

GENERAL DESCRIPTION

The L431 is a three-terminal adjustable shunt regulator utilizing an accurate 2.5V band-gap reference. The output voltage can be set to any value between 2.5V (V_{REF}) to 29V with two external resistors as shown in the typical application circuit. The device exhibit a wide operating current range of 0.4 to 70 mA with a typical dynamic impedance of 0.25Ω . The characteristics of these reference make it excellent replacements for zener diodes in many applications such as digital voltmeters, power supplies, and op amp circuitry. The 2.5V voltage reference makes it convenient to obtain a stable reference from 5.0V logic supplies. The L431 shunt regulator is available in three voltage tolerances (0.5%, 1.0% and 2%) and three package options (TO-92, SOT-23-3, SOT-23-5 and SOIC-8).

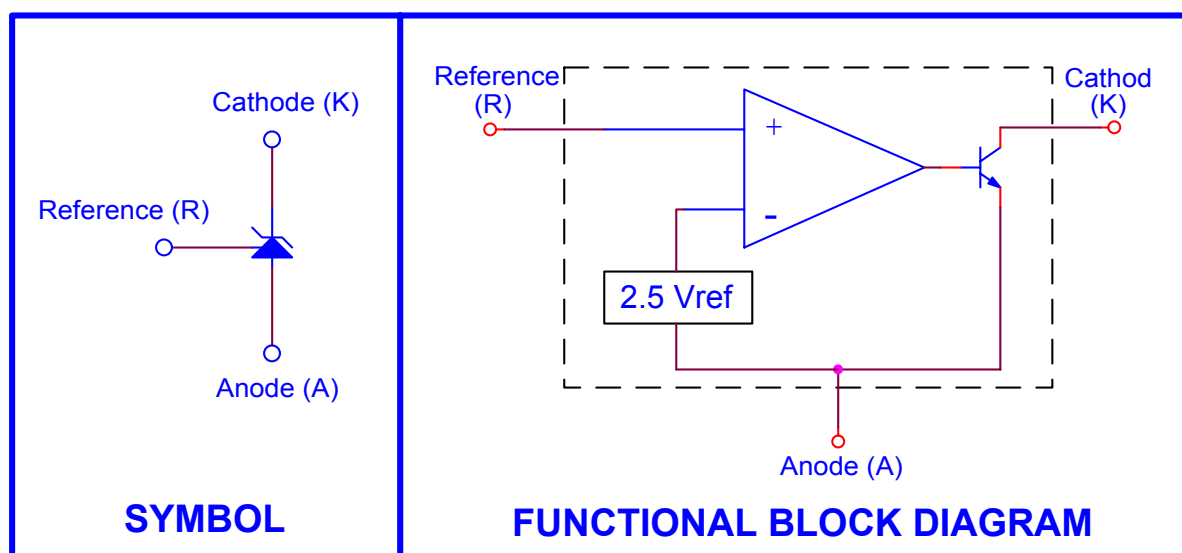
FEATURES

- Internal amplifier with 70 mA capability
- Programmable output voltage to 29V
- 0.25Ω typical output impedance
- Pin to pin compatible with LM431
- Trimmed band-gap design 0.5%, 1.0% and 2% with three package options
- Low cost solution

APPLICATIONS

- Linear regulator controller
- Precision voltage reference
- Switching power supplies
- Battery operating equipment
- Instrumentation
- PCs, Computer disk drives

SYMBOL & BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

PARAMETER	VALUE
Cathode-Anode Reverse Breakdown Voltage - V_{KA}	30V
Anode-Cathode Forward Current - I_{AK}	70 mA
Reference Input Current - I_{REF}	10 mA
Storage Temperature Range - T_{STG}	-65 to +150 °C
Junction Temperature - T_J	150 °C
Lead Temperature (Soldering, 10 Seconds) - T_L	300 °C
Continuous Power at 25 °C - P_D	
TO-92	700 mW
SOIC-8	650 mW
SOT-23	200 mW

RECOMMENDED CONDITIONS

Parameter	Rating
Cathode Voltage (V_{KA})	V_{REF} to 29V
Cathode Current (I_K)	10 mA

