



Kepler: A Search for Terrestrial Planets

Kepler Archive Manual

KDMC-10008

August 30, 2009



**Space Telescope Science Institute
3700 San Martin Drive
Baltimore, MD 21218**

Approved by: _____ Date _____
Chris Middour, SOC Systems Engineer

Approved by: _____ Date _____
Michael Haas, Science Office Director

Approved by: _____ Date _____
Rick Thompson, Ground Segment Systems Engineer

Approved by: _____ Date _____
Steve Jara, Mission Assurance

Concur: _____ Date _____
Ron Gilliland, Co-Investigator, DMC

Prepared by: _____ Date _____
Dorothy Fraquelli, Archive Scientist

Chapter 1 Introduction	5
1.1 Overview of Kepler	5
1.2 Overview of Data Flow	7
1.3 Overview of MAST	7
1.4 Related Documents	8
1.5 User Support Services	8
1.6 Registering as a User	9
1.7 Proprietary Data Periods	9
1.8 Finding Documentation	10
1.9 Getting Your Data	10
1.10 Publication Acknowledgement	11
Chapter 2 Kepler Data Products	12
2.1 Definitions	12
2.2 File Name Syntax	14
2.3 Types of Data in the Archive	16
2.3.1 Light Curves	16
2.3.2 Target Pixel Data	18
2.3.3 Focal Plane Characterization Model	18
2.3.4 Full Frame Image:	20
2.3.5 Calibrated Cadence Data	21
2.3.6: Ancillary Engineering Data	23
2.3.7 Spacecraft Ephemeris	24
2.4 The Standard Kepler Dataset	24
2.5 Times in Kepler Headers	24
Chapter 3 Searching the Archive for <i>Kepler</i> Data	25
3.1 The Kepler Catalogs as Presented at MAST	25
3.2 The MAST Search Forms	29
3.2.1 Kepler Target Searches	30
3.2.2 Kepler Data Searches	33
3.3 Examples	37
3.3.1. kepler_id Search	37
Chapter 4 Go Information	38
4.1 Finding a Target	38
4.2 Getting Your GO Data	39
Appendices	40
A.1: Kepler Light Curve header	41
A.2: Long and Short Cadence Target Pixel Data Headers	43
A.3: Long Cadence Target Pixel Background Header	47
A.4.1: Long Cadence Target Pixel Collateral Headers	51
A.4.2: Short Cadence Target Pixel Collateral Header	54
B.1.1: Target and Background Pixel Cosmic Ray Correction Table header	59
B.1.2: Long Cadence Collateral Pixel Cosmic Ray Correction Table header	61
B.2.1: Short Cadence Collateral Pixel Cosmic Ray Correction Table header	63

C.1.1: Flat Field and 2d Black Image Header.....	65
D.1.1: Cadence Data headers	66
D.1.2: Full Frame Image (FFI) header.....	71
E.1.1: Target and Background Pixel Mapping Reference File header	76
E.1.2: Long Cadence Collateral Pixel Mapping Reference File header	78
E.1.3: Short Cadence Collateral Pixel Mapping Reference File header.....	80
F.1: Kepler Ancillary Engineering data header.....	82
G.1: Compression Histogram header.....	84

Chapter 1 Introduction

Data from the *Kepler* mission are housed in the Archive at the Space Telescope Science Institute (STScI) and accessed through MAST (Multi-mission Archive at Space Telescope). The Kepler Input Catalog (KIC), Kepler Target Catalog (KTC), Characterization Table (CT) and Kepler Results Catalog (KRC) are also accessed through MAST. Products such as light curves and target pixel data are stored on spinning disk. General information about *Kepler* may be found at the *Kepler* Mission <http://www.kepler.arc.nasa.gov/> and the *Kepler* GO Program <http://keplergo.arc.nasa.gov/> web sites.

1.1 Overview of Kepler

The *Kepler* mission is specifically designed to survey a region of the Milky Way galaxy to detect and characterize hundreds of Earth-size and smaller planets in or near the habitable zone. The transit method of planetary detection is used. The expected lifetime of the mission is 3.5 to 6 years.

The *Kepler* telescope has a 0.95-meter aperture and a 105 deg^2 (about 12 degree diameter) field-of-view (FOV). It is pointed at and records data from the same group of stars for the duration of the mission. The single instrument on board, a photometer, is an array of 42 CCDs arranged in 21 modules of 2 CCDs each. Each CCD has 2 outputs. The half-maximum bandpass is 435 to 845 nm, with $>1\%$ relative spectral response as short as 420 nm and as long as 905 nm. Each 50x25 mm CCD has 2200x1024 pixels. The interval between reads of a given pixel of a CCD is the integration time, which is composed of a “selectable” exposure time and fixed readout time of 0.520 seconds. All pixels are read out for each integration, and temporally summed in the Science Data Accumulator (SDA). Mission and GO target lists determine which of those SDA summed pixels are read out of the SDA and transmitted to the Solid State Recorder for later downlink. On average 32 pixels are read out of the SDA per target. The *long cadence* data are summed into onboard memory for 30 minutes, (270 integrations) while the *short cadence* data are 1 minute sums (9 integrations). Downlinks are expected to occur on an approximate monthly basis.

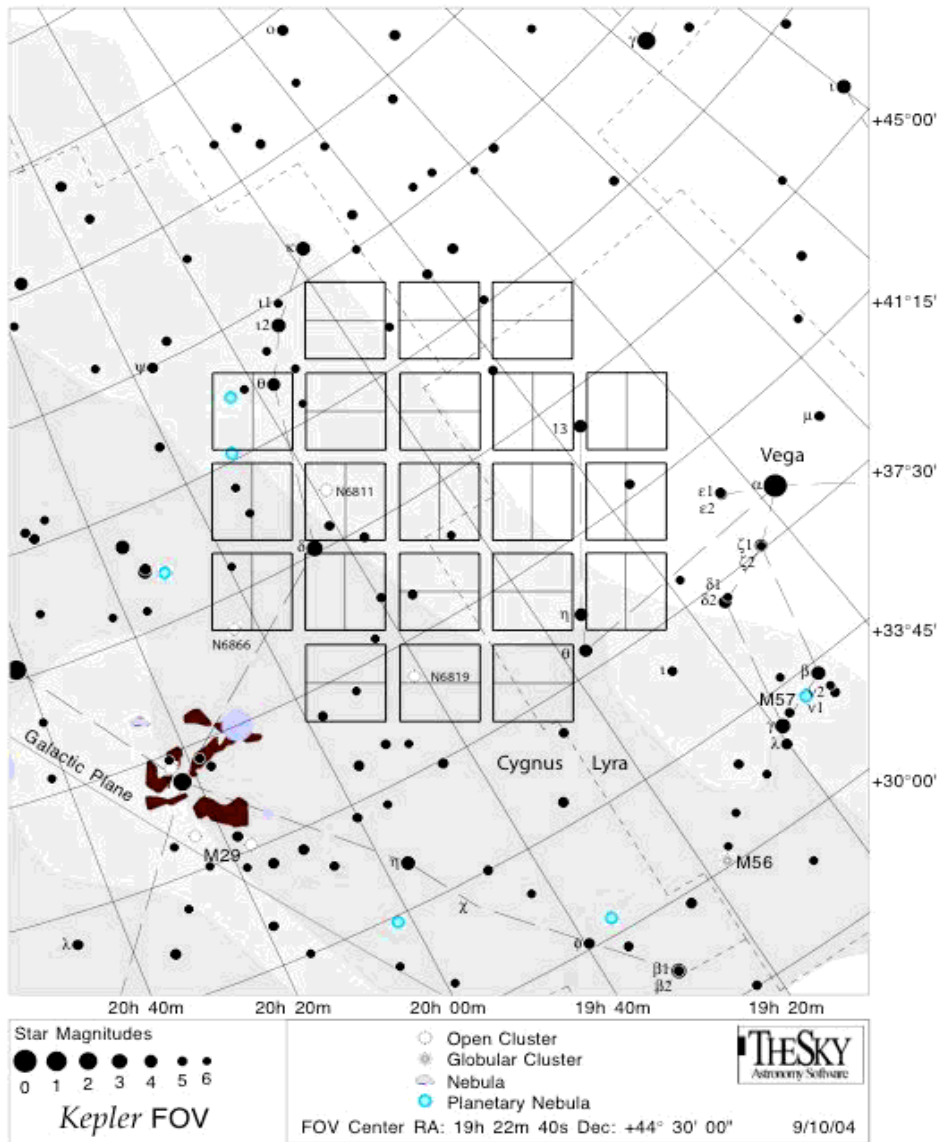
NB: The “selectable” exposure time is **not** specifiable by users.

A star field near the galactic plane, centered on galactic coordinates $l = 76.32^\circ$, $b = +13.5^\circ$ (RA=19h 22m 40s, Dec=+44° 30' 00"), is the “field.” Figure 1-1 shows the field with the *Kepler* FOV superimposed. The squares show the 5 square degree FOV of each of the 21 modules. The gaps between the modules are aligned so that about half of the 15 stars in the FOV brighter than $m_v=6$ fall in these gaps. The 42 CCDs cover a four-way symmetrical pattern on the sky such that the same stars stay visible during the mission, even after a quarterly 90° roll. In addition, the orientation of the rows and columns of each module location on the sky is preserved for all roll orientations. The center module is only 180 degree symmetric. The roll is necessary to keep the solar arrays oriented towards the Sun and the radiator pointed towards deep space.

Kepler is in an Earth-trailing heliocentric orbit with a period of 372.5 days. In this orbit the spacecraft slowly drifts away from the Earth and is at a distance of over 0.5 AU after 3.5 years. The orbit permits continuous pointing on a single region of the sky. Additional advantages are the very stable pointing attitude and the avoidance of high radiation dosage associated with an Earth orbit, but from time to time the spacecraft is subject to solar flares.

The data will be calibrated. Bias (dark level) and smear (the photometer has no shutter) will be removed and values converted to electrons detected per cadence. The Data Management Center (DMC) will sort the raw and calibrated pixel values by target into target pixel files, permitting users to perform their own photometry or other forms of analysis. Light curves for all the stars will be produced on a quarterly basis at NASA Ames Research Center (ARC). These calibrated light curves will be sent to the DMC for archiving. There may be a quarter year lag for processing between receipt of data from the spacecraft and archiving of the data at the DMC. Data retrieval is via MAST.

Figure 1-1 Kepler Field of View



At launch, ~150,000 targets were reserved for the mission. After the first year of operation, a “down select” may occur. The down select is expected to reduce the number of mission targets to ~100,000. The archived data for the deselected targets will become public within about two months of the down select.

During the final 10 days of commissioning and 35 days before the first quarterly roll, all stars brighter than Kepler magnitude = 13.5 were observed. Approximately 20,000 stars from this 45 day period were identified as red giants and were subsequently dropped from the science team program starting with the June 19, 2009 observations.

Through MAST, users will be able to search for existing targets of potential interest, determine when specific observations will be available (consistent with proprietary restrictions) for access and retrieve data. The community may propose to monitor additional objects of any nature that are in the *Kepler* FOV, such as variable stars or active galactic nuclei. See the NASA/ROSES website <http://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=129170/Summary%20of%20Solicitation%20Amend29.pdf> Appendix D.9 for details on allowed GO science. In general, **proposals that duplicate the exoplanet Key Project study are not allowed.** See the GO Program website, <http://kepler.nasa.gov/sci/godap.html> and <http://kelpergo.arc.nasa.gov> for details on the proposal cycle.

For technical information, see <http://kepler.nasa.gov/>.

1.2 Overview of Data Flow

Data are dumped from the spacecraft (S/C) through the Deep Space Network (DSN). They are received by the Mission Operations Center (MOC) at LASP where telemetry packets are binned into files by data type. The data are then sent to the Data Management Center (DMC) at STScI, where they are archived. The data are then decompressed, sorted by cadence (long or short) and pixel type (target, background or collateral), and converted to FITS. The keyword values are populated. At this point in processing, the data are termed to be “original.” The data are then sent to the Science Operations Center (SOC) at NASA Ames, where detailed calibration is performed and light curves are produced. The data are then returned to the DMC for archiving. The target pixel data are produced at the DMC from the returned data, and archived along with the light curves. The total time for one cycle (data dump from the S/C through archiving of the target pixel data) can be 3 to 6 months. For a given target, archive users can access the original and calibrated pixel values in the target pixel files or the integrated flux values in the light curves.

1.3 Overview of MAST

The Multi-mission Archive at STScI supports a variety of astronomical data archives, with the primary focus on scientifically related data sets in the optical, ultraviolet, and near-infrared parts of the spectrum. See <http://archive.stsci.edu/missions.html> for a full list of the missions hosted by MAST and <http://archive.stsci.edu/hlsp/index.html> for the high level science products, surveys, and catalog data distributed by MAST. MAST is a component of NASA's distributed Space Science Data Services (SSDS).

The staff of the Archive Sciences Branch and the Multi-mission Archive at STScI (MAST) provides:

- world-wide technical and scientific leadership in archive system design
- secure storage and reliable retrieval services for data from HST and all MAST-supported missions
- user-friendly and scientifically useful search and cross-correlation tools

- development and support for inter-archive communication and data transfer standards
- accurate and useful mission archive documentation
- helpful user support services with a 1 business day response time

MAST archives a variety of spectral and image data with a range of data characteristics. MAST provides a large suite of searches, including customized searches for each mission. It also provides several cross-mission search tools.

MAST also archives sets of community contributed High-Level Science Products (HLSPs). Users may search for HLSPs by target or coordinates by using the HLSP search page. MAST actively solicits submission of High-Level Science Products related to our missions and we provide guidelines for contributing them to MAST.

The MAST Users Group provides essential user perspectives on archive operations and development, including suggesting priorities for short and long term operational and scientific enhancements to the archive.

User feedback is obtained via an annual survey. Send an e-mail to archive@stsci.edu to participate in the next survey.

The archive website, <http://archive.stsci.edu>, is the best place to start learning about MAST and what it can do to enable your research. The web site should always be consulted for the most current information.

1.4 Related Documents

A reference description of *Kepler* may be found in the Kepler Instrument Handbook (KIH). The KIH describes the design, performance, and operational constraints of the Kepler hardware, and gives an overview of the pixel data sets available. A description of Kepler calibration may be found in the Kepler Data Analysis Handbook (KDAH). It is expected that both KIH and KDAH will be downloadable from MAST at a future time.

1.5 User Support Services

Archive Hotseat

Help or answers to any questions about archive issues may be obtained by sending e-mail to archive@stsci.edu, or by telephoning (410) 338-4547 Monday through Friday, 9 a.m. to 5 p.m. Eastern time.

The helpdesk staff will respond to questions concerning the archive and archive databases, and CDs, DVDs and hard disks provided by STScI. Helpdesk personnel also authorize accounts so that PIs and GOs can access their proprietary data. They will also provide advice concerning basic search strategies, and will investigate and document all problem reports. The archive helpdesk staff may not always know how to solve a problem, but they are responsible for finding out who does know the answer and for continuing to work with you until the problem is resolved. All initial communication from the user community to the archive should be directed to the archive helpdesk.

Questions and Comments

Communication regarding all aspects of the archive should normally be directed to the archive helpdesk (e-mail: archive@stsci.edu, or telephone (410) 338-4547). This will allow Archive staff to respond to your

requests even when individual members of the group are away. If you feel your needs are not being adequately addressed through the helpdesk, place a message in the Suggestion Box located at <http://archive.stsci.edu/suggestions.html>

1.6 Registering as a User

Nomenclature: In this manual the term PI refers to the Kepler Project PI. GO refers to the lead investigator on any proposal submitted to the Kepler GO Program. Co-I refers to all other investigators on the Kepler Project and any additional investigators on any GO proposals.

Registration is not required to search the archive and retrieve public data. *Registration and authorization* is required to retrieve proprietary data, even for the Kepler Principal Investigator (PI) and Guest Observers (GO). An anonymous user has full access to the archive catalog. However, only registered and authorized users can retrieve proprietary data. You can register as an archive user by using the on-line form at <http://archive.stsci.edu/registration>. Alternatively, you can send e-mail to archive@stsci.edu. Within two working days of the receipt of your e-mail, you will be notified by e-mail of your registration as an archive user and will be provided with a username and a password. Note: The password can be changed from the registration page.

The PI and GOs can retrieve their proprietary data from the archive. To do so, they must be registered and authorized users (see above). The PI and GOs should request authorization for themselves when they register for their account. Only the PI and GOs may authorize anyone to access their data. If a Co-I wishes access to their data, they must have the PI or GO on the proposal send e-mail to archive@stsci.edu stating the proposal ID number and the identities of anyone who should be able to retrieve the data.

1.7 Proprietary Data Periods

To minimize the likelihood of false planet claims, the *Kepler* science team will have exclusive access to the data for enough time to perform follow-up ground-based observations for one year on a data stream twice as long as is being made available to the public. This period allows the team time to obtain follow-up observations for at least 3 transits by the time the data for 2 transits are released, assuming the planet's orbital period is 1 year or less. Table 1-1 lists the data release time for the Key Program data, in months from the start of science data collection *for the Mission*, for data taken during through the specified quarter. Not all quarters are listed. A quarter is 3 months long. For example, data from the first quarter of operation will not be publicly released until 1 year (15 months – 3 months) after the end of science data collection for the first quarter.

Upon receipt of the quarterly calibrated data and light curves from the SOC, the DMC will generate the target pixel data for all targets. GOs will be notified of the availability of their data by the GO Office. It is the responsibility of the GOs to fetch their data from the archive. Unlike Kepler Key Program data, **GO data will have a public release date set to one year from the time the light curves are archived.** The DMC will notify the *Kepler* GO Office when GO data are archived. The GO Office will notify the GOs that their data are available. It is the responsibility of the GOs to retrieve their data.

Archived data for mission targets dropped from the planetary search program will generally be made public within 2 months after being dropped from the target list.

Table 1-1 – Data Release Timeline for Key Program

Quarter	Data release time*
1	15
2	27
3 and 4	39
5 and 6	51
7 and 8	63
9 and 10	75
All data	84

*Units are months from start of science data collection for the Mission.

All data are public one year after the end of data acquisition from the mission. Assuming a six year mission, all data should be public seven years from the start of science data collection.

Several types of *Kepler* data are non-proprietary. These are the collateral and background pixels files, the full frame images (FFIs) and the Kepler catalogs. The catalogs include the Kepler Input Catalog (KIC), the Characteristics Table (CT), the Kepler Target Catalog (KTC), and the Kepler Results Catalog (KRC). The catalogs contain metadata that will be staged through the Kepler archive interface at MAST. Information staged in these catalogs through MAST is public. As of this writing, the KTC and KRC are not yet available.

1.8 Finding Documentation

Documentation is available on-line for all archive holdings. The main archive page, <http://archive.stsci.edu> , provides links to a MAST tutorial, a general introduction to MAST and a "getting started" page. Each mission page has links to mission specific information (About ...), a mission specific "getting started" page and the MAST tutorial. MAST Kepler pages are at <http://archive.stsci.edu/kepler/> . Other useful links for Kepler are <http://kepler.nasa.gov/> , <http://www.kepler.arc.nasa.gov/> and <http://keplergo.arc.nasa.gov/> .

1.9 Getting Your Data

GOs on *Kepler* proposals and their authorized Co-Is may retrieve their data via the MAST Kepler Data Search and Retrieval form <http://archive.stsci.edu/kepler/search.php> . Entering the proposal id in the Proposal_id field and clicking on the Search button will return a list of the data in the archive for that proposal. Select the data to retrieve by clicking on the boxes in the Mark column. Note: there is a Mark All box. Click on the Submit button. The Retrieval Options page will be displayed. Fill out the required information then click on the Submit button. E-mail will be sent acknowledging receipt of the retrieval request. A second e-mail will be sent when the data have been retrieved. If the data were retrieved to the staging disk, follow the directions in the e-mail to copy the data from staging. The data will remain on staging for a limited time before being automatically deleted. See Chapter 3 for more details on the MAST Kepler search forms.

