

# MSC50FF120T5H

## SiC MOSFET Module

Preliminary Data

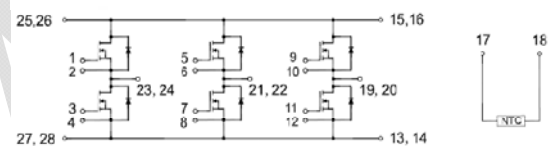
### Features:

- Ultra Low Loss
- High-Frequency Operation
- Zero Reverse Recovery Current from Diode
- Zero Turn-off Tail Current from MOSFET
- Normally-off, Fail-safe Device Operation
- Easy of Paralleling
- Copper Baseplate and Aluminum Nitride Insulator



### Applications:

- Solar Inverter
- 3-Phase PFC
- UPS and SMPS
- Regen Drives
- Motor Drive
- Induction Heating



### Absolute Maximum Ratings ( $T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Description		Value	Units
$V_{DSmax}$	Drain-Source Voltage		1200	V
$V_{GSmax}$	Gate-Source Voltage	Absolute Maximum values	-10/+25	V
$V_{GSop}$	Gate-Source Voltage	Recommended Operational Values	-5/20	V
$I_D$	Continuous Drain Current	$V_{GS}=20\text{V}, T_C=25^\circ\text{C}$	87	A
		$V_{GS}=20\text{V}, T_C=90^\circ\text{C}$	59	A
$I_{D(pluse)}$	Pulsed Drain Current	Pulse width $t_p$ limited by $T_{jmax}$	250	A
$P_D$	Power Dissipation	$T_c=25^\circ\text{C}, T_j=150^\circ\text{C}$	312	W

**Electrical Characteristics of MOSFET ( $T_C=25^\circ\text{C}$  unless otherwise specified)**

Symbol	Description	Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain - Source Breakdown Voltage	$V_{GS}=0V, I_D=100\mu A$	1.2			KV
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = 10 V, I_D = 2.5 \text{ mA}$		2.3		V
		$V_{DS} = 10 V, I_D = 2.5 \text{ mA}, T_J = 150^\circ\text{C}$		1.6		V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 1.2 \text{ kV}, V_{GS} = 0V$		2	100	$\mu A$
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS} = 20 V, V_{DS} = 0V$			0.5	$\mu A$
$R_{DS(on)}$	On State Resistance	$V_{GS} = 20 V, I_{DS} = 50 \text{ A}$		25	34	m $\Omega$
		$V_{GS} = 20 V, I_{DS} = 50 \text{ A}, T_J = 150^\circ\text{C}$		43	63	
$g_{fs}$	Transconductance	$V_{DS} = 20 V, I_{DS} = 50 \text{ A}$		22		S
		$V_{DS} = 20 V, I_{DS} = 50 \text{ A}, T_J = 150^\circ\text{C}$		21		
$C_{iss}$	Input Capacitance	$V_{DS} = 800V, f = 200 \text{ kHz}, V_{AC} = 25 \text{ mV}, V_{GS} = 0V$		2.810		nF
$C_{oss}$	Output Capacitance			0.393		
$C_{rss}$	Reverse Transfer Capacitance			0.014		
$E_{on}$	Turn-On Switching Energy	$V_{DD} = 600 V, V_{GS} = -5V/+20V, I_D = 50 \text{ A}, R_{G(ext)} = 20 \Omega, \text{Load}=412 \mu\text{H}, T_J = 150^\circ\text{C}$		1.1		mJ
$E_{off}$	Turn-Off Switching Energy			0.6		
$R_{G(int)}$	Internal Gate Resistance	$f = 1\text{MHz}, V_{AC} = 25 \text{ mV}$		1.5		$\Omega$
$Q_{GS}$	Gate-Source Charge	$V_{DD} = 800 V, V_{GS} = -5V/+20V, I_D = 50 \text{ A}$		32		nC
$Q_{GD}$	Gate-Drain Charge			30		
$Q_G$	Total Gate Charge			180		
$t_{d(on)}$	Turn-off delay time	$V_{DD} = 800V, V_{GS} = -2/+20V, R_{load}=8 \Omega, R_G = 3.8 \Omega, T_J = 25^\circ\text{C}$		21		ns
$t_r$	Rise Time			30		
$t_{d(off)}$	Turn-off delay time			50		
$t_f$	Fall Time			19		
$R_{\theta JCM}$	Thermal Resistance Junction-To-Case for MOSFET	$T_C = 90^\circ\text{C}, P_D = 150W$		0.37	0.40	$^\circ\text{C/W}$

### Free-Wheeling SiC Schottky Diode Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Description	Conditions	Min	Typ	Max	Unit
$V_{SD}$	Diode Forward Voltage	$I_F = 50\text{ A}, V_{GS} = 0$		1.5	1.7	V
		$I_F = 50\text{ A}, V_{GS} = 0, T_J=150^\circ\text{C}$		2.0	2.3	
$Q_C$	Total Capacitive Charge			0.28		$\mu\text{C}$
$R_{\theta JCD}$	Thermal Resistance Junction-To-Case for Diode	$T_C=90^\circ\text{C}, P_D=130\text{W}$		0.42	0.43	$^\circ\text{C/W}$
$I_F$	Continuous Diode Forward Current	$V_{GS} = -5\text{V}, T_C=90^\circ\text{C}$		50		A

