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TITLE: THE RAW AND FITS DATA ARCHIVE OF THE PICSIT QUALIFICATION MODEL (QM) TEST CAMPAIGN (April 2000) AT LABEN

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1 Introduction

1.1 Purpose and scope

In April 2000 a number of tests have been carried out at Laben in order to verify the performances of the PICsIT Qualification Model (QM) integrated at Module Level.

This model consisted of one flight representative egg crate containing a complete module (512 pixels), obtained by adding 256 pixels to the semimodule of the PICsIT Laboratory Model, and of one complete DFEE.

Along all the test campaign, the PICsIT Test Equipment (TE) was exploited in order to set and command the detector, and to gather the detector data. In particular, as shown in the test set up given in Annex A, the Science Console was in charge of acquiring all the TC and the LBR TM packets (containing the instrument housekeeping) forwarded by the CCOE as well as all the HBR TC and TM packets (containing the science data) forwarded by the HBR SCOE.

The bulk of the data was collected during the Scientific Performance Tests (http://tonno.tesre.bo.cnr.it/~malaguti/INTEGRAL/PICsIT/QM/tests.html). As an example, during exposure to the ^{203}Hg the instrument produced up to about 28 milions of events per hour, corresponding to about 62 Kbyte/s to be acquired from the HBR SCOE and corresponding to 0.5 Gbyte of data (raw and FITS) per hour to be processed and archived on line by the PICsIT Science Console.

The purpose of the present note is to provide information relevant for user of the *QM Test Campaign [April 2000] at LABEN permanent archive* consisting of 28 CDROMs (in 2 copies) where all the log, raw and FITS data files of the relevant measurements archived by the Science Console have been saved.

Part of the document is devoted to the format and content of the data:

- the content and the format of the data produced by the instrument are given chapter 2;
- chapter 3 and Annex B details the format of the data buffers produced by the HBR SCOE with the instrument data, and archived in the raw archive by the Science Console;
- chapter 4 gives an overview on the raw data archiving and processing and on the FITS file production on the Science Console; further details on the content and the format of the FITS files are given in annex C, where the differences with respect to the previous PLM Test Campaign ([6]) are identified;

The remaining of the document is related to the procedure performed in order to create the archive on CDROM and provide the information required in order to identify in which CDROM the files related to a give measurement have been saved and those related to the DAT backup of original data.

Namely:

- chapter 5 lists the different step required in order to save all the log, raw and FITS data on CDROM; this part is actually conceived as a User Manual for the operator;
- annex D contains the whole directory of the permanent archive on CDROMs and on the Magneto Optical Cartdrige which before re-initialisation have been backed up on DAT tapes.

The PICsIT Test Equipment hardware configuration and the software Science Console configuration is detailed in Annex A. A general description of the Science Console software architecture can be found in [5].

1.2 Reference Documents

[1] IST, User Manual for the IBIS Instrument Volume 1, IN-IB-IAS-UM.0017/98, Issue 2, Sep.7, 1998.

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

[3] R.Volkmer, HEPI Interface Description, IN-IM-TUB-TN/EL-018. Issue 5.1 draft

[4] M.Trifoglio, F.Gianotti, J.B.Stephen, Basic Requirements for the Processing of Science Data With the PICsIT and the IBIS Test Equipment, IN-IM-RS-002, Issue 1.0, October 1998.

[5] M.Trifoglio, F.Gianotti, J.B.Stephen, G.Ferro, D.Visparelli, The Science Test Equipment for the INTEGRAL-PICsIT instrument, paper presented at the SPIE's Annual Meeting, 18-23 July 1999, Denver, Colorado USA.

[6] M.Trifoglio, F.Gianotti, J.B.Stephen, The raw and the FITS data archive of the PICsIT Laboratory Model (PLM) Test Campaign (January 2000) at Laben, IN-IM-TES-RP-0036, Issue 1.0, Internal Report 271/99, March 2000.

1.3 Document History

Issue 1.0	first issue.
Issue 2.0	Added section C.2 for the definition of the T10.3b Packet format. Minor changes in chapter 5.

2 Definitions

2.1 Spatial Coordinates

The PICsIT detector consists of 64x64 detector elements (pixels) distributed over 8 modules. Each module consists of two rectangular semi modules of 16x16 pixels.

The 256 pixel pertaining to each semimodule are served by 16 ASICs, each dedicated to a set of 4x4 pixels.

The arrangement of the modules and the semi modules in the detector plane with respect the IBIS Reference Frame is sketched in fig. 2.1-1.

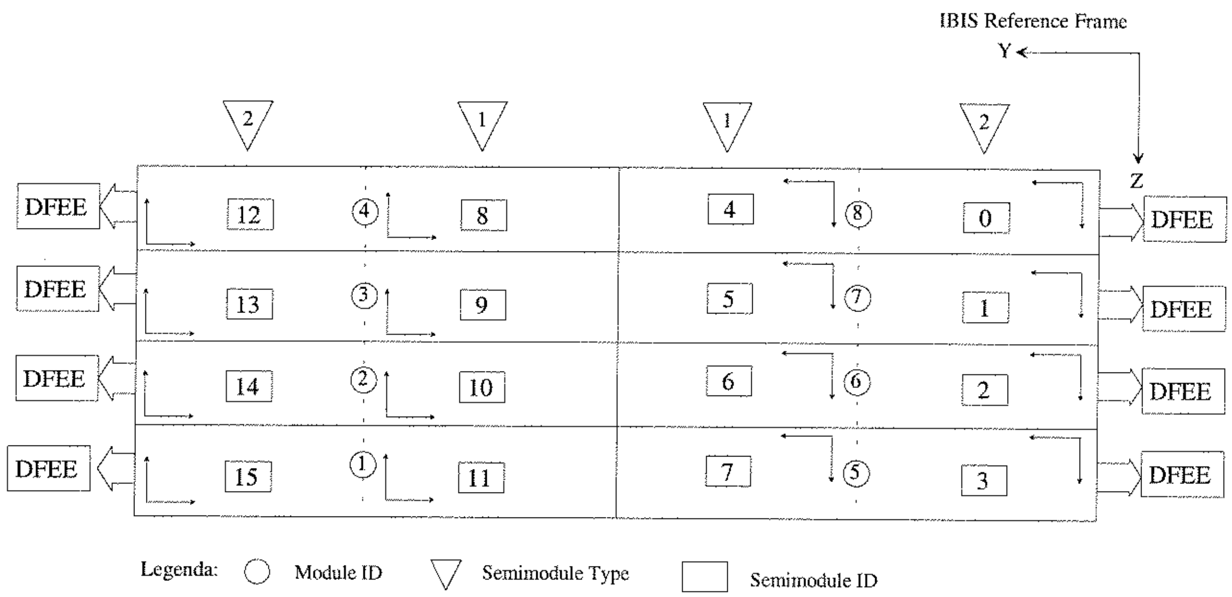


fig. 2.1-1 PICsIT Detector layout

2.1.1 PICsIT Module level

This is the first level of integration (see Annex A.1) where one module, consisting of 1 or 2 semi modules, is operating through one DFEE box.

The DFEE collects the event data and produces the data format detailed in Annex B. This data are formatted by the HBR SCOE into the T10.3a TM packets.

The positional data contained in this format allow:

- the identification of the semi module within the module (semi module type 1 or 2),
- the identification of the ASIC within the semi module (bits A3A3A1A0);
- the identification of the pixel within the given ASIC (bits P3P2P1P0;

The module ID is defined by the operator during the Science Console software startup configuration.

The above ASIC and pixel Ids are in the range 0-15 and follows a given numbering schema. The orientation of the reference frame depends on the semi module.

Fig. 2.1.1-1 below shows the semi module 0-7 case.

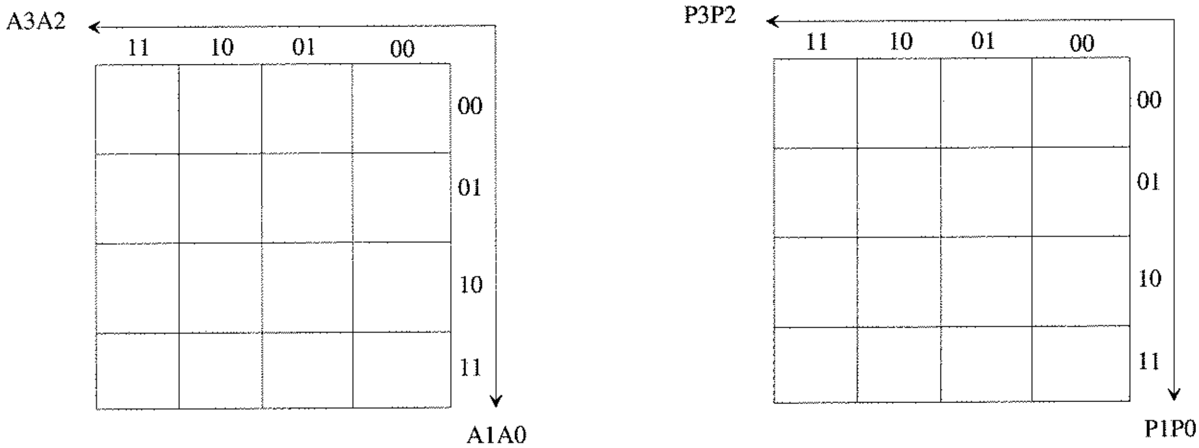


fig. 2-1.1-1 ASICs and the pixels numbering schemas for semimodules 0-7

For semi module 8-15 the schema is the same, but the reference system is rotated by 180 degree, as shown in fig. 2.1-1 in the previous section.

