

B.Baldin
P.Gartung,
S.Los
M.Matulik
05/28/2005

FPix Test Electronics Requirements

Introduction

The main purpose of the Test Electronics is to provide continuous and adequate testing of the attached CMS Forward Pixel (FPix) detector modules (Plaquettes, Panels and Blades with Adapter Boards). The detector modules may or may not be placed in environmental chamber. The environmental chamber for burn-in testing is designed to house 10 shelves, which can hold 20 plaquettes (or 10 panels). The duration of the burn-in test will initially be three days. At a production rate of six plaquettes per day, the capacity of the chamber is sufficient to allow a test of this duration. The Test Electronics must allow multiple parallel connections to the detector modules for real-time data taking.

Each connection to the Test Electronics must provide a full set of signals identical to the final system configuration. At this moment, a set of signals for one panel looks suitable as a universal signal interface. For the readout of plaquettes, a small TBM board is proposed as an interface, which will provide necessary signals for a chain of the readout chips (ROCs). This board can be located on each shelf, which will connect to a plaquette that is wire-bonded to a fan-out board. For the readout of panels and plaquettes a small buffer board is needed to convert TBM signals to Test Electronics interface levels. Similar buffer board can be designed to interface with the input connectors of the FPix adapter board. This will allow production testing of the adapter board as well.

With 20 2x5 plaquettes in the chamber, 200 ROC's will need to be tested. At 4160 pixels per ROC, 832000 pixels will need to be tested at a time. Given the large number of pixels to be tested, the readout chain has to be as fast as possible. Taking this consideration into account, data acquisition interface of the Test Electronics must allow sustained trigger rate of several kilohertz.

Main Test Electronics parameters:

- Number of control channels/card - min. 8
- Number of analog channels/card - min. 8
- Signal interface - FPix panel signal set
- Distance between electronics and detector modules - max. 6 ft.
- Analog digitizers and system clock frequency - 40 MHz
- Control interface instant command rate - min. 5 MHz
- Trigger rate for a single channel - max. 10 KHz

VME-Based Test Electronics

We propose to build FPix Test Electronics using well developed industrial standard – VME. VME-based systems are widely used in high-energy physics experiments as well. There is a wide spectrum of commercial modules available on the market that can be used to build such a system. The main component of the Test Electronics FPix Tester Module is a 9U VME card with multiple data acquisition channels. Each channel includes a serial control interface and analog digitizer with attached memory to sample ROC output. A number of channels per card depends on the available front panel space and estimated to be eight (8) or more. For a 20-channel system one will need three such cards. The Tester Module cards will be housed in a commercial 9U-size VME crate with a VME master. The main mode of operation of the FPix Tester Module uses calibration mode of the ROC, but a capability to use external triggers can be implemented as well.

The VME master can be either a commercial VME processor with Ethernet interface or CAEN 2718 VME-bridge. In a latter case, some software developed for the Test Electronics may be used for a final FPix system. There are working VME-based systems at Fermilab, which may be used as a starting point.

Connection to the detector modules will be done via a multi-wire flat cable. In order to avoid difficulties of transferring non-standard signals (a.k.a. LCDS) used by the TBM chips and simplify design of the FPix Tester Module a various buffer boards will be used at the far end of the cable to interface to the detector modules. The buffer board also will allow reliable transfer of the low level TBM analog output to the digitizer.

Tester Module Signal Interface

The following is a list of signals to control a detector module:

- Serial Timing and Control Interface – five differential signals (SDA, CLK, RDA, TRG and RCK)
- Analog Data – one differential signal (AOUT)
- RESET – one single ended signal
- Power supplies +5V/-5V/GND – multiple wires

The necessary 1.8V/2.5V voltages will be generated on the buffer board to reduce number of wires in the interface cable. We estimate that the VME Tester Module can be designed, build and debugged in about six months from the starting date.

Various detector modules and their connection to the Tester Module are shown in Figure 1. For testing Plaquettes in the environmental chamber one TBM chip in a single channel mode can be used to drive two Plaquettes. As one can see, there are six analog outputs on the Cable Adaptor. For production testing of the Cable Adaptor, it is possible to implement analog multiplexer on the Buffer Board to allow switching between six outputs.

