NI USB-6008

GND	1	17	P0.0
AI 0/AI 0+	2	18	P0.1
AI 4/AI 0–	3	19	P0.2
GND	4	20	P0.3
AI 1/AI 1+	5	21	P0.4
AI 5/AI 1–	6	22	P0.5
GND	7	23	P0.6
AI 2/AI 2+	8	24	P0.7
AI 6/AI 2–	9	25	P1.0
GND	10	26	P1.1
AI 3/AI 3+	11	27	P1.2
AI 7/AI 3–	12	28	P1.3
GND	13	29	PFI 0
AO 0	14	30	+2.5 V
AO 1	15	31	+5 V
GND	16	32	GND

New QPD

Pacific Silicon Sensor

QP 50-6-18u-SD2

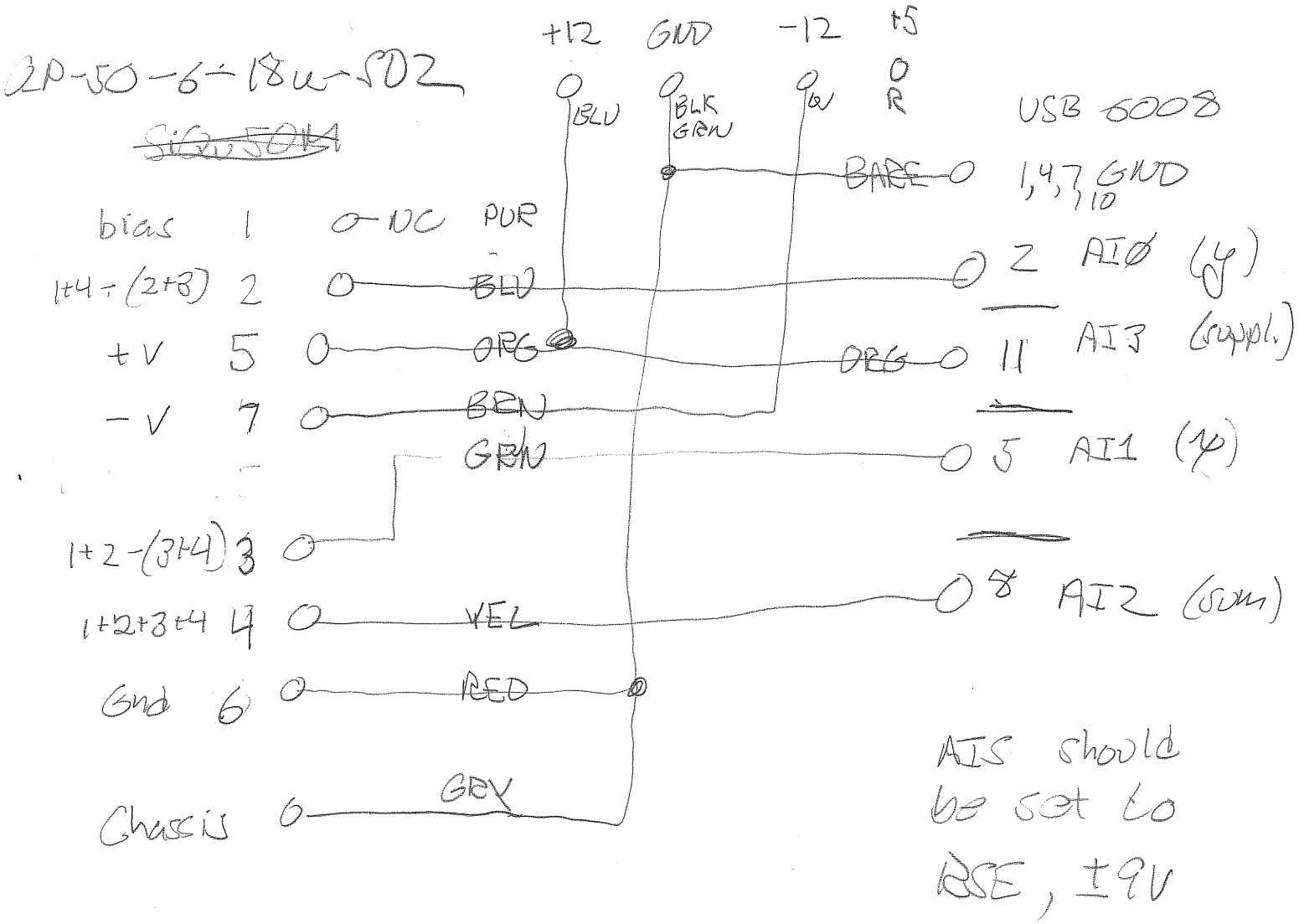
QP

ThorLabs PDA80A

↔

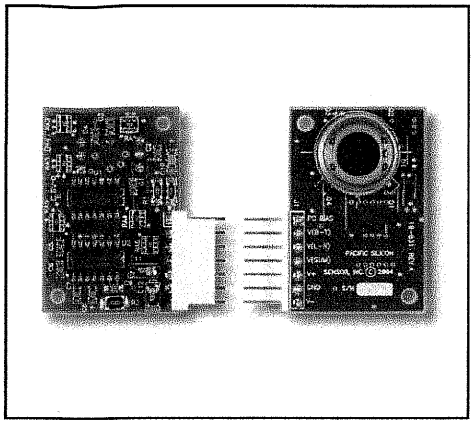
NI USB 6008

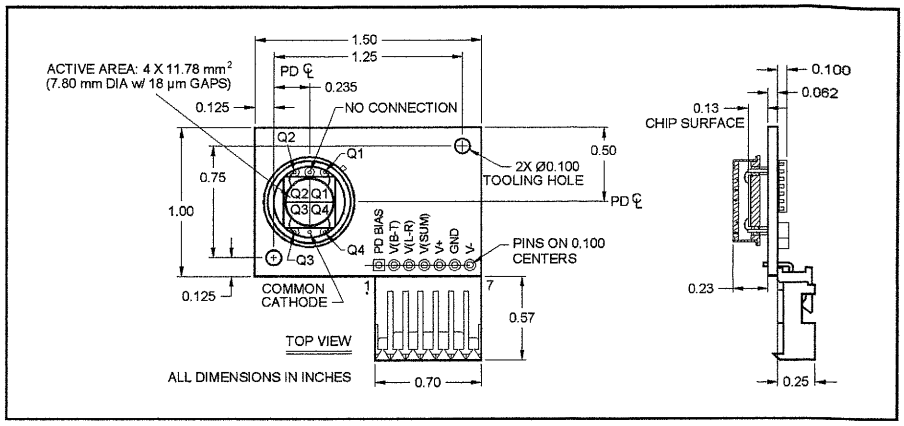
Power



PACIFIC SILICON SENSOR incorporated

Pacific Silicon Sensor Series 6 Data Sheet
Quad Sum and Difference Amplifier
Part Description QP50-6-18u-SD2
Order # 10-027





DESCRIPTION

The **QP50-6-18u-SD2** is a quad photodiode array with current-to-voltage amplifiers that provide bottom minus top and left minus right difference signals. Additionally the **QP50-6-18u-SD2** provides a signal that is the sum