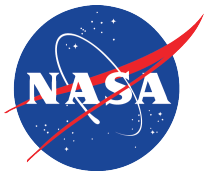

Fine Guidance Sensor Data

KSCI-19112-001

Jeffrey Van Cleve & Jennifer Campbell

19 Apr 2017

NASA Ames Research Center
Moffett Field, CA 94035

Prepared by: _____ Date 4/19/2017
Jeffrey Van Cleve, Science Office

Prepared by: _____ Date 4/20/2017
Jennifer Campbell, Science Operations Center

Approved by: _____ Date 4/19/2017
Douglas A. Caldwell, Instrument Scientist

Approved by: _____ Date 4/19/17
Michael R. Haas, Science Office Director

Approved by: _____ Date 4/19/17
Natalie M. Batalha, *Kepler* Project Scientist

Approved by: _____ Date 4/19/17
Jessie L. Dotson, *K2* Project Scientist

Document Control

Ownership

This document is part of the *Kepler* Project Documentation that is controlled by the *Kepler* Project Office, NASA/Ames Research Center, Moffett Field, California.

Control Level

This document will be controlled under KPO @ Ames Configuration Management system. Changes to this document **shall** be controlled.

Physical Location

The physical location of this document will be in the KPO @ Ames Data Center.

Distribution Requests

To be placed on the distribution list for additional revisions of this document, please address your request to the *Kepler* Science Office:

Michael R. Haas
Kepler Science Office Director
MS 244-30
NASA Ames Research Center
Moffett Field, CA 94035-1000

or

Michael.R.Haas@nasa.gov

DOCUMENT CHANGE LOG

CHANGE DATE	PAGES AFFECTED	CHANGES/NOTES
Apr 19, 2017	All	First issue

Table of Contents

1. Introduction and Overview 6
2. Flux and Centroid Data 7
2.1 Content 7
2.2 File Format for Flux and Centroid (FLC) Time Series 7
2.3 File Format for Ancillary FGS Reference Data (AFR) 9
2.4 File Naming Conventions 11
3. FGS Full-Frame Image Data (FGI) 13
3.1 Content 13
3.2 File Format 14
3.3 File Naming Conventions and File List 15
Appendix A: Example MATLAB FLC File Reader 16
Appendex B: Summary Tables of Unique Stars 17

1. Introduction and Overview

The *Kepler* and *K2* missions collected Fine Guidance Sensor (FGS) data in addition to the science data, as discussed in the *Kepler* Instrument Handbook (KIH, Van Cleve and Caldwell 2016). The FGS CCDs are frame transfer devices (KIH Table 7) located in the corners of the *Kepler* focal plane (KIH Figure 24), which are read out 10 times every second. The FGS data are being made available to the user community for scientific analysis as flux and centroid time series, along with a limited number of FGS full frame images which may be useful for constructing a World Coordinate System (WCS) or otherwise putting the time series data in context. This document will describe the data content and file format, and give example MATLAB scripts to read the time series.

There are three file types delivered as the FGS data.

1. Flux and Centroid (FLC) data: time series of star signal and centroid data.
2. Ancillary FGS Reference (AFR) data: catalog of information about the observed stars in the FLC data.
3. FGS Full-Frame Image (FGI) data: full-frame image "snapshots" of the FGS CCDs.

The FGS data are different than the *Kepler*/*K2* science data in several ways.

1. There are only 44 unique stars in the FGS data for *Kepler*, and 51 in the FGS data for *K2* through campaign 12, compared to >160,000 stars for *Kepler* science and 10,000 to 30,000 stars for a typical *K2* campaign. Note that *Kepler* used 10 FGS stars per module, while *K2* used 1 FGS star per module. Hence, there are FGS observations of more unique stars for *K2,* which sweeps the ecliptic, but much longer duration time series for *Kepler,* which observed a single celestial field of view for its entire four years.
2. The integration time is always 104 ms, without coadding, instead of 30 m for Long Cadence (LC) science and 1 m for Short Cadence (SC) science. Therefore, the shot noise component of Combined Differential Photometric Precision (CDPP) will ~16x higher than that for LC, or ~300 ppm for a 12th magnitude star, while systematic photometric errors at this level of precision are not known.
3. The area subtended by the FGS FFIs is about 1% that subtended by the science FFIs.
4. There are no pixel time series, only centroids and light curves for the guide stars.
5. No calibration has been performed. The time series are those reported by the spacecraft after simple on-board black subtraction. The FGS FFIs are also raw data.
6. The file format is more primitive. The time series are delivered as csv files with simple header lines. The observed stars are identified in a separate ancillary data reference file. The FGS FFIs are delivered as FITS files with minimal identifying information (*i.e.,* campaign, module, time stamp), but no WCS keywords.
7. As might be expected from the short integration time, the FGS stars are several magnitudes brighter than the science targets. For *Kepler*, the FGS stars have a median *Kepler* magnitude (K_p) of 12.1, while for *K2* the median FGS magnitude is 10.1; *K2* requires brighter stars in part to compensate for using one of them instead of 10.

