



General Description

The TL431 is a low voltage three terminal adjustable shunt regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage can be set to any value between 2.495V (VREF) to 36V with two external resistors (see application circuit). The high precise Reference voltage tolerance is $\pm 0.4\%$ and $\pm 1.0\%$ by TL431. This device has a typical output impedance of 0.2Ω . Active output circuitry provides a very sharp turn on characteristic, making this device excel lent replacement for Zener diodes in many applications..

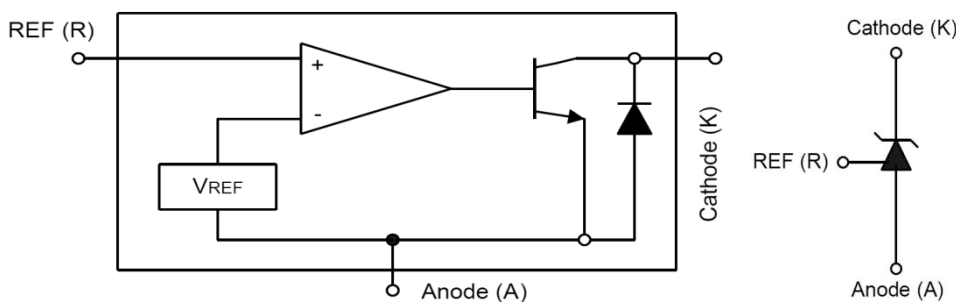
Features

- Precision reference voltage :
 - TL431A : $2.495V \pm 0.4\%$
 - TL431B : $2.495V \pm 1.0\%$
- Adjustable output voltage is VREF to 36V
- Sink current capability is 100mA
- Low dynamic output impedance is 0.2Ω (typ.)
- Minimum Cathode current for regulation is 0.45mA (typ.)

Applications

- Switching Mode Power Supply
- Voltage Reference Application

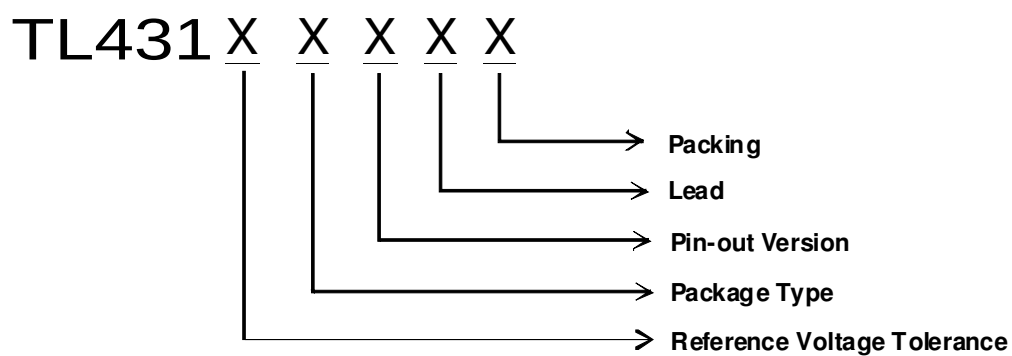
Block Diagram & Symbol



Please be aware that an **Important Notice** concerning availability, disclaimers, and use in critical applications of LSC products is at the end of this document.



Ordering Information

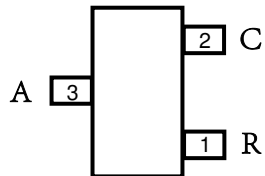


Reference Voltage Tolerance	Package Type	Pin-out Version	Lead	Packing
A : $\pm 0.4\%$ B : $\pm 1.0\%$	C : SOT23-3L	R 1. CATHODE (SOT23-3L) 2. REF 3. ANODE N 1. REF (SOT23-3L) 2. CATHODE 3. ANODE	P : RoHS & Halogen Free (ref. IEC 61249-2-21)	A : Tape & Reel

Product Number	Output Voltage Tolerance	Package	Lead	Packing
TL431ACNPA	0.4 %	SOT23	RoHS& Halogen Free	Taping & Reel
TL431BCNPA	1.0 %	SOT23	RoHS& Halogen Free	Taping & Reel
TL431ACRPA	0.4 %	SOT23	RoHS& Halogen Free	Taping & Reel
TL431BCRPA	1.0 %	SOT23	RoHS& Halogen Free	Taping & Reel

