SDI Silicon Designs Inc.

High-Performance Models 2220 and 2276 Premium 1-Axis DC Accelerometers

- Low Noise: 10 µg√ Hz Typical for ±2g Full Scale Versions
- -55 to +125°C Operating Temperature Range
- Flexible +8 to +32 VDC Power
- Excellent Long-Term Stability
- ±4V Differential Output or 0.5V to 4.5V Single Ended Output
- Responds to Frequencies from Zero (DC) to 2000+ Hz
- Low Impedance Outputs Support up to 2000 Feet of Cable
- Integrated Cable or Connector, Traditional 1" & Small Footprint Sizes
- Simple Four (4) Wire Connection
- Rugged Anodized Aluminum Case
- Fully Calibrated and Serialized for Traceability

AVAILABLE G-RANGES

FULL SCALE ACCELERATION	MODEL SUFFIX
± 2 g	-002
± 5 g	-005
± 10 g	-010
± 25 g	-025
± 50 g	-050
± 100 g	-100
± 200 g	-200
± 400 g	-400

PREMIUM HIGH-PERFORMANCE ACCELEROMETER MODELS 2220 AND 2276

SDI's Premium Models 2220 and 2276 High-Performance Single Axis MEMS DC Accelerometers are rugged plug-and-play measurement devices suitable for a wide array of demanding applications. Both models provide enhanced performance over temperature for use in zero to medium frequency applications experiencing large or rapid temperature variations or maintaining hot or cold extremes for extended periods of time.

The 2220 comes in a traditional 1-inch square package with an integrated cable and is operationally identical to the 2276, the small footprint device designed for tight spaces. The 2220 and 2276 feature a hermetically sealed, low noise SDI Model 1522 surface mount accelerometer, which is individually tested, programmed, calibrated and verified in a climate chamber to ensure the greatest accuracy in thermally volatile conditions. The 2220 and 2276 include initial calibration reports.

Onboard voltage regulation and an internal voltage reference eliminate the need for precision power supplies. The robust, anodized aluminum case is potted then epoxy sealed and can be mounted easily via two screws, an adhesive, or by attaching a magnet.

ZERO (DC) TO MEDIUM FREQUENCY APPLICATIONS

ROBOTICS SEISMIC TILT VIBRATION AUTOMOTIVE IMPACT INSTRUMENTATION MONITOR OEM

PERFORMANCE BY G RANGE

INPUT RANGE	SENSITIVITY, DIFFERENTIAL	*FREQUENCY RESPONSE (TYPICAL, 5%)	*FREQUENCY RESPONSE (TYPICAL, 3 DB)	*FREQUENCY RESPONSE (MINIMUM, 3 DB)	OUTPUT NOISE, DIFFERENTIAL (RMS, TYPICAL)	MAX. MECHANICAL SHOCK (0.1 MS)
g	mV/g	Hz	Hz	Hz	µg/(root Hz)	g (peak)
±2	2000	0 – 250	0 – 525	0 – 300	10	2000
±5	800	0 – 400	0 – 800	0 – 420	15	
±10	400	0 – 700	0 – 1100	0 – 660	23	5000
±25	160	0 – 1300	0 – 1750	0 – 1050	38	
±50	80	0 – 1600	0 – 2100	0 – 1400	60	
±100	40	0 – 1700	0 – 3000	0 – 1700	121	
±200	20	0 – 1900	0 – 3600	0 – 2100	243	
±400	10	0 – 2000	0 – 4200	0 – 2400	475	

By Model: *V_{DD}=V_R=5.0 VDC, T_C=25°C* *Single ended sensitivity is half of values shown.*

PERFORMANCE - ALL VERSIONS

All Models: Unless otherwise specified, Vs=+8 to +32 VDC, TC=25°C, Differential Mode. Span = ±g range = 8000 mV.

PARAMETER	MIN	TYP	MAX	UNITS
Bias Calibration Error (%)		0.25	0.6	± % of span
Bias Calibration Error (mV)		20	48	± mV
Scale Factor Calibration Error [1]		0.5	1.25	± %
Non-Linearity (-90 to +90% of span) [1]		0.15	0.5	± % of span
Bias Temperature Shift (Coefficient)	-100	0	+100	(PPM of span)/°C
Scale Factor Temperature Shift (Coefficient)	-150	0	+50	PPM/°C
Cross Axis Sensitivity		2	3	± %
Power Supply Rejection Ratio	50	>65		dB
Output Impedance		1		Ω
Output Common Mode Voltage		2.5		VDC
Operating Voltage	8		32	VDC
Operating Current (AOP & AON open)		7	10.5	mA DC
Operating Temperature	-55		+125	°C
Mass 2220 / 2276 (not including cable)		10 / 9		grams
Cable Mass (10' integrated cable, 2220)		4.25		grams/foot

Note 1: For 2g thru 50g only; 100g and greater versions are tested and specified from -65 to +65g.
NOTICE: Stresses greater than those listed may cause permanent damage to the device. These are maximum stress ratings only. Functional operation of the device at or above these conditions is not implied.

BIAS & SCALE FACTOR TEMPERATURE SHIFT EXPLAINED

Every accelerometer has a bias and scale factor temperature coefficient, meaning the output shifts slightly due to temperature changes. Many applications operate within a relatively small temperature band or at room temperature, and therefore rarely encounter interference from the bias or scale factor temperature shifts. These customers are ideal candidates for SDI's Low-Cost accelerometer modules (2210, 2260, 2266).

For applications experiencing larger temperature variations (i.e. exposure to engine temperatures or arctic testing) SDI suggests the upgraded Premium High-Performance accelerometer modules (2220, 2276). These have enhanced, temperature compensated, proprietary SDI Model 1522 accelerometer chips, which are individually tested, calibrated and verified in a climate chamber to provide the most accuracy and include a calibration report.

Bias	The accelerometer output with no acceleration present. For SDI's differential output analog accelerometers, it is a signed quantity that is expressed in terms of either g or output volts and is ideally equal to zero g or zero volts.
Scale Factor	The ratio of the change in output to a unit change in the input acceleration expressed in millivolts per g (mV/g). Since the output of most accelerometers is slightly non-linear, the scale factor value is defined as the slope of the least-squares-fit line to the acceleration input vs output curve. SDI measures over the range of -90% to +90% of full scale or from -65g to +65g, whichever is smaller.
Bias Temperature Shift (Coefficient)	The amount of bias shift to expect with a change in temperature expressed as PPM of span per °C. For example, the percent of span bias shift that would occur for a 25g full scale device with a ±200 PPM of span per °C rating and a 55 °C rise from room temperature would be: ±200 / 1,000,000 x (80C - 25C) x 100% of span = ±1.1% of span. The g shift would be ±1.1% of 50g = ±0.55 g. This error in terms of output voltage for a 25 g analog accelerometer would be ±1.1% of span = ±1.1% of 8 V = 88 mV.
Scale Factor Temperature Shift (Coefficient)	The amount of scale factor shift to expect with a change in temperature expressed as PPM per °C. For example, the percent shift in scale factor that would occur for a device with a +200 PPM per °C rating and a 60 °C rise from room temperature would be: +200 / 1,000,000 x (85C - 25C) x 100% = +1.2%. For an analog 10g device, the scale factor would rise from its nominal (8 V)/(20 g) = 400 mV/g at +25C to 400 mV/g +1.2% = 404.8 mV/g.

