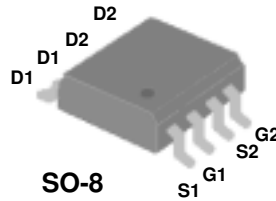




**Complementary N and P-channel
Enhancement-mode Power MOSFETs**

- Simple Drive Requirement
- Good Thermal Performance
- Fast Switching Performance
- RoHS-compliant, halogen-free

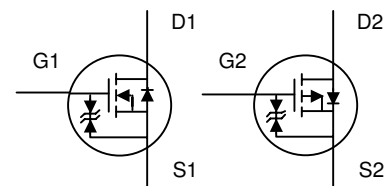


N-CH	BV_{DSS}	30V
	$R_{DS(ON)}$	18m Ω
	I_D	8.4A
P-CH	BV_{DSS}	-30V
	$R_{DS(ON)}$	36m Ω
	I_D	-6A

Description

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

The AP4533GEM-HF-3 is in the industry-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	8.4	-6.0	A
I_D at $T_A=70^\circ\text{C}$	Continuous Drain Current ³	6.7	-3.2	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	Units
Rthj-amb	Maximum Thermal Resistance, Junction-ambient ³	62.5	$^\circ\text{C}/\text{W}$

Ordering Information

AP4533GEM-HF-3TR : in 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
$R_{DS(ON)}$	Static Drain-Source On-Resistance ²	$V_{GS}=10V, I_D=8A$	-	-	18	m Ω
		$V_{GS}=4.5V, I_D=6A$	-	-	36	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	1	-	3	V
g_{fs}	Forward Transconductance	$V_{DS}=10V, I_D=8A$	-	13	-	S
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=24V, V_{GS}=0V$	-	-	1	μA
		Drain-Source Leakage Current ($T_j=70^\circ\text{C}$)	$V_{DS}=24V, V_{GS}=0V$	-	-	25
I_{GSS}	Gate-Source Leakage	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 30	μA
Q_g	Total Gate Charge ²	$I_D=8A$	-	6.5	10.5	nC
Q_{gs}	Gate-Source Charge	$V_{DS}=15V$	-	2.5	-	nC
Q_{gd}	Gate-Drain ("Miller") Charge	$V_{GS}=4.5V$	-	3.3	-	nC
$t_{d(on)}$	Turn-on Delay Time ²	$V_{DS}=15V$	-	8	-	ns
t_r	Rise Time	$I_D=1A$	-	6	-	ns
$t_{d(off)}$	Turn-off Delay Time	$R_G=3.3\Omega, V_{GS}=10V$	-	17	-	ns
t_f	Fall Time	$R_D=15\Omega$	-	6	-	ns
C_{iss}	Input Capacitance	$V_{GS}=0V$	-	540	860	pF
C_{oss}	Output Capacitance	$V_{DS}=25V$	-	150	-	pF
C_{rss}	Reverse Transfer Capacitance	$f=1.0\text{MHz}$	-	90	-	pF

Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{SD}	Forward On Voltage ²	$I_S=1.5A, V_{GS}=0V$	-	-	1.3	V
t_{rr}	Reverse Recovery Time ²	$I_S=8A, V_{GS}=0V$	-	20	-	ns
Q_{rr}	Reverse Recovery Charge	$di/dt=100A/\mu s$	-	12	-	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.

APEC DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

APEC RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN.