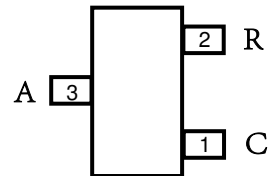
Pin Assignment

SOT23
(Top View)



TL431 AC**N**PA
TL431 BC**N**PA

SOT23
(Top View)



TL431 AC**R**PA
TL431 BC**R**PA

Pin Descriptions

Pin Name	Pin Description
R	Ref
A	Anode
C	Cathode

Absolute Maximum Ratings(at $T_A=25^{\circ}\text{C}$)

Note: Operate over the “Absolute Maximum Ratings” may cause permanent damage to the device.
Exposure to such conditions for extended time may still affect the reliability of the device.

Characteristics	Symbol	Rating	Unit
Cathode Voltage	V_{KA}	37	V
Continuous Cathode Current	I_{KA}	-100-100	mA
Reference Input Current	I_{REF}	0.05-10	mA
Junction Temperature	T_J	120	$^{\circ}\text{C}$
Storage Temperature	T_{STG}	-40~150	$^{\circ}\text{C}$
Moisture Sensitivity	MSL	Please refer the MSL label on the IC package bag/carton for detail	

Note1 : Ratings apply to ambient temperature at 25°C

Recommended Operating Conditions

Characteristics	Symbol	Min	Max	Unit
Cathode Voltage	V_{KA}	V_{REF}	36	V
Cathode Current	I_{KA}	1	100	mA
Operating Temperature (Operating free-air temperature)	T_A	0	70	$^{\circ}\text{C}$

Electrical Characteristics

($T_A=25^{\circ}\text{C}$, unless otherwise specified)

参数	符号	测试条件	最小值	典型值	最大值	单位
基准输入电压	V_{ref}	$V_{KA}=V_{\text{ref}}, I_{KA}=10\text{mA}$	2.445	2.495*	2.545	V
			2.450	2.500*	2.550	
基准电压温度漂移	$\Delta V_{\text{ref}}/\Delta T$	$V_{KA}=V_{\text{ref}}, I_C=100\mu\text{A}$ $T_A=0 \sim 70^{\circ}\text{C}$		4.5	17	mV
基准与阴极电压变化比率	$\Delta V_{\text{ref}}/\Delta V_{KA}$	$I_{KA}=10\text{mA}$, $\Delta V_{KA}=10\text{V} \sim V_{\text{ref}}$		-1.0	-2.7	mV/V
		$I_{KA}=10\text{mA}$ $\Delta V_{KA}=36\text{V} \sim 10\text{V}$		-0.5	-2.0	mV/V
基准输入电流	I_{REF}	$I_{KA}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$		1.5	4	μA
基准输入电流温度变化率	$\Delta I_{\text{REF}}/\Delta T$	$I_{KA}=10\text{mA}, R1=10\text{K}\Omega, R2=\infty$ $T_A=40 \sim 120^{\circ}\text{C}$		0.4	1.2	μA
最小稳压阴极电流	$I_{KA(\text{MIN})}$	$V_{KA}=V_{\text{ref}}$		0.45	1.0	mA
OFF阴极电流	$I_{KA(\text{OFF})}$	$V_{KA}=36\text{V}, V_{\text{ref}}=0$		0.05	1.0	μA
动态阻抗	Z_{KA}	$V_{KA}=V_{\text{ref}}$ $I_{KA}=1 \sim 100\text{mA}$ $f \leq 1.0\text{KHz}$		0.2	0.5	Ω

Note 2 : These specifications are guaranteed by design and are not tested when in mass-production.