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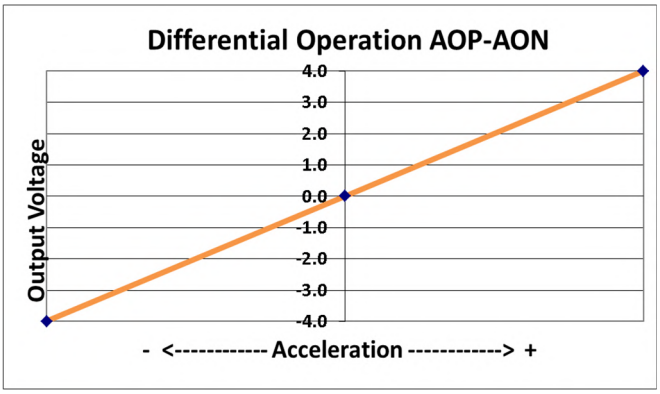
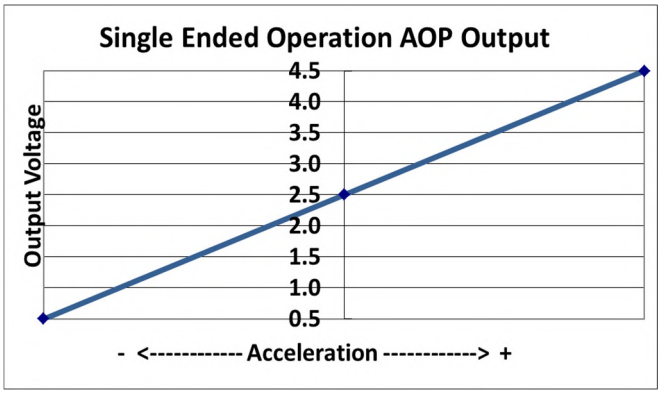
OPERATION

SDI Models 2220 and 2276 MEMS DC Accelerometers provide optimal performance when they are connected to instrumentation in a differential configuration using both the AOP and AON output signals, but they also support single ended operation for complete flexibility.

These Accelerometers produce a differential analog output voltage pair (AON & AOP), which varies with acceleration. The signal outputs are fully differential about a common mode voltage of approximately 2.5 volts. At zero acceleration, the output differential voltage is nominally 0 volts DC; at ±full scale acceleration, the output is ±4 volts DC, respectively, as shown in the figure (below). The output scale factor is independent from the supply voltage of +8 to +32 volts.

When a differential connection is not possible, connect the accelerometer to instrumentation in single ended mode by connecting AOP and GND to the instrumentation and leaving AON disconnected. Keep in mind that the signal to noise ratio is reduced by half for a single-ended vs. a differential connection.

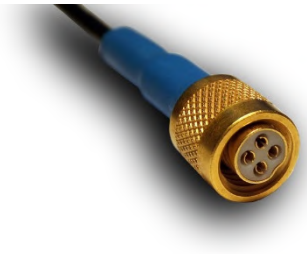




CABLE SPECIFICATIONS

2220: The standard 10' (approx. 3 meters) integrated cable consists of four 28 AWG (7x36) tin-plated copper wires with Teflon FEP insulation surrounded by a 40 AWG tin plated copper braided shield. The shield jacket is Teflon FEP with a nominal outer diameter of 0.096". The cable's braided shield is electrically connected to the case. The black ground (GND) wire is isolated from the case.

2276: The case's integrated connector shell, pins and sockets are gold plated brass. The 4PIN-CAB cable consists of four 30 AWG (7x38) silver-plated copper wires with PTFE insulation surrounded by a braided shield. The black FEP shield jacket has a nominal outer diameter of 0.100".



The 4PIN-CAB is available in five standard lengths, and custom lengths may be available for special order.

NAME	LENGTH - FEET	LENGTH - METERS (APPROXIMATE)
4PIN-CAB-04	4 Feet	1.2 Meters
4PIN-CAB-10	10 Feet	3.0 Meters
4PIN-CAB-20	20 Feet	6.0 Meters
4PIN-CAB-33	33 Feet	10 Meters
4PIN-CAB-50	50 Feet	15.4 Meters

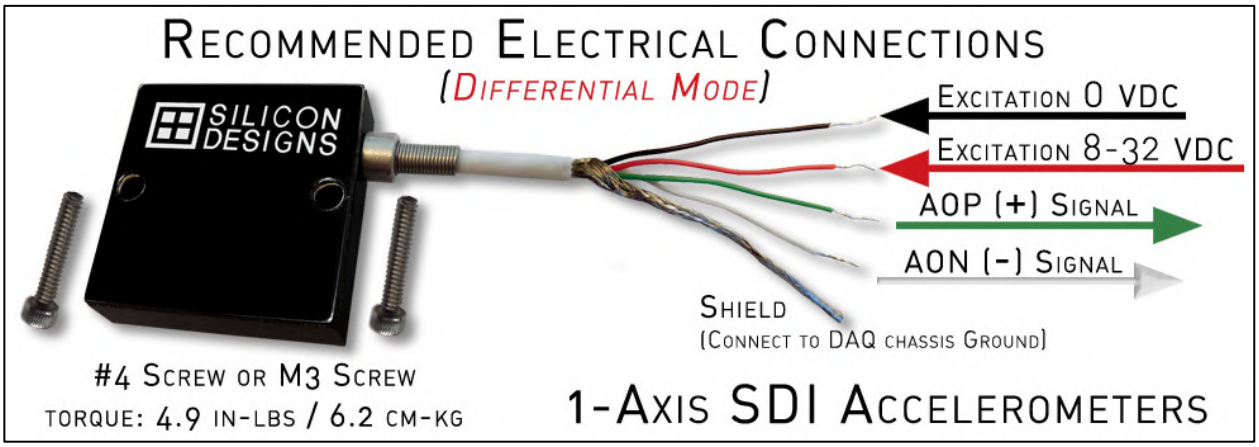
Both cable styles end in a 4-wire pigtail.

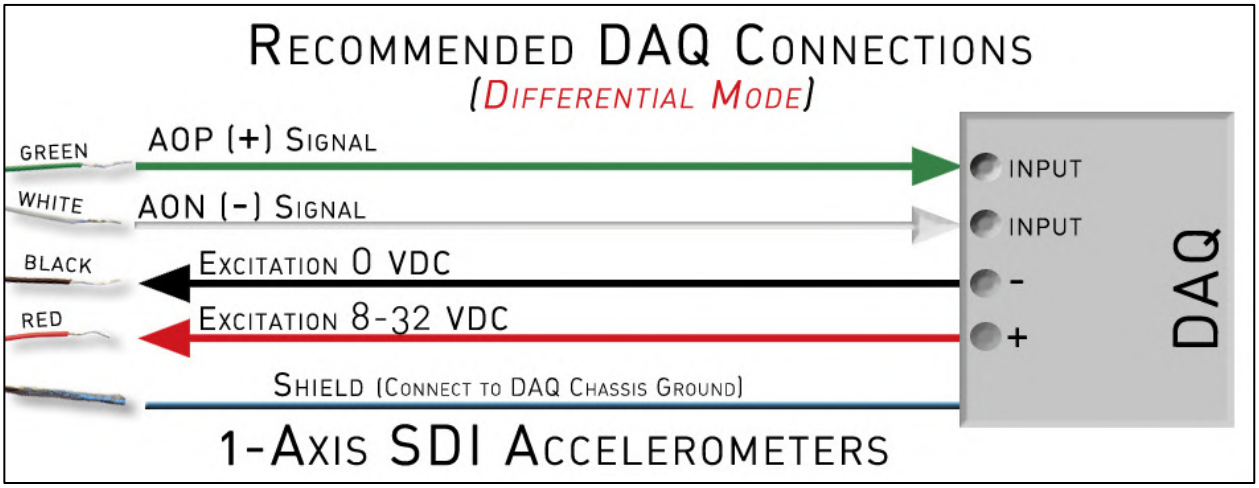
CABLE LENGTH CONSIDERATIONS

Cable lengths of up to 50 feet (15 meters) can be used without the need to test for output instability. For cable lengths exceeding 50 feet, SD recommends checking each individual installation for oscillation by tapping the accelerometer and watching the differential output for oscillation in the 20 kHz to 50 kHz region. If no oscillation is present, extended cable length should behave as expected. From the standpoint of output current drive and slew rate limitations, all SDI 8-32 VDC Accelerometers are capable of driving over 2000 feet (600 meters) of cable. However, at some length ranging between 50 feet and 2000 feet, each device will likely begin to exhibit oscillation.

