

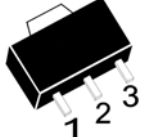
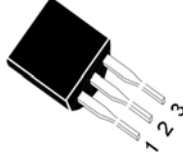
### 3-TERMINAL POSITIVE VOLTAGE REGULATORS

**Description**

- 3-Terminal Regulators
- Output Current Up to 100Ma
- No External Components
- Internal Thermal Overload Protection
- Internal Short-Circuit Limiting
- Direct Replacement for Fairchild  $\mu$ A78L00 Series

**Features**

- Maximum Output Current of 100mA ( $T_c=25^\circ\text{C}$ )
- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- TO-92 & SOT-89 Package

Package	Marking & Pin	Packing
	3-Lead Plastic SOT-89 Package Code: M Pin 1: OUTPUT Pin 2: COMMON Pin 3: INPUT	Tape & Reel 1K/Reel 5K/Box
	3-Lead Plastic TO-92 Package Code: A Pin 1: OUTPUT Pin 2: COMMON Pin 3: INPUT	Plastic Bags 1K/Bags 10K/Box 100K/Carton

■ Schematic Diagram & Equivalent Circuit

<p><b>DESCRIPTION</b></p> <p>This series of fixed-voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation.</p> <p>In addition, they can be used with power-pass elements to make high-current voltage regulators.</p> <p>Each of these regulators can deliver up to 100mA of output current.</p> <p>The internal limiting and termal shutdown features of these regulators make them essentially immune to overload.</p> <p>When used as a replacement for a Zener diode-resistor combination, an effective improvement in output impedance can be obtained together with lower-bias current.</p>	Nominal output voltage	Regulator
	3V	78L03
	3.3V	78L33
	5V	78L05
	6V	78L06
	8V	78L08
	9V	78L09
	10V	78L10
	12V	78L12
	15V	78L15
	18V	78L18
	24V	78L24

Absolute maximum ratings over operating temperature range (unless otherwise noted)

	78L03~78L10	78L12~78L18	78L24	UNIT
Input voltage	30	35	40	V
Operating free-air, case or virtual junction temperature range	-40 to 125	-40 to 125	-40 to 125	°C
Storage temperature range	-65 to 150	-65 to 150	-65 to 150	
Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds	260	260	260	

Recommended operating conditions

Parameter	Min.	Max.	Unit	
Input voltage, $V_I$	78L03	5.5	18	V
	78L33	5.5	18	
	78L05	7	20	
	78L06	8	20	
	78L08	10.5	23	
	78L09	11.5	24	
	78L10	12.5	25	
	78L12	14.5	27	
	78L15	17.5	30	
	78L18	20.5	33	
	78L24	26.5	39	
Output current, $I_O$		100	mA	
Operating virtual junction temperature, $T_J$	0	125	°C	

78L03 electrical characteristics at specified virtual junction temperature,  $V_I=8V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L03			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	2.88	3	3.12	V
	$I_O=1mA$ to 40mA, $V_I=5.5V$ to 18V	0~25°C	2.85	3	3.15	
	$I_O=1mA$ to 70mA		2.85	3	3.15	
Input regulation	$V_I=5.5V$ to 18V	25°C		28	120	mV
	$V_I=6V$ to 18V			23	80	
Ripple rejection	$V_I=6V$ to 16V, $f=120Hz$	25°C	43	51		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		13	50	mV
	$I_O=1mA$ to 40mA			7	35	
Output noise voltage	$f=10Hz-100Hz$	25°C		40		μV
Dropout voltage		25°C		1.7		V
Bias current		25°C		2.4	6	mA
		125°C			5.5	
Bias current change	$V_I=6V$ to 18V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

 78L33 electrical characteristics at specified virtual junction temperature,  $V_I=8.5V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L33			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	3.168	3.3	3.432	V
	$I_O=1mA$ to 40mA, $V_I=5.5V$ to 18V	0~25°C	3.135	3.3	3.465	
	$I_O=1mA$ to 70mA		3.135	3.3	3.465	
Input regulation	$V_I=5.5V$ to 18V	25°C		30	130	mV
	$V_I=7V$ to 18V			25	90	
Ripple rejection	$V_I=7V$ to 16V, $f=120Hz$	25°C	43	50		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		14	55	mV
	$I_O=1mA$ to 40mA			7	35	
Output noise voltage	$f=10Hz-100Hz$	25°C		41		μV
Dropout voltage		25°C		1.7		V
Bias current		25°C		2.5	6	mA
		125°C			5.5	
Bias current change	$V_I=7V$ to 18V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

\*: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Thermal effects must be taken into account separately. All characteristics are measured with a 0.33μF capacitor across the input and a 0.1μF capacitor across the output.

