

P-Channel Power MOSFET

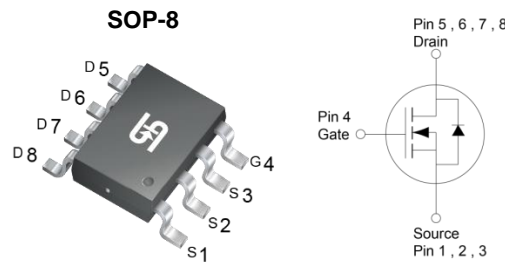
FEATURES

- Advance trench process technology
- High density cell design for ultra-low on-resistance
- RoHS compliant
- Halogen-free

APPLICATIONS

- Battery protection
- Load switch

KEY PERFORMANCE PARAMETERS		
PARAMETER	VALUE	UNIT
V_{DS}	-60	V
$R_{DS(on)}$ (max)	$V_{GS} = -10V$	155
	$V_{GS} = -4.5V$	200
Q_g	18	nC



Note: MSL 3 (Moisture Sensitivity Level) per J-STD-020

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V_{DS}	-60	V
Gate-Source Voltage	V_{GS}	± 20	V
Continuous Drain Current	I_D	-3	A
Pulsed Drain Current (Note 1)	I_{DM}	-12	A
Total Power Dissipation	P_D	$T_A = 25^\circ\text{C}$	2.5
		$T_A = 70^\circ\text{C}$	1.6
Operating Junction and Storage Temperature Range	T_J, T_{STG}	- 55 to +150	$^\circ\text{C}$

THERMAL PERFORMANCE			
PARAMETER	SYMBOL	LIMIT	UNIT
Junction to Ambient Thermal Resistance (Note 2)	$R_{\theta JA}$	50	$^\circ\text{C/W}$

Notes:

1. Pulse Width $\leq 100\mu\text{s}$.
2. Device on a PCB FR4 with 1 in² (single layer, 2 oz thickness) copper area for drain connection.

ELECTRICAL SPECIFICATIONS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

PARAMETER	CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
Static (Note 3)						
Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = -250\mu A$	BV_{DSS}	-60	--	--	V
Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\mu A$	$V_{GS(TH)}$	-1	-1.9	-2.5	V
Gate Body Leakage	$V_{GS} = \pm 20V, V_{DS} = 0V$	I_{GSS}	--	--	± 100	nA
Zero Gate Voltage Drain Current	$V_{DS} = -60V, V_{GS} = 0V$	I_{DSS}	--	--	-1	μA
Drain-Source On-State Resistance	$V_{GS} = -10V, I_D = -3A$	$R_{DS(on)}$	--	36	155	m Ω
	$V_{GS} = -4.5V, I_D = -2.7A$		--	47	200	
Forward Transconductance	$V_{DS} = -10V, I_D = -0.8A$	g_{fs}	--	5.9	--	S
Dynamic (Note 4)						
Total Gate Charge	$V_{DS} = -30V, I_D = -3A,$ $V_{GS} = -10V$	Q_g	--	18	--	nC
Gate-Source Charge		Q_{gs}	--	3.3	--	
Gate-Drain Charge		Q_{gd}	--	2.9	--	
Input Capacitance	$V_{DS} = -30V, V_{GS} = 0V,$ $f = 1.0\text{MHz}$	C_{iss}	--	1101	--	pF
Output Capacitance		C_{oss}	--	359	--	
Reverse Transfer Capacitance		C_{rss}	--	29	--	
Switching (Note 5)						
Turn-On Delay Time	$V_{DD} = -30V, R_G = 6\Omega,$ $I_D = -3A, V_{GS} = -10V$	$t_{d(on)}$	--	6.4	--	ns
Turn-On Rise Time		t_r	--	2.2	--	
Turn-Off Delay Time		$t_{d(off)}$	--	58	--	
Turn-Off Fall Time		t_f	--	32	--	
Source-Drain Diode						
Forward Voltage (Note 3)	$I_S = -3A, V_{GS} = 0V$	V_{SD}	--	-0.8	-1.5	V

Notes:

3. Pulse test: Pulse Width $\leq 300\mu s$, duty cycle $\leq 2\%$.
4. Defined by design. Not subject to production test.
5. Switching time is essentially independent of operating temperature.

