

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 V_{ref} 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.

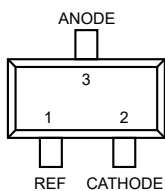
2.Features

- Programmable Output Voltage to 36V.
- Low Dynamic Output Impedance :
TL431xx: 0.27Ω (Typical).
- Sink Current Capability of 0.1mA to 100mA.
- Equivalent Full-Range Temperature Coefficient of $50\text{ ppm}/^\circ\text{C}$
- 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

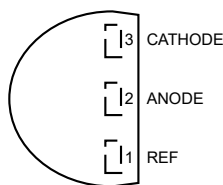
3.Applications

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

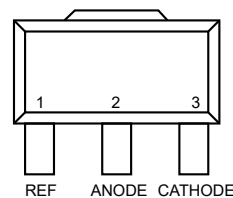
4.Pinning Information



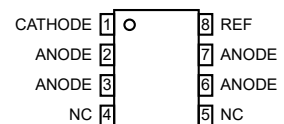
SOT-23



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

$T_A=25^{\circ}\text{C}$, $V_{KA}=V_{REF}$, $I_K=10\text{mA}$ 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
			1%	2.470	2.495	2.520	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	ΔV _{REF} /ΔV _{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

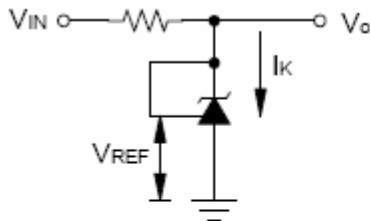


Figure 1. Test Circuit for
 $V_{KA} = V_{REF}$, $V_O = V_{KA} = V_{REF}$

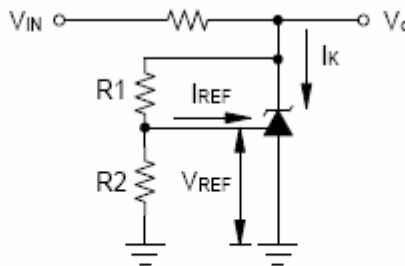


Figure 2. Test Circuit for $V_{KA} > V_{REF}$,
 $V_O = V_{KA} = V_{REF} \times (1 + R_1/R_2) + I_{REF} \times R_1$

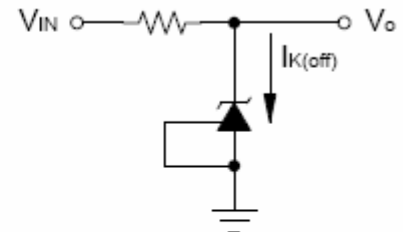
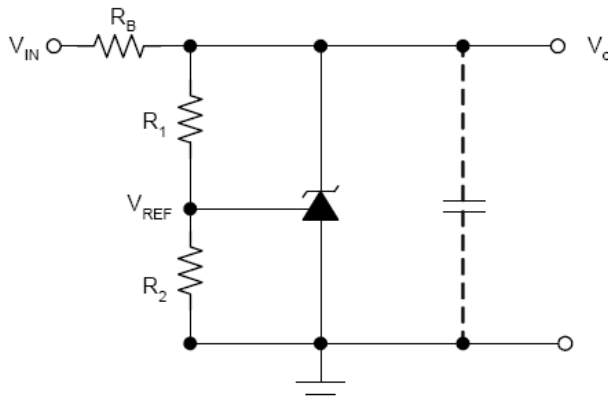
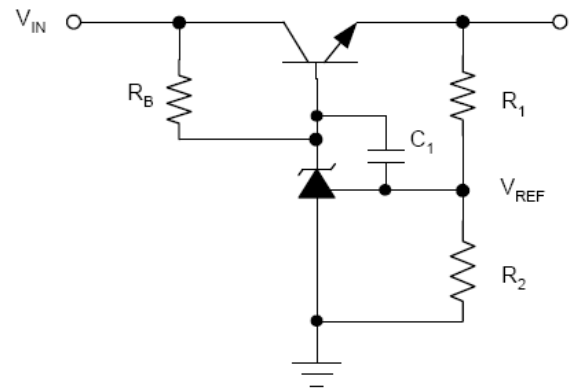


