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Appendix A - Specifications [U6 Datasheet]

Specifications at 25 degrees C and Vusb/Vext = 5.0V, except where noted.

Parameter	Conditions	Min	Typical	Max	Units
General					
USB Cable Length				5	meters
Supply Voltage (1)		4.75	5	5.25	volts
Supply Current (2)			100		mA
Operating Temperature		-40		85	°C
Clock Error	~ 25 °C			±30	ppm
	-10 to 60 °C			±50	ppm
	-40 to 85 °C			±100	ppm
Typ. Command Execution Time (3)	USB High-High	0.6			ms
	USB Other	4			ms
Vs Outputs					
Typical Voltage (4)	Self-Powered	4.75	5	5.25	volts
	Bus-Powered	4.8	5	5.25	
Maximum Current (4)	Self-Powered		400		mA
	Bus-Powered		0		mA
Vm+/Vm- Outputs					
Typical Voltage	No-load		±13		volts
	@ 2.5 mA		±12		volts
Maximum Current			2.5		mA
10UA & 200UA Current Outputs					
Absolute Accuracy (5)	~ 25 °C		±0.1	±0.2	%
Temperature Coefficient	See Section 2.5				ppm/°C
Maximum Voltage			VS - 2.0		volts

(1) Device should operate down to about 3.5 volts, with the following considerations. The hi-res converter on the U6-Pro is not specified for operation below 4.75 volts. The voltage drive capability of the current sources will be reduced. The maximum output of the DACs will be limited by VS. The input range of the analog inputs will be reduced approximately 3 volts for each 1 volt that VS is below 4.5 volts.

(2) Typical current drawn by the U6 itself, not including any user connections

(3) Total typical time to execute a single Feedback function with no analog inputs. Measured by timing a Windows application that performs 1000 calls to the Feedback function. See Section 3.1 for more timing information

(4) These specifications are related to the power provided by the host/hub. Self- and bus-powered describes the host/hub. not the U6. Self-powered would apply to USB hubs with a power supply, all known desktop computer USB hosts, and some notebook computer USB hosts. And example of bus powered would be a hub with no power supply, or many PDA ports. The current rating is the maximum current that should be sourced through the U6 and out of the Vs terminals

(5) This is compared to the value stored during factory calibration

Parameter	**Conditions**	**Min**	**Typical**	**Max**	**Units**
Analog Inputs					
Typical Input Range (6)	Gain=1	-10.5		10.1	volts
Max AIN Voltage to GND (7)	Valid Readings	-11.5		11.5	volts
Max AIN Voltage to GND (8)	No Damage	-20		20	volts
Input Bias Current (9)			20		nA
Input Impedance (9)			1		GΩ
Source Impedance (9)			1		kΩ
Integral Linearity Error	Range=10, 1, 0.1			±0.01	% FS
	Range=10			±0.1	% FS
Absolute Accuracy	Range=±10, ±1, ±0.1			±0.01	% FS
	Range=±10			±2000	µV
	Range=±1			±200	µV
	Range=±0.1			±20	µV
	Range=±0.01			±0.1	% FS
	Range=±0.01			±20	µV
Temperature Drift			15		ppm/°C
Channel Crosstalk (10)	< 1kHz		-100		dB

	1kHz - 50kHz		20		dB/dec
Noise (Peak-To-Peak)	See Appendix B			<1	µV
Effective Resolution (RMS)	See Appendix B			22	bits
Noise-Free Resolution	See Appendix B			20	bits
Command/Response Speed	See Section 3.1				
Stream Performance	See Section 3.2				

(6) Differential or single-ended

(7) This is the maximum voltage on any AIN pin compared to ground for valid measurements on that channel. For single-ended readings on the channel itself, inputs are limited by the "Typical Input Range" above, and for differential readings consult the signal range tables in Section 2.6.5. Further, if a channel has over 13.0 volts compared to ground, readings on other channels could be affected. Because all even channels are on 1 front-end mux, and all odd channels on a 2nd front-end mux, an overvoltage (>13V) on a single channel will generally affect only even or only odd channels.

