

AP4688S

N+P Channel Power MOSFET

● Features

N-Channel

$V_{DS} = 60V$,

$I_D = 8.0 A$

$R_{DS(ON)} @ V_{GS} = 10V$, TYP 32m Ω

$R_{DS(ON)} @ V_{GS} = 4.5V$, TYP 39m Ω

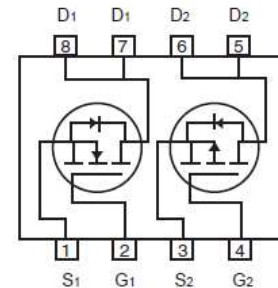
P-Channel

$V_{DS} = -60V$,

$I_D = -6.0A$

$R_{DS(ON)} @ V_{GS} = 10V$, TYP 52m Ω

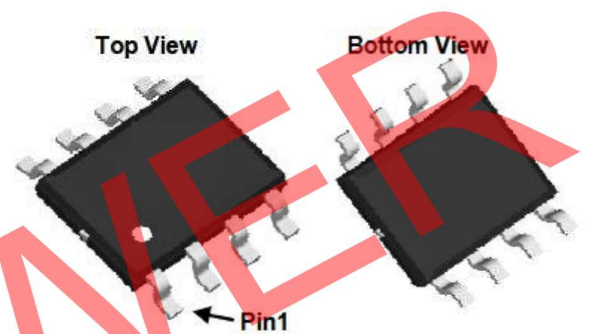
$R_{DS(ON)} @ V_{GS} = 4.5V$, TYP 65m Ω



● General Description

Motor Control

Synchronous Rectification



● Absolute Maximum Ratings @ $T_A=25^\circ C$ unless otherwise noted

Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	V_{DSS}	60	-60	V	
Gate-Source Voltage	V_{GSS}	± 20	± 20	V	
Drain Current (Continuous) *AC	I_D	$T_A=25^\circ C$	8.0	-6.0	A
		$T_A=70^\circ C$	6.5	-4.5	
Drain Current (Pulse) *B	I_{DM}	15	-12	A	
Power Dissipation	$T_A=25^\circ C$	3		W	
Operating Temperature/ Storage Temperature	T_J/T_{STG}	-55~150		$^\circ C$	

● Thermal Resistance Ratings

Parameter	Symbol	Maximum	Unit
Maximum Junction-to-Ambient	R_{thJA}	62.5	$^\circ C/W$

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N-Channel Electrical Characteristics @ $T_A=25^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	60	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 48V, V_{GS} = 0V$	--	--	1	μA
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_{BS} = 250\mu A$	1	1.6	3	V
Gate Leakage Current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$	--	--	± 100	nA
Drain-Source On-state Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 4.5A$	--	32	50	m Ω
	$R_{DS(on)}$	$V_{GS} = 4.5V, I_D = 3.5A$	--	39	60	m Ω
Forward Transconductance	g_{FS}	$V_{DS} = 10V, I_D = 4A$	2	--	--	S
Diode Forward Voltage	V_{SD}	$I_{SD} = 2A, V_{GS} = 0V$	--	--	1.2	V
Diode Forward Current	I_S	$T_C = 25^{\circ}\text{C}$	--	--	4.5	A
Switching						
Total Gate Charge	Q_g	$V_{GS} = 10V, V_{DS} = 30V, I_D = 4.5A$	--	13	--	nC
Gate-Source Charge	Q_{gs}		--	1.7	--	nC
Gate-Drain Charge	Q_{gd}		--	2.6	--	nC
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 30V, V_{GS} = 10V, I_D = 1A, R_{GEN} = 6\Omega$	--	11	--	ns
Turn-on Rise Time	t_r		--	3	--	ns
Turn-off Delay Time	$t_{d(off)}$		--	30	--	ns
Turn-Off Fall Time	t_f		--	3	--	ns
Dynamic						
Input Capacitance	C_{iss}	$V_{DS} = 25V, V_{GS} = 0V, f = 1.0\text{MHz}$	--	670	--	pF
Output Capacitance	C_{oss}		--	80	--	pF
Reverse Transfer Capacitance	C_{rss}		--	45	--	pF

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The value in any given application depends on the user's specific board design.

B: Repetitive rating, pulse width limited by junction temperature.

C: The current rating is based on the $t \leq 10\text{s}$ junction to ambient thermal resistance rating.

