Drivers for Measurement Computing Ethernet Devices on Linux

Mark Rivers

GeoSoilEnviroCARS, Advanced Photon Source

University of Chicago

Motivation

- Measurement Computing offers many unexpensive I/O devices
- EPICS measComp module has been available for several years with drivers for many of these.
- Limited to Windows because the vendor "Universal Library" is Windows only.
- Most devices were USB, which has length limitations.
- They have begun to introduce more Ethernet devices
- Open source Linux drivers for many modules are available from Warren Jaspers at North Carolina State University (https://wjasper.github.com)
- Seemed like a good idea to provide EPICS support for Linux

Solution for Linux

- Use Warren Jasper drivers at the low-level
- Write a thin wrapper layer that emulates the vendor "Universal Library" on Linux.
  - This calls Jasper's drivers
- The EPICS drivers thus always use the UL API and are identical on Linux and Windows.
- The Linux UL emulation layer is independent of EPICS
  - Uses std::thread and std::mutex to provide the required threading and mutex capabilities.
  - These methods require C++11, and so will not build with very old compilers.
  - They do build with gcc 4.8.5 (e.g. RHEL 7/Centos 7), and gcc 4.4.7 (e.g. RHEL 6/Centos 6).
- Currently the E-1608, E-TC, and E-TC32 models are supported on Linux.
- Support for other modules is straightforward to add and can be done as the need arises.
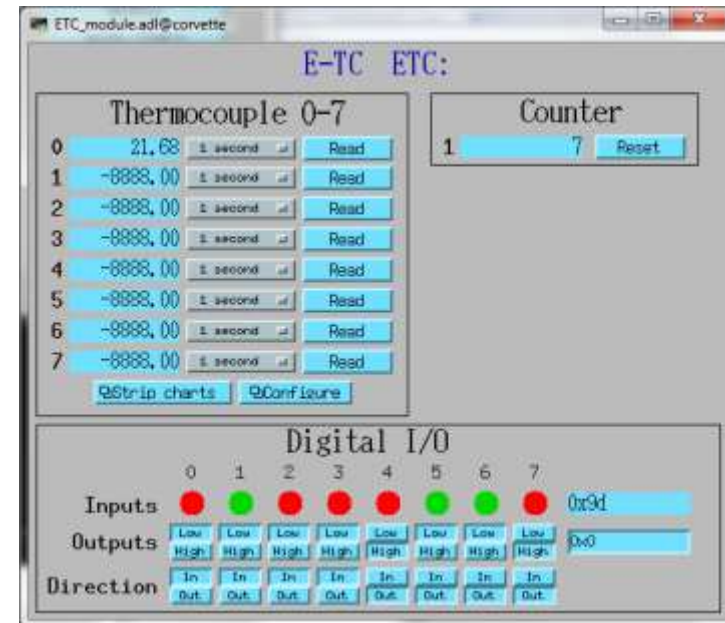
E-1608 ($525)

- Ethernet interface

- 16-bit analog inputs

  - 8 single-ended channels or 4 differential channels

  - Programmable per-channel range: +-1V, +-2V, +-5V, +-10V

  - 250 kHz total maximum input rate.

  - Internal or external trigger.

  - Internal or external clock for input signals.

  - Input FIFO, unlimited waveform length

- 16-bit analog outputs

  - 2 channels, fixed +-10V range

- Digital inputs/outputs

  - 8 signals, individually programmable as inputs or outputs

- Counter

  - 1 input

  - 10 MHz maximum rate, 32-bit register
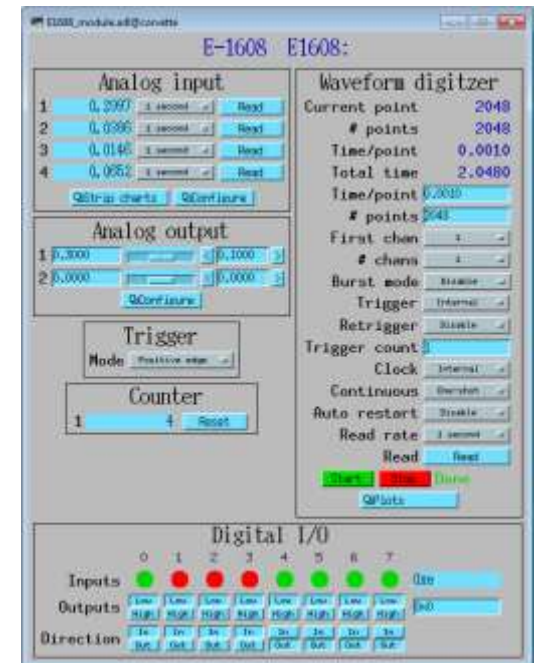
E-TC ($505)

- Ethernet interface
- 8 thermocouple inputs
  - 8 channels with cold-junction compensation. Types J, K, T, E, R, S, B, and N.
  - 4 samples/s.16-bit analog outputs
- Digital inputs/outputs
  - 8 signals, individually programmable as inputs or outputs
- Counter
  - 1 input
  - 10 MHz maximum rate, 32-bit register

TC-32 ($1999)

- Ethernet and USB interfaces, either can be used.

- 32 thermocouple inputs
  - 32 channels with cold-junction compensation. Types J, K, T, E, R, S, B, and N.
  - 3 samples/s if reading all 32 channels, faster if reading fewer.

- Digital inputs
  - 8 digital inputs, switch-selectable pullup resistor

- Digital outputs
  - 32 digital inputs, switch-selectable pullup resistor
  - Each output can either be controlled by software or can be controlled by the alarm status of the corresponding thermocouple. Flexible alarm configuration, i.e. hysteresis.

Future Directions

- Measurement Computing recently introduced their own Universal Library for Linux.

- It is a completely different API than the Universal Library for Windows, so would require new EPICS drivers

- It only supports a small subset of their devices, and does not currently support any Ethernet devices

- My solution is easily extended to any device that Warren Jaspers supports and allows EPICS drivers to work on Linux and Windows.

- APS is using USB devices with Windows now for vibration measurement. E-1608 with Linux is an attractive option for the future.

- These devices are a potential replacement for VME analog and digital I/O on beamlines in the future.