TITLE: # Planck LFI – Test Plan for the TMH/TQL software

DOC. TYPE: TECHNICAL NOTE

PROJECT REF.: PL-LFI-OAT-PL–009 **PAGE:** I of V, 97

ISSUE/REV.: 1.1 **DATE:** 13 Dec 2006

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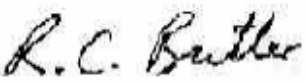
Approved by	**R.C. BUTLER** **LFI Program Manager**	**Date:** **Signature:**	**13 Dec 2006** 
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CHANGE RECORD

Issue	Date	Sheet	Description of Change	Release
0.0	2005 Oct 20		Starting of the document	
0.1	2005 Oct 28		First circulated draft, not all the tests are listed or completed, some quantitative aspects, as signal properties still TBD, some sw still TBD, cross checking of sw requirements and tests to be completed, document number to be assigned.	
0.2	2005 Nov 15		List of tests extended, comments to the 0.1 issue introduced, only limited circulation for editing.	
0.3	2005 Nov 18		Pre-issue for the first issue. Quite complete description of signals introduced, description of instruments introduced, test list extended, DAE description extended.	
1.0	2005 Nov 15		First Issue	
1.1	1006 Dec 13		All test cases defined have been reviewed. Added a traceability matrix for the TMH and TQL URDs	SGS-IR

TABLE OF CONTENTS

1 SCOPE

This document defines the end-to-end tests and calibration plan for the TMH / FM using RAA tests data and hardware equipment (EGESE, REBA, DAE) at ALENIA/LABEN site.

1.1 LIMITS OF APPLICABILITY

This document refers only to LFI / FM hardware and software and to the (TQL/TMH) / FM software developed for RAA tests.

This document refers to the functional end-to-end tests in which it is assumed that TQL/TMH have been already tested at unit level (i.e. stand-alone) using data provided from any other external source.

The stand-alone tests for TQL /TMH are outside the scopes of this document.

Other limitations depend on the Issue as will be specified in the following.

2 APPLICABLE/REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS

[AD-1] Planck-LFI Communications, ICD,
M. Miccolis
PL-LFI-PST-ID –013

[AD-2] Descrizione della REBA e del sw di bordo

[AD-3] Telemetry Handling System – User Requirements Document
F.Pasian, D.Maino, A.Zacchei
PL-LFI-OAT-UR-004

[AD-4] Planck LFI – DPC Software Integration and Testing Plan
F.Pasian et al
PL-LFI-OAT-PL-006

2.2 REFERENCE DOCUMENTS

[RD-1] Reconfiguration for LFI on-board data processing and scientific telemetry
M. Miccolis, A. Mennella, M. Bersanelli, M. Maris
PL-LFI-PST-TN-037

[RD-2] Planck LFI – Characterization of the Compression Rate for the New Baseline for the Scientific Data Streams Coding
M. Maris
PL-LFI-OAT-TN–029

[RD-3] Planck LFI – Characterization of the Onboard Processing Parameters
M. Maris
PL-LFI-OAT-TN–030

[RD-4] Planck LFI – Test Report on the TMH/TQ Type 1 and 2 Processing Using RAA Tests Data
M. Maris
PL-LFI-OAT-RP–012,

[RD-5] Data Acquisition Electronics (DAE) Interface Control Document
Roberto Silvestri:
PL-LFI-LAB-ID-003, TL 18324, Issue 3.0.

2.3 ACRONYMS LIST

ADU	Analog / Digital Unit
FP	Floating Point
TMH	Telemetry Handler
TMU	Telemetry Unscrambler
TQL	Telemetry Quick-Look
HK	House Keeping
AC	Acquisition Chain
DAE	Digital Acquisition Electronic
REBA	Radiometer Electronic Box Assembly

3 TEST PHYLOSOPHY

The scope of this test is to assess the operation of the TMH/TQL software vs. its requirements by using, as much as possible, the data generated by the QM and FM flight model of the instrument.

In particular, during the QM and FM campaign, dedicated tests, designed according to this plan, are performed to generate specific data to be used to test the TMH/TQL in each of its aspects.

In this section, after a short, introductive description of the TMH/TQL, the basic philosophy of the tests will be described and a short list of required data, sw and hw tools will be given.

3.1 MODEL OF THE ACQUISITION CHAIN

The complete *Acquisition Chain* (AC) of LFI is implemented through a *Digital Acquisition Electronic unit* (DAE) and the REBA. The first biases the radiometers (voltage drivers with relevant HK information) and digitizes the radiometric output signal (PGA, Offset removal and A/D conversion). All this information is used by the REBA for the construction of the telemetry packets.

The test is designed assuming a simple model of the AC [AD-3].

In the model the AC has:

1. a set of input gates we classify input gates as:
    a. HK digital gates (as an example the one sampling the status of a switch),
    b. HK analog gates sampled by an equivalent number of ADC,
    c. scientific gates sampled by an equivalent number of ADC,
2. an internal clock generating sampling periods and ON BOARD TIME (OBT);
3. an application SW performing on board processing of OBT, HK and Scientific data.
4. the details of the processing are defined by a set of processing parameters.

The AC:

1. accepts and executes telecommands;
2. changes the processing parameters by executing telecommands;
3. generates data packets;
4. the telemetric data are generated by the LFI AC. Data are formatted in packets according to [AD-3].
5. the scientific packets are self consistent, their content may be interpreted just looking to the packet content.

3.2 SHORT DESCRIPTION OF THE TMH/TQL

The TMH/TQL is a software dedicated to the handling of the Planck/LFI telemetric data [AD-3], both scientific and HK.

It shall provide:

1. acquisition and storage of TM packets from SCOS 2000,
2. time unscrambling operations,
3. decoding of TM packets,
4. conversion of content of TM packets into physical units,
5. creation of TOIs,
6. graphical display for Quick Look Analysis
7. simple on-the-fly analysis tools for Quick Look Analysis.
8. All of this both for scientific and HK packets.

The TMH/TQL is split into two applicative packages:

1. TQL in charge of on-the-fly display and data analysis
2. TMH in charge of final conversion of TM packets into TOIs

Within the SGS1 the TMH [AD-2] has the following tasks

1. to store packets from the instrument as they are sent to SCOS2000 without any modification and irrespectively of their content;
2. to unscramble the packets selecting them according to time stamp and content;
3. to decoded the packet content generating TOIs for each kind of information.

In each of these operations TMH generates intermediate files which may be analysed in order to check its outcome.

The data set associated to a given set is identified by the content of a directory with the same name of the test i.e. the *test-directory*.

Within a test-directory each subset of by products of the TMH are identified by the content of subdirectories, in particular:

`/tm` contains the raw telemetric packets, both science and HK, stored in FITS files, one file per hour of data acquisition

`/tmu` contains unscrambled telemetry with decoded headers but not decoded data, stored in FITS files, one file per data source, both science and HK

`/toi` contains TOIs, both of science and HK. Scientific data are decoded as SKY and LOAD, time stamps properly assigned to each sample, stored in FITS files, one file per data source and for REBA processing type (RAW for Type 0, AVR for Type 1, COM for Type 2). HK data are decoded and converted in voltages, and stored in FITS files, one for each HK parameter.

3.3 PHILOSOPHY OF THE TEST

To assess the most realistic conditions of testing, data generated from the real hw will be used during the test as much as possible.

Ideally, testing of TMH may be split into a test at unit level, with TMH running as a stand-alone software using input provided by any convenient external source and at end-to-end level with the TQL connected to the EGSE and the AC.

It shall be noted here, that it is assumed that the first level of testing has been already completed before to run the end-to-end tests, which are the scope of this document.

However, due to limits in the time which may be allocated for end-to-end testing at the testing site, it is expected that part of the data analysis for tests will be performed off-line, after the end of the data acquisition campaign for this testing.

The usage of simulated data, if any, will be limited only to cases which will be not possible to be simulated by the HW set-up.

Tests will have to assess:

1. proper coverage of the requirements for the TMH/TQL
2. validation of the TMH/TQL operations.

The main testing scheme will be *forward comparison* between the input data provided by the HW and the output data provided by the TMH.

In *forward comparison* a known signal / data-set will be injected in the TMH/TQL. Metrics will be applied to the output of TMH/TQL to assess the proper representation of the input. Depending on the kind of test, identity between input and output or statistical compatibility will be used as a criteria to assess the success or failure of the test.

As an example: packets will be decoded in order to check that the hexadecimal dump will work properly, in order to use the hexadecimal dump each time the exact packet content will have to be recovered.

In some cases *backward comparison* will be used to better identify the sw responsible for the problem and fix it.

Tests will be ordered according to the *functional classification* of requirements.

We identify the following functional classes of requirements:

1. Handling of raw TM packets
    a. Communication with SCOS
    b. Storing of raw packets
    c. Proper interpretation of primary and secondary headers
    d. Proper commutation of packets according to their purpose (TC, TM), source, service, size and time stamp.
    e. Hexadecimal dumping of packets content

f. Other packets related services (if any).
2. Handling of time information
3. Decompression, Decoding and Reconstruction of scientific packets content.
4. Decoding and Reconstruction of HK packets content.
5. TOIs generation
6. Graphical Display
7. On the flight software analysis
8. Other services

Note that there is a partial hierarchy of such classes so that few tests will be enough to test classes 1, 2 and 3. The logic then is to test early the basic functionalities, and then go to the higher level ones.

In addition, the content of the graphical display is better tested comparing it with TOIs, since the basic handling functionalities are in common with TOIs generation, but it is easiest to compare the graphical display with TOIs generated from the same date set, rather than the opposite.

Due to limits in the time for testing, only a limited subset of HK parameters will be tested. In particular the test covers the two kinds of HK calibration.

The same hold for the on-the-flight software analysis tools.

It is required that HW is able to provide:

1. a signal with known characteristics (time dependence, time phase, amplitude, shape).
2. an independent registration of the signal

Note that some of the tests have been already done in [RD-4].

3.4 TESTING OF HK PARAMETERS

HK parameters require a different testing philosophy.

First of all there are three classes of HK parameters
1. Memory HK parameters (usually in the SLOW telemetry)
2. HK parameters not requiring conversion
3. HK converted to physical units through a polynomial relation
4. HK converted to physical units through a lookup table.

Processing of the parameters of all of these classes will have to be tested.

Processing of HK parameters will be tested against:
1. Input known signal
2. SCOS 2000 analysis tools

in the assumption that SCOS 2000 tables are correct.

On the other hand, primary and secondary headers of HK packets are in common to scientific packets, so there is no need to tests separately the handling of the raw HK and scientific packets.

3.5 ANCILLARY SW AND TEST ANALYSIS LIBRARY

An IDL analysis library for testing is delivered by the DPC.

The library requires:

1. IDL 6.2
2. Astrolib
3. Healpix 1.2

The library shall operate on the output of the TMH (TM, TMU, TOI and LOG).

It shall provide the following functionalities:

1. scan scientific packets in TM files
2. scan scientific data in TMU files
3. scan scientific TOI
4. scan LOG files
5. decode time stamps in packets
6. decode OBT in TOI
7. gives a resume of the tertiary header parameters in TOIs
8. split tests into frames
9. detect pulses of known shapes within packets or TOIs
10. identify the source packet from which a given sample of a given OBT belong
11. provide a framework for higher order analysis methods
12. provide repeatability of tests and test analysis.
13. Provide simulation of AC/TQL processing for Type 2 data.
14. Provide comparison tools between TOIs and scientific packets.
15. Provide limited automated reporting.

Other required ancillary sw is:

1. KHexEdit
2. scientific calculator with hex/dec/oct/bin converter
3. LaTeX
4. FitsView (fv)

4 REQUIREMENTS ON THE INPUT SIGNAL

Input signals of known properties shall be injected in the AC/TQL chain in order to test the behaviour of the system.

This section describes the requirements for the input signals.

