



More on Echotek Board Setup

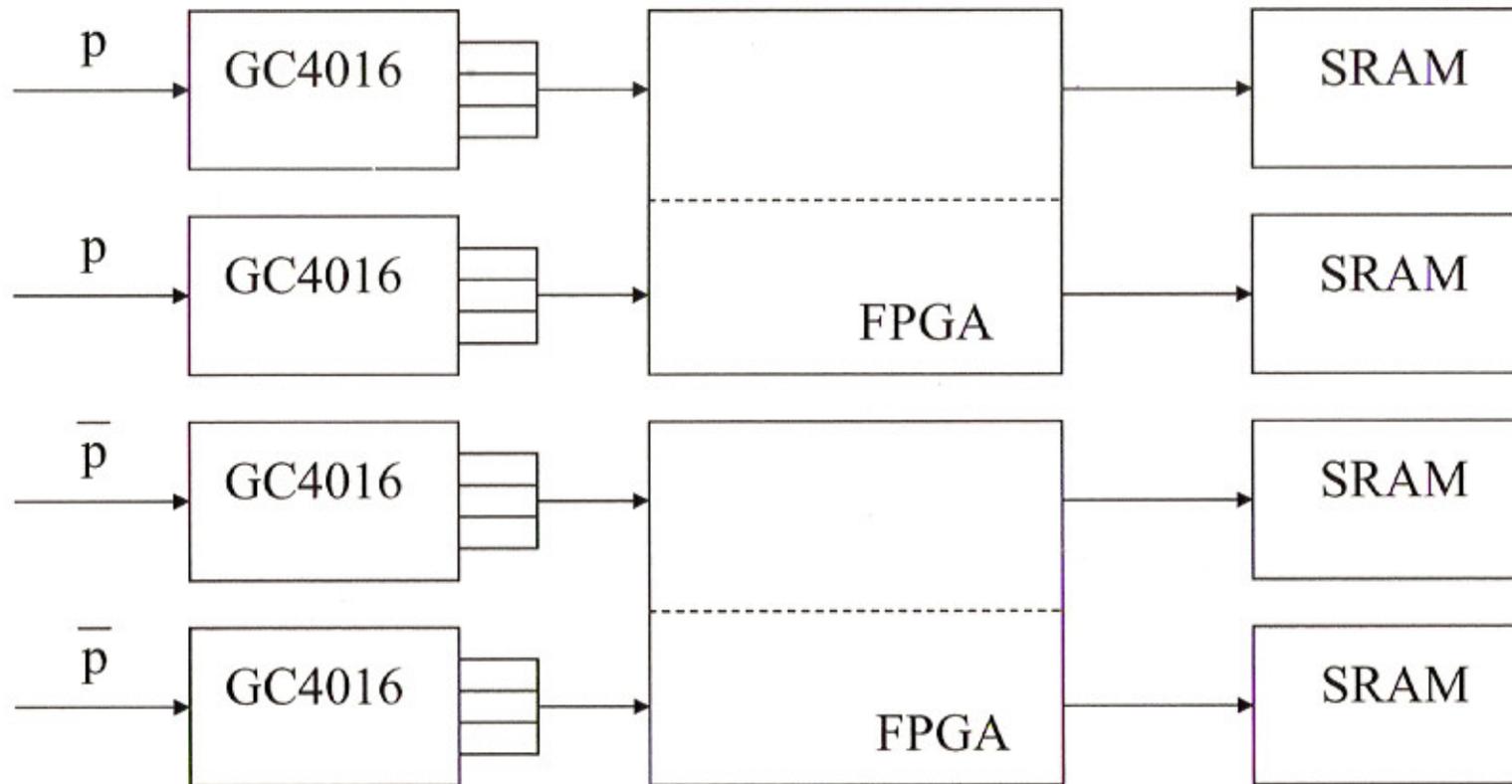
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TeV BPM Meeting



General Setup (4 Channels)





Flexibility of Trigger

- **Operating Modes**
 - Gated Mode : Data is collected as long as external trigger signal is active.
 - Counted Burst : Collects pre-loaded number of data samples on rising edge of external trigger.
(Q: Is this the number of input sample points or the number of down-converted outputs?)
- **Best guess based on current documentation is one choice for all eight channels (default).**



Delayed Triggers

- One feature found in documentation for new Echotek board (not on older version ?) is the ability to have programmable trigger delays for channel pairs 1-2, 3-4, 5-6, and 7-8.
- This could be useful for adjusting timing of trigger for anti-proton channels to start the digitization process on a particular bunch.