By using the above ASIC and the pixel positional information, it is possible to derive the event coordinates in the ***semimodule detector coordinate system*** (Ya, Za) defined by:

$$Ya = A3\ A2\ P3\ P2\ ;$$

$$Za = A1\ A0\ P1\ P0$$

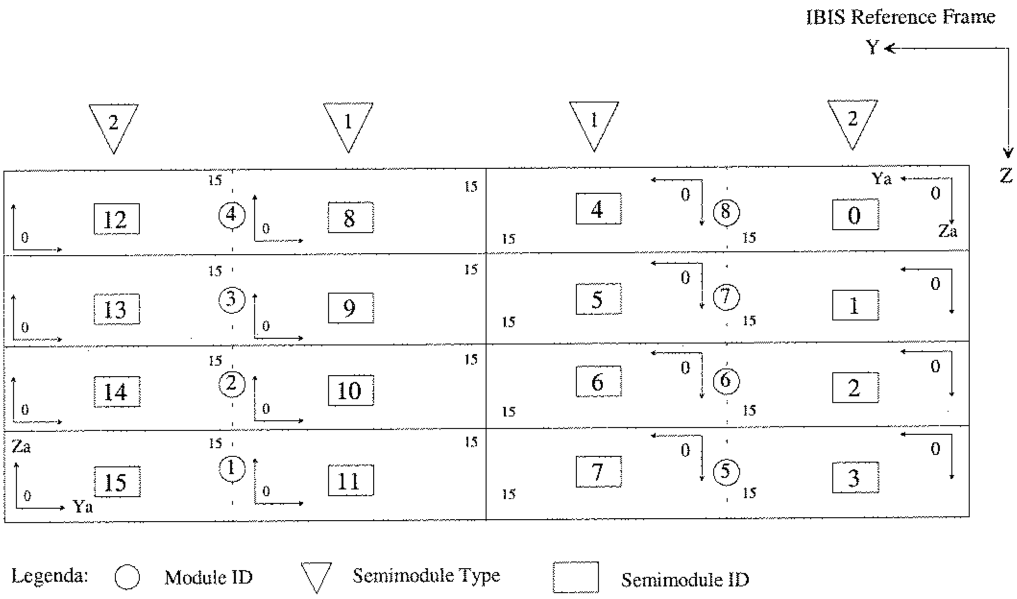


fig. 2.1.1-2 PICsIT semimodule detector coordinate system (Ya, Za)

In addition, by using the Semi Module Type information, it is possible to transform the above coordinates to the ***module detector coordinate system***, by applying the following transformation:

for semimodules type 2:	Ya' = Ya;	Za'=Za
for semimodules type 1:	Ya' = Ya + 16;	Za'= Za

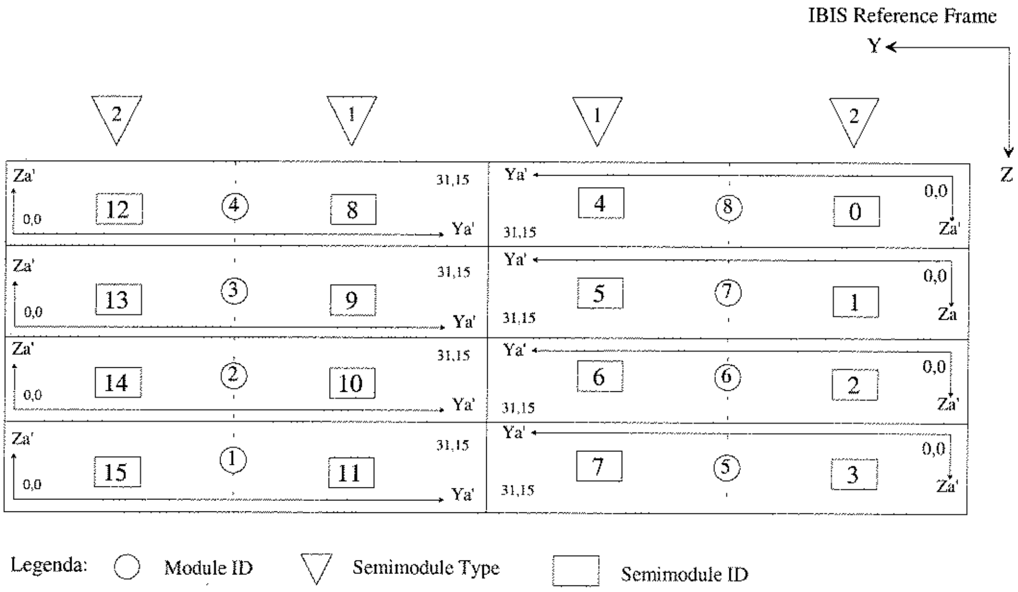


fig. 2.1.1-3 PICsIT module detector coordinate system (Ya',Za')

No information on the Module ID and on semi module ID is provided on the data stream, but the former can be set by the operator during the Science Console software configuration at startup.

By combining the Module ID and the Semimodule Type, it is possible to obtain the semi module ID:

for Module ID 1-4	Semimodule Type 2:	Semi module ID = 16 - Module ID
	Semimodule Type 1:	Semi module ID = 12 - Module ID
for Module ID 5-8	Semimodule Type 1:	Semi module ID = 12 - Module ID
	Semimodule Type 2:	Semi module ID = 8 - Module ID

The Semimodule ID can then be used in order to derive from the ASIC ID and the pixel ID the event spatial coordinates in the IBIS Reference Frame (Y,Z) as performed by the PDFM at PICsIT Detector level described hereafter.

2.1.2 PICsIT Detector level

This is the second level of integration (see Annex A.1), where the DFEE of each module (with one or two semimodules) is interfaced to the PEB box, which produces the event format given in Annex C. These data are formatted by the HBR SCOE into the T10.3b TM packets.

The positional data contained in the fields Y0-Y5 and Z0-Z5 provide the IBIS-oriented PICsIT detector coordinates (Y,Z), as given below.

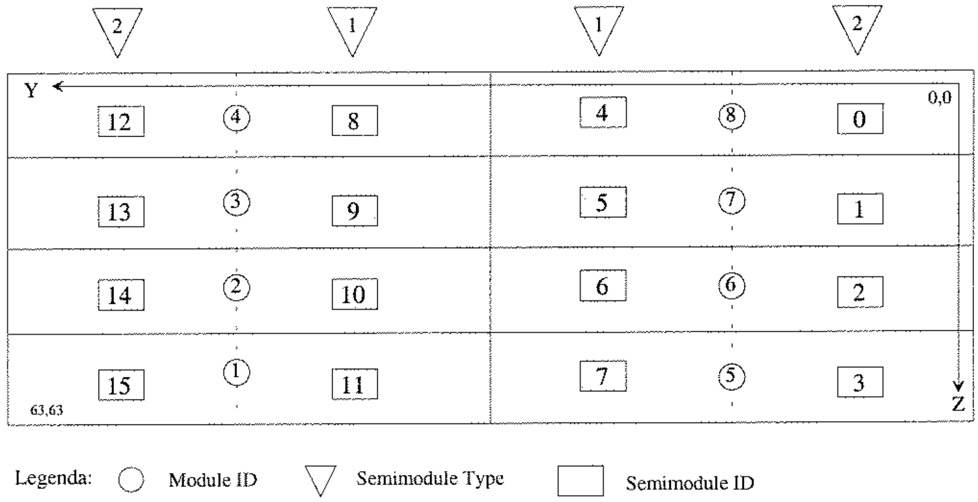


fig. 2.1.2-1 IBIS-oriented PICsIT detector coordinates (Y,Z)

These coordinates are obtained by the PFDM as follows:

- it derives, from the ASIC and the Pixel addresses, the IBIS-oriented PICsIT semimodule detector coordinates (Ya",Za") shown in fig. 2.1.2.-2 below:

  for semi module Ids 0-7 Ya"=(A3A2P3P2), Za"=(A1A0P1P0)

  for semi module Ids 8-15 Ya"=($\overline{A3}$ $\overline{A2}$ $\overline{P3}$ $\overline{P2}$), Za"=($\overline{A1}$ $\overline{A0}$ $\overline{P1}$ $\overline{P0}$)

note: the transformation for the semi modules rotated by 180^{o} is obtained by inverting each bit;

- it uses the semi module ID, the 4 bit binary address S3,S2,S1,S0 (MSb is S3) it has assigned to each semimodule, in order to transform the above coordinate to the IBIS-reference frame (Y,Z):

  Y = Ya" + (S3S2)*2**4 i.e.: (Y5Y4Y3Y2Y1Y0) = (S3S2A3A2P3P2)

  Z = Za" + (S1S0)*2**4 i.e.: (Z5Z4Z3Z2Z1Z0) = (S1S0A1A0P1P0)

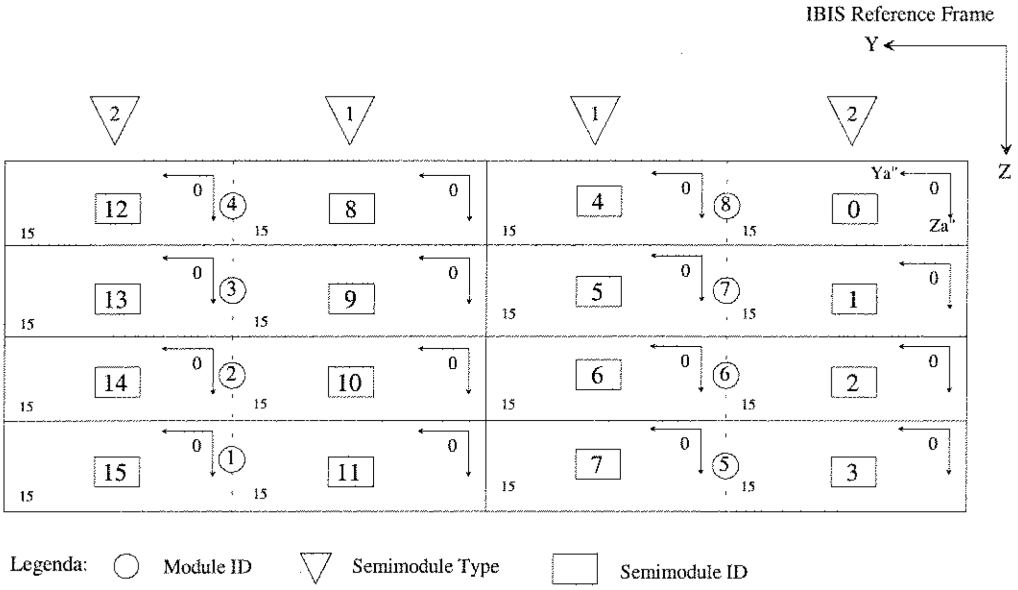


fig. 2.1.2-2 IBIS-oriented PICsIT semimodule detector coordinates (Ya",Za")

2.1.3 IBIS Detector level

This is the third level of integration (see Annex A.2), where up to 8 PICsIT modules are connected to the IBIS Data Handling System (IDHS) which creates the TM packets containing the events or indirect information (e.g. spectra). The TM packets are acquired by the EGSE and made available to the ECOE and to the PICsIT Science Console.

At this level the event coordinate are given as provided by the PEB, i.e. in the IBIS Reference System (Y,Z) presented in the previous section.

2.2 Energy coordinates

2.2.1 PICsIT

The event pulse is digitized into ADC channels by the DFEE on a 10-bit scale. For all the modes but the transparent mode, HEPI applies to these energy in digital channels an offset and an amplitude correction (for the calibration events: offset=0, amplitude correction=1).

2.3 Time coordinates

2.3.1 PICsIT

The DFEEs mark each event with a time tag with 238 nsec resolution within 2 sec (23 bit).

As specified in [3], in all the modes, but the transparent mode, HEPI reads them out and looks for time coincidences between the two detector layers (PICsIT and ISGRI). Then the last 8 bit of the time information are cut off and 17 bit additional time information (the number of passed time of 2 sec periods) is added to the time field. The resulting time resolution is 61.035 μsec within 72.8 h (32 bit).