Figure 3. Test Circuit for $I_{K(off)}$

10. Typical Application Circuits



Precision Voltage Reference



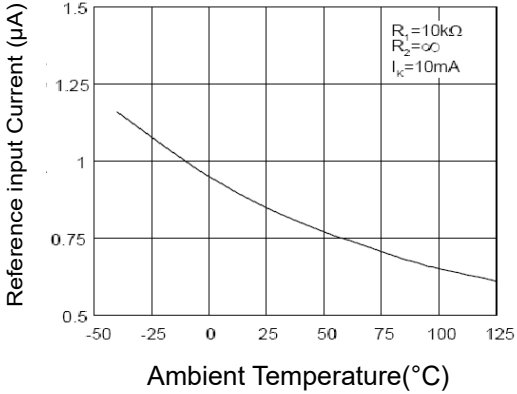
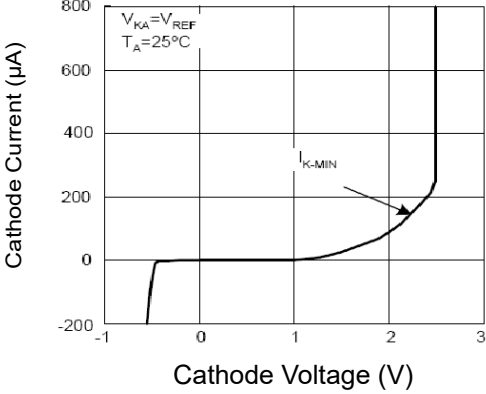
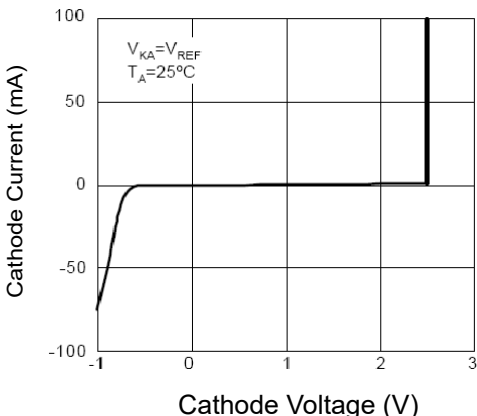
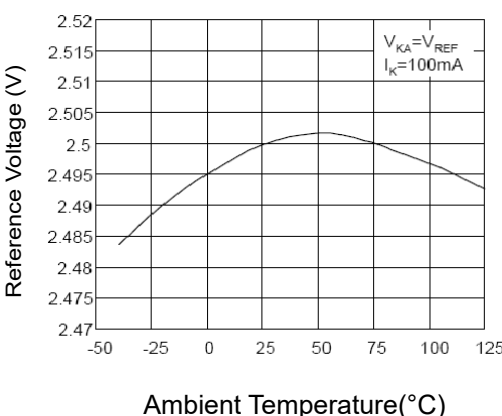
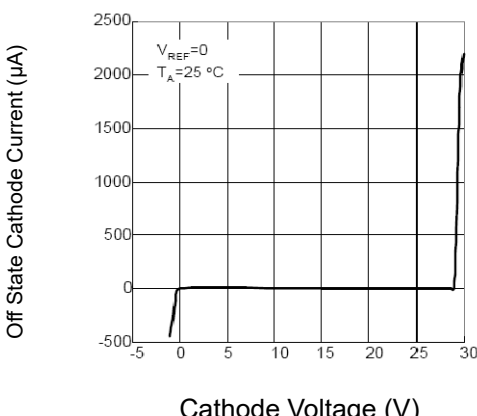
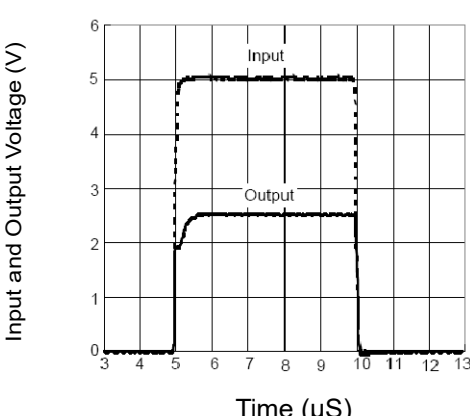
Precision High-Current Series Regulator

