

# MSKSEMI

SEMICONDUCTOR



ESD



TVS



TSS



MOV



GDT



PLED

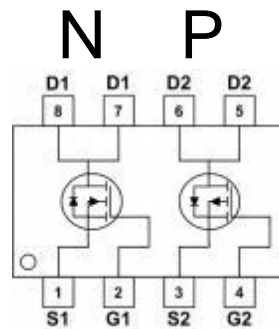
Product data sheet

[www.msksemi.com](http://www.msksemi.com)

**Product Summary**

BVDSS	RDSON	ID
60V	65mΩ	4.8A
-60V	75mΩ	-3.7A

- ★ Super Low Gate Charge
- ★ 100% EAS Guaranteed
- ★ Green Device Available
- ★ Excellent CdV/dt effect decline
- ★ Advanced high cell density Trench technology

**SOP8 Pin Configuration**

**Description**

The MS4559 is the high performance complementary N-ch and P-ch MOSFETs with high cell density, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications .

The MS4559 meet the RoHS and Green Product requirement 100% EAS guaranteed with full function reliability approved.

**Absolute Maximum Ratings**

Symbol	Parameter	Rating		Units
		N-Channel	P-Channel	
$V_{DS}$	Drain-Source Voltage	60	-60	V
$V_{GS}$	Gate-Source Voltage	±20	±20	V
$I_{D@T_A=25^{\circ}C}$	Continuous Drain Current, $V_{GS} @ 10V^1$	4.8	-3.7	A
$I_{D@T_A=70^{\circ}C}$	Continuous Drain Current, $V_{GS} @ 10V^1$	3.8	-3	A
$I_{DM}$	Pulsed Drain Current <sup>2</sup>	9.6	-7.5	A
EAS	Single Pulse Avalanche Energy <sup>3</sup>	25.5	35.3	mJ
$I_{AS}$	Avalanche Current	22.6	-26.6	A
$P_D@T_A=25^{\circ}C$	Total Power Dissipation <sup>4</sup>	1.5	1.5	W
$T_{STG}$	Storage Temperature Range	-55 to 150	-55 to 150	°C
$T_J$	Operating Junction Temperature Range	-55 to 150	-55 to 150	°C

**Thermal Data**

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JA}$	Thermal Resistance Junction-Ambient <sup>1</sup>	---	85	°C/W
$R_{\theta JC}$	Thermal Resistance Junction-Case <sup>1</sup>	---	36	°C/W

**N-Channel Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA	60	---	---	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	BV <sub>DSS</sub> Temperature Coefficient	Reference to 25°C, I <sub>D</sub> =1mA	---	0.063	---	V/°C
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance <sup>2</sup>	V <sub>GS</sub> =10V, I <sub>D</sub> =4A	---	65	80	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =2A	---	75	95	
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =250uA	1.2	---	2.5	V
ΔV <sub>GS(th)</sub>	V <sub>GS(th)</sub> Temperature Coefficient		---	-5.24	---	mV/°C
I <sub>DSS</sub>	Drain-Source Leakage Current	V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C	---	---	1	uA
		V <sub>DS</sub> =48V, V <sub>GS</sub> =0V, T <sub>J</sub> =55°C	---	---	5	
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> = ±20V, V <sub>DS</sub> =0V	---	---	±100	nA
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =4A	---	21	---	S
R <sub>g</sub>	Gate Resistance	V <sub>DS</sub> =0V, V <sub>GS</sub> =0V, f=1MHz	---	3.2	---	Ω
Q <sub>g</sub>	Total Gate Charge (4.5V)	V <sub>DS</sub> =48V, V <sub>GS</sub> =4.5V, I <sub>D</sub> =4A	---	12.6	---	nC
Q <sub>gs</sub>	Gate-Source Charge		---	3.2	---	
Q <sub>gd</sub>	Gate-Drain Charge		---	6.3	---	
T <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, R <sub>G</sub> =3.3Ω, I <sub>D</sub> =4A	---	8	---	ns
T <sub>r</sub>	Rise Time		---	14.2	---	
T <sub>d(off)</sub>	Turn-Off Delay Time		---	24.4	---	
T <sub>f</sub>	Fall Time		---	4.6	---	
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, f=1MHz	---	1378	---	pF
C <sub>oss</sub>	Output Capacitance		---	86	---	
C <sub>rss</sub>	Reverse Transfer Capacitance		---	64	---	

**Diode Characteristics**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>S</sub>	Continuous Source Current <sup>1,5</sup>	V <sub>G</sub> =V <sub>D</sub> =0V, Force Current	---	---	4.8	A
I <sub>SM</sub>	Pulsed Source Current <sup>2,5</sup>		---	---	9.6	A
V <sub>SD</sub>	Diode Forward Voltage <sup>2</sup>	V <sub>GS</sub> =0V, I <sub>S</sub> =1A, T <sub>J</sub> =25°C	---	---	1.2	V

**Note :**

- The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
- The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%
- The EAS data shows Max. rating. The test condition is V<sub>DD</sub>=25V, V<sub>GS</sub>=10V, L=0. 1mH, I<sub>AS</sub>=22.6A
- The power dissipation is limited by 150°C junction temperature
- The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.