TYPICAL THERMAL RESISTANCES

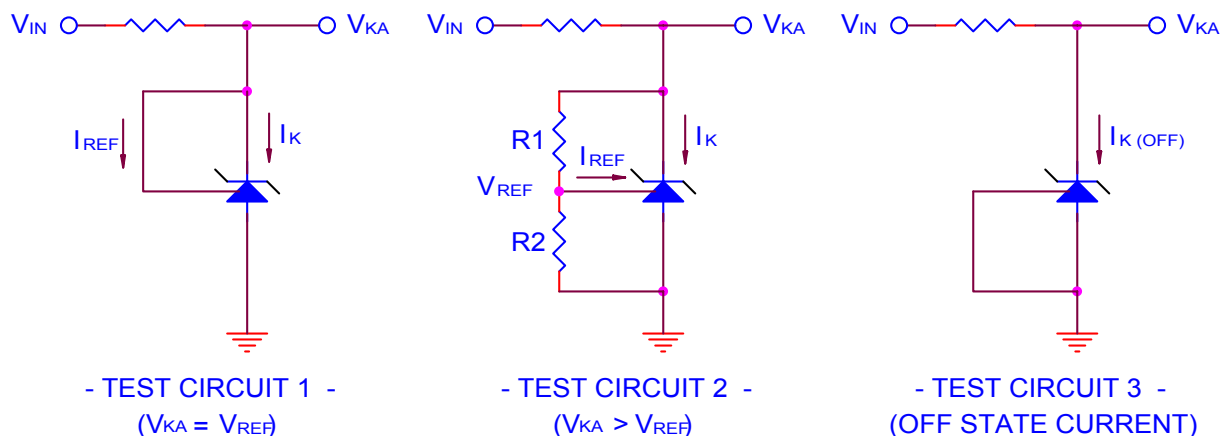
Package	θ_{JA}	θ_{JC}	Typ. Derating
TO-92	160 °C/W	80 °C/W	6.3 mW/°C
SOIC-8	175 °C/W	45 °C/W	5.7 mW/°C
SOT-23	575 °C/W	150 °C/W	1.7 mW/°C

ELECTRICAL SPECIFICATIONS

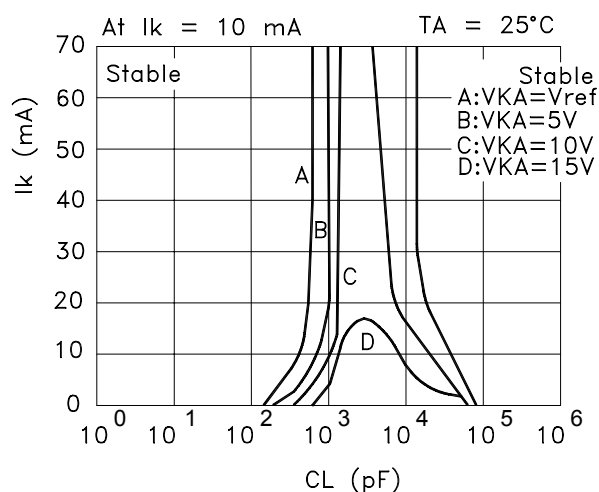
(Ambient temperature must be derated base on power dissipation and package thermal characteristics. The conditions are: $V_{KA} = V_{REF}$ and $I_K = 10$ mA unless otherwise stated)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	TEST CIRCUIT
Reference Voltage	$T_A = 25$ °C, L431 (0.5%)	2.482	2.495	2.507	V	1
	$T_A = 25$ °C, L431 (1%)	2.470	2.495	2.520		
	$T_A = 25$ °C, L431 (2%)	2.445	2.495	2.550		
ΔV_{REF} with Temp.			0.07	0.2	mV/°C	1
Ration of Change in V_{REF} to Cathode Voltage	V_{REF} to 10V	-2.7	-1.0		mV/V	2
	10V to 30V	-2.0	-0.4	0.3		
Reference Input Current			0.7	4	μA	2
I_{REF} Temp. Deviation	Over Temp.		0.4	1.2	μA	2
Min. I_K for Regulation			0.4	1	mA	1
Off State Leakage	$V_{REF} = 0V$, $V_{KA} = 30V$		0.04	250	nA	3
Dynamic Output Impedance	$f \leq 1KHz$, $I_K = 1$ to 70 mA		0.25	0.5	Ω	1

