



AK4201

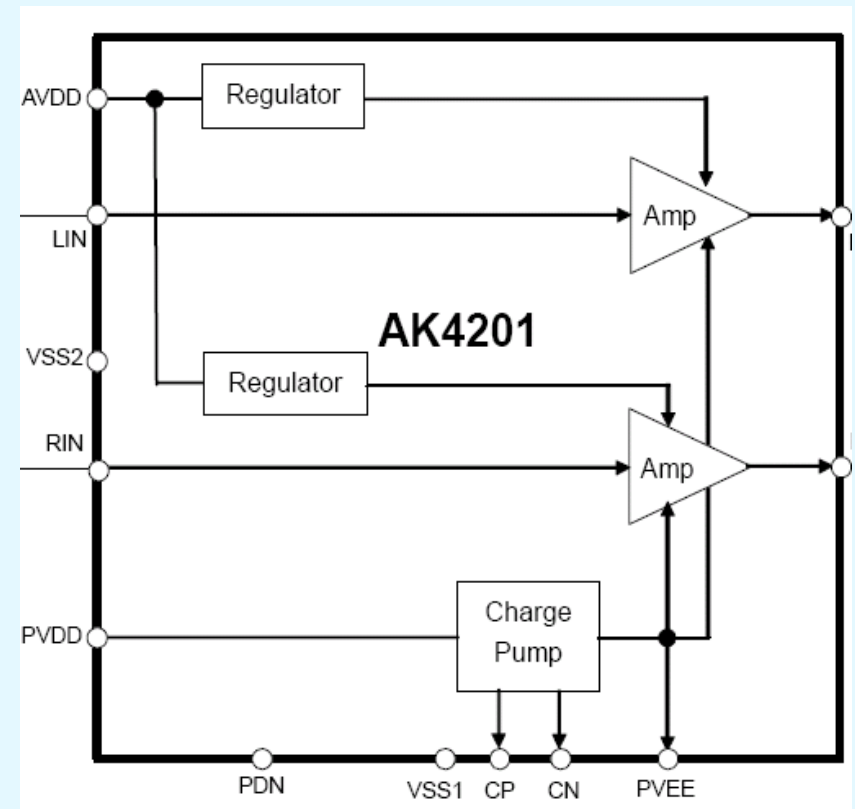
Headphone Amp / Line Driver



AK4201

2Vrms Line Driver / Headphone Amplifier

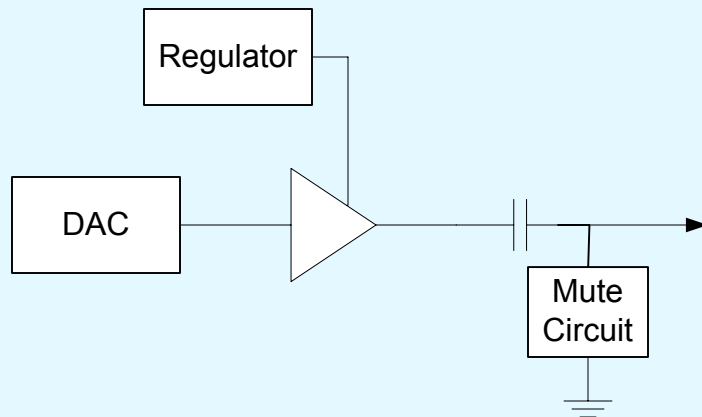
- **Cap-less architecture**
 - True ground referenced outputs
- **High PSRR with integrated regulators**
 - 100dB at 5V, 70dB at 3.3V
- **Low output noise level: 11 μ Vrms**
- **High THD+N performance:**
 - 100dB @ 5k Ω load, $V_o = 2V_{rms}$
- **Flexible gain adjusted by external resistors**
- **No pop noise at power ON/OFF and mute**
- **Turn on time < 50ms**
- **Power down/Mute Function**
 - 20ohms to ground
 - Replaces external mute circuit
- **Power Supplies: 2.6 ~ 5.5V**
 - Low quiescent current: 3.8mA
 - Low power shutdown mode, < 0.1uA
- **Ta: -40 ~ 85°C**
- **Package:**
 - 12pin USON (≈ 2.2 mm x 2.9 mm, 0.5mm pitch)



