

MMFE8 v2B (FEAST + VMM3) Noise Measurements

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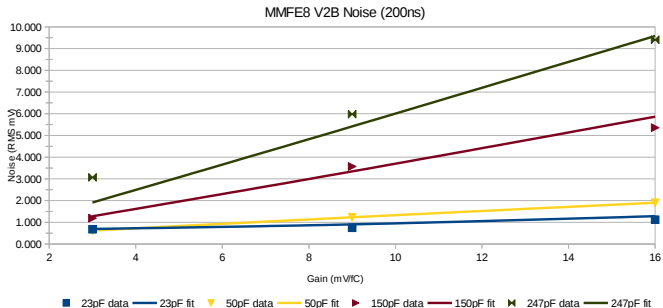
CERN FEAST

- ▶ FEAST: low-noise, radiation- and B -tolerant buck converter.
 - ▶ Developed specifically for LHC experiments.
 - ▶ Supplied as module or ASIC.
- ▶ Layout, component selection, EMI shielding *critical* for noise performance.
 - ▶ CERN Ph.D. (C. Fuentes Rojas): CERN-THESIS-2011-195
 - ▶ Reference design is based on this work.

MMFE v2B

- ▶ VMM3 + redesigned power:
 - ▶ Remove sensitive grounds beneath DC-DCs
 - ▶ Ensure switch-nodes and buck inductors are enclosed by shields.
 - ▶ Optimized component selection (capacitor SRF, etc.).
 - ▶ Layout in closer accord with CERN recommendations.

MMFE v2B: BENCHTOP NOISE MEASUREMENTS



$$\sigma_{\text{tot}} = \sqrt{\sigma_{\text{ins}}^2 + [\sigma_p G]^2 + [\sigma_s C G]^2}$$

G = Gain

C = Channel capacitance

$$\sigma_{\text{ins}} = 0.66 \text{ mV}$$

$$\sigma_p = 0.04 \text{ fC (250 ele)}$$

$$\sigma_s = 2.4 \mu\text{V (15 ele/pF)}$$

- ▶ Measure noise RMS on MO vs. gain, capacitance.
- ▶ Model as indep. noise sources in quadrature (left)
- ▶ Outlier at $C = 247 \text{ pF}$, $G = 3$

- ▶ **Expected VMM series noise:**
 $\sigma_s \simeq 1.6 \mu\text{V (10 ele/pF)}$

Measured noise levels 50% above VMM intrinsic

- ▶ Conducted ripple is under control.
 - ▶ Benchtop noise is comparable to VMM intrinsic.
 - ▶ Room to push this further if necessary.
- ▶ EMI issues must also be fully understood.
 - ▶ This is where v2B improvements should make the most impact.
 - ▶ Preliminary noise measurements on U. Arizona test chamber: comparable to bench measurements.
 - ▶ Ways to push further downward:
 - ▶ Continued layout improvements
 - ▶ Thicker cans
 - ▶ Soldered down instead of clips
 - ▶ Cooling plate might make effective shielding
 - ▶ Critical information: measurements with multiple boards on full-size chambers.