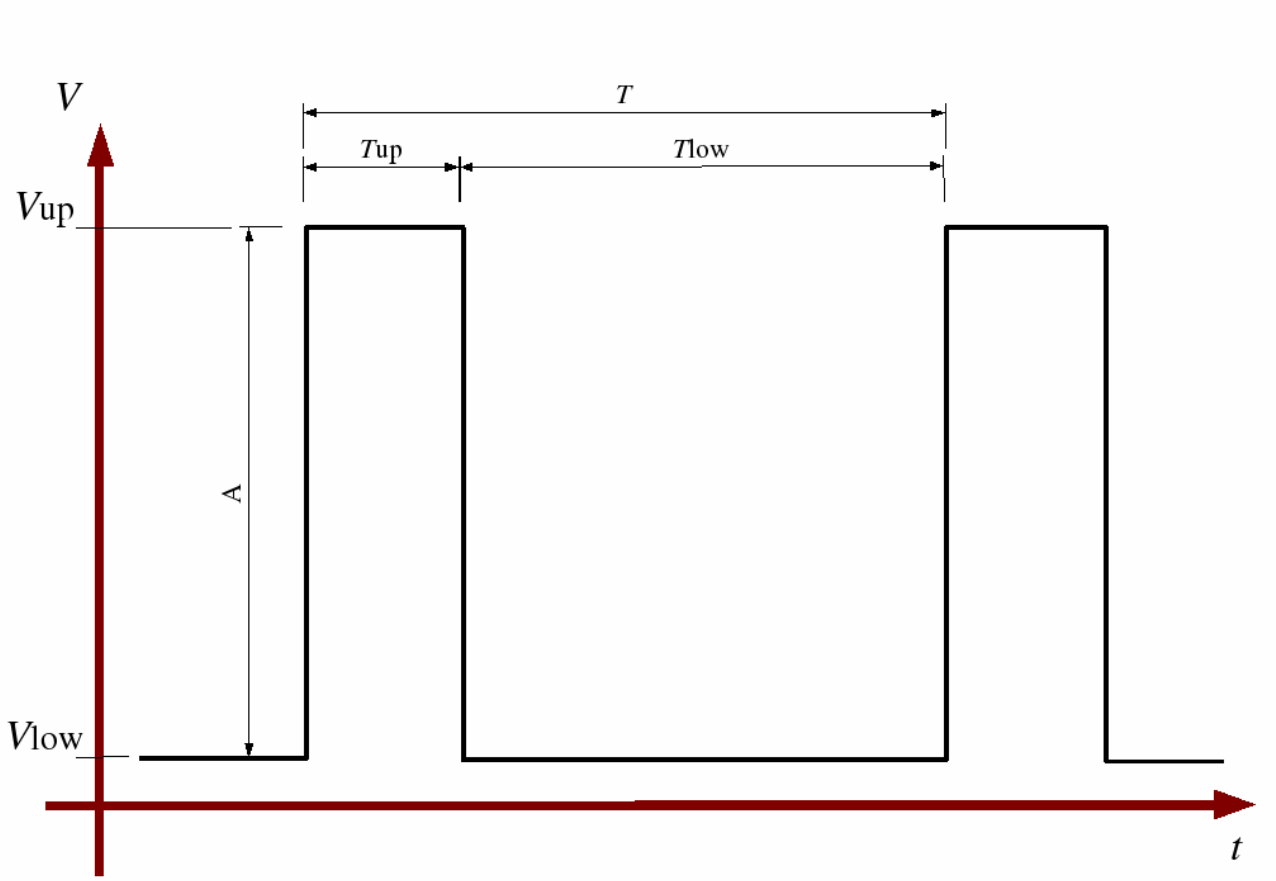

Fig. 1 Parameters describing the main features of the known signal.

4.1 GENERALITIES

Fig.1 illustrates the parameters defining the input signal in addition to the shape:

1. The period *T*
2. The duration of the *high* state *T*up
3. The duration of the *low* state *T*down

4. The duty cycle *T*up/*T*.
5. The *low* state voltage *V*low
6. The *high* state voltage *V*up
7. The peak-to-peak amplitude *A* = *V*up – *V*low.

In general the source of the signal shall assure

1. Shape shall be known accurately
2. Duty cycle shall be known within 10% of the sampling period
3. The relative phase shall be known
4. The amplitude shall assure at least S/N~20.
5. The signal shall fit the range of voltages acceptable to the Input Gate at which it is connected,
6. The signal shall fit the range of voltages acceptable to the Input Gate at which it is connected,
7. The signal shall be stable, within the quantization step of the ADC converter at which the input signal will be applied.
8. Vlow, Vup, Tp, Td shall be adjustable within a wide range of values.

In particular to test the scientific acquisition, denoting with *T*adc the sampling period of the ADC converter (*T*adc ~ 1/8 KHz) and Tsci the sampling period of the scientific telemetry

$$Tsci = Naver\ Tadc$$

we require:

$$3\ Tadc \leq Thigh \leq 10\ Tsci \sim 400\ Tadc$$

$$5\ Tadc \leq T \leq 100\ sec$$

For the HK TM provided that the sampling time *T*hk is 1 sec:

$$3\ Thk \leq Thigh \leq 10\ Thk \sim 10\ sec$$

$$9\ Thk \leq Thigh \leq 100\ Thk \sim 100\ sec$$

The stability of the signal shall be assured by using an oscilloscope or other adequate analysis instrument.

4.2 DAE ANALOG GATES DESCRIPTION

The way in which the signal is recorded depends on the way the signal is processed by the analog gates.

4.2.1 DAE SCIENTIFIC ANALOG GATES

The signals entering a scientific analog gate is processed in two steps:

a. Preprogrammed differential amplification
b. ADC converter

The differential amplification formula for an Input signal Vin into an output Vout is

$V_{out} = DAE\_Gain*(V_{in} - DAE\_Offset)$.

Only a limited set of values for DAE_Gain and DAE_Offset are allowed. Values are fixed by TCs through a lookup table. The exact calibration of the lookup table depends on the analog gate taken in consideration, but they have the following averaged values

DAE_Gain = 1, 2, 3, 4, 6, 8, 12, 16, 24, 48.

DAE_OFFSET = from +0 up to +2.5 V, 256 steps of ~0.0097656 V.

It has to be noted that always DAE_Offset > 0 and DAE_Gain > 1.

The analog-to-digital converter (ADC) is a 14 bits uniform quantizer, which quantizes the V_{out} in uniform steps.

The ADC accepts voltages in the range $-2.5\ V \leq V_{ADC} \leq +2.5\ V$.

The quantization step is (assuming no sign bit is used): q_{adc}=0.30518 mV.

The output is a 14-bits unsigned integer in the range $[0_{dec}, 16383_{dec}]$ with 0_{dec} for V_{ADC} = -2.5 V, 8191_{dec} for V_{ADC} = +0.V and 16383_{dec} for V_{ADC} = +2.5 V.

The ADC has a linear response in the range $-1.2\ V \leq V_{ADC} \leq +1.2\ V$ (from 4259_{dec} to 12124_{dec}).

The maximum range of voltages expected from the BEM input to the DAE scientific analog gates is $-0.8\ V \leq V_{BEM} \leq +0.8\ V$.

4.2.2 DEFAULT SETUPS FOR THE DAE SCIENTIFIC ANALOG GATES

The default values assume all over the plan, unless specified, are

DAE_Gain = 1

DAE_OFFSET = +0 V

However it would advisable to perform some test varying these parameters too.

4.2.3 DAE HK ANALOG GATES

HK data covers both SW variables (as an example the codes for DAE_Gain and DAE_Offsets) as well as sensor data. Unlike the DAE, the HK analog gates have not a differential amplifier in input so that the ADC senses directly the V_{in}.

The ADCs for these gates are identical to those used for the scientific analog gates.

4.3 CONSTANT SIGNALS

In some cases constant signals shall be applied to detectors.

We classify signals as follow:

1. UCS – Underflow Constant signal is a signal with a voltage below the lower ADC range.
2. BCS – Baseline Constant Signal is a signal with a voltage equal to the lower ADC range.
3. LCS - LOW Constant Signal is a signal with a voltage Vlow usually below half of the ADC range.
4. ZCS - ZERO Constant Signal is a signal with a voltage Vzer usually equal to half of the ADC range.
5. HCS - HIGH Constant Signal is a signal with a voltage Vup usually above half of the ADC range.
6. TCS – Top Constant Signal is a signal with a voltage equal to the upper ADC range.
7. OCS – Underflow Constant signal is a signal with a voltage over the upper ADC range.

These definitions refer to the kind of stimulus sent to the ADC taking in account of DAE Gain and Offset.

Unless specified and for DAE_Gain =1, DAE_Offset = +0 V, the signals are so defined:

	UCS	**BCS**	**LCS**	**ZCS**	**HCS**	**TCS**	**OCS**
Value	-1.5 V	-1.2 V	-0.8 V	+0.0 V	+0.8 V	+1.2 V	+1.5 V

Other cases will be scaled according to DAE Gain and Offset.

In general, unless specified, it is assumed that ALL the detectors of a radiometer at which a variable signal is NOT applied are connected to a ZCS generator.

The expected statistical indicators on these kinds of signals are, for a noisless signal:

	Mean	**Variance**	**RMS**
LCS	Vlow	0	0
ZCS	Vzer	0	0
HCS	Vup	0	0

4.4 SQUARE PULSES

A list of square pulses is illustrated in the following tables.

The column of scopes defines the main scopes the pulse is designed for.

Scopes are:

[1] : Registration
[2] : OBT reconstruction
[3] : Calibration

The column of Length is the time required for acquisition per detector.

Pulses are classified as: SP-SCI-<<TYPE>>-<<NUMBER>>, ex: SP-SCI-T0-001

Remember that pulse fitting requires:

1. Tup >= to at least three samples
2. T – Tup >= to at least three samples
3. At least 2 pulses per packet
4. At least 10 packets

Pulses for Type 0 Testing

Code SP-SCI-T0	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	10	1/66	1.5252	10	Vmin+0.1Range	Vmax – 0.1range
002	2, 3	10	1/33	2.0504	10	Vmin+0.1Range	Vmax – 0.1range
003	2, 3	10	1/11	4.1008	10	Vmin+0.1Range	Vmax – 0.1range
004	3	0.5	1/33	2.0504	10	Vmin+0.1Range	Vmin + 0.2range
005	3	0.5	1/33	2.0504	10	Vmin+0.1Range	Vmin + 0.4range
006	3	0.5	1/33	2.0504	10	Vmin+0.1Range	Vmin + 0.5range
007	3	0.5	1/33	2.0504	10	Vmin+0.1Range	Vmax + 0.6range
008	3	0.5	1/33	2.0504	10	Vmin+0.1Range	Vmax + 0.8range
009	3	0.5	1/33	2.0504	10	Vmin+0.1Range	Vmax + 1range

For Type 1 and following pulses depends on Naver, here the list refers to the case of Naver = 126 other cases (for other radiometers or Naver) will be obtained scaling consequently times and periods.

Pulses for Type 1, 4 Testing Naver = 126

Code SP-SCI-T1	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	10	0.5	50	10	Vmin+0.1Range	Vmax – 0.1range
002	2, 3	10	1.0	100	10	Vmin+0.1Range	Vmax – 0.1range
003	2, 3	10	2.0	200	10	Vmin+0.1Range	Vmax – 0.1range
004	3	5	1.0	100	10	Vmin+0.1Range	Vmin + 0.2range
005	3	5	1.0	100	10	Vmin+0.1Range	Vmin + 0.4range
006	3	5	1.0	100	10	Vmin+0.1Range	Vmin + 0.5range
007	3	5	1.0	100	10	Vmin+0.1Range	Vmax + 0.6range
008	3	5	1.0	100	10	Vmin+0.1Range	Vmax + 0.8range
009	3	5	1.0	100	10	Vmin+0.1Range	Vmax + 1range

In addition an high duration test lasting over many hours (during the night) would have to be planned.

Pulses for Type 2, 3, 5, 6 Testing Naver = 126

Code SP-SCI-T2	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	10	0.5	50	10	Vmin+0.1Range	Vmax – 0.1range
002	2, 3	10	1.0	100	10	Vmin+0.1Range	Vmax – 0.1range
003	2, 3	10	2.0	200	10	Vmin+0.1Range	Vmax – 0.1range
004	3	5	1.0	100	10	Vmin+0.1Range	Vmin + 0.2range
005	3	5	1.0	100	10	Vmin+0.1Range	Vmin + 0.4range
006	3	5	1.0	100	10	Vmin+0.1Range	Vmin + 0.5range
007	3	5	1.0	100	10	Vmin+0.1Range	Vmax + 0.6range
008	3	5	1.0	100	10	Vmin+0.1Range	Vmax + 0.8range
009	3	5	1.0	100	10	Vmin+0.1Range	Vmax + 1range

Pulses for HK Testing

Code SP-HK	Scopes	Length [min]	Period [1/Hz]	Tup [sec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	10	60	30	50	Vmin+0.1Range	Vmin + 0.8range
003	3	5	60	30	50	Vmin+0.1Range	Vmin + 0.2range
004	3	5	60	30	50	Vmin+0.1Range	Vmin + 0.4range
005	3	5	60	30	50	Vmin+0.1Range	Vmin + 0.5range
006	3	5	60	30	50	Vmin+0.1Range	Vmin + 0.6range
007	3	5	60	30	50	Vmin+0.1Range	Vmin + 0.8range
008	3	5	60	30	50	Vmin+0.1Range	Vmin + 1.0range

The expected statistical indicators for square pulses (assuming to average over an integer number of periods) and for a noisless signal are:

Mean $\langle V \rangle = (Tup*Vup + Tlow*Vlow)/T$

Variance $Var(V) = [(Vup - \langle V \rangle)^2*Tup + (Vlow - \langle V \rangle)^2*Tlow]/T$

In particular for a signal with Tup/Tlow = 1.

