Programmable Shunt Regulator

KA431S, KA431SA, KA431SL

SOT23−FL3L
CASE 318AB

MF	MF2
1. Cathode	1. Ref
2. Ref	2. Cathode
3. Anode	3. Anode

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 2 of this data sheet.

ORDERING INFORMATION

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

Description

The KA431S / KA431SA / KA431SL are three−terminal adjustable regulator series with a guaranteed thermal stability over the operating temperature range. The output voltage can be set to any value between V_{REF} (approximately 2.5 V) and 36 V with two external resistors. These devices have a typical dynamic output impedance of 0.2 Ω. Active output circuitry provides a sharp turn−on characteristic, making these devices excellent replacement for zener diodes in many applications.

Features

- Programmable Output Voltage to 36 V
- Low Dynamic Output Impedance 0.2 Ω (Typical)
- Sink Current Capability: 1.0 to 100 mA
- Equivalent Full−Range Temperature Coefficient of 50 ppm/°C (Typical)
- Temperature Compensated for Operation Over Full Rated Operating Temperature Range
- Low Output Noise Voltage
- Fast Turn−on Response
- These Devices are Pb−Free and Halogen Free

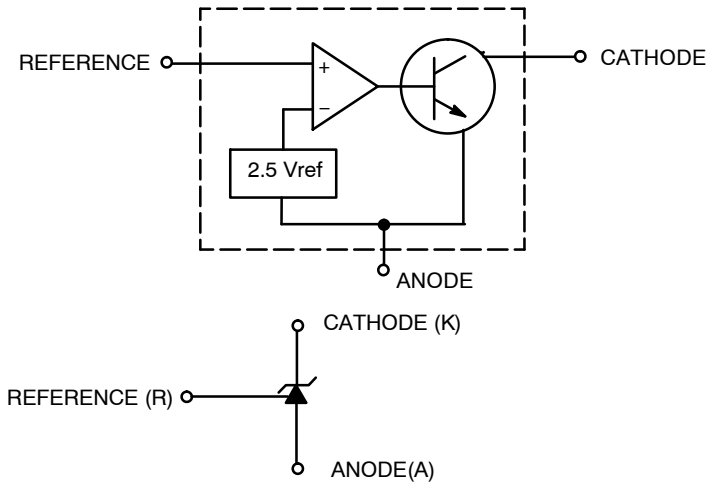

Figure 1. Block Diagram

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MARKING INFORMATION

Figure 2. Top Mark (per package)

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C unless otherwise noted

Symbol	Parameter	Value	Unit
V_{KA}	Cathode Voltage	37	V
I_{KA}	Cathode Current Range (Continuous)	−100 ~ +150	mA
I_{REF}	Reference Input Current Range	−0.05 ~ +10	mA
$R_{\theta JA}$	Thermal Resistance Junction−Air (Note 1) (Note 2) MF Suffix Package	350	°C/W
I_{REF}	Power Dissipation (Note 3) (Note 4) MF Suffix Package	350	mW
T_J	Junction Temperature	150	°C
T_{OPR}	Operating Temperature Range	−25 ~ +85	°C
T_{STG}	Storage Temperature Range	−65 ~ +150	°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.

1. Thermal resistance test board:
   Size: 1.6 mm x 76.2 mm x 114.3 mm (1S0P))
   JEDEC Standard: JESD51−3, JESD51−7
2. Assume no ambient airflow.
3. T_{JMAX} = 150°C; Ratings apply to ambient temperature at 25°C.
4. Power dissipation calculation: $P_D = (T_J - T_A) / R_{\theta JA}$.

RECOMMENDED OPERATING RANGES

Symbol	Parameter	Min.	Max.	Unit
V_{KA}	Cathode Voltage	V_{REF}	36	V
I_{KA}	Cathode Current	1	100	mA

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS (Note 5)
Values are at T_A = 25°C unless otherwise noted

