

MOSFET – Dual, P-Channel, POWERTRENCH[®]

-60 V

NDS9948

General Description

This P-Channel MOSFET is a rugged gate version of onsemi's advanced POWERTRENCH process. It has been optimized for power management applications requiring a wide range of gate drive voltage ratings (4.5 V – 20 V).

Features

- -2.3 A, -60 V $R_{DS(on)} = 250 \text{ m}\Omega @ V_{GS} = -10 \text{ V}$
 $R_{DS(on)} = 500 \text{ m}\Omega @ V_{GS} = -4.5 \text{ V}$
- Low Gate Charge (9 nC Typical)
- Fast Switching Speed
- High Performance Trench Technology for Extremely Low $R_{DS(on)}$
- High Power and Current Handling Capability
- This is a Pb-Free and Halide Free Device

Features

- Power Management
- Load Switch
- Battery Protection

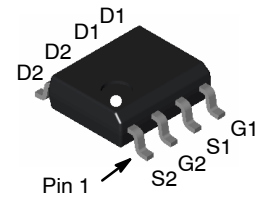
ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain-Source Voltage	-60	V
V_{GSS}	Gate-Source Voltage	± 20	V
I_D	Drain Current – Continuous (Note 1a.) – Pulsed	-2.3 -10	A
P_D	Power Dissipation for Dual Operation	2	W
P_D	Power Dissipation (Note 1a.) for Single Operation (Note 1b.) (Note 1c.)	1.6 1.0 0.9	W
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to +175	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

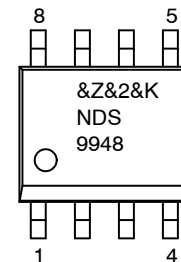
THERMAL CHARACTERISTICS

Symbol	Parameter	Ratings	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (Note 1a.) (Note 1c.)	78 135	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case (Note 1)	40	$^\circ\text{C/W}$



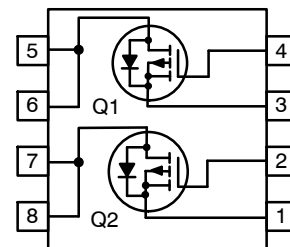
SOIC8
CASE 751EB

MARKING DIAGRAM



&Z = Assembly Plant Code
 &2 = 2-Digit Date Code (Year and Week)
 &K = 2-Digit Lot Run Code
 NDS9948 = Specific Device Code

ELECTRICAL CONNECTION



ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

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

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
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DRAIN-SOURCE AVALANCHE RATINGS (Note 2)

W_{DSS}	Drain-Source Avalanche Energy	Single Pulse, $V_{DD} = -54\text{ V}$	–	–	15	mJ
I_{AR}	Drain-Source Avalanche Current		–	–	–10	A

OFF CHARACTERISTICS

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_D = -250\text{ }\mu\text{A}$	–60	–	–	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\text{ }\mu\text{A}$, Referenced to 25°C	–	–52	–	mV/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = -40\text{ V}$, $V_{GS} = 0\text{ V}$ $V_{DS} = -40\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = -55^\circ\text{C}$	–	–	–2 –25	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 20\text{ V}$, $V_{DS} = 0\text{ V}$	–	–	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -20\text{ V}$, $V_{DS} = 0\text{ V}$	–	–	–100	nA

ON CHARACTERISTICS (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = -250\text{ }\mu\text{A}$	–1	–1.5	–3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\text{ }\mu\text{A}$, Referenced to 25°C	–	4	–	mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{ V}$, $I_D = -2.3\text{ A}$ $V_{GS} = -4.5\text{ V}$, $I_D = -1.6\text{ A}$ $V_{GS} = -10\text{ V}$, $I_D = -2.3\text{ A}$, $T_J = 125^\circ\text{C}$	– – –	138 175 225	250 500 433	m Ω
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -10\text{ V}$, $V_{DS} = -5\text{ V}$	–10	–	–	A
g_{FS}	Forward Transconductance	$V_{DS} = -10\text{ V}$, $I_D = -2.3\text{ A}$	–	5	–	S

