

### GENERAL DESCRIPTION

The CM431L is a low voltage three terminal adjustable shunt regulator with thermal stability guaranteed over temperature. The output voltage can be adjusted to any value from 1.24V ( $V_{REF}$ ) to 20V with two external resistors. The CM431L has a typical dynamic output impedance of  $0.25\Omega$ . Active output circuitry provides a very sharp turn on characteristic, making the CM431L an excellent replacement for zener diodes.

The CM431L shunt regulator is available in four voltage tolerances (0.5%, 0.7%, 1.0% and 2.0%) and four package options (SOT-23-3, SOT-23-5, SOT-89, TO-92, and SOP-8). Four voltage tolerances allow the designer the opportunity to select the proper cost/tolerance for their application.

### FEATURES

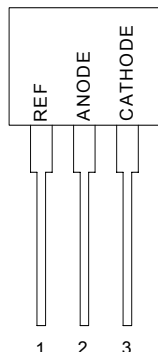
- ◆ LOW voltage operation (1.24V)
- ◆ Adjustable output voltage  $V_O = V_{REF}$  to 20V
- ◆ Wide operating current range  $60\mu A$  to 100mA
- ◆ LOW dynamic output impedance  $0.25\Omega$  typ.
- ◆ Trimmed bandgap design  $\pm 0.5\%$

### APPLICATIONS

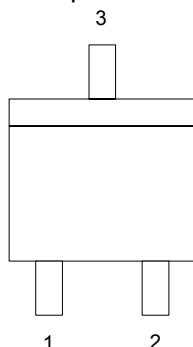
- ◆ Linear Regulators
- ◆ Adjustable Supplies
- ◆ Switching Power Supplies
- ◆ Battery Operated Computers
- ◆ Instrumentation
- ◆ Computer Disk Drivers

### PIN CONFIGURATION

TO-92  
Front View



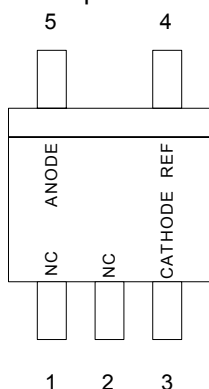
SOT-23-3  
Top View



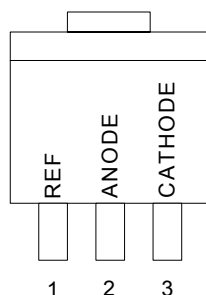
	CM431LXCM233	CM431LXCM2R3
Pin 1	REF	CATHODE
Pin 2	CATHODE	REF
Pin 3	ANODE	ANODE

Suffix "X": Grade "A", "B", "C", or "D"

