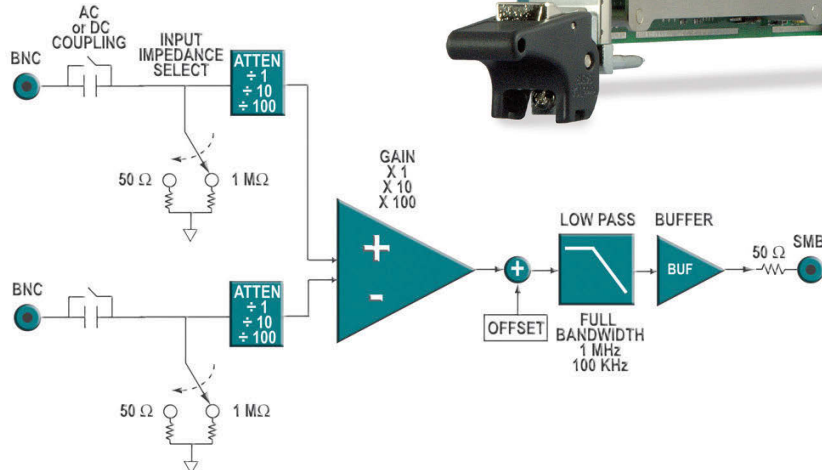


# Differential Instrumentation Amplifier

- Differential 100 V Common Mode Input
- DC-50 MHz Bandwidth
- AC/DC Coupling
- Programmable Attenuation/Gain/Offset
- 9 nV/√Hz Input Noise
- 50 Ω Output



Figure 1.1 Block Diagram



The TEGAM Model 4040A expands the measurement range of your digitizer or analog inputs to real-world signals ranging from 100 V supply voltages to millivolt detector outputs. Elevated voltages and noisy environments present a barrier to making acceptable measurements with common digitizers that are limited by input impedance and voltage levels. Your investment in a high performance digitizer is significantly enhanced by having an instrumentation grade connection to the point of measurement.

The TEGAM Model 4040A includes six stages of signal-matching to ensure that you get the maximum use from your high-speed digitizer:

1. **Selectable input impedance** of 50 Ω or 1 MΩ, to match impedance with coaxial cables or oscilloscope probes.
2. Selectable **AC or DC coupling** allows processing of small AC signals with large DC offset.
3. **Selectable input attenuations** of ÷10 and ÷100 allows input levels as high as 100 V to be safely processed by the digitizer<sup>1</sup>.
4. Instrumentation amplifier to **reject common-mode voltages** and provides gain of X1, X10 and X100 for measuring small signals<sup>1</sup>.
5. **Programmable low-pass filters** to assist with noisy signals or to anti-alias at lower sampling rates.
6. **Programmable output offset** allows centering the output signal in the digitizer's span to maximize dynamic range.

<sup>1</sup>See Table 1.1 for specific combinations and limitations of settings.

### Software

The TEGAM Model 4040A comes complete with VISA-compliant drivers for LabVIEW, Microsoft C++ and Visual Basic. In addition, an interactive front panel application provides manual control of all of the board's features.

Table 1.1 – Various Combination Possibilities of the 4040A

Net Gain	Input Attenuation	Internal Amplifier Gain	Peak AC Input Amplitudes (V) <sup>a</sup> per channel a,b,c,d.	Max Differential Voltage (V) w/o clipping a,b,c,d.	Max Volts to Chassis a,b,c.	Noise Referred to Input	-3 dB Bandwidth
÷100	÷100	X1	≤100	≤100	100 V	990 nV/√Hz	20 MHz
÷10	÷10	X1	≤10	≤10	40 V	99 nV/√Hz	20 MHz
÷10	÷100	X10	≤10	≤10	100 V	990 nV/√Hz	50 MHz
1	÷1	X1	≤1	≤1	4 V	9 nV/√Hz	20 MHz
1	÷10	X10	≤1	≤1	40 V	99 nV/√Hz	50 MHz
1	÷100	X100	≤1	≤1	100 V	990 nV/√Hz	20 MHz
10	÷1	X10	≤0.1	≤0.1	4 V	9 nV/√Hz	50 MHz
10	÷10	X100	≤0.1	≤0.1	40 V	99 nV/√Hz	20 MHz
100	÷1	X100	≤0.01	≤0.01	4 V	9 nV/√Hz	20 MHz

a) DC coupled, 1 MΩ input  
 b) AC coupled, 1 MΩ input: DC + Peak AC not to exceed 100 V; Peak AC component not to exceed table  
 c) 5 Vrms max into 50 Ω  
 d) DAC offset adjustment to zero



