United Kingdom Infra Red Telescope

Joint Astronomy Centre

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UKIRT FITS headers

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This document lists the FITS headers to be created by UKIRT instrumentation, including those used by the ORAC Data Reduction pipeline.

1.0 Introduction

1.1 Purpose

This document specifies the ancillary data stored in FITS headers within *unprocessed* datasets generated by UKIRT instruments.

1.2 Scope

At present the generic headers and UFTI-specific instrument keywords are presented. The keywords associated with other instruments will be added once these are agreed. Headers for world co-ordinate systems for spectroscopic data have yet to be agreed.

1.3 Overview

This document lists the keywords, comments, data types, and allowed values for UKIRT FITS headers. It also specifies the order of the headers. The headers are arranged into groups of generic keywords common to all instruments, and groups of instrument-specific keywords. Instrument headers are currently defined for UFTI, IRCAM3, and CGS4.

An example set of FITS headers for UFTI is presented.

2.0 General Remarks

2.1 Classes and Groups

FITS headers in UKIRT datasets are divided into two classes: the generic information which apply to all datasets, and headers relating to specific instruments. Within each class the headers are further grouped into related information, such as astrometric, meteorological, and instrument configuration. All but the mandatory headers and specification comments are preceded by the group title written in a blank-keyword comment. All but the mandatory headers are followed by a blank line. This arrangement discriminates the various groups of keywords for easier assimilation and location of required keywords both in this document and in the datasets themselves. Astronomers will appreciate the improved readability.

2.2 Order

The groups and their constituent header shall be the order given in this document. A complete set of headers shall comprise the generic and the appropriate instrument headers terminated by the standard END card. Data-reduction software accessing the headers, however, should, not make assumptions concerning the order of UKIRT FITS headers.

2.3 Fixed value

The values of certain keywords are constant. When this is the case, the value is tabulated in a column labelled ‘Fixed value’.

2.4 Units

Standard units [X-15, X-17] for keywords appear in brackets at the end of comments.

3.0 Generic FITS headers

3.1 Mandatory headers

These are the mandatory headers which start the FITS file. They are described in the NOST FITS standard. [X-15] The value of BITPIX may be instrument dependent to match the output from the instrument, but BITPIX is most likely to be 32 or 16.

Keyword	Data type	Fixed value	Comment in header
SIMPLE	logical	T	file does conform to FITS standard
BITPIX	integer		number of bits per data pixel
NAXIS	integer	2	number of data axes
NAXIS1	integer		length of data axis 1
NAXIS2	integer		length of data axis 2

3.2 FITS specification comments

These are the standard FITSIO [X-16] comments referencing the FITS standard. The exact wording and number of comment lines may change in line with FITS documentation and FITSIO. It is expected that the mandatory headers and these comments will be written

Keyword	Comment in header
COMMENT	FITS (Flexible Image Transport System) format defined in Astronomy and
COMMENT	Astrophysics Supplement Series v44/p363, v44/p371, v73/p359, v73/p365
COMMENT	Contact the NASA Science Office of Standards and Technology for the
COMMENT	FITS Definition document #100 and other FITS information.

using FITSIO routine FTPHPR with EXTEND parameter set to false. Note that this routine does not append the blank line.

3.3 Headers specifying the data-array attributes

These are the FITS headers with reserved names, which qualify the data array. The value of BLANK will depend on the value of BITPIX. BLANK should not appear if BITPIX is

Keyword	Data type	Fixed value	Comment in header
BSCALE	real	1.0	True_value = BSCALE * FITS_value + BZERO
BZERO	real	0.0	True_value = BSCALE * FITS_value + BZERO
BLANK	integer		Array value whose physical value is undefined
BUNIT	character	'ADU per integration'	Units of the primary array

negative. For two-byte data, BLANK is -32768; whereas for four-byte values, BLANK is -2147483648.

3.4 Identification headers

These are the FITS headers which identify the object, and the origin and creation date of the dataset. All but OBSREF and USERID are reserved names. [X-15] To adhere to the FITS standard, OBSERVER should specify names, not initials. USERID gives a handle to the CONFIGs and EXECs used, and will be the identifier in the observation database.

