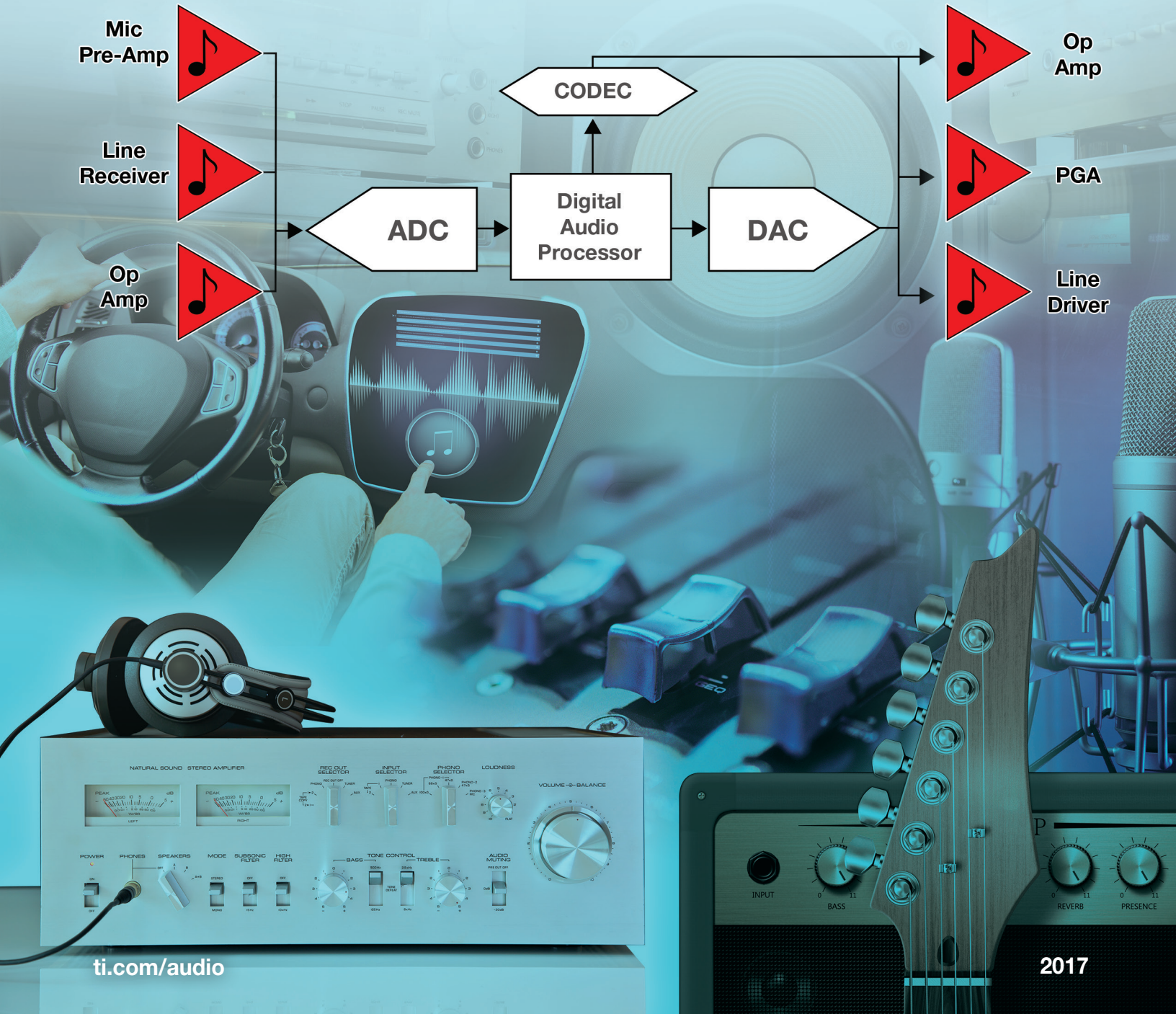
Precision Linear Audio Amplifiers

Texas Instruments



ti.com/audio

2017

Newest Linear Audio Products

INA1650 / INA1650-Q1* Differential Line Receivers

The highest CMRR for professional audio applications

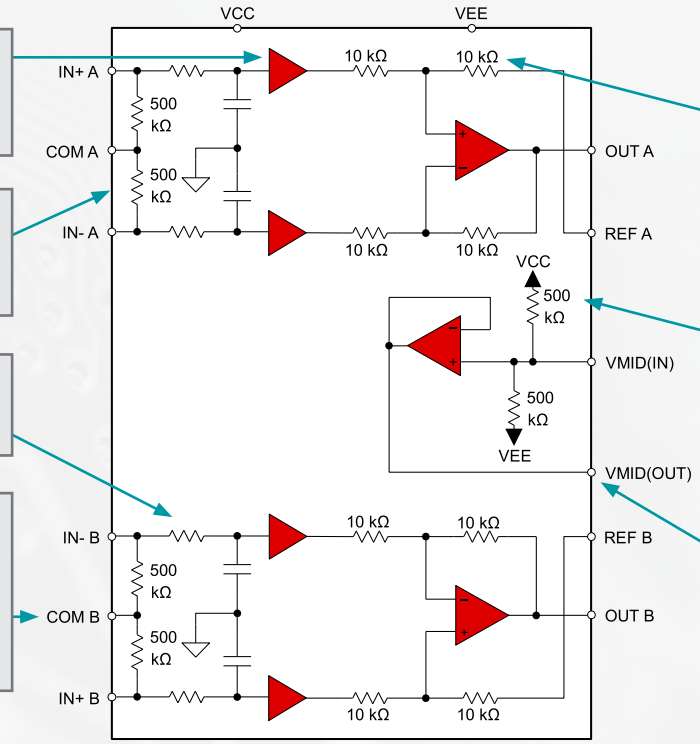
What's Inside?

Low-noise FET-input buffers reduce CMRR sensitivity to external resistance mismatches

500kΩ input resistors matched to 0.01% allow for smaller AC coupling capacitors

Input EMI filters further reduce external component count

COM pins allow input common mode biasing with mid-supply output. External resistor can be attached to further increase common-mode input impedance

