

ADJUSTABLE SHUNT REGULATOR

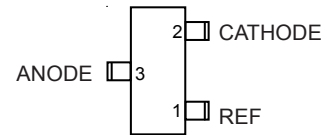
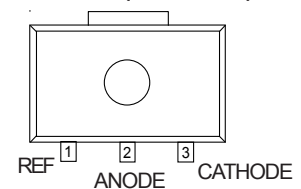
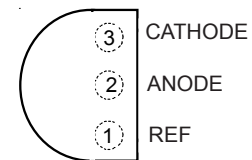
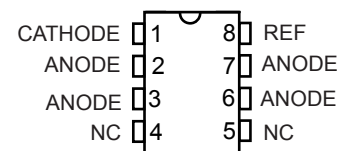
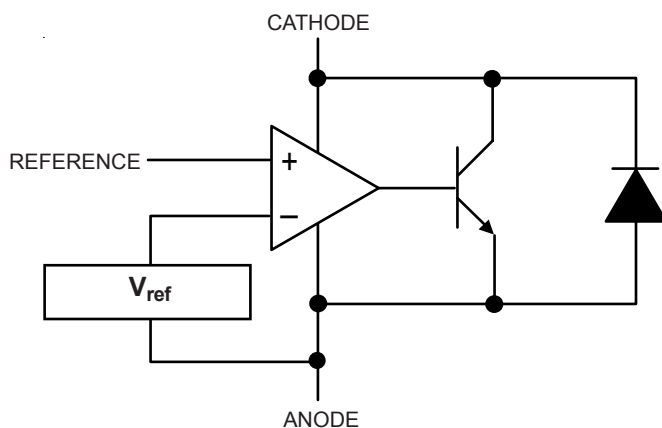
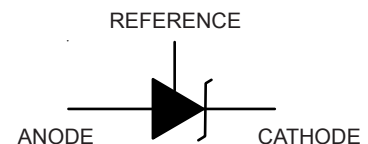
- Wide operating current range, 1 mA to 100mA
- Low dynamic output impedance, 0.2Ω typ.
- 0.5%, 1% or 2% reference voltage tolerance
- Alternate for TL1431, TL431, LM431 & AS431
- Industrial temperature range -40° to +85° C
- Available in SOT-23-3, TO-92, SOT-89 and SOP-8 packages

The GM431 is a three terminal adjustable shunt regulator with thermal stability guaranteed over temperature. Output voltage can be adjusted to any value from 2.5V (V_{ref}) to 36V using two external resistors. The GM431 has a typical dynamic output impedance of 0.2Ω. Active output circuitry provides a very sharp turn on characteristic, making the GM431 an excellent replacement for zener diodes in many applications such as onboard regulation and adjustable power supplies. The GM431 is an ideal voltage reference for 3.0 to 3.3V switching power supplies.

The GM431 shunt regulator is available with 3 voltage tolerances 0.5%, 1.0% and 2.0% over $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, and four package options (SOT-23-3, TO-92, SOT-89 and SOP-8). Whatever your application, the GM431 offers the optimum combination of performance, reliability and economy.

Applications:

- Switching power supplies
- Linear regulators
- Adjustable supplies
- Battery-operated computers
- Computer disk drives
- Instrumentation

PIN CONFIGURATIONS
SOT-23-3 (TOP VIEW)

SOT-89 (TOP VIEW)

TO-92 (TOP VIEW)

SOP-8 (TOP VIEW)

BLOCK DIAGRAM (POSITIVE LOGIC)

LOGIC SYMBOL


ADJUSTABLE SHUNT REGULATOR
ABSOLUTE MAXIMUM RATINGS (over free-air temperature range except as noted)

PARAMETER	SYMBOL	MAXIMUM	UNIT
Cathode Voltage ⁽¹⁾	V_{KA}	37	V
Continuous cathode current	I_K	150	mA
Reference input current	I_{ref}	10	mA
Power dissipation at $T_A = 25^\circ\text{C}$ SOT-23 SO-8 TO-92	P_D	0.37 0.78 0.95	W
Package thermal impedance ^(2, 3) SOT-23-3 TO-92 SO-8	θ_{JA}	336 132 163	$^\circ\text{C/W}$
Operating ambient temperature range	T_A	-40 to +85	$^\circ\text{C}$
Operating junction temperature range	T_J	-40 to +150	$^\circ\text{C}$
Lead temperature (soldering) 10 seconds	T_{LEAD}	300	$^\circ\text{C}$
Storage temperature range	T_{STG}	-65 to + 150	$^\circ\text{C}$
ESD rating (human body model)	V_{ESD}	2	kV

These are stress ratings only. Functional operation of the device at these or any conditions beyond the “recommended operating conditions” is not implied. Exposure to absolute maximum rated conditions may affect device reliability.

