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HUYGENS MVDA-2004 DESCRIPTION

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1 INTRODUCTION

MVDA (Mission Visual Data Analysis) is a tool for post-processing data from any Huygens Checkout (or Mission) Stream whose Housekeeping TM data are stored in the history files of HMCS.

MVDA generates ASCII text files of TM Parameter data for distribution to end-users, usually PIs, Industry and the Huygens Mission Team. The data are output in a tabular structure which is appropriate for input to MS Excel or other software. For each Probe Flight Checkout, a standard set of "Spreadsheets" will be produced by the Flight Control team using MVDA. Additional "Spreadsheets" will be generated on an as-needed basis, typically for engineering analysis of Probe Checkouts, and of Test Sessions run on the Huygens Engineering Model.

2 TERMINOLOGY

2.1 Definition of Some Terms Used in this Document

Time:	Unless otherwise stated, references to time mean the SCET (Spacecraft Event Time) of occurrence of the event (packet generation, parameter sampling) on-board the Probe Support Avionics or the Probe according to context. Times are expressed in UTC. User input time format to be used in Steering Files and command-line arguments: yyyy-doyThh:mm:ss.ssssss For the “seconds” field “ss.ssssss” the fractional part, including the decimal point, is optional and may be written with any number of digits following the decimal point. In this specification, a Time value to be provided by the user in the above format is indicated as: <time-value>
[Checkout] Stream:	A concept in HMCS for partitioning of TM data processing and archiving in the HMCS History Files

Spreadsheet [file]:	An ASCII text file of Spreadsheet data generated by MVDA. These files are suitable for importing to MS Excel.
User:	Any HMCS user who invokes MVDA executables.
End-user:	An end-user of MVDA Spreadsheet data.
Intermediate Data File:	Conceptually, an intermediate file of all values and associated Packet times for a given Parameter, retrieved from the HMCS History Files for a specified time window and HMCS Checkout Stream.
Main Control File:	Defines parameters for MVDA execution (corresponds to “Auto.dat” in the old MVDA)
Retrieval Parameter List:	A list of all Parameters to be retrieved from the HMCS History Files (not used in old MVDA)
Spreadsheet Control File:	Defines the content of a Spreadsheet output file (corresponding files exist for the old MVDA)
Filenames Control File:	A list of Spreadsheet Control Files to be used when running MVDAbatch, which performs a "batch production" of Spreadsheets (the file corresponds approximately to the “Filenames” file in the old MVDA)
MVDA run:	An invocation of one or more MVDA executables in the context of processing a given set of data, as defined by a Main Control File.
old MVDA:	The version of MVDA in current use with HMCS Release 7.0 (at 31 December 2003).
Parameter:	Spelled as a title with a capital “P” means a TM/synthetic/derived Parameter as defined in the usual HMCS context. When spelled all lower-case it has the general meaning of “parameter” in English language. A Parameter is identified by a 6-character **ParameterID.**
Derived Parameter:	In this document, the term is used to mean a non-TM Parameter, namely a Parameter which is derived locally in HMCS by combining values of TM Parameters (and other Derived Parameaters). These parameters are marked D (derived) or H (hard-coded) in PCF field PCF_NATUR in the HMCS MIB.

Supercommutated Parameter: A Parameter which is encoded more than once in a Probe or PSA Housekeeping Packet. (at regular intervals within the packet). Such Parameters are identified here by two kinds of name:

Parameter Base ID (in effect, synonymous with ParameterID): A 6-character identifier which refers to all occurrences (instances) of the Parameter within the packet.

Supercommutation (Parameter) Instance ID: A unique name given to identify a specific occurrence (at a specific location) of the Parameter encoding within the packet. Instance IDs are formed by appending a 2-digit decimal index number to the Base ID. The index counts the instances of the Parameter encoding in the packet, counting from 00. E.g. XA800000, XA800004.

ParameterViewName Note “ParameterView” here does not have precisely the same meaning as this term has in the context of SCOS-2 internal design. ParameterViewNames appear in MVDA Spreadsheet output, and indicate how the accompanying Parameter values are to be interpreted by the user:

Parameter Engineering (/Synthetic/Derived) ViewName:
<ParameterID> without suffix

Parameter Raw (decimal) Viewname:
<ParameterID>:R

Parameter Raw (hexadecimal) ViewName:
<ParameterID>:X

ParameterID here may be substituted by a Supercommutation Instance ID where appropriate (see Section "MVDA Output Files" for clarification)

Engineering value: The SCOS “engineering value view” of a Parameter in HMCS. This includes equivalent “value views” of HMCS Synthetic and Derived Parameters.

Raw value: The “SCOS raw value view” of a TM Parameter in HMCS, formatted for output as a decimal integer value

Hex value: The “SCOS raw value view” of a TM Parameter in HMCS formatted for output as a hexadecimal value. The number of hex digits is determined by the field size of the raw parameter in the TM packet.

MIB:	Mission Information Base: Reference database of HMCS.

2.2 Specification Syntax for User Input

The syntax used here to specify User inputs basically follows the UNIX “man page” conventions. Additionally, the occurrence of an item between “< >” eg “<item>” indicates a place-holder for an input value, which is explained in each case. Thus:

text	signifies that the text has to be entered as shown. May optionally be included in quotes according to normal UNIX shell conventions.
[<item>]	signifies an optional input argument referred to here as "item"
{ input-a | input_b }	signifies a choice of one of the two strings "input_a" and "input_b"

3 REFERENCE DOCUMENTS

R.1 SCOSII-ICD-MIBimport-2.0-RE SCOS II MIB Import ICD
Issue 2.0, March 1996

4 MVDA PROCESS ARCHITECTURE

MVDA processing for a given Huygens TM Stream proceeds in three Steps:

1. **MVDAretrieve:** Retrieval of TM Parameters from HMCS history files, and production of Intermediate Data Files for a specified time-window and Checkout Stream.
2. **MVDAgenerate:** Production of Spreadsheet Files; the data in the Spreadsheets are derived from the Intermediate Data Files created in Step 1, and the HMCS spacecraft reference database (MIB)
3. **zip:** Creation of zipped Spreadsheet Files for distribution per PI or other user.. The zipped files are compatible with PC-WinZip.

Each generated Intermediate Data File contains values and corresponding Packet times (and may include sample times) of all samples of a given Parameter, for the HMCS Stream and time window (start-stop times) specified for the MVDA run. The physical implementation of Intermediate Data Files is transparent to the User, but is so far as possible compatible with that of the old MVDA, in order to facilitate processing of these files by the old MVDA Plotting facility on HMCS (PV-Wave).

Step 2 **MVDAgenerate** may optionally be repeated any number of times, for different output Spreadsheet sets. The contents and layout of each Spreadsheet are User-specified by means of Spreadsheet Control (Steering) files.