While the data set has the limitations listed above, it is important to note some stars of possible scientific interest: the Kepler Data Characteristics Handbook (KDCH) §4.5 shows an intrinsically variable star and an eclipsing binary (EB) in the *Kepler* FGS data, and the *K2* C6 Data Release Notes (DRN) and the addendum https://keplerscience.arc.nasa.gov/images/release-notes/c6/var_fgs_kso-391_drnC6_addendum_16040722.pdf discuss the EB EPIC 212783022 in the *K2* FGS data shown in Figure 1.

The *Kepler* FGS data delivery is complete, as the *Kepler* mission is over. The *K2* FGS data is complete through mid-campaign 12, and will be updated at the end of the *K2* mission for campaigns 13 and later.

2. Flux and Centroid Data

2.1 Content

Since there are many measurements performed on each FGS star per quarter or campaign, it was convenient to separate the FGS data into two types of files:

1. Flux and centroid data (FLC), which is the time series of star signal and centroid computed on-board the spacecraft and used by the spacecraft Attitude Determination and Control System (ADCS). The underlying pixel data are not saved on the spacecraft, except in the relatively rare commanded FGS FFI. The file name gives the quarter or campaign, and the file header line identifies the module and star index on that module with a string identifying the type of data: SIGMAG for flux (signal magnitude), CENTCOL (centroid column), or CENTROW (centroid row).

2. Ancillary FGS reference (AFR) data contains catalog information about the observed stars, and the location and size of the Pixel of Interest (POI) block from which the centroids were calculated. The star information is keyed to the quarter/campaign, module, and star index in the FLC file. Users can then associate a star with known catalog magnitude and astronomical coordinates with an absolute (row, column) position on the module. This information may be useful in identifying the other stars in the FGS FFIs.

The quantities SIGMAG, CENTCOL, and CENTROW are calculated every 104 ms FGS frame, but values are saved from this data stream only once every 16 s to 60 s due to onboard storage limitations. That is, only one out of every 160 - 600 calculations is saved. The units of SIGMAG are raw data numbers from the FGS CCD analog-to-digital converter, summed over the black-subtracted pixels in the POI block. A very rough calibration suggests that

$$\text{SIGMAG} \approx 37068 * 2.71^{(8.5-\text{Kp})}.$$

The units of CENTCOL and CENTROW are FGS pixels (13.0 microns or 1.92 arcsec) with respect to the (0, 0) corner of the POI block. Only the electronic black is subtracted from the pixels before centroiding. Since the sky background is not subtracted, the calculated centroids will contain small systematic errors proportional to product of the sky background and the displacement of the centroid from the POI center; an example manifestation of this problem would be a centroid that tracks the brightness of the star.

Though the onboard sampling rate is fixed, the sampling rate for the saved data can vary within a quarter or campaign, or from one data set to the next. Most data sets include a ~1-hour burst of high-speed data collection, where FLC data is stored every 104 ms for diagnostic use. The save rate or its phase can be different for various telemetry items, so while each time stamp has at least one datum, not all data are necessarily present at each time stamp in the file as described in the next section.

2.2 File Format for Flux and Centroid (FLC) Time Series

The FLC data files contain up to 31 columns. The first column is the date/time at which the data were collected. Columns 2-31 are the flux values and row/column pixel values of the centroid data for each target observed, as shown in Table 1.

Table 1: FLC File Format

TELEMETRY NAME	Unit	Format
SPACECRAFT_DATETIME	UTC	MM/DD/YY HH:MM:SS.s
FGM[MM]SIGMAG[TT]	Signal Magnitude DN	Double precision: n.8E2 The resolution of the data is 1 DN, so digits beyond the 3rd after the decimal place are all zero. [MM] is the FGS Module number: 01, 05, 21, or 25. [TT] is the FGS Target number: 01, 02, …, 10 for *Kepler*; 01 or 02 for *K2*.
FGM[MM]CENTCOL[TT]	Fractional Column Pixel Number	Double precision: n.8E2 [MM] is the FGS Module number: 01, 05, 21, or 25. [TT] is the FGS Target number: 01, 02, …, 10 for *Kepler*; 01 or 02 for *K2*.
FGM[MM]CENTROW[TT]	Fractional Row Pixel Number	Double precision: n.8E2 [MM] is the FGS Module number: 01, 05, 21, or 25. [TT] is the FGS Target number: 01, 02 … through 10 for *Kepler*; 01 or 02 for *K2*.

