MMTL431T

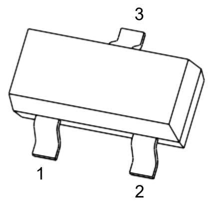
Programmable Precision References

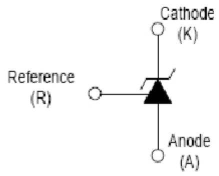
The MMTL431T integrated circuits are three–terminal programmable shunt regulator diodes. These monolithic IC voltage references operate as a low temperature coefficient zener which is programmable from V_{ref} to 36 V with two external resistors. These devices exhibit a wide operating current range of 1.0 mA to 100 mA with a typical dynamic impedance of 0.22 Ω. The characteristics of these references make them excellent replacements for zener diodes in many applications such as digital voltmeters, power supplies, and op amp circuitry. The 2.5 V reference makes it convenient to obtain a stable reference from 5.0 V logic supplies, and since the MMTL431T operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

SOT-23

1. REFERENCE
2. CATHODE
3. ANODE

MARKING:431





FEATURES

- The output voltage can be adjusted to 36V
- Low dynamic output impedance, its typical value is 0.2Ω
- Trapping current capability is 1 to 100mA
- Low output noise voltage
- Fast on -state response
- The effective temperature compensation in the working range of full temperature
- The typical value of the equivalent temperature factor in the whole temperature scope is 50 ppm/℃

Parameter	Symbol	Value	Unit
Cathode Voltage	V_{KA}	37	V
Cathode Current Range (Continuous)	I_{KA}	- 100 to + 150	mA
Reference Input Current Range	I_{REF}	- 0.05 to + 10	mA
Power Dissipation	P_D	350	mW
Operating Temperature Range	T_{opr}	- 25 to + 125	°C
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_{stg}	- 65 to + 150	°C

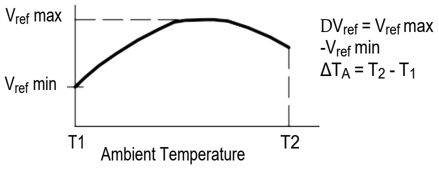
Recmmended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit
Cathode Voltage	V_{KA}	V_{REF}	36	V
Cathode Current	I_{KA}	1	100	mA

Characteristics at T_a = 25 °C

Parameter		Symbol	Min.	Typ.	Max.	Unit
Reference Input Voltage at $V_{KA} = V_{REF}$, I_{KA} = 10 mA	0.5%	V_{REF}	2.487	2.50	2.513	V
Reference Input Voltage at $V_{KA} = V_{REF}$, I_{KA} = 10 mA	1%	V_{REF}	2.475	2.50	2.525	V
Reference Input Voltage at $V_{KA} = V_{REF}$, I_{KA} = 10 mA	2%	V_{REF}	2.44	2.495	2.55	V
Deviation of Reference Input Voltage Over Temperatue at $V_{KA} = V_{REF}$, I_{KA} = 10 mA, - 25 °C ≤ T_a ≤ + 125 °C		$\Delta V_{REF}/\Delta T$	-	4.5	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage at I_{KA} = 10 mA	ΔV_{KA} = 10 V to V_{REF}	$\Delta V_{REF}/\Delta V_{KA}$	-	-1.0	-2.7	mV/V
	ΔV_{KA} = 36 V to 10 V		-	-0.5	-2	
Reference Input Current at I_{KA} = 10 mA, R1 = 10 KΩ, R2 = ∞		I_{REF}	-	1.5	4	μA
Deviation of Reference Input Current Over Full Temperatue at I_{KA} = 10 mA, R1 = 10 KΩ, R2 = ∞, - 25 °C ≤ T_a ≤ + 125 °C		$\Delta I_{REF}/\Delta T$	-	0.4	1.2	μA
Minimum Cathode Current for Regulation at $V_{KA} = V_{REF}$		$I_{KA(min)}$	-	0.45	1	mA
Off-Stage Cathode Current at V_{KA} = 36 V, V_{REF} = 0		$I_{KA(OFF)}$	-	0.05	1	μA
Dynamic Impedance at $V_{KA} = V_{REF}$, I_{KA} = 1 to 100 mA, f ≤ 1 KHz		Z_{KA}	-	0.15	0.5	Ω

1. The deviation parameter ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full operating ambient temperature range that applies.