The DATE keyword shall use the revised format *yyyy-mm-dd* from 1999 January 1, but the *dd/mm/yy* format before then.

The observation numbers commence at 1 for each new date of observation. A sequence of related observations, such as jittered frames, form groups. Each group has a group number,

Keyword	Data type	Fixed value	Comment in header
			Identification:
TELESCOP	character	'UKIRT, Mauna Kea, HI'	Telescope name
INSTRUME	character		Instrument name
OBSERVER	character		Name(s) of observer(s)
USERID	character		User identification code
OBSREF	character		Observer reference
OBJECT	character		Name of observed object
ORIGIN	character		Organisation creating the FITS file
DATE	character		Date (UTC) when FITS file was created

which is the observation number of the first member of the group. Within each group there is a sequence number, starting at 1.

3.5 Data reduction

These are the FITS headers needed by the ORAC data-reduction pipeline. [O-11] Note that these are not the only headers used by ORACDR. The choice of options for keyword OBSTYPE may be extended. STANDARD = T means this is an observation of a photometric standard for imaging data; and a ratioing standard for spectroscopy. STANDARD is is only reserved, and ignored unless OBSTYPE is "OBJECT". GRPMEM counts from 1.

Keyword	Data type	Fixed value	Comment in header
			Data reduction:
OBSNUM	integer		Observation number
GRPNUM	integer		The number of the group applied to all members
GRPMEM	integer		Sequence number of a member of a group
GRPMAX	integer		Maximum number of group members, 0=arbitrary
OBSTYPE	character		Type (BIAS | DARK | ARC | FLAT | OBJECT | SKY)
STANDARD	logical		Whether or not the object is a standard
RECIPE	character		Name of data-reduction recipe to be used

3.6 Astrometric and Time headers

These are the FITS headers which record the time of the observation, identify the direction the telescope was pointing, the plate scale, the orientation of the detector, telescope and crosshead offsets, and airmass.

Unfortunately, because of the continuing debate concerning astrometric or world co-ordinate systems (WCS) in FITS, there is still no standard even for the simple tangent-plane image of the sky. What there is fails to address the problem of spectroscopic data, where the raw image from the detector is two dimensional, but the astrometric co-ordinate system is three dimensional (two sky co-ordinates, and pixel or wavelength in the dispersion direction). However, some concensus was reached at the 1998 ADASS conference, and recently three new papers have appeared, including one on spectroscopic co-ordinates. These are expected to be approved at the 1999 ADASS conference.

Once there is a FITS WCS agreement, UKIRT should adopt it. In the meantime, we shall use the widely recognised AIPS-style headers. Note that these only apply to imaging. Headers for spectroscopic data are TBD.

The DATE-OBS and DATE_END keywords shall use the revised time format *yyyy-mm-dd*T*hh:mm:ss*Z.

TBD: The offset and zero points (keywords RABASE to TDECOFF below) may need to change to be consistent with the future crosshead system, not the current one.

Keyword	Data type	Fixed value	Comment in header
			Astrometric and Time Information:
DATE-OBS	character		Date and time (UTC) of start of observation
DATE-END	character		Date and time (UTC) of end of observation
EQUINOX	real	2000.0	Equinox of object position FK5 [years]
CTYPE1	character	'RA---TAN '	Equatorial tangent-plane projection
CRPIX1	real		Pixel at reference point along axis 1
CRVAL1	real		RA at reference point [deg]
CDELT1	real		Increment per pixel at reference point [deg]
CUNIT1	character	'deg '	Physical units of axis 1
CTYPE2	character	'DEC--TAN '	Equatorial tangent-plane projection
CRPIX2	real		Pixel at reference point along axis 2
CRVAL2	real		Declination at reference point
CDELT2	real		Incerement per pixel at reference point [deg]
CROTA2	real		Angle of Dec axis wrt axis 2 measured ccw [deg]
CUNIT2	character	'deg '	Physical units of axis 2
RABASE	real		Offset zero point in RA, FK5 [deg]
DECBASE	real		Offset zero point in Dec, FK5 [deg]
XRAOFF	real		Crosshead offset in RA at equinox [arcsec]
XDECOFF	real		Crosshead offset in Dec at equinox [arcsec]
TRAOFF	real		Telescope offset in RA at equinox [arcsec]
TDECOFF	real		Telescope offset in Dec at equinox [arcsec]
AMSTART	real		Airmass at the start of the observation
AMEND	real		Airmass at the end of the observation
UTSTART	real		Start UTC of observation (DR efficiency) [h]
UTEND	real		End UTC of observation (DR efficiency) [h]

3.7 Environment

These FITS headers specify the meteorological conditions and the dome environment.