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
$R_{DS(ON)}$	Static Drain-Source On-Resistance ²	$V_{GS}=-10V, I_D=-6A$	-	-	36	m Ω
		$V_{GS}=-4.5V, I_D=-4A$	-	-	65	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=-250\mu A$	-1	-	-3	V
g_{fs}	Forward Transconductance	$V_{DS}=-10V, I_D=-6A$	-	9.4	-	S
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=-24V, V_{GS}=0V$	-	-	-1	μA
	Drain-Source Leakage Current ($T_j=70^\circ\text{C}$)	$V_{DS}=-24V, V_{GS}=0V$	-	-	-25	μA
I_{GSS}	Gate-Source Leakage	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 30	μA
Q_g	Total Gate Charge ²	$I_D=-6A$	-	9	14.5	nC
Q_{gs}	Gate-Source Charge	$V_{DS}=-15V$	-	2.5	-	nC
Q_{gd}	Gate-Drain ("Miller") Charge	$V_{GS}=-4.5V$	-	5.5	-	nC
$t_{d(on)}$	Turn-on Delay Time ²	$V_{DS}=-15V$	-	8	-	ns
t_r	Rise Time	$I_D=-1A$	-	9.5	-	ns
$t_{d(off)}$	Turn-off Delay Time	$R_G=3.3\Omega, V_{GS}=-10V$	-	20	-	ns
t_f	Fall Time	$R_D=15\Omega$	-	20	-	ns
C_{iss}	Input Capacitance	$V_{GS}=0V$	-	500	800	pF
C_{oss}	Output Capacitance	$V_{DS}=-25V$	-	180	-	pF
C_{rss}	Reverse Transfer Capacitance	$f=1.0\text{MHz}$	-	135	-	pF

Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{SD}	Forward On Voltage ²	$I_S=-1.5A, V_{GS}=0V$	-	-	-1.3	V
t_{rr}	Reverse Recovery Time ²	$I_S=-6A, V_{GS}=0V$	-	25	-	ns
Q_{rr}	Reverse Recovery Charge	$di/dt=-100A/\mu s$	-	17	-	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, $t_c < 10\text{sec}$; 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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Typical N-channel Electrical Characteristics