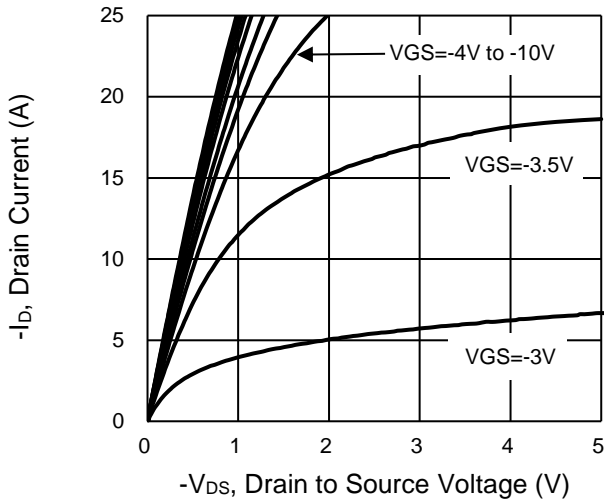
ORDERING INFORMATION

ORDERING CODE	PACKAGE	PACKING
TSM9409CS RLG	SOP-8	2.5kpcs / 13" Reel

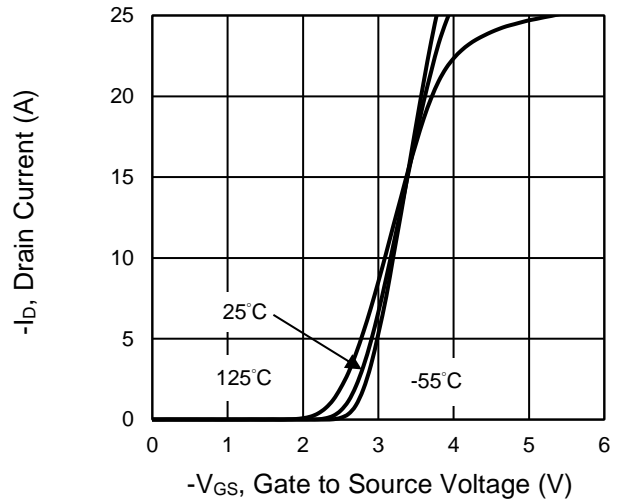
CHARACTERISTICS CURVES

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

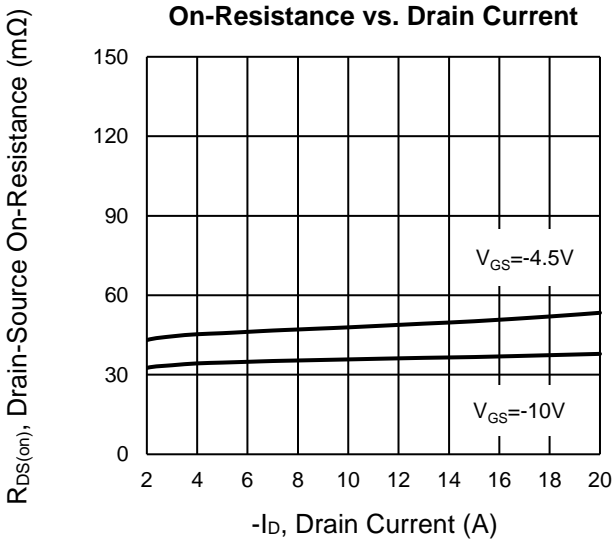
Output Characteristics