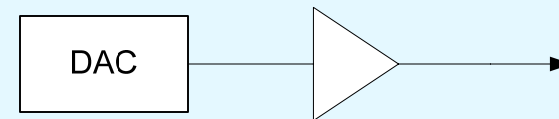


Implementation Comparison

- Traditional Implementation



- AK4201 Implementation



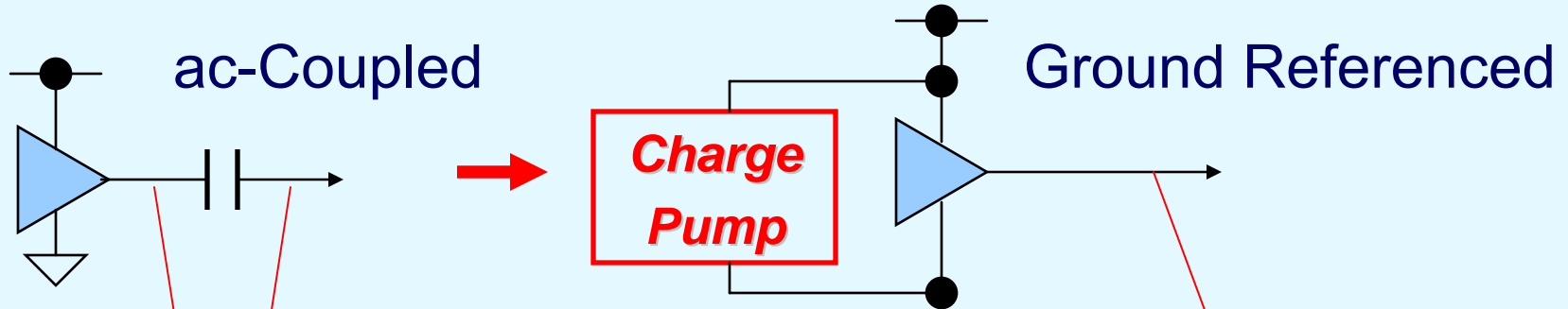


2V_{RMS} Advantage

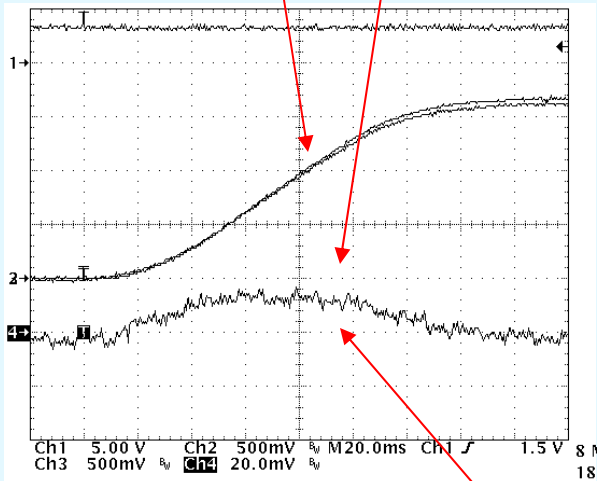
- AK4201 integrated charge pump enables 2V_{RMS} output from 3~5V supply input
 - 2V_{RMS} = 5.6V_{pp}
 - The defacto consumer audio voltage standard
 - Not possible from a single 5V supply
 - Normalizes volume level between devices for user



