CONSERT
Experiment User Manual

ORBITER Instrument

DOCUMENT APPROVAL

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DOCUMENT CHANGE RECORD

Issue	Rev	Section	Page	Date	Change
Draft 0	0	All	All	01/09/00	Generation of document
Issue 1	0	2.4	table	01/10/00	Cruise checkout phase tests required each time it is possible
Issue 1	0	3.1		01/10/00	Note concerning Lander timing requirements added
Issue 1	0	3.2		01/10/00	Section of Mission table parameters for Tuning phase chapter included
Issue 1	0	6.2		01/10/00	TC information updated Database mnemonics included Length information clarified
Issue 1	0	6.4		01/10/00	Telemetry information updated Database mnemonics included Length information clarified
Issue 1	0	6.4		01/10/00	Wording for event ID 41004 changed to “shall be switched off”
Issue 1	0	5.3.2		01/10/00	Flight Control Procedure chapter completed, as per EFDR inputs
Issue 1	0	5.3.1		01/10/00	Consert Switch-on conditions defined
Issue 1	1	6.4		26/10/00	TM science report length definition changed, 2 spare bytes forgotten
Issue 1	1	6		26/11/00	TM & TC definition updated for service 1.2 (wrong CRC) and service 9 (memory check)
Issue 1	1	5.1.1.10		26/11/00	FCP name included in UFT description
Issue 1	1	5.3		26/11/00	FCP CONSERT_ON and CONSERT_OFF added
Issue 1	1	6.3.2		26/11/00	Typo corrected in database names for NCND03xx
Issue 1	1	5.3.3		26/11/00	Chapter split into Commissioning and FCP chapter.
2	0			17/09/01	General update after delivery of Flight Model
2	1	5.3.1		02/10/01	Flight Ops redefined
2	2	A5		10/10/01	Length of TM/TC Packets corrected
2	3	5.3.4.		10/01/02	OCXO Frequency updated for FSL
2	4	5.3.4.5		24/01/02	Alternative MT added
2	5	5.3		19/02/02	Minor updates in FCPs
		5.1.3.2.		28/05/02	TBC removed
2	6	5.2		19/06/02	Detail of OBCP Added

		5.4.3.1 to .4		17/10/02	Updated Mission tables
		5.4.3.1 to .4		08/11/02	Deltatic (= 4.95 sec) updated for all tables
2	8	6.1 6.3.2.		01/09/03	TC Packet category is #12 Typing error (Packet Category for Memory Dump is #9)
3	0	Title	2	1/12/03	Signatures page added
3	1	6.3.1.1.	66	12/01/04	First HK rep 60 sec after Switch-on
3	2	6.3	66	09/11/04	Changed named Title
3	2	6.3.2	66	09/11/04	Service type column and Memory Check line integrated in table TM packet type summary
3	2	6.4	67	09/11/04	Added an introduction
3	2	Annexe 5	93 to 98	09/11/04	Changed SCET by OBT in TMs
3	2	Annexe 5	98	09/11/04	Changed & completed TM

TABLE OF CONTENTS

1. General description

1.1. Scientific objectives

The scientific objectives of the CONSERT experiment on the ROSETTA mission are described in the original proposal (ROSETTA MISSION : Surface Science Instruments for Champollion and RoLand, Comet Nucleus Sounding Experiment by Radiowave Transmission CONSERT, volume I, Investigation and Technical Plan) and in a recent paper published by Kofman et al., 1998. The purpose of the experiment is to determine the main dielectric properties from the propagation delay and, through modelling, to set constraints on the cometary composition (materials, porosity…) to detect large-size structures (several tens of meters) and stratification, to detect and characterize small-scale irregularities within the nucleus. A detailed analysis of the radio-waves which have passed through all or parts of the nucleus will put real constraints on the materials and on inhomogeneities and will help to identify blocks, gaps or voids. From this information we attempt to answer some fundamental questions of cometary physics : How is the nucleus built up? Is it homogeneous, layered or composed of accreted blocks (cometesimals, boulders). What is the nature of the refractory component ? Is it chondritic as generally expected or does it contain inclusions of unexpected electromagnetic properties? With the answer to these questions, it should also be possible to provide answers to the basic question of the formation of the comet. Did it form directly from unprocessed interstellar grain-mantle particles or from grains condensed in the presolar nebula ? Did the accretion take place in a multi step process leading first to the formation of cometesimals which then collided to form a kilometres size body ?