Symbol	Parameter	Conditions	KA431S			KA431SA			KA431SL			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{REF}	Reference Input Voltage	$V_{KA} = V_{REF}$, I_{KA} = 10 mA	2.450	2.500	2.550	2.470	2.495	2.520	2.482	2.495	2.508	V
$\Delta V_{REF}/\Delta T$	Deviation of Reference Input Voltage Over−Temperature	$V_{KA} = V_{REF}$, I_{KA} = 10 mA, $T_{MIN} \le T_A \le T_{MAX}$	−	4.5	17.0	−	4.5	17.0	−	4.5	17.0	mV
$\Delta V_{REF}/\Delta V_{KA}$	Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	I_{KA} = 10 mA, ΔV_{KA} = 10 V − V_{REF}	−	−1.0	−2.7	−	−1.0	−2.7	−	−1.0	−2.7	mV/V
		I_{KA} = 10 mA, ΔV_{KA} = 36 V − 10 V	−	−0.5	−2.0	−	−0.5	−2.0	−	−0.5	−2.0	
I_{REF}	Reference Input Current	I_{KA} = 10 mA, R1 = 10 kΩ, R2 = ∞	−	1.5	4.0	−	1.5	4.0	−	1.5	4.0	μA
$\Delta I_{REF}/\Delta T$	Deviation of Reference Input Current Over Full Temperature Range	I_{KA} = 10 mA, R1 = 10 kΩ, R2 = ∞, T_A = Full Range	−	0.4	1.2	−	0.4	1.2	−	0.4	1.2	μA
$I_{KA(MIN)}$	Minimum Cathode Current for Regulation	$V_{KA} = V_{REF}$	−	0.45	1.00	−	0.45	1.00	−	0.45	1.00	mA
$I_{KA(OFF)}$	Off-Stage Cathode Current	V_{KA} = 36 V, V_{REF} = 0	−	0.05	1.00	−	0.05	1.00	−	0.05	1.00	μA
Z_{KA}	Dynamic Impedance	$V_{KA} = V_{REF}$, I_{KA} = 1 to 100 mA, f ≥ 1.0 kHz	−	0.15	0.50	−	0.15	0.50	−	0.15	0.50	Ω

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.