Application Circuit

Fig1: $V_{KA} = V_{REF}$

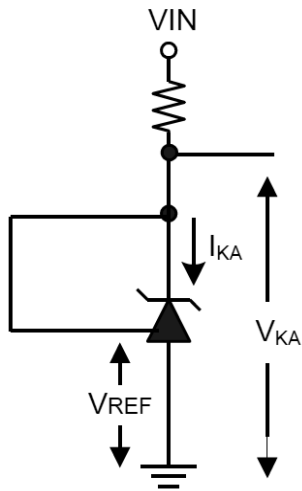


Fig2: $V_{KA} > V_{REF}$

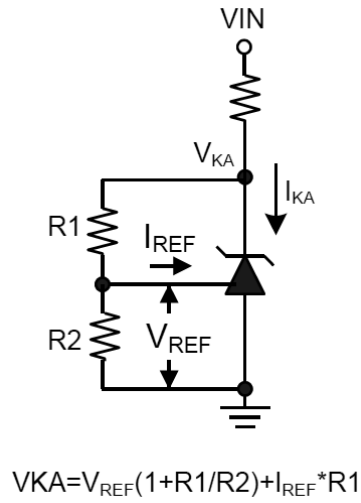
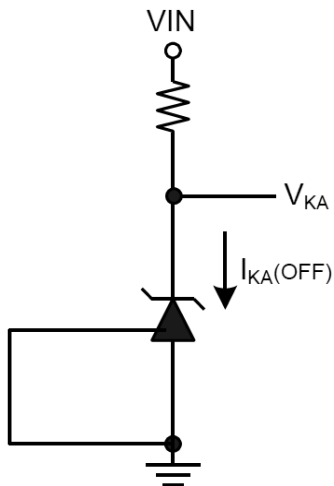