Keyword	Data type	Fixed value	Comment in header
			Environment:
AIR_TEMP	real		External air temperature in degrees Celsius
DOMETEMP	real		Dome air temperature in degrees Celsius
HUMIDITY	real		Percentage air humidity
WIND_SPD	real		Wind speed [km/h]
WIND_DIR	real		Wind direction, azimuth [deg]

4.0 UFTI Instrument headers

4.1 Configuration

These headers specify the configuration of the UFTI instrument, and include ancillary data needed by the data-reduction system. At present there are no plans for polarimetry or Fabry-Perot interometry with UFTI; however, keywords WPLANGLE, FP_X, FP_Y, and FP_Z are defined should either eventuality arise. Values for these keywords when the Wollaston prism or Fabry-Perot etalon are absent are TBD. The options for keyword READ_TYP may be extended.

Keyword	Data type	Fixed value	Comment in header
			Instrument Configuration:
EXP_TIME	real		Exposure time for each co-add [s]
INT_TIME	real		Total integration time (sum of all co-adds) [s]
NEXP	integer		Number of exposures in the integration
MODE	character		Observing mode (STARE | NDSTARE | 10-NDSTARE)
SPD_GAIN	character		Readout speed (normal | fast) or high gain
GAIN	real		Electrons per data number
FILTER	character		Combined filter name
FILTER1	character		Filter in wheel 1
FILTER2	character		Filter in wheel 2
WPLANGLE	real		IRPOL waveplate angle [deg]
FP_X	integer		Fabry-Perot x setting
FP_Y	integer		Fabry-Perot y setting
FP_Z	integer		Fabry-Perot z setting
DETECTOR	character		Detector array used
DROWS	integer		Number of detectors in a row
DCOLUMNS	integer		Number of detectors in a column
RDOUT_X1	integer		Start column of array readout
RDOUT_X2	integer		End column of array readout
RDOUT_Y1	integer		Start row of array readout
RDOUT_Y2	integer		End row of array readout

4.2 Engineering

This is a list of the UFTI instrument status and engineering data, unlikely to be of use to astronomers processing the dataset. At the time of writing, this list may not be complete, and some keyword names may change.

Keyword	Data type	Fixed value	Comment in header
			Engineering
CNFINDEX	integer		Index increments when hardware config. changes
TEMP_ARR	real		Temperature of array [K]
TEMP_TAB	real		Temperature of UFTI table [K]
TEMP_ST1	real		Temperature of UFTI cooler stage 1 [K]
TEMP_ST2	real		Temperature of UFTI cooler stage 2 [K]
TFOCUS	real		Telescope focus position [mm]
V1	real		UFTI -15V supply [V]
V2	real		UFTI -9 V supply [V]
V3	real		UFTI -5 V supply [V]
V4	real		UFTI +30 V supply [V]
V5	real		UFTI +15 V supply [V]
V6	real		UFTI +9 V supply [V]
V7	real		UFTI +5 V supply [V]
V8	real		UFTI Digital [V]
V13	real		UFTI Analog in [V]
SENS	real		UFTI temperature sensor on motherboard [K]

5.0 IRCAM3 Instrument headers

5.1 Configuration

These headers specify the configuration of the IRCAM3 instrument, and include ancillary data needed by the data-reduction system. DROWS and DCOLUMNS specify the full dimensions of the detector array. The options for keyword READ_TYP may be extended.

5.2 Engineering

This is a list of the IRCAM3 instrument status and engineering data, unlikely to be of use to astronomers processing the dataset.