**P-Channel Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V , I <sub>D</sub> =-250uA	-60	---	---	V
ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	BV <sub>DSS</sub> Temperature Coefficient	Reference to 25°C , I <sub>D</sub> =-1mA	---	-0.03	---	V/°C
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance <sup>2</sup>	V <sub>GS</sub> =-10V , I <sub>D</sub> =-3A	---	75	90	mΩ
		V <sub>GS</sub> =-4.5V , I <sub>D</sub> =-2A	---	90	125	
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250uA	-1.2	---	-2.5	V
ΔV <sub>GS(th)</sub>	V <sub>GS(th)</sub> Temperature Coefficient		---	4.56	---	mV/°C
I <sub>DSS</sub>	Drain-Source Leakage Current	V <sub>DS</sub> =-48V , V <sub>GS</sub> =0V , T <sub>J</sub> =25°C	---	---	1	uA
		V <sub>DS</sub> =-48V , V <sub>GS</sub> =0V , T <sub>J</sub> =55°C	---	---	5	
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> = ±20V , V <sub>DS</sub> =0V	---	---	±100	nA
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =-5V , I <sub>D</sub> =-3A	---	15	---	S
R <sub>g</sub>	Gate Resistance	V <sub>DS</sub> =0V , V <sub>GS</sub> =0V , f=1MHz	---	13.5	---	Ω
Q <sub>g</sub>	Total Gate Charge (-4.5V)	V <sub>DS</sub> =-48V , V <sub>GS</sub> =-4.5V , I <sub>D</sub> =-3A	---	9.86	---	nC
Q <sub>gs</sub>	Gate-Source Charge		---	3.1	---	
Q <sub>gd</sub>	Gate-Drain Charge		---	2.95	---	
T <sub>d(on)</sub>	Turn-On Delay Time	V <sub>DD</sub> =-15V , V <sub>GS</sub> =-10V , R <sub>G</sub> =3.3Ω , I <sub>D</sub> =-1A	---	28.8	---	ns
T <sub>r</sub>	Rise Time		---	19.8	---	
T <sub>d(off)</sub>	Turn-Off Delay Time		---	60.8	---	
T <sub>f</sub>	Fall Time		---	7.2	---	
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =-15V , V <sub>GS</sub> =0V , f=1MHz	---	1447	---	pF
C <sub>oss</sub>	Output Capacitance		---	97.3	---	
C <sub>rss</sub>	Reverse Transfer Capacitance		---	70	---	

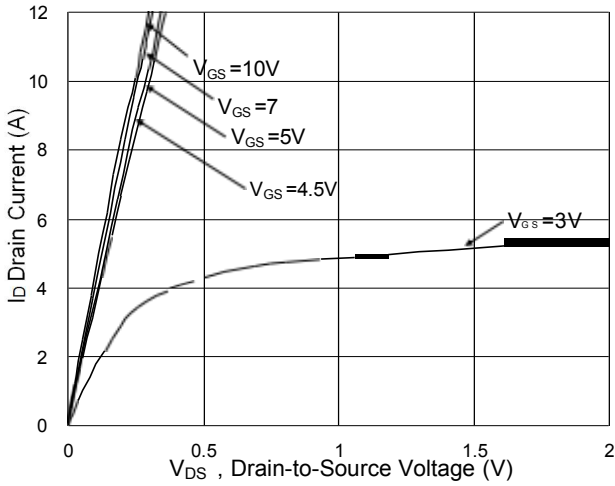
**Diode Characteristics**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I <sub>S</sub>	Continuous Source Current <sup>1,5</sup>	V <sub>G</sub> =V <sub>D</sub> =0V , Force Current	---	---	-3.7	A
I <sub>SM</sub>	Pulsed Source Current <sup>2,5</sup>		---	---	-7.5	A
V <sub>SD</sub>	Diode Forward Voltage <sup>2</sup>	V <sub>GS</sub> =0V , I <sub>S</sub> =-1A , T <sub>J</sub> =25°C	---	---	-1.2	V

