

## Shut Mode Audio Click-and-Pop Eliminator

### Features

- **Wide supply voltage range from 1.7V to 3.6V**
- **Low quiescent current 1mA**
- **Adjustable turn off time by SET pin**
- **Fast turn on time : 100us(typ)**
- **Low switch resistance :0.3W**
- **Distortion-Free, Click-and-Pop Elimination**
- **Available in WLCSP1.42x0.92 - 6 Packages**
- **Lead Free Green Devices Available (RoHS Compliant)**

### Applications

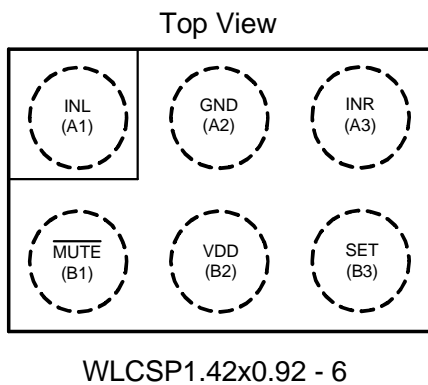
- **Smart Phones**
- **Tablet PCs**
- **Portable Media Players**

### General Description

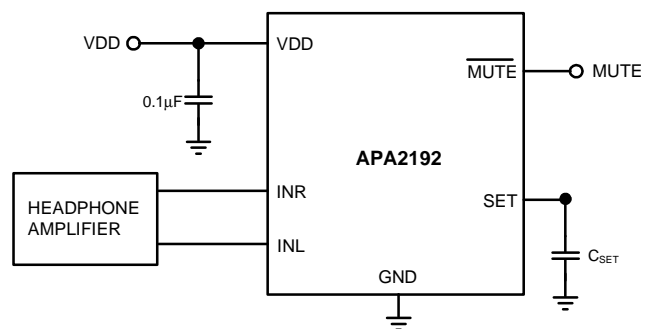
The APA2192 is an audio click-and-pop eliminator for portable multimedia devices. Operating from a 1.7V to 3.6V supply, the APA2192 connects to the output of the existing system amplifier and provides a low-impedance path to ground during startup and shutdown. The inputs INL and INR accept voltage swings from  $V_{DD}$  to 5.5V below  $V_{DD}$ . See the Setting the Supply Voltage section for more information. The power-up and power down transients are shunted to ground to prevent clicks and pops from becoming audible.

The APA2192 features two low-impedance analog switches controlled by MUTE that opens and closes the switches. The switches are open during normal operation and have no impact on the output signal. During startup and shutdown of the amplifier, the APA2192 can be activated to short the outputs to ground and prevent clicks and pops from pulling current through the headphones.

### Pin Configuration



### Simplified Application Circuit



ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

## Ordering and Marking Information

<p>APA2192 <span style="border: 1px solid black; padding: 2px;">□□□</span> - <span style="border: 1px solid black; padding: 2px;">□□□</span></p> <div style="margin-left: 40px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> </div>	<p>Package Code HA : WLCSP1.42x0.92-6</p> <p>Operating Ambient Temperature Range I : - 40 to 85 C</p> <p>Handling Code TR : Tape &amp; Reel</p> <p>Assembly Material G : Halogen and Lead Free Device</p>
<p>APA2192 HA: <span style="border: 1px solid black; padding: 2px; margin-left: 20px;">● 92X</span></p>	<p>X - Date Code</p>

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. ANPEC defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

## Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Rating	Unit
V <sub>DD</sub>	VDD to GND Voltage	-0.3 ~ 6	V
V <sub>MUTE,SET</sub>	MUTE,SET to GND Voltage	-0.3 ~ 6	V
V <sub>INR,INL</sub>	INR,INL to GND Voltage	VDD-6V ~ VDD+0.3V	V
I <sub>INR,INL</sub>	Continuous Output current, INR & INL	350	mA
T <sub>J</sub>	Maximum Junction Temperature	150	°C
T <sub>STG</sub>	Storage Temperature	-65 ~ 150	°C
T <sub>SDR</sub>	Maximum Lead Soldering Temperature (10 Seconds)	260	°C
V <sub>ESD</sub>	Minimum ESD Rating (Human Body Mode) (MM Mode) (CMD Mode)	±5	kV
		200	V
		1000	V

