GP431

Precision Adjustable Shunt Voltage Reference

DESCRIPTION

The GP431 is a three-terminal adjustable shunt voltage regulator with specified thermal stability. The output voltage can be adjusted to any value between V_{REF} and 36V by using two external resistors. The GP431 offers low output impedance for improved load regulation with a typical output impedance of 200mΩ. Because of the active output circuitry, the GP431 can replace the zener diodes in applications with improved turn-on characteristics.

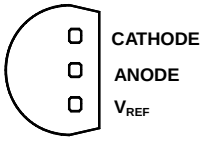
FEATURES

- **Initial voltage reference accuracy of 0.5%, 1.0%, and 1.5%**
- **Sink current capability from 1mA to 100mA**
- **Typical output dynamic impedance less than 200mΩ;**
- Adjustable output voltage from V_{REF} to 36V
- Available in 3L-TO92 and surface mount SOT89, SOT23 and 8 pin SO packages
- Low output noise
- Typical equivalent full range temperature coefficient of 30ppm/°C

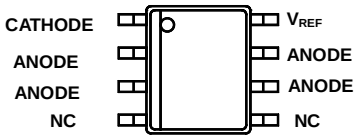
APPLICATIONS

- Voltage Reference
- Precision shunt regulator
- High current shunt regulator
- PWM down converter with reference
- Voltage monitor

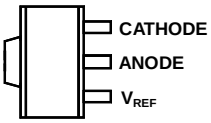
PACKAGE PIN OUT



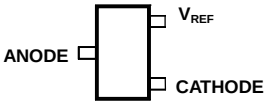
3-Pin Plastic TO-92
(Top View)



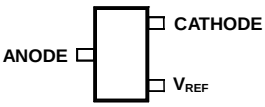
8-Pin Plastic SO
Surface Mount
(Top View)



3-Pin Plastic SOT-89
Surface Mount
(Top View)



(Note 1)
3-Pin Plastic SOT-23
Surface Mount
(Top View)



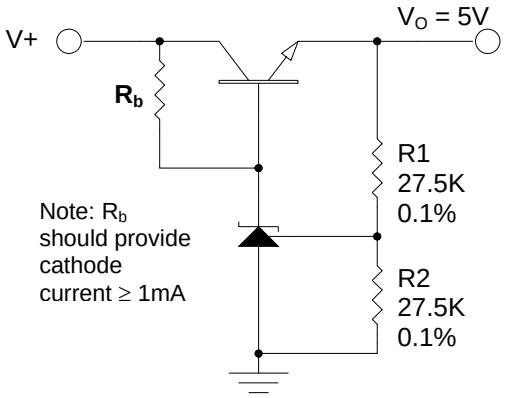
(Note 2)
3-Pin Plastic SOT-23
Surface Mount
(Top View)

ORDER INFORMATION

T_A (°C)	Initial Tolerance	DM SOIC 8-pin	LP TO-92 3-pin	PK SOT-89 3-pin	DB SOT-23 3-pin	DB SOT-23 3-pin
0 to 70	1.5%	--	GP431CLP	--	--	--
	1%	GP431DM	GP431LP	GP431PK	GP431DB	GP431RDB
	0.5%	--	GP431BLP	GP431BPK	GP431BDB	GP431BRDB

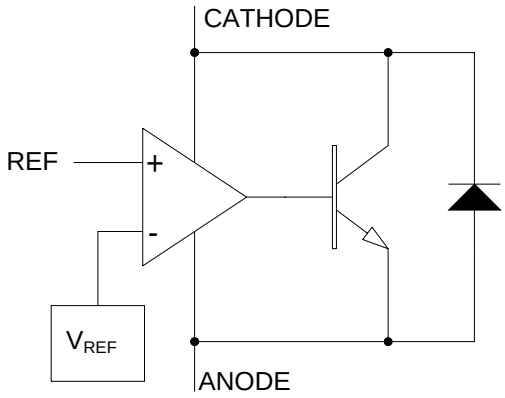
Note: 1. For GP431DB and GP431BDB.
2. For GP431RDB and GP431BRDB.
3. For surface-mount and TO-92 packages in Tape & Reel, add suffix "T" (e.g., GP431LPT, GP431DBT).
4. For TO-92 in Tape & Box (without reel), add suffix "TB" (e.g., GP431LPTB).
5. DB package is only available in Tape & Reel.