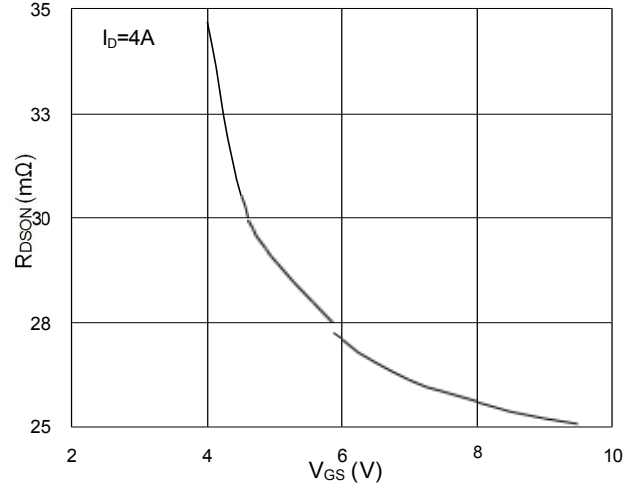
Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%
- 3.The EAS data shows Max. rating . The test condition is V<sub>DD</sub>=-25V,V<sub>GS</sub>=-10V,L=0. 1mH,I<sub>AS</sub>=-26.6A
- 4.The power dissipation is limited by 150°C junction temperature
- 5.The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub> , in real applications , should be limited by total power dissipation.

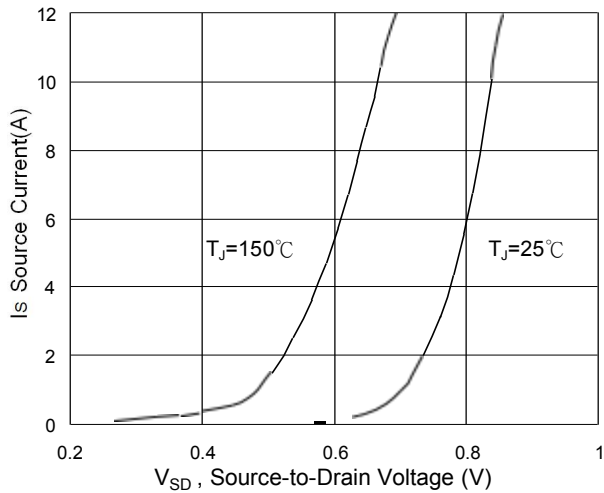
**N-Channel Typical Characteristics**



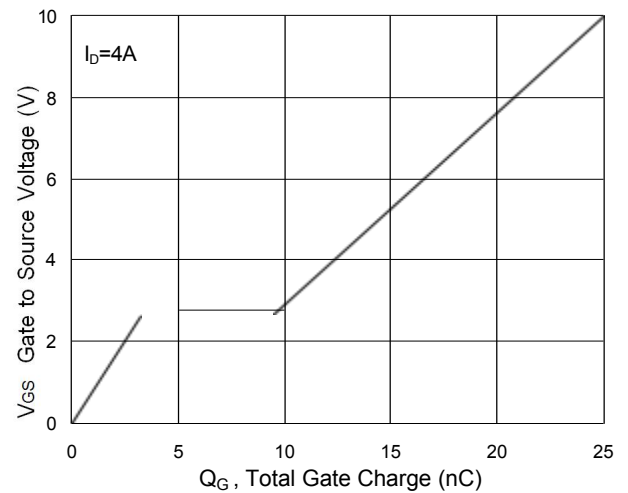
**Fig. 1 Typical Output Characteristics**



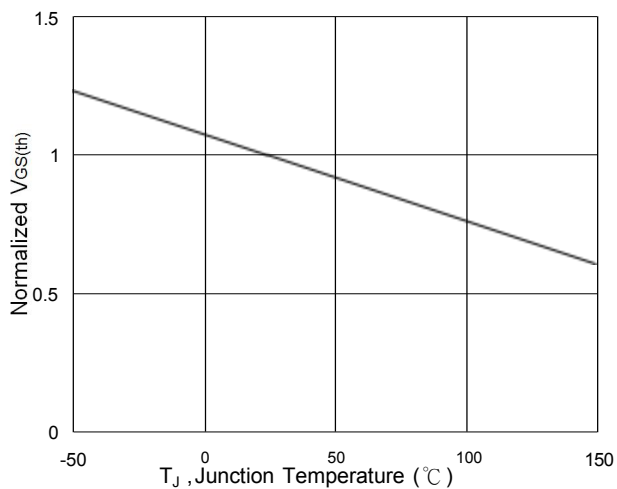
**Fig. 2 On-Resistance v.s Gate-Source**