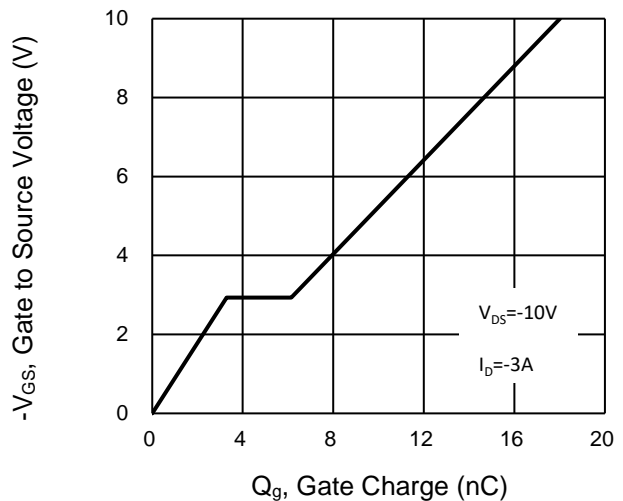
Transfer Characteristics



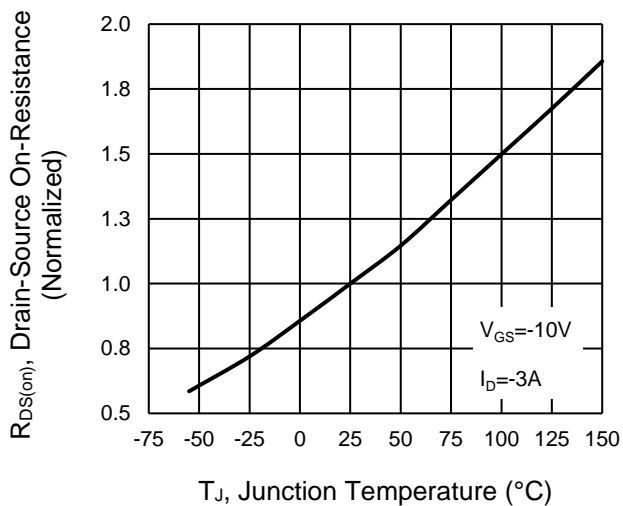
On-Resistance vs. Drain Current



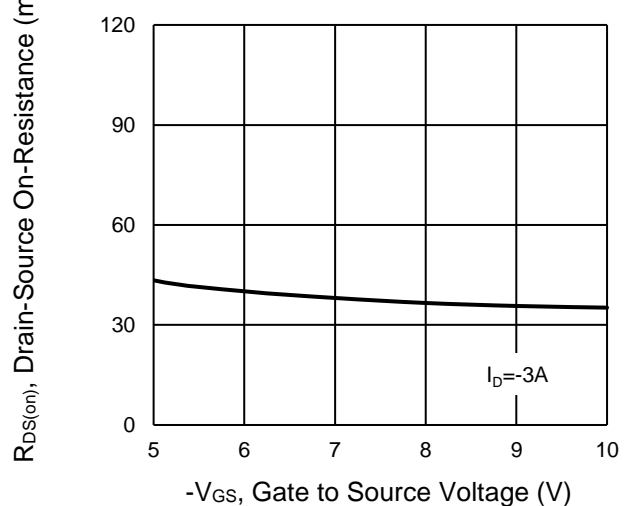
Gate-Source Voltage vs. Gate Charge



On-Resistance vs. Junction Temperature



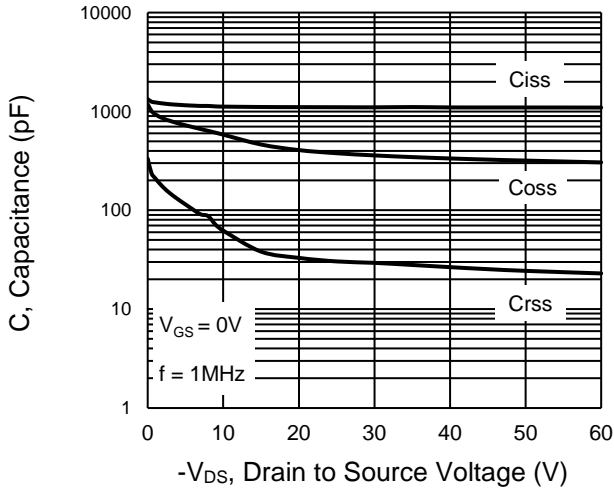
On-Resistance vs. Gate-Source Voltage