Note 1: Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Thermal Characteristics

Symbol	Parameter	Typical Value	Unit
θ <sub>JA</sub>	Junction-to-Ambient Thermal Resistance in free air <sup>(Note 2)</sup> WLCSP1.42x0.92 -6	125	°C/W
θ <sub>JC</sub>	Junction-to-Case Thermal Resistance in free air <sup>(Note 2)</sup> WLCSP1.42x0.92 -6	18	°C/W

Note 2: θ<sub>JA</sub> is measured with the component mounted on a high effective thermal conductivity test board in free air.

**Recommended Operating Conditions** (Note3)

Symbol	Parameter	Range	Unit
V <sub>DD</sub>	IN Input Voltage	1.7 ~ 3.6	V
V <sub>IN</sub>	VIN Input Power Voltage	V <sub>DD</sub> -5.5 ~ V <sub>DD</sub>	V
V <sub>MUTE</sub>	MUTE Input Voltage	0 ~ V <sub>DD</sub> +0.3	V
C <sub>VDD</sub>	VDD Input Capacitor	0.1 ~	uF
C <sub>SET</sub>	SET Pin Capacitor	220 ~ 100nF	pF
T <sub>A</sub>	Ambient Temperature	-40 ~ 85	°C
T <sub>J</sub>	Junction Temperature	-40 ~ 125	°C

Note 3 : Refer to the typical application circuit.

**Electrical Specifications for the Digital Section**

Unless otherwise specified, these specifications apply over V<sub>DD</sub> = 3V. Typical values are at T<sub>A</sub> = 25°C.

Symbol	Parameter	Test Conditions	APA2192			Unit	
			Min	Typ	Max		
V <sub>DD</sub>	Operation Supply Voltage		1.7	-	3.6	V	
I <sub>DD</sub>	Supply Current	V <sub>DD</sub> =5.5V, V <sub>MUTE</sub> =3.3V	-	0.5	1	μA	
		V <sub>DD</sub> =5.5V, V <sub>MUTE</sub> =0V	-	0.5	1		
V <sub>IN</sub>	Input Voltage Range	Guaranteed by input leakage current test	V <sub>DD</sub> -5.5 V	-	V <sub>DD</sub>	V	
T <sub>ON</sub>	Turn-On Time (Figure 1)	Measured from MUTE = GND and input voltage settled to 90% of its final value	-	100	-	ns	
T <sub>OFF</sub>	Turn-Off Time (Figure 1)	C <sub>SET</sub> =500pF	5	10	15	ms	
		C <sub>SET</sub> =50pF	-	1	-		
		C <sub>SET</sub> =50nF	-	1000	-		
R <sub>SET</sub>	Turn-On Time Resistor	C <sub>SET</sub> =500pF	350	800	1300	kΩ	
R <sub>ON</sub>	Switch On-Resistance	V <sub>DD</sub> =3.0V	-	0.2	-	Ω	
		V <sub>DD</sub> =1.7V	-	-	2		
		V <sub>DD</sub> =5.5V	-	-	1		
	Click-and-Pop Reduction	R <sub>SERIES</sub> = 30Ω, R <sub>LOAD</sub> = 16Ω	-	40	-	dB	
I <sub>IN</sub>	Input Leakage Current	T <sub>A</sub> =+25 °C	V <sub>IN</sub> = V <sub>DD</sub> - 5.5V, V <sub>DD</sub> = 1.7V	-	-	±1	μA
			V <sub>IN</sub> = V <sub>DD</sub> , V <sub>DD</sub> = 5.5V	-	-	±1	
I <sub>MUTE</sub>	MUTE Leakage Current	V <sub>DD</sub> = 5.5V, V <sub>MUTE</sub> = 0 or 5.5V, T <sub>A</sub> = +25 °C	-	-	±1	μA	
V <sub>IH</sub>	MUTE Input-Voltage High		1.5	-	-	V	
V <sub>L</sub>	MUTE Input-Voltage Low		-	-	0.4	V	