Keyword	Data type	Fixed value	Comment in header
			Instrument Configuration:
EXP_TIME	real		Exposure time for each co-add [s]
INT_TIME	real		Total integration time (sum of all co-adds) [s]
NEXP	integer		Number of exposures in the integration
NEXP_PH	integer		Number of exposures in each chop phase
MODE	character		Observing mode (STARE | ND_STARE)
READ_TYP	character		Type of readout (standard | fast | deepwell)
GAIN	real		Electrons per data number
FILTER	character		Combined filter name
FILTER1	character		Filter in wheel 1
FILTER2	character		Filter in wheel 2
MAGNIFIC	real		Magnifier factor (1.0 means magnifier is out)
CHOPDIFF	logical		Whether or not main-offset beam value stored
IF_SHARP	logical		Whether or not shift and add enabled
LINEAR	logical		Whether or not linearisation enabled
WPLANGLE	real		IRPOL waveplate angle [deg]
FP_X	integer		Fabry-Perot x setting
FP_Y	integer		Fabry-Perot y setting
FP_Z	integer		Fabry-Perot z setting
DETECTOR	character		Detector array used
DROWS	integer		Number of detectors in a row
DCOLUMNS	integer		Number of detectors in a column
RDOUT_X1	integer		Start column of array readout
RDOUT_X2	integer		End column of array readout
RDOUT_Y1	integer		Start row of array readout
RDOUT_Y2	integer		End row of array readout

Keyword	Data type	Fixed value	Comment in header
			Engineering:
CNFINDEX	integer		Index increments when hardware config. changes
TEMP_ARR	real		Temperature of array [K]
TEMP_ST1	real		Temperature of cooler stage 1 [K]
TEMP_ST2	real		Temperature of cooler stage 2 [K]
TFOCUS	real		Telescope focus position [mm]
DFOCUS	real		Detector focus
RESET_DL	real		NDR reset delay [s]
CHOP_DEL	real		Chop delay [s]
READ_INT	real		NDR read interval [s]
CLOCK0	real		ALICE CLOCK0 voltage [V]
CLOCK1	real		ALICE CLOCK1 voltage [V]
CLOCK2	real		ALICE CLOCK2 voltage [V]
CLOCK3	real		ALICE CLOCK3 voltage [V]
CLOCK4	real		ALICE CLOCK4 voltage [V]
CLOCK5	real		ALICE CLOCK5 voltage [V]
CLOCK6	real		ALICE CLOCK6 voltage [V]
VSLEW	real		ALICE VSLEW voltage [V]
VDET	real		ALICE VDET voltage [V]
DET_BIAS	real		ALICE DET_BIAS voltage [V]
VDDUC	real		ALICE VDDUC voltage [V]
VDETGATE	integer		ALICE VDETGATE voltage [V]
VGG_A	real		ALICE VGG_ACTIVE voltage [V]
VGG_INA	real		ALICE VGG_INACTIVE voltage [V]
VDDOUT	real		ALICE VDDOUT voltage [V]
V3	real		ALICE V3 voltage [V]
VLCLR	real		ALICE VLCLR voltage [V]
VLD_A	real		ALICE VLOAD active voltage [V]
VLD_INA	real		ALICE VLOAD_INACTIVE voltage [V]
WFREQ	real		ALICE waveform state frequency [Mhz]

6.0 CGS4 Instrument headers

6.1 Configuration

These headers specify the configuration of the CGS4 instrument, and include ancillary data needed by the data-reduction system. Note that the end row and column of the readout are given by RLBOUND2+NAXIS2-1 and RLBOUND1+NAXIS1-1 respectively. DROWS and DCOLUMNS specify the full dimensions of the detector array.

Although PA_SLIT (formerly PA) is included, I'd like to see this information eventually part of the world co-ordinate system.

