asyn Driver Tutorial and Demo

Measurement Computing 1608GX-2A0

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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, USB-4303, USB-CTR04/08) 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: +-1V, +-2V, +-5V, +-10V
  - 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 +-10V 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.