

Formerly FRF150R4

25A, 100V, 0.070 Ohm, Rad Hard,  
N-Channel Power MOSFET

June 1998

### Features

- 25A, 100V,  $r_{DS(ON)} = 0.070\Omega$
- Total Dose
  - Meets Pre-RAD Specifications to 100K RAD (Si)
- Dose Rate
  - Typically Survives 3E9 RAD (Si)/s at 80%  $BV_{DSS}$
  - Typically Survives 2E12 if Current Limited to  $I_{DM}$
- Photo Current
  - 7.0nA Per-RAD(Si)/s Typically
- Neutron
  - Maintain Pre-RAD Specifications for 3E13 Neutrons/cm<sup>2</sup>
  - Usable to 3E14 Neutrons/cm<sup>2</sup>

### Description

The Intersil Corporation has designed a series of SECOND GENERATION hardened power MOSFETs of both N-Channel and P-Channel enhancement types with ratings from 100V to 500V, 1A to 60A, and on resistance as low as 25mΩ. Total dose hardness is offered at 100K RAD (Si) and 1000K RAD (Si) with neutron hardness ranging from 1E13 for 500V product to 1E14 for 100V product. Dose rate hardness (GAMMA DOT) exists for rates to 1E9 without current limiting and 2E12 with current limiting.

This MOSFET is an enhancement-mode silicon-gate power field effect transistor of the vertical DMOS (VDMOS) structure. It is specially designed and processed to exhibit minimal characteristic changes to total dose (GAMMA) and neutron ( $n^0$ ) exposures. Design and processing efforts are also directed to enhance survival to dose rate (GAMMA DOT) exposure.

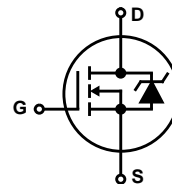
Also available at other radiation and screening levels. See us on the web, Intersil's home page: <http://www.semi.harris.com>. Contact your local Intersil Sales Office for additional information.

### Ordering Information

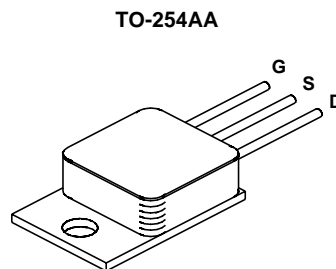
PART NUMBER	PACKAGE	BRAND
JANSR2N7292	TO-254AA	JANSR2N7292

Die family TA17651.  
MIL-PRF-19500/605.

### Symbol



### Package



CAUTION: Beryllia Warning per MIL-S-19500 refer to package specifications.

# JANSR2N7292

## Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

	JANSR2N7292	UNITS
Drain to Source Voltage . . . . .	100	V
Drain to Gate Voltage ( $R_{GS} = 20k\Omega$ ) . . . . .	100	V
Continuous Drain Current		
$T_C = 25^\circ\text{C}$ . . . . .	25	A
$T_C = 100^\circ\text{C}$ . . . . .	20	A
Pulsed Drain Current . . . . .	75	A
Gate to Source Voltage . . . . .	$\pm 20$	V
Maximum Power Dissipation		
$T_C = 25^\circ\text{C}$ . . . . .	125	W
$T_C = 100^\circ\text{C}$ . . . . .	50	W
Linear Derating Factor . . . . .	1.00	W/ $^\circ\text{C}$
Single Pulsed Avalanche Current, $L = 100\mu\text{H}$ , (See Test Figure) . . . . .	75	A
Continuous Source Current (Body Diode) . . . . .	25	A
Pulsed Source Current (Body Diode) . . . . .	75	A
Operating and Storage Temperature . . . . .	-55 to 150	$^\circ\text{C}$
Lead Temperature (During Soldering) . . . . .	300	$^\circ\text{C}$
(Distance $>0.063\text{in}$ (1.6mm) from Case, 10s Max)		
Weight (Typical) . . . . .	9.3	g

