USB-2600 Series
16-Bit, 1 MS/s, High-Speed Data Acquisition

Overview
The USB-2600 Series offers high-speed, multifunction data acquisition in a low-cost, board-only design. Each board offers voltage input, digital trigger input, counter input, timer output, digital I/O, and clock input. Analog output is also available on the USB-2627 and USB-2637.

Analog Input
Each USB-2600 Series board has a 16-bit, 1 MS/s ADC coupled with 16 SE analog inputs (USB-2623 and USB-2627), 64 SE analog inputs (USB-2633 and USB-2637). The input range is fixed at ±10 V.

Analog Output (USB-2627/USB-2637)
The four 16-bit, 1 MS/s analog output channels have an output range of ±10 V. The maximum rate at which analog outputs update depends on several factors, including the speed of the USB port. Typically, with the A/D operating at the full 1 MS/s rate, each analog output updates continuously from computer memory at 1 MS/s regardless of the number of channels in a scan.

Digital I/O
The 24 TTL-level digital I/O lines are software selectable for input or output. The typical maximum transfer rate (system paced, asynchronous) is 4,000 8-bit port or single-bit reads/writes per second.

Pull-Up/Down Configuration
Each board has an onboard jumper for configuring the digital I/O lines for pull-up or pull-down (default).

Trigger Input
An external digital trigger input is software selectable for edge sensitive or level sensitive mode.

Features
• 16-bit resolution
• 1 MS/s sample rate
• Up to 64 single-ended analog inputs
• Up to four 16-bit, 1 MS/s analog outputs
• 24 digital I/O lines
• Four 32-bit event counters
• Four timer outputs
• USB powered (no external power required)
• Includes USB cable and standoffs
• Small footprint for OEM and embedded applications

Supported Operating Systems
• Windows® 10/8/7/Vista® XP 32/64-bit
• Linux®
• Android™

Counter Input
Four 32-bit counters are included in USB-2600 Series devices. Each counter accepts frequency inputs up to 20 MHz.

Timer Output
Four pulse width modulation (PWM) timer outputs can generate a square wave with a programmable frequency in the range of 0.015 Hz to 32 MHz.

External Clock I/O
One external clock input is provided for pacing analog inputs. The USB-2627 and USB-2637 also have an external clock input for pacing analog outputs.

USB-2600 Series Selection Chart

<table>
<thead>
<tr>
<th>Model</th>
<th>Analog Inputs</th>
<th>Sample Rate</th>
<th>Analog Outputs</th>
<th>Digital I/O</th>
<th>Counters</th>
<th>Timer Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB-2623</td>
<td>16 SE (16-bit)</td>
<td>1 MS/s max</td>
<td>0</td>
<td>24</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>USB-2627</td>
<td>16 SE (16-bit)</td>
<td>1 MS/s max</td>
<td>4</td>
<td>24</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>USB-2633</td>
<td>64 SE (16-bit)</td>
<td>1 MS/s max</td>
<td>0</td>
<td>24</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>USB-2637</td>
<td>64 SE (16-bit)</td>
<td>1 MS/s max</td>
<td>4</td>
<td>24</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
USB-2600 Series

Features

Calibration
The USB-2600 Series is factory-calibrated using a NIST-traceable calibration process. Specifications are guaranteed for one year. The USB-2600 Series also supports field calibration for users to calibrate the device locally with the InstaCal utility.

Signal Connections
All signals are available from the 68-pin SCSI connectors or the four header connectors. The headers also provide two additional timer outputs, and an additional 48 SE analog inputs on the USB-2633 and USB-2637. Use a C40FF-x or custom cable for header connections.

TB-100 Screw Terminal Board
The optional TB-100 screw terminal board connects directly to the SCSI connector using a CA-68-xx ribbon cable. The TB-100 provides access to 16 SE analog inputs, up to four analog outputs, 24 digital I/O, and all counters/timers. When using the TB-100 with the USB-2633 and USB-2637, access to the remaining 48 SE analog inputs is available through the 40-pin header connectors.

TB-103 Screw Terminal Board
The optional TB-103 screw terminal board connects directly to the 40-pin headers on a USB-2600 Series board, and secures to the board with the included stand-offs. The TB-103 provides access for up to 64 SE analog inputs (when using a USB-2633 or USB-2637), up to 4 analog outputs (when using a USB-2627 or USB-2637), 24 digital I/O and all counters/timers.

USB-2600 Series Block Diagram

USB-2637 connected to TB-103 screw-terminal board.
# USB-2600 Series Software

## Software Support
USB-2600 Series devices are supported by the software in the table below.

<table>
<thead>
<tr>
<th>Ready-to-Run Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAQami™</strong></td>
</tr>
<tr>
<td><strong>InstaCal™</strong></td>
</tr>
<tr>
<td><strong>TracerDAQ™ and TracerDAQ Pro</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>General-Purpose Programming Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Universal Library™ (UL) for Windows</strong></td>
</tr>
<tr>
<td><strong>UL for Linux®</strong></td>
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<tr>
<td><strong>UL for Android™</strong></td>
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</table>

<table>
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<tr>
<th>Application-Specific Programming Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ULx for NI LabVIEW™</strong></td>
</tr>
<tr>
<td><strong>DASYLab®</strong></td>
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</tbody>
</table>
USB-2600 Series

Specifications

Specifications
All specifications are subject to change without notice. Typical for 25 °C unless otherwise specified.