Trigger Counter

- Another (new?) feature of this board is the trigger counter. This feature allows one to collect data from a certain number of triggers before turning off data acquisition.
- It's not clear from the documentation if this is a single parameter for the entire board or if it can be different channel to channel.
- Also, need to understand if this feature can be turned off.

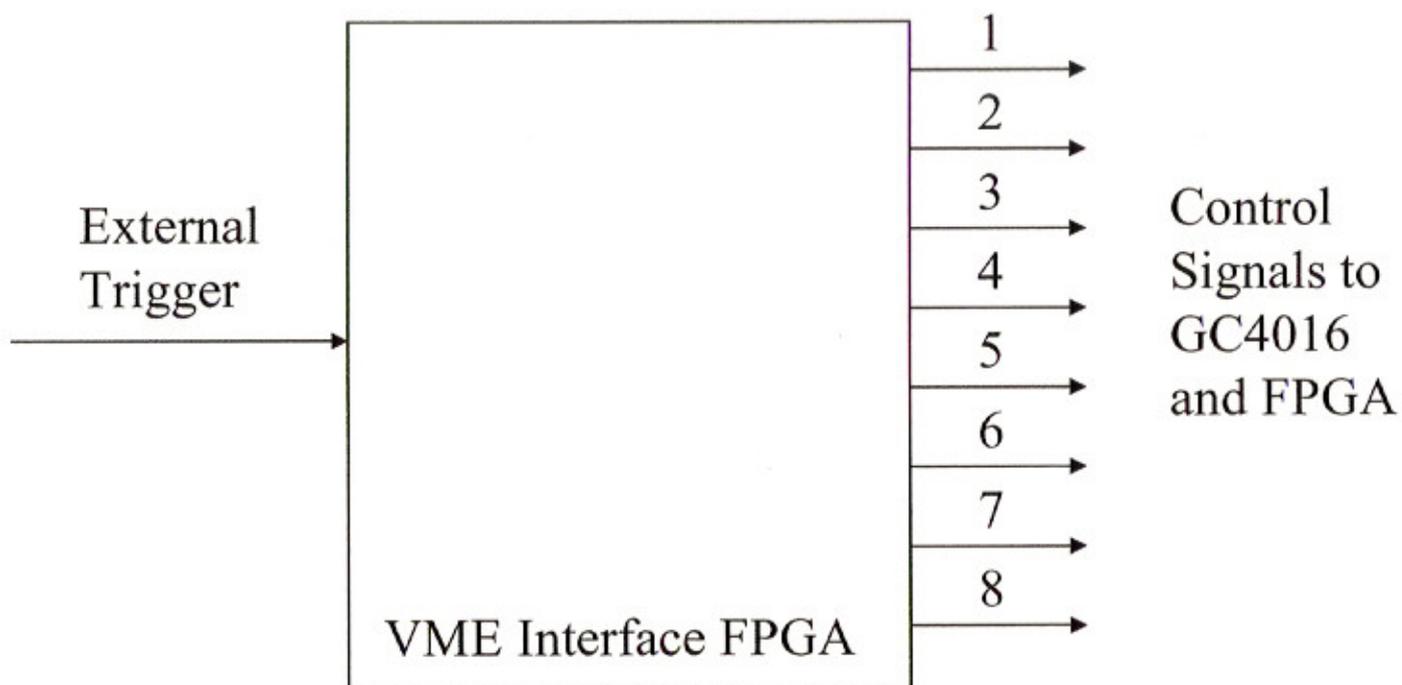


VME interface FPGA

- The external trigger does appear to be routed through the VME interface FPGA, however.
- In theory, this FPGA could be modified to provide different trigger signals to different channels.
- This FPGA is apparently only loadable via JTAG, though, so it would be a little bit tougher to modify in the system.



Routing of External Trigger





Output of GC4016

- Use packed mode (16 bits each of I and Q data packed into a single 32 bit word).
- Potential output from up to four channels on each GC4016.
- Transfer of data from GC4016 to FPGA is a black box (referred to in the manual as data formatting logic). It does appear from the documentation that the GC4016 serves as the master for these transfers



Maximum Output Rates

- Minimum down-conversion for single channel is 32. Assuming 80 MHz sampling rate, GC4016 output rate = 2.5 MHz. With equivalent output rate on all four GC4016 channels, this increases to 10 MHz which implies 100 ns per GC4016 to FPGA word transfer (seems reasonable).



FPGA

- Another change in the documentation between old and new boards is that there is no mention of an averaging capability in the default FPGA program for new boards.
- The documentation suggests that the FPGA simply receives words from the GC4016 chips and writes them directly into the on-board memories.