Mean $\langle V \rangle = (Vup + Vlow)/2$

Variance $Var(V) = (Vup - Vlow)^2$

4.5 TRIANGULAR PULSES

A list of triangular pulses is illustrated here.

Triangular pulses are used to assess proper time ordering, calibration, compression and display.

Triangular pulses shall be asymmetrical (long rising ramp, short decreasing ramp).

A ramp shall cover more than one packet in time and at least 10 cycles would be provided.

Pulses for Type 0, 1, 2, 3, 4, 5, 6 Testing

Code TP-SCI-T0	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	1	1	900	90	-0.8	+0.8
002	2, 3	1	1	900	90	-1.2	+1.2
003	2, 3	1	1	900	90	-2.5	+2.5
004	2, 3	5	10	9 000	90	-1.2	+1.2
005	2, 3	5	60	54 000	90	-1.2	+1.2

Pulses for Type 1, 2, 3, 4, 5, 6 Testing

Code TP-SCI-T1	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	2	2	900	90	-0.8	+0.8
002	2, 3	2	2	900	90	-1.2	+1.2
003	2, 3	2	2	900	90	-2.5	+2.5
004	2, 3	5	10	9 000	90	-1.2	+1.2
005	2, 3	5	60	54 000	90	-1.2	+1.2
006	2, 3	10	60	54 000	90	-2.5	+2.5

Pulses for HK Testing

Code TP-HK	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	1	10	9000	90	-2.5	+2.5

4.6 SINUSOIDAL PULSES

A list of sinusoidal pulses is illustrated here.

Sinusoidal pulses are used to assess proper time ordering, calibration, compression, display and FFT testing (Scope 4).

In addition sinusoidal pulses may be used to verify the relative calibration of the OBT scale, simply measuring the cross-correlation between the same sinusoidal pulse injected into two different analog gates.

Pulses for Type 0, 1, 2, 3, 4, 5, 6 Testing

Code SP-SCI-T0	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1,2,3	480	0.1			-0.8	+0.8
002	1	5	1			-0.8	+0.8
003	2, 3	1	1			-1.2	+1.2
004	2, 3	1	1			-2.5	+2.5
005	2, 3	5	10			-1.2	+1.2
006	2, 3	5	60			-1.2	+1.2

Pulses for Type 0, 1, 2, 3, 4, 5, 6 and HK Testing

Code SP-SCI-T1	Scopes	Length [min]	Period [1/Hz]	Tup [msec]	Duty Cycle [%]	Vlow [V]	Vhigh [V]
001	1, 2, 3	5	5			-0.8	+0.8
002	1	480	5			-0.8	+0.8

4.7 INSTRUMENTATION

In this section the instrumentation required is described.

4.7.1 SIGNAL GENERATOR

A signal generator with the following features is required:

1. At least two independent channels
2. V_{out} in the range -3 V, +3 V.
3. Voltage resolution 0.15 mV.
4. Frequency coverage 1/60Hz up to 10 KHz.
5. Waveforms: squared, triangular and sinusoidal.
6. Dutycicle variable between 5% and 95%.
7. Stability in frequency 1:1e4 over 24 hours.
8. Stability in phase 0.01 sec over 24 hours
9. Stability in voltage

It would be desirable to have the ability to modulate the signal.

4.7.2 MEASURE INSTRUMENTS

Digital Multimeters

1. measure scale -3V, +3V
2. resolution: 1 mV.

We need 2 digital multimeters.

Oscilloscope

1. two channels oscilloscope

4.7.3 SIGNAL DISTRIBUTOR

Some times the same signals shall be distributed to different inputs.

A signal distributor shall be used with the following requirements.

1. Minimizes signal distortion at 10 KHz.
2. Splits the input signal in up to four channels.
3. Allows to measure the signal at input and output.

The simplest electrical scheme is represented by a multiple connector.

4.7.4 CONSTANT SIGNAL GENERATOR

A generator of stable and constant signals is required.

The generator shall assure

1. stability over time scales of hours
2. Possibility to verify the voltages
3. no ripples
4. Range of voltages -2.5 V, -1.2 V, -0.8 V, 0.0V, +0.8 V, +1.2 V, +2.5 V.
5. Ability to switch between different voltages in sequence.
6. Ability to overlap with the signal generator.

An example of such constant signal generator (covering only two voltages) is in the figure below.

The input I1 and I2 are connected to the output of the signal generator. I1 is for the ground or the zero point. The output is O1 and O2, O1 for ground. Two identical batteries B1 and B2 are the voltage generators. The switch S is used to select the signal which is wanted to send in output. Note that in position 1 the signal is the signal of the signal generator, while in 5 no signal is sent. M11, M12, … M32 are connections for a measure instrument.

The device is used to:

1. send constant signals.
2. send sequences of pulses used to split the frames during the tests.

This device would be useful for qualitative tests, as those in which the registration of signals is simply measured.

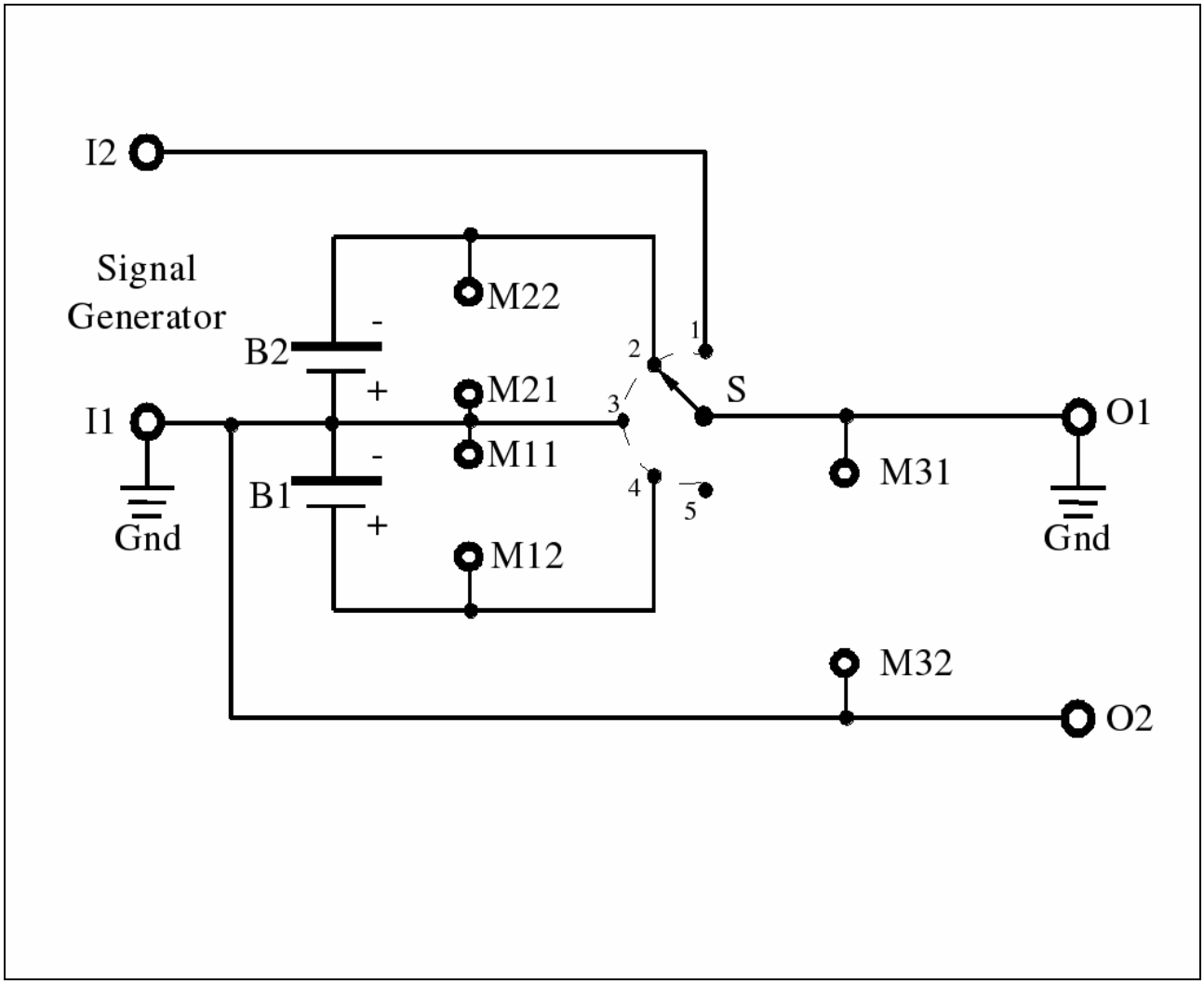

Figure 2: An example of constant signal generator.

5 TESTS FRAMING AND SYNCRONIZZATION

Each test is split into *FRAMES*.

Each frame has one specific task within the test.

Each frame is characterized by:

1. frame number (0…)
2. frame scope
3. frame OBT interval
4. AC parameters SETUP.

Each frame has a START and an END recorded in the operator log.

Marker for the begin of frame is an entry in the operator log of the kind

#FRAME_START [number]

Marker for the end of frame is an entry in the operator log of the kind

#FRAME_END [number]

All the tests begins with a mandatory FRAME 0.

The frame 0 has the task of synchronizing (within 5 sec accuracy) the OBT with the operator LOG.

The frame 0 is generated according to the following procedure:

1. test initiated with acquisition off,
2. the log message: #FRAME_START 0 is added to the log
3. the acquisition is started and left to run for 60 sec.
4. the log message #FRAME_END 0 is added to the log
5. the analysis s/w will correlate the operator log time for #FRAME0_START with the OB_TIME when the acquisition start to fix a correlation between OBT and UTC.

Note that since framing has only the scope of allow automatic splitting of data sets, an accuracy of 5 seconds in synchronization is sufficient.

6 TESTS ORDERED BY CLASSES

6.1 HANDLING OF RAW TM PACKETS

6.1.1 PURPOSES

To assess that all the TM packets are received and stored.
To assess the proper handling of the SCOS 2000 header in the packets fits files.
To assess hexadecimal dumping of packets content
To assess the proper interpretation of primary and secondary headers.
To assess proper commutation of packets according to their purpose (TC, TM), source, service, size and time stamp.
To assess services related to other packets (if any).

6.1.2 LOGIC

A uniform source of packets is activated, SCOS 2000 log will be used to take track of the list of packets sent to the TQL and of their SCOS 2000 header. The packet database will be then scanned to check whether all the packets are present, and whether the SCOS header are properly interpreted.

6.1.3 REQUIRED DATA SET

Streams of telemetry packets, generated by AC, in different conditions of work load.

6.2 HANDLING OF TIME INFORMATION

6.2.1 PURPOSES

To assess that all the time information is properly processed and reported in TOIs.

Note that this test is critical in order to assess that all the analysis carried on scientific data is not hampered by un-proper matching of data due to errors in OB_TIME calculation.

6.2.2 LOGIC

A signal with a very sharp waveform (ideally an impulsive function) and regular time dependence is generated by the hardware for a single radiometric channel.

AC will process it as type 0 or type 1.

TQL will generate the related TOI.

The test is passed if the relative OBT and UT of impulses as detected in the TOI corresponds to those introduced in the signal.

The test will be complemented by checking proper identification of OBT of samples at the beginning of a packet and the corresponding OBT in the TOIs.

6.2.3 REQUIRED DATA SET

A data stream of pulses with

1. fixed zero point.
2. fixed amplitude
3. known time spacing.
4. known AC processing parameters
    a. Processing type (either 0 or 1)
    b. Naver
    c. Processing group

Time spacing will have to be large enough to assess that pulses are separated by more than 10 rebinned samples but that there are at least two pulses into a packet.

The accuracy in time spacing determination shall be better than 1/10000 sec.