NOTES:

- Voltage values are with respect to the anode except as noted.
- Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA} and T_A . Maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Operation at absolute maximum T_J of 150°C can affect device reliability.
- Package thermal impedance is calculated per JESD 51.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MINIMUM	MAXIMUM	UNIT
Cathode Voltage	V_{KA}	V_{ref}	36	V
Cathode Current	I_K	1.0	100	mA
Operating free-air temperature range	T_A	-40	+85	$^\circ\text{C}$

ADJUSTABLE SHUNT REGULATOR
ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)
GM431A (0.5%)

PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
Reference Voltage	V_{ref}	$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}, T_A = 25^\circ\text{C}^{(1)}$	2.487	2.500	2.512	V
		$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}, T_A = -40\text{ to }+85^\circ\text{C}^{(1)}$				
V_{ref} temp deviation	V_{dev}	$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}^{(1)}$		8	17	mV
Ratio of change in V_{ref} to change in V_{KA}	$\frac{\Delta V_{\text{ref}}}{\Delta V_{\text{KA}}}$	$I_{\text{K}} = 10\text{ mA}, \Delta V_{\text{KA}} = 16\text{V to }V_{\text{ref}}$		-0.5	-2.7	mV/V
Reference input current	I_{ref}	$I_{\text{K}} = 10\text{ mA}, R_1 = 10\text{K}\Omega, R_2 = \infty^{(2)}$		0.5	4.0	μA
I_{ref} temp deviation	$I_{\text{ref(dev)}}$	$I_{\text{K}} = 10\text{ mA}, R_1 = 10\text{K}\Omega, R_2 = \infty^{(2)}$ $T_A = \text{full range}$		0.4	12	μA
Minimum operating current	$I_{\text{K(min)}}$	$V_{\text{KA}} = V_{\text{ref}}^{(1)}$			100	μA
Off-state cathode current	$I_{\text{K(off)}}$	$V_{\text{KA}} = 36\text{V}, V_{\text{ref}} = 0\text{V}^{(3)}$		0.04	0.50	μA
		$V_{\text{KA}} = 16\text{V}, V_{\text{ref}} = 0\text{V}^{(3)}$				
Dynamic impedance	$ Z_{\text{KA}} $	$f \leq 1\text{kHz}, V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 100\mu\text{A to }100\text{mA}^{(1)}$		0.25	0.50	Ω

GM431B (1.0%)

PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
Reference Voltage	V_{ref}	$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}, T_A = 25^\circ\text{C}^{(1)}$	2.475	2.500	2.525	V
		$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}, T_A = -40\text{ to }+85^\circ\text{C}^{(1)}$				
V_{ref} temp deviation	V_{dev}	$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}^{(1)}$		8	25	mV
Ratio of change in V_{ref} to change in V_{KA}	$\frac{\Delta V_{\text{ref}}}{\Delta V_{\text{KA}}}$	$I_{\text{K}} = 10\text{ mA}, \Delta V_{\text{KA}} = 16\text{V to }V_{\text{ref}}$		-0.5	-2.7	mV/V
Reference input current	I_{ref}	$I_{\text{K}} = 10\text{ mA}, R_1 = 10\text{K}\Omega, R_2 = \infty^{(2)}$		0.5	4.0	μA
I_{ref} temp deviation	$I_{\text{ref(dev)}}$	$I_{\text{K}} = 10\text{ mA}, R_1 = 10\text{K}\Omega, R_2 = \infty^{(2)}$ $T_A = \text{full range}$		0.4	1.2	μA
Minimum operating current	$I_{\text{K(min)}}$	$V_{\text{KA}} = V_{\text{ref}}^{(1)}$			100	μA
Off-state cathode current	$I_{\text{K(off)}}$	$V_{\text{KA}} = 36\text{V}, V_{\text{ref}} = 0\text{V}^{(3)}$		0.04	0.50	μA
		$V_{\text{KA}} = 16\text{V}, V_{\text{ref}} = 0\text{V}^{(3)}$				
Dynamic impedance	$ Z_{\text{KA}} $	$f \leq 1\text{kHz}, V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 100\mu\text{A to }100\text{mA}^{(1)}$		0.25	0.50	Ω

NOTES:

(1) See test circuit 1 on page 4.