A top-level script **MVDAbatch** is provided to automate the MVDA processing of a typical Checkout by performing Steps 1 to 3 above.

5 MVDA STEERING FILES

MVDA processing is driven by three types of Steering File:

- Main Control File: Defines parameters for MVDA execution (corresponds to “Auto.dat” in the old MVDA)
- Retrieval Parameter List file: Contains a list of all Parameters to be retrieved in Step 1 (there was no corresponding file in the old MVDA).
- Spreadsheet Control Files: Defines the content of Spreadsheet output files to be generated in Step 2 (corresponding control files “Acp, Aeros, Disr ...” exist for the old MVDA)
- Filenames Control File: A list of Spreadsheet Control Files. It corresponds approximately to the “Filenames” file in the old MVDA, but is used by **MVDAbatch** only.

All steering files are text files, to be configured by the User. Multiple spaces are treated as one space. Blank lines are ignored.

Italicised text is used here for explanatory notes, which do not form part of the content of the files.

Time formats in all Steering Files and command-line arguments:

Format yyyy-doyThh:mm:ss.ssssss

For the “seconds” field “ss.ssssss” the fractional part, including the decimal point, is optional and may be written with any number of digits following the decimal point. In this specification, a Time value to be provided by the user in the above format is indicated as: <time-value>

5.1 Main Control File:

Defines overall parameters for a particular usage of MVDA. The corresponding file in the old MVDA system is “Auto.dat”.

The file contains one item per line on 5 lines in order, each item being prefixed by a fixed keyword delimited by one or more spaces. A hypothetical example for a Flight Checkout (F14) follows.

```
MIB 3.1                             MIB identification
PCO Checkout410_F14                 Checkout name
Stream 410                          Stream number
Start 2004-196T14:30:00             Start time for retrieval
Stop  2004-196T23:30:00             Stop time for retrieval
DDB_T0 2004-196T14:52:05.413        DDB T0 (parachute deployment)
```

The lines specify the following items:

1. MIB: HMCS MIB Database Release to be used for the MVDA execution.
2. PCO: Probe Checkout name. This is an arbitrary name string which will appear in MVDA output. Maximum number of characters allowed: 64
3. Stream: The HMCS “Checkout Stream” (identified by a number) from which the TM Parameter History data are to be retrieved by MVDAretrieve
4. Start: The earliest time for which Stream data are to be retrieved or output to spreadsheets. Any value earlier than the actual start time of available TM History data will result in retrieval of the earliest data available.
5. Stop: The latest time for which data are to be retrieved or output to spreadsheets. Any time later than the actual finish time of available TM History data will result in retrieval of data up to the latest available.
6. DDB_T0: The time of the Sytem T0 event (parachute deployment), equivalent to DDB T0, being the instant when the DDB Status was changed from “Pre-T0” to “Post-T0” and the value of “DDB Time” (counter) as broadcast in the DDB packets was reset to re-commence counting from zero. The time is printed in the header of each spreadsheet output file.

5.2 Retrieval Parameter List File:

This file contains a list of Parameter IDs defining all the Parameters to be retrieved from the HMCS History File Archive (or from the appropriate HMCS source in the case of Derived Parameters), by **MVDAretrieve.** Parameter IDs in the list are separated by spaces and newlines. The maximum number of Parameter IDs which may be coded on one line is TBD by the MVDA developer, but not less than 64. For Supercommutated Parameters, only Parameter Base IDs (not supercommutation instance IDs) are to be listed; however, all instances (samples) of each listed supercommutated ParameterID will be retrieved.

5.3 Filenames Control File

The use of a Filenames Control File is somewhat similar to that for the old MVDA, for the production of spreadsheets: It is a list of Spreadsheet Control Files, coded one file per line, to be applied in a given run of **MVDAbatch** for automated spreadsheet production. Absolute pathnames of the Spreadsheet Control Files are to be specified following standard UNIX (shell) conventions. Pathnames may include shell environment variable names defined by the User, coded in upper case in the format ${VARIABLE}, eg

```
/MVDA/Checkout_${MY_STREAM}/MyFilenames
```

5.4 *Spreadsheet Control Files*

These govern the execution of **MVDAgenerate** for Spreadsheet generation. The structure and content of each Spreadsheet Control File is somewhat similar but not identical to that for the old MVDA. Nominally, each Spreadsheet Control File defines a set of spreadsheets to be generated for a given End-user name (Aeros, Acp... etc). However, "End-user names" are not fixed in MVDA, they are definable by the User for the context of each MVDA run.

The structure of a Spreadsheet Control File is:

Spreadsheet Spec	defines one spreadsheet output file

Spreadsheet Spec
...
EOF

There is no limit to the number of Spreadsheet Specs in a Spreadsheet Control File..

The contents of a Spreadsheet Spec are (italicised text not included):

Spreadsheet Spec Header (Items to be specified in the order shown)

$File <spreadsheetFile>	*name of output spreadsheet file*
$Tstamp { packet | sample }	*timestamp option (see below)*
[$Partition <minutes>]	*optional partition period*

Parameter List:

<ParameterSpec> ...

#	*end of Spreadsheet Spec*

Explanations:

$File <spreadsheetFile>

The output spreadsheet file (base)name

$Tstamp { packet | sample }

Specification for time-stamping of parameter values in spreadsheet output. Specify "packet" or "sample". See section "MVDA Output Files" for detailed explanation.

[$Partition <minutes>]

Option requesting “partitioned” spreadsheet output. A set of spreadsheet files will be generated, covering successive periods of the specified maximum duration. The names of the files will be generated from the basename specified by the $File line, suffixed by an index number .0 .1 .2 etc.

<ParameterSpec>

A ParameterSpec is a string with no embedded spaces or newlines, identifying a Parameter to be included on the spreadsheet output, and optionally, one or more output forms for the parameter:

ParameterID[:<viewForms>]

ParameterID identifies the Parameter

<viewForms> (optional) specifies any combination of the following output forms, as a single character string, without separator characters:

E	Engineering (/Synthetic/Derived) value
R	Raw value as decimal value
X	Raw value as hexadecimal value

The default viewForm will be Engineering value.

In every case where a ParameterSpec requests (explicitly or by default) the Engineering value of a Parameter, MVDA will generate a corresponding output. In cases where the MIB does not provide for an "Engineering View" (or Synthetic/Derived view) of a requested Parameter, MVDA will output the Raw ParameterViewName and the raw values in decimal.

Example ParameterSpecs:

A1001H:ER requests output of Parameter A1001H in Engineering and Raw (decimal) forms.

A1001H:R requests output of Parameter A1001H in Raw (decimal) form only.

A1001H requests (default) output of Parameter A1001H in Engineering form only.

The Parameter List specifies the Parameters to appear on the spreadsheet. A Parameter List may include a given Parameter ID **only once** (but a given Parameter ID may appear in more than one Spreadsheet Spec in the Steering Control File). Parameter Specs are separated by spaces and/or newlines.

