

RL431 Series

Adjustable Shunt Regulator

Description

The RL431 series are three-terminal adjustable regulators with guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between V_{REF} (approximately 2.495 volts) and 36 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω . Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.

Features

- Programmable output voltage
- Temperature coefficient is $50\text{ppm}/^\circ\text{C}$ typical
- Temperature compensated for operation over full temperature range
- Low output noise voltage
- Fast turn on response

Absolute Maximum Ratings

(Operating temperature range applies unless otherwise specified)

Characteristics	Symbol	Value		Unit
Cathode Voltage	V_{KA}	36		V
Cathode Current Range (Continuous)	I_K	-100~+150		mA
Reference Input Current Range	I_{REF}	0.05~+10		mA
Power Dissipation	P_D	SOT-23	280	mW
		TO-92	770	
Operating Temperature Range (Max.)	T_{opr}	-40~+120 *		$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-65~+150		$^\circ\text{C}$

*. RL431CN, RL431CA

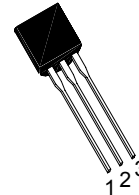
Operating Conditions

Characteristics	Symbol	Min.	Max.	Unit
Cathode Voltage	V_{KA}	V_{REF}	36	V
Cathode Current Range (Continuous)	I_K	1	100	mA

RL431 Series Pin Assignment

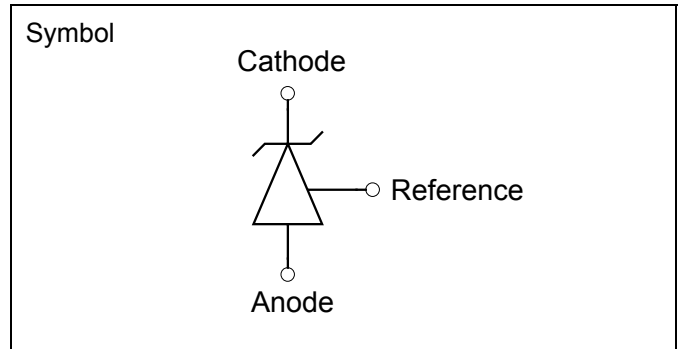
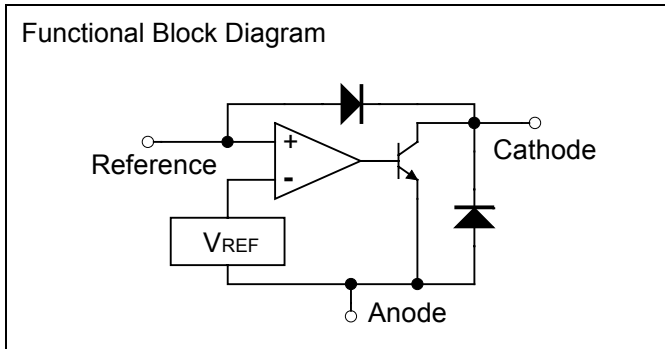


3-Lead Plastic **SOT-23**
 Package Code: N
 Pin 1: Reference
 Pin 2: Cathode
 Pin 3: Anode

