

# Time-Stamp Verification with - SEXTA

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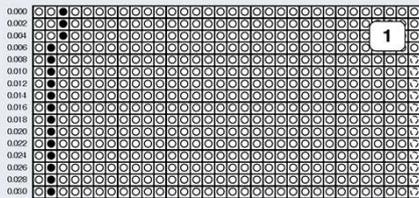
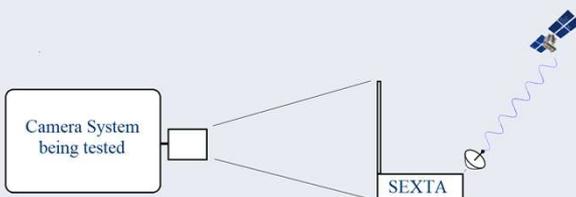
## Southern EXposure Time Analyzer - SEXTA

SEXTA is a time-stamp verification device that can be used with any camera and recorder, and offers temporal resolution of 2 msec UTC.

SEXTA-Reader is an application to load FITS (and other file format) image files, and will decode the LED display and provides exposure information for both the SEXTA display and the FITS header. It allows for the examination image sequence continuity and inter-frame dead time, as well as batch processing, output to .csv file.

SEXTA uses inexpensive, off-the-shelf components, requires minimal assembly and requires no high-voltage components or connections. The source code, wiring diagrams and applications are provided to aid the successful construction and use of the device.

### SEXTA schema



1. DMD panel of 500 LEDs.
2. 1pps LED
3. DMD-Lock LED
4. Almanac-OK LED
5. A 7-segment LED array to indicate HH:MM:SS UTC and the number of satellites in the GPS fix
6. An array of ten LEDs to indicate the last digit of UT integer seconds 0-9

e.g.

exposure start time is 12:34:56.038 UTC  
exposure end time is 12:34:56.070 UTC

The system has 5 satellites in the fix, the almanac is current and the DMD panel is locked to GPS-1pps.

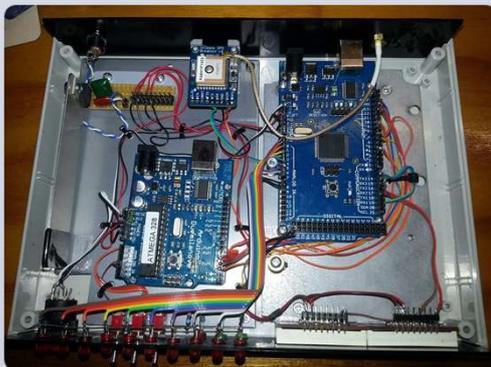
The image does not contain a UT integer boundary, so the 1pps LED is not lit.

### Example of SEXTA construction



### SEXTA - main components

- Arduino MEGA
- Arduino Duemilanova
- PA6H GPS receiver
- 2x Sparkfun 7-Segment LED Array
- 11x red LEDs
- 2x green LEDs
- Lots of hookup wire and superglue :-)



## SEXTA-Reader Analysis

A calibration image of SEXTA startup illuminates reference LEDs so a map can be defined

SEXTA reader v15

File Edit Utilities

Open Map Stamp Batch

01 03  
02 04

0 sec 9 sec

1PPS A-OK Lock

Hold down Control while clicking to define a point

Make map

Save Map

No.	(xy)
TL	(37, 82)
BL	(33, 357)
TR	(616, 83)
BR	(616, 360)
0	(154, 391)
9	(324, 390)
1PPS	(285, 417)
ACK	(303, 418)
Lock	(322, 417)
Upper	0.90
Lower	0.61

Read optical time stamp

2019-06-03\_T\_06-58-02-6430\_L-Cal\_image\_00500.FIT

Time Stamps	Central time	Start time	Stop time	Exposure
Optical	---	---	---	---
FITS	---	---	4.328	0.024
File	---	---	2019-06-03T06:58:14.328	---

Hold down Shift while moving the mouse over the map to read off the LED number and time of illumination.

SEXTA display is decoded and compared to FITS-Header time.

SEXTA reader v15

File Edit Utilities

Open Map Stamp Batch

Preferred format

FITS IPEG  
BMP PNG

Image

Sweep = 1 sec

Load Image

Load map  with images

Manual White = 45874

Black = 13762

Recompose

Read optical time stamp

2019-06-03\_T\_07-11-12-0338\_L-80ms\_image\_00000.FIT

Time Stamps	Central time	Start time	Stop time	Exposure
Optical	2.697	2.657	2.737	0.080
FITS	---	---	2.657	0.080
File	---	---	2019-06-03T07:11:12.657	---

Hold down Shift while moving the mouse over the map to read off the LED number and time of illumination.

Batch processing of images allows analysis of many minutes or hours of running.