of all four quadrant diode signals. The difference signals are voltage analogs of the light intensity difference sensed by the pairs of photodiode elements in the array. The board has a 7 pin connector attached for easy hook up.

APPLICATIONS

- NIR & visible pulsed light positioning and tracking
- Laser beam centering

RoHS COMPLIANT

PINOUT FOR THORLABS PDB80A

1
2 ORG
3 DK BLU
4 GRN
5 RED V+
6 WHT GND
7 YEL V-

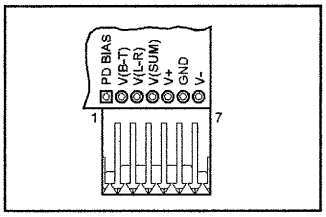
OPTIONS

- Can be purchased without connector, use order # 10-007.
- For alternate gap size, see data sheet QP50-6SD2 for 42 µm gap version.
- Also available with quad detector active area sizes ranging from 1mm² to 20 mm².

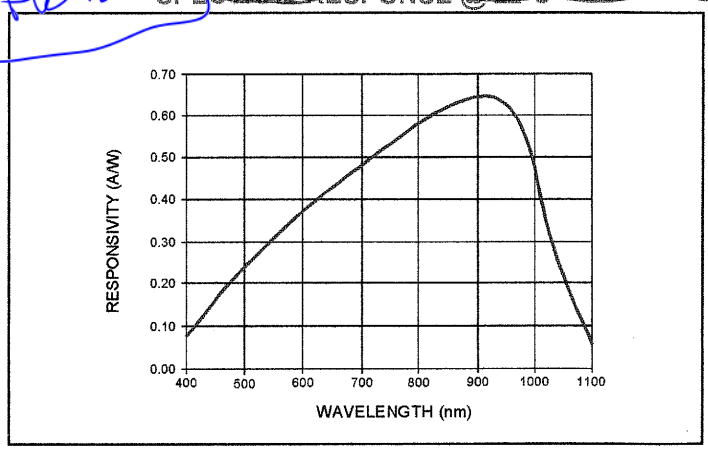
ABSOLUTE MAXIMUM RATING

SYMBOL	PARAMETER	MIN	MAX	UNITS
T_{STG}	Storage Temp	-15	+100	°C
T_{OP}	Operating Temp	0	+70	°C
V_S	Power Supply Voltage Recommended ±15V	±4.5	±18	V
V_R	Applied Bias Voltage*	0	15	V

