MkV Beam Position Monitor Readout

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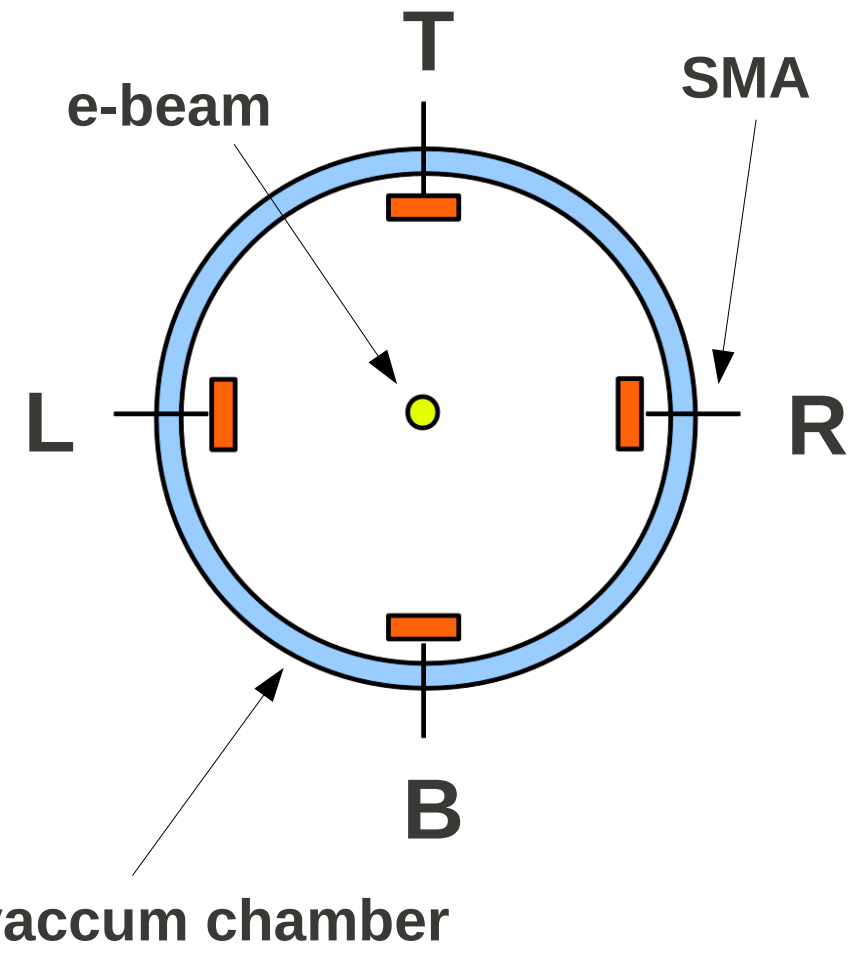
BPM Overview

- BPM's have 4 striplines oriented at 90 degrees
- E-beam capacitively couples to striplines
  - f_{RF} = 2.865 GHz
- SMA feedthrough to stripline
- With e-beam centered, each pickoff sees same signal level



BPM Signal Mixing

- Problems: direct measurement of high frequency RF BPM signals
  - Comparing signals is phase senstitive
  - High cable loss for detector in CR
  - High radiation for detector in tunnel
  - Few reliable detectors available
- Better: use heterodyne technique, local oscillator in tunnel
  - $f_{LO} = f_{RF}$ +/- 10 MHz
  - Phase and cable loss no longer a problem
  - Wide range of commercially available detectors
  - Detector and DAQ can be located in CR

Beam Position Error Calculation

- Separate position into vertical and horizontal components
- Use AD640 Log-Amp to measure signal level for each pickoff
  - Absolutely calibrated slope and reference
  - DC – 120 MHz
  - 50 dB dynamic range
- Take difference of log-amp output for H and V pairs to generate error signal