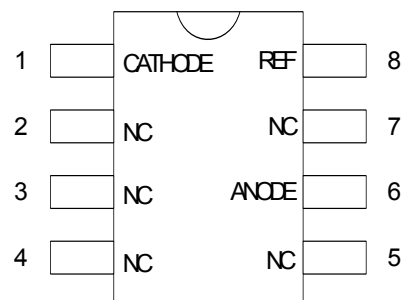
SOT-23-5  
Top View



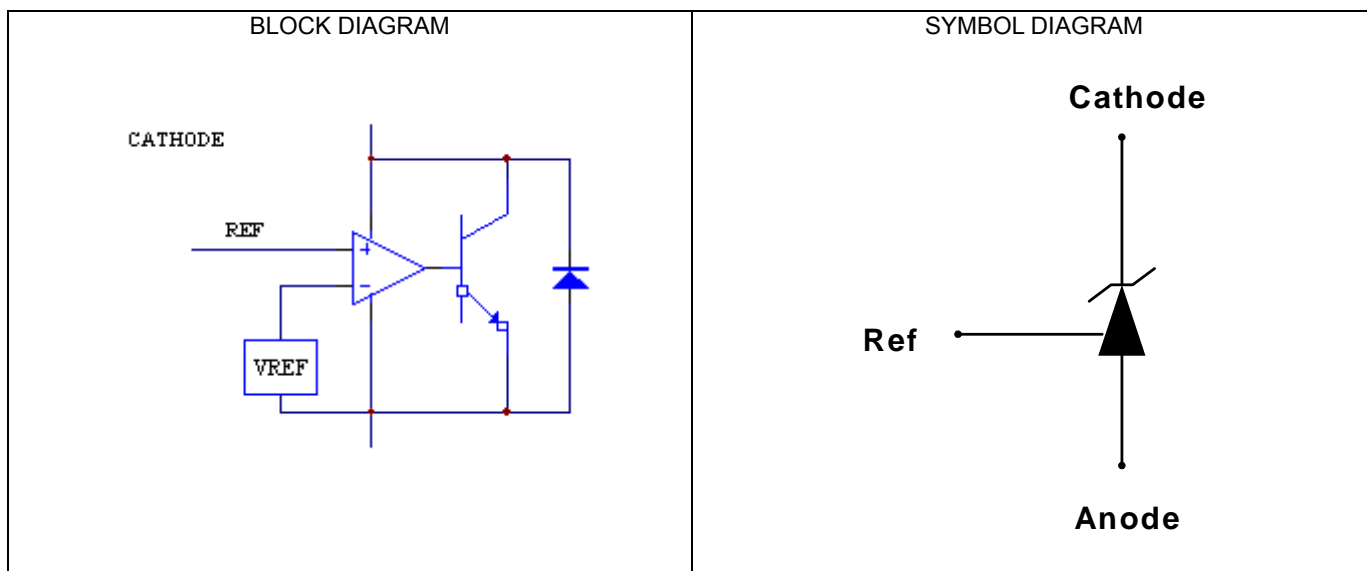
SOT-89  
Top View



SOP-8  
Top View



### BLOCK DIAGRAM



### ORDERING INFORMATION

PACKAGE	TOLERANCE				
	0.5%	0.7%	1.0%	2.0%	T/R Quantity
SOT-23-3 <sup>(1)</sup>	CM431LACM233	CM431LDCM233	CM431LBCM233	CM431LCCM233	TR=3K
SOT-23-3 <sup>(1)</sup>	CM431LACM2R3	CM431LDCM2R3	CM431LBCM2R3	CM431LCCM2R3	TR=3K
SOT-23-5 <sup>(1)</sup>	CM431LACM235	CM431LDCM235	CM431LBCM235	CM431LCCM235	TR=3K
SOT-89 <sup>(1)</sup>	CM431LACM89	CM431LDCM89	CM431LBCM89	CM431LCCM89	TR=1K
TO-92 <sup>(2)</sup>	CM431LACN	CM431LDCN	CM431LBCN	CM431LCCN	TA=2K
SOP-8	CM431LACS	CM431LDCS	CM431LBCS	CM431LCCS	
SOT-23-3 <sup>(1)</sup>	CM431LGACM233*	CM431LGDCM233*	CM431LGBCM233*	CM431LGCCM233*	TR=3K
SOT-23-3 <sup>(1)</sup>	CM431LGACM2R3*	CM431LGDCM2R3*	CM431LGBCM2R3*	CM431LGCCM2R3*	TR=3K
SOT-23-5 <sup>(1)</sup>	CM431LGACM235*	CM431LGDCM235*	CM431LGBCM235*	CM431LGCCM235*	TR=3K
SOT-89 <sup>(1)</sup>	CM431LGACM89*	CM431LGDCM89*	CM431LGBCM89*	CM431LGCCM89*	TR=1K
TO-92 <sup>(2)</sup>	CM431LGACN*	CM431LGDCN*	CM431LGBCN*	CM431LGCCN*	TA=2K
SOP-8	CM431LGACS*	CM431LGDCS*	CM431LGBCS*	CM431LGCCS*	

Notes :

- (1) Add suffix "TR" for Tape & Reel.
- (2) Add suffix "TA" for Tape Ammo.
- (3) **\*Note:** Add suffix "G" for Pb Free Product

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Maximum	Units
Cathode Voltage	$V_Z$	20	V
Continuous Cathode Current	$I_Z$	100	mA
Reference Current	$I_{REF}$	3	mA
Operating Junction Temperature Range	$T_J$	-40 to +150	°C
Storage Temperature Range	$T_{STG}$	-65 to + 150	°C
Thermal Resistance	$\theta_{JA}$		°C/W
TO-92		160	
SOT-23-3		410	
SOT-23-5		256	
SOT-89		110	
SOP-8		175	
Power Dissipation at $T_A = 25^\circ\text{C}$	$P_D$		W
TO-92		0.78	
SOT-23-3		0.30	
SOT-23-5		0.30	
SOT-89		1.00	
SOP-8		0.71	
Lead Temperature ( Soldering ) 10 seconds	$T_{LEAD}$	250	°C

**RECOMMENDED OPERATING CONDITION**

	Min	Max	Symbol
Cathode Voltage. $V_Z$	$V_{REF}$	16	V
Cathode Current. $I_Z$	80	100	mA
Operating Temperature	0	105	°C

