Technical Note
SimuCam pattern requirement

PLATO-LESIA-PL-TN-023
Iss. 01, Rev. 02

Prepared by:	Function:	Signature:
Loïc Gueguen	PLATO N-DPU ASW GSE Manager	
Approved by:	**Function:**	**Signature:**
Authorized by:	**Function:**	**Signature:**
Philippe Plasson	PLATO N-DPU ASW Project Manager	

SimuCam pattern requirement

Ref: **PLATO-LESIA-PL-TN-023**
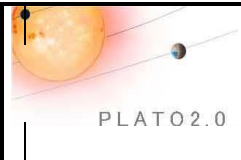**Issue: 01**
Revision : 02
Date : **19/12/2017**

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Change Record

Issue	Rev.	Date	Authors	Modifications
1	0	13/01/2016	Loïc Gueguen	First issue of the document
1	1	27/03/2017	Ph. Plasson	FEENB has been replaced by CCDID The number of rows has been updated. A display of the pattern obtained with a plotter has been added. The pattern sample figure has been corrected.
1	2	19/12/2017	Ph. Plasson	The coordinate system has been updated in order to be compliant with the system specification.

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1 GENERAL

1.1 Scope of the Document

This document describes the data pattern which shall be implemented by SimuCam (see [RD1]) for test purpose.

1.2 Applicable Documents

This document responds to the requirements of the documents listed in the following table:

Mark	Reference	Title of the document
AD1		
AD2		

1.3 Reference Documents

This document is based on the documents listed in the following table:

Mark	Reference	Title of the document
RD1	PLATO-LESIA-PL-SP-004	N-FEE Simulator URD
RD2	PLATO CCD Definition	PLATO-MSSL-PL-TN-008
RD3	PLATO FEE-to-DPU Interface Requirement Document (IRD)	PLATO-DLR-PL-ICD-002

1.4 Convention

A word is made up of 16 bits.
In all this document, when describing structure of data to be emitted, the less significant bit (named LSB) of a word is noted b0, the most significant bit (named MSB) is noted b15. The bit b0 is transmitted first.
If more than one word is used, they are noted word0, word1, …, wordn. The word0 is transmitted first.

When describing the structure of data, we use a representation like the following:

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 1																
⋮																
Word n																
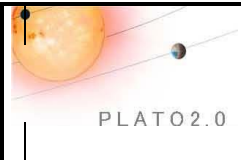
Table 1 - Packet general representation

This representation is only for high level data structure description. Those data are then transformed through communication protocol (SpaceWire).
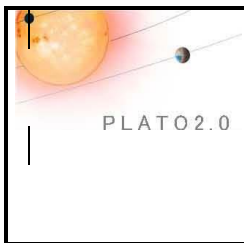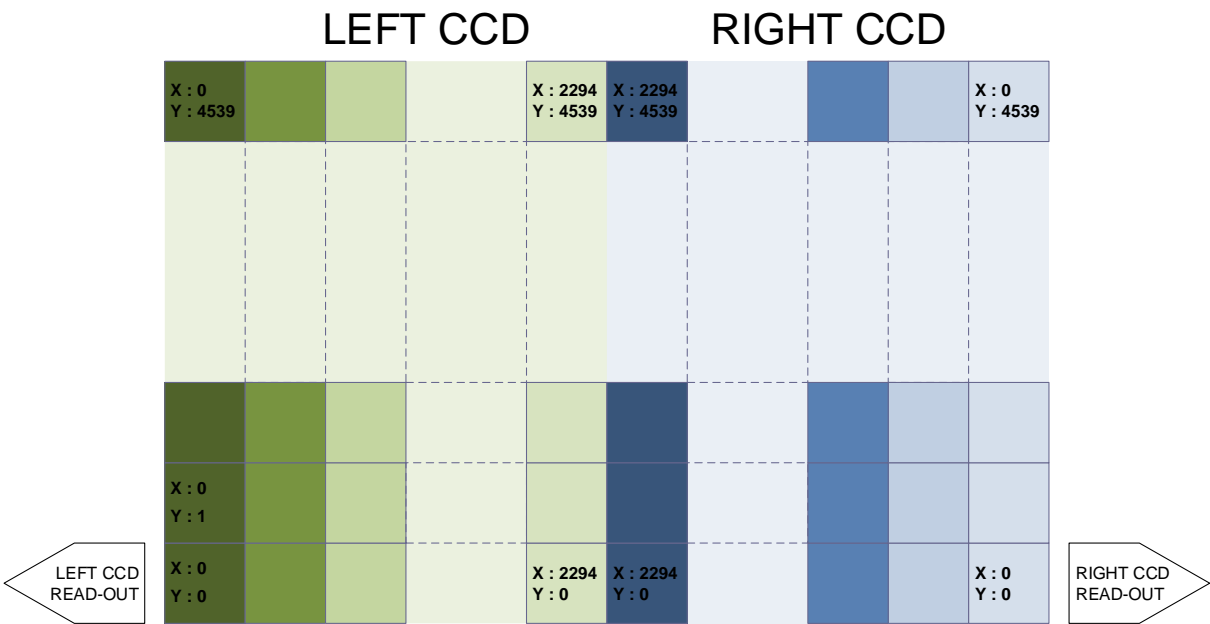
2 CCD COORDINATE REFERENCE

