95028

PROTEK DEVICES
ANALOG PRODUCTS DIVISION

PA4402
Click-Pop Suppression Device

FEATURES

- 12V (typical) operation
- 3V RMS Capability
- Power-Up and Power-Down “POP” suppression
- ESD protected outputs
- Series operation
- Only 1 external capacitor required
- Ron (On resistance): 3.75 ohms
- Ron Flatness: <0.2 ohms
- Total Harmonic Distortion: <1%
- Current drain: <5mA

APPLICATIONS

- Portable DVD players
- Set-top boxes
- Car Audio
- High End Audio
- Televisions
- Stereo Systems
- Digital Video Recorders
- LCD TVs
- Home Theater systems

GENERAL DESCRIPTION

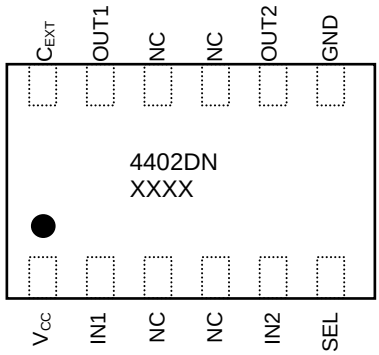
The PA4402 provides click-pop suppression for devices that lack a click-less/pop-less startup or shutdown. The PA4402 is placed between the codec and the output coupling capacitor.

The click-pop noise is generated at the coupling capacitors while the system is starting up as well as shutting down. The PA4402 controls the ramping of the DC voltage into the coupling capacitors thus reducing the click-pop noise generated during the startup and shutdown. The start time can be controlled or changed using an external capacitor.

ESD protection circuits are provided at the inputs and outputs of the device.

The PA4402 consumes less than 5mA of current and provides a THD of less than 1%.

Pin Layout and Description



FUNCTIONAL DIAGRAM

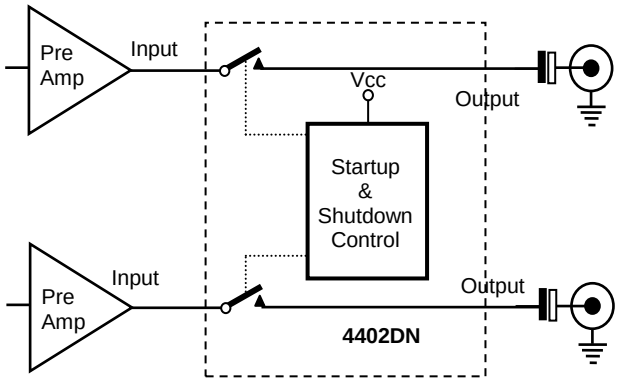


Figure 1: Functional block diagram of PA4402

Pin	Symbol	Designation
1	Vcc	Voltage
2	In1	Audio Input 1
3	NC	No Connect (Leave OPEN)
4	NC	No Connect (Leave OPEN)
5	In2	Audio Input 2
6	SEL	See SEL Logic Table
7	GND	Ground
8	Out2	Audio Output 2
9	NC	No Connect (Leave OPEN)
10	NC	No Connect (Leave OPEN)
11	Out1	Audio Output 1
12	C_{EXT}	External Capacitor

SEL Logic Table

System Voltage	SEL Status
12V	GND
>12.5V	V_{cc}

Ordering Information

Temp Range	Package	Part Number
-40 to 85 °C	12 Lead DFN	PA4402-T7

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95029. Rev2. 2/2012;

NOT FOR USE IN LIFE SUPPORT SYSTEMS

ABSOLUTE MAXIMUM RATINGS

(All Voltages are referenced to GND)

V_{CC} .....+15V
Continuous Current (IN_, OUT_).....±150mA
Continuous Current (All Other Pins) .....±20mA
Continuous Power Dissipation (T_A = +70°C)

Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature .....+150°C
Lead Temperature (soldering, 10s) .....+300°C

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{CC}=12V, SEL = GND, T_A = Ambient Temperature = 25 °C.