With this time information the events are handed over by HEPI to the DPE. The DPE calculates from this information the time of the events in spacecraft time units and puts them into the data packages optimizing the space allocation (e.g.: by including the full time information only in the data field header and leaving in the event format only the LSB).

2.4 Tabular file layout

In the description of a tabular file, the following terms, mutuated from the FITS BINTABLE terminology [2], are used to define the fields (column) in a record (row).

- column is

a sequence number of the field. It has been dictated by programming convenience, i.e. word alignment.

- TTYPE is the name of the field.

- TUNIT are the physical units in which the quantity is expressed (if known)

- TFORM is the "minimum" format of the quantity in the FITS notation *nX*.. *n* indicates the dimensionality (usually 1, but a quantity may also be present as an array of *n* elements), while *X* is coded as *I* for 16-bit integers, *J* for 32-bit integers, *E* for 32-bit floating points and *D* for 64-bit double precision.

- Content finally describes what the field is, in terms of data present in original data stream, and of the reprocessing described.

3 HBR SCOEs Data Formats

3.1 HBR SCOE Packets Structure

With the data acquired from the instrument chain, the HBR SCOE generates packets having the same basic structure of the IBIS Packet TM.

Each packets is of fixed length of 440 bytes and consists of a Packet Header (6 bytes), a Packet Data field (434 bytes).

Each packet is sent to the SC (either PICsIT SC or IBIS SC) in one TCP/IP message containing a prefix of two bytes which contains the total number of bytes contained in the packet, specified in binary format (big-endian)

Data words belonging to the same event cannot be split into two different packets.

The part of the Source Data Field which does not contain event data is filled with dummy bytes.

The value of the dummy byte is configurable (e.g.: 0x00, 0xFF).

3.1.1 Packet header

The Packet Header has the following format:

Packet Header (3x16-bit word)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MSB															LSB
Version Number			Type	DHFH	APID										
SF		Source Sequence Counter													
Packet Length															

Where:

Version number:	must be set to '100' binary (PKT_VERS_NUM)
Type:	must be set to '0' binary (PKT_HTYPE)
DFHF:	Data Field Header Flag, must be set to '1' binary (PKT_DFHF)
APID:	Application Process Identifier, it is different for each packet type (as specified in the following sections) (PKT_APID)
SF:	Sequence Flag, must be set to '11' bin (SEQ_FLAG)
Source Sequence Counter:	counts the packets of a given APID (SOURCE_SEQ_COUNT)
Packet Length:	must be set to: (Number of octects in Packet Data Field) - 1 (PKT_LENGTH)

3.1.2 Packet Data Field

The Packet Data Field will have the following format:

Data Field Header (2 16-bit word)

0 MSB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 LSB
Packet Type				Packet Sub Type				Spare (set to 0) or Time Tag (MSB)							
Time Tag (LSB)															

Where:

Packet Type and Subtype: identify the data field content, as specified in the following sections (PKT_TYPE; PKT_STYPE);

Time Tag: provides a time tag info, its length is 2 or 3 bytes depending on the packets, as specified in the following sections.

Source Data Field (215 16-bit word)

0 MSB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 LSB
Source Data Field (word 1)															
...															
Source Data Field (word 215)															

3.2 PICsIT Module Level Testing

At this level the tests is carried out on one single PICsIT module (consisting of one or two semi-modules) with the PICsIT&Module Test Equipment in the test setup shown in Annex A.

On the HBR interface, the HBR SCOE acquires the event data produced by the DFEE in the format specified in Annex B.

As these input format are the same in all test conditions, it is worth to identify for the packet stream to be produced by the HBR SCOE just one packet format.

This is named hereafter "HBR transparent packet" format (identified as T10.3a packet) as it is very similar to the transparent packet to be produced by the DPE in Diagnostic Mode.

3.2.1 HBR transparent packets T10.3a

These packets have the same APID (nominal), Type and Subtype of the IBIS TM Diagnostic packets (VC0):

APID	Packet Type	Packet Subtype
1293	13	3

The Data field header have the following format:

Data Field Header 2 Word:

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="8">MSB</td><td colspan="8">LSB</td></tr>
<tr><td colspan="4">Packet Type</td><td colspan="4">Packet Sub Type</td><td colspan="8">Spare (set to 0)</td></tr>
<tr><td colspan="16">Packet Creation Time</td></tr>
</table>

Where:

Packet Creation Time: This is a 16 bit unsigned representing the time measured by the HBR SCOE CPU clock when the first event was written to this packet. The resolution is one second in 65535 sec (18h). This time counter will be reset by the HBR SCOE at startup and upon receival of an asynchronous Science Console/CCOE command devoted to this purpose.

The HBR SCOE copies each 64 bit event format in the Source Data Field.

In case the maximum number of events are contained, the Source Data Field (wds. 1-212) has the following format:

Event Data Format

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="8">MSB</td><td colspan="8">LSB</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>SM</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="16">DFEE Time Tag MSBits</td></tr>
<tr><td colspan="8">DFEE Time Tag LSBits</td><td>CLF</td><td>>3F</td><td colspan="2">Multiplicity flag</td><td colspan="2">Pulse identifier flag</td><td colspan="2">Energy (amplitude) value MSBits</td></tr>
<tr><td colspan="8">Energy (amplitude) value LSBits</td><td colspan="4">ASIC address in the semimodule (A3A2A1A0)</td><td colspan="4">Pixel Address in the ASIC (P3P2P1P0)</td></tr>
</table>

3.3 PICsIT Detector Level Testing

At this level the tests is carried out on the PICsIT detector (consisting of up to 8 modules) with the PICsIT&Module Test Equipment in the test setup shown in Annex A.

On the HBR interface, the HBR SCOE acquires the event data produced by the PEB in the format specified in Annex B.

As these input format will be the same in all test conditions, it is worth to identify for the packet stream to be produced by the HBR SCOE just one packet format.

This is named hereafter "HBR transparent packet" format (identified as T10.3b packet) as it is very similar to the transparent packet to be produced by the DPE in Diagnostic Mode.

3.3.1 HBR transparent packet T10.3b

These packets has the same APID (nominal), Type and Subtype of the IBIS TM Diagnostic packets (VC0):

APID	Packet Type	Packet Subtype
1293	13	3

The Data Field Header has the following format:

Data Field Header 2 Word:

0 MSB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 LSB
Packet Type				Packet Sub Type				Spare (set to 0)							
Packet Creation Time															

Where:

Packet Creation Time: as for packet T10.3a.

The HBR SCOE copies each 64 bit event format in the Source Data Field. In case the maximum number of events are contained, the Source Data Field (wds. 1-212) has the following format:

Source Data Field 53 x 4 Word Record:

0 MSB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 LSB
PEB event data block (word 1)															
PEB event data block (word 2)															
PEB event data block (word 3)															
PEB event data block (word 4)															

The remaining words are filled with dummy bytes.

Each event data block has the format prepared by the PEB as detailed in Annex B, i.e.:

Event Data Format

0 MSB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 LSB
DFEE Time Tag MSBits															
DFEE Time Tag LSBits								0							
CLF	MM	Pulse identifier flag		Multiplicity flag		Energy (amplitude) value									
0				pixel "Y" address (Y5Y4Y3Y2Y1Y0)						pixel "Z" address (Z5Z4Z3Z2Z1Z0)					

4 On-line archiving and processing on the Science Console

4.1 Raw archiving

The Science Console provides the archiving of all the raw TC and TM packets of each measurement, which is identified by a ***run id*** number generated automatically by the software at the start of a new observation.

After verification of the APID and the SSC, each acquired packet is written into two files, one containing all the TC/TM packets, and the other containing only the TC and the HK packets. These files are archived in the ***archive*** directory tree under the ***raw*** subdirectory tree, where a subdirectory is devoted to each decade of run IDs. The files are univocally associated to a given measurement by including in their names the campaign ID **ccc**, the run ID **nnnnn** and the date of creation **yymmdd**, i.e:

cccnnnnn_yymmdd__.ext
cccnnnnn_yymmdd_.ext
cccnnnnn_yymmdd.ext

One underscore character appended to the name identifies the files related to the idle period between two consecutive measurements. Two of these characters are used for the first idle period in the test session.

The suffix **ext** identifies the two files and the chain from which the data are collected, namely:

ext:	*x*rt	for the files containing all the packets (***x***=h for HBR SCOE, ***x***=c for CCOE, ***x***=e for ECOE)
	*x*hk	for the files containing the HK and the TC packets (***x***=h for HBR SCOE, ***x***=c for CCOE, ***x***=e for ECOE).

Since the PICsIT QM April Campaign, the SC software was modified in order to limit automatically each measurement to a maximum of 400000 TM packets (corresponding to the maximum size of ~ 600 Mbytes available on a CD-ROM). Indeed once this limit is reached, the software closes all the files related to the current measurement and opens a new set of files, after having incremented the measurement RUN ID.

4.2 Raw Data Processing

As the packets are read from the raw archive, they are sorted by APID and are made available to the related unpacking processor on the specific channel of the shared memory SHM. In turn each processor writes to the SHMF shared memory the unpacked data to be analysed by the quick look program based on IDL. The channels of the two shared memories are assigned to the different APIDs as given in the table 4.2-1 below.

APID Nominal/	Packet type/ subtype	Function name	SHM channel	Unpacking processor on the Science Console	SHMF Channel

Redundant					
1348 , 1476	S1	PPM CdTe	0		0
1352 , 1480	S2	PPM CdTe Calibration	1		1
1356 , 1484	S3.0	PPM Compton single	2	Picsit	2
1357 , 1485	S3.1	PPM Compton multiple	3	Picsit	3
1360 , 1488	S4.0	PPM CsI single	4	Picsit	4
1361 , 1489	S4.1	PPM CsI multiple	5	Picsit	5
1364 , 1492	S5	Histogram CsI Calibration	6		6
1368 , 1496	S6	Histogram CsI polarimetric	7		7
1372 , 1500	S7.0	Spectral Imaging CsI single histograms	8	histog (no FITS)	8
1373 , 1501	S7.1	Spectral Imaging CsI multiple histograms	9	histog (no FITS)	9
1376 , 1504	S8	Spectral Timing	10		10
1293 , 1421	S13.1,2,3 (VC0)	All Diagnostic (VC0)	11		11
1280 , 1408	HK1	HK 1	12		12
1281 , 1409	HKn	HK 2,3,4	13		13
1285 , 1413	T5	Report Task Parameter	14		14
1286 , 1414	Dump	Dump Packet	15		15
1397 , 1525	S13.1 (VC1)	CdTe Diagnostic (VC1)	16	Picsit	16
1398 , 1526	S13.2 (VC1)	CsI Diagnostic (VC1)	17	Picsit	17
1399 , 1527	S13.3 (VC1)	All Diagnostic (VC1)	18	Picsit	18
1293	T10.3a	HBR-SCOE DFEE	18	Picsit	18
1293	T10.3b	HBR-SCOE PEB	18	Picsit	18

Table 4.2-1 APID and shared memories channels mapping

4.3 FITS Archiving

The unpacking processor devoted to a given APID archives the information extracted from the raw packets on files written in FITS format. These files are located under the ***erdf*** subdirectory tree in the ***archive*** directory, where a subdirectory is devoted to each decade of run IDs.

