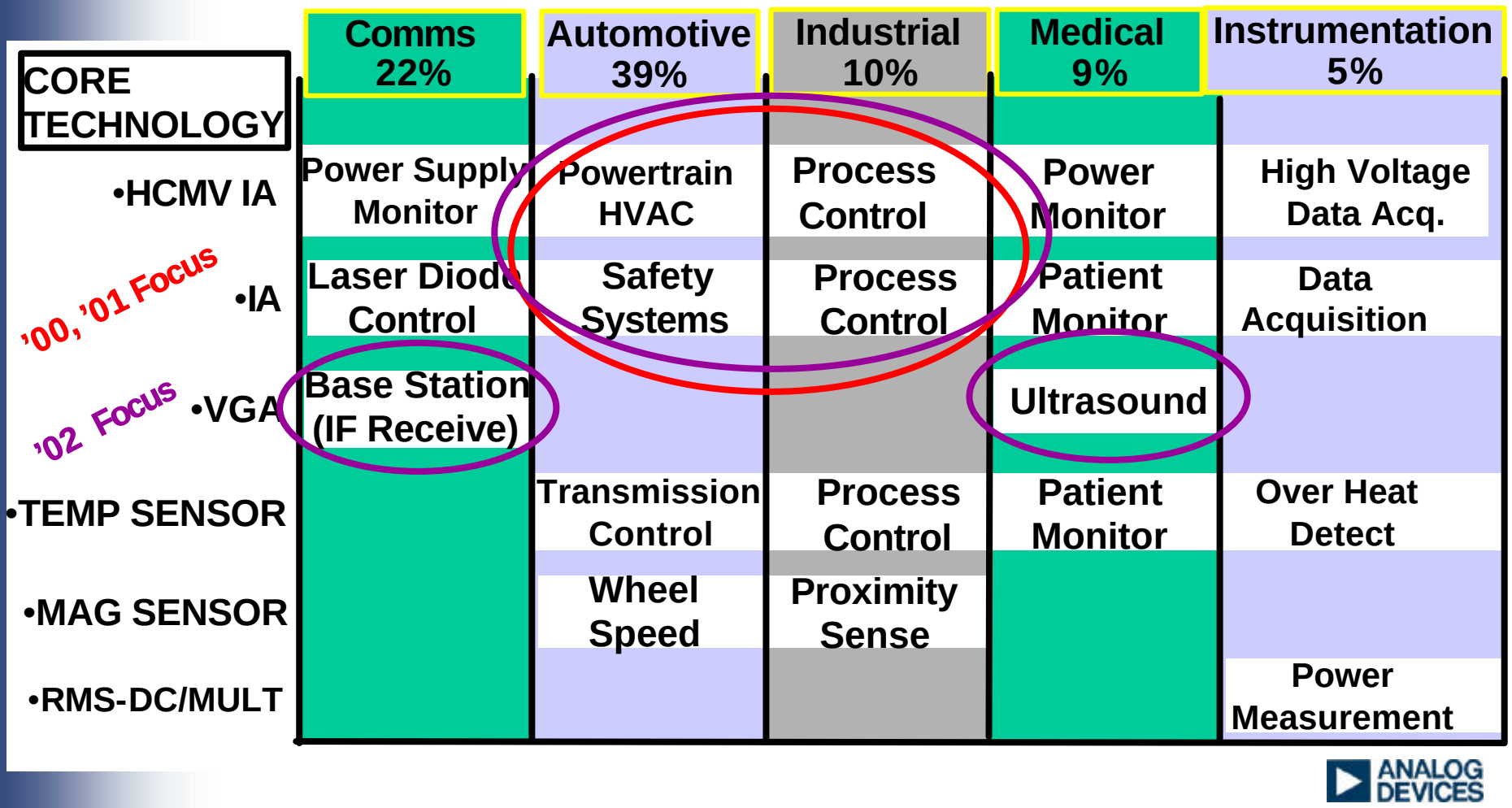
Advanced Linear Products

Industrial, Instrumentation and Automotive Products (IIA)

ANALOG DEVICES

IIA Core Technology and Markets with Growth Rate

Strategy - Leverage Broad Product Portfolio and Customer Base into Higher Growth Markets with Value Added Solutions

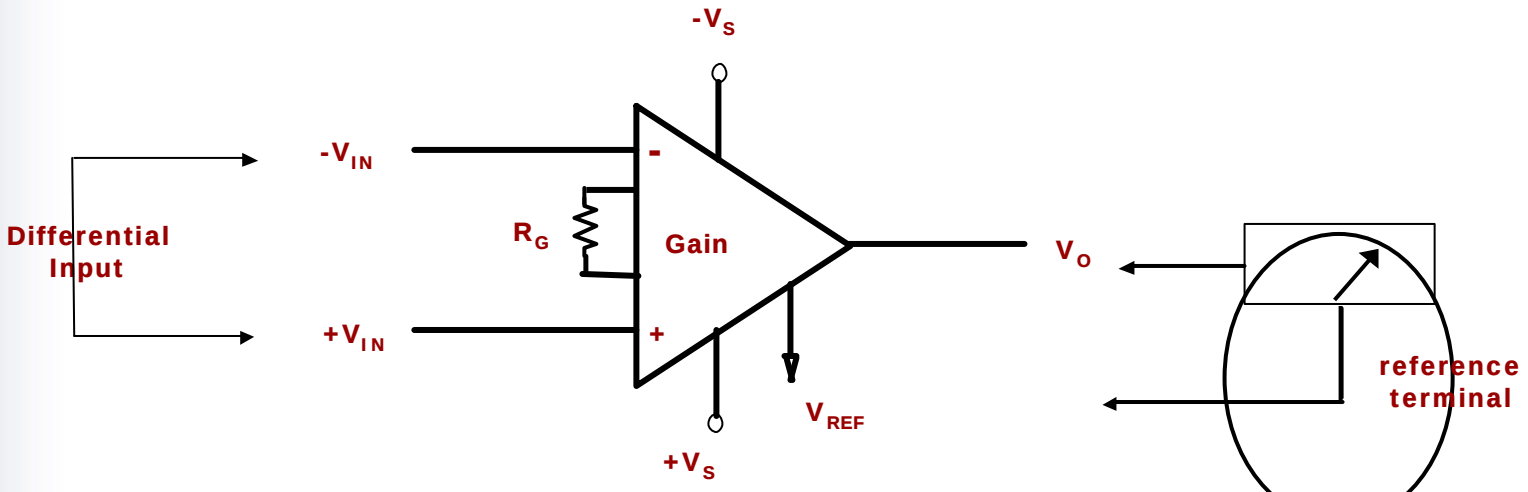


ANALOG DEVICES

Instrumentation Amplifier Facts

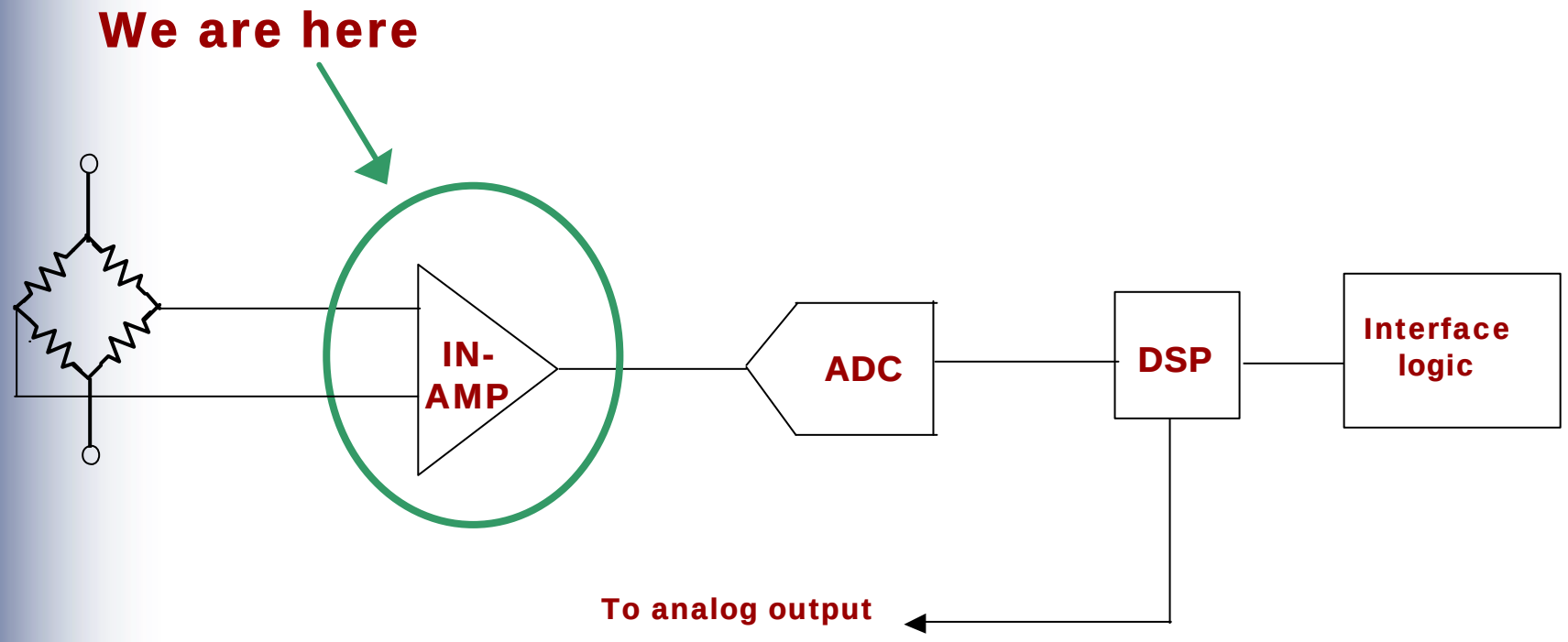
What is an In-Amp?