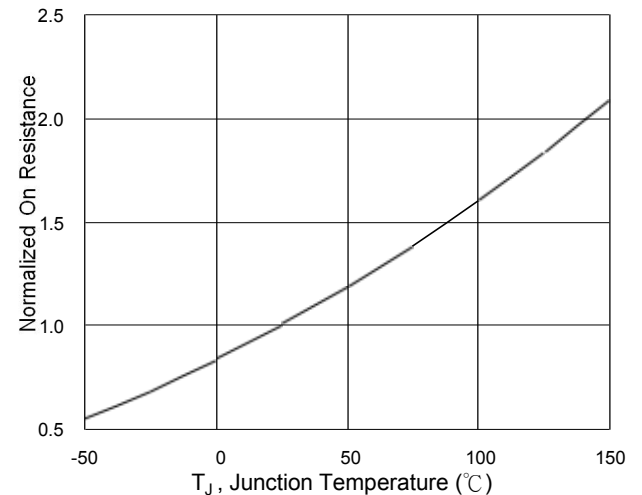
**Fig. 3 Forward Characteristics of Reverse**



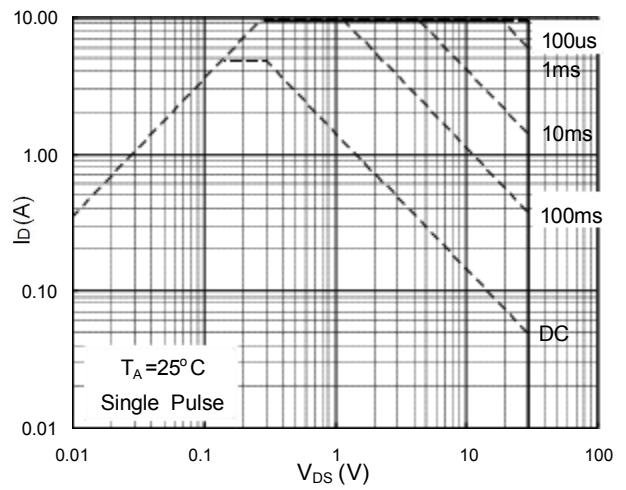
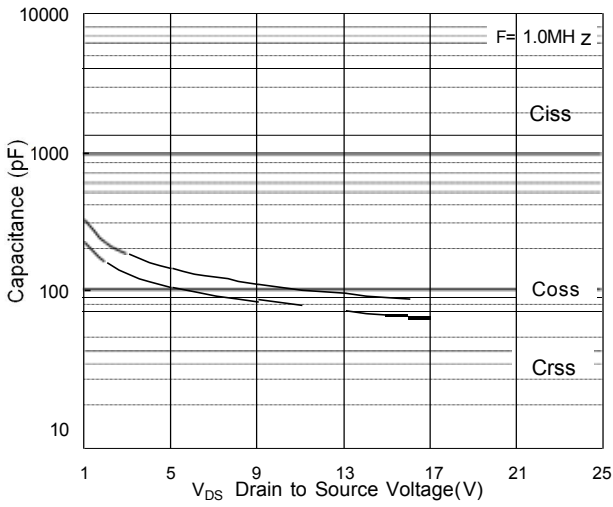
**Fig. 4 Gate-Charge Characteristics**