The files in the erdf directory tree are univocally associated to a given measurement by a naming similar to the one used for the raw files, i.e.:

ccc_nnnnn_yymmdd_hhmmss_APID.elf

in this case, the name includes also:

hhmmss	hours minutes seconds (2+2+2)
APID	APID of the packet type

The ELF files are tabular files with one row per event. Details on the actual implementation of these files for the PICsIT QM is given in Annex C.

5 The procedure to create the permanent archive on CDROM

Purpose of this archive is to save on CD-ROM all the relevant data archived on-line by the Science Console during a given test campaign.

This is accomplished in different steps:

- on the Science Console:

  - the data are moved from the internal magnetic disk to a magneto-optical disk cartridge;
  - via NFS, the data are copied from the magneto-optical disk cartridge to the internal magnetic disk of a PC equipped with the CD writer;

- on the PC:

  - the CD image is created;
  - the master copy of the CD is burned;
  - the master copy is verified against the CD image;
  - a second copy of the CD is burned;
  - the CD image is removed.

As detailed in the following sections, most of the above operations are automated by means of shell scripts which are executed by the operator on the Science Console through the Archive Control widget shown below (it is noted that before starting with a new campaign, the shell scripts must be configured with the campaign ID).

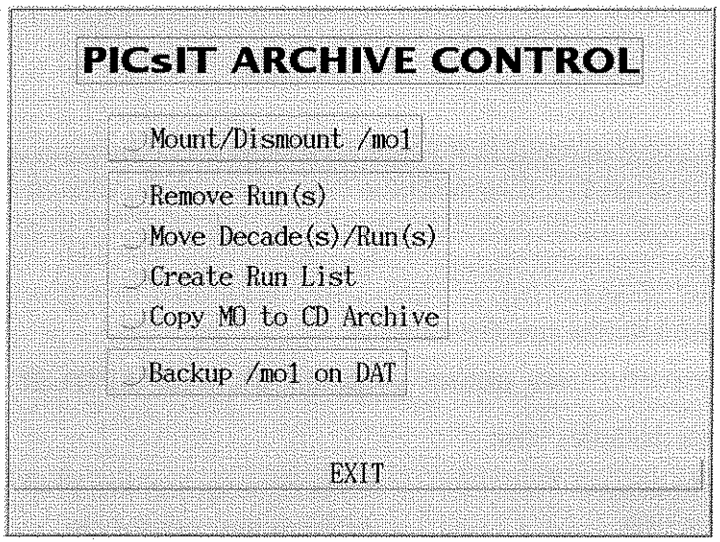


Fig. 5-1 PICsIT Archive Control widget on the Science Console.

The above widget is obtained by typing *archive* to run Idl, and then typing *arc* to run the required Idl procedure.

5.1 Temporary archive on Magneto Optical Disks

This first step is performed on-site, during the test campaign. On the Science Console, the Log, Raw and FITS files archived in near real time on the internal hard disk (4GB) are moved on Magneto Optical Disk Cartridges (1.2GB) in order to provide disk space for the forthcoming measurements.

To this purpose, time to time, by means of the widget panel shown above, the operator:

- by selecting the "*Remove Runs*" item list, runs the script which removes from the internal disk the files related to dummy measurements; to this purpose the operator specifies the lowest and the highest RUN Id of the set of measurements to be eliminated;
- by selecting the "*Mount/Dismount MO1*" item list, runs the script which makes accessible one of the two sides of a Magneto Optical Cartridge, capable of containing 1.2 GB;
- by selecting the "*Move Decade(s)/Run(s)*" item list, runs the script which shows how many MBs are available on the MO cartridge currently mounted on the */mo1* file system and prompt the user for the number of MB to be moved; then:
  - the script moves on the MO cartridge all the decades of runs which fit the quantity specified by the user;
  - for the first decade which does not fit, the script copies as much as possible runs (only complete run sets).

5.2 Permanent archive on CD-ROM

The data on the MO Cartridge are copied on CD-ROMs by using a PC running Linux (Red Hat 6.1).

As detailed below, this is performed on a set of MO cartridges at a time. The number of MO cartridges is dictated by the disk space available on the PC.

For each set, the different steps create a number of ancillary ASCII files that are saved in the Science Console directory */users/ibis_report/<campaign>/setpro,* where */<campaign>* identifies the test campaign (e.g. *QM*).

Once the copy of the whole set is completed, the subdirectory *setpro* must be renamed by the operator to *setxxx* (e.g. *set001*) and a new *setpro* subdirectory must be created before starting with the next set.

5.2.1 Creating summary information on the MO

This step is performed on each MO cartridge in order to:

1. Remove any file related to measurements which are meaningless;
2. Identify the run which total size does not fit into a CDROM (600 Mbytes); in this case the script:
   - creates a file consisting of the copy of the header of the FITS elf file containing the data;

- compresses the elf file, and if necessary, compresses the raw file.

3. creates the *Run List* file containing a list of summary information related to all the run contained in the MO.

The following operations are required:

- the operator selects the "*Remove Run(s)*" widget list item (see fig 5-1 above), specifies */mo1/archive* as "Data archive top directory", and provides the minimum and maximum Run ID of the set of measurements to be removed.

- the operator selects the "*Create Run List*" widget list item (see fig 5-1 above), which runs the script that assigns to the MO cartridge an identification number "*nnnn*" provided by the operator and creates on the MO cartridge itself (under the *archive/summary* subdirectory) the *Run List* file /mo1/archive/summary/mo*nnnn*list.create. A copy of the *Run List* file is created by the script in the *setpro* subdirectory.

  The *Run List* file is an ASCII file containing for each measurement one line consisting of the following fields (separated by ";"):

  - MO identification number
  - RUN ID;
  - Measurement Date;
  - Measurement start time;
  - Measurement end time;
  - Measurement total number of events;
  - the total size in bytes of the files (Log, Raw, Erdf) related to the measurement
  - packet type.

  Date, times, total number of events and packet type are copied from the header of the FITS file and are set to "unknown" in case this file is missing.

  A zero value for the "Measurement total number of events" means that the measurement has been terminated abnormally and the NAXIS2 header keyword has not been updated to the correct value. In this case, if necessary, the FITS files can be reproduced in playback from the raw files.

5.2.2 Copying the MO to the PC local disk

As the PC is not equipped with a MO reader and the capacity of the MO (1.2 GB) is greater than the capacity of the CDROM (600MB), as next step:

- each MO cartridge must be copied to a local magnetic disk of the PC under the directory */data1/cd_area/picsit* which has been mounted via NFS on the Science Console directory */data1/remote_cdarchive* (e.g.: *gamma2.tesre.bo.cnr.it:/data1/cd_area/picsit* mounted on */data1/remote_cdarchive*);

- the data of each MO cartridge will be grouped in the */data1/remote_cdarchive* directory under one or two subdirectories;

- the subdirectories will be named cd*xxxx*, where *xxxx* is an incremental number which will identify the CDs. This numbering has been started from 1 with the PLM campaign and will be incremented for all the remaining PICsIT campaigns (QM, FM).
- in each subdirectory a maximum of 600 MB of measurement files will be copied having care of keeping on the same subdirectory all the files related to a given measurement (i.e. the files related to one measurement cannot be split among CDs).

On the Science Console, the operator selects the "*Copy MO to CD Archive*" item list (see fig. 5-1 above) in order to run the shell script which performs the required operations.

The script copies the whole MO data to the *cdxxxx* subdirectory by iterating the following steps:

- based on the ID number *xxxx* assigned to the last prepared CD, the script evaluates whether in the subdirectory *cdxxxx* there is enough space to host at least the files related to the first run to be copied. If there is not space left, or the subdirectory *cdxxxx* does not exist at all, the scripts increments the ID number *xxxx* and creates a new subdirectory *cdxxxx*.
- the script copies the MO data to the *cdxxxx* subdirectory up to the maximum of 600 MB, having care of keeping together all the files related to a given measurement.
- the script writes on the MO directory */mo1/archive/summary* the file *cdxxxxlist.copy*, containing the lists of the runs copied on the *cdxxxx* directory of the PC.

5.2.3 Verifying the MO copy

The verification that the copy operation have been completed correctly is performed by running also on the *cdxxxx* subdirectory the same scripts which has been run on the MO in order to produce the summary information of each run, and by comparing the results obtained in the two cases.

To this purpose, once an MO cartridge has been copied the user:

- runs the script *create_all_cds_run_lists*, which in turn runs the *Create Run List* in order to perform on each . *cdxxxx* subdirectory found in the PC disk the same processing of the script which created on the MO cartridges the *monnnnlist.create* files.

  This time, the script, after having removed any previous version of *Run List* files, it produces in each *cdxxxx/summary* subdirectory the file *cdnnnnlist.create* containing the same kind of information produced for the MO case, namely:

  - CD identification number
  - RUN ID;
  - Measurement Date;
  - Measurement start time;
  - Measurement end time;
  - Measurement total number of events;

- the total size in bytes of the files (Log, Raw, Erdf) related to the measurement
- packet type.

The *cdnnnnlist.create* files are also copied to the Science Console *setpro* subdirectory.

- runs the script *verify_run_list,* which:

  - merges in the file *mo.db* all the *monnnnlist.create* files;
  - creates the file *mo.merge* by copying the file *mo.db* without the first column;
  - merges in the file *cd.db* all the *cdnnnnlist.create* files;
  - creates the file *cd.merge* by copying the file *cd.db* without the first column;
  - presents to the user any difference found by comparing byte to byte the content of the files *mo.merge* and *cd.merge;*

  As already detailed in the previous section, one of the fields in the run lists gives the total size in bytes of the files related to each measurement. Hence in case the *.merge* files are identical, the copy was successful.

  All the above ASCII files are copied to the Science Console *setpro* subdirectory.

The above operations are performed as long as there are MO cartridges which are ready to be copied and there is enough space left on the local disk of the PC.

5.2.4 Burning the CDROMs

Once a complete set of MO have been copied and verified as detailed in the previous sections, the local magnetic disk of the PC contains a subdirectory */cd_area/picsit/cdxxxx* for each of the CDROM which is ready to be burned.

