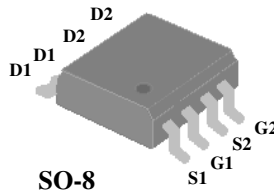




**Complementary N and P-channel
Enhancement-mode Power MOSFETs**

- Simple Drive Requirement
- Low On-resistance
- Fast Switching Performance
- RoHS-compliant, halogen-free

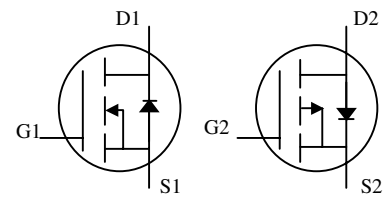


N-CH	BV_{DSS}	30V
	$R_{DS(ON)}$	14m Ω
	I_D	10A
P-CH	BV_{DSS}	-30V
	$R_{DS(ON)}$	20m Ω
	I_D	-8.4A

Description

Advanced Power MOSFETs from APEC provide the designer with the best combination of fast switching, low on-resistance and cost-effectiveness.

The AP4509GM-HF-3 is in a standard SO-8 package, which is widely used for commercial and industrial surface-mount applications, and is well suited for applications such as DC and servo motor drives.



Absolute Maximum Ratings

Symbol	Parameter	Rating		Units
		N-channel	P-channel	
V_{DS}	Drain-Source Voltage	30	-30	V
V_{GS}	Gate-Source Voltage	± 20	± 20	V
I_D at $T_A=25^\circ\text{C}$	Continuous Drain Current ³	10.0	-8.4	A
I_D at $T_A=70^\circ\text{C}$	Continuous Drain Current ³	7.9	-6.7	A
I_{DM}	Pulsed Drain Current ¹	30	-30	A
P_D at $T_A=25^\circ\text{C}$	Total Power Dissipation	2.0		W
	Linear Derating Factor	0.016		W/ $^\circ\text{C}$
T_{STG}	Storage Temperature Range	-55 to 150		$^\circ\text{C}$
T_J	Operating Junction Temperature Range	-55 to 150		$^\circ\text{C}$

Thermal Data

Symbol	Parameter	Value	Unit
R_{thj-a}	Maximum Thermal Resistance, Junction-ambient ³	62.5	$^\circ\text{C}/\text{W}$

Ordering Information

AP4509GM-HF-3TR RoHS-compliant, halogen-free SO-8, shipped on tape and reel (3000 pcs/reel)



N-channel Electrical Specifications at $T_j=25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	30	-	-	V
$\Delta BV_{DSS} / \Delta T_j$	Breakdown Voltage Temperature Coefficient	Reference to $25^\circ\text{C}, I_D=1\text{mA}$	-	0.02	-	V/ $^\circ\text{C}$
$R_{DS(ON)}$	Static Drain-Source On-Resistance ²	$V_{GS}=10V, I_D=9A$	-	-	14	m Ω
		$V_{GS}=4.5V, I_D=5A$	-	-	20	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	1	-	3	V
g_{fs}	Forward Transconductance	$V_{DS}=10V, I_D=9A$	-	14	-	S
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=30V, V_{GS}=0V$	-	-	1	μA
		Drain-Source Leakage Current ($T_j=70^\circ\text{C}$)	$V_{DS}=24V, V_{GS}=0V$	-	-	25
I_{GSS}	Gate-Source Leakage	$V_{GS}=\pm 20V$	-	-	± 100	nA
Q_g	Total Gate Charge ²	$I_D=9A$	-	23	65	nC
Q_{gs}	Gate-Source Charge	$V_{DS}=24V$	-	6	-	nC
Q_{gd}	Gate-Drain ("Miller") Charge	$V_{GS}=4.5V$	-	14	-	nC
$t_{d(on)}$	Turn-on Delay Time ²	$V_{DS}=15V$	-	14	-	ns
t_r	Rise Time	$I_D=1A$	-	10	-	ns
$t_{d(off)}$	Turn-off Delay Time	$R_G=3.3\Omega, V_{GS}=10V$	-	36	-	ns
t_f	Fall Time	$R_D=15\Omega$	-	17	-	ns
C_{iss}	Input Capacitance	$V_{GS}=0V$	-	1770	2830	pF
C_{oss}	Output Capacitance	$V_{DS}=25V$	-	430	-	pF
C_{rss}	Reverse Transfer Capacitance	$f=1.0\text{MHz}$	-	350	-	pF

Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{SD}	Forward On Voltage ²	$I_S=1.7A, V_{GS}=0V$	-	-	1.2	V
t_{rr}	Reverse Recovery Time ²	$I_S=9A, V_{GS}=0V$	-	31	-	ns
Q_{rr}	Reverse Recovery Charge	$di/dt=100A/\mu s$	-	25	-	nC

Notes:

1. Pulse width limited by maximum junction temperature.
2. Pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.
3. Surface mounted on 1 in² copper pad of FR4 board, $t \leq 10\text{sec}$; 135°C/W when mounted on min. copper pad.

THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

USE OF THIS PRODUCT AS A CRITICAL COMPONENT IN LIFE SUPPORT OR OTHER SIMILAR SYSTEMS IS NOT AUTHORIZED.

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P-channel Electrical Specifications at $T_j=25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=-250\mu A$	-30	-	-	V
$\Delta BV_{DSS}/\Delta T_j$	Breakdown Voltage Temperature Coefficient	Reference to $25^\circ\text{C}, I_D=-1\text{mA}$	-	-0.02	-	V/ $^\circ\text{C}$
$R_{DS(ON)}$	Static Drain-Source On-Resistance ²	$V_{GS}=-10V, I_D=-8A$	-	-	20	m Ω
		$V_{GS}=-4.5V, I_D=-4A$	-	-	30	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=-250\mu A$	-1	-	-3	V
g_{fs}	Forward Transconductance	$V_{DS}=-10V, I_D=-8A$	-	14	-	S
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=-30V, V_{GS}=0V$	-	-	-1	μA
		Drain-Source Leakage Current ($T_j=70^\circ\text{C}$)	$V_{DS}=-24V, V_{GS}=0V$	-	-	-25
I_{GSS}	Gate-Source Leakage	$V_{GS}=\pm 20V$	-	-	± 100	nA
Q_g	Total Gate Charge ²	$I_D=-8A$	-	27	45	nC
Q_{gs}	Gate-Source Charge	$V_{DS}=-24V$	-	4	-	nC
Q_{gd}	Gate-Drain ("Miller") Charge	$V_{GS}=-4.5V$	-	18	-	nC
$t_{d(on)}$	Turn-on Delay Time ²	$V_{DS}=-15V$	-	16	-	ns
t_r	Rise Time	$I_D=-1A$	-	11	-	ns
$t_{d(off)}$	Turn-off Delay Time	$R_G=3.3\Omega, V_{GS}=-10V$	-	40	-	ns
t_f	Fall Time	$R_D=15\Omega$	-	25	-	ns
C_{iss}	Input Capacitance	$V_{GS}=0V$	-	1580	2530	pF
C_{oss}	Output Capacitance	$V_{DS}=-25V$	-	540	-	pF
C_{rss}	Reverse Transfer Capacitance	$f=1.0\text{MHz}$	-	450	-	pF

Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{SD}	Forward On Voltage ²	$I_S=-1.7A, V_{GS}=0V$	-	-	-1.2	V
t_{rr}	Reverse Recovery Time ²	$I_S=-8A, V_{GS}=0V$	-	40	-	ns
Q_{rr}	Reverse Recovery Charge	$di/dt=-100A/\mu s$	-	32	-	nC

Notes:

1. Pulse width limited by maximum junction temperature.
2. Pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.
3. Surface mounted on 1 in² copper pad of FR4 board, $t \leq 10\text{sec}$; 135°C/W when mounted on min. copper pad.

THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

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Typical N-channel Electrical Characteristics