Fig3: Off state current



Typical Characteristics

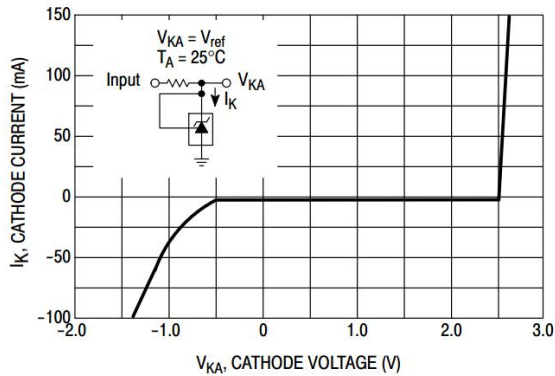


Figure 4. Cathode Current versus Cathode Voltage

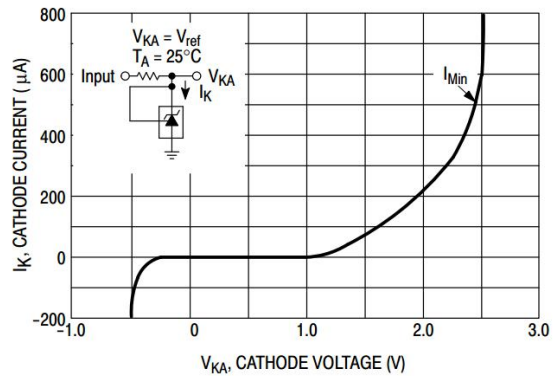


Figure 5. Cathode Current versus Cathode Voltage

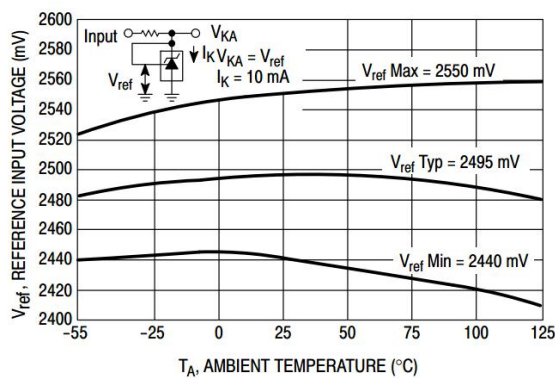


Figure 6. Reference Input Voltage versus Ambient Temperature

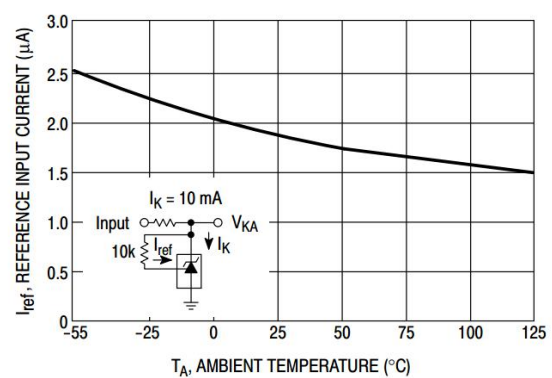


Figure 7. Reference Input Current versus Ambient Temperature

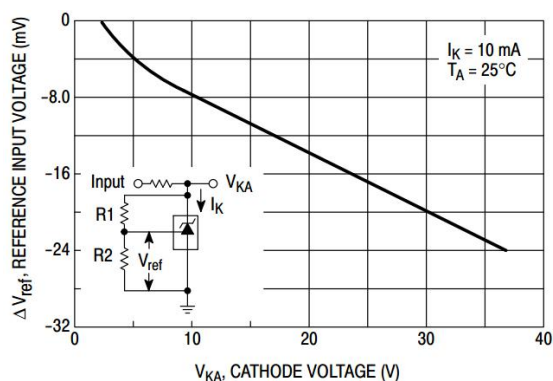


Figure 8. Change in Reference Input Voltage versus Cathode Voltage

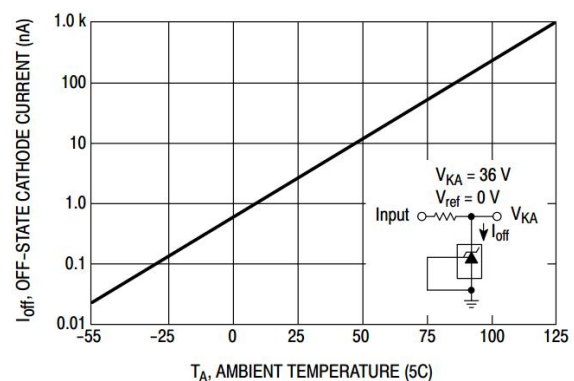


Figure 9. Off-State Cathode Current versus Ambient Temperature

Typical Characteristics(Continued)