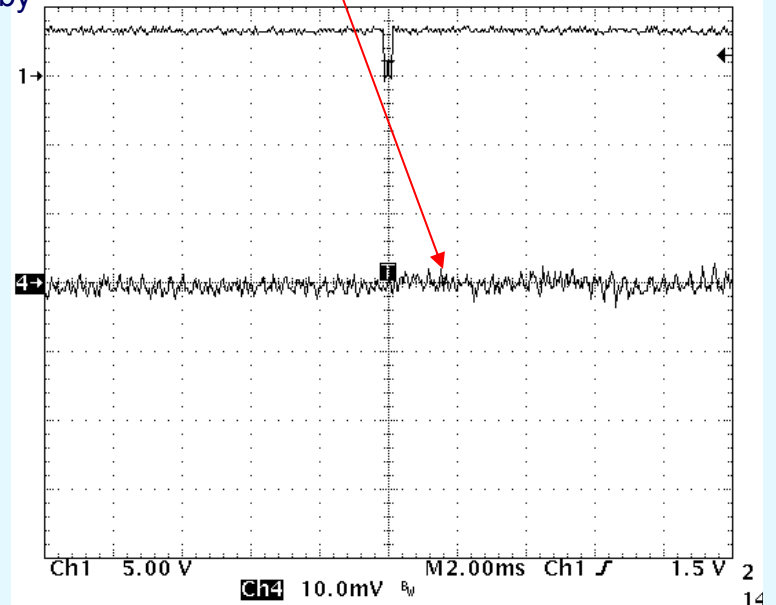
Ground Referenced Advantage



• Negative supply is generated by integrated charge pump



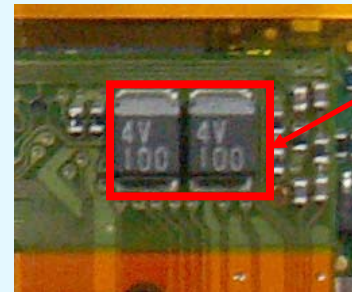
Pop Noise





Benefits of Removing ac Coupling Capacitors

- Cost
 - Large surface mount capacitors are expensive
- Popping
 - Capacitors can cause popping from bias change
- Frequency Response
 - Bass response limited with ac coupling capacitors



**100 μ F x 2
(5mm²)**



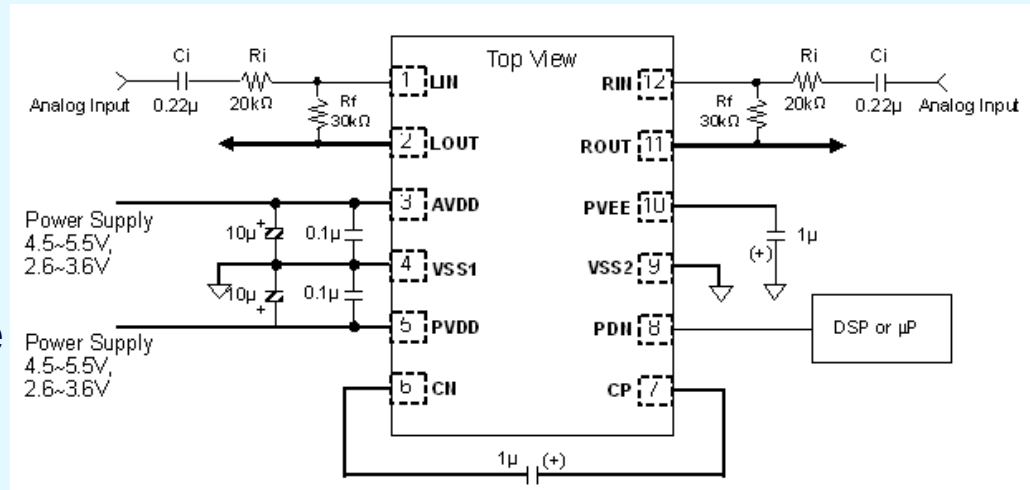
Removed !

AK4201
• 12pin USON (\approx 2.2 mm x 2.9 mm)

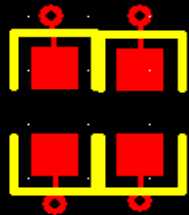


AK4201 Pin-out

- Pin-out optimized for:
 - Implementation board space
 - PSRR performance
 - Analog audio performance
 - Channel isolation performance

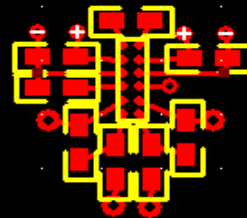


Classic Implementation



2 - 1206 Capacitors

AK4201 1 Sided Implementation



0402 Components

AK4201 2 Sided Implementation



0402 Components



Guaranteed Offset and Startup

- Integrated offset correction
 - ±0mV offset (typ)
 - ±1mV offset (max)
 - *Truly No Pop!*
- Fast startup time
 - <50ms

AKM CONFIDENTIAL [AK4201]

ANALOG CHARACTERISTICS (AVDD=PVDD=5.0V)

(AVDD=PVDD=5.0V, PDN=5.0V, Ta=25°C, VSS1=VSS2=0V, Input Signal Frequency = 1kHz, Measurement band width=10Hz ~ 20kHz, Gain=+3.5dB (Rn=20kΩ, Rp=50kΩ), Headphone-Amp: Rn=16Ω, Charge Pump Circuit External Capacitance: C1=C2= 1μF (Figure 3), unless otherwise specified)