5. T_{MIN} = −25°C, T_{MAX} = +85°C

TEST CIRCUITS

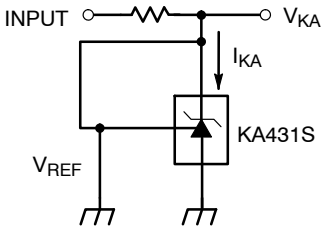


Figure 3. Test Circuit for $V_{KA} = V_{REF}$

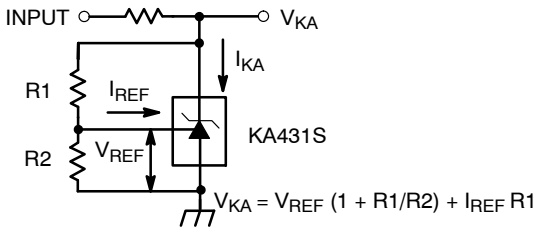


Figure 4. Test Circuit for $V_{KA} \ge V_{REF}$

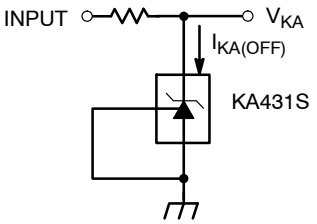


Figure 5. Test Circuit for $I_{KA(OFF)}$

TYPICAL APPLICATIONS

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

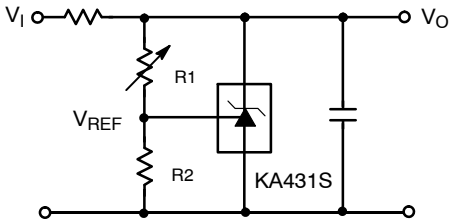


Figure 6. Shunt Regulator

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

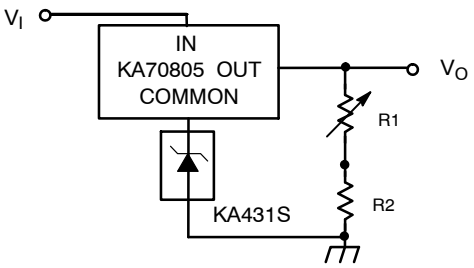


Figure 7. Output Control for Three−Terminal Fixed Regulator

$$V_O = \left(1 + \frac{R_1}{R_2}\right) V_{ref}$$

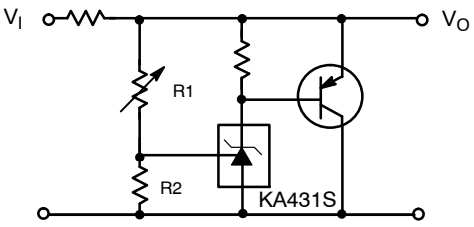


Figure 8. High Current Shunt Regulator

$$I_O = \frac{V_{REF}}{R_{CL}}$$

