EST	EPIC

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1. INTRODUCTION

Several EGSE configurations will be used to support the EPIC AIV from unit level to system level.

The tests and calibrations of the MOS and p-n chains (EMCS1, EMCS2, EPCS), before delivery to ESA, will be carried out with the LABEN GSE (see Ref. [5]) and an ExDH simulator will be used in case the ExDH is missing.

One component of the LABEN GSE, the Experiment Checkout Equipment (EXP-COE), will be delivered to ESA, together with each EPIC Camera System, as Instrument Station (IS) in order to support the AIV after integration into the S/C.

A specific IS will be provided by LABEN for the system level test of the EPIC Radiation Monitor (ERMS). However, subsystem level test and calibration of the ERMS will be supported by ERMS GSE.

1.1. Purpose and scope

The aim of the present document is to present the file formats for the archiving of the data collected during the EPIC instrument tests and calibration. Each complex of activities at a specific site will be termed a "*measurement campaign*".

This first issue contains only the part devoted to the MOS and pn Camera Systems. This part applies to the file formats of the data archive to be produced by the EXP-COE and IS as well as by the ExDH simulator.

A second part devoted to the ERMS should be added to deal with the ERMS file formats which should apply to the ERMS Instrument Station to be delivered to ESA. For the time being, ERMS data archiving specifications are given in ref.[4].

The formats given in this document have been defined taking into account portability guidelines which have been agreed with the Calibration Data Analysis Working Group (CDAWG) to facilitate the off-line analysis of the data at the Institute premises and at the calibration premises (the detailed definition of the formats is subject to revision by the CDAWG and will be refined in the next issue).

The archive will be made available on DAT tapes. At Orsay and Panter, the archive will be ingested by the EPIC Consortium-provided s/w running on the Calibration Checkout Equipment (CAL-COE) and on the End-To-End Checkout Equipment (ETE-COE), respectively.

1.2. Definition, acronyms and abbreviations

AIV	Assembly, Integration and Verification
APID	Application Process Identifier
CAL-COE	Calibration Check-Out Equipment
CCOE	Central Check-Out Equipment
CDAWG	Calibration and Data Analysis Working Group
EMCS	Epic Mos Camera System
EPCS	Epic Pn Camera System
EPIC	European Photon Imaging Camera
ERMS	Epic Radiation Monitor System
ESA/CCS	European Space Agency Central Check-out System
ETE-COE	End-to-End Check Out Equipment
ETOL	European Test Operation Language
EXP-COE	Experimental Check Out Equipment
FITS	Flexible Image Transport System
FTP	File Transfer Protocol
FWHM	Full Width at Half Maximum
HEW	Half Energy Width
HK	Housekeeping
ISU	Interface Simulator Unit
LAN	Local Area Network
NFS	Network File System
OLA	On-Line Analysis
OOL	Out of Limit
PCF	Primary Calibration File
QLA	Quick Look Analysis
SID	Structure Identifier
SQL	Structured Query Language
TBD	To Be Defined
TBV	To Be Verified
TBW	To Be Written
TM	Telemetry
XMM	X-ray Multi Mirror

1.3. Reference documents

[1] L. Chiappetti, Basic requirements for processing of EPIC science telemetry, EPIC-EST-SP-005, Issue 1

[2] EMCS Commanding philosophy, EPIC-EST-TN-001, Issue 1

[3] EPCS Commanding philosophy, EPIC-EST-TN-002, Issue 1

[4] Specification for the archiving of the EPIC Radiation Monitor Calibration Science Telemetry, EPIC-CES-SR-002

[5] EPIC GSE System Requirements, EPIC-LAB-SR-001

[6] M. Denby, Calibration File Formats for the XMM EPIC, EPIC-LUX-SP-026

[7] Definition of the Flexible Image Transport System (FITS), NASA NOST, latest issue, as available on line at *href=http://www.gsfc.nasa.gov/astro/fits/fits_home.html*

[8] A User's Guide for the Flexible Image Transport System (FITS), NASA NOST, latest issue, as available on line at *href=http://www.gsfc.nasa.gov/astro/fits/fits_home.html*

[9] XMM Operations Interface Requirements, PX-RS-0028, I.4

1.4. Change Record

1.0	First issue.
1.1 draft	Updated the EPCS part to be reviewed on 24/07/96 with the pn Team. Modified file naming and instrument related FITS keywords as suggested by the CDAWG. Rearranged FITS keywords as suggested by Laben/SSI.
1.2 draft	Updated after review on 24/07/96.
1.3	Updated after EQM MOS Panter Training, taking into account Lucio's e-mail on 14 October 1996.

Vertical bar on the right hand side show changes since issue 1.0 until issue 1.2 draft

Thick vertical bar on the right hand side show changes with respect to issue 1.2 draft.

2. MOS AND PN CAMERA SYSTEMS

2.1. Framework

Each campaign will foresee the operation of (one or more) EPIC cameras according to the standard commanding philosophy [Ref.2,3], i.e. all commanding will occur in Idle mode and data taking will be performed during "*exposures*" or "*measurement runs*"

A given measurement run will produce a number of files (the science and HK files determined by the operating mode plus some summary files). These files will be generated on disk as FITS files (with the possible exception of the summary files which can be plain ASCII). These files will be archived to DAT tape in tar format.

All the corresponding raw files will be archived on tar files as backup.