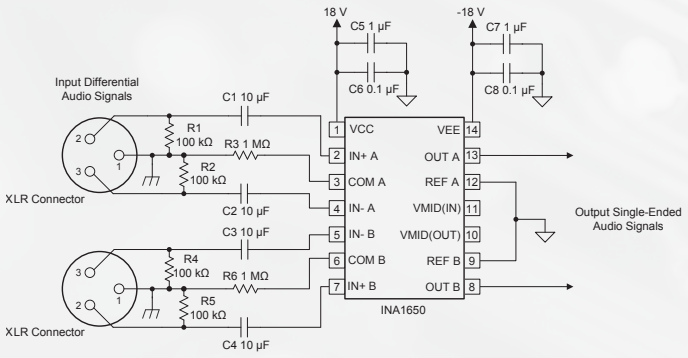


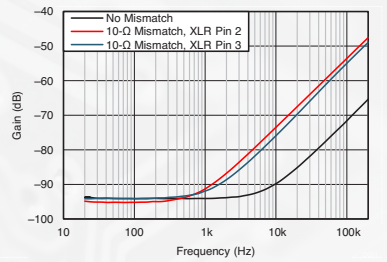
Internal 10k resistors matched to within 0.0013% to achieve 91dB CMRR

Internal supply splitter with 500kΩ resistors matched to 0.01%. VMID(IN) pin allows external filtering capacitor

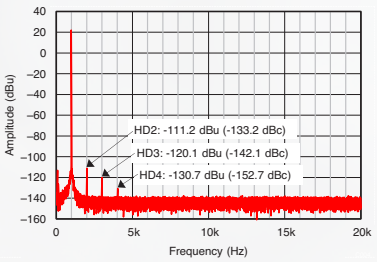
Low-impedance VMID(OUT) connects to REF and COM pins for single-supply applications. Also provides convenient bias voltage for additional circuitry

Application and Measured Performance





CMRR vs Frequency
(1V_{RMS} common-mode signal)



Output Spectrum
(22-dBu Output Amplitude)