RECOMMENDED CONNECTIONS - DIFFERENTIAL

SDI Models 2220 and 2276 MEMS DC Accelerometers provide optimal performance when they are connected to instrumentation in a differential configuration using both the AOP and AON output signals.





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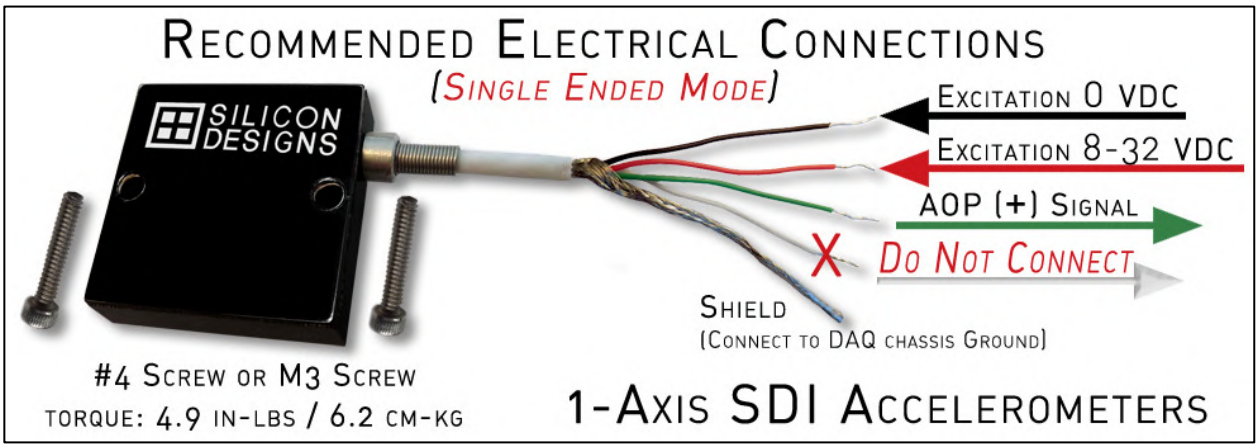
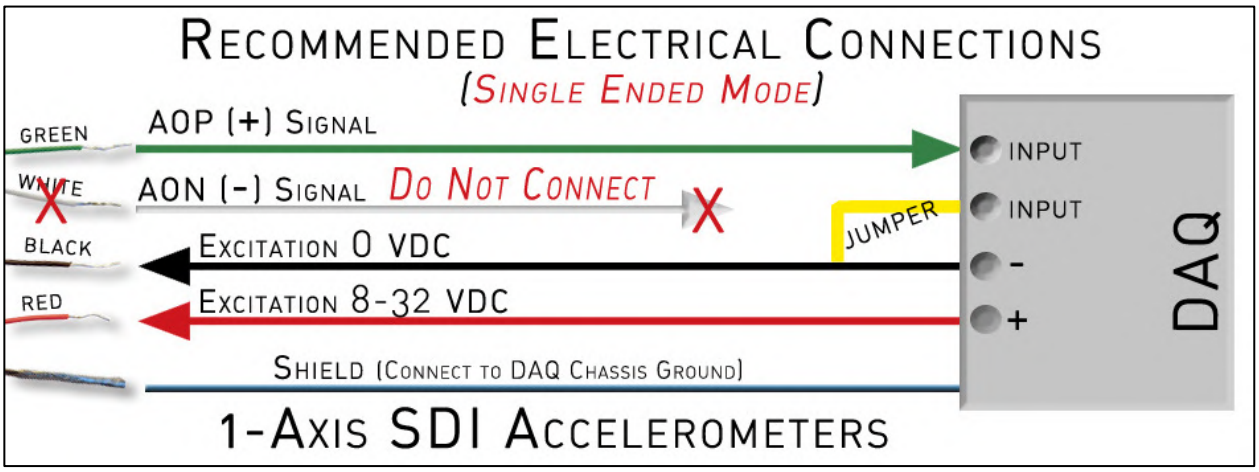
RECOMMENDED CONNECTIONS – SINGLE ENDED

Single ended operation is also possible with minor changes to the wiring configuration, as described below.





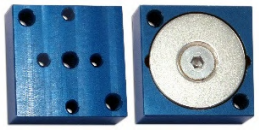
OPTIONAL ACCESSORIES

Model 2230 Triaxial Mounting Block

- Anodized 6061-T6 aluminum 1.25" cube
- Mix and Match g-levels for custom combinations

Model 2232 Magnetic Mount

- 10 lbs / 4.6 KG pull force
- Rated for use up to ±50G
- Low mass: 23 grams

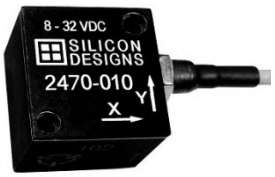


Model 2235 Stud Mount Adaptor Block

- Stud mount Adaptor for any SDI module
- Anodized 6061-T6 aluminum block
- 6.2 grams, 0.7" x 1" footprint

COMPARABLE 3-AXIS MODELS

SDI's high-performance, single axis accelerometers are also built in three-axis configurations for multi-dimensional sensing in one package with only a single excitation connection. The high-performance SDI Models 2470 and 2476 are the three axis versions of the 2220 and 2276 with similarly upgraded SDI Model 1522 surface mount accelerometers, improved bias and scale factor temperature shift performance, and include an initial calibration certificate.

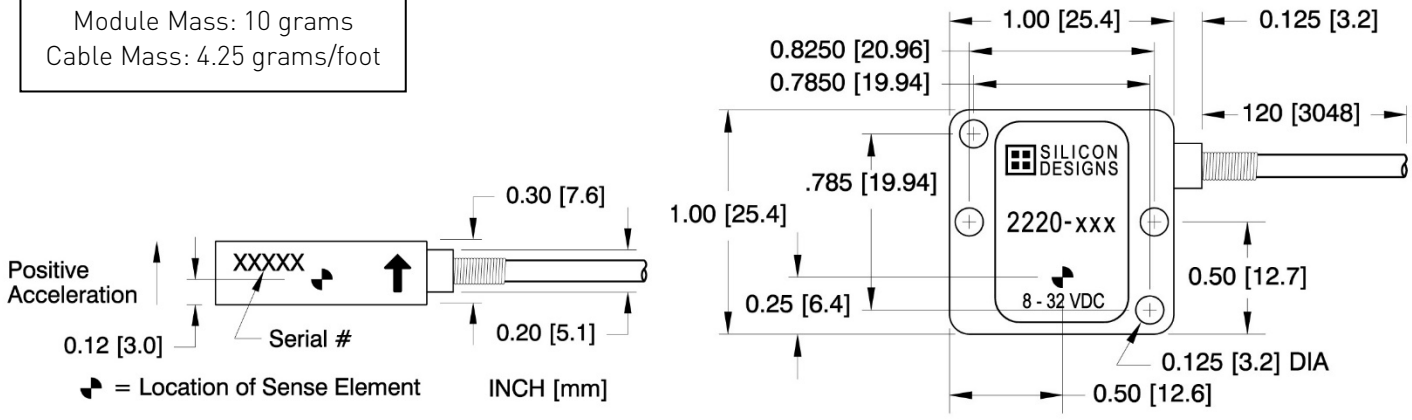


The 2470 includes a 3-foot integrated cable and is operationally identical to the 2476, which features a connector for easily customized cable lengths and positions.