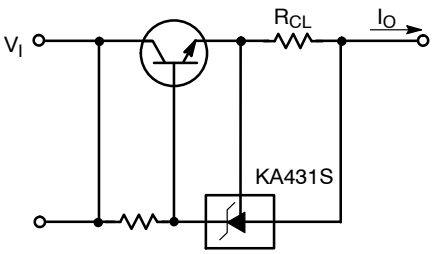


Figure 9. Current limit or Current Source

$$I_O = \frac{V_{REF}}{R_S}$$

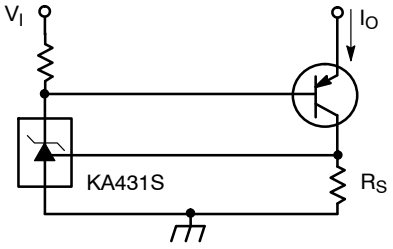


Figure 10. Constant−Current Sink

TYPICAL CHARACTERISTICS

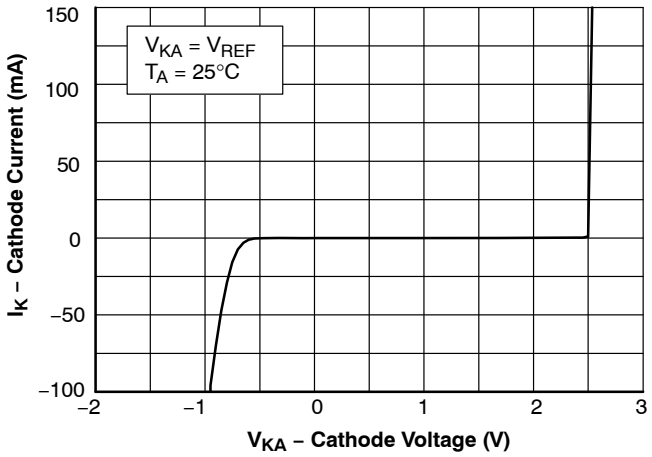


Figure 11. Cathode Current vs. Cathode Voltage

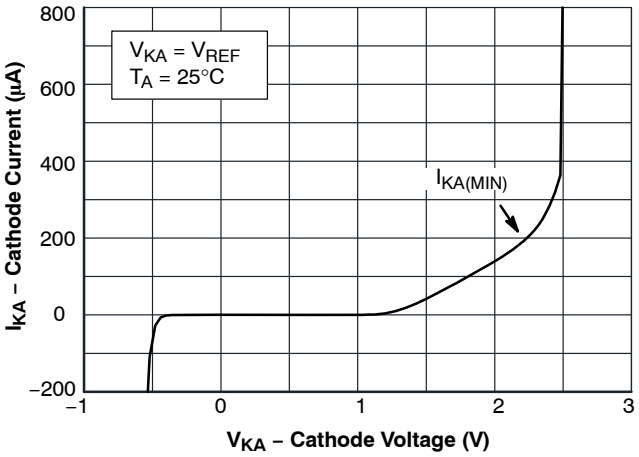


Figure 12. Cathode Current vs. Cathode Voltage

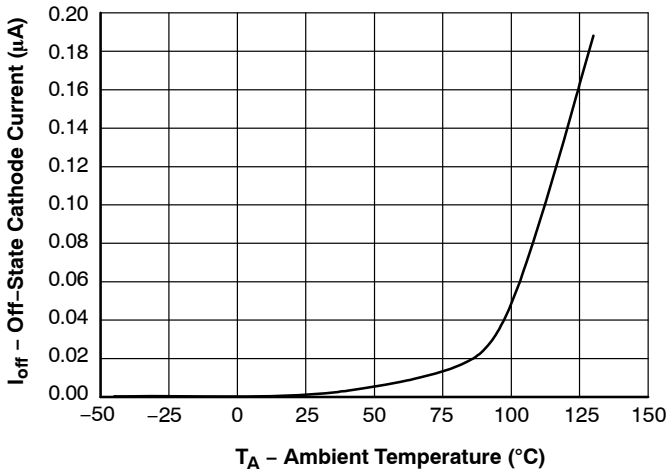


Figure 13. OFF–State Cathode Current vs. Ambient Temperature

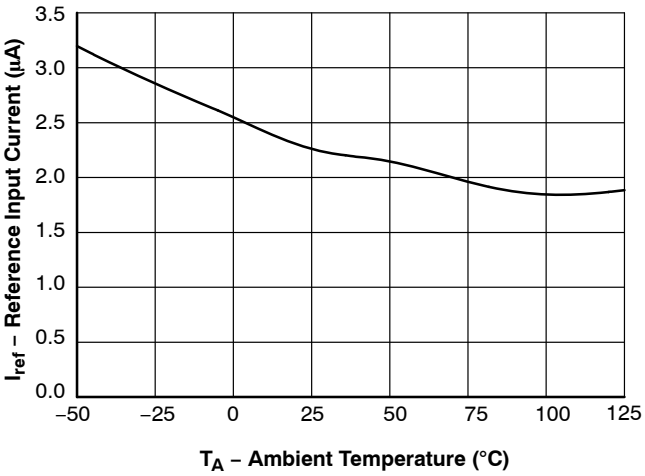


Figure 14. Reference Input Current vs. Ambient Temperature

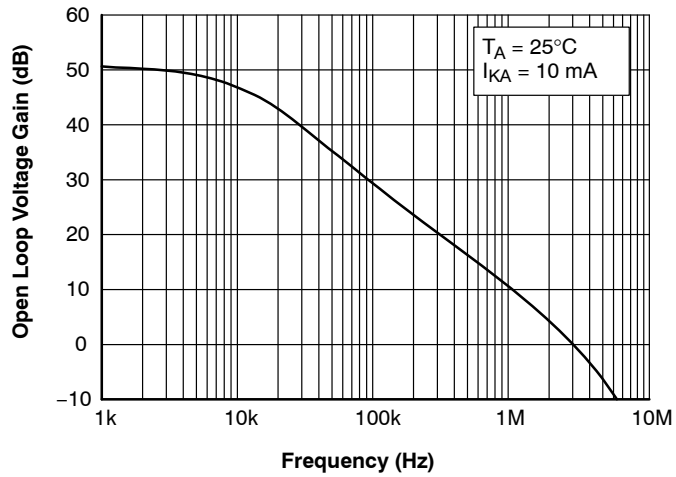


Figure 15. Frequency vs. Small Signal Voltage Amplification

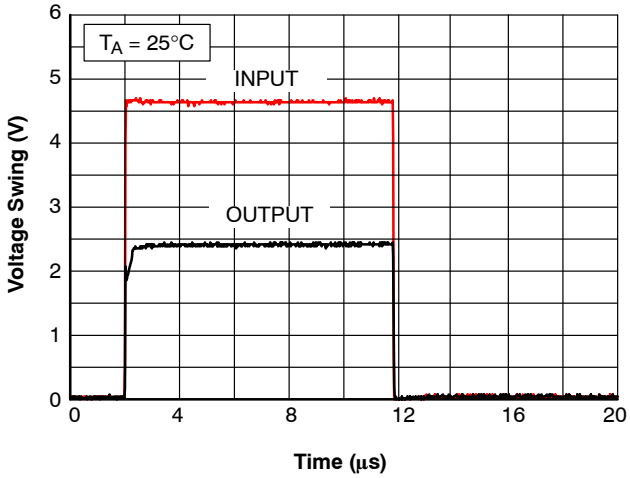


Figure 16. Pulse Response

TYPICAL CHARACTERISTICS (Continued)