A sample of the *Kepler* FLC file for Q15 module 5 is given below, with highlighted examples of lines where not all telemetry items are present for a particular timestamp. For simplicity, only the data for the first star is shown.

```
# Kepler Fine Guidance Sensor Flux and Centroid Data
# SPACECRAFT_DATETIME,FGM05SIGMAG01,FGM05CENTCOL01,FGM05CENTROW01,…
#UTC, DN, Pixel, Pixel,…
01/01/13 00:00:13.596,2.5080000000000E+03,3.8125996810207E+00,4.2204944178628E+00,…
01/01/13 00:00:43.096,2.4930000000000E+03,3.8110709987966E+00,4.1913357400722E+00,…
01/01/13 00:01:12.596,2.4720000000000E+03,3.8131067961165E+00,4.2063106796117E+00,…
Skip a few lines to get to an example of irregular sampling
01/01/13 00:26:46.596,2.4990000000000E+03,3.8111244497799E+00,4.1996798719488E+00,…
01/01/13 00:27:16.083,2.4730000000000E+03,3.8139911039224E+00,4.1775171856045E+00,…
01/01/13 00:27:45.583,2.4810000000000E+03,3.8041112454655E+00,4.1983071342201E+00,…
01/01/13 00:27:52.083,,3.8066720257235E+00,4.2081993569132E+00,,…
01/01/13 00:28:15.096,2.4910000000000E+03,3.8229626655961E+00,4.1790445604175E+00,…
```

Similarly, a sample of the *K2* FLC file is given below, again with missing values highlighted. While the K2 fields for stars 2-10 may be populated with numbers in the FLC files, those numbers are not meaningful, and are not shown below.

```
# K2 Fine Guidance Sensor Flux and Centroid Data
# SPACECRAFT_DATETIME, FGM01SIGMAG01, FGM01CENTCOL01, FGM01CENTROW01
#UTC, DN, Pixel, Pixel
04/22/16 13:09:49.5,2.90410000E+04,,
04/22/16 13:09:50.0,,1.84047635E+01,1.72141533E+01
04/22/16 13:10:49.0,2.92190000E+04,,
04/22/16 13:10:49.5,,1.67686223E+01,1.91416534E+01
04/22/16 13:11:48.5,2.91110000E+04,,
04/22/16 13:11:49.0,,1.65819180E+01,1.93507855E+01
```

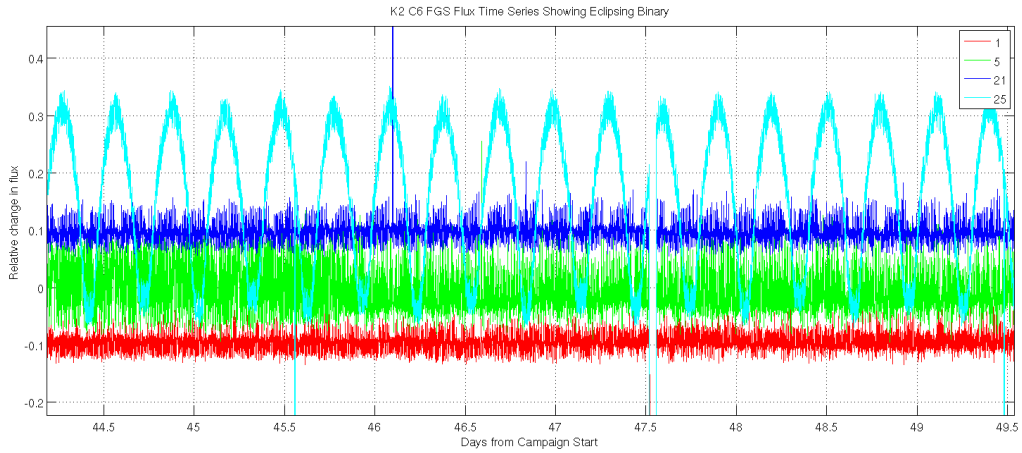

Figure 1: FGS Flux Time Series from K2 C6 Showing Eclipsing Binary on mod 25. Relative flux is flux/median - 1. Legend shows module number.

2.3 File Format for Ancillary FGS Reference Data (AFR)

The AFR data are contained in a comma-separated text file. The file contains four header lines and then a body. The header lines are marked with a leading character '#'. The fields in the body of the file are described in Table 2.

Table 2: AFR Field Description

Column number	Column Heading	Description	Units/ Format
1	QUARTER|CAMPAIGN	The quarter number for the *Kepler* Mission, or campaign number for the *K2* Mission.	U: Number F: Two-digit integer with leading 0's
2	FGS_MODULE	The FGS Module number, one of: 01, 05, 21, 25.	U: Number F: Two-digit