1.10 Publication Acknowledgement

Publications based on *Kepler* data retrieved from MAST should carry the following acknowledgment, which is in addition to any acknowledgement required by the Kepler project.

"Some/all of the data presented in this paper were obtained from the Multimission Archive at the Space Telescope Science Institute (MAST). STScI is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS5-26555. Support for MAST for non-HST data is provided by the NASA Office of Space Science via grant NAG5-7584 and by other grants and contracts."

See the MAST Data Use Policy http://archive.stsci.edu/data_use.html for the current MAST grant number.

Chapter 2 *Kepler* Data Products

Many different files and products are archived for *Kepler*. These include, but are not limited to, light curves, target pixel data, focal plane characterization files (aka reference files), calibrated cadence data, which contain the pixel values from the spacecraft and the flux calibrated values, and background and collateral pixel files. Some products are available to GOs, others are available only to the *Kepler* Project PI and team members until the mission proprietary period has expired and still others are relevant only to the DMC as they are used to recreate data that have been corrupted or lost.

2.1 Definitions

The nomenclature for *Kepler* data can be a bit confusing. The following definitions are provided to help the reader distinguish among the variety of products.

File: For *Kepler* archival users, a file is in FITS format or ASCII text. See <http://fits.gsfc.nasa.gov/> for the current FITS standard.

File name: The name a file has as it appears on disk or in the database. See section 2.2 for details.

Data set: A group of one or more files that are related to each other. For example, a data set may consist of the calibrated cadence data, the corresponding collateral data and the processing history file. The files in a data set are archived as a group. A data set may consist of a single file.

Data set name: The archive name for a group of one or more files that are archived as a group. Retrieval of a data set will result in retrieval of all files in the group.

Cadence: A cadence is the frequency with which summed data are read out of the SDA. Short cadence is a 1-minute sum while long cadence is a 30-minute sum. As pixels for every target are read out in each detector read, every “cadence file” includes pixel values for every target in the active target table at that time.

Cadence Data: In a general sense, cadence data are the temporal sum of pixel values read from the detector. In the strictest sense, cadence data consist of the original pixel values and the calibrated pixel values, for all targets, packaged in the same file. The file is called the calibrated cadence data and it is what is placed in the archive. In this document, unless otherwise noted, cadence data refers to the calibrated cadence data returned from the SOC.

Cadence Data Set: The cadence data for all the targets and collateral pixels, the background data, the cosmic ray correction tables and the history files make up the cadence data set. NB: All targets are contained in the same file. Most users will have no need for the cadence data set. NB: Because each cadence data set contains pixel values for *all* targets, the cadence data will follow the proprietary data release timeline shown in Table 1-1. See below for more details.

Target Pixel Data: After the flux calibrated cadence data are returned to the DMC, the individual target, background and collateral pixels are copied to separate target, background and collateral data files for each target. These target-based data are then archived. NB: Do not confuse the target pixel data, which is produced from the calibrated cadence data, with the cadence data.

Light Curve: For each target, the SOC provides two flux calibrated light curves for each quarter, using two different techniques. The techniques are optimal aperture photometry (OAP) and difference image analysis (DIA). Both light curves are contained within a single FITS format file.

Focal Plane Characterization Model: A set of reference files describing the response of the detectors, produced by the SOC, and used by the SOC and DMC to calibrate the data. These files are non-proprietary.

Pixel Mapping Reference Files: Called PMRF files, these files provide the key to identifying which data values in a given cadence data set belong to which targets. These files are produced at the DMC from the quarter-specific target and aperture definitions provided by the SOC. The PMRF files are non-proprietary.

Full Frame Image: Called FFI, this is a full readout of every CCD pixel. An FFI is taken before and after each quarterly roll of the spacecraft. The FFI is formatted as a FITS image.

Mod/out: Short for module/output, mod/out indicates which CCD recorded the data and which read amplifier was used to read out the detector. The values for mod start at 2 and run through 24, omitting 5 and 21. (Modules 1, 5, 21 and 25 are the fine guidance sensors.) The values of output range from 1 to 4. Although not used in this document, the syntax for mod/out is m.o, where m is the module number and o is the output number. Mod/out ranges from 2.1, 2.2, .. 2.4, 3.1 .. through 24.4, omitting 5 and 21. For a given target, the mod/out will change on a quarterly basis. See Figure 2-1 for the module numbering.

Channel: The sequential numbering, from 1 through 84, of the mod/outs. See Figure 2.1 for the channel numbering.

A general archive user can request light curves and target pixel data, after they are public. A Guest Observer (GO) can request their proprietary light curves and target pixel data. The *Kepler* PI, and authorized members of the team, can request non-GO proprietary light curves and target pixel data, and calibrated cadence data sets. All users can request focal plane characterization files, pixel mapping reference files and FFIs.

NB: The *Kepler* Project PI and authorized team members can *not* retrieve GO data until the proprietary period for those data has expired.

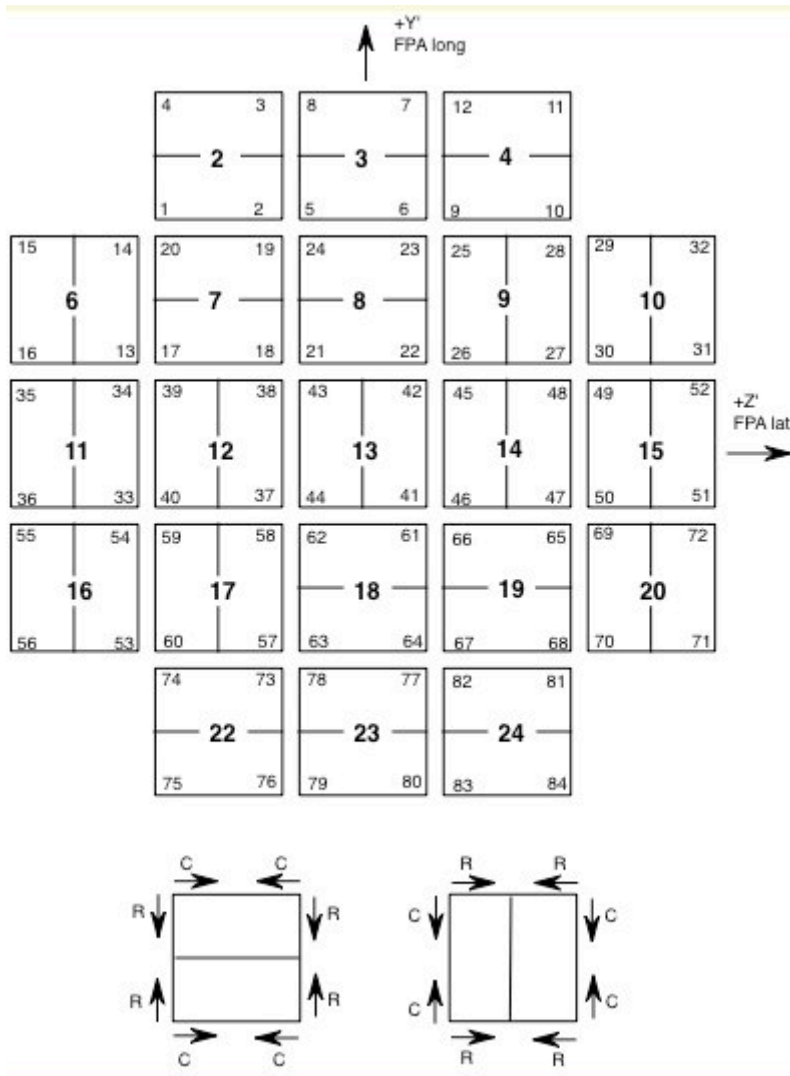


Figure 2-1 Modules and channels with column and row directions. Each square shows 2 CCDs. The bold number in the each square is the module number. The smaller numbers in the corners of each square are the channel numbers. In the lower part of the figure, the column (C) and row (R) directions are indicated.

2.2 File Name Syntax

Some 35 different file types are archived for *Kepler*. Many of these file types are for the telemetry or for input files to the DMC or SOC processing. Less than half are for products that are available to a general archive user. To prevent confusion in the ground system, a standard syntax is used for *Kepler* filenames.

Kepler filenames have 3 components.

- **Rootname:** Usually a timestamp, for some file types the rootname contains other identifiers such as the `kepler_id` or the module/output (mod/out) number. The rootname begins with the character string 'kplr' followed by a time stamp of the form `yyyydddhmmss` (e.g., `kplr<stop_time>`), where `ddd` is the day of year. If `kepler_id` or `mod/out` is present in the rootname, it precedes the timestamp (e.g., `kplr<kepler_id>_<stop_time>`). See table 2-1 for a list of rootnames.

- **Suffix:** The suffix indicates the type of data in the file within the data set (short cadence light curve, target pixel background data, etc.) See table 2-1 for a list of suffixes.
- **Extension:** The extension indicates the format of data contained in the file to application software (fits, or txt)

These three components are concatenated as shown to form the file name. This is the name of the file on disk.

<rootname>_<suffix>.<extension>

In the archive, the data set name is the rootname.

Table 2-1: Rootnames and Suffixes for *Kepler* Filenames

Type of Data+	Rootname*	suffix
Calibrated Light Curves:		
Long cadence calibrated light curves	<kepler id>-<stop time>	llc
Short cadence calibrated light curves	< kepler _id>-<stop_time>	slc
Target Pixel Data:		
Target pixel data - long	< kepler _id>-<stop_time>	lpd-targ
Target pixel data – short	< kepler _id>-<stop_time>	spd-targ
Target pixel collateral data - long	<mod/out>-<stop_time>	lpd-col
Target pixel collateral data - short	< kepler _id>-<stop_time>	spd-col
Target pixel background data	<mod/out>-<stop_time>	lpd-bkg
Focal Plane Characterization Model:		
Small scale flat	<yyyymmddhh>	ssflat
Large scale flat	<yyyymmddhh>	lsflat
Combined flat	<yyyymmddhh>	cflat
linearity	<yyyydddmmhh>	linearity
Read noise	<yyyydddmmhh>	read-noise
Pixel response function	<yyyydddmmhh>	prf
Gain table	<yyyydddmmhh>	gain
Hot/bad pixel list	<yyyydddmmhh>	bad-pixel
Focal plane geometry model	<yyyydddmmhh>	geometry
2-d black table	<yyyydddmmhh>	2d-black
LDE undershoot table	<yyyydddmmhh>	undershoot
Full Frame Image:		
FFI original data	<stop_time>	ffi-orig
FFI calibrated data	<stop_time>	ffi-cal
Processing history	<stop_time>	ffi-history
FFI cosmic ray correction table	<stop_time>	ffi-crct
Pixel Mapping Reference Files:		
Long cadence target pixel mapping table	<yyyydddhhmss>-<Tdid> <Adid>	lcm
Short cadence target pixel mapping table	<yyyydddhhmss>-<Tdid>-<Adid>	scm
Background pixel mapping table	<yyyydddhhmss>-<Tdid>-<Adid>	bgm
Long cadence collateral pixel mapping table	<yyyydddhhmss>-<Tdid>-<Adid>	lcc
Short cadence collateral pixel mapping table	<yyyydddhhmss>-<Tdid>-<Adid>	scc
Calibrated Cadence Data Set:		
LC target data	<stop_time>	lcs-targ

LC collateral data	<stop_time>	lcs-col
Background data	<stop_time>	lcs-bkg
LC processing history	<stop_time>	lcs-history
LC target cosmic ray correction table	<stop_time>	lcs-crct
LC collateral cosmic ray correction table	<stop_time>	lcs-crcc
SC target data	<stop_time>	scs-targ
SC collateral data	<stop_time>	scs-col
SC processing history	<stop_time>	scs-history
SC cosmic ray correction table	<stop_time>	scs-crct
SC collateral cosmic ray correction table	<stop_time>	scs-crcc

+ LC = long cadence, SC = short cadence

* All rootnames begin with kplr.

2.3 Types of Data in the Archive

The general user will usually be interested in the light curves and the target pixel data. Although the focal plane characterization model files and full frame images (FFI) are non-proprietary, they are not generally useful at the target level. A person intending to propose for *Kepler* time will be interested in the KIC, CT and KTC. These catalogs are discussed in Chapter 3.

FITS headers:

Kepler science data will use FITS format in order to comply with astronomical data standards. Data headers will use standard FITS keywords to formulate the data definition. In addition, Kepler data will attempt to comply with all FITS recommended keyword usage current at the time of header design. FITS headers for cadence science data are specified in Appendix A. The primary header will contain keywords inherited by all subsequent extensions. The primary header/data unit (HDU) will not contain a data array.

Each file that has the photometer as the data source, that is the calibrated cadence and FFI data, will contain 84 binary table extensions, one extension for each of the 84 CCD channels with independent World Coordinate System parameters. Primary header keywords will specify data processing inputs, data quality, observational modes (long cadence, short cadence, FFI), proposal information (GO, PI), etc.

Keyword values are populated as processing proceeds through the DMC and SOC.

2.3.1 Light Curves

Light curves are produced for each target. At any time, there will be some 100,000 – 150,000 long cadence targets and up to 512 short cadence targets being observed. Short cadence targets will also be observed at long cadence. (There is an indication from the Project that this may not strictly be true. Any deviation is expected to be rare.) Long cadence targets will be observed for at least a quarter and short cadence targets will be observed for one to three months. Most planetary targets will be observed for the life of the mission. In the case where a target is observed at both long and short cadence, there will be one long cadence light curve and three short cadence light curves *for each quarter*.

As shown in Table 2-1, light curves are expected to have file names like kplr<kepler_id>-<stop_time>, with a suffix of either llc (long cadence) or slc (short cadence), and a file name extension of fits. A request for a long

cadence light curve, by default, will return both the long cadence light curve and any associated short cadence light curves. The short cadence light curves will be packaged as a tar file.

A light curve is time series data, that is, a series of data points in time. Each data point corresponds to a measurement from a long or short cadence. Long and short cadence data are not mixed in a given light curve. For each data point there are multiple flux values, which the SOC derives using optimal aperture photometry and difference image analysis, along with uncertainties for each flux value. The centroid position for the target and time of the data point are also included. At this writing, the time is not yet settled (Gilliland, June, 2009).

There will be a single light curve *file* per target object (up to 4 (1 long cadence and 3 short cadence) if the target has both long cadence and short cadence data) generated each quarter. The file will contain both the OAP and DIA derived light curves.

The light curves are packaged as FITS binary table files. The fields of the binary table, all of which are scalar, are briefly described below and are listed in Table 2-2. The FITS header is listed in Appendix A.1.

The following data values are given for each data point in a light curve:

- time of the data point
- for the optimal aperture photometry
 - centroid position of the target and uncertainty
 - raw flux value and uncertainty
 - corrected un-filled flux value and uncertainty
 - instrument magnitude flux value and uncertainty
- for the difference image analysis
 - raw flux value and uncertainty
 - corrected un-filled flux value and uncertainty
 - instrument magnitude flux value and uncertainty

Table 2-2 – Light curve data table fields

Column Number	Field	Bytes	Description
1	time	4	Delta time from time series zero point (seconds)*
2	cad num	4	cadence number
Optimal Aperture Photometry (OAP)			
3	row _{cent}	4	row pixel location
4	σ_{row}	4	row position error
5	column _{cent}	4	column pixel location
6	σ_{column}	4	column position error
7	raw flux	4	raw flux value
8	σ_{raw}	4	raw flux error
9	cal flux	4	corrected un-filled flux value
10	σ_{cal}	4	corrected un-filled flux error
11	ins flux	4	instrument magnitude flux value
12	σ_{ins}	4	instrument magnitude flux error
Difference Image Analysis (DIA)			

13	raw flux	4	raw flux value
14	σ_{raw}	4	raw flux error
15	cal flux	4	corrected un-filled flux value
16	σ_{cal}	4	corrected un-filled flux error
17	ins flux	4	instrument magnitude flux value
18	σ_{ins}	4	instrument magnitude flux error

*Time in data table is referenced to a barycentric start time in the header. All times are in units of MHJD.

The instrument magnitude flux value provides an “Instrument magnitude flux time series” that is scaled to astronomically meaningful magnitudes as best they can be reconstructed.

2.3.2 Target Pixel Data

Target pixel data files are produced for *each target* from the calibrated cadence data returned from the SOC. These are **not** cadence data. Recall, cadence data contain pixels for all targets. Up to 5 different files are produced for each target. These consist of the long and short cadence pixel data for the target, the collateral pixels for the long and short cadences, and the background pixels. See Table 2-1 for the file name syntax and Appendix A.2 for the description of the FITS binary tables. The term mod/out, which is short for module/output, indicates which CCD recorded the data and which read amplifier was used to read out the detector.

Both original pixel values and calibrated flux values are in the target pixel data files. The original pixel value is the integer value as recorded on the spacecraft. The calibrated flux values are those provided by the SOC. On average there are 32 pixels per target. The original and flux calibrated values are listed for each pixel.

The target pixel data files are archived as a dataset. A request for the data will return all extensions that were archived with the dataset.

2.3.3 Focal Plane Characterization Model

There are several different calibration or reference files, which constitute the focal plane characterization model, that are used by the DMC and SOC in processing and calibrating the cadence and FFI data. Table 2-1 lists the filenames and Table 2-3 gives the file type. For the FITS files, the headers are listed in Appendix C. Although these files are non-proprietary, they are of limited use to the archive user because the calibrations are applied to the cadence data, not to the individual exposure or light curve.

Table 2-3 Focal Plane Characterization Model (FPCM)

Type of Data	extension	+type
Small scale flat	ssflat	FITS
Large scale flat	lsflat	FITS
Combined flat	cflat	FITS
gain	gain	ASCII
linearity	linearity	ASCII
Hot/bad pixel list	bad-pixel	ASCII
2-d black level	2d-black	FITS
Read noise	read-noise	ASCII

LDE undershoot	undershoot	ASCII
Focal plane geometry	geometry	ASCII
Pixel response function	prf	FITS

+ values delimited with | for ASCII files

Table 2-4 shows the calibration steps performed at the DMC and which FPCM file is used in the step.

Table 2-4 – Focal Plane Characterization Model files used in DMC pipeline processing

Processing step	FPCM file used	Comment
World Coordinate System parameters	Focal plane geometry	Focal plane to sky coordinate conversion.
FFI 2-d black level correction	2-d black level	Subtract 2-d black level model values from pixel values.
FFI dynamic black level correction	N/A	
FFI gain correction	Gain	Multiply pixel value by gain. Populate GAIN keyword value in science extension header.
FFI nonlinearity correction	Linearity	Multiply pixel value by linearity (evaluated at the value of uncorrected pixel).
FFI undershoot correction	LDE undershoot	
FFI dark current correction	N/A	Subtract dark current
FFI smear correction	N/A	Subtract smear level
FFI flat field correction	Combined flat	Divide by effective flat field
Population of FFI images statistic keywords	Hot/bad pixel list	
Population of READNOIS keyword value in science extension headers	Read noise	

The small scale flat, large scale flat and pixel response function files are not directly used in pipeline processing. However, they are archived for potential use or analysis by archival researchers

Within each file is a “use after” time, indicating when the file is applicable. The “use after” time is the time when this version of the file supersedes the previous version.

Bad Pixel Table

Bad pixel data is used to flag targets that contain bad pixels. The bad pixel list is a table containing all of the various types of anomalous pixels. Each bad pixel is assigned a type, as listed in Table 2-5, and a value. One purpose of the Bad Pixel Table is to provide the capability for archive users to improve the Kepler image data.