6.3 DECOMPRESSION, DECODING AND RECONSTRUCTION OF SCIENTIFIC PACKETS CONTENT

6.3.1 PURPOSES

To assess that all the information in scientific packets content is properly processed

6.3.2 LOGIC

A signal of known amplitude and time shape is injected into the AC/TQH scientific ADC gates, the AC acquires in two modes at a time the signal (e.g. mode 1, mode 2), the TMH generates the TOIs with the data streams, the signals acquired in the two modes are compared each other and with the known signal. Various combinations of processing modes and processing parameters will be tested. Metrics for the test will be statistical moments of differences between the various acquisition modes and the original signals. The test will be considered successful if the difference will not be greater than the processing error expected from simulations and/or theoretical formulae.

6.3.3 REQUIRED DATA SET

Data stream of pulses.

Data stream of triangular signals.

Each data stream acquired with different combinations of acquisition parameters.

Part of the data stream of pulses may be the same used for the test of OBTIME processing.

Electrical features of pulses shall assure:
1. High S/N.
2. Covering of a significant part of the dynamical range of the input gate.

6.4 DECODING AND RECONSTRUCTION OF HK PACKETS CONTENT

6.4.1 PURPOSES

To assess that all the information in HK packets is properly processed.

6.4.2 LOGIC

A signal of know amplitude and time shape is injected into the AC/TQL HK gates, the signals acquired are compared with the known input signal. Metrics for the test will be statistical moments of differences between the various acquisition modes and the original signals. The test will be considered successful if the difference will be not greater than the processing error expected from: simulations and / or theoretical formulae. A preliminary comparison with the know signal will be performed graphically also with the SCOS 2000 graphic display for the HK parameters for which a graphical representation in SCOS 2000 exists.

6.4.3 REQUIRED DATA SET

Data streams of pulse with pulse parameters compatible with HK sampling time.

Data stream of triangular signals.

Electrical features of pulses shall assure:
1. High S/N.
2. Covering of a significant part of the dynamical range of the input gate.

6.5 GRAPHICAL DISPLAY

6.5.1 PURPOSES

To assess that the graphical display reflects the content of TOIs

6.5.2 LOGIC

The test will be carried on at two separate stages:

1. a preliminary, on-the-fly test, which will assess qualitatively that the TQL displays properly the data for all acquisition modes and data sources, the test will be considered successful if the displayed signal will correspond to the input signal. In particular it will have to be assed the consistency of the source identification (example: sky/load identification). For HK it will have also assessed that the displayed data corresponds to the SCOS display.
2. off-line, the playback ability of the TQL will be exploited in order to obtain the generation of snapshots of the displayed data, to be compared with TOIs content displayed by using tools as IDL or fv.

The test will be considered successful if the graphical display will be able to properly represent the data.

Part of this tests could be performed in parallel to the functional end-to-end verification of the TQL+DAE+REBA+EGSE, where an input signal of known amplitude is fed to the DAE (on each channel separately) and the TQL output verified. The remaining will be performed off-line.

6.5.3 REQUIRED DATA SET

The same data sets used for the remaining part of the tests.

6.6 ON-THE-FLY SOFTWARE ANALYSIS

6.6.1 PURPOSES

To assess that on-the-fly analysis software is correct.

6.6.2 LOGIC

The on-the-fly analysis software is part of the TQL.

This test will be carried on off-line using the playback ability of the TQL.

Compared to other tests, this set of tests is of lower priority and may be performed even on archived data.

An input data stream will be analyzed off-line with IDL which will simulate snap-shots of the results expected from the function under verification.

The results will be compared graphically with the output of the function under verification.

6.6.3 REQUIRED DATA SET

Data streams of pulse with pulse parameters compatible with HK sampling time.

Data stream of triangular signals.

Data stream of sinusoidal signals.

7 TEST CASE CONTROL SHEETS

This is a list of test control sheets.

7.1 DEFINITIONS

Resume of Sci Packets
the information contained in the HDR file reporting for each packet:

1. the content of the headers of packet
2. the binary statistics of the data in the packet

Raw Packets Content
The binary content of the selected packets without any transformation. This may be recovered from /tmu directory.

FSP
First Sample in the Packet

7.2 HANDLING OF RAW TM PACKETS

The ID codes for this kind of test will be:

RAW-TM-nnn

for any kind of telemetry,

RAW-SCI-nnn

for science telemetry and

RAW-HK-nnn

for HK telemetry.

TEST CONTROL SHEET	**ID:** RAW-TM-01 **Title:** Receiving of all the packets **Type:** Raw Packets Handling	**Model: FM**

OBJECTIVE:

To verify that all the packets delivered by SCOS 2000 during a particular test are received.

INSTRUMENTS REQUIRED:

None

ANCILLARY SOFTWARE REQUIRED:

1. Packet scanner in TM data file

DATA-SETS REQUIRED:

1. TM data files
2. Log of SCOS 2000 with the list of packets processed

TEST METHOD:

1. Compare the log of SCOS 2000 packets sent in output with the list of packets stored by the TMH into TM directory..
2. The test shall be carried on with different workloads.

OUTPUTS:

Estimates of number of packets lost by the TQL.

ENVIRONMENTAL NEEDS:

None

PASS/FAIL CRITERIA:

No packets should be lost.

TEST CONTROL SHEET	**ID:** RAW-TM-02 **Title:** Packets Commutation **Type:** Raw Packets Handling	**Model: FM**

OBJECTIVE:

To verify that all of the packets received are properly commutated in the TM file.

INSTRUMENTS REQUIRED:

Generator of pulses

ANCILLARY SOFTWARE REQUIRED:

1. Packet scanner in TM data file
2. Packet scanner in TMU data file
3. TOI scanner

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. The pulse generator is applied to one of the input gates of the AC.
2. For each packet in the TM data file verify if it has been properly copied in the tmu file and then in the proper TOI.
3. Compare the log of SCOS 2000 packets sent in output with the SCOS headers for packets stored by the TMH into TM directory.
4. The test shall be carried on with different workloads.

OUTPUTS:

Estimates of number of errors in interpretation.

ENVIRONMENTAL NEEDS:

None

PASS/FAIL CRITERIA:

No errors should occur.

7.3 HANDLING OF TIME INFORMATION

The ID codes for this kind of test will be:

OBT-DDR-nnn

for science telemetry and

OBT-HK-nnn

for HK telemetry.

TEST CONTROL SHEET	**ID:** OBT-SCI-01a **Title:** Scientific OBT Reconstruction **Type:** Time Handling	**Model: FM**

OBJECTIVE:

To verify that the OBT is properly reconstructed by the TMH/TQL in scientific data.

INSTRUMENTS REQUIRED:

1. A well defined scientific channel, i.e.: FH, Detector, Radiometer
2. The EGSE/REBA/DAE equipment.
   a. Set up to generate only on the selected channel
      Processing A : Type 0
      Processing B : Type 1 for a defined Naver
3. The signal generator
   a. connected to the selected channel plug
   b. generating pulses

ANCILLARY SOFTWARE REQUIRED:

1. Pulse analyzer on TOI
2. Packet time

DATA-SETS REQUIRED:

1. TOIs produced from the input data
2. Resume of SCI Packets

TEST METHOD:

1. Pulses generated by the signal generator are recorded.
2. Pulse OBT differences in TOIs are measured and compared to the pulse time differences in the generator.
3. Pulse time differences reconstructed by using the OBT in calculating the TOIs, differences shall be compared with the time differences expected from the signal generator.
4. The test shall be carried on for different combinations of pulse periods and Naver.

OUTPUTS:

1. Estimates of OBT calculation error for different processing types and Naver.
2. TOIs of pulses

ENVIRONMENTAL NEEDS:

None

PASS/FAIL CRITERIA:

The errors in the estimated OBT shall never exceed the sampling time resolution:

1. 8KHz for Type 0.
2. 8KHz / Naver for Type 1.

TEST CONTROL SHEET	**ID:** OBT-SCI-01b **Title:** Scientific OBT Reconstruction **Type:** Time Handling	**Model: FM**

OBJECTIVE:

To verify that the association of data in TOIs to the original packets is possible using only the OBT.

INSTRUMENTS REQUIRED:

NONE

ANCILLARY SOFTWARE REQUIRED:

1. Pulse analyzer on TOI
2. TMU Packet Analyser

DATA-SETS REQUIRED:

1. The same of OBT-SCI01a
2. raw packets content
3. Resume of SCI Packets

TEST METHOD:

1. Pulses generated by the signal generator are recorded.
2. Pulse of OBT differences in TOIs are measured and compared to the time stamp of each packet
3. Number of samples between the pulse and the FSP is calculated
4. The position of the pulse in the packet is identified
5. It is compared the sample number where the pulse is found in the packet with the sample number in the TOI relative to the OBT at which the packet starts.
6. The test shall be carried on for different combinations of pulse periods and Naver.

OUTPUTS:

Estimates of OBT calculation error for different processing types and Naver.

ENVIRONMENTAL NEEDS:

None

PASS/FAIL CRITERIA:

The test is passed if looking both in the position of pulses relative to the packet first sample is the same in TOI and in packets.

TEST CONTROL SHEET	**ID:** OBT-SCI-01c **Title:** Scientific OBT Reconstruction **Type:** Time Handling	**Model: FM**

OBJECTIVE:

To verify that the association of data of Type 0 to data of Type 1 is possible through the OBT analysis.

INSTRUMENTS REQUIRED:

None

ANCILLARY SOFTWARE REQUIRED:

1. Pulse analyzer on TOI

DATA-SETS REQUIRED:

3. TOIs produced from the input data
4. Resume of SCI Packets

TEST METHOD:

1. Pulses generated by the signal generator are recorded.
2. Pulses OBT are compared with the OBT of the FSP of each packet for each data type and the number of samples between the pulse and the begin of packet shall be same.
3. Conversion between sample index in the packet of Type 0 to Sample index in packets of Type 1 is performed.
4. The calculated Type 1 index and the expected Type 1 (from measures) are compared.
5. The test shall be carried on for different combinations of pulse periods and Naver.

OUTPUTS:

Estimates of relative OBT calculation error between different processing types and Naver.

ENVIRONMENTAL NEEDS:

None

PASS/FAIL CRITERIA:

The two indexes shall coincide always.

TEST CONTROL SHEET	**ID:** OBT-SCI-03 **Title:** Scientific OBT Reconstruction **Type:** Time Handling	**Model: FM**

OBJECTIVE:

To verify that the association of data of different Types is possible through the OBT analysis.

INSTRUMENTS REQUIRED:

None

ANCILLARY SOFTWARE REQUIRED:

1. Pulse analyzer on TOI

DATA-SETS REQUIRED:

1. TOIs produced from the input data
2. Resume of SCI Packets

TEST METHOD:

1. A sinusoidal signal is splitted and injected in the Sky and Load channels of a single radiometer, data are recorded and TOIs generated.
2. Data shall be acquired at least either as type 0 and type 1 or type 2 and type 5.
3. Sinusoids are compared in the two channels.
4. The relative phase shift, frequency shift, frequency width of the FFT of the two sinusoids is measured.
5. The test shall be carried on for at least 3 hours in order to asses the proper time resolution, for this reason it is suggested to run it at night.
6. The sinusoids shall not saturate the AC converter, as they should assess a good S/N. An amplitude spanning nearly all of the AC range shall be considered. The frequency shall be selected according to the sampling frequency of the scientific acquisition mode. As an example, with a 100 Hz sampling frequency, the highest frequency for the sinusoid shall be 10 Hz.

OUTPUTS:

Estimates of relative phase shifts, frequency shifts, peak width of the FFT of the sinusoids.

ENVIRONMENTAL NEEDS:

None

PASS/FAIL CRITERIA:

The phase shift shall not exceed the 1/8000sec.

The frequency shift shall not exceed the peak width.
The peak width shall not exceed 1/T, where T is the time over which data are continuously acquired.

7.4 DECOMPRESSION, DECODING AND RECONSTRUCTION OF SCIENTIFIC PACKETS CONTENT

The ID codes for this kind of test will be:

DDR-SCI-nnn

TEST CONTROL SHEET	**ID:** DDR-SCI-001 **Title:** Scientific Data Registration **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that scientific data are properly registered in TOIs.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
Signal generator with a constant signal applied both to load and sky detector.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Data are generated for a single FH, DTC and Radiometer.
2. Data are acquired just for the given FH, DTC and Radiometer; other acquisitions are suspended.
3. Acquisition shall be organized according to the following scheme

For each acquisition mode:

1. Acquire only processing group A
2. Acquire only processing group B
3. Acquire both processing groups A and B

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. Only TOIs corresponding to the FH, DTC and Radiometer considered are generated.
2. Only the TOIs corresponding to the expected processing type are generated.

3. In case of data coming from different processing groups it shall be possible to distinguish whether they come from Processing Group A or B even if the two processing groups are used to generate the same kind of data.