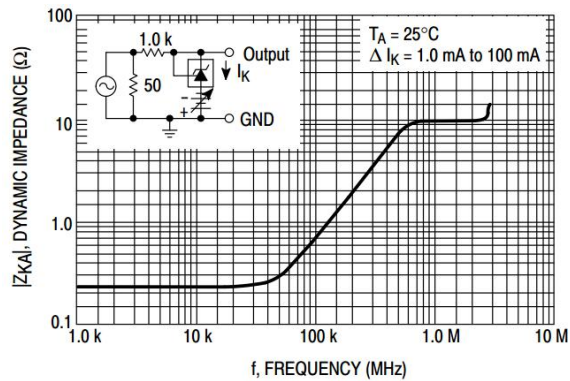


Figure 10. Dynamic Impedance versus Frequency

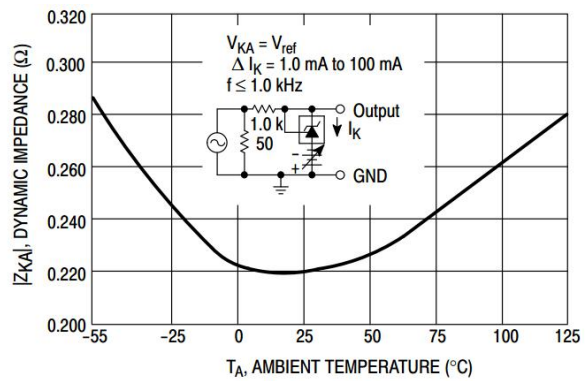


Figure 11. Dynamic Impedance versus Ambient Temperature

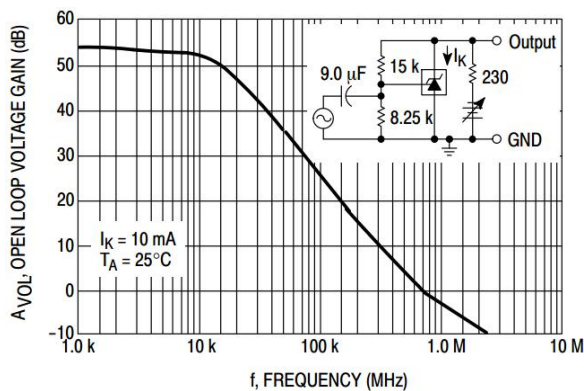


Figure 12. Open-Loop Voltage Gain versus Frequency

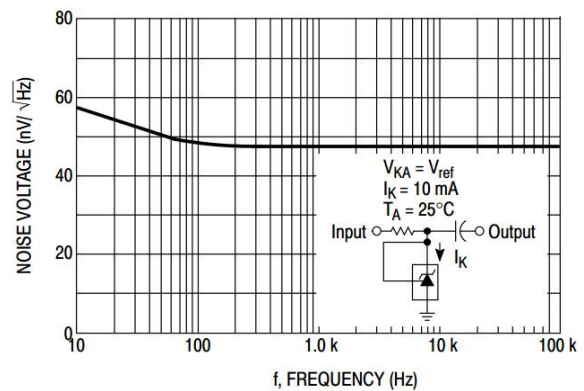


Figure 13. Spectral Noise Density

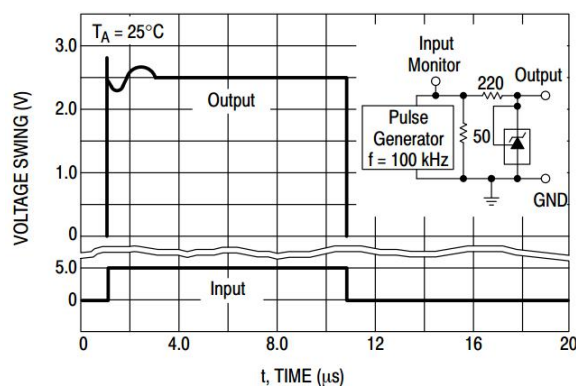


Figure 14. Pulse Response

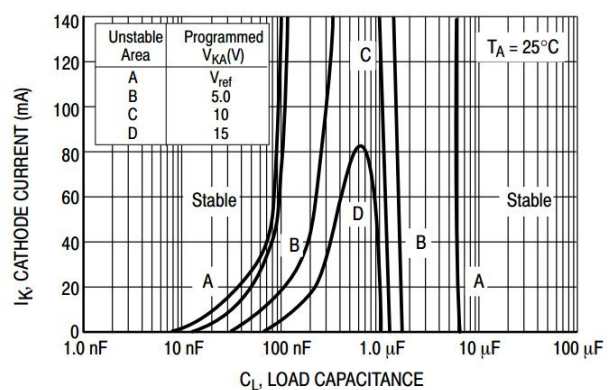
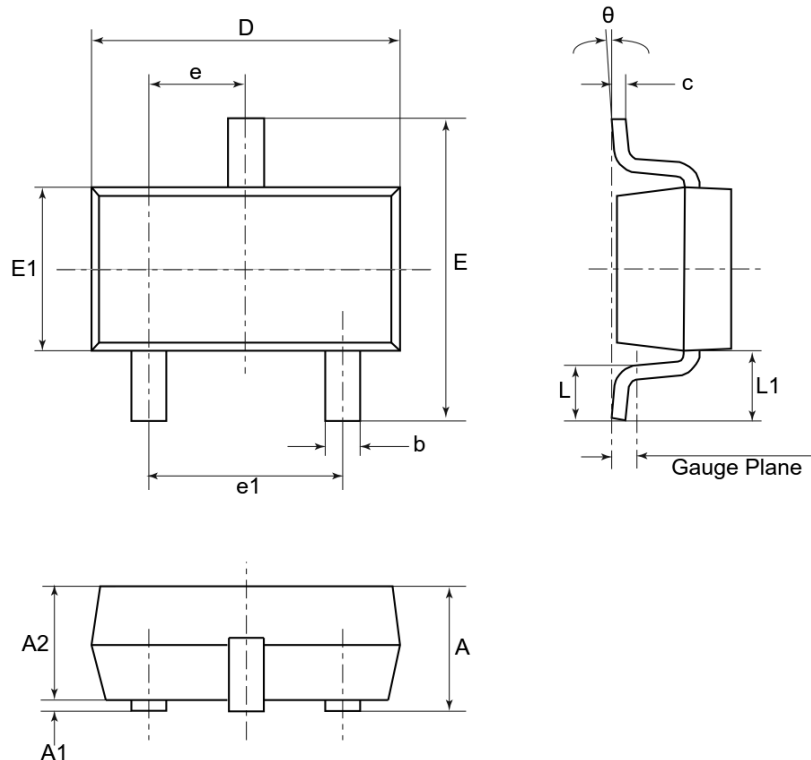