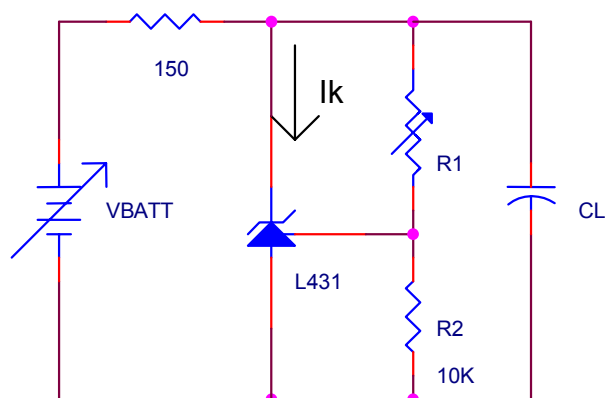
TEST CIRCUITS



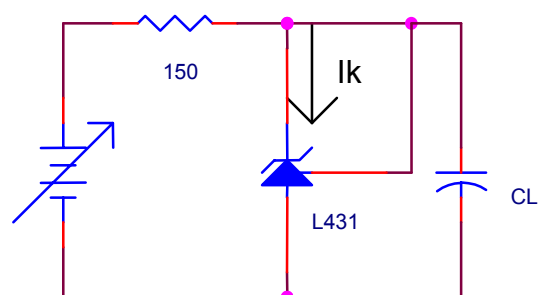
Stability Boundary Condition For Shunt Regulation VS. Cathode Current and Load Capacitance



Test Circuit for $V_{ka} > V_{ref}$

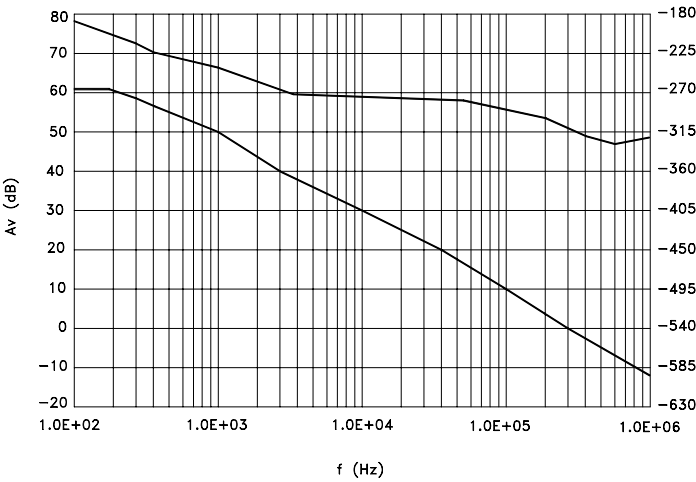


Test Circuit for $V_{ka} = V_{ref}$

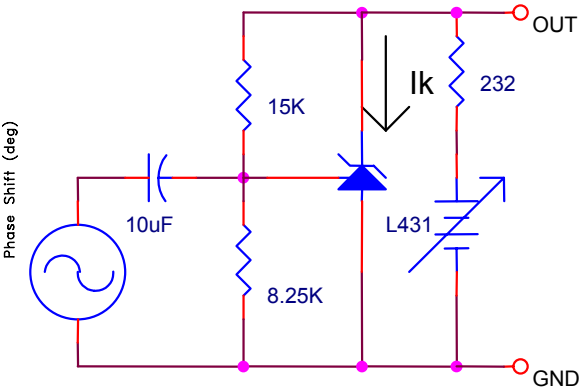


The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C and D, R_1 and V_{BATT} were adjusted to establish the initial V_{KA} and I_{KA} conditions with $C_L = 0$. V_{BATT} and C_L then were adjusted to determine the ranges of stability.

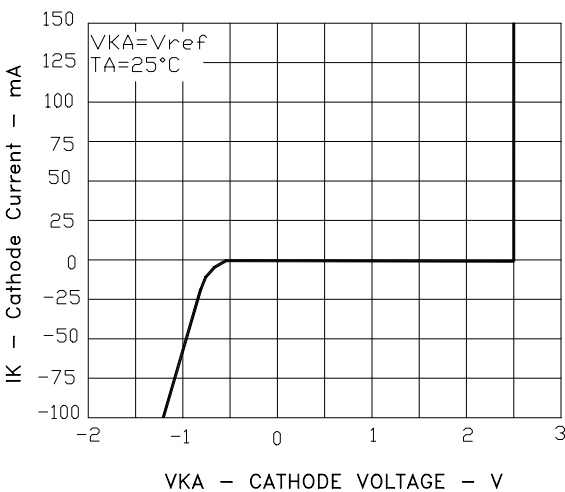
Small-Signal Gain and Phase Shift
VS. Frequency