TEST CONTROL SHEET	**ID:** DDR-SCI-002 **Title:** Scientific Data Sky/Load Registration of Type 0, 1, 2, 4, 5 **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that scientific data of Type 0, 1, 2, 4 and 5 are properly registered in TOIs according to the Phase Switch parameter.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
Signal generator connected to SKY with a constant and HIGH signal in SKY.
Signal generator connected to LOAD with a constant and LOW signal in LOAD.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Data are generated for a single FH, DTC and Radiometer putting alternatively the radiometer switching ON or OFF.
2. Data are acquired just for the given FH, DTC and Radiometer; other acquisitions are suspended.
3. This test shall be carried on for Types 0, 1, 2, 4, 5:
   a. For Type 2 and Type 5 data it shall be assumed: GMF1 = 1; GMF2 = -1; Offset_Adjust = 0; SECOND_QUANT = 1;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if, according to the phase switch flag and the switching status:

1. For all of the processing types the HIGH signals are classified properly as SKY.
2. For all of the processing types the LOW signals are classified properly as LOAD according to the phase switch flag.

TEST CONTROL SHEET	**ID:** DDR-SCI-003 **Title:** Processing Type 0 Conversion **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Processing Type 0 data are properly converted in TOIs.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer.
   b. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 0 data.
      i. Pulse periods shall be in the range of 0.02 sec, T_{up} shall be in in the range of some 1/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
2. Type 0 data are recorded just from the Feed Horn under examination.
3. Data are recorded in both the processing group A or B.
4. Pulse detection and fitting is applied to both Sky and Load.
5. Amplitudes of detected pulses shall be analyzed examining the following properties:
   a. The measured offset in ADC units;
   b. the measured amplitude in ADC units;
   c. the measured offset in Volts;
   d. the measured amplitude in Volts;
   e. the quantization level in ADC units: q_{adc};
   f. the quantization level in Volts;
   g. the difference between the input signal and the output signal;
   h. the effect of saturation.

OUTPUTS:

Estimated signal parameters in ADC units and Volts and the differences with the input signal.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are equal to the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occurs between the two processing groups.
5. No pulses shall appear in Load if the signal generator is applied to sky and “vice versa”.
6. No pulses shall appear in any detector of the FH at which the signal is not applied.

TEST CONTROL SHEET	**ID:** DDR-SCI-004 **Title:** Processing Type 1 Conversion **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 1 data are properly acquired and converted.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Pulses generated by the signal generator are recorded as follow:
   a. Either processing A for Type 0 and Processing B for Type 1 or the reverse.
   b. For Type 1 different values of Naver shall be considered over the nominal Naver for the FH under examination.
   c. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer.
   d. Sequences of pulses with different amplitudes, zero point , and duty cycles are generated to tests the full range of possible values of Type 0 data.
      i. Pulse periods shall be in the range of ½*Naver/8000 sec, T_{up} shall be in in the range of some Naver/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
2. Type 0 data and Type1 data are recorded just from the Feed Horn under examination.
3. Pulse detection and fitting is applied to both Sky and Load and both Type 0 and Type 1.
4. Amplitudes of detected pulses shall be analyzed for Type 1 examining the following properties:
   a. The measured offset in ADC units;
   b. the measured amplitude in ADC units;
   c. the measured offset in Volts;
   d. the measured amplitude in Volts;
   e. the quantization level in ADC units;
   f. the quantization level in Volts;

g. the difference between the input signal and the output signal;
h. the effect of saturation;
i. comparison with the expected Type 1 data derived from Type 0;

OUTPUTS:

Estimated signal parameters in ADC units and Volts and the differences with the input signal.
Conversion errors from Type 0 to Type 1.
Transfer functions and errors for Type 1 conversion.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are equal to the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occurs interchanging the role of the two processing groups.
5. No pulses shall appear in Load if the signal generator is applied to Sky and “vice versa”.
6. No pulses shall appear in any detector of the FH at which the signal is not applied.
7. Quantization step shall be at most q_{adc}/sqrt(Naver);
8. The difference between Type 1 recorded and Type 1 simulated from Type 0 shall be 0 ADU before Type 1 conversion from long integers to floating point;
9. The difference between Type 1 recorded and Type 1 simulated from Type 0 shall be less than floating point accuracy (1e-6 ADU) after Type 1 conversion from long integers to floating point.

TEST CONTROL SHEET	**ID:** DDR-SCI-005 **Title:** Processing Type 2 Conversion: second quantization and offset **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 2 data are properly decoded regarding second quantization and offset.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator either:

1. pulsed signal alternatively on SKY or LOAD (the other detector is kept at constant level).
2. Triangular pulses applied as before.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. It is assumed that packets sent to TMH are homogeneous i.e. acquisition is stopped before changing any acquisition parameter and restarted just after its change.
2. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer,
   b. Either processing A for Type 1 and Processing B for Type 2 or the reverse.
   c. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 1 data.
      i. Pulse periods shall be in the range of ½*Naver/8000sec, T_{up} shall be in the range of some Naver/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
3. Type 2 acquisition shall be carried on with a list of possible parameters in the table below:

Table of acquisition parameters for the test			
OFFSET	**SECOND_QUANT**	**GMF1**	**GMF2**
-100	0.5	1.	0.
-10.	0.5	1.	0.
0.	0.5	1.	0.
+10.	0.5	1.	0.
+100.	0.5	1.	0.
-100.	1.	1.	0.
-10.	1.	1.	0.
0.	1.	1.	0.
+10.	1.	1.	0.
+100.	1.	1.	0.
-100.	2.	1.	0.
-10.	2.	1.	0.
0.	2.	1.	0.
+10.	2.	1.	0.
+100.	2.	1.	0.
-100	0.5	0.	1.
-10.	0.5	0.	1.
0.	0.5	0.	1.
+10.	0.5	0.	1.
+100.	0.5	0.	1.
-100.	1.	0.	1.
-10.	1.	0.	1.
0.	1.	0.	1.
+10.	1.	0.	1.
+100.	1.	0.	1.
-100.	2.	0.	1.
-10.	2.	0.	1.
0.	2.	0.	1.
+10.	2.	0.	1.
+100.	2.	0.	1.

4. Type 1 and Type 2 data are recorded just from the Feed Horn under examination.
5. Pulse detection and fitting is applied to both SKY and LOAD of Type 1 and to Type 2.
5. Amplitudes of detected pulses shall be analyzed for Type 2 examining the following properties:
   a. The measured offset in ADC units;
   b. the measured amplitude in ADC units;
   c. the measured offset in Volts;
   d. the measured amplitude in Volts;
   e. the quantization level in ADC units;
   f. the quantization level in Volts;

g. the difference between the input signal and the output signal;
h. the effect of saturation;
i. comparison with the expected Type 2 data derived from Type 1;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are the same than the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occur interchanging the role of the two processing groups.
5. No pulses shall appear in any detector of the FH at which the signal is not applied.
6. The difference between Type 2 recorded and Type 2 simulated from Type 1 shall be 0 ADU before Type 2 conversion from long integers to floating point;
7. The difference between Type 2 recorded and Type 2 simulated from Type 1 shall be less than floating point accuracy (1e-6 ADU) after Type 2 conversion from long integers to floating point.

TEST CONTROL SHEET	**ID:** DDR-SCI-006 **Title:** Processing Type 2 Conversion: mixing **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 2 data are properly decoded regarding mixing.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator either:

1. pulsed signal alternatively on SKY or LOAD (the other detector is kept at constant level).
2. Triangular pulses applied as before.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. It is assumed that packets sent to TMH are homogeneous i.e. acquisition is stopped before changing any acquisition parameter and restarted just after its change.
2. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer,
   b. Either processing A for Type 1 and Processing B for Type 2 or the reverse.
   c. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 1 data.
      i. Pulse periods shall be in the range of ½*Naver/8000sec, T_{up} shall be in the range of some Naver/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
3. Type 2 acquisition shall be carried on with a list of possible parameters in the table below:

Table of acquisition parameters for the test			
OFFSET	**SECOND_QUANT**	**GMF1**	**GMF2**
0.	1	-1.	0.
0.	1	-1.	1.
0.	1	0.	-1.
0.	1	0.	+1.
0.	1	+1.	-1.
0.	1	+1.	0.

4. Type 1 and Type 2 data are recorded just from the Feed Horn under examination.
5. Pulse detection and fitting is applied to both SKY and LOAD of Type 1 and to Type 2.
6. Amplitudes of detected pulses shall be analyzed for Type 2 searching for
   a. The measured offset in ADC units;
   b. the measured amplitude in ADC units;
   c. the measured offset in Volts;
   d. the measured amplitude in Volts;
   e. the quantization level in ADC units;
   f. the quantization level in Volts;
   g. the difference between the input signal and the output signal;
   h. the effect of saturation;
   i. comparison with the expected Type 2 data derived from Type 1;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are the same than the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occur interchanging the role of the two processing groups.
5. No pulses shall appear in any detector of the FH at which the signal is not applied.
6. The difference between Type 2 recorded and Type 2 simulated from Type 1 shall be 0 ADU before Type 2 conversion from long integers to floating point;
7. The difference between Type 2 recorded and Type 2 simulated from Type 1 shall be less than floating point accuracy (1e-6 ADU) after Type 2 conversion from long integers to floating point.

TEST CONTROL SHEET	**ID:** DDR-SCI-007 **Title:** Processing Type 3 Conversion **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 3 data are properly decoded.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator:

1. pulsed signal alternatively on SKY or LOAD

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer,
   b. Either processing A for Type 1 and Processing B for Type 3 or the reverse.
   c. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 1 data.
      i. Pulse periods shall be in the range of ½* Naver/8000sec, T_{up} shall be in the range of some Naver/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
2. Type 3 acquisition shall be carried on with the following parameters:
   a. OFFSET_ADJUST = 0, -1000, +1000;
   b. SECOND_QUANT = 0.5, 1, 2, 4;
   c. GMF_1 = 0.5, 1.0, 2.0, 4.0;
   d. GMF_2 = 0.0.
3. Type 1 and Type 3 data are recorded just from the Feed Horn under examination.
4. Pulse detection and fitting is applied to both SKY and LOAD of Type 1 and to Type 3.
7. Amplitudes of detected pulses shall be analyzed for Type 1 examining the following properties:

a. The measured offset in ADC units;
b. the measured amplitude in ADC units;
c. the measured offset in Volts;
d. the measured amplitude in Volts;
e. the quantization level in ADC units;
f. the quantization level in Volts;
g. the difference between the input signal and the output signal;
h. the effect of saturation;
i. comparison with the expected Type 3 data derived from Type 1.

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are the same than the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occur interchanging the role of the two processing groups.
5. No pulses shall appear in any detector of the FH at which the signal is not applied.
6. The difference between Type 1 recorded and Type 1 simulated from Type 0 shall be 0 ADU before Type 1 conversion from long integers to floating point;
7. The difference between Type 1 recorded and Type 1 simulated from Type 0 shall be less than floating point accuracy (1e-6 ADU) after Type 1 conversion from long integers to floating point.

TEST CONTROL SHEET	**ID:** DDR-SCI-008 **Title:** Processing Type 4 Conversion **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 4 data are properly decompressed and decoded.
To verify that the (de)compression facility properly decodes data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer.
   b. Either processing A for Type 0 and Processing B for Type 4 or the reverse.
   c. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 0 data.
      i. Pulse periods shall be in the range of 0.02 sec, T_{up} shall be in the range of some 1/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
2. Type 0 and Type 4 data are recorded just from the Feed Horn under examination.
3. Resume file of Type 4 headers is analyzed in order to extract compressed packet information:
   a. Packet Time Stamp
   b. Packet Entropy
   c. Packet Compression Rate
   d. Packet uncompressed length
4. Pulse detection and fitting is applied to both Sky and Load of both Type 0 and Type 4.
5. Pulses shall be analyzed looking for
   a. the location of the first pulse in Type 0 packets and in Type 4 packets;

b. match Type 0 and Type 4 TOIs according to location of pulses (alternatively looking to OBT).
c. compares samples of Type 0 and Type 4;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are the same than the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occur interchanging the role of the two processing groups.
5. No pulses shall appear in Load if the signal generator is applied to Sky and "vice versa".
6. No pulses shall appear in any detector of the FH at which the signal is not applied.
7. Quantization step shall be at most q_{adc}/sqrt(Naver);
8. The difference between Type 1 recorded and Type 1 simulated from Type 0 shall be 0 ADU before Type 1 conversion from long integers to floating point;
9. The difference between Type 1 recorded and Type 1 simulated from Type 0 shall be less than floating point accuracy (1e-6 ADU) after Type 1 conversion from long integers to floating point.