Keyword	Data type	Fixed value	Comment in header
			Instrument Configuration:
EXP_TIME	real		Exposure time for each co-add [s]
INT_TIME	real		Total integration time (sum of all co-adds) [s]
NEXP	integer		Number of exposures in the integration
NEXP_PH	integer		Number of exposures in each chop phase
NINT	integer		Number of integrations in the observation
MODE	character		Observing mode (STARE|ND_STARE|CHOP|ND_CHOP)
READ_TYP	character		Type of readout (standard | fast | deepwell)
GAIN	real		Electrons per data number
FILTER	character		Combined filter name
FILTER1	character		Filter in wheel 1
FILTER2	character		Filter in wheel 2
SWIDTH	real		Width of slit [pixel]
PA_SLIT	real		Position angle of the slit on the sky [deg]
GRATING	character		Name of grating
GLAMBDA	real		Requested grating wavelength [um]
CNFINDEX	integer		Index increments when hardware config. changes
GANGLE	real		Grating angle [deg]
GORDER	integer		Grating order
GDISP	real		Grating dispersion [um/pixel]
CVF	character		Name of CVF
CLAMBDA	real		CVF wavelength [um]
LAMP	character		Name of calibration lamp (off means no lamp)
BBTEMP	real		Black-body temperature [K]
DETINCR	real		Increment between scan positions [pixel]
DETNINCR	integer		Number of scan positions in scan

Keyword	Data type	Fixed value	Comment in header
PEAK_ROW	integer		Pixel index of peakup row
PBOX_XL	integer		Lower x pixel-index bound of peakup box
PBOX_XU	integer		Upper x pixel-index bound of peakup box
PBOX_YL	integer		Lower y pixel-index bound of peakup box
PBOX_YL	integer		Upper y pixel-index bound of peakup box
CHOPDIFF	logical		Whether or not main-offset beam value stored
IF_SHARP	logical		Whether or not shift and add enabled
LINEAR	logical		Whether or not linearisation enabled
WPLANGLE	real		IRPOL waveplate angle [deg]
FP_X	integer		Fabry-Perot x setting
FP_Y	integer		Fabry-Perot y setting
FP_Z	integer		Fabry-Perot z setting
DETECTOR	character		Detector array used
DROWS	integer		Number of detectors in a row
DCOLUMNS	integer		Number of detectors in a column
RDOUT_X1	integer		Start column of array readout
RDOUT_X2	integer		End column of array readout
RDOUT_Y1	integer		Start row of array readout
RDOUT_Y2	integer		End row of array readout

6.2 Engineering

This is a list of the CGS4 instrument status and engineering data, unlikely to be of use to astronomers processing the dataset.

Keyword	Data type	Fixed value	Comment in header
			Engineering:
TEMP_ARR	real		Temperature of array [K]
RESET_DL	real		NDR reset delay [s]
TEMP_ST1	real		Temperature of cooler stage 1 [K]
TEMP_ST2	real		Temperature of cooler stage 2 [K]

Keyword	Data type	Fixed value	Comment in header
TFOCUS	real		Telescope focus position [mm]
DFOCUS	real		Detector focus
CHOP_DEL	real		Chop delay [s]
READ_INT	real		NDR read interval [s]
SANGLE	real		Angle of slit wrt ? [deg]
SLIT	character		Name of the slit
SLENGTH	real		Slit length [mm]
DENCBASE	integer		Zeropoint (steps) of detector translation
IRTANGLE	real		Image rotator angle [deg]
CALAPER	real	10	Aperture of tungsten-halogen lamp (%)
THLEVEL	integer		Level of tungsten-halogen lamp
CLOCK0	real		ALICE CLOCK0 voltage [V]
CLOCK1	real		ALICE CLOCK1 voltage [V]
CLOCK2	real		ALICE CLOCK2 voltage [V]
CLOCK3	real		ALICE CLOCK3 voltage [V]
CLOCK4	real		ALICE CLOCK4 voltage [V]
CLOCK5	real		ALICE CLOCK5 voltage [V]
CLOCK6	real		ALICE CLOCK6 voltage [V]
VSLEW	real		ALICE VSLEW voltage [V]
VDET	real		ALICE VDET voltage [V]
DET_BIAS	real		ALICE DET_BIAS voltage [V]
VDDUC	real		ALICE VDDUC voltage [V]
VDETGATE	integer		ALICE VDETGATE voltage [V]
VGG_A	real		ALICE VGG_ACTIVE voltage [V]
VGG_INA	real		ALICE VGG_INACTIVE voltage [V]
VDDOUT	real		ALICE VDDOUT voltage [V]
V3	real		ALICE V3 voltage [V]
VLCLR	real		ALICE VLCLR voltage [V]
VLD_A	real		ALICE VLOAD active voltage [V]
VLD_INA	real		ALICE VLOAD_INACTIVE voltage [V]
WFREQ	real		ALICE waveform state frequency [Mhz]

7.0 Michelle

7.1 Configuration

These headers specify the configuration of the Michelle instrument, and include ancillary data needed by the data-reduction system.