DYNAMIC CHARACTERISTICS

C_{iss}	Input Capacitance	$V_{DS} = -30\text{ V}$, $V_{GS} = 0\text{ V}$ $f = 1.0\text{ MHz}$	–	394	–	pF
C_{oss}	Output Capacitance		–	53	–	pF
C_{rss}	Reverse Transfer Capacitance		–	23	–	pF

SWITCHING CHARACTERISTICS (Note 2)

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -30\text{ V}$, $I_D = -1\text{ A}$ $V_{GS} = -10\text{ V}$, $R_{GEN} = 6\text{ }\Omega$	–	6	12	ns
t_r	Turn-On Rise Time		–	9	18	ns
$t_{d(off)}$	Turn-Off Delay Time		–	16	29	ns
t_f	Turn-Off Fall Time		–	3	6	ns
Q_g	Total Gate Charge	$V_{DS} = -30\text{ V}$, $I_D = -2.3\text{ A}$ $V_{GS} = -10\text{ V}$	–	9	13	nC
Q_{gs}	Gate-Source Charge		–	1.4	–	nC
Q_{gd}	Gate-Drain Charge		–	1.7	–	nC

DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS

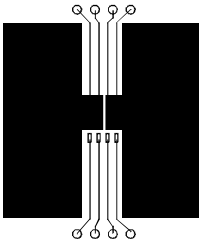
I_S	Maximum Continuous Drain-Source Diode Forward Current		–	–	–1.7	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$, $I_S = -1.7\text{ A}$ (Note 2)	–	–0.8	–1.2	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}$, $I_F = -2.3\text{ A}$, $di_F/dt = 100\text{ A}/\mu\text{s}$	–	25	–	ns

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

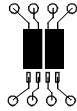
NOTES:

- $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.

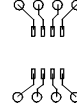
NDS9948



a. 78°C/W when mounted on a 0.5 in² pad of 2 oz. Copper.



b. 125°C/W when mounted on a 0.02 in² pad of 2 oz. copper.