(2) See test circuit 2 on page 4.

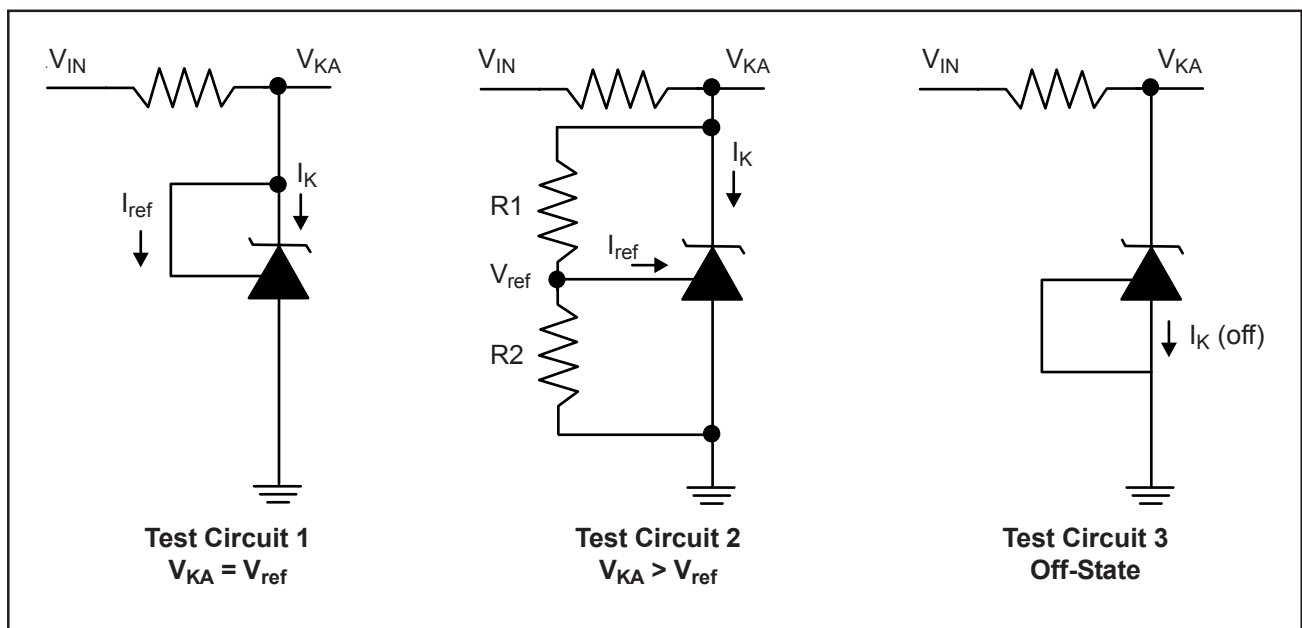
(3) See test circuit 3 on page 4.