Analog Input
A/D converter (ADC) type: Successive approximation; 16-bit resolution
Number of channels
USB-2623/USB-2627: 16 SE
USB-2633/USB-2637: 64 SE
Input voltage range: ±10 V
Absolute maximum input voltage
C1x relative to AGND: ±25 V max (power on), ±10.5 V max (power off)
Input impedance: 1 GΩ (power on), 390 Ω (power off)
Input bias current: ±100 pA
Input bandwidth: Small signal (~3 dB): 3.1 MHz
Input capacitance: 40 pF
Maximum working voltage: ±10.1 V max relative to AGND
Crosstalk
Adjacent channels, DC to 10 kHz: ~80 dB
Input coupling: DC
Sample rate: 0.0149 S/s to 1,000 S/s; software selectable
Trigger source: TTLTRG
A/D pacing: Internal input scan clock, external input scan clock (XAPCR)
Burst mode: Burst rate = 1 µs, software selectable,
Throughput
Software paced: 33 S/s to 4,000 S/s typ; system dependent
Hardware paced: 1 MS/s max
Channel queue
USB-2623/USB-2627: Up to 16 element list of random channels
USB-2633/USB-2637: Up to 64 element list of random channels
Warm-Up Time: 15 minutes min

Accuracy
Analog Input DC Voltage Measurement Accuracy
Range: ±10 V
Gain error (% of reading): 0.031
Offset error: 915 µV
INL error (% of Range): 0.0076
Absolute accuracy at full scale: 4775 µV
Gain temperature coefficient (% reading/°C): 0.0013
Offset temperature coefficient (µV/°C): 35

Noise Performance
For peak-to-peak noise distribution test, the input channel connects to AGND at the input terminal block, and 32,000 samples are acquired at the maximum throughput.
Range: ±10 V
Counts: 8
LSB rms: 1.21

Settling Time for Multichannel Measurements
Range: ±10 V
1 µs settling accuracy (% FS): 0.0152
5 µs settling accuracy (% FS): 0.0061
10 µs settling accuracy (% FS): 0.0015

Analog Input/Output Calibration
Recommended warm-up time: 15 minutes min
Calibration method: Self-calibration (firmware)
Calibration interval: 1 year (factory calibration)
AI calibration reference: 5 V, ±2.5 mV max. Measured values stored in EEPROM.
Tempco: 5 ppm/°C max
Long term stability: 15 ppm/1,000 hours
AO calibration procedure (USB-2627/USB-2637 only): Analog output pins internally routed to the analog input circuit. For best results, disconnect any XDACx connections at the I/O connectors before performing AOUT calibration.

Analog Output (USB-2627/USB-2637 Only)
Number of channels: 4; leave unused analog output channels disconnected.
Resolution: 16 bits
Output ranges (calibrated): ±10 V
Output transient
Host computer is reset, powered on, suspended, or a reset command is issued to the device (analog outputs default to 0 V)
Duration: 100 ms
Amplitude: 2 V p-p
Power Off
Duration: 100 ms
Amplitude: 5 V peak
Differential nonlinearity: ±0.25 LSB typ, ±1 LSB max
Output Current
XDACx pins: ±3.5 mA max
Output short-circuit protection
XDACx connected to AGND: Unlimited duration
Output coupling: DC
Power on and reset state
DACs cleared to zero-scale: 0 V, ±150 mV
Pacer source: Internal output scan clock and external output scan clock (XDPACR), independent of external input scan clock (XAPCR)
Trigger sources: TTLTRG (refer to the "External trigger" specifications below)
Output update rate: 1 MS/s max; not affected by the number of scan channels
Settling time to rated accuracy, 10 V step: 2 µs
Slew rate: 20 V/µs
Throughput
Software paced: 33 S/s to 4,000 S/s typ, system-dependent
Hardware paced: 1 MS/s max, system-dependent

Calibrated Absolute Accuracy
Range: ±10 V
% of reading: ±0.0183
Offset: ±1.831
Offset Tempco: 12.7 µV/°C
Gain Tempco: 13 ppm of range/°C

Relative Accuracy (±LSB)
Range: ±10 V
Relative Accuracy (INL): 4.0 typ

Digital Input/Output
Digital type: TTL
Number of I/O: 24
Configuration: Three banks of 8. Bit-configurable as input or output.
Pacer source: Internal output scan clock and external output scan clock (XDPACR), independent of external input scan clock (XAPCR)
Digital I/O transfer rate (system paced, asynchronous): 33 to 4,000 port reads/writes or single bit reads/writes per second typ; system dependent.
Input high voltage: 2.0 V min, 5.0 V absolute max
Input low voltage: 0.8 V max, 0 V recommended min
Output high voltage: 4.4 V min (IOH = 50 µA), 3.76 V min (IOH = –24 mA)
Output low voltage: 0.1 V max (IOL = 50 µA), 0.44 V max (IOL = 24 mA)
Output current: 60 mA max, not to exceed 24 mA for one bit, resulting in 2.5 mA max when all 24 bits are enabled.