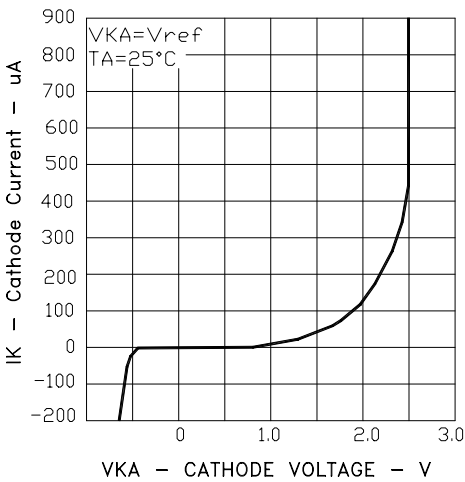
Test Circuit for Small Signal Gain and Phase



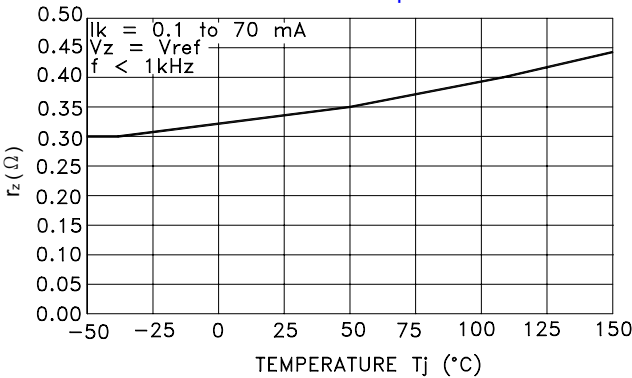
Cathode Current
VS. Cathode Voltage



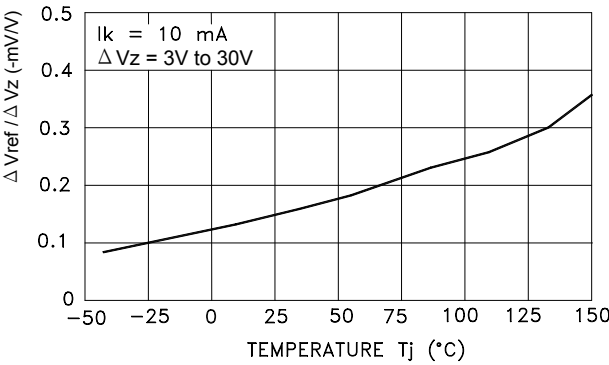
Cathode Current
VS. Cathode Voltage



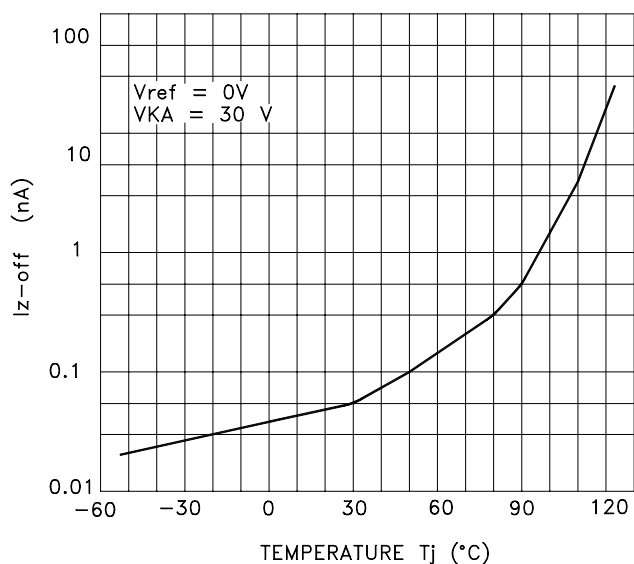
Reference Impedance
VS. Junction Temperature