### Timing Diagram

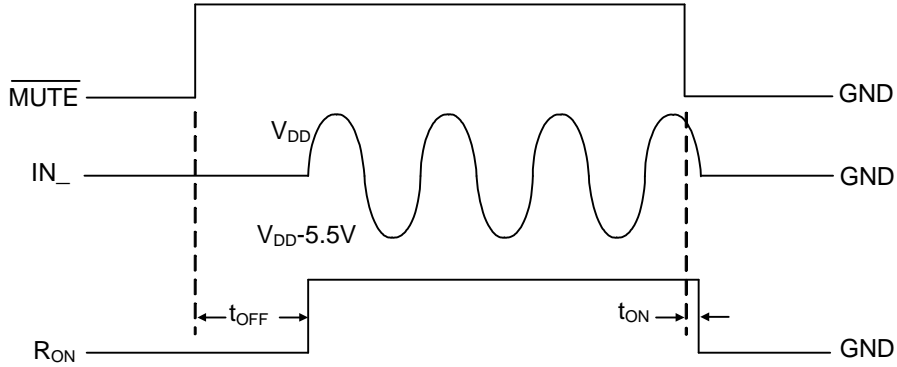
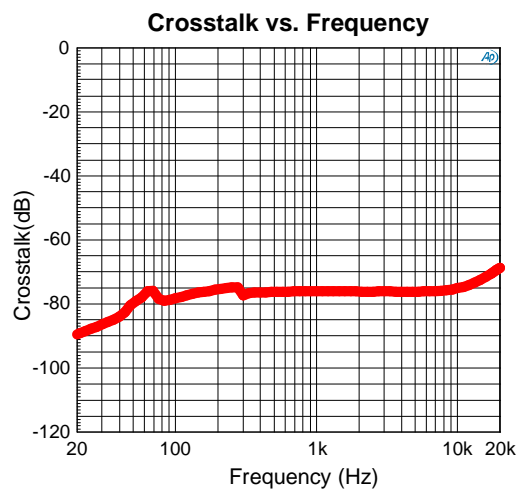
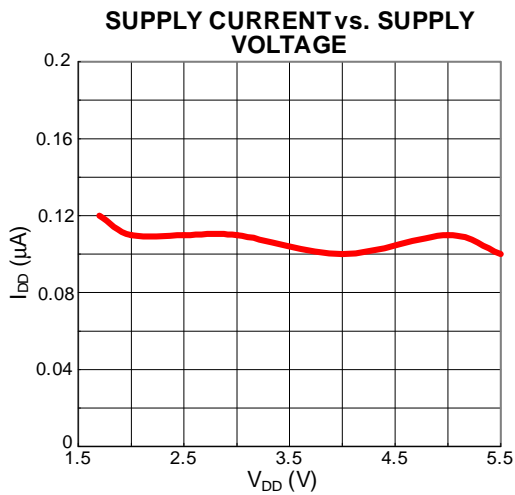
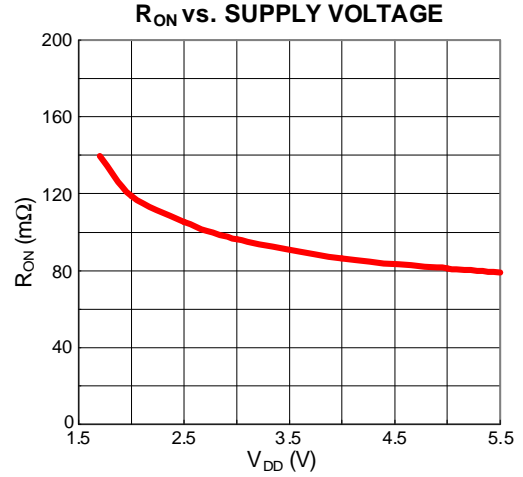
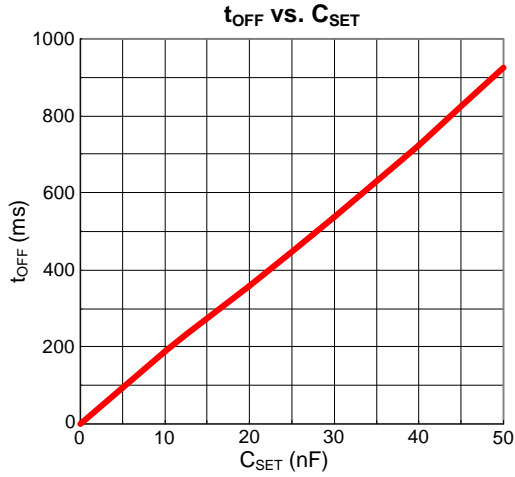


