Ground Non-Linearity Calibration

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Below we summarize our analysis of Sample-Up-the-Ramp (SUR) data from the FEB taken during the first MIC2 test for calibrating the non-linearity. Flight Model (FM) test data was acquired on 11-12-2008 and Engineering Model (EM) data on 11-19-2008.

Here's a summary of the delivered products:

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gndlincal-w1-est-v3.fits
gndlincal-w1-msk-v3.fits
gndlincal-w1-unc-v3.fits

gndlincal-w2-est-v3.fits
gndlincal-w2-msk-v3.fits
gndlincal-w2-unc-v3.fits

gndlincal-w3-est-v3.fits
gndlincal-w3-msk-v3.fits
gndlincal-w3-unc-v3.fits

gndlincal-w4-est-v2.fits
gndlincal-w4-msk-v2.fits
gndlincal-w4-unc-v2.fits
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where "est" = estimate of non-linearity (quadratic) coefficient; "msk" = calibration mask indicating highly non-linear, very uncertain, and bad ramp-fit pixels; "unc" = 1-sigma uncertainty in non-linearity coefficient.

All the above used the FM electronics data at nominal temperature (as defined at the time - see below). Non-linearity estimates using the EM data are very close to those from FM, albeit slightly smaller (or less non-linear) across all bands. This could be due to the difference in array temperatures.

The main difference between this version and the previous (v2) is that this version also fits for a *y*-intercept in the quadratic non-linearity model. Results are very similar to v2 where the ramps were adjusted to have zero *y*-intercept before fitting. Methodology is described in the v2 document where the only addition is that a *y*-intercept should be included in the fitting equations. Also, as in previous versions, the first ramp sample was omitted for bands 1 and 2 before fitting.

Table 1 compares the percentage non-linearity estimates across all the available apertures (illuminations) using the formalism of *method 2* in the v2 document. The percentage deviation from non-linearity is defined as:

$$\%NL = 100 * \left(\frac{m_{lin}}{m_{obs}} - 1 \right) \%, \qquad \text{(Eq. 17)}$$

where m_{lin} = linearized median DEB pixel signal and m_{obs} = observed (raw) DEB pixel signal in DN.

Aperture # (~illumination)	**W1 %NL; m_{obs}**	**W2 %NL; m_{obs}**	**W3 %NL; m_{obs}**	**W4 %NL; m_{obs}**
3	0.87; 1624	1.16; 1512	3.29; 3157	10.23; 10767
4	2.03; 3320	2.78; 3104	4.09; 4365	10.14; 11511
5	4.31; 6568	6.08; 6114	5.16; 6392	10.46; 11116
6	10.72; 12603	14.85; 11526	7.14; 10606	10.66; 11455
7	*27.42; *22056	*39.81; *19150	10.49; 18311	10.89; 11855
8	too saturated	too saturated	*18.98; *32051	11.60; 13103
10	too saturated	too saturated	too saturated	13.58; 18417
11	too saturated	too saturated	too saturated	*24.04; *30266

Table 3: Median percentage deviations from linearity (%NL) at the median observed DEB signals (m_{obs} in DN) over each array; computed using *method 2* for the FM data. Asterisked numbers (*) used partial ramps (≥6 samples each) due to saturation.