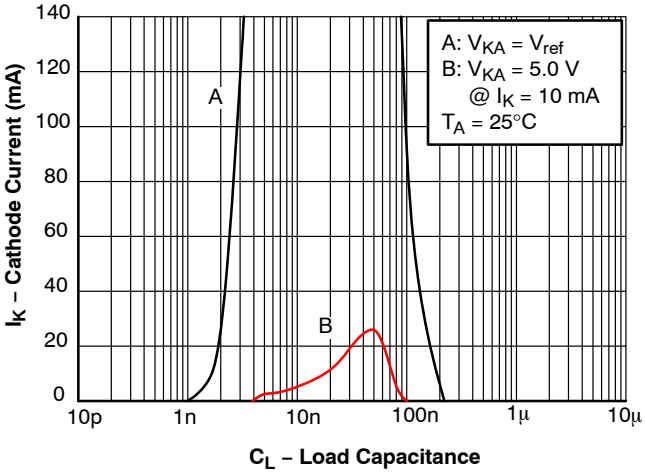


Figure 17. Stability Boundary Conditions

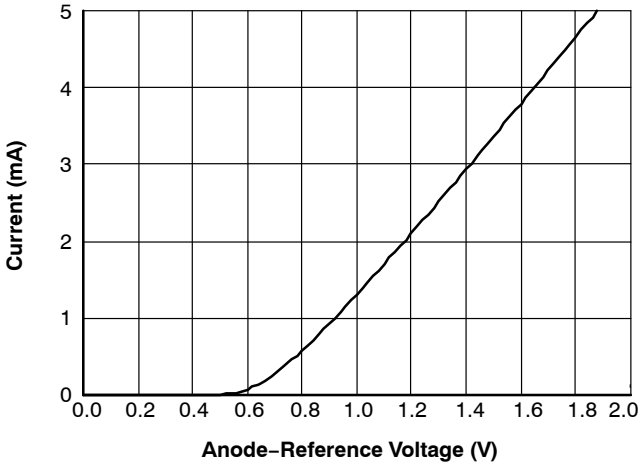


Figure 18. Anode−Reference Diode Curve

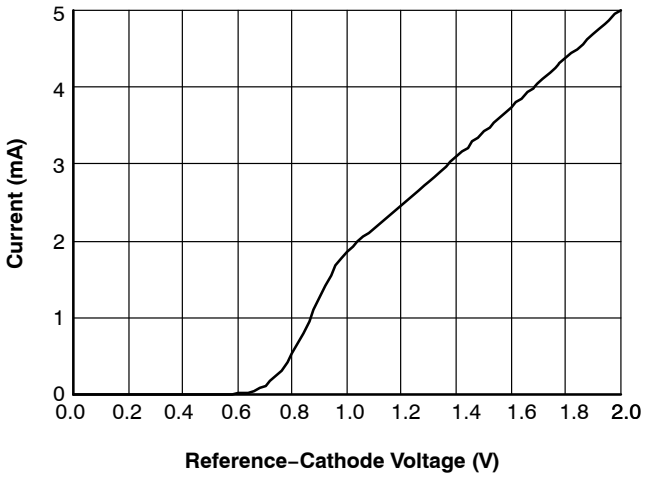


Figure 19. Reference−Cathode Diode Curve

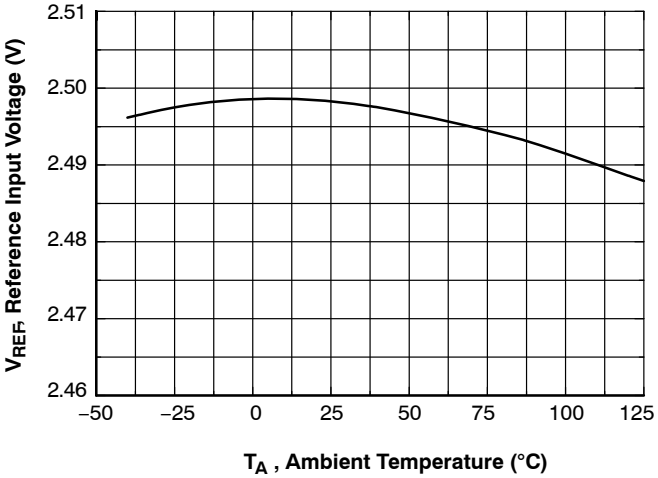


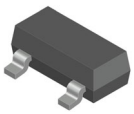
Figure 20. Reference Input Voltage vs. Ambient Temperature