The size of the CCD images managed by the N-FEE is 4590x4540 pixels where:
- 4590 is the width composed by 2 x (25 serial prescan pixels + 2255 visible pixels + 15 serial overscan pixels) columns
- 4540 is the height composed by 4510 rows (visible pixels) + 30 overscan rows (parallel overscan zone)

For a given CCD image, whose the size is 4590x4540 pixels, we give hereafter the coordinate system (see [RD2] for the detailed definition):


Figure 1 - CCD Coordinate Reference

At the beginning of each readout cycle, the first pixel of the CCD left part to be read out is the pixel (X:0,Y:0): this pixel is the first pixel conveyed in the SpaceWire data packet sent to the N-DPU in the left-side packets.

At the end of each readout cycle, the last pixel of the CCD left part to be read out is the pixel (X:2294,Y:4539): this pixel is the last pixel conveyed in the SpaceWire data packet sent to the N-DPU in the left-side packets.

At the beginning of each readout cycle, the first pixel of the CCD right part to be read out is the pixel (X:0,Y:0): this pixel is the first pixel conveyed in the SpaceWire data packet sent to the N-DPU in the right-side packets.

At the end of each readout cycle, the last pixel of the CCD right part to be read out is the pixel (X:2294,Y:4539): this pixel is the last pixel conveyed in the SpaceWire data packet sent to the N-DPU in the right-side packets.
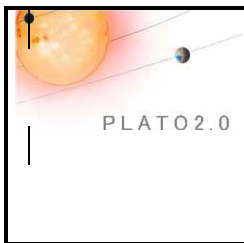
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3 PATTERN DESCRIPTION

For test purpose, SimuCam shall implement a mode in which emitted pixels values are patterns. In this mode, expected patterns shall respect the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TC			CCDID		CCD SIDE	ROWNB					COLNB				

Table 2 - Pattern format

Given the following definition:
- *%* Is the modulo function
- *X* is the column number in [0..2294]
- *Y* is the row number in [0..4539]
- *TiCo* is the current time-code as emitted before CCD\<n\> readout and transfer

We define hereafter values for each entry in the previous table:
- TC: value of the time code in [0..7]
  - ➔ *TC = TiCo % 8*
- CCDID: ID of the CCD in [0..3]
- CCDSIDE: 0 for left, 1 for right
- ROWNB: row number in [0..31]
  - ➔ *ROWNB = Y % 32*
- COLNB: column number in [0..31]
  - ➔ *COLNB = X % 32*

The following figure gives an example of the CDD image content as received by the N-DPU when the pattern mode is enabled, for the two following cases:
- First exposure of CCD 0 (time-code = 0)
- Third exposure of CCD 2 (time-code = 10)

Note: the pattern defined above is identical to the one defined for the real FEE (see [RD3]).
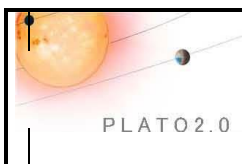
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CCD 0, LEFT, Time-code = 0

	Column 0					Column 1					Column 2294				
Row 0	000	00	0	00000	00000	000	00	0	00000	00001	000	00	0	00000	10110
Row 1	000	00	0	00000	00000	000	00	0	00000	00001	000	00	0	00000	10110
Row 31	000	00	0	11111	00000	000	00	0	11111	00001	000	00	0	11111	10110
Row 32	000	00	0	00000	00000	000	00	0	00000	00001	000	00	0	00000	10110
Row 4539	000	00	0	11011	00000	000	00	0	11011	00001	000	00	0	11011	10110

CCD 0, RIGHT, Time-code = 0

	Column 0					Column 1					Column 2294				
Row 0	000	00	1	00000	00000	000	00	1	00000	00001	000	00	1	00000	10110
Row 1	000	00	1	00000	00000	000	00	1	00000	00001	000	00	1	00000	10110
Row 31	000	00	1	11111	00000	000	00	1	11111	00001	000	00	1	11111	10110
Row 32	000	00	1	00000	00000	000	00	1	00000	00001	000	00	1	00000	10110
Row 4539	000	00	1	11011	00000	000	00	1	11011	00001	000	00	1	11011	10110

