

## **SMEI DHU Software Patch 34**

### **Commanding Changes**

**M.P.Cooke**

**University of Birmingham**

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## **1. Introduction**

The SMEI instrument has the capability to upload new version of the flight software. The capability will be used to upload revision 34 of the SMEI flight software. This revision has been made to address issues raised during the first 18 months of operation.

This technical note details the changes made, and the revised commanding formats required. It should be read as an addendum to the SMEI/BU/SPE/001 and SPEI/BU/SPE/002 and SMEI/BU/TN/002 commanding documents.

## 2. Compressed Patch Data Upload (SM\_PATCH\_BIN)

The capability was added to the flight software to allow the transmission of a new binary flat field table to SMEI in an efficient format. It operates in the same way as the SM\_PATCH\_UPL command, but instead of directly providing 29 16-bit words of data for the patch buffer, it provides 154 3-bit symbols, which are expanded to one or two pixel values.

The bits are taken least-significant-bit first, starting with the word at offset 3, through to offset 32.

Once the bits have been expanded into the patch buffer, the data can be written to non-volatile storage using the SM\_PATCH\_CMT command.

Symbol	Word 1	Word 2
000	0xFFFF	
001	0x7FFF	
010	0x5331	
011	0x3FFF	
100	0x0000	
101	0x3FFF	0x3FFF
110	0x5331	0x5331
111	0x5331	0x0000

Additional ground support software was written to process an ASCII text file, where the first line specified the array dimensions (1272 x 256), and subsequent lines have up to 19 space-separated values. A 0 signifies that the pixel should have a gain factor of zero, and a 1 indicates that the pixel should have the nominal gain factor, adjusted for the number of pixels which are present in a 2x2 bin.

It should be noted that the coordinate scheme for this ASCII text file is in digitised-pixel coordinates, not physical CCD locations. In other words, the first value in the text file should be for the first pixel digitised – ie, the top-left pixel in an IMG file produced by the Birmingham EGSE software.

To enable this new command, the command execution tables in bank 0x40 of the SMEI e<sup>2</sup>prom need to be updated.

### 3. 2x2 Binning Data Processing

To enable a linear flat field scale for camera 3 for bins which only have 1 active pixel, the data processing pipeline in 2x2 mode was adjusted to provide an additional factor of 2 gain.

This has operational impact for using 2x2 mode.

- 2x2 mode, at-launch flat-field

The additional gain means that it is required to use a new dynamic observation configuration for these modes.

The Cx\_FF\_SCALE field must be reduced to 16383 instead of 32767 to compensate. This slightly reduces the precision of the flat field corrections due to bit-truncation.

- 2x2 mode, flat field disabled

The additional gain cannot be compensated for in this mode as pixels are scaled by 0x7FFF as they arrive. In 4x4 and 1x1 binning modes, this corresponds to a gain of 1.0, but it is 2.0 for 2x2 mode.

Bin values will be clipped to full-scale if the bin value is more than can be encoded in 16 bits.

- 2x2 mode, 3-bit binary flat-field

The additional 2.0 gain factor is compensated for in the flat field table itself.