The average temperature coefficient of the reference input voltage, αV_{ref} is defined as:

$$V_{ref}\ \frac{ppm}{^\circ C} = \frac{\left(\frac{\Delta V_{ref}}{V_{ref}\ @\ 25^\circ C}\right)\times 10^6}{\Delta T_A} = \frac{\Delta V_{ref}\times 10^6}{\Delta T_A\,(V_{ref}\ @\ 25^\circ C)}$$

αV_{ref} can be positive or negative depending on whether V_{ref} Min or V_{ref} Max occurs at the lower ambient temperature. (Refer to Figure 6.)

Example : ΔV_{ref} = 8.0 mV and slope is positive,
V_{ref} @ 25 °C = 2.495 V, ΔT_A = 70 °C

$$\alpha V_{ref} = \frac{0.008\times 10^6}{70\,(2.495)} = 45.8\ ppm/^\circ C$$

2. The dynamic impedance Z_{KA} is defined as: $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_K}$. When the device is programmed with two external resistors, R1 and R2, (refer to Figure 2) the total dynamic impedance of the circuit is defined as: $|Z_{KA}'| \approx |Z_{KA}|\left(1+\frac{R1}{R2}\right)$

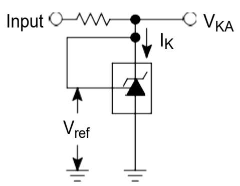


Figure 1. Test Circuit for $V_{KA} = V_{ref}$

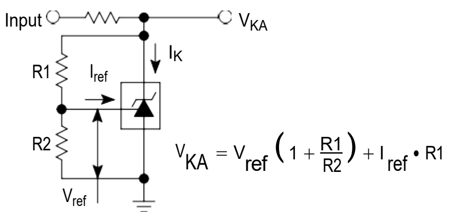


Figure 2. Test Circuit for $V_{KA} > V_{ref}$

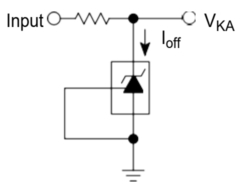


Figure 3. Test Circuit for I_{off}

Typical Characteristics

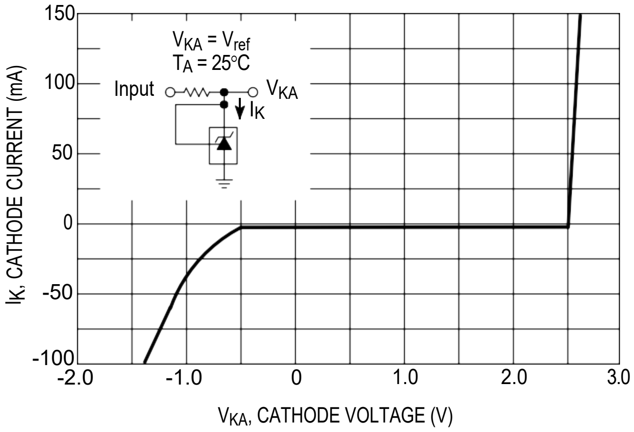


Figure 4. Cathode Current versus Cathode Voltage

