UMW TL431

Adjustable Precision Shunt Regulator

1.Description

The UMW TL431 is a three-terminal adjustable regulator series with a guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between Vref and 36 volts with two external resistors. These device have a typical dynamic output impedance of 0.27Ω, Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.

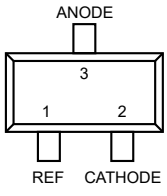
2.Features

- Programmable Output Voltage to 36V.
- Low Dynamic Output Impedance : TL431xx: 0.27 Ω (Typical).
- Sink Current Capability of 0.1mA to 100mA.
- Equivalent Full-Range Temperature Coefficient of 50 ppm/°C
- Temperature Compensated for Operation over Full Rated Operating Temperature Range.
- Low Output Noise Voltage.
- Fast Turn on Responds.
- SOT-23, TO-92, SOT-89, SOP-8, packages

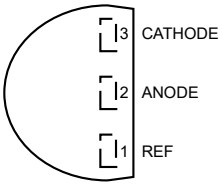
3.Applications

- Precision Voltage Reference
- Linear Regulator
- Adjustable Power Supply
- Switching Power Supply
- Graphic Card
- Adapter

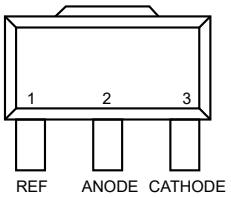
4.Pinning Information



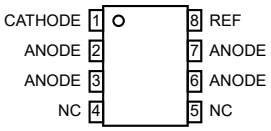
SOT-23



TO-92



SOT-89



SOP-8

5.Absolute Maximum Ratings

Parameter		Symbol	Value	Units
Cathode Voltage	UMW TL431x	V_{KA}	40	V
Cathode Current Range (Continuous)		I_K	-100 to 150	mA
Reference Input Current Range		I_{REF}	0.05 to 10	mA
Operating Temperature Range	UMW TL431x	$T_{oper.}$	-40 to 85	°C
Junction Temperature Range		T_J	150	°C
Storage Temperature Range		T_{STG}	-65 to 150	°C

6.Thermal Characteristics

Parameter	Package	Symbol	Value	Units
Thermal Resistance From Junction to Ambient in Free Air. (Measured with the component mounted on a high effective thermal conductivity test board in free air.)	SOT-23	θ_{JA}	400	°C/W
	TO-92		400	°C/W
	SOT-89		400	°C/W
	SOP-8		450	°C/W

7.Recommended Operating Conditions

Characteristic		Symbol	Min	Typ	Max	Units
Cathode Voltage	UMW TL431x	V_{KA}	V_{REF}		36	V
Cathode Current	UMW TL431x	I_K	0.5		100	mA

8.Electrical Characteristics

T_A=25°C, V_{KA}=V_{REF}, I_K=10mA unless otherwise noted.

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Reference input Voltage	V_{REF}	V_{KA}=V_{REF}, I_K=10mA	0.5%	2.483	2.495	2.508	V
Deviation of Reference Input Voltage Over Full Temperature Range	$V_{REF(dev)}$	T_{min}≤T_a≤T_{max}			3	17	mV
Ratio of change in Reference input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	ΔV_{KA}=10V-V_{REF}		-0.4		2.7	mV/V
		ΔV_{KA}=36V-10V		-0.4		2	mV/V
Reference Input Current	I_{REF}	R_1=10KΩ, R_2=∞			1.8	4	μA
Deviation of Reference Input Current Over Full Temperature Range	$I_{REF(dev)}$	R_1=10KΩ, R_2=∞			0.4	1.2	μA
Minimum Cathode Current for Regulation	$I_{K(min)}$				0.25	0.5	mA
Off-State Cathode Current	$I_{K(off)}$	V_{KA}=40V, V_{REF}=0			0.17	0.9	μA
Dynamic Impedance	Z_{KA}	I_K=1mA to 100mA, f≤1.0KHz			0.27	0.5	Ω