- Has differential input
- Very high CMRR
- Very high R_{in}
- Ultra-low input bias currents
- Provides gain
- Has single-ended output with respect to a reference terminal



ANALOG DEVICES

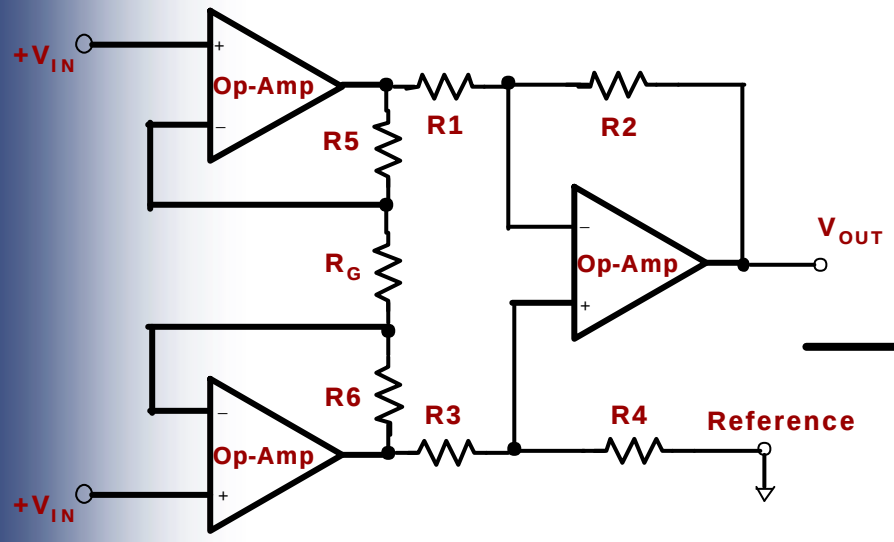
Signal Chain



ANALOG DEVICES

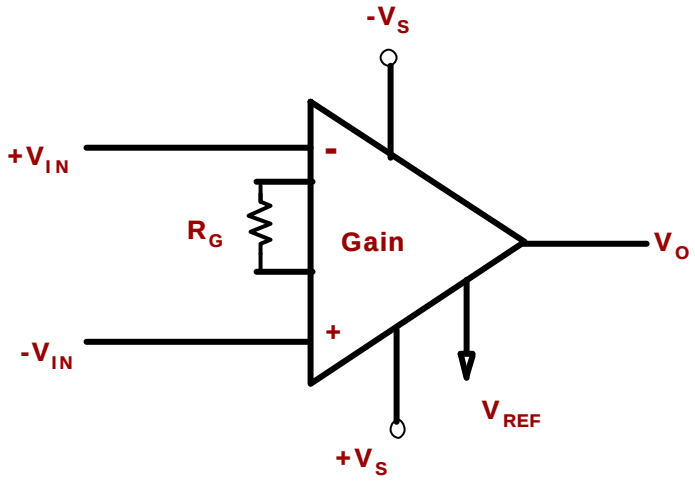
Benefits of Monolithic In-Amps

Discrete



- 2-3 op amps
- 7-9 resistors
- Too much board space
- High costs
  - bill of materials
  - manufacturing

Monolithic

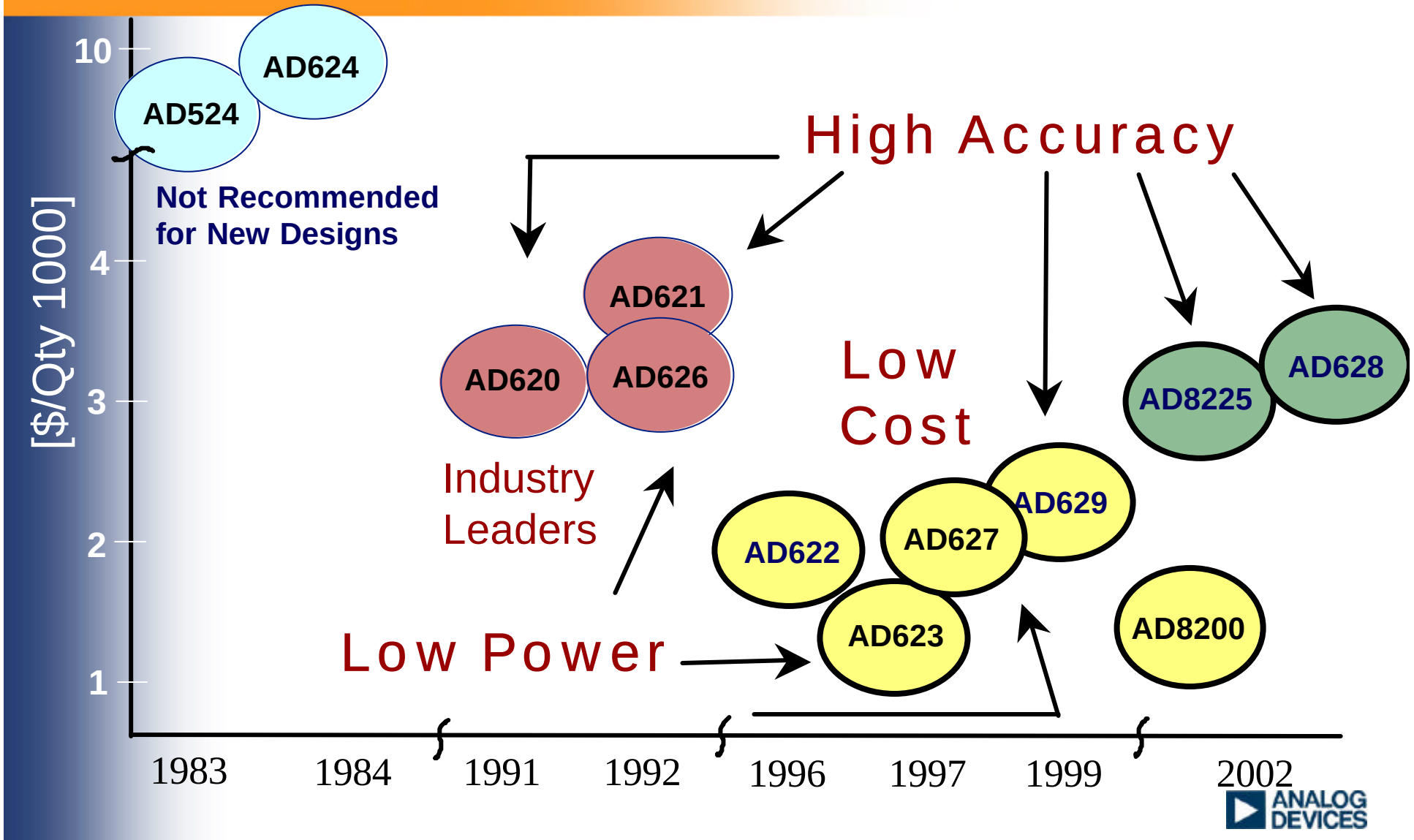


- 1 in amp
- 1 resistor
- Less board space
- Less cost
- Better performance
- Less components