1.2. Experiment overview

Consert experiment consists in the rough tomography of the comet nucleus performed by the instrument (COmet Nucleus Sounding Experiment by Radiowave Transmission). It works as a time domain transponder between one module which will land on the comet surface (Lander) and another that will fly around the comet (Orbiter). The Figure 1 gives a schematic diagram of the experiment. Basically, a 90 MHz sinusoidal waveform is phase modulated by a pseudorandom code or PSK (Phase Shift Keying) Coding. Such frequency, in the radio range, is expected to minimize the losses during the propagation inside the comet material and the generated pulse code maximize the signal to noise ratio. In this experimental conditions great attempt is made on the good measurement of the mean dielectric properties and on the detection of large size embedded structures or small irregularities within the comet nucleus.

CONSERT ELECTRONICS ARCHITECTURE

In Figure 2, a complete structure of CONSERT experiment on the orbiter is given. At the left is the antenna which is connected to the Transmit and Receive (TR) switch. The upper part of the figure shows the receiver. From left to right, one can recognize the Radio Frequency section, with Front End Amplifier (FEA), Band Pass filters, automatic gain control (AGC), then a mixer with a 120 MHz Local Oscillator. It is followed by a wide band intermediate frequency section (WIF) at 30 MHz feeding the in-phase and quadrature detectors. A low pass filter is provided for both I and Q base band amplifiers (WBB) and a high pass section is present to eliminate DC components. Each receiver section (RF, WIF, and WBB) has a maximum gain of about 30 dB and each AGC

gain take a value between 0 and -31 dB. Therefore, the total gain of the analogic part take a value between 28 and 90 dB. The in-phase and quadrature signals are converted by two 8-bits analog to digital converters. The accumulation realize in the coherent integrator systems (CANACCU) and the tuning Phase Locked Loop (PLL) will not be considered here. The bottom part of the diagram corresponds to the Transmitter with a shift register pseudo-noise (PN) generator, frequency multipliers, a phase modulator and a power amplifier.

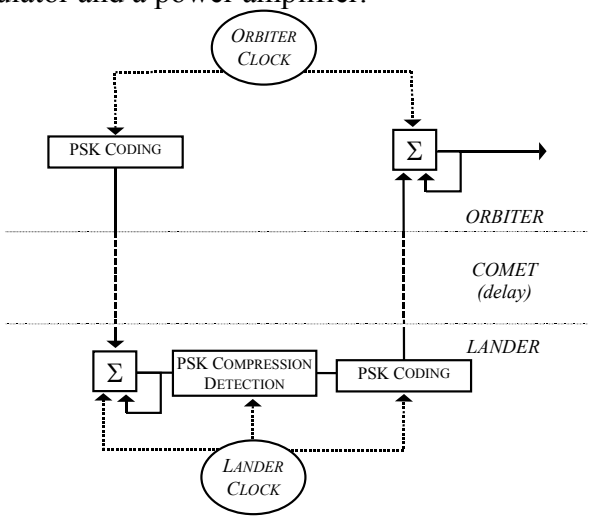


Figure 1 : Block diagram of the CONSERT experiment. The coded signal is emitted from the Orbiter. The Lander make a coherent addition (Σ) and a detection of the correlation principal peak. A clean coded signal is finally emitted with the found delay. The Orbiter accumulate the signal and send it to the earth (via the satellite interface).

