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James Clerk Maxwell Telescope
Design Note 008.5

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JCMT Single Dish Data System

Contents

1 Introduction

1.1 Purpose

This document provides a description of the current use of the General Single Dish Data Format System at the JCMT.

1.2 Scope

The scope includes all data stored in General Single Dish Data Format at the JCMT.

1.3 Definitions and abbreviations

GSD General Single Dish Data handling routines, JCMT only.

GSDD General Single Dish Data Format.

GSDF General Single Dish JCMT Data definition file.

JCMT James Clerk Maxwell Telescope.

ADAM Astronomical Data Aquisition and Monitor.

NBS Noticeboard System from the Starlink collection.

FITS Flexible Image Transport System.

1.4 References

1. **MTDN008** General Single Dish Data Format System, Version 4. *Fairclough,Kenderdine,Titterington 23rd Jan 1987*
2. **NRAO** Single Dish Data Format *Brown, Stobie 21st Oct 1986*
3. **NRAO** Single Fits Tape *Stobie, Morgan 21st Oct 1986*

1.5 Overview

The General Single Dish Data Format System specifies the physical format, structure and type of information that comprise observations as agreed by NRAO, IRAM and UK/NL MT teams at a meeting of these parties back in 1986.

This format system has since failed to be adopted by any of the organisations that participated in its creation. The Format itself has not been developed further, however at JCMT a similar system based upon the General Single Dish Data Format System has evolved.

Some of the reasoning behind the implementation route taken was based upon the dominance of a single operating system (VMS), the lack of a developed or applicable FITS standard (with BINTABLES) and the performance limitations of the hardware of that period.

With time the system at JCMT has actively evolved without plan, control or documentation. This document attempts to define what is currently done at the JCMT in terms of data storage content and is to provide a basis on which the future of the system may be decided.

2 GSD Architecture

The GSD Architecture described in MTDN008 Version 4 (Reference 1) remains the same. Each file follows the format described starting with the single file descriptor, an item descriptor for each datum, and then the data.

3 JCMT Storage Data Definitions

The JCMT system of Storing data in GSD files utilizes a set of user supplied files containing data definitions. These files (GSDF files) define what data is to be stored by the Observing system STORAGE task.

Each data definition includes,

COMMENT A character string describing the item.

FITS NAME A JCMT specific FITS keyword.

GSDD NAME The General Single Dish Data Format item identifier.

CLASS A mask used to identify items stored together.

TYPE The data type (Char,Integer,Real,Double,Logical)

LOCATION The Adam NBS location of the data item.

DIMENSION Dimensions of array, zero being a scalar.

DIMENSIONS The GSDD NAME of each item that will contain the value of a dimension at run time.

There exist 17 top level GSDF files which are composed of 94 component files defining a total of nearly 600 seperate items. Many of these are historical.

For this document and for the current definition of the data items to be stored only the following GSDF files will be considered as "in use".

- STORAGE_CBE_FULL.GSDF
- STORAGE_AOSC_FULL.GSDF
- STORAGE_UKT14_FULL.GSDF
- STORAGE_IFD_FULL.GSDF
- STORAGE_DAS_FULL.GSDF
- STORAGE_DAS_TP_FULL.GSDF
- STORAGE_DAS_CROSS_CORR_FULL.GSDF

4 The Class System

The Class system is described in MTDN008 Version 4 (Reference 1) where three Systems of classes are explained, the Simple System, System 1 and System 2. A class is a grouping of similar data items under a naming convention.

Each of the three Systems has a different number of classes where the classes are not the same between Systems. For continuity, for this version, the same Class headings as those of System 1 and System 2 have been used. The two additional Classes are Class 55 which is used for data related to dual dish interferometry and the No Class which contains data items that do not currently belong to any other class.

4.1 Class 1: Identity Parameters

Item	Mnemonic	Format	Units
Telescope name	C1TEL	C*16	
Identifies the observing program	C1PID	C*16	
Name of the primary observer	C1OBS	C*16	
Name of the support scientist	C1ONA1	C*16	
Name of the telescope operator	C1ONA2	C*16	
Source name part 1	C1SNA1	C*16	
Source name part 2	C1SNA2	C*16	
Character code of commanded centre	C1HGT	R*8	KM
Geographical longitude of telescope (W +ve)	C1LONG	R*8	DEG
Geodetic latitude of telescope (N +ve)	C1LAT	R*8	DEG
Observation number	C1SNO	R*8	
Name of the frontend	C1RCV	C*16	
Type of frontend	C1FTYP	C*16	
Name of the backend	C1BKE	C*16	
Type of backend	C1BTYP	C*16	

C1HGT is Character code of commanded centre or source coordinate system.
C1SNO is listed as D (Real*8) in the GSDF files but as an Integer in control task.