9.Test Circuit

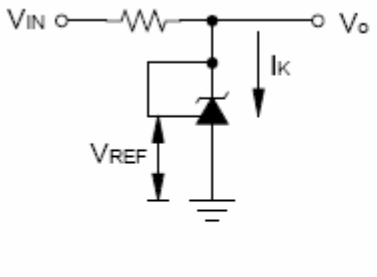


Figure 1. Test Circuit for $V_{KA}=V_{REF}$, $V_O=V_{KA}=V_{REF}$

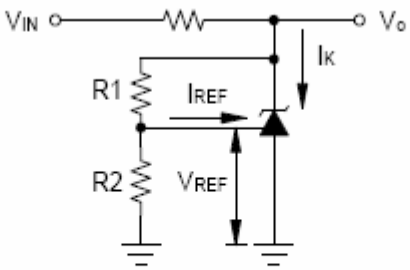


Figure 2. Test Circuit for $V_{KA}>V_{REF}$, $V_O=V_{KA}=V_{REF}\times(1+R_1/R_2)+I_{REF}\times R_1$

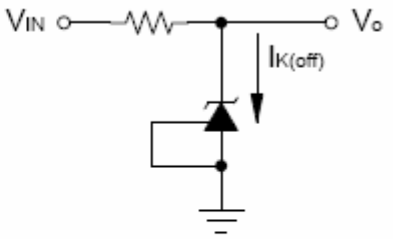
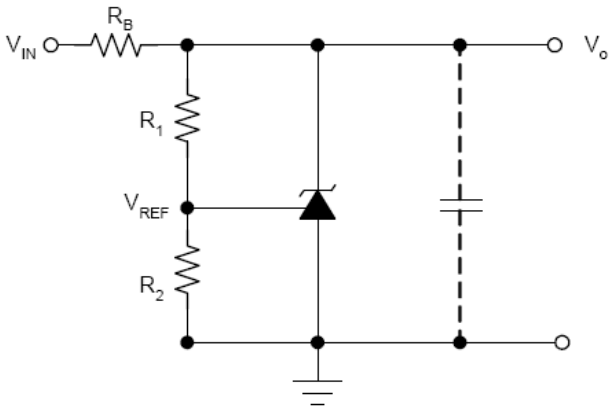
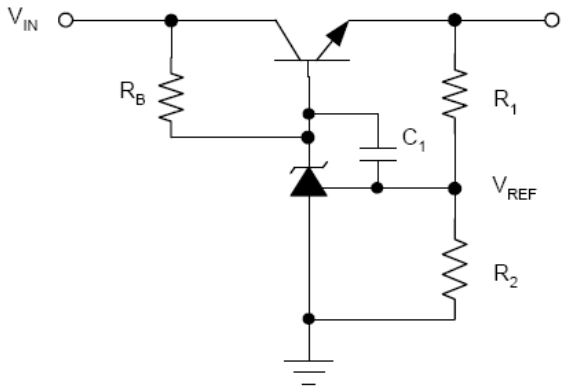


Figure 3. Test Circuit for $I_{K(off)}$

10.Typical Application Circuits



Precision Voltage Reference



Precision High-Current Series Regulator

Notes for Typical Application Circuits:

1. For the series regulator applications, add a compensation capacitor C_1 between CATHODE and REF is strongly recommended to improve the stability of output voltage.

2. Set Vo according to the following equation: $V_O=V_{REF}(1+R_1/R_2)+I_{REF}xR_1$.

3. Choose the Value for R_B as below:

(1). The maximum limit for R_B should be such that the cathode current (I_K) is greater than the minimum operating current (0.5mA) at $V_{IN(MIN)}$.

(2). The minimum limit for RB should be such that the cathode current (I_K) does not exceed 100mA under all load conditions, and the instantaneous turn-on value for I_K does not exceed 120mA.