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P-Channel Electrical Characteristics @ $T_A=25^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = -250\mu A$	-60	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -48V, V_{GS} = 0V$	--	--	-1	μA
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_{DS} = -250\mu A$	-1	-1.6	-3	V
Gate Leakage Current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$	--	--	± 100	nA
Drain-Source On-state Resistance	$R_{DS(on)}$	$V_{GS} = -10V, I_D = -4.5A$	--	52	65	m Ω
	$R_{DS(on)}$	$V_{GS} = -4.5V, I_D = -3.8A$	--	65	75	m Ω
Forward Transconductance	g_{FS}	$V_{DS} = -10V, I_D = -3.1A$	2	--	--	S
Diode Forward Voltage	V_{SD}	$I_{SD} = -1A, V_{GS} = 0V$	--	--	-1.2	V
Diode Forward Current	I_S	$T_C = 25^{\circ}\text{C}$	--	--	-3.5	A
Switching						
Total Gate Charge	Q_g	$V_{GS} = -10V, V_{DS} = -30V, I_D = -3.5A$	--	11	--	nC
Gate-Source Charge	Q_{gs}		--	2.4	--	nC
Gate-Drain Charge	Q_{gd}		--	1.6	--	nC
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = -30V, V_{GS} = -10V, I_D = -1A, R_{GEN} = 6\Omega$	--	12	--	ns
Turn-on Rise Time	t_r		--	4	--	ns
Turn-off Delay Time	$t_{d(off)}$		--	38	--	ns
Turn-Off Fall Time	t_f		--	12	--	ns
Dynamic						
Input Capacitance	C_{iss}	$V_{DS} = -30V, V_{GS} = 0V, f = 1.0\text{MHz}$	--	885	--	pF
Output Capacitance	C_{oss}		--	85	--	pF
Reverse Transfer Capacitance	C_{rss}		--	80	--	pF

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The value in any given application depends on the user's specific board design.

B: Repetitive rating, pulse width limited by junction temperature.

C: The current rating is based on the $t_s \leq 10s$ junction to ambient thermal resistance rating.

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Typical Performance Characteristics (($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted))