Other Applications

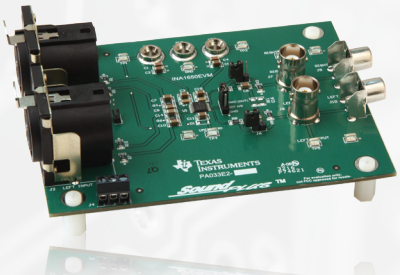
- Differential Line Receiver for Single-Supply Applications
- Floating Single-Ended Input Line Receiver for Ground Loop Noise Reduction
- Floating Single-Ended Input Line Receiver With Differential Outputs
- TRS Audio Interface in Single-Supply Applications
- Differential Line Driver With Single-Ended Input

* In Development

INA1650 Evaluation Module

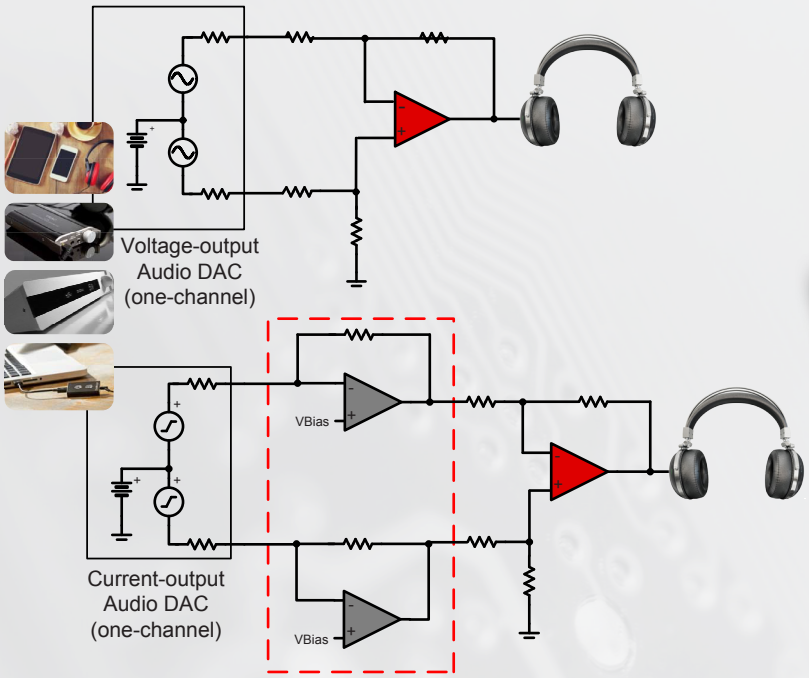
Hardware platform for evaluating the performance of the INA1650 differential line receiver

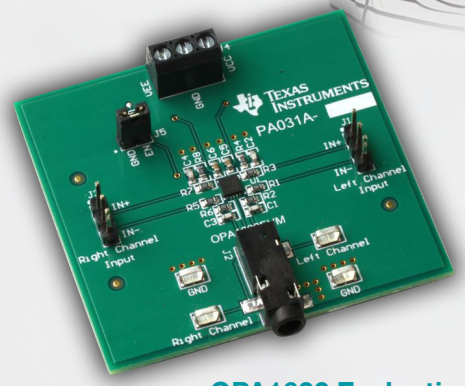
www.ti.com/tool/INA1650EVM



Newest Linear Audio Amplifiers

OPA1622 and OPA1688 High-Fidelity Headphone Amplifiers





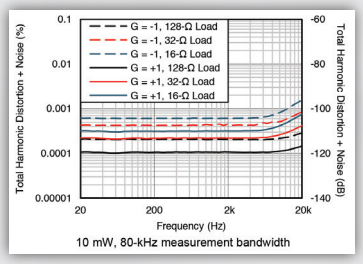
OPA1622 Evaluation Module

Hardware platform for evaluating the performance of the OPA1622 audio op amp

www.ti.com/tool/OPA1622EVM

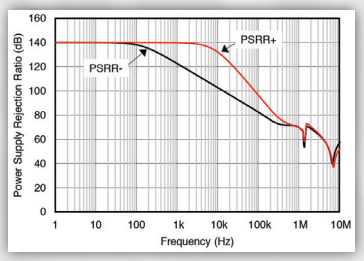
OPA1622: Pushing the boundaries of audio quality