Table 2-5 – Bad Pixel types

Pixel type	Type	Pixel value description	Pixel
------------	------	-------------------------	-------

	identifier		value units
BLOOMING_TYPE	"blooming"	blooming trail count above background level	e-/sec
CROSSTALK_TYPE	"crosstalk"	cross talk signal count above background flux	e-/sec
UNUSABLE_TYPE	"unusable"	flag indicating cause of unusability: 0=unknown, 1=pixel defect, 2=row defect, 3=column defect	integer flag
HOT_TYPE	"hot"	dark current above mean dark current	e-/sec
DEAD_TYPE	"dead"	pixel response relative to mean pixel response	value relative to 1
GHOST_TYPE	"ghost"	ghost flux above the background flux	e-/sec
SCATTERED_TYPE	"scattered"	scattered light flux above background flux	e-/sec

The hot/bad pixel file is a character separated text file, where a bar (“|”) is used to separate the fields. There are 7 fields per line. These fields are listed in Table 2-6. Each bad pixel has a separate line in the file. The modified Julian day is used to denote the time at which the model becomes applicable. MJD is repeated on each line, but in practice these start times are required to be the same for all lines.

Table 2-6 – Hot/bad Pixel Table file format

Contents	Description	Data Type
MJD	Modified Julian Day, start time for model use	ASCII text
Module	The module for this gain value (2-4,6-20,22-24)	ASCII text
Output	The output for this gain value (1-4)	ASCII text
CCD row	The pixel row number in accumulation memory coordinates	ASCII text
CCD column	The pixel column number	ASCII text
Type	The type of bad pixel, where type is one of the identifiers	ASCII text
Value	The value of the bad pixel. The units of the bad pixel value depend on the type	ASCII text

Note: *Kepler* CCD coordinates are defined with rows 0-1060 and columns 0-1131. The row and column numbers include the collateral pixel regions, that is, all pixels stored in “accumulation memory” on board the flight segment. Rows 20-1043 and columns 12-1111 contain the photosensitive pixels.

There is one file for the entire focal plane. The file name contains a version identifier of the form YYYYMMDDHH. YYYY is the four-digit year, MM is the month in the year, DD is the day of the month, HH is hours in the day (in Pacific Time). For example, the name for a file generated on November 1, 2008 at 8:45 AM PT would be kplr2008110108_bad-pixel.txt.

2.3.4 Full Frame Image:

A Full Frame Image (FFI) is produced by reading and recording every pixel in each of the 42 CCDs. These images, which are taken before and after each roll of the spacecraft, are used to confirm the proper orientation and placement of the detector on the sky. FFIs are non-proprietary and are expected to occur quarterly. A complete FFI dataset consists of 4 files, each with a filename like Kplr<stop_time>_suffix. Three of the files are the result of DMC processing and 1 is produced by the SOC. See Tables 2-1 and 2-7 for details on the file names and data set.

Full Frame Images were taken during commissioning and are planned to be taken at least every 90 days, during periods of spacecraft roll, to verify target positions and assess photometer health.

The DMC process generates the two FFI data files, one containing the original (uncalibrated) pixels (ffi-orig) and one containing the calibrated pixels (ffi-cal), and the processing log. Each of the data files contains 84 image extensions, one for each module/output. See Appendix D.1.2 for a listing of the FFI data header. The FFI cosmic ray correction table, an ascii file, is produced by the SOC.

Table 2-7 – FFI Data set and files

Data type	File suffix	Format
FFI - original	ffi-orig	FITS image
FFI - calibrated	ffi-cal	FITS image
FFI cosmic ray correction table	ffi-crct	ASCII
FFI Processing history file	ffi-history	FITS table (binary)

Original data are formatted as 32 bit integers (I*4) to hold the 23 bit data values. Original pixel values are contained in FITS image extensions, one extension per module/output. The data are represented as 32-bit two's complement binary integers as indicated by the BITPIX = 32 keyword value in the FITS table extension header. In the event of a gap in the cadence data, a data fill value of 0xFFFFFFFF is used for the missing pixels. For original data represented as 32-bit two's complement binary integers, the gap fill value from the cadence data will be replaced by -1 in the FFI data table.

Calibrated data will be formatted as 32 bit (R*4) floating-point numbers. Each calibrated pixel is 23 bits deep (uncompressed). In the event of a gap in the cadence data, the data fill value of 0xFFFFFFFF for the missing pixels will be propagated to the calibrated pixel value; there will be no calibration operations performed on fill pixels.

2.3.5 Calibrated Cadence Data

As received at the DMC, the cadence data contain pixels for *all* targets, as well as the background and collateral pixels. From the cadence data, the DMC produces 5 separate FITS files each of which contains one of the five types of photometer data present in the cadence telemetry: long cadence target data, short cadence target data, background data, long cadence collateral data, and short cadence collateral data. Processing history files for long and short cadence processing are also produced. These files, known as the original cadence data set, are transferred to the SOC, where the data are calibrated and the cosmic ray correction tables are produced. The SOC then returns what is called the calibrated cadence data set to the DMC for archiving. Original and calibrated cadence data will be stored as separate binary table columns in the same file. Table 2.8 lists the 11 files that comprise the calibrated cadence data set. Note that only targets observed at both short and long cadence will have the full set of files. The FITS headers are listed in Appendix D.

The cadence target data files are FITS binary tables with 84 extensions, one extension for each module/output. The data in the binary table are contained in three fields: one for the raw pixel value, one for the calibrated pixel value, and one for the calibration uncertainty. The raw pixel values are 32-bit integers and the calibrated pixel values and calibration uncertainty are 32-bit floating-point numbers. Note that targets will appear in different module/outputs in different seasons.

Table 2-8: Calibrated Cadence Data files

Data type	Cadence	File suffix
Long cadence target data	30 min	lcs-targ
Long cadence collateral data	30 min	lcs-col
Background pixels	30 min	lcs-bkg
Long cadence cosmic ray correction table	30 min	lcs-crct
Long cadence collateral cosmic ray correction table	30 min	lcs-crcc
LC Processing history file	30 min	lcs-history
Short cadence target data	1 min	scs-targ
Short cadence collateral data	1 min	scs-col
Short cadence cosmic ray correction table	1 min	scs-crct
Short cadence collateral cosmic ray correction table	1 min	scs-crcc
SC Processing history file	30 x 1 min	scs-set-history

Notes on Table 2-8:

- Subtraction is performed on-board for short cadence readouts so that each file represents independent 1-minute integrations.
- There are no background pixels in the short cadence readouts.
- LC is long cadence and SC is short cadence.

Long and short cadence target data

Both the long and short cadence target data files will hold a table that contains raw and calibrated pixel values each stored in 32 bits. There will be 30 short cadence target data files and 1 long cadence target data file in the cadence data set.

Background data

The background data files have the same format as the long and short cadence target data files. Background pixels are only taken at long cadence with 4500 pixels in each of the 84 mod/outs.

Long cadence collateral data

For each module, the long cadence collateral data contains: 1070 black level pixels, 1100 masked pixels, and 1100 virtual smear pixels. All three types of collateral data are contained in a single file. Long cadence collateral data are defined in the spacecraft configuration parameters and thus have no corresponding target or aperture ids for inclusion in a pixel mapping reference file.

FITS header keywords describe the content of the long cadence collateral data files. They specify a sentinel value for the collateral pixel data type (black level, masked, virtual smear), a table row number for start of each collateral data type, and a number of pixels for each collateral data type. The long cadence collateral pixel definition may change over time, but such changes are expected to be infrequent if they occur at all.

Short cadence collateral data

Pixels selected for the short cadence collateral data are based on a projection of the target aperture onto the collateral pixel rows and columns. Hence, because of the relatively small number of targets per mod/out in short cadence data, not all collateral data in a channel are read out. Each target contains on average: 9 black pixels, 9 masked smear pixels, 9 virtual smear pixels, 1 black-masked pixel, and 1 black-smear pixel.

History files

History files provide a record of the steps, along with associated comments and warnings, taken during the processing of a long cadence, short cadence, or FFI data set. History files are ASCII files produced during data processing at the DMC and the SOC.

Cosmic Ray Correction Table

The CRCT file is in FITS format with 84 binary table extensions, one binary table extension for each module/output. The binary table extension contains the fields for each entry as listed in Table 2-9. The FITS header specification for the CRCT data is listed in Appendix B.

Table 2-9 – Data table fields for CRCT

data field	size (bytes)
position of pixel along a row (range: 0-1069)	2
position of pixel along a column (range: 0- 1131)	2
pixel correction value	4
target ID	4
aperture ID	4
total	16

The CRCT is generated at the SOC for each cadence and incorporated into the cadence data set. There is one CRCT for the long cadence pixel data, and for short cadence data there are 30 CRCTs. Hence, for a single long cadence there will be 31 CRCT files. Cosmic ray corrections for background pixels are included in the long cadence CRCT files.

Cosmic ray correction tables are also generated for the collateral pixels. Again, the Cosmic Ray Collateral Correct (CRCC) tables will be generated at the SOC for each cadence and incorporated into the cadence data set. There is one CRCC for the long cadence pixel data, and for short cadence data there are 30 CRCCs, for a total of 31 CRCC files per long cadence.

The pixel correction value in the CRCT data table lists the correction applied to the cosmic ray affected pixels. The cosmic ray corrected pixel values replace the calibrated pixel values in the pixel data file. A data user willing to accept the DMC and SOC pipeline generated cosmic ray correction could ignore the CRCT. The pixel data file will hold the original (uncalibrated) pixel value and the cosmic ray corrected, calibrated pixel value. A data user could recover the uncorrected pixel values by *adding* the correction value (delta) in the CRCT to the calibrated pixel value in the pixel data file.

2.3.6: Ancillary Engineering Data

Ancillary engineering data is a subset of the engineering telemetry incorporated into the science data set in order to support science data analysis. There is an ancillary engineering data file for each interval that corresponds to the long cadence timing. The ancillary engineering data is included as a file with each long cadence data set.

An ancillary engineering data file exists, even if there is no corresponding long cadence science data. In this case, the ancillary engineering file forms its own data set. Typically, the ancillary engineering data is incorporated into the corresponding original cadence or FFI data set. The ancillary engineering data header is specified in Appendix F. As of this writing, ancillary engineering data are non-proprietary.

2.3.7 Spacecraft Ephemeris

The ephemeris is available through the SPICE system at NAIF, NASA's Solar System Exploration Ancillary Information Facility (<http://naif.jpl.nasa.gov/naif/>). The vast majority of *Kepler* data users will not need the ephemeris.

2.4 The Standard *Kepler* Dataset

For an archive user, the standard *Kepler* dataset is the light curves. Users may also consider requesting the target pixel data, although the light curves are expected to satisfy the needs of most researchers.

2.5 Times in *Kepler* Headers

There are several FITS keywords in the *Kepler* data headers that relate to time. A good rule of thumb is the times in the primary header will be UTC (geocentric), while the times in the extension headers will be barycentric dynamical time (TDB). It is expected that times related to processing, such as when the FITS file was created or when the processing was completed will be in UTC. Times related to the date in the FITS file will be in TDB.

NB: By definition, TDB includes a relativistic correction. This is a periodic term, which may be as large as 1.6 milliseconds. The yearly average of the periodic term is zero (0). As of this writing, the relativistic correction is not included in any of the *Kepler* data.

As of this writing, Modified Julian Date (MJD) is a common unit for the time. We anticipate a change from MJD to Julian Date (JD).

As of this writing, the FITS headers for the light curves are undergoing a review process, with the intent of improving the header content.

Chapter 3 Searching the Archive for *Kepler* Data

Users can search for Kepler data in a multitude of ways. Common searches are based on position, time of observation, target name or kepler_id, but all catalog fields are searchable. MAST allows the upload of a file containing a list of up to 1000 kepler_id's, coordinates and/or target names for which the user wants searches conducted. Cross correlation with catalogs may be allowed in the future. Please note kepler_id and target name are different identifiers. MAST makes this distinction so that users may enter, say, NGC 6791 or TrES-2, as the target name and the Resolver will return the coordinates. Existing Resolvers do not yet recognize kepler_id as a target name.

This chapter contains descriptions of the MAST Kepler Data Search and Retrieval form, the MAST Kepler Target Search form, and the Kepler Input Catalog (KIC), Characteristics Table (CT) and Kepler Target Catalog (KTC) as hosted by MAST. Users intending to propose for *Kepler* time should search the KIC for targets via the Kepler Target Search form. Users interested in existing data should use the Kepler Data Search & Retrieval Form to search the archive catalog for data of interest.

3.1 The *Kepler* Catalogs as Presented at MAST

As of this writing, the Kepler catalogs at MAST consist of the Kepler Input Catalog (KIC), the Kepler Input Catalog modified by the Characteristics Table (CT), which will be called the merged KIC, and the Kepler Target Catalog (KTC) with additional fields from the archive catalog. The Kepler Results Catalog (KRC) will be hosted at MAST, although no version or description of it is yet available.

The Kepler Input Catalog contains information on approximately 15 million sources, most of which are visible in or nearby the *Kepler* FOV. Each source has an identification number, called the kepler_id, and a position (RA and Dec). Additional fields may or may not have values for each source. Table 3-1 lists the fields in the merged KIC, along with a short description of the field. Fields added by MAST are flagged. See the MAST help files at http://archive.stsci.edu/kepler/kepler_input_catalog/help/columns.html for more details.

Here are some facts for the KIC and CT.

- The full KIC contains 13,161,029 rows (objects)
- The CT (and likewise the merged KIC) contains 6,569,466 rows (about half of the KIC total)
- The number of merged KIC entries considered on CCD for at least one season is 4,412,616 (about a third of the KIC total)
- The number of merged KIC entries on CCD every season is 4,382,449.

The Kepler Target Catalog (KTC) contains all objects observed or scheduled for observation by *Kepler*. At launch, there will be some 170,000 targets, or more, in the KTC. The KTC, which is updated on a quarterly basis, holds planned observation start and stop times for each target. The times are given in both Modified Julian Date (MJD) and standard date format (i.e., YYYY-MM-DD HH:MM:SS). Table 3-2 lists all columns of the KTC, including several from the archive. For a given object, the kepler_id is the same in both the KIC and the KTC. The counter, a MAST added field, should not be used as an id as it can change with each KTC update. For more details on the columns see the MAST help files at http://archive.stsci.edu/kepler/kepler_target_catalog/help/columns.html.

The Characteristics Table (CT) contains parameters indicating if a given kepler_id is observable (“on silicon” is the term used by the Kepler Science Team) for each of the 4 seasons, as well as other characteristics. Note there are plans to add a “reserved target” field, which will indicate that a given object is reserved for the Kepler Key Project. The GO Office directs proposers to not select these objects as target. Not all sources in the KIC have values for all parameters. In fact, only about half of the KIC entries are ever “on silicon.” Table 3-3 lists the CT parameters. MAST does not provide a direct search capability for the CT. Instead, the CT fields have been included in the merged KIC, which contains only those objects that have entries in both the KIC and CT. The Kepler Target Search form is used to search the merged KIC. Information about the CT parameters is given in the MAST help files, http://archive.stsci.edu/kepler/kepler_fov/help/search_help.html.

The Kepler Results Table (KRT) contains results obtained for the mission targets. Initially the KRT will be empty, as results are not expected to be available until some years after mission start. The final KRT will not be received until at least 1 year after mission end. The format of the KRT has not yet been defined.

Table 3-1 Fields in the Merged Kepler Input Catalog (KIC) as Displayed by MAST

Column	Description
kepler_id	Kepler identification number
ra*	Right ascension of object in hours
dec	Declination of object in decimal degrees
pmra	Proper Motion in right ascension
pmdec	Proper Motion in declination
umag	U magnitude
gmag	G magnitude
rmag	R magnitude
imag	I magnitude
zmag	Z magnitude
gredmag	GRed magnitude
d51mag	D51 magnitude
jmag	2MASS J magnitude
hmag	2MASS H magnitude
kmag	2MASS K magnitude
kepmag	Kepler magnitude
2massid%	2Mass catalog ID
sepid	ID from the SCPKEY table
altid	ID from an alternate source
altsource	Source of alternate ID
Star/gal ID	Star/galaxy indicator.
blend	Is object a blend
variable	Is object variable
Availability flag	2= reserved to Project, 1 = observed not reserved, 0 = not observed, not reserved
teff	Derived effective temperature
logg	Derived surface gravity
metallicity	Derived metallicity (Fe/H)
E(B-V)	Derived excess reddening E(B-V)
A_v	Derived extinction Av
radius	Estimate stellar radius
cq	Catalog quality indicator

pq	Photometry quality indicator
aq	Astrophysics quality indicator
Catalog key	Link to CATKEY table
SCP key	Link SCPKEY table
parallax	Parallax in arcseconds
Gal Lon	Galactic longitude
Gal Lat	Galactic latitude
pmtotal	Proper motion in arcsec/year
g-r color	(G-R) color
j-k color	(J-K) color
g-k color	(G-K) color
degree_ra	Right Ascension in decimal degrees
*fov_flag	Is object in the Kepler FOV or in the KTC
+sky_group_id	The channel where the target falls in season 2. Values will range from 1 to 84.
+crowding	The fraction of light in the aperture due to the target star. 1 means all the light is from the target, 0 implies all background. 0.5 means half the light is due to the target.
+Channel_season_0	Integer channel number for season 0.
+Channel_season_1	Integer channel number for season 1.
+Channel_season_2	Integer channel number for season 2.
+Channel_season_3	Integer channel number for season 3.
+Column_season_0	Column number for season 0.
+Column_season_1	Column number for season 1.
+Column_season_2	Column number for season 2.
+Column_season_3	Column number for season 3.
+Module_season_0	Integer module number for season 0.
+Module_season_1	Integer module number for season 1.
+Module_season_2	Integer module number for season 2.
+Module_season_3	Integer module number for season 3.
+Output_season_0	Integer output number per module for season 0.
+Output_season_1	Integer output number per module for season 1.
+Output_season_2	Integer output number per module for season 2.
+Output_season_3	Integer output number per module for season 3.
+Row_season_0	Row number for season 0.
+Row_season_1	Row number for season 1.
+Row_season_2	Row number for season 2.
+Row_season_3	Row number for season 3.

* Field added/modified by MAST.

% Although the field name is 2Mass ID, the field does not contain the standard 2Mass ID. See the "User's Guide to the 2Mass All Sky Data Release," for information on the pts_key/cntr field at the following link.
<http://www.ipac.caltech.edu/2mass/releases/allsky/doc/explsup.html>

+ Field taken from the Characteristics Table.

Table 3-2 Fields in the Kepler Target Catalog (KTC) as Displayed by MAST

Column	Description
Kepler Id	Running Kepler ID number
+Dataset Name	Dataset name for the exposure
RA(J2000)	RA in decimal degrees
Dec(J2000)	Dec in decimal degrees
Target Type	Cadence – LC or SC
Target Category	Target category
Planned Observation Start Time (MJD)	Planned start time MJD
Planned Observation Stop Time (MJD)	Planned start time in MJD
*Planned Observations Start Time	Planned start time in standard date format
*Planned Observation Stop Time	Planned end time in standard date format
Actual Observation Start Time	Actual start time
Actual Observation End Time	Actual end time
*KTC Counter	Sequential id
+VTC End Time	Value from END_TIME keyword in FITS file
+Release Date	Date when data become public.

+ Field taken from the archive.