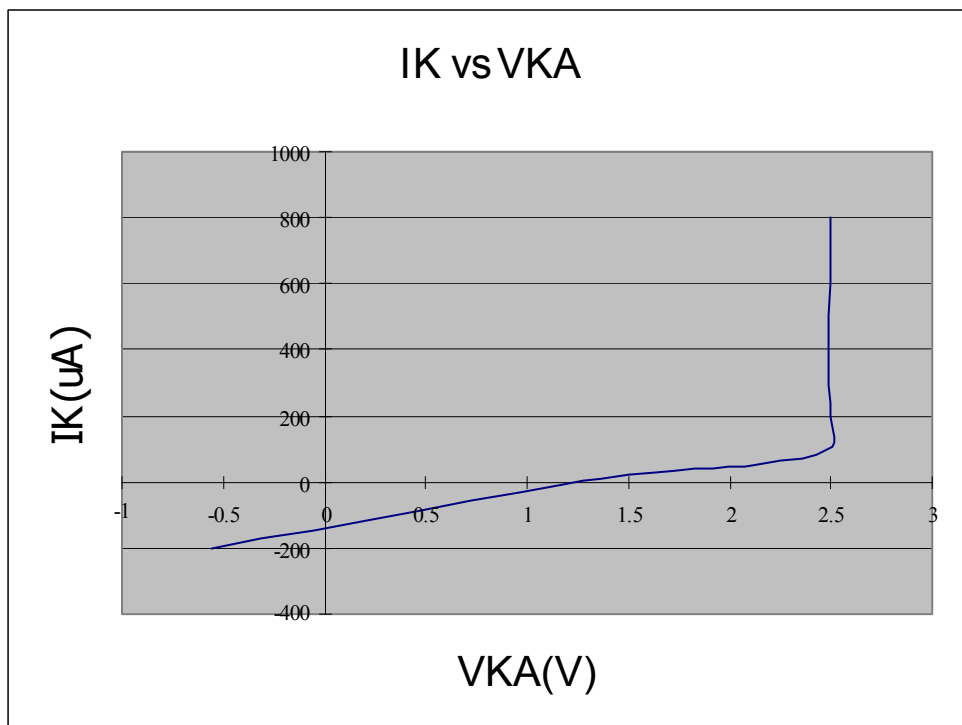
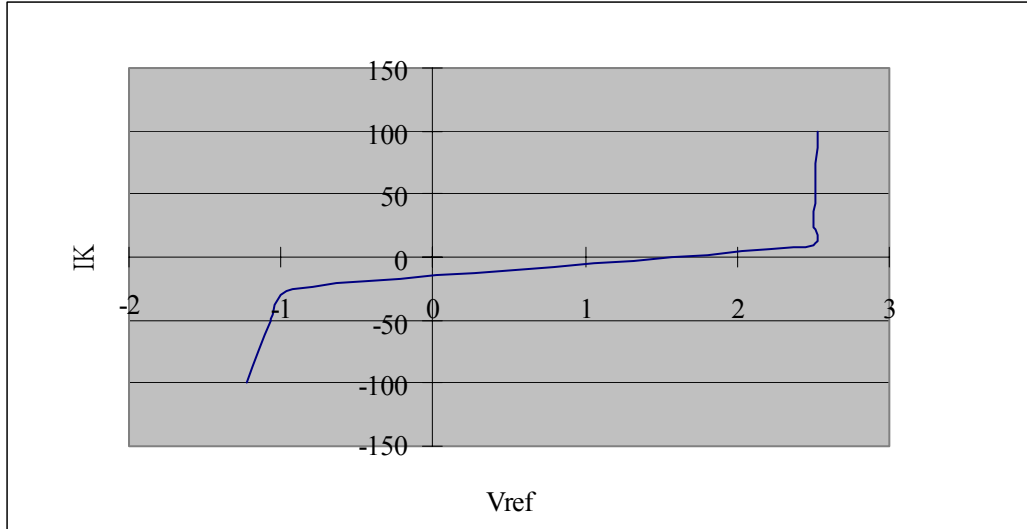
ADJUSTABLE SHUNT REGULATOR
ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)
GM431C (2.0%)