TYPICAL APPLICATION



5V Precision Regulator

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Note 1)	
Cathode to Anode Voltage (V_{KA}) (Note 2)	-0.3V to 37V
Continuous Cathode Current (I_K)	-100mA to 150mA
Reference Input Current (I_{REF})	-50uA to 10mA
Maximum junction temperature range, T_J	150°C
Storage temperature range	-65°C to 150°C
Lead temperature (soldiering, 10 seconds)	260°C

Note 1: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.

Note 2: Voltage values are with respect to the anode terminal unless otherwise noted.

POWER DISSIPATION TABLE

Package	θ_{JA} (°C /W)	Derating factor D_F(mW/°C) $T_A \geq 25$°C	$T_A \leq 25$°C Power rating(mW)	T_A=70°C Power rating(mW)	T_A= 85°C Power rating (mW)
DM	165	6.06	757	485	394
LP	156	6.41	801	513	417
PK	71(note)	14.1	1763	1128	916
DB	285	3.5	438	280	228

Note :

1. For PK package, Thermal Resistance-Junction to Tab (θ_{JT}) = 35°C /W. $T_J = T_{TAB} + (P_D \times \theta_{JT})$. P_D: Power Dissipation.
2. θ_{JA}: Thermal Resistance-Junction to Ambient, $D_F = 1/\theta_{JA}$
   Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
   The θ_{JA} numbers are guidelines for the thermal performance of the device/PC-board system.
   All of the above assume no ambient airflow.

RECOMMENDED OPERATING CONDITIONS	Min	Max	Units
Operating free air temperature range, T_A	0	70	°C
Cathode current, I_K	1	100	mA
Cathode voltage, V_{KA}	0	36	V

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, these specifications apply over the operating ambient temperatures with T_A =

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Reference Input Voltage	V_{REF}	I_K = 10mA, V_{KA} = V_{REF}, note 1	2.475	2.500	2.525	V
Reference Input Voltage	V_{REF}	I_K = 10mA, V_{KA} = V_{REF}, note 2	2.462	2.500	2.538	V
Reference Input Voltage	V_{REF}	I_K = 10mA, V_{KA} = V_{REF}, note 3	2.487	2.500	2.513	V
Reference Drift		I_K = 10mA, V_{KA} = V_{REF}, 0°C ≤ T_A ≤ 70°C		4	17	mV
Voltage Ratio, Ref to Cathode (note 4)		I_K = 10mA, V_{KA} = 2.5V to 36V		-1.4	-2.7	mV/V
Reference Input Current	I_{REF}	I_K = 10mA,V_{KA} = V_{REF}			2.3	µA
		I_K = 10mA,V_{KA} = V_{REF}, 0°C ≤ T_A ≤ 70°C		2	4	
Minimum Operating Current	I_{MIN}	V_{KA} = V_{REF}		0.4	1	mA
Off-State Cathode Current	I_{OFF}	V_{KA} = 36V, V_{REF} = 0V		0.1	1	µA
Dynamic Impedance	$\|Z_{KA}\|$	V_{KA} = V_{REF}, I_K = 1mA to 100mA, f ≤ 1kHz		0.2	0.5	Ω

Note 1: For GP431 only. The output accuracy is 1.0%.

Note 2: For GP431B only. The output accuracy is 0.5%.

Note 3: For GP431C only. The output accuracy is 1.5%.

Note 4: $\frac{\triangle V_{REF}}{\triangle V_{KA}}$ Ratio of change in reference input voltage to the change in cathode voltage