PACKAGE DIMENSIONS

2220

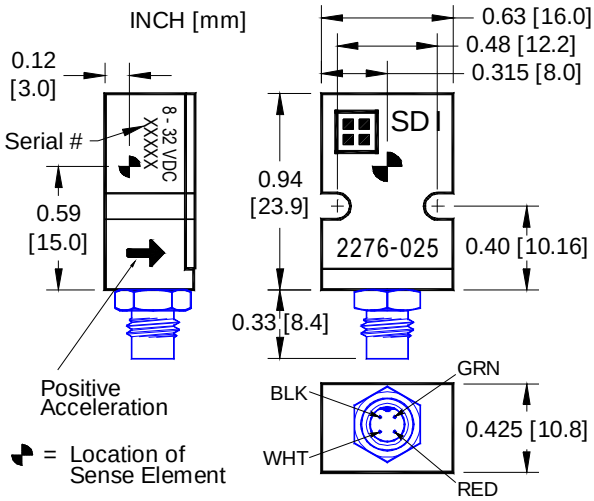
Module Mass: 10 grams
Cable Mass: 4.25 grams/foot



NOTE: The SDI Model 2220's case was updated as of December 1, 2021.
No performance specifications were changed.
Contact SDI for previous versions of this data sheet.

2276

Module Mass: 9 grams

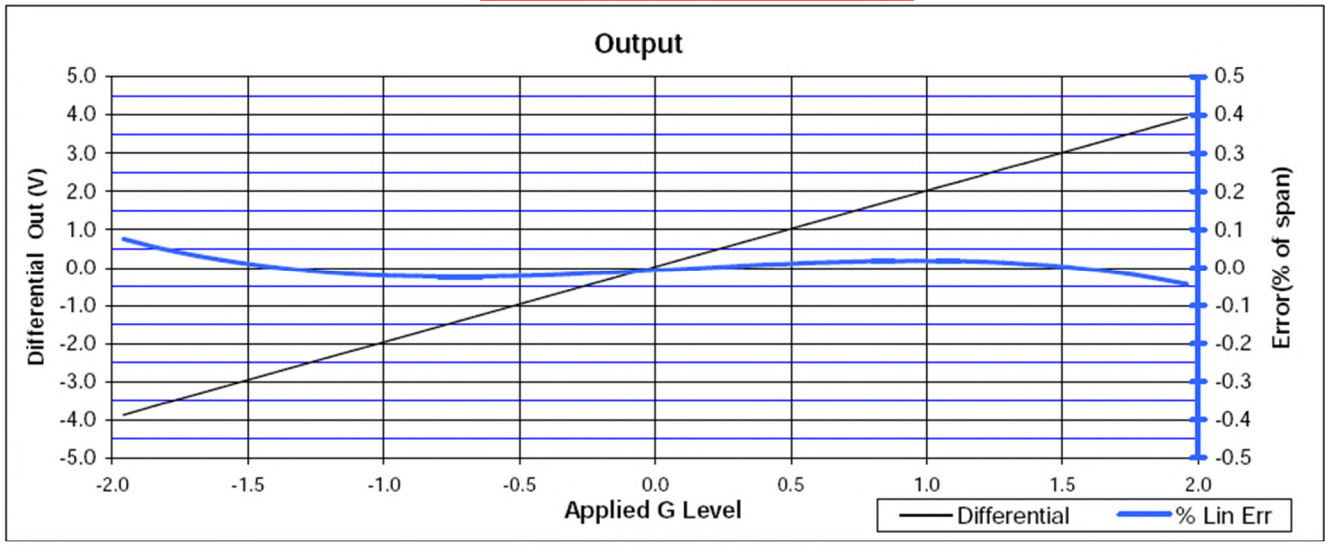


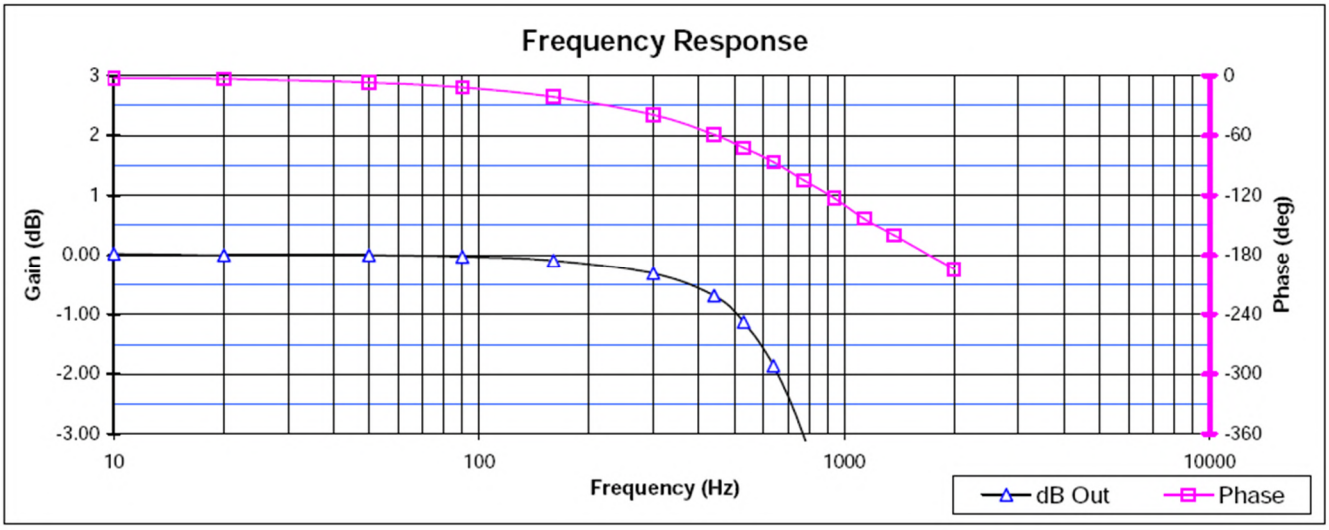
Note: Connector index may not be positioned as drawn

CALIBRATION REPORT EXAMPLES
LINEARITY, PHASE & FREQUENCY RESPONSE BY G-LEVEL

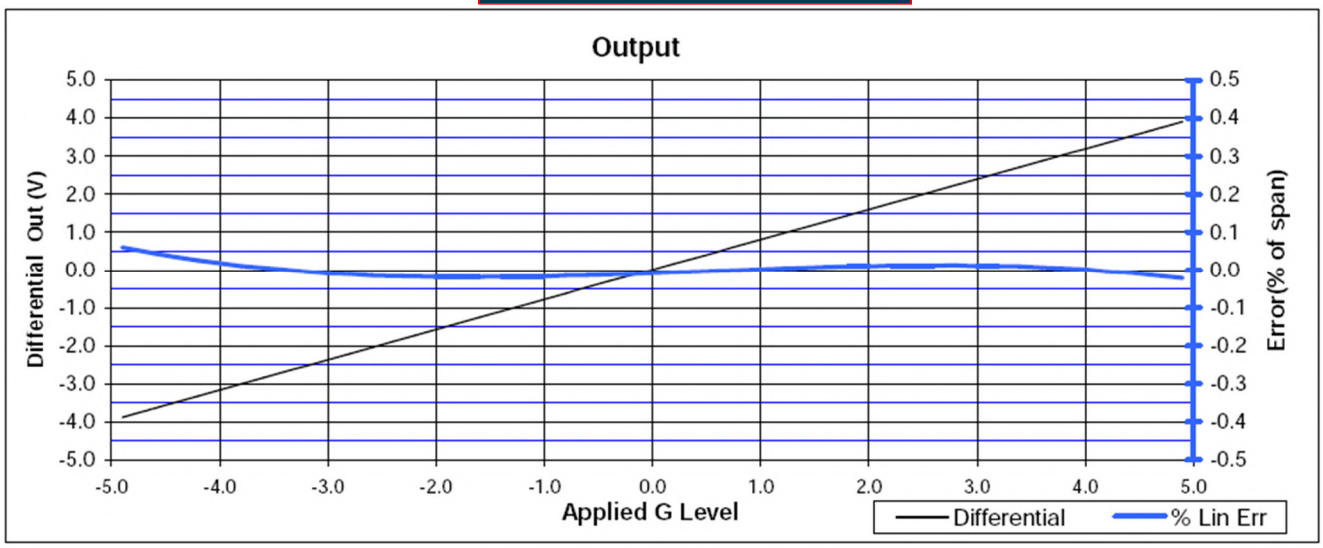
The included calibration reports provide additional information about the linearity, output, phase, and frequency response as tested for each individual unit. The following are examples of the graphical data supplied on calibration reports, by G-level.