N-Channel

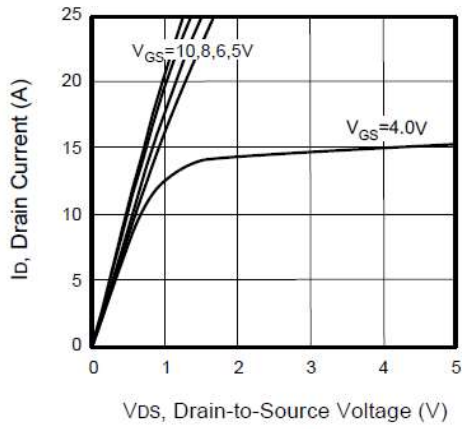


Figure 1. Output Characteristics

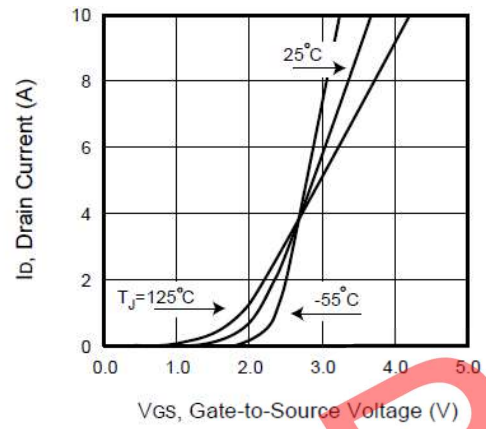


Figure 2. Transfer Characteristics

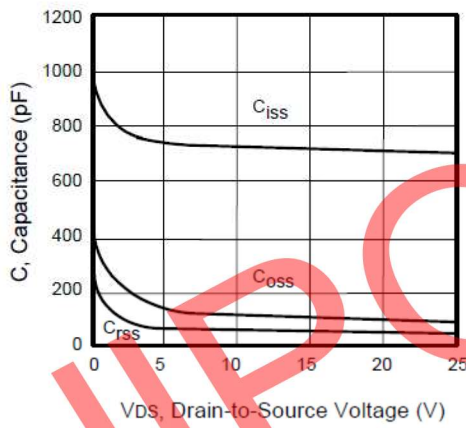


Figure 3. Capacitance

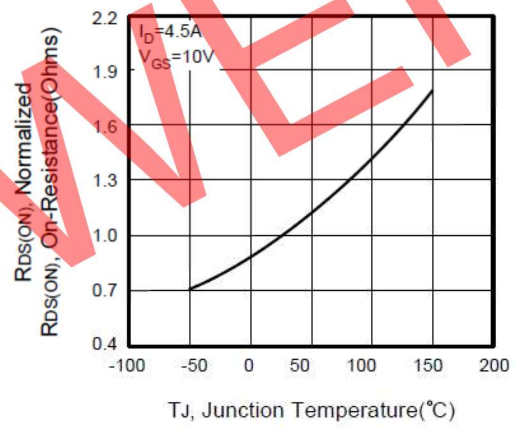


Figure 4. On-Resistance Variation with Temperature

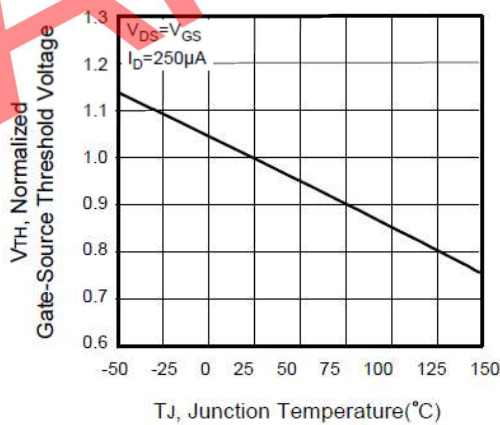


Figure 5. Gate Threshold Variation with Temperature

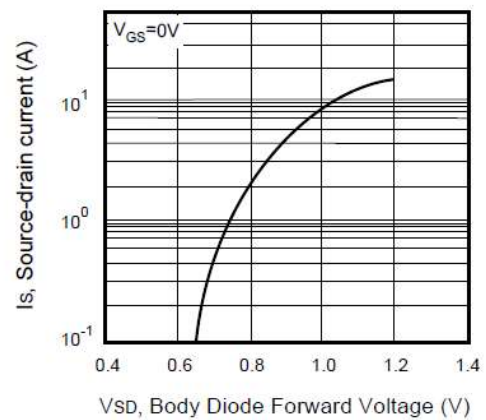


Figure 6. Body Diode Forward Voltage Variation with Source Current

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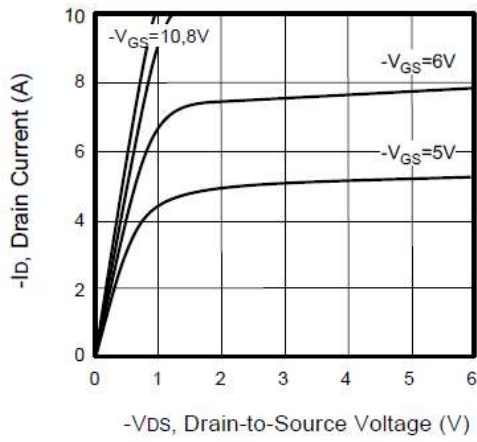


