Micropower Voltage Reference

FEATURES

- Operating Current from 20μA to 20mA.
- Low Temperature Coefficient.
- 1% and 2% Initial Tolerance.
- Low Dynamic Impedance.

APPLICATIONS

- Portable, Battery-Powered Equipment.
- Instrumentation.
- Process Control.
- Energy Management.
- Product Testing.
- Automotive.
- Precision Audio Components.

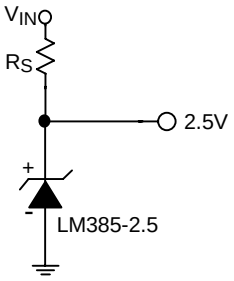
DESCRIPTION

The LM385-2.5 is a micropower 2-terminal bandgap voltage reference, which can operate in a 20μA to 20mA current range, they feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming is used to achieve tight voltage tolerance. Since the LM385-2.5 bandgap reference uses only transistors and resistors, low noise and good long-term stability result.

Careful design of the LM385-2.5 has made the device exceptionally tolerant of capacitive loading, making it easy to use in almost any reference application. The wide dynamic operating range allows for its use with widely varying supplies with excellent regulation.

The extremely low power drain of the LM385-2.5 makes it useful for micropower circuitry. This voltage reference can be used to make portable meters, regulators, or general-purpose analog circuitry with battery life approaching shelf life. Further, the wide operating current allows it to replace older references with a tighter tolerance.

TYPICAL APPLICATION CIRCUIT



Precision 2.500V Voltage Reference

ORDERING INFORMATION

LM385X-2.5XXXX

- PACKING TYPE
  - BG: BAG
  - TB: TUBE (for SOP-8)
  - TR: TAPE & REEL
- PACKAGE TYPE
  - S: SOP-8
  - U: SOT-23
  - X: SOT-89
  - Z: TO-92
- C: COMMERCIAL
  P: LEAD FREE COMMERCIAL
  G:GREEN PACKAGE
- TOLERANCE
  - Default: 2%
  - B: 1%

Example: LM385-2.5PSTR

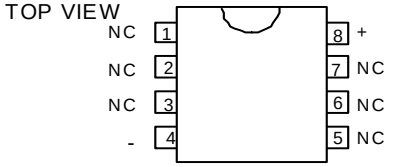
→ 2% version, in Lead Free SOP-8 Package & Taping & Reel Packing Type

LM385-2.5GSTR

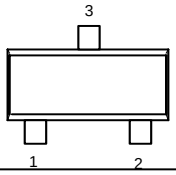
→ 2% version, in SOP-8 Green Package & Taping & Reel Packing Type

PIN CONFIGURATION

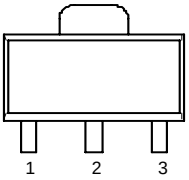
SOP-8
TOP VIEW



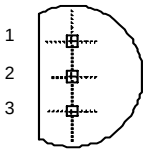
SOT-23
TOP VIEW
1: -
2: NC
3: +



SOT-89
TOP VIEW
1: NC
2: -
3: +



TO-92
TOP VIEW
1: NC
2: +
3: -



- **SOT-23 Marking**

Part No.	Marking	Part No.	Marking	Part No.	Marking
LM385-25CU	AIA2	LM385-25PU	AIA2P	LM385-25GU	AIA2G
LM385B-25CU	AIB2	LM385B-25PU	AIB2P	LM385B-25GU	AIB2G

- **SOT-89 Marking**

Part No.	**Marking**	**Part No.**	**Marking**	**Part No.**	**Marking**
LM385-25CX	AI25	LM385-25PX	AI25P	LM385-25GX	AI25G
LM385B-25CX	AIB25	LM385B-25PX	AI2BP	LM385B-25GX	AI2BG

ABSOLUTE MAXIMUM RATINGS

Reverse Current 30mA

Forward Current 10mA

Operating Temperature Range ..... -40°C to 85°C

Junction Temperature ..... 125°C

Storage Temperature Range ..... -65°C to 150°C

Lead Temperature (soldering, 10s) ..... 260°C

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

TEST CIRCUIT

Refer to TYPICAL APPLICATION CIRCUIT.