PARAMETER MEASUREMENT INFORMATION

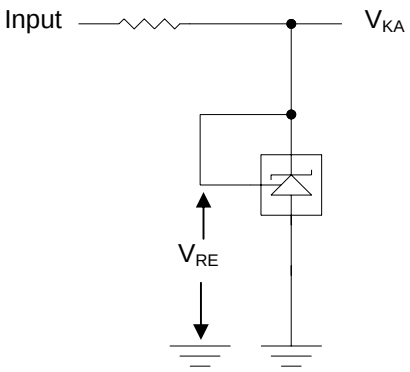


Figure 1. Test Circuit for $V_{KA} = V_{REF}$

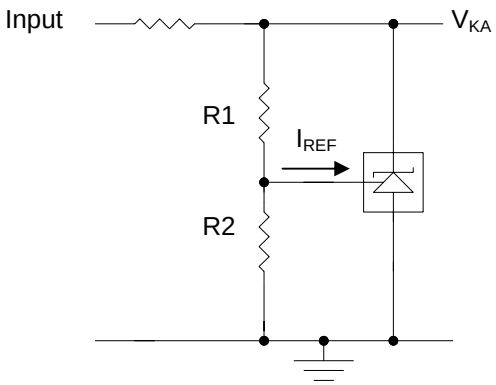


Figure 2. Test Circuit for $V_{KA} > V_{REF}$

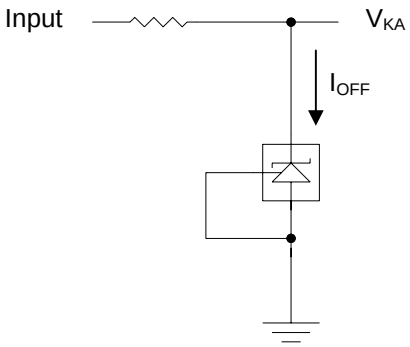
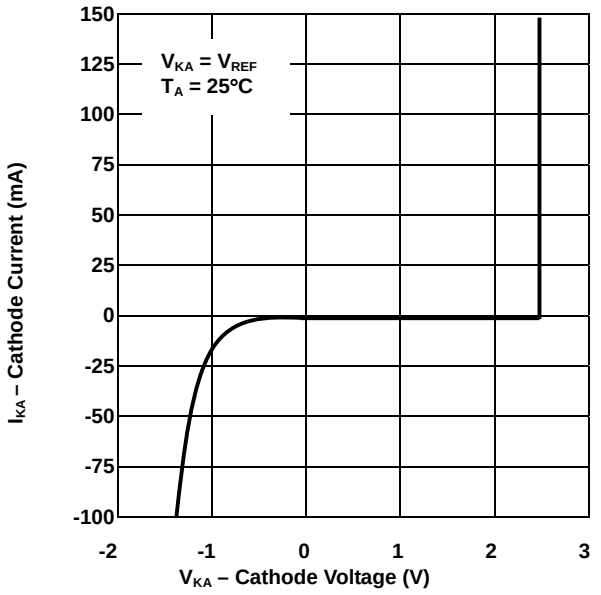