\*\* : This specification applies only for dc power dissipation permitted by absolute maximum ratings.

78L05 electrical characteristics at specified virtual junction temperature,  $V_I=10V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L05			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	4.8	5	5.2	V
	$I_O=1mA$ to 40mA, $V_I=7V$ to 20V	0~25°C	4.75	5	5.25	
	$I_O=1mA$ to 70mA		4.75	5	5.25	
Input regulation	$V_I=7V$ to 20V	25°C		32	150	mV
	$V_I=8V$ to 18V			26	100	
Ripple rejection	$V_I=8V$ to 18V, $f=120Hz$	25°C	41	49		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		15	60	mV
	$I_O=1mA$ to 40mA			8	30	
Output noise voltage	$f=10Hz-100Hz$	25°C		42		μV
Dropout voltage		25°C		1.7		V
Bias current		25°C		2.6	6	mA
		125°C			5.5	
Bias current change	$V_I=8V$ to 20V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

 78L06 electrical characteristics at specified virtual junction temperature,  $V_I=11V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L06			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	5.75	6	6.25	V
	$I_O=1mA$ to 40mA, $V_I=8V$ to 20V	0~25°C	5.7	6	6.3	
	$I_O=1mA$ to 70mA		5.7	6	6.3	
Input regulation	$V_I=8V$ to 20V	25°C		35	175	mV
	$V_I=9V$ to 20V			29	125	
Ripple rejection	$V_I=9V$ to 19V, $f=120Hz$	25°C	40	48		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		16	80	mV
	$I_O=1mA$ to 40mA			9	40	
Output noise voltage	$f=10Hz-100Hz$	25°C		46		μV
Dropout voltage		25°C		1.7		V
Bias current		25°C		2.7	6	mA
		125°C			5.5	
Bias current change	$V_I=9V$ to 20V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

\*: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Thermal effects must be taken into account separately. All characteristics are measured with a 0.33μF capacitor across the input and a 0.1μF capacitor across the output.

\*\* : This specification applies only for dc power dissipation permitted by absolute maximum ratings.

78L08 electrical characteristics at specified virtual junction temperature,  $V_I=14V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L08			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	7.7	8	8.3	V
	$I_O=1mA$ to 40mA, $V_I=10.5V$ to 23V	0~25°C	7.6	8	8.4	
	$I_O=1mA$ to 70mA		7.6	8	8.4	
Input regulation	$V_I=10.5V$ to 23V	25°C		42	175	mV
	$V_I=11V$ to 23V			36	125	
Ripple rejection	$V_I=13V$ to 23V, $f=120Hz$	25°C	37	46		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		18	80	mV
	$I_O=1mA$ to 40mA			10	40	
Output noise voltage	$f=10Hz-100Hz$	25°C		54		µV
Dropout voltage		25°C		1.7		V
Bias current		25°C		2.8	6	mA
		125°C			5.5	
Bias current change	$V_I=11V$ to 23V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

78L09 electrical characteristics at specified virtual junction temperature,  $V_I=16V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L09			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	8.6	9	9.4	V
	$I_O=1mA$ to 40mA, $V_I=12V$ to 24V	0~25°C	8.55	9	9.45	
	$I_O=1mA$ to 70mA		8.55	9	9.45	
Input regulation	$V_I=12V$ to 24V	25°C		45	175	mV
	$V_I=13V$ to 24V			40	125	
Ripple rejection	$V_I=15V$ to 25V, $f=120Hz$	25°C	38	45		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		19	90	mV
	$I_O=1mA$ to 40mA			11	40	
Output noise voltage	$f=10Hz-100Hz$	25°C		58		µV
Dropout voltage		25°C		1.7		V
Bias current		25°C		2.9	6	mA
		125°C			5.5	
Bias current change	$V_I=13V$ to 24V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

\*: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Thermal effects must be taken into account separately. All characteristics are measured with a 0.33µF capacitor across the input and a 0.1µF capacitor across the output.

\*\* : This specification applies only for dc power dissipation permitted by absolute maximum ratings.

