Experience with Forward Pixel DAQ Test Bench

Simon Kwan, Ping Tan, Marcos Turqueti

Jul, 2006

Abstract

This is to summarize experience with the Forward Pixel DAQ test bench at SiDet. Step-by-step operation of this bench is also given.

0.1 Forward Pixel Data Acquisation System

Pixel Front-end-digitizer (FED) has been extensively tested by users at PSI, Vanderbilt, and Fermilab. There are some known bugs or some required features are not implemented so far. For system integration, the lack of interface to respond the B-channel commands received and broadcasted by a TTCrx chip is the main problem to achieve fast system control. It makes more difficult to to synchonize the FED with incoming signal from TBM in real operation, since FED does compare the TBM event header with event counter from TTCrx. However, this is promised to have in version four.

In our current system setup, which is described in the following section, we are running the FED in a synchonized system and try to take the incoming real data. We have concentrated on two working modes

- taking incoming data in transparent mode with L1A to enable transparent gate.
- taking incoming data in a normal data-taking, which means only decoded data are put into FIFO-I and all the way to FIFO-III.

We have also tried to use take transparent mode data with a VME write to enable the gate; we played with test DAC. However, these are not our concentration.

0.2 System Setup at SiDet

Here is a historic list of the system setup.

0.3 Operation Procedure

0.3.1 Power On/Off

This is our current procedure to turn on/off the whole system.

1. Power on the pulse generator. Check on the scope for signal. The clock should be ECL signal with a frequency of 40.08 MHz.
2. Power on the VME crate.
3. Connect the power connectors (for both port card and adapter board/panel) to port card. Do a quick visual inspection and make sure every connector and port card is properly insulated.
4. Double check the voltage setting (2.5 V) and current setting (1.0 A). Power on the port card, check for current load (should be about 0.4 A).

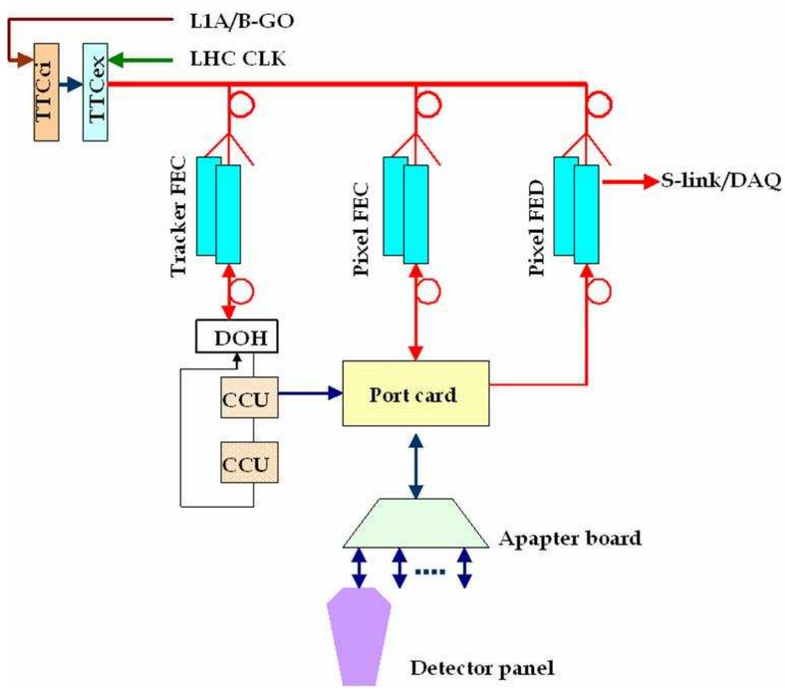

Figure 1: The setup of current system. FED received Clock/L1A/B-channel command from TTCex.

5. Double check the digital voltage/current setting (2.5 V/2.5 A) and analog voltage/current setting (1.6 V/2.0 A). Power on the Adapter Board & Panels, watch for the current load. The load should be about 2.1 A for digital current and about 1.5 for analog current. A variation of 0.2-0.3 A should be in normal.

Here is a guideline to turn off the whole system,

1. Power off adapter board & panels.
2. Power off port card.
3. It is suggested at this moment to disconnect physically above two connectors.
4. Power off VME crate.
5. Power off the pulse generator.

0.3.2 Check System Clock

The whole system should be running with one single clock, the 40.08MHz LHC clock. For the system setup at SiDet, one external clock is used to drive the whole system. This external clock is ECL signal and is feed into "CLK" connector of TTCex.