11.1 Typical Characteristic

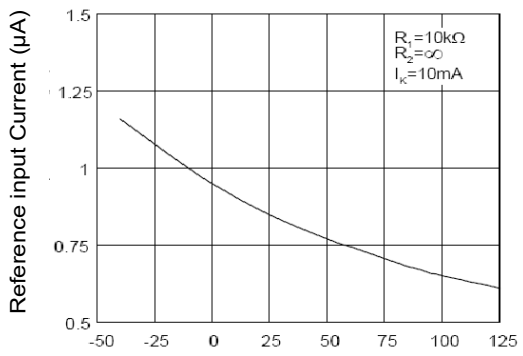


Figure 1: Reference Input Current vs. Ambient Temperature

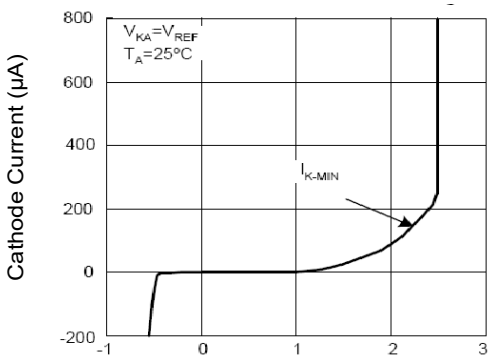


Figure 2: Cathode Current vs.Cathode Voltage

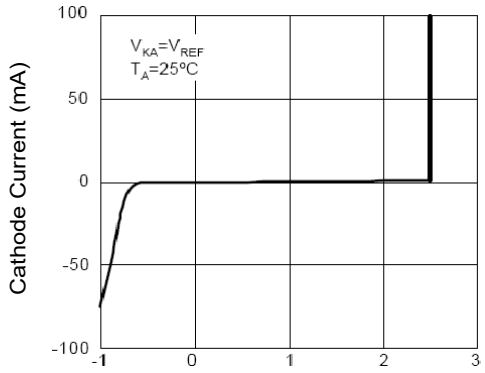


Figure 3: Cathode Current vs. Cathode Voltage

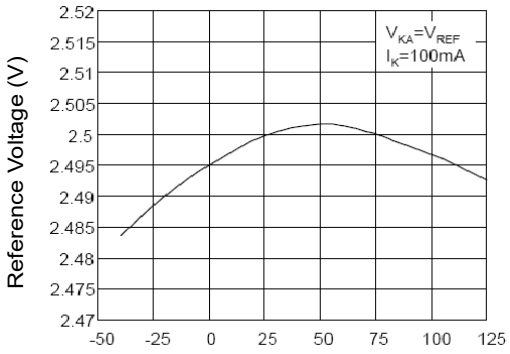


Figure 4: Reference Voltage vs. Ambient Temperature

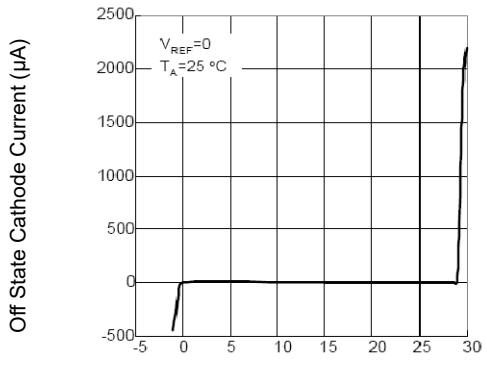


Figure 5: Off State Cathode Current vs. Cathode Voltage

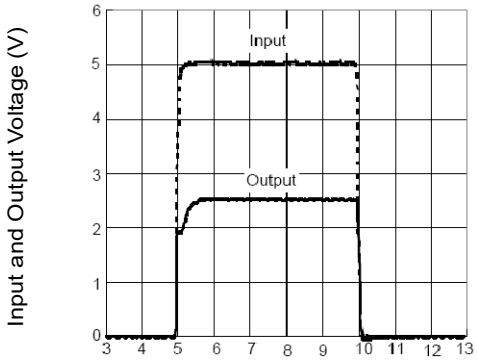


Figure 6: Pulse Response

11.2 Typical Characteristic

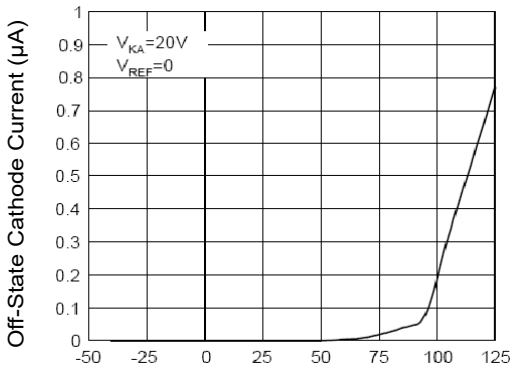


Figure 7: Off-State Cathode Current vs. Ambient Temperature

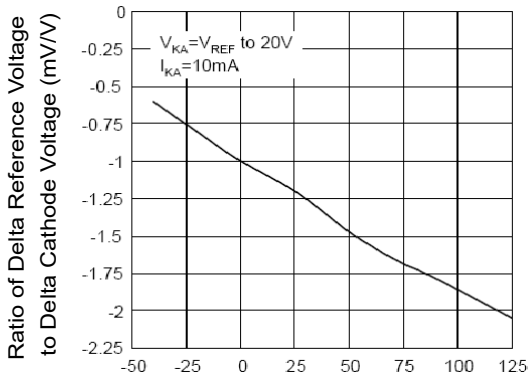


Figure 8: Ratio of Delta Reference Voltage to Delta Cathode Voltage vs.Ambient Tmperature