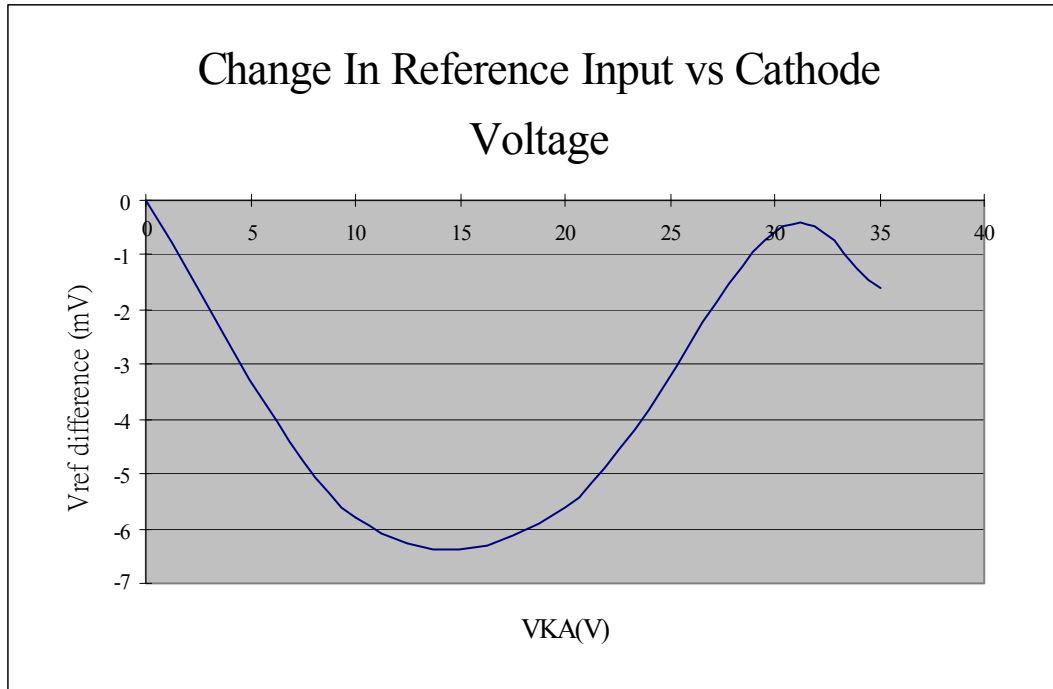
PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
Reference Voltage	V_{ref}	$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}, T_A = 25^\circ\text{C}^{(1)}$	2.45	2.5	2.55	V
		$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}, T_A = -40\text{ to }+85^\circ\text{C}^{(1)}$				
V_{ref} temp deviation	V_{dev}	$V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 10\text{ mA}^{(1)}$		15	30	mV
Ratio of change in V_{ref} to change in V_{KA}	$\frac{\Delta V_{\text{ref}}}{\Delta V_{\text{KA}}}$	$I_{\text{K}} = 10\text{ mA}, \Delta V_{\text{KA}} = 10\text{V to }V_{\text{ref}}$		-0.5	-2.7	mV/V
Reference input current	I_{ref}	$I_{\text{K}} = 10\text{ mA}, R1 = 10\text{K}\Omega, R2 = \infty^{(2)}$		0.5	4	μA
I_{ref} temp deviation	$I_{\text{ref(dev)}}$	$I_{\text{K}} = 10\text{ mA}, R1 = 10\text{K}\Omega, R2 = \infty^{(2)}$ $T_A = \text{full range}$		0.4	1.2	μA
Minimum operating current	$I_{\text{K(min)}}$	$V_{\text{KA}} = V_{\text{ref}}^{(1)}$			100	μA
Off-state cathode current	$I_{\text{K(off)}}$	$V_{\text{KA}} = 36\text{V}, V_{\text{ref}} = 0\text{V}^{(3)}$		0.04	0.50	μA
Dynamic impedance	$ Z_{\text{KA}} $	$f \leq 1\text{kHz}, V_{\text{KA}} = V_{\text{ref}}, I_{\text{K}} = 100\mu\text{A to }100\text{mA}^{(1)}$		0.25	0.50	Ω

NOTES:

- (1) See test circuit 1.
 (2) See test circuit 2.
 (3) See test circuit 3.