Parameter	min	typ	max	Units
Output Power				
Rn=16Ω, 0.68Vrms Input	-	65	-	mW
THD+N				
0.68Vrms Input, Po = 65mW @ Rn=16Ω	-	-40	TBD	dB
0.60Vrms Input, Po = 50mW @ Rn=16Ω	-	-60	TBD	dB
1.33Vrms Input, Vo = 2.0Vrms @ Rn=5kΩ	-	-90	TBD	dB
S/N (Signal-to-Noise Ratio)				
Rn=16Ω (A-weighted) (Note 6)	TBD	102	-	dB
Rn=5kΩ (A-weighted) (Note 7)	TBD	108	-	dB
PSRR (Power Supply Rejection Ratio) (Note 8)				
217Hz	-	100	-	dB
1kHz	-	90	-	dB
Interchannel Isolation				
Rn=16Ω	60	80	-	dB
Rn=5kΩ	-	80	-	dB
Output Offset Voltage				
	-	±0.5	±5.0	mV
Start-up time (Note 9)				
	-	-	50	ms
Power Supplies				
AVDD + PVDD (Normal Mode, No Output)	-	4	TBD	mA
AVDD + PVDD (Power-Down Mode, PDN=0V)	-	0.1	TBD	μA

Note 6. In case of 0.68Vrms Input (Po=65mW).
 Note 7. In case of 1.33Vrms Input (Vo=2Vrms).
 Note 8. PSRR is applied to AVDD and PVDD with 500mVpp sine wave.
 Note 9. The time from PDN pin "H" to when the AK4201 can output the data.