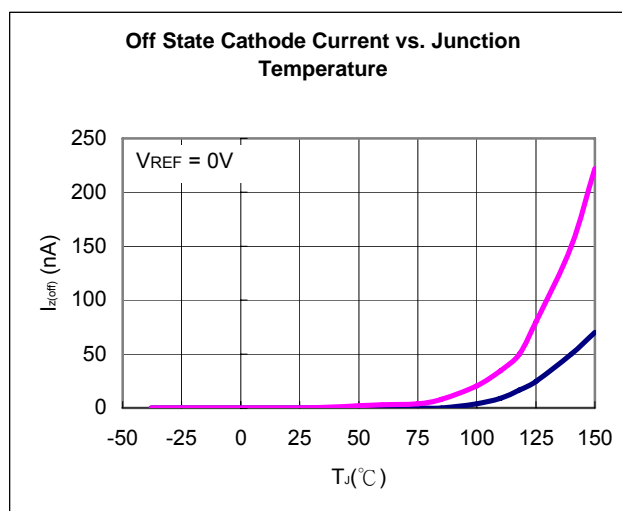
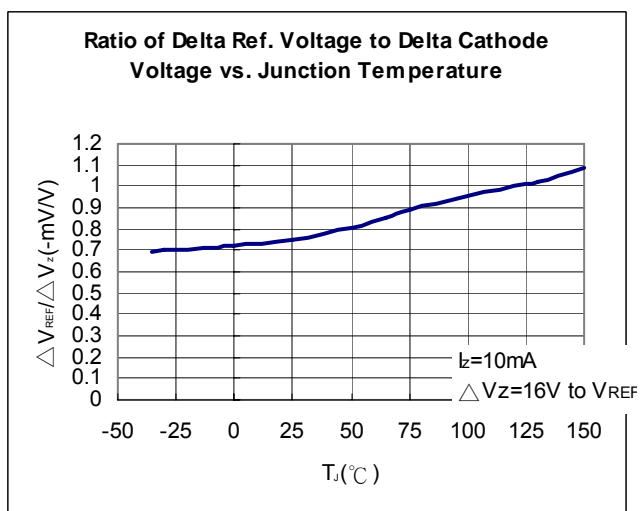
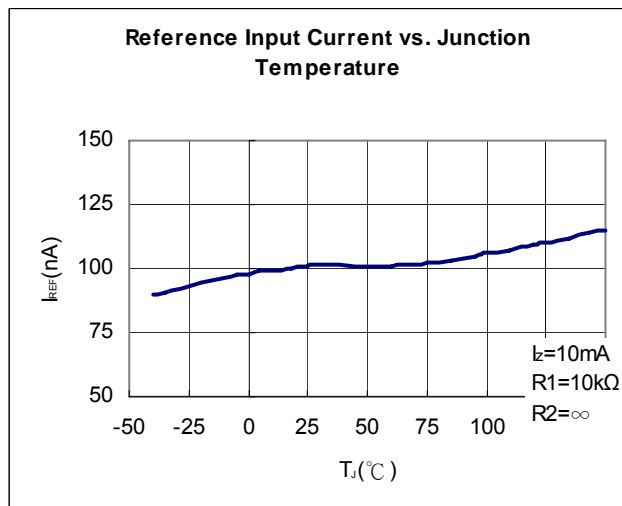
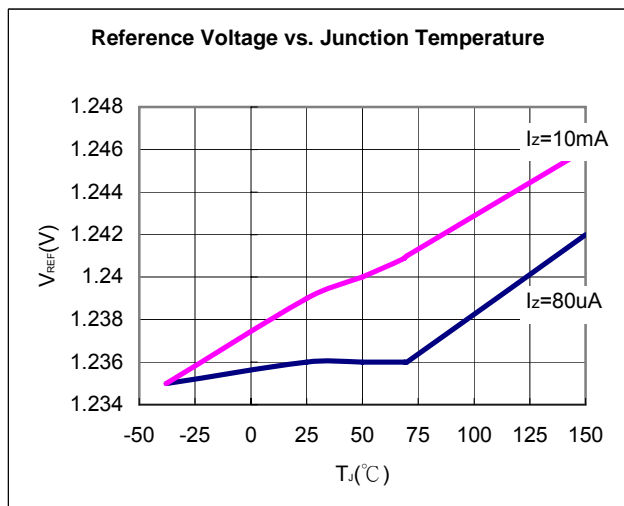
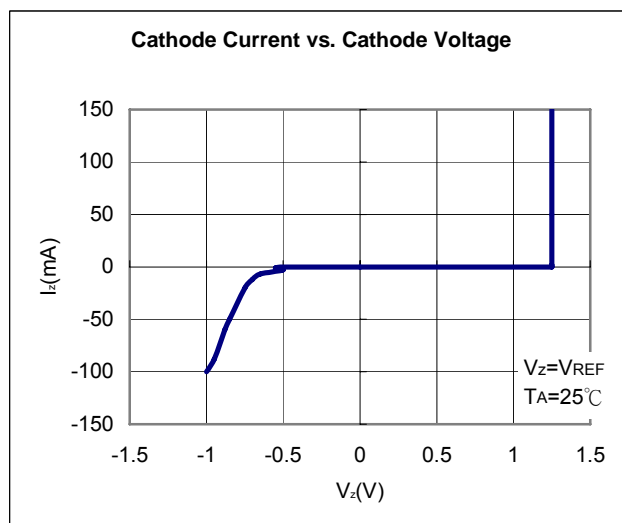
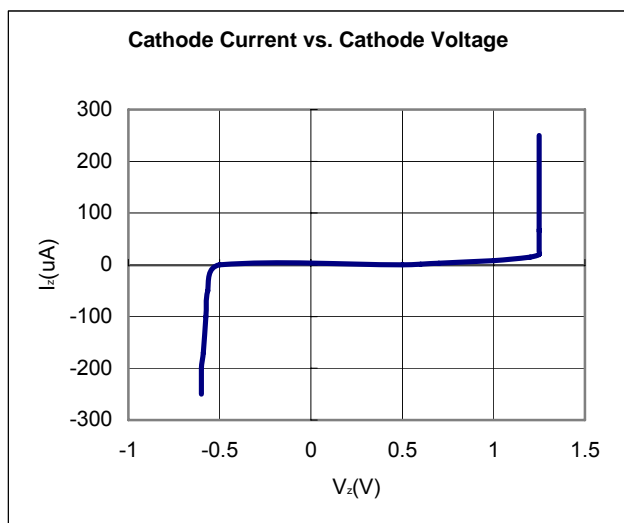
**ELECTRICAL CHARACTERISTICS** Unless specified,  $T_A = 25^\circ\text{C}$ 