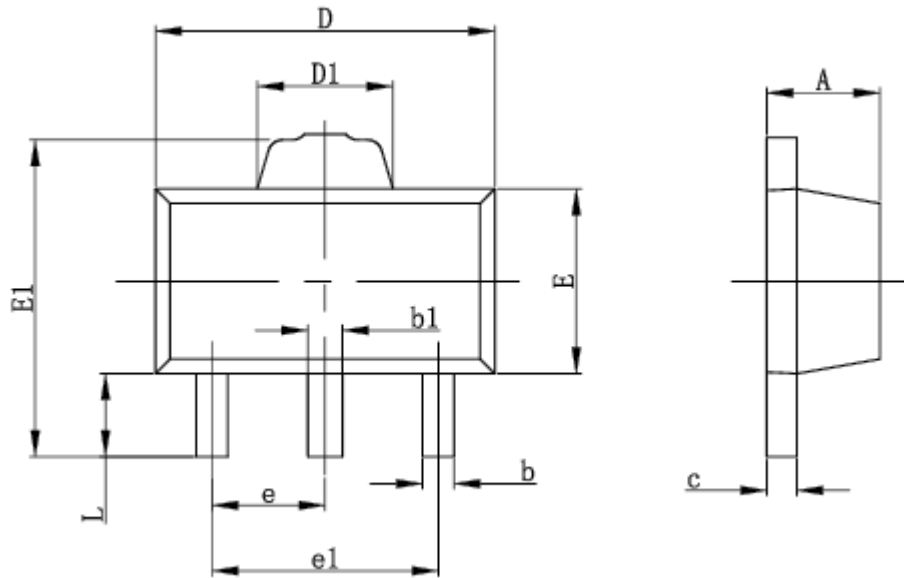
TEST CIRCUITS


ADJUSTABLE SHUNT REGULATOR


ADJUSTABLE SHUNT REGULATOR

■ ORDERING INFORMATION

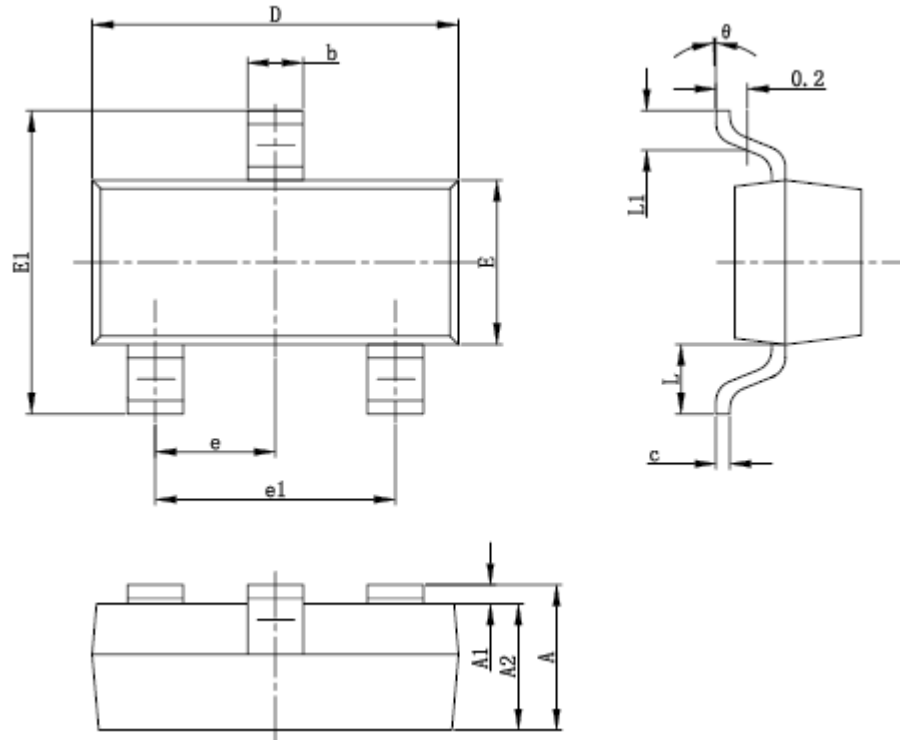
GM431	PACKAGE	Reference Voltage Tolerance		
		0.5%	1%	2%
	SOT-23	GM431A-ST23	GM431B-ST23	GM431C-ST23
	SO-8	GM431A-S8	GM431B-S8	GM431C-S8
	TO-92	GM431A-T92	GM431B-T92	GM431C-T92
	SOT-89	GM431A-ST89	GM431B-ST89	GM431C-ST89