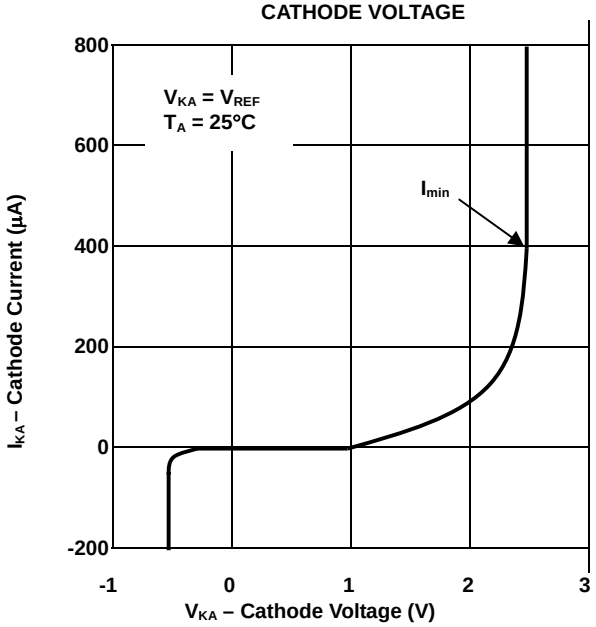
Figure 3. Test Circuit for I_{OFF}

CHARACTERIZATION CURVES

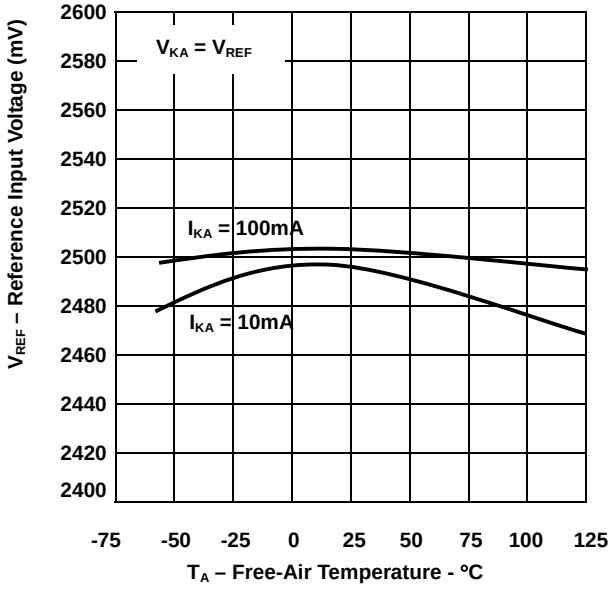
CATHODE CURRENT
vs
CATHODE VOLTAGE



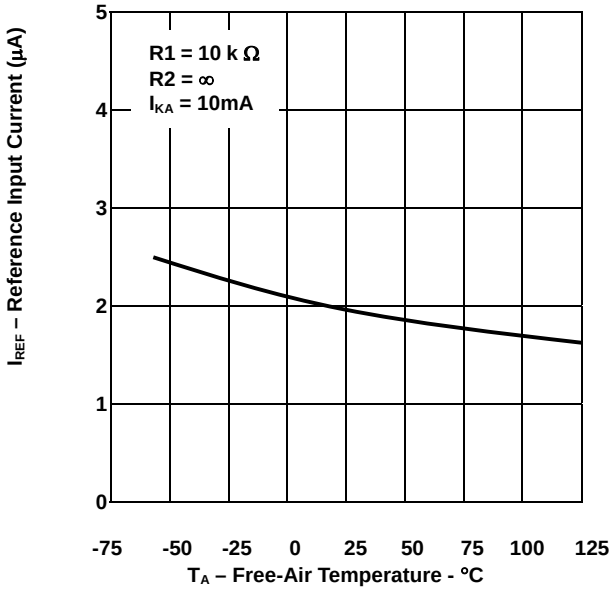
CATHODE CURRENT
vs
CATHODE VOLTAGE



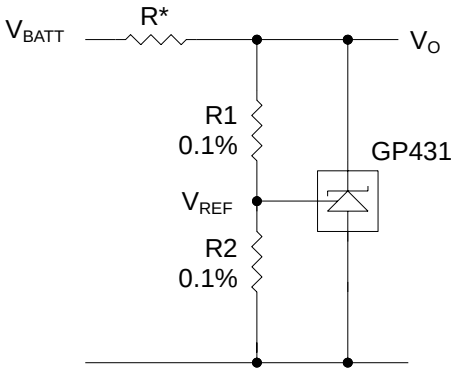
REFERENCE INPUT VOLTAGE
vs
FREE-AIR TEMPERATURE



REFERENCE INPUT CURRENT
vs
FREE-AIR TEMPERATURE



APPLICATION INFORMATION



$$V_O = (1 + R1/R2) \times V_{REF}$$

Note: R should provide 1mA cathode current to the GP431 of minimum V_{BATT}

Figure 4. Shunt Regulator

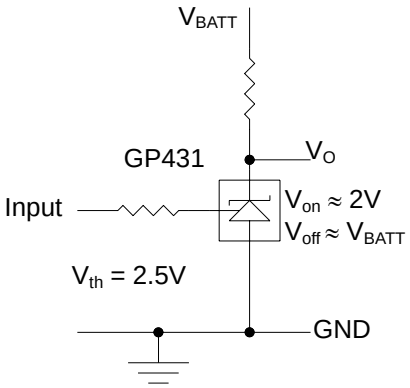
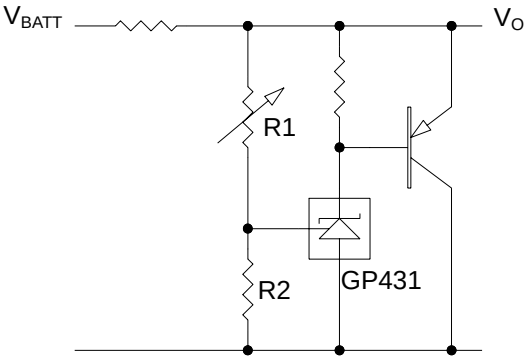