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

## Electrical Specifications $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
Drain to Source Breakdown Voltage	$BV_{DSS}$	$I_D = 1\text{mA}$ , $V_{GS} = 0\text{V}$	100	-	-	V	
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}$ , $I_D = 1\text{mA}$	$T_C = -55^\circ\text{C}$	-	-	5.0	V
			$T_C = 25^\circ\text{C}$	2.0	-	4.0	V
			$T_C = 125^\circ\text{C}$	1.0	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 80\text{V}$ , $V_{GS} = 0\text{V}$	$T_C = 25^\circ\text{C}$	-	-	25	$\mu\text{A}$
			$T_C = 125^\circ\text{C}$	-	-	250	$\mu\text{A}$
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	$T_C = 25^\circ\text{C}$	-	-	100	nA
			$T_C = 125^\circ\text{C}$	-	-	200	nA
Drain to Source On-State Voltage	$V_{DS(ON)}$	$V_{GS} = 10\text{V}$ , $I_D = 25\text{A}$	-	-	1.84	V	
Drain to Source On Resistance	$r_{DS(ON)}$	$I_D = 20\text{A}$ , $V_{GS} = 10\text{V}$	$T_C = 25^\circ\text{C}$	-	-	0.070	$\Omega$
			$T_C = 125^\circ\text{C}$	-	-	0.140	$\Omega$
Turn-On Delay Time	$t_d(ON)$	$V_{DD} = 50\text{V}$ , $I_D = 25\text{A}$ , $R_L = 2.0\Omega$ , $V_{GS} = 10\text{V}$ , $R_{GS} = 25\Omega$	-	-	134	ns	
Rise Time	$t_r$		-	-	628	ns	
Turn-Off Delay Time	$t_d(OFF)$		-	-	642	ns	
Fall Time	$t_f$		-	-	490	ns	
Total Gate Charge (Not on slash sheet)	$Q_g(TOT)$	$V_{GS} = 0\text{V}$ to $20\text{V}$	$V_{DD} = 50\text{V}$ , $I_D = 25\text{A}$	-	-	552	nC
Gate Charge at 10V	$Q_g(10)$	$V_{GS} = 0\text{V}$ to $10\text{V}$		-	-	314	nC
Threshold Gate Charge (Not on slash sheet)	$Q_g(TH)$	$V_{GS} = 0\text{V}$ to $2\text{V}$		-	-	17	nC
Gate Charge Source	$Q_{gs}$			-	-	46	nC
Gate Charge Drain	$Q_{gd}$			-	-	164	nC
Thermal Resistance Junction to Case	$R_{\theta JC}$			-	-	1.0	$^\circ\text{C/W}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$		-	-	48	$^\circ\text{C/W}$	

## Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Forward Voltage	$V_{SD}$	$I_{SD} = 25\text{A}$	0.6	-	1.8	V
Reverse Recovery Time	$t_{rr}$	$I_{SD} = 25\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	-	1400	ns

# JANSR2N7292

## Electrical Specifications up to 100K RAD $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	MAX	UNITS
Drain to Source Breakdown Volts (Note 3)	$BV_{DSS}$	$V_{GS} = 0, I_D = 1\text{mA}$	100	-	V
Gate to Source Threshold Volts (Note 3)	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 1\text{mA}$	2.0	4.0	V
Gate to Body Leakage (Notes 2, 3)	$I_{GSS}$	$V_{GS} = \pm 20\text{V}, V_{DS} = 0\text{V}$	-	100	nA
Zero Gate Leakage (Note 3)	$I_{DSS}$	$V_{GS} = 0, V_{DS} = 80\text{V}$	-	25	$\mu\text{A}$
Drain to Source On-State Volts (Notes 1, 3)	$V_{DS(ON)}$	$V_{GS} = 10\text{V}, I_D = 25\text{A}$	-	1.84	V
Drain to Source On Resistance (Notes 1, 3)	$r_{DS(ON)}$	$V_{GS} = 10\text{V}, I_D = 20\text{A}$	-	0.070	$\Omega$

### NOTES:

1. Pulse test, 300 $\mu\text{s}$  Max.
2. Absolute value.
3. Insitu Gamma bias must be sampled for both  $V_{GS} = 10\text{V}, V_{DS} = 0\text{V}$  and  $V_{GS} = 0\text{V}, V_{DS} = 80\% BV_{DSS}$ .