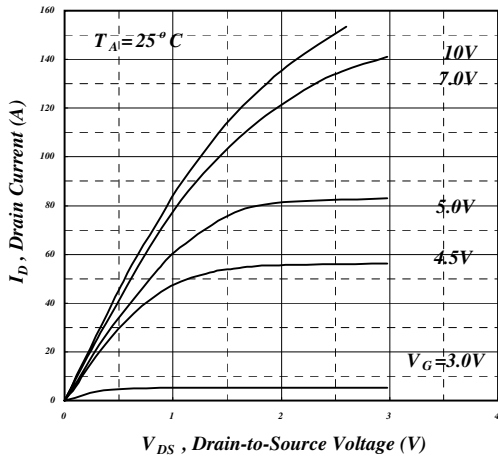


Fig 1. Typical Output Characteristics

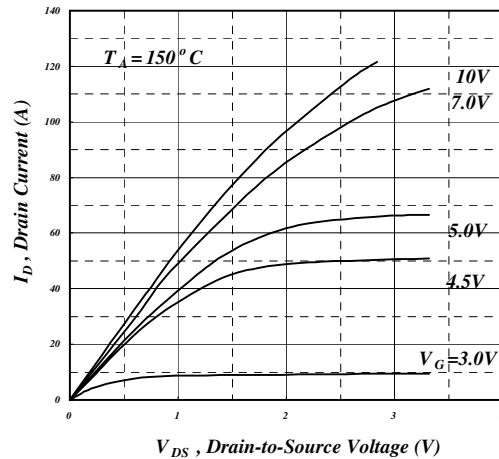


Fig 2. Typical Output Characteristics

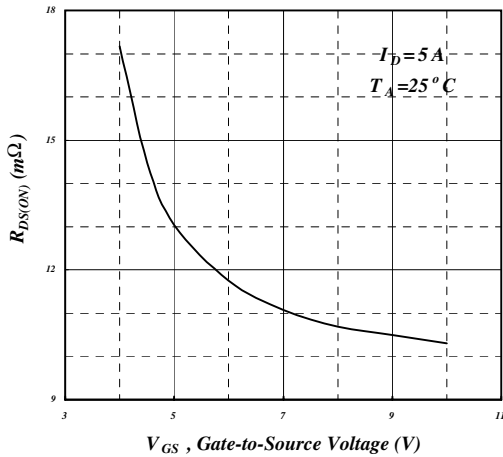


Fig 3. On-Resistance vs. Gate Voltage

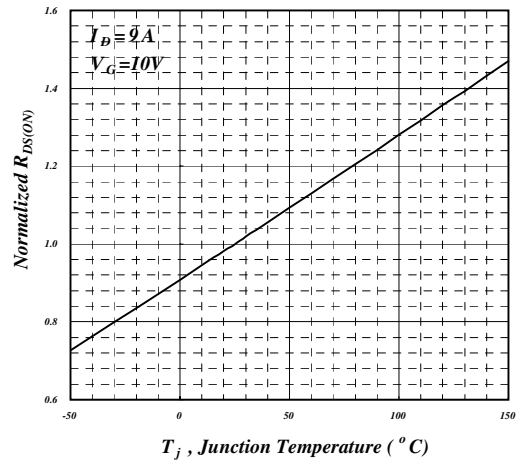


Fig 4. Normalized On-Resistance vs. Junction Temperature

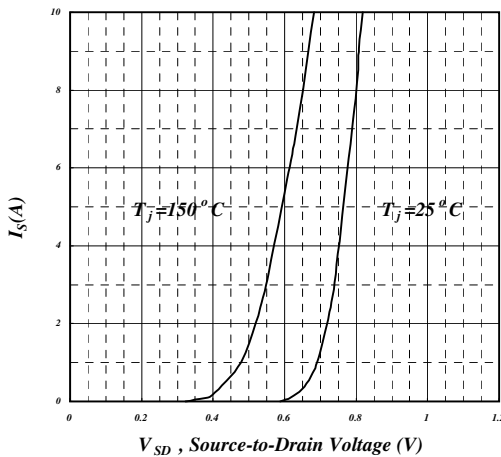


Fig 5. Forward Characteristic of Reverse Diode

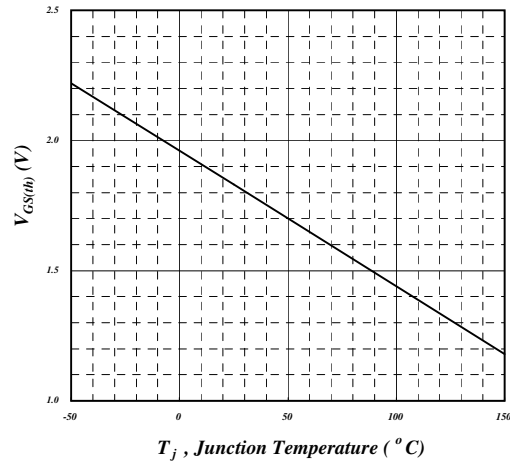


Fig 6. Gate Threshold Voltage vs. Junction Temperature



Typical N-channel Electrical Characteristics (cont.)