Column number	Column Heading	Description	Units/ Format
			integer with leading 0's
3	STAR_INDEX	FGS Target number, [TT] in Table 1. Normally set to 01 for *K2*; may be incremented to indicate guide star changes during a campaign.	U: Number F: Two-digit integer with leading 0's
4	*KEPLER*_ID	The *Kepler* Input Catalog (KIC) Target ID for *Kepler* Mission data, or EPIC ID for *K2* Mission data.*	U: Number F: Nine-digit integer with leading 0's
5	RA	The Right Ascension (RA) position of the target in degrees for J2000 epoch. If not in J2000, then the epoch needs to be stated as an additional comment in the file header.	U: Decimal Degrees F: Fixed-point float with 8 digits after decimal, of which only the first 6 are meaningful.
6	DEC	The Declination (DEC) position of the target in degrees for J2000 epoch. If not in J2000, then the epoch needs to be stated as an additional comment in the file header.	U: Decimal Degrees F: Fixed-point float with 8 digits after decimal, of which only the first 6 are meaningful.
7	KEPMAG	The *Kepler* Magnitude of the target.	U: Magnitude F: Fixed-point float with 3 digits after decimal.
8	APERTURE_REF_ROW	The reference row pixel position of the lower left-hand corner of the smallest target aperture used in a given quarter/campaign. APERTURE_REF_ROW is a zero-based index.	U: Number F: Three-digit integer with leading 0's
9	APERTURE_REF_COLUMN	The reference column pixel position of the lower	U: Number F: Three-digit

Column number	Column Heading	Description	Units/ Format
		left-hand corner of the smallest target aperture used in a given quarter/campaign. APERTURE_REF_COLUMN is a zero-based index.	integer with leading 0's
10	APERTURE_SIZE	The one-dimensional size, in pixels, of the smallest square POI used in a given quarter/campaign.+	U: Number F: Two-digit integer with leading 0's

*For *Kepler*, the KIC target ID (column 4) was known at the time of observation. For *K2*, FGS stars were selected from other catalogs, and later matched to the EPIC catalog using their positions and magnitudes.

+At times, the *Kepler* POI block size will change during a quarter, which can be detected by watching for sudden jumps in the centroids. Only block sizes of 8 x 8 and 16 x 16 were ever used, so simultaneous jumps of ~4 pixels in the row and column centroids typically mark these block-size transitions.

The header lines for the AFR data are shown below:

```
# Kepler Ancillary FGS Reference Data
# Date written: 1/13/2016
# QUARTER,FGS_MODULE,STAR_INDEX,KEPLER_ID,RA,DEC,KEPMAG,APERTURE_REF_ROW,APERTURE_REF_COLUMN,APERTURE_SIZE
# Number,Number,Number,Number,Decimal Degrees,Decimal Degrees,Magnitude,Number,Number,Number
```

2.4 File Naming Conventions

The FLC data file names have the following format:

`[kplr|ktwo]-flc-[q|c][NN]-[MM].txt`

For the case in which all data for a module cannot be included in a single file, the FLC data file name has the following format:

`[kplr|ktwo]-flc-[q|c][NN]-[MM]-[XX].txt`

where

- [kplr|ktwo] is kplr for *Kepler* mission data, or ktwo for *K2* mission data
- [q|c] is q (for quarter) for *Kepler* mission data, or c (for campaign) for *K2* mission data
- [NN] is the quarter or campaign number and is formatted %02.0f (*i.e.*, 02, 11, etc.)
- [MM] is the FGS module number and is formatted %02.0f (*i.e.*, 01, 05, 21, 25)
- [XX] is an incrementing number used to differentiate between multiple files associated with a single module and is formatted %02.0f (*i.e.*, 01, 02, …)

Examples of a single file per module: `kplr-flc-q02-01.txt, ktwo-flc-c10-05.txt`

Examples of multiple files per module: `kplr-flc-q02-01-00.txt, kplr-flc-q02-01-01.txt`

For *K2*, STAR_INDEX is incremented beyond 01 to indicate guide star changes that occur during a single campaign. In this case, the FLC data is divided into multiple files with the filename field XX set equal to STAR_INDEX. For example, XX = 01 for C11a and XX = 02 for C11b so that the "01" and "02" in the ancillary file each point to a unique FLC data set.

The AFR data filename has the following format:

`[kplr|ktwo]-anc-<YYYYDOYHHMMSS>.txt`

where

- [kplr|ktwo] is kplr for *Kepler* mission data, or ktwo for *K2* mission data
- [YYYYDOYHHMMSS] is the UTC time when the file was produced, and is formatted: 4-digit year (YYYY formatted %04.0f), 3-digit day of year (DOY formatted %03.0f), hour (HH formatted %02.0f), minute (MM formatted %02.0f), second (SS formatted %02.0f)

Examples: `kplr-anc-2016214120500.txt, ktwo-anc-2016244120500.txt`

3. FGS Full-Frame Image Data (FGI)

The FGS FFI are 104-ms "snapshots" collected from time to time for ADCS diagnostic purposes. The signal content of an FGS FFI image is shown in **Figure 2**, and the detector properties of this frame transfer device are shown in KIH Table 7. After each 104-ms integration, the image is snapped to a shielded storage area and read out. Note that each of the four FGS modules has a unique sky orientation with respect to pixel rows and columns, as shown in KIH Figure 24. The data type is denoted as FGI in the file name.