Figure 5. Single –Supply Comparator With Temperature compensated threshold.



$$V_O = (1 + R1/R2) \times V_{REF}$$

Figure 6. High-Current Shunt Regulator

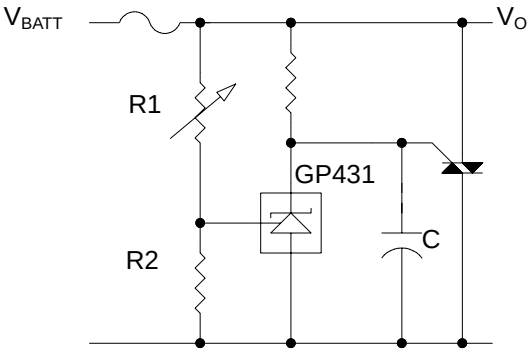


Figure 7. Crowbar Circuit

APPLICATION INFORMATION

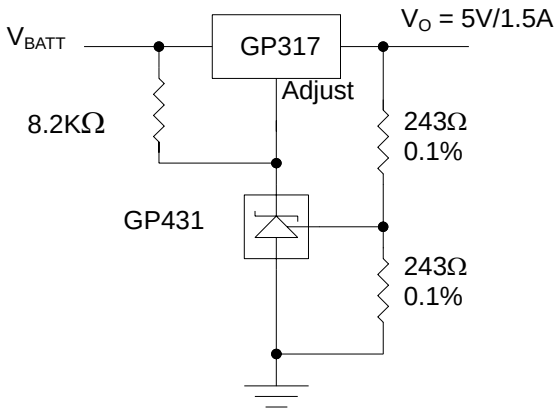


Figure 8. Precision 5V, 1.5A Regulator

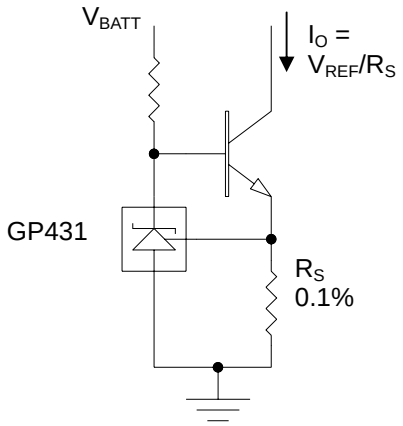
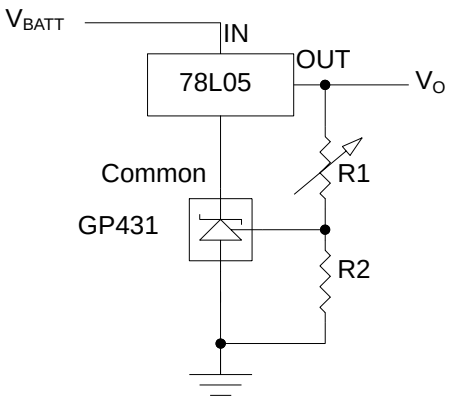


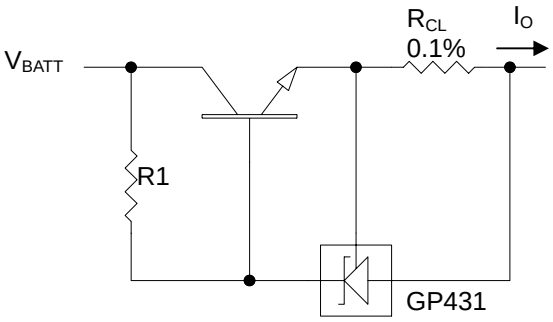
Figure 9. Precision Constant Current Sink