- There is a LED light "PLL lock" on the front panel of TTCci to indicate if the TTCci is locked to external input clock. In our setup, this external clock is from TTCex. Green is a good sign.
- There is also a LED light ("TTC IN") on the front panel of FEC. In firmware version yyy, an orange color indicates that the FEC is locked to external clock from TTC. In firmware version xxx, green light shows the FEC is locked to external clock from TTC.
- There is no QPLL on the Pixel FED board. If the LED light next to the TTC input fibre is green, it shows that the FED is operating with the external TTC clock.

Before any test, always try to make sure the whole system is synchonized. Otherwise, you may run into many problems. After power on the detector, the TTCci might not be locked to external clock. Check the external clock and make sure it is at 40.08 MHz, then proceed to the next step to initialize the system. Check again once the initialization. If problem still exists, ask for help.

0.3.3 System Initialization

0.4 Power Supply

In the real detector operation, the detector is powered by CAEN power supply modules located about 40 meters away from the detector area.

0.5 Test Results

0.5.1 Characteristics of AOH

Temperature Calibration

We have checked the correlation between the enviroment temperature and the AOH on-chip temperature, of which the latter is measured by gluing a xxx RTD on the laser diode. Figure 2 shows the results. A straight line is fitted to the data, which is used to obtain the temperature of the laser diode basing on the enviroment temperature. This also suggested about 16 °C temperature difference between laser diode to enviroment temperature. Note that all these measurements are performed with a 26 mA bias current on the laser.

We also checked the temperature dependence with respect to the bias current of the laser diode. Figure 3 shows the results, where we measured the

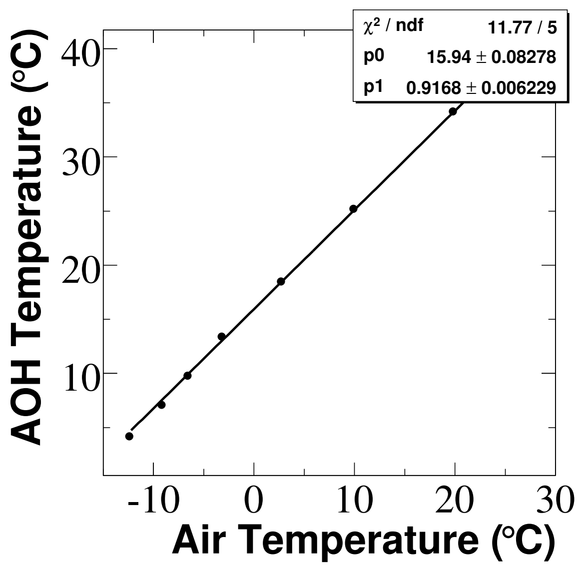

Figure 2: The temperature correlation between the laser diode and the enviroment temperature. Figure 3 shows the result, we checked the correlation at two difference laser

temperature of the laser diode with respecting to the bias current at two different air temperature. Both are fitted to a straight line. The slope of these two is about 0.1.

From above results, we can conclude that the laser diode tempeature is about 13 $\circ C$ higher than enviroment temperature. The temperature of the laser diode is increased with bias current at a rate of about 0.1 °C/mA.

Laser Diode Photon Efficiency

We then measure the output photon of the laser diode with respecting to the bias current at different enviromental temperatures, ranging from room temperature to -12 °C. We have calculated the laser diode temperature (at zero bias current) basing above results, which are used to label each measurement. Keep in mind that the laser diode change it's temperature by about 2 °C/mA for each curve. The results are shown in Figure 4 and Figure 5.

For each temperature, we have decided to use the data points between 18 mA to 30 mA to fit to a straight line. The slope of the fitted results are then used as the photon efficiency (in unit mW/mA), and the interception with x axis is defined as the threshold current. The fitted line is then extended to the low bias current region. Above the threshold, very good linearity is shown at all temperature range. Slight non-linearity is shown at the low bias current. The threshold current found is about 3 mA.

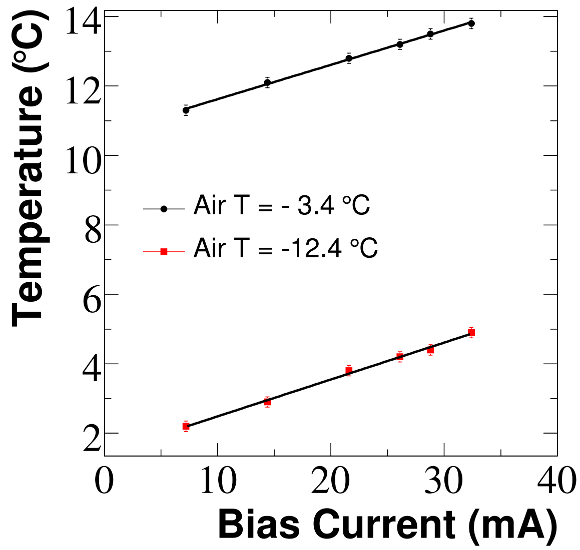

Figure 3: The dependence of the laser diode temperature on the bias current.

