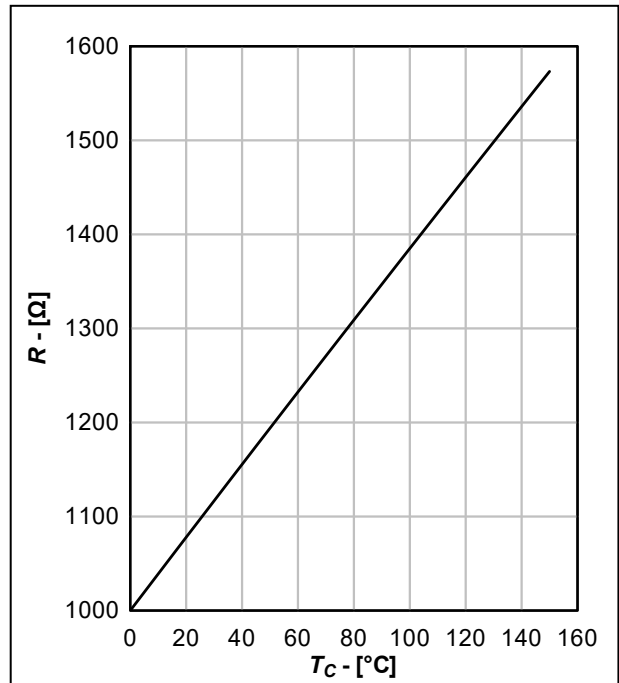
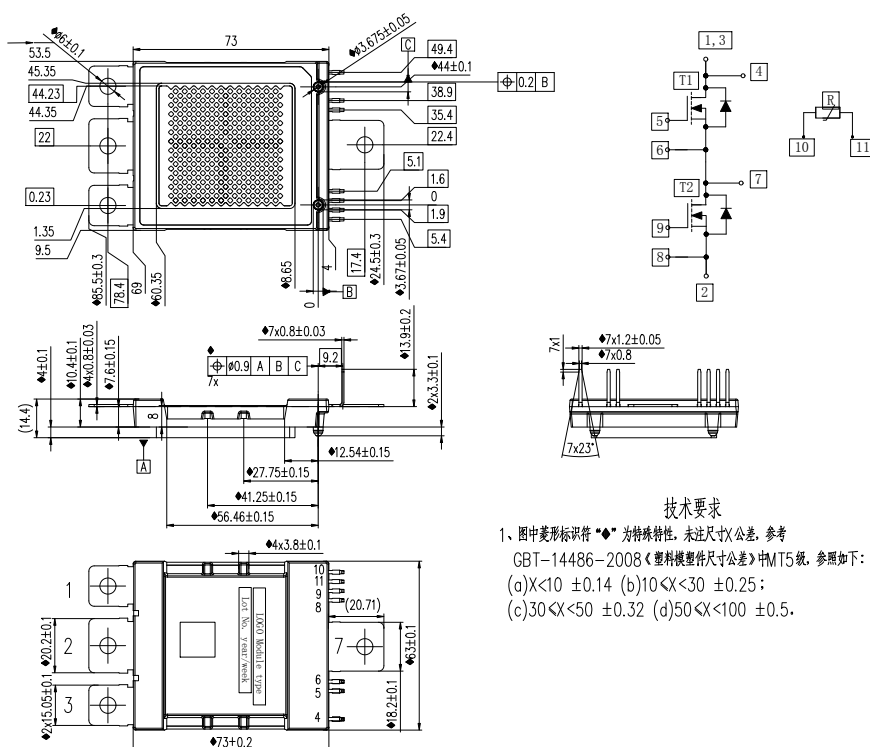


图 18. 热敏电阻典型特性曲线, $R = f(T_C)$

Fig.18 Typical NTC thermistor characteristic, $R = f(T_C)$



重量 Weight: 209 g

模块外观类型 Module outline code: L5

图 4. 模块外观尺寸

Fig. 4 Module outlines

株洲中车时代半导体有限公司

ZHUZHOU CRRC TIMES SEMICONDUCTOR CO., LTD.

地 址	Address	湖南省株洲市石峰区田心工业园 Tianxin Industrial Park, Shifeng District, ZhuZhou City, Hunan Province, China
邮 编	Zipcode	412001
电 话	Telephone	+86 (0)731-28498268, 28498238, 28493472
传 真	Fax	+86 (0)731-28498851, 28498494
电子邮箱	Email	sbu@crzcic.cc
网 址	Web Site	http://www.sbu.crzcic.cc

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