Derived Parameters:

Derived Parameters do not appear in Packets. They **may not be included** in a Parameter List for a Spreadsheet of type $Tstamp packet.

Supercommutated Parameters:

In the event that a Parameter included in the Parameter List of a Spreadsheet Spec is supercommutated (in a TM Packet), MVDA recognises this by reference to the MIB, and will automatically generate an ID and values in the spreadsheet output for each associated supercommutated instance (sample) of the Parameter.

One or more ParameterSpecs may specify individual Supercommutated Instance IDs (eg XA800000, XA800004) for any supercommutated Parameter. In such a case, only those named supercommutated instances for the Parameter will appear in the output for this Spreadsheet. The same Parameter Base ID (without supercommutation instance suffixes) may not appear in the Parameter List.

Examples of Spreadsheet Control Files:

1. A hypothetical Spreadsheet Control File for End-user Aeros could be:

$SHEET_CTRL/Aeros with content:

```
$File  psa_cnt.txt
$Tstamp packet
A1001H
A1002H
A2001H
A2002H
#
$File  psa_a_health1.txt
$Tstamp packet
A1003H   A1004H  A1005H  A1006H  A1008H  A1001W
A1003W  A1004W  A1005W
R5015B
#
```

This will result in generation of two Spreadsheet files:

```
.../psa_cnt.txt

.../ psa_a_health1.txt
```

2. A hypothetical Spreadsheet Control File for End-user Lebreton specifying super-commutated parameters could be:

$ SHEET_CTRL /Lebreton   with content:

```
$File Lebreton_AGC_A.txt
$Tstamp sample
$Partition 60
XA8000
#
$File Lebreton_AGC_B.txt
$Tstamp sample
$Partition 60
XB8000
#
```

Parameters XA8000 and XB8000 are each supercommutated to appear 8 times in the Packet. MVDA will generate a value for each appearance (sample) in the Packet.

3. A hypothetical Spreadsheet Control File specifying explicitly named supercommutated instances, could contain the following:

```
$Tstamp packet
A1001H  A1002H
XA800000 XA800004
XB800000 XB800004
A2001H A2002H
#
```

6 MVDA EXECUTABLES INVOCATION:

The MVDA executables are invoked from a shell command line. In general, standard UNIX shell conventions apply in the referencing of MVDA input files by the User as arguments to the executables. In the descriptions here, the occurrence of an item between "< >" eg "<item>" indicates a place-holder for an input value.

The User may specify either absolute pathnames (with a leading "/"), or pathnames relative to the $pwd (no leading "/"). Pathnames may include shell environment variable names defined by the User, coded in upper case in the format ${VARIABLE}, eg

```
/MVDA/Checkout_${CO_STRNR}/myMainControlFile
```

Within a Filenames Control File, pathnames must be absolute, but may include shell environment variable names as above.

All MVDA executables generate their output as a set of subdirectories and files within the Present Working Directory $pwd at the time of their invocation. The directory and file structures are specified below for each executable.

6.1 MVDAretrieve: Parameter Retrieval from HFA

User command:

```
MVDAretrieve    -m <mainControlFile>   -p <retrievalParameterListFile>
```

Retrieval of Parameter data from the HMCS History Fila Archive. Production of Intermediate Data Files containing both Engineering and Raw values of Parameters.

Arguments:

-m <mainControlFile>: pathname of the Main Control File defining overall parameters relating to this retrieval.

-p <retrievalParameterListFile>: a file containing a list of all Parameters to be retrieved.

MVDAretrieve creates Intermediate Data Files for all Parameters named in the retrievalParameterListFile, covering the time window specified in the Main Control File.

The Intermediate Data Files are written to a subdirectory $pwd/Data which is created by MVDAretrieve.

6.2 MVDAgenerate: Spreadsheet production

User command:

```
MVDAgenerate   [e]   [ -d  { doy | mmdd } ]   [ -t  <startTime>  <stopTime> ]
        -m  <mainControlFile>    -r  <retrieveDataDir>
         <spreadsheetControlFile>
```

Arguments:

-e: optional: Output only Engineering values (suppress output of any Raw/Hex ParameterViewNames and values requested by the Spreadheet Control File). Output a Warning message to STDERR stating "...Option –e applies: Engineering output only.
Note: The effect of this option is automatically overridden for Parameters where only Raw values are available.

-d optional: Request output date formatting as:
doy: yyyy-dddThh:mm:ss.sss
mmdd: yyyy-mm-ddThh:mm:ss.sss (default)
All times are output with resolution rounded to the nearest millisecond.

-t optional: Specifies start and stop times to be used to select data for this Spreadsheet. Default times are those specified in the Main Control File. This option allows to select a subset of data for a given time window.

-m <mainControlFile>: pathname of the Main Control File defining overall parameters relating to this spreadsheet production. The user must ensure that it is consistent with the Main Control File previously specified for MVDAretrieve whose output will be used for this spreadsheet generation, otherwise the results may be unpredictable.

-r <retrieveDataDir>: pathname of the "Data" directory created previously by MVDAretrieve to receive the Intermediate Data Files needed for this spreadsheet production

<spreadsheetControlFile>: a Spreadsheet Control File. If this argument is not present, then MVDAgenerate will read this data (must be in Spreadsheet Control File Format) on STDIN, thus it is possible to "pipe" this input data from another process, e.g. cat

MVDAgenerate creates Spreadsheet files according to the specifications contained in the specified Spreadsheet Control File

The data in the Spreadsheets is derived from the Intermediate Data Files previously generated by MVDAretrieve.

The Spreadsheet files are generated in $pwd/. The file basenames are specified in the Spreadsheet Control File.

6.3 MVDAbatch : Standard MVDA batch processing

User command:

```
MVDAbatch     [ -e ]   [ -d  { doy | mmdd } ]     -m  <mainControlFile>
        -p  <retrievalParameterListFile>  -n  <filenamesFile>
```

Automated MVDA batch run for a typical Checkout. Performs Steps 1 to 3 of MVDA processing.

Arguments:

-e: optional: Output only Engineering values (suppress output of any Raw/Hex values and ParameterViewNames).

-d optional: Specifies output date format as for MVDAgenerate. Default is yyyy-mm-dd.

-m <mainControlFile>: pathname of the Main Control File defining overall parameters relating to this spreadsheet production

-p <retrievalParameterListFile>: a file containing a list of all Parameters to be retrieved in Step 1 (MVDAretrieve).

-n <filenamesFile>: a Filenames Control File, containing a list of Spreadsheet Control File pathnames, one per line. Pathnames are absolute, but may contain shell environment variables in format ${VARIABLE}. No duplication of file basenames is allowed.