In order to proceed, on the PC the operator (logged in as root) has to perform the following operations:

- open a first terminal from which executes the commands:

  - *cd /data1/cd_area*
  - *./create_picsit_cd* <*xxxx*> where *xxxx* identifies the CD to be burned

  This runs the scripts which:

  - by using the command */usr/bin/mkisofs* (Version 1.12b5, 17 Feb 1998), it creates the raw image /cd_area/picsitcdxxxx.raw corresponding to the subdirectory *cdxxxx;*
  - by using the command */usr/bin/cdrecord* (AUTHOR: Joerg Schilling, Seestr. 110 D-13353

Berlin Germany)burns the image on the CD; assigning the volume name *picsitxxxx;*

- open a second terminal from which verify the burned CD against the image, by using the *xcdroast* package; this CD will be kept as master copy.
- on the first terminal, run again the above script:
  - *./create_picsit_cd <xxxx>*

  this time the scripts finds the raw image and only burns a second CD to be kept as working copy.
- remove the raw image;
- remove the subdirectory *cdxxxx.*

The labels for the CDs are produced using the Fujifilm CD-Labeling System by Labelle^{TM}.

5.2.5 Backing up the MO

Before re-initialisation for re-usage, each MO is backed up on DAT tape by using tar. Each DAT (90 m) is capable of containing 2 or 3 MO cartridges (depending on the MO data size).

For each MO the following command are required (logged in as root):

- *cd /*
- *mount /mo1*
- *cd /mo1*
- *tar cvf /dev/rmt/0mn ./*
- *cd /*
- *umount /mo1*

It is noted that the tape is not rewound by the tar command; the tape rewinding must be commanded by hand after the 2rd /3rd MO has been backed up.

5.2.6 Archive Documentation

The directory */users/ibis_report/<campaign>/doc* is used to collect the ancillary files related to the whole campaign.

Once the last set of CDROM of campaign has been burned, the following steps are required in order to create in the *doc* subdirectory the ASCII files containing the complete directory of the CDROMs and the MOs of the whole campaign which have been included in Annex D of the present document.

To this purpose, on the Science Console, the user will:

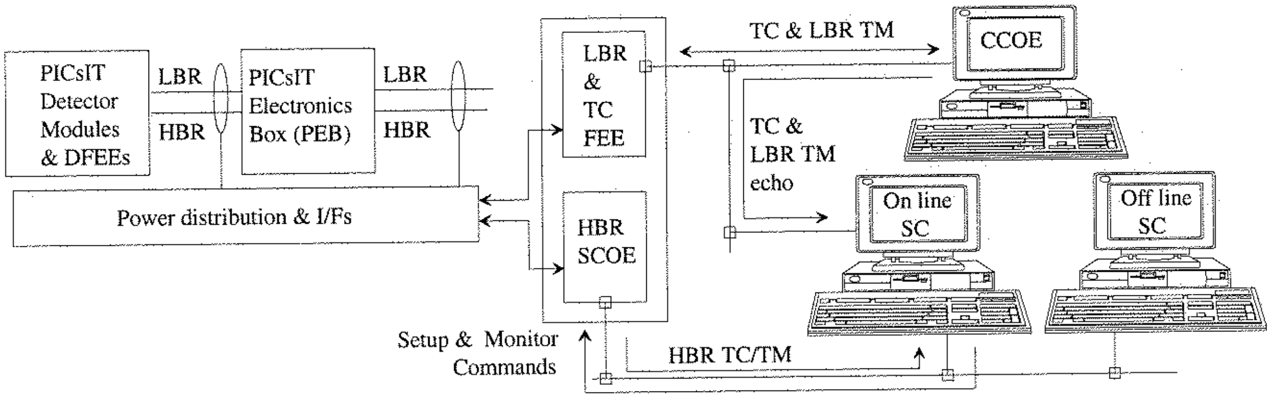
- rename the *setpro* subdirectory is renamed to *setxxx*, starting with *xxx*=001*;*

- *cd /users/ibis/Archive* and run the *create_docs* script which in the above *doc* directory:
  - merges in the file *all_mo.db* all the *mo.db* files found under all the *setnnn* directories;
  - merges in the file *all_cd.db* all the *cd.db* files found under all the *setnnn* directories;
- create by hand the ASCII file *doc/all_mo_tar.db* which contains, for each MO backed up as given in the previous section; the MO #, the DAT #, the File # within the DAT (separated by semicolon).

Annex A Test set up configuration

A.1 PICsIT Module Level and Detector Level Testing

A.1.1 PICsIT Test Equipment Hardware Configuration



The above diagram sketches the general configuration where:

- at Module Level, one DFEE can be connected to 1 or 2 semi modules.
- at Detector Level the DFEEs are connected to the PICsIT Electronics Boxes (PEB); in case all the 16 semimodules are present, only one PEB will be active at a time, as they are in cold redundancy.

The PICsIT Laboratory Model consisted of only one semimodule connected to one DFEE.

A.1.2 PICsIT Science Console Software Configuration

For the QM, the Science Console software was updated from version 7 (PLM Campaign) to version 8.

As detailed below, with respect to the previous version (see [6]) only the Processor and the Quick Look codes have been modified.

```
#
# ********************************************
# * VERSION
# * 6  -> EM Model
# * 7  -> PLM Model
# * 8  -> QM Model
# ********************************************
#
#
##################################################################################
```

```
#
#       Main
#
##########################################################################
#
#
    CONSOLEDIR=/users/ibis/Console
    TESTDIR=/users/ibis/Test/New
    SYSDIR=/users/ibis/Sys/New
    QLDIR=/users/ibis/QL/picsit
    PROCDIR=/users/ibis/Proc/New/bin
#
######################################################################
#               VERSIONE 8                  #
######################################################################
#
    VERSION=8
    version_file="AAAVERSION"
#
    CONSVER=7
    TESTVER=7
    SYSVER=7
    PROCVER=4
    QLVER=8
#
#     Console
#
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/startup.con_${CONSVER}     ${CONSOLEDIR}/startup.con
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/console_${CONSVER}      ${CONSOLEDIR}/console
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/con_${CONSVER}.pro      ${CONSOLEDIR}/con.pro
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/acw_bgroup_${CONSVER}.pro
${CONSOLEDIR}/acw_bgroup.pro
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/config_${CONSVER}.sav     ${CONSOLEDIR}/config.sav
         CreateLink  ${CONSOLEDIR}/v${CONSVER}/change_status_${CONSVER}.pro
${CONSOLEDIR}/change_status.pro
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/check_status_${CONSVER}.pro
${CONSOLEDIR}/check_status.pro
         CreateLink  ${CONSOLEDIR}/v${CONSVER}/connect_CCOE_${CONSVER}
${CONSOLEDIR}/connect_CCOE
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/connect_HBR_${CONSVER}
${CONSOLEDIR}/connect_HBR
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/monitor_ccoe_${CONSVER}
${CONSOLEDIR}/monitor_ccoe
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/monitor_hbr_${CONSVER}     ${CONSOLEDIR}/monitor_hbr
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/monitor_play_${CONSVER}
${CONSOLEDIR}/monitor_play
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/play_${CONSVER}      ${CONSOLEDIR}/play
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/smcmd_${CONSVER}      ${CONSOLEDIR}/smcmd
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/startup_${CONSVER}.ql     ${CONSOLEDIR}/startup.ql
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/goidl_${CONSVER}      ${CONSOLEDIR}/goidl
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/picsit_small.bmp_${CONSVER}
${CONSOLEDIR}/picsit_small.bmp
     CreateLink  ${CONSOLEDIR}/v${CONSVER}/tesre_small.bmp_${CONSVER}
${CONSOLEDIR}/tesre_small.bmp
#
#     Test
```

```
#
    CreateLink ${TESTDIR}/v${TESTVER}/log_end_run_${TESTVER}        ${TESTDIR}/log_end_run
    CreateLink ${TESTDIR}/v${TESTVER}/play_picsit_hbr_${TESTVER}    ${TESTDIR}/play_picsit_hbr
    CreateLink ${TESTDIR}/v${TESTVER}/real_picsit_ccoe_${TESTVER}   ${TESTDIR}/real_picsit_ccoe
    CreateLink ${TESTDIR}/v${TESTVER}/real_picsit_hbr_${TESTVER}    ${TESTDIR}/real_picsit_hbr
#
#    Sys
#
    CreateLink ${SYSDIR}/a2b_${SYSVER}.hp        ${SYSDIR}/a2b.hp
    CreateLink ${SYSDIR}/a2sc_${SYSVER}.hp       ${SYSDIR}/a2sc.hp
    CreateLink ${SYSDIR}/monitor_${SYSVER}.hp    ${SYSDIR}/monitor.hp
    CreateLink ${SYSDIR}/n2bs_${SYSVER}.hp       ${SYSDIR}/n2bs.hp
    CreateLink ${SYSDIR}/sc2hbr_${SYSVER}.hp     ${SYSDIR}/sc2hbr.hp
#
# N.B. in Makefile di Sys aggiungere creazione new_ver dei seguenti file
#   per ora lasciata versione 6
    CreateLink ${SYSDIR}/clean_SC_6.bat       ${SYSDIR}/clean_SC.bat
    CreateLink ${SYSDIR}/kill_idl_6.bat       ${SYSDIR}/kill_idl.bat
    CreateLink ${SYSDIR}/kill_all_6.bat       ${SYSDIR}/kill_all.bat
    CreateLink ${SYSDIR}/clean_tmpfile_6.bat  ${SYSDIR}/clean_tmpfile.bat
    CreateLink ${SYSDIR}/_ipcrm_6.bat         ${SYSDIR}/_ipcrm.bat
#
#    QL ( Note: this uses the SYSVER version for the libidl )
#
    CreateDirLink ${QLDIR}_v${QLVER}  ${QLDIR}
    CreateLink ${QLDIR}_v${QLVER}/New/Lib/libidl_${SYSVER}_hp.so
${QLDIR}_v${QLVER}/New/Lib/libidl_hp.so
    CreateLink ${QLDIR}_v${QLVER}/Old/Lib/libidl_${SYSVER}_hp.so
${QLDIR}_v${QLVER}/Old/Lib/libidl_hp.so
#
#    Proc
#
    CreateLink ${PROCDIR}/histog_v${PROCVER}_hp  ${PROCDIR}/histog_hp
    CreateLink ${PROCDIR}/picsit_v${PROCVER}_hp  ${PROCDIR}/picsit_hp;;
#
```

Annex B PICsIT HBR SCOE Data formats

B.1 DFEE Level

This format is identical to the format used in the previous PICsIT EM and PLM Campaigns.