**Fig. 5 Normalized  $V_{GS(th)}$  v.s  $T_J$**

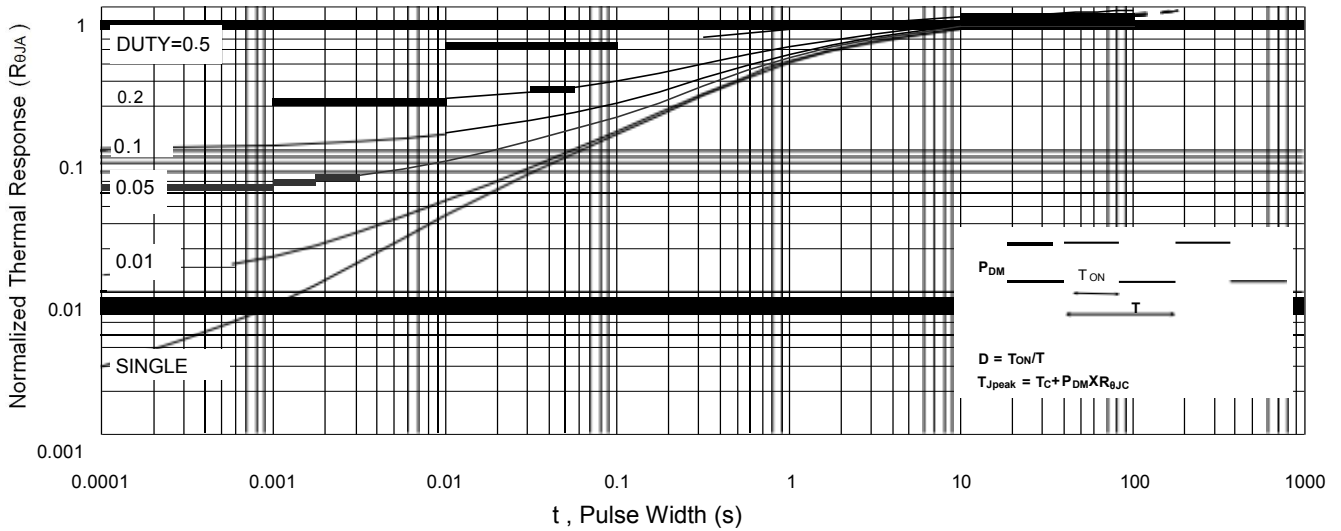


**Fig. 6 Normalized  $R_{DS(on)}$  v.s  $T_J$**

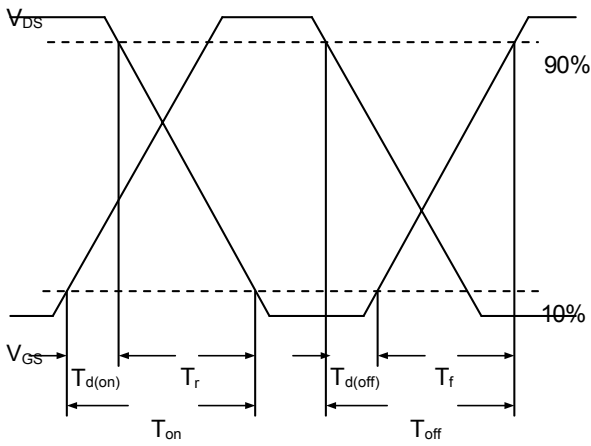


**Fig. 7 Capacitance**

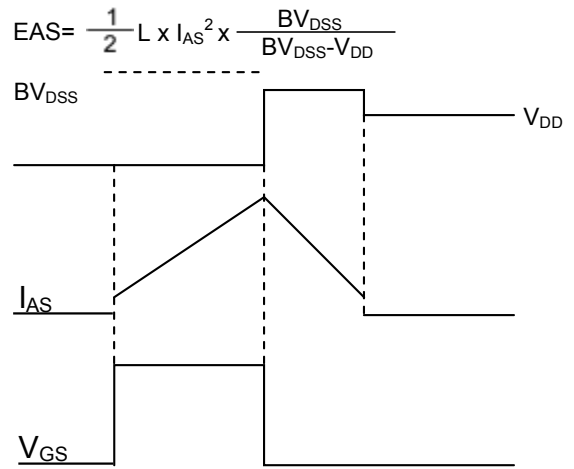
**Fig. 8 Safe Operating Area**



**Fig. 9 Normalized Maximum Transient Thermal Impedance**

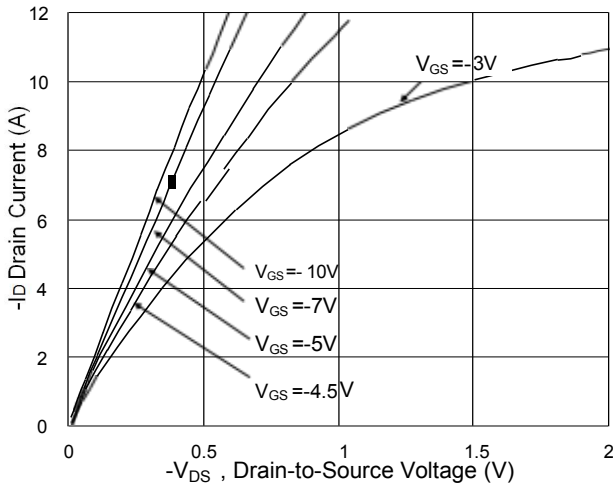