Notes for Typical Application Circuits:

- 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.
- Set V_O according to the following equation: $V_O = V_{REF} \times (1 + R_1/R_2) + I_{REF} \times R_1$.
- Choose the Value for R_B as below:
 - 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 $V_{IN(MIN)}$.
 - The minimum limit for R_B 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

 Reference input Current (μA) Ambient Temperature($^{\circ}\text{C}$) $R_1=10\text{k}\Omega$ $R_2=\infty$ $I_K=10\text{mA}$	 Cathode Current (μA) Cathode Voltage (V) $V_{KA}=V_{REF}$ $T_A=25^{\circ}\text{C}$ I_{K-MIN}
Figure 1: Reference Input Current vs. Ambient Temperature	Figure 2: Cathode Current vs.Cathode Voltage
 Cathode Current (mA) Cathode Voltage (V) $V_{KA}=V_{REF}$ $T_A=25^{\circ}\text{C}$	 Reference Voltage (V) Ambient Temperature($^{\circ}\text{C}$) $V_{KA}=V_{REF}$ $I_K=100\text{mA}$
Figure 3: Cathode Current vs. Cathode Voltage	Figure 4: Reference Voltage vs. Ambient Temperature
 Off State Cathode Current (μA) Cathode Voltage (V) $V_{REF}=0$ $T_A=25^{\circ}\text{C}$	 Input and Output Voltage (V) Time (μs) Input Output
Figure 5: Off State Cathode Current vs. Cathode Voltage	Figure 6: Pulse Response



11.2 Typical Characteristic

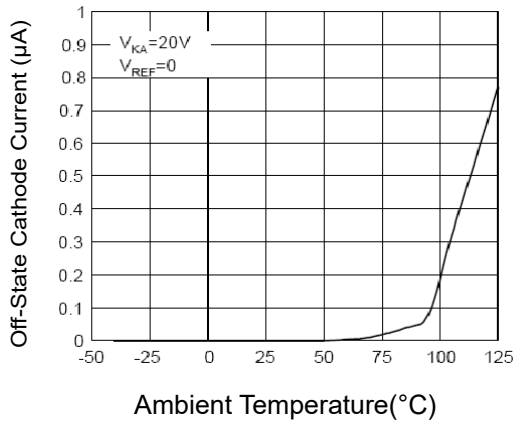


Figure 7: Off-State Cathode Current vs. Ambient Temperature

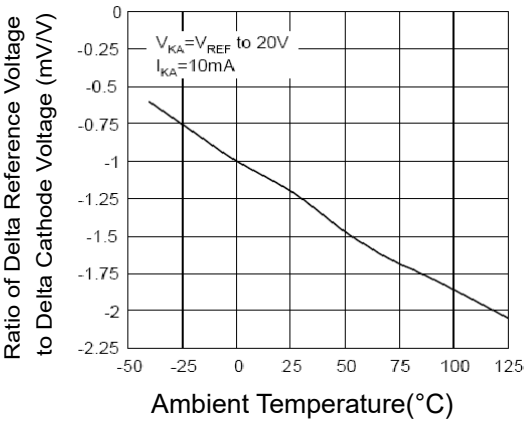


Figure 8: Ratio of Delta Reference Voltage to Delta Cathode Voltage vs. Ambient Temperature