For each detected pulse event the DFEE produces four 16-bit words having the following format:

Event Data Format

<table>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td colspan="8">MSB</td><td colspan="8">LSB</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>SM</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="16">DFEE Time Tag MSBits</td></tr>
<tr><td colspan="8">DFEE Time Tag LSBits</td><td>CLF</td><td>>3F</td><td colspan="2">Multiplicity flag</td><td colspan="2">Pulse identifier flag</td><td colspan="2">Energy (amplitude) value MSBits</td></tr>
<tr><td colspan="8">Energy (amplitude) value LSBits</td><td colspan="4">ASIC address in the semimodule (A3A2A1A0)</td><td colspan="4">Pixel Address in the ASIC (P3P2P1P0)</td></tr>
</table>

Where:

SM	if = 0 the Semi Module type is 1, if = 1 the Semi Module type is 2
DFEE Time Tag:	this is the time counter assigned by the DFEE to the detected event; it has a 238 nsec resolution within 2 sec (23 bit). This counter is reset every 2 sec by HEPI.
CLF:	Calibration Flag (=1 if the pulse is in CAL coincidence, i.e. the DFEE detected an event in coincidence with an event detected by the Calibration System).
>3F:	">3F" flag (=1 if the pulse is part of a greater that 3 multiplicity event); these events will be discarded by the PEB; it is noted that in case one 3 multiplicity event is spread on more than one semi-module it will not be recognise as such !!
Multiciplity Flag:	00=one pulse event, 01=two pulse event, 10=three pulse event; i.e.: within a semimodule the DFEE detected within 5 μs period one or two or three pulse events, respectively. It is noted that the Time Tag of all these pulse events is set to the same value (the arrival time of the first one).
Pulse Identifier Flag:	in a multiple pulse event gives the order of arrival of the detected pulse events (00=first, 01=second, 10=third).

B.2 PEB Level

For each detected pulse event the PEB produces four 16-bit words having the following format:

Event Data Format

<table>
<tr><td>0
MSB</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15
LSB</td></tr>
<tr><td colspan="16">DFEE Time Tag MSBits</td></tr>
<tr><td colspan="8">DFEE Time Tag LSBits</td><td colspan="8">0</td></tr>
<tr><td>CLF</td><td>MM</td><td colspan="2">Pulse identifier flag</td><td colspan="2">Multiplicity flag</td><td colspan="10">Energy (amplitude) value</td></tr>
<tr><td colspan="4">0</td><td colspan="6">pixel "Y" address (Y5Y4Y3Y2Y1Y0)</td><td colspan="6">pixel "Z" address (Z5Z4Z3Z2Z1Z0)</td></tr>
</table>

Where:

DFEE Time Tag:	this is the time counter as provided by the DFEE (see Annex B).
CLF:	Calibration Flag (=1 if the pulse is in CAL coincidence), as provided by the DFEE (see Annex B)
MM	Multi-semi-Module coincidence flag added by the PEB (=1 if the pulse is part of a multi-semi-module coincidence event. i.e.: the PEB received from the DFEE one or more events pertaining to different semimodules).
Multiciplity Flag:	00=one pulse event, 01=two pulse event, 10=three pulse event, as provided by the DFEE (see Annex B).
Pulse Identifier Flag:	in a multiple pulse event (00=first, 01=second, 10=third) as provided by the DFEE (see Annex B).

Note: pulses related to events with active 'CAL' flag and multiplicity flag >1 shall be rejected.

Annex C Science Console Data Formats

C.1 T103a Packets

C.1.1 FITS files format

As shown below, with respect to the format of the PLM Campaign ([6]), the following modification have been applied:

- the SSCOUNT and RISETIME data have not been included anymore in the binary table;
- the VERSION keyword has been added in order to keep track of the version of the Processor program used to write the file.

Consequently, the FITS header has been modified as shown in the following table:

XTENSION= 'BINTABLE'	
BITPIX = 8	
NAXIS = 2	
NAXIS1 = 16~~20~~	
NAXIS2 = 445239	
PCOUNT = 0	
GCOUNT = 1	
TFIELDS = 5~~7~~	
TTYPE1 = 'time '	24-bit DFEE time tag
TFORM1 = 'D '	
TUNIT1 = 's '	Actually no conversion has been applied, so the resolution is 238 nsec
~~TTYPE2 = 'SSCOUNT '~~	Source Sequence Counter from the Packet Header of the packet containing the event
~~TFORM2 = 'I '~~	
~~TUNIT2 = 'N/A '~~	
TTYPE2~~3~~ = 'Y '	Module Detector coordinate Ya'
TFORM2~~3~~ = 'I '	
TUNIT2~~3~~ = 'PIXEL '	
TTYPE3~~4~~ = 'Z '	Module Detector coordinate Za'
TFORM3~~4~~ = 'I '	
TUNIT3~~4~~ = 'PIXEL '	
TTYPE4~~5~~ = 'PHA '	10 bit Energy Amplitude as read from the packet
TFORM4~~5~~ = 'I '	
TUNIT4~~5~~ = 'CHANNEL '	
~~TTYPE6 = 'RISETIME'~~	Set to 0
~~TFORM6 = 'I '~~	
~~TUNIT6 = 'n/a '~~	
TTYPE5~~7~~ = 'EVTYPE '	See note 1 below
TFORM5~~7~~ = 'I '	
TUNIT5~~7~~ = 'N/A '	
TELESCOP= 'INTEGRAL'	
INSTRUME= 'IBIS '	
MODEL = '**QM**~~PLM~~ '	
DETNAM = 'PICSIT '	
PACKET = 'T10.3a '	

TESTLEVE= 'DFEE '	
DATATYPE= 'Diagnostic'	
RUNID = 754	
CAMPAIGN= 'lab '	
FILENAME= 'lab_00754_990324_110138_1293.elf'	
DATE = '1999-03-24'	
DATE-OBS= '1999-03-24'	
TIME-OBS= '11:01:36'	
DATE-END= '1999-03-24'	
TIME-END= '11:26:38'	
RESEGSET= 'unknown '	
RESOBT = 0	
OBTEGSET= 0	
VERSION = 4	
COMMENT0= ' '	
COMMENT1= ' '	
COMMENT2= ' '	
COMMENT3= ' '	
COMMENT4= ' '	
COMMENT5= ' '	
COMMENT6= ' '	
COMMENT7= ' '	
COMMENT8= ' '	
COMMENT9= ' '	
END	

Note 1:

- in the T10.3a packet , where the HEPI Event Type is not available, the flags provided in the event data format by the instrument are copied in TYPE column in the following format:

	...	10	11	12	13	14	15
MSB							LSB
0	0	CLF	>3F	Multiplicity flag		Pulse identifier flag	

It is noted that, since this version 4, the *time* column does not assume anymore negative values as the SC software deals with the unexpected format (24 bit instead of 23) of the DFEE counter.

A sample of the QM format is given in below:

```
XTENSION= 'BINTABLE'
BITPIX  =          8
NAXIS   =          2
NAXIS1  =         16
NAXIS2  =   11519786
PCOUNT  =          0
GCOUNT  =          1
TFIELDS =          5
TTYPE1  = 'time    '
TFORM1  = 'D       '
TUNIT1  = 's       '
```

```
TTYPE2  = 'Y       '
TFORM2  = 'I       '
TUNIT2  = 'PIXEL   '
TTYPE3  = 'Z       '
TFORM3  = 'I       '
TUNIT3  = 'PIXEL   '
TTYPE4  = 'PHA     '
TFORM4  = 'I       '
TUNIT4  = 'CHANNEL '
TTYPE5  = 'EVTYPE  '
TFORM5  = 'I       '
TUNIT5  = 'N/A     '
TELESCOP= 'INTEGRAL'
INSTRUME= 'IBIS    '
MODEL   = 'QM      '
DETNAM  = 'PICSIT  '
PACKET  = 'T10.3a  '
TESTLEVE= 'DFEE    '
DATATYPE= 'Diagnostic'
RUNID   =          2900
CAMPAIGN= 'lab     '
FILENAME= 'lab_02900_000406_120357_1293.elf                    '
DATE    = '2000-04-06'
DATE-OBS= '2000-04-06'
TIME-OBS= '12:03:52'
DATE-END= '2000-04-06'
TIME-END= '12:33:52'
RESEGSET= 'unknown '
RESOBT  =             0
OBTEGSET=             0
VERSION =             4
COMMENT0= '        '
COMMENT1= '        '
COMMENT2= '        '
COMMENT3= '        '
COMMENT4= '        '
COMMENT5= '        '
COMMENT6= '        '
COMMENT7= '        '
COMMENT8= '        '
COMMENT9= '        '
END
```

C.1.2 Quick Look shared memory data format

This format has not been changed with respect the previous PLM Campaign ([6]).

The parameters defining the dimensions of the Quick Look shared memory (SHMF) and the buffer BUFFER to be written on it, are set as follows:

```
C from parameters.inc
C
C        SIZE_FRAME was set to 4224 to be multiply by:
C                100 ( buffers per SHMF channel)
C                21  ( total number of SHMF channels)
```

```
C                    ---> total of 8.870.400 byte of RAM
C          N.B.: on 25/01/2000 changed from 100 a 300
C
C   BLHEADER  is the header length in bytes
C
C   BLEVENT  is the event length  in bytes
C   for the time being, for each event it is reserved the maximum
C   space as required by the Compton events.
C
C   MAXEV    is the max number of events per frame which can be
C         written in each SHMF buffer; this is also the number of events
C         which are buffered in the FITS arrays.
C         Note: in the SHMF buffer are written: 1 header+1frame+1header
C
      INTEGER*4 BLEVENT
      PARAMETER (BLEVENT=24)
C
      INTEGER*4 BLBUFFER, BLHEADER, MAXEV, MAXCELL
      PARAMETER (BLBUFFER=4224, BLHEADER=40,
     +         MAXEV=( (BLBUFFER-2*BLHEADER)/(BLEVENT) ) /2 ,
     +         MAXCELL=848)
C
```

The following format is applied to the structure which contains the header and the events. Depending on the number of events, one or more of this structure can fit into the buffer BUFFER located in the SHMF shared memory.

```
C from PUTFRAME
C
      INTEGER*2 HEADER(BLHEADER/2), BUFFER(BLBUFFER/2)
C
C   HEADER  is the array where the header info are prepared
C
C   word  1: BLHEADER, header length in bytes
C   word  2: PKT_APID, APID
C   word  3: SUBTYPE
C   word  4: SHM channel
C   word  5: NEVENT, number of events contained in the frame
C   word  6: BLEVENT, event length in bytes
C   word  7: SPARE
C   word  8-9: NFRAME, frame #
C   word 10-16: used by Histog.f
C   word 17-18: RUNID
C   word 19-20: spare
C
C   Each event consist of the following info:
C
C   word  1-4: TIME (8 bytes)
C   word  5:    Event type (2 bytes)
C   word  6:    CsI Amplitude (2 bytes)
C   word  7:    CdTe Amplitude (2 bytes)
C   word  8:    Rise Time (2 bytes)
C   word  9:    CsI Y Position (2 bytes)
C   word  10:   CsI Z Position (2 bytes)
```

```
C    word 11:   CdTe Y Position (2 bytes)
C    word 12:   CdTe Z Position (2 bytes)
C
C
C    BUFFER is the buffer where HEADER + events are
C          saved to the Shared Memory SHMF when the current
C          frame does not fit into it
C
```

It is noted that the above is the format applied for each event, irrespective of the actual operating mode. The event component (e.g. RISETIME) which are not used by the operating mode are set to 0. Instead, on the FITS files the event format depends on the operating mode.