Figure 1. Output Characteristics

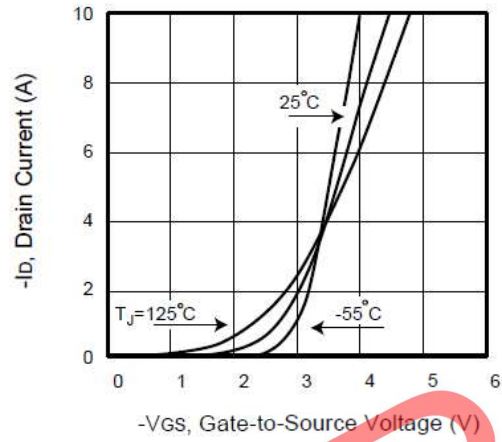


Figure 2. Transfer Characteristics

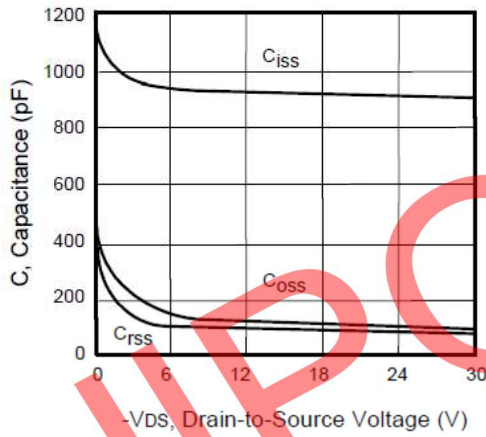


Figure 3. Capacitance

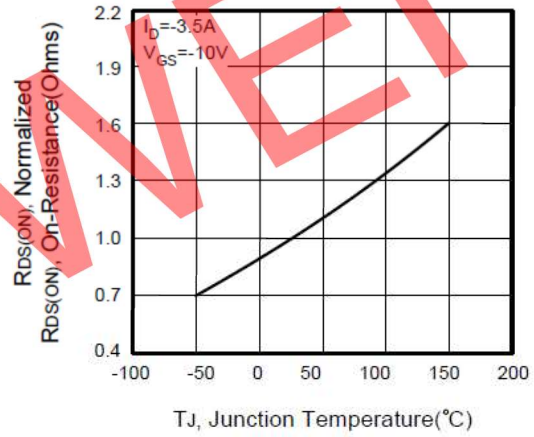


Figure 4. On-Resistance Variation with Temperature

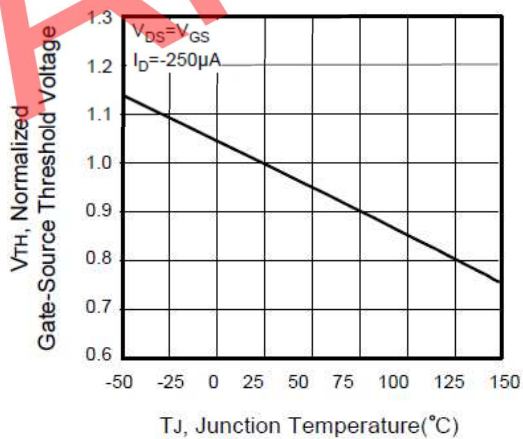


Figure 5. Gate Threshold Variation with Temperature

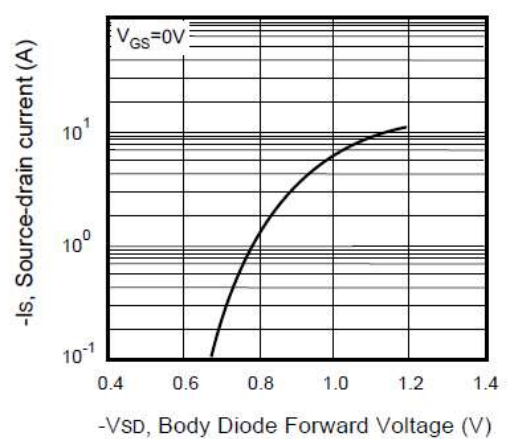


Figure 6. Body Diode Forward Voltage Variation with Source Current

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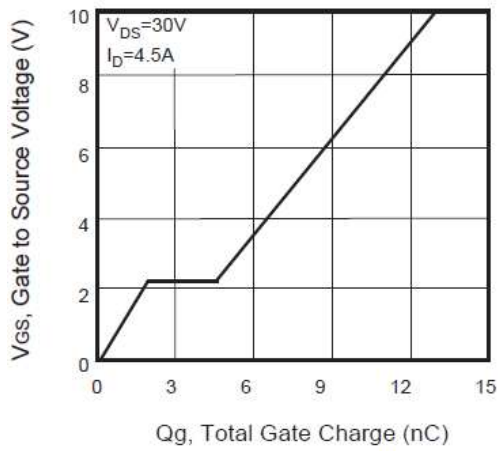