It is proposed that a tar file is created every 10 runs. This will avoid tar files to be excessively long . This way it will be also very easy to locate a run on the tape, e.g. to locate the files for run 147 :

> one shall skip 14 tar files (mt -f /dev/*tapedrive* fsf 14) Note that a forward skip operation is a fast operation, much faster than any skip-by-record implied e.g. by native storage of FITS to tape.
>
> one shall either extract (tar xvf /dev/*tapedrive*) all files of runs 141 to 150 or use a script to construct the list of possible files for the wished run.

2.2. File naming

It is proposed that *campaigns* are identified by a three-letter code *ppp*.

It is proposed that *runs* within a campaign are identified by a five-digit sequential number *nnnnn* (from 00001 to 99999)

The filename (in Unix sense) will be by definition composed by two parts termed the *name* (the part preceding the only and mandatory dot in the filename), and the *type* (the part following the dot)

The name part will include the sequential number and the date and time of creation in the form: *nnnnn_YYMMDD_HHMMSS*.

The adoption of an 8.3 naming scheme might be preserved if some users (e.g. for MS-DOS) feel it is desirable, but is not a requirement. In particular :

> Campaign codes ppp might be longer than three letters if desired.
>
> Run sequential numbers might be in a range shorter than 5 digits, however if the range is n digits the sequence numbers shall be written in Fortran In.n format (i.e. if n=3 the range is from 001 to 999)
>
> Anyhow long names shall be avoided for ease of typing and mnemonic reasons.
>
> The type code shall be uniquely associated to the internal layout of the files (i.e. indirectly to the modes), and to the origin of the file (EPIC chain and chip/quadrant). We propose below both a short (3-character) and long type code.
>
> The long form will be used by default.

An utility will allow the user to change from the long to the short form all the files related to a given measurement run (and viceversa).

For simplicity filenames shall be all in lower case.

EGSE reduced data files are stored in a directory structure whose subdirectories names identify the Decade of run involved (so directory 1 contains 1 to 10, 2 11 to 20, ..., n contains (n-1)*10+1 to n*10). Each subdirectory will be archived on the DAT tape in a single tar file.

E.g.:

Before starting the measurement run n.141, the subdirectory ./15 is created to host the files related to the measurement run n. 141, 142, ..., 150.

The whole subdirectory will be archived on DAT with the command:

tar cvf /dev/xxxxx -C /virtual_root/15 ./*

allowing an easy and fast retrieval of a given run from the tape (see 2.1 above).

Further identifications (chain code, CCD/quadrant code, operating mode, ...) will be allowed by the *file type*.

2.3. File types

We list here the different file types which can be produced in the various operating modes according to Ref. [1]. We give two tables.

The first gives a *complete* list of all different file types (as identified by a different type code) while at the same time it identifies the (much smaller) number of different logical and physical file layouts. The second table indicates which family of files is produced when a CCD is operated in a given mode.

The file type codes have been constructed provisionally as follows :

The long form is built as *ditttlll* where :

d is a one-letter code indicating the EPIC chain (ideally this shall use the XMM "subsystem" codes defined in Ref. [9], under revision. According to ESA customs we have used m for MOS chain one, n for MOS chain 2 and p for pn chain. Please note that files with a prefix of m or n and all other letters equal will by definition share the same layout.

i is a one-digit code indicating the MOS CCD (range 1-7) or the pn quadrant (range 0-3). Please note that files having all other letters equal (but the CCD/quadrant code) will by definition share the same layout.

ttt is a mnemonic code (whose length is not prescribed) related to the mode generating the data (and therefore to the internal layout), e.g. ima for imaging, tim for timing, diag for diagnostics etc.

lll is an optional mnemonic code (whose length is not prescribed) related to the kind of data contained in the file (hence also to the FITS file organization). This information is redundant and should be included only if felt useful. I have used the codes elf or relf for an event list file (FITS binary table), ima for a FITS image and none for other FITS tables. The distinction between elf and relf (*raw* event list file) is optional, but might be useful in the case a later processing may e.g. recombine events for photon reconstruction producing a "true" event list. (see ref. [1]).

The short form is built as a three letter code *dix* where :

The EPIC chain code *d* is as described above

The CCD/quadrant code *i* is as described above

The third letter *x* (usually the inital of ttt described above) is such to generate unique codes.

The columns indicated with "Layout" identify respectively the logical and physical layout. Physical layout is associated with the file physical organization, e.g. any 192x200 pixel image file irrespective of content, or any binary table with the same TTYPEn and TFORMn. Logical layout is associated with the file usage, e.g. the EMCS reduced imaging and timing event list files have the same physical layout but the interpretation of the usage of the "raw time" and "raw y" columns is different, or the EMCS imaging and timing files are identical with the exception of the TTYPE of one column (frame or cycle number respectively). On the other hand the EMCS standard and reduced imaging event files are physically different since the TFORM of the energy column is different.