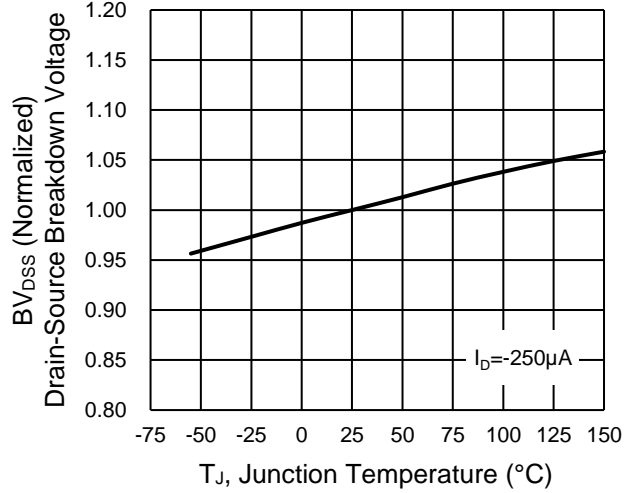
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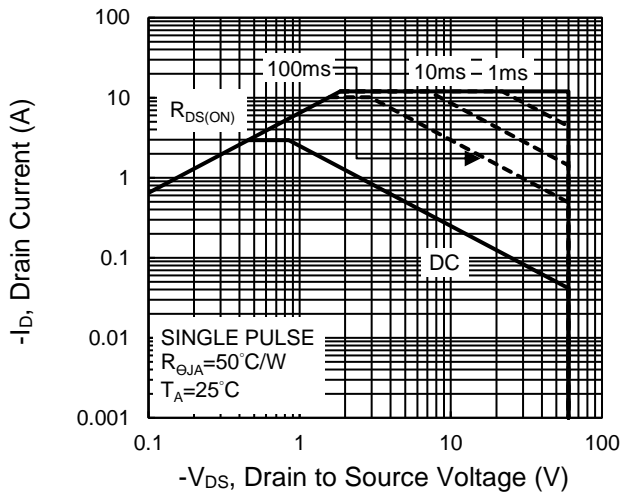
Capacitance vs. Drain-Source Voltage



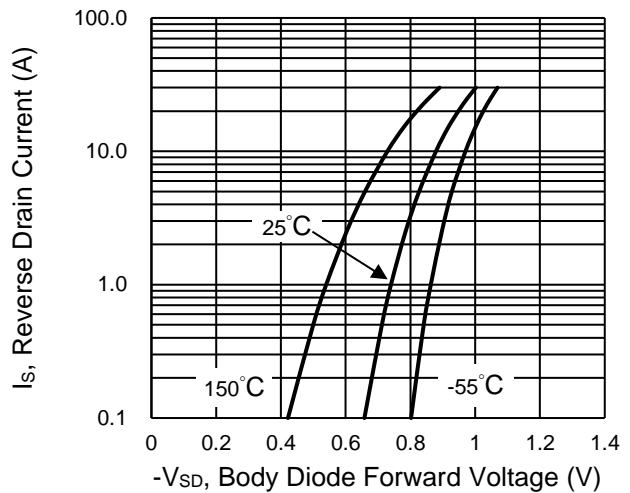
BV_{DSS} vs. Junction Temperature



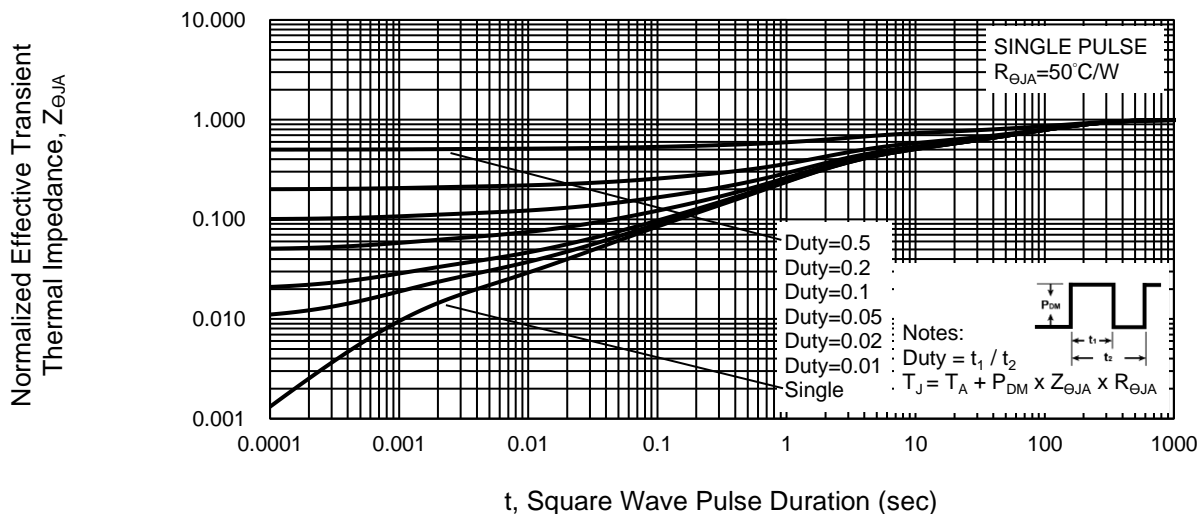
Maximum Safe Operating Area, Junction-to-Ambient