**Fig. 10 Switching Time Waveform**

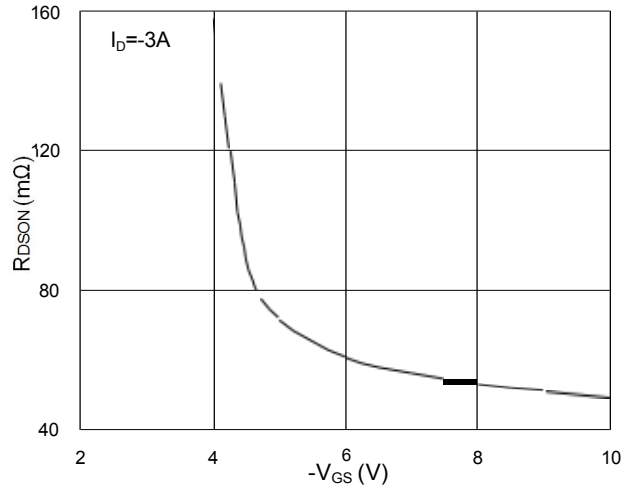


**Fig. 11 Unclamped Inductive Waveform**

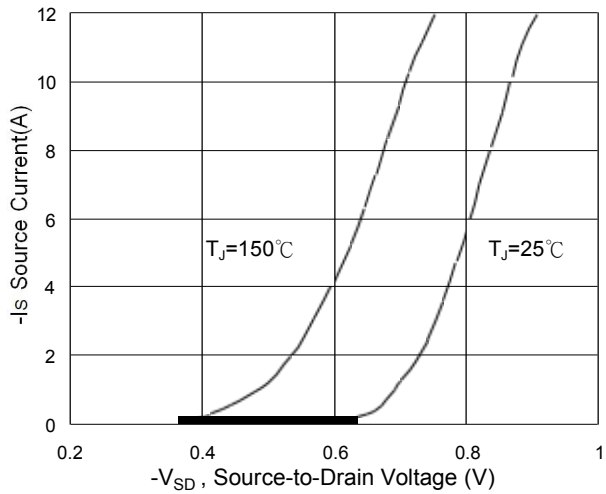
**P-Channel Typical Characteristics**



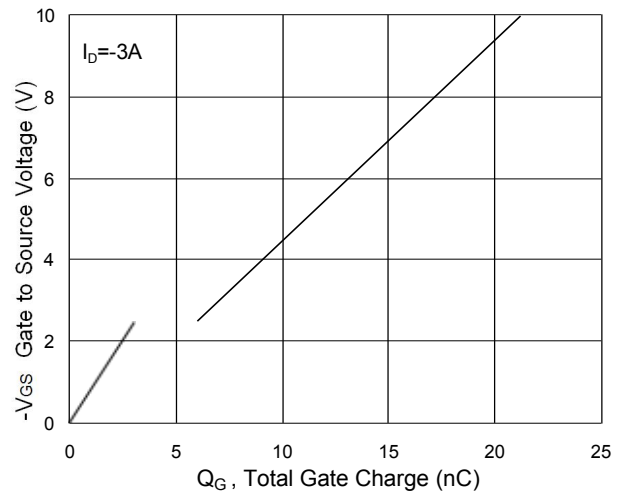
**Fig.1 Typical Output Characteristics**



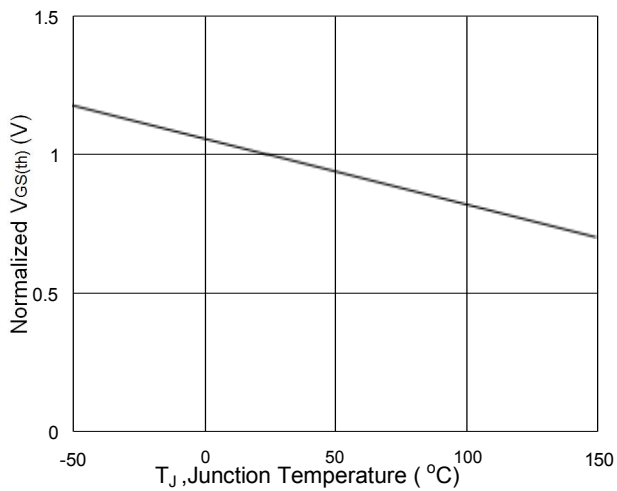
**Fig.2 On-Resistance v.s Gate-Source**



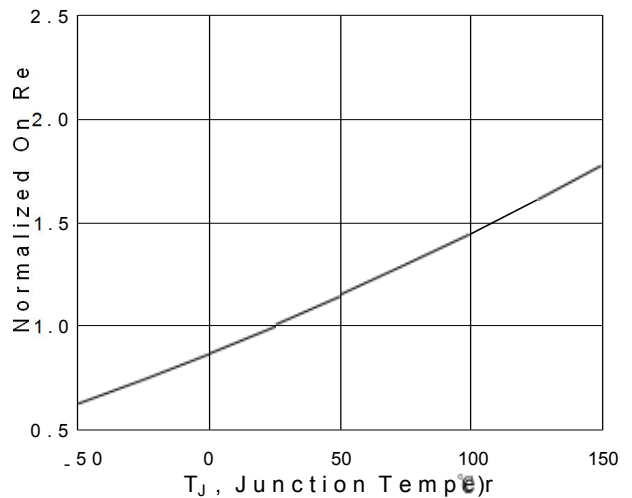
**Fig.3 Forward Characteristics of Reverse**