FileName	A	B	C	D	E	F	G	H
	FITStime	FITS exposure	FITSsec	SEXTA optical start	SEXTA optical end	SEXTA optical central	SEXTA optical duration	
1								
2	2019-06-03_T_07-11-12-0338_L-80ms_image_00001.FIT	2019-06-03T07:11:12.256	0.08	0	2.257	2.337	2.297	0.08
3	2019-06-03_T_07-11-12-0338_L-80ms_image_00002.FIT	2019-06-03T07:11:13.537	0.08	0	3.537	3.617	3.577	0.08
4	2019-06-03_T_07-11-12-0338_L-80ms_image_00003.FIT	2019-06-03T07:11:14.817	0.08	0	4.817	4.897	4.857	0.08
5	2019-06-03_T_07-11-12-0338_L-80ms_image_00004.FIT	2019-06-03T07:11:16.097	0.08	0	6.097	6.177	6.137	0.08
6	2019-06-03_T_07-11-12-0338_L-80ms_image_00005.FIT	2019-06-03T07:11:17.377	0.08	0	7.377	7.457	7.417	0.08
7	2019-06-03_T_07-11-12-0338_L-80ms_image_00006.FIT	2019-06-03T07:11:18.657	0.08	0	8.657	8.737	8.697	0.08
8	2019-06-03_T_07-11-12-0338_L-80ms_image_00007.FIT	2019-06-03T07:11:19.937	0.08	0	9.937	10.017	9.977	0.08
9	2019-06-03_T_07-11-12-0338_L-80ms_image_00008.FIT	2019-06-03T07:11:21.217	0.08	0	11.217	11.297	11.257	0.08
10	2019-06-03_T_07-11-12-0338_L-80ms_image_00009.FIT	2019-06-03T07:11:22.497	0.08	0	12.497	12.577	12.537	0.08
11	2019-06-03_T_07-11-12-0338_L-80ms_image_00010.FIT	2019-06-03T07:11:23.777	0.08	0	13.777	13.857	13.817	0.08
12	2019-06-03_T_07-11-12-0338_L-80ms_image_00011.FIT	2019-06-03T07:11:25.057	0.08	0	15.057	15.137	15.097	0.08
13	2019-06-03_T_07-11-12-0338_L-80ms_image_00012.FIT	2019-06-03T07:11:26.337	0.08	0	16.337	16.417	16.377	0.08
14	2019-06-03_T_07-11-12-0338_L-80ms_image_00013.FIT	2019-06-03T07:11:27.617	0.08	0	17.617	17.697	17.657	0.08
15	2019-06-03_T_07-11-12-0338_L-80ms_image_00014.FIT	2019-06-03T07:11:28.897	0.08	0	18.897	18.977	18.937	0.08
16	2019-06-03_T_07-11-12-0338_L-80ms_image_00015.FIT	2019-06-03T07:11:30.177	0.08	0	20.177	20.257	20.217	0.08
17	2019-06-03_T_07-11-12-0338_L-80ms_image_00016.FIT	2019-06-03T07:11:31.457	0.08	0	21.457	21.537	21.497	0.08
18	2019-06-03_T_07-11-12-0338_L-80ms_image_00017.FIT	2019-06-03T07:11:32.737	0.08	0	22.737	22.817	22.777	0.08
19	2019-06-03_T_07-11-12-0338_L-80ms_image_00018.FIT	2019-06-03T07:11:34.017	0.08	0	24.017	24.097	24.057	0.08
20	2019-06-03_T_07-11-12-0338_L-80ms_image_00019.FIT	2019-06-03T07:11:35.297	0.08	0	25.297	25.377	25.337	0.08
21	2019-06-03_T_07-11-12-0338_L-80ms_image_00020.FIT	2019-06-03T07:11:36.577	0.08	0	26.577	26.657	26.617	0.08
22	2019-06-03_T_07-11-12-0338_L-80ms_image_00021.FIT	2019-06-03T07:11:37.857	0.08	0	27.857	27.937	27.897	0.08
23	2019-06-03_T_07-11-12-0338_L-80ms_image_00022.FIT	2019-06-03T07:11:39.137	0.08	0	29.137	29.217	29.177	0.08
24	2019-06-03_T_07-11-12-0338_L-80ms_image_00023.FIT	2019-06-03T07:11:40.417	0.08	0	30.417	30.497	30.457	0.08
25	2019-06-03_T_07-11-12-0338_L-80ms_image_00024.FIT	2019-06-03T07:11:41.697	0.08	0	31.697	31.777	31.737	0.08
26	2019-06-03_T_07-11-12-0338_L-80ms_image_00025.FIT	2019-06-03T07:11:42.977	0.08	0	32.977	33.057	32.977	0.08
27	2019-06-03_T_07-11-12-0338_L-80ms_image_00026.FIT	2019-06-03T07:11:44.257	0.08	0	34.257	34.337	34.297	0.08

## References and Contact details

Paper - <http://arxiv.org/abs/1503.05705>

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