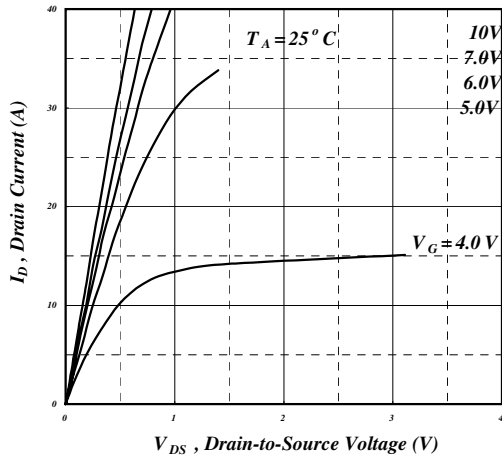


Fig 1. Typical Output Characteristics

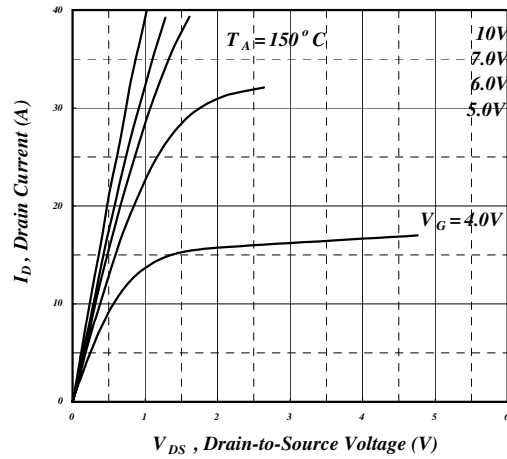


Fig 2. Typical Output Characteristics

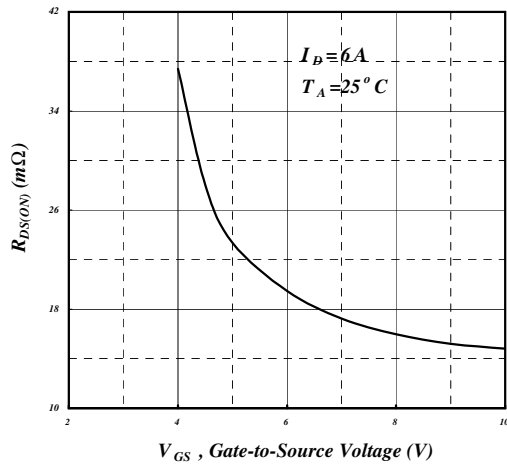


Fig 3. On-Resistance v.s. Gate Voltage

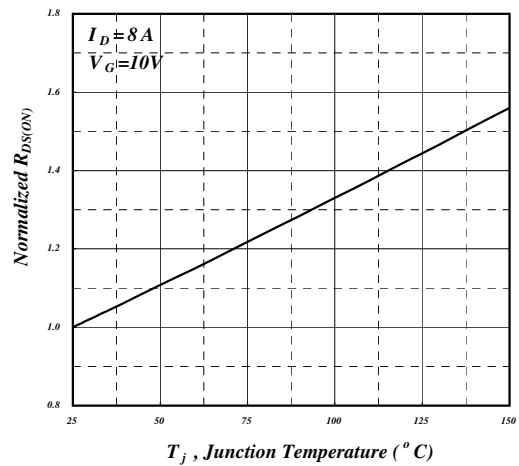


Fig 4. Normalized On-Resistance
v.s. Junction Temperature

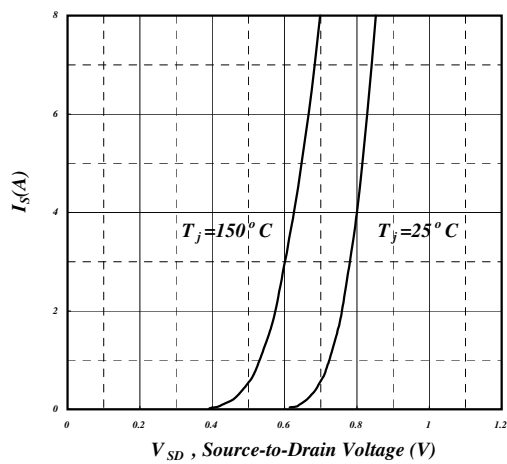


Fig 5. Forward Characteristic of
Reverse Diode

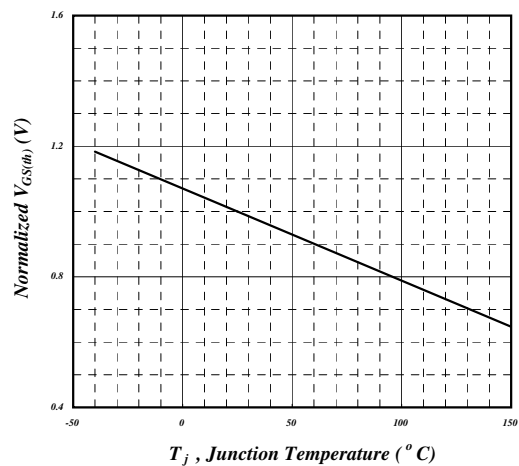


Fig 6. Gate Threshold Voltage v.s.
Junction Temperature



Typical N-channel Electrical Characteristics (cont.)