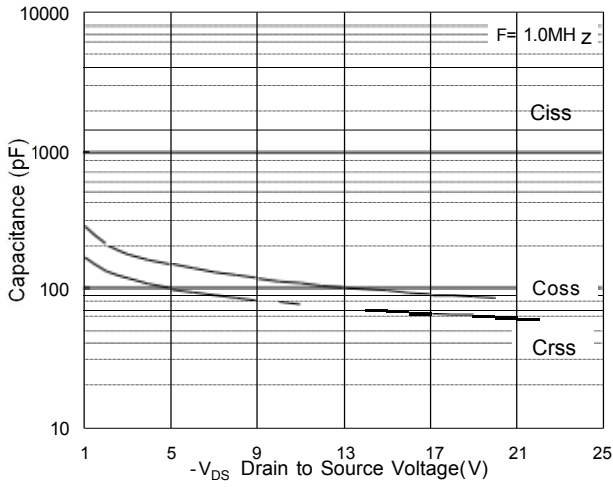
**Fig.4 Gate-Charge Characteristics**



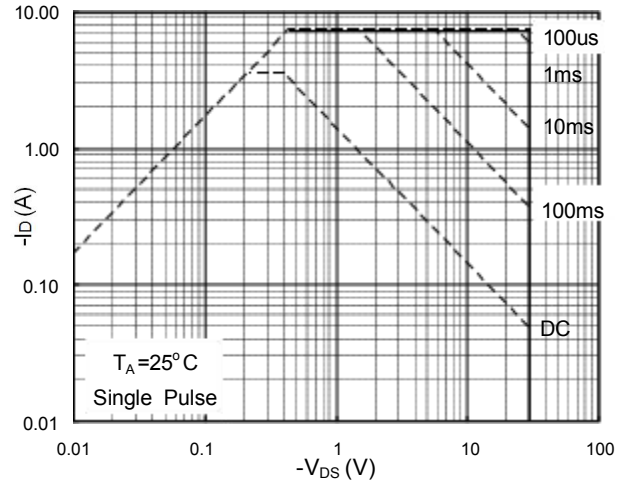
**Fig.5 Normalized  $V_{GS(th)}$  v.s  $T_J$**



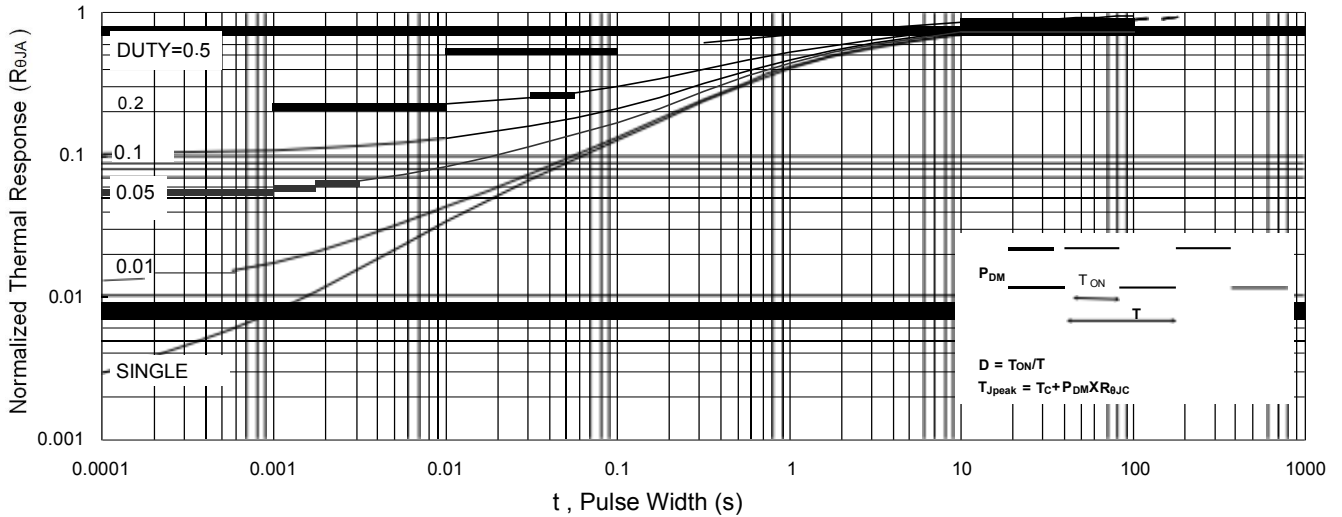
**Fig.6 Normalized  $R_{DS(on)}$  v.s  $T_J$**