Figure 15. Stability Boundary Conditions

Mechanical Information

(1) Package type: SOT23

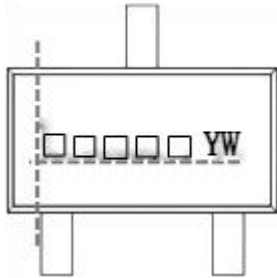


Unit: mm

Symbol	Min	Max
A	0.90	1.15
A1	0.00	0.10
A2	0.90	1.05
b	0.30	0.50
c	0.07	0.18
D	2.80	3.04
E	2.10	2.64
E1	1.20	1.40
e	0.95 REF	
e1	1.80	2.00
L	0.30	0.50
L1	0.55 REF	
θ	0°	8°
Gauge Plane	0.25 BSC	

Marking Information

(1) SOT23



1) □□□□□ = Marking Name

ACNPA=TL431ACNPA

BCNPA=TL431BCNPA

ACRPA=TL431ACRPA

BCRPA=TL431BCRPA

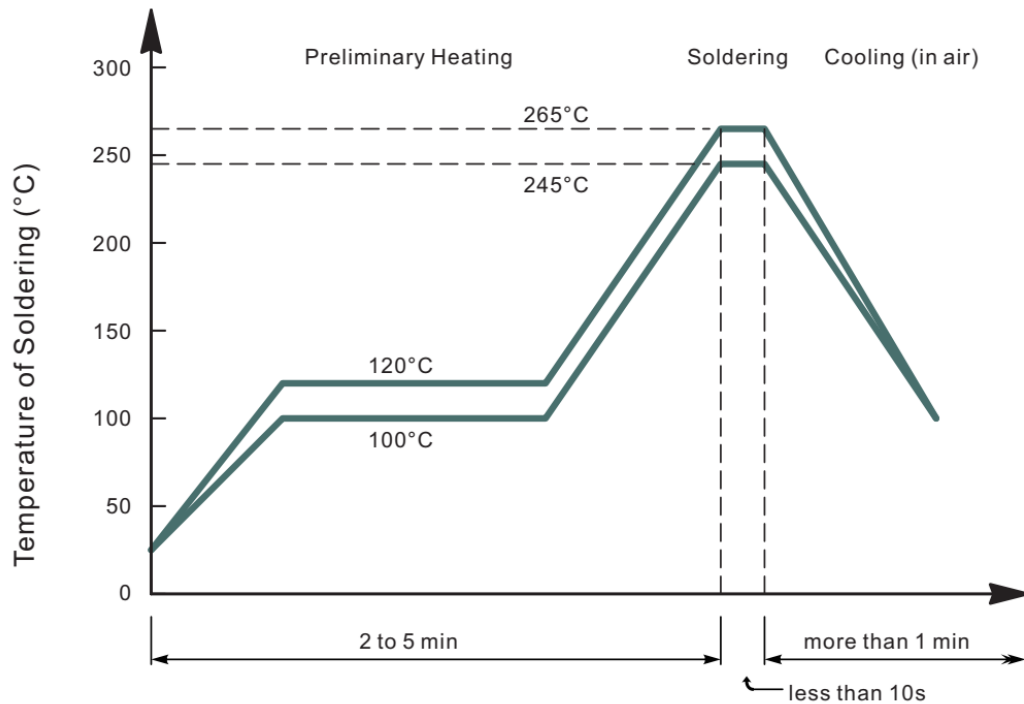
2) YW = Date Code

Y = Year

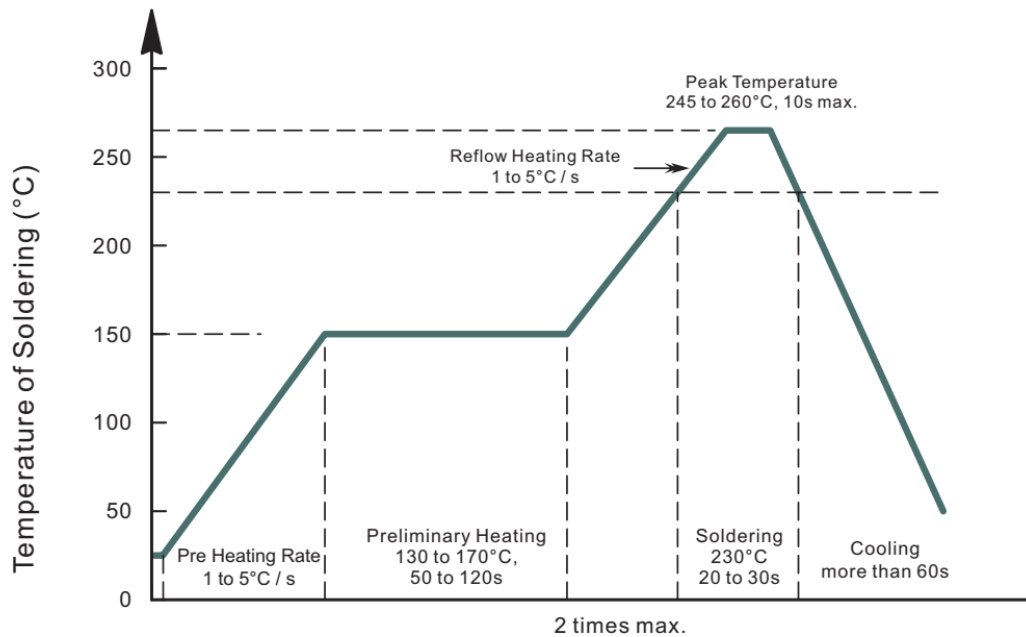
W = Week



Recommended condition of flow soldering



Recommended condition of reflow soldering



MSL (Moisture Sensitive Level) Information
IPC/JEDEC J-STD-020D.1 Moisture Sensitivity Levels Table

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS				
			Standard		Accelerated Equivalent ¹		
					eV 0.40-0.48	eV 0.30-0.39	CONDITION
	TIME	CONDITION	TIME (hours)	CONDITION	TIME (hours)	TIME (hours)	
1	Unlimited	≤30 °C /85% RH	168 +5/-0	85 °C /85% RH	NA	NA	NA
2	1 year	≤30 °C /60% RH	168 +5/-0	85 °C /60% RH	NA	NA	NA
2a	4 weeks	≤30 °C /60% RH	696 ² +5/-0	30 °C /60% RH	120 -1/+0	168 -1/+0	60 °C/ 60% RH
3	168 hours	≤30 °C /60% RH	192 ² +5/-0	30 °C /60% RH	40 -1/+0	52 -1/+0	60 °C/ 60% RH
4	72 hours	≤30 °C /60% RH	96 ² +2/-0	30 °C /60% RH	20 +0.5/-0	24 +0.5/-0	60 °C/ 60% RH
5	48 hours	≤30 °C /60% RH	72 ² +2/-0	30 °C /60% RH	15 +0.5/-0	20 +0.5/-0	60 °C/ 60% RH
a	24 hours	≤30 °C /60% RH	48 ² +2/-0	30 °C /60% RH	10 +0.5/-0	13 +0.5/-0	60 °C/ 60% RH