Keyword	Data type	Fixed value	Comment in header
			Instrument Configuration:
EXP_TIME	real		Exposure time for each co-add [s]
INT_TIME	real		Total integration time (sum of all co-adds) [s]
NEXP	integer		Number of exposures in the integration
NEXP_PH	integer		Number of exposures in each chop phase
NINT	integer		Number of integrations in the observation
MODE	character		Observing mode (STARE|ND_STARE|CHOP|ND_CHOP)
READ_TYP	character		Type of readout (standard | fast | deepwell)
GAIN	real		Electrons per data number
FILTER	character		Combined filter name
FILTER1	character		Filter in wheel 1
FILTER2	character		Filter in wheel 2
SWIDTH	real		Width of slit [pixel]
PA_SLIT	real		Position angle of the slit on the sky [deg]
GRATING	character		Name of grating
GLAMBDA	real		Requested grating wavelength [um]
CNFINDEX	integer		Index increments when hardware config. changes
GANGLE	real		Grating angle [deg]
GORDER	integer		Grating order
GDISP	real		Grating dispersion [um/pixel]
CVF	character		Name of CVF
CLAMBDA	real		CVF wavelength [um]
LAMP	character		Name of calibration lamp (off means no lamp)
BBTEMP	real		Black-body temperature [K]
DETINCR	real		Increment between scan positions [pixel]
DETNINCR	integer		Number of scan positions in scan
PEAK_ROW	integer		Pixel index of peakup row
PBOX_XL	integer		Lower x pixel-index bound of peakup box

Keyword	Data type	Fixed value	Comment in header
PBOX_XU	integer		Upper x pixel-index bound of peakup box
PBOX_YL	integer		Lower y pixel-index bound of peakup box
PBOX_YL	integer		Upper y pixel-index bound of peakup box
CHOPDIFF	logical		Whether or not main-offset beam value stored
IF_SHARP	logical		Whether or not shift and add enabled
LINEAR	logical		Whether or not linearisation enabled
WPLANGLE	real		IRPOL waveplate angle [deg]
FP_X	integer		Fabry-Perot x setting
FP_Y	integer		Fabry-Perot y setting
FP_Z	integer		Fabry-Perot z setting
DETECTOR	character		Detector array used
DROWS	integer		Number of detectors in a row
DCOLUMNS	integer		Number of detectors in a column
RDOUT_X1	integer		Start column of array readout
RDOUT_X2	integer		End column of array readout
RDOUT_Y1	integer		Start row of array readout
RDOUT_Y2	integer		End row of array readout

7.2 Engineering

This is a list of the Michelle instrument status and engineering data, unlikely to be of use to astronomers processing the dataset.

Keyword	Data type	Fixed value	Comment in header
			Engineering:
TEMP_ARR	real		Temperature of array [K]
RESET_DL	real		NDR reset delay [s]
TEMP_ST1	real		Temperature of cooler stage 1 [K]
TEMP_ST2	real		Temperature of cooler stage 2 [K]
TFOCUS	real		Telescope focus position [mm]
DFOCUS	real		Detector focus
CHOP_DEL	real		Chop delay [s]
READ_INT	real		NDR read interval [s]