Superior audio quality



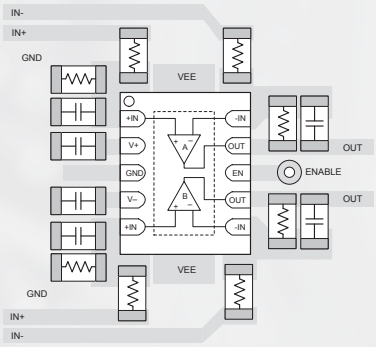
- THD+N: -119 dB (32Ω, 142 mW)
- Voltage Noise: 2.8 nV/√Hz at 1 kHz
- Linear output current: 80 mA_{RMS}
- Click/pop suppression

Ideal for portable audio



- Excellent PSRR of –97 / –123 dB at 20 kHz
- Low power consumption: 2.6 mA/ch
- Small package: 3mm x 3mm DFN

Design-ease pinout



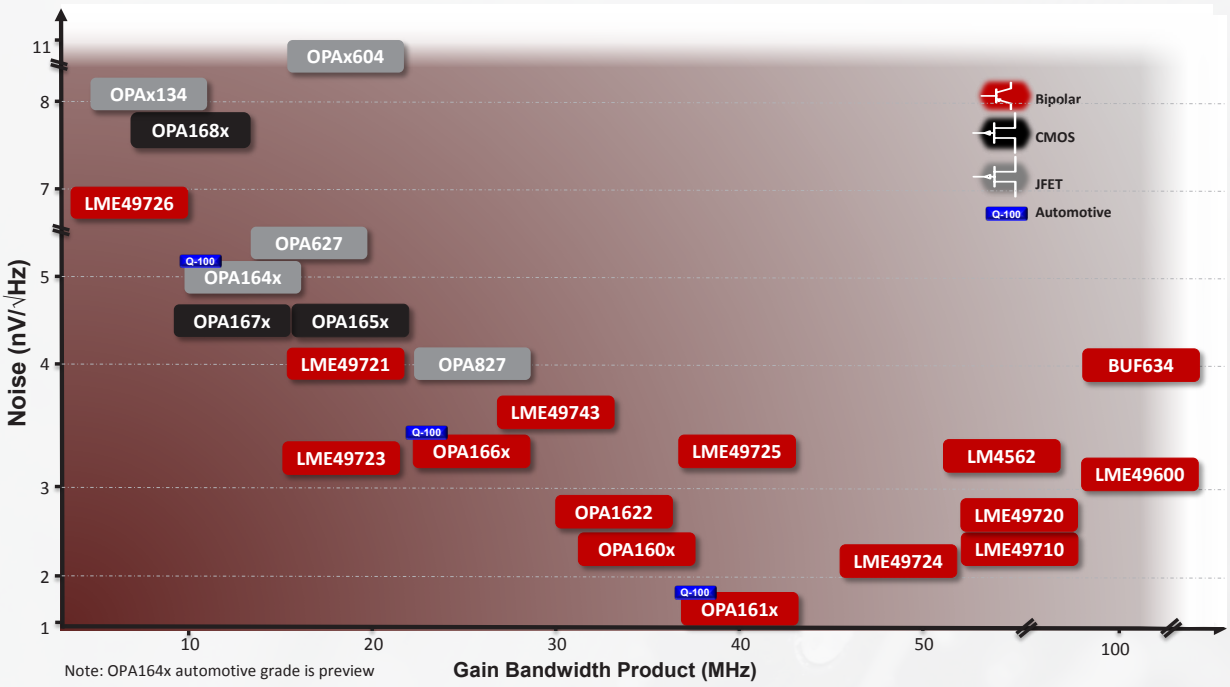
- Unique pinout improves PCB layout and eliminates thermal distortion effects

Audio Headphone Amplifier Portfolio

Parameters	OPA1612	OPA1688	OPA1622
Power Supply Current Per Channel	3.6 mA	1.6 mA	2.6 mA
Input Voltage Noise	1.1 nV/√Hz	8 nV/√Hz	2.8 nV/√Hz
Input Current Noise	1.7 pA/√Hz	0.0018 pA/√Hz	0.8 pA/√Hz
Linear Output Current	30mA_{RMS}	43 mA_{RMS}	80 mA_{RMS}
Short Circuit Current	+55/–62 mA	±75 mA	+145/–130 mA
Gain Bandwidth Product	40 MHz	10 MHz	32 MHz
Slew Rate	27 V/µs	8 V/µs	10 V/µs
THD+N (1kHz, 10 mW, 32Ω)	–112.2 dB	–111 dB	–113.9 dB
Click-Free Enable	No	No	Yes
Cap Load Drive	100 pF	200 pF	>600pF
Package	3x3 mm^2; DFN-8 pin	3x3 mm^2; DFN-8 pin	3x3 mm^2; DFN-10 pin