Specifications	VALUE	CLARIFICATIONS
<b>Input Specifications</b>		
Channels	Single Channel	Differential Inputs
Gains	100, 10, 1, 0.1, 0.01	
Maximum Voltage Range	$\pm 100$ V	DC + Peak AC
Coupling	AC, DC	In AC 10 Hz and above
Input Impedance	1 M $\Omega$    20 pF, 50 $\Omega$	$\pm 1\%$ , Selectable
Input Voltage Range	$\pm 100$ V $\pm 10$ V $\pm 5$ V $\pm 1$ V $\pm 0.1$ V $\pm 0.011$ V	For Gain 0.01 @ 1 M $\Omega$ Input Impedance For Gain 0.1 @ 1 M $\Omega$ Input Impedance For Gain 0.1 @ 50 $\Omega$ Input Impedance For Gain 1 For Gain 10 For Gain 100
Connection Type	BNC Jacks	50 $\Omega$ , Quantity 2
Common Mode Rejection Ratio (CMRR)	77 dB at 60 Hz ( $> 50$ dB at 1 MHz) 57 dB at 60 Hz 37 dB at 60 Hz	For Gain setting of x1, x10, and x100 & Attenuation setting of $\div 1$ For Attenuation setting of $\div 10$ For Attenuation setting of $\div 100$
Total Harmonic Distortion	$< -60$ dB @ 1 MHz	Output 1 Vp-p into 50 $\Omega$
DC Gain Accuracy	$\pm(0.1\% \text{ input} + 100 \mu\text{V})$ $\pm(1.5\% \text{ input} + 300 \mu\text{V})$	Offset set to 0 for Gain 10, 1, 0.1, 0.01 Offset set to 0 for Gain 100
(Basic) AC Gain Accuracy	$\pm 0.15$ dB	Attenuation of 1, Gain of 1, See Figures 1.2, 1.3 and 1.4 for other settings
Over-voltage Protection (In Any Range)	$\pm 100$ V	DC + Peak AC
Offset Range	0 to $\pm$ Full Scale	Full Scale output of $\pm 1$ V into 50 $\Omega$ , All Gain Ranges
Offset Resolution	38 $\mu\text{V}$ per step	65,535 total DAC steps into 50 $\Omega$
Offset Accuracy	$\pm(0.5\% \text{ of Setting} + 300 \mu\text{V})$	Referenced to 1 V Range
Temperature Stability	$\pm(0.01\% \text{ of rdg} + 40 \mu\text{V})/^{\circ}\text{C}$	All Gain Ranges
Noise	9 nV/ $\sqrt{\text{Hz}}$	CMR= $\pm 1$ V, Gain 10 and 100, Referred to Input for Frequencies $> 100$ Hz
Rise Time	$\leq 3.5$ ns	
<b>Output Specifications</b>		
Maximum Output Voltage	$\pm 1$ V	Single Ended into 50 $\Omega$
Connection Type	SMB Jack	50 $\Omega$
Output Impedance	50 $\Omega$	$\pm 1\%$
LP Filter, Cutoff Frequency	100 kHz, 1 MHz	Single Pole Filter
Bandwidth	See Table 1.1	
Passband Flatness	See Figures 1.2, 1.3 and 1.4 for limits	Limits off charts will not exceed $\pm 3$ dB for the Bandwidths listed in Table 1.1
<b>Environmental Specifications</b>		
Operating Temperature	0 $^{\circ}\text{C}$ to +45 $^{\circ}\text{C}$ , (32 $^{\circ}\text{F}$ to 113 $^{\circ}\text{F}$ ) Ambient	
Storage Temperature	-20 $^{\circ}\text{C}$ to +50 $^{\circ}\text{C}$ , (-4 $^{\circ}\text{F}$ to +122 $^{\circ}\text{F}$ )	
Humidity Range	$< 80\%$ RH Non-Condensing	
Warm-Up Time	30 minutes	

Specifications	VALUE	CLARIFICATIONS
Included Accessories	CD Manual	4040A-840
Optional Accessories	1 ft SMB Female to SMB Female Cable	CA-3-12
	1 ft BNC Male to SMB Female Cable	CA-4-12
	3 ft BNC Male to SMB Female Cable	CA-4-36
	3 ft BNC Cable for General Purpose I/O Connections	CBL-3102
	50 ohm BNC (F-M-F) Tee adapter	BNC-3285