* Field added by MAST

Table 3-3 Parameters in the CT

Column	Description	Values
Kepler ID	The kepler id	integer
Channel season 0	Integer channel number for season 0.	1-84
Channel season 1	Integer channel number for season 1.	1-84
Channel season 2	Integer channel number for season 2.	1-84
Channel season 3	Integer channel number for season 3.	1-84
Column season 0	Column number for season 0.	20 to 1043
Column season 1	Column number for season 1.	-201 to 1111
Column season 2	Column number for season 2.	-225 to 1094
Column season 3	Column number for season 3.	-225 to 1094
Module season 0	Integer module number for season 0.	2-24
Module season 1	Integer module number for season 1.	2-24
Module season 2	Integer module number for season 2.	2-24
Module season 3	Integer module number for season 3.	2-24
Output season 0	Integer output number per module for season 0.	1-4
Output season 1	Integer output number per module for season 1.	1-4
Output season 2	Integer output number per module for season 2.	1-4
Output season 3	Integer output number per module for season 3.	1-4
Row season 0	Row number for season 0.	-225 to 1094
Row season 1	Row number for season 1.	-225 to 1094
Row season 2	Row number for season 2.	-225 to 1094
Row season 3	Row number for season 3.	-225 to 1094
Skygroup ID	The module/output where the target falls. Values will range from 1 to 84.	1-84

Crowding Value	The fraction of light in the aperture due to the target star. 1 means all the light is from the target, 0 implies all background. 0.5 means half the light is due to the target.	0 - 1
Availability flag	2 = observed, reserved to Project, 1 = observed, not reserved, 0 = not observed, not reserved	0,1,2

3.2 The MAST Search Forms

MAST provides separate forms for searching for targets to observe (ie., exploring the merged KIC) and for locating *Kepler* data in the archive. Each form serves a different purpose. Searches of the merged KIC are done in support of proposal preparation. Called Kepler Target Searches or Kepler FOV searches, these searches of the merged KIC are via MAST's Kepler Target Search form, and are used to find targets to observe with *Kepler* or to find astronomical information about the targets. Searches of the archive for existing data are called Kepler Data Searches, are done using MAST's Kepler Data Search and Retrieval form and are based on the archive catalog and the KTC. These searches are done to locate and retrieve data from the archive. The forms function in the same manner although the search fields are different as the underlying catalogs and database contain different information. The `kepler_id` is the same in both forms.

An additional MAST form is under development. The form will allow database searches for FFIs, calibrated cadence data and engineering telemetry.

MAST provides standard forms, that is, forms that look and operate the same from mission to mission. On the "standard form", the top section consists of a place to enter a target name or coordinates and a Resolver. If a target name is entered, the coordinates will be resolved using SIMBAD or NED and these coordinates will be used in the search. The user can also choose the search radius (the default is to 0.02 arcmin). Note the Resolver uses a standard MAST hierarchy, whose order is NED, SIMBAD, etc. The user can select a Resolver from the pull down menu. One of the options is 'Don't Resolve.'

Note the "**file upload form**" link near the top right of the form. Clicking on the link brings up a version of the standard form that allows the upload of a user created file. The file must be an ASCII text file or table with one entry per line with one or more fields (e.g. RA and Dec) separated with one of the allowed delimiters. Searches are allowed on coordinates, target name or `kepler_id`. Other fields are allowed in the file, but are not searchable. Up to 5000 lines are allowed. Several coordinate formats and delimiters are allowed. Check the help for information. The name of the file is the name the file has on the user's disk. A browse button is provided.

The middle section of the search page contains mission specific fields, which can be used to qualify the search. For Kepler, four user-specified fields are provided. The menu (down arrow) next to each of these fields contains a complete list of the table columns. Select the desired field to add it to the search form. For more information about each field click on the link "Field Descriptions". This brings up a page of all the available columns the database column name, the label, the data type, the valid values in that field, and additional notes where applicable.

The third section provides output options for the search results. On the left side is a list of columns that is displayed by default. Columns can be removed by highlighting that column and clicking on the remove button to the right. Columns are added by choosing columns from the select box below and clicking the add button to the left of the select box. Change the order by clicking on field in the output columns box and click on the up and down buttons to the right. Clicking on the reset button will restore the default output columns settings. The output can be sorted by up to three columns. Note the following behavior when a sort option is used. If the

upload contains more than 200 entries, the order of entries from the uploaded file **is maintained**. If the upload file contains less than 200 entries, the order in the uploaded file is **not preserved**. A ‘null’ option is available if no sorting is desired. When the no sort option is specified, the results are returned in the order in which they are stored in the database and for Kepler, this means in order of kepler_id.

The output format can be specified from a menu. Formats include HTML, comma separated value text, Excel spread sheet, and VO table format. The HTML format will give access to useful links and retrieval options. Since the astrophysical fields in the KIC are not populated for every object, searches that direct the results to a output file should use the Excel Spreadsheet output, or one of the CVS outputs that uses a character (i.e., comma or semi-colon) as the delimiter. Use of a space delimited CVS format can result in non-interpretable results.

Output coordinates are displayed in sexagesimal by default, but decimal degrees or decimal hours can be specified. Click on the headings for additional help.

3.2.1 Kepler Target Searches

Figure 3.1 shows the Kepler Target Search form located at http://archive.stsci.edu/kepler/kepler_fov/search.php. The form allows searches based on kepler_id, position, target name and/or physical characteristics, where the available physical characteristics are those provided in the merged KIC. Note: since there are ~7 million objects in catalog searched by this form, it is not a good idea to submit an unqualified search. Indeed, such a search is likely to time out, with no results returned.

There are 3 fields on or available through the Kepler Target Search form, which are not listed in Table 3-1 or Table 3-3, above. These fields are calculated from KIC or CT fields that are given above.

Min. Distance from Edge: The user may enter a value in pixels. The output value is calculated from the row and column values for each season and restricts the search to targets at least this number of pixels from the detector edge.

Seasons Target on CCD: The user may enter a given season, all or accept the default of any to define when or how often a target is on silicon. The returned values for this field are determined from the various channel, output, module, row and column fields in the CT. The planned start date for each season is given in Table 3-4. The seasons are numbered from 0 to 3, with 0 corresponding to Summer.

Table 3-4 Planned Start Date for Seasons

Year	Spring	Summer	Winter	Fall
2009	May 12	Jun 18	Sep 17	Dec 17
2010	Mar 22	Jun 24	Sep 23	Dec 22
2011	Mar 28	Jun 27	Sep 29	Dec 29
2012	Apr 2	Jun 28		

Contamination is 1 – Crowding, where the Crowding value is taken from the CT. Contamination is a floating point number between 0 and 1 representing the fraction of light in the aperture due to the target star. A value of 0 means all the light is from the target, 1 implies all background. 0.5 means half the light is due to the target. The user may enter a value for contamination or leave it unspecified. Contamination may be added via one of the user-specified field elements.

Archive Status [\(Help\)](#)

Kepler Target Search

[Standard Form](#) [File Upload Form](#)

Target Name
Resolver
Radius (arcmin)

Right Ascension
Declination
Equinox

Kepler_ID
Availability Flag
Teff
Log_G

Seasons Target on CCDs
Min. Distance from Edge
KEP_Mag
2MASS ID

User-specified field 1
Field Descriptions
User-specified field 2
Field Descriptions

User-specified field 3
Field Descriptions
User-specified field 4
Field Descriptions

Output Columns

Sort By:
 Reverse
 Reverse
 Reverse

Output Coords:
 Sexigesimal
 Degrees
 Hours

Output Format

Show Query
 Make Rows Distinct

Maximum Records:

Records per Page:

Figure 3-1 MAST Kepler Target Search Form

Figure 3-1 shows the MAST Target Search Form, set up for search. The Contamination, Teff and Log G fields have values entered to qualify the search. Note the use of carets, < and >, to provide starting or ending values. Also note the input in the Log G field, 3.0..3.5, which specifies a range of values starting with 3.0 and ending with 3.5. A User-specified field, R_Mag, was used to allow the R magnitude of the search to be qualified.

Finally, in the Output Columns box, a number of fields were removed to make the results more readable. This search was executed and the results are shown in Figure 3-2. More information on general usage of MAST search forms is provided in the on-line MAST tutorial, which is accessible via the (Help) link in the top right corner of form.

KEPLER_FOV Search - Mozilla Firefox

File Edit View History Bookmarks Tools Help

FAQ KEPLER_FOV Search

Mission Search / Missions / Contacts / STScI / MAST Columns Help / Archive Status

Kepler Target Search Results

Edit Query

[Display numeric columns graphically using VOPlot](#)

number of rows returned = 11

Kepler_ID	2MASS ID	RA_(J2000)	Dec_(J2000)	Availability Flag	R_Mag	J_Mag	KIC_Mag	Teff	Log_G
1571152	19234056+3709547	19 23 40.56	+37 09 54.8	2	9.229	8.547	9.268	7048	3.164
2166218	19305705+3730357	19 30 57.05	+37 30 35.8	2	9.433	8.768	9.465	7153	3.345
3760826	19394821+3853479	19 39 48.22	+38 53 47.9	1	8.789	8.477	8.758	8640	3.421
6668729	18535062+4210158	18 53 50.62	+42 10 15.8	2	8.597	8.089	8.590	7767	3.484
7060333	19541213+4233399	19 54 12.14	+42 33 39.9	2	9.081	8.532	9.088	7576	3.475
7119530	19291904+4238290	19 29 19.03	+42 38 29.1	2	8.536	8.002	8.517	7777	3.487
7273950	19170644+4249187	19 17 06.46	+42 49 18.8	2	9.356	8.696	9.389	7030	3.474
7827131	19334714+4331022	19 33 47.14	+43 31 02.2		8.012	7.623	7.986	8286	3.487
8649198	19572616+4446301	19 57 26.16	+44 46 30.1		9.251	8.727	9.253	7800	3.488
9812351	18461032+4637509	18 46 10.32	+46 37 51.0	2	7.949	7.451	7.934	7794	3.470
12055345	19105861+5030322	19 10 58.61	+50 30 32.2	2	9.420	9.134	9.379	8953	3.414

[Kepler ID](#) [2MASS ID](#) [RA \(J2000\)](#) [Dec \(J2000\)](#) [Availability Flag](#) [R Mag](#) [J Mag](#) [KIC Mag](#) [Teff](#) [Log G](#)

[Top of Page](#) [archive@stsci.edu](#)
[Copyright Notice](#) http://archdev.stsci.edu/kepler/kepler_fov/search.php Modified: Mar 18, 2009 12:10

Figure 3-2 Results of Target Search

The results in Figure 3-2 are in the default HTML form. Clicking on the column name at the top of a column will sort the input by that column. A second click will order the sort in the opposite direction. A click on the column name link at the bottom of the results will bring up a page that describes the column.

Other output forms are available and can be specified on the Search Form, see Figure 3-1, in the lower right. Consult the on-line tutorial for additional details.

3.2.2 Kepler Data Searches

Users wishing to search for and/or retrieve Kepler data should use the Data Search and Retrieval Form, which is available at <http://archive.stsci.edu/kepler/search.php>. The features of this form are similar to those of the Target Search Form and function in the same way. On-line help is available. The search for data is a search using information from the archive tables, the KIC and the KTC. As of this writing, this form is not quite in its final state.

Figure 3-3 shows the Data Search and Retrieval Form set up for a very simple search, with only the Kepler ID as a qualifier. The results of this search are shown in Figure 3-4.

In the Search Results Form, note the Mark column, which is used to indicate the data to retrieve. When it is highlighted in yellow, the data are proprietary. Recall, proprietary data may only be retrieved by the PI of the proposal for which the data were taken, and any authorized co-Is. See section 1.5. The release data column, at the far right, shows when these data become public. To send a retrieval Request for these data, click the Mark boxes or click on “Mark all”, as shown in Figure 3-5, then click on Submit marked data for retrieval from STDAS. This will open up the Retrieval Options page, as shown in Figure 3-6.

The Retrieval Options Form is used for retrieval of public and proprietary data, and for anonymous retrievals of public data. For proprietary data, the user **must** enter their archive account username and password. For public or non-proprietary data, an archive account may be used, or anonymous retrieval is available. Enter anonymous for the Archive Username and your e-mail for the Archive Password. For all requests, even anonymous, a valid e-mail account is necessary in order for the archive to send status information regarding the retrieval request.

Under Delivery options, indicate how the data should be delivered. If requesting FTP delivery, fill out the boxes on the right side of the page, giving the name of the receiving computer, the location for the data, and a valid account name and password. Click on Send retrieval request to ST-DADS. The page shown in Figure 3-7 is displayed.

Some error checking is done for data that are to be ftp’ed, to ensure access to the computer and location for the data. A confirming e-mail is sent if the checks pass. If there is a problem, an e-mail reporting the problem is sent to the user.

If the Stage option is selected, the retrieved data are written to an Archive staging disk. The user is responsible for ftp’ing the data from the staging disk. After clicking on Submit, the page shown in Figure 3-7 is displayed.

For all retrievals, e-mail is sent confirming the retrieval request was received, where the data will be placed and what datasets will be retrieved. After the retrieval is complete, a second e-mail is sent listing the files that were delivered. If the Stage option was used, the location of the data is sent.

Standard ftp is used to retrieve data from the staging disk. Users are advised to issue bin (for binary) and, if using mget, prompt (to turn off prompting). Attempting to ftp the data from the staging disk before the retrieval is complete will result in incomplete datasets. The ftp should not be started until after the completion e-mail has been received.

File Edit View History Bookmarks Tools Help

FAQ x KEPLER Search x

Kepler Home About Kepler Getting Started Registration Kepler Data Search Kepler Target Search Forum

Archive Status Kepler Data Search & Retrieval [\(Help\)](#)

[Standard Form](#) [File Upload Form](#)

Search Reset Clear Form

Target Name **Resolver** NED **Radius (arcmin)** 0.02
Right Ascension **Declination** **Equinox** J2000

Kepler ID 1571152 **Proposal ID** **2Mass ID**
KIC Mag **Target Type** Long Cadence Short Cadence **Release Date**
Teff **Log_G**

User-specified field 1 [Field Descriptions](#) **User-specified field 2** [Field Descriptions](#)
 Kepler ID Kepler ID
User-specified field 3 [Field Descriptions](#) **User-specified field 4** [Field Descriptions](#)
 Kepler ID Kepler ID

Output Columns
 Mark
 Kepler ID
 Proposal ID
 Dataset Name
 RA (J2000)
 Dec (J2000)
 Target Type
 Planned Observation Start Time
 Planned Observation Stop Time
 KTC Counter

Sort By:
 ang_sep (') Reverse
 Kepler ID Reverse
 null Reverse
Output Coords: Sexagesimal Degrees Hours
Output Format
 HTML_Table
 Show Query Make Rows Distinct
Maximum Records: 1001
Records per Page: 50

add Mark Search Reset Clear Form

Figure 3-3 The MAST Data Search and Retrieval Form

KEPLER Search - Mozilla Firefox

Mission Search / Missions / Contacts / STSci / MAST

Columns Help / Archive Status

KEPLER Search Results

Edit Query

[Display numeric columns graphically using VOPlot](#)

number of rows returned = 2

Click on top column headers to sort the table on the column contents.
Click on bottom column headers for more information about the data in that column.

Submit marked data for retrieval from STDADS

Mark all Unmark all Mark public Unmark public Mark proprietary Unmark proprietary

Mark	Kepler ID	Dataset Name	RA (J2000)	Dec (J2000)	Target Type	Target Category	Planned Observation Start Time	Planned Observation Stop Time	Release Date
<input type="checkbox"/>	1571152	KPLR001571152_2009169012045	19 23 40.57	+37 09 54.8	LC	PLANETARY	2009-03-18 12:00:00	2009-09-16 12:00:00	2010-08-13 01:58:55
<input type="checkbox"/>	1571152	KPLR001571152-2009168180601	19 23 40.57	+37 09 54.8	LC	PLANETARY	2009-03-18 12:00:00	2009-09-16 12:00:00	2010-08-13 01:58:55

Submit marked data for retrieval from STDADS

Mark all Unmark all Mark public Unmark public Mark proprietary Unmark proprietary

[Top of Page](#)
[Copyright Notice](#)

<http://archive.stsci.edu/kepler/search.php>

archive@stsci.edu
Modified: Nov 26, 2008 16:07

Figure 3-4 Data Search Results

Datasets Marked for Retrieval - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Datasets Marked for Retrieval

[Archive Status](#)

new [Important Downtime Message](#) **new**

2 datasets (0 public, 2 proprietary) marked.

Submit marked data for retrieval from STDADS

Mark all Unmark all Mark proprietary Unmark proprietary Mark public Unmark public

Row	Mark	Dataset	Class	Release	Archived	Row
1	<input checked="" type="checkbox"/> @	KPLR001571152-2009168180601	CLC	2010-08-13 01:58:55	2009-02-08 22:10:32	1
2	<input checked="" type="checkbox"/> @	KPLR001571152_2009169012045	CLC	2010-08-13 01:58:55	2009-02-09 18:40:21	2

Submit marked data for retrieval from STDADS

Mark all Unmark all Mark proprietary Unmark proprietary Mark public Unmark public

Tue Feb 24 12:10:14 2009
archive@stsci.edu

[Copyright](#) © 2009 [AURA, Inc.](#)
All Rights Reserved.

Figure 3-5 Marked Datasets for Retrieval

Retrieval Options - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Retrieval Options

[Archive Status](#)

NEW [Important Downtime Message](#) **NEW**

2 datasets (0 public, 2 proprietary) marked.

<u>Archive Username</u> archive_user	<u>Archive Password</u> xxxxxxxxxx
---	---------------------------------------

<p><u>Delivery options</u></p> <p><input checked="" type="radio"/> FTP: FTP the data to the destination shown</p> <p><input type="checkbox"/> Use sftp (OpenSSHv2)</p> <p><input type="radio"/> STAGE: Put the data onto the Archive staging disk*</p> <p><input type="radio"/> DVD: Send the data to me on DVD.</p> <p><input type="radio"/> CD: Send the data to me on CD-R.</p> <p><input type="checkbox"/> Compress the files using gzip.</p>	<p><u>Destination (if you selected FTP):</u></p> <p><u>Hostname</u> my_computer</p> <p><u>Directory</u> my_data</p> <p><u>Username</u> my_computer_usernam</p> <p><u>Password</u> xxxxxxxxxxxx</p>
---	--

[Light Curves](#)

[Light Curves and Target Pixel Data](#)

[Light Curves, Target Pixel Data and Focal Plane Characterization Files](#)

Send retrieval request to ST-DADS Reset form to default values

To override the above defaults:
To select specific file extensions, use the input fields below.

File Extensions Requested

LLC
LPD-TARG

or enter a specific extension:

Tue Feb 24 12:11:32 2009
archive@stsci.edu

Copyright © 2009 [AURA, Inc.](#)
All Rights Reserved.

Figure 3-6 Retrieval Options Page

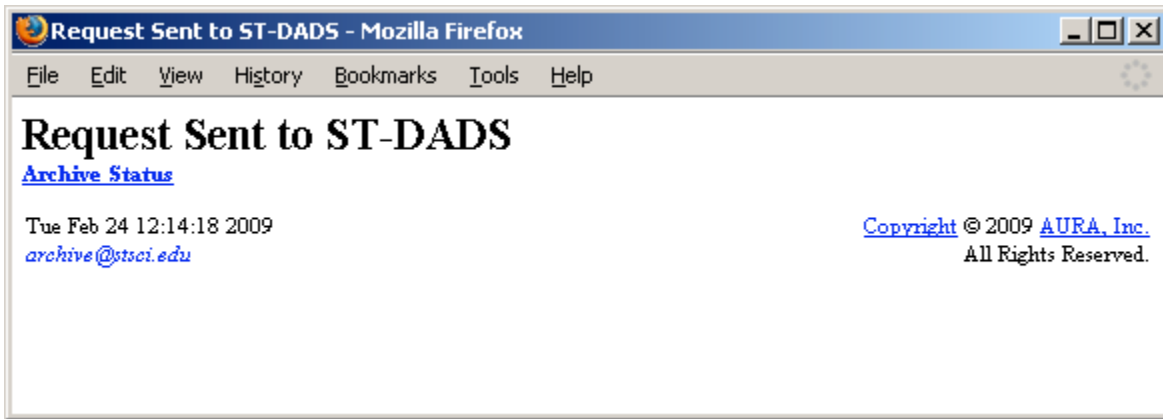


Figure 3-7 Confirmation Page

3.3 Examples

List a number of examples, starting with a very simple search on kepler_id and advancing to searches qualified by physical characteristics. Add searches by dataset name and/or proposal id. Also searches by date.

3.3.1. kepler_id Search

Given a range of kepler_id's, determine if any of the objects have been or are scheduled to be observed.

Chapter 4 Go Information

Persons interested in proposing for *Kepler* time should check the Kepler Mission website <http://kepler.nasa.gov/sci/godap.html> or the Kepler Guest Observer Web Site <http://keplergo.arc.nasa.gov/> for information.