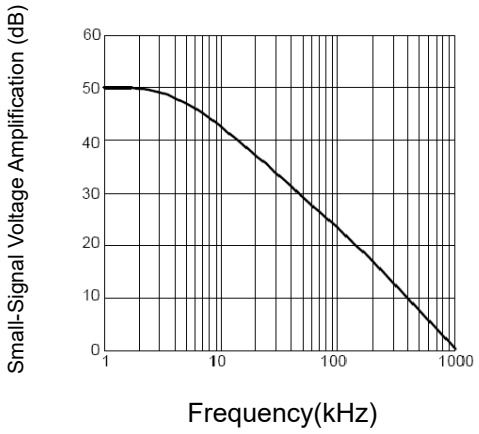


Figure 9: small-signal Voltage Amplification vs. Frequency

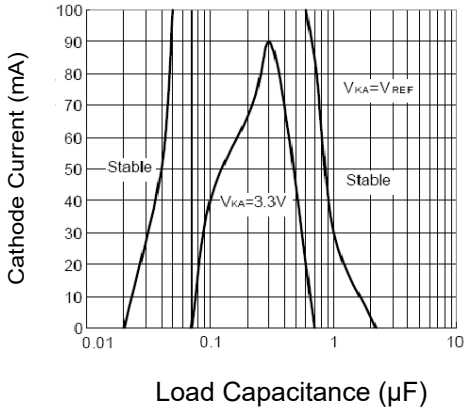


Figure 10: Stability Boundary Conditions

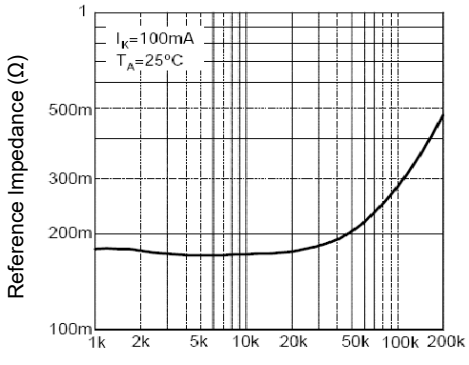


Figure 11: Reference Impedance vs.Frequency

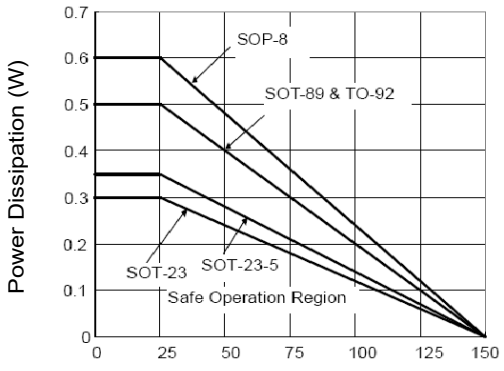
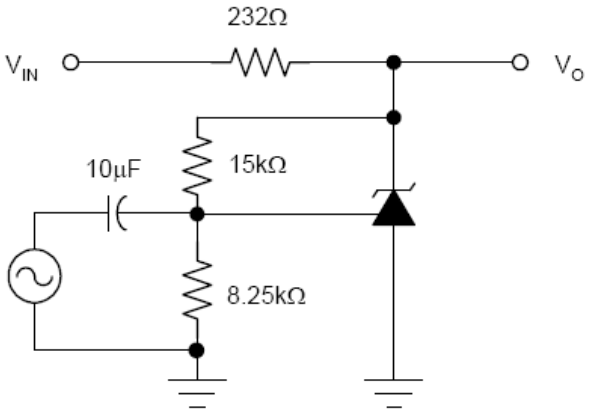
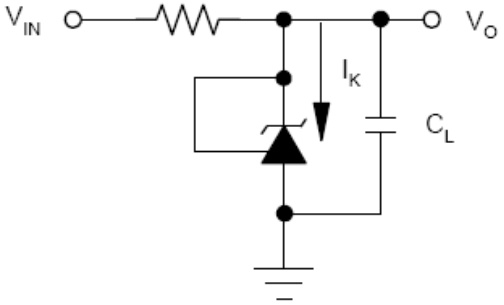