## Typical Performance Curves Unless Otherwise Specified

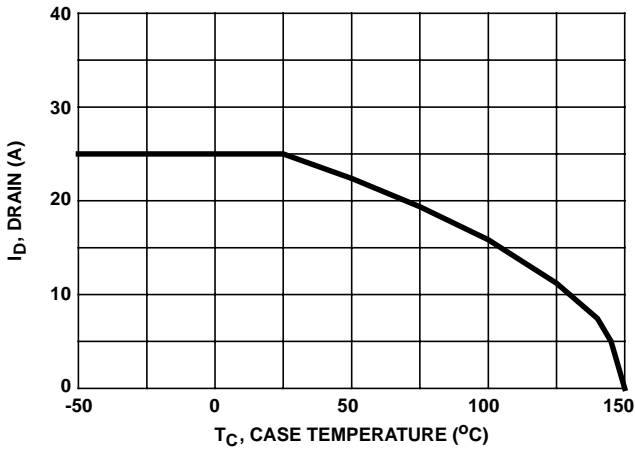


FIGURE 1. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

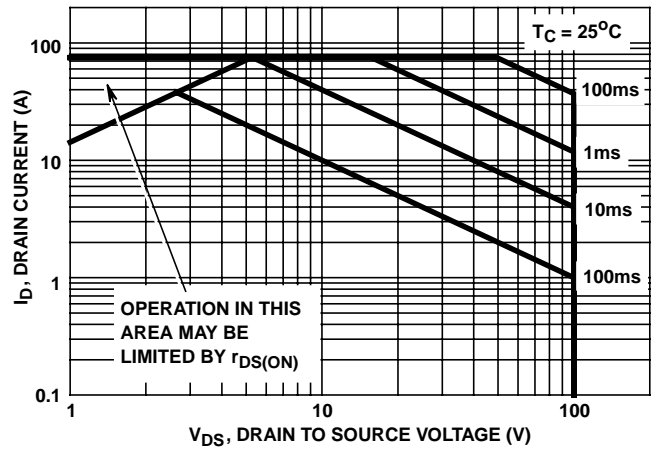


FIGURE 2. FORWARD BIAS SAFE OPERATING AREA

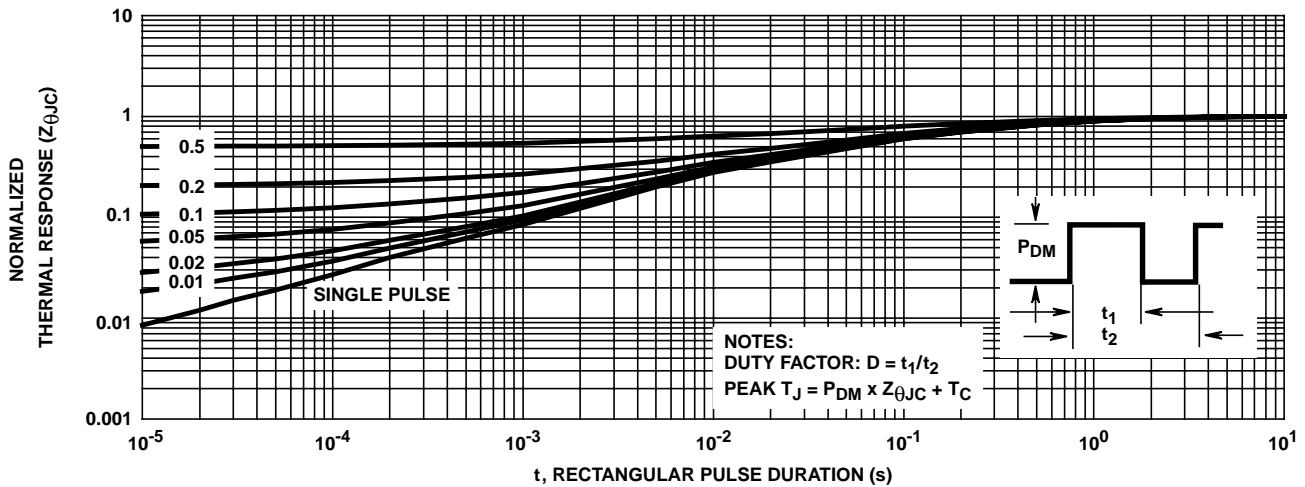


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL RESPONSE

Test Circuits and Waveforms

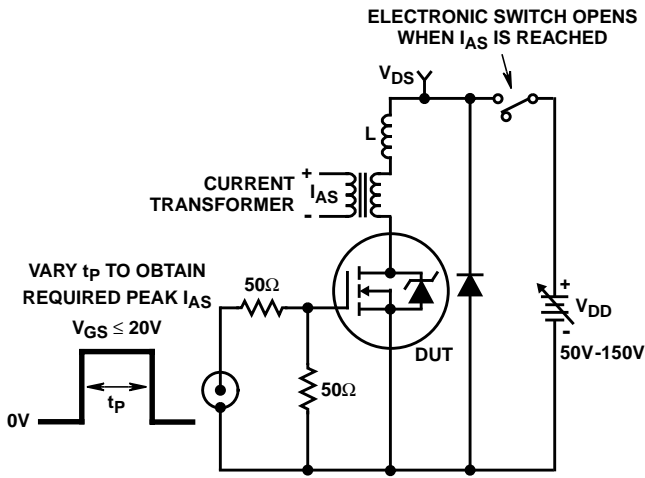


FIGURE 4. UNCLAMPED ENERGY TEST CIRCUIT

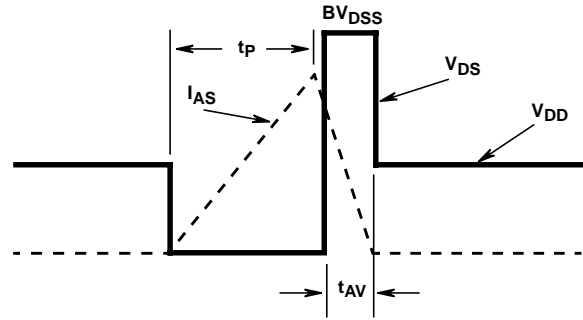


FIGURE 5. UNCLAMPED ENERGY WAVEFORMS

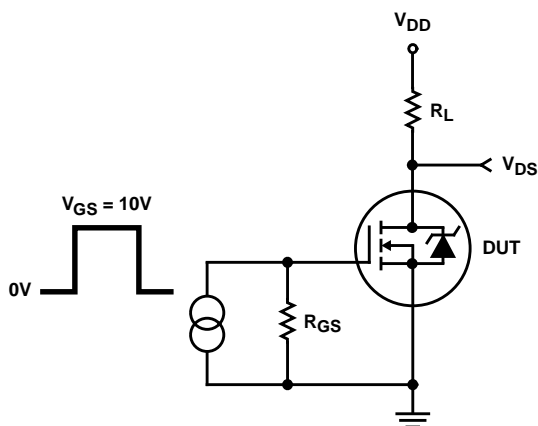


FIGURE 6. RESISTIVE SWITCHING TEST CIRCUIT

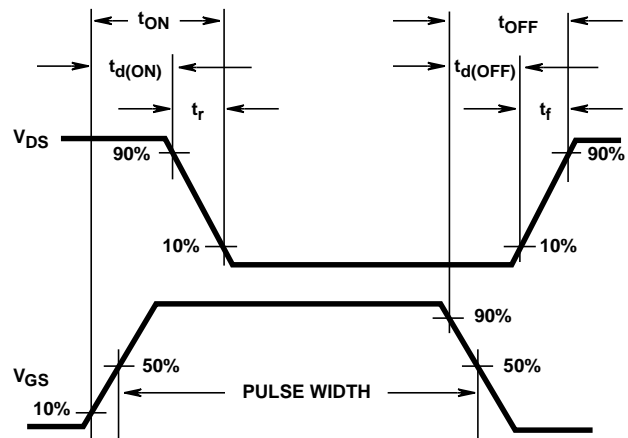


FIGURE 7. RESISTIVE SWITCHING WAVEFORMS

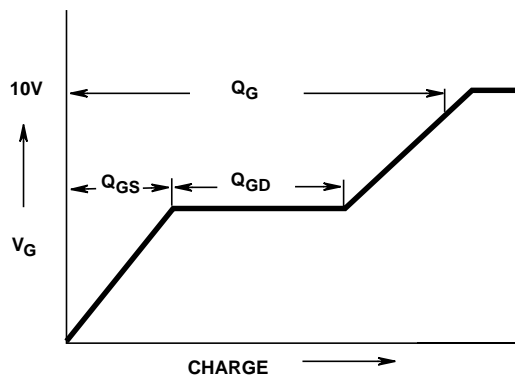


FIGURE 8. BASIC GATE CHARGE WAVEFORM

## JANSR2N7292

### Screening Information

Screening is performed in accordance with the latest revision in effect of MIL-S-19500, (Screening Information Table).