Parameter	Symbol	Condition		CM431L 0.5%			CM431L 0.7%			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
Reference Voltage	$V_{\text{REF}}$	$V_Z = V_{\text{REF}}, I_Z = 10\text{mA}$	$T_A = 25^\circ\text{C}$	1.234	1.240	1.246	1.231	1.240	1.249	V
			$T_A = -40 \text{ to } +85^\circ\text{C}$	1.222		1.258	1.222		1.258	
$V_{\text{REF}}$ Temp Deviation	$V_{\text{DEV}}$	$T_A = -40 \text{ to } +85^\circ\text{C}, V_Z = V_{\text{REF}}, I_Z = 10\text{mA}$			10	25		10	25	mV
Ratio of Change in $V_{\text{REF}}$ to Change in Cathode Voltage	$\frac{\Delta V_{\text{REF}}}{\Delta V_Z}$	$I_Z = 10\text{mA}, \Delta V_Z = 16\text{V to } V_{\text{REF}}$			-1.0	-2.7		-1.0	-2.7	mV/V
Reference Input Current	$I_{\text{REF}}$	$R1 = 10\text{k}\Omega, R2 = \infty, I_Z = 10\text{mA}$			0.15	0.5		0.15	0.5	$\mu\text{A}$
$I_{\text{REF}}$ Temp Deviation	$I_{\text{REF (DEV)}}$	$T_A = -40 \text{ to } +85^\circ\text{C}, R1 = 10\text{k}\Omega, R2 = \infty, I_Z = 10\text{mA}$			0.1	0.4		0.1	0.4	$\mu\text{A}$
Off State Cathode Current	$I_{Z(\text{off})}$	$V_{\text{REF}} = 0\text{V}$	$V_Z = 6\text{V}$		0.5	2.0		0.5	2.0	$\mu\text{A}$
			$V_Z = 16\text{V}$		0.5	2.0		0.5	2.0	
Dynamic Output Impedance	$r_z$	$f < 1\text{KHz}, V_Z = V_{\text{REF}}, I_Z = 100\mu\text{A to } 100\text{mA}$			0.25	0.4		0.25	0.4	$\Omega$
Minimum Operating Current	$I_{Z(\text{min})}$	$V_Z = V_{\text{REF}}$			60	80		60	80	$\mu\text{A}$

**ELECTRICAL CHARACTERISTICS (CONTINUED)** Unless specified,  $T_A = 25^\circ\text{C}$ 

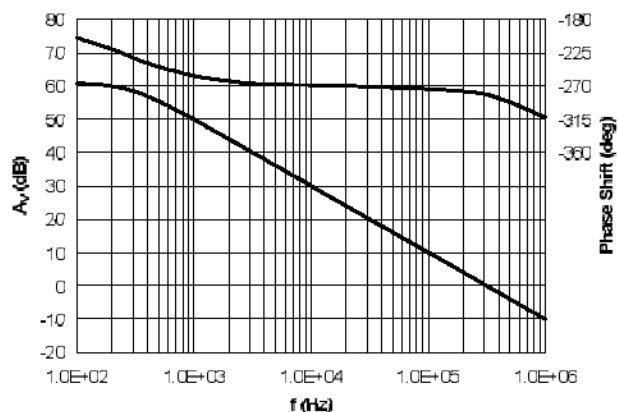
Parameter	Symbol	Condition		CM431L 1%			CM431L 2%			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
Reference Voltage	$V_{\text{REF}}$	$V_Z = V_{\text{REF}}, I_Z = 10\text{mA}$	$T_A = 25^\circ\text{C}$	1.228	1.240	1.252	1.215	1.240	1.265	V
			$T_A = -40 \text{ to } +85^\circ\text{C}$	1.215		1.265	1.200		1.280	
$V_{\text{REF}}$ Temp Deviation	$V_{\text{DEV}}$	$T_A = -40 \text{ to } +85^\circ\text{C}, V_Z = V_{\text{REF}}, I_Z = 10\text{mA}$			10	25		10	35	mV
Ratio of Change in $V_{\text{REF}}$ to Change in Cathode Voltage	$\frac{\Delta V_{\text{REF}}}{\Delta V_Z}$	$I_Z = 10\text{mA}, \Delta V_Z = 16\text{V to } V_{\text{REF}}$			-1.0	-2.7		-1.0	-2.7	mV/V
Reference Input Current	$I_{\text{REF}}$	$R1 = 10\text{k}\Omega, R2 = \infty, I_Z = 10\text{mA}$			0.15	0.5		0.15	0.5	$\mu\text{A}$
$I_{\text{REF}}$ Temp Deviation	$I_{\text{REF (DEV)}}$	$T_A = -40 \text{ to } +85^\circ\text{C}, R1 = 10\text{k}\Omega, R2 = \infty, I_Z = 10\text{mA}$			0.1	0.4		0.1	0.4	$\mu\text{A}$
Off State Cathode Current	$I_{Z(\text{off})}$	$V_{\text{REF}} = 0\text{V}$	$V_Z = 6\text{V}$		0.5	2.0		0.5	2.0	$\mu\text{A}$
			$V_Z = 16\text{V}$		0.5	2.0		0.5	2.0	
Dynamic Output Impedance	$r_z$	$f < 1\text{KHz}, V_Z = V_{\text{REF}}, I_Z = 100\mu\text{A to } 100\text{mA}$			0.25	0.4		0.25	0.4	$\Omega$
Minimum Operating Current	$I_{Z(\text{min})}$	$V_Z = V_{\text{REF}}$			60	80		60	60	$\mu\text{A}$