Figure 12: Power Dissipation vs.Ambient Temperature

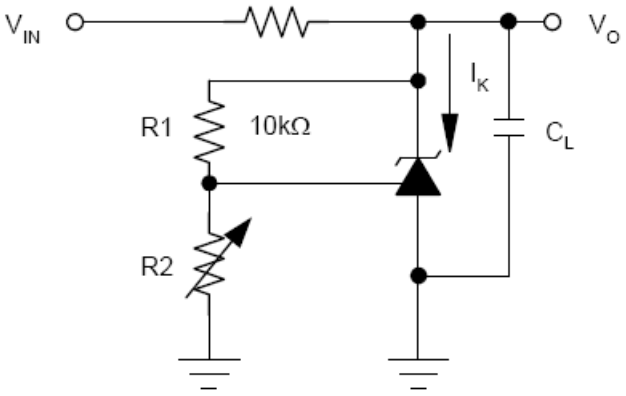
11.3 Typical Applications



Voltage Amplification
Test Circuit

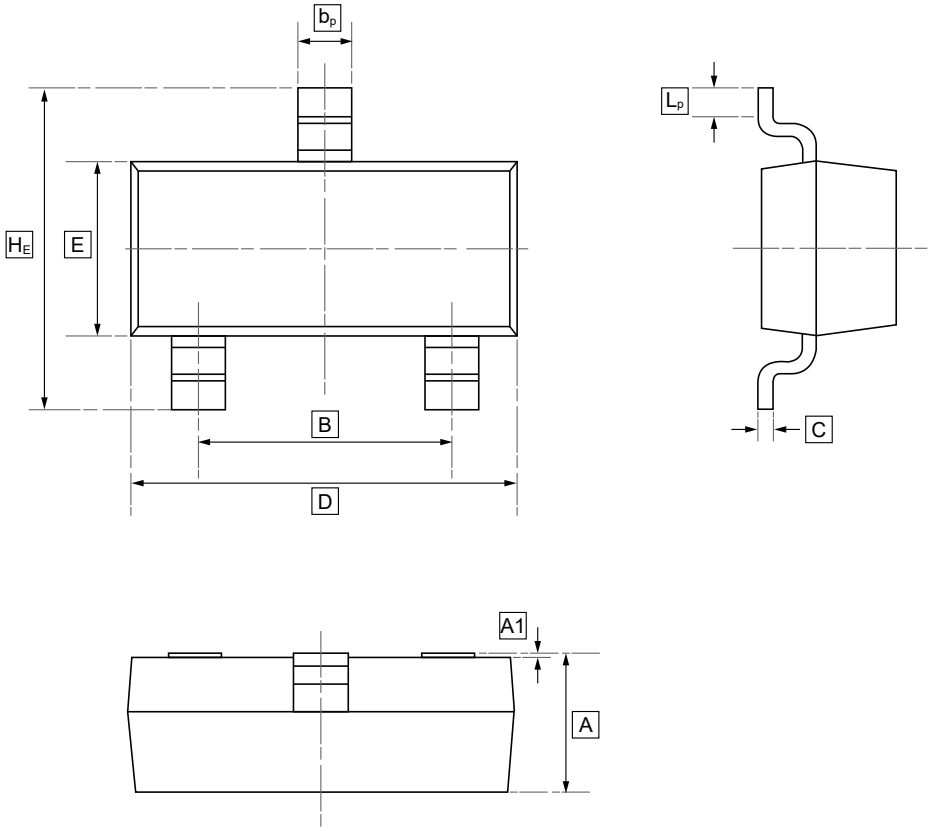


Stability Test Circuit for $V_{KA}=V_{REF}$



Stability Test Circuit for $V_{KA}>V_{REF}$,