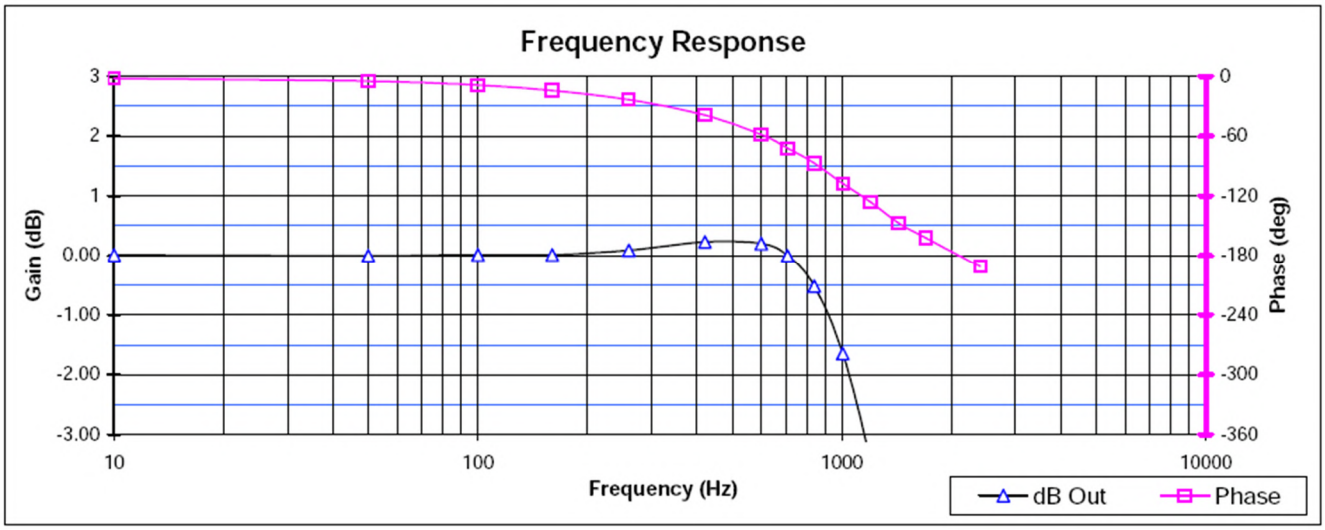
EXAMPLE 2G



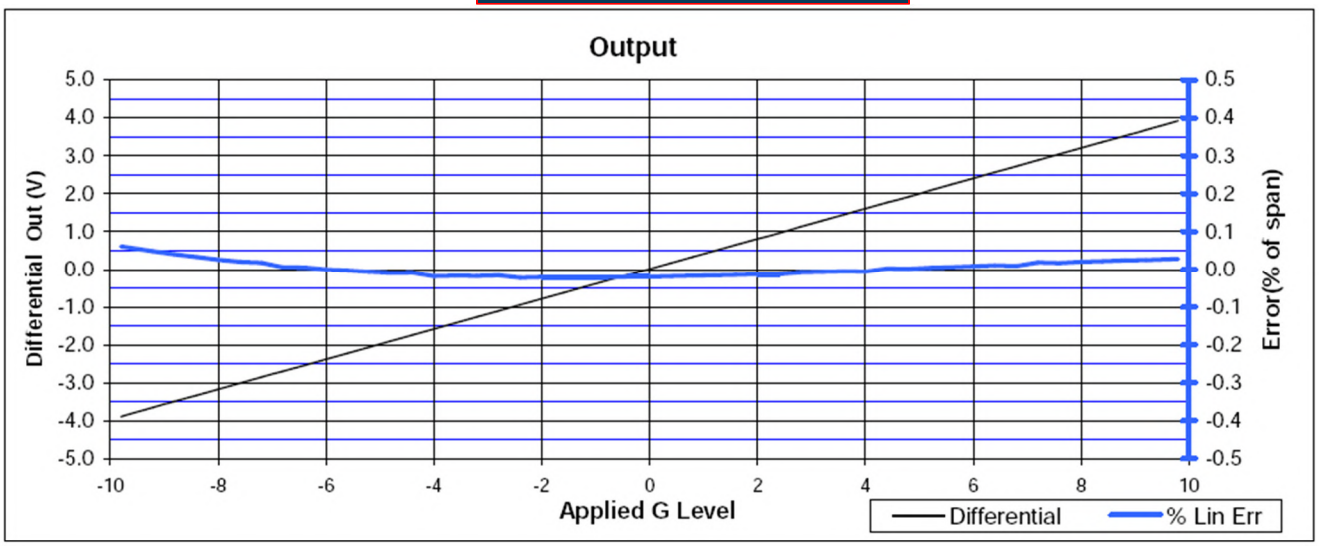


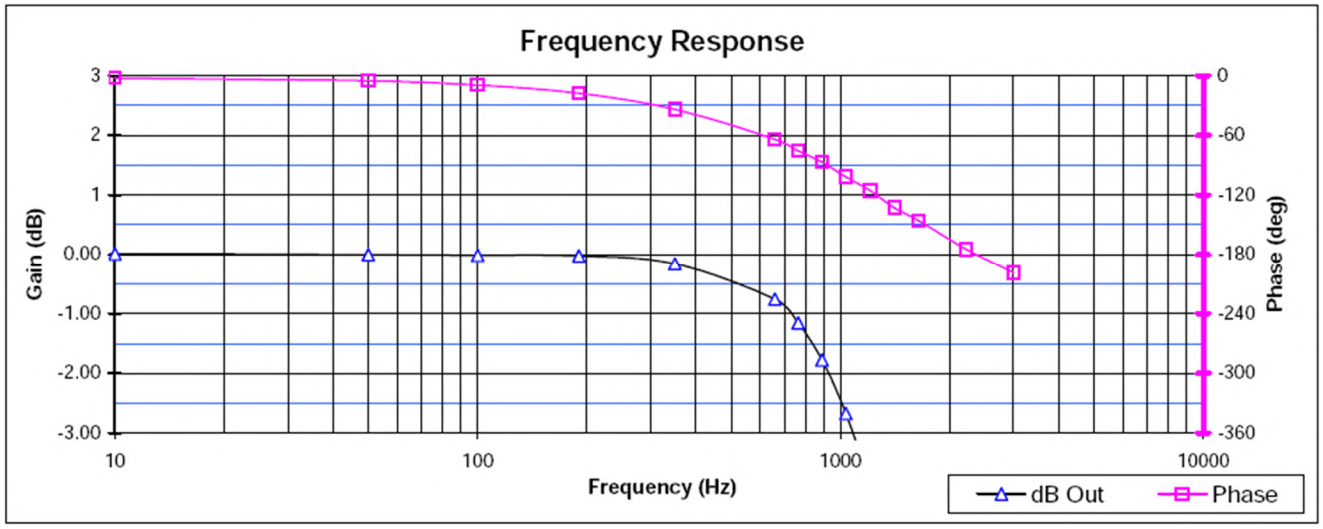
EXAMPLE 5G


Output
Differential Out (V)
Error(% of span)
Applied G Level
Differential
% Lin Err