The output files are written to subdirectories created in $pwd as follows:

$pwd/Data/	created by MVDAretrieve; contains the Intermediate Data Files
$pwd/Spreadsheet/	will contain contain the Spreadsheets in subdirectories created and named after the respective Spreadsheet Control File basenames listed in the Filenames Control File, eg: $pwd/Spreadsheet/Aeros/ , $pwd/Spreadsheet/Hasi/ , etc.

$pwd/Distribution/	created in Step 3 contains one PC-WinZip-compatible Zipfile per Spreadsheet Control File, containing in zipped form all the Spreadsheets defined by that Control File. Each Zipfile is named after the corresponding Spreadsheet Control File basename, suffixed by ".zip", eg: "Aeros.zip", "Hasi.zip" ... etc.

6.4 MVDA Error handling:

All MVDA executables will terminate immediately with a meaningful error message to SYSERR on any of the following conditions (as relevant to the context of each executable):

- Command-line options/arguments do not conform to the specification
- Non-existent input file specified by User
- Parameter named in a Retrieval Parameter List is non-existent in HMCS (MVDAretrieve)
- No data available in the HMCS history files, for the Start-Stop time window specified by the Main Control File (MVDAretrieve)
- No data available in the specified Intermediate Data Files, for the Start-Stop time window specified by the Main Control File (MVDAgenerate)
- No Intermediate Data File found for a ParameterID specified in a Spreadsheet Control File (MVDAgenerate)
- An output file or directory which is to be created by the MVDA executable is found to exist already.
- Transgression by the User of other rules stated in this document
- Other errors to be identified by the MVDA Developer

7 MVDA OUTPUT FILES

7.1 Files output by MVDAretrieve

The Intermediate Data Files written by MVDAretrieve are written to $pwd/Data. The content of these files is transparent to the User, but the User must specify the directory pathname to where the subdirectory Data is to be found when running MVDAgenerate.

7.2 Files output by MVDAgenerate

MVDAgenerate outputs Spreadsheet Files to $pwd. The file basenames are specified in the Spreadsheet Control File.

7.3 Files output by MVDAbatch

See Section: MVDA Executables Invocation.

7.4 Spreadsheet File Output Format and Content

Each Spreadsheet File has the following structure:

Header information (Checkout name, MIB Information, Start/Stop Times)

Parameter Characteristics: Lists static characteristics for each Parameter extracted or derived from the MIB.

Parameter Statistics: Statistics are calculated per Parameter as follows:

- First and last Times of the relevant sample value in the specified time window
- Number of samples of the Parameter in the specified time window
- For the Engineering values of non-Status Parameters: Minimum; Maximum; Average; Sigma;
  For Status parameters, these fields are output as null.

Parameter Values: Details of all specified Parameter values (engineering / synthetic / derived / raw / hex). This section is structured in one of two possible ways, according to the **$Tstamp** option specified in the relevant Spreadsheet Spec:

- Lines are stamped with Packet generation time and may list values of many Parameters. End-users may compute the sample time of each Parameter value by means of the TOFSET constant output under Parameter Characteristics.
- Lines are stamped with a ParameterID (or Supercommutation Instance ID) and the time when the listed Parameter value was sampled on-board.

The section headings in the spreadsheet data are prefixed with "# " and are output as shown.

Generally, output lines contain a number of items or fields delimited by a semicolon ";" . In the examples given here, spaces have sometimes been added for legibility. However, the actual output generated by MVDA will omit such extraneous spaces.

The format of output UTC Times depends on the option –d selected when executing MVDAgenerate or MVDAbatch. All the examples here assume that the default option has been used, i.e. format yyyy-mm-ddThh:mm:ss.sss

The output format of numeric floating-point engineering values will be equivalent to C "printf" format specifier %11g (including possible minus sign)

The decimal output format for integer values will be equivalent to C "printf" format specifier %d

The hexadecimal output format for raw Parameter values will include a prefix "0x" immediately followed by a string of 2, 4, 6, or 8 hexadecimal digits left-padded with zeros; the number of digits will depend on the TM packet field size of the raw Parameter rounded up to the nearest whole byte. Example hexadecimal outputs:

TM field size (bits)	**raw value (decimal)**	**hex output**
1	1	0x01
6	63	0x3f
14	8191	0x1fff
30	8191	0x00001fff

Examples of Spreadsheet Files are given below. In the examples, blank lines are included for readability. They are not output by MVDA.

Explanations/comments not included in the actual output are shown here in *italics*.

Interpretation of ParameterSpecs:

Each ParameterSpec included in the Parameter List of the relevant Spreadsheet Spec (see section Spreadsheet Control File) is expanded by MVDA to create a ParameterViewName for each form of output required. Note “ParameterView” here does not have precisely the same meaning as this term has in the context of SCOS-2 internal design. ParameterViewNames are constructed as follows:

Parameter Engineering (/Synthetic/Derived) ViewName:	<ParameterID> without suffix
Parameter Raw (decimal) Viewname:	<ParameterID>:R
Parameter Raw (hexadecimal) ViewName:	<ParameterID>:X

Examples of ParameterSpecs and their expansions:

ParameterSpec A1001H:ERX

would be expanded to three ParameterViewNames:

A1001H, A1001H:R, A1001H:X

ParameterSpec XA8000:ER

Parameter XA8000 is supercommutated 8 times. This ParameterSpec therefore requests values for the following ParameterViewNames:

XA800000 XA800000:R XA800001 XA800001:R XA800002 XA800002:R XA800003 XA800003:R

XA800004 XA800004:R XA800005 XA800005:R XA800006 XA800006:R XA800007 XA800007:R

ParameterSpec XA800000 XA800004 XB800000 XB800004

specifies explicitly that supercommjutated instances 00 and 04 of XA8000 and XB8000 are to be reported (as engineering values)

ParameterSpecs, ParameterIDs, and ParameterViewNames are used according to the context (spreadsheet output section) as shown in the examples below.

Spreadsheet Header Section

Example:

```
# PCO; Checkout380_PPLT_DoY347;                                 Checkout name (from Main Control File)

# MIB; 3.1;                                                     MIB version (from Main Control File)

# Time Window; 2003-12-13T03:45:00.000; 2003-12-13T10:50:00.000;  Spreadsheet Data Start/Stop times
```

Spreadsheet Section Parameter Characteristics :

Each requested Parameter is listed with information from the MIB (or derived from the MIB):

NAME	ParameterID
DESCR	Parameter Description (text)
UNIT	Units of Engineering value eg "Volt"
PKTYP	Packet type: A 3-character ID defined in the HMCS MIB. For (Derived) Parameters not represented in the MIB PLF, the field is null.
TOFSET	Packet Timestamp + TOFSET value (secs) give Sample Time of Parameter (1st) occurrence in packet
TDNEXT	For supercommutated Parameters only: Delta time (secs) between successive samples. Null if not applicable

Example:

```
# Parameter Characteristics;

# NAME; DESCR; UNIT; PKTYP; TOFSET; TDNEXT;

D1002A; CDMU A SUPL VOLT; Volt; H2A; -6.110; ;
D1003A; CDMU A A/D 4V; Volt; H2A; -1.200; ;
D1004A; CDMU A A/D 0.3V; Volt; H2A; -12.312; ;
D1005A; CDMU A A/D 0.5V; Volt; H2A; -8.375; ;
```

Spreadsheet Section Parameter Statistics :

One statistics line is output for each ParameterID in the Spreadsheet Spec.

