Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Analog input

Table 1. Analog input specifications

Parameter	Conditions	Specification
A/D converter type		16-bit successive approximation type
Number of channels		Eight differential
		Eight single-ended
Input configuration		Individual A/D per channel
Sampling method		Simultaneous
Analog input modes	Power up and reset state	CHx_H and CHx_L inputs are disconnected from their screw terminal pins and internally connected to GND (recommended configuration for unused inputs).
	Single-ended	CHx_H inputs are connected directly to their screw terminal pins.
		CHx_L inputs are disconnected from their screw terminal pins and internally connected to GND.
	Differential	CHx_H and CHx_L inputs are connected directly to their screw terminal pins.
Absolute maximum input voltage	*CHx IN to GND.* *TRIG_IN to GND*	*±25 V maximum (power on)* *±15 V maximum (power off)*
Input impedance	*CHx IN*	*1 GΩ (power on)* *1.5 kΩ (power off)*
Input bandwidth (-3 dB)	All input ranges	330 kHz
Input leakage current		*±25 pA*
Input capacitance		*50 pf*
Input ranges	Software-selectable per channel	±10 V, ±5 V, ±2 V, ±1 V
A/D pacing		Onboard A/D clock, external source (SYNC_IN). See Table 8 on page 4.
A/D trigger source		TRIG_IN input. See Table 7 on page 3.
A/D trigger modes		External analog. See Table 7 on page 3.
Maximum working voltage (signal + common mode)		±0.05% FSR maximum.
Sampling rate		0.009 S/s to 250 kS/s, software-programmable
Throughput	Software-paced	33 to 8000 S/s all channels, system-dependent
	Scan to PC memory	250-kS/s per channel maximum (throughput rate may be limited on USB 1.1 ports).
Resolution		16 bits
Differential non-linearity (Note 1)	Calibrated	±2.0
	Un-calibrated	± 0.5 LSB typical. ±1.0 LSB max.
CMRR (60 Hz)	*±10 V range*	*81 db minimum*
	±5 V range	*81 db minimum*
	±2 V range	*92 db minimum*
	±1 V range	*92 db minimum*

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Note 1: The maximum differential non-linearity specification applies to the entire 0-55 °C temperature range of the USB-1608HS. This specification also accounts for the maximum errors due to the software calibration (in Calibrated mode only) and the AD7685 analog to digital converter non-linearities.

Table 2. Calibrated absolute accuracy

Range	Accuracy (mV)
±10 V	± 7.019
±5 V	± 3.509
±2 V	± 1.403
±1 V	± 0.702

Table 3. Accuracy components - All values are (±)

Range	Integral Non Linearity (% FSR)	Gain error at FS (mV)	Offset (mV)	Gain tempco (ppm/°C)	Offset tempco (µV/°C)
±10 V	0.00915	4.578	1.526	3.8	19.5
±5 V	0.00915	2.289	0.763	7.0	19.5
±2 V	0.00915	0.916	0.305	16.5	24.3
±1 V	0.00915	0.458	0.153	40.1	29.2

Note 2: When connecting differential inputs to floating input sources, the user must provide a DC return path from each differential input to ground. This can be accomplished by simply connecting a resistor from each of the differential inputs to AGND. A value of approximately 100 kΩ can be used for most applications.

Table 4. Noise performance – all values are (±)

Range	Peak to Peak Noise (counts)	RMS noise LSBrms
±10 V	8	1.21
±5 V	8	1.21
±2 V	8	1.21
±1 V	8	1.21

Table 4 summarizes the noise performance for the USB-1608HS. Noise distribution is determined by gathering 50 kS with inputs tied to ground at the user connector. Samples are gathered at the maximum specified sampling rate of 250 kS/s.

Analog input calibration

Table 5. Analog input calibration specifications

Parameter	Specifications
Recommended warm-up time	15 minutes minimum
Calibration method	Software calibration
Calibration interval	1 year
Calibration reference	+10.000 V, ±5 mV maximum. Actual measured values stored in EEPROM
	Tempco: 5 ppm/°C maximum
	Long term stability: 30 ppm/1000 h

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Digital input/output

Table 6. Digital I/O specifications

Digital type	5 V CMOS
Number of I/O	16
Configuration	Eight input, eight output
Pull-up/pull-down configuration	The eight input pins have 47 k resistors that may be configured to either pull-up or pull-down with a jumper
Digital I/O transfer rate (system-paced)	System-dependent, 33 to 8000 port reads/writes or single bit reads/writes per second.
Input high voltage	2.0 V minimum, 5.5 V absolute maximum
Input low voltage	0.8 V maximum, −0.5 V absolute minimum
Output high voltage (IOH = −2.5 mA)	3.8 V minimum
Output low voltage (IOL = 2.5 mA)	0.7 V maximum
Power on and reset state	Outputs: driven low
LED indicators	Each I/O pin has an associated LED status indicator. A high at the pin will cause the LED to be on. The LEDs may be disabled with jumpers - one jumper for the input LEDs (JP1), and one jumper for the output LEDs (JP2).