Figure 1. Turn-On/Off Time

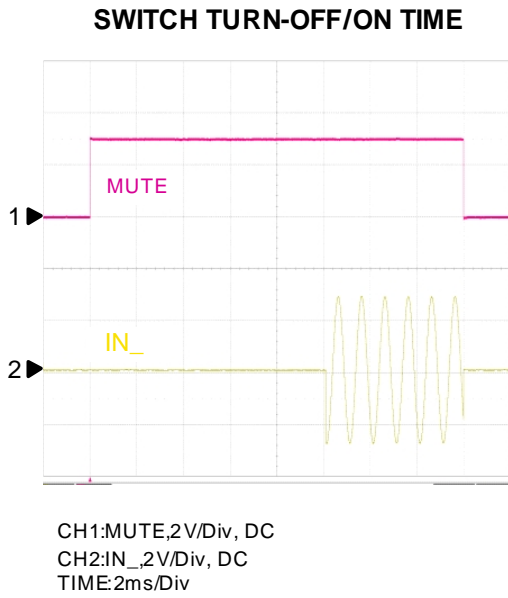
### Pin Description

PIN		Function
WLCSP1.5x1-6	NAME	
A1	INL	Left-Channel Input. Connect INL in between the output coupling capacitor and the headphone jack.
A2	GND	Ground
A3	INR	Right-Channel Input. Connect INR in between the output coupling capacitor and the headphone jack.
B1	$\overline{\text{MUTE}}$	Active-Low Enable. Do not keep this pin floating.
B2	VDD	Power Supply
B3	SET	Turn-Off Time Set. Connect an external capacitor in between SET and GND to set the switch open delay.