$V_O= V_{KA}= V_{REF}$ x (1+R1/R2) + I_{REF} x R1
Use the MLCC for C_L

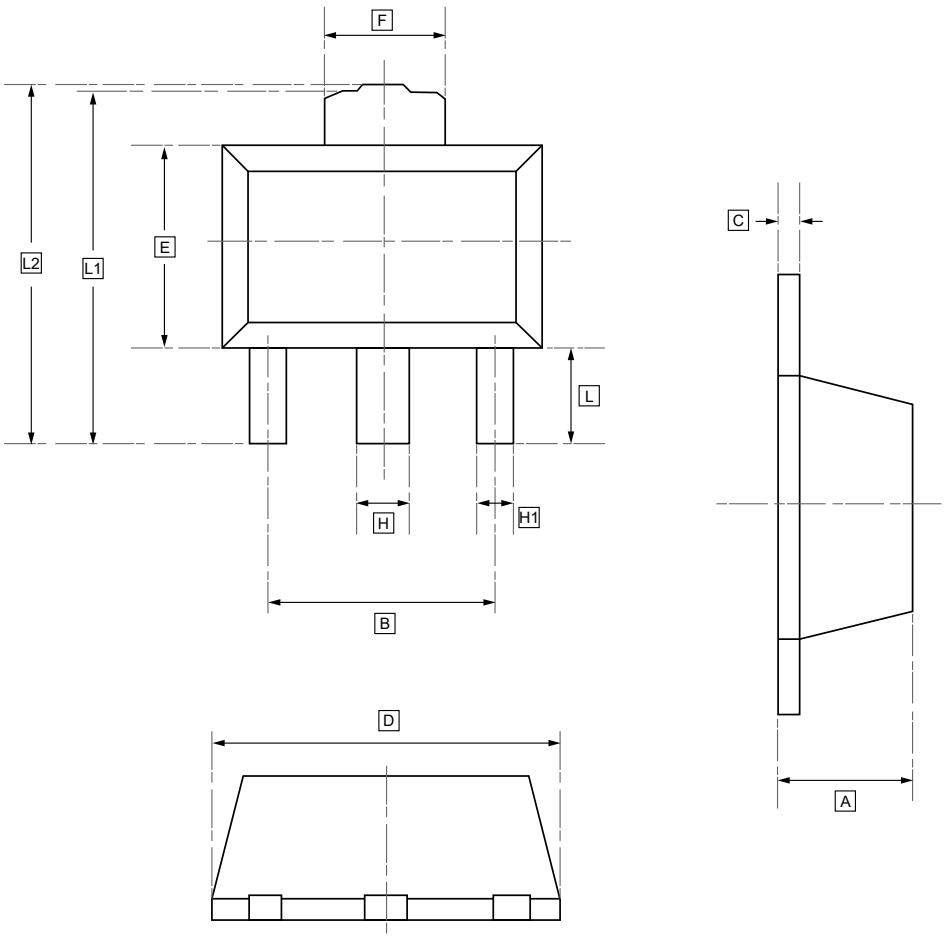
12.1 SOT-23 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	B	b_p	C	D	E	H_E	A1	L_p
Min	0.95	1.78	0.35	0.08	2.70	1.20	2.20	0.013	0.20
Max	1.40	2.04	0.50	0.19	3.10	1.65	3.00	0.100	0.50