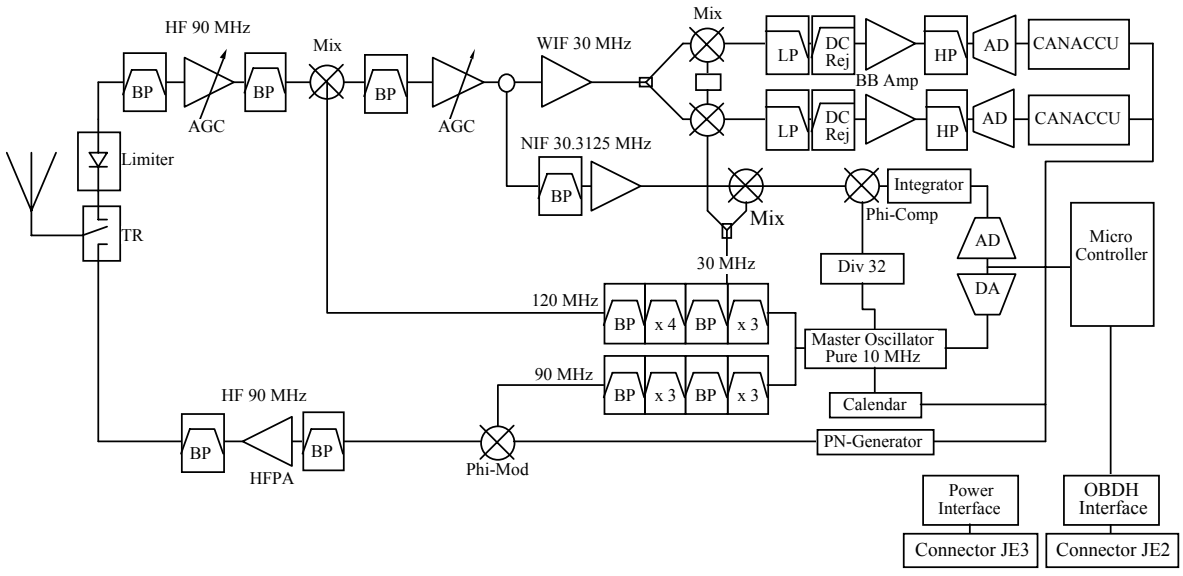


Figure 2 : Electronic box of the CONSERT experiment.