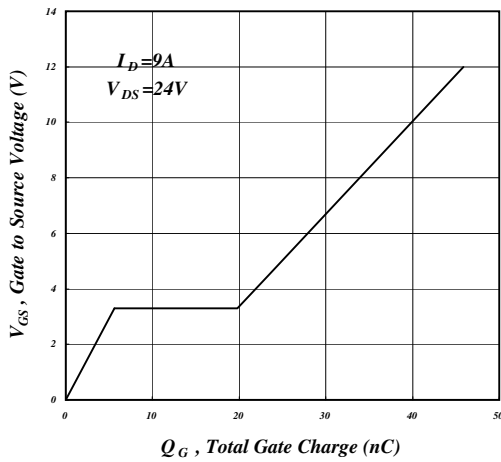


Fig 7. Gate Charge Characteristics

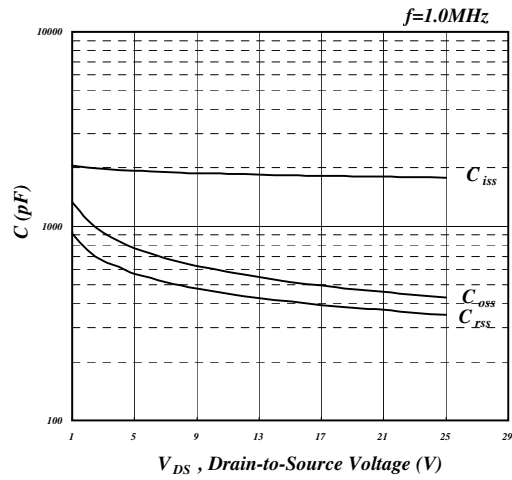


Fig 8. Typical Capacitance Characteristics

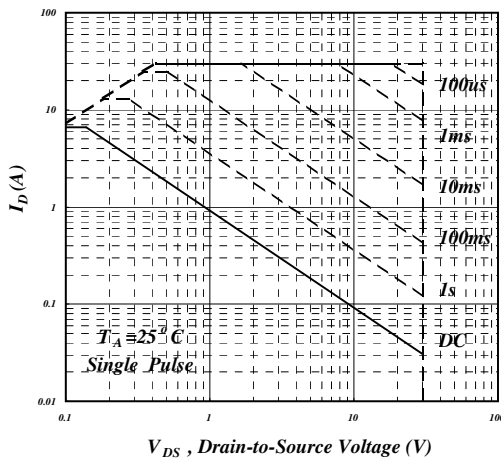


Fig 9. Maximum Safe Operating Area

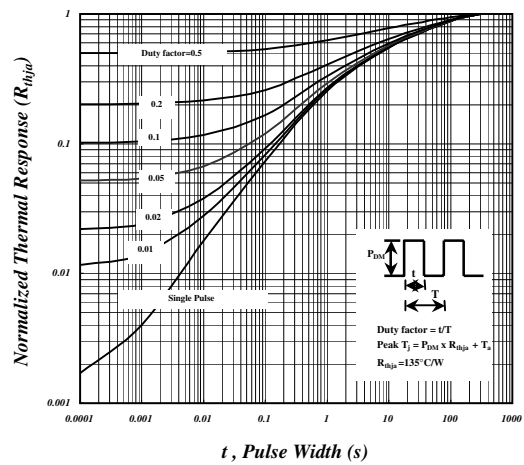


Fig 10. Effective Transient Thermal Impedance

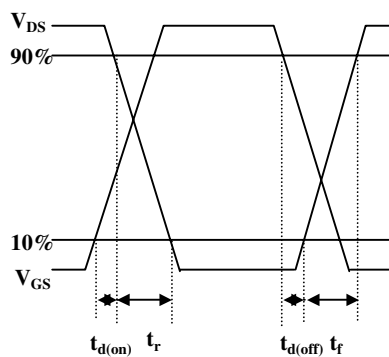


Fig 11. Switching Time Waveforms

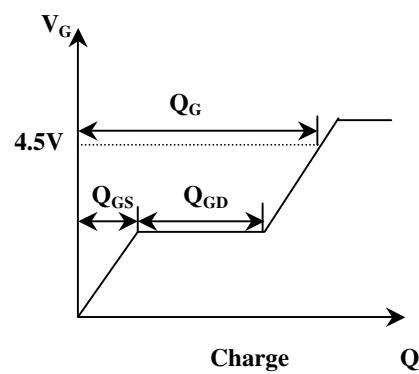


Fig 12. Gate Charge Waveform



Typical P-channel Electrical Characteristics

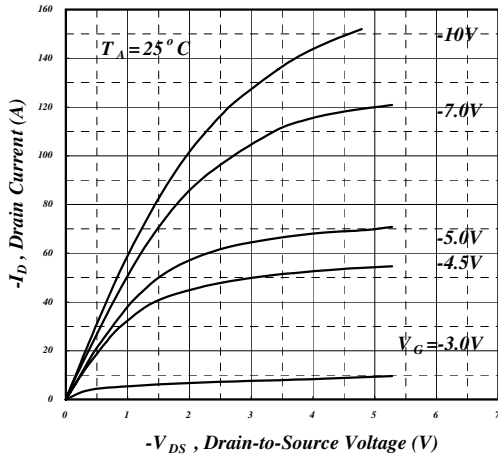