Source-Drain Diode Forward Current vs. Voltage



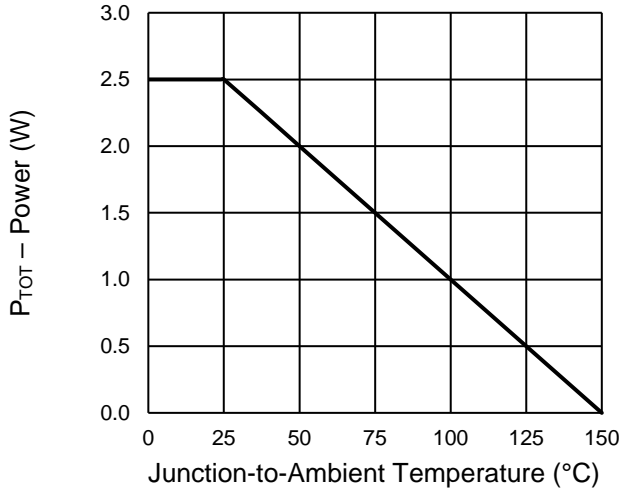
Normalized Thermal Transient Impedance, Junction-to-Ambient



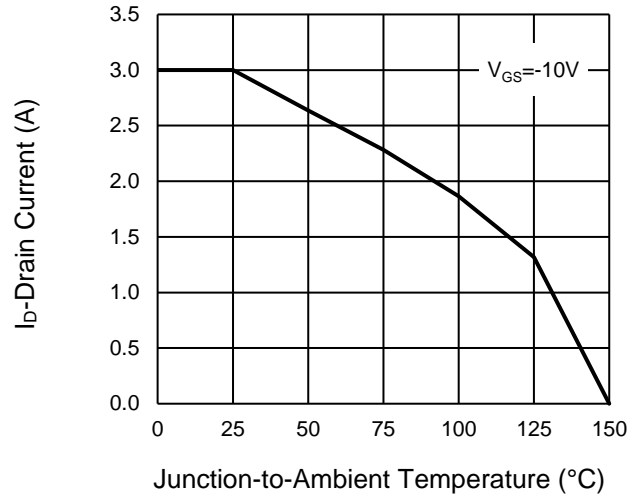
CHARACTERISTICS CURVES

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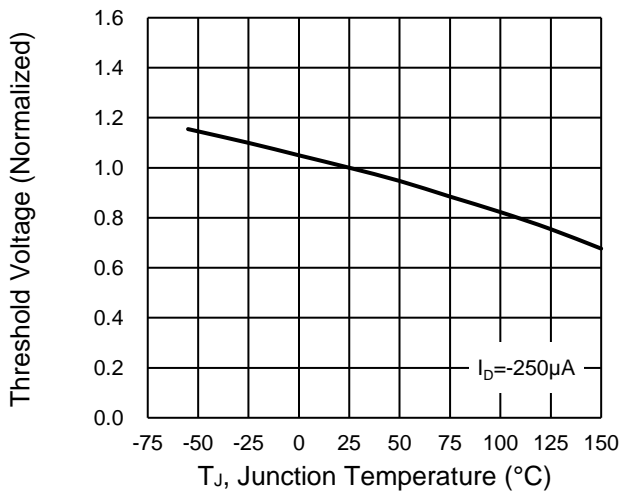
Power Dissipation