2. Experiment Configuration

2.1. Physical

See Consert EID B vol 2.2

2.2. Electrical

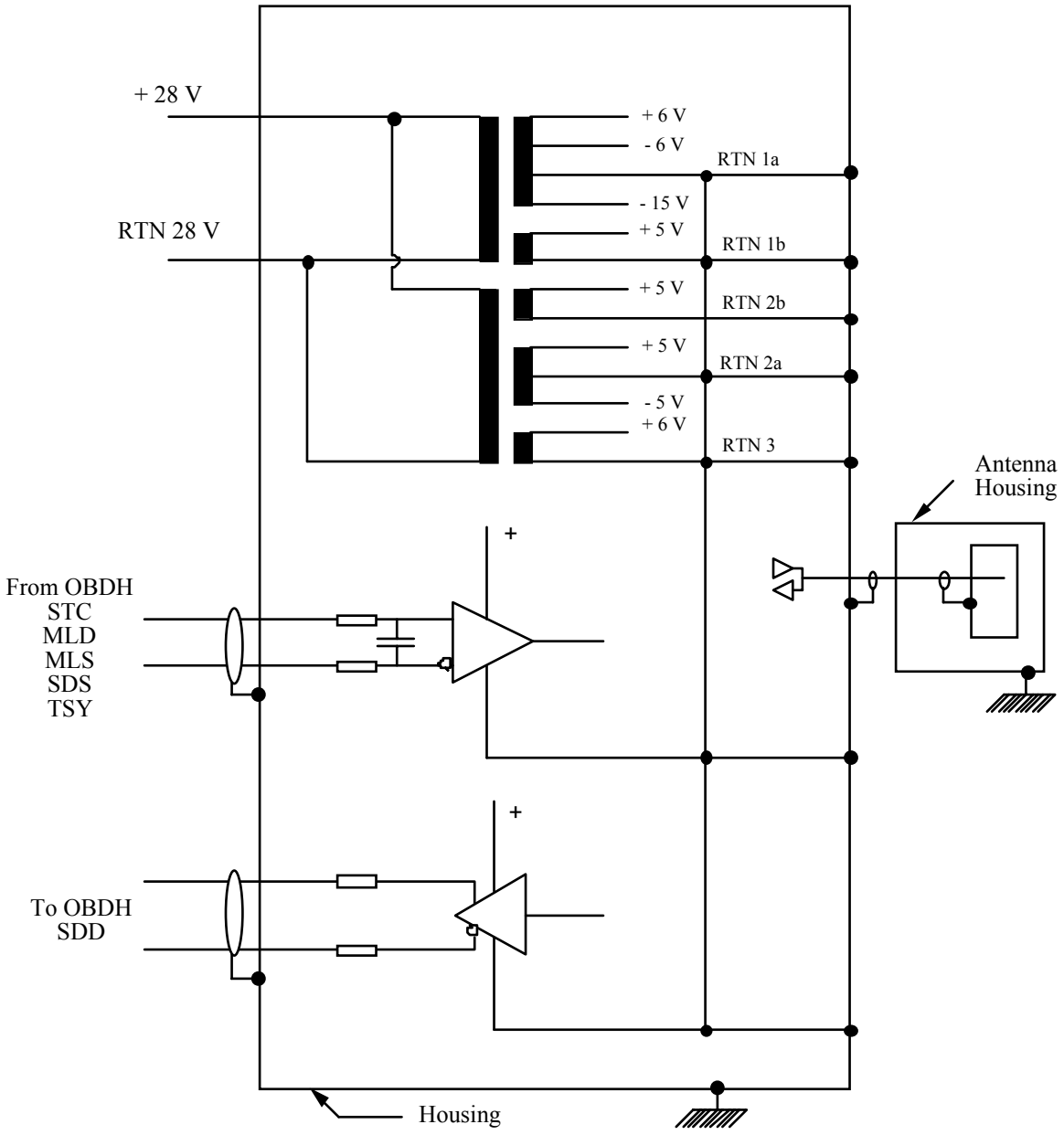


Figure 2.2a : Experiment Grounding Diagram

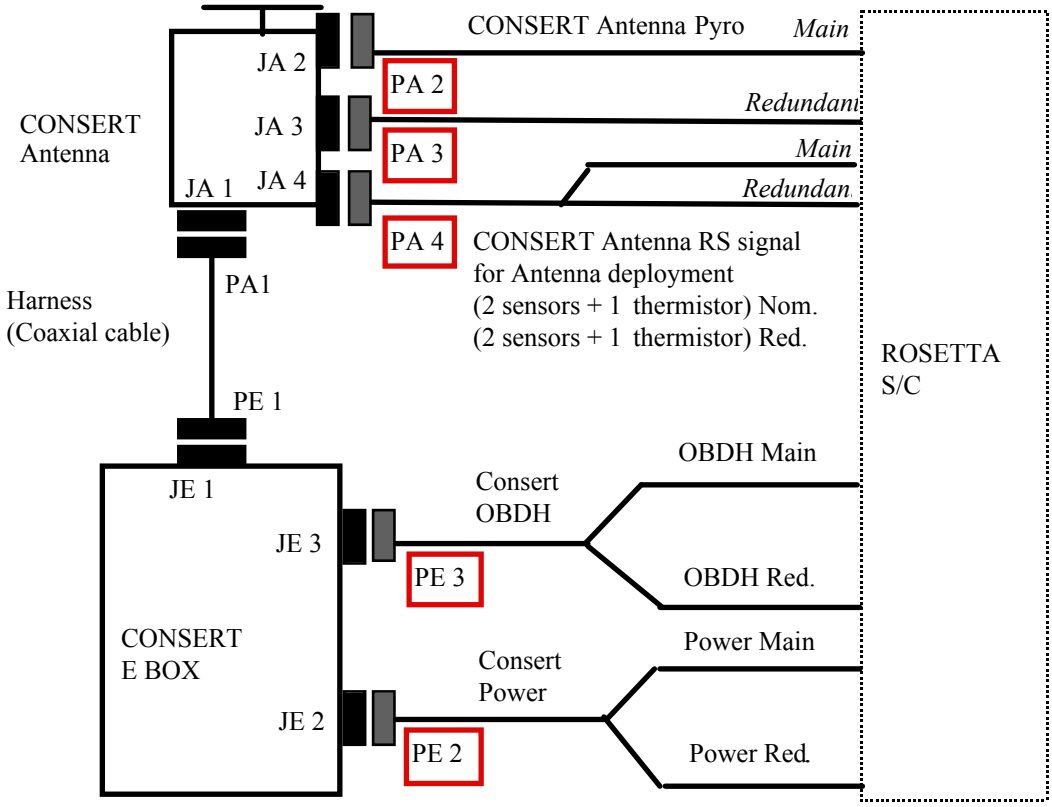


Figure 2.2b : Interconnexion Harness Bloc Diagram

For more details, see also :

Consert EID B vol 2.4 (power I/F)
Consert EID B vol 2.5 (pyro I/F)
Consert EID B vol 2.7 (OBDH I/F)

2.2.1. OBDH Channel names and characteristics

Function	Line	Dir.	Name	Circuit type	Connector
Serial Data Transfert clock	Nom True	IN	NSTCT	SBDL reciever HS-26C32RH	OBDH
	Nom Comp	IN	NSTCC		OBDH
	Red True	IN	RSTCT	SBDL reciever HS-26C32RH	OBDH
	Red Comp	IN	RSTCC		OBDH
Serial Memory Load Data	Nom True	IN	NMLDT	SBDL reciever HS-26C32RH	OBDH
	Nom Comp	IN	NMLDC		OBDH
	Red True	IN	RMLDT	SBDL HS-26C32RH	OBDH
	Red Comp	IN	RMLDC		OBDH
Serial Memory Load Sampling	Nom True	IN	NMLST	SBDL reciever HS-26C32RH	OBDH
	Nom Comp	IN	NMLSC		OBDH
	Red True	IN	RMLST	SBDL reciever HS-26C32RH	OBDH
	Red Comp	IN	RMLSC		OBDH
Serial Telemetry Sampling	Nom True	IN	NSDST	SBDL reciever HS-26C32RH	OBDH
	Nom Comp	IN	NSDSC		OBDH
	Red True	IN	RSDST	SBDL reciever HS-26C32RH	OBDH
	Red Comp	IN	RSDSC		OBDH
Timer Sync. Pulse	Nom True	IN	NTSYT	SBDL reciever HS-26C32RH	OBDH
	Nom Comp	IN	NTSYC		OBDH
	Red True	IN	RTSYT	SBDL reciever HS-26C32RH	OBDH
	Red Comp	IN	RTSYC		OBDH
Serial Telemetry Data	Nom True	OUT	NSDDT	SBDL driver HS-26C31RH	OBDH
	Nom Comp	OUT	NSDDC		OBDH
	Red True	OUT	RSDDT	SBDL driver HS-26C31RH	OBDH
	Red Comp	OUT	RSDDC		OBDH

