

AP4409AGEM-VB Datasheet

P-Channel 30-V (D-S) MOSFET

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^d	Q_g (Typ.)
- 30	0.011 at $V_{GS} = -10$ V	- 13.5	29.5 nC
	0.015 at $V_{GS} = -4.5$ V	- 11.6	

FEATURES

- Halogen-free
- Trench Power MOSFET
- 100 % R_g Tested
- 100 % UIS Tested


RoHS
 COMPLIANT

APPLICATIONS

- Load Switch
- Notebook Adaptor Switch



P-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$, unless otherwise noted

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	- 30	V
Gate-Source Voltage	V_{GS}	± 20	
Continuous Drain Current ($T_J = 150^\circ\text{C}$)	I_D	$T_C = 25^\circ\text{C}$	- 13.5
		$T_C = 70^\circ\text{C}$	- 11.9
		$T_A = 25^\circ\text{C}$	- 10.9 ^{a, b}
		$T_A = 70^\circ\text{C}$	- 8.6 ^{a, b}
Pulsed Drain Current	I_{DM}	- 50	A
Continuous Source-Drain Diode Current	I_S	$T_C = 25^\circ\text{C}$	- 4.1
		$T_A = 25^\circ\text{C}$	- 2.2 ^{a, b}
Avalanche Current	I_{AS}	- 20	
Single-Pulse Avalanche Energy	E_{AS}	20	mJ
Maximum Power Dissipation	P_D	$T_C = 25^\circ\text{C}$	5.0
		$T_C = 70^\circ\text{C}$	3.2
		$T_A = 25^\circ\text{C}$	2.7 ^{a, b}
		$T_A = 70^\circ\text{C}$	1.7 ^{a, b}
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	$^\circ\text{C}$

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient ^{a, c}	R_{thJA}	38	46	$^\circ\text{C/W}$
Maximum Junction-to-Foot	R_{thJF}	20	25	

Notes:

- Surface mounted on 1" x 1" FR4 board.
- $t = 10$ s.
- Maximum under Steady State conditions is 85°C/W .
- Based on $T_C = 25^\circ\text{C}$.

SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted							
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = -250\text{ }\mu\text{A}$	- 30			V	
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	$I_D = -250\text{ }\mu\text{A}$		- 34		mV/ $^{\circ}\text{C}$	
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$			5.3			
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = -250\text{ }\mu\text{A}$	- 1.4		- 2.5	V	
Gate-Source Leakage	I_{GSS}	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 100	nA	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -30\text{ V}$, $V_{GS} = 0\text{ V}$			- 1	μA	
		$V_{DS} = -30\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 55\text{ }^{\circ}\text{C}$			- 5		
On-State Drain Current ^a	$I_{D(on)}$	$V_{DS} \geq -10\text{ V}$, $V_{GS} = -10\text{ V}$	- 30			A	
Drain-Source On-State Resistance ^a	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$, $I_D = -10\text{ A}$		0.011		Ω	
		$V_{GS} = -4.5\text{ V}$, $I_D = -8\text{ A}$		0.015			
Forward Transconductance ^a	g_{fs}	$V_{DS} = -10\text{ V}$, $I_D = -10\text{ A}$		28		S	
Dynamic ^b							
Input Capacitance	C_{iss}	$V_{DS} = -15\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$		2550		pF	
Output Capacitance	C_{oss}			455			
Reverse Transfer Capacitance	C_{rss}			390			
Total Gate Charge	Q_g	$V_{DS} = -15\text{ V}$, $V_{GS} = -10\text{ V}$, $I_D = -10\text{ A}$		57	86	nC	
		$V_{DS} = -15\text{ V}$, $V_{GS} = -4.5\text{ V}$, $I_D = -10\text{ A}$		29.5	45		
					8		
					22		
Gate-Source Charge	Q_{gs}						
Gate-Drain Charge	Q_{gd}						
Gate Resistance	R_g	$f = 1\text{ MHz}$	0.5	2.2	4.4	Ω	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -15\text{ V}$, $R_L = 1.5\text{ }\Omega$ $I_D \cong -10\text{ A}$, $V_{GEN} = -10\text{ V}$, $R_g = 1\text{ }\Omega$		13	25	ns	
Rise Time	t_r			12	24		
Turn-Off DelayTime	$t_{d(off)}$			40	70		
Fall Time	t_f			9	18		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -15\text{ V}$, $R_L = 1.5\text{ }\Omega$ $I_D \cong -10\text{ A}$, $V_{GEN} = -4.5\text{ V}$, $R_g = 1\text{ }\Omega$		48	80		
Rise Time	t_r			92	160		
Turn-Off DelayTime	$t_{d(off)}$			34	60		
Fall Time	t_f			19	35		
Drain-Source Body Diode Characteristics							
Continous Source-Drain Diode Current	I_S	$T_C = 25\text{ }^{\circ}\text{C}$			- 4.1	A	
Pulse Diode Forward Current	I_{SM}				- 60		
Body Diode Voltage	V_{SD}	$I_S = -3\text{ A}$, $V_{GS} = 0\text{ V}$		- 0.75	- 1.2	V	
Body Diode Reverse Recovery Time	t_{rr}	$I_F = -10\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $T_J = 25\text{ }^{\circ}\text{C}$		27	45	ns	
Body Diode Reverse Recovery Charge	Q_{rr}			16	27	nC	
Reverse Recovery Fall Time	t_a			12		ns	
Reverse Recovery Rise Time	t_b			15			