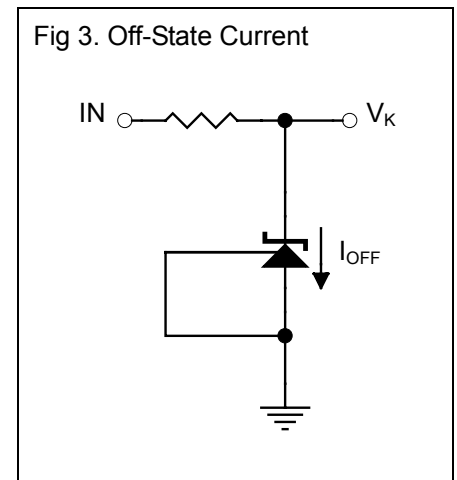
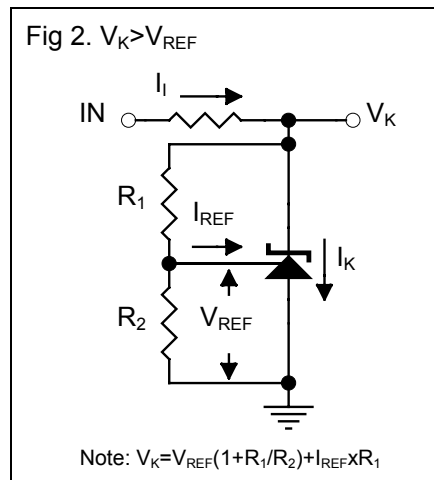
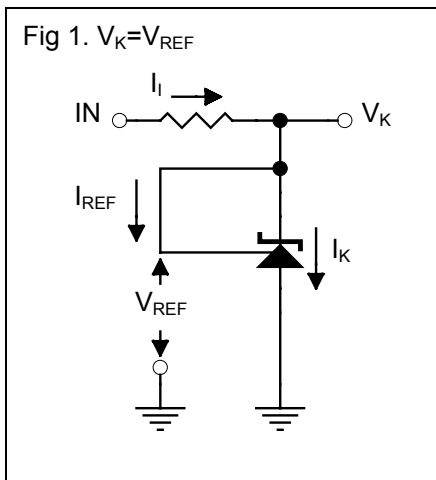


3-Lead Plastic **TO-92**
 Package Code: A
 Pin 1: Reference
 Pin 2: Anode
 Pin 3: Cathode