6	Time on Label (TOL)	≤30 °C /60% RH	TOL	30 °C /60% RH	NA	NA	NA

Note 1: CAUTION - To use the "accelerated equivalent" soak conditions, correlation of damage response (including electrical, after soak and reflow), should be established with the "standard" soak conditions. Alternatively, if the known activation energy for moisture diffusion of the package materials is in the range of 0.40 - 0.48 eV or 0.30 - 0.39 eV, the "accelerated equivalent" may be used. Accelerated soak times may vary due to material properties (e.g .mold compound, encapsulant, etc.). JEDEC document JESD22-A120 provides a method for determining the diffusion coefficient.

Note 2: The standard soak time includes a default value of 24 hours for semiconductor manufacturer's exposure time (MET) between bake and bag and includes the maximum time allowed out of the bag at the distributor's facility. If the actual MET is less than 24 hours the soak time may be reduced. For soak conditions of 30 °C/60% RH, the soak time is reduced by 1 hour for each hour the MET is less than 24 hours. For soak conditions of 60 °C/60% RH, the soak time is reduced by 1 hour for each 5 hours the MET is less than 24 hours. If the actual MET is greater than 24 hours the soak time must be increased. If soak conditions are 30 °C/60% RH, the soak time is increased 1 hour for each hour that the actual MET exceeds 24 hours. If soak conditions are 60 °C/60% RH, the soak time is increased 1 hour for each 5 hours that the actual MET exceeds 24 hours.