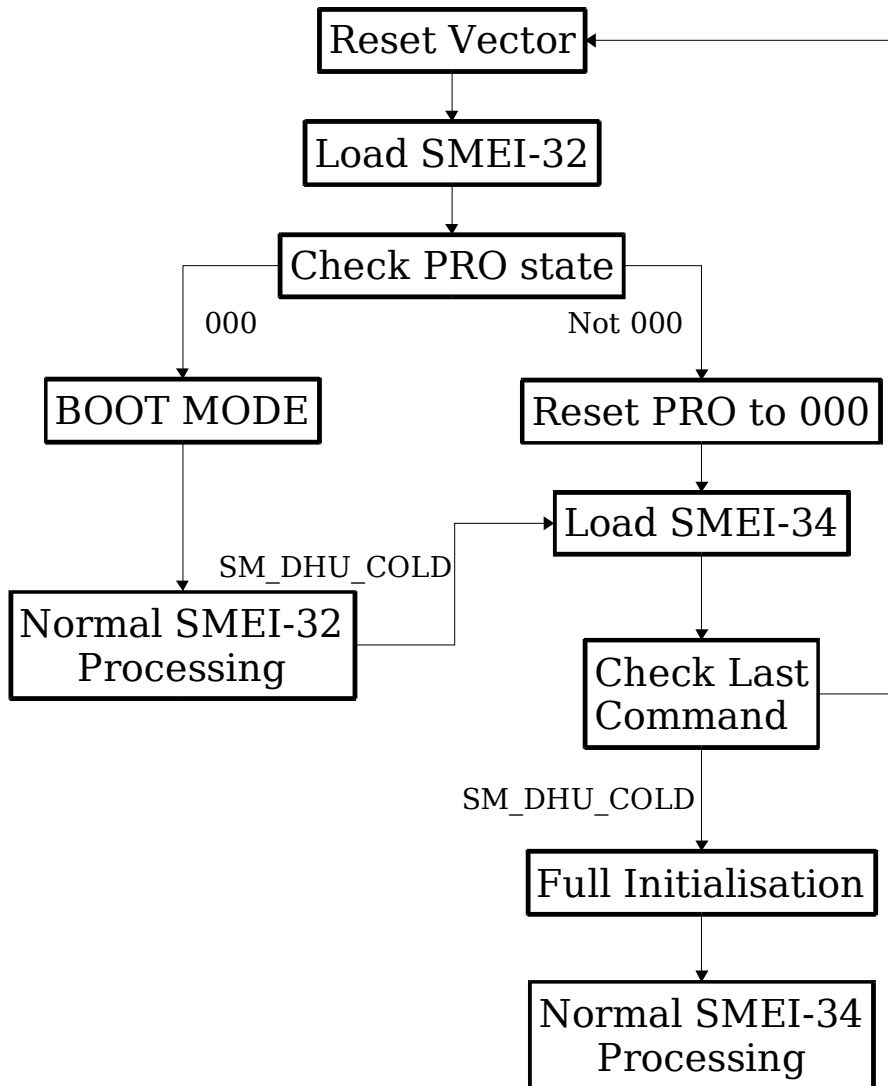
The Cx\_FF\_SCALE field of the dynamic configuration must be set to 65535 to provide the full range of output (0.0, 1.0, 1.3, 2.0 and 4.0 gain factors).

#### 4. Warm Booting Initialisation

The original SMEI software has an in-built feature to attempt to resume an observation if the processor crashed after the software had been running for 4 minutes. It has been found by experience that this feature complicates the early part of the SMEI reset procedure (SMEI-05) by permitting SMEI to be in BOOT, CONFIG or OBSERVE modes after a reset pulse is applied, and to have had varying levels of re-initialisation of the DHU applied.

To rationalise the restart process to always enter BOOT mode, and to ensure a full reset was always performed, it was desired that this warm start facility was removed.

The SMEI bootstrap process was therefore modified so that the flow is as follows.



## 5. Camera Frame EOF Not Incrementing

Capability was added to check that at least one of the cameras is completing frames if SMEI is in observation mode. If there are no frames being queued, then SMEI software attempts to restart observing mode.

To prevent a re-initialisation loop, two bits are used in SYSCONF.

- Bit 11 is checked to inhibit this feature. A value of 1 prevents this automated check.
- Bit 12 is set when an automatic restart is performed.

An observation restart is only performed if:

- Bit 11 is 0, indicating the check is not inhibited
- Bit 12 is 0, indicating the restart has not been tried already
- SMEI is in observing mode
- No frames have been successfully completed in the last 200 frame-starts

An observation restart consists of:

- Set SMEI to configuration mode, but without closing the shutters
- Reset the telemetry buffers
- Queue a SM\_GOTO\_OBS transition
- Perform a standard observation start, including filter wheel motion

This is almost the same process followed when an SM\_GOTO\_CONF is followed by an SM\_GOTO\_OBS. The only difference is that the filter wheel movement is skipped for the configuration mode step. It should be noted that the filter-wheels will move.

This 'mid-observation movement' can be detected by tracking bit 12 of the SYSCONF word, or by tracking the stepper motor telemetry points. SYSCONF bit 12 will transition from 0 to 1 when the internal re-initialisation is performed.

It should be noted that the SMEI\_MODE telemetry point will not switch from observing to configuration and back to observing, as the transition is immediate in the DHU software.

A new telemetry point was added to word 31, hk id=9 which tracks this timer.

## **6. I2C State Machine Stuck**

Capability was added to check that the i2c link to the cameras is returning to the idle state as expected. If this is not true, the SMEI software forces a reset of the i2c state machine, and indicates this in SYSCONF.

- Bit 13 is set if an I2C error has been detected.

A new telemetry point was added to word=30, hk id=9 which tracks the timer used by this event.