File type code		Description	Layout	
Long	Short		Log.	Phys.
m1ima1elf	m1i	EMCS 1, CCD 1 standard imaging mode event list file	A	1
m2ima1elf	m2i	EMCS 1, CCD 2 standard imaging mode event list file	A	1
m3ima1elf	m3i	EMCS 1, CCD 3 standard imaging mode event list file	A	1
m4ima1elf	m4i	EMCS 1, CCD 4 standard imaging mode event list file	A	1
m5ima1elf	m5i	EMCS 1, CCD 5 standard imaging mode event list file	A	1
m6ima1elf	m6i	EMCS 1, CCD 6 standard imaging mode event list file	A	1
m7ima1elf	m7i	EMCS 1, CCD 7 standard imaging mode event list file	A	1
m1imaasf	m1a	EMCS 1, CCD 1 imaging mode ancillary science file	B	2
m2imaasf	m2a	EMCS 1, CCD 2 imaging mode ancillary science file	B	2
m3imaasf	m3a	EMCS 1, CCD 3 imaging mode ancillary science file	B	2
m4imaasf	m4a	EMCS 1, CCD 4 imaging mode ancillary science file	B	2
m5imaasf	m5a	EMCS 1, CCD 5 imaging mode ancillary science file	B	2
m6imaasf	m6a	EMCS 1, CCD 6 imaging mode ancillary science file	B	2
m7imaasf	m7a	EMCS 1, CCD 7 imaging mode ancillary science file	B	2
m1ima2elf	m1j	EMCS 1, CCD 1 reduced imaging mode event list file	C	3
m2ima2elf	m2j	EMCS 1, CCD 2 reduced imaging mode event list file	C	3
m3ima2elf	m3j	EMCS 1, CCD 3 reduced imaging mode event list file	C	3
m4ima2elf	m4j	EMCS 1, CCD 4 reduced imaging mode event list file	C	3
m5ima2elf	m5j	EMCS 1, CCD 5 reduced imaging mode event list file	C	3
m6ima2elf	m6j	EMCS 1, CCD 6 reduced imaging mode event list file	C	3
m7ima2elf	m7j	EMCS 1, CCD 7 reduced imaging mode event list file	C	3
m1timrelf	m1t	EMCS 1, CCD 1 timing mode event list file	D	3
m2timrelf	m2t	*EMCS 1, CCD 2 timing mode event list file*	D	3
m3timrelf	m3t	*EMCS 1, CCD 3 timing mode event list file*	D	3
m4timrelf	m4t	*EMCS 1, CCD 4 timing mode event list file*	D	3
m5timrelf	m5t	*EMCS 1, CCD 5 timing mode event list file*	D	3
m6timrelf	m6t	*EMCS 1, CCD 6 timing mode event list file*	D	3
m7timrelf	m7t	*EMCS 1, CCD 7 timing mode event list file*	D	3
m1timasf	m1b	EMCS 1, CCD 1 timing mode ancillary science file	E	2
m2timasf	m2b	*EMCS 1, CCD 2 timing mode ancillary science file*	E	2
m3timasf	m3b	*EMCS 1, CCD 3 timing mode ancillary science file*	E	2
m4timasf	m4b	*EMCS 1, CCD 4 timing mode ancillary science file*	E	2
m5timasf	m5b	*EMCS 1, CCD 5 timing mode ancillary science file*	E	2
m6timasf	m6b	*EMCS 1, CCD 6 timing mode ancillary science file*	E	2
m7timasf	m7b	*EMCS 1, CCD 7 timing mode ancillary science file*	E	2
m1diagima	m1d	EMCS 1, CCD 1 diagnostic image file	F	4
m2diagima	m2d	EMCS 1, CCD 2 diagnostic image file	F	4
m3diagima	m3d	EMCS 1, CCD 3 diagnostic image file	F	4
m4diagima	m4d	EMCS 1, CCD 4 diagnostic image file	F	4
m5diagima	m5d	EMCS 1, CCD 5 diagnostic image file	F	4