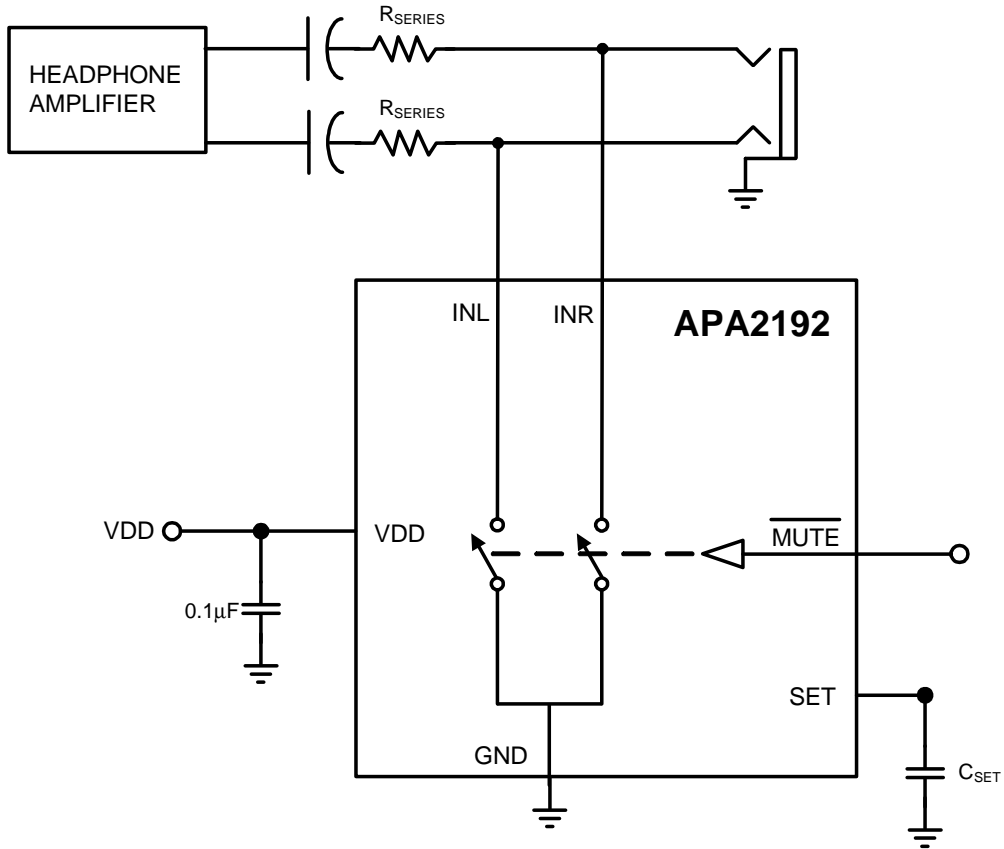
Typical Operating Characteristics



### Operating Waveforms



Application Circuit



## Function Description

### Setting the Turn-Off Time

The APA2192 features a SET input that allows the turnoff time to be adjusted from 1ms to 1000ms to match the click-and-pop profile of the amplifier startup. The value of an external capacitor sets the switch open delay, as shown in the following equation:

$$t_{\text{OFF}} \text{ (ms)} = 0.02 \times C_{\text{SET}} \text{ (pF)}$$

When the headphone amplifier is enabled, the APA2192 automatically waits the set delay time before opening the analog switches. This allows amplifier turn on click and pop to be eliminated.



## Application Information

### Setting the Supply Voltage

The APA2192 operates from 1.7V to 3.6V supply voltage. The inputs, INL and INR, accept voltage swings from VDD to VDD - 5.5V. The audio signal applied to a headphone is ground biased, meaning that the signal swings just as much negative as positive. Since the APA2192 input voltage is limited to VDD - 5.5V on the negative side, the voltage on VDD must be set properly to pass the audio signal when the switch is open (Figure 2).

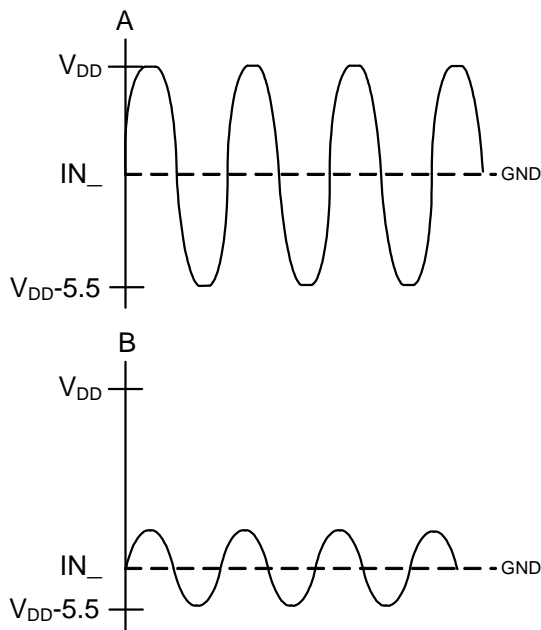
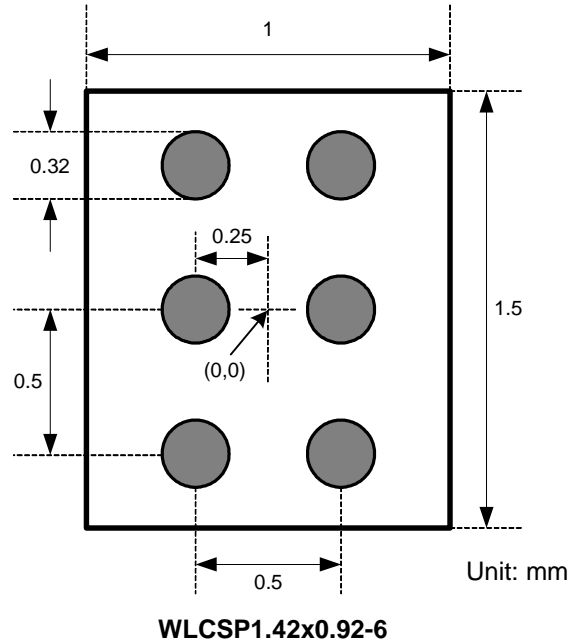