ELECTRICAL CHARACTERISTICS (T_A=25°C, unless otherwise specified.) (Note1)

PARAMETER	TEST CONDITIONS		SYMBOL	MIN.	TYP.	MAX.	UNIT
Reverse Breakdown Voltage	I_R=100μA	LM385B-2.5 LM385-2.5	V_R	2.475 2.450	2.500 2.500	2.525 2.550	V
Reverse Breakdown Voltage Change with Current	20μA≤I_R ≤1mA		ΔV_R			2	mV
	1mA≤I_R ≤20mA		ΔV_R			20	mV
Reverse Dynamic Impedance	I_R=100μA, f=20Hz		Z_R		1		Ω
Minimum Operating Current			I_{RMIN}		13	20	μA
Wideband Noise (rms)	I_R=100μA, 10Hz≤ f ≤10KHz		e_N		120		μVrms
Average Temperature Coefficient (Note 2)	I_R=100μA		αV_R		100		ppm/°C
Long Term Stability	I_R=100μA, T=1000Hrs, T_A=25°C		$\Delta V_R / \Delta t$		20		ppm

Note 1: Specifications are production tested at TA=25°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

Note 2: The average temperature coefficient is defined as the maximum deviation of reverse breakdown voltage at all measured temperatures from T_{MIN} to T_{MAX}, divided by T_{MAX} - T_{MIN}. The measured temperatures are 0°C, 25°C, 50°C and 70°C.