Notes:

a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

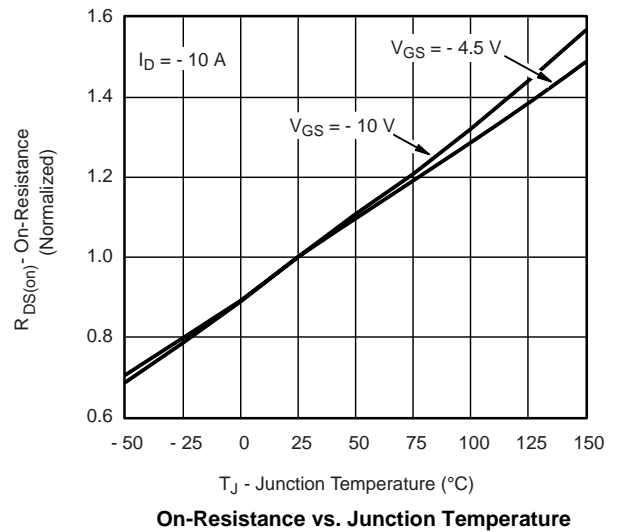
TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Output Characteristics

Transfer Characteristics

On-Resistance vs. Drain Current

Capacitance

Gate Charge

On-Resistance vs. Junction Temperature

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Source-Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



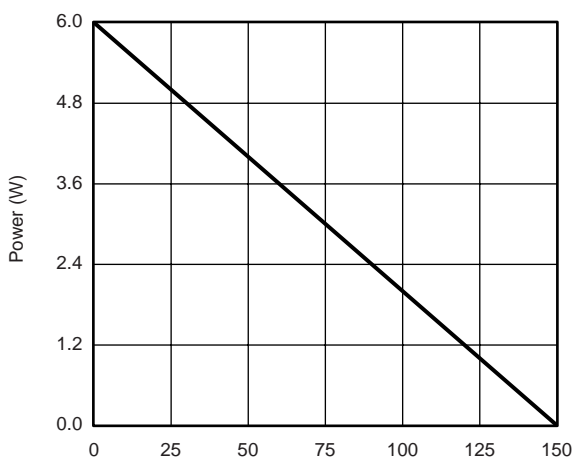
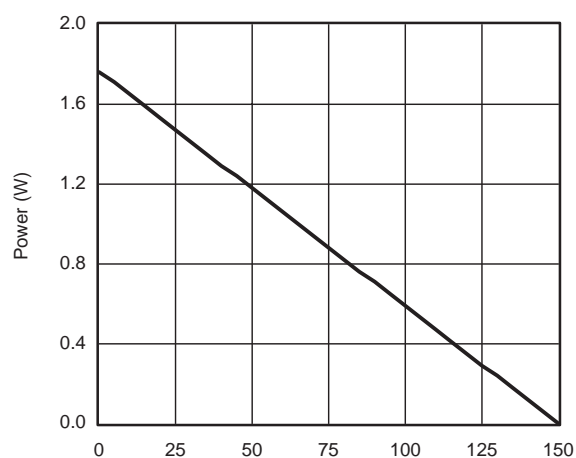
Single Pulse Power, Junction-to-Ambient