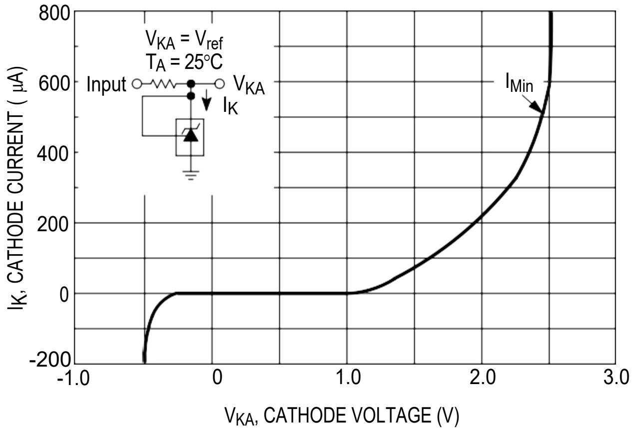


Figure 5. Cathode Current versus Cathode Voltage

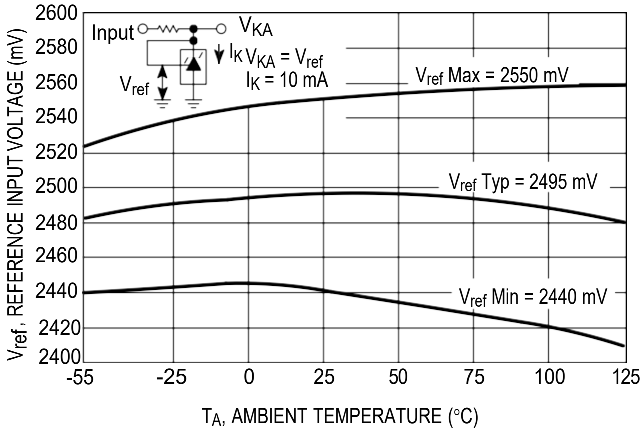


Figure 6. Reference Input Voltage versus Ambient Temperature

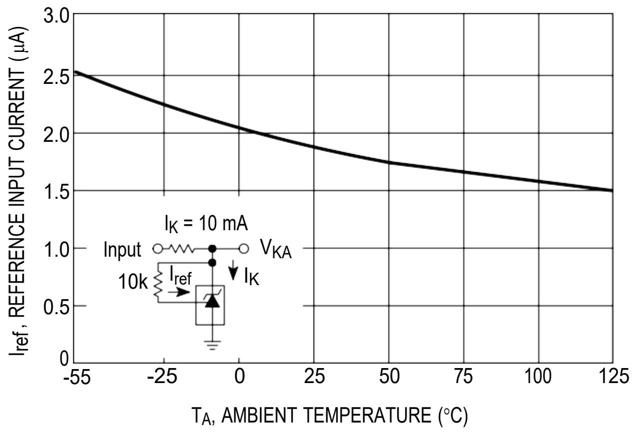


Figure 7. Reference Input Current versus Ambient Temperature

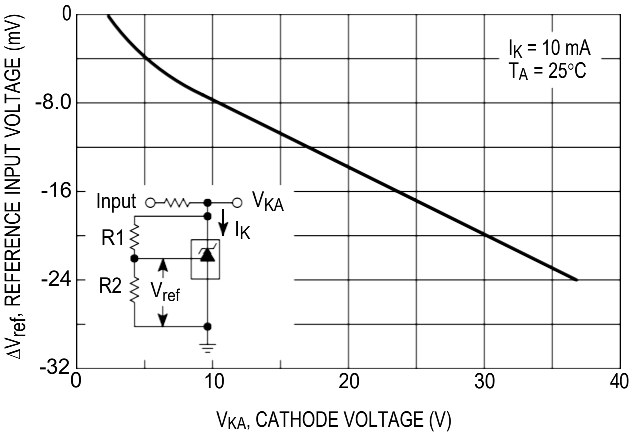


Figure 8. Change in Reference Input Voltage versus Cathode Voltage

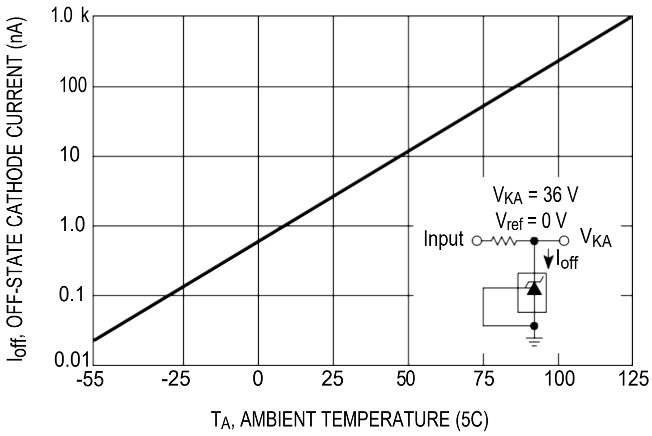


Figure 9. Off–State Cathode Current versus Ambient Temperature

Typical Characteristics

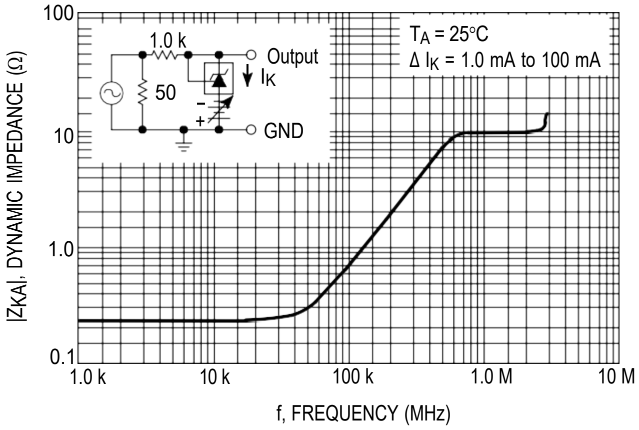


Figure 10. Dynamic Impedance versus Frequency