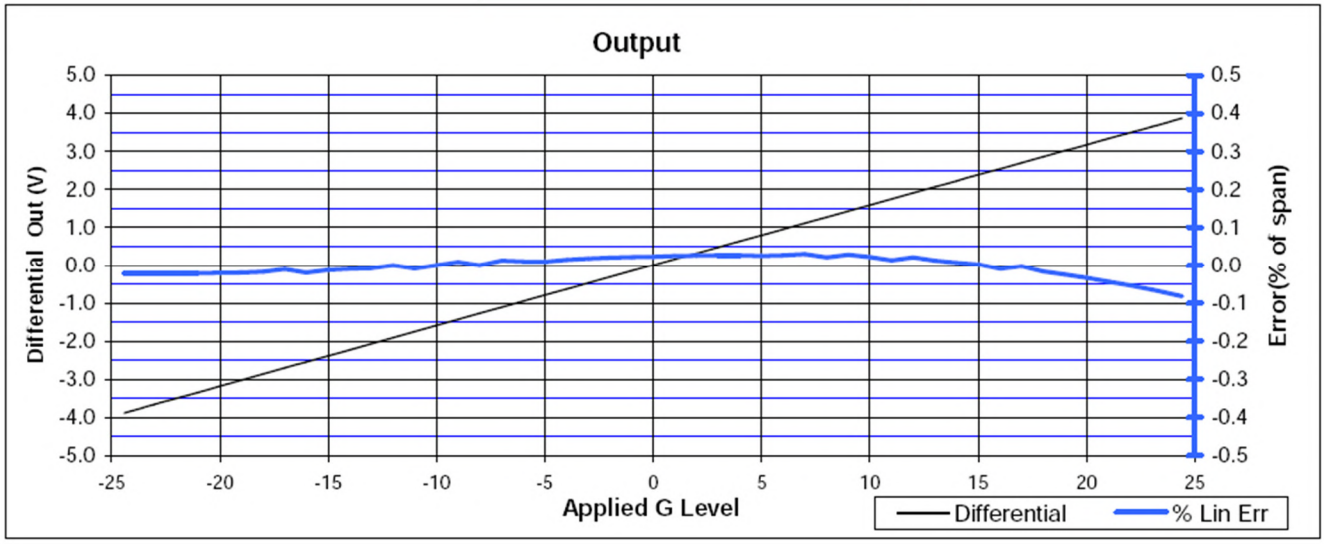

Frequency Response
Gain (dB)
Phase (deg)
Frequency (Hz)
dB Out
Phase

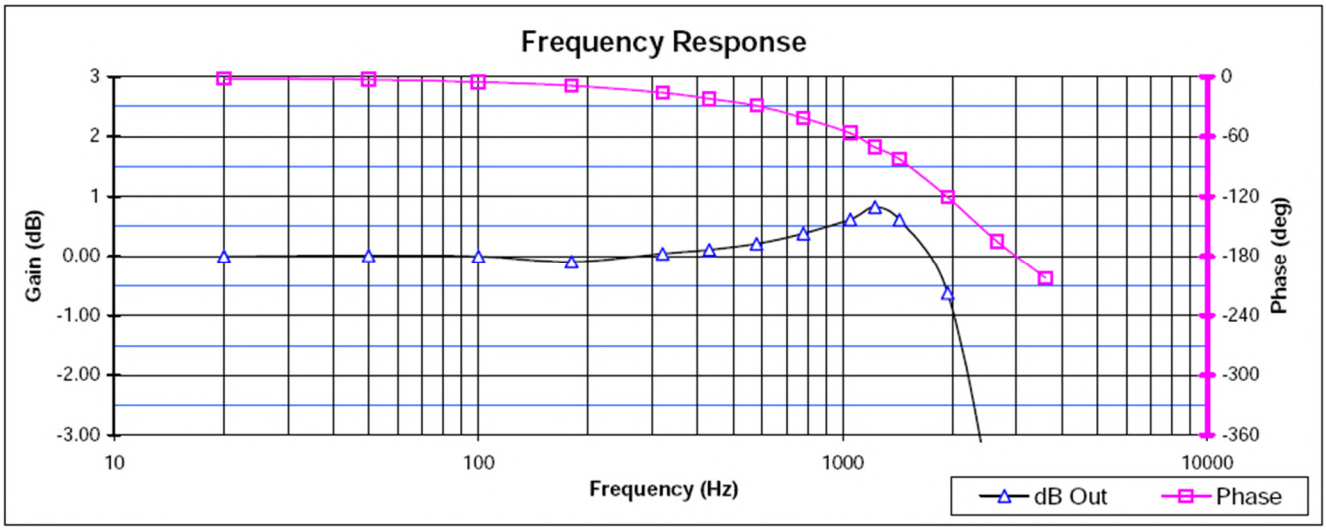
EXAMPLE 10G


Output
Differential Out (V)
Error(% of span)
Applied G Level
Differential
% Lin Err