TYPICAL PERFORMANCE CHARACTERISTICS

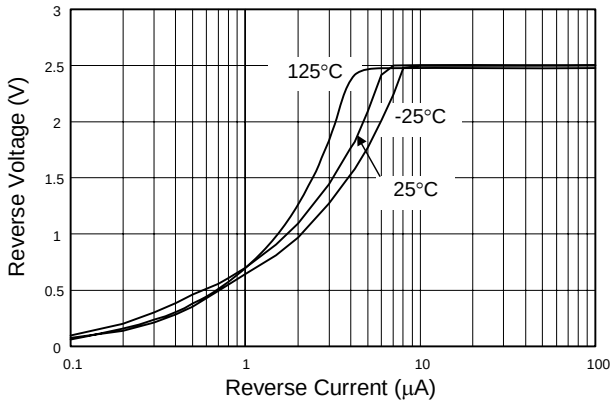


Fig. 1 Reverse Characteristics

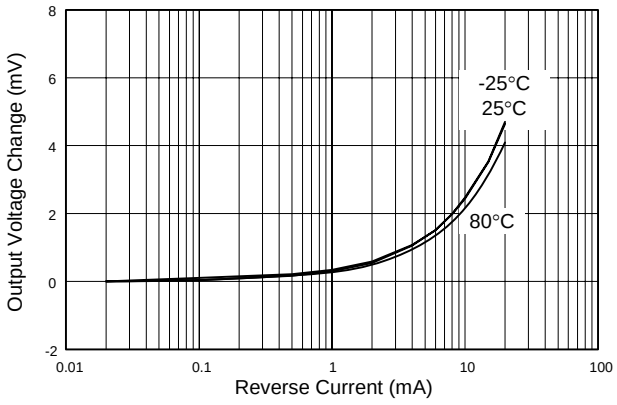


Fig. 2 Reverse Characteristics

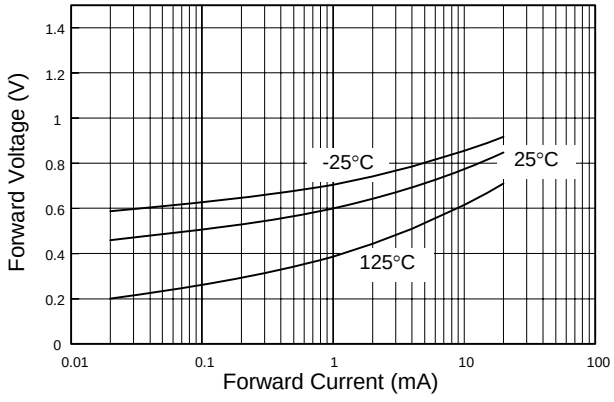


Fig. 3 Forward Characteristics

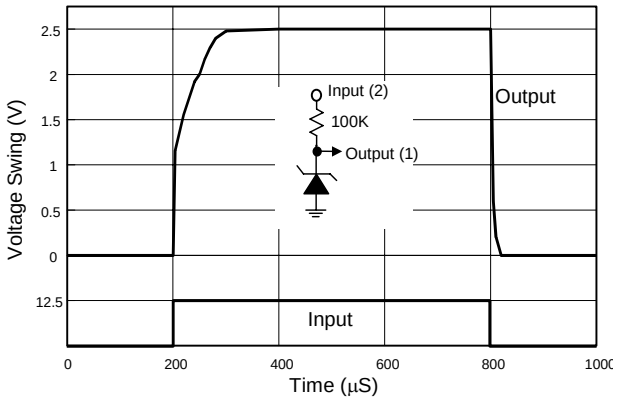


Fig. 4 Response Time

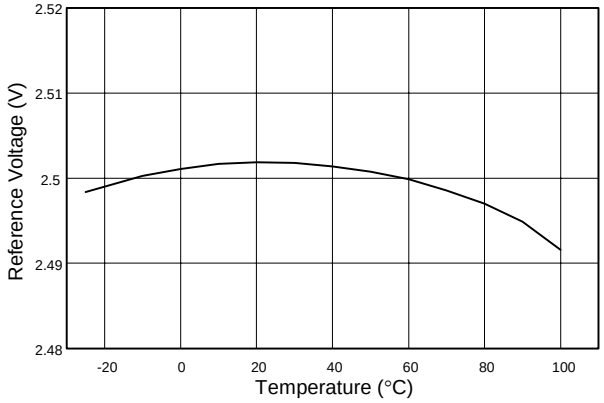


Fig. 5 Temperature Drift

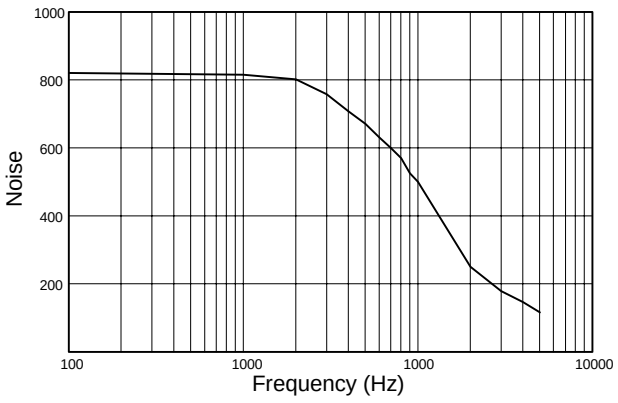
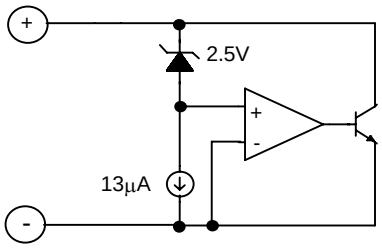


Fig. 6 Noise Voltage ($nV/\sqrt{Hz}$)

BLOCK DIAGRAM



- **SYMBOL**

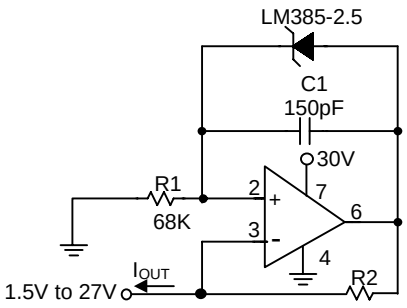
PIN DESCRIPTIONS

PIN + - sinks current with a range from 20μA to 20mA for normal applications. And a stable positive voltage, relative to Pin-, occurs on Pin+.

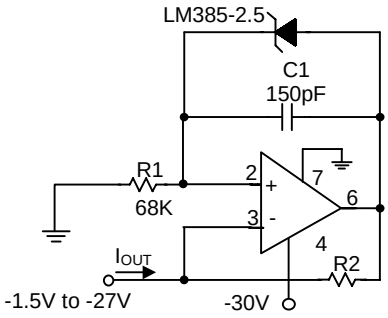
PIN - - Pin- sources current for normal application. The current value is the same as Pin+.

PIN NC - Not connected.