(8) Maximum voltage, compared to ground, to avoid damage to the device. Protection level is the same whether the device is powered or not.

(9) The key specification here is the maximum source impedance. As long as the source impedance is not over this value, there will be no substantial errors due to impedance problems. For source impedance greater than this value, there are two error sources that need to be considered. First, there is a simple offset error due to the input bias current flowing through the source impedance. Second, if sampling more than 1 channel, there can be a more complex settling error if the analog input system needs to quickly swing from one voltage to another. Required settling time to meet specifications can depend on the source impedance of the signal, channel order, resolution index, and gain/range.

(10) Typical crosstalk on a grounded AIN pin, with 20Vpp sine wave on adjacent AIN pin. An adjacent AIN pin refers to multiplexer channel location not channel number, e.g. AIN0-AIN2 or AIN1-AIN3 pairs.

Parameter	**Conditions**	**Min**	**Typical**	**Max**	**Units**
Analog Outputs (DAC)					
Nominal Output Range (11)	No Load	0.04		4.95	volts
	@ ±2.5 mA	0.255		4.775	volts
Resolution			12		bits
Absolute Accuracy	5% to 95% FS		±0.1		% FS
Integral Linearity Error			±0.35	±1	counts
Differential Linearity Error			±0.1	±0.5	counts
Error Due To Loading	@ 100 µA		0.1		%
	@ 1 mA		1		%

Source Impedance			50		Ω
Short Circuit Current (12)	Max to GND		50		mA
Time Constant			300		µs
Digital I/O, Timers, Counters					
Low Level Input Voltage		-0.3		0.8	volts
High Level Input Voltage		2		5.8	volts
Maximum Input Voltage (13)	FIO	-10		10	volts
	EIO/CIO	-6		6	volts
Output Low Voltage (14)	No Load		0		volts
--- FIO	Sinking 1 mA		0.55		volts
--- EIO/CIO	Sinking 1 mA		0.18		volts
--- EIO/CIO	Sinking 5 mA		0.9		volts
Output High Voltage (14)	No Load		3.3		volts
--- FIO	Sourcing 1 mA		2.75		volts
--- EIO/CIO	Sourcing 1 mA		3.12		volts
--- EIO/CIO	Sourcing 5 mA		2.4		volts
Short Circut Current (14)	FIO		6		mA
	EIO/CIO		16		mA
Output Impedance (14)	FIO		550		Ω
	EIO/CIO		180		Ω
Counter Input Frequency (15)				8	MHz
Input Timer Total Edge Rate (16)	No Stream			30000	edges/s
	While Streaming			7000	edges/s

(11) Maximum and minimum analog output voltage is limited by the supply voltages (Vs and GND). The specifications assume Vs is 5.0 volts. Also, the ability of the DAC output buffer to driver voltages close to the power rails, decreases with increasing output current, but in most applications the output is not sinking/source much current as the output voltage approaches GND.

(12) Continuous short circuit will not cause damage.

(13) Maximum voltage to avoid damage to the device. Protection works whether the device is powered or not, but continuous voltages over 5.8 volts or less than -0.3 volts are not recommended when the U3 is unpowered, as the voltage will attempt to supply operating power to the U3 possibly causing poor start-up behavior.

(14) These specifications provide the answer to the question. "How much current can the digital I/O sink or source?". For instance, if EIO0 is configured as output-high and shorted to ground, the current sourced by EIO0 is configured as output-high and shorted to ground, the current sourced by EIO0 into ground will be about 16 mA (3.3/180). If connected to a load that draws 5 mA, EIO0 can provide that current but the voltage will droop to about 2.4 volts instead of the nominal 3.3 volts. If connected to a 180 ohm load to ground, the resulting voltage and current

will be about 1.65 volts @ 9 mA.
(15) Hardware counters. 0 to 3.3 volt square wave.
(16) To Avoid missing edges, keep the total number of applicable edges on all applicable timers below this limit. See section 2.9 for more information.