c. 135°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

2. Pulse Test Pulse Width < 300 μ s, Duty Cycle < 2.0%

TYPICAL CHARACTERISTICS

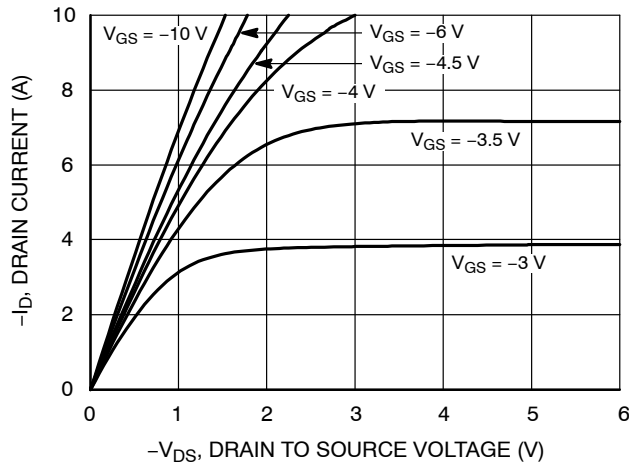


Figure 1. On-Region Characteristics

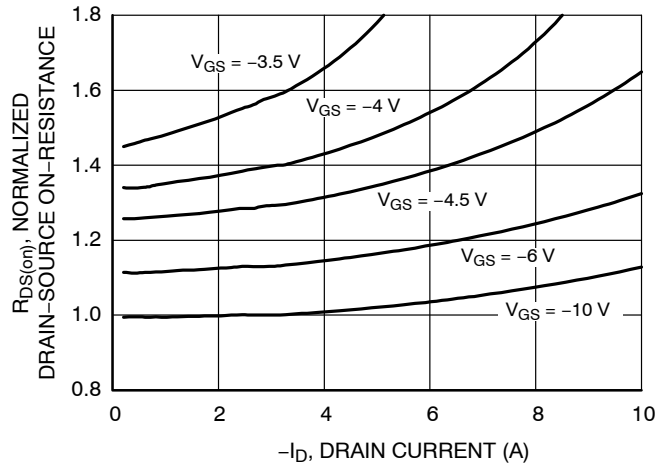


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

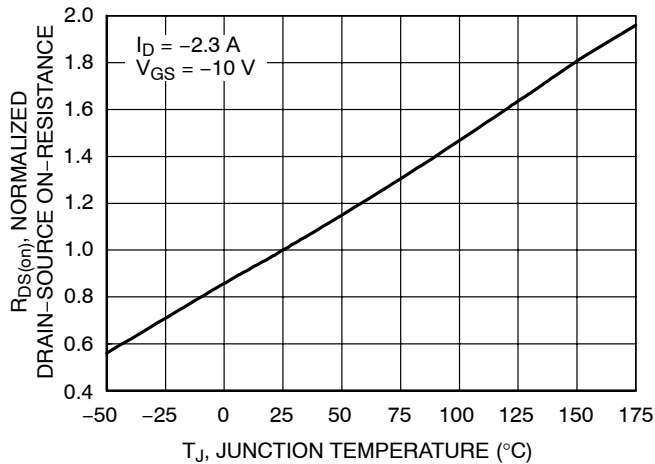


Figure 3. On-Resistance Variation with Temperature

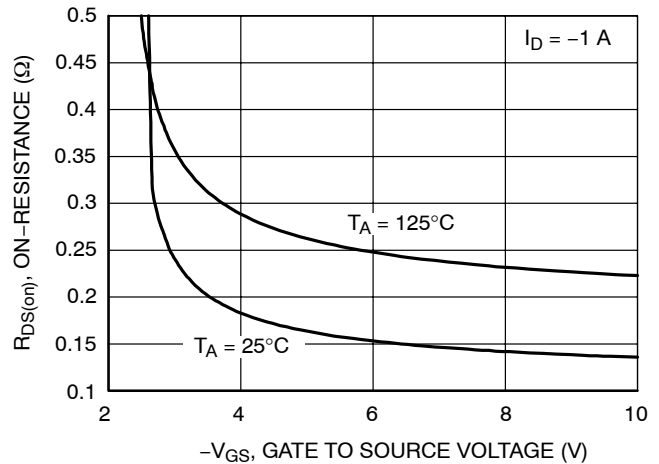


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

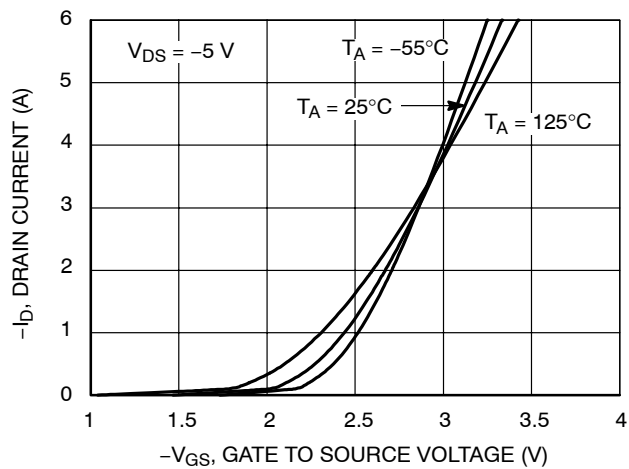


Figure 5. Transfer Characteristics

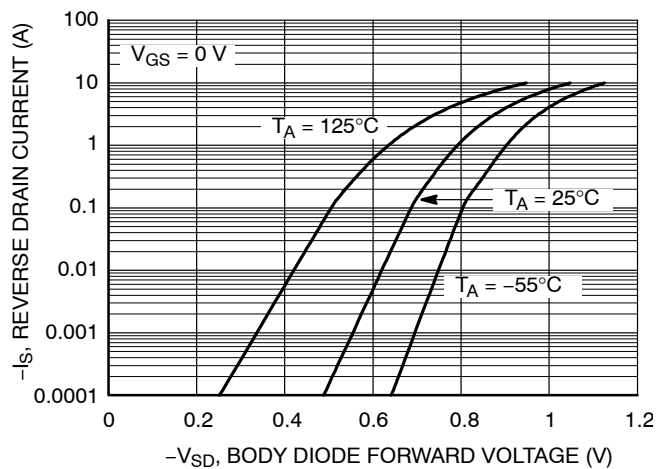


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

TYPICAL CHARACTERISTICS (continued)