3.1 Content

The readout and physical attributes of an FGS FFI image are shown in **Figure 2.**

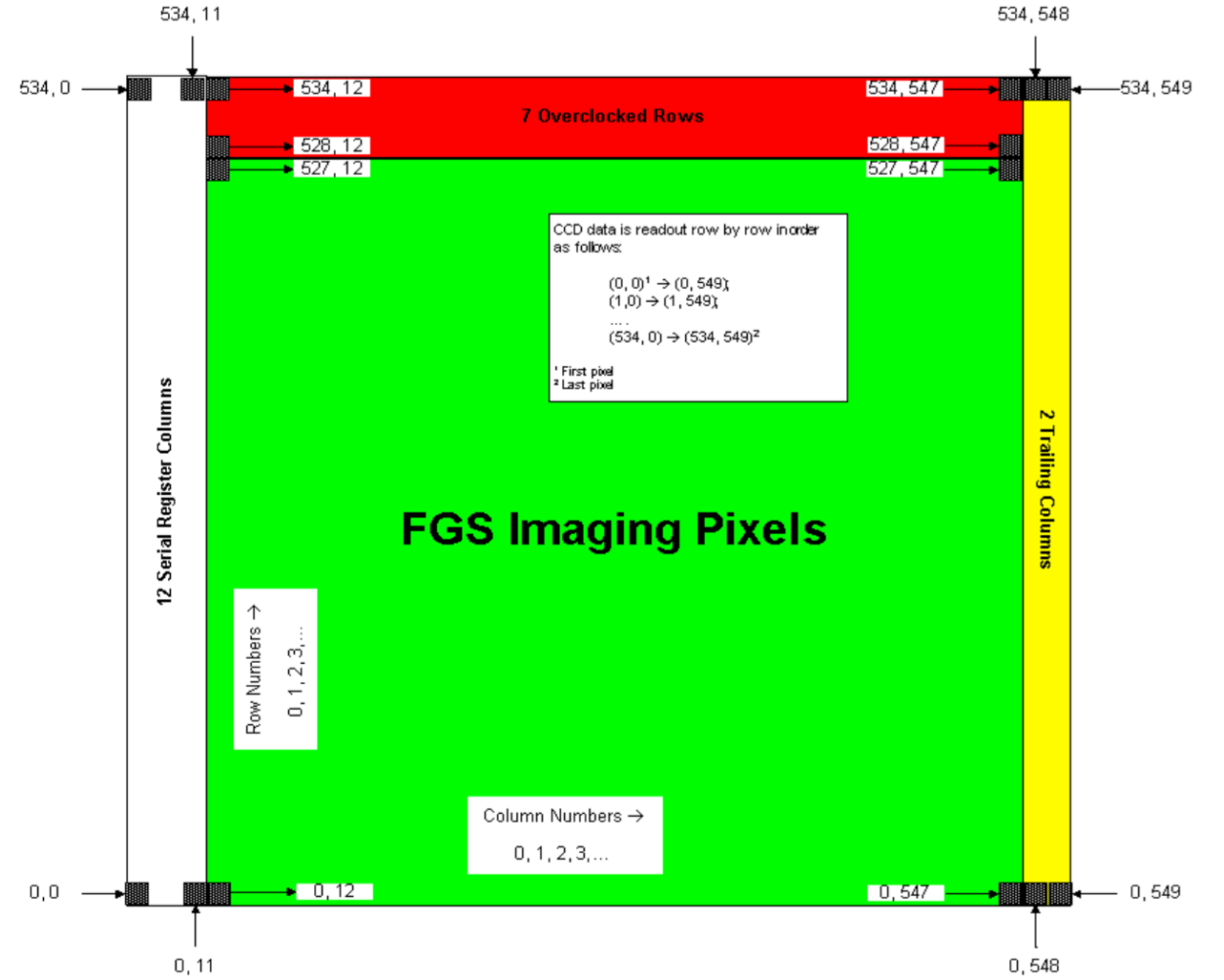

Figure 2: **FGS CCD Signal Content Map. The output amplifier is in the lower left corner**.