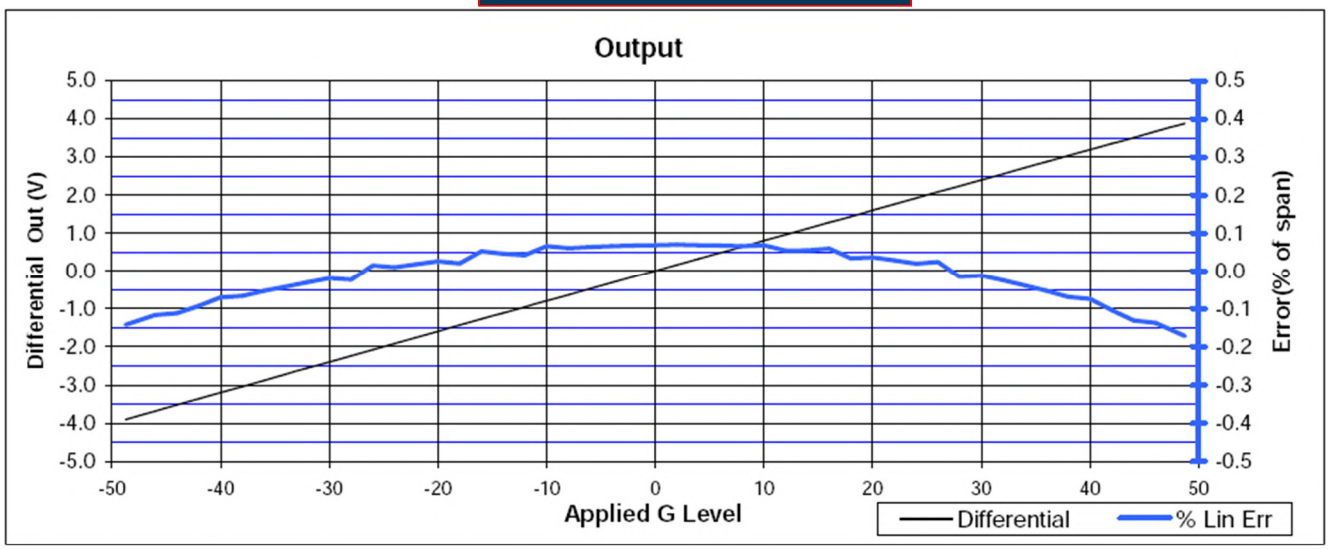

Frequency Response
Gain (dB)
Phase (deg)
Frequency (Hz)
dB Out
Phase

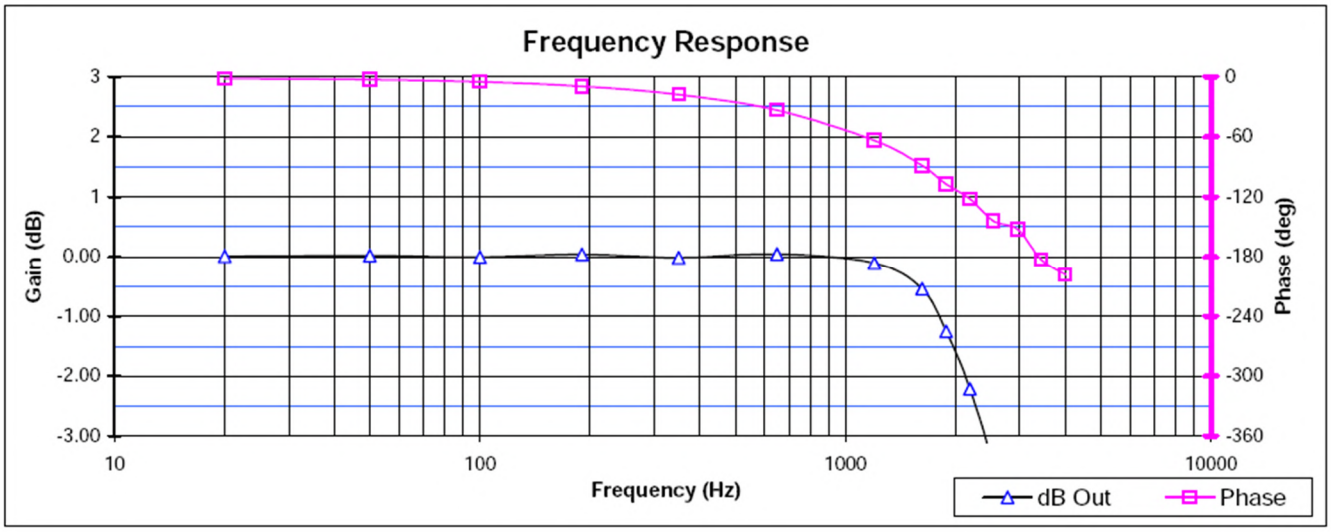
EXAMPLE 25G


Output
Differential Out (V)
Error(% of span)
Applied G Level
Differential
% Lin Err

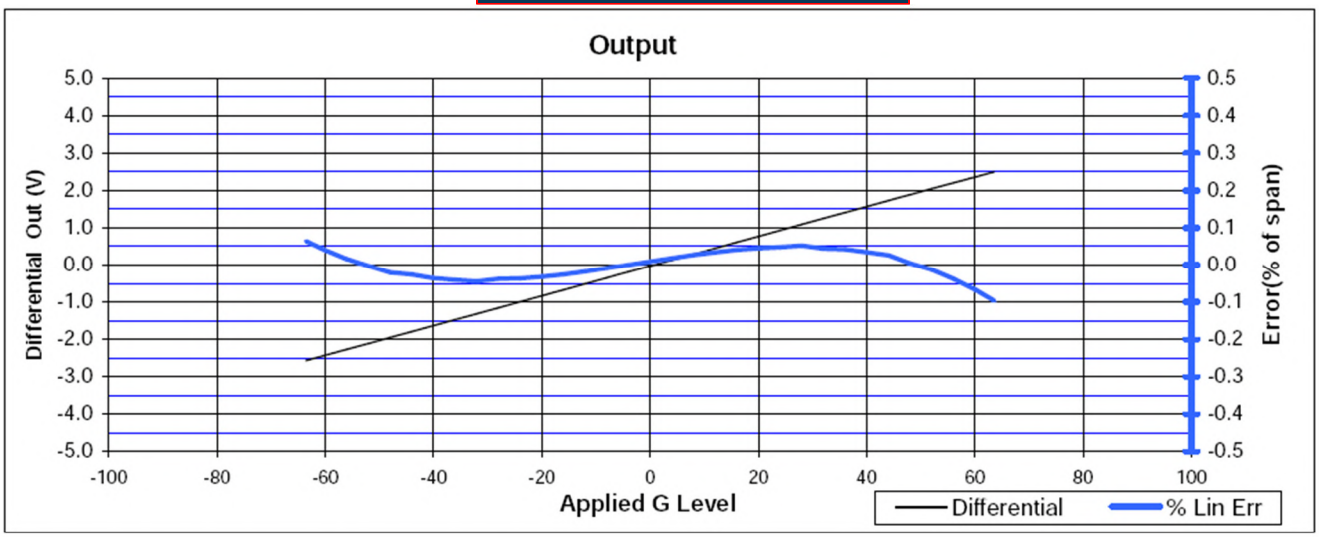

Frequency Response
Gain (dB)
Phase (deg)
Frequency (Hz)
dB Out
Phase

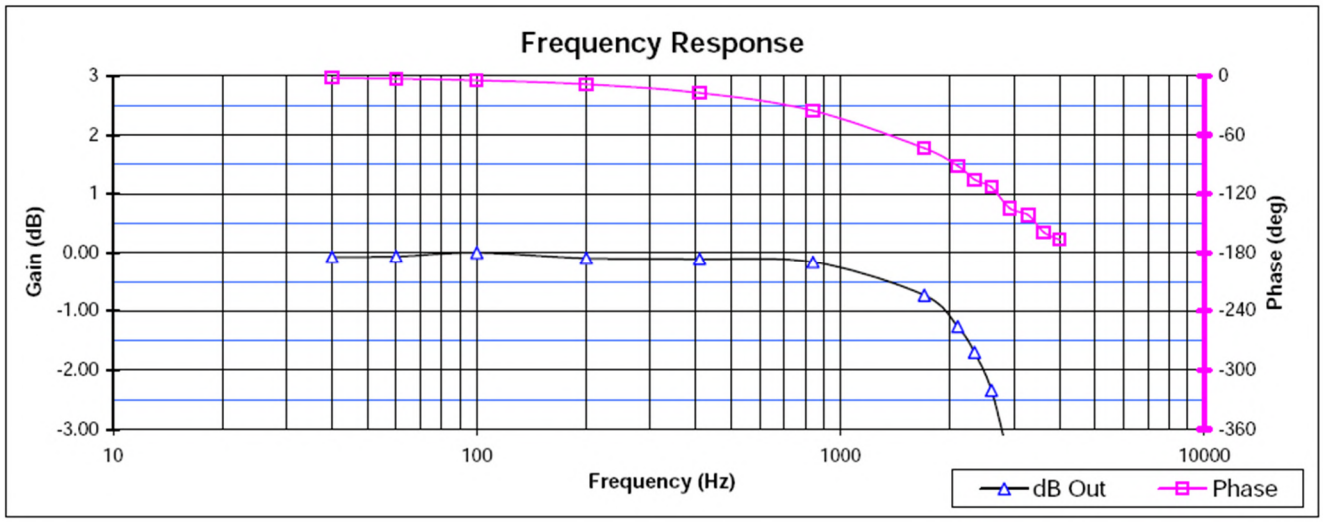
EXAMPLE 50G


Output
Differential Out (V)
Error(% of span)
Applied G Level
Differential
% Lin Err