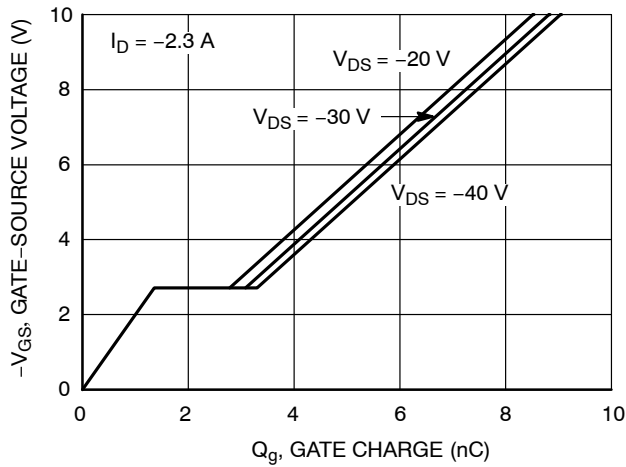


Figure 7. Gate-Charge Characteristics

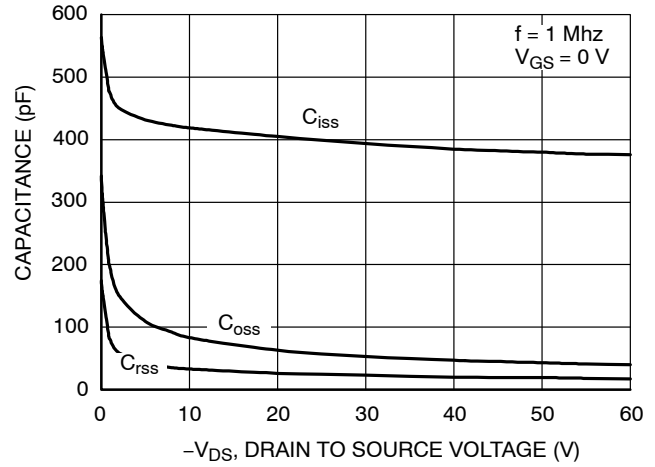


Figure 8. Capacitance Characteristics

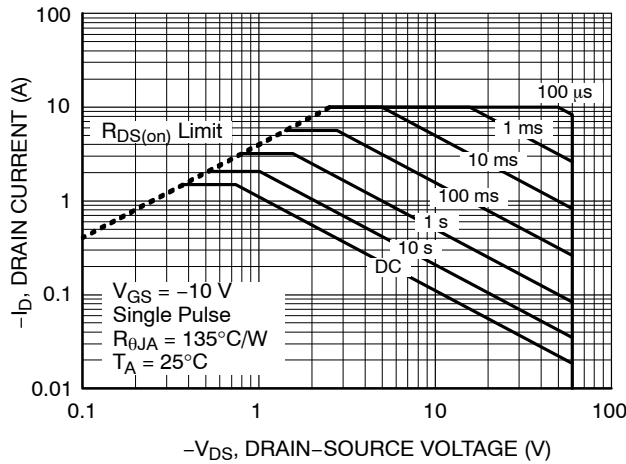


Figure 9. Maximum Safe Operating Area

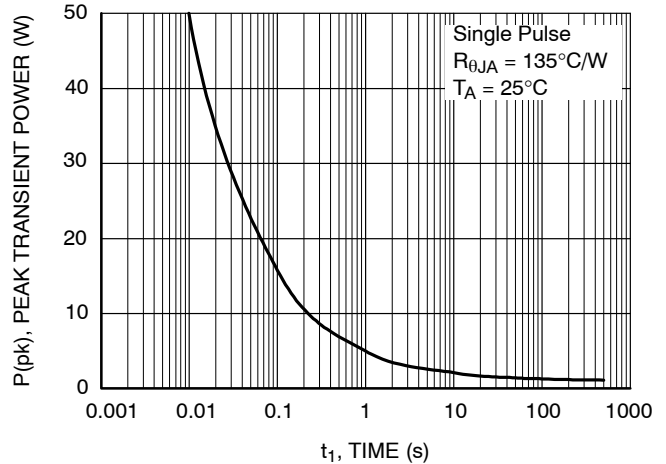


Figure 10. Single Pulse Maximum Power Dissipation

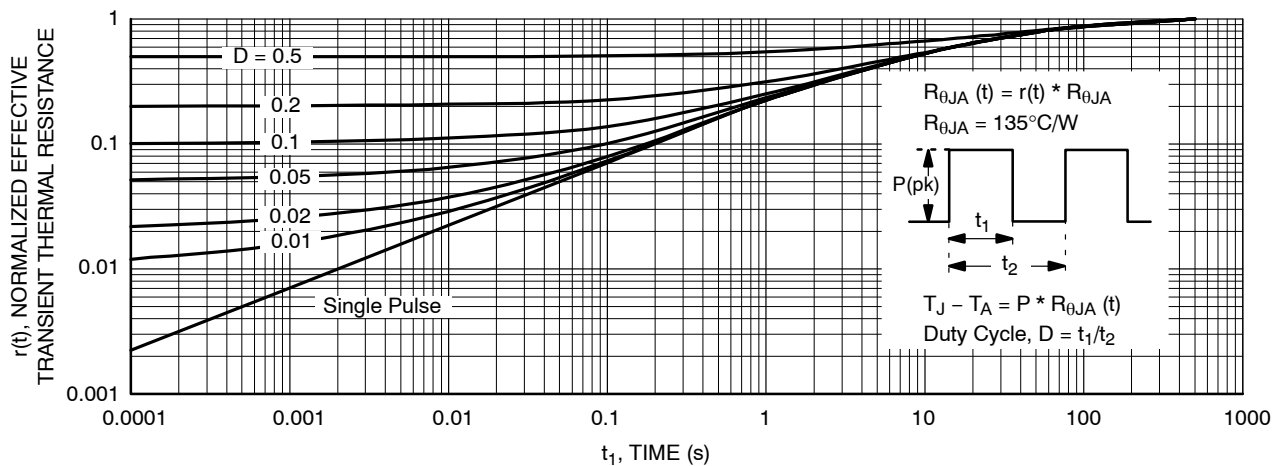


Figure 11. Transient Thermal Response Curve

Thermal characterization performed using the conditions described in Note 1c.
Transient thermal response will change depending on the circuit board design.

NDS9948

ORDERING INFORMATION

Device Marking	Device	Package Type	Reel Size	Tape Width	Shipping [†]
NDS9948	NDS9948	SOIC8 (Pb-Free, Halide Free)	13"	12 mm	2500 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