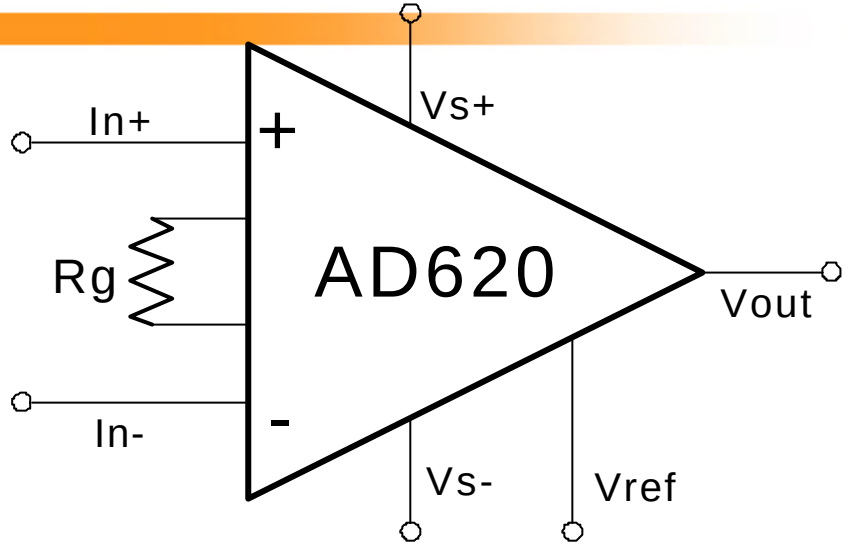
equals better reliability

ANALOG DEVICES

Selecting Instrumentation Amplifiers



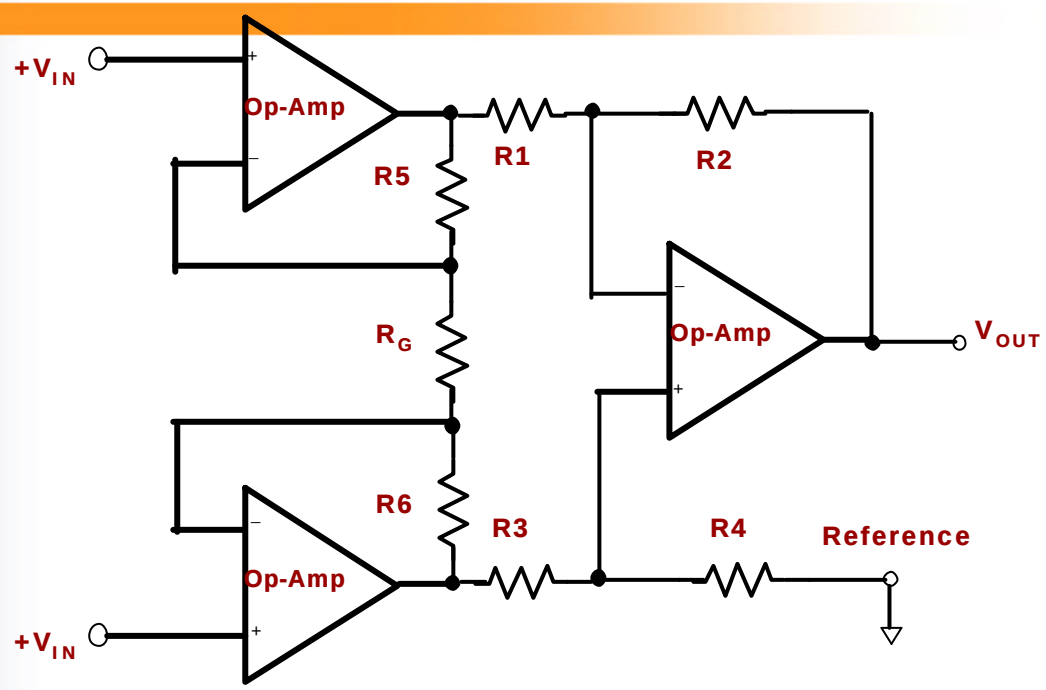
AD620 - Industry Standard



- Bandwidth (G=1): 800kHz
- RTI Voltage Noise, 1kHz: 13 nV/√Hz (max)
- Input Offset Drift: 1 µV/°C

ANALOG DEVICES

AD623 – Low Cost In Amp



CMRR G=1 (min)

70 dB Min @ 60Hz

Offset Drift (max)

2㎷/°C Max

Gain Drift (max)

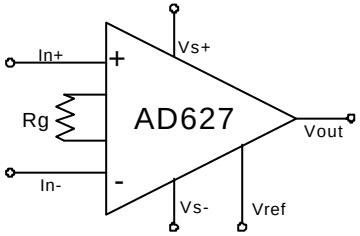
10 ppm/°C

- **Available in micro SOIC package**
- **Single Supply +5 V**
- **Rail-to-Rail Output Swing**

ANALOG DEVICES

AD627 – Low Power In Amp

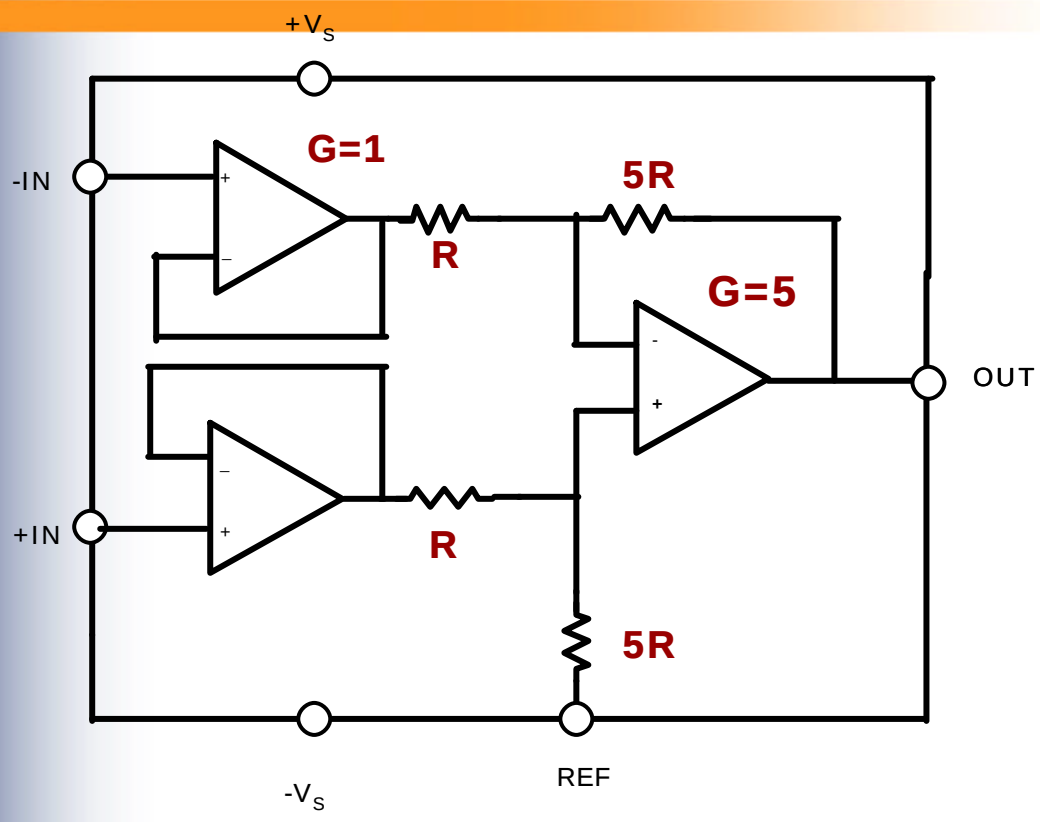
- Supply Current (max): **85mA**
- Wide Supply Voltage Range: +2.2V to +36V



+/-5V Vs; G = 5;