### TYPICAL CHARACTERISTICS

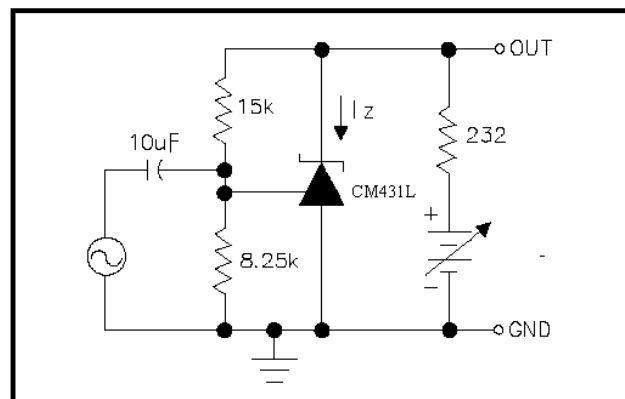


## TYPICAL CHARACTERISTICS (Conti)

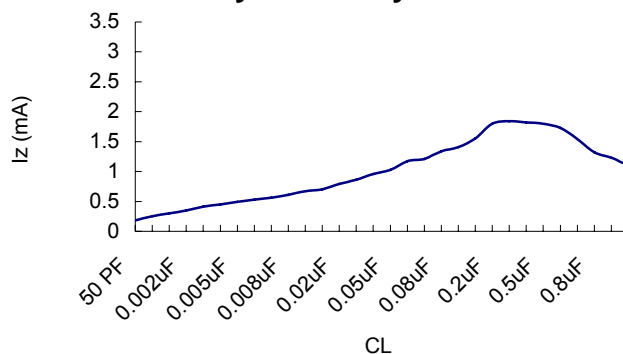
**Small Signal Gain and Phase Shift vs. Frequency**



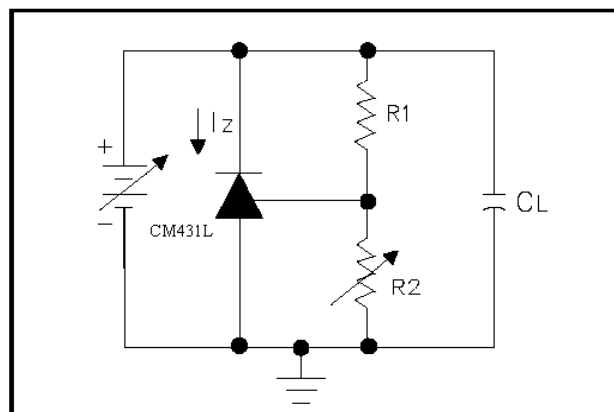
**Test Circuit For Small-Signal Gain and Phase Shift**