#### Delta Tests and Limits (JANS) $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MAX	UNITS
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	$\pm 20$ (Note 4)	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 80\%$ Rated Value	$\pm 25$ (Note 4)	$\mu\text{A}$
Drain to Source On Resistance	$r_{DS(ON)}$	$T_C = 25^\circ\text{C}$ at Rated $I_D$	$\pm 20\%$ (Note 5)	$\Omega$
Gate Threshold Voltage	$V_{GS(TH)}$	$I_D = 1.0\text{mA}$	$\pm 20\%$ (Note 5)	V

NOTES:

4. Or 100% of Initial Reading (whichever is greater).
5. Of Initial Reading.

### Screening Information

TEST	JANS
Gate Stress	$V_{GS} = 30\text{V}$ , $t = 250\mu\text{s}$
Pind	Required
Pre Burn-In Tests (Note 6)	MIL-S-19500 Group A, Subgroup 2 (All Static Tests at $25^\circ\text{C}$ )
Steady State Gate Bias (Gate Stress)	MIL-STD-750, Method 1042, Condition B $V_{GS} = 80\%$ of Rated Value, $T_A = 150^\circ\text{C}$ , Time = 48 hours
Interim Electrical Tests (Note 6)	All Delta Parameters Listed in the Delta Tests and Limits Table
Steady State Reverse Bias (Drain Stress)	MIL-STD-750, Method 1042, Condition A $V_{DS} = 80\%$ of Rated Value, $T_A = 150^\circ\text{C}$ , Time = 240 hours
PDA	5%
Final Electrical Tests (Note 6)	MIL-S-19500, Group A, Subgroups 2 and 3