Functional Block Diagram & Symbol



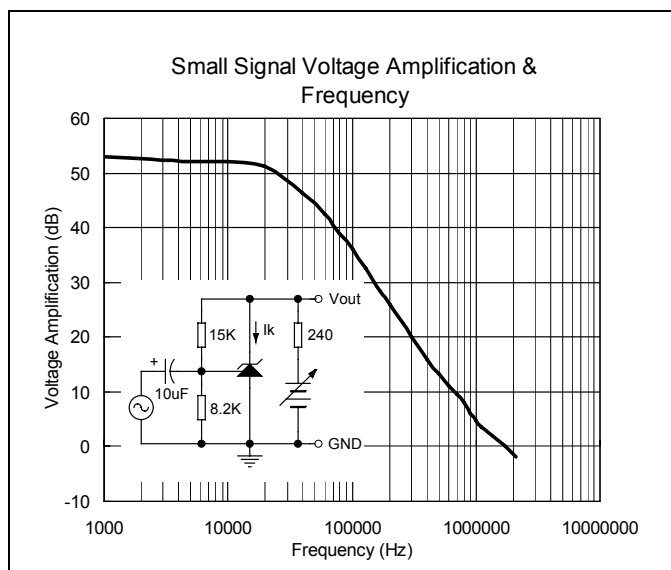
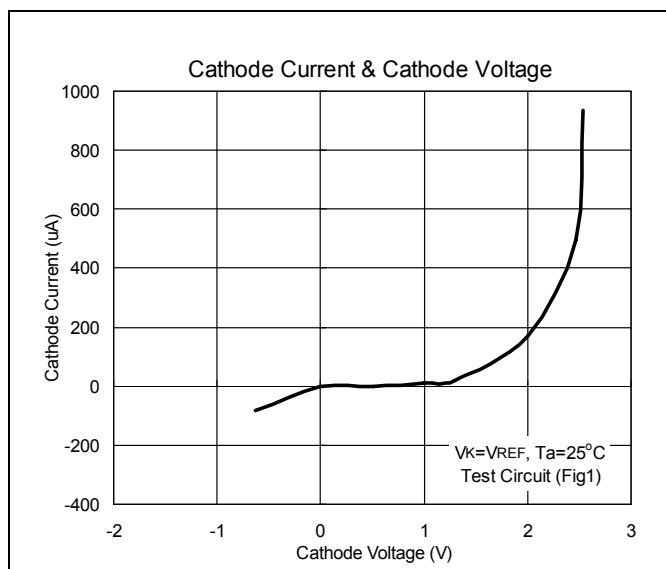
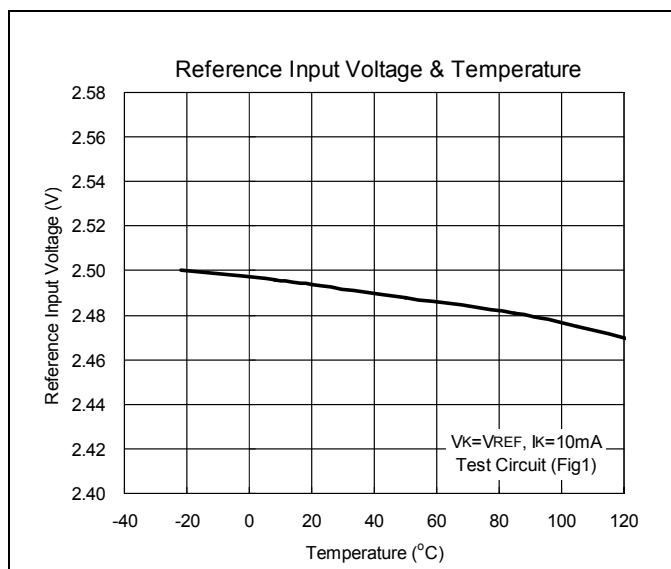
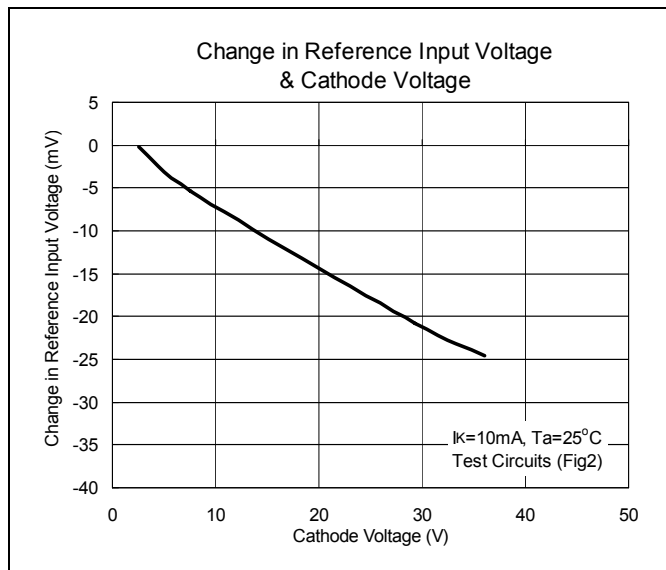
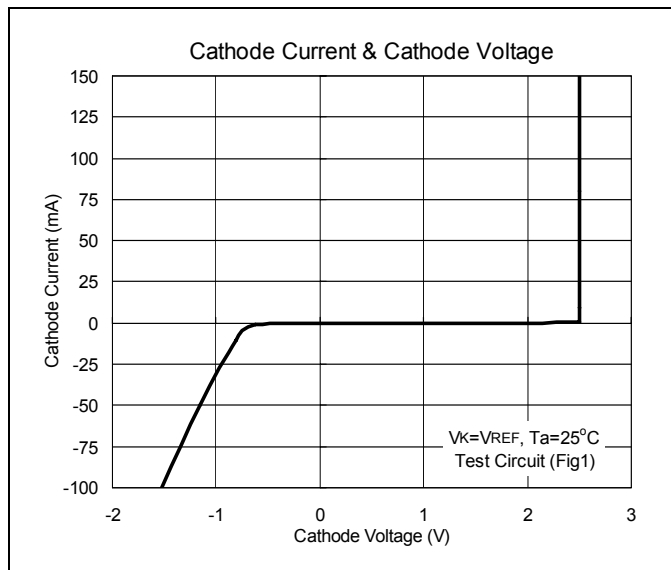
Test Circuits