4.1 Finding a Target

MAST provides a Target Search form, see Figure 3-1, which allows users to do qualified searches of the cataloged sources in the *Kepler* FOV so only records for objects or targets meeting the entered criteria are returned. Not every source in the merged KIC can be observed. Some will be too bright or too faint, while others will fall in the seams between the CCDs. In addition, some sources may not be observable at certain roll angles. NASA/Ames has provided a *Kepler* FOV calculator, <http://kepler.nasa.gov/cgi-bin/ra2pix.pl/>, that can be used to determine if a given position (RA and Dec) is imaged by a *Kepler* pixel. The FOV calculator is accessible through MAST or directly at the link given above. Other sources are reserved to the team or other GOs. Be aware that there are some 15 million cataloged sources. Unqualified searches are not recommended. At launch, some 150 thousand sources are mission targets and 1-2000 GO targets.

On all standard MAST search forms, the top section provides input boxes for target name and coordinates. Please do *not* enter the kepler_id in the target name field. There is a separate field for the kepler_id. If a value is entered in the Target name field, a database search is initiated, which will provide coordinates if the target name is found. A cone search is then done using the returned coordinates.

The "file upload form" in the top section allows the user to submit a file that contains a list of up to 5000 targets, coordinates and/or data ids. The local file name is the name of the file on your system. The file must be an ASCII text file with one entry per line with the fields (e.g. RA, Dec, kepler_id and/or target_name) separated by one of the allowed delimiters. The file may contain a single column. Coordinates may be in several formats including sexagesimal or decimal degrees. Use the form to designate the column in which the kepler_id, target name or RA and Dec are to be found. If appropriate, designate the delimiter (tab, bar (`|`), comma (`,`), semi-colon(`;`)). Choose the desired resolver option.

The middle section of the search page contains mission specific fields that can be used to perform searches on various physical properties associated with the source and well as seasonal availability. The former include total proper motion, effective temperature, radius, E(B-V), log g and metallicity. Four additional search fields may be added using the "User-specified field n" boxes, where n = 1, 2, 3 or 4, at the bottom of the middle section of the web-based form. For more information about the available search fields, click on the link "Field Descriptions". This brings up a page describing all the available columns (the database column name, the label, the data type, the valid values in that field), additional notes where applicable and the UCD (unique content descriptor).

The third section provides choices for the display and format of the search results. On the left hand side is the list of output columns to be displayed. Remove any of the columns by highlighting that column and clicking on the remove button to the right. Add columns by choosing columns from the select box below and clicking the add button to the left of the select box. Change the order by selecting (click) a field in the output columns box and click on the up or down buttons to the right. Clicking on the reset button will restore the default output columns settings. The output may be sorted by choosing the columns to sort on in the "Sort By" boxes on the

right side on the screen. Output may be sorted by up to three columns. Note the following behavior when a sort option is used. If the upload contains more than 200 entries, the order of entries from the uploaded file **is maintained**. If the upload file contains less than 200 entries, the order in the file is **not preserved**. A 'null' option is available if no sorting is desired. When the no sort option is specified, the results are returned in the order in which they are stored in the database and for Kepler, this means in order of kepler_id. Choose from nine output formats. Click on the headings for additional help. The HTML format is the format that gives access to retrieval options. In the lower right hand section of the search form are the "Show Query" and "Make Rows Distinct" checkboxes, and the "Maximum Records" and "Records per Page" menus. Check the Show Query box to see the SQL query produced for your search. The SQL will be displayed at the top of the search result page. See the on-line help for details on these features.

4.2 Getting Your GO Data

GOs who have successfully proposed for *Kepler* time will be notified by the GO Office when their data are ready for retrieval. In order to retrieve these data, the GO should use the Kepler Data Search and Retrieval page <http://archive.stsci.edu/kepler/search.php>, [this link is not yet valid] which is shown in Figure 3-3. The simplest way to locate GO data is via the proposal id. Enter the proposal id in the Proposal_ID box on the search form and click Search. The Search Results page will be displayed as in Figure 3-4. Follow the instructions in section 3.2.2 to retrieve these data.

An alternate, but still simple method of locating data is via the kepler id's of the targets. The kepler id's may be entered as a comma separated set of numbers in the Kepler_ID box on the Kepler Data Search & Retrieval page. If a large number of targets are involved, a list of the kepler id's can be entered via the File Upload Form option. The link to the "**file upload form**" link is at the top right of the form. Clicking on the link brings up a version of the standard form that allows the upload of a user created file. See section 4.1 for details on using the file upload form. Enter the filename to upload, then click Search. The search results will be displayed as in Figure 3-4. Follow the instructions in section 3.2.2 to retrieve these data.

Appendices

Appendix A: Calibrated Data Headers – Light Curves and Target Pixel Data

A.1: Kepler Light Curve header

```
SIMPLE = T / Java FITS: Fri Apr 03 09:38:51 GMT-08:00 2009
BITPIX = 32
NAXIS = 0 / Dimensionality
EXTEND = T / File may contain standard extensions.
NEXTEND = 1 / Number of standard extensions.
GROUPS = F / image is in group format
TELESCOP= 'Kepler ' /
INSTRUME= 'CCD ' /
EQUINOX = 2000.0 / Equinox of the celestial coord. system.
DATE = '2009-04-03' / Date this file was written in yyyy-mm-dd format
ORIGIN = 'NASA/Ames' /
FILENAME= 'kplr001160867-2009106141044_slc.fits' /
DATSETNM= 'kplr001160867-2009106141044' /
COMMENT Times are in modified Julian day.
LC_START= 54908.50034056094 / Start of time series in corrected barycentric t
LC_END = 54937.924124439065 / End of time series in corrected barycentric tim
KEPLERID= 1160867 / Kepler identifier.
PROPTYPE= 'PI ' /
RA_TARG = 19.3943987 /
DEC_TARG= 36.84518 /
PMRA = 0.0078999999618530273 /
PMDEC = 0.0032999999821186066 /
UMAG = 14.107000350952148 /
GMAG = 10.956000328063965 /
RMAG = 9.503999710083008 /
IMAG = 8.902999877929688 /
ZMAG = 8.53600025177002 /
GREDMAG = 11.9350004196167 /
D51MAG = 10.623000144958496 /
JMAG = 7.040999889373779 /
HMAG = 6.2779998779296875 /
KMAG = 6.080999851226807 /
KEPMAG = 9.519000053405762 /
2MASSID = 261789092 /
SCPID = 261789092 /
ALTCATID= 629387 /
ALTCAT = 2 /
GALAXY = 0 /
BLEND = 0 /
VARIABLE= 0 /
EFF_TEMP= 3753 /
SURFGRAV= 4.565999984741211 /
METALLIC= -0.35199999809265137 /
REDDENG = 0.003000000026077032 /
EXTINCT = 0.00800000037997961 /
RADIUS = 0.5899999737739563 /
SOURCE = 'SCP ' /
PHOTQUAL= 7 /
AST_QUAL= 6 /
PARALLAX
GAL_LONG= 69.36228 /
GAL_LAT = 9.998097 /
PM_TOTAL= 0.00860000029206276 /
```

```

GR_COLOR= 1.4520000219345093 /
JK_COLOR= 0.9599999785423279 /
GK_COLOR= 4.875 /
CATKEY = 989727 /
LCTRFILElong cadence target definition file name
SCTRFILEshort cadence target definition file name
BKTRFILEbackground target definition file name
TRAPFILEtarget aperture definition file name
BKAPFILEbackground aperture definition file name
REQNFILErequantization table file name
HUFFFILEHuffman encoding table file name
END

```

```

XTENSION= 'BINTABLE' / Java FITS: Fri Apr 03 09:38:51 GMT-08:00 2009
BITPIX = 8
NAXIS = 2 / Dimensionality
NAXIS1 = 72
NAXIS2 = 43200
PCOUNT = 0
GCOUNT = 1
TFIELDS = 18
TFORM1 = '1E ' /
TDISP1 = 'F10.2 ' /
TUNIT1 = 'seconds ' /
COMMENT Cadence information
TTYPE2 = 'cadence_number' /
TFORM2 = '1J ' /
TDISP2 = 'I16.0 ' /
COMMENT Aperture Photometry (AP)
TTYPE3 = 'ap_centroid_rows' /
TFORM3 = '1E ' /
TDISP3 = 'F10.6 ' /
TUNIT3 = 'pixels ' /
TTYPE4 = 'ap_cent_rows_err' /
TFORM4 = '1E ' /
TDISP4 = 'F10.6 ' /
TUNIT4 = 'sd pixels' /
TTYPE5 = 'ap_centroid_cols' /
TFORM5 = '1E ' /
TDISP5 = 'F10.6 ' /
TUNIT5 = 'pixels ' /
TTYPE6 = 'ap_cent_cols_err' /
TFORM6 = '1E ' /
TDISP6 = 'F10.6 ' /
TUNIT6 = 'sd pixels' /
COMMENT Difference Image Analysis (DIA)
TTYPE7 = 'ap_raw_flux' /
TFORM7 = '1E ' /
TDISP7 = 'F11.3 ' /
TUNIT7 = 'flux ' /
TTYPE8 = 'ap_raw_err' /
TFORM8 = '1E ' /
TDISP8 = 'F11.3 ' /
TUNIT8 = 'sd flux ' /
TTYPE9 = 'ap_corr_flux' /
TFORM9 = '1E ' /
TDISP9 = 'F11.3 ' /
TUNIT9 = 'flux ' /
TTYPE10 = 'ap_corr_err' /
TFORM10 = '1E ' /

```

```

TDISP10 = 'F11.3  ' /
TUNIT10 = 'sd flux ' /
TTYPE11 = 'ap_ins_flux' /
TFORM11 = '1E      ' /
TDISP11 = 'F11.3  ' /
TUNIT11 = 'flux     ' /
TTYPE12 = 'ap_ins_err' /
TFORM12 = '1E      ' /
TDISP12 = 'F11.3  ' /
TUNIT12 = 'sd flux ' /
COMMENT Difference Image Analysis (DIA)
TTYPE13 = 'dia_raw_flux' /
TFORM13 = '1E      ' /
TDISP13 = 'F11.3  ' /
TUNIT13 = 'flux     ' /
TTYPE14 = 'dia_raw_err' /
TFORM14 = '1E      ' /
TDISP14 = 'F11.3  ' /
TUNIT14 = 'sd flux ' /
TTYPE15 = 'dia_corr_flux' /
TFORM15 = '1E      ' /
TDISP15 = 'F11.3  ' /
TUNIT15 = 'flux     ' /
TTYPE16 = 'dia_corr_err' /
TFORM16 = '1E      ' /
TDISP16 = 'F11.3  ' /
TUNIT16 = 'sd flux ' /
TTYPE17 = 'dia_ins_flux' /
TFORM17 = '1E      ' /
TDISP17 = 'F11.3  ' /
TUNIT17 = 'flux     ' /
TTYPE18 = 'dia_ins_err' /
APTYPE  = 'Simple  ' / aperture photometry type: Optimal or Simple
MODULE  =          10 / CCD Module
OUTPUT  =          4 / CCD Output
CHANNEL =          32 / CCD Channel
TTYPE1  = 'time    ' /
TFORM18 = '1E      ' /
TDISP18 = 'F11.3  ' /
TUNIT18 = 'sd flux ' /
END

```

A.2: Long and Short Cadence Target Pixel Data Headers

```

SIMPLE = T           data conform to FITS standard
BITPIX = 0          bits per data value
NAXIS  = 0          number of data array dimensions
EXTEND  = T         File may contain standard extensions
NEXTEND =           Number of standard extensions

TELESCOP= Kepler    telescope used to acquire data
INSTRUME= CCD       identifier for instrument used to acquire data
EQUINOX  = 2000.0   equinox of celestial coord. system

DATE     =          date this file was written (yyyy-mm-dd)
ORIGIN   = STScI    institution responsible for creating FITS file
FILENAME=          name of file
DATSETNM=          data set name of the file
DATE-OBS=          UT date of end of observation (yyyy-mm-dd)

```

TIME-OBS= UT time of end of observation (hh:mm:ss.sss)

/ Target and aperture identifiers

TARGETID= Kepler target identifier
APER ID = aperture identifier

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Pointing information

RA-XAXIS= 290.66667 s/c -x axis Right Ascension (deg.)
DEC-XAXS= 44.5 s/c -x axis declination (deg.)
ROLLANGL= 110 s/c roll angle (deg. from N.)

LASTROLL= approximate MJD time of last roll maneuver
DATAEND = MJD stop time of data taking prior to last roll
DATASTRT= MJD start time of data taking after last roll

/ Science data processing parameters

PROCTIME= DMC processing time (MJD)
DMC VER = DMC software version

/ Spacecraft Configuration ID Map Parameters

SCCONFID= commanded s/c configuration id
SCCONFMTM= time when s/c configuration id is commanded

FGSFRPER= 103.79 FGS frame period (milli-seconds)
NUMFGSFP= 56 number of FGS frame periods per exposure
EXP TIME= exposure time (seconds)
READTIME= 518.95 read out time (milli-seconds)
INT TIME= integration time (seconds) (exp + readout time)
NUMSHORT= 9 number of integrations in a short cadence frame
TEXP SC = total short cadence exposure time (seconds)
TREAD SC= total short cadence readout time (seconds)
TINT SC = total short cadence integration time (seconds)
SHRTLONG= 30 number of short cadences per long cadence
TEXP LC = total long cadence exposure time (seconds)
TREAD LC= total long cadence readout time (seconds)
TINT LC = total long cadence integration time (seconds)
NUMLCBAS= 48 number of long cadences per baseline
NUM FFI = 270 number of integrations in a science FFI
TEXP FFI= total FFI exposure time (seconds)
TREADFFI= total FFI readout time (seconds)
TINT FFI= total FFI integration time (seconds)

REV CLCK= F reverse-clocking in effect (T/F)

OPERTEMP= commanded FPA temperature set point (deg C)
FOCPOS1 = mechanism 1 focus position (micrometer)
FOCPOS2 = mechanism 2 focus position (micrometer)
FOCPOS3 = mechanism 3 focus position (micrometer)
LCFXDOFF= 419400 long cadence FSW black level fixed offset (cnts)
SCFXDOFF= 219400 short cadence FSW black level fixed offset (cnts)

/ Collateral Pixel Definition

VSMRSROW= 1045 science collateral virtual smear region start row
VSMREROW= 1058 science collateral virtual smear region end row
NROWVSMR= number of rows binned in virtual smear region
VSMRSCOL= 12 science collateral virtual smear region start col
VSMRECOL= 1111 science collateral virtual smear region end col
NCOLVSMR= 1100 number of columns in virtual smear region
MASKSROW= 6 science collateral masked region start row
MASKEROW= 18 science collateral masked region end row
NROWMASK= number of rows binned in masked region
MASKSCOL= 12 science collateral masked region start column
MASKECOL= 1111 science collateral masked region end column
NCOLMASK= 1100 number of columns in masked region
BLCKSROW= 0 science collateral black region start row
BLCKEROW= 1069 science collateral black region end row
NROWBLCK= 1070 number of rows in black region
BLCKSCOL= 1115 science collateral black region start column
BLCKECOL= 1131 science collateral black region end column
NCOLBLCK= number of columns binned in black region

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

/ Focal Plane Characterization Model files

FPGMFILE= focal plane geometry model file name
2DBLKFIL= 2-d black level file name
GAINFILE= gain table file name
LINFILE = linearity table file name
LDEUNFIL= LDE undershoot file name
CFLATFIL= combined flat field file name

BADPXLFL= bad pixel list file name
SSFLTFILE= small scale flat field file name
LSFLTFILE= large scale flat field file name
RNDSFILE= read noise file name

PRFFILE = pixel response function file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ World Coordinate System and related parameters

WCSAXES = 2 number of World Coordinate System axes (RA & Dec)
CRPIX1 = reference pixel along more rapidly varying axis
CRPIX2 = reference pixel along less rapidly varying axis
CRVAL1 = right ascension (degrees) at reference pixel
CRVAL2 = declination (degrees) at reference pixel
CTYPE1 = RA---TAN the coordinate type for the first axis
CTYPE2 = DEC--TAN the coordinate type for the second axis
CDELTA1 = -0.0011055556 degrees per pixel, increasing eastward
CDELTA2 = 0.0011055556 degrees per pixel, increasing northward
PC1_1 = 1.0 linear transformation matrix element cos(theta)
PC1_2 = 0.0 linear transformation matrix element -sin(theta)
PC2_1 = 0.0 linear transformation matrix element sin(theta)
PC2_2 = 1.0 linear transformation matrix element cos(theta)

/ Barycentric times of series

BSTRTIMS= Solar System Barycentric start time of series
BSTPTIMS= Solar System Barycentric stop time of series

/ Module/output Calibration Parameters

GAIN = 1.0 channel gain in electrons/DN
READNOIS= read noise value per readout (units of DN)
TIMSLICE= time-slice readout sequence section
MEANBLCK= FSW mean black level (counts)

/ Data table definitions

TTYPE1 = time name of field 1: seconds since start of series
TFORM1 = 1E format in which field 1 is coded: sp floating pt
TDISP1 = F10.2 format in which field 1 is displayed
TUNIT1 = seconds units of data value in field 1
TTYPE2 = row name of field 2: row pixel location (0-1069)
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed

TUNIT2 = pixels units of data value in field 2
TTYPE3 = column name of field 3: column pixel location (0-1131)
TFORM3 = 1I format in which field 3 is coded: one 16 bit int
TDISP3 = I4.1 format in which field 3 is displayed
TUNIT3 = pixels units of data value in field 3
TTYPE4 = orig_value name of field 4: original data value
TFORM4 = 1J format in which field 4 is coded: one 32 bit int
TDISP4 = I10 format in which field 4 is displayed
TUNIT4 = DN units of data value in field 4
TTYPE5 = cal_value name of field 5: calibrated data value
TFORM5 = 1E format in which field 5 is coded: sp floating pt
TDISP5 = F16.3 format in which field 5 is displayed
TUNIT5 = e- units of data value in field 5
TTYPE6 = cal_uncert name of field 6: calibrated uncertainty value
TFORM6 = 1E format in which field 6 is coded: sp floating pt
TDISP6 = F16.3 format in which field 6 is displayed
TUNIT6 = sd e- units of data value in field 6

END

A.3: Long Cadence Target Pixel Background Header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss.sss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Pointing information

RA-XAXIS= 290.66667 s/c -x axis Right Ascension (deg.)
DEC-XAXS= 44.5 s/c -x axis declination (deg.)