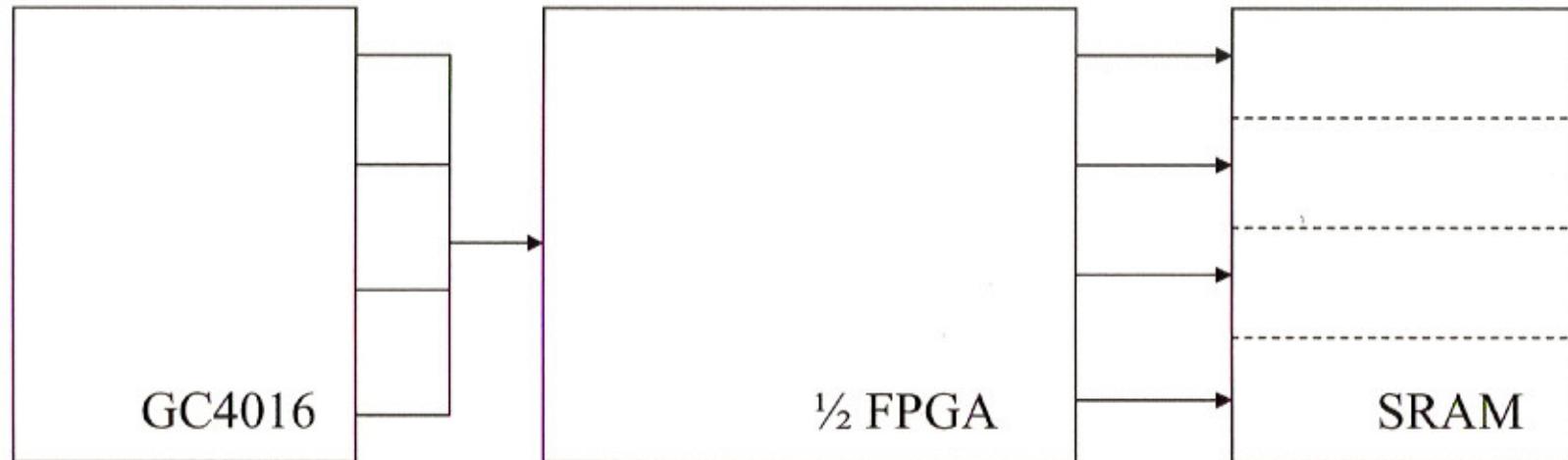


FPGA

- Another important question which is not answered directly by the board documentation is whether the output from GC4016 channels is written to different sections of the on-board memories for each channel.
- This is an important because one does not want to have to search through a big block of words in memory to find the smaller number associated with the closed orbit measurement.



FPGA





One Potential Setup

- Send a trigger to the board once per turn (trigger signal could be masked on certain events such as an abort).
- GC4016 proton signal decimation = 512.
- GC4016 anti-proton signal decimation = 32.
- Collect three data points per trigger.
- Make closed orbit measurements in FPGA based on this data.



Turn by Turn Measurement

- Sampling rate = 74.346 MHz.
- Turn by Turn Measurement = 47.74 KHz
- Decimation factor ~ 1557 .
- But, real choices are 1024 (72.60 KHz) and 2048 (36.30 KHz).
- Note that three data points per turn implies 143.22 KHz (decimation ~ 519) which is close to 512.



Turn by Turn Measurement

- Potential setup :
 - Set GC4016 decimation to 512.
 - Trigger on each turn.
 - Take three data points/turn (burst count = 3).
 - Use trigger counter to request single turn or some number of turns or just run continuously.
 - Combine three data points into one offline or inside of FPGA.



Anti-proton Measurements

- Seems possible to do anti-proton measurements using a similar setup.
 - Still trigger once per turn.
 - Use trigger delay settings to pick out position of anti-proton bunch to be measured.
 - Measurement of a single bunch corresponds to 2.525 MHz (decimation ~ 29). Set GC4016 decimation to 32. Take one point per trigger (or take three to match turn-by-turn and throw away the second two offline or inside FPGA).



Closed Orbit Measurements

- It is not obvious how one could directly make a closed orbit measurement on another GC4016 channel while triggering on every turn.
- It's possible (but not likely) that extra triggers are ignored on GC4016 channels that have yet to collect all data points from a previous trigger.