ANALOG DEVICES

AD8225 – Precision G=5 In-Amp Performance VS. AD620 in Gain of 5



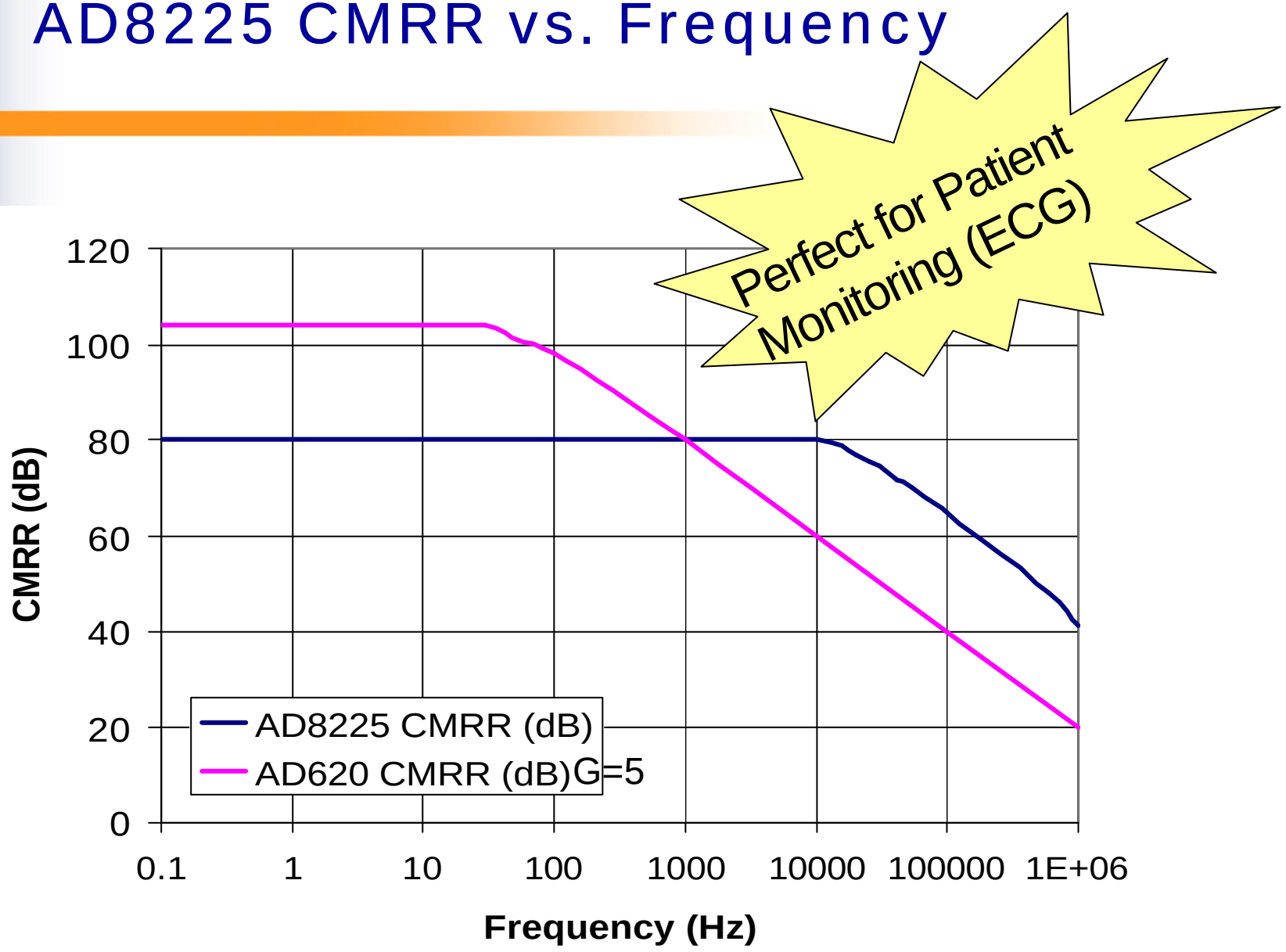
Check the specs yourself!

AD8225 has….

- **Lower Gain Drift**
- **Lower Offset and Drift**
- **Faster Slew Rate**
- **Better Common Mode Voltage Range**
- **No Need for Gain Set Resistor**
- **Samples: Now**
- **Intro: 1Q02**

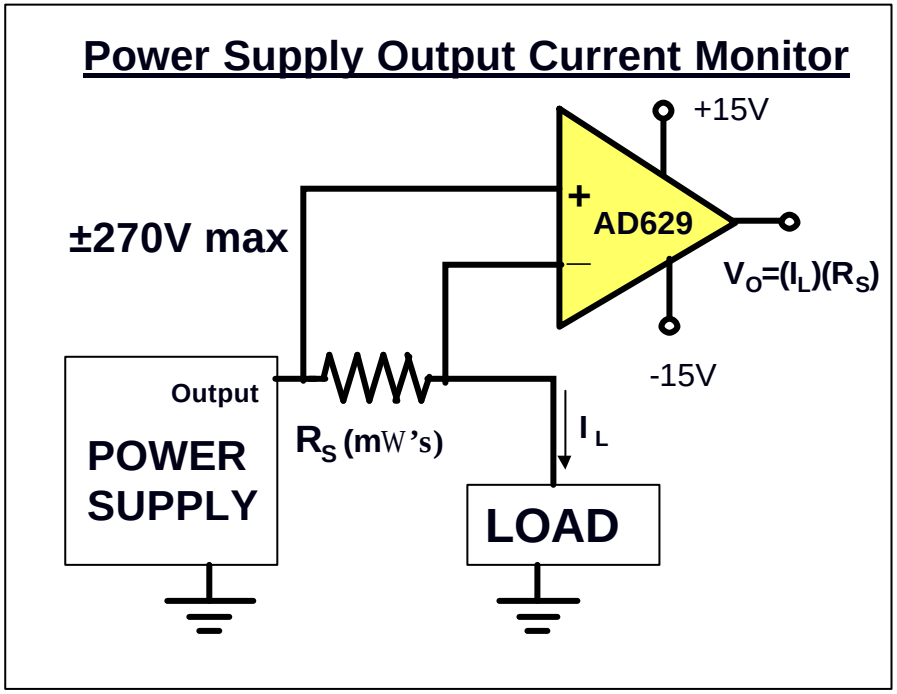
ANALOG DEVICES

AD8225 CMRR vs. Frequency



ANALOG DEVICES

AD629 – Difference Amplifier



CMRR G=1 (min)

77dB min @ 60Hz

Offset Drift (max)

20㎷/°C

Gain Drift (max)

10 ppm/°C

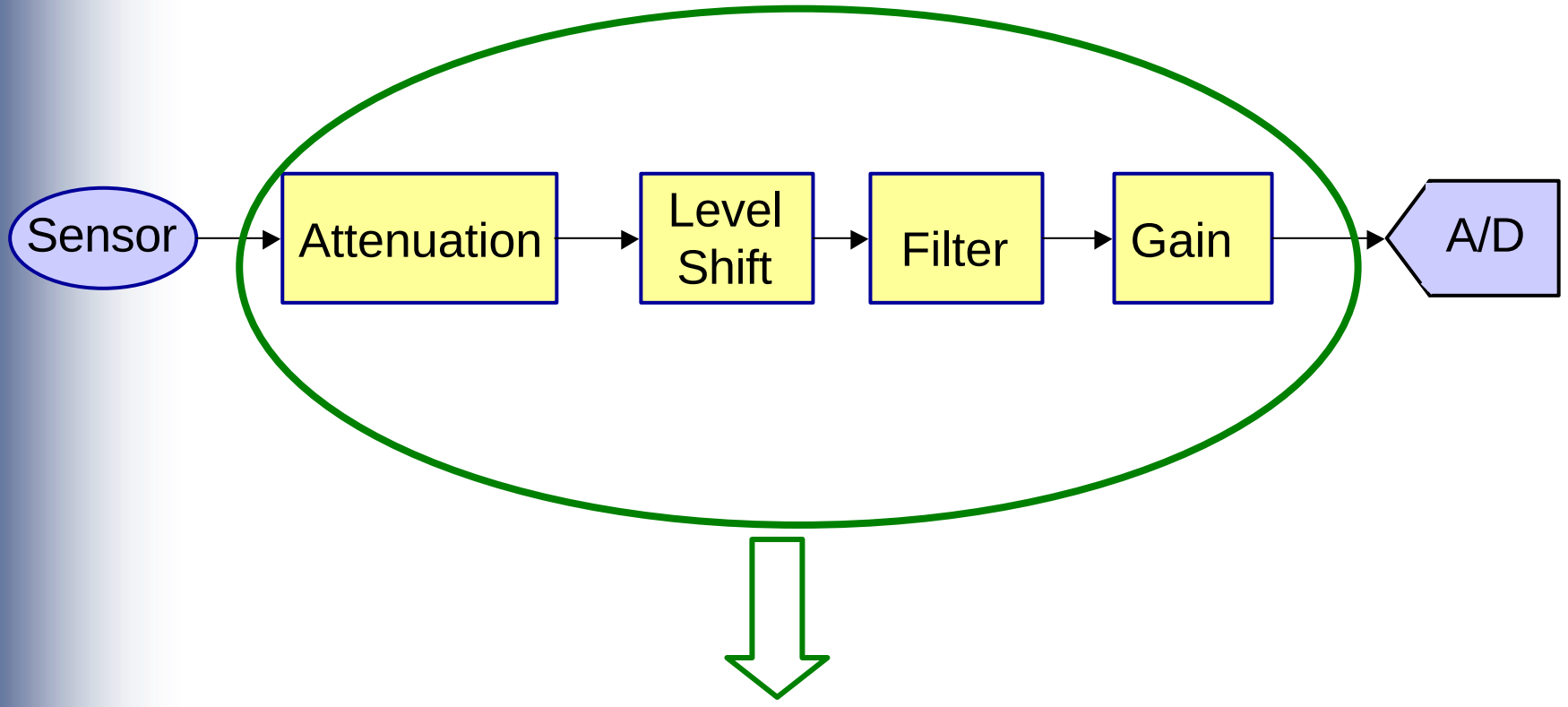
Poor Man's Isolation Amplifier

- ±270V Common Mode Voltage Operating Range
- ±500V Input Protection

ANALOG DEVICES

AD628 - High Common Mode Voltage Difference Amplifier

Where does it fit in the Signal Chain?