Figure 1.2

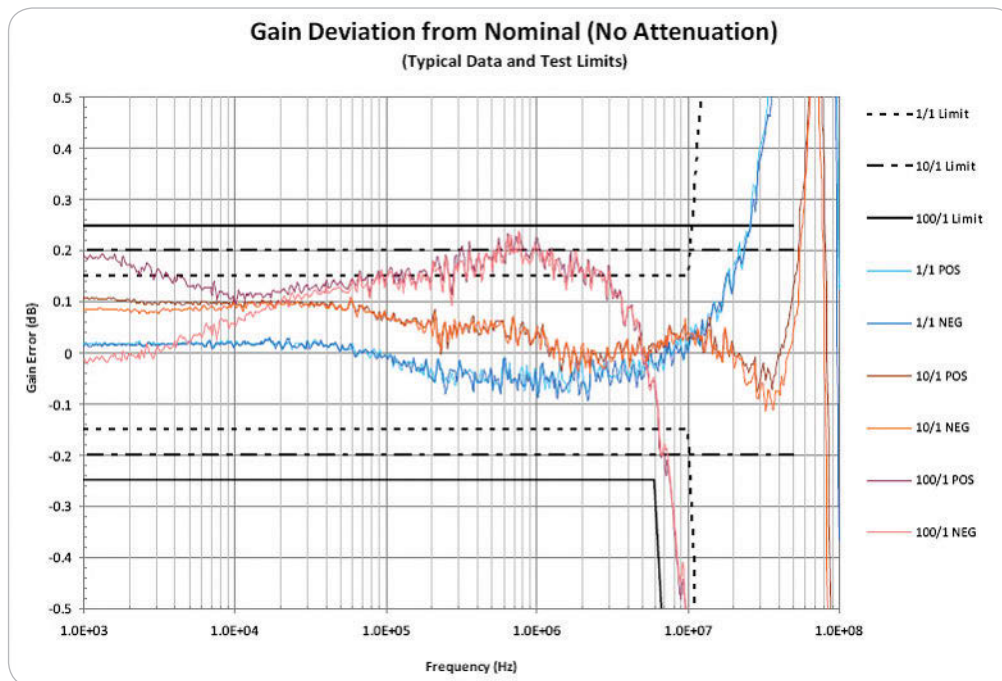


Figure 1.3

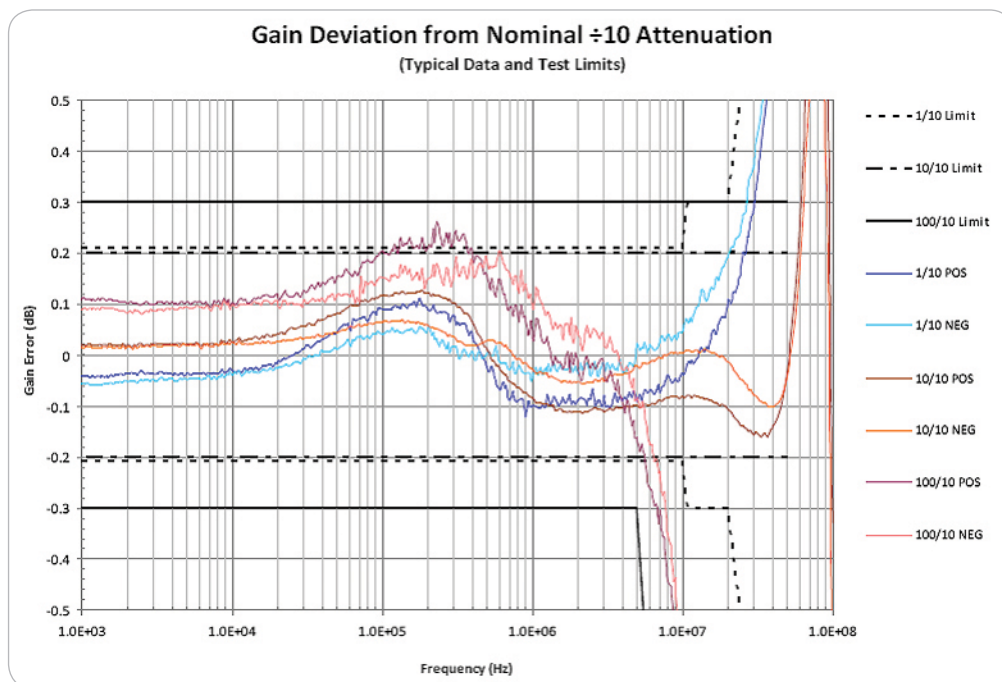


Figure 1.4