Linear Audio Amplifier Portfolio

For The Most Discerning Audio Enthusiasts



Note: OPA164x automotive grade is preview

Device	Channels	Supply Range (V)	Vn @ 1kHz (Typ) (nV/√Hz)	In @ 1kHz (Typ) (fA/√Hz)	GBW (MHz)	Iq (Typ) (mA)	Slew Rate (V/µs)	Pin/Pkg
OPA1611/OPA1612	1, 2	5-36	1.1	1700	40	3.6	27	Single: SO-8, MSOP-8; Dual: SO-8, DFN-8
LME49724	1	5-36	2.1	-	50	10	18	SO-PowerPAD
OPA1602/OPA1604	2, 4	5-36	2.5	1800	35	2.6	20	Dual: SOIC-8, MSOP-8; Quad: SOIC-14, TSSOP-14
LME49710	1	5-34	2.5	1600	55	4.8	20	SOIC, TO-99, PDIP
LME49720	2	5-34	2.5	1600	55	5	20	SOIC, TO-99, PDIP
LME49860	2	5-44	2.5	1600	55	5	20	SOIC
LM4562	2	5-34	2.7	1600	55	5	20	SOIC, TO-99, PDIP
OPA1622	2	4-36	2.8	800	32	2.6	10	DFN-10
LME49600	1	4.5-36	3	-	180	14	2000	DDPAK/TO-263
LME49723	2	5-34	3.2	700	19	3.35	8	SOIC
OPA1662/OPA1664	2, 4	3-36	3.3	1000	22	1.5	17	Dual: SO-8, MSOP-8; Quad: SO-14, TSSOP-14
LME49725	2	2.5-5.5	3.3	1400	40	3	15	SOIC
LME49743	4	8-34	3.5	1600	30	2.5	12	TSSOP
OPA827	1	8-36	4	2.2	22	4.8	28	SO-8, VSSOP-8
LME49721	2	2.2-5.5	4	-	20	2.15	8.5	SOIC
OPA1652/OPA1654	2, 4	4.5-36	4.5	3	18	2	10	Dual: SO-8, MSOP-8, DFN-8; Quad: SO-14, TSSOP-14
OPA1678/9	2, 4	4.5-36	4.5	3	16	2	9	Dual: SOIC-8, VSSOP-8; Quad: SOIC-14, TSSOP-14
OPA1641/OPA1642/ OPA1644	1, 2, 4	5-36	5.1	0.8	11	1.8	20	Single: SO-8; Dual: SO-8, MSOP-8; Quad: SO-14, TSSOP-14
OPA627	1	9-36	5.2	2.5	16	7	55	PDIP-8, SO-8
LME49726	2	2.5-5.5	6.9	750	6.25	0.7	3.7	MSOP-PowerPAD
OPA1688	2	4.5-36	8	1.8	10	1.6	8	SO-8, DFN-8
OPA134/OPA2134/ OPA4134	1, 2, 4	5-36	8	3	8	4	20	Single: PDIP-8, SO-8; Dual: PDIP-8, SO-8; Quad: SO-14
OPA604/OPA2604	1, 2	9-48	11	4	20	5.3	25	Single: PDIP-8, SO-8; Dual: PDIP-8, SO-8

Linear Audio Products Portfolio - Special Function

Line Receivers and Line Drivers

Audio line receiver and driver products are used in professional audio environments such as live concerts, recording and broadcasting studios. These products are also used in other areas to keep signals clean and interference-free such as industrial and automotive data transmission applications. By using well-matched thin film resistors and low-noise amplifiers, these products offer outstanding common-mode rejection and excellent dynamic response.