$$\delta x \propto V^R / V^L$$

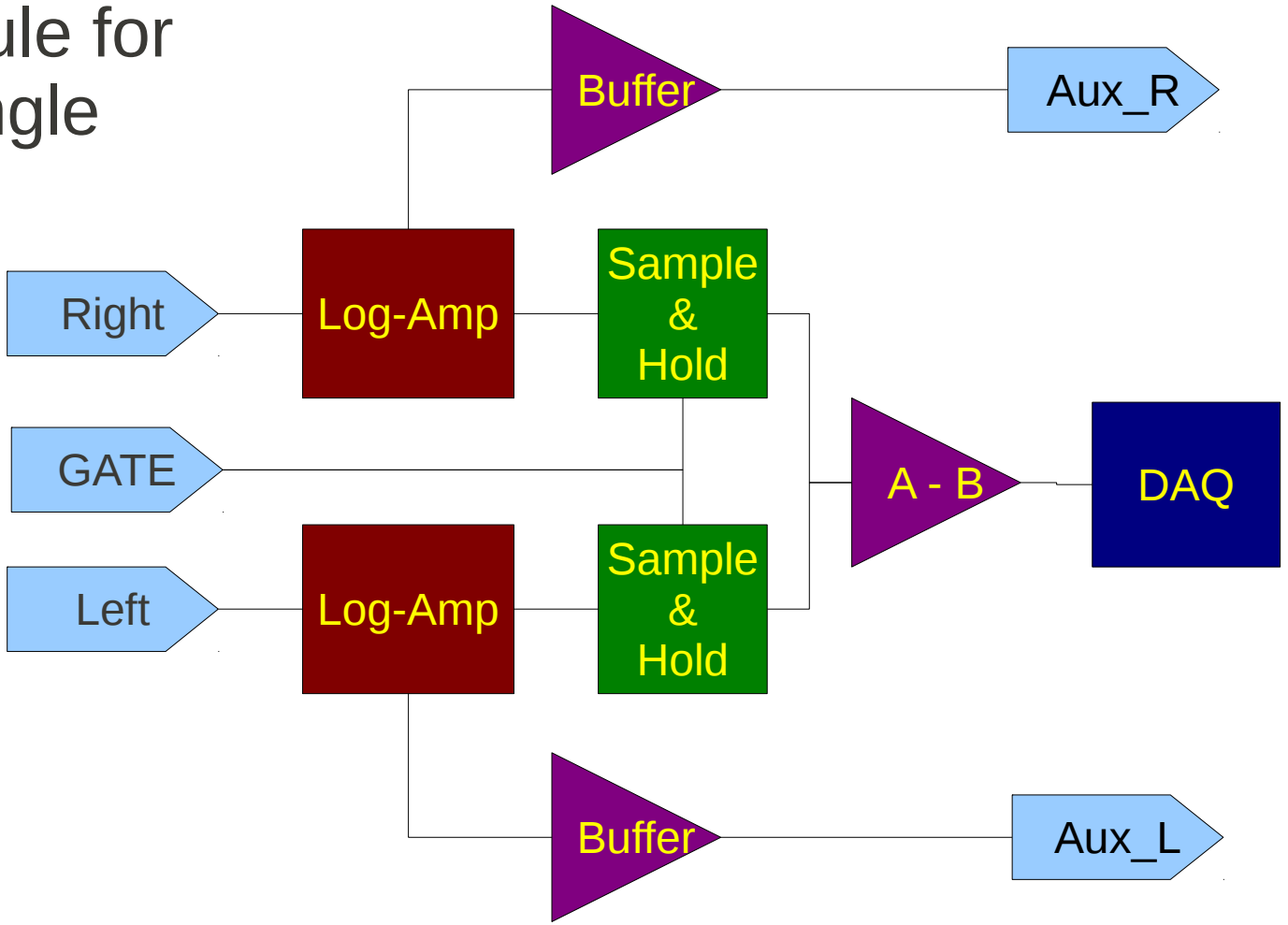
$$\delta y \propto V^T / V^B$$

$$V_{out} = V_{slope} \log\left(V_{input} / V_{ref}\right)$$

$$V_{out}^R - V_{out}^L = V_{slope} \log\left(V_{input}^R / V_{input}^L\right)$$

