



Accelerometer with Analog and Digital I/O for StackableUSB™ USB1600



Features

- ✓ Tri-axis sensing, six degrees of freedom
- ✓ Selectable high-resolution 1.5g – 200g sensing ranges
- ✓ 12-bit, 250ksps simultaneous sampling
- ✓ UART, SPI, I2C, ADC, temperature sensor, analog comparators, PCA, timers, twenty (20) configurable I/O Pins
- ✓ 64KB Flash, 2k (256x8) EEPROM, 4352 bytes RAM
- ✓ Small 1.85" x 1.78" board
- ✓ -40° to +85°C operation



The USB1600 accelerometer module provides the ideal mix of sensing ranges, resolutions, and sampling rates for rugged, compact embedded systems. The module stacks directly onto any StackableUSB Host computer or microcontroller, supplying OEMs with a cost effective solution for measuring acceleration and vibration. The USB1600 comes with sample software and full documentation.

The USB1600 offers standard sensing ranges from 1.5g – 6g and is configurable for ranges up to 200g. In addition, a dedicated Analog Devices ADC provides simultaneous sampling on all three (3) accelerometer axis (X, Y, Z),

allowing the USB1600 to sense six (6) degrees of freedom. Powered by a Silicon Labs C8051F340 microcontroller with Pipelined 48-MIPS architecture, the USB1600 also provides a great set of additional features including digital I/O, timers, PWMs, SPI, I2C, RS232, and more.

The 1.85" x 1.78" module is USB 2.0 compliant providing users the advantages of plug-and-play interfacing. The module stacks onto the top or bottom of any StackableUSB host single board computer or microcontroller forming a small, rugged, embeddable system, ideal for harsh environments. The USB1600 can be connected to desktop PCs and laptops via a Mini-B USB connector for development.

Software/Driver Support

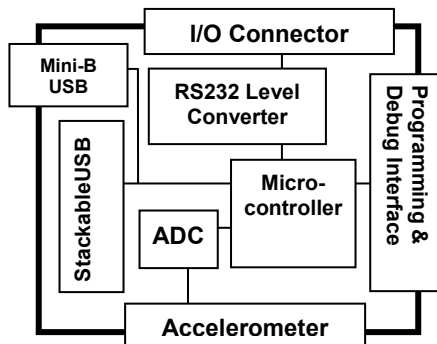
Windows XP
Windows CE
Linux
Host MCU firmware
On-board MCU firmware
Sample software

Compatible Hardware

StackableUSB Host single board computers and microcontrollers
PC Host desktops and laptops
SPI, I2C, UART
Analog Devices
SILabs DEBUGADPTR-USB

Mounting/Packaging

¼-Size 104™ Form Factor
Standoffs, STDOFFUSB



Technical Details:

The USB1600 features software selectable ranges from 1.5g – 6g. Accelerometers with lower g ranges have higher resolutions and can better detect smaller movements than those with high g ranges. For systems requiring a higher magnitude, the USB1600 can be equipped with a more powerful range (maximums of 50g or 200g). The versatility of the USB1600 is important because an ill-matched accelerometer range will result in false readings. If an acceleration outside the sensing range occurs, then the output will be clipped and read as the maximum. As a rule of thumb, a 20% gap should be given in respect to the highest g-force expected to be encountered in an application. (Figure 1.1 provides a scale to help decide which USB1600 configuration best suites the OEM application. The graph shows some acceleration values that are experienced in common day-to-day events along with the sensing ranges of the USB1600 options.)

A host connected to the USB1600 can determine roll, pitch, and yaw using simple algorithms eliminating the need for an expensive Gyro.

At the core of the USB1600 is the Silicon labs C8051F340 8-bit microcontroller which houses a high-speed, 48-MIPS pipelined architecture CIP-51™ CPU Core. This provides excellent throughput allowing

execution of 70% of instructions in 1 or 2 system clocks.