### NTC Characteristics

Symbol	Conditions	Min	Typ	Max	Unit
$R_{25}$	$T_C=25^\circ\text{C}$		5		$\text{K}\Omega$
Delta R/R	$T_C=100^\circ\text{C}, R_{100}=481\Omega$			$\pm 5$	%
$P_{25}$	$T_C=25^\circ\text{C}$			20	mW
$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15\text{K}))]$		3380		K
$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15\text{K}))]$		3440		K

### Module

Symbol	Description	Conditions	Min	Typ	Max	Unit
$T_{Jmax}$	Junction Temperature		-40		150	$^\circ\text{C}$
$T_C, T_{STG}$	Case and Storage Temperature Range		-40		125	$^\circ\text{C}$
Viso	Case Isolation Voltage	AC, 50 HZ, 1 min	4.5			KV
$L_{stray}$	Stray Inductance	Measured between terminals 2 and 3			30	nH
G	Weight			180		g
M	Mounting Torque	To heatsink and terminal			5	N·m
	Clearance Distance	Terminal to terminal			14.09	mm
	Creepage Distance	Terminal to terminal			14.11	mm
		Terminal to baseplate			17.46	mm

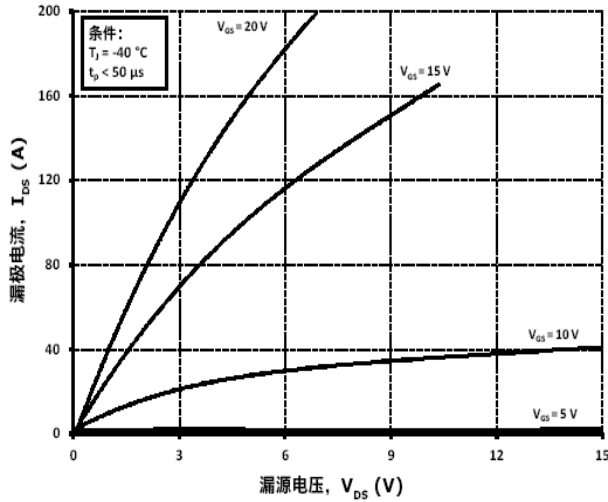


Fig.1 Output Characteristic  $T_j = -40^\circ\text{C}$

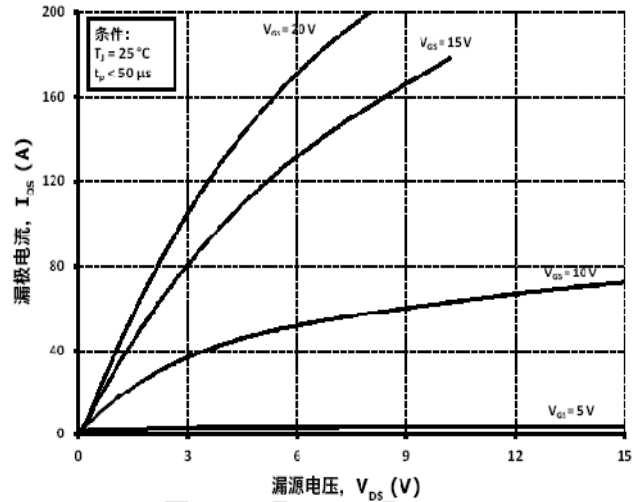


Fig.2 Output Characteristic  $T_j = 25^\circ\text{C}$

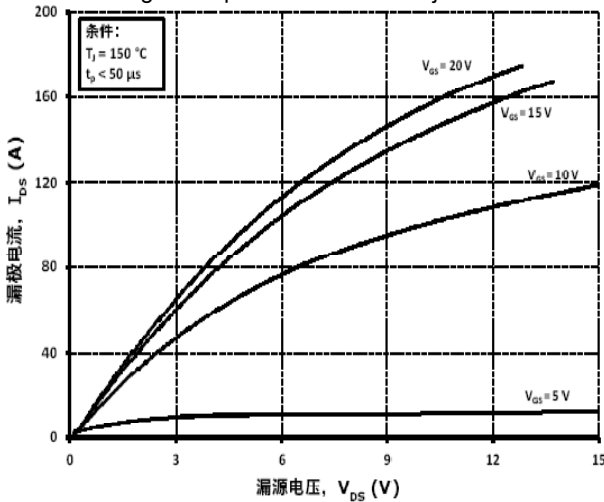


Fig.3 Output Characteristic  $T_j = 150^\circ\text{C}$

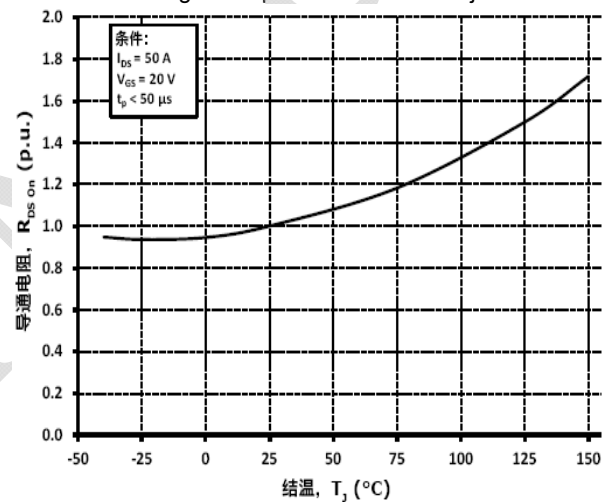


Fig.4 Normalized On-Resistant VS Temperature

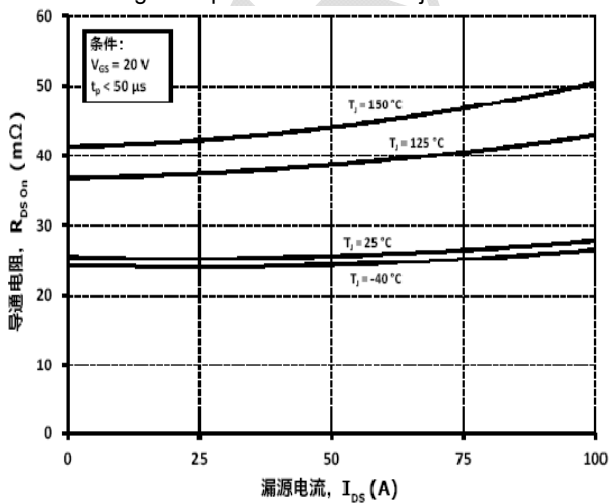


Fig.5 On-Resistant VS Drain Current For Various Temperatures