External Trigger
Trigger source: TTLTRG
Trigger mode: edge or level sensitive, rising or falling edge, high or low level
Trigger latency: 1 µs + 1 clock cycle max
Trigger pulse width: 100 ns min
Input type: 33 Ω series resistor and 49.9 kΩ pull-down to GND
Input high voltage: 2.2 V min, 5.5 V absolute max
Input low voltage: 1.5 V max, –0.5 V absolute min, 0 V recommended min

External Clock
Terminal names: XAPCR, XDPACR
Terminal types: Input, active on rising edge
Terminal descriptions: Receives pacer clock from external source
Input clock rate: 1 MHz max
Clock pulse width: 100 ns min
Input type: 33 Ω series resistor, 47 kΩ pull-down to GND
Input high voltage: 2.2 V min, 5.5 V absolute max
Input low voltage: 1.5 V max, –0.5 V absolute min, 0 V recommended min
USB-2600 Series

Ordering

Counter
Number of channels: 4 channels
Resolution: 32-bit
Counter type: Event counter
Input type: 33 kΩ series resistor, 47 kΩ pull-down to GND
Counter read/writes rates (software paced): 33 to 8,000 reads/writes per second
  - Input voltage: 2.2 V min high, 1.5 V max low
  - Input frequency: 20 MHz max
  - High/low pulse width: 25 ns min

Input low voltage: maximum input voltage range: –5 V to +10 V max
+VO output voltage range: 4.25 V to 5.25 V
+VO output current: 10 mA max

Power
Supply current: Quiescent current: 360 mA; includes up to 10 mA for the LED; does not include potential loading of the DIO bits, +VO pin, or XDACx outputs.

–5 V to +10 V max
+VO output voltage range: 4.25 V to 5.25 V
+VO output current: 10 mA max

Internal clock frequency: 64 MHz
Register widths: 32-bit
High pulse width: 10.42 ns, min
Low pulse width: 10.42 ns, min
Output high voltage: 4.4 V min (IOH = –50 µA)
3.76 V min (IOH = –1.0 mA)
Output low voltage: 0.1 V max (IOL = 50 µA), 0.44 V max (IOL = 1.0 mA)
Output waveform: Square wave
Output rate: 64 MHz base rate divided by 2^n; software selectable.

Environmental
Operating temperature range: 0 °C to 55 °C max
Storage temperature range: –40 °C to 85 °C max
Humidity: 0% to 90% non-condensing max

Order Information

Hardware

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB-2623</td>
<td>USB-based DAQ device with 16 SE analog inputs, 1 MS/s throughput; 24 digital I/O lines; four 32-bit counter input channels; and four timer outputs.</td>
</tr>
<tr>
<td>USB-2627</td>
<td>USB-based DAQ device with 16 SE analog inputs, 1 MS/s throughput; 4 analog outputs, 24 digital I/O lines; four 32-bit counter input channels; and four timer outputs.</td>
</tr>
<tr>
<td>USB-2633</td>
<td>USB-based DAQ device with 64 SE analog inputs, 1 MS/s throughput; 24 digital I/O lines; four 32-bit counter input channels; and four timer outputs.</td>
</tr>
<tr>
<td>USB-2637</td>
<td>USB-based DAQ device with 64 SE analog inputs, 1 MS/s throughput; 4 analog outputs, 24 digital I/O lines; four 32-bit counter input channels; and four timer outputs.</td>
</tr>
</tbody>
</table>

Software also Available from MCC

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAQami</td>
<td>Data acquisition companion software for acquiring data and generating signals</td>
</tr>
<tr>
<td>TracerDAQ Pro</td>
<td>Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version</td>
</tr>
<tr>
<td>DASYLab</td>
<td>Icon-based data acquisition, graphics, control, and analysis software</td>
</tr>
</tbody>
</table>

Accessories & Cables

<table>
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<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB-100</td>
<td>Termination board with screw-terminals; connects via a CA-68-3R, CA-68-3S, or CA-68-6S cable</td>
</tr>
<tr>
<td>TB-103</td>
<td>Termination board with screw terminals; mates directly with the USB-2600 Series; includes mounting stand-offs</td>
</tr>
<tr>
<td>CIO-MINI40</td>
<td>40-pin universal screw-terminal board</td>
</tr>
<tr>
<td>CA-68-3R</td>
<td>68-conductor ribbon cable, 3 ft.</td>
</tr>
<tr>
<td>C40FF-x</td>
<td>40-conductor ribbon cable, female to female, available in 2 ft. to 50 ft.</td>
</tr>
</tbody>
</table>

The TB-103 termination board mounts directly onto a USB-2600 Series board

The TB-100 termination board connects to a USB-2600 Series board with a ribbon cable