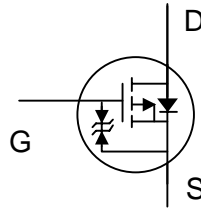




P-channel Enhancement-mode Power MOSFET

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

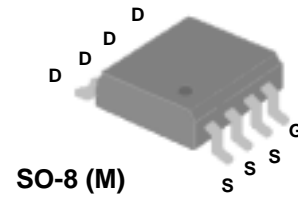


BV_{DSS}	-35V
$R_{DS(ON)}$	7.5mΩ
I_D	-14.5A

Description

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

The AP4409GEM-HF-3 is in the SO-8 package, which is widely used for commercial and industrial surface-mount applications, and is well suited for low voltage applications such as DC/DC converters.



Absolute Maximum Ratings

Symbol	Parameter	Rating	Units
V_{DS}	Drain-Source Voltage	-35	V
V_{GS}	Gate-Source Voltage	±20	V
I_D at $T_A=25^{\circ}C$	Continuous Drain Current ³	-14.5	A
I_D at $T_A= 70^{\circ}C$	Continuous Drain Current ³	-12	A
I_{DM}	Pulsed Drain Current ¹	-50	A
P_D at $T_A=25^{\circ}C$	Total Power Dissipation	2.5	W
	Linear Derating Factor	0.02	W/°C
T_{STG}	Storage Temperature Range	-55 to 150	°C
T_J	Operating Junction Temperature Range	-55 to 150	°C

Thermal Data

Symbol	Parameter	Value	Unit
Rthj-a	Maximum Thermal Resistance, Junction-ambient	50	°C/W

Ordering Information

AP4409GEM-HF-3TR : in RoHS-compliant halogen-free SO-8, shipped on tape and reel (3000 pcs/reel)



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	$V_{GS}=0V, I_D=-250\mu A$	-35	-	-	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	$V_{GS}=-10V, I_D=-7A$	-	-	7.5	m Ω
		$V_{GS}=-4V, I_D=-7A$	-	-	15	m Ω
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=-250\mu A$	-0.8	-	-2	V
g_{fs}	Forward Transconductance	$V_{DS}=-10V, I_D=-7A$	-	13	-	S
I_{DSS}	Drain-Source Leakage Current	$V_{DS}=-30V, V_{GS}=0V$	-	-	-10	μA
	Drain-Source Leakage Current ($T_j=70^\circ\text{C}$)	$V_{DS}=-24V, V_{GS}=0V$	-	-	-25	μA
I_{GSS}	Gate-Source Leakage	$V_{GS}=\pm 20V$	-	-	± 30	μA
Q_g	Total Gate Charge ²	$I_D=-14A$	-	55	90	nC
Q_{gs}	Gate-Source Charge	$V_{DS}=-30V$	-	10	-	nC
Q_{gd}	Gate-Drain ("Miller") Charge	$V_{GS}=-4.5V$	-	30	-	nC
$t_{d(on)}$	Turn-on Delay Time ²	$V_{DS}=-15V$	-	18	-	ns
t_r	Rise Time	$I_D=-1A$	-	10	-	ns
$t_{d(off)}$	Turn-off Delay Time	$R_G=3.3\Omega, V_{GS}=-10V$	-	160	-	ns
t_f	Fall Time	$R_D=15\Omega$	-	110	-	ns
C_{iss}	Input Capacitance	$V_{GS}=0V$	-	4100	6600	pF
C_{oss}	Output Capacitance	$V_{DS}=-25V$	-	860	-	pF
C_{rss}	Reverse Transfer Capacitance	$f=1.0\text{MHz}$	-	770	-	pF

Source-Drain Diode

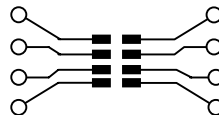
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{SD}	Forward On Voltage ²	$I_S=-14A, V_{GS}=0V$	-	-	-1.3	V
t_{rr}	Reverse Recovery Time ²	$I_S=-14A, V_{GS}=0V,$	-	43	-	ns
Q_{rr}	Reverse Recovery Charge	$di/dt=100A/\mu s$	-	37	-	nC

Notes:

1. Pulse width limited by maximum junction temperature.
2. Pulse test - pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$
3. Surface mounted on 1 in² copper pad of FR4 board; 125 $^\circ\text{C}/\text{W}$ on minimum copper pad.



