

THEMIS VIS Calibration Procedure (Version 0.2)

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0) Acquire raw Mars image and convert to EDR format.

1) Expand 8-bit values (0 - 255) to their original 11-bit range (0 - 2047).

The 11-bit values acquired by the detector are converted to 8-bit format via a square-root-encoding algorithm prior to downlink. This step uses a look-up table to restore the data to its original linear 11-bit range.

2) Identify invalid pixels

Two types of invalid pixels are identified and flagged as null pixels using the PDS standard representation:

- i) Rows and columns near the boundary of each filter which are always unusable due to filter edge effects.
- ii) Saturated pixels

3) Subtract detector bias.

The detector bias is determined by acquiring and averaging VIS exposures over the night side of the planet. . The bias is determined independently for each spatial summing mode. Dark current has been found to be negligible in flight

4) Remove detector read-out smear.

Data pixels accumulate additional charge (read-out smear) while being transferred down the vertical registers during the detector read-out process. This read-out smear is subtracted using a flight-data-based empirical model.

5) Remove optical stray light.

A linear regression model is applied to the flight data on a pixel by pixel basis to predict the stray light component as a function of mean image DN level. This predicted stray light image is then subtracted from the flight data. This procedure is performed independently for each filter of each spatial summing mode.

6) Correct for pixel-to-pixel responsivity (flatfield) variations.

The flatfield is generating by averaging all available stray light corrected images independently for each filter of each spatial summing mode. Each image is normalized to a mean value of 1.0 before inclusion in the average. Each image is then divided by its appropriate flatfield image.