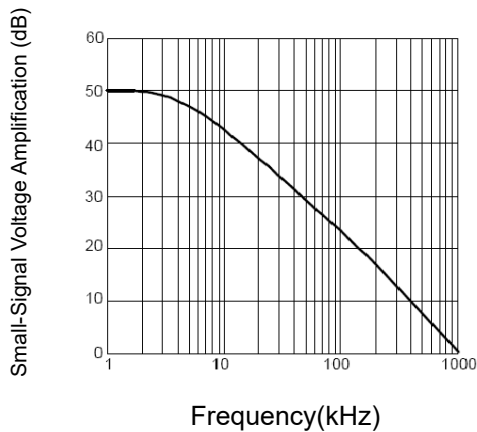


Figure 9: small-signal Voltage Amplification vs. Frequency

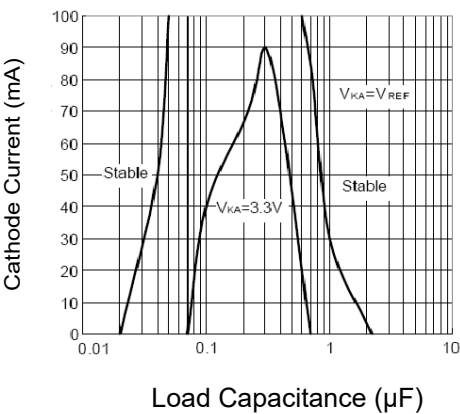


Figure 10: Stability Boundary Conditions

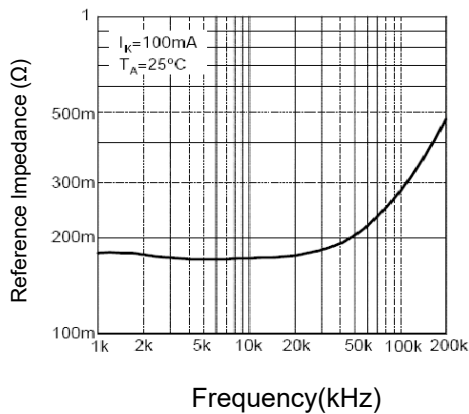


Figure 11: Reference Impedance vs. Frequency

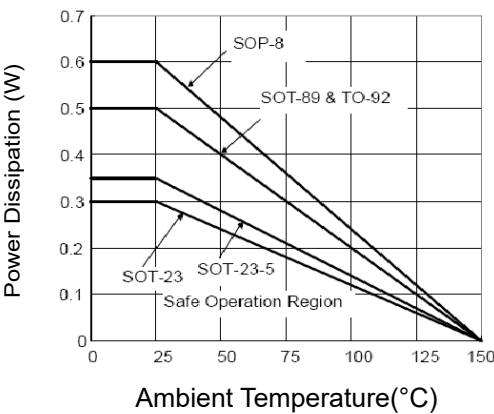
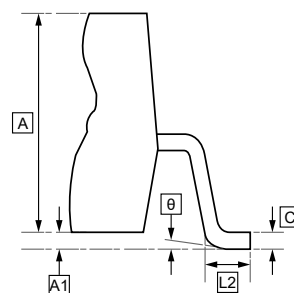
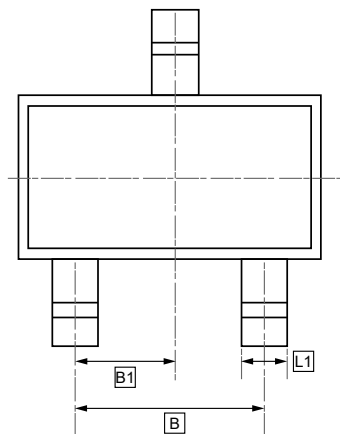
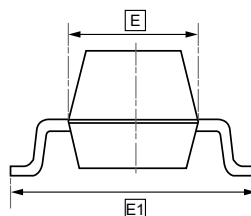
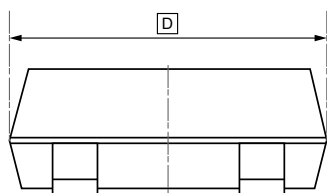