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

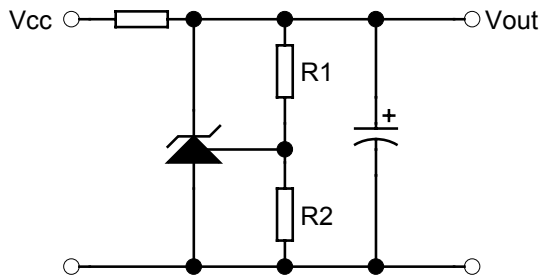
Characteristics		Symbol	Test Conditions	Min	Typ	Max	Unit
Reference Input Voltage (Fig1)	RL431BN/BA (1.0%)	V_{REF}	$V_K = V_{REF}$, $I_K = 10\text{mA}$	2.470	2.495	2.520	V
	RL431CN/CA (0.5%)			2.483	2.495	2.507	
Deviation of Reference Input Voltage Over-Temperature (Fig1)		$V_{REF(\text{dev})}$	$V_K = V_{REF}$, $I_K = 10\text{mA}$ $T_{\text{min}} \leq T_a \leq T_{\text{max}}$	-	4	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage (Fig2)		$\Delta V_{REF} / \Delta V_K$	$I_K = 10\text{mA}$, $\Delta V_K = 10\text{V to } V_{REF}$	-	-1.4	-2.7	mV/V
			$I_K = 10\text{mA}$, $\Delta V_K = 36\text{V to } 10\text{V}$	-	-1.0	-2.0	mV/V
Reference Input Current (Fig2)		I_{REF}	$I_K = 10\text{mA}$, $R_1 = 10\text{k}\Omega$, $R_2 = \infty$	-	2	4	μA
Deviation of Reference Input Current Over Full Temperature Range (Fig2)		$I_{REF(\text{dev})}$	$I_K = 10\text{mA}$, $R_1 = 10\text{k}\Omega$, $R_2 = \infty$, $T_a = \text{Full Range}$	-	0.4	1.2	μA
Minimum Cathode Current for Regulation (Fig1)		$I_{K(\text{min})}$	$V_K = V_{REF}$	-	0.4	1.0	mA
Off-State Cathode Current (Fig3)		$I_{K(\text{off})}$	$V_K = 36\text{V}$, $V_{REF} = 0$	-	0.1	1.0	μA
Dynamic Output Impedance (Fig1)		Z_K	$V_K = V_{REF}$, $f \leq 1\text{kHz}$ $I_K = 1 \text{ to } 100\text{mA}$	-	0.2	0.5	Ω