The only processing applied to FGS FFI data is to strip leading transmission bits and reform the data into module-by-module images. The values are the raw data numbers coming out of the 14-bit A/D converter on board the *Kepler* spacecraft, stored as 32-bit unsigned integers in the Science/FGS Data Accumulator. Unlike the science FFIs, the FGS FFIs are not coadded. The maximum data value is thus 2^{14}-1. An example image is shown in **Figure 3.**

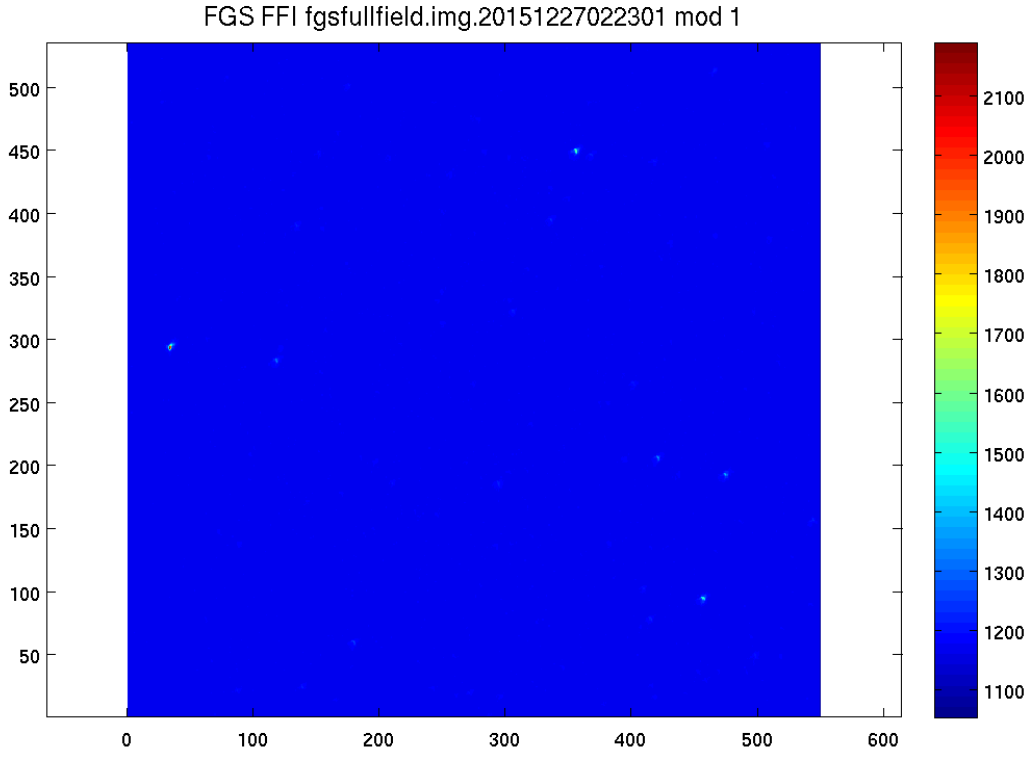

Figure 3: Example FGS FFI Image for Module 1, showing a few stars.

3.2 File Format

This image data have been formed into FITS data cubes, where the four planes correspond to modules 1, 5, 21, 25, respectively. No special tool is needed to read them, any standard FITS reader will work. The bare-bones FITS header looks like this:

```
SIMPLE  =                    T / file does conform to FITS standard
BITPIX  =                  -64 / number of bits per data pixel
NAXIS   =                    3 / number of data axes
NAXIS1  =                  550 / length of data axis 1
NAXIS2  =                  535 / length of data axis 2
NAXIS3  =                    4 / length of data axis 3
EXTEND  =                    T / FITS dataset may contain extensions
COMMENT   FITS (Flexible Image Transport System) format is defined in 'Astronomy
```

```
COMMENT   and Astrophysics', volume 376, page 359; bibcode: 2001A&A...376..359H
END
```

The FGI data filenames contain the only other available information (*i.e.*, quarter/campaign and time of data collection) for these data, as described in the next section.

3.3 File Naming Conventions and File List

The FGI data filenames have the following format:

`[kplr|ktwo]-fgi-[q|c][NN]-<YYYYDOYHHMMSS>.fits`

where

- [kplr|ktwo] is kplr for *Kepler* mission data, or ktwo for *K2* mission data
- [q|c] is q (for quarter) for *Kepler* mission data, or c (for campaign) for *K2* mission data
- [NN] is the quarter or campaign number and is formatted %02.0f (*i.e.*, 02, 11, etc.)
- [YYYYDOYHHMMSS] is the UTC end time for data collection and is formatted as: 4-digit year (YYYY formatted %04.0f), 3-digit day of year (DOY formatted %03.0f), hour (HH formatted %02.0f), minute (MM formatted %02.0f), second (SS formatted %02.0f)