ORDERING INFORMATION

Part Number	Output Voltage Tolerance	Operating Temperature Range	Top Mark	Package	Shipping†
KA431SMFTF	2%	−25 to +85°C	43A	SOT23−FL3L (Pb−Free)	3000 / Tape and Reel
KA431SMF2TF			43D		
KA431SAMFTF	1%		43B		
KA431SAMF2TF			43E		
KA431SLMFTF	0.5%		43C		
KA431SLMF2TF			43F		

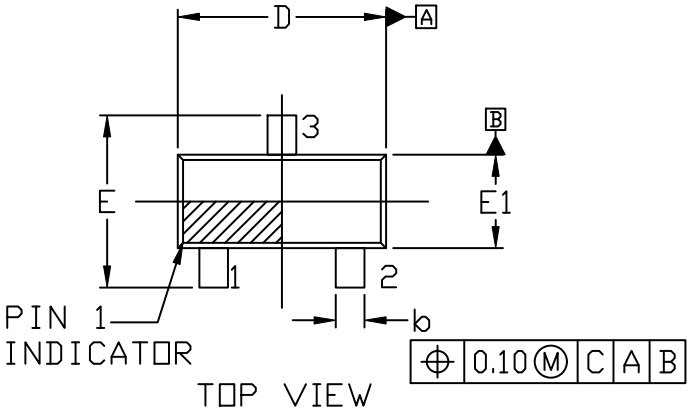
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

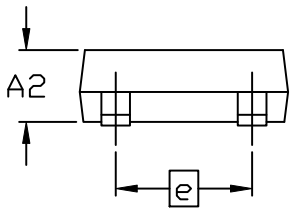
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

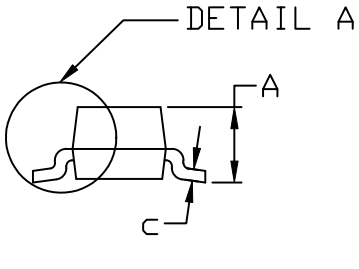


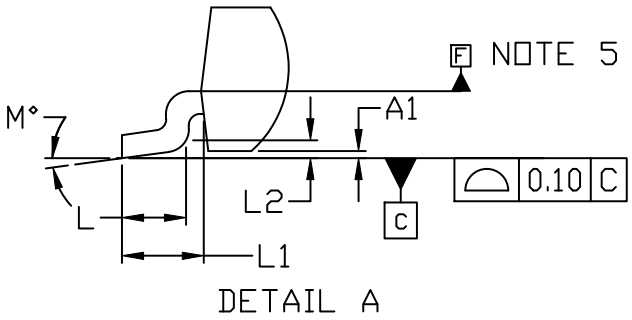
SOT23−3L
CASE 318AB
ISSUE A

DATE 14 DEC 2021



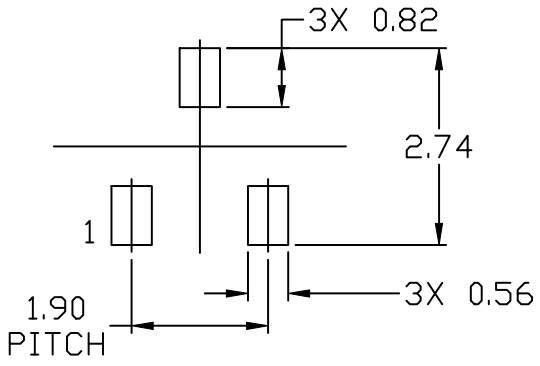






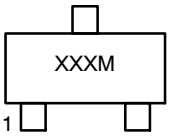
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.127 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM F.
5. DATUMS A AND B ARE TO BE DETERMINED AT DATUM F.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.
7. LEAD THICKNESS (c) AND LEAD WIDTH (b) INCLUDE PLATING THICKNESS.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	1.15
A1	0.00	---	0.10
A2	0.90	1.00	1.10
b	0.30	---	0.50
c	0.127 REF		
D	2.80	2.90	3.00
E	2.25	2.40	2.55
E1	1.20	1.30	1.40
e	1.90 BSC		
L	0.30	---	---
L1	0.55 REF		
L2	0.25 REF		
M	0°	---	8°



* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC
MARKING DIAGRAM*



XXX = Specific Device Code
M = Date Code

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

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DESCRIPTION:	**SOT23−3L**	**PAGE 1 OF 1**

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