APPLICATION EXAMPLES



$$I_{OUT} = \frac{2.5V}{R2}$$

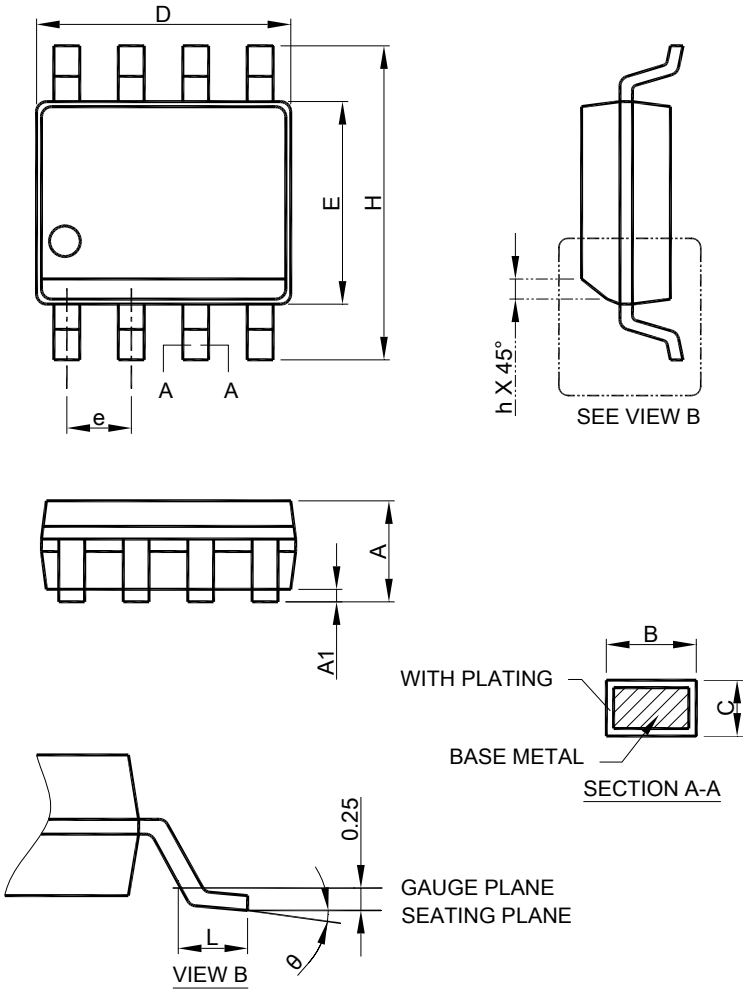


$$I_{OUT} = \frac{2.5V}{R2}$$

Fig. 7 Precision 1μA to 1mA Current Source

PHYSICAL DIMENSIONS (unit: mm)

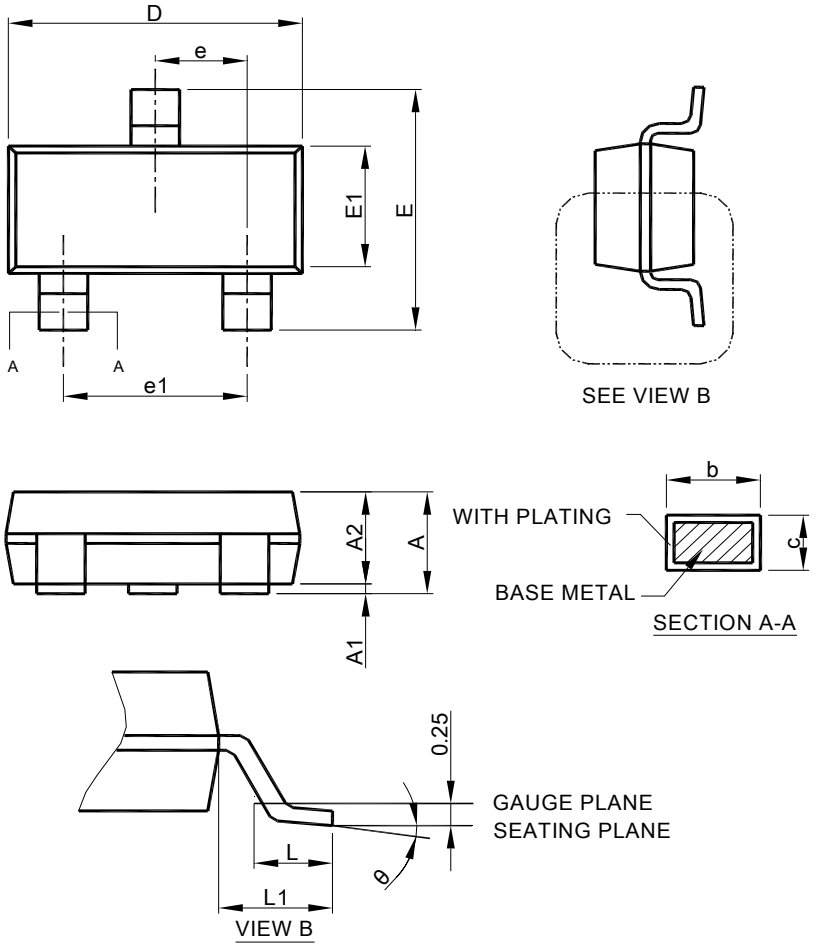
- **SOP-8**



SYMBOL	SOP-8	
	MILLIMETERS	
	MIN.	MAX.
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
θ	0°	8°