In the case of supercommutated Parameters, one statistics line is output per ParameterID named in a ParameterSpec for the given SpreadsheetSpec. The presence of any individual Supercommutation Instance ID in the SpreadsheetSpec implies the respective ParameterID, so a single statistics line for the ParameterID will be output also in this case.

For the calculation of the statistics, engineering values only are used. For Status Parameters the only statistic given is the number of samples, the fields Minimum; Maximum; Average; Sigma; are blank

Name	ParameterID
First Sample Time:	Sample time of the first value delivered for the Parameter (within the specified Start-Stop time-window)
Last Sample Time:	Sample time of the last value delivered for the Parameter (within the specified Start-Stop time-window)
Samples :	Number of samples used (values of Parameter retrieved in Packets)
Minimum, Maximum :	The minimum and maximum values retrieved for the Parameter (blank for Status Parameters). In case an engineering value was found to be greater than the threshold defined to trigger overflow protection (currently 10^{10} see Appendix A) the Maximum value field will show "******" (6 asterisks). This will indicate a possible error in the MIB calibration data, or in the HMCS calibration process.
Average, Sigma :	The arithmetic Mean and Standard Deviation of the sample values of the Parameter (blank for Status Parameters)

The algorithm for calculation of the Mean and Standard Deviation, and protection against floating-point under- or overflow is described in Appendix A.

Example output follows:

```
# Parameter Statistics;

# Name; First Sample Time; Last Sample Time; Samples; Minimum; Maximum; Average; Sigma;

D1002A; 2003-12-13T03:46:55.484; 2003-12-13T10:48:31.444; 1582; 4.9980; 5.0862; 5.0375; 0.0225;
D1003A; 2003-12-13T03:46:55.484; 2003-12-13T10:48:31.444; 1582; 4.5200; 4.5400; 4.5398; 0.0018;
D1004A; 2003-12-13T03:46:55.484; 2003-12-13T10:48:31.444; 1582; 0.3000; 0.3000; 0.3000; 0.0000;
D1005A; 2003-12-13T03:46:55.484; 2003-12-13T10:48:31.444; 1582; 0.5000; 0.5000; 0.5000; 0.0000;
```

Spreadsheet Section “Parameter Values” for option “$Tstamp packet”

The Section header line includes "time offsets" information:

Parameter Values; Tofset; <timeOffsets>

where <timeOffsets> is a list of time offsets in seconds, each delimited by ";". There is one offset output per ParameterViewName which appears on the following line. The sample time of each Parameter value listed on subsequent lines can be computed by the user by adding the given time offset to the Packet time listed for each line.

The next line in this section (field-descriptor line) defines the content of the fields output on the subsequent lines. The line specifies:

Packet Time; Delta_T; PkTyp; <ParameterViewNames>

The line includes each ParameterViewName (delimited by ";") for which values will appear below. For each supercommutated Parameter, the Supercommutation Instance ID is quoted as part of the respective ParameterViewName

The next line lists the engineering units for each column, except where the column will display Status, Raw or Hex values. of a Parameter. This line can be used to define plot axis annotations.

The subsequent lines contain output values according to the field-descriptor line, i.e.

Packet Timestamp of the TM packet which delivered one or more of the values for the ParameterViewName fields on this line

Delta_T is the time offset (seconds, precision msecs) of the Packet time, from the Start Time quoted in "# Time Window" in the Spreadsheet Header section. It can be used as the time-axis value when plotting values of Parameters against time.

PkTyp is a 3-character Packet Type ID, of the TM packet. The PkTyp IDs are defined in the HMCS MIB (S/C reference database).

A list of values according to the required ParameterViewNames, delimited by “;”

Lines are output in chronological order.

The output is “compressed” according to the following rules:

- The first line contains data corresponding to the earliest Packet timestamp, within the specified start/stop time window.

- Following the first line output, a new line is output only when a new (changed) value is found for any of the output Parameters, ie whenever the value field for any Parameter has to be different from that on the line previously output.

- A line is output for the latest retrieved Packet timestamp within the specified start/stop time window.

- When no value is available for a specified Parameter (not included in the first Packet found in the specified time window), a null value is output.

For the application of these rules, “Parameter” signifies one of the following:

- a non-supercommutated Parameter
- any instance of a given supercommutated Parameter; the Supercommutation Instance ID is reported

Thus the minimum possible number of output lines is 2 (one each for the earliest and latest data in the specified time window).

Note that if desired, the effect of the "compression" can be suppressed by including in the Spreadsheet the Parameters which are the Packet Source Sequence Counters (SSC) for each of the Packet Types (PktId) which delivers Parameters to the Spreadsheet. The SSC will change for each Packet, thus ensuring that a new line will be output for each occurrence of each Packet.

Example (with "compression"):

```
# Parameter Values; Tofset; ; -6.110; -6.110; -1.200; -12.312; -8.375;        2 views of D1002A: same Tofsets

# Packet Time; Delta_T; PkTyp; D1002A; D1002A:R; D1003A; D1004A; D1005A;

# ; ; ; Volt; ; Volt; Volt;                                                   5th field: Raw value, so no units

2003-12-13T03:46:55.484; 415.484; H2A; 5.0568; 205; 4.5200; 0.3000; 0.5000;   first data retrieved
2003-12-13T03:47:11.484; 431.484; H2A ; 5.0568; 205; 4.5400; 0.3000; 0.5000;
2003-12-13T03:47:43.483; 463.483; H2A ; 5.0862; 223; 4.5400; 0.3000; 0.5000;
2003-12-13T03:47:59.483; 479.483; H2A ; 5.0274; 179; 4.5400; 0.3000; 0.5000;

. . . .   lines omitted from example for the sake of brevity
2003-12-13T10:48:15.444; 25695.444; H2A ; 5.0274; 179; 4.5400; 0.3000; 0.5000;
2003-12-13T10:48:31.444; 25711.444; H2A ; 5.0274; 179; 4.5400; 0.3000; 0.5000;      last data retrieved

# Lines; 1030;          The number of lines of data output above, following the line # Packet Time…
```

Spreadsheet Section “Parameter Values” for option “$Tstamp sample”

The Section header line is:

Parameter Values;

The next line in this section (field-descriptor line) defines the content of the fields output on the subsequent lines. The line specifies:

Sample Time; Delta_T; Name; Eng; Raw; heX;

The subsequent lines contain output values according to the field-descriptor line, i.e.