C.2 T103b Packets

C.2.1 FITS files format

Although in this campaign no T10.3b packets have been produced as the instrument did not include the PEB, this format was modified as for the T10.3a packets, in view of the next campaigns.

Hence, as shown below, with respect to the format of the PLM Campaign ([6]), the following modification have been applied:

- the SSCOUNT and RISETIME data have not been included anymore in the binary table;
- the VERSION keyword has been added in order to keep track of the version of the Processor program used to write the file.

Consequently, the FITS header has the format shown in the following table:

XTENSION= 'BINTABLE'	
BITPIX = 8	
NAXIS = 2	
NAXIS1 = 16	
NAXIS2 = 445239	
PCOUNT = 0	
GCOUNT = 1	
TFIELDS = 5	
TTYPE1 = 'time '	24-bit DFEE time tag
TFORM1 = 'D '	
TUNIT1 = 's '	Actually no conversion has been applied, so the resolution is 238 nsec
TTYPE2 = 'Y '	IBIS Oriented PICsIT Coordinate Y as provided by the PEB
TFORM2 = 'I '	
TUNIT2 = 'PIXEL '	
TTYPE3 = 'Z '	IBIS Oriented PICsIT Coordinate Z as provided by the PEB
TFORM3 = 'I '	
TUNIT3 = 'PIXEL '	
TTYPE4 = 'PHA '	10 bit Energy Amplitude as read from the packet
TFORM4 = 'I '	
TUNIT4 = 'CHANNEL	
TTYPE5 = 'EVTYPE '	See note 1 below
TFORM5 = 'I '	
TUNIT5 = 'N/A '	
TELESCOP= 'INTEGRAL'	
INSTRUME= 'IBIS '	
MODEL = 'QM '	
DETNAM = 'PICSIT '	
PACKET = 'T10.3b '	
TESTLEVE= 'PEB '	
DATATYPE= 'Diagnostic'	
RUNID = 754	
CAMPAIGN= 'lab '	

FILENAME= 'lab_00754_990324_110138_1293.elf'	
DATE = '1999-03-24'	
DATE-OBS= '1999-03-24'	
TIME-OBS= '11:01:36'	
DATE-END= '1999-03-24'	
TIME-END= '11:26:38'	
RESEGSET= 'unknown '	
RESOBT = 0	
OBTEGSET= 0	
VERSION = 4	
COMMENT0= ' '	
COMMENT1= ' '	
COMMENT2= ' '	
COMMENT3= ' '	
COMMENT4= ' '	
COMMENT5= ' '	
COMMENT6= ' '	
COMMENT7= ' '	
COMMENT8= ' '	
COMMENT9= ' '	
END	

Note 1:

- in the T10.3b packets , where the HEPI Event Type is not available, the flags provided in the event data format by the instrument are copied in TYPE column in the following format:

	...	10	11	12	13	14	15

MSB LSB

0	0	CLF	MM	Multiplicity flag	Pulse identifier flag

A sample of the QM format is given in below:

```
XTENSION= 'BINTABLE'
BITPIX =          8
NAXIS  =          2
NAXIS1 =         16
NAXIS2 =     907529
PCOUNT =          0

GCOUNT =          1
TFIELDS =         5
TTYPE1 = 'time   '
TFORM1 = 'D      '
TUNIT1 = 's     '
TTYPE2 = 'Y      '
TFORM2 = 'I      '
TUNIT2 = 'PIXEL  '
TTYPE3 = 'Z      '
```

```
TFORM3  = 'I       '
TUNIT3  = 'PIXEL   '
TTYPE4  = 'PHA     '
TFORM4  = 'I       '
TUNIT4  = 'CHANNEL '
TTYPE5  = 'EVTYPE  '
TFORM5  = 'I       '
TUNIT5  = 'N/A     '
TELESCOP= 'INTEGRAL'
INSTRUME= 'IBIS    '
MODEL   = 'QM      '
DETNAM  = 'PICSIT  '
PACKET  = 'T10.3b  '
TESTLEVE= 'PEB     '
DATATYPE= 'Diagnostic'
RUNID   =                 3378
CAMPAIGN= 'lab     '
FILENAME= 'lab_03378_000620_172238_1293.elf                    '
DATE    = '2000-06-20'
DATE-OBS= '2000-06-20'
TIME-OBS= '17:22:37'
DATE-END= '2000-06-20'
TIME-END= '17:38:18'
RESEGSET= 'unknown '
RESOBT  =                    0
OBTEGSET=                    0
VERSION =                    4
COMMENT0= '        '
COMMENT1= '        '
COMMENT2= '        '
COMMENT3= '        '
COMMENT4= '        '
COMMENT5= '        '
COMMENT6= '        '
COMMENT7= '        '
COMMENT8= '        '
COMMENT9= '        '
END
```

C.2.2 Quick Look shared memory data format

The same format defined for the T10.3a packets applies herein.

It is noted that, also in this case, this format is applied for each event, irrespective of the actual operating mode. The event component which are not used by the operating mode (e.g. RISETIME) are set to 0. Instead, on the FITS files the event format depends on the operating mode.

Annex D Permanent Archive Directory

D.1 The CDROM Archive

CDROM #	Run ID	Measurement Date	Measurement Star Time	Measurement Stop Time	Total number of events	Total size (bytes)	Packet Type
0046	2747	2000-03-24	17:59:41	18:05:33	274770	6682416	T10.3a
0046	2748	2000-03-24	18:05:45	18:22:58	5320562	129042160	T10.3a
0046	2755	2000-03-27	12:35:25	13:35:53	4126280	100124668	T10.3a
0046	2756	unknown	unknown	unknown	0	26795660	T10.3a
0046	2760	2000-03-27	14:48:15	15:12:09	4413520	106949544	T10.3a
0046	2763	2000-03-27	15:41:47	15:57:47	8135428	197503700	T10.3a
0046	2765	unknown	unknown	unknown	0	52440008	T10.3a
0047	2770	2000-03-27	16:14:44	16:30:22	7956462	193168536	T10.3a
0047	2771	2000-03-27	16:34:25	16:50:09	14937254	375266920	T10.3a
0048	2772	2000-03-27	16:52:06	17:08:28	14960990	381268864	T10.3a
0049	2779	2000-03-27	17:10:51	17:26:30	10364548	251641148	T10.3a
0049	2780	2000-03-27	17:29:19	17:45:03	10413396	252826112	T10.3a
0049	2835	2000-03-25	16:23:44	16:47:55	1490294	36175200	T10.3a
0049	2836	unknown	unknown	unknown	0	49477740	T10.3a
0049	2839	2000-03-25	20:56:12	21:00:03	247078	6005684	T10.3a
0050	2842	2000-03-25	23:31:30	00:06:37	1711916	41575624	T10.3a
0050	2845	2000-03-28	19:51:09	20:21:07	1884518	45740664	T10.3a
0050	2850	2000-03-29	16:38:51	17:02:56	1232552	29921544	T10.3a
0050	2855	2000-04-04	15:19:54	15:50:08	2111730	51252640	T10.3a
0050	2856	2000-04-04	16:32:48	16:43:30	136138	3336424	T10.3a
0050	2860	2000-04-05	08:02:56	08:24:23	1385632	33633544	T10.3a
0050	2861	2000-04-05	08:26:03	08:52:05	6175058	150527900	T10.3a
0050	2862	2000-04-05	08:52:33	09:07:39	970510	23559636	T10.3a
0050	2864	unknown	unknown	unknown	0	42349828	T10.3a
0051	2865	2000-04-05	09:45:31	10:15:42	11487278	278574672	T10.3a
0051	2866	2000-04-05	10:16:18	10:46:26	11471024	278178788	T10.3a
0052	2867	2000-04-05	10:49:12	11:21:44	14920484	361747732	T10.3a
0053	2868	2000-04-05	11:22:24	11:52:57	13993060	339280408	T10.3a
0053	2869	2000-04-05	11:55:31	12:25:39	11894058	288429772	T10.3a
0054	2870	2000-04-05	12:26:18	12:56:53	12073024	292764912	T10.3a
0054	2871	2000-04-05	12:57:31	13:57:34	3837148	93128420	T10.3a
0055	2872	2000-04-05	13:59:28	14:30:35	11731346	284487780	T10.3a
0055	2873	2000-04-05	14:31:01	15:01:08	11340820	275025732	T10.3a
0056	2874	2000-04-05	15:02:44	15:35:29	12317092	298677972	T10.3a
0056	2875	2000-04-05	15:35:58	16:06:13	11373414	275948568	T10.3a
0057	2876	2000-04-05	16:06:39	16:36:45	11324566	274632680	T10.3a
0057	2877	2000-04-05	16:37:29	17:07:37	11340820	275025732	T10.3a
0058	2878	2000-04-05	17:12:21	17:42:31	11357074	275418784	T10.3a
0059	2883	2000-04-05	17:54:59	18:25:04	11357074	275151044	T10.3a
0059	2884	2000-04-05	18:25:54	18:56:04	11357074	275418712	T10.3a
0060	2885	2000-04-05	18:58:02	19:28:13	11910312	288822872	T10.3a
0060	2886	2000-04-05	19:29:08	19:59:17	11910312	288822824	T10.3a
0061	2887	2000-04-05	20:00:23	20:30:34	11910312	288822824	T10.3a
0061	2888	2000-04-05	20:31:59	21:02:07	13748992	333501152	T10.3a