CONNECTIONS



SPECTRAL RESPONSE @ 22°C



ELECTRO-OPTICAL CHARACTERISTICS @ 22° C

SYMBOL	CHARACTERISTIC	TEST CONDITIONS	MIN	TYP	MAX	UNITS
V_O	Output Voltage (all outputs)		---	$+V_s$ -3	---	V
			---	$-V_s$ +3	---	
I_O	Output Current Limit	V_s = ± 15 V; V_R = 0 V	---	---	25	mA
	Slew Rate	V_s = ± 15 V; V_R = 0 V	---	---	10	V/µs
	Theoretical noise	V_s = ± 15 V; V_R = 0 V	---	15	---	nV/√Hz
Δf_{-3dB}	Bandwidth**	V_s = ± 15 V; V_R = 5 V; λ = 880 nm	---	250	---	kHz

* actual bias voltage to photodiode: pad 1 voltage times 0.91. Do not apply negative voltages to pad 1.
** dependant on bias voltage

Disclaimer: Due to our policy of continued development, specifications are subject to change without notice.

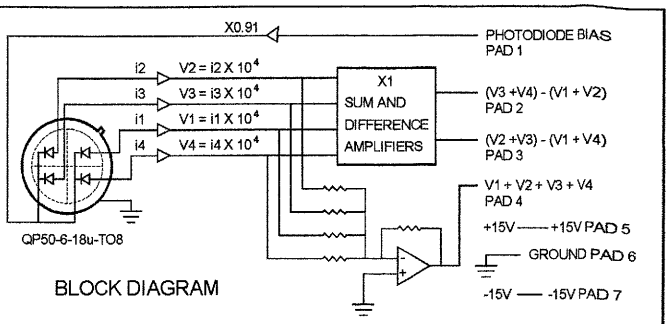
The **QP50-6-18u-SD2** outputs are labeled as B-T for bottom minus top, L-R for left minus right. The output voltages are obtained by routing the diode element currents into current-to-voltage amplifiers with a gain of 10^4:

$V_{B-T} = [(I_{3,4}) - (I_{1,2})] \bullet (10^4)$ on Pad 2.

$V_{L-R} = [(I_{2,3}) - (I_{1,4})] \bullet (10^4)$ on Pad 3.

$V_{SUM} = [(I_{1,2,3,4}) \bullet (10^4)$ on Pad 4.

$I_{X,Y}$ is the sum of the currents generated by photodiode elements x and y. Looking down through the window of the photodiode, the quadrants are identified in drawing on page one.



BLOCK DIAGRAM

APPLICATION NOTES

Beam Size

The light spot applied to the QP50-6-18u-SD2 must be smaller than the diameter of the quadrant photodiode array. The detector active area has a diameter of 7.8 millimeters. If the light spot is too large, it may be reduced to fit the photodiode array by use of a lens. A decrease in output signal strength is observed as the light spot crosses the separation boundary of the quadrants, usually referred to as the "gap". This effect is more pronounced as the diameter of the light spot decreases, as a larger percentage of the light spot's power falls within the non-active gap. For this reason, the minimum light beam diameter should be a least one millimeter. A lens may be used to increase the beam diameter.

Photodiode Bias Operation

The QP50-6-18u-SD2 array may be operated either in the zero bias or the reverse bias mode. Pin 1 is connected, via a resistor divider, to the non-inverting input of a voltage follower operational amplifier. This line may be left unterminated, grounded or connected to a voltage source of zero volts to operate in the zero bias mode. If the photodiode bias line is connected to a positive voltage source (but less than Vcc), then the photodiode elements in the array will be biased at 0.91 x VBias. Do not connect Pin 1 to negative voltages, as this will forward bias the photodiode array, making it inoperable and possibly damaging the circuit.

Use of Sum and Difference Signals for Alignment

The sum output signal may be used to help preliminary alignment of the QP50-6-18u-SD2 to the source light beam. First, the beam or the QP50-6-18u-SD2 is adjusted for maximum sum output signal. Second, the beam or QP50-6-18u-SD2 is adjusted until the L-R and B-T signals are at minimum. This procedure results in the beam being centered on the quad photodiode array.

