APV25 Power supply ripple sensitivity measurements

Measurement technique



Signal generator adds sinusoidal ripple on top of power supply rail, amplitude and frequency variable

Scope measures amplitude, which depends on frequency dependent impedances of power rails and signal generator amplitude setting

APV output frames acquired in normal way and analysed for power supply disturbance effects.

VSS is treated as the reference rail

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Picture of setup



Low frequency regime (<10kHz)



Common mode (baseline offset) effect on analogue section of output data frame

Can be subtracted but magnitude important from dynamic range limitation viewpoint

Higher frequencies (>10 kHz)



Power supply ripple effects couple into analogue baseline

Common mode effects evident too

Measurement protocol

Trigger APV randomly and acquire data frames

Apply sinewave disturbance to power supply of chosen frequency, adjusting amplitude to avoid saturation effects to APV output

Measure noise of one APV channel, using data from all channels to calculate and correct for any common mode effect

For each chosen frequency record

amplitude of sinewave on power supply rail rms common mode noise channel noise after common mode subtraction

Plot noise dependence on frequency, using amplitude data to normalise

Power supply ripple applied to 0V w.r.t VSS



ripple waveform normalised to 10 mV (pk-pk)

e.g. a sinusoidal ripple at 10 kHz with a peak-peak amplitude of 10 mV results in an rms common mode noise of ~1800 electrons (peak mode) and an extra channel noise contribution of ~ 120 electrons

Observations

No major dependence on mode of operation (peak/decon)

Low frequency interference (<20kHz) less troublesome as common mode correction can reduce significantly

As frequency increases the common mode noise increases and cannot be completely corrected for (analogue baseline has a portion of interference waveform superimposed)

Peak at ~ 2.5 MHz corresponds to shaper filter response

Power supply disturbance applied to VDD w.r.t. VSS



Observations

Effects very similar to 0V rail plot but more sensitivity at high frequency end

Conclusions/Observations

Are results here useful?

possibly qualitatively

magnitudes of effects likely to depend on hybrid layout (supply line/plane impedances, parasitic couplings, decoupling components)

Power supply rails should be "clean" at the power supply end but this doesn't guarantee they will still be clean at the front-end module.

decoupling components on hybrid (or mother cable?) must take care of this but difficult to anticipate requirements in advance

reasonably realistic system tests (including cabling) required