Sample Time of the value of the (single) ParameterID named on this line

Delta_T is the time offset (seconds, precision msecs) of the Sample Time, from the Start Time quoted in "Time Window" in the Spreadsheet Header section. It can be used as the time-axis value when plotting values of Parameters against time.

ParameterID of the (single) Parameter value reported on this line. In the case of a supercommutated Parameter, the reported ParameterID will be a Supercommutation Instance ID

A list of 3 values according to the ParameterViews (eng / raw/ hex) for this ParameterID, each value delimited by “;” Where no such View was requested by the User for a given Parameter, or is not available, a null value will be output.

Lines are output in chronological order of the listed Sample Times..

“Output compression” will be applied according to the following rules:

- A line is output for the first sample of each specified Parameter, retrieved in the requested time window
- A line is output for the last sample of each Parameter, retrieved in the requested time window
- An additional line is output each time that a new sample of any requested Parameter has a different value compared to the previous sample listed for that Parameter.

For the application of these rules, “Parameter” signifies one of the following:

- a non-supercommutated Parameter
- any instance of a given supercommutated Parameter; the Supercommutation Instance ID is reported

Thus the minimum possible number of output lines is 2 * the number of requested ParameterIDs

Examples of Spreadsheet output:

Main Control File for the following examples:

```
MIB 3.1                                   MIB identification
PCO Checkout380_PPLT_DoY347               Checkout name
Stream   380                              Stream number
Start    2003-347T03:45:00                Start time for retrieval
Stop     2003-347T10:50:00                Stop time for retrieval
DDB_T0   2003-347T04:07:06.431            DDB_T0 time
```

Spreadsheet Example 1: Analog Parameters
Options: Tstamp packet, engineering values, no supercommutated Parameters

The Spreadsheet Spec for this example is:

```
$F Example_1.txt
```

```
$Tstamp packet
D1002A D1003A D1004A D1005A
#
```

Example output follows:

```
# PCO; Checkout380_PPLT_DoY347;

# MIB; 3.1;

# Time Window; 2003-12-13T03:45:00.000; 2003-12-13T10:50:00.000;

# DDB_T0; 2003-347T04:07:06.431;

# Parameter Characteristics;

# NAME; DESCR; UNIT; PKTYP; TOFSET; TDNEXT;

D1002A; CDMU A SUPL VOLT; Volt; H2A; -6.110; ;        TDNEXT values null because Parameter not supercommutated
D1003A; CDMU A A/D 4V; Volt; H2A; -1.200; ;
D1004A; CDMU A A/D 0.3V; Volt; H2A; -12.312; ;
D1005A; CDMU A A/D 0.5V; Volt; H2A; -8.375; ;

# Parameter Statistics;
```

For the calculation of the following statistics, engineering values only are used. For Status Parameters the only statistic given is the number of samples, the fields Minimum; Maximum; Average; Sigma; are blank

First Sample Time:	*Sample time (UTC) of first sample of the named Parameter in the specified time-window*
Last Sample Time:	*Sample time (UTC) of last sample of the named Parameter in the specified time-window*
Samples :	*Number of samples used (values of Parameter retrieved in the specified time-window)*
Minimum, Maximum :	*The minimum and maximum values retrieved for the Parameter (blank for Status Parameters)*
Average, Sigma :	*The arithmetic Mean and Standard Deviation of the retrieved values of the Parameter (blank for Status Parameters)*

```
# Name; First Sample Time; Last Sample Time; Samples; Minimum; Maximum; Average; Sigma;

D1002A; 2003-12-13T03:46:49.374; 2003-12-13T10:48:25.334; 1582; 4.9980; 5.0862; 5.0375; 0.0225;
D1003A; 2003-12-13T03:46:54.284; 2003-12-13T10:48:30.244; 1582; 4.5200; 4.5400; 4.5398; 0.0018;
D1004A; 2003-12-13T03:46:43.172; 2003-12-13T10:48:19.132; 1582; 0.3000; 0.3000; 0.3000; 0.0000;
D1005A; 2003-12-13T03:46:47.109; 2003-12-13T10:48:23.69; 1582; 0.5000; 0.5000; 0.5000; 0.0000;

# Parameter Values; Tofset; ; -6.110; -1.200; -12.312; -8.375;
```

Packet Time: Latest known Packet timestamp when listed values applied.
Delta_T: Corresponds to “Time”, expressed as offset (secs) from the Start Time” specified for this particular Spreadsheet generation. Precision: msecs

```
# Packet Time; Delta_T; PkTyp; D1002A; D1003A; D1004A; D1005A;
# ; ; ; Volt; ; Volt; Volt;

2003-12-13T03:46:55.484; 415.484; H2A; 5.0568; 4.5200; 0.3000; 0.5000;        first data retrieved
2003-12-13T03:47:11.484; 431.484; H2A; 5.0568; 4.5400; 0.3000; 0.5000;
2003-12-13T03:47:43.483; 463.483; H2A; 5.0862; 4.5400; 0.3000; 0.5000;
2003-12-13T03:47:59.483; 479.483; H2A; 5.0274; 4.5400; 0.3000; 0.5000;
2003-12-13T03:48:31.483; 511.483; H2A; 5.0862; 4.5400; 0.3000; 0.5000;
2003-12-13T03:48:47.483; 527.483; H2A; 5.0568; 4.5400; 0.3000; 0.5000;
```

. . . .   lines omitted from example for the sake of brevity

```
2003-12-13T10:47:43.444; 25663.444; H2A; 4.9980; 4.5400; 0.3000; 0.5000;
2003-12-13T10:47:59.444; 25679.444; H2A; 5.0568; 4.5400; 0.3000; 0.5000;
2003-12-13T10:48:15.444; 25695.444; H2A; 5.0274; 4.5400; 0.3000; 0.5000;
2003-12-13T10:48:31.444; 25711.444; H2A; 5.0274; 4.5400; 0.3000; 0.5000;      last data retrieved

# Lines; 1030;          The number of lines of data output above, following the line # Packet Time...
```

Spreadsheet Example 2: Mixed type Parameters; illustration of different PkTyp IDs Options: Tstamp packet, engineering, and hex values, no supercommutated Parameters

The Spreadsheet Spec for this example is:

```
$F Example_2.txt
$Tstamp packet
D1002A D1003A:EX S1015C
#
```