Signal Null Detector for Servo Applications

A common application for the QP50-6-18u-SD2 is a signal null detector as part of a servo system that maintains the position of a light beam. Errors in beam position are reported by the QP50-6-18u-SD2 and may be used to adjust a positioning device that restores the beam or the beam's source to a null position.

Speed of Response

Increasing the photodiode bias voltage will increase the speed of the QP50-6-18u-SD2. Operating with zero reverse bias is sufficient for many applications (-3dB is around 150 kHz at 880 nm). As noted above, Pin 1 is provided for applying positive bias voltage to the quad for higher frequency response. Care should be taken not to exceed the circuit common mode values and the breakdown voltage of the quad photodiode. See Absolute Maximum Ratings on page one for maximum values.

Temperature Considerations

The operation temperature must be between 0 to 70 °C. For best resolution the temperature should be kept at or below 25 °C. Thermal gradients across the detector will cause position errors and should be avoided.

Offsets

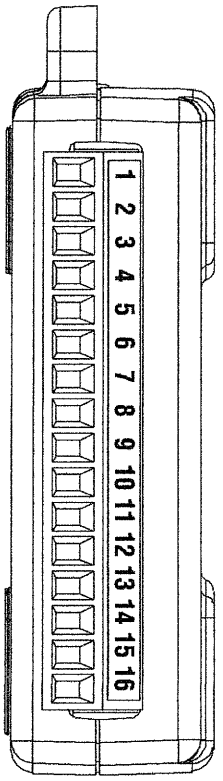
Precision components are used in the circuitry but as much as 10 millivolts of dark offset may still be present in the outputs. If this causes a problem the offsets should be removed externally.

USA:
Pacific Silicon Sensor, Inc.
5700 Corsa Avenue, #105
Westlake Village, CA 91362 USA
Phone (818) 706-3400
Fax (818) 889-7053
Email: sales@pacific-sensor.com
www.pacific-sensor.com

International sales:
Silicon Sensor International AG
Wilhelminenhofstrasse 76-77
D-12459 Berlin, Germany
Phone +49 (0)30-63 99 23 10
Fax +49 (0)30-63 99 23 33
Email: sales@silicon-sensor.de
www.silicon-sensor.de

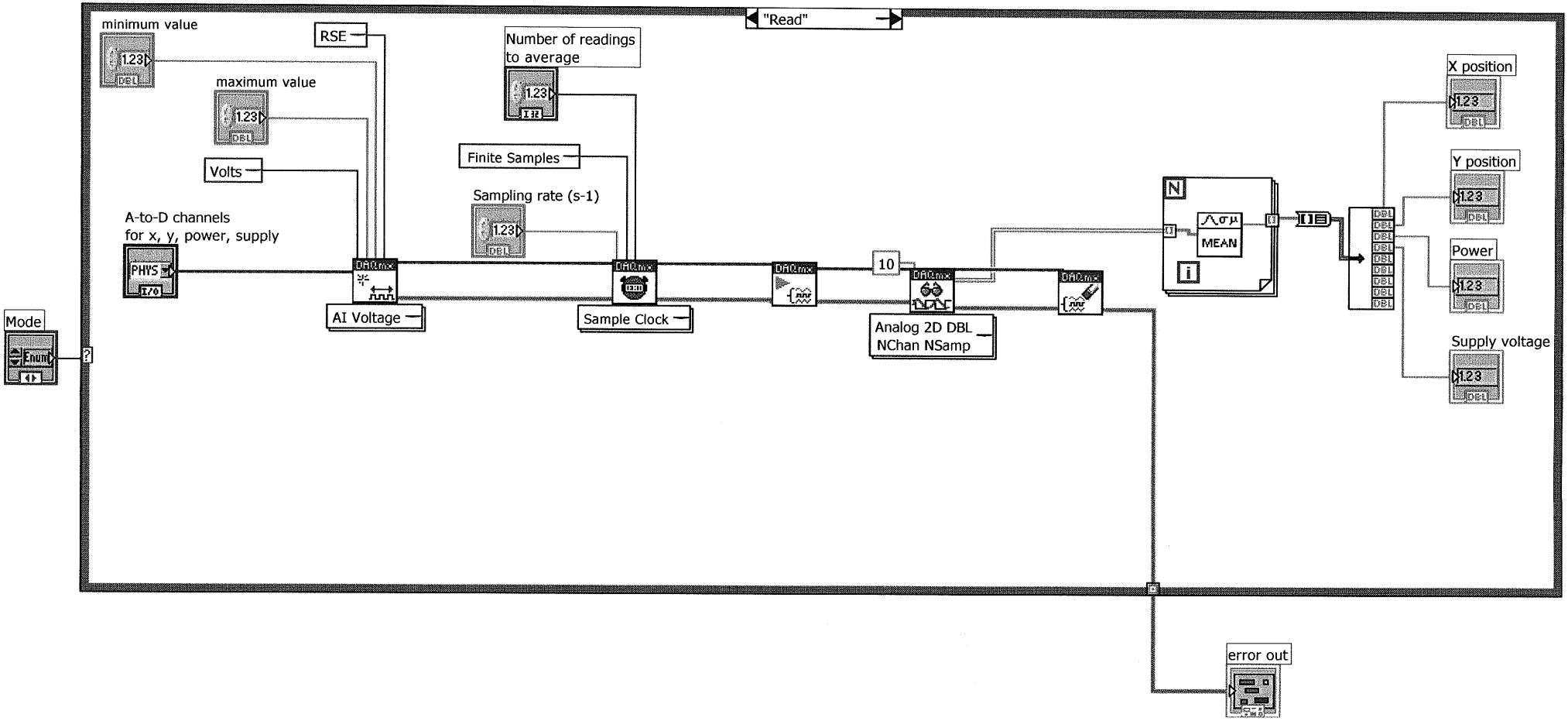
Table 4 lists the analog terminal assignments, and Table 5 lists the digital terminal assignments.