2.3. Software

See Consert EID B vol 2.8

2.4. Budgets

See EID B Vol 2

Mission phase	Operation type	Typical duration	Power (W)	TM volume	TC volume	Remark
Commis-sioning	Antenna deployment	10 min	0	0	0	Consert E-Box is off Under SC monitoring
Commis-sioning	Instrument checkout and Solar Panel Influence	20 hours	mean 3 W peak 10 W	60 Mbits	10 kbit	Coordinated operations with Consert Lander instrument
Cruise checkout **each time it is possible**	Instrument checkout and Time Synchro	2 hours	mean 3 W peak 10 W	1 Mbit	1 kbit	Coordinated operations with Consert Lander instrument
SSP Lander predelivery operations	Instrument checkout, Time Synchro and software updates	3 hours	mean 3 W peak 10 W	1 Mbit	2 kbit	Coordinated operations with Consert Lander instrument
SSP relay (5 days)	Scientific measurements set n°1	10 hours min = 3 h max = 30 h	mean 3 W peak 10 W	24 Mbits (max 48 Mbits)	1 kbit	Coordinated operations with Consert Lander instrument SPECIFIC ORBIT REQUIREMENTS
SSP relay (5 days)	Scientific measurements set n°2	10 hours min = 3 h max = 30 h	mean 3 W peak 10 W	24 Mbits (max 48 Mbits)	1 kbit	Coordinated operations with Consert Lander instrument SPECIFIC ORBIT REQUIREMENTS
Rest of SSP lifetime	Scientific measurements (values for each comet scanning)	10 hours min = 3 h max = 30 h	mean 3 W peak 10 W	24 Mbits (max 48 Mbits)	1 kbit	Coordinated operations with Consert Lander instrument SPECIFIC ORBIT REQUIREMENTS

3. Experiment operations

3.1. Operating principles

3.1.1. Software overview

The Consert Instrument flight software is running on an 80C32 micro-controller, with 64 K Octets of accessible RAM memory.
No real-time kernel is used, and no interrupts are used. All Activities are started on polling basis only.
The time reference inside Consert is based on an internal Clock (Sorep OCXO), which is used to start the various Consert phases and to maintain the Rosetta SCET.
The unit is a TIC. Its value is:

$$1 \text{ TIC} = 2^{14} / 10^{7} = 1.6384 \text{ millisecond}$$

3.1.2. Autonomy concept

After the switch-on (by a time tagged TC or spacecraft procedure OBCP), the SCET has to be delivered to the instrument (earliest 20 second, latest 60 seconds after switch on).
The Nominal/Redundant channel selection is performed automatically by the instrument based on the first transition detected on the STS (Serial Telemetry Sampling) lines after switch-on. Once a channel is selected, it remains selected until switch-off or instrument internal Reset.
After The SCET time delivery, the instrument waits for its Mission table, delivered as a private TC (data size is 20 bytes). This table defines all the timings and set-ups to be used in the instrument during the operation phase.
After the Mission table has been received, the instrument will perform all operations autonomously.
A time-tagged TC or spacecraft procedure will switch off the instrument at completion of the scientific operations.
The Rosetta Orbiter Spacecraft should be able to initiate the Consert Orbiter instrument Switch-on procedure with a time accuracy of 10 seconds with respect to ground UT.

> NB : The same request should also apply to the Consert Lander in instrument; i.e. the Lander CDMS system should be able to initiate the Consert Lander instrument Switch-on procedure with a time accuracy of 10 seconds with respect to ground UT.
>
> In fine, the overall maximum uncertainty on the relative Consert Orbiter and Lander instruments will be less then 20 seconds.
> See § 3.2. for detailed timing constraints during Consert Operation.