ROLLANGL= 110 s/c roll angle (deg. from N.)
LASTROLL= approximate MJD time of last roll maneuver
DATAEND = MJD stop time of data taking prior to last roll
DATASTRT= MJD start time of data taking after last roll

/ Science data processing parameters

PROCTIME= DMC processing time (MJD)
DMC VER = DMC software version

/ Spacecraft Configuration ID Map Parameters

SCCONFID= commanded s/c configuration id
SCCONFMTM= time when s/c configuration id is commanded

FGSFRPER= 103.79 FGS frame period (milli-seconds)
NUMFGSFP= 56 number of FGS frame periods per exposure
EXP TIME= exposure time (seconds)
READTIME= 518.95 read out time (milli-seconds)
INT TIME= integration time (seconds) (exp + readout time)
NUMSHORT= 9 number of integrations in a short cadence frame
TEXP SC = total short cadence exposure time (seconds)
TREAD SC= total short cadence readout time (seconds)
TINT SC = total short cadence integration time (seconds)
SHRTLONG= 30 number of short cadences per long cadence
TEXP LC = total long cadence exposure time (seconds)
TREAD LC= total long cadence readout time (seconds)
TINT LC = total long cadence integration time (seconds)
NUMLCBAS= 48 number of long cadences per baseline
NUM FFI = 270 number of integrations in a science FFI
TEXP FFI= total FFI exposure time (seconds)
TREADFFI= total FFI readout time (seconds)
TINT FFI= total FFI integration time (seconds)

REV CLCK= F reverse-clocking in effect (T/F)
OPERTEMP= commanded FPA temperature set point (deg C)
FOCPOS1 = mechanism 1 focus position (micrometer)
FOCPOS2 = mechanism 2 focus position (micrometer)
FOCPOS3 = mechanism 3 focus position (micrometer)
LCFXDOFF= 419400 long cadence FSW black level fixed offset (cnts)
SCFXDOFF= 219400 short cadence FSW black level fixed offset (cnts)

/ Collateral Pixel Definition

VSMRSROW= 1045 science collateral virtual smear region start row
VSMREROW= 1058 science collateral virtual smear region end row
NROWVSMR= number of rows binned in virtual smear region
VSMRSCOL= 12 science collateral virtual smear region start col
VSMRECOL= 1111 science collateral virtual smear region end col
NCOLVSMR= 1100 number of columns in virtual smear region
MASKSROW= 6 science collateral masked region start row
MASKEROW= 18 science collateral masked region end row
NROWMASK= number of rows binned in masked region
MASKSCOL= 12 science collateral masked region start column
MASKECOL= 1111 science collateral masked region end column
BLCKSROW= 0 science collateral black region start row
BLCKEROW= 1069 science collateral black region end row
NROWBLCK= 1070 number of rows in black region
BLCKSCOL= 1115 science collateral black region start column

BLCKECOL= 1131 science collateral black region end column
NCOLBLCK= number of columns binned in black region

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

/ Focal Plane Characterization Model files

FPGMFILE= focal plane geometry model file name
2DBLKFIL= 2-d black level file name
GAINFILE= gain table file name
LINFILE = linearity table file name
LDEUNFIL= LDE undershoot file name
CFLATFIL= combined flat field file name

BADPXLFL= bad pixel list file name
SSFLTFIL= small scale flat field file name
LSFLTFIL= large scale flat field file name
RNDSFILE= read noise file name
PRFFILE = pixel response function file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ World Coordinate System and related parameters

WCSAXES = 2 number of World Coordinate System axes (RA & Dec)
CRPIX1 = reference pixel along more rapidly varying axis
CRPIX2 = reference pixel along less rapidly varying axis
CRVAL1 = right ascension (degrees) at reference pixel
CRVAL2 = declination (degrees) at reference pixel
CTYPE1 = RA---TAN the coordinate type for the first axis
CTYPE2 = DEC--TAN the coordinate type for the second axis
CDELT1 = -0.0011055556 degrees per pixel, increasing eastward
CDELT2 = 0.0011055556 degrees per pixel, increasing northward
PC1 1 = 1.0 linear transformation matrix element cos(theta)
PC1 2 = 0.0 linear transformation matrix element -sin(theta)
PC2 1 = 0.0 linear transformation matrix element sin(theta)
PC2 2 = 1.0 linear transformation matrix element cos(theta)

/ Barycentric times of series

BSTRTIMS= Solar System Barycentric start time of series
BSTPTIMS= Solar System Barycentric stop time of series

/ Module/output Calibration Parameters

GAIN = 1.0 channel gain in electrons/DN
READNOIS= read noise value per readout (units of DN)
TIMSLICE= time-slice readout sequence section
MEANBLCK= FSW mean black level (counts)

/ Data table definitions

TTYPE1 = time name of field 1: seconds since start of series
TFORM1 = 1E format in which field 1 is coded: sp floating pt
TDISP1 = F10.2 format in which field 1 is displayed
TUNIT1 = seconds units of data value in field 1
TTYPE2 = row name of field 2: row pixel location (0-1069)
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TUNIT2 = pixels units of data value in field 2
TTYPE3 = column name of field 3: column pixel location (0-1131)
TFORM3 = 1I format in which field 3 is coded: one 16 bit int
TDISP3 = I4.1 format in which field 3 is displayed
TUNIT3 = pixels units of data value in field 3
TTYPE4 = orig_value name of field 4: original data value
TFORM4 = 1J format in which field 4 is coded: one 32 bit int
TDISP4 = I10 format in which field 4 is displayed
TUNIT4 = DN units of data value in field 4
TTYPE5 = cal_value name of field 5: calibrated data value
TFORM5 = 1E format in which field 5 is coded: sp floating pt
TDISP5 = F16.3 format in which field 5 is displayed
TUNIT5 = e- units of data value in field 5
TTYPE6 = cal_uncert name of field 6: calibrated uncertainty value
TFORM6 = 1E format in which field 6 is coded: sp floating pt
TDISP6 = F16.3 format in which field 6 is displayed
TUNIT6 = sd e- units of data value in field 6
TTYPE7 = aperture_id name of field 7: aperture ID
TFORM7 = 1I format in which field 7 is coded: one 16 bit int
TDISP7 = I5 format in which field 7 is displayed

END

A.4.1: Long Cadence Target Pixel Collateral Headers

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss.sss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Pointing information

RA-XAXIS= 290.66667 s/c -x axis Right Ascension (deg.)
DEC-XAXS= 44.5 s/c -x axis declination (deg.)
ROLLANGL= 110 s/c roll angle (deg. from N.)

LASTROLL= approximate MJD time of last roll maneuver
DATAEND = MJD stop time of data taking prior to last roll
DATASTRT= MJD start time of data taking after last roll

/ Science data processing parameters

PROCTIME= DMC processing time (MJD)
DMC VER = DMC software version

/ Spacecraft Configuration ID Map Parameters

SCCONFID= commanded s/c configuration id
SCCONFMTM= time when s/c configuration id is commanded

FGSFRPER= 103.79 FGS frame period (milli-seconds)
NUMFGSFP= 56 number of FGS frame periods per exposure
EXP TIME= exposure time (seconds)
READTIME= 518.95 read out time (milli-seconds)
INT TIME= integration time (seconds) (exp + readout time)
NUMSHORT= 9 number of integrations in a short cadence frame
TEXP SC = total short cadence exposure time (seconds)
TREAD SC= total short cadence readout time (seconds)

TINT SC = total short cadence integration time (seconds)
SHRTLONG= 30 number of short cadences per long cadence
TEXP LC = total long cadence exposure time (seconds)
TREAD LC= total long cadence readout time (seconds)
TINT LC = total long cadence integration time (seconds)
NUMLCBAS= 48 number of long cadences per baseline
NUM FFI = 270 number of integrations in a science FFI
TEXP FFI= total FFI exposure time (seconds)
TREADFFI= total FFI readout time (seconds)
TINT FFI= total FFI integration time (seconds)

REV CLCK= F reverse-clocking in effect (T/F)
OPERTEMP= commanded FPA temperature set point (deg C)
FOCPOS1 = mechanism 1 focus position (micrometer)
FOCPOS2 = mechanism 2 focus position (micrometer)
FOCPOS3 = mechanism 3 focus position (micrometer)
LCFXDOFF= 419400 long cadence FSW black level fixed offset (cnts)
SCFXDOFF= 219400 short cadence FSW black level fixed offset (cnts)

/ Collateral Pixel Definition

VSMRSROW= 1045 science collateral virtual smear region start row
VSMREROW= 1058 science collateral virtual smear region end row
NROWVSMR= number of rows binned in virtual smear region
VSMRSCOL= 12 science collateral virtual smear region start col
VSMRECOL= 1111 science collateral virtual smear region end col
NCOLVSMR= 1100 number of columns in virtual smear region
MASKSROW= 6 science collateral masked region start row
MASKEROW= 18 science collateral masked region end row
NROWMASK= number of rows binned in masked region
MASKSCOL= 12 science collateral masked region start column
MASKECOL= 1111 science collateral masked region end column
NCOLMASK= 1100 number of columns in masked region
BLCKSROW= 0 science collateral black region start row
BLCKEROW= 1069 science collateral black region end row
NROWBLCK= 1070 number of rows in black region
BLCKSCOL= 1115 science collateral black region start column
BLCKECOL= 1131 science collateral black region end column
NCOLBLCK= number of columns binned in black region

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

/ Focal Plane Characterization Model files

FPGMFILE= focal plane geometry model file name
2DBLKFIL= 2-d black level file name
GAINFILE= gain table file name
LINFILE = linearity table file name
LDEUNFIL= LDE undershoot file name
CFLATFIL= combined flat field file name

BADPXLFL= bad pixel list file name
SSFLTFIL= small scale flat field file name
LSFLTFIL= large scale flat field file name
RNDSFILE= read noise file name
PRFFILE = pixel response function file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ World Coordinate System and related parameters

WCSAXES = 2 number of World Coordinate System axes (RA & Dec)
CRPIX1 = reference pixel along more rapidly varying axis
CRPIX2 = reference pixel along less rapidly varying axis
CRVAL1 = right ascension (degrees) at reference pixel
CRVAL2 = declination (degrees) at reference pixel
CTYPE1 = RA---TAN the coordinate type for the first axis
CTYPE2 = DEC--TAN the coordinate type for the second axis
CDELTA1 = -0.0011055556 degrees per pixel, increasing eastward
CDELTA2 = 0.0011055556 degrees per pixel, increasing northward
PC1_1 = 1.0 linear transformation matrix element cos(theta)
PC1_2 = 0.0 linear transformation matrix element -sin(theta)
PC2_1 = 0.0 linear transformation matrix element sin(theta)
PC2_2 = 1.0 linear transformation matrix element cos(theta)

/ Barycentric times of series

BSTRTMS= Solar System Barycentric start time of series
BSTPTMS= Solar System Barycentric stop time of series

/ Module/output Calibration Parameters

GAIN = 1.0 channel gain in electrons/DN
READNOIS= read noise value per readout (units of DN)
TIMSLICE= time-slice readout sequence section

MEANBLCK= FSW mean black level (counts)

/ Collateral pixel type identifier

COLLTYPE= collateral pixel type

/ Data table definitions

TTYPE1 = time name of field 1: seconds since start of series
TFORM1 = 1E format in which field 1 is coded: sp floating pt
TDISP1 = F10.2 format in which field 1 is displayed
TUNIT1 = seconds units of data value in field 1
TTYPE2 = pixel_offset name of field 2: pixel offset
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TUNIT2 = pixels units of data value in field 3
TTYPE3 = orig_value name of field 3: original data value
TFORM3 = 1J format in which field 3 is coded: one 32 bit int
TDISP3 = I10 format in which field 3 is displayed
TUNIT3 = DN units of data value in field 3
TTYPE4 = cal_value name of field 4: calibrated data value
TFORM4 = 1E format in which field 4 is coded: sp floating pt
TDISP4 = F16.3 format in which field 4 is displayed
TUNIT4 = e- units of data value in field 4
TTYPE5 = cal_uncert name of field 5: calibrated uncertainty value
TFORM5 = 1E format in which field 5 is coded: sp floating pt
TDISP5 = F16.3 format in which field 5 is displayed
TUNIT5 = sd e- units of data value in field 5

END

A.4.2: Short Cadence Target Pixel Collateral Header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss.sss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Data Collection Timeline

DCT TIME= data collection time in Data Collection Timeline
DCT TYPE= data type from Data Collection Timeline
DCT PURP= data purpose from Data Collection Timeline
LC INTER= number of long cadence intervals
LC COUNT= number of long cadences executed
SC INTER= number of short cadence intervals
SC COUNT= number of short cadences executed

/ Pointing information

RA-XAXIS= 290.66667 s/c -x axis Right Ascension (deg.)
DEC-XAXS= 44.5 s/c -x axis declination (deg.)
ROLLANGL= 110 s/c roll angle (deg. from N.)
LASTROLL= approximate MJD time of last roll maneuver
DATAEND = MJD stop time of data taking prior to last roll
DATASTRT= MJD start time of data taking after last roll

/ Science data processing parameters

PROCTIME= DMC processing time (MJD)
DMC VER = DMC software version

/ Spacecraft Configuration ID Map Parameters

SCCONFID= commanded s/c configuration id
SCCONFMTM= time when s/c configuration id is commanded
FGSFRPER= 103.79 FGS frame period (milli-seconds)
NUMFGSFP= 56 number of FGS frame periods per exposure
EXP TIME= exposure time (seconds)
READTIME= 518.95 read out time (milli-seconds)
INT TIME= integration time (seconds) (exp + readout time)
NUMSHORT= 9 number of integrations in a short cadence frame
TEXP SC = total short cadence exposure time (seconds)
TREAD SC= total short cadence readout time (seconds)
TINT SC = total short cadence integration time (seconds)
SHRTLONG= 30 number of short cadences per long cadence
TEXP LC = total long cadence exposure time (seconds)
TREAD LC= total long cadence readout time (seconds)
TINT LC = total long cadence integration time (seconds)
NUMLCBAS= 48 number of long cadences per baseline
NUM FFI = 270 number of integrations in a science FFI
TEXP FFI= total FFI exposure time (seconds)
TREADFFI= total FFI readout time (seconds)
TINT FFI= total FFI integration time (seconds)
REV CLCK= F reverse-clocking in effect (T/F)
OPERTEMP= commanded FPA temperature set point (deg C)
FOCPOS1 = mechanism 1 focus position (micrometer)

FOCPOS2 = mechanism 2 focus position (micrometer)
FOCPOS3 = mechanism 3 focus position (micrometer)
LCFXDOFF= 419400 long cadence FSW black level fixed offset (cnts)
SCFXDOFF= 219400 short cadence FSW black level fixed offset (cnts)

/ Collateral Pixel Definition

VSMRSROW= 1045 science collateral virtual smear region start row
VSMREROW= 1058 science collateral virtual smear region end row
NROWVSMR= number of rows binned in virtual smear region
VSMRSCOL= 12 science collateral virtual smear region start col
VSMRECOL= 1111 science collateral virtual smear region end col
NCOLVSMR= 1100 number of columns in virtual smear region
MASKSROW= 6 science collateral masked region start row
MASKEROW= 18 science collateral masked region end row
NROWMASK= number of rows binned in masked region
MASKSCOL= 12 science collateral masked region start column
MASKECOL= 1111 science collateral masked region end column
NCOLMASK= 1100 number of columns in masked region
BLCKSROW= 0 science collateral black region start row
BLCKEROW= 1069 science collateral black region end row
NROWBLCK= 1070 number of rows in black region
BLCKSCOL= 1115 science collateral black region start column
BLCKECOL= 1131 science collateral black region end column
NCOLBLCK= number of columns binned in black region

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

/ Target and aperture identifiers

TARGETID= Kepler target identifier
APER ID = aperture identifier

/ Pixel mapping reference files

LCTPMTAB= N/A long cadence target pixel mapping table
SCTPMTAB= N/A short cadence target pixel mapping table
BKGPMTAB= N/A background pixel mapping table
LCCPMTAB= N/A long cadence collateral pixel mapping table
SCCPMTAB= N/A short cadence collateral pixel mapping table

/ Focal Plane Characterization Model files

FPGMFILE= focal plane geometry model file name
2DBLKFIL= 2-d black level file name
GAINFILE= gain table file name
LINFILE = linearity table file name
LDEUNFIL= LDE undershoot file name
CFLATFIL= combined flat field file name

BADPXLFL= bad pixel list file name
SSFLTFIL= small scale flat field file name
LSFLTFIL= large scale flat field file name
RNDSFILE= read noise file name
PRFFILE = pixel response function file name

/ Calibration switches

CAL VERS= calibration software version number
2DBLKCOR= PERFORM 2-d black correction (perform, omit, complete)
DYBLKCOR= PERFORM dynamic black correction (perform, omit, complete)
GAINCORR= PERFORM gain correction (perform, omit, complete)
LINCORR = PERFORM linearity correction (perform, omit, complete)
UNSHCORR= PERFORM undershoot correction (perform, omit, complete)
DARKCORR= PERFORM calculate dark current (perform, omit, complete)
SMEARCOR= PERFORM smear correction (perform, omit, complete)
FLATCORR= PERFORM flat field correction (perform, omit, complete)

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ World Coordinate System and related parameters

WCSAXES = 2 number of World Coordinate System axes (RA & Dec)
CRPIX1 = reference pixel along more rapidly varying axis
CRPIX2 = reference pixel along less rapidly varying axis
CRVAL1 = right ascension (degrees) at reference pixel
CRVAL2 = declination (degrees) at reference pixel
CTYPE1 = RA---TAN the coordinate type for the first axis
CTYPE2 = DEC--TAN the coordinate type for the second axis
CDELTA1 = -0.0011055556 degrees per pixel, increasing eastward
CDELTA2 = 0.0011055556 degrees per pixel, increasing northward
PC1 1 = 1.0 linear transformation matrix element cos(theta)
PC1 2 = 0.0 linear transformation matrix element -sin(theta)

PC2 1 = 0.0 linear transformation matrix element sin(theta)
PC2 2 = 1.0 linear transformation matrix element cos(theta)

/ Barycentric times of series

BSTRTIMS= Solar System Barycentric start time of series
BSTPTIMS= Solar System Barycentric stop time of series

/ Module/output Calibration Parameters

GAIN = 1.0 channel gain in electrons/DN
READNOIS= read noise value per readout (units of DN)
TIMSLICE= time-slice readout sequence section
MEANBLCK= FSW mean black level (counts)

/ Collateral pixel type identifier

COLLTYPE= collateral pixel type

/ Data table definitions

TTYPE1 = time name of field 1: seconds since start of series
TFORM1 = 1E format in which field 1 is coded: sp floating pt
TDISP1 = F10.2 format in which field 1 is displayed
TUNIT1 = seconds units of data value in field 1
TTYPE2 = pixel_offset name of field 2: pixel offset
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TUNIT2 = pixels units of data value in field 3
TTYPE3 = orig_value name of field 3: original data value
TFORM3 = 1J format in which field 3 is coded: one 32 bit int
TDISP3 = I10 format in which field 3 is displayed
TUNIT3 = DN units of data value in field 3
TTYPE4 = cal_value name of field 4: calibrated data value
TFORM4 = 1E format in which field 4 is coded: sp floating pt
TDISP4 = F16.3 format in which field 4 is displayed
TUNIT4 = e- units of data value in field 4
TTYPE5 = cal_uncert name of field 5: calibrated uncertainty value
TFORM5 = 1E format in which field 5 is coded: sp floating pt
TDISP5 = F16.3 format in which field 5 is displayed
TUNIT5 = sd e- units of data value in field 5

END

Appendix B: Cosmic Ray Correction Data FITS headers

B.1.1: Target and Background Pixel Cosmic Ray Correction Table header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions

NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ Cosmic Ray Correction Table parameters

TTYPE1 = row name of field 1: row pixel location (0-1069)
TFORM1 = 1I format in which field 1 is coded: one 16 bit int
TDISP1 = I4.1 format in which field 1 is displayed
TUNIT1 = pixels units of data value in field 1
TTYPE2 = column name of field 2: column pixel location (0-1131)
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TUNIT2 = pixels units of data value in field 2
TTYPE3 = cr_corr_value name of field 3: cosmic ray correction value
TFORM3 = 1E format in which field 3 is coded: sp floating pt
TDISP3 = F16.3 format in which field 3 is displayed
TUNIT3 = ADU units of data value in field 3
TTYPE4 = target_id name of field 4: target id
TFORM4 = 1J format in which field 4 is coded: one 32 bit int
TDISP4 = I10 format in which field 4 is displayed
TTYPE5 = aperture_id name of field 5: aperture id
TFORM5 = 1I format in which field 5 is coded: one 16 bit int
TDISP5 = I5 format in which field 5 is displayed

END

B.1.2: Long Cadence Collateral Pixel Cosmic Ray Correction Table header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table

```

GCOUNT = 1           number of groups
TFIELDS =         number of fields in each table row
INHERIT = T       inherit the primary header
EXTNAME =         extension name
EXTVER =         extension version number

/ Extension parameters

CHANNEL =         channel number (1-84)
MODULE =         module number (2-24, except 5 and 21)
OUTPUT =         module output number (1-4)

/ Cosmic Ray Correction Table parameters

TTYPE1 = col_pixel_type name of field 1: collateral pixel type
TFORM1 = B         format in which field 1 is coded: character
TDISP1 = I2        format in which field 1 is displayed
TTYPE2 = pixel_offset name of field 2: pixel offset
TFORM2 = 1I        format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1      format in which field 2 is displayed
TTYPE3 = cr_corr_value name of field 3: cosmic ray correction value
TFORM3 = 1E        format in which field 3 is coded:sp floating pt
TDISP3 = F16.3     format in which field 3 is displayed
TUNIT3 = ADU        units of data value in field 3

END