4.2 Class 2: Time Parameters

Item	Mnemonic	Format	Units
Secondary mirror x displacement from nominal at observation start	C2FV	R*4	MM
Secondary mirror y displacement from nominal at observation start	C2FL	R*4	MM
Secondary mirror z displacement from nominal at observation start	C2FR	R*4	MM

4.3 Class 3: Position Parameters

Item	Mnemonic	Format	Units
UT1 date of observation	C3DAT	R*8	YYYY.MMDD
UT1 hour of observation	C3UT	R*8	HOUR
UT1-UTC correction interpolated from time service telex	C3UT1C	R*8	DAY
Local sidereal time at start of the observation	C3LST	R*8	HOUR
Calibration observation?	C3CAL	L*1	
Centre moves between scans?	C3CEN	L*1	
Data taken on the fly or in discrete mode?	C3FLY	L*1	
Focus observation?	C3FOCUS	L*1	
Map observation?	C3MAP	L*1	
Number of dimension in the map table	C3NPP	I*4	
Number of map points	C3NMAP	I*4	
Number of scans	C3NIS	I*4	
Number of scans done	C3NSAMPLE	I*4	
Number of scan table 1 variables	C3NO_SCAN_VARS1	I*4	
Number of scan table 2 variables	C3NO_SCAN_VARS2	I*4	
Total time of scan	C3SRT	I*4	SEC
Maximum number of map points done in a phase	C3MXP	I*4	
Maximum number of cycles in the scan	C3NCI	I*4	
Number of cycles done in the scan	C3NCYCLE	I*4	
Duration of each cycle	C3CL	I*4	SEC
Total number of xy positions observed during a cycle	C3NCP	I*4	
Number of phase table variables	C3NSV	I*4	
Number of phases per cycle	C3PPC	I*4	
No. of frontend output channels	C3NFOC	I*4	
Number of IF inputs to each section	C3NOIFPBES	I*4	
What's in the DATA array	C3AOSOUTPUT	C*8	
BE input channels connected to this section	C3BESCONN	I	
IF output channels connected to BE input channels	C3BEINCON	I*4	
Number of channels per backend section	C3LSPC	I*4	
Subsystem nr to which each backend section belongs	C3BESSPEC	I*4	
Copy of frontend LO frequency per backend section	C3BEFENULO	R*8	
Total IF per backend section	C3BETOTIF	R*8	
Copy of frontend sideband sign per backend section	C3BEFESB	I*4	
Scan integration time	C3INTT	I*4	
Number of backend output channels	C3NCH	I*4	
Number of backend sections	C3NRS	I*4	
Number of backend input channels	C3NRC	I*4	
Backend configuration	C3CONFIGNR	I*4	
Description of output in DAS DATA	C3DASOUTPUT	C*8	
DAS calibration source for backend calibration	C3DASCALSRC	C*6	
DAS calibration source for backend calibration	C3DASSHFTFRAC	R*4	
Subband overlap	C3OVERLAP	R*4	