**Stability Boundary Condition**

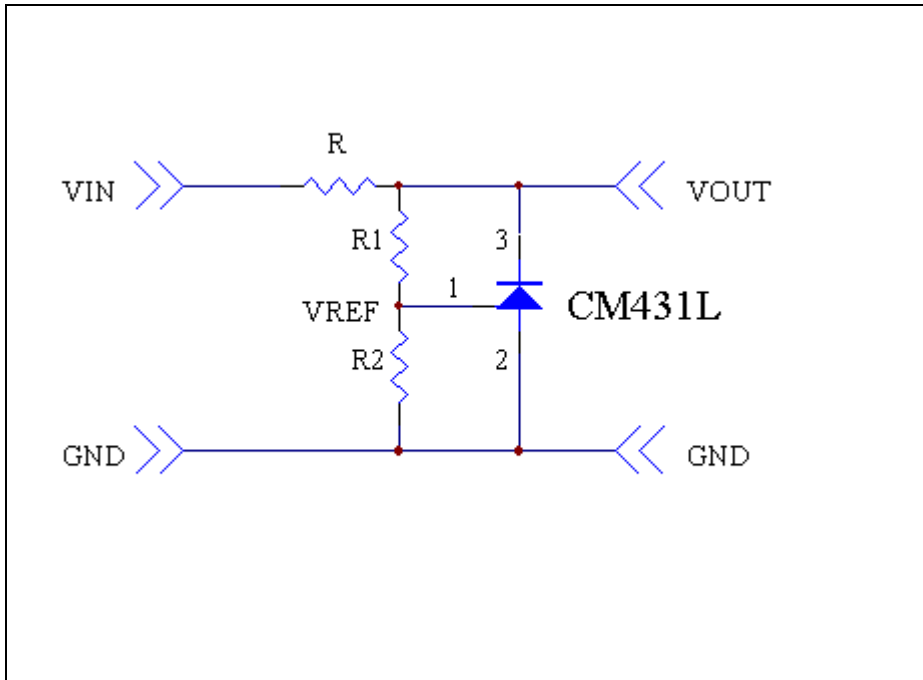


**Stability Circuit**





## APPLICATION CIRCUIT



Notes for Application Circuit :

- 1) Set  $V_{OUT}$  according to the following equation :

$$V_{OUT} = V_{REF} (1 + R1/R2) + I_{REF} R1$$

- 2) Choose the value for R as follows :

- The maximum limit for R should be such that the cathode current,  $I_z$ , is greater than the minimum operating current ( $80\mu A$ ) at  $V_{IN(min)}$ .
- The minimum limit for R should be such that  $I_z$  does not exceed 100mA under all load conditions, and the instantaneous turn-on value for  $I_z$  does not exceed 150mA. Both of the following conditions must be met :

$$R_{min} \geq \frac{V_{IN(max)}}{150mA} \quad (\text{to limit instantaneous turn-on } I_z)$$

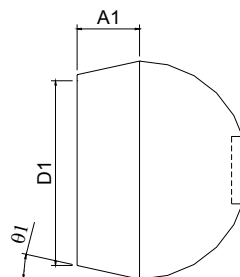
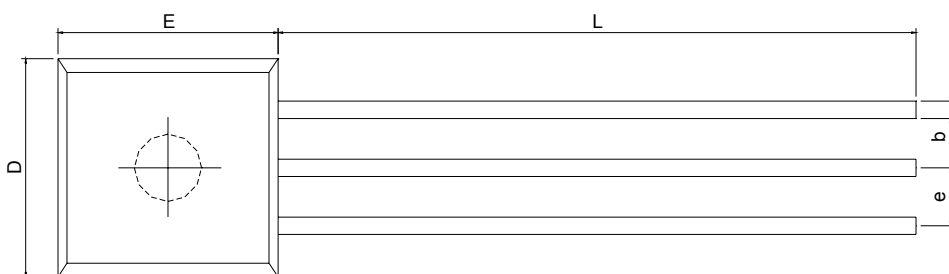
$$R_{min} \geq \frac{V_{IN(max)} - V_{OUT}}{I_{OUT(min)} + 100mA} \quad (\text{to limit } I_z \text{ under normal operating conditions})$$

### PACKAGE DIMENSION

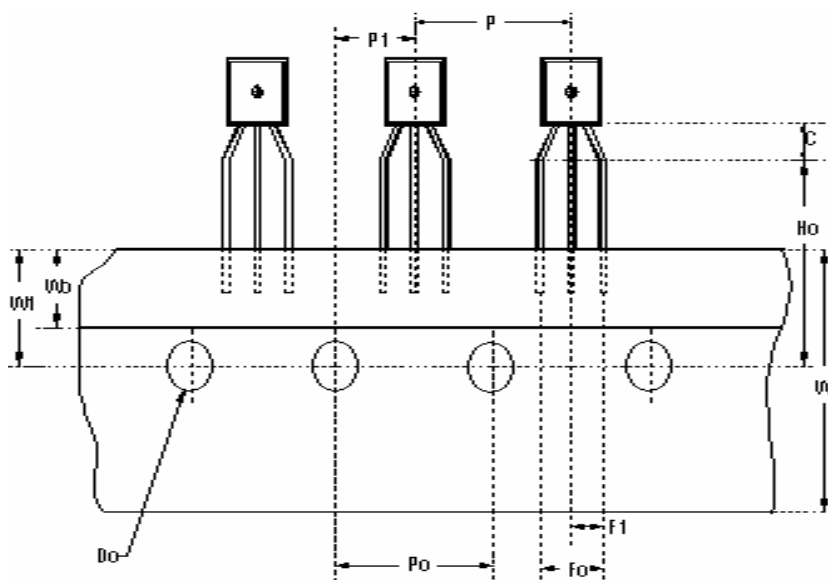
#### TO-92



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	3.45	3.58	3.66	0.136	0.140	0.144
A1	1.22	1.30	1.37	0.048	0.051	0.054
b	---	0.38	---	---	0.015	---
D	4.27	4.52	4.78	0.168	0.178	0.188
D1	4.14	4.29	4.45	0.163	0.169	0.175
E	4.32	4.57	4.83	0.170	0.180	0.190
L	12.98	13.49	14.00	0.511	0.531	0.551
e	---	1.27	---	---	0.050	---
theta	---	5°	---	---	5°	---
theta1	---	5°	---	---	5°	---