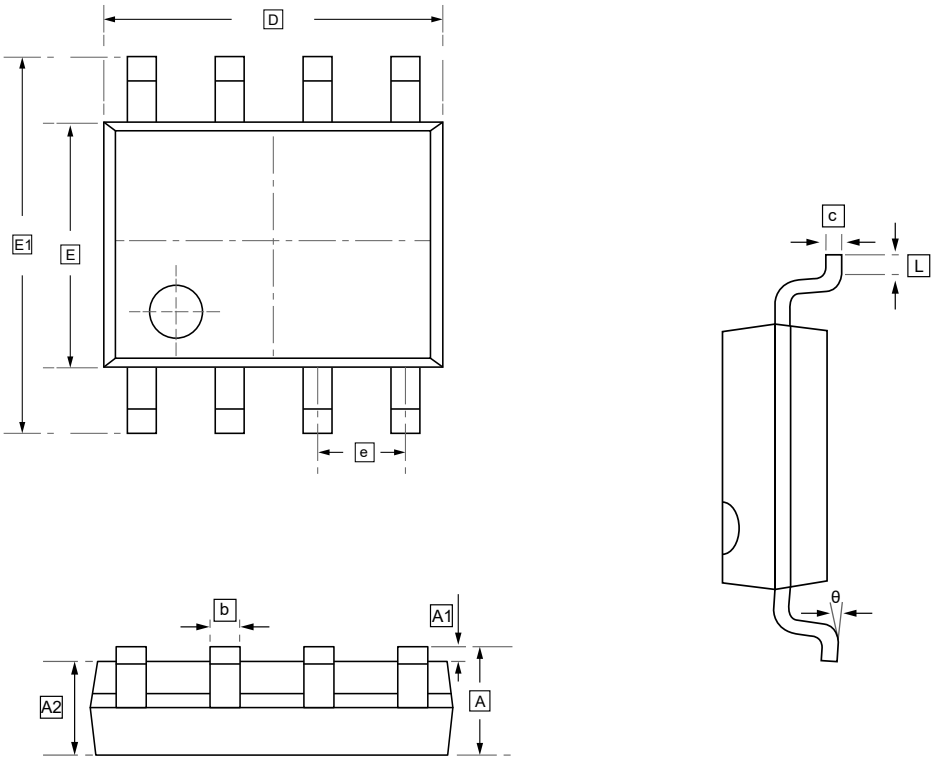
12.2 SOT-89 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	B	C	D	E	F	H	H1	L	L1	L2
Min	1.450	2.950	0.330	4.450	2.450	1.650	0.450	0.370	0.900	4.100	4.100
Max	1.550	3.050	0.430	4.550	2.550	1.750	0.580	0.480	1.000	4.300	4.350