NOTE:

6. Test limits are identical pre and post burn-in.

### Additional Screening Tests

PARAMETER	SYMBOL	TEST CONDITIONS	MAX	UNITS
Safe Operating Area	SOA	$V_{DS} = 80\text{V}$ , $t = 10\text{ms}$	5	A
Unclamped Inductive Switching	$I_{AS}$	$V_{GS(PEAK)} = 15\text{V}$ , $L = 0.1\text{mH}$	75	A
Thermal Response	$\Delta V_{SD}$	$t_H = 100\text{ms}$ ; $V_H = 25\text{V}$ ; $I_H = 4\text{A}$	136	mV
Thermal Impedance	$\Delta V_{SD}$	$t_H = 500\text{ms}$ ; $V_H = 25\text{V}$ ; $I_H = 4\text{A}$	187	mV

**Rad Hard Data Packages - Intersil Power Transistors**

**1. JANS Rad Hard - Standard Data Package**

- A. Certificate of Compliance
- B. Serialization Records
- C. Assembly Flow Chart
- D. SEM Photos and Report
- E. Preconditioning Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - HTRB - Hi Temp Gate Stress Post Reverse Bias Data and Delta Data
  - HTRB - Hi Temp Drain Stress Post Reverse Bias Delta Data
- F. Group A - Attributes Data Sheet
- G. Group B - Attributes Data Sheet
- H. Group C - Attributes Data Sheet
- I. Group D - Attributes Data Sheet