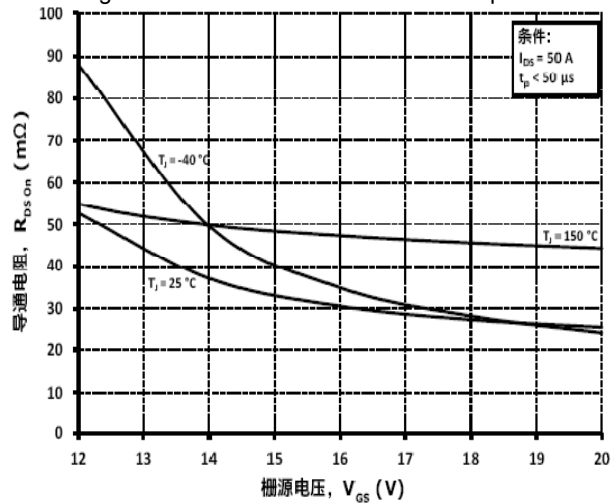


Fig.6 On-Resistant VS Gate-Source Voltage For Various Temperature

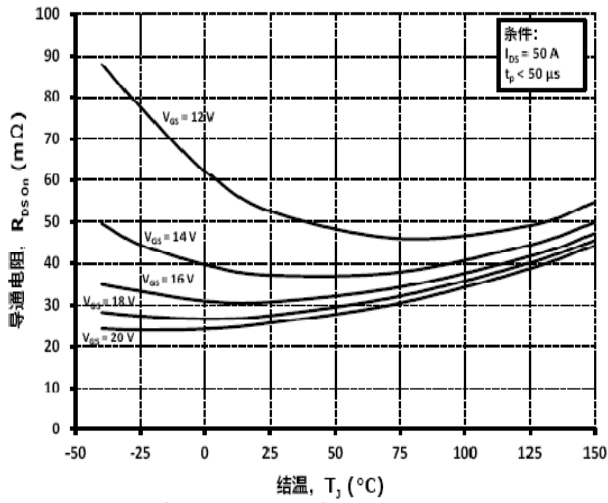


Fig.7 On-Resistant VS Temperatures For Gate-Source Voltage

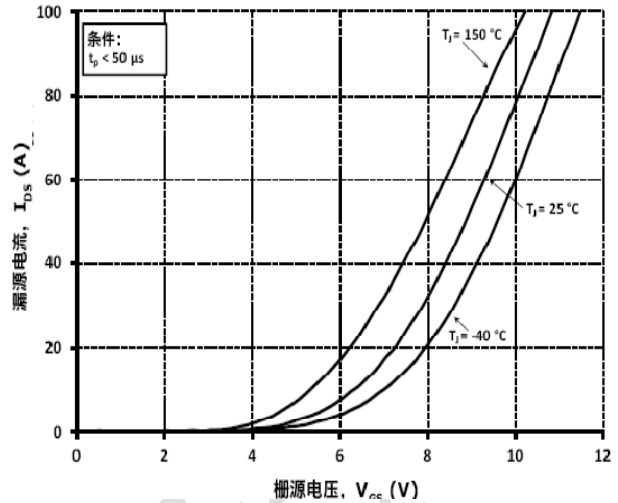


Fig.8 Transfer Characteristic for Various Junction Temperature

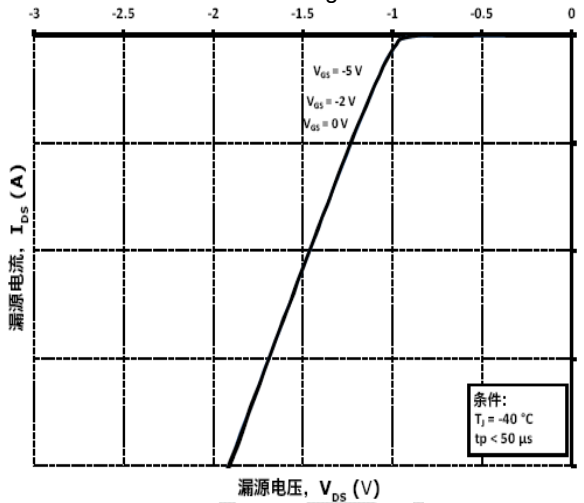


Fig.9 Diode Characteristic at -40 °C

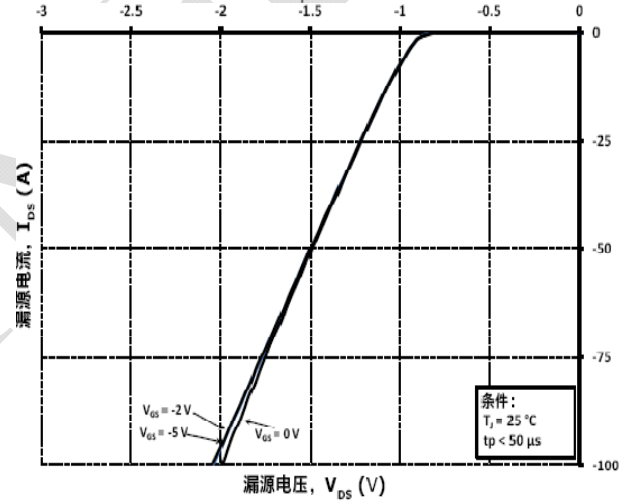


Fig.10 Diode Characteristic at 25 °C

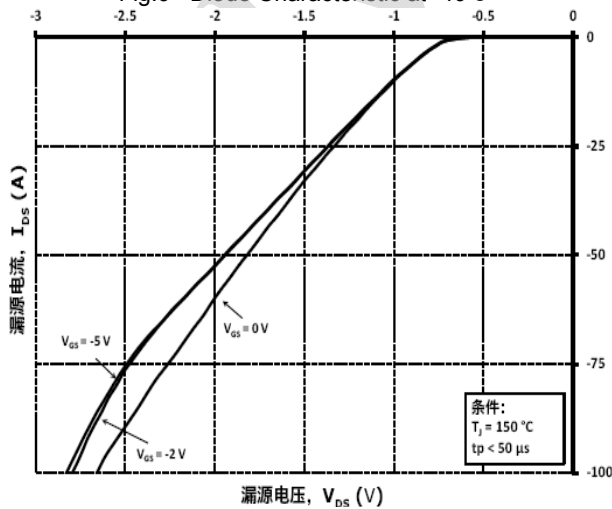


Fig.11 Diode Characteristic at 150 °C

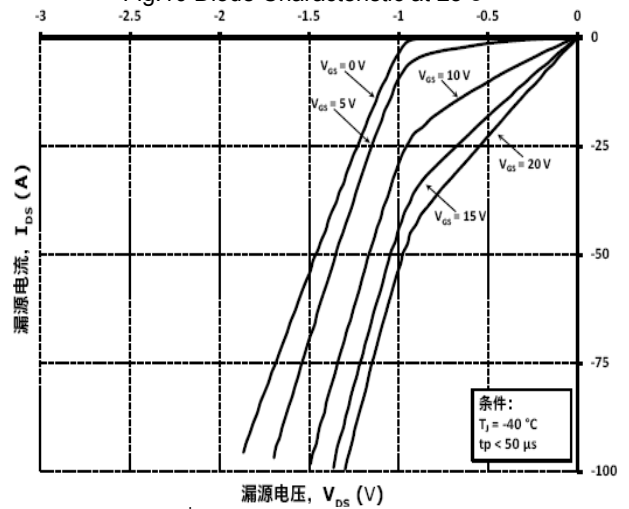


Fig.12 3<sup>rd</sup> Quadrant Characteristic at -40 °C

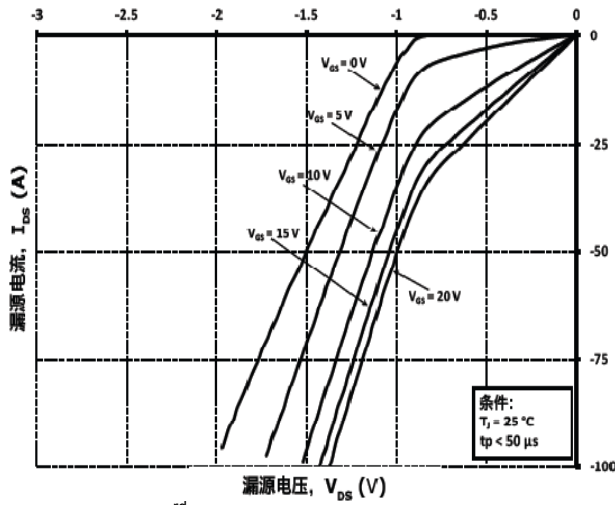