Drain Current

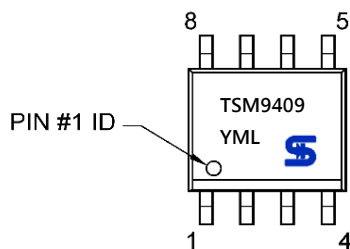
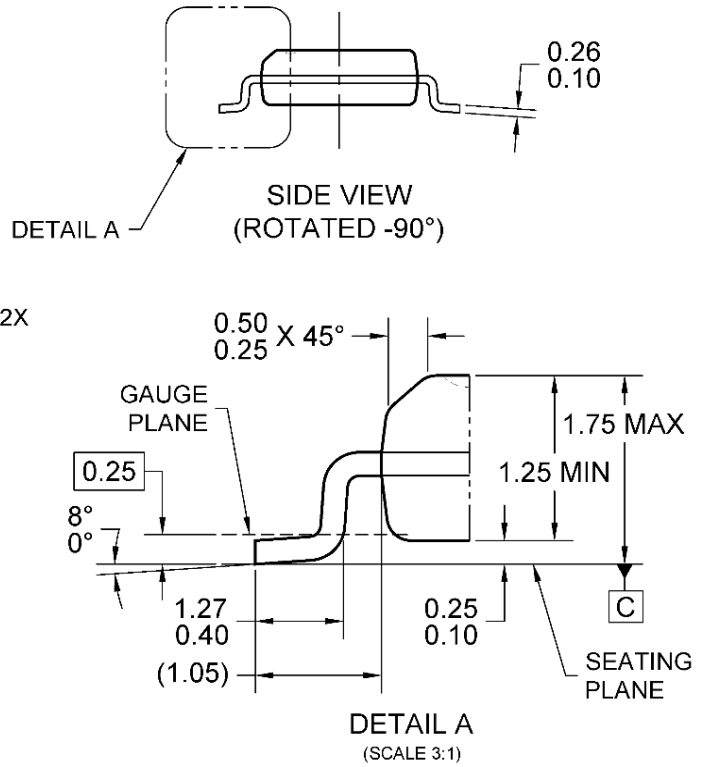
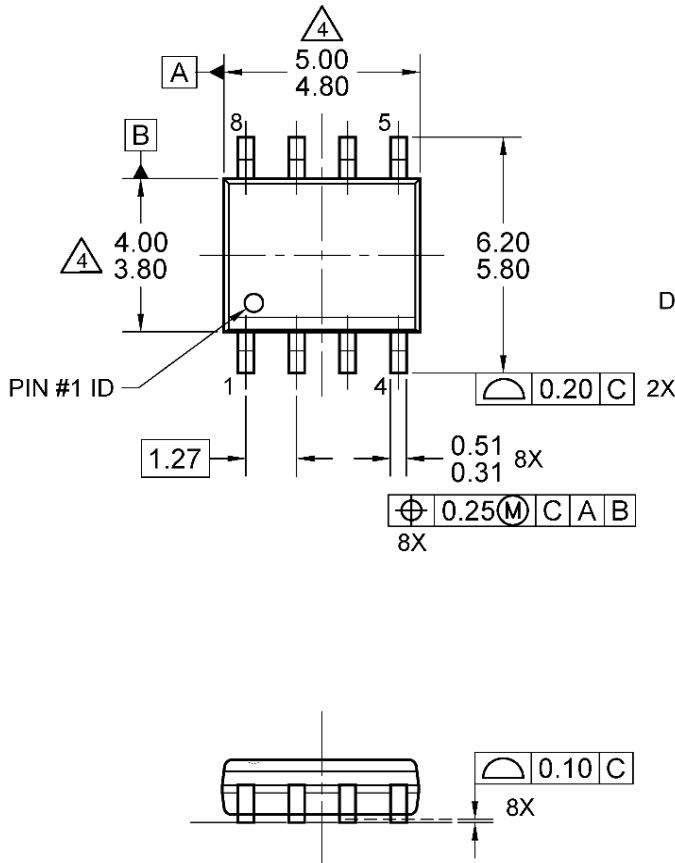


Normalized gate threshold voltage vs Temperature

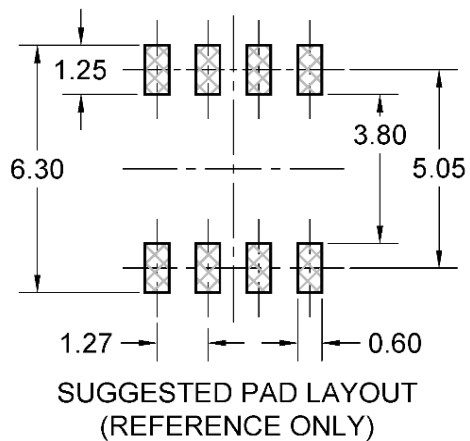


PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

SOP-8



MARKING DIAGRAM



SUGGESTED PAD LAYOUT
(REFERENCE ONLY)

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. PACKAGE OUTLINE REFERENCE: JEDEC MS-012, ISSUE G, VARIATION AA.
4. MOLDED PLASTIC BODY DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
5. DWG NO REF: HQ2SD07-SOP8STD-028 REV A.

- Y** = YEAR CODE
M = MONTH CODE FOR HALOGEN FREE PRODUCT
 O = JAN P = FEB Q = MAR R = APR
 S = MAY T = JUN U = JUL V = AUG
 W = SEP X = OCT Y = NOV Z = DEC
L = LOT CODE

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