Note: 1. Refer to JEDEC MS-012AA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

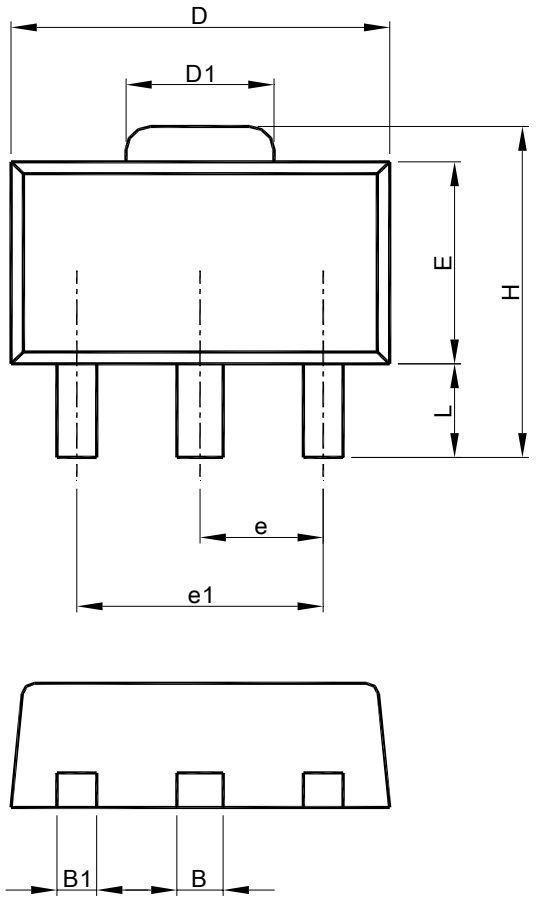
- **SOT-23**

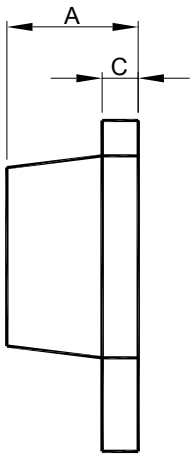


SYMBOL	SOT-23	
	MILLIMETERS	
	MIN.	MAX.
A	0.95	1.45
A1	0.05	0.15
A2	0.90	1.30
b	0.30	0.50
c	0.08	0.22
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.95 BSC	
e1	1.90 BSC	
L	0.30	0.60
L1	0.60 REF	
θ	0°	8°

Note: 1. Refer to JEDEC MO-178.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.
3. Dimension "E1" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

- **SOT-89**

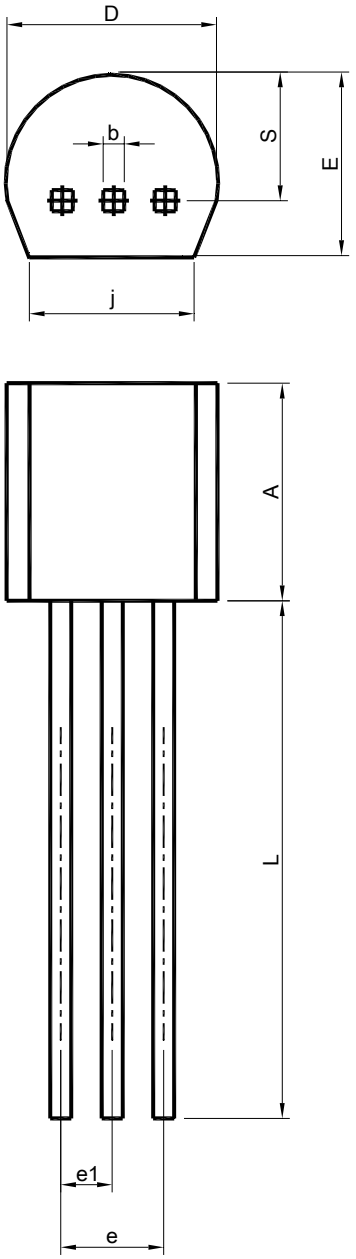




SYMBOL	SOT-89	
	MILLIMETERS	
	MIN.	MAX.
A	1.40	1.60
B	0.44	0.56
B1	0.36	0.48
C	0.35	0.44
D	4.40	4.60
D1	1.50	1.83
E	2.29	2.60
e	1.50 BSC	
e1	3.00 BSC	
H	3.94	4.25
L	0.89	1.20