4.4 Class 4: Pointing Parameters

Item	Mnemonic	Format	Units
Character code of commanded centre	C4CSC	C*16	
centre coords	C4CECO	I*4	
Type of epoch, JULIAN, BESSELIAN or APPARENT	C4EPT	C*16	
Centre moving flag (solar system object)	C4MCF	L*1	
Date of the RA/DEC coordinates (1950)	C4EPH	R*8	YEAR
Right ascension of source for EPOCH	C4ERA	R*8	DEG
Declination of source for EPOCH	C4EDEC	R*8	DEG
Right Ascension of date	C4RADATE	R*8	DEG
Declination of date	C4DECDATE	R*8	DEG
Right ascension J2000	C4RA2000	R*8	DEG
Declination J2000	C4EDEC2000	R*8	DEG
Galactic longitude	C4GL	R*8	DEG
Galactic latitude	C4GB	R*8	DEG
Azimuth at observation date	C4AZ	R*8	DEG
Elevation at observation date	C4EL	R*8	DEG
Char. code for local x-y coord.system	C4LSC	C*16	
Units of cell and mapping coordinates	C4ODCO	C*16	
Angle between cell y axis and x-axis (CCW)	C4AXY	R*8	DEG
Commanded x centre position	C4SX	R*8	
Commanded y centre position	C4SY	R*8	
Reference x position	C4RX	R*8	
Reference y position	C4RY	R*8	
DAZ:Net Az offset at start	C4AZERR	R*8	ARCSEC
DEL:Net El offset at start	C4ELERR	R*8	ARCSEC
Secondary mirror is chopping	C4SM	L*1	
Secondary mirror chopping waveform	C4FUN	C*10	
Secondary mirror chopping period	C4FRQ	R*4	Hz
Secondary mirror chopping coordinate system	C4SMCO	C*2	
Secondary mirror chop throw	C4THROW	R*4	ARCSEC
Secondary mirror chop position angle	C4POSANG	R*4	DEG
Secondary mirror offset parallel to lower axis (E-W Tilt)	C4OFFS_EW	R*4	ARCSEC
Secondary mirror offset parallel to upper axis (N-S Tilt)	C4OFFS_NS	R*4	ARCSEC
Secondary mirror absolute X position at observation start	C4X	R*4	MM
Secondary mirror absolute Y position at observation start	C4Y	R*4	MM
Secondary mirror absolute Z position at observation start	C4Z	R*4	MM
Secondary mirror ew chop scale	C4EW_SCALE	R*4	ARCSEC/ENC
Secondary mirror ns chop scale	C4NS_SCALE	R*4	ARCSEC/ENC
Secondary mirror ew encoder value	C4EW_ENCODER	I*4	ENCODER
Secondary mirror ns encoder value	C4NS_ENCODER	I*4	ENCODER
Mounting of telescope	C4MOCO	C	

The items C4AXY, C4SX, C4SY, C4RX, C4RY, are stored as Real*8 but are actually Real*4 in the control task.

Item C4CSC may also be source coordinate system.
Item C4MOCO is defined as LOWER/UPPER axes, e.g; AZ/ALT.
Item C4ODCO is offset definition code.
Item C4CECO is centre coords where AZ=1; EQ=3; RD=4; RB=6; RJ=7; GA=8.

4.5 Class 5: Environment Parameters

Item	Mnemonic	Format	Units
Ambient temperature	C5AT	R*8	DEG C
Mean atmospheric pressure	C5PRS	R*8	MM HG
Mean atmospheric relative humidity	C5RH	R*8	%

The items C54AT, C5PRS, C5RH, are stored as Real*8 but are actually Real*4 in the telescope task.

4.6 Class 6: Mapping Parameters

Item	Mnemonic	Format	Units
Local x-y AZ= 1;EQ=3;RD=4;RB=6;RJ=7;GA=8	C6FC	I*4	
Type of observation	C6ST	C*16	
Map rows scanned in alternate directions?	C6REV	L*1	
Map rows are in X or Y direction	C6SD	C*16	
In first row x increases (T) or decreases (F)	C6XPOS	L*1	
In first row y increases (T) or decreases (F)	C6YPOS	L*1	
Number of sky points completed in the observation	C6NP	I*4	
Observation mode	C6MODE	C*20	
Cycle reversal flag	C6CYCLREV	L*1	
Cell x dim,; descriptive origin item 1	C6DX	R*8	
Cell y dimension; descriptive origin item 2	C6DY	R*8	
Scanning angle, angle local vertical to x axis measured CW	C6MSA	R*8	
X map dimension; number of points in the x-direction	C6XNP	I*4	
Y map dimension; number of points in the y-direction	C6YNP	I*4	
X coordinate of the first map point	C6XGC	R*4	
Y coordinate of the first map point	C6YGC	R*4	

The items C6DX, C6DY, C6MSA are stored as Real*8 but are actually Real*4 in the control task.