Examples: `kplr-fgi-q02-2009259232411.fits`, `ktwo-fgi-c08-2016014203204.fits`

There were 38 FGS FFIs in Kepler, all of which were in Q0:

```
kplr-fgi-q00-2009099235418.fits  kplr-fgi-q00-2009106235316.fits  kplr-fgi-q00-2009111032452.fits
kplr-fgi-q00-2009099235556.fits  kplr-fgi-q00-2009106235454.fits  kplr-fgi-q00-2009111032630.fits
kplr-fgi-q00-2009099235734.fits  kplr-fgi-q00-2009106235631.fits  kplr-fgi-q00-2009111194206.fits
kplr-fgi-q00-2009099235912.fits  kplr-fgi-q00-2009106235809.fits  kplr-fgi-q00-2009111194344.fits
kplr-fgi-q00-2009100000050.fits  kplr-fgi-q00-2009106235947.fits  kplr-fgi-q00-2009111194524.fits
kplr-fgi-q00-2009100000228.fits  kplr-fgi-q00-2009111031145.fits  kplr-fgi-q00-2009111194702.fits
kplr-fgi-q00-2009100000406.fits  kplr-fgi-q00-2009111031323.fits  kplr-fgi-q00-2009111194840.fits
kplr-fgi-q00-2009100000544.fits  kplr-fgi-q00-2009111031504.fits  kplr-fgi-q00-2009111195018.fits
kplr-fgi-q00-2009100000722.fits  kplr-fgi-q00-2009111031642.fits  kplr-fgi-q00-2009111195156.fits
kplr-fgi-q00-2009100000900.fits  kplr-fgi-q00-2009111031820.fits  kplr-fgi-q00-2009111195334.fits
kplr-fgi-q00-2009106234823.fits  kplr-fgi-q00-2009111031958.fits  kplr-fgi-q00-2009111195512.fits
kplr-fgi-q00-2009106235001.fits  kplr-fgi-q00-2009111032136.fits  kplr-fgi-q00-2009111195650.fits
kplr-fgi-q00-2009106235139.fits  kplr-fgi-q00-2009111032314.fits
```

There have been 3 FGS FFIs to date in K2:

```
ktwo-fgi-c03-2015035030338.fits
ktwo-fgi-c04-2015114090008.fits
ktwo-fgi-c07-2015361022301.fits
```

Appendix A. Example MATLAB FLC File Reader

This program will read the FLC data and plot it, even if a time stamp does not have data for all telemetry items. It relies on MATLAB's relatively benign handling of NaNs in plots. It is up to the end user to account for such missing data in any subsequent analyses.

```
%constants hand-edited for Kepler quarter 15 module 1,
%which is known to have 10 stars per module
fname = 'kplr-flc-q15-05.txt';
% starNumber = 3;
fileID = fopen(fname);
C = textscan(fileID,['%s ' repmat('%f ',1,30)],'CommentStyle',{'#'},'Delimiter',',',...
    'CollectOutput',true);
fclose(fileID);
%plot each star with data ordered signal, column, row
for starNumber = 1:10
    close all
    TCAD_Times = C{1};
    TimeStringArray = char(TCAD_Times);
    timeInDays = datenum(TimeStringArray,'mm/dd/yy HH:MM:SS');
    timeInMinFromStart = (timeInDays - timeInDays(1))*24*60;
    %plot centroids of first star
    plot(timeInMinFromStart,C{2}(:,(starNumber - 1)*3 + 2) - 3,'-+')
    hold on
    plot(timeInMinFromStart,C{2}(:,(starNumber - 1)*3 + 3) - 3,'g-+')
    grid on
    axis([0 60 0 4])
    medianSignal = nanmedian(C{2}(:,(starNumber - 1)*3 + 1));
    plot(timeInMinFromStart,C{2}(:,(starNumber - 1)*3 + 1)/medianSignal,'r-+')
    legend('col - 3','row - 3',['signal/' num2str(medianSignal)])
    title(['FGS data file ' fname ' Star ' num2str(starNumber)],'FontSize',12)
    xlabel('time from start (min)')
    pause(1)
end
```

Appendix B. Summary Tables of Unique Stars

Unique FGS Stars for *Kepler*

ANC file: kplr-anc-2017013163000.txt

nQ = number of Quarters this star was used

KepId	RA(deg)	DEC(deg)	Kp	nQ	Quarters used
2564891	289.11509	37.86175	12.62	18	all
2564902	289.11793	37.89535	11.96	18	all
2564943	289.12707	37.87800	11.16	18	all
2702489	288.85366	37.95832	12.46	18	all
2702652	288.89931	37.94624	12.68	18	all
2703055	289.01190	37.93423	12.30	18	all
2703297	289.07746	37.93012	12.65	18	all
2841963	288.89456	38.01393	11.04	18	all
2842204	288.96774	38.04761	11.31	2	0,1
2842228	288.97492	38.02445	11.45	16	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
2842495	289.04412	38.02122	12.97	18	all
7232119	299.70359	42.78750	12.08	18	all
7232520	299.80143	42.79381	11.45	18	all
7312553	299.42625	42.88445	10.55	18	all
7312692	299.45648	42.86780	12.82	18	all
7313143	299.53994	42.80860	12.42	2	0,1
7313592	299.62430	42.80439	11.43	18	all
7313623	299.63150	42.87240	13.45	18	all
7313808	299.67558	42.84248	13.04	18	all
7394220	299.59292	42.95465	10.94	16	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
7394260	299.60266	42.90705	11.26	18	all
7394669	299.70467	42.90186	11.74	18	all
8999055	281.27343	45.31813	13.06	18	all
8999288	281.43214	45.37056	12.34	18	all
8999341	281.47357	45.39422	11.73	18	all
9068487	281.23392	45.48416	13.06	18	all
9068628	281.32822	45.43674	13.77	18	all
9068779	281.43185	45.47927	12.36	18	all
9068851	281.48147	45.44275	13.06	18	all
9134448	281.18670	45.51307	11.36	18	all
9134538	281.25132	45.54009	9.82	18	all
9134679	281.33753	45.56874	13.52	18	all
12260253	292.61933	50.97333	11.73	15	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17