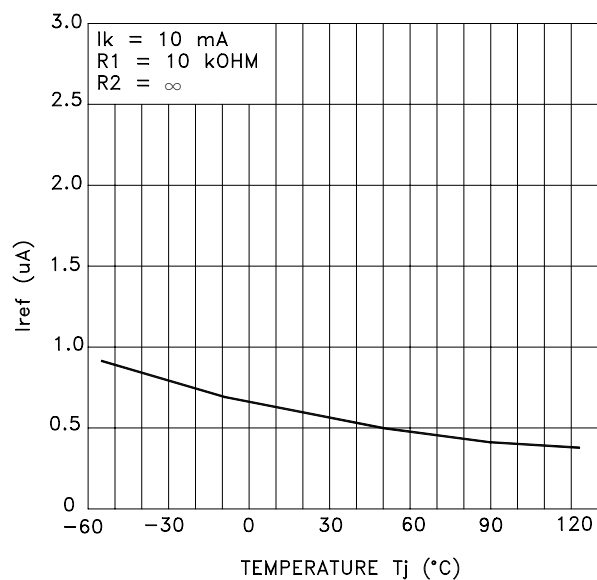
Ratio of Delta Reference Voltage to Delta Cathode Voltage
VS. Junction Temperature



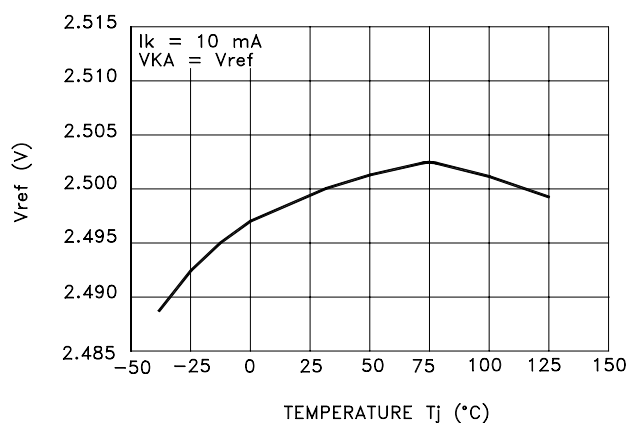
Off-State Cathode Current
VS. Junction Temperature



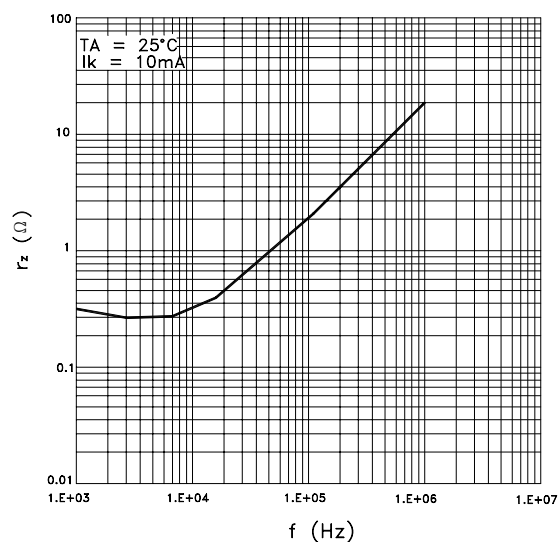
Reference Input Current
VS. Junction Temperature



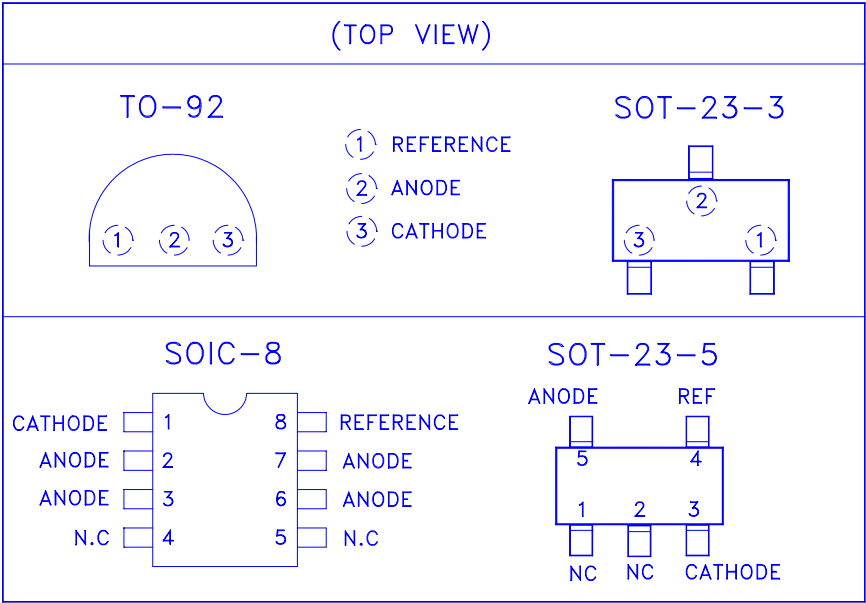
Reference Voltage
VS. Junction Temperature