Fig 1. Typical Output Characteristics

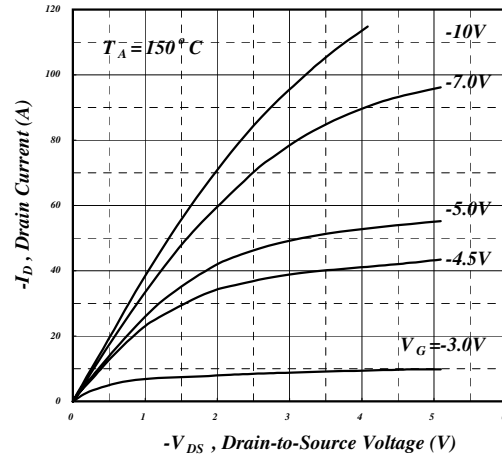


Fig 2. Typical Output Characteristics

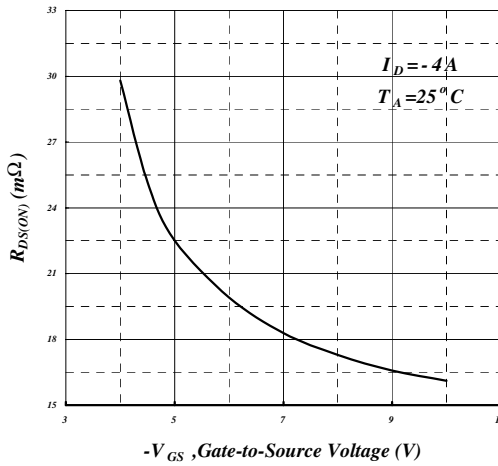


Fig 3. On-Resistance vs. Gate Voltage

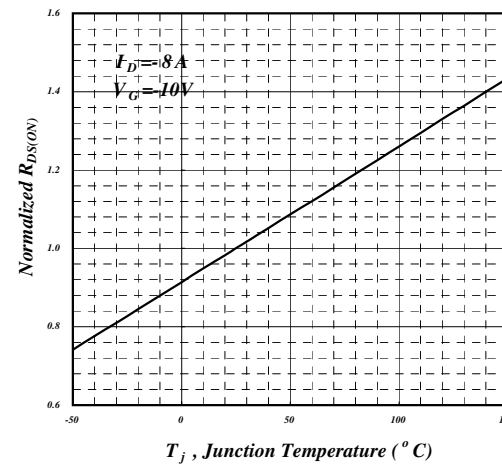


Fig 4. Normalized On-Resistance vs. Junction Temperature

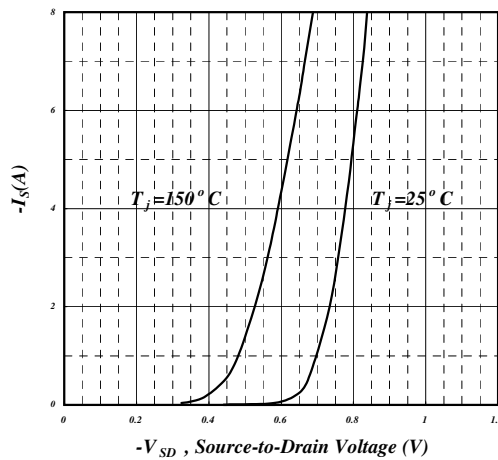


Fig 5. Forward Characteristic of Reverse Diode

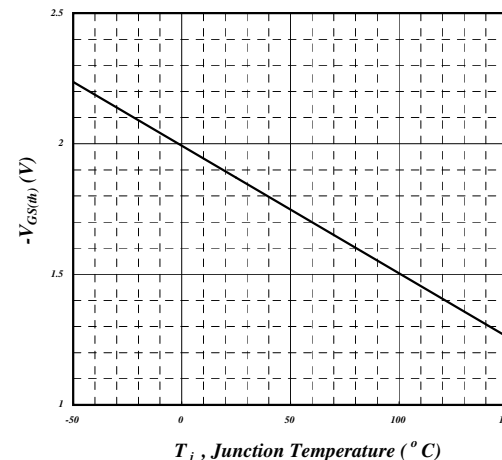


Fig 6. Gate Threshold Voltage vs. Junction Temperature



Typical P-channel Electrical Characteristics (cont.)