Example output follows:

```
# PCO; Checkout380_PPLT_DoY347;

# MIB; 3.1;

# Time Window; 2003-12-13T03:45:00.000; 2003-12-13T10:50:00.000;

# DDB_T0; 2003-347T04:07:06.431;

# Parameter_Characteristics;

# NAME; DESCR; UNIT; PKTYP; TOFSET; TDNEXT;;

D1002A; CDMU A SUPL VOLT; Volt; H2A; -6.110; ;
D1003A; CDMU A A/D 4V; Volt; H2A; -1.200; ;
S1015C; PAR J3 SRS A;; H1A; -3.567; ;

# Parameter Statistics;

# Name; First Sample Time; Last Sample Time; Samples; Minimum; Maximum; Average; Sigma;

D1002A; 2003-12-13T03:46:49.374; 2003-12-13T10:48:25.334; 1582; 4.9980; 5.0862; 5.0375; 0.0225;
D1003A; 2003-12-13T03:46:54.284; 2003-12-13T10:48:30.244; 1582; 4.5200; 4.5400; 4.5398; 0.0018;
S1015C; 2003-12-13T03:46:53.484; 2003-12-13T10:48:25.444; 1581; ; ; ; ;    no min, max, avg, sigma for Status Parameters
```

```
# Parameter Values; Tofset; ; -6.110; -1.200; -1.200; -3.567;          note: a Tofset value for each ParameterViewName
# Packet Time; Delta_T; PkTyp; D1002A; D1003A; D1003A:X; S1015C;
# ; ; ; Volt; Volt; ; ;

2003-12-13T03:46:55.484; 415.484; H2A; 5.0568; 4.5200; 0x7f; SQUIBNOSEL;      first data retrieved
2003-12-13T03:47:07.484; 427.484; H1A; 5.0568; 4.5200; 0x7f; SQUIBSEL;        S1015C changed
2003-12-13T03:47:11.484; 431.484; H2A; 5.0568; 4.5400; 0x9a; SQUIBSEL;        D1003A changed
2003-12-13T03:47:23.484; 443.484; H1A; 5.0568; 4.5400; 0x9a; SQUIBNOSEL;      S1015C changed
2003-12-13T03:47:43.483; 463.483; H2A; 5.0862; 4.5400; 0x9a; SQUIBNOSEL;      format size of hex values according
2003-12-13T03:47:59.483; 479.483; H2A; 5.0274; 4.5400; 0x9a; SQUIBNOSEL;      Parameter TM length (bytes rounded up)
2003-12-13T03:48:31.483; 511.483; H2A; 5.0862; 4.5400; 0x9a; SQUIBNOSEL;
2003-12-13T03:48:47.483; 527.483; H2A; 5.0568; 4.5400; 0x9a; SQUIBNOSEL;

. . . .   lines omitted from example for the sake of brevity

2003-12-13T10:47:43.444; 25663.444; H2A; 4.9980; 4.5400; 0x9a; SQUIBNOSEL;
2003-12-13T10:47:59.444; 25679.444; H2A; 5.0568; 4.5400; 0x9a; SQUIBNOSEL;
2003-12-13T10:48:15.444; 25695.444; H2A; 5.0274; 4.5400; 0x9a; SQUIBNOSEL;
2003-12-13T10:48:31.444; 25711.444; H2A; 5.0274; 4.5400; 0x9a; SQUIBNOSEL;    last data retrieved

# Lines; 1030;
```

Spreadsheet Example 3: Status Parameters
Options: Tstamp packet, engineering values, no supercommutated Parameters

The Spreadsheet Spec for this example is:

```
$F Example_3.txt
$Tstamp packet
S1015C S1015D S1015E
S1015F
#
```

Example output follows:

```
# PCO; Checkout380_PPLT_DoY347;

# MIB; 3.1;

# Time Window; 2003-12-13T03:45:00.000; 2003-12-13T10:50:00.000;

# DDB_T0; 2003-347T04:07:06.431;

# Parameter Characteristics;

# NAME; DESCR; UNIT; PKTYP; TOFSET; TDNEXT;

S1015C; PAR J3 SRS A ; ; H1A; -3.567; ;
S1015D; PAR J2 SRS A; ; H1A; -3.567; ;
S1015E; PAR J1 SRS A; ; H1A; -3.567; ;
S1015F; PDD SRS A; ; H1A; -3.567; ;
```

in this example, all TOFSETs are same because the Parameters are all sampled simultaneously and delivered in 1 TM word.

```
# Parameter Statistics;

# Name; First Sample Time; Last Sample Time; Samples; Minimum; Maximum; Average; Sigma;
S1015C; 2003-12-13T03:46:55.484; 2003-12-13T10:48:27.444; 1581; ; ; ; ; ;     no min, max, avg, sigma for
S1015D; 2003-12-13T03:46:55.484; 2003-12-13T10:48:27.444; 1581; ; ; ; ; ;     Status Parameters
S1015E; 2003-12-13T03:46:55.484; 2003-12-13T10:48:27.444; 1581; ; ; ; ; ;
S1015F; 2003-12-13T03:46:55.484; 2003-12-13T10:48:27.444; 1581; ; ; ; ; ;

# Parameter Values; Tofset; ; -3.567; -3.567; -3.567; -3.567;

# Packet Time; Delta_T; PkTyp; S1015C; S1015D; S1015E; S1015F;
# ; ; ; ; ; ; ;

2003-12-13T03:46:51.484; 411.484; H1A; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL;    first data retrieved
2003-12-13T08:15:23.504; 16523.504; H1A; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL; SQUIBSEL;    S1015F change
2003-12-13T08:15:39.503; 16539.503; H1A; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL;  S1015F change
2003-12-13T08:30:19.498; 17419.498; H1A; SQUIBSEL; SQUIBSEL; SQUIBSEL; SQUIBNOSEL;        S1015C,S1015D,S1015E change
2003-12-13T08:30:35.498; 17435.498; H1A; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL;  S1015C,S1015D,S1015E change
2003-12-13T10:48:27.444; 25707.444; H1A; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL; SQUIBNOSEL;  last data retrieved

Lines;  6
```

Spreadsheet Example 4: Status Parameters with supercommutation
Options: Tstamp packet, engineering data

The Spreadsheet Spec for this example is:

```
$F Example_4.txt
$Tstamp packet
A2004W R50018                                    R50018 is supercommutated 8 times per PSA packet
#
```