(a) 1 in² pad of 2 oz copper



(b) 125 $^\circ\text{C}/\text{W}$ when mounted on a 0.003 in² pad of 2 oz copper

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.



Typical Electrical Characteristics

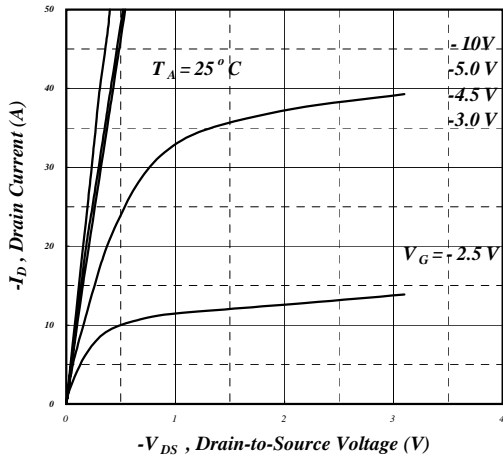


Fig 1. Typical Output Characteristics

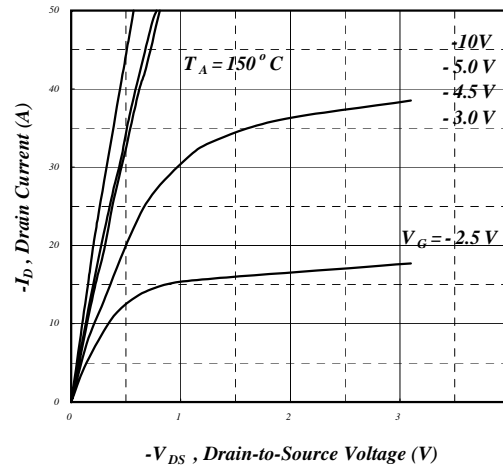


Fig 2. Typical Output Characteristics

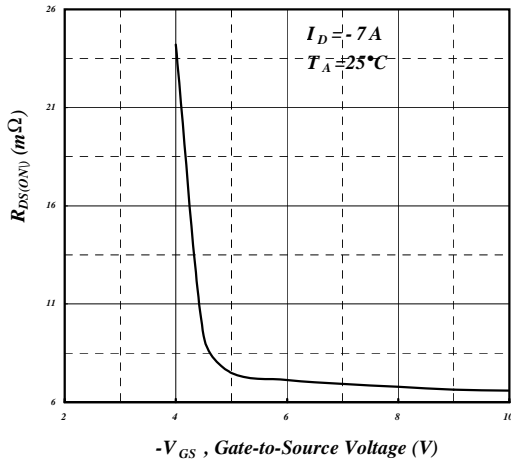


Fig 3. On-Resistance vs. Gate Voltage

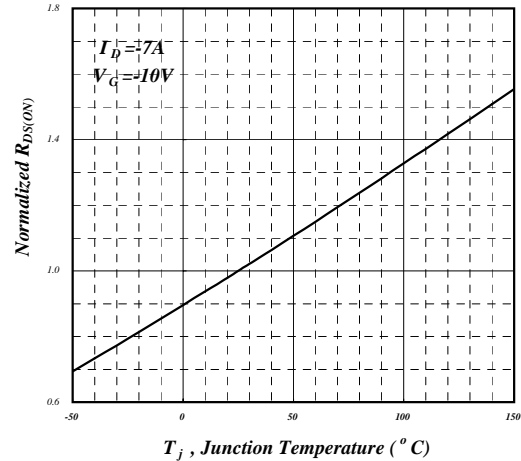


Fig 4. Normalized On-Resistance vs. Junction Temperature

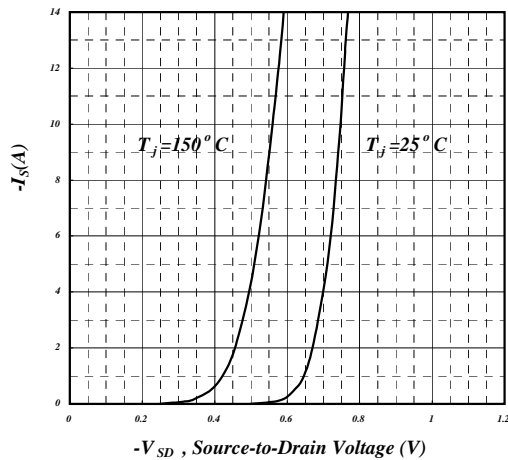


Fig 5. Forward Characteristic of Reverse Diode

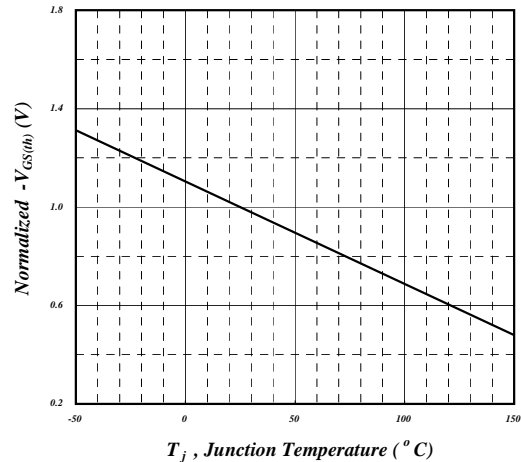


Fig 6. Gate Threshold Voltage vs. Junction Temperature



Typical Electrical Characteristics (cont.)