Figure 12: Power Dissipation vs. Ambient Temperature



12.1 SOT-23 Package Outline Dimensions

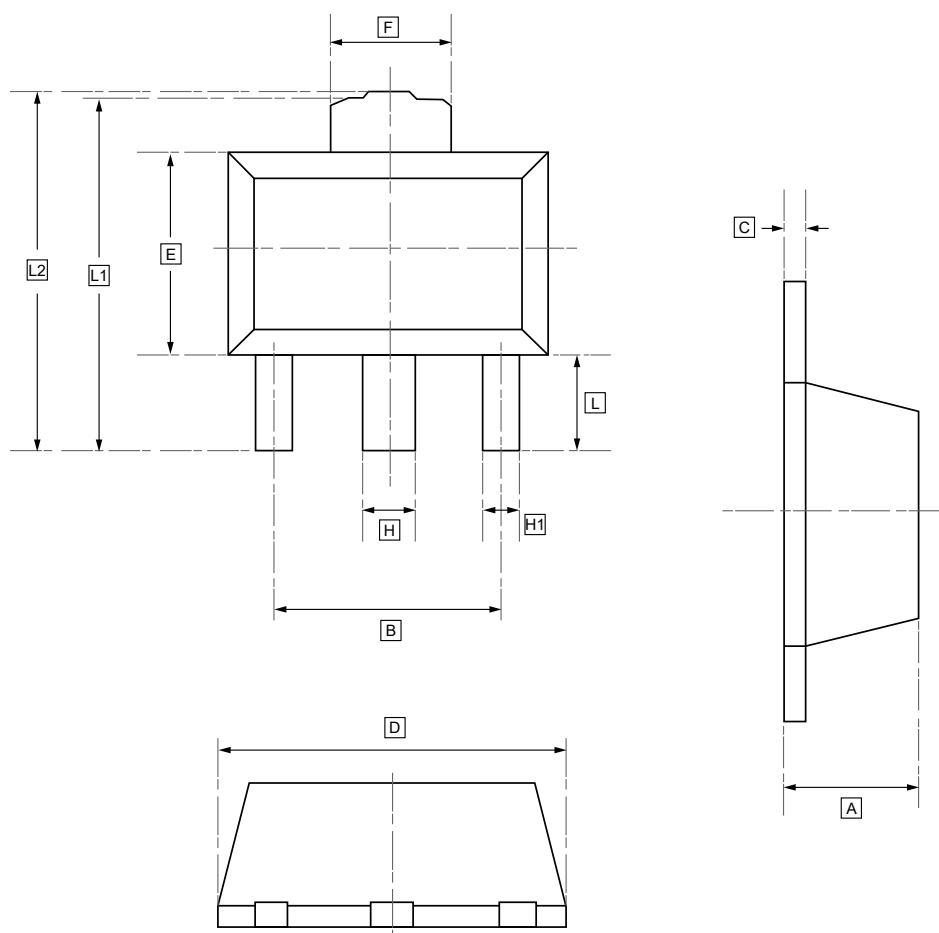


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	L1	L2	C	D	E	E1	B	B1	θ
Min	0.900	0.020	0.300	0.300	0.100	2.800	1.200	2.300	1.800	0.950	0°
Max	1.100	0.100	0.500	0.500	0.120	3.000	1.400	2.500	2.000	TYP	8°