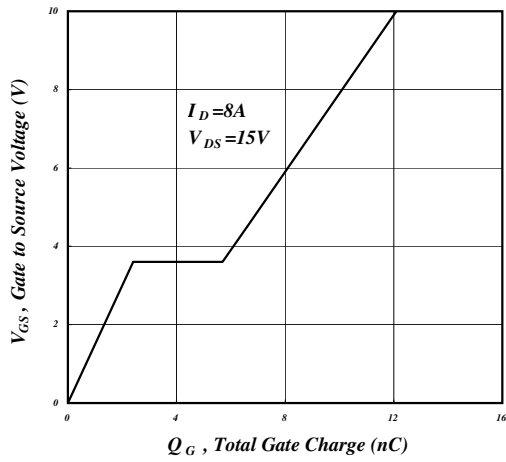


Fig 7. Gate Charge Characteristics

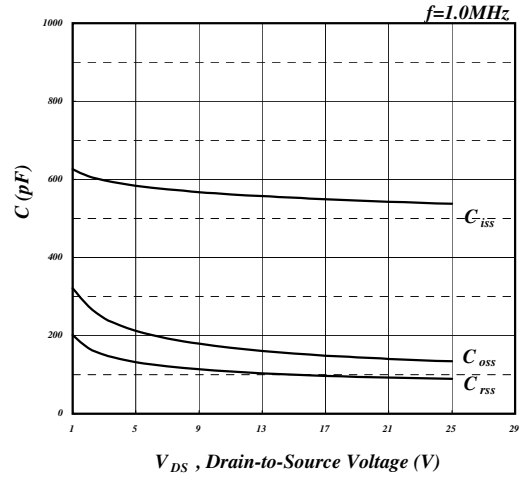


Fig 8. Typical Capacitance Characteristics

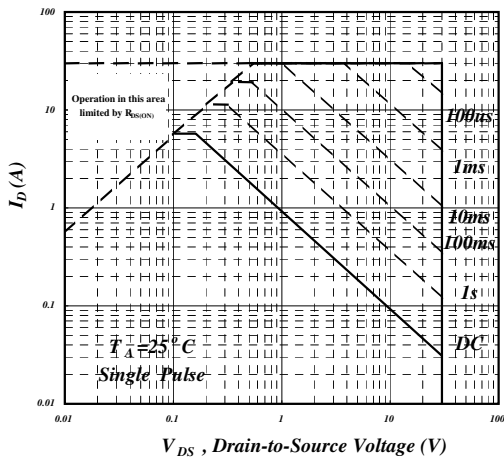


Fig 9. Maximum Safe Operating Area

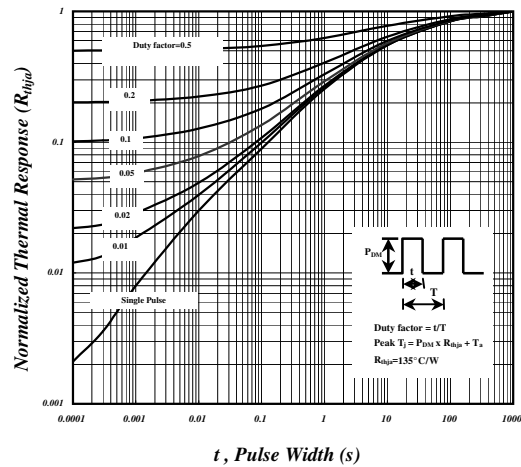


Fig 10. Effective Transient Thermal Impedance

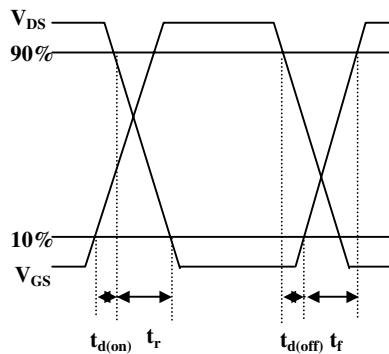


Fig 11. Switching Time Waveform

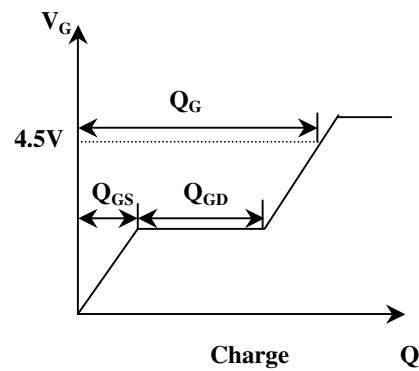


Fig 12. Gate Charge Waveform



Typical P-channel Electrical Characteristics

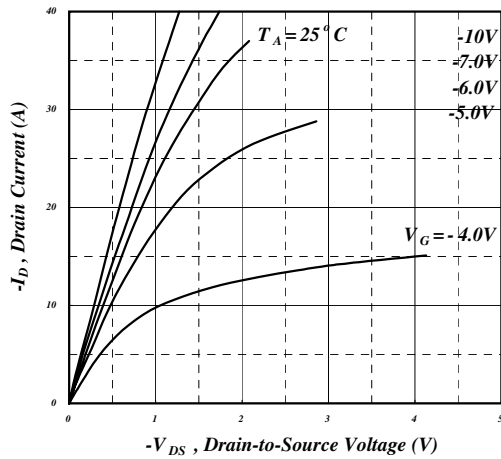