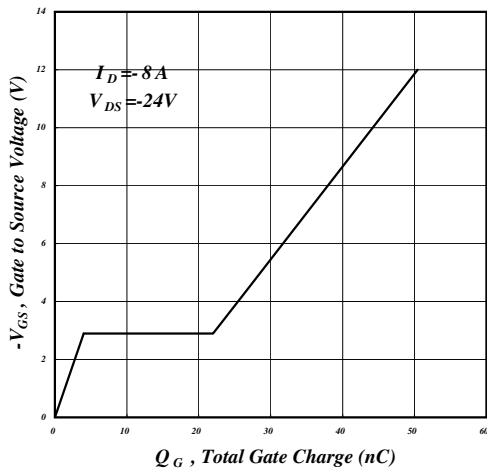


Fig 7. Gate Charge Characteristics

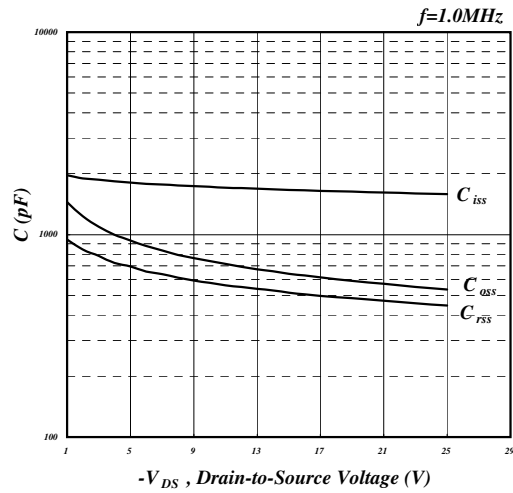


Fig 8. Typical Capacitance Characteristics

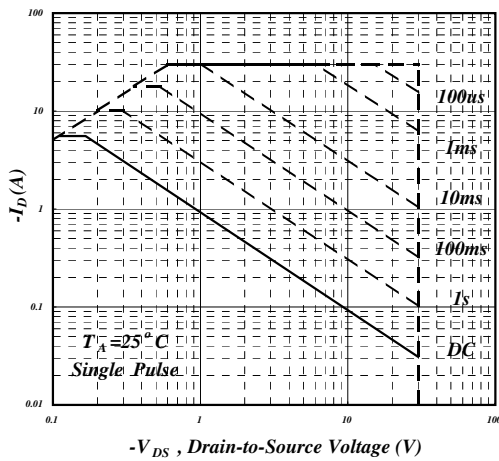


Fig 9. Maximum Safe Operating Area

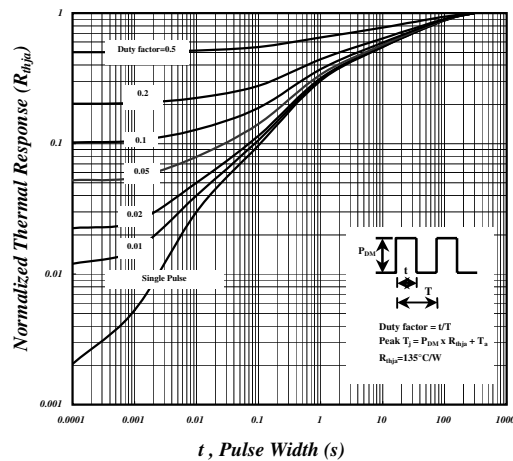


Fig 10. Effective Transient Thermal Impedance

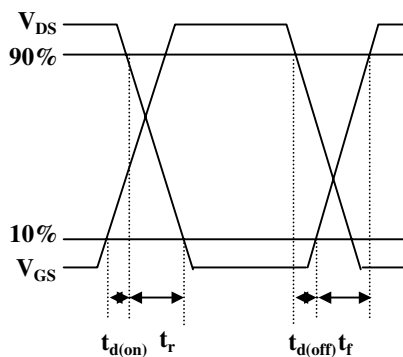


Fig 11. Switching Time Waveforms

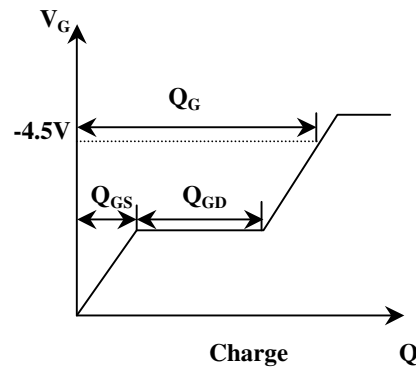
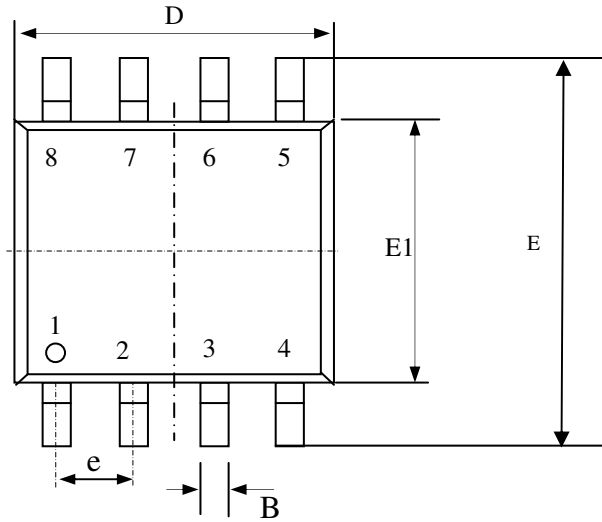


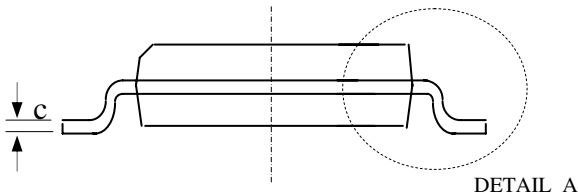
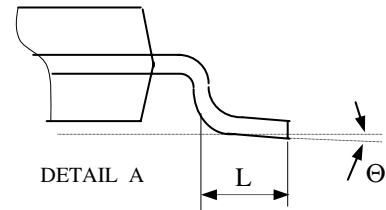