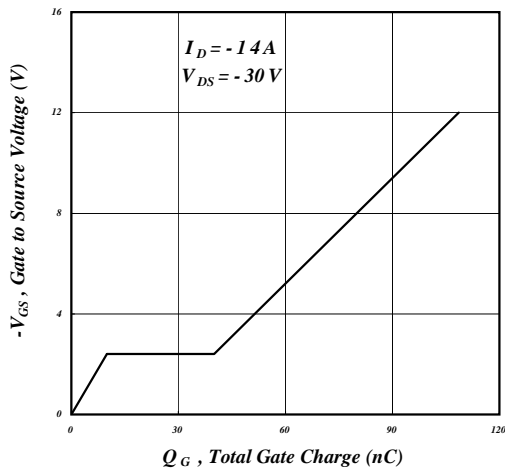


Fig 7. Gate Charge Characteristics

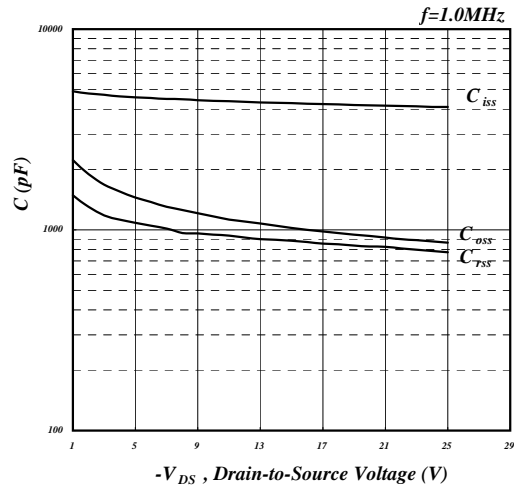


Fig 8. Typical Capacitance Characteristics

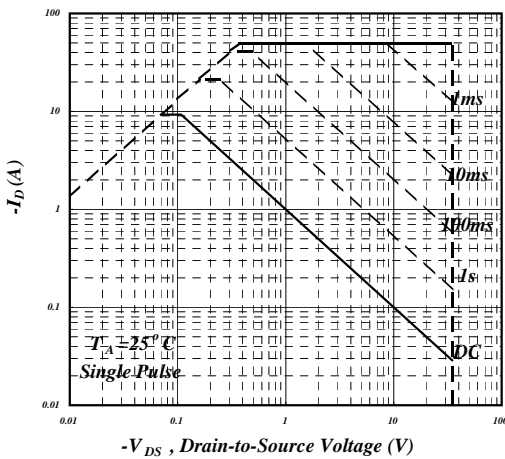


Fig 9. Maximum Safe Operating Area

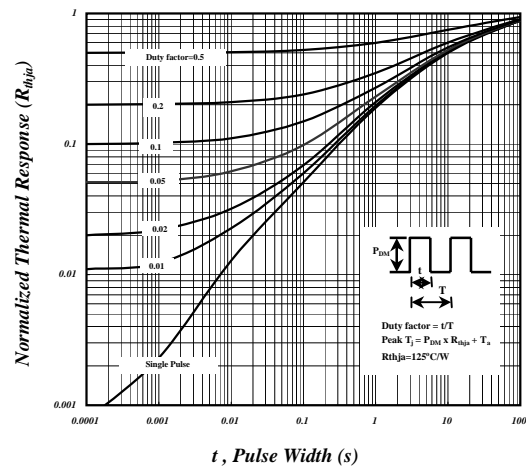


Fig 10. Effective Transient Thermal Impedance

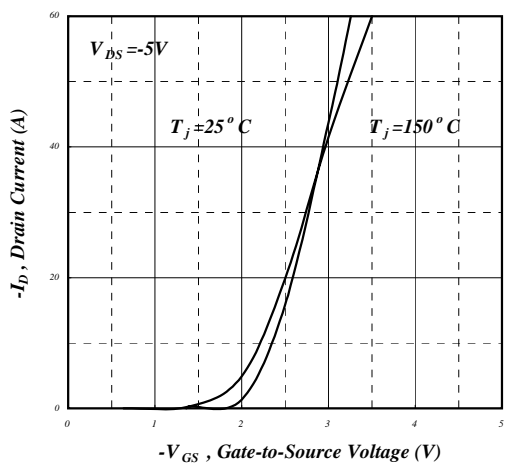


Fig 11. Transfer Characteristics

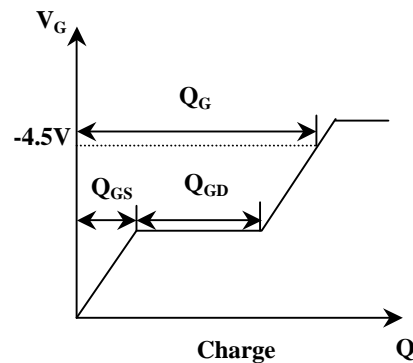
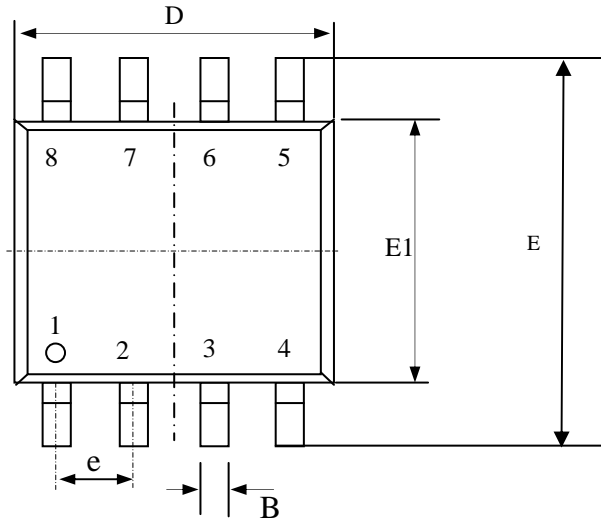


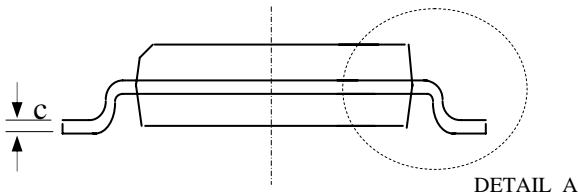
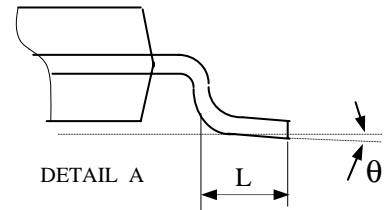