Reference Impedance
VS. Frequency

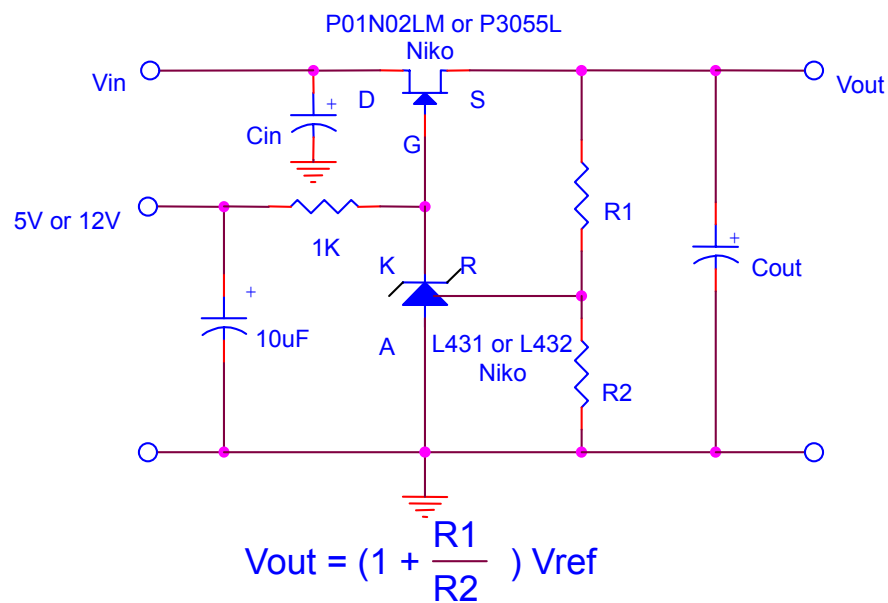


PIN CONFIGURATION



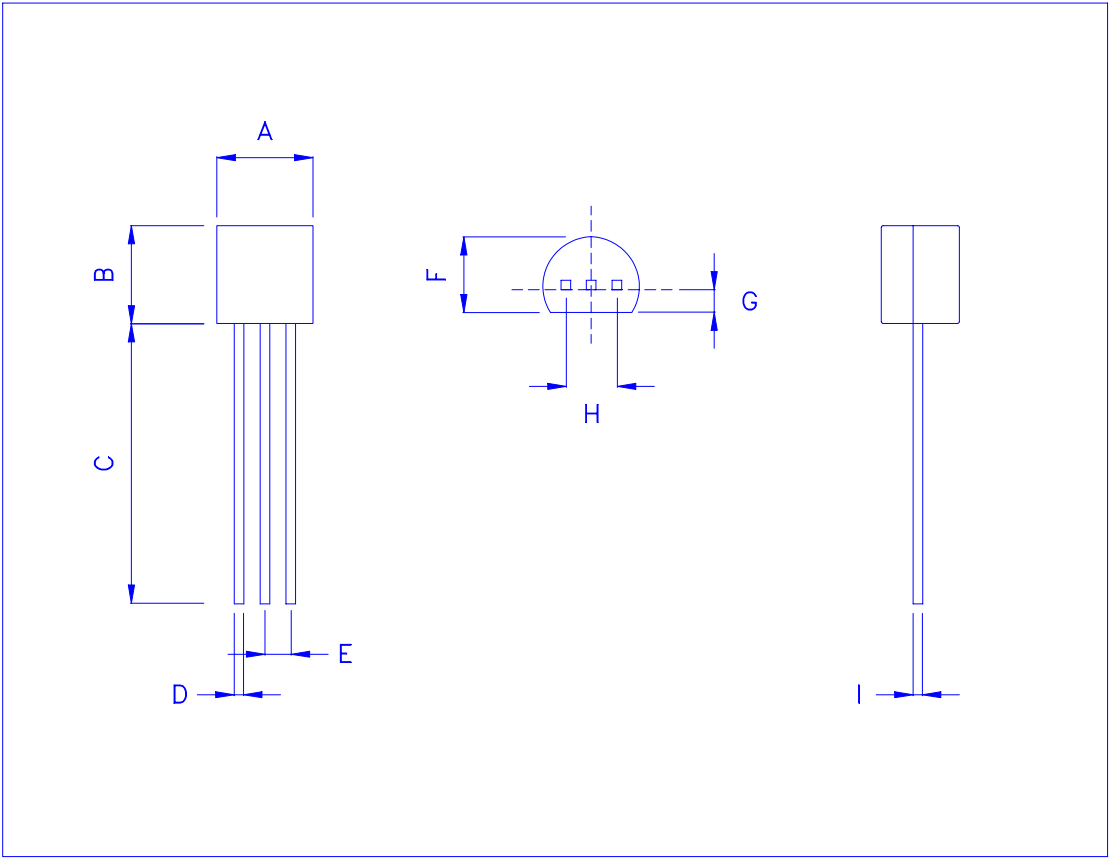
DEVICE SELECTION GUIDE

Device	L431NB	L431M3R	L431VB	L431M5B
Package	TO-92	SOT-23-3	SOIC-8	SOT-23-5
Marking	L431N	1M3R	L431V	1M5A
Tolerance	1%	1%	1%	1%