The complete Consert experiment is composed of :

- One Orbiter instrument (Electronics, antenna, harness)
- One Lander instrument (Electronics, antennas, harness)

Each scientific measurement sequence (called **scanning sequence**) involves the Orbiter instrument and the Lander instrument.
The duration of this Scan sequence is related to the duration of the orbit of the Rosetta Spacecraft relatively to the Lander on the rotating comet nucleus. This duration is typically of the order of one revolution around the nucleus
During this scan sequence, about 3000 individual measurements, called **soundings** are taken. The individual duration of this sounding is less than one second.

3.1.3. Duration of one scanning sequence

This duration is typically of the order of one revolution around the nucleus and should correspond to the time when the Lander and the orbiter are separated by the comet.
During the direct line of sight periods, the synchronization occurs. This means that the duration of the data recording will not correspond to the total time of one revolution.
The number of samples is given by the following formula :

2 * PI *Radius of comet/(lambda/2)

where lambda is wave length

During the scanning sequence, for a circular comet with a 750m radius, about 3000 individual measurements, called soundings are taken.
This formula assumes that the rotation of S/C is much faster than the rotation of comets. In general case it will be necessary to take into accounts the relative motions in order to establish the number of samples.

3.1.4. Nominal Comet and Spacecraft orbit parameters

The general structure of the CONSERT operational scenario is not dependant on the comet type that will be explored during the Rosetta mission. But a certain amount of the parameters are dependant of the shape and size of the comet nucleus and of the orbit of the spacecraft and nucleus rotation.

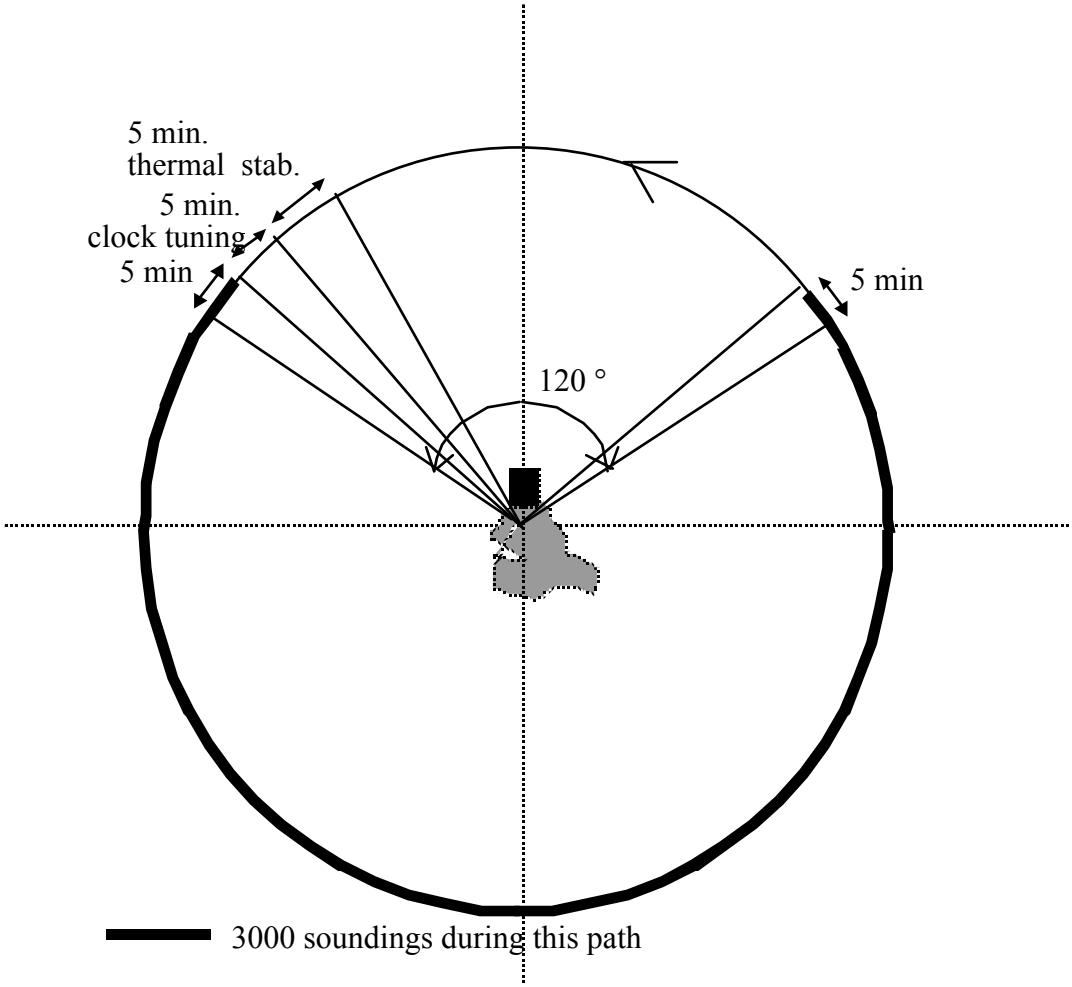
The numbers used here to derive the numerical parameters are :