Fig 1. Typical Output Characteristics

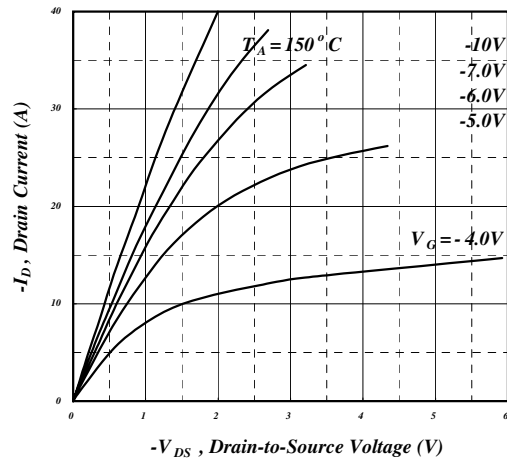


Fig 2. Typical Output Characteristics

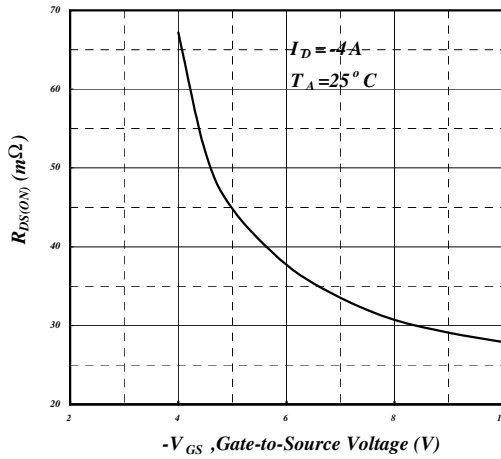


Fig 3. On-Resistance v.s. Gate Voltage

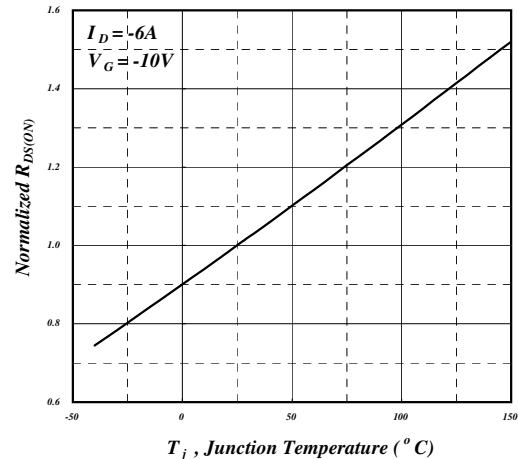


Fig 4. Normalized On-Resistance v.s. Junction Temperature

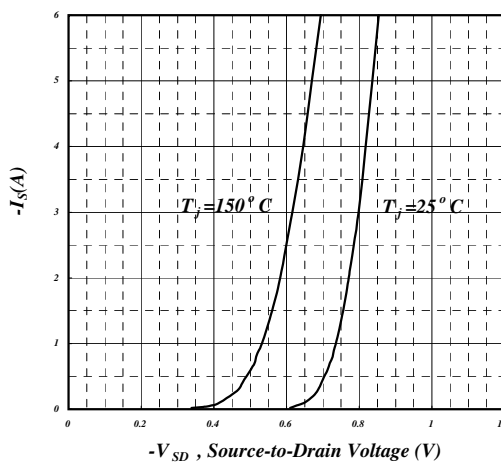


Fig 5. Forward Characteristic of Reverse Diode

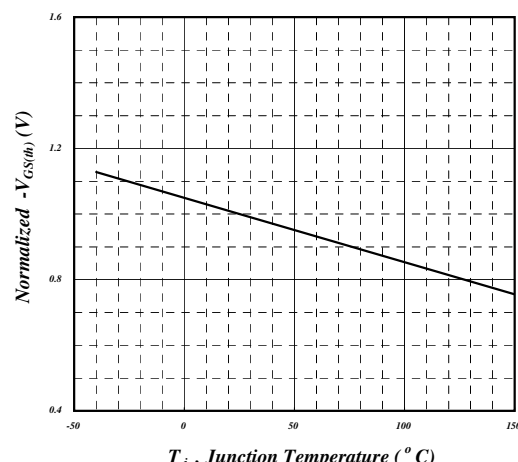


Fig 6. Gate Threshold Voltage v.s. Junction Temperature



Typical P-channel Electrical Characteristics (cont.)