Figure 2. Proper Supply Selected for a Given Input Signal  
 A: Supply Voltage with a Large Signal  
 B: Supply Voltage with a Small Signal

### Selecting Series Resistors

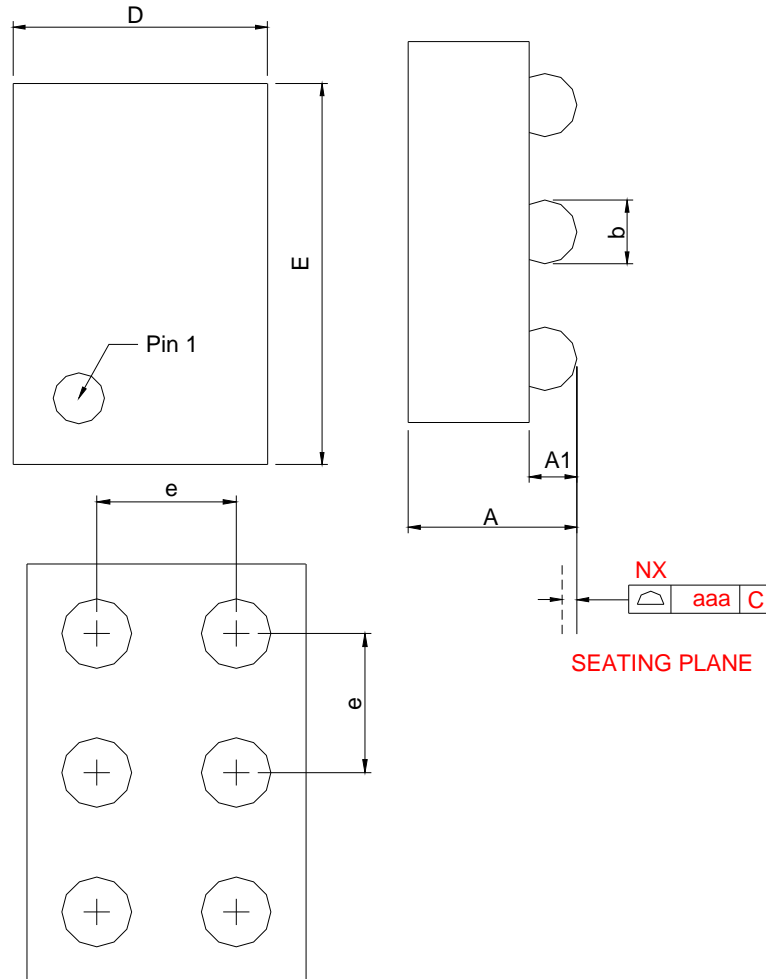
A series resistor (R<sub>SERIES</sub>), as shown in the Typical Operating Circuit, is necessary to achieve optimal click and-pop reduction. See the Click and Pop vs. R<sub>SERIES</sub> graph in the Typical Operating Characteristics for details on how much click-and-pop reduction to expect for a given series resistor.