Symbol	Parameter	Condition	Limit			Unit
			Min	Typical	Max	
V_{CC}	Power Supply	Normal Operation	12.0		15.0	V
I_{DD}	Supply Current	Normal Operation			5	mA
T_A	Ambient Temperature	Normal Operation	-40		+85	ºC
R_{ON}	ON Resistance	1uF on Cext		3.75	5	Ω
$R_{FLAT(ON)}$	ON Resistance Flatness	Over Input Voltage Range		15		mΩ
THD	Total Harmonic Distortion	R_L = 600 Ω, V_{SIG} = $2V_{RMS}$ f = 1kHz		.020	1	%
X_{TALK}	Crosstalk (on)	f = 20kHz		-100		dB
Q_{IRR}	Off Isolation	f = 20kHz R_L= 600 Ω		-108		dB
V_{SIG}	Analog Signal Range	Normal Operation			3.0	V_{RMS}
V_{ESD}	ESD Protection	HBM		4		kV
f_{CO}	Bandwidth			>100		kHz
V_{UVLO}	Power Off Threshold	V_{CC} Falling	9.0	9.3		V_{CC}

PRODUCT DESCRIPTION

Figure 2 shows the normal setup of a Pre Amplifier system. Since the system is built on a single ended power supply the outputs of the pre-amplifier need to be routed through a bypass capacitor to get rid of the DC bias.

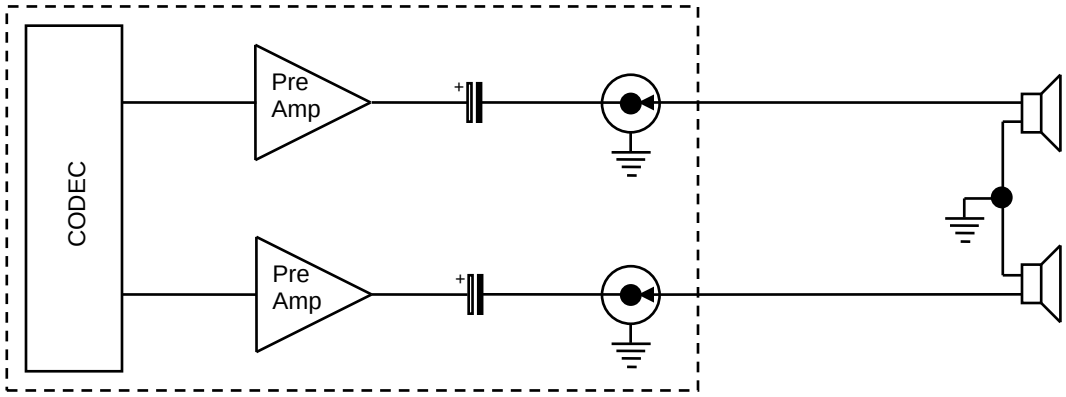


Figure 2: Normal setup for a pre amplifier output

When the power supply to the system is turned ON there is a spike in the output of the system because of the charging of various components in the system. This spike is called a "*Click or Pop Noise*". When this click/pop noise passes through the Power Amplifiers, the noise is amplified and listeners hear an audible 'pop' which causing undesired noise. The reverse operation happens when the system is powering down. The connection diagram is shown in Figure 3. The Powering Up sequence is shown in Figure 4 and the Powering Down sequence is shown in Figure 5. The audible POP noise heard can be caused by the powering up/down of the pre amp and/or CODEC devices. The PA4402 placed at the final output stage can suppress these noises.

CONNECTION DIAGRAM

The PA4402 will be placed after the pre-amplifier and before the output bypass capacitors.