Output Offset Voltage	-	± 0	± 1	mV
Start-up time (Note 13)	-	-	50	ms



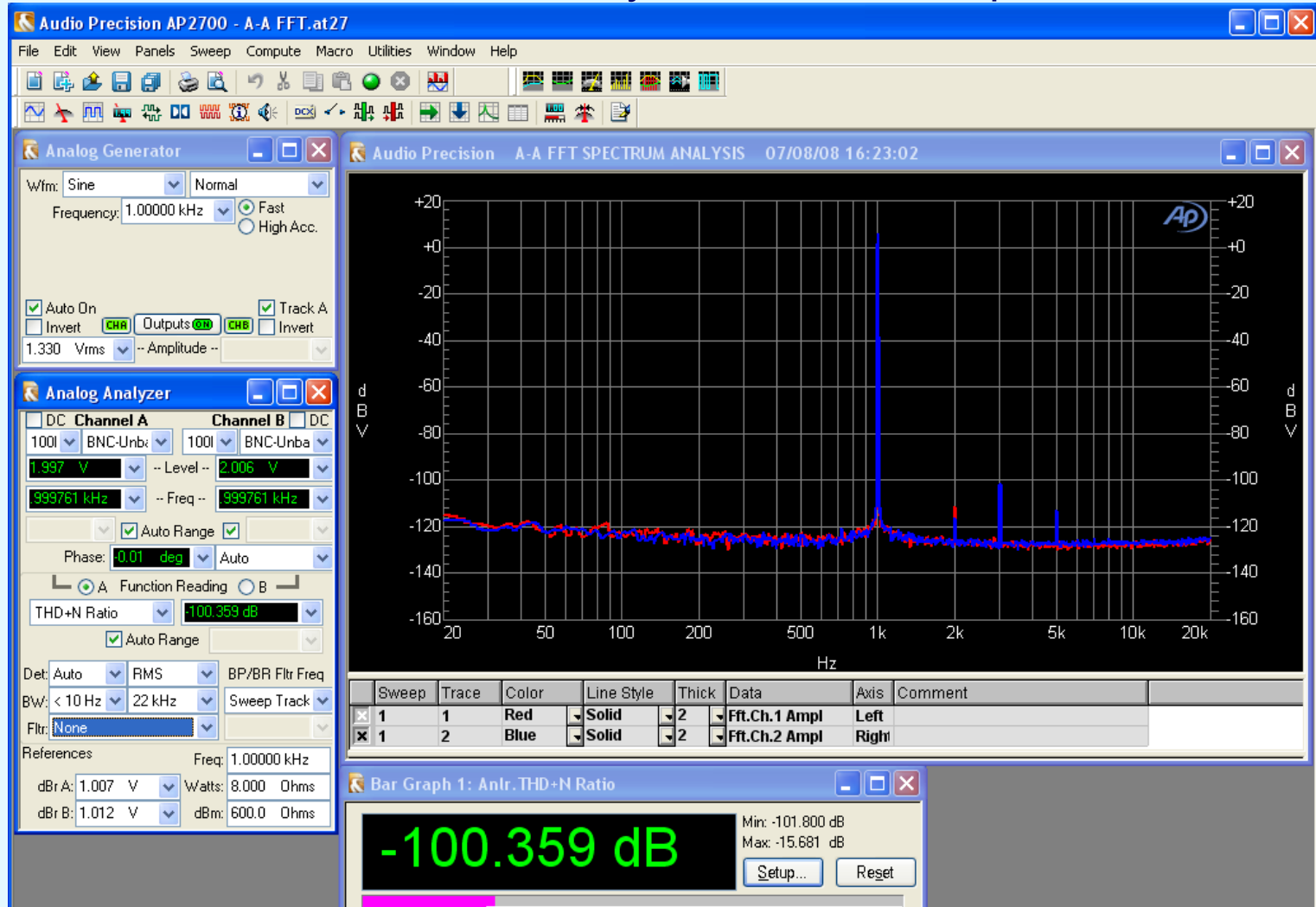
AK4201 High PSRR

- Integrated regulator for high PSRR
 - 100dB at 60Hz @ 5V
 - 100dB at 217Hz @5V
 - 90dB at 1kHz @ 5V
 - 70dB at 60Hz @ 3.3V
 - 70dB at 217Hz @ 3.3V
 - 70dB at 1kHz @ 3.3V
- Capable of connecting directly to USB 5V power and achieve good performance, despite the USB noise
- Internal regulator bypassed automatically at low voltage operation
 - At 3.3V operation, output is capable of driving 2Vrms (5.6Vpp)