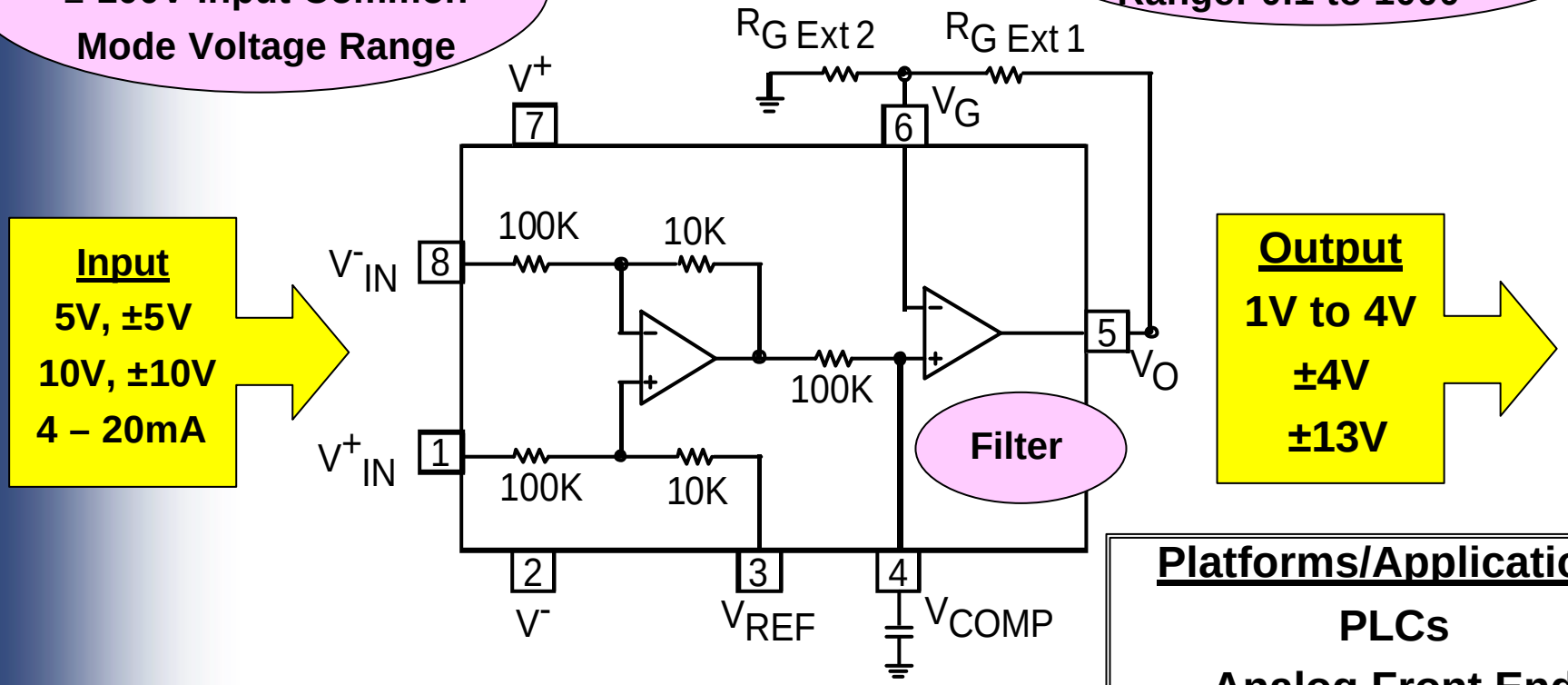
AD628 integrates these blocks

ANALOG DEVICES

AD628 - High Common Mode Voltage Difference Amplifier

10:1 Attenuation at Input
± 100V Input Common Mode Voltage Range

Programmable Gain
Range: 0.1 to 1000



Input
5V, ±5V
10V, ±10V
4 – 20mA

Output
1V to 4V
±4V
±13V

V_{OSI}	1mV
V_{OSI} TC	10mV/°C
CMRR	80dB

Platforms/Applications

- PLCs
- Analog Front End
- Isolation
- Motor Control
- High Voltage Current Sensing

AD628 Pricing and Availability

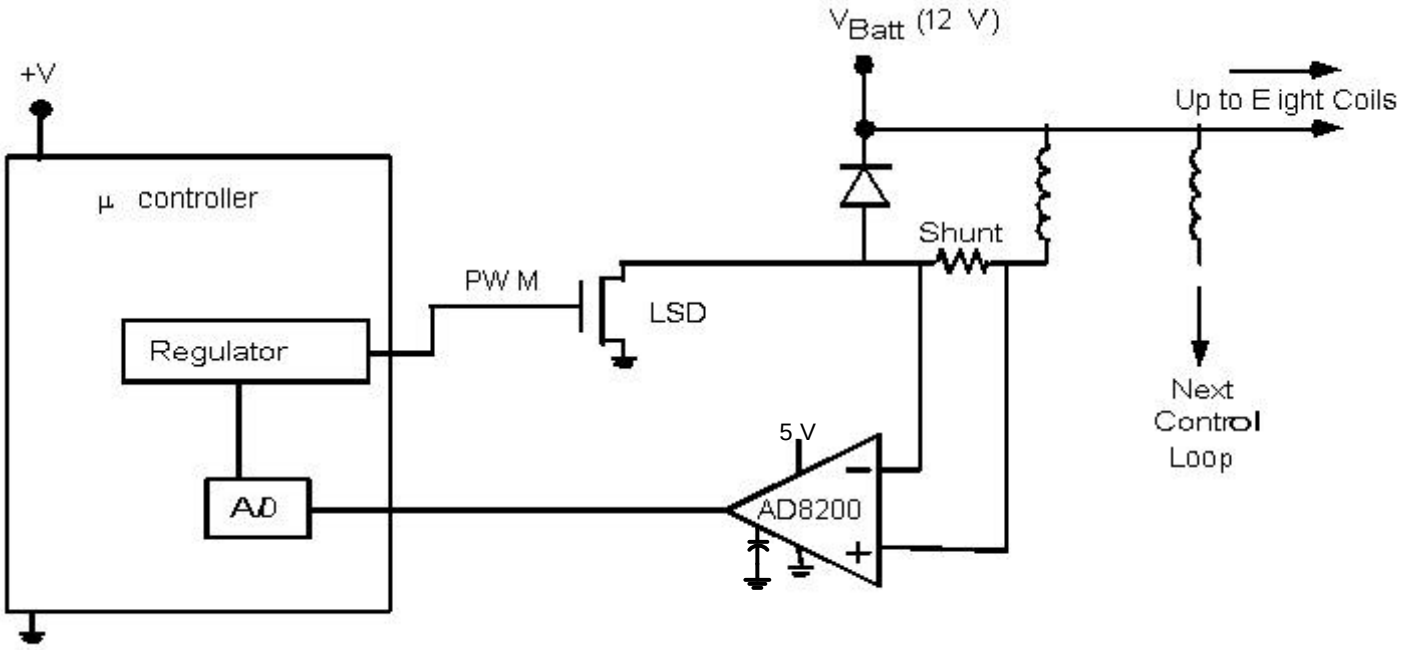
- Samples February 2002
- Release July 2002