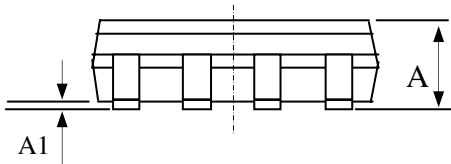
Fig 12. Gate Charge Waveform



Package Dimensions: SO-8

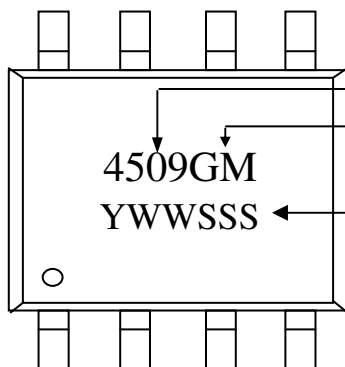


SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.33	0.41	0.51
C	0.19	0.22	0.25
D	4.80	4.90	5.00
E1	3.80	3.90	4.00
E	5.80	6.15	6.50
L	0.38	0.71	1.27
θ	0	4.00	8.00
e	1.27 TYP		



1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

Marking Information:



Product: AP4509
 Package:
 GM = RoHS-compliant SO-8
 Date/lot code (YWWSSS)
 Y: Last digit of the year
 WW: Work week
 SSS: Lot code sequence