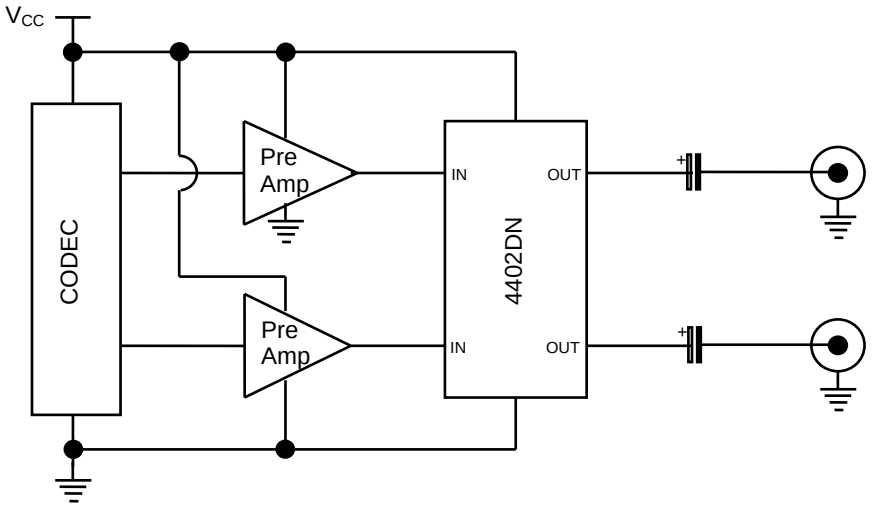


Figure 3: Typical Connection Configuration for PA4402

APPLICATION INFORMATION

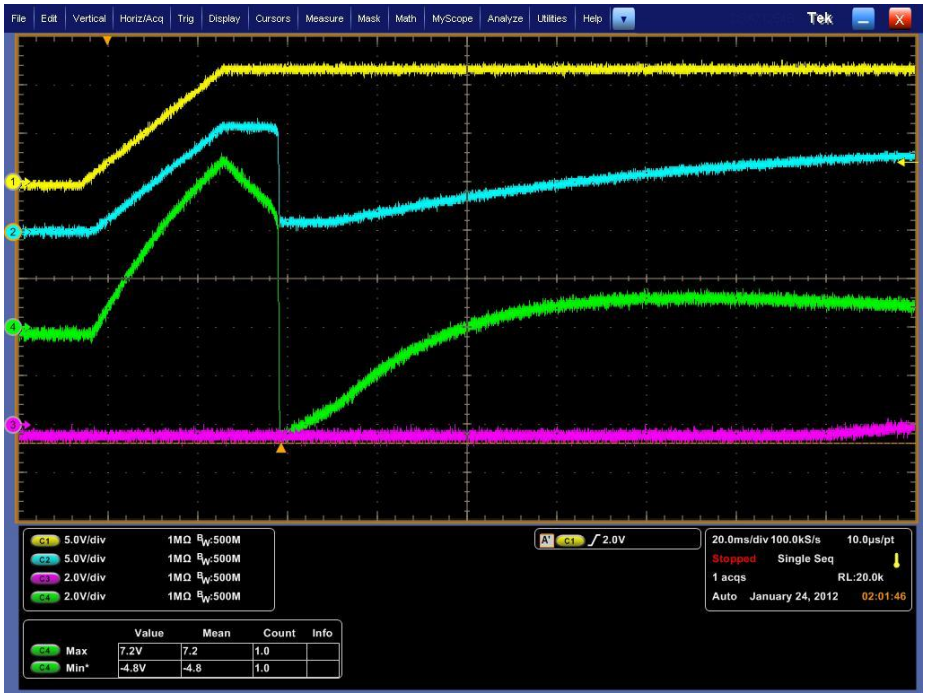


Figure 4: Power Up sequence waveforms

Channel 1 (yellow waveform) is the rise of the 12V power supply.
Channel 2 (blue waveform) is the waveform at the bypass capacitor input plate.
Channel 4 (green waveform) is the waveform at the bypass capacitor output plate without the PA4402.
Channel 3 (magenta waveform) is the waveform at the bypass capacitor output plate with the PA4402.

In Figure 3, the audible POP noise would be as high as 7.2V (Channel 4) and may also swing in the negative direction as well creating a Pk-Pk voltage of 12V, creating a loud undesirable POP noise. This noise is minimized on Channel 3 using the PA4402. As the Turn-On time is about 172mS (with a 1 µF on CEXT), thus suppressing the POP noise during power up.