Characteristics Curve



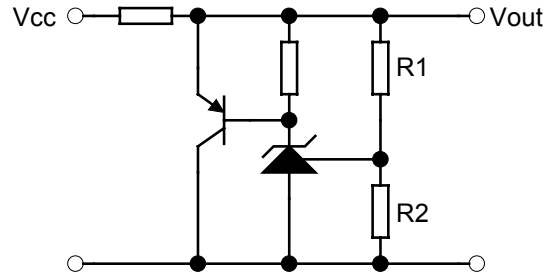
Typical Application

Fig 4. Shunt Regulator



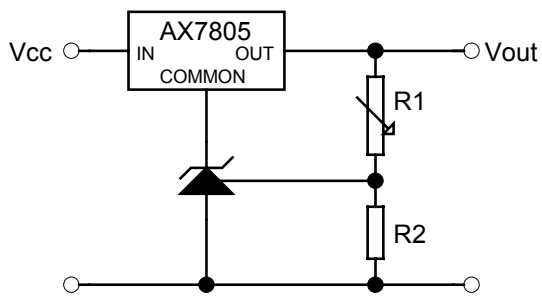
$$V_{out} = (1 + R_1/R_2)V_{REF}$$

Fig 5. High Current Shunt Regulator



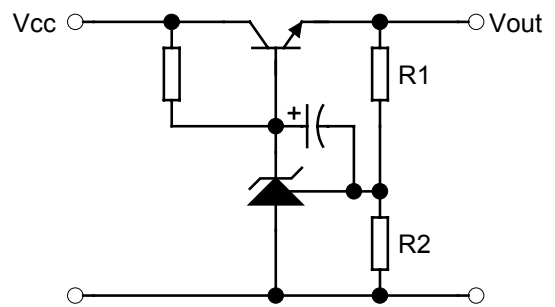
$$V_{out} = (1 + R_1/R_2)V_{REF}$$

Fig 6. Output Control of a Three-Terminal Fixed Regulator



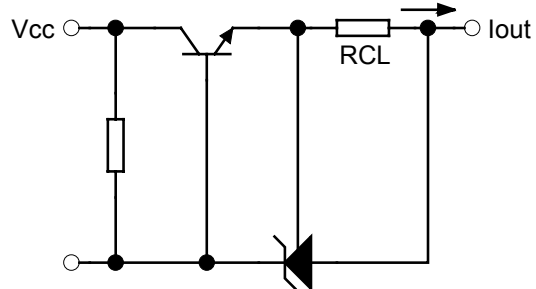
$$V_{out} = (1 + R_1/R_2)V_{REF}; V_{out(min)} = V_{REF} + 5V$$

Fig 7. Series Pass Regulator



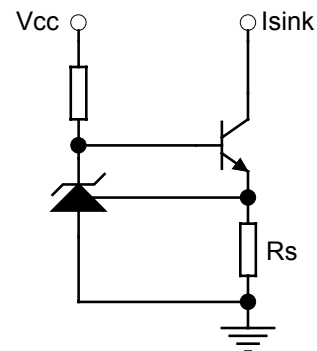
$$V_{out} = (1 + R_1/R_2)V_{REF}; V_{out(min)} = V_{REF} + V_{BE}$$

Fig 8. Current Limiter or Current Source



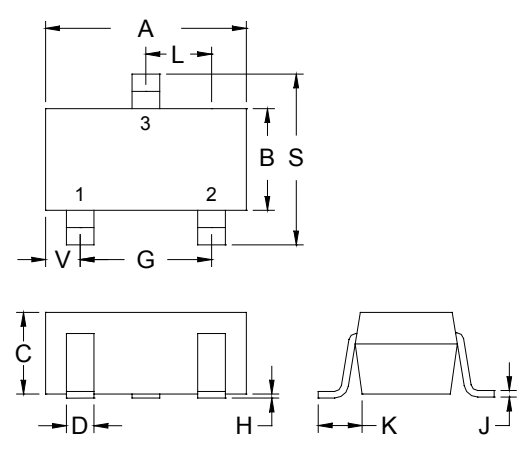
$$I_{out} = V_{REF}/R_{CL}$$

Fig 9. Constant Current Sink



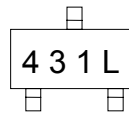
$$I_{sink} = V_{REF}/R_S$$

SOT-23 Dimension



3-Lead SOT-23 Plastic Surface Mounted Package
Package Code: N

Marking:



Note: Pb-free product can distinguish by the green label or the extra description on the right side of the label.

Pin Style: 1.Reference 2.Cathode 3.Anode

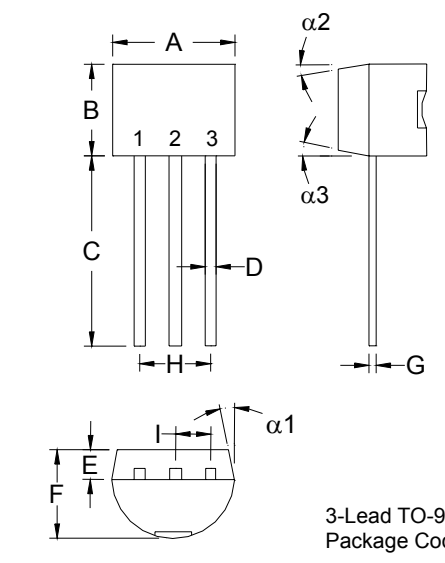
Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	2.80	3.04
B	1.20	1.60
C	0.89	1.30
D	0.30	0.50
G	1.70	2.30
H	0.013	0.10
J	0.085	0.177
K	0.32	0.67
L	0.85	1.15
S	2.10	2.75
V	0.25	0.65

