

## Portable Test System Using MCC DAQ and Raspberry Pi® *using USB-1608FS-Plus*

### Introduction

Townsend Engineering Services, Inc. is a consulting company with extensive experience in the design of hardware and software for data acquisition and analysis used in the testing of complex mechanical systems.

### The Challenge

One of our customers, ASET Services, Inc., approached us to design a system to be used in their testing of sports and playground surfaces. Required was a rugged system which could be integrated with their analysis software to control a variety of test configurations and provide data acquisition for analysis. The system would be battery operated to facilitate field testing and provide signal conditioning and data acquisition for a variety of transducers, including LVDTs, load cells and accelerometers. In addition, it would control an electromagnet used to drop a calibrated mass used in many of the tests. A Wi-Fi connection to a laptop computer running the analysis software would be used to control the system and transfer data.

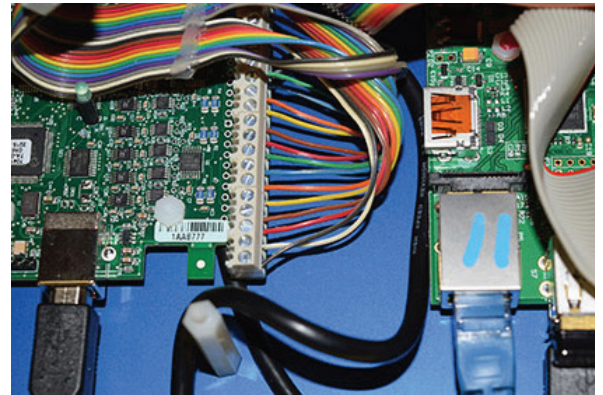
As many as eight transducers would be needed. Sampling rate for most of the tests would be 5 kHz, but up to 20 kHz in some cases. Although not a strict requirement, it was desired to have simultaneous sampling of all channels so that the system could be used for transfer function measurement.

The load cells and accelerometers would be IEPE (Integrated Electronics Piezoelectric) transducers. Current sources as well as anti aliasing filters would be required for those signals. DC type LVDTs were to be used so no special signal conditioning would be necessary for them.

### The Solution

The system was designed around the Raspberry Pi which was used to manage test rig control and data acquisition and communications. This allowed the use of off-the-shelf devices for the DAQ and communications, reducing design cost significantly.

The Measurement Computing [USB-1608FS-Plus](#) device was selected for use in the system because of its good performance, reasonable cost, and low power



*USB-1608FS-Plus simultaneous sampling DAQ device connected to the Raspberry Pi Model B board*

requirements. The USB interface and availability of a C language library were also important factors which simplified integration with the Raspberry Pi. It was possible to achieve 50 kHz simultaneous sampling on all DAQ channels which more than met the requirements for the system.

For maximum flexibility and to allow future modifications, the four inputs used for the LVDTs are in a single cable which connects to a small external box containing the 24v power supply they require. This allows the use of other transducers when necessary by simply providing a different external box which contains any special power supply, signal conditioning, or filtering which might be required.

A Client/Server approach was used for communications with the laptop. The Client runs on the laptop and allows the analysis software to control the system via a Wi-Fi connection to the Server running on the Raspberry Pi. A set of simple server requests handles all operation of the system so it can be easily integrated with the customer's test software.

### Result

The final system consists of the [USB-1608FS-Plus](#), a Raspberry Pi B, and a custom circuit board containing signal conditioning, magnet control, and power

supplies. These are mounted to the back of the unit's front panel containing switches and connectors for the transducers. The completed unit and battery are housed in a sturdy water resistant field case for portability. The system has been in regular use around the world for over a year. System performance and reliability have been excellent.

**Townsend Engineering Services, Inc.**  
513-898-0767  
[www.tesnet.com](http://www.tesnet.com)  
[info@tesnet.com](mailto:info@tesnet.com)

**ASET Services, Inc.**  
812-528-2743  
[www.asetervices.com](http://www.asetervices.com)  
[info@asetervices.com](mailto:info@asetervices.com)

## MCC Product used in this application:



### **16-BIT, 400 KS/S, MULTIFUNCTION USB DATA ACQUISITION DEVICE** **USB-1608FS-Plus**

- 8 single-ended analog inputs
- 16-bit resolution
- Simultaneous sampling (1 A/D converter per input)
- Up to 400 kS/s sample rate (100 kS/s max for any channel), up to 800 kS/s BURSTIO mode
- 8 digital I/O
- 1 event counter
- External digital trigger input
- No external power required
- Included software and drivers