TEST CONTROL SHEET	**ID:** DDR-SCI-009 **Title:** Processing Type 5 Conversion **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 5 data are properly decompressed and decoded.
To verify that the (de)compression facility properly decodes data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer.
   b. Either processing A for Type 2 and Processing B for Type 5 or the reverse.
   c. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 2 data.
      i. Pulse periods shall be in the range of Naver/8000, T_{up} shall be in the range of some Naver/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
2. Type 2 and Type 5 data are recorded just from the Feed Horn under examination.
3. Resume file of Type 4 headers is analyzed in order to extract compressed packet information:
   a. Packet Time Stamp
   b. Packet Entropy
   c. Packet Compression Rate
   d. Packet uncompressed length
4. Pulse detection and fitting is applied to both Sky and Load of both Type 2 and Type 5.
5. Pulses shall be analyzed looking for
   a. the location of the first pulse in Type 2 packets and in Type 5 packets;

b. match Type 2 and Type 5 TOIs according to location of pulses (alternatively looking to OBT).
c. compares samples of Type 2 and Type 5;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are the same than the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occur interchanging the role of the two processing groups.
5. No pulses shall appear in Load if the signal generator is applied to Sky and "vice versa".
6. No pulses shall appear in any detector of the FH at which the signal is not applied.
7. Quantization step shall be at most q_{adc}/sqrt(Naver);
8. The difference between Type 2 recorded and Type 5 shall be 0 ADU.

TEST CONTROL SHEET	**ID:** DDR-SCI-010 **Title:** Processing Type 6 Conversion **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify that Type 6 data are properly decompressed and decoded.
To verify that the (de)compression facility properly decodes data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Pulses generated by the signal generator are recorded as follow:
   a. Pulses are applied alternatively just to either the Sky or the Load detector of the examined radiometer.
   b. Either processing A for Type 3 and Processing B for Type 6 or the reverse.
   c. Sequences of pulses with different amplitudes, zero point , and duty cycle are generated to tests the full range of possible values of Type 3 data.
      i. Pulse periods shall be in the range of Naver/8000, T_{up} shall be in the range of some Naver/8000 sec.
      ii. Amplitudes shall cover the full dynamical range of the ADC converter and amplitudes shall be varied in steps smaller than the ADC quantization step.
2. Type 3 and Type 6 data are recorded just from the Feed Horn under examination.
3. Resume file of Type 6 headers is analyzed in order to extract compressed packet information:
   a. Packet Time Stamp
   b. Packet Entropy
   c. Packet Compression Rate
   d. Packet uncompressed length
4. Pulse detection and fitting is applied to both Type 3 and Type 6.
5. Pulses shall be analyzed looking for
   a. the location of the first pulse in Type 3 packets and in Type 6 packets;

b. match Type 3 and Type 6 TOIs according to location of pulses (alternatively looking to OBT).
c. compares samples of Type 3 and Type 6;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. all the pulses are properly recorded and reconstructed (no pulses are missing, the reconstruction error is never greater than the rms of the quantization error and the instrumental noise, the offsets are the same than the offsets in input).
2. Conversion from ADC to Volts is properly performed.
3. The case of saturated signals is properly handled (saturated signals should not result in changes of sign in the TOIs).
4. No differences occur interchanging the role of the two processing groups.
5. No pulses shall appear in any detector of the FH at which the signal is not applied.
6. The difference between Type 3 recorded and Type 6 shall be 0 ADU.

TEST CONTROL SHEET	**ID:** DDR-SCI-011 **Title:** Processing Type 4 Compressibility **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify the compressibility of Type 4 data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with: constant signals, pulse shapes signals, triangular signals, sinusoidal signals.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

1. Signals are generated by the signal generator and recorded either on sky and load:
2. Type 4 and Type 0 are recorded.
3. Decompressed signal is analyzed to extract relevant statistics:
   a. Entropy;
   b. Minimum values;
   c. Maximum values;
   d. Mean;
   e. RMS.
4. Resume file of Type 4 headers is analyzed in order to extract compressed packet information:
   a. Packet Time Stamp
   b. Packet Entropy
   c. Packet Compression Rate
   d. Packet uncompressed length
5. The compression rate is compared with the rate expected from theory for the given input signal.

OUTPUTS:

Estimate of compression rate and processing errors in different operative conditions.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. The compression rates agree with the theoretical expectation of the compression rates within the sampling variance, estimated on the variance of the Packet Entropy.

TEST CONTROL SHEET	**ID:** DDR-SCI-012 **Title:** Processing Type 5 Quantization Error and Compression Optimization **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify the optimization procedures for the compression of Type 5 data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with: constant signals, pulse shapes signals, triangular signals, sinusoidal signals generated with a wide range of parameters (zero points, amplitudes, duty cycles and periods).

DATA-SETS REQUIRED:

1. TMU data file
2. TOI data file

TEST METHOD:

1. Signals are generated by the signal generator and recorded on sky and load:
2. Type 1 and Type 5 data are recorded.
3. Decompressed Type 5 signal is analyzed to extract relevant statistics:
   a. Entropy;
   b. Minimum values;
   c. Maximum values;
   d. Mean;
   e. RMS.
4. Resume file of Type 5 headers is analyzed in order to extract compressed packet information:
   a. Packet Time Stamp
   b. Packet Entropy
   c. Packet Compression Rate
   d. Packet uncompressed length
5. The compression rate is compared with the rate expected from theory for the given input signal, the quantization error is compared to the expected quantization error from theory.
6. The process is repeated with different combinations of parameters in order to assess that the optimization procedure works.

OUTPUTS:

Estimates of quantization errors and compression rates.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. The compression rate agree with the theoretical compression rate within the sampling variance, estimated on the variance of the Packet Entropy.
2. The error estimate agrees with the error expected from theory within the sampling variance.
3. It is possible in different conditions to obtain the expected compression rate.

TEST CONTROL SHEET	**ID:** DDR-SCI-013 **Title:** Susceptibility of Processing Type 5 Quantization Error and Compression Rate **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify the susceptibility of compression rate, quantization error and tuning to changes in the signal statistics from Type 5 data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with: constant signals, pulse shapes signals, triangular signals, sinusoidal signals generated with a wide range of parameters (zero points, amplitudes, duty cycles and periods).

DATA-SETS REQUIRED:

1. TMU data file
2. TOI data file

TEST METHOD:

1. Signals are generated by the signal generator and recorded on sky and load:
2. Type 1 and Type 5 data are recorded.
3. Statistics of Type 1 signals is used to asses the optimized set of parameters.
4. Processing parameters are tuned according to the optimized statistics;
5. Optimized Type 1 and Type 5 data are recorded.
6. Input signal statistics are varied.
7. The compression rate and quantization error is computed and susceptibility is evaluated.
8. The process is repeated with different combinations of parameters in order to assess that the optimization procedure works.

OUTPUTS:

An estimate of the susceptibility of compression rates and quantization error to changes in the signal statistics.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. The susceptibility to changes in signal statistics expected over two days of data is kept within the sampling variance.

TEST CONTROL SHEET	**ID:** DDR-SCI-014 **Title:** Processing Type 6 Quantization Error and Compression Optimization **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify the optimization procedures for the compression of Type 6 data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with: constant signals, pulse shapes signals, triangular signals, sinusoidal signals generated with a wide range of parameters (zero points, amplitudes, duty cycles and periods).

DATA-SETS REQUIRED:

1. TMU data file
2. TOI data file

TEST METHOD:

1. Signals are generated by the signal generator and recorded on sky and load:
2. Type 1 and Type 6 data and are recorded.
3. Decompressed Type 6 signal is analyzed to extract relevant statistics:
   f. Entropy;
   g. Minimum values;
   h. Maximum values;
   i. Mean;
   j. RMS.
4. Resume file of Type 6 headers is analyzed in order to extract compressed packet information:
   a. Packet Time Stamp
   b. Packet Entropy
   c. Packet Compression Rate
   d. Packet uncompressed length
5. The compression rate is compared with the rate expected from theory for the given input signal, the quantization error is compared to the expected quantization error from theory.
6. The process is repeated with different combinations of parameters in order to asses that the optimization procedure works.

OUTPUTS:

Estimate of compression rate and processing errors in different operative conditions.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. The compression rates agree with the theoretical compression rates within the sampling variance, estimated on the variance of the Packet Entropy.
2. The error estimate agrees with the error expected from theory within the sampling variance.
3. It is possible in different conditions to obtain the expected compression rate.

TEST CONTROL SHEET	**ID:** DDR-SCI-015 **Title:** Susceptibility of Processing Type 6 Quantization Error and Compression Rate **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify the susceptibility of compression rate, quantization error and tuning to changes in the signal statistics from Type 6 data.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with: constant signals, pulse shapes signals, triangular signals, sinusoidal signals generated with a wide range of parameters (zero points, amplitudes, duty cycles and periods).

DATA-SETS REQUIRED:

1. TMU data file
2. TOI data file

TEST METHOD:

1. Signals are generated by the signal generator and recorded on sky and load:
2. Type 1 and Type 6 data and are recorded.
3. Statistics of Type 1 signals is used to asses the optimized set of parameters.
4. Processing parameters are tuned according to the optimized statistics;
5. Optimized Type 1 and Type 6 data are recorded.
6. Input signal statistics are varied.
7. The compression rate and quantization error is computed and susceptibility is evaluated.
8. The process is repeated with different combinations of parameters in order to asses that the optimization procedure works.

OUTPUTS:

Estimates of: susceptibility for the compression rates, and quantization error for changes in the signal statistics.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. The susceptibility to changes in signal statistics expected over two days of data is kept within the sampling variance.

TEST CONTROL SHEET	**ID:** DDR-SCI-016 **Title:** Processing Type 1, 2, 3, 5 and 6 Scientific Packets Homogeneity **Type:** Scientific Data Handling	**Model: FM**

OBJECTIVE:

To verify the homogeneity of data delivered by the acquisition chain.

For homogeneity it is intended that all the data, in all of the scientific packets may be properly decoded by just using the contents of the tertiary header of the packet.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator with either

a. LCS applied to LOAD and HCS applied to SKY
b. LCS applied to LOAD and triangular signals applied to SKY.
c. triangular signals applied to LOAD and LCS applied to SKY.
d. LCS applied to LOAD and sinusoidal signals applied to SKY.
e. sinusoidal signals applied to LOAD and LCS applied to SKY.

DATA-SETS REQUIRED:

1. TM data files
2. TMU data file
3. TOI data file

TEST METHOD:

For any processing types 1, 2, 3, 4, 5 and 6.

1. A set of processing parameters is applied.
2. Signals are generated by the signal generator and recorded.
3. Type 1 and the processing Type 2, 3, 4 ,5 and 6 in testing are recorded.
4. Raw data (as an example not decoded Type 2 data from TMU files) are analysed and compared to simulated not decoded data generated from Type 1 data assuming the processing parameters applied by the AC are those in the packets recovered by the TMH.
5. TCs are sent changing the processing parameters.
6. A check is performed to assess whether any inhomogeneous packet is generated when TC are executed.

In the following examples we will denote with T1_LCS, T1_HCS and T1_TRI the LCS, the HCS and the Triangular signals as coded in Type 1 data.

The test requires that all the data in any packet will match (within the noise) the values from the equations in the examples.

Example 1:

Type 2: LCS applied to LOAD and HCS applied to SKY then

Q1 = round(([T1_HCS – gmf_1*T1_LCS]/Naver+ OFFSET_ADJUST)*SECOND_QUANT)
Q2 = round(([T1_HCS – gmf_2*T1_LCS]/Naver + OFFSET_ADJUST)*SECOND_QUANT)

The relative zero points of data within a given packet and measured respect to the first sample in the packet, will have not to change when a processing parameter is changed.

Example 2:

Type 2: LCS applied to LOAD and triangular signal to SKY then

Q1 = round(([T1_TRI – gmf_1*T1_LCS]/Naver+ OFFSET_ADJUST)*SECOND_QUANT)
Q2 = round(([T1_TRI – gmf_2*T1_LCS]/Naver + OFFSET_ADJUST)*SECOND_QUANT)

The intercept and the slope of the data within a given packet and measured respect to the first sample in the packet, will have not to change when a processing parameter is changed.

Example 3:

Type 2: triangular signal applied to LOAD and LCS to SKY then

Q1 = round(([T1_LCS – gmf_1*T1_TRI]/Naver+ OFFSET_ADJUST)*SECOND_QUANT)
Q2 = round(([T1_LCS – gmf_2*T1_TRI]/Naver + OFFSET_ADJUST)*SECOND_QUANT)

The intercept and the slope of the data within a given packet and measured respect to the first sample in the packet, will have not to change when a processing parameter is changed.