0062	2889	2000-04-05	21:03:24	21:33:30	11438430	277389804	T10.3a
0062	2890	2000-04-05	21:34:07	22:04:14	11438430	277389756	T10.3a
0062	2892	2000-04-06	08:01:26	08:19:33	1158162	28115708	T10.3a
0062	2893	2000-04-06	08:20:01	08:50:08	1927346	46776212	T10.3a
0063	2894	2000-04-06	08:55:16	09:25:19	11552380	280149736	T10.3a
0063	2895	2000-04-06	09:26:48	09:56:48	11519786	279360824	T10.3a
0064	2896	2000-04-06	09:57:53	10:27:54	11519786	279360824	T10.3a
0064	2897	2000-04-06	10:29:43	10:59:44	11536126	279756708	T10.3a
0065	2898	2000-04-06	11:02:08	11:32:08	11519786	279360824	T10.3a
0065	2899	2000-04-06	11:32:46	12:02:46	11519786	279360824	T10.3a
0066	2900	2000-04-06	12:03:52	12:33:52	11519786	279360824	T10.3a
0066	2901	2000-04-06	12:34:30	13:04:29	11519786	279360824	T10.3a
0067	2902	2000-04-06	13:06:05	14:06:13	3826656	92869820	T10.3a
0067	2904	unknown	unknown	unknown	0	133588360	T10.3a
0067	2906	2000-04-06	14:45:56	15:15:57	11324566	274632608	T10.3a
0068	2907	2000-04-06	15:16:27	15:46:28	11324566	274632644	T10.3a
0068	2908	2000-04-06	15:47:15	16:17:15	11324566	274632644	T10.3a
0069	2909	2000-04-06	16:17:47	16:47:46	11308312	274236700	T10.3a
0069	2910	2000-04-06	16:48:26	17:18:27	11324566	274632680	T10.3a
0070	2911	2000-04-06	17:19:02	17:49:00	11308312	274236748	T10.3a
0070	2912	2000-04-06	17:49:21	18:19:23	11324566	274632680	T10.3a
0071	2913	2000-04-06	18:19:47	18:49:47	11324566	274632680	T10.3a
0071	2914	2000-04-06	18:50:47	18:54:04	212076	5159204	T10.3a
0071	2919	2000-04-07	09:33:04	09:56:46	1526672	37060380	T10.3a
0071	2920	2000-04-07	09:57:45	10:27:45	11243210	272661660	T10.3a
0072	2921	2000-04-07	10:28:22	10:58:23	11243210	272661588	T10.3a
0072	2922	2000-04-07	11:13:20	11:43:20	11186794	271757340	T10.3a
0073	2923	2000-04-07	11:55:03	12:25:04	11243210	272661660	T10.3a
0073	2924	2000-04-07	12:26:04	13:26:03	3810746	92486624	T10.3a
0073	2925	2000-04-07	14:34:49	15:34:47	3804640	92333332	T10.3a
0073	2929	2000-04-07	16:37:06	17:09:08	408758	9994028	T10.3a
0073	2930	2000-04-07	17:09:54	17:40:21	2135896	51834588	T10.3a
0073	2931	2000-04-07	17:40:49	18:10:46	1885808	45772596	T10.3a
0073	2934	2000-04-10	09:56:54	10:11:16	199262	4877552	T10.3a
0073	2936	2000-04-10	10:19:01	10:24:28	69918	1718576	T10.3a
0073	2937	2000-04-10	10:35:21	10:40:27	65618	1612396	T10.3a

D.2 The MO Archive

MO #	Run ID	Measurement Date	Measurement Star Time	Measurement Stop Time	Total number of events	Total size (bytes)	Packet Type
0001	2747	2000-03-24	17:59:41	18:05:33	274770	6682464	T10.3a
0001	2748	2000-03-24	18:05:45	18:22:58	5320562	129042160	T10.3a
0001	2755	2000-03-27	12:35:25	13:35:53	4126280	100124668	T10.3a
0001	2756	unknown	unknown	unknown	0	26795660	T10.3a
0001	2760	2000-03-27	14:48:15	15:12:09	4413520	106949544	T10.3a
0001	2763	2000-03-27	15:41:47	15:57:47	8135428	197503700	T10.3a
0001	2765	unknown	unknown	unknown	0	52440008	T10.3a

0002	2770	2000-03-27	16:14:44	16:30:22	7956462	193168572	T10.3a
0002	2771	2000-03-27	16:34:25	16:50:09	14937254	375266920	T10.3a
0002	2772	2000-03-27	16:52:06	17:08:28	14960990	381268864	T10.3a
0003	2779	2000-03-27	17:10:51	17:26:30	10364548	251641196	T10.3a
0003	2780	2000-03-27	17:29:19	17:45:03	10413396	252826112	T10.3a
0003	2835	2000-03-25	16:23:44	16:47:55	1490294	36175200	T10.3a
0003	2836	unknown	unknown	unknown	0	49477740	T10.3a
0003	2839	2000-03-25	20:56:12	21:00:03	247078	6005684	T10.3a
0003	2842	2000-03-25	23:31:30	00:06:37	1711916	41575624	T10.3a
0003	2845	2000-03-28	19:51:09	20:21:07	1884518	45740664	T10.3a
0004	2850	2000-03-29	16:38:51	17:02:56	1232552	29921544	T10.3a
0004	2855	2000-04-04	15:19:54	15:50:08	2111730	51252640	T10.3a
0004	2856	2000-04-04	16:32:48	16:43:30	136138	3336424	T10.3a
0004	2860	2000-04-05	08:02:56	08:24:23	1385632	33633544	T10.3a
0004	2861	2000-04-05	08:26:03	08:52:05	6175058	150527900	T10.3a
0004	2862	2000-04-05	08:52:33	09:07:39	970510	23559636	T10.3a
0004	2864	unknown	unknown	unknown	0	42349828	T10.3a
0005	2865	2000-04-05	09:45:31	10:15:42	11487278	278574672	T10.3a
0005	2866	2000-04-05	10:16:18	10:46:26	11471024	278178788	T10.3a
0005	2867	2000-04-05	10:49:12	11:21:44	14920484	361747732	T10.3a
0006	2868	2000-04-05	11:22:24	11:52:57	13993060	339280408	T10.3a
0006	2869	2000-04-05	11:55:31	12:25:39	11894058	288429820	T10.3a
0006	2870	2000-04-05	12:26:18	12:56:53	12073024	292764912	T10.3a
0006	2871	2000-04-05	12:57:31	13:57:34	3837148	93128420	T10.3a
0007	2872	2000-04-05	13:59:28	14:30:35	11731346	284487780	T10.3a
0007	2873	2000-04-05	14:31:01	15:01:08	11340820	275025732	T10.3a
0007	2874	2000-04-05	15:02:44	15:35:29	12317092	298677972	T10.3a
0008	2875	2000-04-05	15:35:58	16:06:13	11373414	275948568	T10.3a
0008	2876	2000-04-05	16:06:39	16:36:45	11324566	274632680	T10.3a
0008	2877	2000-04-05	16:37:29	17:07:37	11340820	275025732	T10.3a
0008	2878	2000-04-05	17:12:21	17:42:31	11357074	275418784	T10.3a
0009	2883	2000-04-05	17:54:59	18:25:04	11357074	275151044	T10.3a
0009	2884	2000-04-05	18:25:54	18:56:04	11357074	275418712	T10.3a
0009	2885	2000-04-05	18:58:02	19:28:13	11910312	288822872	T10.3a
0009	2886	2000-04-05	19:29:08	19:59:17	11910312	288822872	T10.3a
0010	2887	2000-04-05	20:00:23	20:30:34	11910312	288822872	T10.3a
0010	2888	2000-04-05	20:31:59	21:02:07	13748992	333501200	T10.3a
0010	2889	2000-04-05	21:03:24	21:33:30	11438430	277389804	T10.3a
0011	2890	2000-04-05	21:34:07	22:04:14	11438430	277389804	T10.3a
0011	2892	2000-04-06	08:01:26	08:19:33	1158162	28115708	T10.3a
0011	2893	2000-04-06	08:20:01	08:50:08	1927346	46776212	T10.3a
0011	2894	2000-04-06	08:55:16	09:25:19	11552380	280149736	T10.3a
0011	2895	2000-04-06	09:26:48	09:56:48	11519786	279360824	T10.3a
0012	2896	2000-04-06	09:57:53	10:27:54	11519786	279360824	T10.3a
0012	2897	2000-04-06	10:29:43	10:59:44	11536126	279756756	T10.3a
0012	2898	2000-04-06	11:02:08	11:32:08	11519786	279360824	T10.3a
0012	2899	2000-04-06	11:32:46	12:02:46	11519786	279360824	T10.3a
0013	2900	2000-04-06	12:03:52	12:33:52	11519786	279360824	T10.3a
0013	2901	2000-04-06	12:34:30	13:04:29	11519786	279360824	T10.3a
0013	2902	2000-04-06	13:06:05	14:06:13	3826656	92869820	T10.3a
0013	2904	unknown	unknown	unknown	0	133588360	T10.3a
0013	2906	2000-04-06	14:45:56	15:15:57	11324566	274632608	T10.3a
0014	2907	2000-04-06	15:16:27	15:46:28	11324566	274632644	T10.3a

0014	2908	2000-04-06	15:47:15	16:17:15	11324566	274632644	T10.3a
0014	2909	2000-04-06	16:17:47	16:47:46	11308312	274236748	T10.3a
0014	2910	2000-04-06	16:48:26	17:18:27	11324566	274632680	T10.3a
0015	2911	2000-04-06	17:19:02	17:49:00	11308312	274236748	T10.3a
0015	2912	2000-04-06	17:49:21	18:19:23	11324566	274632680	T10.3a
0015	2913	2000-04-06	18:19:47	18:49:47	11324566	274632680	T10.3a
0015	2914	2000-04-06	18:50:47	18:54:04	212076	5159204	T10.3a
0015	2919	2000-04-07	09:33:04	09:56:46	1526672	37060380	T10.3a
0016	2920	2000-04-07	09:57:45	10:27:45	11243210	272661660	T10.3a
0016	2921	2000-04-07	10:28:22	10:58:23	11243210	272661588	T10.3a
0016	2922	2000-04-07	11:13:20	11:43:20	11186794	271757340	T10.3a
0016	2923	2000-04-07	11:55:03	12:25:04	11243210	272661660	T10.3a
0017	2924	2000-04-07	12:26:04	13:26:03	3810746	92486624	T10.3a
0017	2925	2000-04-07	14:34:49	15:34:47	3804640	92333332	T10.3a
0017	2929	2000-04-07	16:37:06	17:09:08	408758	9994028	T10.3a
0017	2930	2000-04-07	17:09:54	17:40:21	2135896	51834588	T10.3a
0017	2931	2000-04-07	17:40:49	18:10:46	1885808	45772596	T10.3a
0017	2934	2000-04-10	09:56:54	10:11:16	199262	4877552	T10.3a
0017	2936	2000-04-10	10:19:01	10:24:28	69918	1718576	T10.3a
0017	2937	2000-04-10	10:35:21	10:40:27	65618	1612396	T10.3a

D.3 The MO Archive Backup

MO Cartridge #	DAT Tape #	DAT Tape File
1	1	1
2	1	2
3	1	3
4	2	1
5	2	2
6	2	3
7	3	1
8	3	2
9	4	1
10	4	2
11	5	1
12	5	2
13	6	1
14	6	2
15	7	1
16	7	2
17	7	3