Figure 13. Gate Charge

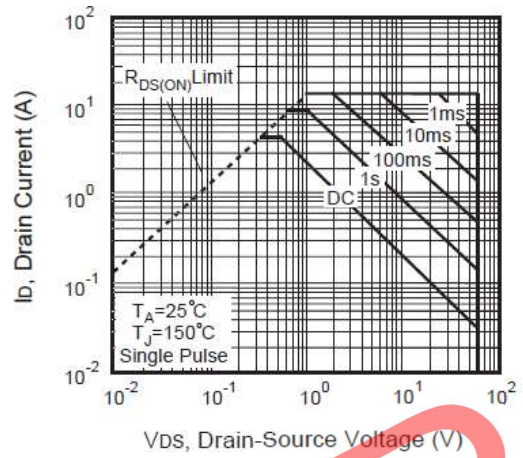


Figure 14. Maximum Safe Operating Area

P-Channel

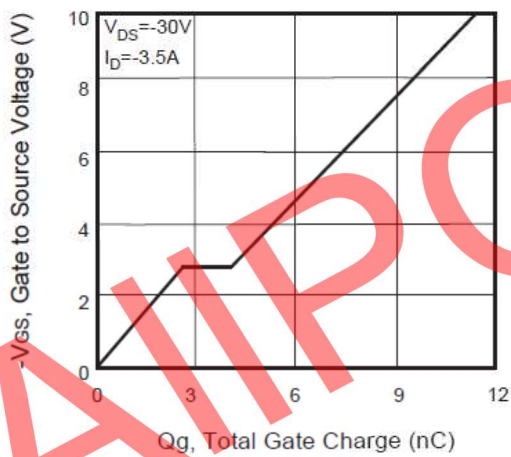


Figure 15. Gate Charge

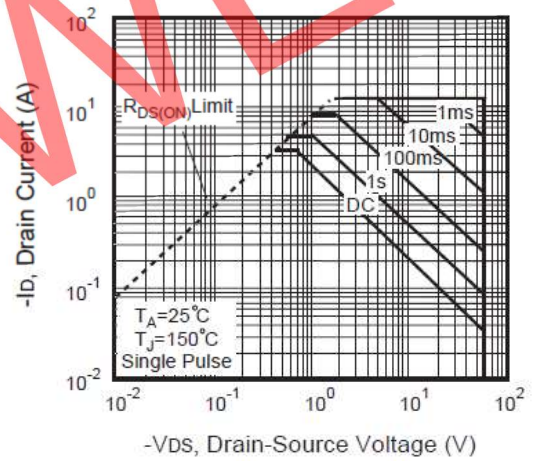


Figure 16. Maximum Safe Operating Area

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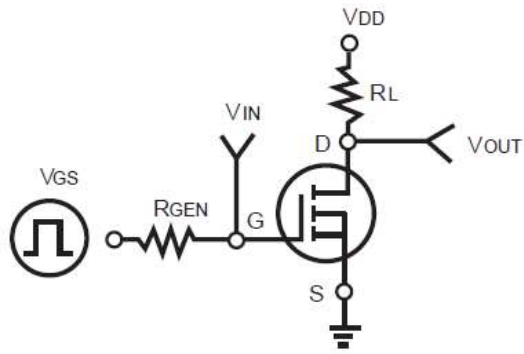