Fig. 13 3<sup>rd</sup> Quadrant Characteristic at 25°C

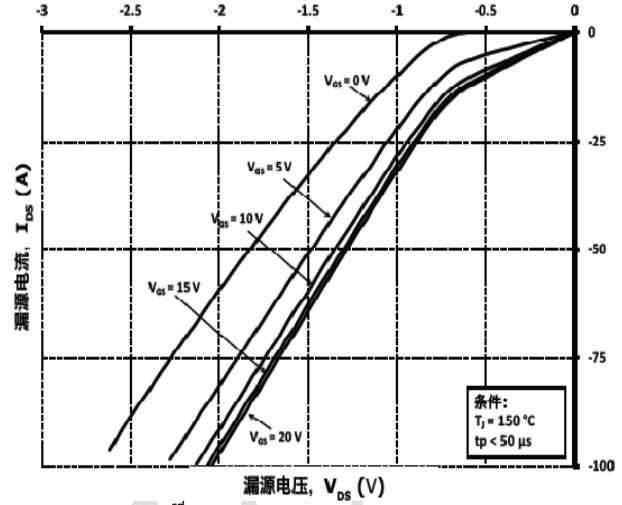


Fig. 14 3<sup>rd</sup> Quadrant Characteristic at 150°C

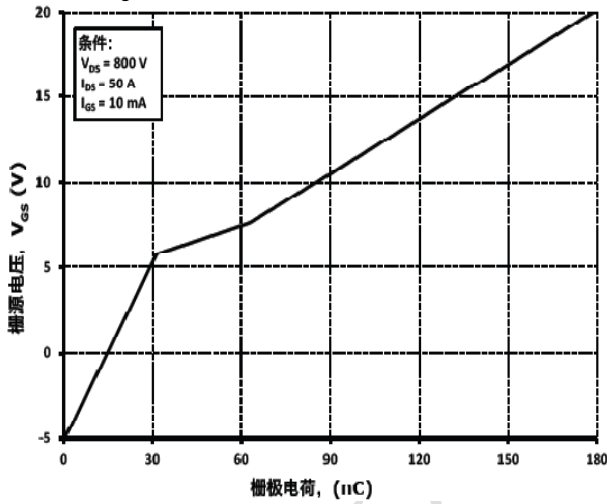


Fig. 15 Typical Gate Charge Characteristic

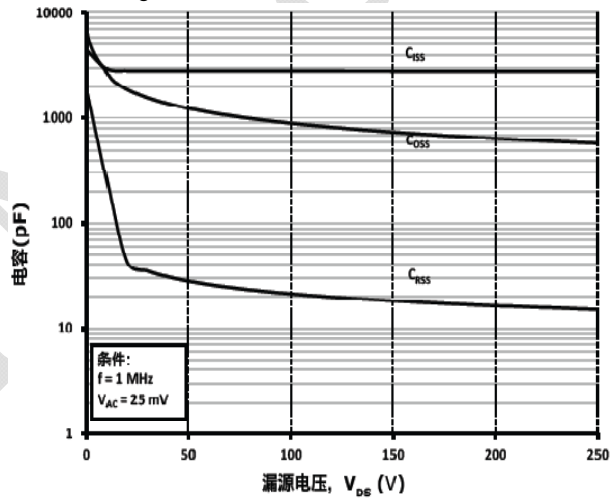


Fig. 16 Capacitances VS Drain-Source Voltage (0-200V)

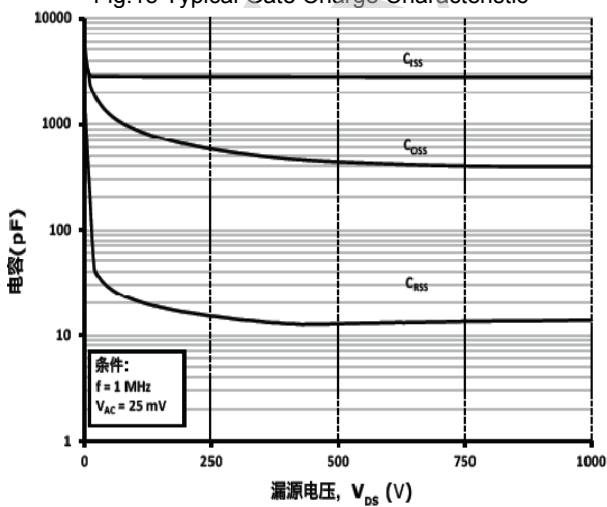


Fig. 17 Capacitances VS Drain-Source Voltage (0-1kV)

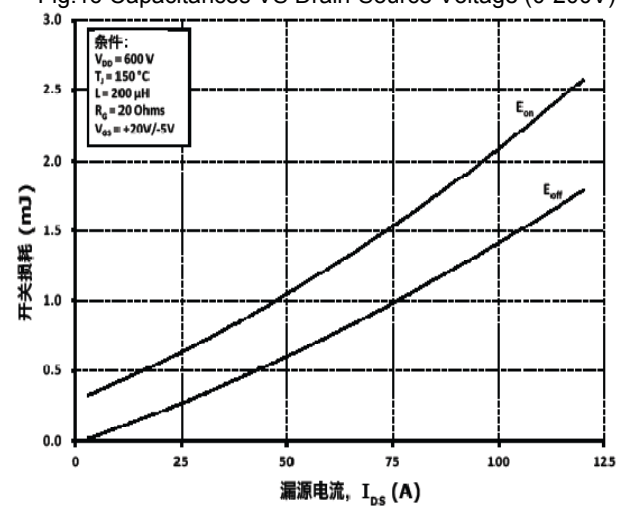


Fig. 18 Inductive Switching Energy VS Drain Current ( $V_{DS}=600V, R_G=20 \Omega$ )

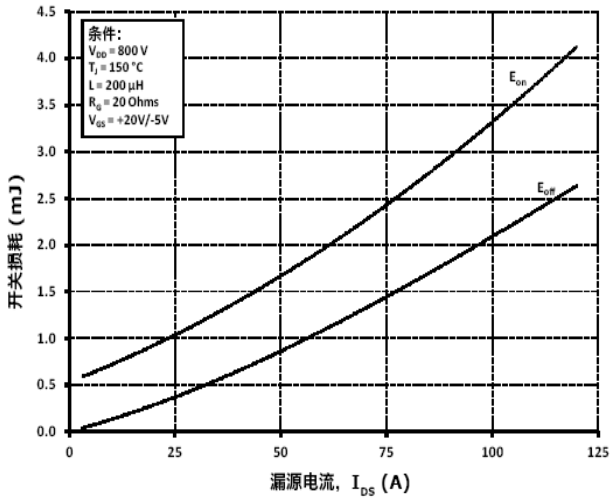


Fig.19 Inductive Switching Energy VS Drain Current ( $V_{DS}=800\text{V}, R_G=20\text{ }\Omega$ )