### Recommended Minimum Footprint



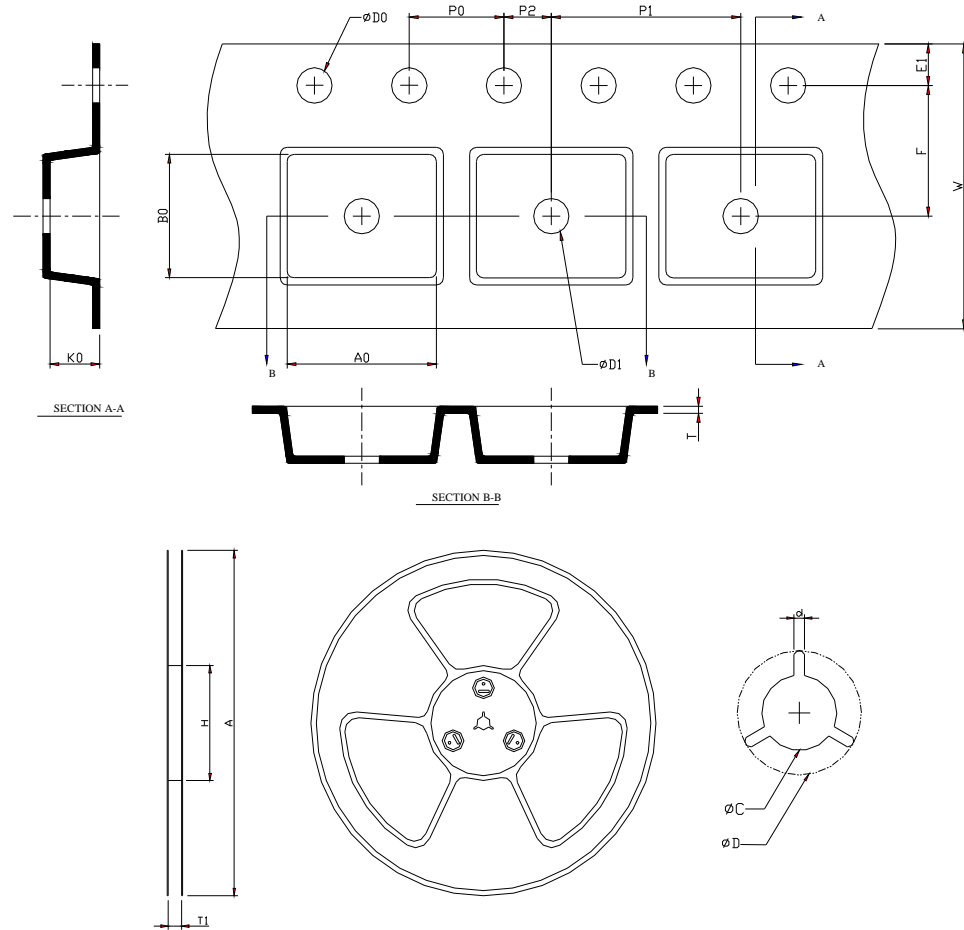
Package Information

WLCSP1.42x0.92-6



SYMBOL	WLCSP1.42*0.92-6			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		0.69		0.027
A1	0.15	0.25	0.006	0.010
b	0.25	0.35	0.010	0.014
D	0.92	1.00	0.036	0.039
E	1.42	1.50	0.056	0.059
e	0.50 BSC		0.020 BSC	
aaa	0.08		0.003	

Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
WLCSP(1.42X0.92)	178.0±2.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0±0.30	1.75±0.10	3.5±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0±0.10	4.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	1.24±0.05	1.70±0.05	0.76±0.05

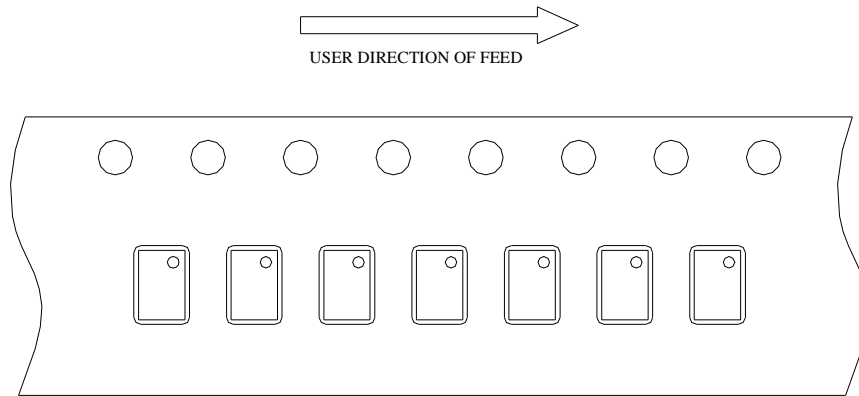
(mm)