m6diagima	m6d	EMCS 1, CCD 6 diagnostic image file	F	4
m7diagima	m7d	EMCS 1, CCD 7 diagnostic image file	F	4
m1ovf	m1o	EMCS 1, CCD 1 offset-variance file	G	5
m2ovf	m2o	EMCS 1, CCD 2 offset-variance file	G	5
m3ovf	m3o	EMCS 1, CCD 3 offset-variance file	G	5
m4ovf	m4o	EMCS 1, CCD 4 offset-variance file	G	5
m5ovf	m5o	EMCS 1, CCD 5 offset-variance file	G	5
m6ovf	m6o	EMCS 1, CCD 6 offset-variance file	G	5
m7ovf	m7o	EMCS 1, CCD 7 offset-variance file	G	5
n1ima1elf	n1i	EMCS 2, CCD 1 standard imaging mode event list file	A	1
n2ima1elf	n2i	EMCS 2, CCD 2 standard imaging mode event list file	A	1
n3ima1elf	n3i	EMCS 2, CCD 3 standard imaging mode event list file	A	1
n4ima1elf	n4i	EMCS 2, CCD 4 standard imaging mode event list file	A	1
n5ima1elf	n5i	EMCS 2, CCD 5 standard imaging mode event list file	A	1
n6ima1elf	n6i	EMCS 2, CCD 6 standard imaging mode event list file	A	1
n7ima1elf	n7i	EMCS 2, CCD 7 standard imaging mode event list file	A	1
n1imaasf	n1a	EMCS 2, CCD 1 imaging mode ancillary science file	B	2
n2imaasf	n2a	EMCS 2, CCD 2 imaging mode ancillary science file	B	2
n3imaasf	n3a	EMCS 2, CCD 3 imaging mode ancillary science file	B	2
n4imaasf	n4a	EMCS 2, CCD 4 imaging mode ancillary science file	B	2
n5imaasf	n5a	EMCS 2, CCD 5 imaging mode ancillary science file	B	2
n6imaasf	n6a	EMCS 2, CCD 6 imaging mode ancillary science file	B	2
n7imaasf	n7a	EMCS 2, CCD 7 imaging mode ancillary science file	B	2
n1ima2elf	n1j	EMCS 2, CCD 1 reduced imaging mode event list file	C	3
n2ima2elf	n2j	EMCS 2, CCD 2 reduced imaging mode event list file	C	3
n3ima2elf	n3j	EMCS 2, CCD 3 reduced imaging mode event list file	C	3
n4ima2elf	n4j	EMCS 2, CCD 4 reduced imaging mode event list file	C	3
n5ima2elf	n5j	EMCS 2, CCD 5 reduced imaging mode event list file	C	3
n6ima2elf	n6j	EMCS 2, CCD 6 reduced imaging mode event list file	C	3
n7ima2elf	n7j	EMCS 2, CCD 7 reduced imaging mode event list file	C	3
n1timrelf	n1t	EMCS 2, CCD 1 timing mode event list file	D	3
n2timrelf	n2t	*EMCS 2, CCD 2 timing mode event list file*	D	3
n3timrelf	n3t	*EMCS 2, CCD 3 timing mode event list file*	D	3
n4timrelf	n4t	*EMCS 2, CCD 4 timing mode event list file*	D	3
n5timrelf	n5t	*EMCS 2, CCD 5 timing mode event list file*	D	3
n6timrelf	n6t	*EMCS 2, CCD 6 timing mode event list file*	D	3
n7timrelf	n7t	*EMCS 2, CCD 7 timing mode event list file*	D	3
n1timasf	n1b	EMCS 2, CCD 1 timing mode ancillary science file	E	2
n2timasf	n2b	*EMCS 2, CCD 2 timing mode ancillary science file*	E	2
n3timasf	n3b	*EMCS 2, CCD 3 timing mode ancillary science file*	E	2
n4timasf	n4b	*EMCS 2, CCD 4 timing mode ancillary science file*	E	2
n5timasf	n5b	*EMCS 2, CCD 5 timing mode ancillary science file*	E	2
n6timasf	n6b	*EMCS 2, CCD 6 timing mode ancillary science file*	E	2

n7timasf	n7b	*EMCS 2, CCD 7 timing mode ancillary science file*	E	2
n1diagima	n1d	EMCS 2, CCD 1 diagnostic image file	F	4
n2diagima	n2d	EMCS 2, CCD 2 diagnostic image file	F	4
n3diagima	n3d	EMCS 2, CCD 3 diagnostic image file	F	4
n4diagima	n4d	EMCS 2, CCD 4 diagnostic image file	F	4
n5diagima	n5d	EMCS 2, CCD 5 diagnostic image file	F	4
n6diagima	n6d	EMCS 2, CCD 6 diagnostic image file	F	4
n7diagima	n7d	EMCS 2, CCD 7 diagnostic image file	F	4
n1ovf	n1o	EMCS 2, CCD 1 offset-variance file	G	5
n2ovf	n2o	EMCS 2, CCD 2 offset-variance file	G	5
n3ovf	n3o	EMCS 2, CCD 3 offset-variance file	G	5
n4ovf	n4o	EMCS 2, CCD 4 offset-variance file	G	5
n5ovf	n5o	EMCS 2, CCD 5 offset-variance file	G	5
n6ovf	n6o	EMCS 2, CCD 6 offset-variance file	G	5
n7ovf	n7o	EMCS 2, CCD 7 offset-variance file	G	5
p0imarelf	p0i	EPCS, Quadrant 0 imaging mode event list file	H	6
p1imarelf	p1i	EPCS, Quadrant 1 imaging mode event list file	H	6
p2imarelf	p2i	EPCS, Quadrant 2 imaging mode event list file	H	6
p3imarelf	p3i	EPCS, Quadrant 3 imaging mode event list file	H	6
p0asf	p0a	EPCS, Quadrant 0 all mode ancillary science file	I	7
p1asf	p1a	EPCS, Quadrant 1 all mode ancillary science file	I	7
p2asf	p2a	EPCS, Quadrant 2 all mode ancillary science file	I	7
p3asf	p3a	EPCS, Quadrant 3 all mode ancillary science file	I	7
p0timrelf	p0t	EPCS, Quadrant 0 timing mode event list file	J	6
p1timrelf	p1t	EPCS, Quadrant 1 timing mode event list file	J	6
p2timrelf	p2t	EPCS, Quadrant 2 timing mode event list file	J	6
p3timrelf	p3t	EPCS, Quadrant 3 timing mode event list file	J	6
p0burrelf	p0b	EPCS, Quadrant 0 burst mode event list file	K	6
p1burrelf	p1b	EPCS, Quadrant 1 burst mode event list file	K	6
p2burrelf	p2b	EPCS, Quadrant 2 burst mode event list file	K	6
p3burrelf	p3b	EPCS, Quadrant 3 burst mode event list file	K	6
p0statima	p0s	EPCS, Quadrant 0 pixel status image file	L	8
p1statima	p1s	EPCS, Quadrant 1 pixel status image file	L	8
p2statima	p2s	EPCS, Quadrant 2 pixel status image file	L	8
p3statima	p3s	EPCS, Quadrant 3 pixel status image file	L	8
p0offima	p0o	EPCS, Quadrant 0 offset image file	M	8
p1offima	p1o	EPCS, Quadrant 1 offset image file	M	8
p2offima	p2o	EPCS, Quadrant 2 offset image file	M	8
p3offima	p3o	EPCS, Quadrant 3 offset image file	M	8
p0noiseima	p0n	EPCS, Quadrant 0 noise image file	N	8
p1noiseima	p1n	EPCS, Quadrant 1 noise image file	N	8
p2noiseima	p2n	EPCS, Quadrant 2 noise image file	N	8
p3noiseima	p3n	EPCS, Quadrant 3 noise image file	N	8

