Beam Intensity Monitor

David Christian

Fermilab

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Three Functions

- "Splat block"
  - Compute a running sum of beam intensity for N rf buckets (equivalent to an average)
  - Inhibit triggers if sum exceeds threshold
- Event readout
  - On trigger, output beam intensity for M rf buckets (number and offset wrt trigger are adjustable)
- Spill readout
  - At end of spill, output beam intensity + flags for every rf bucket in the spill

“Splat block”

- Input from N_2 Cerenkov Counter upstream of the targets.
  - Single 8-stage (ET 9215B) phototube w/fully transistorized base (large dynamic range)
  - Digitization by a QIE-10
    - Clocked by Main Injector rf (53 MHz)
    - 10 bits output each clock cycle (~17-bit dynamic range)
      - 6 bits mantissa, 2 bits exponent, 2 bits Capacitor ID
- Intensity summed over N rf buckets
  - Trigger inihibit asserted if Sum>Threshold

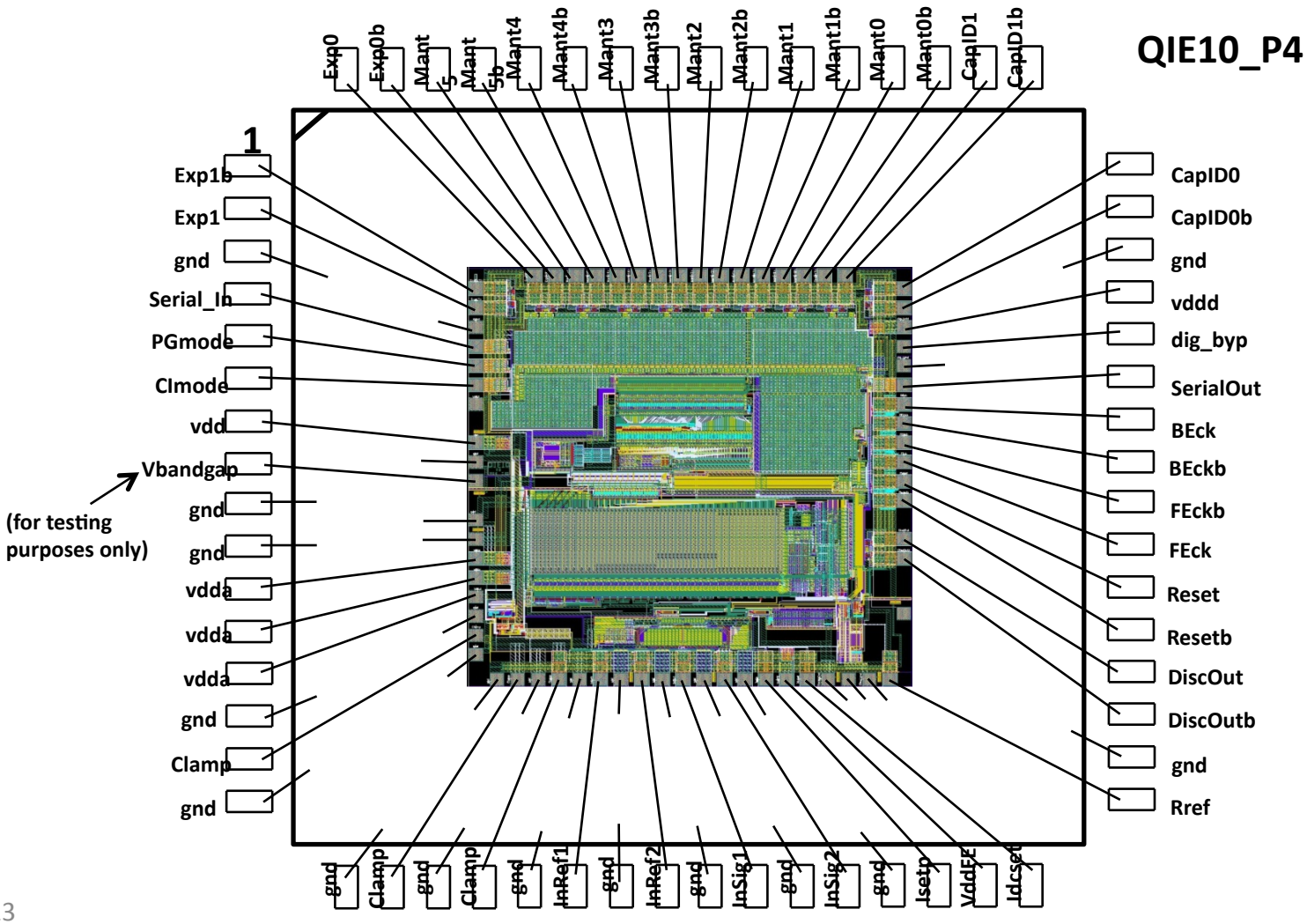
Event Readout

- On trigger, output to “TDC.”
  - Uses two LVDS twisted pair ribbon cables (16 bits each)
  - M rf buckets of information; for each bucket:
    - Beam intensity (16 or 17 bit integer)
    - Beam intensity (10 bit raw QIE data)
    - I/O control signals
  - “TDC” microcode will allow readout of either or both beam intensity formats

Spill Readout

- At End-of-Spill (EOS), output via Ethernet:
  - Beginning of Spill record
  - For each rf bucket (~4-5 x 53 million buckets):
    - Beam intensity (16-17 bit integer)
    - Single bit flags:
      - DAQ live
      - Trigger inhibited (splat block)
      - Trigger received
      - Turn marker
  - End of Spill record
  - Assuming 24 bits/rf bucket & no data compression,
    - 4 sec spill = 5 Gbits
    - 5 sec spill = 6.4 Gbits
    - ➔ ~ 10 sec @ .5 Gbps

Status (1) – QIE-10_p4 in hand & tested.



Status (2) – Specification ~95% complete

- Same module will also be used by AD as part of their instrumentation – initially looking at a scintillation counter upstream of the 2-way split between SeaQuest & Meson.
- AD version will use different microcode, or microcode option; will output 588 rf bucket sums at ~ 10 Hz.

Timeline to complete

- Schematic-level design starts as soon as new St.1 phototube base layout is complete
- Layout follows
  - Expect ~3 weeks for layout, 1 week for verification.
- PCB production follows
  - ~2 weeks for bids & production
- Assembly follows
  - 7-8 weeks from start to 1st complete module

Testing Plan

- R/O tests will proceed in parallel with microcode testing after ~ 2 weeks of software development.
- If detailed design starts on 2/1, expect R/O tests to begin ~4/15.
- Commissioning with beam can be expected to take 1 – 2 weeks.