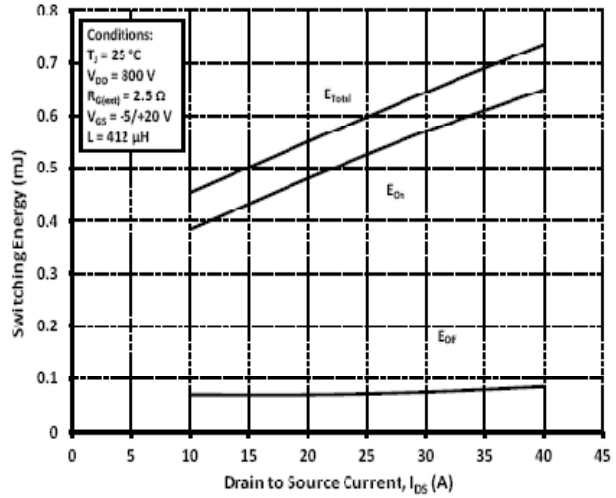


Fig.20 Inductive Switching Energy VS Drain Current ( $V_{DS}=800\text{V}, R_G=2.5\text{ }\Omega$ )

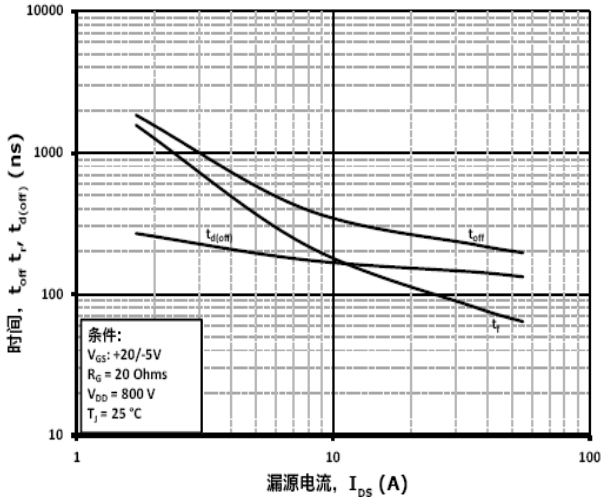


Fig.21 Timing VS Drain Current

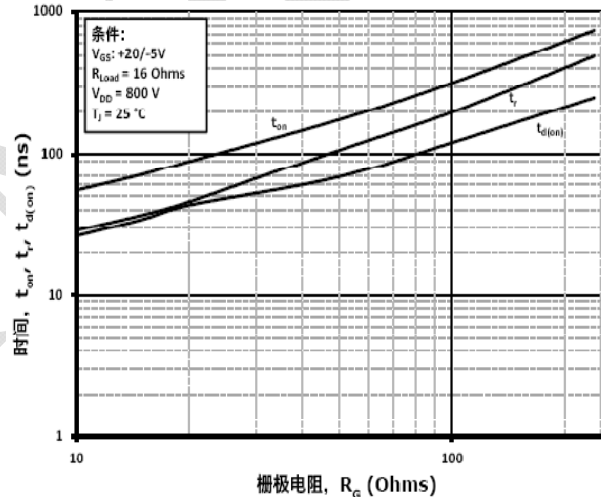


Fig.22 Timing VS  $R_{G(ext)}$

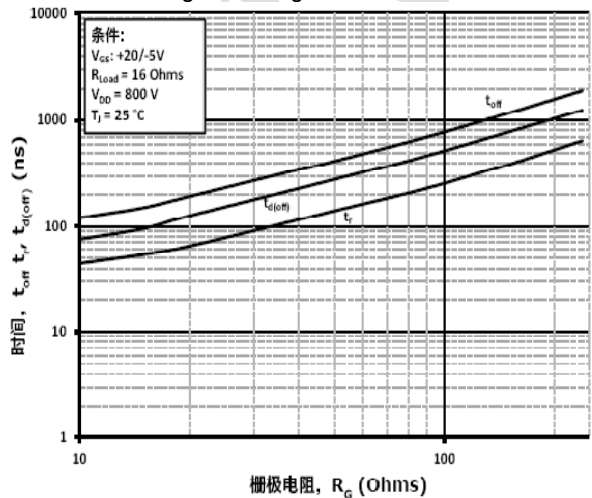


Fig.23 Timing VS  $R_{G(ext)}$

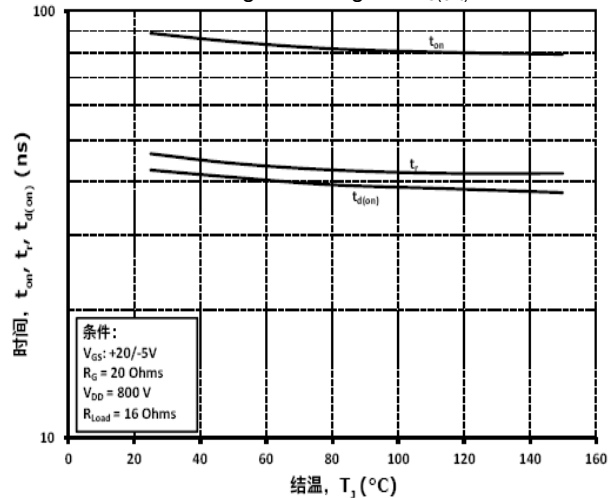


Fig.24 Timing VS Junction Temperature

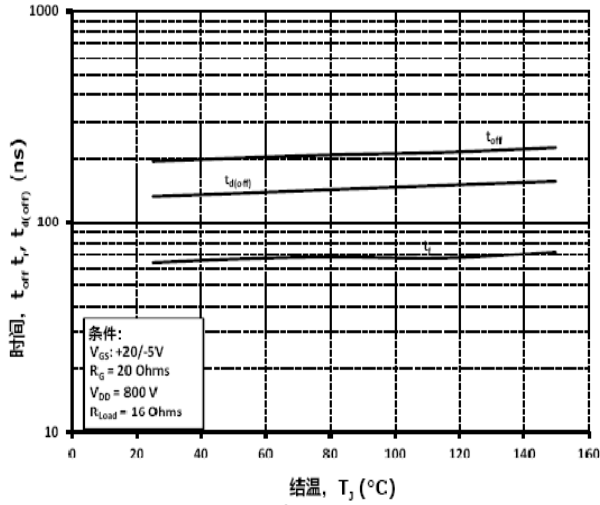