p0expmap	p0e	EPCS, Quadrant 0 discarded line exposure map file	O	9
p1expmap	p1e	EPCS, Quadrant 1 discarded line exposure map file	O	9
p2expmap	p2e	EPCS, Quadrant 2 discarded line exposure map file	O	9
p3expmap	p3e	EPCS, Quadrant 3 discarded line exposure map file	O	9
p0diagima	p0d	EPCS, Quadrant 0 diagnostic image file	P	10
p1diagima	p1d	EPCS, Quadrant 1 diagnostic image file	P	10
p2diagima	p2d	EPCS, Quadrant 2 diagnostic image file	P	10
p3diagima	p3d	EPCS, Quadrant 3 diagnostic image file	P	10

Note: the usage of pn diagnostics files has to be clarified in ref. [1]

In table below the italic camera code *m* will mean either m (EMCS1) or n (EMCS2)

Camera and chip/quadrant	**in mode**	**will produce files**
MOS chip *i*	imaging	*mi*ima1elf *mi*imaasf
MOS chip *i*	reduced imaging	*mi*ima2elf *mi*imaasf
MOS chip *i*	timing	*mi*timrelf *mi*timasf
MOS chip *i*	compressed timing (see note)	*mi*timrelf *mi*timasf
MOS chip *i*	diagnostics	*mi*diagima
MOS chip *i*	offset-variance computation	*mi*ovf
pn quadrant *i*	imaging (FF, LW, SW)	p*i*imarelf p*i*asf
pn quadrant *i*	timing	p*i*timrelf p*i*asf
pn quadrant *i*	burst	p*i*burrelf p*i*asf
pn quadrant *i*	pixel characteristics producing offset/badpixel map	p*i*statima p*i*offima
pn quadrant *i*	pixel characteristics producing pixel noise map	p*i*noiseima
pn quadrant *i*	pixel characteristics producing discarded line map	p*i*expmap
pn quadrant *i*	diagnostic	p*i*diagima

<u>Note</u> that there will be no difference between timing uncompressed and compressed options for what

concerns file layout, since decompression will be part of the generation of the event files as specified in Ref. [1] in 2.4.2.

2.4. File formats

This document gives only a *tentative* prescription for the organization of the files (names of keywords and columns) and does not specify how the relevant data is generated from "telemetry" (in broad sense, including EMCR/EPEA inputs to ExDH or ExDH simulator box). For the processing make reference to Ref. [1].

For what concerns formal syntax, in case of conflict between this document and the formal FITS specifications (ref.[7]), the latter have priority.

Also this document assumes familiarity with all formal FITS documentation.

All details of file layout are described exclusively by the relevant FITS header.

All strings and numbers given below shall appear as typed, unless they appear in italics, in which case their value may change case to case. A notation in italics with a pipe like *1|2* indicates "either 1 or 2", a notation in italics with an hyphen like *1-7* indicates a single value ranging 1 to 7.

It is assumed that (for binary tables) the primary header contains only the minimum mandatory set of keywords and that all other keywords appear in the (only) extension header.

Whenever a cell contains the sign ‹ this means the keyword assumes the same value as in the cell on the left. Whenever a cell is blank it means it is not used for that particular file (with the exception of the END keyword which is mandatory as such)

The definition of the FILTER and FILPART keywords have been taken from [6].

2.4.1. MOS event and ancillary files

	file type				
Keyword	***mi*ima1elf**	***mi*ima2elf**	***mi*timrelf**	***mi*imaasf**	***mi*timasf**
SIMPLE	T	‹	‹	‹	‹
BITPIX	8	‹	‹	‹	‹
NAXIS	0	‹	‹	‹	‹
EXTEND	T	‹	‹	‹	‹
END					
XTENSION	'BINTABLE'	‹	‹	‹	‹
BITPIX	8	‹	‹	‹	‹
NAXIS	2	‹	‹	‹	‹
NAXIS1	*sum TFORMn*	‹	‹	‹	‹
NAXIS2	*n of events*	‹	‹	*n of frames*	*n of cycles*
PCOUNT	0	‹	‹	‹	‹
GCOUNT	1	‹	‹	‹	‹
TFIELDS	**6**	‹	‹	**7**	‹
TTYPE1	'TIME'	‹	'RAWTIME'	'TIME'	‹