$V_O = (1 + R1/R2) \times V_{REF}$

Min $V_O = V_{REF} + 5V$

Figure 10. Output Control of a Three-Terminal Fixed Regulator

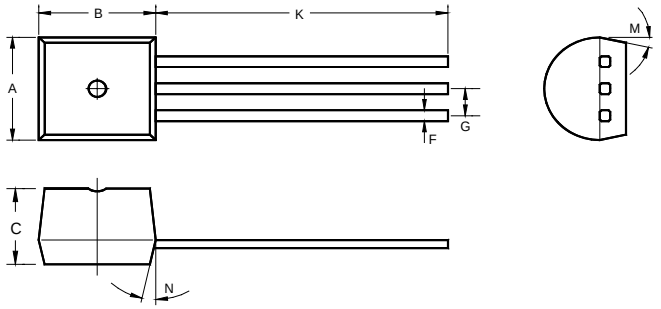


$I_{OUT} = (V_{REF}/R_{CL}) + I_{KA}$

$R1 = V_{BATT}/((I_O/h_{FE}) + I_{KA})$

Figure 11. Precision Current Limiter

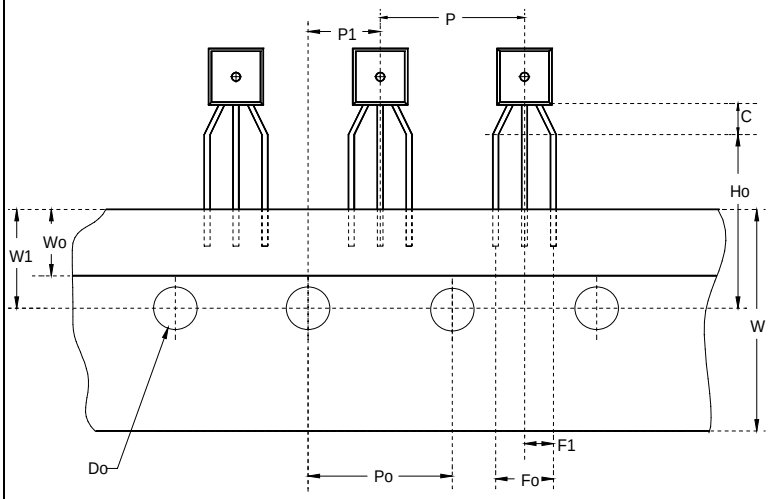
3-Pin Plastic TO-92



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.175	0.180	0.205	4.45	4.57	5.21
B	0.170	0.180	0.210	4.32	4.57	5.33
C	0.125	0.142	0.165	3.18	3.62	4.19
F	-	0.015	-	-	0.38	-
G	-	0.050	-	-	1.27	-
J	-	0.150	-	-	3.81	-
K	0.500	0.580	-	12.70	14.73	-
M	-	5º	-	-	5º	-
N	-	5º	-	-	5º	-

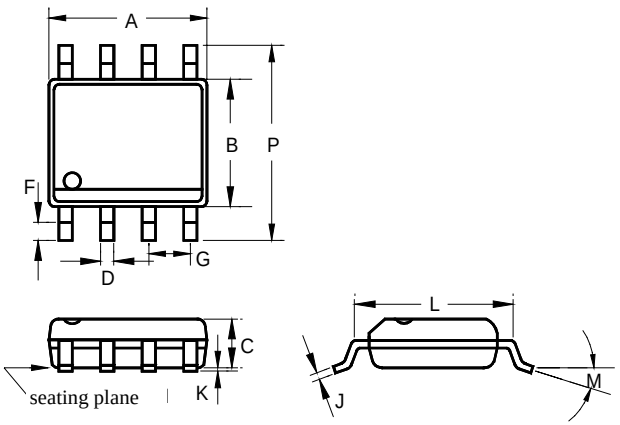
Note: For TO-92 in taping, refer to TO-92 package and taping dimension data for lead dimensions.