Example output follows:

```
# PCO; Checkout380_PPLT_DoY347;

# MIB; 3.1;

# Time Window; 2003-12-13T03:45:00.000; 2003-12-13T10:50:00.000;

# DDB_T0; 2003-347T04:07:06.431;

# Parameter Characteristics;

# NAME; DESCR; UNIT; PKTYP; TOFSET; TDNEXT;

A2004W; SASW B HLT MSW ; ; S_A; -3.567; ;
R50018; VITERBI DEC ST A; ; S_A; -0.875; 0.125;       R50018 is supercommutated at .125-sec intervals

# Parameter Statistics;

# Name; First Sample Time; Last Sample Time; Samples; Minimum; Maximum; Average; Sigma;

A2004W; 2003-12-13T03:45:18.829; 2003-12-13T10:48:16.229; 25460; ; ; ; ;
R50018; 2003-12-13T03:45:18.109; 2003-12-13T10:48:18.109; 203681; ; ; ; ;
```

```
# Parameter Values; Tofset; ; -3.567; -0.875; -0.750; -0.625; -0.500; -0.375; -0.250; -0.125; 0.000;

# Packet Time; Delta_T; PkTyp; A2004W; R5001800; R5001801; R5001802; R5001803; R5001804; R5001805; R5001806; R5001807;

# ; ; ; ; ; ; ; ; ; ; ; ;

2003-12-13T03:45:18.109; 318.109; S_A; OK; UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;
2003-12-13T03:49:34.109; 574.109; S_A; OK; UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;LOCKED;LOCKED;
2003-12-13T03:49:50.109; 590.109; S_A; OK; LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;
2003-12-13T03:51:34.109; 694.109; S_A; OK; LOCKED;LOCKED;UNLOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;
2003-12-13T03:51:50.109; 710.109; S_A; OK; LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;
2003-12-13T05:42:40.109; 7360.109; S_A; UNHLTH; LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;
2003-12-13T05:42:43.109; 7363.109; S_A; OK; LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;LOCKED;
2003-12-13T10:46:34.109; 25594.109; S_A; OK; LOCKED;LOCKED;LOCKED;UNLOCKED;LOCKED;UNLOCKED;UNLOCKED;UNLOCKED;
2003-12-13T10:46:50.109; 25610.109; S_A; OK; UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;
2003-12-13T10:48:18.109; 25698.109; S_A; OK; UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;UNLOCKED;

# Lines;  10;
```

Spreadsheet Example 5: Status Parameters with supercommutation
Options: Tstamp sample, engineering, raw and hex data

For reasons of legibility on the A4 page, only one ParameterID is named in this example. In a typical MVDA production, several ParameterIDs, both super-commutated and non-supercommutated, could be included on one Spreadsheet.

The Spreadsheet Spec for this example is:

```
$F Example_4.txt
$Tstamp sample
A2004W R50018:ERX                         R50018 is supercommutated 8 times per PSA packet

#
```

Example output follows: By requesting "Tstamp sample", the volume of output is exploded:

```
# PCO; Checkout380_PPLT_DoY347;

# MIB; 3.1;

# Time Window; 2003-12-13T03:45:00.000; 2003-12-13T10:50:00.000;

# DDB_T0; 2003-347T04:07:06.431;

# Parameter Characteristics;

# NAME; DESCR; UNIT; PKTYP; TOFSET; TDNEXT;

A2004W; SASW B HLT MSW ; ; S_A; -3.567; ;
R50018; VITERBI DEC ST A; ; S_A; -0.875; 0.125;       R50018 is supercommutated at .125-sec intervals

# Parameter Statistics;

# Name; First Sample Time; Last Sample Time; Samples; Minimum; Maximum; Average; Sigma;
```

```
A2004W; 2003-12-13T03:45:18.054; 2003-12-13T10:48:32.054; 25460; ; ; ; ;
R50018; 2003-12-13T03:45:18.109; 2003-12-13T10:48:32.109; 203681; ; ; ; ;
# Parameter Values;

# Sample Time; Delta_T; Name; eng; raw; hex;

2003-12-13T03:45:18.054; 318.054; A2004W ; OK; ; ;                  first value for  A2004W
2003-12-13T03:45:18.109; 318.109; R5001800; UNLOCKED; 0; 0x00;      first value for  R50018
2003-12-13T03:49:46.109; 586.109; R5001806; LOCKED; 1; 0x01;        R50018 change
2003-12-13T03:51:38.109; 698.109; R5001802; UNLOCKED;  0; 0x00;     R50018 change
2003-12-13T03:51:40.109; 700.109; R5001803; LOCKED; 1; 0x01;        R50018 change
2003-12-13T05:42:40.054; 7360.054; A2004W ; UNHLTH; ; ;             A2994W change
2003-12-13T05:42:43.054; 7363.054; A2004W ; OK; ; ;                 A2994W change
2003-12-13T10:46:40.109; 25600.109; R5001803; UNLOCKED;  0; 0x00;   R50018 change
2003-12-13T10:46:42.109; 25602.109; R5001804; LOCKED; 1; 0x01;      R50018 change
2003-12-13T10:46:44.109; 25604.109; R5001805; UNLOCKED;  0; 0x00;   R50018 change
2003-12-13T10:48:32.054; 25712.054; A2004W ; OK; ; ;                last value for  A2004W
2003-12-13T10:48:32.109; 25712.109; R5001807; UNLOCKED;  0; 0x00;   last value for  R50018

# Lines;  12;
```

8 APPENDIX A: CALCULATION OF MEAN AND STANDARD DEVIATION

The Mean and Standard Deviation of a series of numbers X_1, X_2, ... X_N can be calculated by means of the following “pseudocode” algorithm shown below.

```
sumX = 0
sumXsq = 0
N = 0

for each  X in series, do:
  N++
  sumX = sumX + X
  sumXsq = sumXsq + X**2
done

meanX  = sumX / N

standardDeviation =  sqrt( (sumXsq / N) – meanX**2 )
```

Precautions against arithmetic undeflow or overflow:

The statistics computations will be performed using the equivalent of C++ double-precision floating-point variables (type "double") in the program code. Each Parameter sample value "X" to be processed will first be expressed as a variable of type "double". The available range of this type defined in /usr/include/values.h on the HMCS Server workstation is:

```
#define MAXDOUBLE       1.79769313486231570e+308
#define MINDOUBLE       4.94065645841246544e-324
```

The most numerous HK Parameter samples are those which are supercommutated 8 times per PSA HK Packet, the packet being generated at the rate of one per second. This translates to a maximum of 3600 * 8 = 28800 sample values per hour for these Parameters. The MIB calibrations are so designed that when expressed in their specified engineering units, all Parameter values normally lie in the range $– 10^{10}$ **..** $+ 10^{10}$. Thus the maximum expected value for the sum of squares for a supercommutated PSA HK Parameter during an arbitrarily extreme case of a 10-hour data Stream is less than +/- $300 * 10^{300}$ which is well within the magnitude range of floating-point variables in C++ programs, so no overflows should occur, barring errors in the MIB calibration data (or the calibration process). Nevertheless, a precaution will be taken against this possibility (see below).

There exists the possibility of floating-pont underflow in the accumulation of the sum of X^2 unless precautions are taken.

To avoid the possible occurrence of floating-point overflow or underflow, the following corrections will be applied in the statistics computation

For any Abs(X) < 1.0E-150, use the value 0.0 instead.

For any Abs(X) > 1.0E+150, use the value +/- 1.0E+150, but keep a count of these corrections per Parameter.

After computation of the statistics is complete, for each Parameter for which the value was capped to +/- 1.0E+150 output a Warning message to STDERR with the Parameter ID (or Parameter Base ID) and the count of corrections made. For these Parameters, output "******" (6 asterisks) in the Maximum value field of the statistics line.

The two threshold constants quoted above will be coded as HMCS MISCconfig parameters.