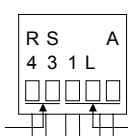
*: Typical, Unit: mm

TO-92 Dimension



3-Lead TO-92 Plastic Package
Package Code: A

Marking:



Date Code Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.Reference 2.Anode 3.Cathode

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	4.33	4.83
B	4.33	4.83
C	12.70	-
D	0.36	0.56
E	-	*1.27
F	3.36	3.76
G	0.36	0.56
H	-	*2.54
I	-	*1.27
$\alpha 1$	-	*5°
$\alpha 2$	-	*2°
$\alpha 3$	-	*2°

*: Typical, Unit: mm

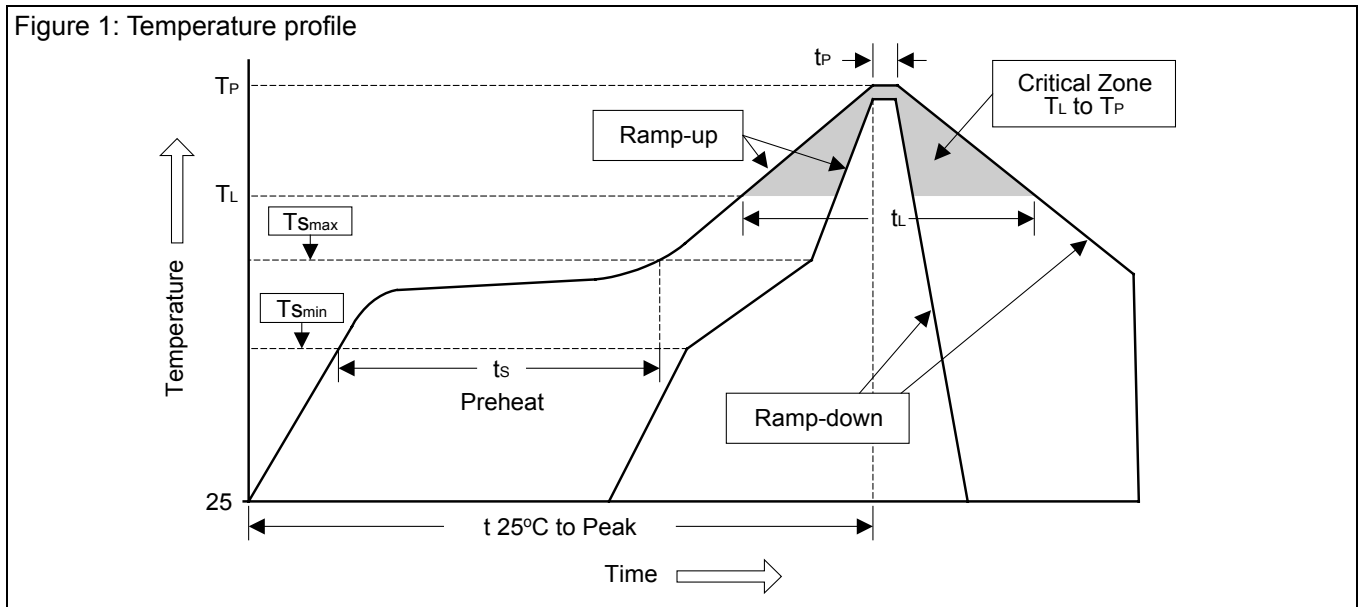
Ordering Information

Package	V _{REF} : 2.5±1%	V _{REF} : 2.5±0.5%
SOT-23	RL431BN	RL431CN
TO-92	RL431BA	RL431CA

Soldering Methods for Orister's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T _L to T _P)	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (T _{Smin})	100°C	150°C
- Temperature Max (T _{Smax})	150°C	200°C
- Time (min to max) (t _s)	60~120 sec	60~180 sec
T _{Smax} to T _L		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (T _L)	183°C	217°C
- Time (t _L)	60~150 sec	60~150 sec
Peak Temperature (T _P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t _P)	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec

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