3-Pin Plastic TO-92 Package and Taping Dimensions



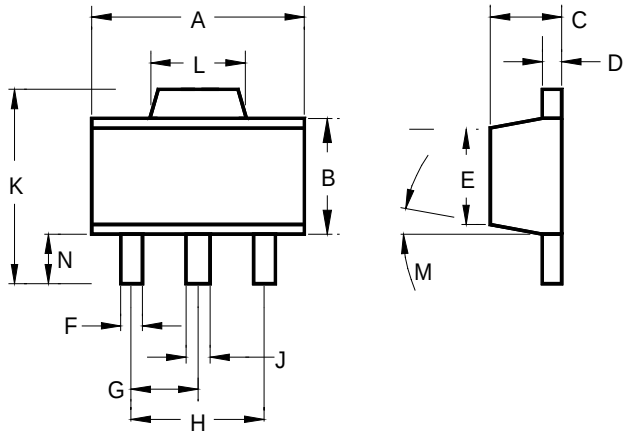
	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
C	0.079	-	-	2.00	-	-
P	0.480	0.500	0.520	12.2	12.7	13.2
Po	0.488	0.500	0.512	12.4	12.7	13.0
Do	0.150	0.157	0.165	3.8	4.0	4.2
P1	0.230	0.250	0.256	5.85	6.35	6.85
Fo	0.165	0.197	0.220	4.2	5.0	5.6
W	0.669	0.709	0.748	17.0	18.0	19.0
Ho	0.610	0.630	0.649	15.5	16.0	16.5
Wo	0.224	0.236	0.248	5.7	6.0	6.3
W1	0.335	0.354	0.374	8.5	9.0	9.5

8-Pin Plastic SO



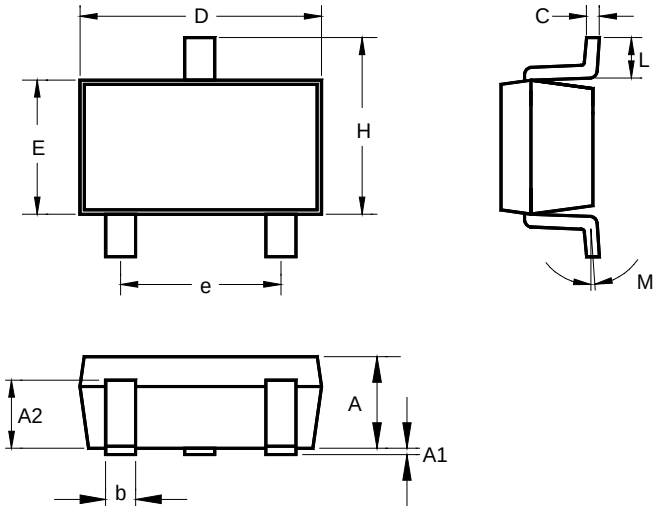
	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.183	-	0.202	4.65	-	5.13
B	0.144	-	0.163	3.66	-	4.14
C	0.068	-	0.074	1.35	-	1.88
D	0.010	-	0.020	0.25	-	0.51
F	0.015	-	0.035	0.38	-	0.89
G	0.050 BSC			1.27 BSC		
J	0.007	-	0.010	0.19	-	0.25
K	0.005	-	0.010	0.13	-	0.25
L	0.189	-	0.205	4.80	-	5.21
M	-	-	8º	-	-	8º
P	0.228	-	0.244	5.79	-	6.20

3-Pin Surface Mount SOT- 89



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.173	-	0.181	4.39	-	4.59
B	0.090	-	0.102	2.28	-	2.59
C	0.055	-	0.063	1.39	-	1.60
D	0.015	-	0.017	0.38	-	0.43
E	0.084	-	0.090	2.13	-	2.28
F	0.016	-	0.019	0.33	-	0.48
G	0.059 BSC			1.49 BSC		
H	0.118 BSC			2.99 BSC		
J	0.018	-	0.022	0.45	-	0.55
K	0.155	-	0.167	3.94	-	4.24
L	0.067	-	0.072	1.70	-	1.82
M	0°	-	8°	0°	-	8°
N	0.035	-	0.047	0.89	-	1.19

Surface Mount SOT-23



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.039	0.043	0.051	1.00	1.10	1.30
A1	0.000	-	0.004	0.00	-	0.10
A2	0.028	0.032	0.035	0.70	0.80	0.90
b	0.014	0.016	0.020	0.35	0.40	0.50
C	0.004	0.005	0.010	0.10	0.15	0.25
D	0.106	0.114	0.122	2.70	2.90	3.10
E	0.055	0.063	0.071	1.40	1.60	1.80
e	0.075 TYP.			1.90 TYP.		
H	0.102	0.110	0.118	2.60	2.80	3.00
L	0.015	-	-	0.37	-	-
M	1°	5°	9°	1°	5°	9°

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