```

B.2.1: Short Cadence Collateral Pixel Cosmic Ray Correction Table header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table

GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ Cosmic Ray Correction Table parameters

TTYPE1 = col_pixel_type name of field 1: collateral pixel type
TFORM1 = B format in which field 1 is coded: character
TDISP1 = I2 format in which field 1 is displayed
TTYPE2 = pixel_offset name of field 2: pixel offset
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TTYPE3 = cr_corr_value name of field 3: cosmic ray correction value
TFORM3 = 1E format in which field 3 is coded:sp floating pt
TDISP3 = F16.3 format in which field 3 is displayed
TUNIT3 = ADU units of data value in field 3
TTYPE4 = target_id name of field 4: target id
TFORM4 = 1J format in which field 4 is coded: one 32 bit int
TDISP4 = I10 format in which field 4 is displayed
TTYPE5 = aperture_id name of field 5: aperture id
TFORM5 = 1I format in which field 5 is coded: one 16 bit int
TDISP5 = I5 format in which field 5 is displayed

END

Appendix C: Focal Plane Characterization Model FITS file headers

C.1.1: Flat Field and 2d Black Image Header

All flat fields (small scale, large scale and combined) and the 2d black level file have the same FITS header structure.

```
SIMPLE = T           data conform to FITS standard
BITPIX = 0          bits per data value
NAXIS  = 0          number of data array dimensions
EXTEND = T          File may contain standard extensions
NEXTEND =           Number of standard extensions

TELESCOP= Kepler    telescope used to acquire data
INSTRUME= CCD        identifier for instrument used to acquire data
EQUINOX = 2000.0    equinox of celestial coord. system

DATE    =           date this file was written (yyyy-mm-dd)
ORIGIN  = STScI     institution responsible for creating FITS file
FILENAME=           name of file
DATSETNM=           data set name of the file
```

/ File characteristics

```
PIXELTYP=           type of pixel in file: ssflat, cflat, 2d-black
VALIDTIM=           MJD time when file becomes valid
```

END

```
XTENSION= BINTABLE  extension type
BITPIX  =           bits per data value
NAXIS   = 2          number of data array dimensions
NAXIS1  =           length of first data axis
NAXIS2  =           length of second data axis
PCOUNT  = 0          number of parameter bytes following data table
GCOUNT = 1          number of groups
TFIELDS =           number of fields in each table row
INHERIT = T          inherit the primary header
EXTNAME =           extension name
EXTVER  =           extension version number
```

/ Extension parameters

```
CHANNEL =           channel number (1-84)
MODULE  =           module number (2-24, except 5 and 21)
OUTPUT  =           module output number (1-4)
```

/ Image statistics

```
MINPIXEL=           minimum pixel value in image extension
MAXPIXEL=           maximum pixel value in image extension
```

END

Appendix D: Calibrated Cadence and FFI FITS headers

D.1.1: Cadence Data headers

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file
DATE-OBS= UT date of end of observation (yyyy-mm-dd)
TIME-OBS= UT time of end of observation (hh:mm:ss)

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.

/ Data Collection Timeline

DCT TIME= data collection time in Data Collection Timeline
DCT TYPE= data type from Data Collection Timeline
DCT PURP= data purpose from Data Collection Timeline

LC INTER= number of long cadence intervals
LC COUNT= number of long cadences executed
SC INTER= number of short cadence intervals
SC COUNT= number of short cadences executed

/ Pointing information

RA-XAXIS= 290.66667 s/c -x axis Right Ascension (deg.)
DEC-XAXS= 44.5 s/c -x axis declination (deg.)
ROLLANGL= 110 s/c roll angle (deg. from N.)

LASTROLL= approximate MJD time of last roll maneuver
DATAEND = MJD stop time of data taking prior to last roll
DATASTRT= MJD start time of data taking after last roll

/ Science data processing parameters

PROCTIME= DMC processing time (MJD)
DMC VER = DMC software version

ANC ENG = ancillary engineering data included in dataset?

/ Spacecraft Configuration ID Map Parameters

SCCONFID= commanded s/c configuration id
SCCONFMTM= time when s/c configuration id is commanded

FGSFRPER= 103.79 FGS frame period (milli-seconds)
NUMFGSFP= 56 number of FGS frame periods per exposure
EXP TIME= exposure time (seconds)
READTIME= 518.95 read out time (milli-seconds)
INT TIME= integration time (seconds) (exp + readout time)
NUMSHORT= 9 number of integrations in a short cadence frame
TEXP SC = total short cadence exposure time (seconds)
TREAD SC= total short cadence readout time (seconds)
TINT SC = total short cadence integration time (seconds)
SHRTLONG= 30 number of short cadences per long cadence
TEXP LC = total long cadence exposure time (seconds)
TREAD LC= total long cadence readout time (seconds)
TINT LC = total long cadence integration time (seconds)
NUMLCBAS= 48 number of long cadences per baseline
NUM FFI = 270 number of integrations in a science FFI
TEXP FFI= total FFI exposure time (seconds)
TREADFFI= total FFI readout time (seconds)
TINT FFI= total FFI integration time (seconds)

REV CLCK= F reverse-clocking in effect (T/F)
OPERTEMP= commanded FPA temperature set point (deg C)
FOCPOS1 = mechanism 1 focus position (micrometer)
FOCPOS2 = mechanism 2 focus position (micrometer)
FOCPOS3 = mechanism 3 focus position (micrometer)
LCFXDOFF= 419400 long cadence FSW black level fixed offset (cnts)
SCFXDOFF= 219400 short cadence FSW black level fixed offset (cnts)

/ Collateral Pixel Definition

VSMRSROW= 1045 science collateral virtual smear region start row
VSMREROW= 1058 science collateral virtual smear region end row
NROWVSMR= number of rows binned in virtual smear region
VSMRSCOL= 12 science collateral virtual smear region start col
VSMRECOL= 1111 science collateral virtual smear region end col
NCOLVSMR= 1100 number of columns in virtual smear region
MASKSROW= 6 science collateral masked region start row
MASKEROW= 18 science collateral masked region end row
NROWMASK= number of rows binned in masked region
MASKSCOL= 12 science collateral masked region start column
MASKECOL= 1111 science collateral masked region end column
NCOLMASK= 1100 number of columns in masked region
BLCKSROW= 0 science collateral black region start row
BLCKEROW= 1069 science collateral black region end row
NROWBLCK= 1070 number of rows in black region
BLCKSCOL= 1115 science collateral black region start column
BLCKECOL= 1131 science collateral black region end column
NCOLBLCK= number of columns binned in black region

/ On-board compression parameters

REQUANT = T data requantized for downlink (T/F)
HUFFMAN = T data entropic compressed for downlink (T/F)
BASELINE= F data originated as baseline image (T/F)
BASENAME= rootname of baseline image

BASERCON= F baseline created from residual baseline image
RBASNAME= rootname of residual baseline image

/ On-board compression statistics

BITSPIXC= actual avg number of bits per compressed pixel
TBITSPXC= theoretical avg num of bits per compressed pixel

/ SPICE kernel files

SPC-LSK = file name of leap second kernel
SPC-SCLK= file name of spacecraft clock kernel
SPC-SPK = file name of Kepler spacecraft ephemeris kernel
SPC-SPK2= file name of NAIF planet ephemeris kernel

/ Photometer Configuration Error Flags

SEFI_ACC= F Single Event Funtional Interrupt in accum memory
SEFI_CAD= F Single Event Funtional Interrupt in cadence mem
LDE_OOS = F Local Detector Electronics OutOfSynch reported
FINE_PNT= F Fine Point pointing status during accumulation
MMNTMDMP= F momentum dump occurred during accumulation
LDEPARER= F Local Detector Electronics parity error occurred
SCRC_ERR= F SDRAM Controller memory pixel error occurred

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG_APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

/ Pixel mapping reference files

LCTPMTAB= N/A long cadence target pixel mapping table
SCTPMTAB= N/A short cadence target pixel mapping table
BKGPMTAB= N/A background pixel mapping table
LCCPMTAB= N/A long cadence collateral pixel mapping table
SCCPMTAB= N/A short cadence collateral pixel mapping table

/ Focal Plane Characterization Model files

FPGMFILE= focal plane geometry model file name
2DBLKFIL= 2-d black level file name
GAINFILE= gain table file name
LINFILE = linearity table file name
LDEUNFIL= LDE undershoot file name
CFLATFIL= combined flat field file name

BADPXLFL= bad pixel list file name
SSFLTFIL= small scale flat field file name
LSFLTFIL= large scale flat field file name
RNDSFILE= read noise file name
PRFFILE = pixel response function file name

/ Calibration switches

CAL VERS= calibration software version number
2DBLKCOR= PERFORM 2-d black correction (perform, omit, complete)
DYBLKCOR= PERFORM dynamic black correction (perform,omit,complete)
GAINCORR= PERFORM gain correction (perform, omit, complete)
LINCORR = PERFORM linearity correction (perform, omit, complete)
UNSHCORR= PERFORM undershoot correction (perform, omit, complete)
DARKCORR= PERFORM calculate dark current (perform, omit, complete)
SMEARCOR= PERFORM smear correction (perform, omit, complete)
FLATCORR= PERFORM flat field correction (perform, omit, complete)

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ World Coordinate System and related parameters

WCSAXES = 2 number of World Coordinate System axes (RA & Dec)
CRPIX1 = reference pixel along more rapidly varying axis
CRPIX2 = reference pixel along less rapidly varying axis
CRVAL1 = right ascension (degrees) at reference pixel
CRVAL2 = declination (degrees) at reference pixel
CTYPE1 = RA---TAN the coordinate type for the first axis
CTYPE2 = DEC--TAN the coordinate type for the second axis
CDELTA1 = -0.0011055556 degrees per pixel, increasing eastward
CDELTA2 = 0.0011055556 degrees per pixel, increasing northward
PC1 1 = 1.0 linear transformation matrix element cos(theta)
PC1 2 = 0.0 linear transformation matrix element -sin(theta)
PC2 1 = 0.0 linear transformation matrix element sin(theta)
PC2 2 = 1.0 linear transformation matrix element cos(theta)

/ Velocity Aberration Corrections

DVA RA = velocity aberration correction RA offset (rad)
DVA DEC = velocity aberration correction Dec offset (rad)
VA SCALE= velocity aberration scale factor

/ Barycentric Times

BTC ROW = 531 Barycentric time correction reference pixel row
BTC COL = 561 Barycentric time correction reference pixel column
BARYDELTA= calculated Barycentric time correction from UTC
BSTRTIME= Solar System Barycentric start time of cadence
BSTPTIME= Solar System Barycentric stop time of cadence

/ Module/output Calibration Parameters

GAIN = 1.0 channel gain in electrons/DN
READNOIS= read noise value per readout (units of DN)
TIMSLICE= time-slice readout sequence section
MEANBLACK= FSW mean black level (counts)

/ Data table definition

TTYPE1 = orig_value name of field 1: original data value
TFORM1 = 1J format in which field 1 is coded: one 32 bit int
TDISP1 = I10 format in which field 1 is displayed
TUNIT1 = DN units of data value in field 1
TTYPE2 = cal_value name of field 2: calibrated data value
TFORM2 = 1E format in which field 2 is coded: sp floating pt
TDISP2 = F16.3 format in which field 2 is displayed
TUNIT2 = e- units of data value in field 2
TTYPE3 = cal_uncert name of field 3: calibrated uncertainty value
TFORM3 = 1E format in which field 3 is coded: sp floating pt
TDISP3 = F16.3 format in which field 3 is displayed
TUNIT3 = sd e- units of data value in field 3

END

Note: The calibrated pixels are in units of photo electrons; the calibration uncertainties are in units of standard deviation of photoelectrons, except for the calibrated black pixels which are in units of residual ADUs.

D.1.2: Full Frame Image (FFI) header

```
SIMPLE = T / data conform to FITS standard
BITPIX = 8 / bits per data value
NAXIS = 0 / number of data array dimensions
EXTEND = T / File may contain standard extensions
NEXTEND = 84 / Number of standard extensions

TELESCOP= 'Kepler' / telescope used to acquire data
INSTRUME= 'CCD' / identifier for instrument used to acquire data
EQUINOX = 2000.0 / equinox of celestial coord. system

DATE = '2009-04-14' / date this file was written (yyyy-mm-dd)
ORIGIN = 'STScI' / institution responsible for creating FITS file
FILENAME= 'kplr2009104172126_ffi-orig.fits' / name of file
DATSETNM= 'kplr2009104172126' / data set name of the file
DATE-OBS= '2009-04-14' / UT date of end of observation (yyyy-mm-dd)
TIME-OBS= '17:21:26.580' / UT time of end of observation (hh:mm:ss.sss)

/ Data content

DATATYPE= 'ffi' / data type: short cadence, long cadence, FFI
PIXELTYP= 'all' / pixel type: target, background, collateral, all
FOUNDGAP= F / one or more data gaps were found

/ Data times

STARTIME= 5.493571300747E+04 / UTC start time of data in MJD
END_TIME= 5.493572322430E+04 / UTC end time of data in MJD
FRAMELEN= 882.734 / duration of observation (end - start) in second
MID_TIME= 5.493571811589E+04 / central time used in velocity aberration corr.

/ Data Collection Timeline

DCT_TIME= '2009104172126' / data collection time in Data Collection Timeline
DCT_TYPE= 'FFI' / data type from Data Collection Timeline
DCT_PURP= 'KACR 451 Additional FFIs with encircled energy'

LC_INTER= 0 / number of long cadence intervals
LC_COUNT= 232 / number of long cadences executed

/ Pointing information

RA-XAXIS= 290.667 / s/c -x axis Right Ascension (deg.)
DEC-XAXS= 44.5 / s/c -x axis declination (deg.)
ROLLANGL= 20.0 / s/c roll angle (deg. from N.)

LASTROLL= 0.000000000000E+00 / approximate MJD time of last roll maneuver
DATAEND = 0.000000000000E+00 / MJD stop time of data taking prior to last roll
DATASTRT= 0.000000000000E+00 / MJD start time of data taking after last roll

/ Science data processing parameters

PROCTIME= ' 5.493587444444E+04' / DMC processing time (MJD)
DMC_VER = 'KEPLER 2009_7C' / DMC software version
ANC_ENG = F / ancillary engineering data included in dataset?

/ Spacecraft Configuration ID Map Parameters
```

SCCONFID= 20 / commanded s/c configuration id
 SCCONFTM= '2009104170039' / time when s/c configuration id is commanded

 FGSFRPER= 103.79 / FGS frame period (milli-seconds)
 NUMFGSFP= 58 / number of FGS frame periods per exposure
 EXP_TIME= 6.01982 / exposure time (seconds)
 READTIME= 518.95 / read out time (milli-seconds)
 INT_TIME= 6.53877 / integration time (seconds) (exp + readout time)
 NUMSHORT= 9 / number of integrations in a short cadence frame
 TEXP_SC = 54.1784 / total short cadence exposure time (seconds)
 TREAD_SC= 4.67055 / total short cadence readout time (seconds)
 TINT_SC = 58.8489 / total short cadence integration time (seconds)
 SHRTLONG= 30 / number of short cadences per long cadence
 TEXP_LC = 1625.35 / total long cadence exposure time (seconds)
 TREAD_LC= 140.117 / total long cadence readout time (seconds)
 TINT_LC = 1765.47 / total long cadence integration time (seconds)
 NUMLCBAS= 48 / number of long cadences per baseline
 NUM_FFI = 135 / number of integrations in a science FFI
 TEXP_FFI= 812.676 / total FFI exposure time (seconds)
 TREADFFI= 70.0583 / total FFI readout time (seconds)
 TINT_FFI= 882.734 / total FFI integration time (seconds)

 REV_CLK= F / reverse-clocking in effect (T/F)
 OPERTEMP= -85.0 / commanded FPA temperature set point (deg C)
 FOCPOS1 = 89.277 / mechanism 1 focus position (micrometer)
 FOCPOS2 = 88.0608 / mechanism 2 focus position (micrometer)
 FOCPOS3 = -0.7186 / mechanism 3 focus position (micrometer)
 LCFXDOFF= 419400 / long cadence FSW black level fixed offset (cnts)
 SCFXDOFF= 219400 / short cadence FSW black level fixed offset (cnts)

/ Collateral Pixel Definition

VSMRSROW= 1048 / science collateral virtual smear region start r
 VSMREROW= 1057 / science collateral virtual smear region end row
 NROWVSMR= 10 / number of rows binned in virtual smear region
 VSMRSCOL= 12 / science collateral virtual smear region start c
 VSMRECOL= 1111 / science collateral virtual smear region end col
 NCOLVSMR= 1100 / number of columns in virtual smear region
 MASKSROW= 6 / science collateral masked region start row
 MASKEROW= 15 / science collateral masked region end row
 NROWMASK= 10 / number of rows binned in masked region
 MASKSCOL= 12 / science collateral masked region start column
 MASKECOL= 1111 / science collateral masked region end column
 NCOLMASK= 1100 / number of columns in masked region
 BLCKSROW= 0 / science collateral black region start row
 BLCKEROW= 1069 / science collateral black region end row
 NROWBLCK= 1070 / number of rows in black region
 BLCKSCOL= 1118 / science collateral black region start column
 BLCKECOL= 1131 / science collateral black region end column
 NCOLBLCK= 14 / number of columns binned in black region

/ SPICE kernel files

SPC-LSK = 'naif0009.tls' / file name of leap second kernel
 SPC-SCLK= 'kplr2009091010044.tsc' / file name of spacecraft clock kernel
 SPC-SPK = 'spk_2009098000000_2009098235027_kplr.bsp' / file name of Kepler space
 SPC-SPK2= 'de421.bsp' / file name of NAIF planet ephemeris kernel

/ Photometer Configuration Error Flags

SEFI_ACC= F / Single Event Funtional Interrupt in accum memor


```

SEFI_CAD=          F / Single Event Funtional Interrupt in cadence mem
LDE_OOS =          F / Local Detector Electronics OutOfSynch reported
FINE_PNT=          T / Fine Point pointing status during accumulation
MMNTMDMP=          F / momentum dump occurred during accumulation
LDEPARER=          F / Local Detector Electronics parity error occurre
SCRC_ERR=          F / SDRAM Controller memory pixel error occurred

```

/ Science Data Collection Configuration

```

LCTRGDEF=          0 / long cadence target definition identifier
SCTRGDEF=          0 / short cadence target definition identifier
BKTRGDEF=          0 / background definition identifier
TARGAPER=          0 / target aperture definition identifier
BKG_APER=          0 / background aperture definition identifier
COMPTABL=          -1 / compression tables identifier

```

/ Target and aperture definition, and compression

```

LCTRFIL= 'None      ' / long cadence target definition file name
SCTRFIL= 'None      ' / short cadence target definition
BKTRFIL= 'None      ' / background target definition file name
TRAPFIL= 'None      ' / target aperture definition file name
BKAPFIL= 'None      ' / background aperture definition file name
REQNFIL= 'None      ' / requantization table file name
HUFFFIL= 'None      ' / Huffman encoding table file name

```

/ Pixel mapping reference files

```

LCTPMTAB= 'N/A      ' / long cadence target pixel mapping table
SCTPMTAB= 'N/A      ' / short cadence target pixel mapping table
BKGPMTAB= 'N/A      ' / background pixel mapping table
LCCPMTAB= 'N/A      ' / long cadence collateral pixel mapping table
SCCPMTAB= 'N/A      ' / short cadence collateral pixel mapping table

```

/ Focal Plane Characterization Model files

```

FPGMFIL= 'kplr2008123000_geometry.txt' / focal plane geometry model file name
2DBLKFIL= 'kplr2008298000_2d-black.fits' / 2-d black level file name
GAINFIL= 'kplr2008072318_gain.txt' / gain table file name
LINFIL = 'kplr2008102717_linearity.txt' / linearity table file name
LDEUNFIL= 'kplr2008102809_undershoot.txt' / LDE undershoot file name
CFLATFIL= 'kplr2007022208_cflat.fits' / combined flat field file name