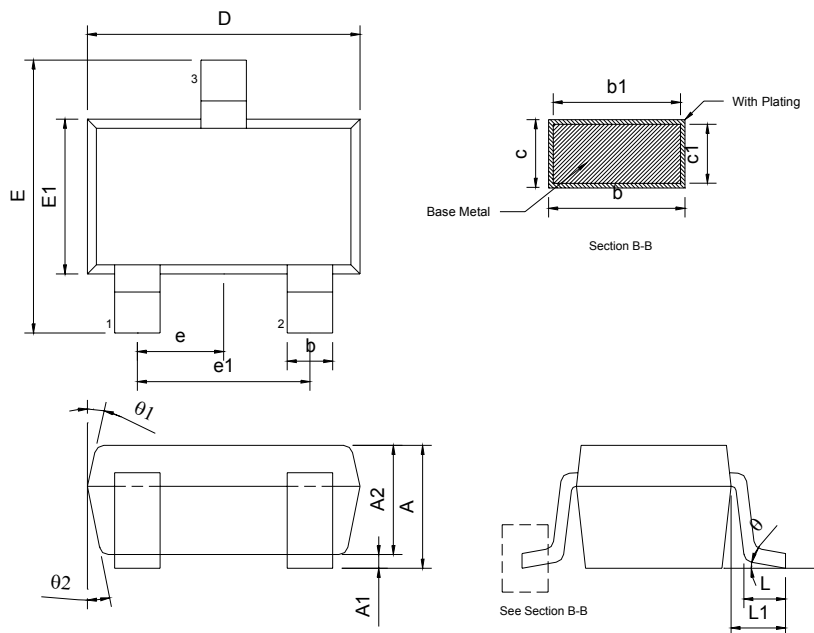
#### 3-Pin Plastic TO-92 Carrier Dimensions



INCHES			MILLIMETERS		
MIN	TYP	MAX	MIN	TYP	MAX
0.375	-	-	9.53	-	-
0.480	0.500	0.520	12.2	12.7	13.2
0.488	0.500	0.512	12.4	12.7	13.0
0.160	0.167	0.168	4.1	4.2	4.3
0.230	0.250	0.258	5.8	6.3	6.5
0.165	0.197	0.220	4.2	5.0	5.6
0.360	0.709	0.748	9.1	18.0	19.0
0.310	0.630	0.649	7.9	16.0	16.5
0.220	0.238	0.248	5.6	6.0	6.3
0.335	0.354	0.374	8.5	9.0	9.5

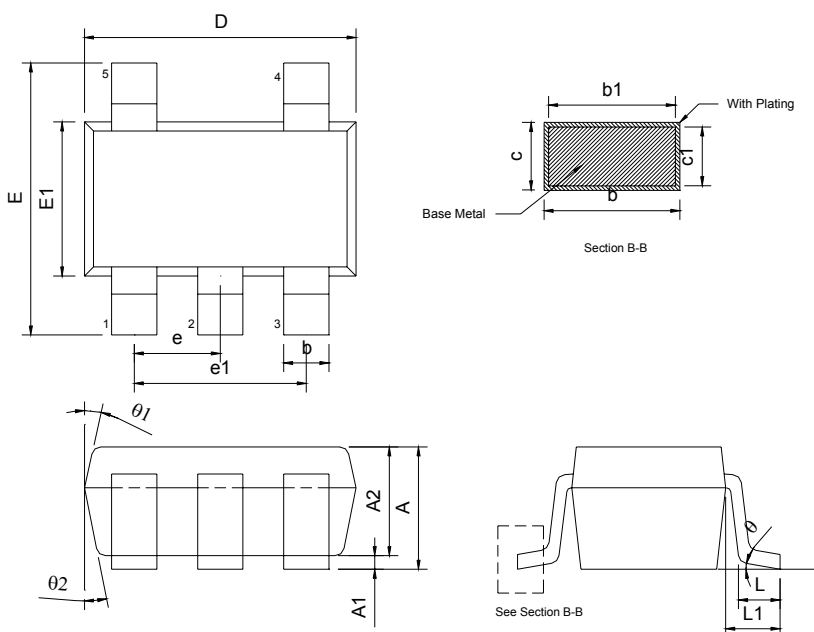
### PACKAGE DIMENSION (CONTINUED)