12.2 SOT-89 Package Outline Dimensions

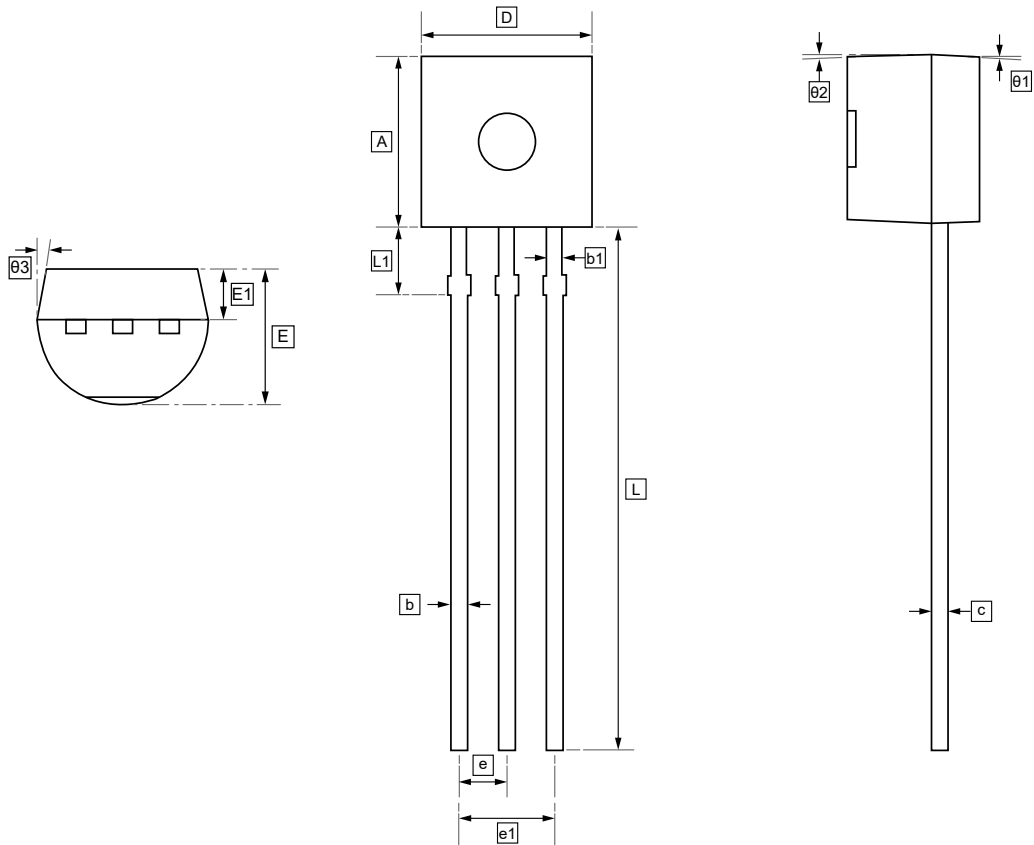


DIMENSIONS (mm are the original dimensions)

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 TO-92 Package Outline Dimensions



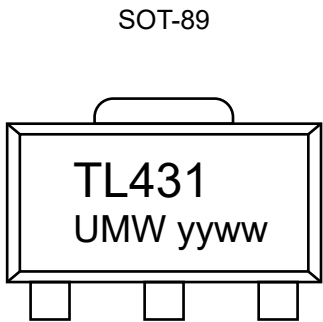
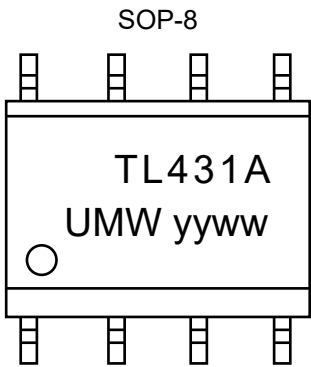
DIMENSIONS (mm are the original dimensions)

Symbol	A	b	b1	c	D	E	E1	e	e1	L	L1	Ø1
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	Ø2	Ø3
Min	2°	5°
Max		



13.Ordering information



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode	Accuracy
UMW TL431 0.5%	TL431	TO-92	2000	Ammo outfit	0.5%
UMW TL431(0.5%)	TL431A	TO-92	1000	Bulk Bag	0.5%
UMW TL431	431	SOT-23	3000	Tape and reel	0.5%
UMW TL431 1%	431	SOT-23	3000	Tape and reel	1%
UMW TL431S	TL431	SOT-89	1000	Tape and reel	0.5%
UMW TL431G	TL431	SOT-23	3000	Tape and reel	0.5%



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