* $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

Safe Operating Area

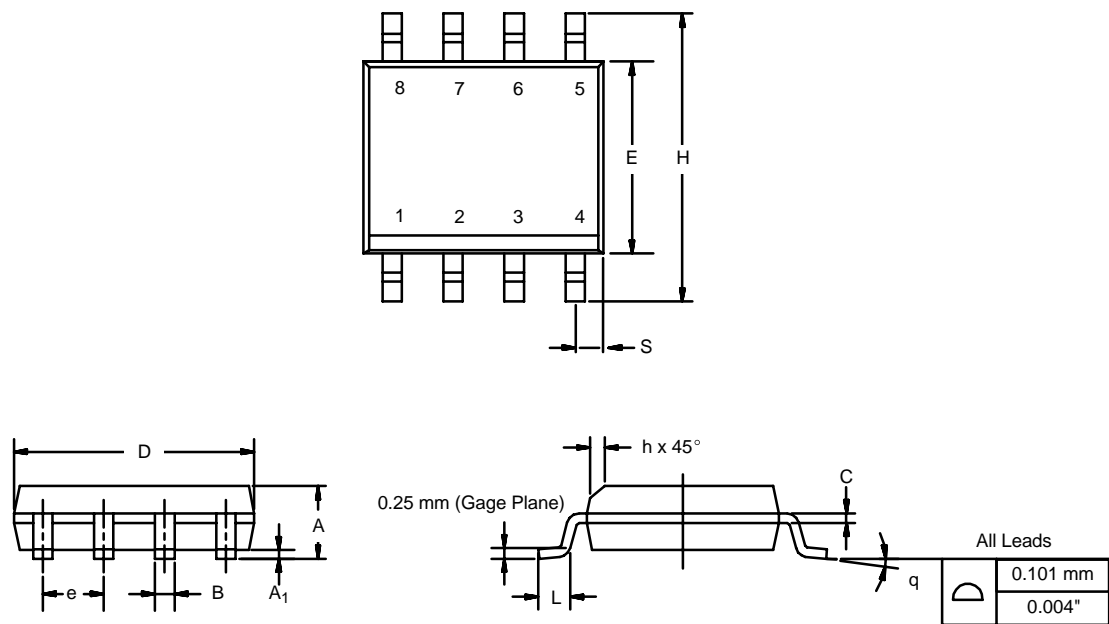
MOSFET TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

Current Derating*

Power, Junction-to-Foot

Power Derating, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


SOIC (NARROW): 8-LEAD
JEDEC Part Number: MS-012



DIM	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A ₁	0.10	0.20	0.004	0.008
B	0.35	0.51	0.014	0.020
C	0.19	0.25	0.0075	0.010
D	4.80	5.00	0.189	0.196
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.020
L	0.50	0.93	0.020	0.037
q	0°	8°	0°	8°
S	0.44	0.64	0.018	0.026
ECN: C-06527-Rev. I, 11-Sep-06				
DWG: 5498				

RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads
Dimensions in Inches/(mm)

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