Audio Line Receivers

Part	Channels (#)	Gain (V/V)	CMRR (Min) (dB)	THD+N @ 1kHz(%)	Noise Floor (RTO)(dBu)	Input Impedance (kΩ)		Slew Rate (Typ) (V/µs)	Supply Range (V)	Iq/ch (Typ) (mA)	Small-Signal Bandwidth (Typ) (MHz)	Operating Temperature (°C)	Package
						Differential	Common-mode						
INA134/ INA2134	1, 2	1	74	0.0005	-100	50	25	14	8-36	2.4	3.1	-40 to 85	PDIP, SOIC
INA137/ INA2137	1, 2	0.5, 2	74	0.0005	-106	24	18	14	8-36	2.4	4	-40 to 85	PDIP, SOIC
INA1650	2	1	85	0.00039	-104.7	1000	250	10	4.5-36	5.25	2.7	-40 to 125	TSSOP

Audio Line Drivers

Part	Channels (#)	Gain (V/V)	THD+N @ 1kHz(%)	Noise Floor (RTO)(dBu)	Load Capacitance (µF)	Slew Rate (Typ)(V/µs)	Small-Signal Bandwidth (Typ) (MHz)	Supply Range (V)	Iq (Typ) (mA)	Operating Temperature (°C)	Package
DRV134 / DRV135	1	2	0.0005	-98	1	15	1.5	9-36	5.2	-55 to +125	PDIP (DRV134 only), SOIC

Microphone Preamplifiers

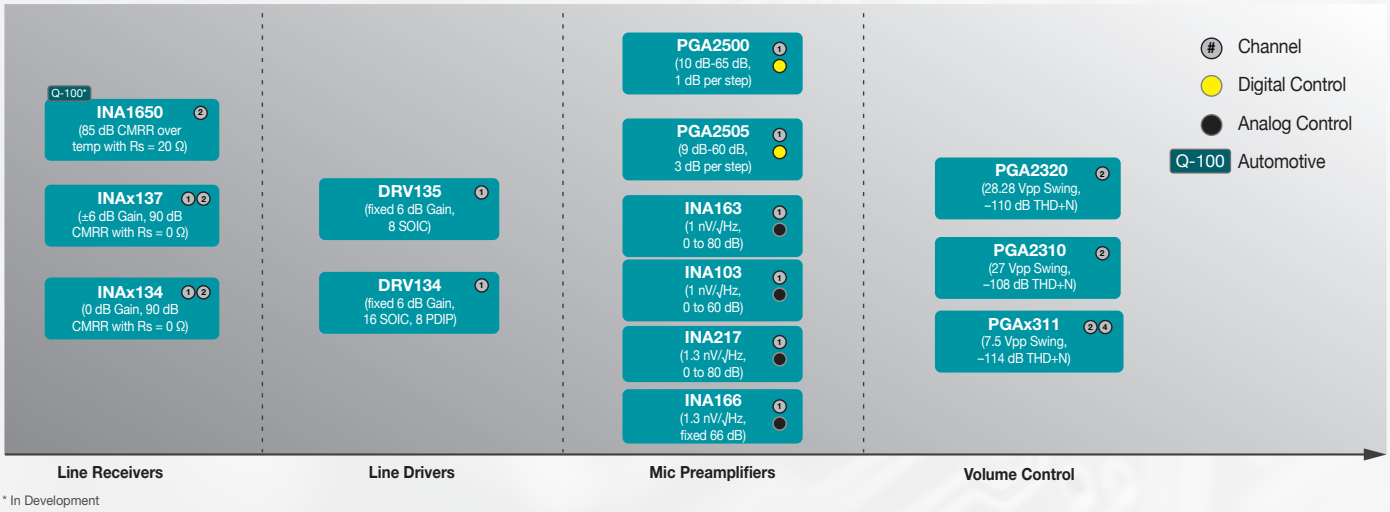
Microphone preamplifier products offer low noise and both analog and digitally-configurable gains to accommodate a wide range of microphone types and audio systems.