ANALOG DEVICES

Typical High Side Current Sense Application

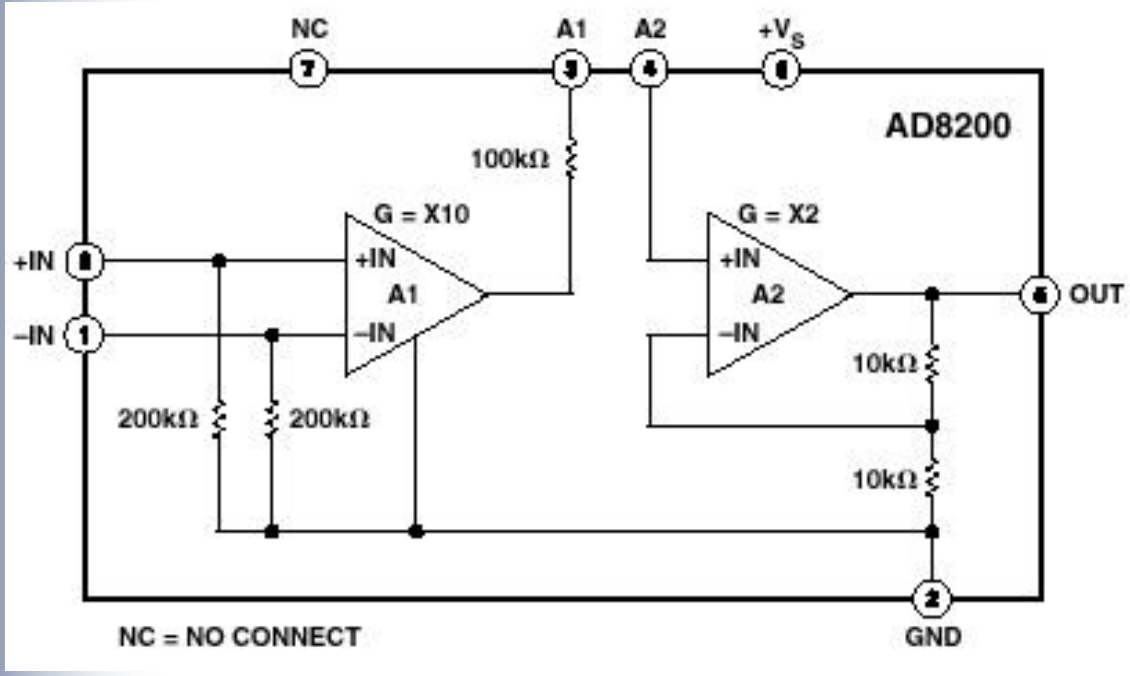
ADI VS. Discrete

Architecture - Precision DC Design for Low Drift Errors WITH Flat CMRR (80db) Out to 10kHz (Difficult to find a DC precision op amp with “high frequency” performance)



ANALOG DEVICES

AD8200 – High Common-Mode Voltage Difference Amplifier



- **CMRR**

80dB Min DC to 10 kHz

- **Gain Drift**

20 ppm/°C Max

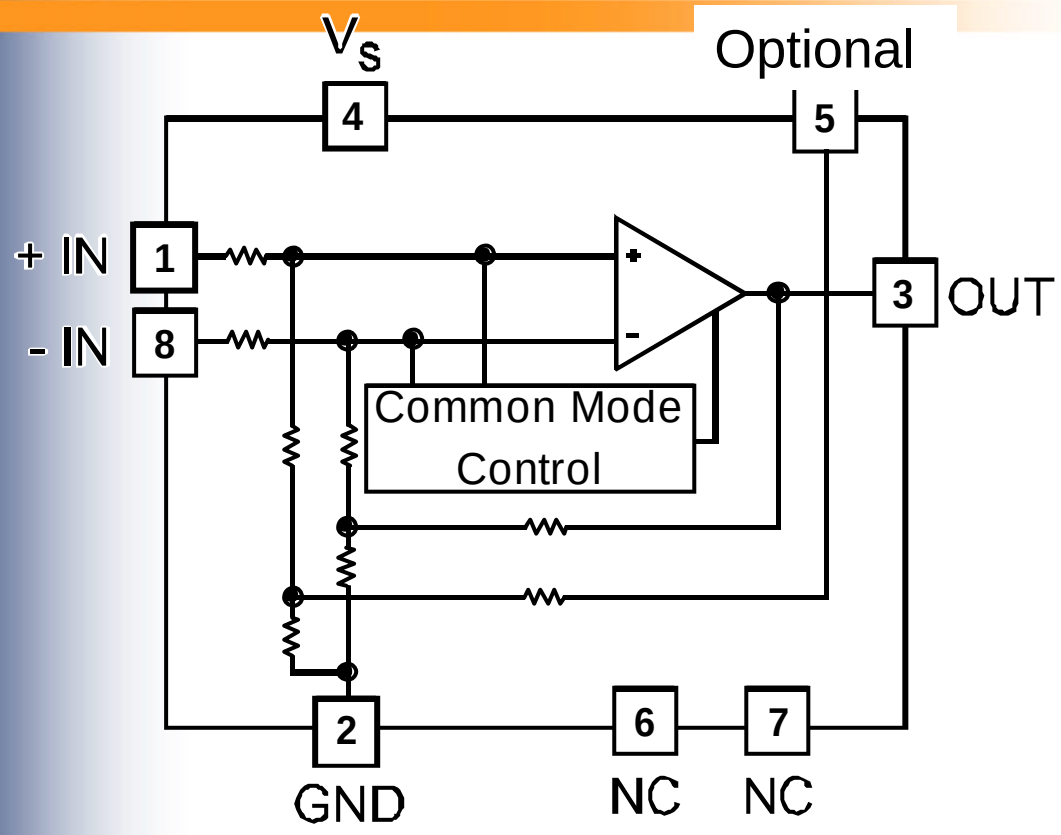
- **Offset Drift**

15 mV/°C Max

- **Common-Mode Voltage Operating Range: –2V to 24V @ 5V Supply**
- **Operating Temperature Range: –40 to 150°C**
- **Load Dump Protection 44V for 300mS**

ANALOG DEVICES

AD8200 VS. AD8201 (In Red)



- **CMRR**
- **80dB Min DC to 10 kHz**
- **(70dB Min DC to 10 kHz)**
- **Gain Drift**
- **20 ppm/°C Max**
- **(30 ppm/°C Max)**
- **Offset Drift**
- **15 mV/°C Max**
- **(20 mV/°C Max)**

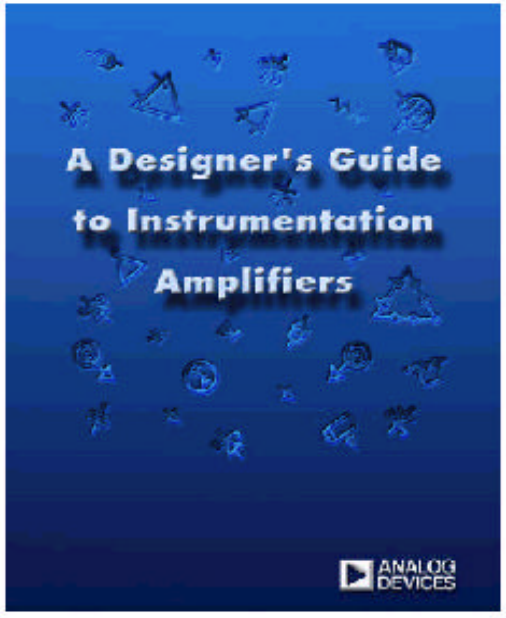
- **Common-Mode Voltage Operating Range: –2V to 24V @ 5V Supply**
- **Operating Temperature Range: –40 to 150°C**
- **Load Dump Protection 44V for 300mS**

ANALOG DEVICES

Where to Find More Information on ADI's Instrumentation Amplifiers

- Website: www.analog.com/inamps
- Application Guides: "A Designer's Guide to Instrumentation Amplifiers" (01/00)
- Selection Guide August 2001
  - ➔ www.analog.com/support/standard_linear/selection_guides/inamp.html
- Amplifier Solutions Bulletin May 2001
  - ➔ www.analog.com/bulletins/amps
- Amplifier Sales Primer
- Technical Topics
- Short Form Guide
- ADI Faxback System
- Distributor Corner
  - ➔ www.Analog.com/distributor
- Technical Apps: 1-800-ANALOG-D
- Now Available: AD620/1/2/3/7 & AMP02/04

  Evaluation Boards



Background of VGAs at ADI

- VGAs are a core competency of ADI
- ADI has been providing VGAs for ultrasound since 1991 (first products were AD600/602)
- Leader in high performance VGAs for frequencies below 100 MHz
- Next generation VGAs will extend high performance beyond 100 MHz all the way to 2.5 GHz
- VGAs are a strategic focus for ADI