ADJUSTABLE SHUNT REGULATOR

 ■ **SOT-89-3L PACKAGE OUTLINE DIMENSIONS**


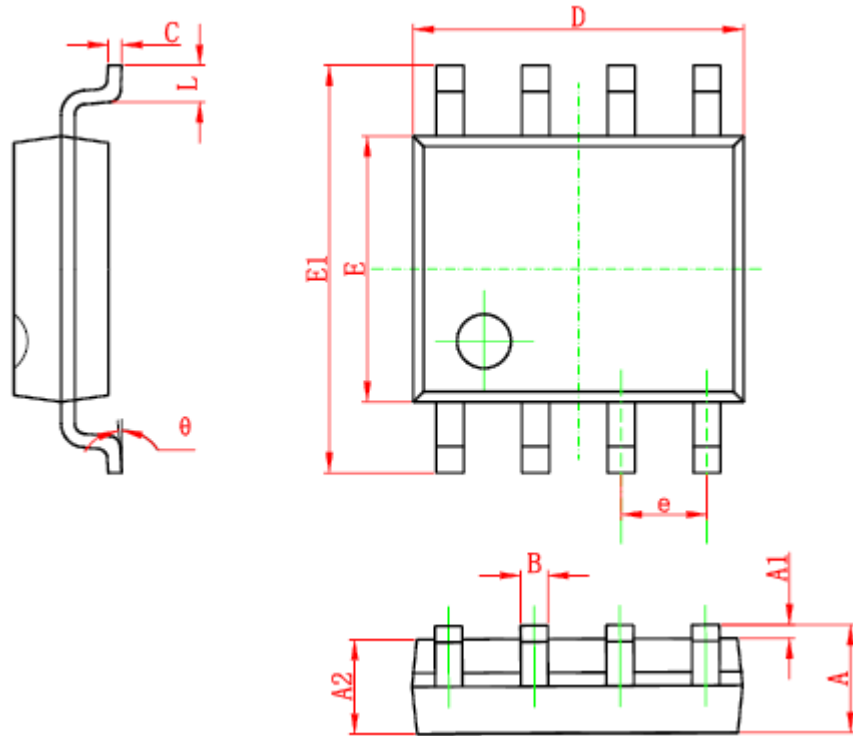
SYMBOL	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.360	0.560	0.014	0.022
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500TYP		0.060TYP	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043

ADJUSTABLE SHUNT REGULATOR

 ■ **SOT-23-3 PACKAGE OUTLINE DIMENSIONS**


SYMBOL	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.550TYP		0.022TYP	
L1	0.300	0.500	0.012	0.020
theta	0°	8°	0°	10°

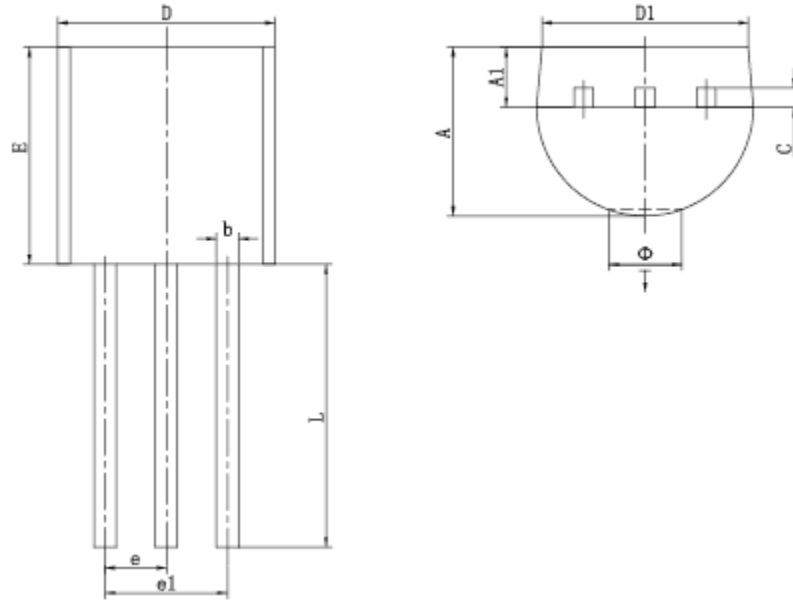
ADJUSTABLE SHUNT REGULATOR

 ■ **SOP-8 PACKAGE OUTLINE DIMENSIONS**


SYMBOL	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.45	1.75	0.057	0.069
A1	0.1	0.25	0.004	0.01
A2	1.35	1.55	0.053	0.061
B	0.306	0.506	0.012	0.02
C	0.153	0.253	0.006	0.01
D	4.81	5.01	0.189	1.197
E	3.84	4.04	0.151	0.159
E1	5.84	6.24	0.23	0.246
e	1.27		0.05	
L	0.45	1	0.018	0.039
θ	0°	8°	0°	8°

ADJUSTABLE SHUNT REGULATOR

■ TO-92 PACKAGE OUTLINE DIMENSIONS



SYMBOL	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.400	4.700	0.173	0.185
D1	3.430	-	0.135	-
E	4.300	4.700	0.169	0.185
e	1.270TYP		0.050TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ	-	1.600	-	0.063
↓	0.000	0.380	0.000	0.015