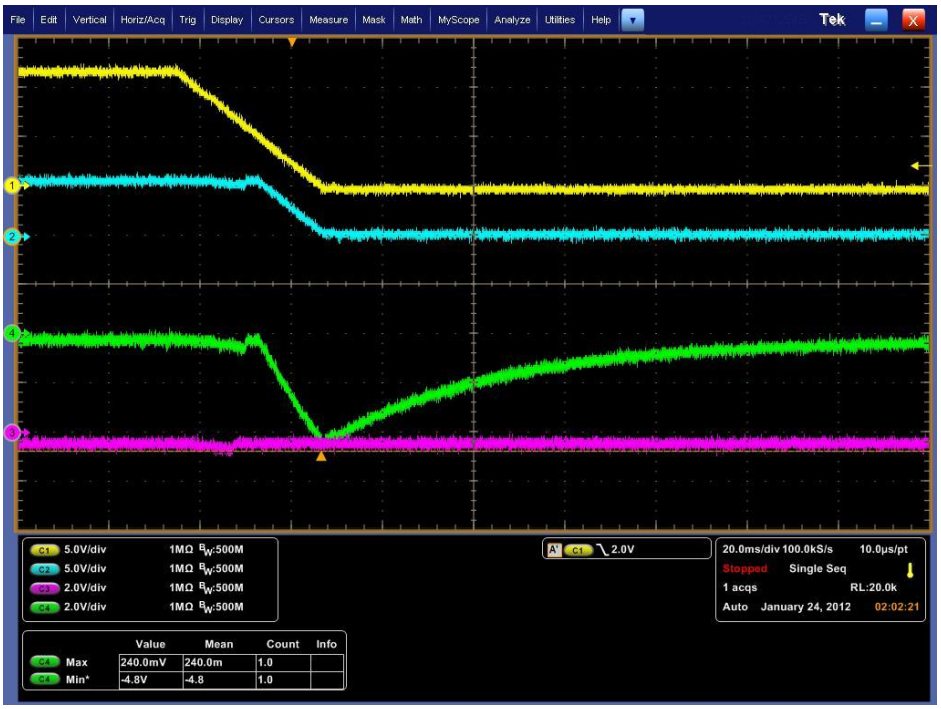
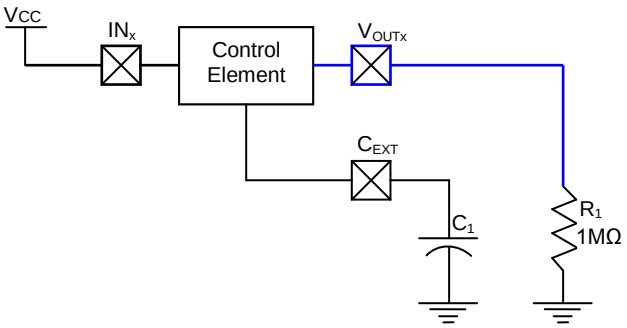


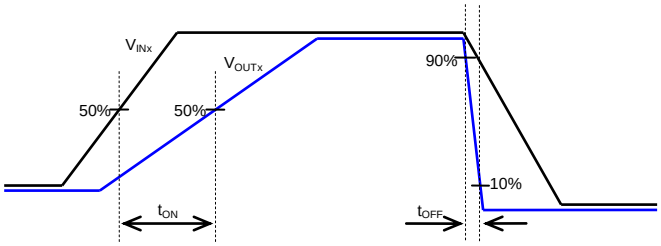
Figure 5: Power Down sequence waveforms

Channel 1 (yellow waveform) is the fall of the 12V power supply.
Channel 2 (blue waveform) is the waveform at the bypass capacitor input plate.
Channel 4 (green waveform) is the waveform at the bypass capacitor output plate without the PA4402.
Channel 3 (magenta waveform) is the waveform at the bypass capacitor output plate with the PA4402.

In Figure 4, the audible POP noise can be as high as 4.8V (Channel 4) with a negative swing without using the PA4402. When the PA4402 is active this negative swing is suppressed to less than 200mV (Channel 3) in this case.