Figure 17. Switching Test Circuit

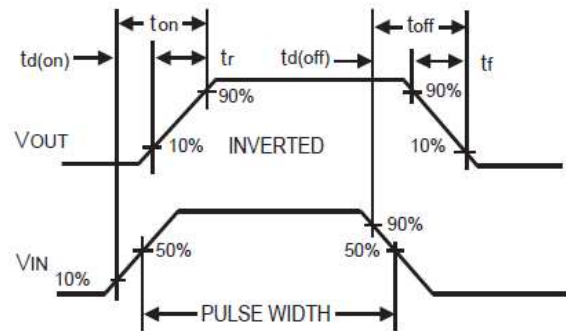


Figure 18. Switching Waveforms

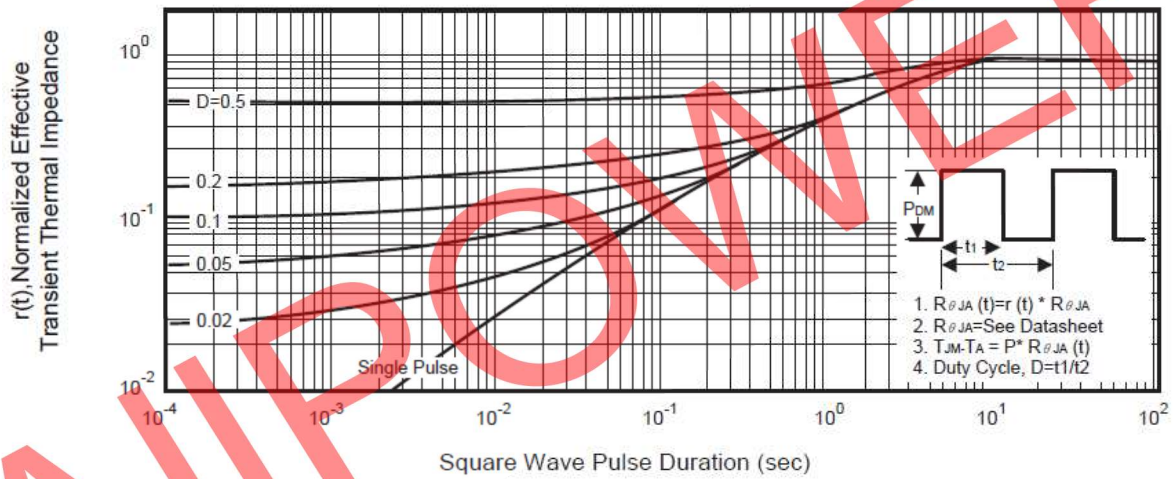
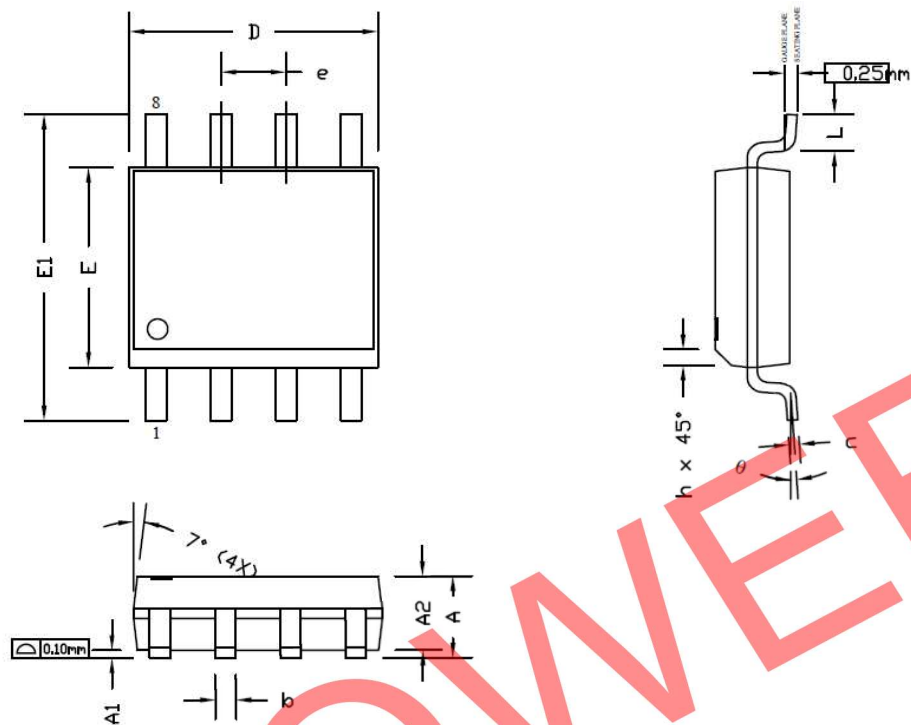


Figure 19. Normalized Thermal Transient Impedance Curve

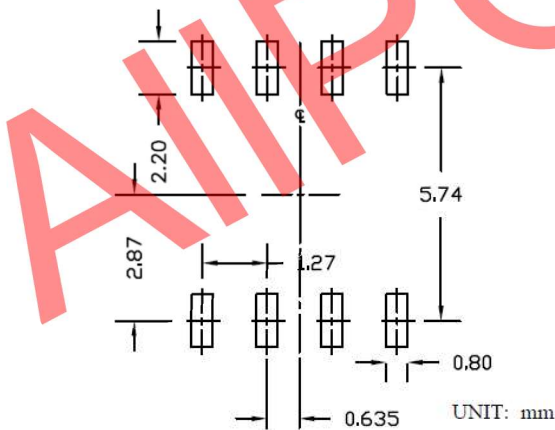
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Package Information



RECOMMENDED LAND PATTERN



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.65	1.75	0.053	0.065	0.069
A1	0.10	0.15	0.25	0.004	0.006	0.010
A2	1.25	1.50	1.65	0.049	0.059	0.065
b	0.31	0.41	0.51	0.012	0.016	0.020
c	0.17	0.20	0.25	0.007	0.008	0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	3.80	3.90	4.00	0.150	0.154	0.157
e	1.27 BSC			0.050 BSC		
E1	5.80	6.00	6.20	0.228	0.236	0.244
h	0.25	0.30	0.50	0.010	0.012	0.020
L	0.40	0.69	1.27	0.016	0.027	0.050
θ	0°	4°	8°	0°	4°	8°

NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS ARE INCLUSIVE OF PLATING.
3. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS EACH.
4. DIMENSION L IS MEASURED IN GAUGE PLANE.
5. CONTROLLING DIMENSION IS MILLIMETER.
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

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