4.7 Class 7: Velocity Parameters

Item	Mnemonic	Format	Units
Number of elements of vradial array	C7SZVRAD	I*4	NO
Radial velocity of the source	C7VR	R*8	KM/S
Bad channel value	C7BCV	R*4	IN
TEL's array for computing radial velocities	C7VRADIAL	R*8	
Filter	C7FIL	C*16	
Aperture	C7AP	C*16	
Sensitivity range of lockin	C7SNTVTYRG	C*16	
Lockin time constant	C7TIMECNST	C*16	
Lockin sensitivity in scale range units	C7SNSTVTY	I*4	
Lockin phase	C7PHASE	R*4	
CSO tau at 225GHz	C7TAU225	R*4	
CSO tau time (YYMMDDHHMM)	C7TAUTIME	C	
Seeing at JCMT	C7SEEING	R*4	
SAO seeing time (YYMMDDHHMM)	C7SEETIME	C	

4.8 Class 8: Engineering Parameters

Item	Mnemonic	Format	Units
Ratio total power observed/incident on the telescope	C8AAE	R*8	%
Fraction of beam in diffraction limited main beam	C8ABE	R*8	%
Antenna gain	C8GN	R*8	
Rear spillover and scattering efficiency	C8EL	R*8	
Forward spillover and scattering efficiency	C8EF	R*8	

4.9 Class 9: Data Parameters

Item	Mnemonic	Format	Units
None			

4.10 Class 10: Reciever Parameters

Item	Mnemonic	Format	Units
None			

4.11 Class 11: Phase Control Table

Item	Mnemonic	Format	Units
Names of the cols. of phase table	C11VD	C*16	
Phase table: switching scheme dependent	C11PHA	R*4	

4.12 Class 12: Phase Value Table

Item	Mnemonic	Format	Units
Cold load temperature	C12TCOLD	R*4	K
Ambient load temperature	C12TAMB	R*4	K
Velocity definition code - radio, optical, or relativistic	C12VDEF	C*20	
Velocity frame of reference - LSR, Bary-, Helio-, or Geo- centric	C12VREF	C*20	
Units of spectrum data	C12CAL	C*20	
Calibration instrument used (FE, BE, or USER)	C12CALTASK	C*20	
Type of calibration (THREELOADS or TWOLOADS)	C12CALTYPE	C*20	
Way of calibrating the data (RATIO or DIFFERENCE)	C12REDMODE	C*20	
Names of the cols. of scan table1	C12SCAN_VARS1	C*16	
Names of the cols. of scan table2	C12SCAN_VARS2	C*16	
Begin scan table	C12SCAN_TABLE_1	R*4	
End scan table	C12SCAN_TABLE_2	R*4	
Centre frequencies (rest frame of source)	C12CF	R*8	GHZ
Rest frequency	C12RF	R*8	GHZ
BE input frequencies	C12INFREQ	R*8	GHZ
Frequency resolution	C12FR	R*8	MHZ
Bandwidth	C12BW	R*4	MHZ
Receiver temperature	C12RT	R*4	K
System temperature	C12SST	R*4	K
Sky temperature at last calibration	C12TSKY	R*4	K
Telescope temp. from last skydip	C12TTEL	R*4	K
Gain value (kelvins per volt or equivalent)	C12GAINS	R*4	K/V
Calibration temperature	C12CT	R*4	K
Water opacity	C12WO	R*4	NEPER
Sky transmission from last calibration	C12ETASKY	R*4	
Ratio of signal sideband to image sideband sky transmission	C12ALPHA	R*4	
Normalizes signal sideband gain	C12GS	R*4	
Telescope transmission	C12ETATEL	R*4	
Frontend-derived Tsky, image sideband	C12TSKYIM	R*4	
Frontend-derived sky transmission	C12ETASKYIM	R*4	
Frontend-derived Tsys, image sideband	C12TSYSIM	R*4	
Ratio of signal sideband to image sideband sky transmission	C12TASKY	R*4	
Correlation function mode	C12CM	I*4	
Correlation bit mode	C12BM	I*4	
Centre frequencies (rest frame of source)	C12CF	R*8	GHZ
Rest frequency; FITS: [Hz]; GSD: [GHz]	C12RF	R*8	GHZ
Frequency resolution; FITS: [Hz]; GSD: [MHz]	C12FR	R*8	MHZ
Bandwidth; FITS: [Hz]; GSD: [MHz]	C12BW	R*8	MHZ
Calibration temperature	C12CT	R*8	K
Water opacity	C12WO	R*8	NEPER

The item C12CT as C1BKE.TCAL is saved as a Real*8 but us a Real*4 in the ukt14 task.