Frequency Response
Gain (dB)
Phase (deg)
Frequency (Hz)
dB Out
Phase

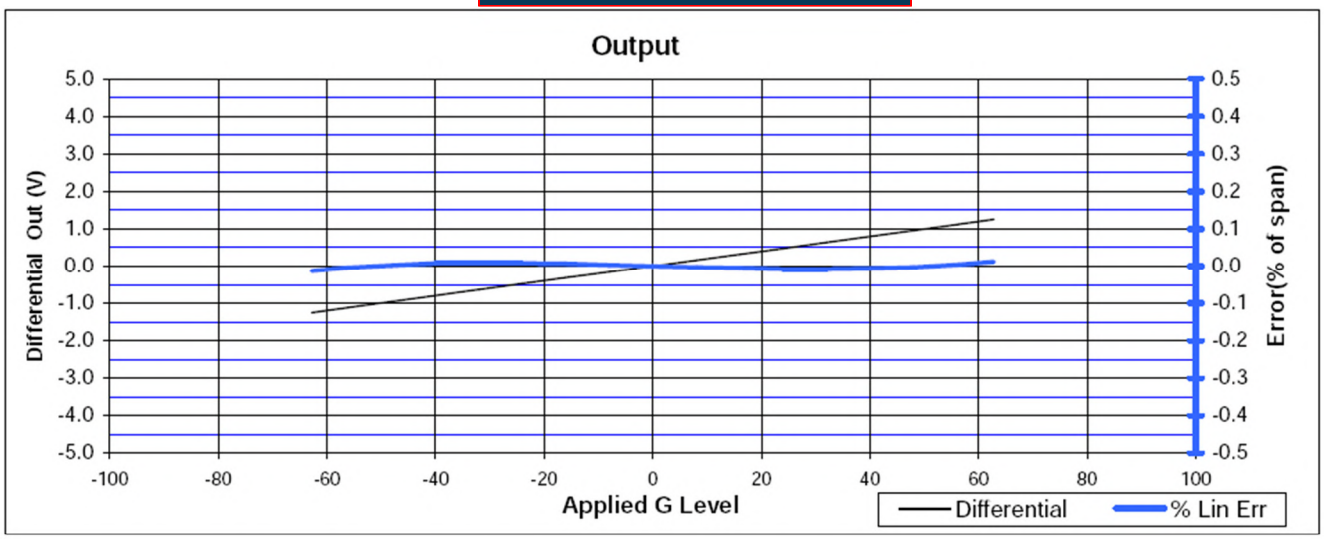
EXAMPLE 100G

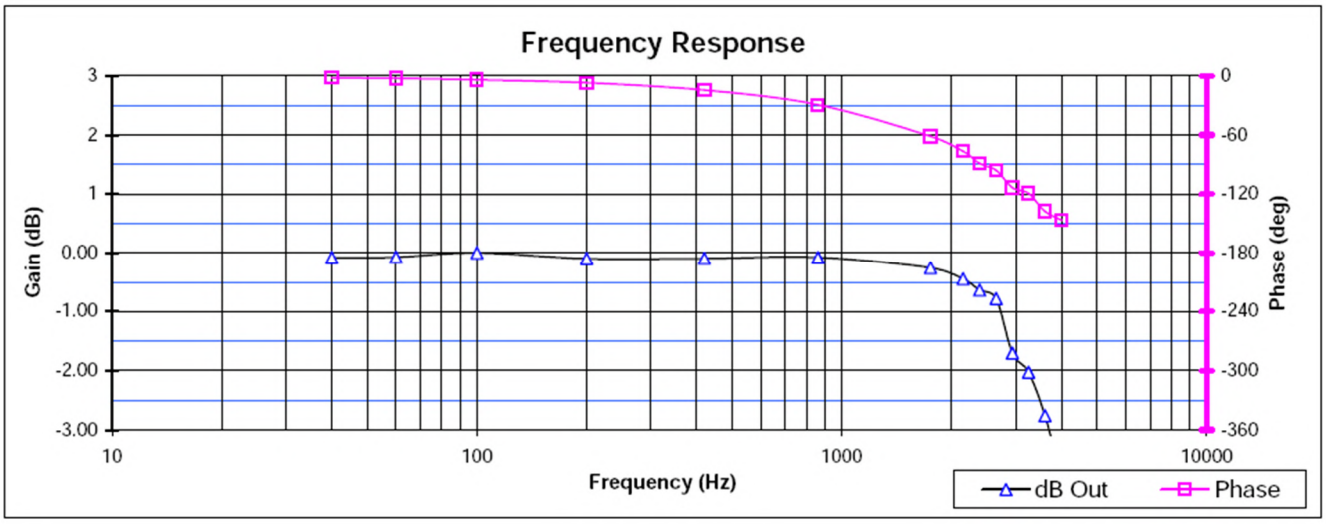




100g and greater versions are tested and specified from -65 to +65g.

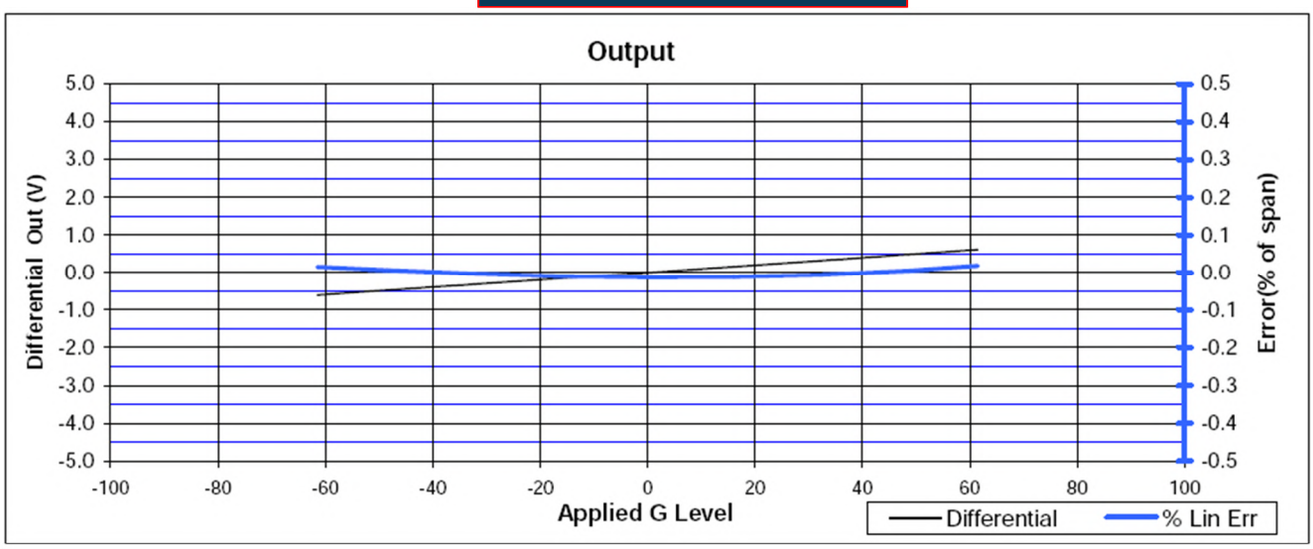
EXAMPLE 200G

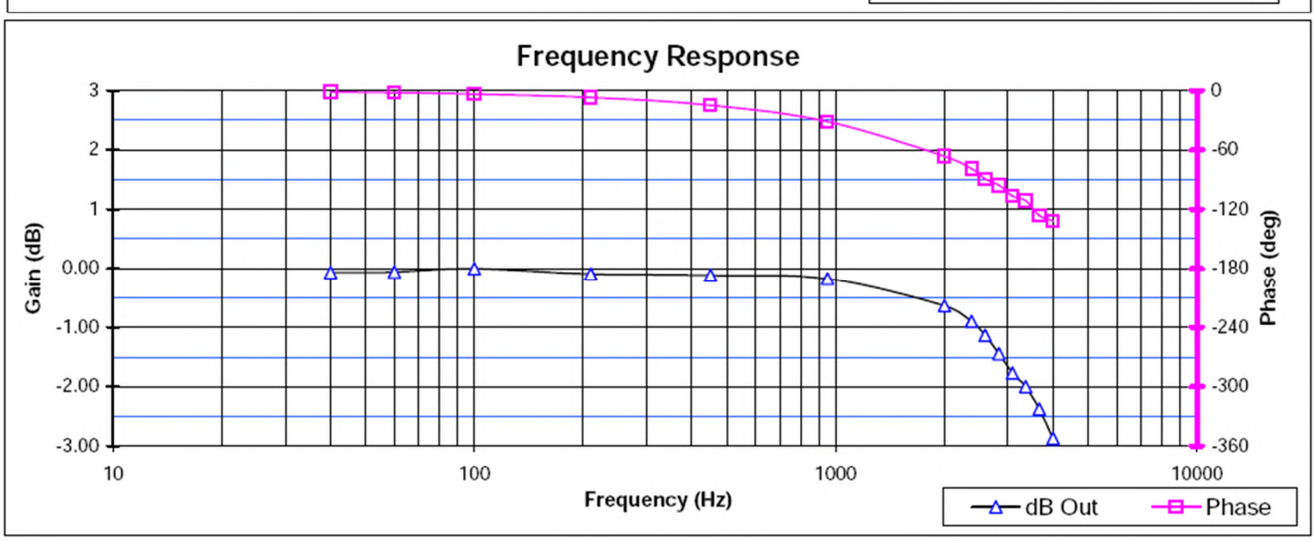




100g and greater versions are tested and specified from -65 to +65g.

EXAMPLE 400G





100g and greater versions are tested and specified from -65 to +65g.