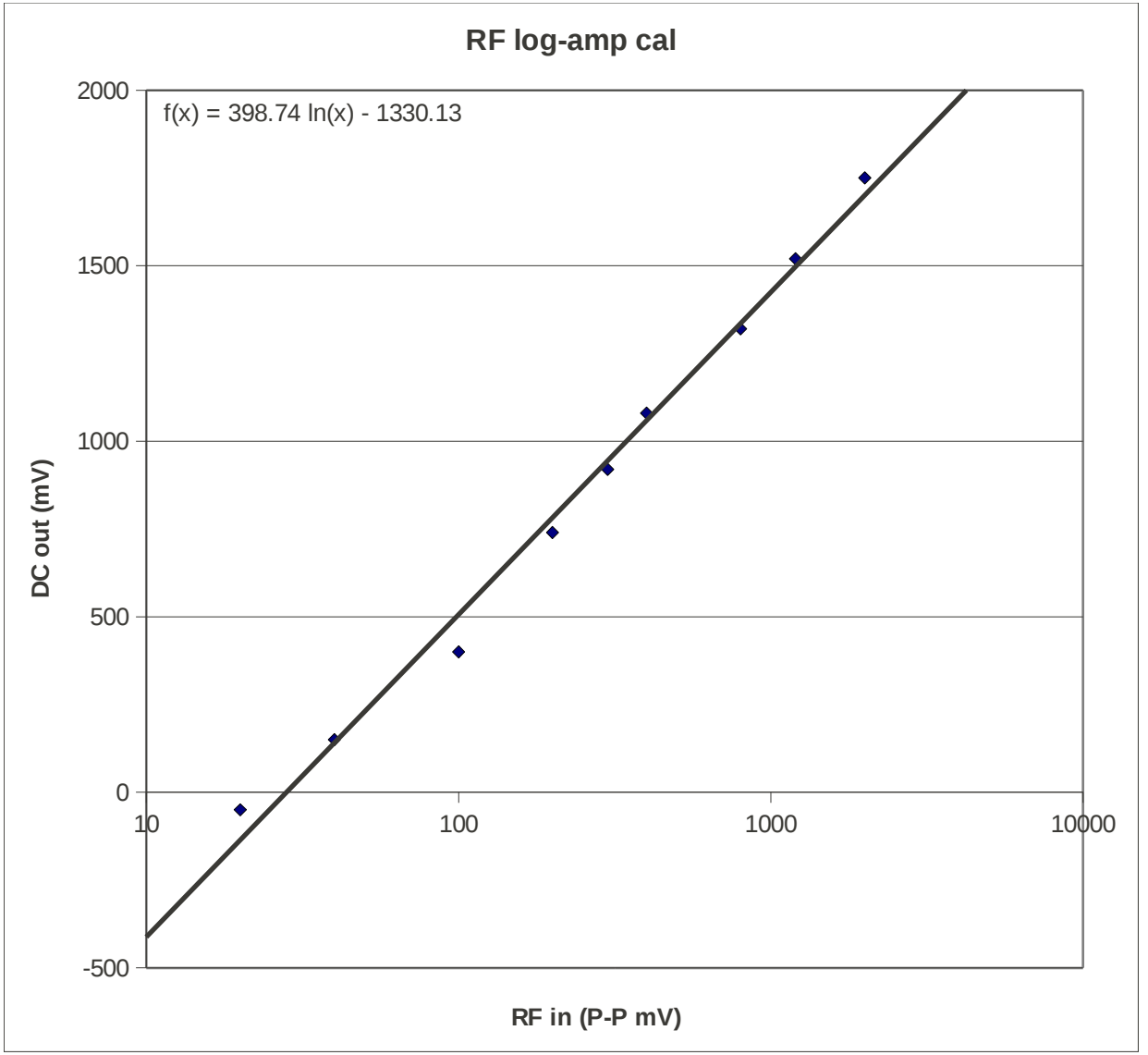
BPM Readout Block Diagram

- 2-Channel Module for either axis of single BPM
- 2 modules for each BPM/PCB
- DAQ to read all PCB's
- AUX signals available for time-dependent measurements