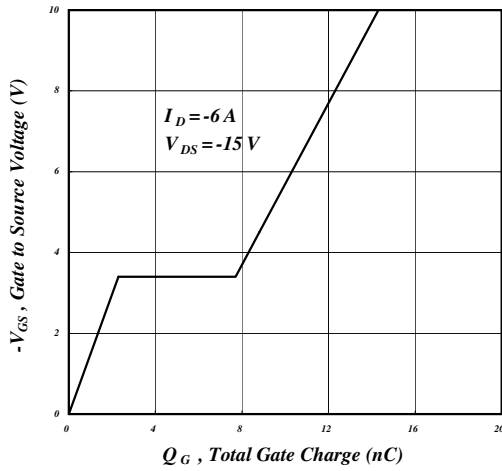


Fig 7. Gate Charge Characteristics

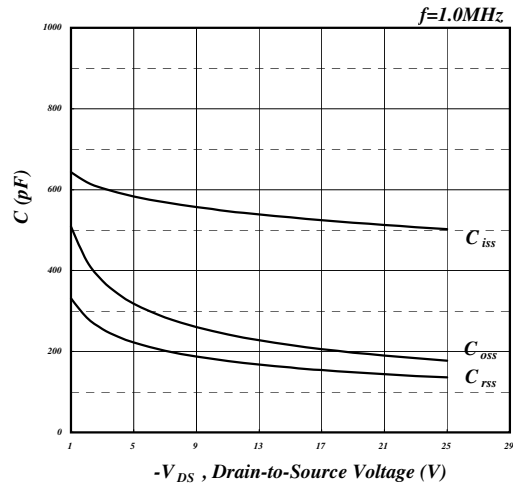


Fig 8. Typical Capacitance Characteristics

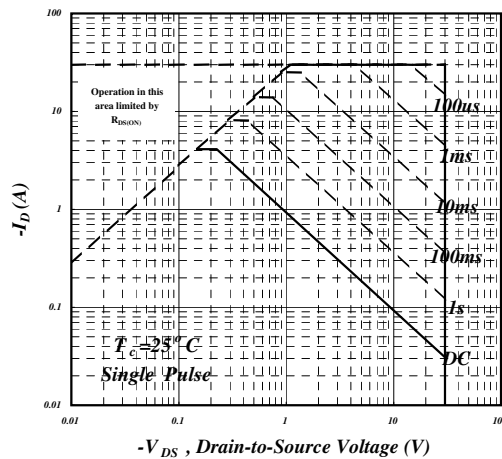


Fig 9. Maximum Safe Operating Area

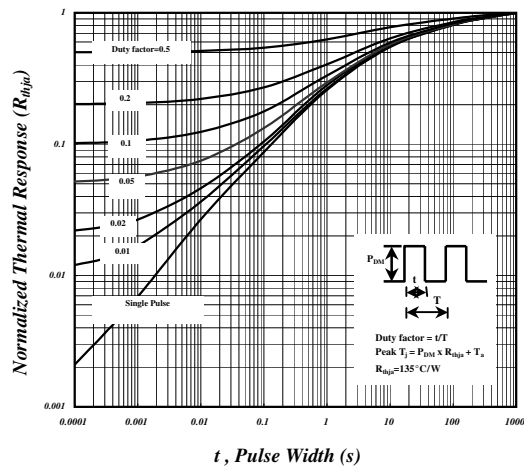


Fig 10. Effective Transient Thermal Impedance

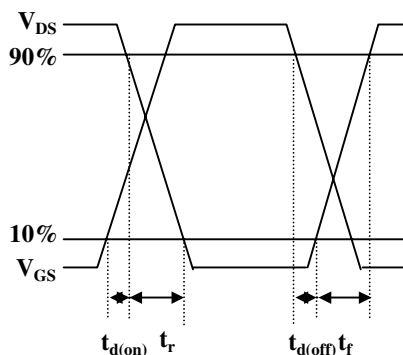


Fig 11. Switching Time Waveform

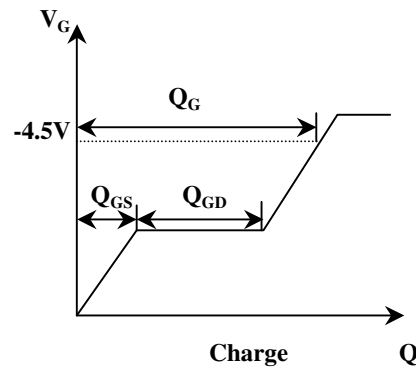
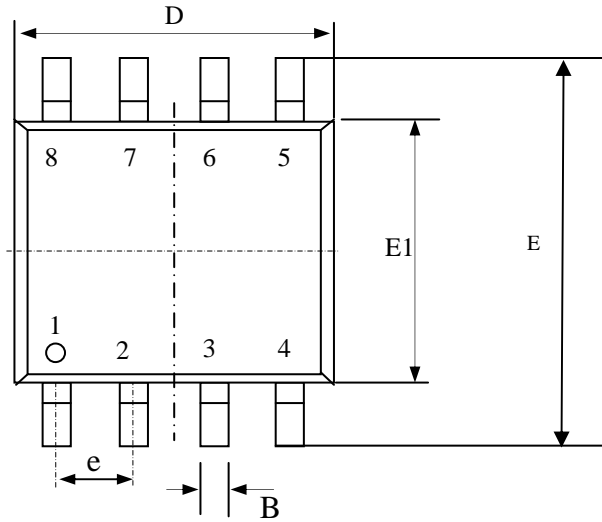


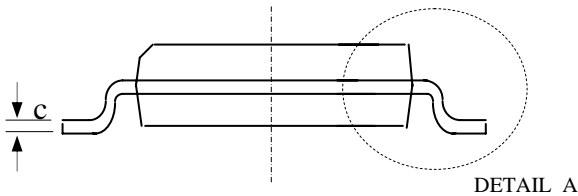
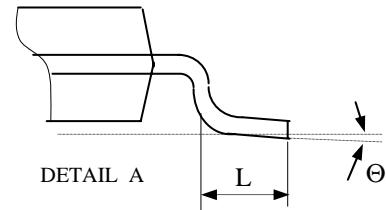