Part	Gain Range (dB)	Input Voltage Noise (Typ) (nV/√Hz)	Power Supply	Iq (Typ) (mA)	Interface	Operating Temperature (°C)	Package
PGA2505	9dB through 60dB, in 3dB steps	3	±5	30	Digital SPI	-40 to 85	SSOP
PGA2500	0dB, and 10dB to 65dB in 1dB steps	1.2	±5	30	Digital SPI	-40 to 85	SSOP
INA163	0 to 80dB	1	±4.5 to ±18	10	Analog	-40 to 125	SOIC
INA217	0 to 80dB	1.3	±4.5 to ±18	10	Analog	-40 to 125	SOIC, PDIP
INA103	0 to 80dB	1	±9 to ±25	9	Analog	-40 to 85	SOIC, PDIP
INA166	66dB	1.3	±4.5 to ±18	10	Analog	-40 to 125	SOIC

Volume Control

Stereo audio volume control products are used in a wide array of professional and consumer audio equipment. Internal switches are used to select taps in a resistor network that determine the gain of the amplifier stage. Switch selections are programmed using a serial control port, which allows connection to a wide variety of host controllers.

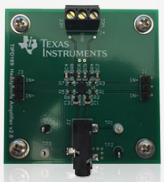
Part	Channels (#)	Power Supply (V)	Gain and Attenuation (dB)	THD+N @ 1kHz(%)	Interchannel Crosstalk @ 1 kHz (dBFS)	Gain Error (dB) (Gain=31.5dB)	Dynamic Range (dB)	Load Capacitance (pF)	Operating Temperature (°C)	Package
PGA2320	2	±15	+31.5dB to -95.5dB with 0.5dB steps	0.0003	-126	±0.1	120	1000	-40 to 85	SOIC
PGA2310	2	±15		0.0004	-126	±0.05		1000		PDIP, SOIC
PGA2311/PGA4311	2, 4	±5		0.0002	-130	±0.05		100		PDIP (PGA2311 only), SOIC



* In Development

Linear Audio Products

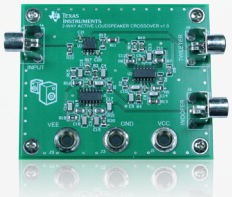
Linear Audio Reference Designs



Hi-Fi headphone amplifier for voltage output audio DACs

High-fidelity headphone amplifier circuit suitable for portable applications, such as smartphones and tablets

ti.com/TIPD189



Analog active crossover circuit for two-way loudspeakers

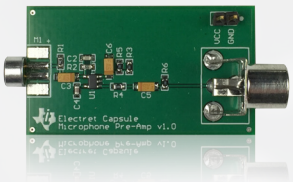
Analog active crossover design for two-way loudspeakers that can be used in recording studios or residental high-fidelity systems

ti.com/TIPD134

Active volume control for professional audio

Split-supply, high-performance volume control that attenuates a professional line-level audio signal with minimal distortion and noise

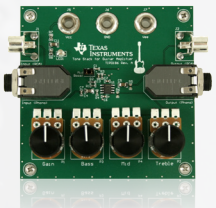
ti.com/TIPD136



Single-supply electret microphone preamplifier

Amplifies the output of the microphone to common analog line level voltages

ti.com/TIPD181



Tone stack for electric guitars

Split-supply, high-performance guitar tone circuit that provides control of the bass, mid, and treble frequencies for an electric guitar signal

ti.com/TIPD186

Hi-Fi headphone amplifier for current output audio DACs

Converts the differential current output of audio DACs to a single-ended voltage capable of driving low impedance headphones

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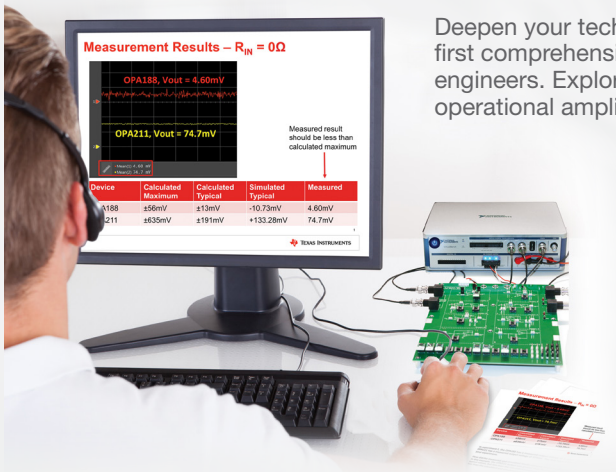

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