```

```

BADPXLFL= 'kplr2008020721_bad-pixel.txt ' / bad pixel list file name
SSFLTFIL= 'kplr2008022614_ssflat.txt ' / small scale flat field file name
LSFLTFIL= 'kplr2008031015_lsflat.txt' / large scale flat field file name
RNDSEFIL= 'kplr2008102416_read-noise.txt' / read noise file name
PRFFIL = 'kplr2008274155900_prf.bin' / pixel response function file name

```

/ Calibration switches

```

CAL_VERS= '          ' / calibration software version number
2DBLKCOR= 'PERFORM ' / 2-d black correction (perform, omit, complete)
DYBLKCOR= 'PERFORM ' / dynamic black correction (perform,omit,complete)
GAINCORR= 'PERFORM ' / gain correction (perform, omit, complete)
LINCORR = 'PERFORM ' / linearity correction (perform, omit, complete)
UNSHCORR= 'PERFORM ' / undershoot correction (perform, omit, complete)
DARKCORR= 'PERFORM ' / calculate dark current (perform, omit, complete)
SMEARCOR= 'PERFORM ' / smear correction (perform, omit, complete)
FLATCORR= 'PERFORM ' / flat field correction (perform, omit, complete)

```

/ Black-level fit input parameters for cosmic ray

```

BLKRCOR= 'PERFORM ' / search for cosmic rays during black-level fit
FMSKRBLK= 6 / first masked row in black-level fit
LMSKRBLK= 13 / last masked row in black-level fit
FVRTBLK= 1051 / first virtual row in black-level fit
LVRTBLK= 1058 / last virtual row in black-level fit
FSRC_BLK= 2 / first serial register column in black-level fit
LSRC_BLK= 9 / last serial register column in black-level fit
FVRTCBLK= 1121 / first virtual column in black-level fit
LVRTCBLK= 1128 / last virtual column in black-level fit
NCOL_BLK= 16 / total number of columns in black-level fit
N_BLKMSK= 0 / number of pixels in black and masked regions
N_BLKVIR= 0 / number of pixels in black and virtual regions

```

END

```

XTENSION= 'IMAGE ' / extension type
BITPIX = 32 / bits per data value
NAXIS = 2 / number of data array dimensions
NAXIS1 = 1132 / length of first data axis
NAXIS2 = 1070 / length of second data axis
PCOUNT = 0 / number of parameter bytes following data table
GCOUNT = 1 / number of groups
INHERIT = T / inherit the primary header
EXTNAME = 'CHANNEL ' / extension name
EXTVER = 1 / extension version number

```

/ Extension parameters

```

CHANNEL = 1 / channel number (1-84)
MODULE = 2 / module number (2-24, except 5 and 21)
OUTPUT = 1 / module output number (1-4)

```

/ World Coordinate System and related parameters

```

WCSAXES = 2 / number of World Coordinate System axes (RA & De
CRPIX1 = 1084.88896 / reference pixel along more rapidly varying axis
CRPIX2 = 1114.93919 / reference pixel along less rapidly varying axis
CRVAL1 = 284.6425895649439 / right ascension (degrees) at reference pixel
CRVAL2 = 39.92811159291637 / declination (degrees) at reference pixel
CTYPE1 = 'RA---TAN' / the coordinate type for the first axis
CTYPE2 = 'DEC--TAN' / the coordinate type for the second axis
CDELTA1 = -0.001105606457224929 / degrees per pixel, increasing eastward
CDELTA2 = 0.001105606457224929 / degrees per pixel, increasing northward
PC1_1 = -0.9388817439074866 / linear transformation matrix element cos(theta)
PC1_2 = 0.344239845104016 / linear transformation matrix element -sin(theta)
PC2_1 = -0.344239845104016 / linear transformation matrix element sin(theta)
PC2_2 = -0.9388817439074866 / linear transformation matrix element cos(theta)

```

/ Velocity Aberration Corrections

```

DVA_RA = 0.0006832425580164342 / velocity aberration correction RA offset (rad)
DVA_DEC = 0.0002341730009882745 / velocity aberration correction Dec offset (rad)
VA_SCALE= 1.000046001508137 / velocity aberration scale factor

```

/ Barycentric Times

```

BTC_ROW = 531 / Barycentric time correction reference pixel row
BTC_COL = 561 / Barycentric time correction reference pixel col
BARYDELTA= -1.068033120088417 / calculated Barycentric time correction from UTC

```

BSTRTIME= 54935.71299510851 / Solar System Barycentric start time of cadence
BSTPTIME= 54935.72321193851 / Solar System Barycentric stop time of cadence

/ Parameters from black-level fit

BLKMSKSM= 0.000000 / scalar sum of black values in masked region
BLKVIRSM= 0.000000 / scalar sum of black values in virtual rows
BLKMSKAV= 0.000000 / scalar average of black values in masked region
BLKVIRAV= 0.000000 / scalar average of black values in virtual region
BLKSLOPE= 0.0000000000000E+00 / slope of the linear fit for black level
BLKINTER= 0.0000000000000E+00 / intercept of linear fit for black level
BLKVAR = 0.0000000000000E+00 / variance of deviations of the intercept
BLKVAR_I= 0.0000000000000E+00 / normalized variance of the intercept
BLKVAR_S= 0.0000000000000E+00 / normalized variance of the slope
BLKCOVAR= 0.0000000000000E+00 / normalized covariance of slope and intercept

/ Module/output Calibration Parameters

GAIN = 111.230 / channel gain in electrons/DN
READNOIS= 0.7876 / read noise value per readout (units of DN)
TIMSLICE= 4 / time-slice readout sequence section

/ Image Statistics

GOODMIN = 95021.0 / minimum value of good pixels
GOODMAX = 1569405.0 / maximum value of good pixels
GOODMEAN= 103697.0 / mean value of good pixels

END

There are 83 more extensions, one for each module/output.

Appendix E. Pixel Mapping Reference File FITS headers

E.1.1: Target and Background Pixel Mapping Reference File header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.
USE TIME= UT time to start use of this reference file

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions

NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ Data table definition

TTYPE1 = row name of field 1: row pixel location (0-1069)
TFORM1 = 1I format in which field 1 is coded: one 16 bit int
TDISP1 = I4.1 format in which field 1 is displayed
TUNIT1 = pixels units of data value in field 1
TTYPE2 = column name of field 2: column pixel location (0-1131)
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TUNIT2 = pixels units of data value in field 2
TTYPE3 = target_id name of field 3: target id
TFORM3 = 1J format in which field 3 is coded: one 32 bit int
TDISP3 = I10 format in which field 3 is displayed
TTYPE4 = aperture_id name of field 4: aperture id
TFORM4 = 1I format in which field 4 is coded: one 16 bit int
TDISP4 = I5 format in which field 4 is displayed

END

E.1.2: Long Cadence Collateral Pixel Mapping Reference File header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.
USE TIME= UT time to start use of this reference file

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups

TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ Data table definition

TTYPE1 = col_pixel_type name of field 1: collateral pixel type
TFORM1 = B format in which field 1 is coded: character
TDISP1 = I2 format in which field 1 is displayed
TTYPE2 = pixel_offset name of field 2: pixel offset
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed

END

E.1.3: Short Cadence Collateral Pixel Mapping Reference File header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file

/ Data content

DATATYPE= long cadence data type: short cadence, long cadence, FFI
PIXELTYP= target pixel type: target, background, collateral, all
FOUNDGAP= F one or more data gaps were found

/ Data times

STARTIME= UTC start time of data in MJD
END TIME= UTC end time of data in MJD
FRAMELEN= duration of observation (end - start) in seconds
MID TIME= central time used in velocity aberration corr.
USE TIME= UT time to start use of this reference file

/ Science Data Collection Configuration

LCTRGDEF= long cadence target definition identifier
SCTRGDEF= short cadence target definition identifier
BKTRGDEF= background definition identifier
TARGAPER= target aperture definition identifier
BKG APER= background aperture definition identifier
COMPTABL= compression tables identifier

/ Target and aperture definition, and compression table file names

LCTRFILE= long cadence target definition file name
SCTRFILE= short cadence target definition
BKTRFILE= background target definition file name
TRAPFILE= target aperture definition file name
BKAPFILE= background aperture definition file name
REQNFILE= requantization table file name
HUFFFILE= Huffman encoding table file name

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups

TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Extension parameters

CHANNEL = channel number (1-84)
MODULE = module number (2-24, except 5 and 21)
OUTPUT = module output number (1-4)

/ Data table definition

TTYPER1 = col_pixel_type name of field 1: collateral pixel type
TFORM1 = B format in which field 1 is coded: character
TDISP1 = I2 format in which field 1 is displayed
TTYPER2 = pixel_offset name of field 2: pixel offset
TFORM2 = 1I format in which field 2 is coded: one 16 bit int
TDISP2 = I4.1 format in which field 2 is displayed
TTYPER3 = target_id name of field 3: target id
TFORM3 = 1J format in which field 3 is coded: one 32 bit int
TDISP3 = I10 format in which field 3 is displayed

END

Appendix F: Engineering Telemetry (Ancillary data) FITS headers

F.1: Kepler Ancillary Engineering data header

SIMPLE = T data conform to FITS standard
BITPIX = 0 bits per data value
NAXIS = 0 number of data array dimensions
EXTEND = T File may contain standard extensions
NEXTEND = Number of standard extensions

TELESCOP= Kepler telescope used to acquire data
INSTRUME= CCD identifier for instrument used to acquire data
EQUINOX = 2000.0 equinox of celestial coord. system

DATE = date this file was written (yyyy-mm-dd)
ORIGIN = STScI institution responsible for creating FITS file
FILENAME= name of file
DATSETNM= data set name of the file

/ Configuration identifiers

FLSW_VER= Flight Software version number
SCCONFIG= Spacecraft configuration counter

END

XTENSION= BINTABLE extension type
BITPIX = bits per data value
NAXIS = 2 number of data array dimensions
NAXIS1 = length of first data axis
NAXIS2 = length of second data axis
PCOUNT = 0 number of parameter bytes following data table
GCOUNT = 1 number of groups
TFIELDS = number of fields in each table row
INHERIT = T inherit the primary header
EXTNAME = extension name
EXTVER = extension version number

/ Ancillary Engineering Parameter Attributes

MNEMONIC= Mnemonic of telemetry item
PARAM ID= Numeric identifier for telemetry item
PARDESCR= Ancillary engineering parameter description
PARSAMPR= Parameter telemetry sample rate (seconds)
PAR TYPE= Parameter type: analog (1) or discrete (2)
PARUNITS= Parameter units

APP ID = Science data set flight segment application id
PKT ID = Science data set flight segment packet id
PACKET = Flight segment packet location
BYTE BIT= Flight segment byte:bit location
MODE2RAT= Mode 2 packet rate (seconds)

/ Ancillary Engineering Parameter Table Statistics

ENGSTART= Start time of parameter data in table (MJD)

ENGEND = End time of parameter data in table (MJD)
PARCOUNT= Number of samples
PARAVERG= Average value of mnemonic in table
PARSTDEV= Standard deviation of mnemonic values in table
PAR MIN = Minimum value of parameter in table
PAR MAX = Maximum value of parameter in table

/ Ancillary Engineering Parameter Table Definition

TTYPE1 = TIME Ancillary engineering parameter readout time
TFORM1 = 1D Data format for time: REAL*8
TDISP1 = G20.14 Format in which time is displayed
TUNIT1 = MJD Units for time: Modified Julian Date

/discrete data formats

TTYPE2 = VALUE Parameter value at readout time
TFORM2 = 20A Data format for parameter value: CHARACTER
TDISP2 = A20 Format in which parameter value is displayed

END

/analog data formats

TTYPE2 = VALUE Parameter value at readout time
TFORM2 = 1D Data format for parameter value: REAL*8
TDISP2 = G20.14 Format in which parameter value is displayed

END

Values for each mnemonic are contained in a separate FITS table extension.

Appendix G: Compression Histogram header

G.1: Compression Histogram header

```
SIMPLE = T           data conform to FITS standard
BITPIX = 0           bits per data value
NAXIS  = 0           number of data array dimensions
EXTEND = T           File may contain standard extensions
NEXTEND =            Number of standard extensions

TELESCOP= Kepler     telescope used to acquire data
INSTRUME= CCD         identifier for instrument used to acquire data
EQUINOX = 2000.0     equinox of celestial coord. system

DATE    =            date this file was written (yyyy-mm-dd)
ORIGIN  = STScI      institution responsible for creating FITS file
FILENAME=            name of file
DATSETNM=            data set name of the file

/ Science Data Collection Configuration
LCTRGDEF=            long cadence target definition identifier
SCTRGDEF=            short cadence target definition identifier
BKTRGDEF=            background definition identifier
TARGAPER=            target aperture definition identifier
BKG APER=            background aperture definition identifier
COMPTABL=            compression tables identifier

END

XTENSION= BINTABLE   extension type
BITPIX  =            bits per data value
NAXIS   = 2           number of data array dimensions
NAXIS1  =            length of first data axis
NAXIS2  =            length of second data axis
PCOUNT  = 0           number of parameter bytes following data table
GCOUNT = 1           number of groups
TFIELDS =            number of fields in each table row
INHERIT = T           inherit the primary header
EXTNAME =            extension name
EXTVER  =            extension version number

/ Compression Histogram Table parameters
FIRSTCAD= 0           First longcadence interval number in histogram
LASTCAD = 0           Last long cadence interval number in histogram

/ Compression Histogram Table definition
TTYPE1  = count       name of field 1: Huffman encoding symbol count
TFORM1  = 1J          format in which field 1 is coded: one 32 bit int
TDISP1  = I10         format in which field 1 is displayed

END
```

Appendix H: Acronym and Definition List

ARC – NASA Ames Research Center

Channel – CHANNEL is an integer ranging from 1 to 84 that uniquely specifies the MODULE/OUTPUT pair. An object can have a non-zero channel number if it is off, but near, a CCD. Such cases can be identified by examining the expected ROW and COLUMN values for a specified season. There are 21 modules, each with 4 outputs for a total of 84 channels.

CCD – Charged Couple Device

Column - Each channel has 1132 columns and 1070 rows. There are 1100 science columns enumerated as columns 12 through 1111. Collateral data is enumerated as columns 0 through 11. Pixels 1112 through 1131 are virtual columns used to measure electronic bias levels. These columns are not used in the Kepler Input Catalog since an astronomical object located at that position would fall on the adjacent channel. COLUMN is, therefore, an integer ranging from -205 through 1111. Negative values are enumerated in order to provide information about how far off a target is from the CCD channel.

CR – Cosmic Ray

CRCT – Cosmic Ray Correction Table

CROWDING - The crowding metric is a number between 0 and 1 that specifies the fraction of flux (in the optimal photometric aperture) due to the target star with respect to the total flux from all sources (background flux primarily including that from neighboring stars) in the same aperture. The metric is simulated using a complete end-to-end model of the instrument. It is derived from stellar magnitudes taken from the Kepler Input Catalog. The optimal aperture is the collection of pixels that optimizes the flux SNR of the target star. It purposely avoids bright pixels from nearby stars. The crowding metric is used to estimate the amount of flux dilution from nearby sources and is only an estimator of spatial crowding.

CT – Characteristics Table

DIA – Differential Image Analysis light curve extraction method

DMC – Data Management Center (for Kepler)

DSN – Deep Space Network (NASA)

FFI – Full Frame Image

FITS – Flexible Image Transport System

FOV – Field of View

GO – Guest Observer

HLSP – High Level Science Product, an enhanced data product served by MAST

HST – Hubble Space Telescope

Kepler Data Analysis Handbook (KDAH)

KIC - Kepler Input Catalog

Kepler Instrument Handbook (KIH)

KRC – Kepler Results Catalog

KTC – Kepler Target Catalog

KTC_FLAG - A non-zero KTC_FLAG indicates that the target has been observed by the Kepler photometer and can be found in the Kepler Target Catalog (KTC). A KTC_FLAG equal to "2" means that the target is protected by the Kepler Science Team for its exoplanet survey. A KTC_FLAG of "1" means that the target has been observed but is not restricted to or protected by the Kepler Science Team. The Kepler Science Team has exclusive rights to all targets on the exoplanet survey list (as described in Policy 4 of the Science Utilization Policy; KKPO-16104).

LASP – Laboratory for Atmospheric and Space Physics

MAST – Multi-mission Archive at Space Telescope

Merged KIC – MAST's combination of the KIC and CT. This is the intersection of the KIC and CT. It contains some 6.5 million objects, about 2/3's of which are on silicon.

MJD – Modified Julian Date $MJD = JD - 2400000.5$ days

MOC – Mission Operations Center

Module – A module refers to a pair of CCDs that share one field flattener lens and are read out simultaneously by the detector electronics. There are 21 modules on the focal plane.

MODULE is an integer from the set [2,3,4,6-20,22,23,24]. An object can have a non-zero module number if it is off, but near, a CCD. Such cases can be identified by examining the expected ROW and COLUMN values for a specified season.

MOD/OUT - Module/Output – A means of identifying which CCD recorded the data. Each module consists of 2 CCDs. There are 2 outputs in each CCD. The value of mod/out indicates which CCD recorded the data and which read amplifier was used to read out the detector.

NAIF – Navigation and Ancillary Information Facility (part of NASA's Planetary Sciences Division)

NED – NASA/IPAC Extragalactic Database NED is housed at the Infrared Processing and Analysis Center, Jet Propulsion Lab in California

NASA – National Aeronautics and Space Administration

OAP – Optimal Aperture Photometry, a light curve extraction method

Output - Each module has four output channels (two per CCD). Each output is read out by a unique analog signal chain (e.g. amplifier). OUTPUT is an integer ranging from 1 to 4. An object can have a non-zero output number if it is off, but near, a CCD. Such cases can be identified by examining the expected ROW and COLUMN values for a specified season.

PI – Principal Investigator

PMRF – Pixel Mapping Reference File

Row - Each channel has 1132 columns and 1070 rows. There are 1024 science rows enumerated as rows 20 through 1043. Collateral data is enumerated as rows 0 through 19 and 1044 through 1069. ROW is an integer ranging from -232 through 1098. Values outside 0 through 1069 are enumerated in order to provide information about how far off a target is from the CCD channel.

S/C – spacecraft (i.e., Kepler)

SCP – Stellar Classification Program

SDA – Science Data Accumulator. Pixels are temporally added in the SDA while cadences are accumulating.

SIMBAD – Set of Identifications, Measurements and Bibliography for Astronomical Data. SIMBAD is a database of astronomical data housed at the Centre de Données astronomiques de Strasbourg (CDS) in Strasbourg, France.

SKY_GROUP_ID - As the spacecraft rolls from quarter to quarter (season to season), the stars fall on different CCD channels. The SKY_GROUP_ID is an integer that groups stars together on the sky and, consequently, is time invariant. It is used to specify custom apertures. The SKY_GROUP_ID is equivalent to the channel number an object falls on (or near) during season 2. Stars very close to the boundary separating pixels controlled by different amplifier chains can jump from one sky group to another from season to season. Only one skygroup value is reported in the KIC. Users requiring skygroups for custom apertures should be especially careful for targets close to the amplifier boundary. The boundary is parallel to CCD columns. Column 1111 on one channel is adjacent to column 1111 on the other channel common to that CCD (since columns are counted from the outside edge inward). Consequently, the SKY_GROUP_ID for a target near column 1111 can be misleading. One should consult the on-line pixel calculator for verification.

SOC – Science Operations Center

SPICE – Part of NAIF, SPICE is an information system designed to assist scientists in planning and interpreting scientific observations from space-borne instruments. This is not an acronym.

SQL – Standard Query Language

SSDS – Space Science Data Services

STScI - Space Telescope Science Institute

TBD – To Be Determined

UCD – Uniform Content Descriptor