SPS High Bandwidth Transverse Feedback System MD

Troubleshooting aliased lines seen in the ADC

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1. At CERN during LS1 to make several measurements with the feedback system. There were two goals for this trip, identify the noise floor in the two digitizer systems and try to identify where the aliased lines seen the spectrograms from the ADC snap shot memory and Tek scope originate from.
  - a) The noise floor measurements will try to quantify the dynamic range for the ADC and the Tek scope. Also, we would like to quantify the additive noise detected from the receiver chain (amplifiers, equalizer, etc.) relative to without the receiver chain.
  - b) The alias lines seem to have independent sources for each system. Start with the ADC measurements here. Tek scope measurements were not performed.
2. Setting up the feedback system since being shutdown in February
  - a) Measure trigger levels
    - i. Injection: 600 mV_p , $12 \mu\text{s}$
    - ii. Revolution: 600 mV_p , 5 ns
    - iii. Synchronized clock: 1.6 GHz , 2.6 V_{pp} (just over 10 dBm)
  - b) Power feedback system.
    - i. FPGA loads firmware from memory stick. MMCMs locked
    - ii. Monitor fiducial via Strobe 4. Looks good.
    - iii. Design a pass through FIR filter in Matlab. (This should not be necessary, but as we realized during the February MD, if no filter is loaded and the snap shot tool is used, it will crash the software. John D edited this in a subsequent version of the firmware, but I have not implemented that new firmware to the feedback system. I am currently using version 3.4.)
    - iv. Load filter, ready to acquire snap shots.
      - A. Number of turns before record: 1
      - B. Turns to read: 20k
3. Measurements. First will measure the system with the ADC input terminated at 50Ω at the front panel. From here, the measurements progress to try to narrow down the origin of the signal. Files saved and a description of the system setup are in Table 1.

Table 1: Data files acquired during feedback tests on Mar. 22, 2013 to diagnose to source of noise observed in the spectrograms. Aliased Line Obs. refers to whether the aliased line was seen in the spectrogram produced upon analysis at the time of measurement.

Snapshot File	Aliased Line Obs.?	System Setup
1237	Y(0.196)	50 Ω termination at ADC input on chassis, line at 0.196
1255		
1419		
1420		
1421		
1422		
1433	N	Disconnect cable inputs to each ADC card and terminate inputs with 50 Ω
1434		
1435		
1436		
1437	N	
1450	Y(0.19)	Reconnect cables to both ADC cards. Terminate with 50 Ω ADC input again at front panel
1451		
1452		
1453		
1454	Y	
1652	Y	Place ferrite cores around input signals to both ADC cards
1657	Y	Remove ferrite cores. Terminate ADC # 1 at card. Front panel terminated as well.
1703	N	Terminate ADC #2 at card. Front panel terminated as well.
1714	N	Connect input line of card #2 to card #1, card #2 terminated, line #1 terminated
1719	N	
1723	Y	Connect input line of card #1 to card #2, card #1 terminated, line #2 terminated
1732	Y	On card #2, input cable #1 to INN, INP terminated
1750	Y	Powered down FB system. Place ferrite cores on card #2 Vfan power cables, input cable #1 to INP, INN terminated
1754	Y	Insert DC block to INP on card #2
1759	N	Disconnect input cable #1 from splitter circuit
1801	N	Attach input cable #1 to chassis (at BNC connector on chassis back plane), no termination on other side of BNC
1804	Y	Terminate other side of BNC
1807	N	Disconnect input cable #1 from BNC connector, but terminate end of line

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Table 1 – continued from previous page

Snapshot File	Aliased Line Obs.?	System Setup
1813	Y	Wolfgang notices that the RST clock on card #2 has extender connectors that are zip tied to the chassis, potentially causing a ground loop. Card #1 does not have these extenders, cut zip ties and pull connectors away from chassis, reconnect input cable #1 to BNC connector on back plane and terminate
1817	N	Remove termination from BNC
1830	N	Remove DC block, remove cable from BNC, terminate cable

- a) It definitely looks like ADC card #2 is picking up some kind of noise from within the box, when the cable is connected to the input port and the other end of the cable is connected to the chassis and has 50Ω load (as in the operational case). It's interesting though, that if the cable is not terminated (open), the aliased line is gone.
- b) At this point, we are still not sure of the cause of the induced noise. But, since it seems internal, and not connected to the triggering system at the SPS, this is not a lab bench troubleshooting project.
- c) We should continue these measurements when the hardware is shipped back to SLAC in the near future. These notes should be used as a starting point, to see if the conditions above can be setup and the observations reproduced.