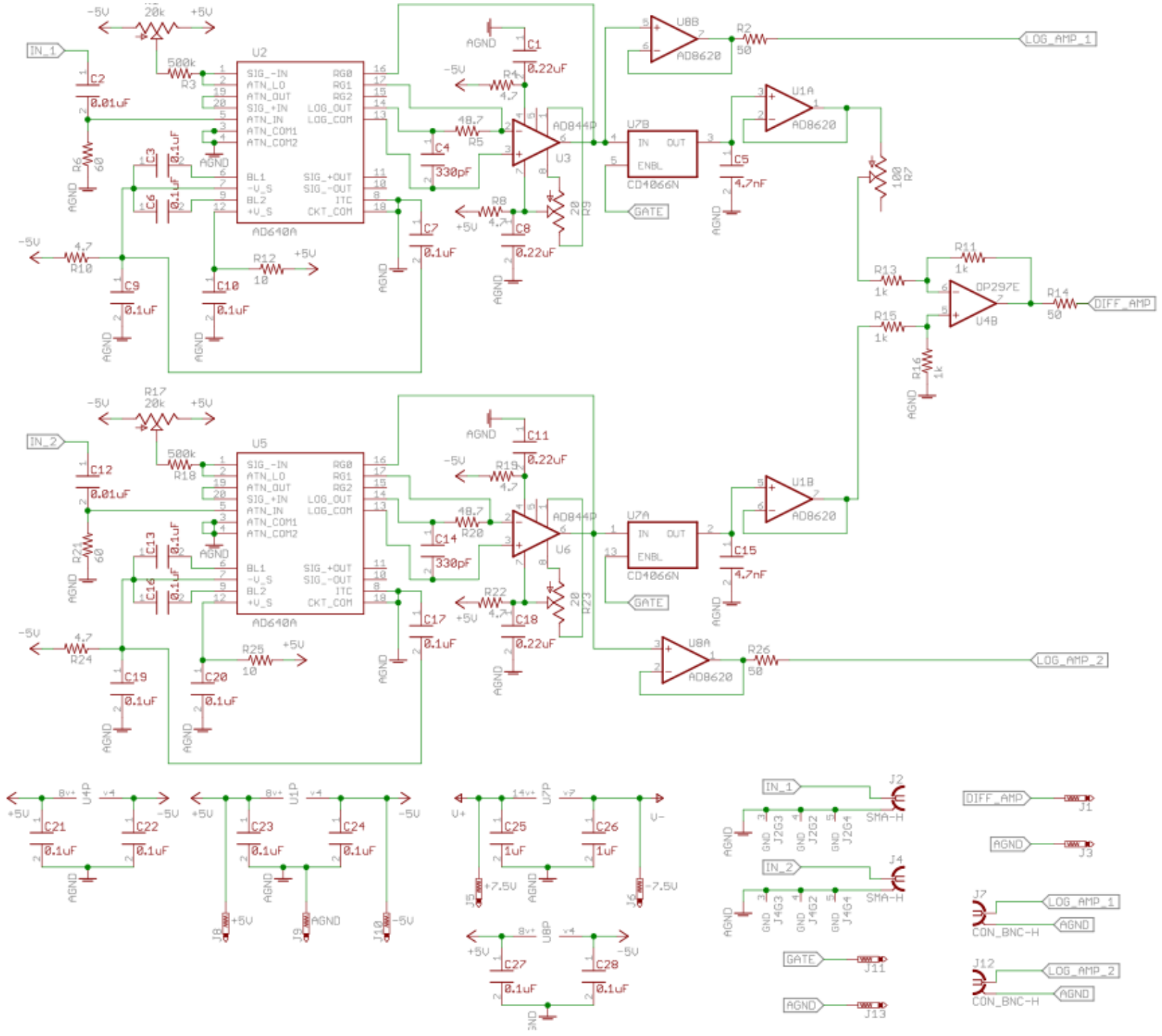


Log-Amp Test Measurements

- Test log-amp in Vector board circuit
- Logarithmic response
- Measure real BPM signal: ~ 1 V
- Verified sample & hold circuit
- Now need to test 2-channel comparison



Schematic


IN_1
IN_2
LOG_AMP_1
LOG_AMP_2
DIFF_AMP
GATE
AGND
AD640A
AD844P
AD8620
OP297E
CD4066N
SMA-H
CON_BNC-H

Layout

- 2-layer, 0.062” FR-4,1 oz.
  - 0.115” trace width for 50 Ohm u-strip
- 10 MHz into SMA input
- 60 Ohm terminator required b/c of internal attenuator
- Ground side of SMA connects directly to log-amp, not ground plane as per AD spec