TFORM1	'1J'	‹	‹	'1J'	‹
TUNIT1	*tbd*	‹	‹	*tbd*	‹
TTYPE2	'X'	‹	‹	'FRAMENO'	'CYCLENO'
TFORM2	'1I'	‹	‹	'1I'	‹
TUNIT2	'PIXEL'	‹	‹	*n/a*	‹
TTYPE3	'Y'	‹	'RAWY'	NPIXEL	‹
TFORM3	'1I'	‹	‹	'1J'	‹
TUNIT3	'PIXEL'	‹	‹	'PIXELS'	‹
TTYPE4	'ENERGY'	‹	‹	'NVALID'	‹
TFORM4	**'8I'**	**'1I'**	‹	'1I'	‹
TUNIT4	'CHANNEL'	‹	‹	'COUNTS'	‹
TTYPE5	'PATTERN'	‹	‹	'NBELOW'	‹
TFORM5	'1I'	‹	‹	'1I'	‹
TUNIT5	*n/a*	‹	‹	'COUNTS'	‹
TTYPE6	'PERIPIX'	‹	‹	'NABOVE'	‹
TFORM6	'1I'	‹	‹	'1I'	‹
TUNIT6	'PIXELS'	‹	‹	'COUNTS'	‹
TTYPE7				'FIFOOVER'	‹
TFORM7				'1I'	‹
TUNIT7				*n/a*	‹
TELESCOP	'XMM'	‹	‹	‹	‹
INSTRUME	'EMCS1|2'	‹	‹	‹	‹
MODEL	'EQM|FM1|FM2'	‹	‹	‹	‹
DETNAM	'CCD1|7'	‹	‹	‹	‹
CCDPART	'aaa-nnnn'	‹	‹	‹	‹
FILTER	'THICK|THIN|MEDIUMn|OPEN|SHUTTER'	‹	‹	‹	‹
FILPART	'aaa-nnn'	‹	‹	‹	‹
NODE	'*Prime | Redundant*"	‹	‹	‹	‹
DATATYPE	'Imaging'	'Im.Reduced'	'*Timing raw| Tim.Com.raw*'	'*Imaging | Im.Reduced*'	'*Timing raw | Tim.Com.raw*'
EDU	*edu-number*	‹	‹	‹	‹
EDUTHRES	*edu-threshold*	‹	‹	‹	‹
FRMTIME	*frame-time*	‹	‹	‹	‹
WINDOWX0=	*window x0*	‹	‹	‹	‹
WINDOWY0=	*window y0*	‹	‹	‹	‹
WINDOWDX=	*window Dx*	‹	‹	‹	‹
WINDOWDY=	*window Dy*	‹	‹	‹	‹
EMDHLOW	*emdh-lowthr*	‹	‹	‹	‹
EMDHHIGH	*emdh-hi thr*	‹	‹	‹	‹
other kwds of	generic nature (see 2.4.7)	‹	‹	‹	
END					

2.4.2. MOS (diagnostic) image files

Keyword	*file type* **miidiagima**
SIMPLE	T
BITPIX	16 *TBD (-32 ?)*
NAXIS	2
NAXIS1	610 *max*
NAXIS2	602 *max*
BUNIT	'DIAGNOSTICS' (TBV)
CTYPE1	'PIXEL'
CTYPE2	'PIXEL'
CRPIX1	1.0
CRPIX2	1.0
CRVAL1	0.0
CRVAL2	0.0
CDELT1	1.0
CDELT2	1.0
TELESCOP	'XMM'
INSTRUME	'EMCS1|2'
MODEL	'EQM|FM1|FM2'
DETNAM	'CCD1|7'
CCDPART	'aaa-nnnn'
FILTER	'THICK|THIN|MEDIUMn|OPEN|SHUTTER'
FILPART	'aaa-nnn'
NODE	'*Prime | Redundant*''
DATATYPE	'Imaging|Timing' (TBV)
FRMTIME	*frame-time*
REFTIME	*reference time*
other kwds of	generic nature (see 2.4.7)
END	

(note: The DATATYPE keyword defines the readout mode of the CCD associated to the EDU operating in Diagnostic Mode).

2.4.3. MOS offset-variance (miscellaneous table) files

Keyword	***file type*** ***miovf***	
SIMPLE	T	
BITPIX	8	
NAXIS	0	
EXTEND	T	
END		
XTENSION	'BINTABLE'	
BITPIX	8	
NAXIS	2	
NAXIS1	*sum TFORMn*	
NAXIS2	*usually 1*	
PCOUNT	0	
GCOUNT	1	
TFIELDS	*2 (or 4)*	*assuming one shot operation as per Ref [1] 2.6.3.1*
TTYPE1	ROWOFFSET	
TFORM1	*usually* '610I	
TUNIT1	*tbd*	
TTYPE2	'COLOFFST'	
TFORM2	*usually* '602I'	
TUNIT2	*tbd*	
TELESCOP	'XMM'	
INSTRUME	'EMCS1|2'	
MODEL	'EQM|FM1|FM2'	
DETNAM	'CCD1|7'	
CCDPART	'aaa-nnnn'	
FILTER	'THICK|THIN|MEDIUMn|OPEN|SHUTTER'	
FILPART	'aaa-nnn'	
NODE	'*Prime | Redundant*''	
DATATYPE	'Offset_variance'	
FRMTIME	*frame-time*	
TIME	*time of the shot*	*assuming one shot operation as per Ref [1] 2.6.3.1*
VARIANCE	*computed variance*	*assuming one shot operation as per Ref [1] 2.6.3.1*
other kwds of	generic nature (see 2.4.7)	
END		