MECHANICAL CASE OUTLINE

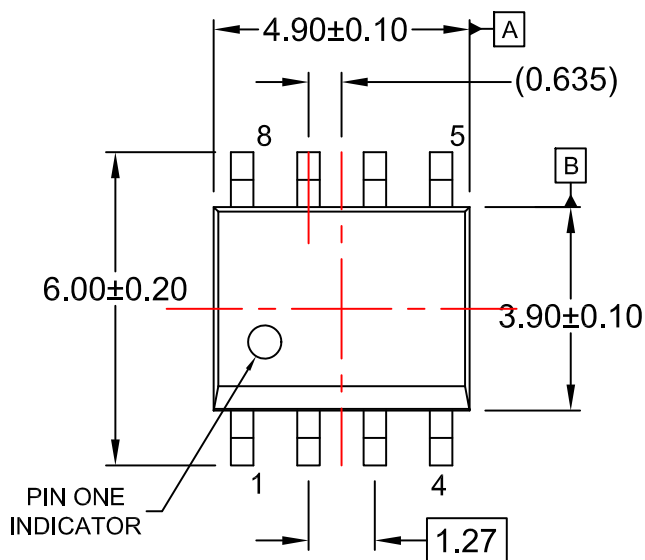
PACKAGE DIMENSIONS

ON Semiconductor®

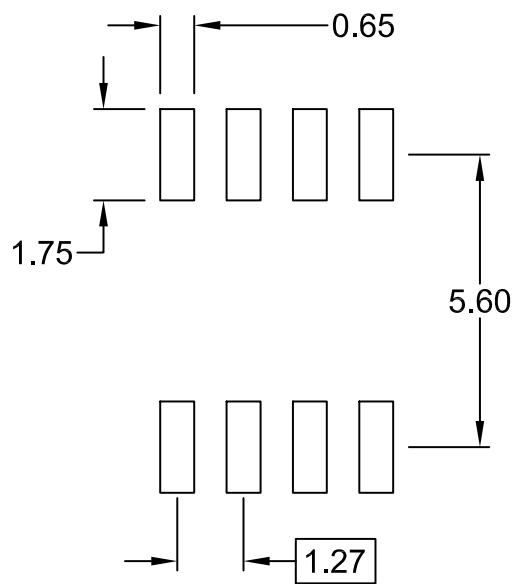


SOIC8
CASE 751EB
ISSUE A

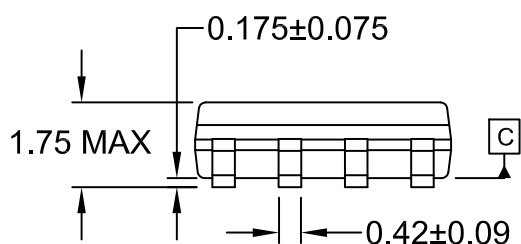
DATE 24 AUG 2017



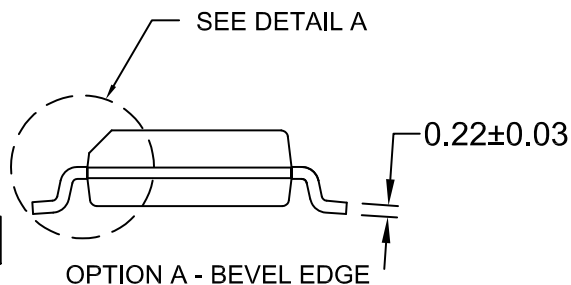
\oplus 0.25(M) C B A



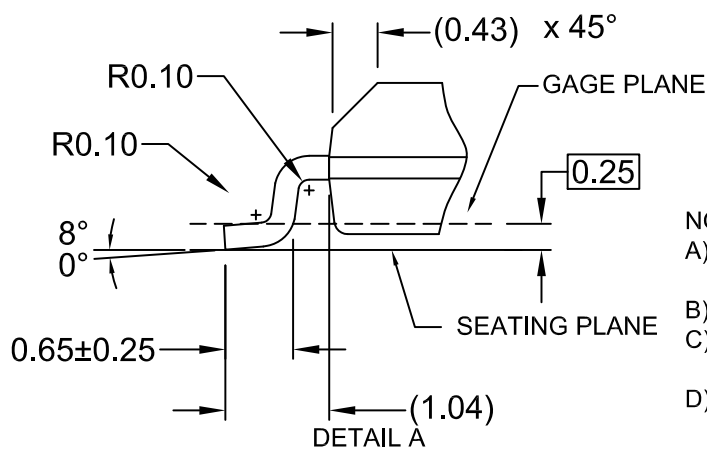
LAND PATTERN RECOMMENDATION



$\frac{1}{2}$ 0.10



OPTION B - NO BEVEL EDGE



DETAIL A

SCALE: 2:1

NOTES:

- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X175-8M

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