Keyword	Data type	Fixed value	Comment in header
SANGLE	real		Angle of slit wrt ? [deg]
SLIT	character		Name of the slit
SLENGTH	real		Slit length [mm]
DENCBASE	integer		Zeropoint (steps) of detector translation
IRTANGLE	real		Image rotator angle [deg]
CALAPER	real	10	Aperture of tungsten-halogen lamp (%)
THLEVEL	integer		Level of tungsten-halogen lamp
CLOCK0	real		ALICE CLOCK0 voltage [V]
CLOCK1	real		ALICE CLOCK1 voltage [V]
CLOCK2	real		ALICE CLOCK2 voltage [V]
CLOCK3	real		ALICE CLOCK3 voltage [V]
CLOCK4	real		ALICE CLOCK4 voltage [V]
CLOCK5	real		ALICE CLOCK5 voltage [V]
CLOCK6	real		ALICE CLOCK6 voltage [V]
VSLEW	real		ALICE VSLEW voltage [V]
VDET	real		ALICE VDET voltage [V]
DET_BIAS	real		ALICE DET_BIAS voltage [V]
VDDUC	real		ALICE VDDUC voltage [V]
VDETGATE	integer		ALICE VDETGATE voltage [V]
VGG_A	real		ALICE VGG_ACTIVE voltage [V]
VGG_INA	real		ALICE VGG_INACTIVE voltage [V]
VDDOUT	real		ALICE VDDOUT voltage [V]
V3	real		ALICE V3 voltage [V]
VLCLR	real		ALICE VLCLR voltage [V]
VLD_A	real		ALICE VLOAD active voltage [V]
VLD_INA	real		ALICE VLOAD_INACTIVE voltage [V]
WFREQ	real		ALICE waveform state frequency [Mhz]

8.0 UFTI example

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SIMPLE  =                    T / file does conform to FITS standard
BITPIX  =                   32 / number of bits per data pixel
NAXIS   =                    2 / number of data axes
NAXIS1  =                 1024 / length of data axis 1
NAXIS2  =                 1024 / length of data axis 2
COMMENT   FITS (Flexible Image Transport System) format defined in Astronomy and
COMMENT   Astrophysics Supplement Series v44/p363, v44/p371, v73/p359, v73/p365.
COMMENT   Contact the NASA Science Office of Standards and Technology for the
COMMENT   FITS Definition document #100 and other FITS information.

BSCALE  =                  1.0 / True_value = BSCALE * FITS_value + BZERO
BZERO   =                  0.0 / True_value = BSCALE * FITS_value + BZERO
BLANK   =          -2147483648 / Array value whose physical value is undefined
BUNIT   = 'ADU per integration' / Units of the primary array

                                 Identification:
TELESCOP= 'UKIRT, Mauna Kea, HI' / Telescope name
INSTRUME= 'UFTI    '           / Instrument
OBSERVER= 'S K Leggett'        / Observer name(s)
USERID  = 'SKL     '           / User identification code
OBSREF  = 'AIC/service'        / Observer reference
OBJECT  = '3C 65   '           / Name of observed object
ORIGIN  = 'JAC, Hilo, Hawaii'  / Organisation creating the FITS file
DATE    = '1999-10-22'         / Date (UTC) when FITS file was created

                                 Data reduction:
OBSNUM  =                   99 / Observation number
GRPNUM  =                   95 / The number of the group applied to all members
GRPMEM  =                    5 / Sequence number of a member of a group
GRPMAX  =                    9 / Maximum number of group members, 0=arbitrary
OBSTYPE = 'OBJECT  '           / Type (BIAS|DARK|ARC|FLAT|OBJECT|SKY)
STANDARD=                    F / Whether or not the object is a standard
RECIPE  = 'QUADRANT_JITTER'   / Data reduction recipe to be used

                                 Astrometric and time information:
DATE-OBS= '1999-10-22T13:24:35Z' / Date and time (UTC) of start of observation
DATE-END= '1999-10-22T13:25:39Z' / Date and time (UTC) of end of observation
EQUINOX =               2000.0 / Equinox of object position FK5 [years]
CTYPE1  = 'RA---TAN'           / Equatorial tangent-plane projection
CRPIX1  =                512.5 / Pixel at reference point along axis 1
CRVAL1  =              52.9533 / RA at reference point [deg]
CDELT1  =            0.0000247 / Increment per pixel at reference point [deg]
CUNIT1  = 'deg     '           / Physical units of axis 1
CTYPE2  = 'DEC--TAN'           / Equatorial tangent-plane projection
CRPIX2  =                512.5 / Pixel at reference point along axis 2
CRVAL2  =              23.4567 / Declination at reference point [deg]
CDELT2  =            0.0000247 / Increment per pixel at reference point [deg]
CUNIT2  = 'deg     '           / Physical units of axis 2
CROTA2  =                 -1.1 / Angle of Dec axis wrt axis 2 measured ccw [deg]