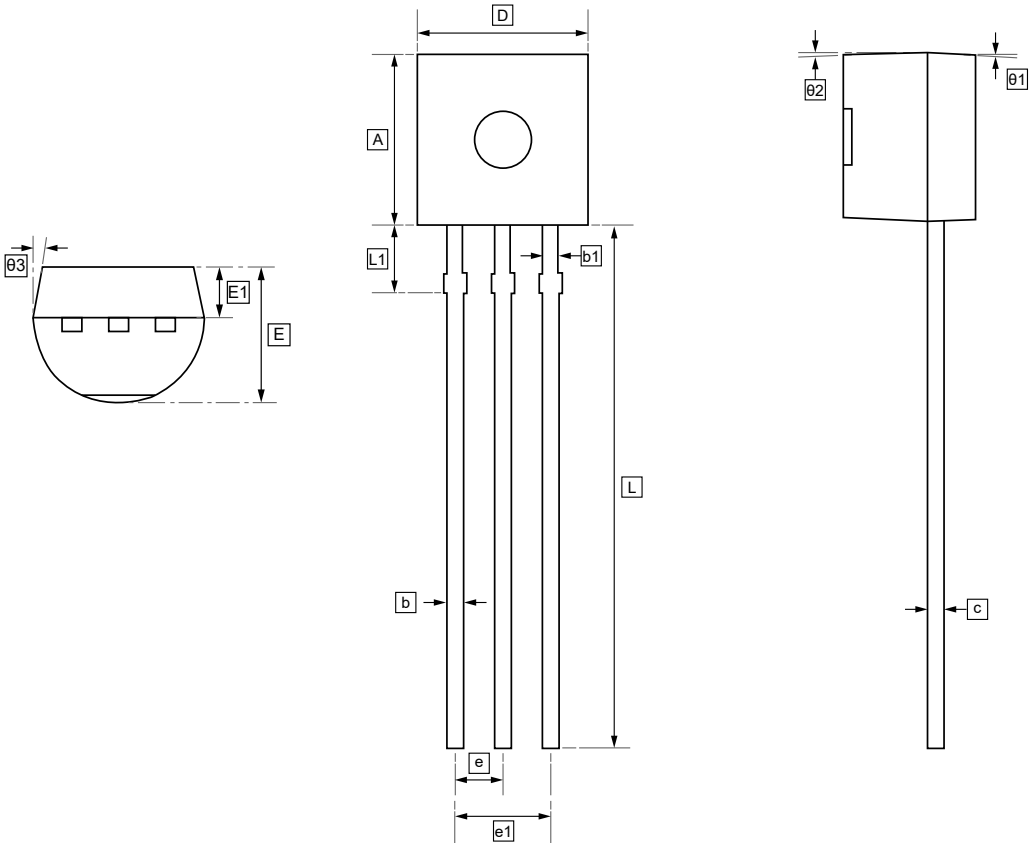
12.3 SOP-8 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	E	E1	e	L	θ
Min	1.350	0.000	1.350	0.330	0.170	4.700	3.800	5.800	1.270	0.400	0°
Max	1.750	0.100	1.550	0.510	0.250	5.100	4.000	6.200	BSC	1.270	8°

12.4 TO-92 Package Outline Dimensions

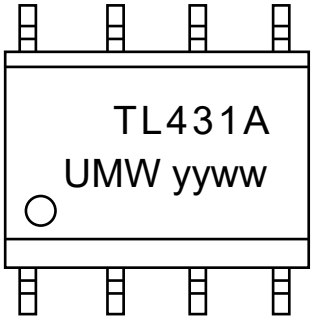


DIMENSIONS (mm are the original dimensions)

Symbol	A	b	b1	c	D	E	E1	e	e1	L	L1	θ1
Min	4.5	0.38	0.46	0.36	4.5	3.45	1.2	1.27	2.54	13.5	1.96	2°
Max	4.7	0.56		0.51	4.7	3.75	1.4			15.3		

Symbol	θ2	θ3
Min	2°	5°
Max		

13.Ordering information



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW TL431 0.5%	TL431	TO-92	2000	Ammo outfit
UMW TL431(0.5%)	TL431A	TO-92	1000	Bulk Bag
UMW TL431	431	SOT-23	3000	Tape and reel
UMW TL431 1%	431	SOT-23	3000	Tape and reel
UMW TL431S	TL431	SOT-89	1000	Tape and reel
UMW TL431AIDR	TL431A	SOP-8	2500	Tape and reel
UMW TL431BIDR	TL431B	SOP-8	2500	Tape and reel

14.Disclaimer

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