Similar examples may be elaborated for any processing type.

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if:

1. Processed data are homogeneous i.e. all the data, in all the scientific packets may be properly decoded by just using the contents of their tertiary header.
2. The test fails if even a single packet cannot be decoded looking solely to the information in its tertiary header.

7.5 DECODING AND RECONSTRUCTION OF HK PACKETS CONTENT

The ID codes for this kind of test will be:

DDR-HK-nnn

TEST CONTROL SHEET	**ID:** DDR-HK-001 **Title:** Regristration of HK telemetry not supercommutated **Type:** House Keeping Decoding	**Model: FM**

OBJECTIVE:

To verify that non supercommutated HK is properly copied within TOIs.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
SCOS 2000
The signal generator connected to a selected set of HK analog gates sending constant signals, pulses or triangular signals.

DATA-SETS REQUIRED:

1. TM
2. HK TOI

TEST METHOD:

1. Constant signals, pulses or triangular ramps are applied alternatively to different HK analog gates.
2. The other gates should be polarized to a constant value corresponding to the zero signal.
3. Amplitudes shall assure proper coverage of all of the dynamical range of each gate. Example: constant signals applied in steps of 10 sec doubling the voltage, starting from the baseline voltage.
4. The shape of the signal is monitored on-the-fly with SCOS 2000.
5. TOIs are explored in order to assess
    a. Signal appears always in the channel under test;
    b. no signals appears in HK channels other than the channel under test.
    c. Sequences of voltage increases are properly reproduced
    d. Handling of underflow or overflow conditions.

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if either:
1. signal appears in one or more samples of channels not under test;

2. signal is missing in one or more samples of the channel under test;
3. the sequence of voltage increases is not reproduced.
4. Underflow or overflow conditions are not properly managed.

TEST CONTROL SHEET	**ID:** DDR-HK-002 **Title:** Registration of HK telemetry supercommutated **Type:** House Keeping Decoding	**Model: FM**

OBJECTIVE:

To verify that supercommutated HK is properly copied within TOIs.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
SCOS 2000
The signal generator connected to a selected set of HK analog gates sending constant signals, pulses or triangular signals.

DATA-SETS REQUIRED:

1. TM
2. HK TOI

TEST METHOD:

1. Constant signals, pulses or triangular ramps are applied alternatively to different HK analog gates related to supercommutated telemetry.
2. The other gates should be polarized to a constant value corresponding to the zero signal.
3. Amplitudes shall assure proper coverage of all of the dynamical range of each gate. Example: constant signals applied in steps of 10 sec doubling the voltage, starting from the baseline voltage.
4. The shape of the signal is monitored on-the-fly with SCOS 2000.
5. TOIs are explored in order to asses
    a. Signal appears always in the channel under test;
    b. no signals appears in HK channels other than the channel under test.
    c. Sequences of voltage increases are properly reproduced
    d. Handling of underflow or overflow conditions.

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if either:
1. signal appears in one or more samples of channels not under test;

2. signal is missing in one or more samples of the channel under test;
3. the sequence of voltage increases is not reproduced.
4. Underflow or overflow conditions are not properly managed.

TEST CONTROL SHEET	**ID:** DDR-HK-003 **Title:** Conversion HK telemetry by Look Up Tables **Type:** House Keeping Conversion	**Model: FM**

OBJECTIVE:

To verify that parameters converted from ADU to Physical Units through a lookup table are properly converted.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
SCOS 2000
The signal generator connected to a selected set of HK analog gates sending constant signals, pulses or triangular signals.

DATA-SETS REQUIRED:

1. TM
2. TMU HK TOIs
3. HK TOI

TEST METHOD:

1. Constant signals, pulses or triangular ramps are applied alternatively to different HK analog gates.
2. The other gates should be polarized to a constant value corresponding to the zero signal.
3. Amplitudes shall assure proper coverage of all of the dynamical range of each gate.
4. The shape of the signal is monitored on-the-fly with SCOS 2000.
5. Amplitudes and zero points of converted signals are measured and compared with the amplitudes and zero points of the input signals.
6. Experimental calibration tables are generated.

OUTPUTS:

1. List of amplitudes of reconstructed signals
2. Calibration functions for the reconstructed signals

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if the reconstructed calibration function differs from the calibration function used for the parameter under study.

TEST CONTROL SHEET	**ID:** DDR-HK-004 **Title:** Conversion HK telemetry by Polynomials **Type:** House Keeping Conversion	**Model: FM**

OBJECTIVE:

To verify that parameters converted from ADU to Physical Units through a polynomial law are properly converted.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
SCOS 2000
The signal generator connected to a selected set of HK analog gates sending constant signals, pulses or triangular signals.

DATA-SETS REQUIRED:

1. TM
2. TMU HK TOIs
3. HK TOI

TEST METHOD:

1. Constant signals, pulses or triangular ramps are applied alternatively to different HK analog gates.
2. The other gates should be polarized to a constant value corresponding to the zero signal.
3. Amplitudes shall assure proper coverage of all of the dynamical range of each gate.
4. The shape of the signal is monitored on-the-fly with SCOS 2000.
5. Amplitudes and zero points of converted signals are measured and compared with the amplitudes and zero points of the input signals.
6. Experimental calibration functions are then generated.

OUTPUTS:

1. List of amplitudes of reconstructed signals
2. Calibration tables for the reconstructed signals

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if the reconstructed calibration tables are not compatible from the calibration function used for the parameter under study.

7.6 GRAPHICAL DISPLAY

The ID codes for this kind of test will be:

GDS-GEN-nnn

for generic functionalities

GDS-SCI-nnn

for scientific data

GDS-HK-nnn

for housekeeping telemetry.

TEST CONTROL SHEET	**ID:** GDS-GEN-001 **Title:** Replay archived data and parallel sessions **Type:** Graphical Display	**Model: FM**

OBJECTIVE:

To verify that the TQL is able to receive on-line TM data while a second instance of the TQL replays an archived TM.

INSTRUMENTS REQUIRED:

SCOS 2000

DATA-SETS REQUIRED:

1. Archived TM

TEST METHOD:

1. The SCOS 2000 system is used to send the telemetry acquired in a previous test to the TMH/TQL system.
2. A first instance of the TQL is launched and setup in order to receive the telemetry from the SCOS system.
3. A second instance of the TQL is launched and an archived TM is opened.
4. Both graphical displays are examined to verify the proper reception and plotting of the telemetry data

OUTPUTS:

1. Snapshots of displays from TMH and SCOS2000.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if either:

1. One of the instances of the TQL is not started correctly
2. The first instance of the TQL doesn't receive the telemetry stream from SCOS while the second instance is running
3. The second instance of the TQL is not able to read and display the archived telemetry while the first instance is running.

TEST CONTROL SHEET	**ID:** GDS-GEN-002 **Title:** Layout of the TQL **Type:** Graphical Display	**Model: FM**

OBJECTIVE:

To verify that it is possible to configure and edit the layout of the display while the TQL is running, that the layout can be saved and that it can be restored. This test can be performed off-line.

INSTRUMENTS REQUIRED:

No other software or instruments are required

DATA-SETS REQUIRED:

1. Archived TM

TEST METHOD:

1. The TQL is launched and an archived TM is opened.
2. The layout of the Scientific and housekeeping displays is changed while the TQL is running.
3. The status of the displays, after it has been changed, is saved on file and the TQL is stopped.
4. The TQL is launched again and the previously saved layout is loaded. The archived TM is opened again with the current layout.

OUTPUTS:

1. Snapshots of displays from TMH and SCOS2000.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if either:

1. It's not possible to change the TQL layout while the TQL is operating
2. The layout is not correctly saved on file.
3. The layout is not correctly restored in a new TQL session.

TEST CONTROL SHEET	**ID:** GDS-SCI-001 **Title:** Scientific Data Sky/Load Registration of Type 0, 1, 2, 4, 5 **Type:** Graphical Display	**Model: FM**

OBJECTIVE:

To verify that scientific data of Type 0, 1, 2, 4 and 5 are properly registered on the Graphical Display.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
Signal generator connected to SKY with a constant and HIGH signal in SKY.
Signal generator connected to LOAD with a constant and LOW signal in LOAD.

DATA-SETS REQUIRED:

1. TM data files

TEST METHOD:

1. Data are generated for a single FH, DTC and Radiometer putting alternatively the radiometer switching ON or OFF.
2. Data are acquired just for the given FH, DTC and Radiometer other acquisitions are suspended.
3. This test shall be carried on for Types 0, 1, 2, 4, 5:
   a. For Type 2 and Type 5 data lt shall be assumed: GMF1 = 1; GMF2 = -1; Offset_Adjust = 0; SECOND_QUANT = 1;

OUTPUTS:

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test is passed if, according to the phase switch flag and the switching status:

1. For all of the processing types the HIGH signals are classified properly as SKY.
2. For all of the processing types the LOW signals are classified properly as LOAD according to the phase switch flag.

TEST CONTROL SHEET	**ID:** GDS-HK-002 **Title:** Registration of HK telemetry not supercommutated **Type:** HK Graphical Display	**Model: FM**

OBJECTIVE:

To verify that non supercommutated HK is properly displayed.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
SCOS 2000
The signal generator connected to a selected set of HK analog gates sending constant signals, pulses or triangular signals.

DATA-SETS REQUIRED:

1. TM

TEST METHOD:

1. Constant signals, pulses or triangular ramps are applied alternatively to different HK analog gates.
2. The other gates should be polarized to a constant value corresponding to the zero signal.
3. Amplitudes shall assure proper coverage of all of the dynamical range of each gate.
   Example: constant signals applied in steps of 10 sec doubling the voltage, starting from the baseline voltage.
4. The shape of the signal is monitored on-the-fly with SCOS 2000.
5. Graphical display is explored in order to asses
   a. Signal appears always in the channel under test;
   b. Sequences of voltage increases are properly reproduced
   c. Handling of underflow or overflow conditions.

OUTPUTS:

1. Snapshots of displays from TMH and SCOS2000.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if either:

1. signal is missing in one or more samples of the channel under test;
2. the sequence of voltage increases is not reproduced.
3. Underflow or overflow conditions are not properly managed.

TEST CONTROL SHEET	**ID:** GDS-HK-003 **Title:** Registration of HK telemetry supercommutated **Type:** HK Graphical Display	**Model: FM**

OBJECTIVE:

To verify that supercommutated HK is properly displayed.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
SCOS 2000
The signal generator connected to a selected set of HK analog gates sending constant signals, pulses or triangular signals.

DATA-SETS REQUIRED:

1. TM

TEST METHOD:

1. Constant signals, pulses or triangular ramps are applied alternatively to different HK analog gates.
2. The other gates should be polarized to a constant value corresponding to the zero signal.
3. Amplitudes shall assure proper coverage of all of the dynamical range of each gate. Example: constant signals applied in steps of 10 sec doubling the voltage, starting from the baseline voltage.
4. The shape of the signal is monitored on-the-fly with SCOS 2000.
5. Graphical display is explored in order to asses
    a. Signal appears always in the channel under test;
    b. Sequences of voltage increases are properly reproduced
    c. Handling of underflow or overflow conditions.

OUTPUTS:

1. Snapshots of displays from TMH and SCOS2000.

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if either:

1. signal is missing in one or more samples of the channel under test;
2. the sequence of voltage increases is not reproduced.
3. Underflow or overflow conditions are not properly managed.

4.

7.7 ON-THE-FLY SOFTWARE ANALYSIS

The ID codes for this kind of test will be:

ASW-SCI-nnn

for scientific data

ASW-HK-nnn

for housekeeping telemetry (if any).

TEST CONTROL SHEET	**ID:** ASW-SCI-001 **Title:** FFT Facility **Type:** Test on Scientific Software	**Model: FM**

OBJECTIVE:

To verify that FFT module properly operates.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.
The signal generator generating sinusoidal signals.

DATA-SETS REQUIRED:

1. TM
2. TOIs

TEST METHOD:

1. A sinusoidal signal is applied to one of the detectors.
2. The FFT display is activated.
3. Snapshots of the FFT are taken.
4. TOIs are generated.
5. Data in TOIs at times corresponding to the snapshots are FFT analyzed using IDL.

OUTPUTS:

1. Snap shots of FFT display
2. IDL FFT

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if:

1. the FFT signal does not appear on the right display.
2. the FFT signal is not refreshed properly.
3. the FFT signal is different from the expectation given by the input signal.
4. the FFT signal is different from IDL results.