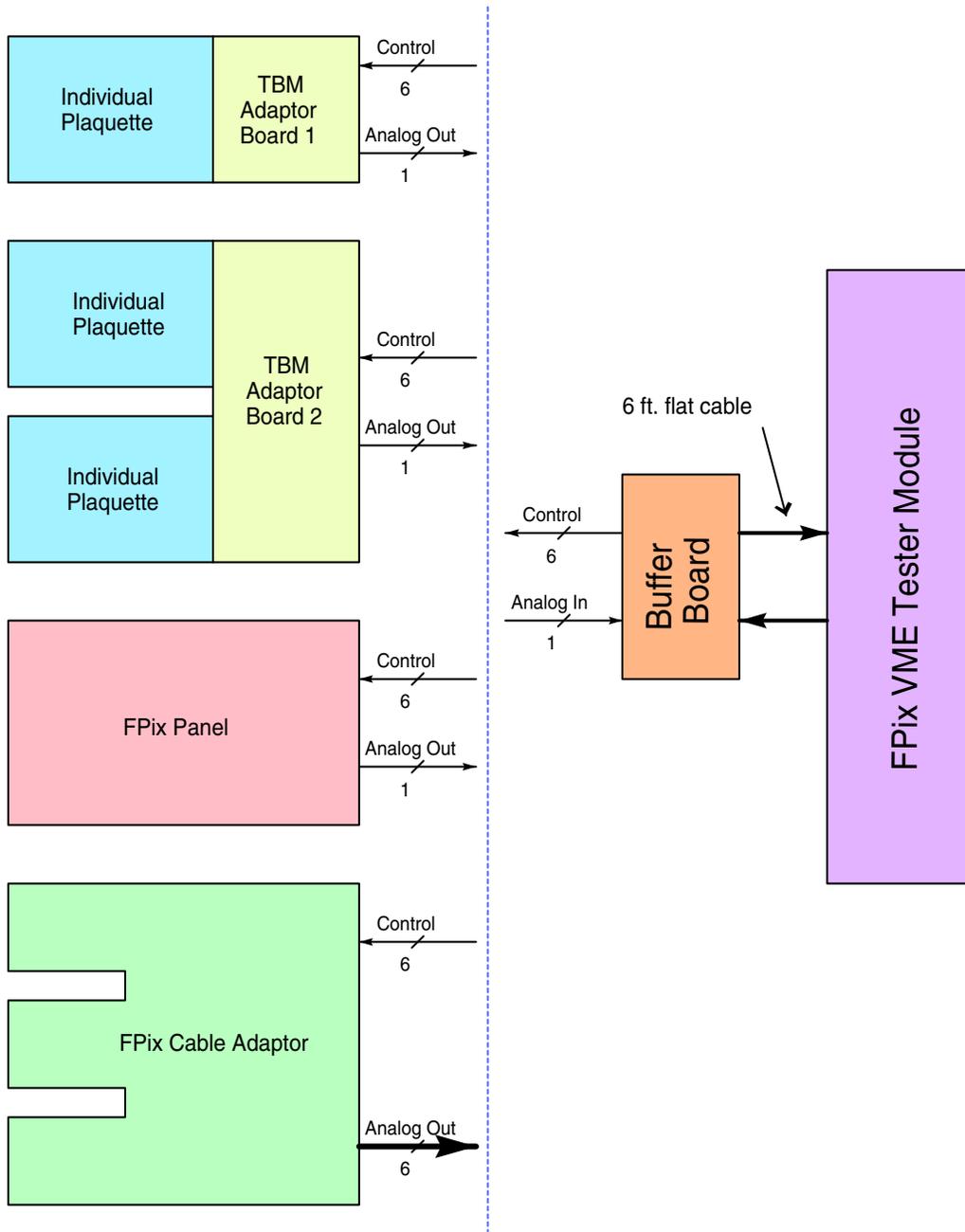


Figure 1 Connection of the Tester Module to various detector modules