Note: 1. Refer to JEDEC TO-243AA.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

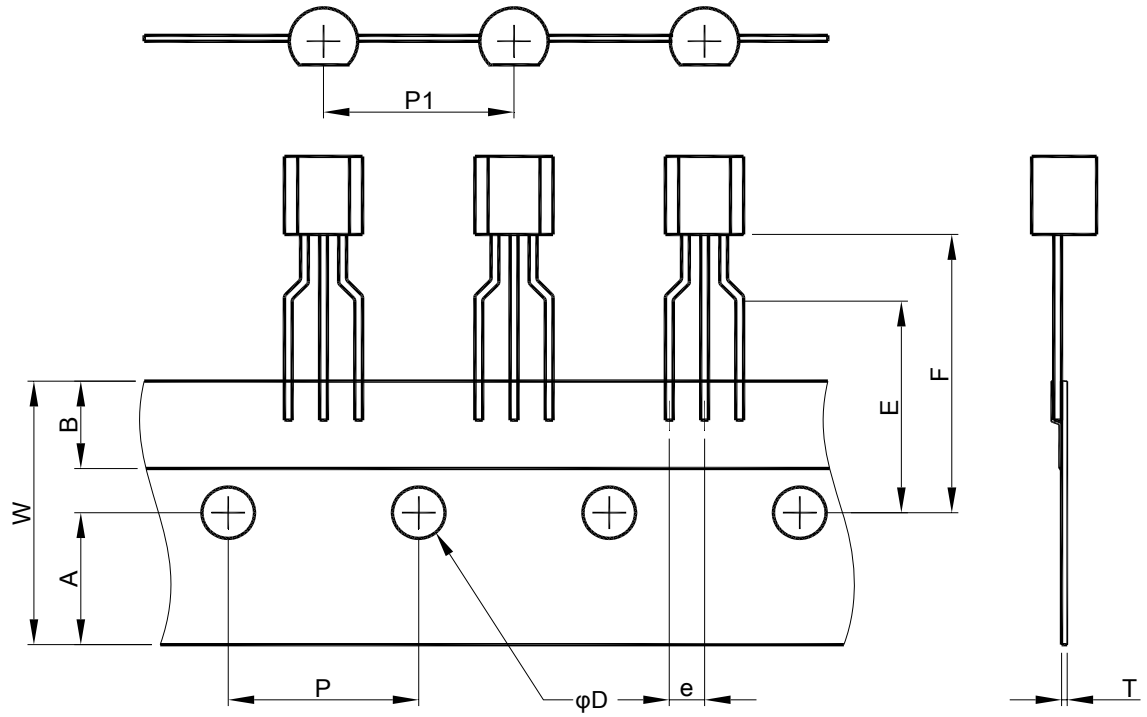
- **TO-92 (BAG)**



SYMBOL	TO-92	
	MILLIMETERS	
	MIN.	MAX.
A	4.32	5.33
b	0.36	0.47
D	4.45	5.20
E	3.18	4.19
e	2.42	2.66
e1	1.15	1.39
j	3.43	
L	12.70	
S	2.03	2.66

Note: 1. Refer to JEDEC TO-226.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "A" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

- **TO-92 (Tape & Reel)**



SYMBOL	W	A	B	E	F
SPEC.	18.0±0.2	9.0±0.2	6.0±0.20	16.0±0.5	19.0±0.5
SYMBOL	P	P1	D	e	T
SPEC.	12.7 BSC	12.7 BSC	4.0±0.2	2.5 BSC	0.6±0.1

Note:

Information provided by AIC is believed to be accurate and reliable. However, we cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in an AIC product; nor for any infringement of patents or other rights of third parties that may result from its use. We reserve the right to change the circuitry and specifications without notice.

Life Support Policy: AIC does not authorize any AIC product for use in life support devices and/or systems. Life support devices or systems are devices or systems which, (I) are intended for surgical implant into the body or (ii) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.