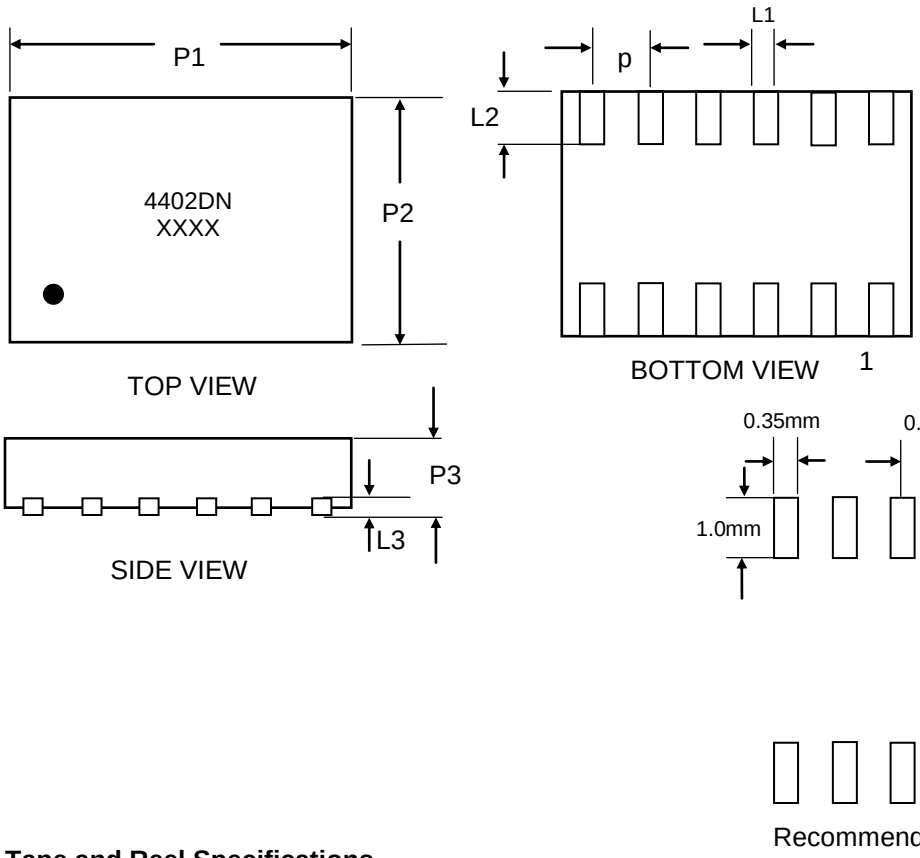
Test Circuit for Turn-On time vs. C_{EXT} and Turn-Off Time vs. C_{EXT}





C_{EXT} (µF)	t_{ON} *(mS)*	t_{OFF} *(mS)*
1	172	19
2.2	362	23
3.3	512	25
4.7	636	34

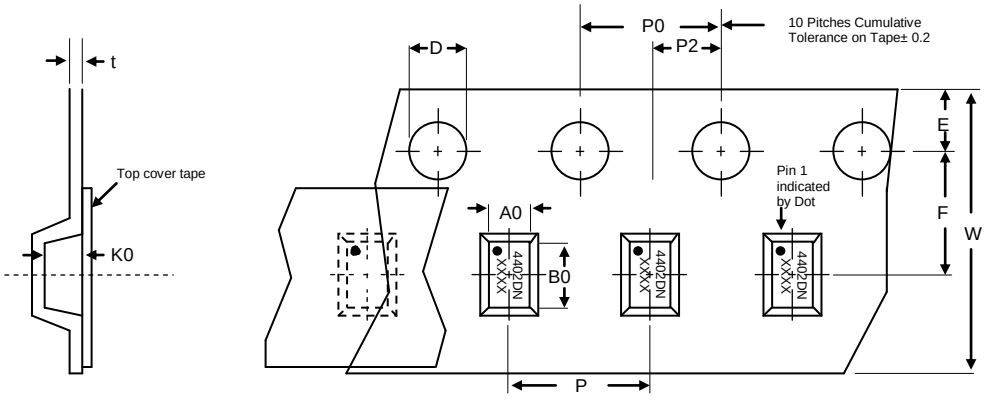
Package Outline and Dimensions DFN-12



Dim	MILLIMETERS		
	MIN	TYP	MAX
P1	3.90	4.00	4.10
P2	2.40	2.50	2.60
P3	0.85	0.90	0.95
L1	0.25	0.30	0.35
L2	0.55	0.60	0.65
L3		0.203	
p		0.65	

Tape and Reel Specifications

Reel Dia	A0	B0	K0	D	E	F	W	P0	P2	P	t-max
178 (7")	2.73±0.10	4.85.00±0.10	0.28±0.10	1.50±0.10	1.75±0.10	5.50±0.05	12.00±0.30	4.00±0.10	2.00±0.05	4.00±0.10	0.25



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