78L10 electrical characteristics at specified virtual junction temperature,  $V_I=17V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L10			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	9.6	10	10.4	V
	$I_O=1mA$ to 40mA, $V_I=13V$ to 25V	0~25°C	9.5	10	10.5	
	$I_O=1mA$ to 70mA		9.5	10	10.5	
Input regulation	$V_I=13V$ to 25V	25°C		51	175	mV
	$V_I=14V$ to 25V			42	125	
Ripple rejection	$V_I=15V$ to 25V, $f=120Hz$	25°C	37	44		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		20	90	mV
	$I_O=1mA$ to 40mA			11	40	
Output noise voltage	$f=10Hz-100Hz$	25°C		62		µV
Dropout voltage		25°C		1.7		V
Bias current		25°C		3	6	mA
		125°C			5.5	
Bias current change	$V_I=14V$ to 25V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

78L12 electrical characteristics at specified virtual junction temperature,  $V_I=19V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L12			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	11.5	12	12.5	V
	$I_O=1mA$ to 40mA, $V_I=14V$ to 27V	0~25°C	11.4	12	12.6	
	$I_O=1mA$ to 70mA		11.4	12	12.6	
Input regulation	$V_I=14V$ to 27V	25°C		55	250	mV
	$V_I=16V$ to 27V			49	200	
Ripple rejection	$V_I=15V$ to 25V, $f=120Hz$	25°C	37	42		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		22	100	mV
	$I_O=1mA$ to 40mA			13	50	
Output noise voltage	$f=10Hz-100Hz$	25°C		70		µV
Dropout voltage		25°C		1.7		V
Bias current		25°C		3.1	6.5	mA
		125°C			6	
Bias current change	$V_I=16V$ to 27V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

\*: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Thermal effects must be taken into account separately. All characteristics are measured with a 0.33µF capacitor across the input and a 0.1µF capacitor across the output.

\*\* : This specification applies only for dc power dissipation permitted by absolute maximum ratings.

78L15 electrical characteristics at specified virtual junction temperature,  $V_I=23V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L15			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	14.4	15	15.6	V
	$I_O=1mA$ to 40mA, $V_I=17.5V$ to 30V	0~25°C	14.25	15	15.75	
	$I_O=1mA$ to 70mA		14.25	15	15.75	
Input regulation	$V_I=17.5V$ to 30V	25°C		65	300	mV
	$V_I=19V$ to 30V			58	250	
Ripple rejection	$V_I=18.5V$ to 28.5V, $f=120Hz$	25°C	34	39		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		25	150	mV
	$I_O=1mA$ to 40mA			15	75	
Output noise voltage	$f=10Hz-100Hz$	25°C		82		$\mu V$
Dropout voltage		25°C		1.7		V
Bias current		25°C		3.4	6.5	mA
		125°C			6	
Bias current change	$V_I=19V$ to 30V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

 78L18 electrical characteristics at specified virtual junction temperature,  $V_I=26V$ ,  $I_O=40mA$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		78L18			Unit
			Min.	Typ.	Max.	
Output voltage**		25°C	17.3	18	18.7	V
	$I_O=1mA$ to 40mA, $V_I=20.5V$ to 33V	0~25°C	17.1	18	18.9	
	$I_O=1mA$ to 70mA		17.1	18	18.9	
Input regulation	$V_I=20.5V$ to 33V	25°C		70	360	mV
	$V_I=22V$ to 33V			64	300	
Ripple rejection	$V_I=21.5V$ to 31.5V, $f=120Hz$	25°C	32	36		dB
Output regulation	$I_O=1mA$ to 100mA	25°C		27	180	mV
	$I_O=1mA$ to 40mA			19	90	
Output noise voltage	$f=10Hz-100Hz$	25°C		89		$\mu V$
Dropout voltage		25°C		1.7		V
Bias current		25°C		3.5	6.5	mA
		125°C			6	
Bias current change	$V_I=22V$ to 33V	0~25°C			1.5	
	$I_O=1mA$ to 40mA				0.1	

\*: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Thermal effects must be taken into account separately. All characteristics are measured with a 0.33 $\mu F$  capacitor across the input and a 0.1 $\mu F$  capacitor across the output.

\*\* : This specification applies only for dc power dissipation permitted by absolute maximum ratings.