**Devices Per Unit**

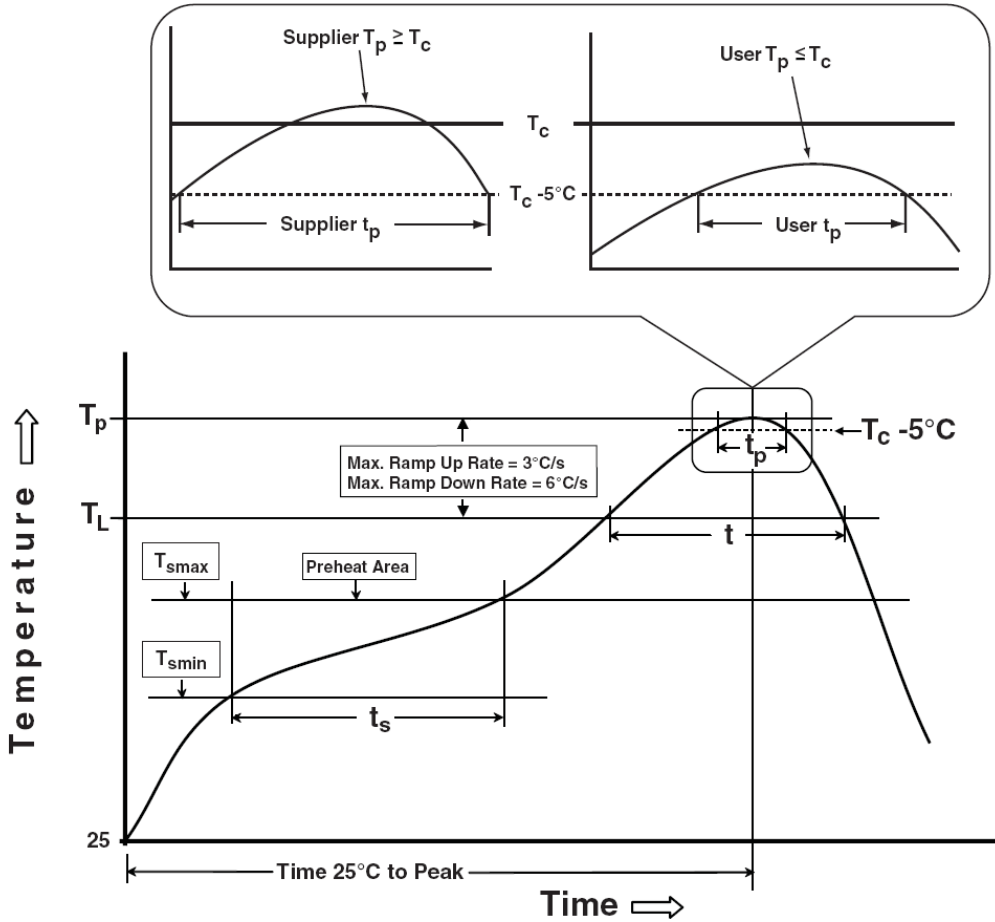
Package Type	Unit	Quantity
WLCSP(1.42x0.92)	Tape & Reel	3000

**Taping Direction Information**

WLCSP1.42x0.92-6



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
Temperature min ( $T_{smin}$ )	100 °C	150 °C
Temperature max ( $T_{smax}$ )	150 °C	200 °C
Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Average ramp-up rate ( $T_{smax}$ to $T_p$ )	3 °C/second max.	3 °C/second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time at liquidous ( $t_L$ )	60-150 seconds	60-150 seconds
Peak package body Temperature ( $T_p$ )*	See Classification Temp in table 1	See Classification Temp in table 2
Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ )	20** seconds	30** seconds
Average ramp-down rate ( $T_p$ to $T_{smax}$ )	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.

\* Tolerance for peak profile Temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.  
 \*\* Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum.

## Classification Reflow Profiles (Cont.)

Table 1. SnPb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (Tc)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

## Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HOLT	JESD-22, A108	1000 Hrs, Bias @ T <sub>f</sub> =125°C
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C
HBM	MIL-STD-883-3015.7	VHBM ≥ 2KV
MM	JESD-22, A115	VMM ≥ 200V
Latch-Up	JESD 78	10ms, 1 <sub>tr</sub> ≥ 100mA

## Customer Service

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