Fig.25 Timing VS Junction Temperature

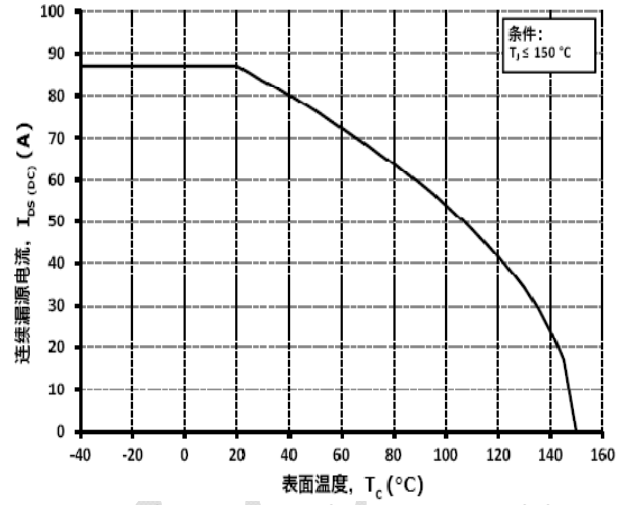


Fig.26 Continuous Drain Current Derating VS Case Temperature

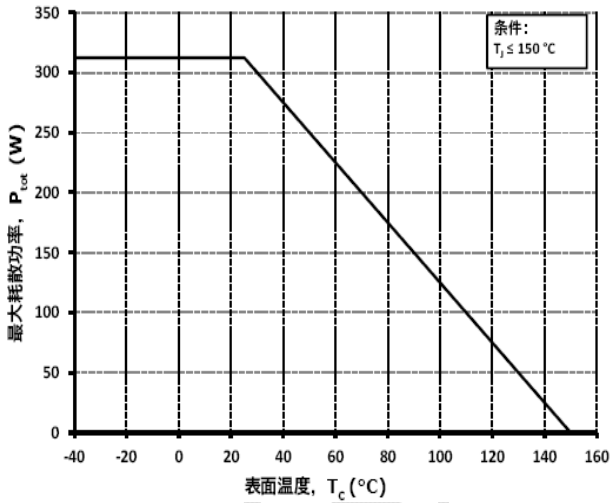


Fig.27 Maximum Power Dissipation (MOSFET) Derating VS Case Temperature

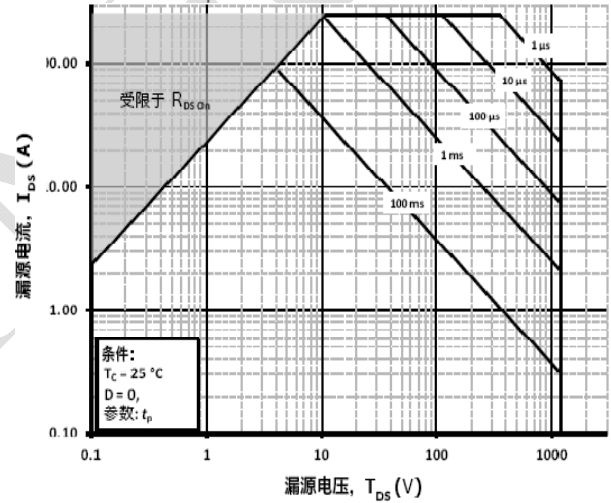


Fig.28 MOSFET Safe Operating Area

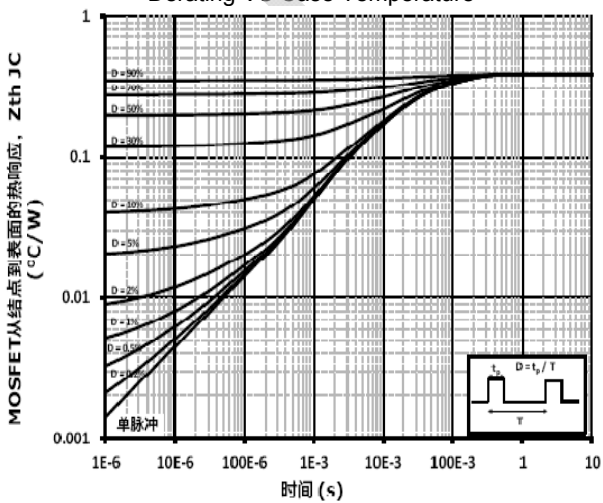


Fig.29 MOSFET Junction to Case Thermal Impedance

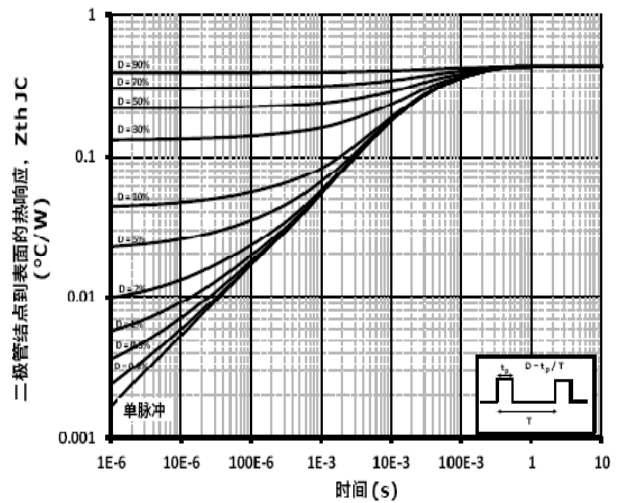