Table 4. Analog Terminal Assignments

Module	Terminal	Signal, Single-Ended Mode	Signal, Differential Mode
	1	GND	GND
	2	AI 0	AI 0+
	3	AI 4	AI 0–
	4	GND	GND
	5	AI 1	AI 1+
	6	AI 5	AI 1–
	7	GND	GND
	8	AI 2	AI 2+
	9	AI 6	AI 2–
	10	GND	GND
	11	AI 3	AI 3+
	12	AI 7	AI 3–
	13	GND	GND
	14	AO 0	AO 0
	15	AO 1	AO 1
	16	GND	GND

Quadrant photodiode read.vi
C:\Documents and Settings\gelles\My Documents\SVN sandbox\microscope plugins\PP-NI quad photodiode\Quadrant photodiode read.vi
Last modified on 7/7/2009 at 5:41 PM
Printed on 7/7/2009 at 5:41 PM

Block Diagram



Reference and Power Sources

The NI USB-6008/6009 creates an external reference and supplies a power source. All voltages are relative to COM unless otherwise noted.

+2.5 External References

The NI USB-6008/6009 creates a high-purity reference voltage supply for the ADC using a multi-state regulator, amplifier, and filter circuit. You can use the resulting +2.5 V reference voltage as a signal for self test.

+5 V Power Source

The NI USB-6008/6009 supplies a 5 V, 200 mA output. You can use this source to power external components.

Note While the device is in USB suspend, the output is disabled.

Specifications

The following specifications are typical at 25 °C, unless otherwise noted.

Analog Input

Converter type ..... Successive approximation

Analog inputs ..... 8 single-ended, 4 differential, software selectable

Input resolution

- NI USB-6008 ..... 12 bits differential, 11 bits single-ended
- NI USB-6009 ..... 14 bits differential, 13 bits single-ended

Max sampling rate (aggregate)[1]

- NI USB-6008 ..... 10 kS/s
- NI USB-6009 ..... 48 kS/s

AI FIFO ..... 512 bytes

Timing resolution ..... 41.67 ns (24 MHz timebase)

[1] System dependent.

Timing accuracy ..... 100 ppm of actual sample rate

Input range

Single-ended ..... ±10 V

Differential ..... ±20 V[1], ±10 V, ±5 V, ±4 V, ±2.5 V, ±2 V, ±1.25 V, ±1 V

Working voltage ..... ±10 V

Input impedance ..... 144 kΩ

Overvoltage protection ..... ±35

Trigger source ..... Software or external digital trigger

System noise[2]

Single-ended

±10 V range ..... 5 mVrms

Differential

±20 V range ..... 5 mVrms

±1 V range ..... 0.5 mVrms

Absolute accuracy at full scale, single-ended

Range	Typical at 25 °C (mV)	Maximum over Temperature (mV)
±10	14.7	138

Absolute accuracy at full scale, differential[3]

Range	Typical at 25 °C (mV)	Maximum over Temperature (mV)
±20	14.7	138
±10	7.73	84.8
±5	4.28	58.4
±4	3.59	53.1
±2.5	2.56	45.1

[1] ±20 V means that |AI+ – (AI–)| <= 20 V. However, AI+ and AI– must both be within ±10 V of GND. Refer to the *Connecting Differential Voltage Signals* for more information.

[2] System noise measured at maximum sample rate.

[3] Input voltages may not exceed the working voltage range.