KepId	RA(deg)	DEC(deg)	Kp	nQ	Quarters used
12260315	292.66116	50.96534	10.92	18	all
12260326	292.66992	50.99905	12.21	18	all
12260474	292.75144	50.92705	11.73	18	all
12260613	292.81878	50.94043	13.41	18	all
12260720	292.88583	50.97510	13.42	18	all
12309156	292.56348	51.00612	11.55	18	all
12309287	292.65576	51.09255	11.34	18	all
12309365	292.70851	51.05231	11.17	18	all
12309615	292.86362	51.04139	11.42	15	3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
12309761	292.93876	51.06154	8.65	3	0,1,2
12309837	292.98654	51.01211	10.82	3	0,1,2

Unique FGS Stars for *K2* through C11b

ANC file: ktwo-anc-2017013163000.txt

Stars with missing matches* omitted

KepId	RA(deg)	DEC(deg)	Kp	nQ	Quarters used
201052614	181.45970	-8.01460	10.46	1	10
201209996	177.98220	-3.86840	10.32	1	1
201301525	168.60540	-2.42800	8.80	1	1
201556486	182.74800	1.38440	10.45	1	10
201805239	179.29240	5.46420	9.39	1	1
201877505	169.91300	6.86320	9.33	1	1
203062040	241.36000	-27.39000	9.58	1	2
204938966	254.54140	-20.17470	10.43	2	11a,11b
205336529	240.66000	-18.17200	8.99	1	2
205497868	250.50000	-17.19500	10.69	1	2
205910349	335.48060	-17.79320	10.46	1	3
206096419	343.29450	-12.19190	10.58	1	3
206193502	329.91400	-9.86940	10.70	1	3
206517350	337.76150	-4.52340	10.81	1	3
207187836	94.54530	15.95206	8.58	1	0
207645006	104.12110	17.85792	10.55	1	0
209481103	92.11690	25.18470	10.02	1	0
210358398	56.84690	12.44990	9.54	1	4
210564922	65.60400	16.44550	10.94	1	4
210851619	52.36870	20.65100	11.04	1	4
211126207	61.32840	25.00070	9.65	1	4

KepId	RA(deg)	DEC(deg)	Kp	nQ	Quarters used
211419389	134.91030	11.93180	8.77	1	5
211422841	125.31850	11.98270	11.10	1	5
212069778	125.10150	21.45190	9.81	1	5
212069876	135.19870	21.45250	8.64	1	5
212334861	209.09730	-16.53510	9.66	1	6
212382936	199.40030	-15.30990	9.86	1	6
212744228	210.10280	-7.13690	10.57	1	6
212783022	200.68670	-6.03530	9.51	1	6
213466762	284.78320	-29.32290	11.27	1	7
214614817	294.53070	-26.05830	10.82	1	7
217446902	281.23330	-20.56020	11.06	1	7
219194013	290.58290	-17.31920	9.43	1	7
220164370	15.40680	-1.40290	11.23	1	8
220370835	22.99710	4.12310	10.56	1	8
220475282	9.76910	6.20390	10.88	1	8
220715266	17.39820	11.91000	9.92	1	8
222365021	266.63450	-27.60040	8.97	2	11a,11b
222477632	266.62890	-27.43860	8.31	1	9
223936813	276.58640	-25.13720	10.10	1	9
227348729	264.31230	-18.37340	9.40	2	11a,11b
227425504	264.23910	-18.18340	8.77	1	9
228144067	273.95350	-16.02380	9.03	1	9
228737911	190.72680	-9.48050	9.12	1	10
229062364	192.04860	-0.15660	10.43	1	10
231611281	256.10420	-29.37050	10.19	2	11a,11b
245931630	350.66960	-11.63330	11.16	1	12
246153172	358.17130	-5.99390	9.27	1	12
246245456	345.18930	-4.13550	10.90	1	12
246476624	352.53170	1.43400	10.19	1	12

*Stars with missing matches in ktwo-anc-2017013163000.txt identified:
Campaign 0, Module 5 at RA = 102.5102, Dec = 27.0035. Magnitude = 8.55 is EPIC 209863186
Campaign 2, Module 1 at RA = 251.7636, Dec = -26.705. Magnitude = 9.7 is EPIC 203264125