Fig.30 Diode Junction to Case Thermal Impedance



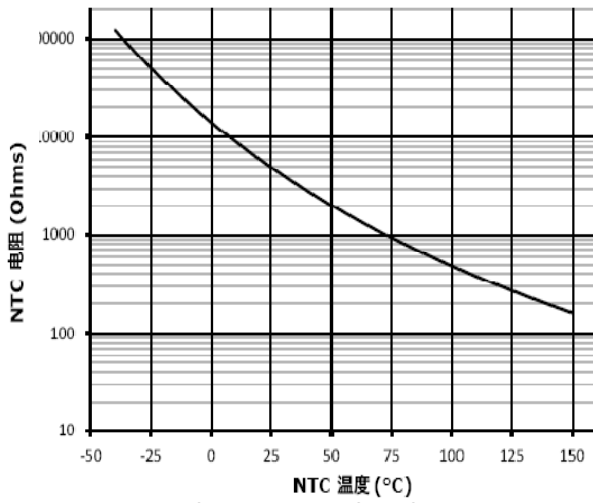


Fig.31 NTC Resistance VS NTC Temperature VS Case Temperature

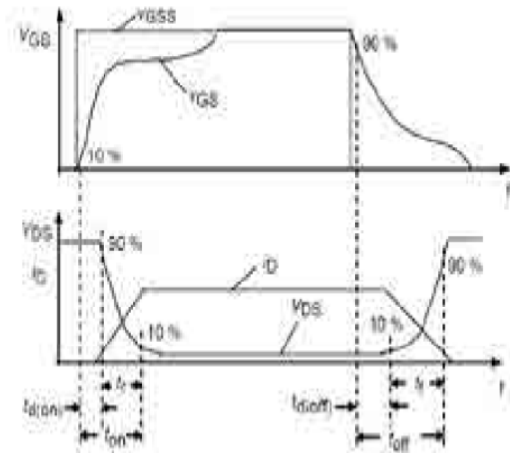
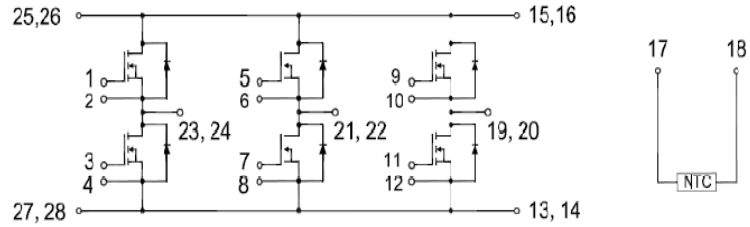


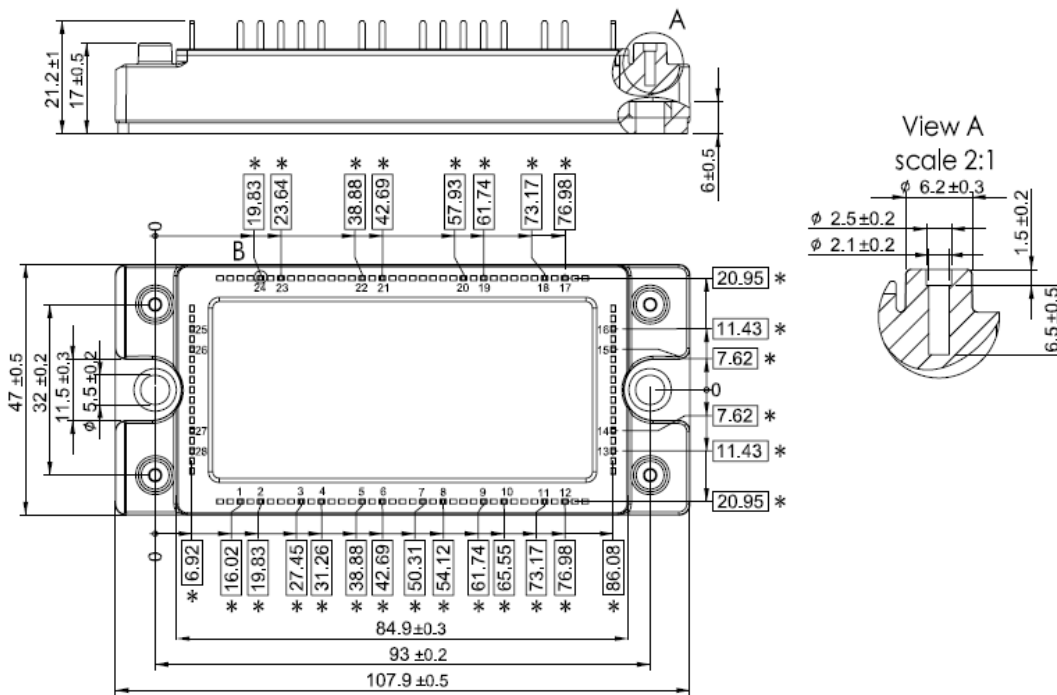
Fig.32 Resistive Switching Time Description

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### Internal Circuit



### Package Outline (Unit: mm):





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