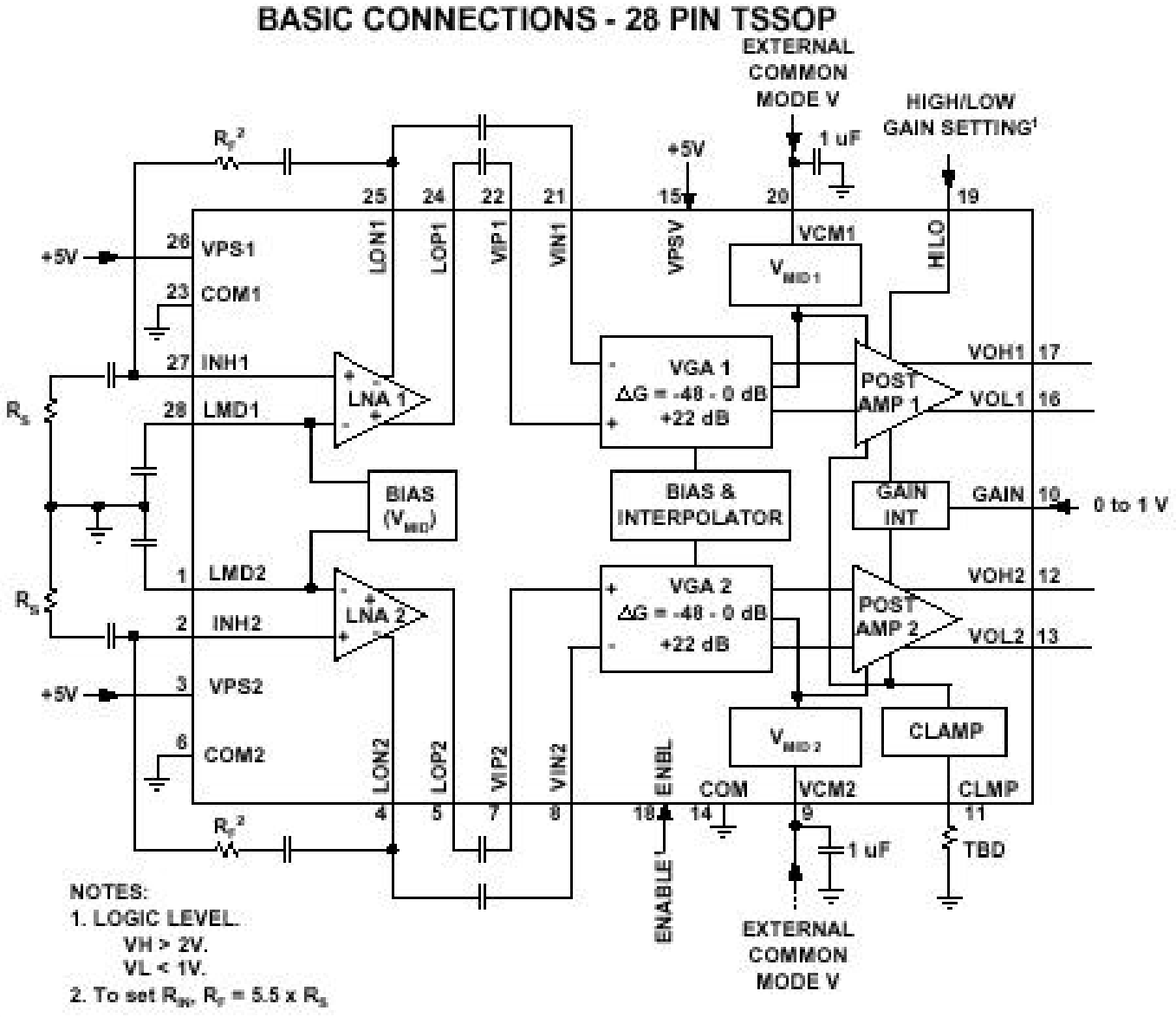
ANALOG DEVICES

AD8331/2/4 Key Features and Specs

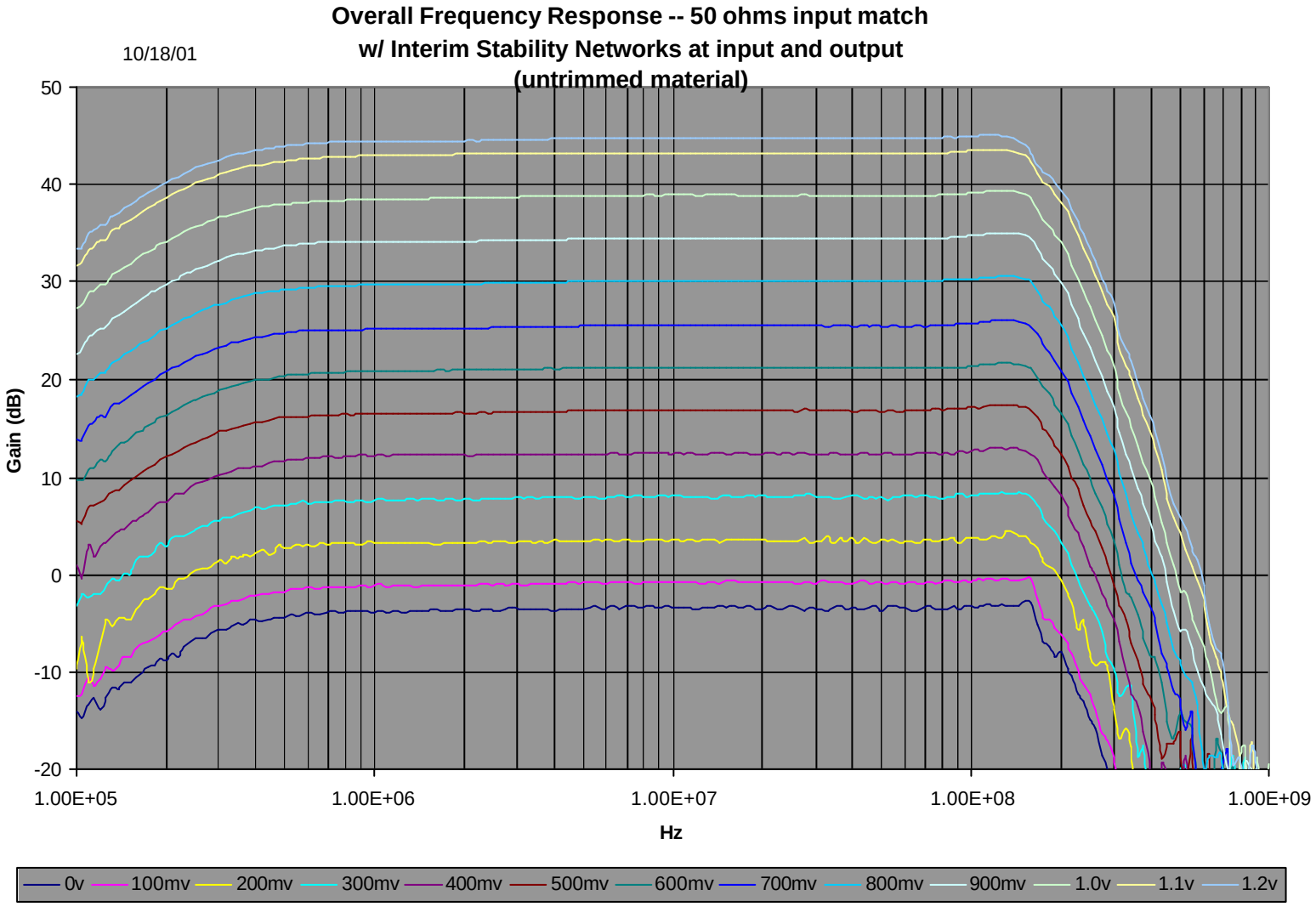
- LNA:
  - Ultralow Noise: 0.75 nV/rt-Hz; 2.5 pA/rt-Hz
  - Active Termination Match via External Resistor
- VGA:
  - 48 dB Gain Range
  - Post-Amplifier with 12 dB Gain Switch
    - Output Noise Optimized for 10/12 bit ADCs
  - Fully Differential
  - Selectable Output Clamping Levels
- LNA + VGA:
  - 150 MHz BW
  - Single +5V Supply
  - Low Power: 125mW per channel
  - AD8331/2/4 (Single/Dual/Quad) have identical Channels