2.4.4. pn event and ancillary files

	file type			
Keyword	**p*i*imarelf**	**p*i*timrelf**	**p*i*burrelf**	**p*i*asf**
SIMPLE	T	‹	‹	‹
BITPIX	8	‹	‹	‹
NAXIS	0	‹	‹	‹
EXTEND	T	‹	‹	‹
END				
XTENSION	'BINTABLE'	‹	‹	‹
BITPIX	8	‹	‹	‹
NAXIS	2	‹	‹	‹
NAXIS1	*sum TFORMn*	‹	‹	‹
NAXIS2	*n of events*	‹	‹	*n of records*
PCOUNT	0	‹	‹	‹
GCOUNT	1	‹	‹	‹
TFIELDS	**4**	‹	‹	**6**
TTYPE1	'TIME'	'RAWTIME'	'RAWTIME'	'TIME'
TFORM1	'1J'	‹	‹	'1J'
TUNIT1	*tbd*	‹	‹	*tbd*
TTYPE2	'X'	‹	‹	'NABOVE'
TFORM2	'1I'	‹	‹	'1J'
TUNIT2	'PIXEL'	‹	‹	'PIXELS'
TTYPE3	'Y'	'RAWY'	'RAWY'	'NDEFA'
TFORM3	'1I'	‹	‹	'1I'
TUNIT3	'PIXEL'	‹	‹	'PIXELS'
TTYPE4	'ENERGY'	‹	‹	'NEPDH'
TFORM4	'1I'	‹	‹	1I
TUNIT4	'CHANNEL'	‹	‹	'PIXELS'
TTYPE5				'COM_MODE'
TFORM5				'1I'
TUNIT5				'ADU'
TTYPE6				'NDISCLIN'
TFORM6				'1I'
TUNIT6				'LINES'
TELESCOP	'XMM'	‹	‹	‹
INSTRUME	'EPCS'	‹	‹	‹
MODEL	'EQM|FM1|FM 2'	‹	‹	‹
DETNAM	'QUADRANT 0-3'	‹	‹	‹
CCDPART	'aaa-nnnn'	‹	‹	‹

<table>
<tr><td>FILTER</td><td>'THICK|THIN|
MEDIUMn|OPE
N|SHUTTER'</td><td>‹</td><td>‹</td><td>‹</td></tr>
<tr><td>FILPART</td><td>'aaa-nnn'</td><td>‹</td><td>‹</td><td>‹</td></tr>
<tr><td>DATATYPE</td><td>'Imaging'</td><td>'Timing'</td><td>'Burst'</td><td>any of ‹</td></tr>
<tr><td>CCD0MODE</td><td>'FF|SW|LW'</td><td>'T|null'</td><td>'B|null'</td><td>any of ‹</td></tr>
<tr><td>CCD1MODE</td><td>'FF|SW|LW'</td><td>'T|null'</td><td>'B|null'</td><td>any of ‹</td></tr>
<tr><td>CCD2MODE</td><td>'FF|SW|LW'</td><td>'T|null'</td><td>'B|null'</td><td>any of ‹</td></tr>
<tr><td>other kwds of</td><td>generic nature
(see 2.4.7)</td><td>‹</td><td>‹</td><td>‹</td></tr>
<tr><td>END</td><td></td><td></td><td></td><td></td></tr>
</table>

2.4.5. pn image files

Keyword	***file type***		
	p*i*statima	**p*i*offima**	**p*i*noiseima**
SIMPLE	T	‹	‹
BITPIX	16	‹	‹
NAXIS	2	‹	‹
NAXIS1	192	‹	‹
NAXIS2	200	‹	‹
BUNIT	'PIXEL STATUS'	'OFFSET'	'PIXEL NOISE'
CTYPE1	'PIXEL'	‹	‹
CTYPE2	'PIXEL'	‹	‹
CRPIX1	1.0	‹	‹
CRPIX2	1.0	‹	‹
CRVAL1	0.0	‹	‹
CRVAL2	0.0	‹	‹
CDELT1	1.0	‹	‹
CDELT2	1.0	‹	‹
TELESCOP	'XMM'	‹	‹
INSTRUME	'EPCS'	‹	‹
MODEL	'EQM|FM1|FM 2'	<	<
DETNAM	'QUADRANT 0-3'	<	<
CCDPART	'aaa-nnnn'	<	<
FILTER	'THICK|THIN|MEDIUMn|OPEN|SHUTTER'	‹	‹
FILPART	'aaa-nnn'	‹	‹
DATATYPE	*'imaging|timing|burst'*	‹	‹
REFTIME	*reference time*	‹	‹
other kwds of	generic nature (see 2.4.7)	‹	‹
END			

(note: in Issue 1.2 draft, BITPIX has been set to 16 as status, offset and noise info are given by 4, 12 and 16 bits respectively

The DATATYPE keyword defines the readout mode of the CCD the status/offset/noise data refer to).

For the Diagnostic Mode, it is assumed that an exposure can comprise more than one 100x4 lines readout.

The following keywords definition (TBV) foresees one FITS Image Extension for each 100x4 lines readout, in order to allow all data related to one exposure be put in a single file. This leads to foresee up to 50 Extensions.