4.13 Class 13: Phase Timing Table

Item	Mnemonic	Format	Units
Spectrum data	C13DAT	R*4	
Spectrum data	C13DAT	R*8	
Individual beam integrations	C13SPV	R*8	
Raw error is accumulated over the scan	C13RAW_ERROR	R*8	
Raw out of phase data samples in each phase	C13SPV_OP	R*8	
Raw (out of phase) error, stored at end scan	C13RAW_ERROR_OP	R*8	
array of responsivities	C13RESP	R*4	
Phase data standard deviation	C13STD	R*8	
Standard error	C13ERR	R*8	

The C13SPV is saved as Real*8 but is a real*4 in the DAS task, and a Real*8 in the ukt14 task.

The C13DAT is listed with two types for saving, that for the DAS task of Real*4 and that for the ukt14 task of Real*8.

4.14 Class 14: Data Value Table

Item	Mnemonic	Format	Units
List of xy offsets for each scan	C14PHIST	R*4	RUNS

4.15 Class 15: Pointing History Table

Item	Mnemonic	Format	Units
None			

4.16 Class 55: Inclinometry

Item	Mnemonic	Format	Units
DAS number of phases for interferometry observing	C55NPH	I*4	
DAS number of phases for interferometry observing	C55NCYC	I*4	
DAS number of phases for interferometry observing	C55NINT	I*4	
DAS number of correlation cycles	C55NCORR	I*4	
RXJ X length of projected baseline in metres	C55LX	R*8	
RXJ Y length of projected baseline in metres	C55LY	R*8	
RXJ Z length of projected baseline in metres	C55LZ	R*8	
RXJ Coeff of sin term in exp for fringe rate	C55A	R*8	M
RXJ Coeff of cos term in exp for fringe rate	C55B	R*8	M
RXJ Coeff of constant term in exp for fringe rate	C55C	R*8	M
RXJ Const term to compensate for differing telescope focal lengths	C55D	R*8	M
RXJ Delay setting of RXJ micro for CSO side	C55CSOSW	I*4	
RXJ Delay setting of RXJ micro for JCMT side	C55JCMTSW	I*4	
RXJ Number of the tick on which integration started	C55SECOND	I*4	
CSO Position of absorber IN or OUT	C55ABSORB	C*1	
CSO TAU value	C55TAU	R*4	
CSO Position offset in az	C55DAZ	R*4	ARCSEC
CSO Position offset in elevation	C55DEL	R*4	ARCSEC
CSO RA	C55RA	R*8	
CSO Dec	C55DEC	R*8	
CSO Epoch of CSO RA and Dec	C55EPOCH	R*8	
CSO Pointing offset in az	C55PAZ	R*4	ARCSEC
CSO Pointing offset in elevation	C55PEL	R*4	ARCSEC
CSO Track mode of telescope Y or N	C55TRACK	C*1	
CSO Focus mode of CSO	C55FMODE	C*1	
CSO X position of focus	C55FX	R*4	
CSO Y position of focus	C55FY	R*4	
CSO Z position of focus	C55FZ	R*4	
CSO LSR velocity of source	C55VLSR	R*4	KM/S
CSO velocity offset	C55VOFF	R*4	KM/S
CSO radial velocity	C55VRAD	R*4	KM/S
CSO Phase lock status L or U	C55PLOCK	C*1	
CSO Rest frequency of line	C55RFREQ	R*8	GHz
CSO IF frequency	C55IFFREQ	R*8	GHz
CSO LO frequency	C55LOFREQ	R*8	GHz
CSO frequency offset	C55FREQOFF	R*8	GHz
CSO Sideband U or L	C55SIDEBAND	C*1	
CSO Multiplier Harmonic number	C55MHN	I*4	
CSO overall status 0 = bad 1 = good	C55CSOSTATUS	I*4	
CENTRE_AZ from tel sdis array	C55TELAZ	R*8	
CENTRE_EL from tel sdis array	C55TELEL	R*8	
Observing frequencies	C55FENUOBS	R*8	
FE side band signs	C55FESBSIGN	I*4	
FE LO frequency	C55FENULO	R*8	
DAS total power measurement on hot load	C55HOTPOWER	R*4	
DAS data processing done	C55DASPRBIT	I*4	
Description of where processing is done	C55DASPRLOC	C*10	
DAS total power measurement on hot load	C55SKYPOWER	R*4	
Samples to store for cross correlation mode	C55SAM	R*4	
DAS total power per subband per integration	C55POWER	R*4	

4.17 No Class

Item	Mnemonic	Format	Units
Position angle of cell y axis (CCW)	CELL_V2Y	R*8	DEG

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