CCD 2, LEFT, Time-code = 10

	Column 0					Column 1					Column 2294				
Row 0	010	10	0	00000	00000	010	10	0	00000	00001	010	10	0	00000	10110
Row 1	010	10	0	00000	00000	010	10	0	00000	00001	010	10	0	00000	10110
Row 31	010	10	0	11111	00000	010	10	0	11111	00001	010	10	0	11111	10110
Row 32	010	10	0	00000	00000	010	10	0	00000	00001	010	10	0	00000	10110
Row 4539	010	10	0	11011	00000	010	10	0	11011	00001	010	10	0	11011	10110
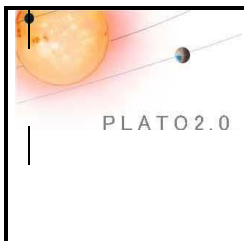
CCD 2, RIGHT, Time-code = 10

|	Column 0					Column 1					Column 2294				
Row 0	010	10	1	00000	00000	010	10	1	00000	00001	010	10	1	00000	10110
Row 1	010	10	1	00000	00000	010	10	1	00000	00001	010	10	1	00000	10110
Row 31	010	10	1	11111	00000	010	10	1	11111	00001	010	10	1	11111	10110
Row 32	010	10	1	00000	00000	010	10	1	00000	00001	010	10	1	00000	10110
Row 4539	010	10	1	11011	00000	010	10	1	11011	00001	010	10	1	11011	10110

Figure 2 - Pattern sample

The figure below gives an overview of the obtained images when they are displayed with a plotter. Missing pixels or erroneous pixels could be easily detected by a quick look.
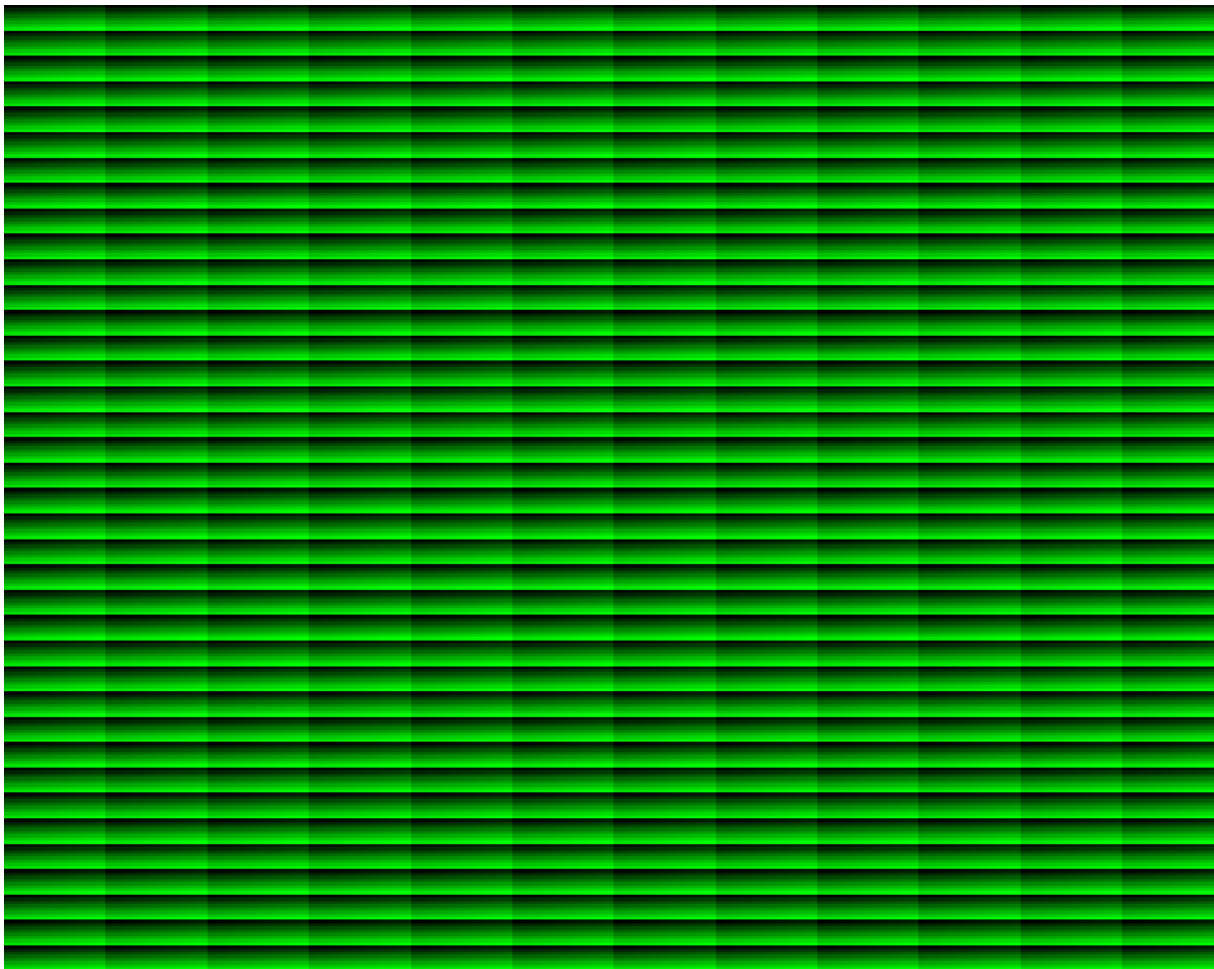
Figure 3 – Pattern sample displayed with a plotter