APPLICATION CIRCUIT


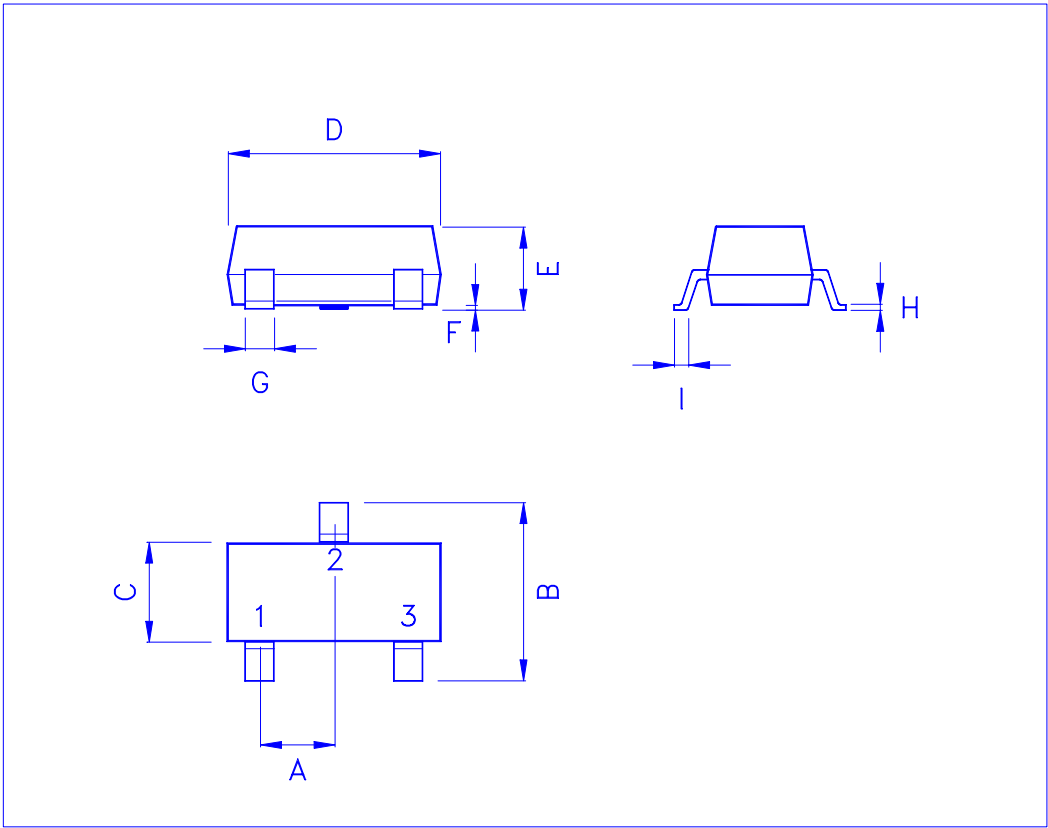
TO-92 MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.445		5.207	H	2.413	2.540	2.667
B	4.318		5.334	I	0.356		0.533
C	12.7		15.5	J			
D	0.356		0.533	K			
E	1.143	1.27	1.397	L			
F	3.175		4.191	M			
G	0.762		1.270	N			