78L24 electrical characteristics at specified virtual junction temperature,  $V_I=32V$ ,  $I_O=40mA$  (unless otherwise noted)

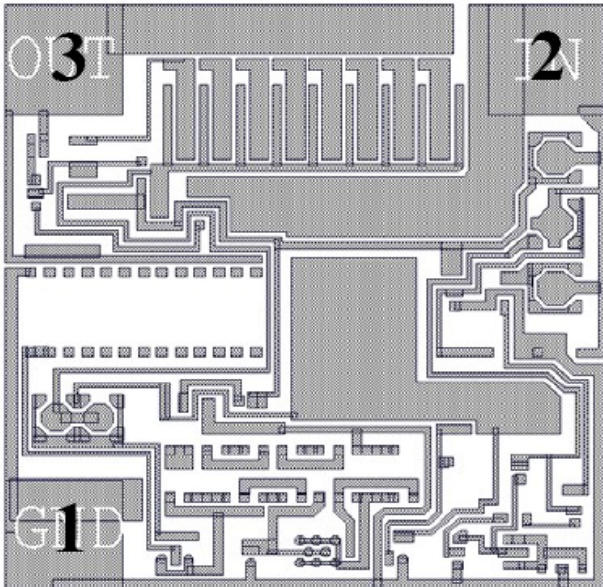
PARAMETER	TEST CONDITIONS*		78L24			Unit
			Min.	Typ.	Max.	
Output voltage**	$I_O=1mA$ to $40mA$ , $V_I=26.5V$ to $39V$	$25^\circ C$	23	24	25	V
		$0\sim 25^\circ C$	22.8	24	25.2	
	$I_O=1mA$ to $70mA$		22.8	24	25.2	
Input regulation	$V_I=26.5V$ to $39V$	$25^\circ C$		95	480	mV
	$V_I=29V$ to $39V$			78	400	
Ripple rejection	$V_I=27.5V$ to $37.5V$ , $f=120Hz$	$25^\circ C$	30	33		dB
Output regulation	$I_O=1mA$ to $100mA$	$25^\circ C$		41	240	mV
	$I_O=1mA$ to $40mA$			28	120	
Output noise voltage	$f=10Hz-100Hz$	$25^\circ C$		97		$\mu V$
Dropout voltage		$25^\circ C$		1.7		V
Bias current		$25^\circ C$		3.6	6.5	mA
		$125^\circ C$			6	
Bias current change	$V_I=28V$ to $39V$	$0\sim 25^\circ C$			1.5	
	$I_O=1mA$ to $40mA$				0.1	

\*: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Thermal effects must be taken into account separately. All characteristics are measured with a  $0.33\mu F$  capacitor across the input and a  $0.1\mu F$  capacitor across the output.

\*\* : This specification applies only for dc power dissipation permitted by absolute maximum ratings.

Pad location 78LXX nd3



Chip size :  $0.64 \times 0.65$  mm

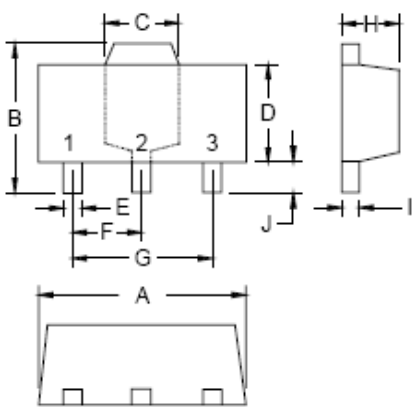
Wafer Thickness:  $460 \pm 30\mu m$  ( $280 \pm 30\mu m$ )  
 Top metal: AlSi  
 Backside metal: - (or Ti-Ni (V)-Ag)  
 Wafer size: 100,150mm

Pad No	Pad Name	X( $\mu m$ )	Y( $\mu m$ )	Pad size ( $\mu m$ )
1	GROUND	105	105	$90 \times 90$
2	INPUT	537	545	$90 \times 90$
3	OUTPUT	105	545	$90 \times 90$



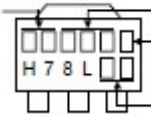
产品封装尺寸数据, 单位: 毫米

**SOT-89 Dimension**



Unit: mm

DIM	Min.	Max.
A	4.40	4.60
B	4.05	4.25
C	1.50	1.70
D	2.40	2.80
E	0.36	0.51
F	1.50	--
G	3.00	--
H	1.40	1.60
I	0.35	0.41