The USB1600 communicates with a host CPU through the StackableUSB connector, the Mini-B USB connector, or can serve as a stand-alone sensor board. A 10-pin connector provides access to the programming and debugging interface, and a high-density 50-pin connector provides access to the microcontroller's multiplexed differential ADC with a built-in temperature sensor, comparators, digital I/O, I2C, SPI, UART ports (one RS232 and one TTL level), timers, and counters. Twenty (20) pins on the microcontroller are provided as user configurable pins and can be configured as analog, digital, or any of the other features mentioned above.

The USB1600 also includes an EEPROM which resides on the I2C bus. This provides programmers with 2k (256x8) of storage space in addition to the microcontroller's 64 KB Flash and 4352 bytes of RAM.

The pre-installed software allows the USB1600 to transfer data between the USB port and all of the on-board peripherals with no need to write additional code to the device side of the system. To ease installation on the host side, USB drivers and example source codes are supplied,

eliminating the need for prior USB experience. Host side operating systems supported are Linux, WinCE, and WinXP.

A command and control protocol implemented over the USB interface allows direct communication with the on-board peripherals via inport and outport driver calls executed on the host computer. A custom interrupt service routine can be called

directly by the host side USB driver. The USB1600 is USB 2.0 compliant and supports both full-speed (12Mbps) and low-speed (1.5Mbps) transfer rates.

Power for the USB1600 is drawn through either the StackableUSB or Mini-B USB port when connected to a PC. An optional power adapter plug may be included for stand-alone functionality.

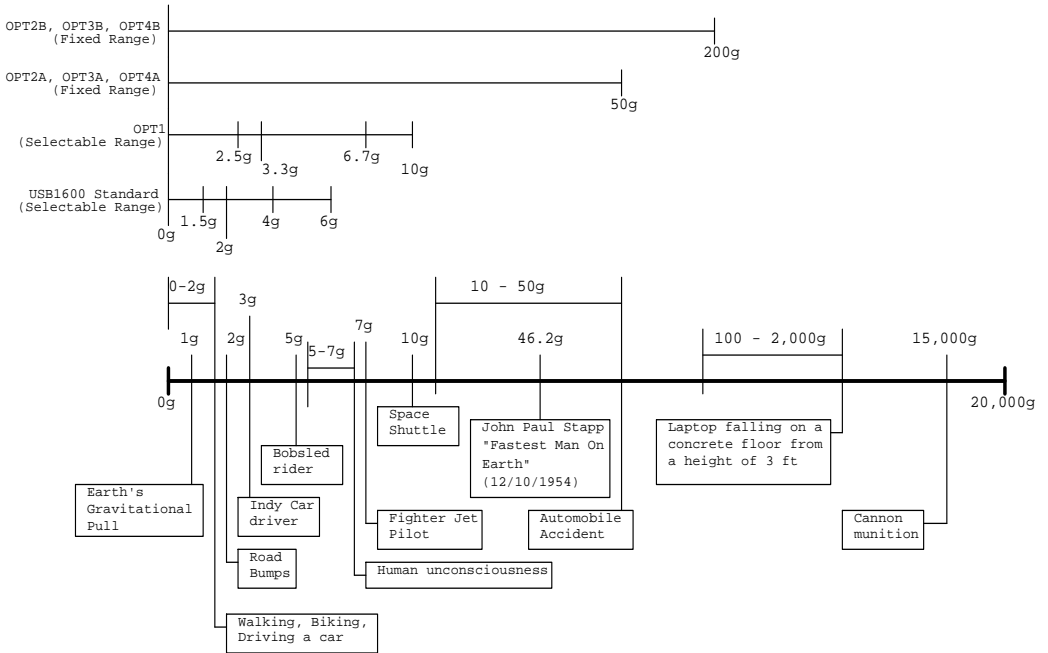


Figure 1.1 USB1600 Sensing Range Chart

Specifications:

Mechanical:

- ❑ 1.85" x 1.78" StackableUSB
- ❑ ¼-Size 104™ Form factor

Power Requirements:

- ❑ +5v ±5%

Power Consumption with Options Installed		
Option	Standard	Sleep Mode
USB1600	38.96 mA	8.47 mA
1600OPT1	+0 mA	+0 mA
1600OPT2A	+4.35 mA	+4.997mA
1600OPT2B	+4.35 mA	+4.997mA
1600OPT3A	+4.35 mA	+4.997mA
1600OPT3B	+4.35 mA	+4.997mA
1600OPT4A	+4.35 mA	+4.997mA
1600OPT4B	+4.35 mA	+4.997mA

Environmental:

- ❑ -40° to +85°C operating temp
- ❑ -40° to +85°C storage temp
- ❑ 5%-95% relative humidity, non-condensing

Accelerometer:

- ❑ Dedicated 12-bit, 250ksp/s, simultaneous sampling ADC (Analog Devices AD7658-1)
- ❑ *Refer to Accelerometer chart*

Processor:

- ❑ 48MHz Silicon Labs C8051F340
- ❑ On-chip debug & development interface
- ❑ Sixteen (16) interrupt sources
- ❑ Nine (9) reset sources
- ❑ Watchdog timer
- ❑ Twenty (20) configurable I/O Pins (5V tolerant)

Analog Peripherals:

- ❑ 10-bit ADC (200ksp/s)
 - Single or differential inputs
 - Built-in temperature sensor
 - External VREF
 - External conversion start trigger
- ❑ Two (2) Comparators

Digital Peripherals:

- ❑ Hardware enhanced SPI
- ❑ SMBus/I2C (Built in 5V pull-up resistors)
- ❑ One (1) RS-232 level UART port
- ❑ One (1) TTL level UART port
- ❑ Four (4) 16-bit general purpose counters/timers
- ❑ 16-bit programmable counter array with five (5) capture/compare modules
- ❑ USB 2.0 Compliant (full-speed or low-speed)

Memory:

- ❑ 4352 bytes RAM
- ❑ 64KB Flash
- ❑ 2K (256x8) EEPROM (on I2C bus)

I/O Interface:

50 Pin I/O Connector B			
Pin	Signal	Signal	Pin
1	RS232_RX0	GND	2
3	RS232_TX0	GND	4
5	P00/SCK	GND	6
7	P01/MISO	P02/MOSI	8
9	GND	GND	10
11	P10/SDA	P11/SCL	12
13	P14	GND	14
15	P15	GND	16
17	P16	GND	18
19	P17	GND	20
21	P20	GND	22
23	P21	GND	24
25	P22	GND	26
27	P23	GND	28
29	P24	GND	30
31	P25	GND	32
33	P26	GND	34
35	P27	GND	36
37	P30	GND	38
39	P31	GND	40
41	P32	GND	42
43	P33	GND	44
45	P34	GND	46
47	P35	GND	48
49	P36	P37	50

Internal Electrical Interface:

- ❑ StackableUSB
- ❑ USB 1.1 & 2.0 compatible, full-speed

Accelerometers:

	USB1600-XX	1600OPT1	1600OPT2	1600OPT3	1600OPT4
Freescale Model	MMA7260QT	MMA7261QT	A= MMA71213EG B= MMA1212EG	A= MMA2202EG B= MMA2301EG	A= MMA2202EG B= MMA2301EG
Sensing Planes	X, Y, Z	X, Y, Z	Z	Y	X
Range	± 1.5g, ± 2g, ± 4g, ± 6g (Selectable)	±2.5g, ±3.3g, ±6.7g, ±10g (Selectable)	A= ± 50g B= ± 200g	A= ± 50g B= ± 200g	A= ± 50g B= ± 200g
Max Acceleration (all axis)	± 5000 g	± 2000 g	±1500g (powered) ±2000g (unpowered)	±1500g (powered) ±2000g (unpowered)	±1500g (powered) ±2000g (unpowered)
Sensitivity	800 mV/g (1.5g) 600 mV/g (2g) 300 mV/g (4g) 200 mV/g (6g)	480 mV/g (2.5g) 360 mV/g (3.3g) 180 mV/g (6.7g) 120 mV/g (10g)	A= 40 mV/g B= 10 mV/g	A= 40 mV/g B= 10 mV/g	A= 40 mV/g B= 10 mV/g
Axis Sensitivity	±0.02 %/°C (x-axis) ±0.01 %/°C (y-axis) ±0.00 %/°C (z-axis)	±0.02 %/°C (x) ±0.01 %/°C (y) ±0.00 %/°C (z)	A= 8 mV/g/V B= 2 mV/g/V	A= 8 mV/g/V B= 2 mV/g/V	A= 8 mV/g/V B= 2 mV/g/V
Bandwidth Response	350 Hz (xy axis) 150 Hz (z axis)	350 Hz (xy axis) 150 Hz (z axis)	400 Hz	400 Hz	400 Hz
RMS noise (.1Hz - 1kHz)	4.7 mVrms	4.7 mVrms	2.8 mVrms	2.8 mVrms	2.8 mVrms
PSD noise (µg/√Hz)	350	350	110	110	110
Operating Voltage	3.3V	3.3V	5V	5V	5V
Operating Current	500µA	500µA	5mA	5mA	5mA
Sleep Current	3µA	3µA	(no sleep function)	(no sleep function)	(no sleep function)

Debug Interface:

10 Pin I/O Connector			
Pin	Signal	Signal	Pin
1	NC	GND	2
3	GND	C2D	4
5	RST#	NC	6
7	RST#/C2CK	NC	8
9	GND	NC	10

External Connectors:

- StackableUSB
- Mini-B USB
- 10-pin development Interface connector
- 50-pin I/O connector

Development Kit:

- Base module
- Complete cable set
- Documentation, schematics, sample software

Ordering Information:

OEM Modules:

USB1600-ST	Accelerometer with Analog & Digital I/O with StackableUSB stack-through connector; X, Y, Z sensing planes; $\pm 1.5g$, $\pm 2g$, $\pm 4g$, $\pm 6g$ software selectable ranges
USB1600-PC	Accelerometer with Analog & Digital I/O with Mini-B USB connector for PC connection; X, Y, Z sensing planes $\pm 1.5g$, $\pm 2g$, $\pm 4g$, $\pm 6g$ software selectable ranges
CS1600	Complete cable set
1600 OPT 1	X, Y, Z sensing planes; $\pm 2.5g$, $\pm 3.3g$, $\pm 6.7g$, $\pm 10g$ software selectable ranges
1600 OPT 2-A	Z axis range $\pm 50g$
1600 OPT 2-B	Z axis range $\pm 200g$
1600 OPT 3-A	Y axis range $\pm 50g$
1600 OPT 3-B	Y axis range $\pm 200g$
1600 OPT 4-A	X axis range $\pm 50g$
1600 OPT 4-B	X axis range $\pm 200g$

Related Products:

STDOFFUSB	StackableUSB standoff kit
BA4051	50-pin breakout cable with DB9 and standard 50-pin header
CA4136	A to Mini-B USB cable
TB50550	50-pin breakout board

Development Board Kits*

DK1600-ST	Accelerometer with Analog & Digital I/O with StackableUSB stack-through connector; X, Y, Z sensing planes; $\pm 1.5g$, $\pm 2g$, $\pm 4g$, $\pm 6g$ software selectable ranges, Windows-ready development kit
DK1600-PC	Accelerometer with Analog & Digital I/O with Mini-B USB connector for PC connection; X, Y, Z sensing planes; $\pm 1.5g$, $\pm 2g$, $\pm 4g$, $\pm 6g$ software selectable ranges, Windows-ready development kit

**See Development Kit Specifications*