TEST CONTROL SHEET	**ID:** ASW-SCI-002 **Title:** Averages, Variance and RMS calculation **Type:** Test on Scientific Software	**Model: FM**

OBJECTIVE:

To verify that Averages, variances and RMS calculation properly operates.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with a two square pulses generators connected to SKY or LOAD with

1. $T_{up} / T_{low} = 1$
2. Same period for sky and load
3. Same phase for sky and load
4. Same V_{low} for sky and load
5. Different Vup for sky and load $V_{up,sky}$, $V_{up,load}$.
6. The expected mean and variance for each of these signals will be (assuming to average over an integer number of periods):
    a. $\langle V \rangle = (V_{up} + V_{low})/2$
    b. $Var(V) = (V_{low}^2+V_{up}^2) - (V_{low}+V_{up}) \langle V \rangle + \langle V \rangle^2$

DATA-SETS REQUIRED:

1. TM
2. TOIs

TEST METHOD:

1. The signal, as specified before, is applied to SKY or LOAD.
2. The Average, variance and RMS calculation is activated.
3. Snapshots of the calculation are taken.
4. The Averages and variances would correspond to the one expected from the formula.
5. TOIs are generated.
6. Data in TOIs at times corresponding to the snapshots are analyzed using IDL.

OUTPUTS:

1. Snap shots of calculation
2. IDL calculations

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if:

1. the calculations does not appear on the right display.
2. the calculations is not refreshed properly.
3. the calculations is different from the expectation given by the input signal.
4. the calculations is different from IDL results.

TEST CONTROL SHEET	**ID:** ASW-SCI-003 **Title:** R Factor Calculation based on variance **Type:** Test on Scientific Software	**Model: FM**

OBJECTIVE:

To verify that R-Factor calculation properly operates.

INSTRUMENTS REQUIRED:

The EGSE/REBA/DAE equipment.

The signal generator with a two square pulses generators connected to SKY and LOAD with

1. $T_{up} / T_{low} = 1$
2. Same period for sky and load
3. Same phase for sky and load
4. Same V_{low} for sky and load
5. Different V_{up} for sky and load $V_{up,sky}$, $V_{up,load}$.
6. The expected mean and variance for each of these signals will be (assuming to average over an integer number of periods):
    a. $\langle V \rangle = (V_{up} + V_{low})/2$
    b. $Var(V) = (V_{low}^2+V_{up}^2) - (V_{low}+V_{up}) \langle V \rangle + \langle V \rangle^2$

DATA-SETS REQUIRED:

1. TM
2. TOIs

TEST METHOD:

1. The signal, as specified before, is applied to SKY and LOAD.
2. The R-Factor calculation based on variance ratio is activated.
3. Snapshots of the R-Factor are taken.
4. The R factors would correspond to $R = Var(V)_{Sky} / Var(V)_{Load}$, where sky or load refers to variances of Sky and Load signals.
5. TOIs are generated.
6. Data in TOIs at times corresponding to the snapshots are analyzed using IDL.

OUTPUTS:

1. Snap shots of R - display
2. IDL R-calculations

ENVIRONMENTAL NEEDS:

PASS/FAIL CRITERIA:

The test fails if:

1. the R signal does not appear on the right display.
2. the R signal is not refreshed properly.
3. the R signal is different from the expectation given by the input signal.
4. the R signal is different from IDL results.

7.8 TRACEBILITY MATRIX

7.8.1 THM USER REQUIREMENTS

URD	Covered?	Test Case	Comments
TMA-GEN-001	X	RAW-TM-01, RAW-TM-02	
TMA -GEN-002	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TMA -GEN-003	X	ALL	Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TMA -GEN-004	X	ALL	Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TMA -GEN-005	N/A		The FTOOLS are used for this purpose, in particular fmerge and fselect
TMU-GEN-001	X	ALL	
TMU-GEN-003	X	OBT-SCI-01a, OBT-SCI-01b, OBT-SCI-01c, OBT-SCI-03	
TMU-GEN-004	X	ALL	In the FM version, UTM sequences are grouped by intervals of 1 hour. The OM version has no UTM archive
TMU-GEN-005	OM version		No events are handled in the FM version
TMU-GEN-006	OM version		No events are handled in the FM version
TMU-GEN-007	X	RAW-TM-02	
TMU-GEN-009	X	RAW-TM-02	
TMU-GEN-010	N/A		It is the Data Receive program which provides the H/K and SCI data to the TQL
TMU-GEN-011	OM version		Auxiliary data will be processed only by the OM version. No UTM archive is generated by this version
TMU-GEN-012	X	RAW-TM-02	The packet error control is recomputed and compared with the one stored in the packet
TMU-GEN-013	X	RAW-TM-02	
TMU-GEN-014	X	DDR-HK-001, DDR-HK-002, DDR-SCI-001	
TMU-HK-001	OM version		The FM version processes only a subset of the H/K packets

URD	Covered?	Test Case	Comments
TMU-HK-002	OM version		In the FM version, the TMU doesn't interpret the H/K parameters within the packets. This task is performed by TM2TOI
TMU-HK-003	X	RAW-TM-02, DDR-HK-001, DDR-HK-002	
TMU-HK-004	X	ALL	In the FM version, UTM sequences are grouped by intervals of 1 hour. The OM version has no UTM archive
TMU-HK-005	OM version		In the FM version, the TMU doesn't interpret the H/K parameters within the packets. This task is performed by TM2TOI
TMU-HK-006	OM version		Events are not considered in the FM
TMU-HK-007	OM version		Events are not considered in the FM
TMU-SCI-001	X	DDR-SCI-001 to DDR-SCI-016	All tests covering the decompression, decoding and reconstruction of scientific packets content
TMU-SCI-002	OM version		In the FM version, the TMU doesn't interpret the source data within the packets. This task is performed by TM2TOI
TMU-SCI-003		RAW-TM-02, DDR-SCI-001	
TMU-SCI-004	X	DDR-SCI-001 to DDR-SCI-016	All tests covering the decompression, decoding and reconstruction of scientific packets content
TMU-SCI-005	X	DDR-SCI-001, DDR-SCI-002, DDR-SCI-008, DDR-SCI-009, DDR-SCI-010	
TMU-SCI-006	OM version		In the FM version, the TMU doesn't interpret the source data within the packets. This task is performed by TM2TOI
TMU-SCI-007	OM version		
TMU-SCI-008	X	DDR-SCI-001, DDR-SCI-002, DDR-SCI-008, DDR-SCI-009, DDR-SCI-010	
TMU-SCI-009	X	DDR-SCI-008, DDR-SCI-009, DDR-SCI-010	
TMU-SCI-010	X	RAW-TM-02	Processing time estimated on a dataset gathered during an acquisition of approximately 12 hours
UTA-GEN-001	X	ALL	
UTA-GEN-002	N/A		Searches are performed on file names. The fv application is used to filter and

URD	Covered?	Test Case	Comments
			display data within a single fits file
UTA-GEN-003	X	ALL	Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-GEN-004	X	ALL	Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-GEN-005	N/A		The FTOOLS are used for this purpose, in particular fmerge and fselect
UTA-GEN-006	X	RAW-TM-02	
UTA-HK-001	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-HK-002	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-HK-003	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-HK-004	N/A		Events will be processed in the OM version. There is no UTM archive in the OM version
UTA-SCI-001	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-SCI-002	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
UTA-SCI-003	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
DP-GEN-001	X	ALL	
DP-GEN-002	OM version		
DP-GEN-003	OM version		
DP-GEN-004	OM version		
DP-GEN-005	X	DDR-HK-003, DDR-HK-004	
DP-GEN-006	X	ALL	
DP-GEN-007	OM version		
DP-GEN-008	OM version		
PD-GEN-001	OM version		
PD-GEN-002	X	DDR-HK-003, DDR-HK-004	
PD-GEN-003	OM version		
PD-GEN-004	X	ALL	
PD-GEN-005	OM version		
PD-GEN-006	OM version		
T2T-GEN-001	X	ALL	
T2T-GEN-002	X	ALL	
T2T-GEN-003	X	OBT_SCI-01a, OBT_SCI-01b	

URD	Covered?	Test Case	Comments
T2T-GEN-004	X	ALL	
T2T-GEN-005	OM version		
T2T-GEN-006	OM version		No events are handled in the FM version
T2T-GEN-007	X	ALL	The FM version stores the TOIs into a FITS archive
T2T-GEN-008	N/A		The FTOOLS are used for this purpose, in particular fmerge and fselect
T2T-GEN-009	X	ALL	
T2T-HK-001	OM version		The FM version processes a subset of the HK packets
T2T-HK-002	X	DDR-HK-001 to DDR-HK-004	
T2T-HK-004	X	DDR-HK-001 to DDR-HK-004	
T2T-HK-005	X	DDR-HK-001 to DDR-HK-004	
T2T-HK-006	OM version		No events are handled in the FM version
T2T-HK-007	OM version		No events are handled in the FM version
T2T-SCI-001	X	DDR-SCI-001 to DDR-SCI-016	
T2T-SCI-003	X	DDR-SCI-001 to DDR-SCI-016	
T2T-SCI-004	X	DDR-SCI-001 to DDR-SCI-016	
T2T-SCI-005	X	DDR-SCI-001 to DDR-SCI-016	
T2T-SCI-006	OM version		
TOA-GEN-001	X	ALL	The FM version stores each TOI in a FITS file
TOA-GEN-002	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-GEN-003	X	ALL	Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-GEN-004	X	ALL	
TOA-HK-001	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-HK-002	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-HK-003	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-HK-004	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-SCI-001	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file
TOA-SCI-002	N/A		Searches are performed on file names.

URD	Covered?	Test Case	Comments
			The fv application is used to filter and display data within a single fits file
TOA-SCI-003	N/A		Searches are performed on file names. The fv application is used to filter and display data within a single fits file

7.8.2 TQL USER REQUIREMENTS

URD	Covered?	Test Case	Comments
QLA-RT-PSD-01a	X	GDS-SCI-001	
QLA-RT-PSD-01b	X	GDS-HK-002, GDS-HK-003	
QLA-RT-PSD-01c	X	GDS-SCI-001	
QLA-RT-PSD-02	N/A		Requirement classified as desirable but not essential
QLA-RT-PSD-03	OM version		
QLA-RT-PSD-04	N/A		Requirement classified as desirable but not essential
QLA-RT-PSD-05	X	GDS-SCI-001	
QLA-RT-PSD-06	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-PSD-07	X	GDS-SCI-001	
QLA-RT-PSD-08	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-PSD-09	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-IR-01	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-OR-01a	X	ALL	
QLA-RT-OR-01b	X	ALL	
QLA-RT-OR-01c	X	ALL	
QLA-RT-OR-01e	X	ALL	
QLA-RT-OR-01f	X	ALL	
QLA-RT-OR-03	X	GDS-GEN-001	
QLA-RT-OR-04	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-OR-05	X	GDS-GEN-001	
QLA-RT-PCKp-01	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-PCKp-03	X	GDS-SCI-001	

URD	Covered?	Test Case	Comments
QLA-RT-PCKp-04	X	GDS-SCI-001	
QLA-RT-PCKp-05	X	GDS-SCI-001	
QLA-RT-PCKp-06	X	GDS-SCI-001	
QLA-RT-PCKa-01	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-PCKa-02	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-RT-PCKa-03	X	ASW-SCI-001, ASW-SCI-002	The TQL embeds the ROOT script interpreter
QLA-RT-GR-01	X	ALL	
QLA-RT-GR-02	X	ALL	Operator comments are issued trough the TQL GUI in all tests
QLA-RT-GR-03	X	ALL	
QLA-RT-MMI-01	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-TA-PSD-01	X	GDS-SCI-001	
QLA-TA-PSD-02	N/A		In the FM version there is no alphanumeric display. See req. QLA-RT-PSD-02
QLA-TA-PSD-03	X	GDS-SCI-001	
QLA-TA-PSD-04	X	GDS-GEN-002	
QLA-TA-PSD-05	X	GDS-GEN-002	
QLA-TA-PSD-06	X	GDS-GEN-002	
QLA-TA-AM-01	X	ALL	
QLA-TA-AM-02	X	ALL	
QLA-TA-AM-03	X	ALL	
QLA-TA-AM-04	OM version		
QLA-TA-AM-05	X	ALL	
QLA-TA-OR-02	X	ALL	
QLA-TA-OR-04	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-TA-OR-05	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	Parameter files (pfiles) are used
QLA-TA-OR-06	X	GDS-SCI-001, GDS-HK-002, GDS-HK-003	
QLA-TA-OR-07	X	ALL	
QLA-TA-PCKp-01	X	ASW-SCI-001, ASW-SCI-002	
QLA-TA-GR-02	OM version		
QLA-TA-GR-03	X	ALL	