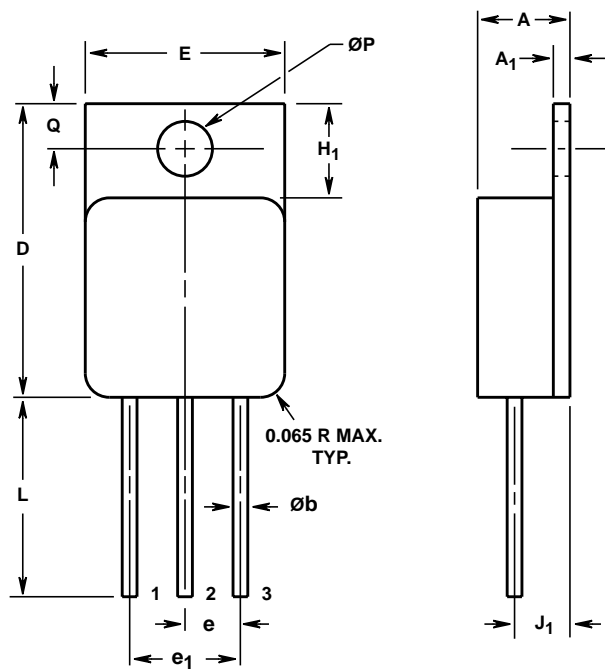
**2. JANS Rad Hard - Optional Data Package**

- A. Certificate of Compliance
- B. Serialization Records
- C. Assembly Flow Chart
- D. SEM Photos and Report
- E. Preconditioning - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - HTRB - Hi Temp Gate Stress Post Reverse Bias Data and Delta Data
  - HTRB - Hi Temp Drain Stress Post Reverse Bias Delta Data
  - X-Ray and X-Ray Report
- F. Group A
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Subgroups A2, A3, A4, A5 and A7 Data
- G. Group B
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Subgroups B1, B3, B4, B5 and B6 Data
- H. Group C
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Subgroups C1, C2, C3 and C6 Data
- I. Group D
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Pre and Post Radiation Data

# JANSR2N7292

## TO-254AA

### 3 LEAD JEDEC TO-254AA HERMETIC METAL PACKAGE



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.249	0.260	6.33	6.60	-
A <sub>1</sub>	0.040	0.050	1.02	1.27	-
Øb	0.035	0.045	0.89	1.14	2, 3
D	0.790	0.800	20.07	20.32	-
E	0.535	0.545	13.59	13.84	-
e	0.150 TYP		3.81 TYP		4
e <sub>1</sub>	0.300 BSC		7.62 BSC		4
H <sub>1</sub>	0.245	0.265	6.23	6.73	-
J <sub>1</sub>	0.140	0.160	3.56	4.06	4
L	0.520	0.560	13.21	14.22	-
ØP	0.139	0.149	3.54	3.78	-
Q	0.110	0.130	2.80	3.30	-

#### NOTES:

1. These dimensions are within allowable dimensions of Rev. A of JEDEC outline TO-254AA dated 11-86.
2. Add typically 0.002 inches (0.05mm) for solder coating.
3. Lead dimension (without solder).
4. Position of lead to be measured 0.250 inches (6.35mm) from bottom of dimension D.
5. Die to base BeO isolated, terminals to case ceramic isolated.
6. Controlling dimension: Inch.
7. Revision 1 dated 1-93.

## WARNING!

### BERYLLIA WARNING PER MIL-S-19500

Packages containing beryllium oxide (BeO) shall not be ground, machined, sandblasted, or subject to any mechanical operation which will produce dust containing any beryllium compound. Packages containing any beryllium compound shall not be subjected to any chemical process (etching, etc.) which will produce fumes containing beryllium or its' compounds.

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