

asyn Driver Tutorial and Demo

Measurement Computing 1608GX-2A0

Mark Rivers

University of Chicago

Measurement Computing Corporation

- Inexpensive I/O devices
- PCI, USB, Ethernet
- Example USB devices
 - DAQ module with 8 analog inputs, up to 12-bit resolution, 50 kS/s, two D/A outputs, and 16 digital I/O lines \$189.00
 - 8-channel quadrature encoder device (differential or single-ended) \$599.00
 - 8-channel electromechanical relay interface device \$249.00
 - 8-channel thermocouple input module \$329.00
 - 16-channel, 500 kS/s device with two analog outputs, eight DIO lines, two 32-bit counter inputs, and one timer output \$799.00
 - 10-channel, 16-bit, high-performance 9513-based counter/timer device \$349.00
- I've purchased the last 2 (USB-1608GX-2A0, and USB-4303) and written EPICS drivers for them



USB-1608GX-2A0 (\$799)

- 16-bit analog inputs
 - 16 single-ended channels or 8 differential channels
 - Programmable per-channel range: $\pm 1\text{V}$, $\pm 2\text{V}$, $\pm 5\text{V}$, $\pm 10\text{V}$
 - 500 kHz total maximum input rate, i.e. 1 channel at 500 kHz, 8 channels at 62.5 kHz, etc.
 - Internal or external trigger. External trigger shared with analog outputs.
 - Internal or external clock, input and output signals.
 - 4 kSample input FIFO, unlimited waveform length
- 16-bit analog outputs
 - 2 channels, fixed $\pm 10\text{V}$ range
 - 500 kHz total maximum input rate, i.e. 1 channel at 500 kHz, 2 channels at 250 kHz
 - Internal or external trigger. External trigger shared with analog inputs.
 - Internal or external clock, input and output signals
 - 2 kSample output FIFO, unlimited waveform length

USB-1608GX-2A0 (\$799)

- Digital inputs/outputs
 - 8 signals, individually programmable as inputs or outputs
- Pulse generator
 - 1 output
 - 64MHz clock, 32-bit registers
 - Programmable period, width, number of pulses, polarity
- Counters
 - 2 inputs
 - 20 MHz maximum rate, 32-bit registers

Measurement Computing EPICS Support

- They provide a nice Windows library for all of their devices. Very few calls to get a lot of functionality.
- Some of their older devices have Linux support from Dr. Warren J. Jasper at NCSU:
 - <ftp://lx10.tx.ncsu.edu/pub/Linux/drivers>
- Measurement Computing have recently released drivers for a few new devices (including USB-1608G) using a new open-source message based driver, with support for Linux, Mac and Windows.
 - However, the driver is written in C#, and so to use it on Linux requires the “mono” compiler for Linux. I don’t think one can call it from gcc/g++, but I am not sure.
 - The C# driver is open-source, so it should definitely be possible to rewrite it in C++.
- For now my drivers use the Windows-only library, as will the example drivers to be presented today.

USB-1608GX-2AO EPICS Support

- Based on asynPortDriver
- Standard asyn device support
- 1250 lines of code
- Digital I/O
 - 8 bi records, 8 bo records, longin, longout
- Pulse generator
 - Control of pulse period (frequency), width, count, polarity
- Analog input
 - ai records, periodically scanned. Programmable range per channel.
- Analog output
 - ao records

USB-1608GX-2AO

EPICS Waveform Generator Support

- Global control
 - Internal/external trigger
 - Internal/external clock
 - Retrigger, retrigger count
 - Continuous/one-shot (hardware)
- Predefined waveforms (defined in driver, not by device)
 - Types
 - Sin wave
 - Square wave
 - Sawtooth
 - Pulse (adjustable width)
 - Random (white noise)
 - Control
 - Number of points in waveform
 - Repeat frequency (or time per point)
 - Amplitude
 - Offset

USB-1608GX-2AO

EPICS Waveform Generator Support

- User-defined waveforms (arbitrary waveform generator)
 - Waveforms defined by external application (e.g. Matlab, IDL, Python) and downloaded to waveform record over Channel Access
 - Control
 - Number of points in waveform
 - Repeat frequency (or time per point)
- Waveforms are defined in volts, not device units
- 16-bit output, maximum 500,000 output voltages/s
- Only limit on number of points is available RAM.

USB-1608GX-2AO

EPICS Waveform Digitizer Support

- Control
 - Number of points to digitize
 - Time per point
 - First channel to digitize
 - Number of channels to digitize
 - Burst mode (all channels measured as close together in time as possible)
 - Internal/external trigger
 - Internal/external clock
 - Retrigger, retrigger count
 - Continuous/one-shot (hardware)
 - Auto-restart (software)
 - Read rate to read device into waveform records. Automatically reads when acquisition completes.
- Waveforms are read in volts, not device units
- 16-bit input, maximum 500,000 conversions/s
- Only limit on number of points is available RAM.

USB-1608GX-2A0 Tutorial

- Will present 5 simplified versions of driver, building feature-by-feature
 - V1: 2 simple analog outputs
 - V2: Add 2 simple analog inputs
 - V3: Add digital outputs
 - V4: Add digital inputs; poller thread
 - V5: Add pulse generator output, counter inputs
 - Full version: Add waveform generators, waveform digitizers, and trigger control.