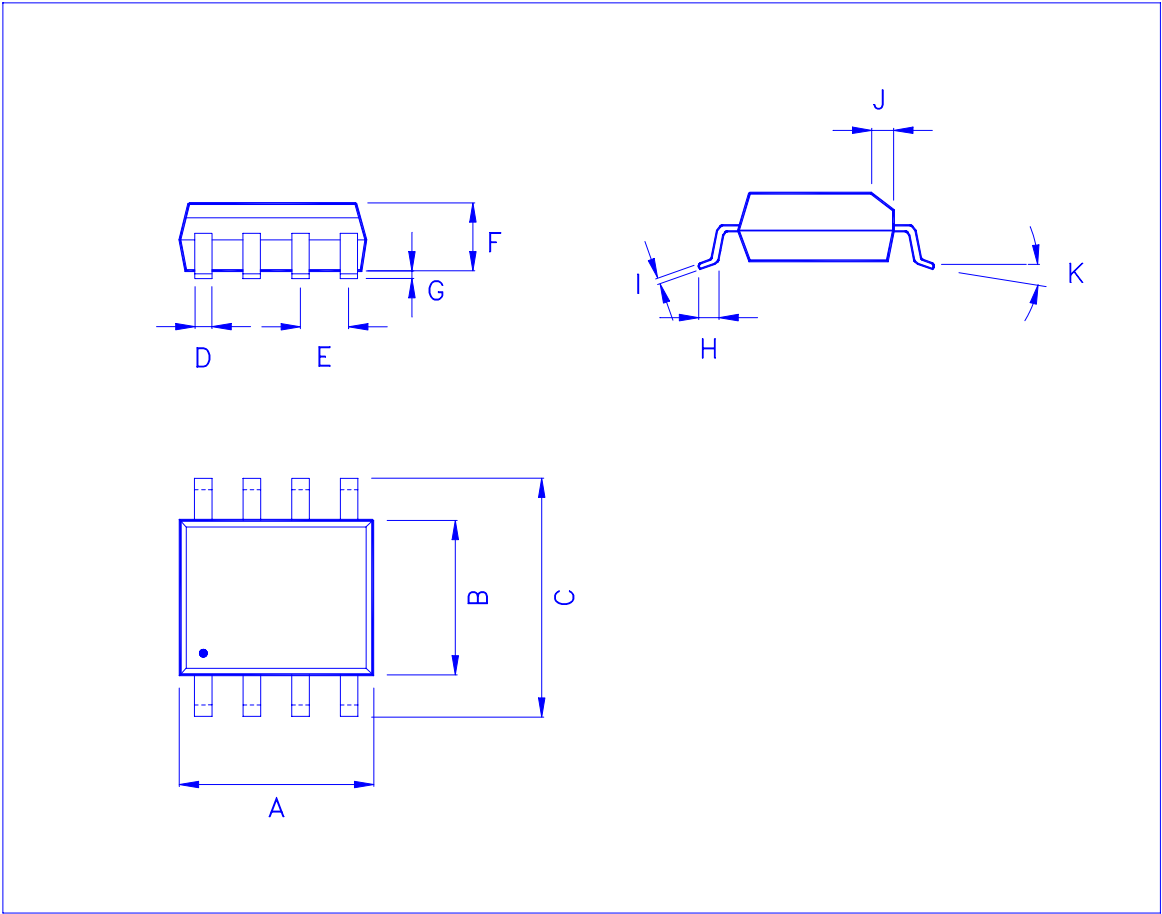
SOT-23 (M3) MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A		0.95		H	0.10	0.15	0.25
B	2.60	2.80	3.00	I	0.37		
C	1.40	1.60	1.80	J			
D	2.70	2.90	3.10	K			
E	1.00	1.10	1.30	L			
F	0.00		0.10	M			
G	0.35	0.4	0.5	N			



SOIC-8 (D) MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.8		5.0	H	0.4		1.27
B	3.8		4.0	I	0.18		0.25
C	5.8		6.2	J		0.22	
D	0.35		0.48	K	0°		8°
E		1.27		L			
F			1.65	M			
G	0.1		0.25	N			



SOT-23 (M5) MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	1.0	1.10	1.30	e		1.90(TYP)	
A1	0.00		0.10	H	2.60	2.80	3.00
A2	0.70	0.80	0.90	L	0.37		
b	0.35	0.40	0.50				
C	0.10	0.15	0.25				
D	2.70	2.90	3.10				
E	1.40	1.60	1.80				