#### SOT-23-3



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.05	---	1.35	0.041	---	0.053
A1	0.05	---	0.15	0.002	---	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.25	---	0.50	0.010	---	0.020
b1	0.25	0.40	0.45	0.010	0.016	0.018
c	0.08	---	0.20	0.003	---	0.008
c1	0.08	0.11	0.15	0.003	0.004	0.006
D	2.70	2.90	3.00	0.106	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
L	0.35	0.45	0.55	0.014	0.018	0.022
L1	0.60 REF			0.024 REF		
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
$\theta$	0°	5°	10°	0°	5°	10°
$\theta_1$	3°	5°	7°	3°	5°	7°
$\theta_2$	6°	8°	10°	6°	8°	10°

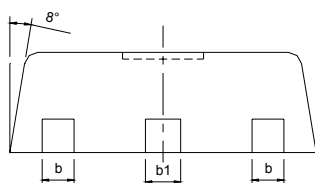
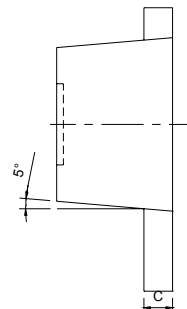
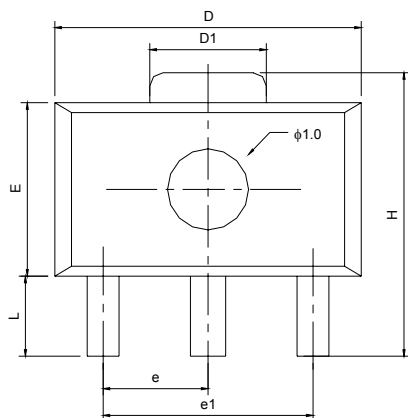
#### SOT-23-5



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.05	---	1.35	0.041	---	0.053
A1	0.05	---	0.15	0.002	---	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.25	---	0.50	0.010	---	0.020
b1	0.25	0.40	0.45	0.010	0.016	0.018
c	0.08	---	0.20	0.003	---	0.008
c1	0.08	0.11	0.15	0.003	0.004	0.006
D	2.70	2.90	3.00	0.106	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
L	0.35	0.45	0.55	0.014	0.018	0.022
L1	0.60 REF			0.024 REF		
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
$\theta$	0°	5°	10°	0°	5°	10°
$\theta_1$	3°	5°	7°	3°	5°	7°
$\theta_2$	6°	8°	10°	6°	8°	10°

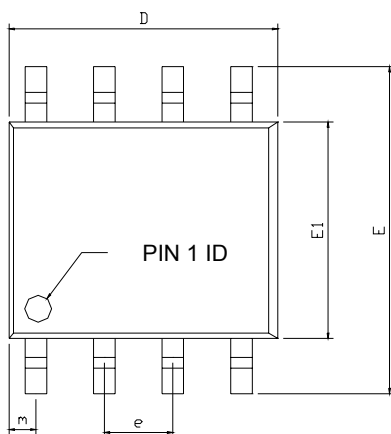
### PACKAGE DIMENSION (CONTINUED)

#### SOT-89

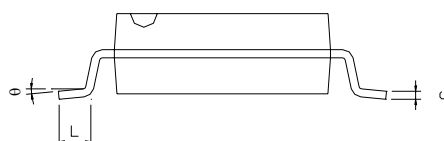
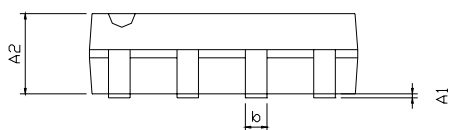


SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.90	0.055	0.059	0.063
L	0.80	---	1.20	0.031	---	0.047
b	0.38	0.42	0.46	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.018	0.020
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.80	1.75	0.055	0.062	0.069
H	3.94	---	4.25	0.155	---	0.167
E	2.40	2.50	2.60	0.094	0.098	0.102
e1	2.90	3.00	3.10	0.114	0.118	0.122
e	1.45	1.50	1.55	0.057	0.059	0.061

#### 8-PIN SOP (S08)



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A1	0.10	---	0.25	0.004	---	0.010
A2	1.40	---	1.55	0.055	---	0.061
b	0.30	---	0.51	0.012	---	0.020
C	0.15	---	0.26	0.006	---	0.010
D	4.60	---	5.06	0.169	---	0.199
E	5.79	---	6.20	0.228	---	0.244
E1	3.76	---	4.01	0.148	---	0.158
e	---	1.27	---	---	0.050	---
L	0.38	---	0.69	0.015	---	0.035
m	0.43	---	0.69	0.017	---	0.027
θ	0°	---	8°	0°	---	8°



## **IMPORTANT NOTICE**

Champion Microelectronic Corporation (CMC) reserves the right to make changes to its products or to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

A few applications using integrated circuit products may involve potential risks of death, personal injury, or severe property or environmental damage. CMC integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life-support applications, devices or systems or other critical applications. Use of CMC products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

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