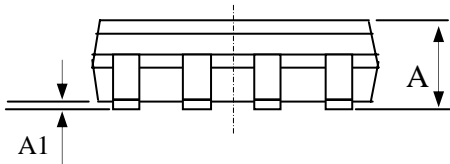
Fig 12. Gate Charge Waveform



Package Dimensions: SO-8

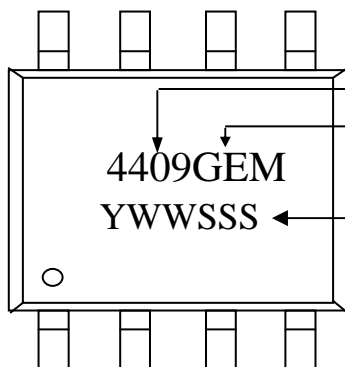


SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.33	0.41	0.51
C	0.19	0.22	0.25
D	4.80	4.90	5.00
E1	3.80	3.90	4.00
E	5.80	6.15	6.50
L	0.38	0.71	1.27
θ	0	4.00	8.00
e	1.27 TYP		



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

Marking Information:



Product: AP4409

Package:

GEM = RoHS-compliant halogen-free SO-8
with gate protection

Date/lot code (YWWSSS)

Y: Last digit of the year

WW: Work week

SSS: Lot code sequence