External trigger

Table 7. External trigger specifications

Parameter	Conditions	Specification
Trigger source		TRIG_IN input
Trigger input range		±10 V max.
Absolute maximum input voltage	*TRIG_IN to GND*	*±25 V maximum (power on)*
		±15 V maximum (power off)
Trigger threshold levels		±10V/4096; Software configurable
Input impedance		*1 MΩ (power on)*
		1.5 kΩ (power off)
Trigger modes		Software configurable for: ▪ Positive or negative slope ▪ Edge/level ▪ Retrigger
Threshold resolution		12 bits, 1 in 4096
Threshold accuracy		±0.25% FSR
Hysteresis		±5 mV
Full power bandwidth (-3 dB)		640 kHz

External clock input/output

Table 8. External clock I/O specifications

Parameter	Conditions	Specification
Pin names		SYNC_IN, SYNC_OUT
Pin type		SYNC_IN: Input SYNC_OUT: Output
Pin descriptions	SYNC_OUT	Outputs A/D pacer clock.
	SYNC_IN	Receives A/D pacer clock from external source. Rising edge sensitive.
Input clock rate		250 kHz maximum.
Clock pulse width	SYNC_IN	1 µs minimum
	SYNC_OUT	2 µs minimum
Input leakage current		*±2.0 µA*
Input high voltage		3.5 V minimum, 6.5 V absolute maximum
Input low voltage		1.5 V maximum, −0.5 V absolute minimum
Output high voltage (see Note 3)	IOH = −2.5 mA	3.3 V minimum
	No load	3.8 V minimum
Output low voltage (see Note 3)	IOL = 2.5 mA	1.1 V maximum
	No load	0.6 V maximum

Note 3:   SYNC_OUT is over-current protected with a 200 Ω series resistor.

Counter

Table 9. Counter specifications

Pin name (see Note 4)	CTR
Counter type	Event counter
Number of channels	1
Input type	TTL, rising edge triggered
Input source	CTR screw terminal
Resolution	32 bits
Schmidt trigger hysteresis	*0.58 V to 0.93 V*
Input leakage current	*±5 µA*
Maximum input frequency	1 MHz
High pulse width	*500 ns minimum*
Low pulse width	*500 ns minimum*
Input high voltage	2.4 V minimum, 6.5 V absolute maximum
Input low voltage	2.19 V maximum, −0.5 V absolute minimum

Note 4:   CTR is a Schmitt trigger input protected with a 1 kΩ series resistor.

Memory

Table 10. Memory specifications

Data FIFO	65536 samples, 131,072 bytes
EEPROM	512 bytes

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Microcontroller

Table 11. Microcontroller specifications

Type	High performance 8-bit RISC microcontroller
Program memory	16,384 words
Data memory	2,048 bytes

Power

Table 12. Power specifications

Parameter	Conditions	Specification
Supply current (see Note 5)	Continuous mode	920 mA
+5V EXT output voltage range (see Note 6)	▪	4.5 V minimum, 5.25 V maximum
+5V EXT output current (see Note 7)		+10 mA maximum

Note 5: This is the total current requirement for the USB-1608HS. This specification does not include any additional contribution due to +5VEXT output current, analog output source current, or DIO loading.

Note 6: Output voltage range assumes input power supply is within specified limits.

Note 7: This refers to the total amount of current that can be sourced from the +5VEXT terminal pin for general use.

External power input

Table 13. External power input specifications

External power input	+5.0 VDC (+5 V power supply included)
External power adapter	+5 V, ±5% @ 2 A

USB specifications

Table 14. USB specifications

USB device type	USB 2.0 (high-speed)
USB device compatibility	USB 1.1, 2.0
USB cable length	Three meters maximum.
USB cable type	A-B cable, UL type AWM 2527 or equivalent (minimum 24 AWG VBUS/GND, minimum 28 AWG D+/D-).

Environmental

Table 15. Environmental specifications

Operating temperature range	0 to 55 °C maximum
Storage temperature range	-40 to 85 °C maximum
Humidity	0 to 90% non-condensing

Mechanical

Table 16. Mechanical specifications

Dimensions	127 mm (L) x 88.9 mm (W) x 35.56 (H))

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Main connector and pin out

Table 17. Main connector specifications

Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Table 18. Main connector pin out, 8-channel differential mode

Pin	Signal name	Pin	Signal name
1	GND	28	NC
2	DI0	29	NC
3	DI1	30	AGND
4	DI2	31	CH0_L
5	DI3	32	CH0_H
6	DI4	33	AGND
7	DI5	34	CH1_L
8	DI6	35	CH1_H
9	DI7	36	AGND
10	GND	37	CH2_L
11	DO0	38	CH2_H
12	DO1	39	AGND
13	DO2	40	CH3_L
14	DO3	41	CH3_H
15	DO4	42	AGND
16	DO5	43	CH4_L
17	DO6	44	CH4_H
18	DO7	45	AGND
19	GND	46	CH5_L
20	SYNC_IN	47	CH5_H
21	SYNC_OUT	48	AGND
22	+5V EXT	49	CH6_L
23	CTR	50	CH6_H
24	TRIG_IN	51	AGND
25	NC	52	CH7_L
26	NC	53	CH7_H
27	AGND	54	AGND

Table 19. Main connector pin out, 8-channel single-ended mode

Pin	Signal name	Pin	Signal name
1	GND	28	NC
2	DI0	29	NC
3	DI1	30	AGND
4	DI2	31	NC
5	DI3	32	CH0_H
6	DI4	33	AGND
7	DI5	34	NC
8	DI6	35	CH1_H
9	DI7	36	AGND
10	GND	37	NC
11	DO0	38	CH2_H
12	DO1	39	AGND
13	DO2	40	NC
14	DO3	41	CH3_H
15	DO4	42	AGND
16	DO5	43	NC
17	DO6	44	CH4_H
18	DO7	45	AGND
19	GND	46	NC
20	SYNC_IN	47	CH5_H
21	SYNC_OUT	48	AGND
22	+5V EXT	49	NC
23	CTR	50	CH6_H
24	TRIG_IN	51	AGND
25	NC	52	NC
26	NC	53	CH7_H
27	AGND	54	AGND

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