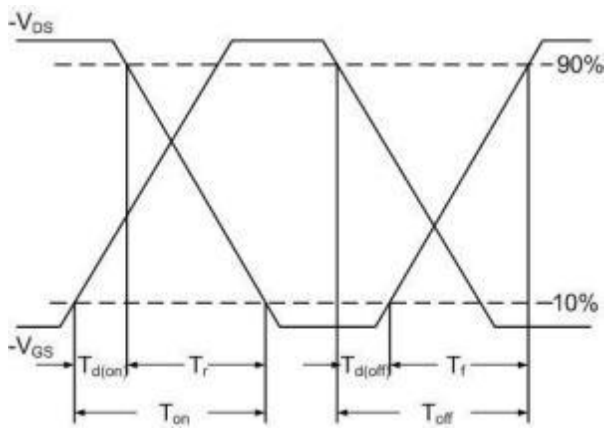
**Fig. 7 Capacitance**



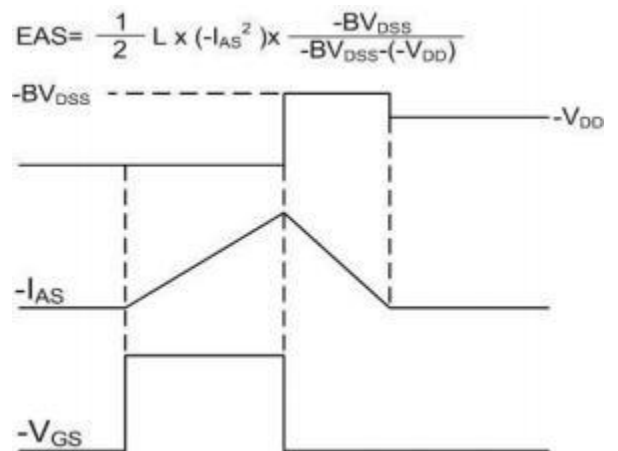
**Fig. 8 Safe Operating Area**



**Fig. 9 Normalized Maximum Transient Thermal Impedance**



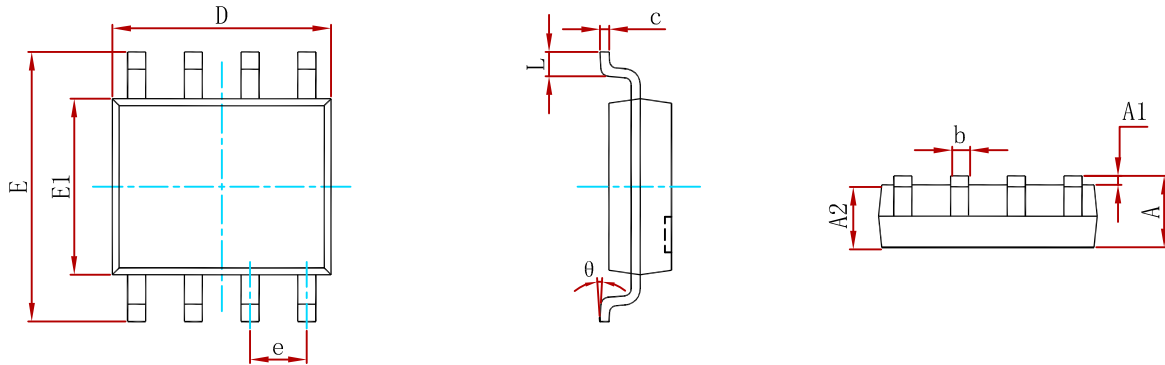
**Fig. 10 Switching Time Waveform**



**Fig. 11 Unclamped Inductive Waveform**

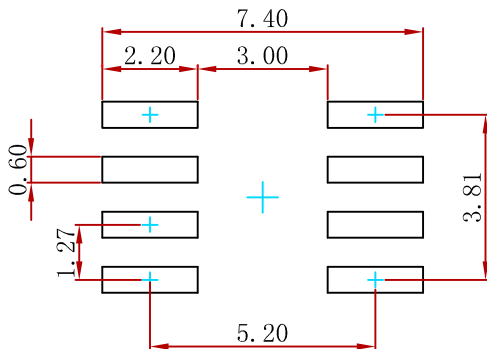


**PACKAGE MECHANICAL DATA**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270 (BSC)		0.050 (BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

**Suggested Pad Layout**



**Note:**

1. Controlling dimension: in millimeters.
2. General tolerance: ± 0.05mm.
3. The pad layout is for reference purposes only.

**REEL SPECIFICATION**

P/N	PKG	QTY
MS4559	SOP-8	3000

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