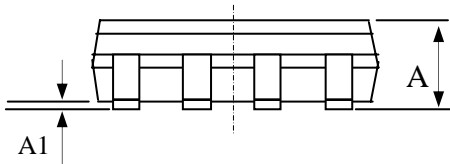
Fig 12. Gate Charge Waveform



Package Dimensions: SO-8

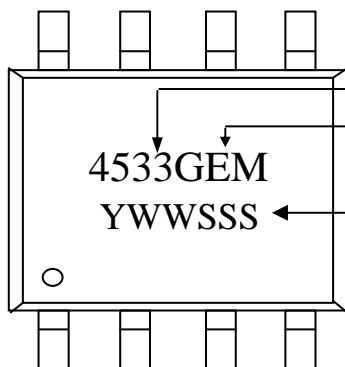


SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.33	0.41	0.51
C	0.19	0.22	0.25
D	4.80	4.90	5.00
E1	3.80	3.90	4.00
E	5.80	6.15	6.50
L	0.38	0.71	1.27
θ	0	4.00	8.00
e	1.27 TYP		



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

Marking Information:



- Product: AP4533
- Package: GEM = RoHS-compliant halogen-free SO-8 with gate-protection diodes
- Date/lot code (YWWSSS)
 - Y: Last digit of the year
 - WW: Work week
 - SSS: Lot code sequence