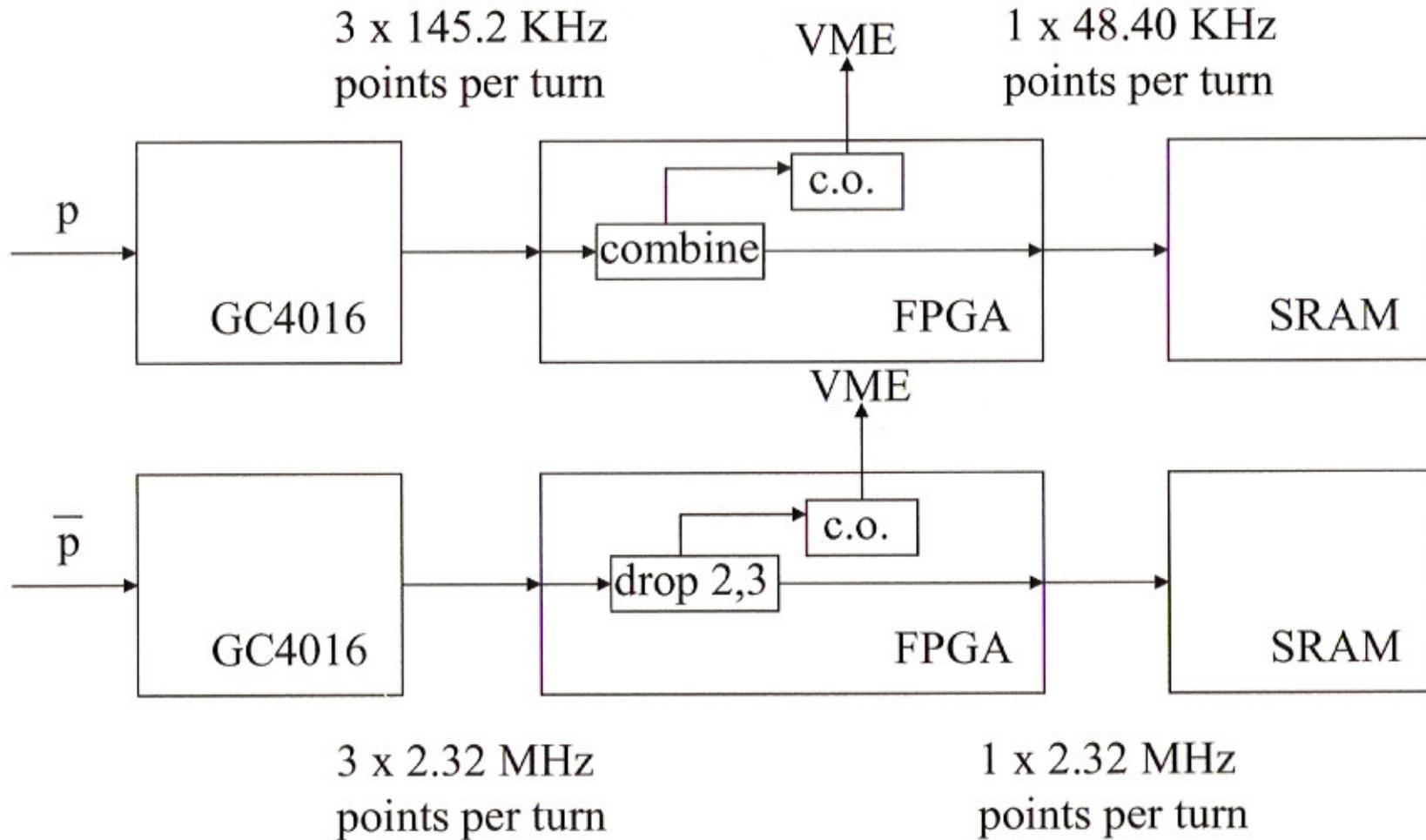


Closed Orbit Measurements

- In this case, it might be possible to set the decimation for a second proton GC4016 channel to the maximum setting (16384) and collect closed orbit data at ~ 5000 Hz.
- One would still need to worry about how the different data types were packed into memory by the default FPGA program.
- A better solution would be to have the FPGA convert turn-by-turn to closed orbit.



Schematic





Operational Modes

- **Normal Operation :**
 - Trigger Counter disabled.
 - Triggers on every turn.
 - Continual Closed Orbit Measurements (both proton and anti-proton).
 - Abort or request for turn-by-turn data could halt triggers pending readout.



Operational Modes

- **Debug Operation :**
 - Trigger Counter enabled (request some number of turn-by-turn measurements).
 - Enable triggers in coincidence with event of interest (e.g. injection).



Summary

- In previous talk, suggested that we make bunch by bunch measurements in GC4016 and do all further processing in FPGA.
- New approach uses trigger delay settings to handle timing issues so changes to FPGA design are more straight-forward.
- Disclaimer : Approach pieced together while creating talk last night. Could be holes in here somewhere.