Radius of the comet nucleus : 500 to 1500 m : : **Nominal radius = 750 m**

Spacecraft orbit period around the comet : : Minimum 3 hours
: **Nominal : 10 hours**
: Maximum : 30 hours

Number of CONSERT soundings during one orbit : : 3000

Note : These calculations are made for the comet Wirtanen.
for a launch in Feb-March 2004, the new target is Churyumov-Gerasimenko whose nominal radius is 2-3 times the one of Wirtanen.
To keep the same surface resolution, it is necessary to increase the number of soundings with the same factor (6000 to 9000 soundings). The data volume will be increased accordingly.


5 min.
thermal stab.
5 min.
clock tuning
5 min
5 min
120 °
3000 soundings during this path

3.1.5. Operational Scenario Preparation

Information needed by the PI team before definition of measurement sequence:

- Rosetta orbital parameters around the Nucleus
- Comet shape and rotation parameters (axis, momentum)
- Lander landing site on the comet nucleus (predicted or measured)

Based on these data's, the team will compute and define the following parameters :

TON $_O$: Consert/Orbiter switch-on time (in UT)
T ON $_L$: Consert/Lander switch-on time (in UT)
TUNESTART $_O$: Start time for Consert/Orbiter Clock Tuning mode (in UT)
TUNESTART $_L$: Start time for Consert/Lander Clock Tuning mode (in UT)
SOUNDSTART : Consert/Orbiter & Consert/Lander Sounding start time (in UT).
NBSOUNDING : Total number of sounding performed by Consert/Orbiter & Consert/Lander
DELTASOUND : Period between each sounding.

The Rosetta Orbiter Spacecraft should be able to initiate the Consert Orbiter instrument Switch-on time-tagged procedures with a time accuracy of 10 seconds with respect to ground UT.
The Rosetta Lander Spacecraft should be able to initiate the Consert Lander instrument Switch-on time-tagged procedures with a time accuracy of 10 seconds with respect to ground UT.

Typical values of these numbers :

We suppose here that the soundings are made during the two third of the orbit ‘behind’ the comet and 5 minutes before and after this 2/3 turn.

T ON $_O$: calculated on ground, based on orbit
T ON $_L$: calculated on ground, based on orbit
$| T ON_O - T ON_L | < 20$ sec
$TUNESTART_O = T ON_O + 6$ minutes
$TUNESTART_L = T ON_L + 6$ minutes
And : $TUNESTART_O = TUNESTART_L + 21$ seconds

SOUNDSTART = TUNESTART + 6 minutes

3.1.6. Generation in the Consert EGSE of the Missioin Table TC based on these data

The complete parameter definition and Packet Structure of this TC is given in chapter 6.2
All parameters of this TC are described hereafter :

- TAB_INDEX (8 bit unsigned value) :
  Index number of table, for ground reference
- TAB_TUNETIC (32 bit unsigned value) :
  Time interval between instrument switch-on and start of tuning phase, expressed in TIC units, i.e. 1.6384 milliseconds periods
  TAB_TUNETIC = TUNESTART $_O$ - T ON $_O$ expressed in TIC units
- TAB_STARTTIC (32 bit unsigned value) :
  Time interval between instrument end of tuning phase and start of the first sounding, expressed in TIC units, i.e. 1.6384 milliseconds periods
  TAB_STARTTIC = SOUNDSTART - TUNESTART $_O$ expressed in TIC units
- TAB_DELTATIC (16 bit unsigned value) :
  Time interval between start of each, expressed in TIC units, i.e. 1.6384 milliseconds periods
  TAB_DELTATIC = DELTA SOUND expressed in TIC units
- TAB_NBSOUND (16 bit unsigned integer) :
  Number of soundings per scan orbit.
  TAB_NBSOUND = NB SOUND
- TAB_INITFREQ (8 bit unsigned integer) :
  Initial frequency of the clock (see calibration in instrument integration procedure)
- TAB_MODEBYTE (8 bit mode byte) :
  Only lsb is used for Orbiter
  lsb = 0 : standard value , data from FPGA (RX accumulation) are sent in TM
  lsb = 1 : test value, tabulated value in ROM memory are sent in TM
- TAB_MINATT (8 bit unsigned integer) :
  Minimum value that can be used for the sounding AGC. Can be used to force the instrument Gain to a given value. (Not operating on FM).
- TAB_MAXATT (8 bit unsigned integer) :
  Maximum value that can be used for the sounding AGC. Can be used to force the instrument Gain to a given value. (Not operating on FM).