RABASE  =              3.52986 / Offset zero-point in RA, FK5 [h]
DECBASE =              23.4617 / Offset zero-point in Dec, FK5 [deg]
XRAOFF  =                 17.7 / Crosshead offset RA at equinox [arcsec]
XDECOFF =                -18.1 / Crosshead offset Dec at equinox [arcsec]
TRAOFF  =                 18.0 / Telescope offset RA at equinox [arcsec]
TDECOFF =                -18.0 / Telescope offset Dec at equinox [arcsec]
```

```
AMSTART =             1.628028 / Airmass at start of observation
AMEND   =             1.628071 / Airmass at end of observation
UTSTART =             13.40972 / Start UTC of observation (DR efficiency) [h]
UTEND   =             13.42750 / End UTC of observation (DR efficiency) [h]

                                 Environment:
AIR_TEMP=                  2.6 / External air temperature in degrees Celsius
DOMETEMP=                  3.2 / Dome air temperature in degrees Celsius
HUMIDITY=                 13.5 / Percentage air humidity
WIND_SPD=                  7.3 / Wind speed [km/h]
WIND_DIR=                  123 / Wind direction, azimuth [deg]

                                 Instrument configuration:
EXP_TIME=                 10.0 / Exposure time for each co-add [s]
INT_TIME=                 60.0 / Total integration time (sum of all co-adds) [s]
NEXP    =                    6 / Number of exposures in the integration
MODE    = 'STARE   '           / Observing mode (STARE | NDSTARE | 10-NDSTARE)
SPD_GAIN= 'Normal  '          / Readout speed (normal | fast) or high gain
GAIN    =                    6 / Electrons per data number

FILTER  = 'K       '           / Combined filter name
FILTER1 = 'Open    '           / Filter in wheel 1
FILTER2 = 'Kocli   '           / Filter in wheel 2
WPLANGLE=                    0 / IRPOL waveplate angle [deg]
FP_X    =                    0 / Fabry-Perot x setting
FP_Y    =                    0 / Fabry-Perot y setting
FP_Z    =                    0 / Fabry-Perot z setting

DETECTOR= 'haw042  '           / Detector array used
DROWS   =                 1024 / Number of detectors in a row
DCOLUMNS=                 1024 / Number of detectors in a column
RDOUT_X1=                    1 / Start column of array read-out
RDOUT_X2=                 1024 / End column of array read-out
RDOUT_Y1=                    1 / Start row of array read-out
RDOUT_Y2=                 1024 / End row of array read-out

                                 Engineering:
CNFINDEX=                  192 / Index increments when hardware config. changes
TEMP_ARR=                  4.0 / Temperature of array [K]
TEMP_TAB=                 15.5 / Temperature of UFTI table [K]
TEMP_ST1=                  9.4 / Temperature of UFTI cooler stage 1 [K]
TEMP_ST2=                  4.7 / Temperature of UFTI cooler stage 2 [K]
TFOCUS  =                 2.06 / Telescope focus position [mm]

V1      =                -11.1 / UFTI -15 V supply [V]
V2      =                 -9.4 / UFTI -9 V supply [V]
V3      =                 -5.2 / UFTI -5 V supply [V]
V4      =                 23.2 / UFTI +30 V supply [V]
V5      =                 12.2 / UFTI +15 V supply [V]
V6      =                  9.4 / UFTI +9 V supply [V]
V7      =                  5.1 / UFTI +5 V supply [V]
V8      =                  4.9 / UFTI Digital [V]
V13     =                 -0.1 / UFTI Analog in  [V]
SENS3   =               -273.0 / UFTI temperature sensor on motherboard [K]

END
```

9.0 Acknowledgments

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