ANALOG DEVICES

AD8332 - Basic Connections

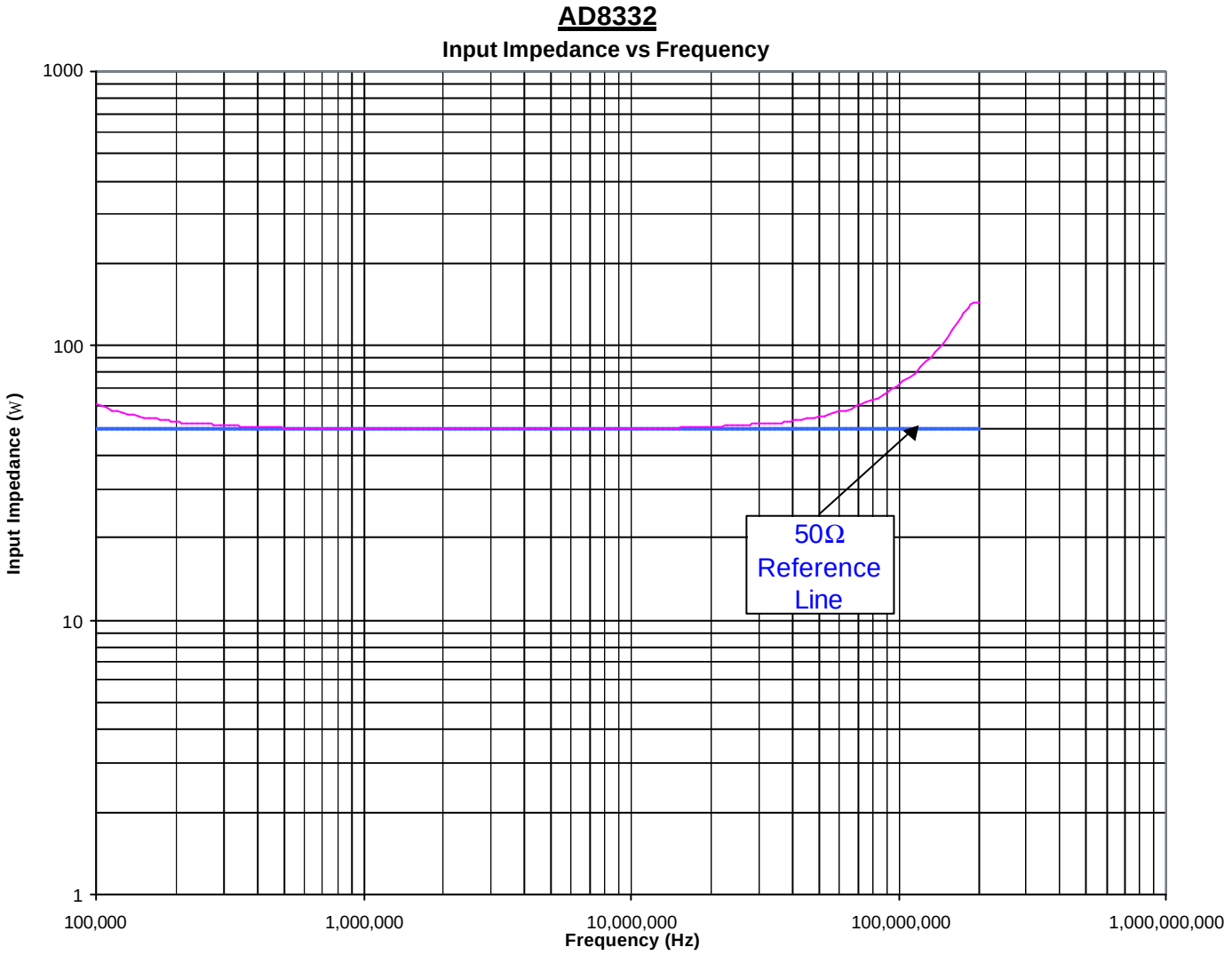


AD8332 1st Silicon Performance



ANALOG DEVICES

AD8332 1st Silicon Performance

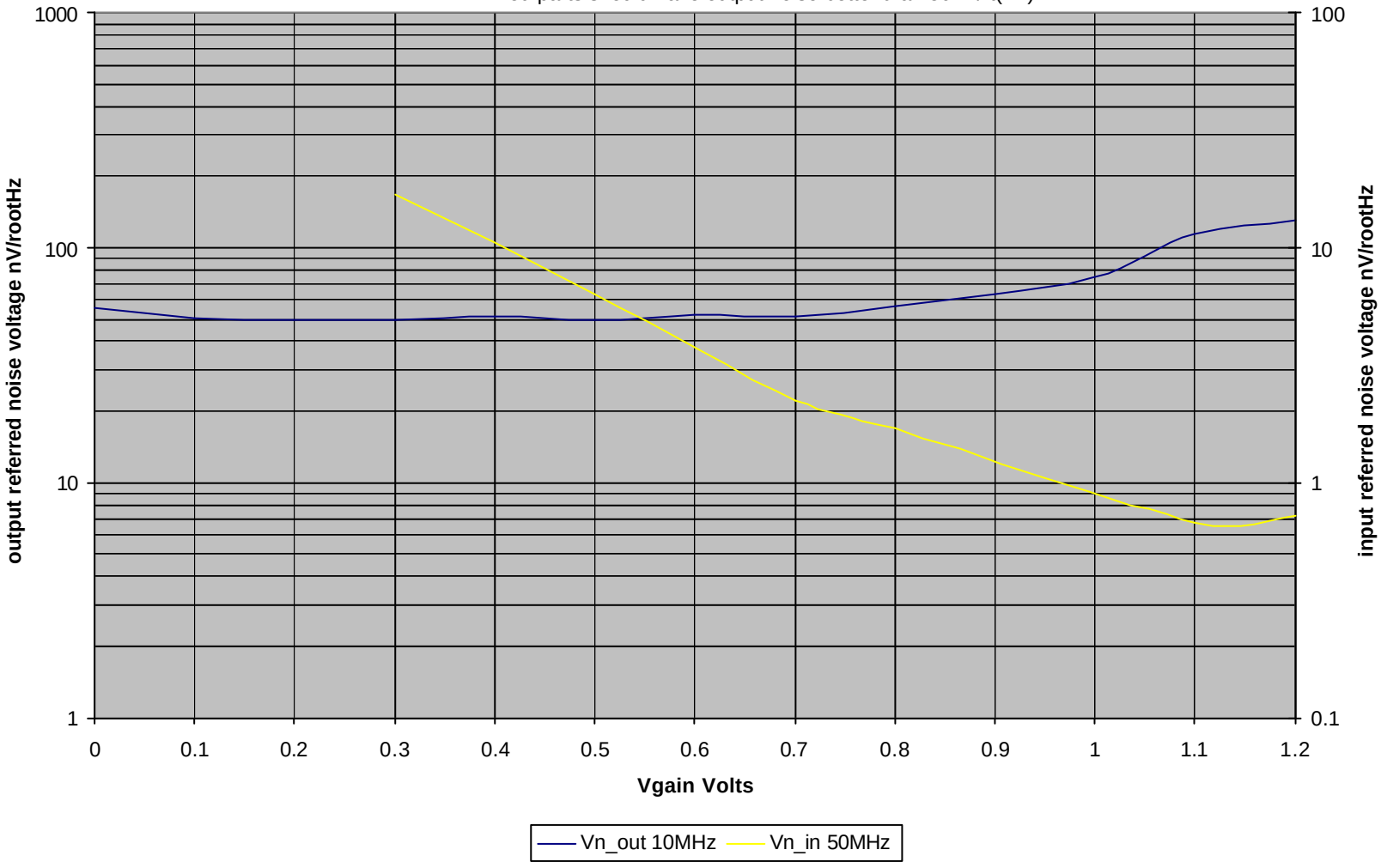


AD8332 1st Silicon Performance

Preliminary output and input referred noise voltage: Vgain at 10MHz

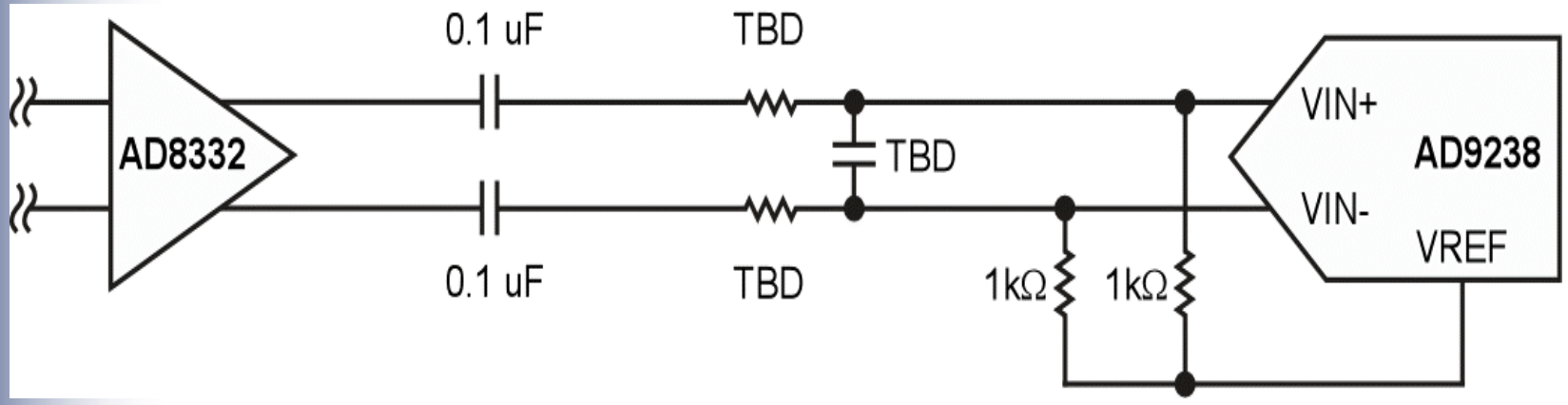
This part untrimmed;

Trimmed parts should have output noise better than 50nV/rt(Hz)



ANALOG DEVICES

Typical Interface between VGA and ADC



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