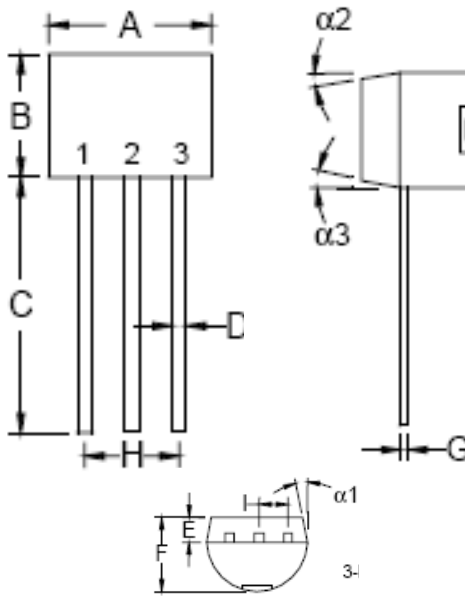
Date Code  Control Code  
 Pb Free Mark  
 Pb-Free: ". " Note)  
 Product Series  
 03, 33, 05, 06, 08  
 09,10,12,15,18,24

HAOHAI Logo

Note: Green label is used for pb-free packing  
 Pin Style: 1.Output, 2.Common, 3.Input  
 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

Package: SOT-89  
 HAOHAI Package Code: M

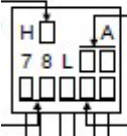
**TO-92 Dimension**



Unit: mm

DIM	Min.	Max.
A	4.33	4.83
B	4.33	4.83
C	12.7	--
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°

Pb Free Mark  
 Pb-Free: (Note)  
 Normal: None

Date Code  Product Series  
 03, 33, 05, 06, 08  
 09,10,12,15,18,24

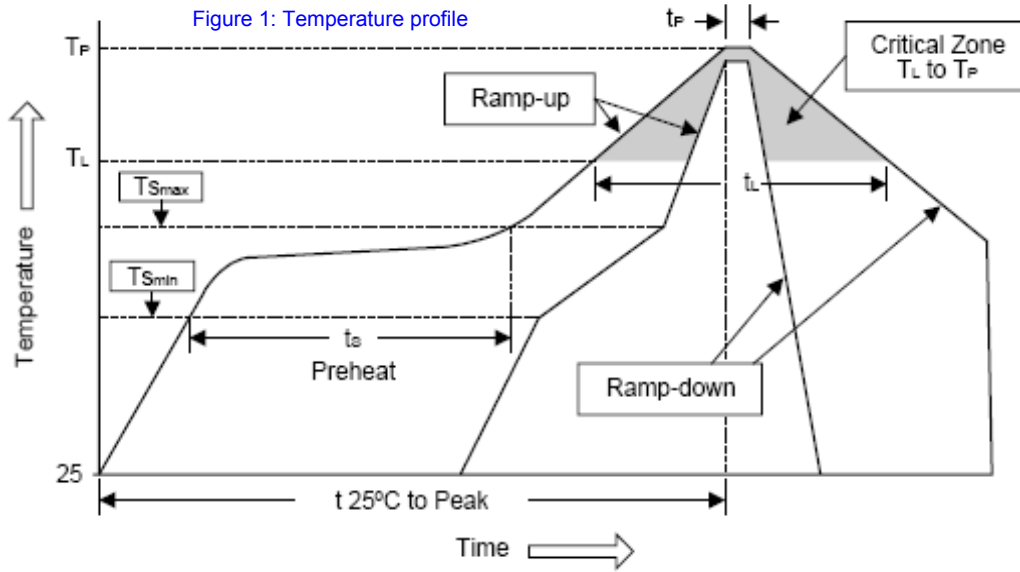
Control Code

Note: Green label is used for pb-free packing  
 Pin Style: 1.Output, 2.Common, 3.Input  
 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

Package: TO-92  
 HAOHAI Package Code: A

■ Soldering Methods for HAOHAI Products 浩海产品的焊接方法

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



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 ( $T_{smin}$ ) - Temperature Max ( $T_{smax}$ ) - Time (min to max) ( $t_s$ )	100°C 150°C 60~120 sec	150°C 200°C 60~180 sec
$T_{smax}$ to $T_L$ - Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above: - Temperature ( $T_L$ ) - Time ( $t_L$ )	183°C 60~150 sec	217°C 60~150 sec
Peak Temperature ( $T_P$ )	240°C +0/-5°C	260°C +0/-5°C
Time within 50C of actual Peak Temperature ( $T_P$ )	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 250C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping) 波峰焊、回流焊、焊锡浸渍温度

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

Manufacturers version information

2010-01-05, HAOHAI™ Product Data-V1.0

2014-07-05, HAOHAI™ Product Data-E2.0



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