Performance Running from USB 5V Supply

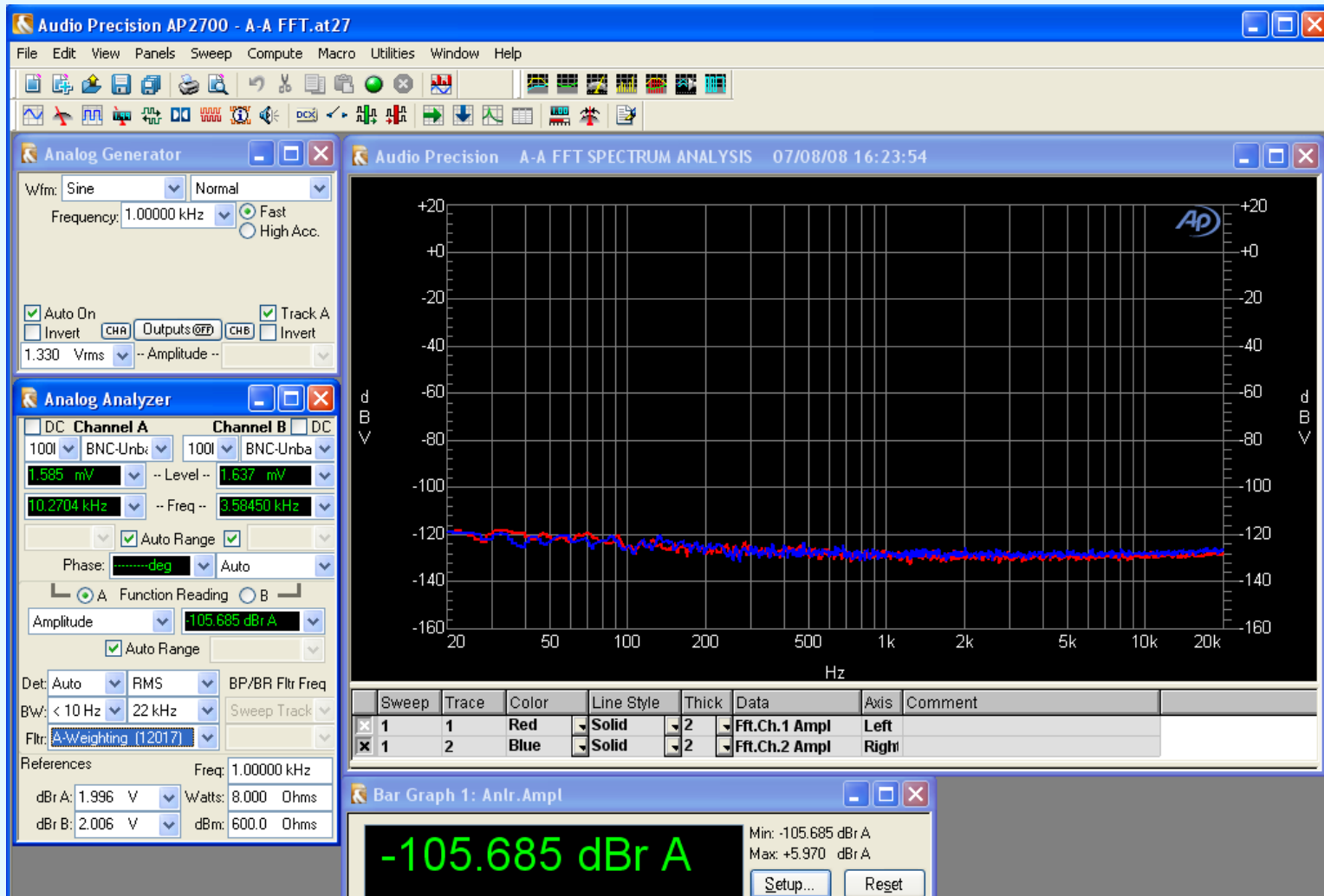
1 kHz THD+N Analysis at 2Vrms Output





Performance Running from USB 5V Supply

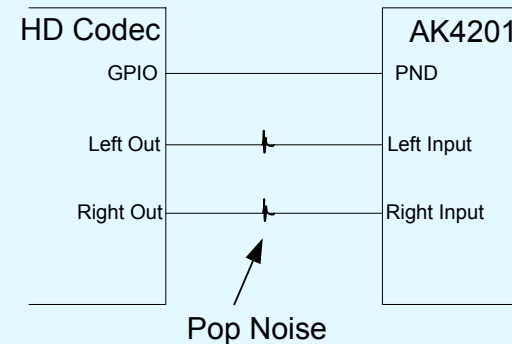
SNR Analysis at 2Vrms Output





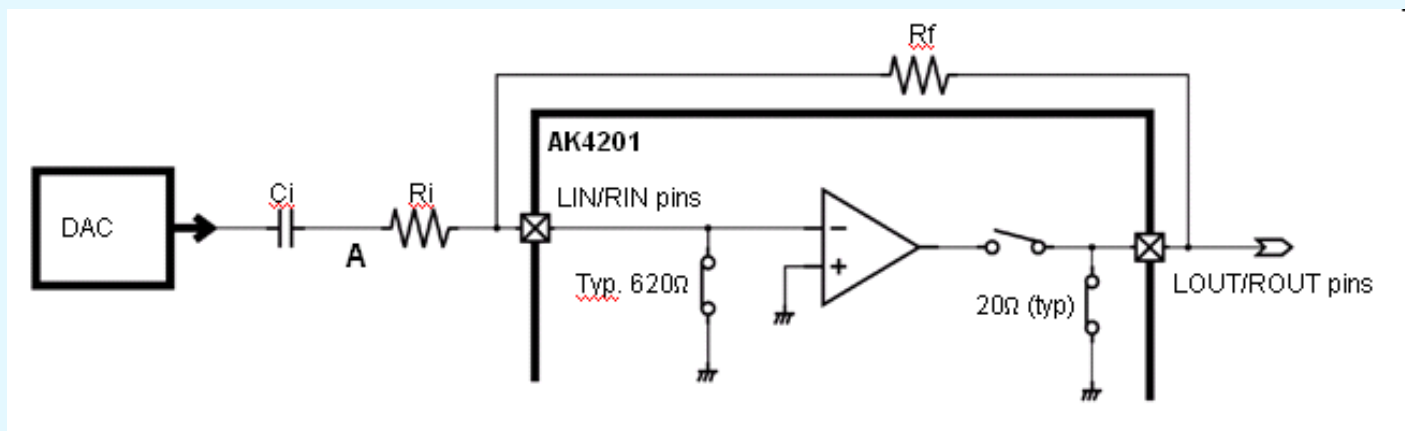
Power Down / Mute Function

- AK4201 power down mode
 - Low power shutdown mode
 - $< 0.1\mu\text{A}$
- During power down, outputs are pulled to ground
 - $20\ \Omega$ (typ.)
 - DAC pops eliminated
- This mode enables a fully effective system output mute