This will maintain the complete information and allow any further processing to derive the final pixel values with the appropiate algorithm (e.g.: average).

	file type
Keyword	**pidiagima**
SIMPLE	T
BITPIX	16
NAXIS	0
EXTEND	T
END	
XTENSION	'IMAGE'
BITPIX	16
NAXIS	2
NAXIS1	256 max
NAXIS2	100 max
PCOUNT	0
GCOUNT	1
BUNIT	'DIAGNOSTICS
CTYPE1	'PIXEL'
CTYPE2	'PIXEL'
CRPIX1	1.0
CRPIX2	1.0
CRVAL1	0.0
CRVAL2	0.0
CDELT1	1.0
CDELT2	1.0
FIRSTL	first line read
LASTL	last line read
TELESCOP	'XMM'
INSTRUME	'EPCS'
MODEL	'EQM|FM1|FM2'
DETNAM	'QUADRANT 0-3'
CCDPART	'aaa-nnnn'
FILTER	'THICK|THIN|MEDIUM n|OPEN|SHUTTER'
FILPART	'aaa-nnn'
DATATYPE	*'imaging|timing|burst'*

REFTIME	*reference time*
other kwds of	generic nature (see 2.4.7)
END	

The DATATYPE keyword defines the readout mode of the CCD associated to the EPEA operating in Common Mode Filter in Trasparent Mode

The REFTIME keyword value will be derived from the Time Info words transmitted in each cycle.

2.4.6. pn miscellaneous table files

Keyword	*file type* piexpmap	
SIMPLE	T	
BITPIX	8	
NAXIS	0	
EXTEND	T	
END		
XTENSION	'BINTABLE'	
BITPIX	8	
NAXIS	2	
NAXIS1	*sum TFORMn*	
NAXIS2	*usually 1*	
PCOUNT	0	
GCOUNT	1	
TFIELDS	**4**	
TTYPE1	'TIME'	
TFORM1	'1J'	
TUNIT1	*tbd*	
TTYPE2	'CCD*x*MAP'	with *x* the CCD number
TFORM2	'200I'	
TUNIT2	'LINES'	
TTYPE3	'CCD*y*MAP'	with *y* the CCD number
TFORM3	'200I'	
TUNIT3	'LINES'	
TTYPE4	'CCD*z*MAP'	with *z* the CCD number
TFORM4	'200I'	
TELESCOP	'XMM'	
INSTRUME	'EPCS'	
MODEL	'EQM|FM1|FM2'	
DETNAM	'QUADRANT 0-3'	
CCDPART	'aaa-nnnn'	
FILTER	'THICK|THIN|MEDIUMn|OPEN |SHUTTER'	
FILPART	'aaa-nnn'	
DATATYPE	'Discarded line counter'	
DURATION	*see below*	
other kwds of	generic nature (see 2.4.7)	
END		

The TIME column and the DURATION keyword will allow to know the period the discarded line counters refers to.

The former will be based on the value of Start Time Data words (the time at which the counters are read and reset). The latter will be calculated taking into account the values in the TIME columns of the last exposure map file.

2.4.7. Generic administrative keywords

For *all* files there are a number of possible additional keywords which can be used to trace the conditions of the measurement run. In principle most of these conditions will be recorded in the 'campaign summary' (see below) indexed by run number.

Therefore they need not be repeated in the header provided there is information on the run number. A minimum set of keywords can be however put in the header.

To simplify things, it will be required to have a simple program which allows adding keywords into a file in a way easily callable by a script (e.g. something like addkey keyname keyvalue)

For the minimal set of keywords one may propose :

Keyword	**All file types**
RUNID	the run sequence number
CAMPAIGN	the campaign id, or description (in comments ?)
FILENAME	the filename (without path)
DATE	when the file was created (dd/mm/yy)
CONTENT	'EMCS1|EMCS2||EPCS|'
ORIGIN	the organization/installation creating the FITS file
DATE-OBS	the starting date of the run (dd/mm/yy)
TIME-OBS	the starting time of the run (hh:mm:ss)
DATE-END	the end date of the run (dd/mm/yy)
TIME-END	the endtime of the run (hh:mm:ss)

Values in the above date and time keywords are based on computer's clock. It is assumed that the GSE and the calibration facilities computers's clock are kept synchronised and remain so after any reset of any of them (or the delay be known) with respect to a common reference within a second units accuracy.

The TIME-OBS will correspond to the time of issuing of the *start observation* command, when the EMCR/EPEA times are reset.

The TIME-END will correspond either to the a change in the mode of the instrument operation or to an explicit operator command.

The reconstruction of time-tags with more stringent requirements (for timing modes 1 ms accuracy is needed) is considered not applicable at EGSE level.

2.4.8. HK files

To be written

(e.g. once details of HK collection by EGSE or ExDH simulator are known)

2.4.9. Summary files

It is proposed that two different kind of summary files exist.

One is a 'run directory'. There will be one such file per run, and the file shall be stored to DAT together with the FITS files. It shall simply be a list of all filenames produced for the given run, together with the relevant number of "logical" records (events, frames, samples *et sim*.). The file can be created just before archiving by some script using the NAXIS2 keyword.

Its format can be a plain ASCII files, with one record per file in Fortran list directed format, e.g.

'ors00010.m1timrelf' 4567

'ors00010.m1timasf' 765

…

The other one is a 'campaign summary'. This file will have one record per run, and will be an ASCII files with tab-separated columns. It could be generated automatically or manually, and will record all relevant setup conditions of a run. Its form is suitable for immediate handling with many tools (e.g. IDL), for import in PC spreadsheets (e.g. Excel) and for post-facto conversion to FITS tables if desired, while it remains easily printable and editable.

The list of relevant parameters will be known later.