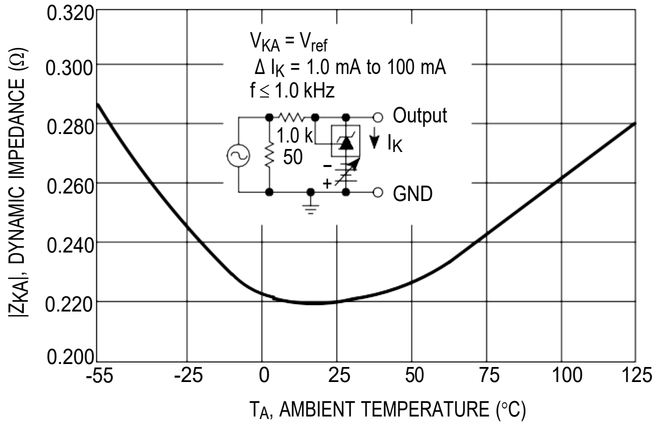


Figure 11. Dynamic Impedance versus Ambient Temperature

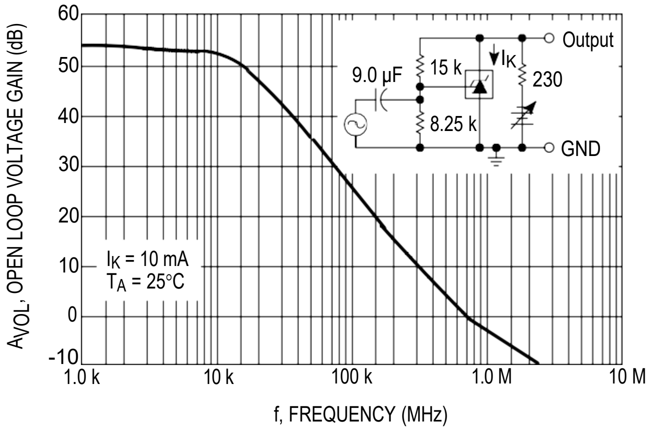


Figure 12. Open−Loop Voltage Gain versus Frequency

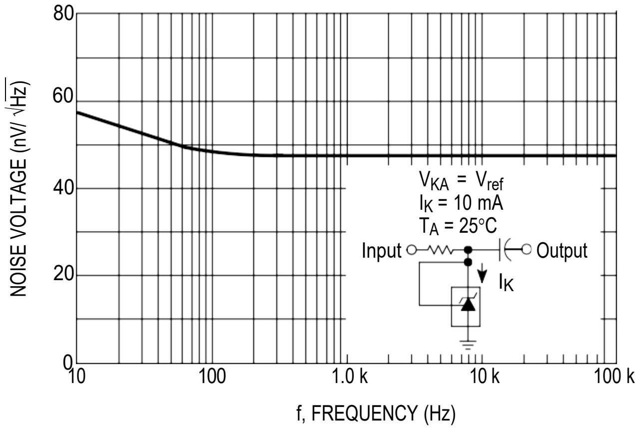


Figure 13. Spectral Noise Density

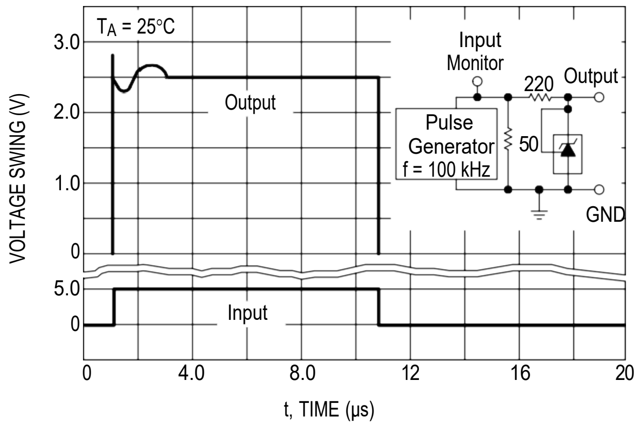


Figure 14. Pulse Response

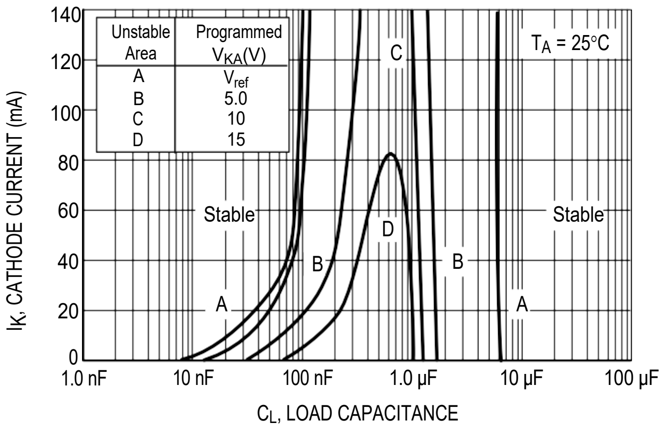
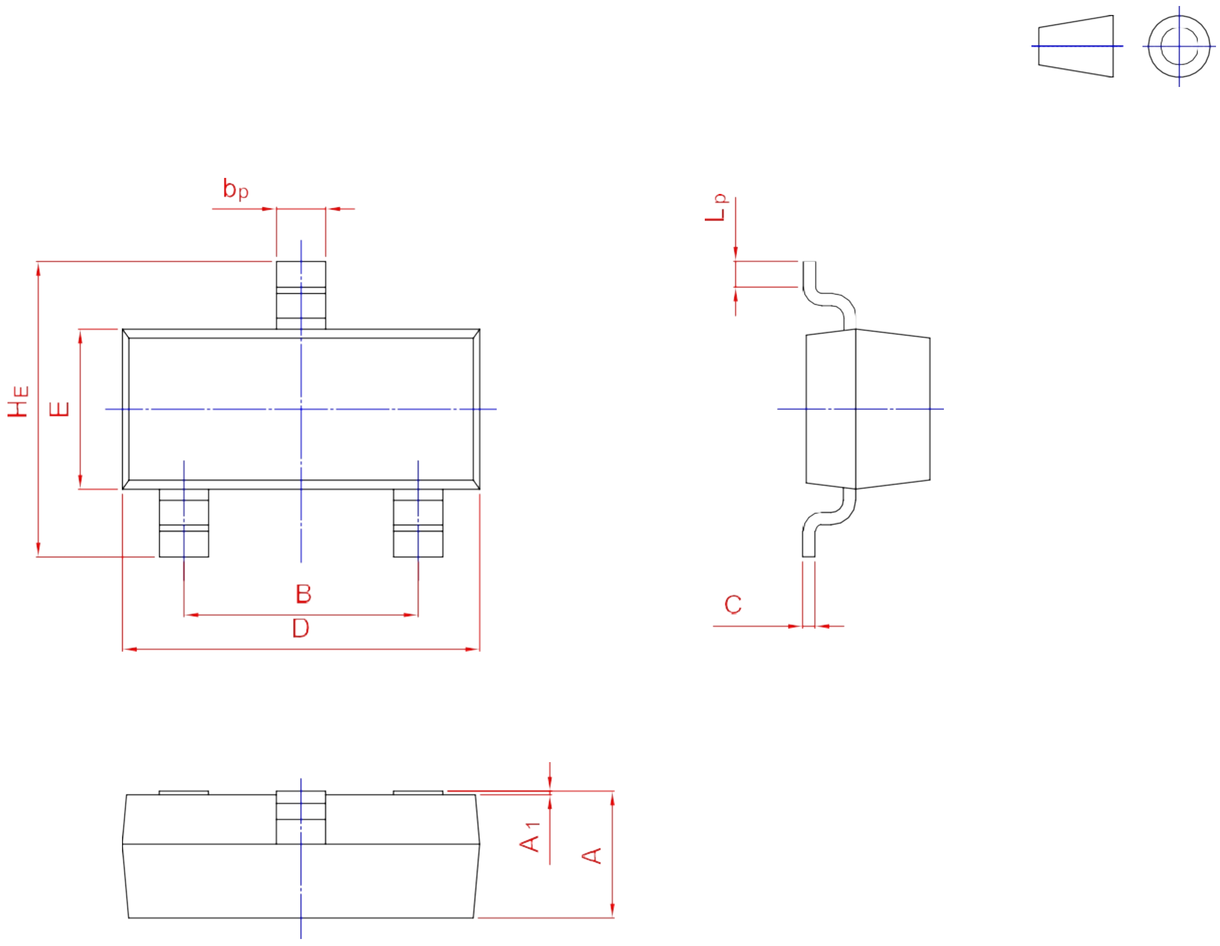


Figure 15. Stability Boundary Conditions

PACKAGE OUTLINE

Plastic surface mounted package; 3 leads **SOT-23**



UNIT	A	B	b_p	C	D	E	H_E	A_1	L_p
mm	1.40 0.95	2.04 1.78	0.50 0.35	0.19 0.08	3.10 2.70	1.65 1.20	3.00 2.20	0.100 0.013	0.50 0.20