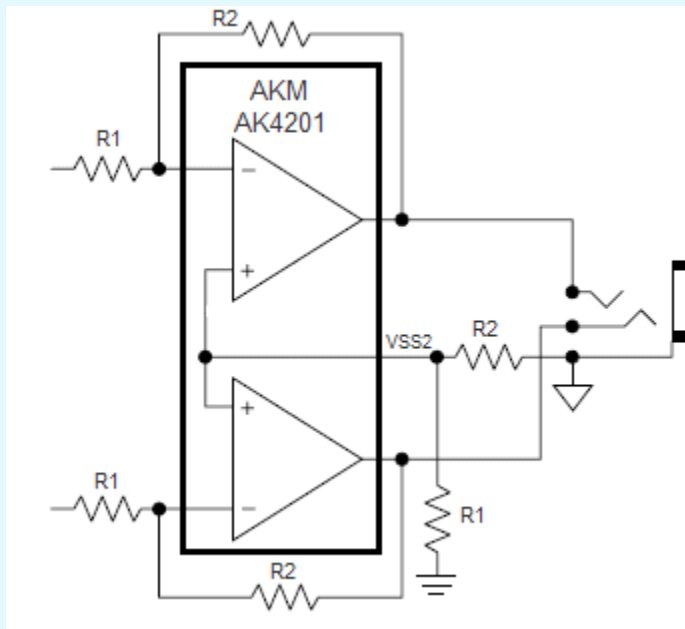
Mute Function Details



- If the output of the amplifier floats, any pop generated by DAC passes through the feedback resistor



Ground Loop Elimination Option

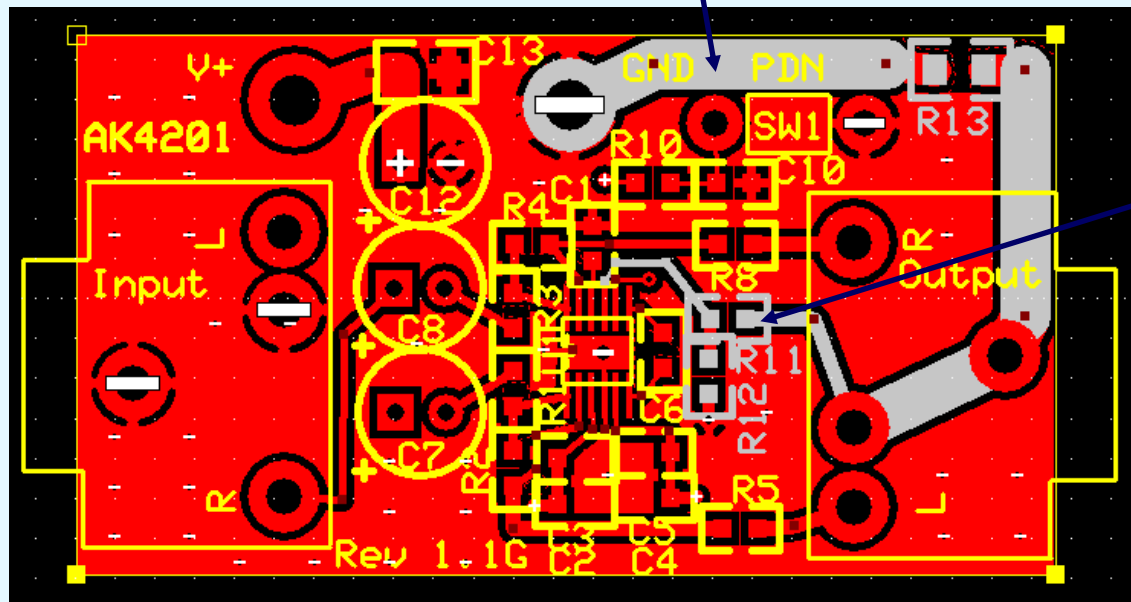


- Ground Loops
 - Connecting multiple devices together can create ground loops
- AK4201 enables noise cancellation using the VSS2 pin



Ground Loop Elimination Layout Example

Output ground signal
isolated back to supply



Ground noise summed
out into signal for
cancelation



AK4201 Differentiating Features

- Offset voltage
 - Industry leading typical and guaranteed
 - 0mV (typ) $\pm 1\text{mV}$ (max)
- Mute / Shutdown feature
 - Only device in the industry to mute at power down
 - Mute supplies 88dB attenuation
- Ground loop noise elimination



AK4201 Applications

- When the line out and HP jack are shared
- Any product that has an integrated DAC with popping issues or line drive limitations
 - HD CODEC
 - MP3 decoders
 - PND
- Systems that need to route audio internally and need to mute