The fitted results are shown in Table 1 and Figure 6. The photon efficiency changed by about 30down to -10°C. It has the trend that this efficiency is less temperature-sensitive at -10°C. However, this has to be confirmed by more data points at low temperature.

0.6 Known Problems

0.7 Ongoing Work

Detectors, CMS internal note 2005/xxx.

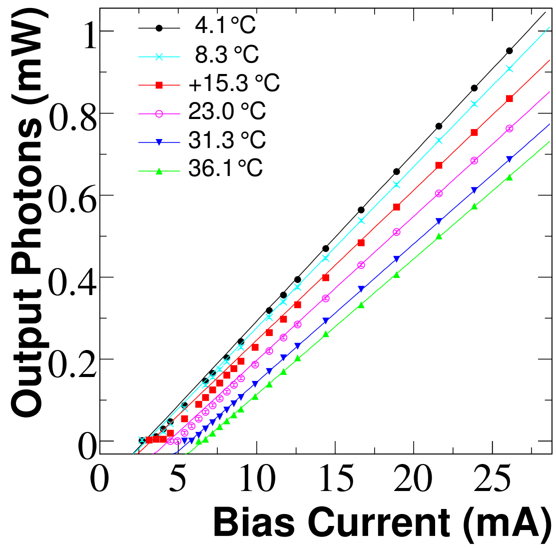

Figure 4: .

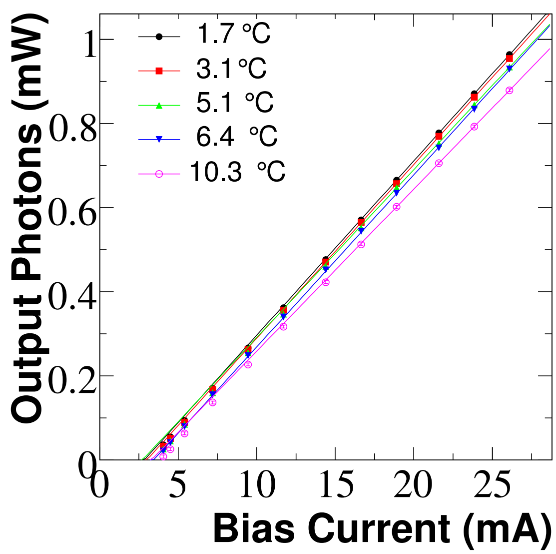

Figure 5: .

ntb

Air Temperature (°C)	Laser Temperature (°C)	Photon Eff. (10^{-2}mW/mA)	Interception (mW)
-10.0	4.1±0.4	4.10±0.07	-0.118±0.015
-5.40	8.3±0.4	3.93±0.07	-0.117±0.015
2.2	15.3±0.4	3.66±0.07	-0.120±0.015
10.6	23.0±0.4	3.51±0.07	-0.154±0.015
19.7	31.3±0.4	3.37±0.07	-0.194±0.015
24.9	36.1±0.4	3.31±0.07	-0.218±0.015
-12.6	1.7±0.4	4.15±0.07	-0.118±0.015
-11.1	3.1±0.4	4.13±0.07	-0.124±0.015
-9.0	5.1±0.4	3.99±0.07	-0.108±0.015
-7.5	6.4±0.4	4.09±0.07	-0.140±0.015
-3.3	10.3±0.4	3.85±0.07	-0.127±0.015

Table 1: The photon efficiency at different laser diode temperature.

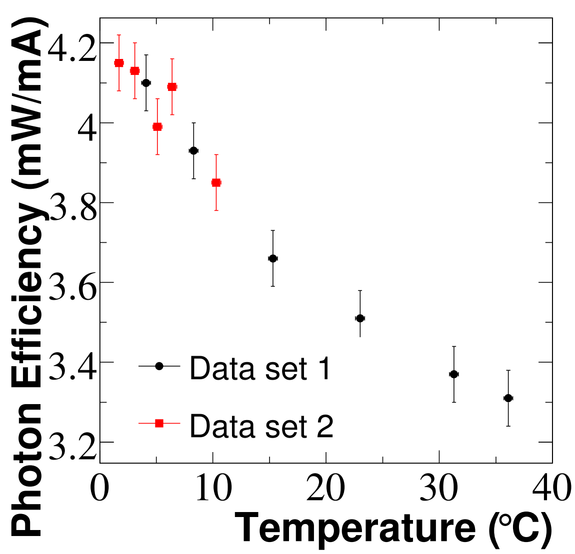

Figure 6: . The photon efficiency at different laser temperature.