At each sounding the Attenuation value (GCW) will be constraint inside [TAB_MINATT; TAB_MAXATT] . (Not operating on the FM).

- TAB_NBL_LEVEL (8 bit unsigned integer) :
  Level in slow ADC unit to be reached during Tuning AGC phase on the internal connector NBL_Level.
  Zero volts at input of the ADC corresponds to a value of 128
- TAB_NBL_ZERO (8 bit unsigned integer):
  Level in slow ADC unit to be detected as disappearing of the Radio Signal during Tuning phase on the internal connector NBL_Level .
  Zero volts at input of the ADC corresponds to a value of 128

Mission Table parameter name	Typical value for AFT test	Increment value	Maximum value
Table Index			
TAB_INDEX	1	1	255
Time between power on and start of tuning			
TAB_TUNETIC	3 minutes = 109863 (dec) TIC = 00 01 AD 27 (hex) TIC	1 TIC = 1.6384 msec	4294967295 TIC = 1954 hours = 81 days
Time between end of tuning and Start of sounding			
TAB_STARTTIC	1 minute = 36621 (dec) TIC = 00 00 8F 0D (hex) TIC	1 TIC = 1.6384 msec	4294967295 TIC = 1954 hours = 81 days
Time between soundings			
TAB_DELTATIC	5 seconds = 3052 (dec) TIC = 0B EC (hex) TIC	1 TIC = 1.6384 msec	65535 TIC = 107 seconds
Total numer of soundings			
TAB_NBSOUND	100 (dec)	1	65535 (dec)
Initial clock frequency (before start of Tuning)			
TAB_INITFREQ	For FMO : 90.000 000 MHz = 126 (dec) = 7E (hex)	1 (dec)	255 (dec)
Test Data			
TAB_MODEBYTE	0	0	1
Min and Max AGC attenuation			
TAB_MINATT	0	1 DN RX attenuation = 2dB	31 DN RX attenuation = 62dB
TAB_MAXATT	31 (dec)	1 DN RX attenuation = 2dB	31 DN RX attenuation = 62dB
Minimum Level to be reached for successful tuning			
TAB_NBL_LEVEL	149 (dec) 95 (hex)	1 DN	255 (dec) 4 Volts
Maximum Level to detect Signal disappearance			
TAB_NBL_ZERO	133 (dec) 85 (hex)	1 DN	255 (dec) 4 Volts

In order to calculate these values easily, one can use a small Labview ™ utility software that will translate Standard unit values into mission table values :
File : M_Tab in directory Mission_Table_gene

NB : leading zeros are not displayed in this software, don’t forget them.

3.2. Selection of Mission Table parameters for Tuning phase

The purpose of this chapter is to define the rules of Mission Table Parameter Generation in order to ensure correct Orbiter & Lander synchronization.

Operational constraints :

C1 : Switch-on time of Orbiter instrument can be defined only with an accuracy of +/- 10 seconds versus UT.
C2 : Switch-on time of Lander instrument can be defined only with an accuracy of +/- 10 seconds versus UT.

Tuning phase Consert constraints

C3 : When the Tuning phase starts on Orbiter instrument (with the AGC loop), the Lander instrument should already be in radio emission (TX) phase in order to ensure good Gain convergence.

C4 : The Orbiter instrument will stop it's tuning phase even if no signal loss is detected, after a duration "Twait" after the end of the PLL loop, that is called TUNE_TIMEOUT_VAL in the flight software.
This duration is coded to 60 seconds (36621 TIC units) in the Flight software and can only be changed by a patch TC.

Software hard-coded parameters

These parameters are hard-coded in the Flight software and can only be changed by a patch TC.
The definition of all these parameters are in an ASCII file called "eq_nm_o" (for Equivalence of Names Orbiter) and "eq_nm_l" (for Equivalence of Names Lander).
If this file is updated the whole flight software (all modules) should be recompiled and linked.

LANDER parameter :
TUNE_DURATION : Tuning CW period is 60 seconds (36621 TIC units)
NB : in the EML as delivered to DLR this value is set to only 30 seconds
The value has been updated for FM (and QML)

ORBITER Parameter :
TUNE_TIMEOUT_VAL = 60 seconds (36621 TIC units)

Parameters that can be selected by TC (in the mission table)

LANDER parameters :
Lander TUNETIC :
Duration between Lander instrument switch-on and start of the Lander Tuning phase
Lander STARTTIC :
Duration between end of Tuning phase and start of the first sounding on Lander
Lander INITFREQ :
Setting of the OCXO frequency (in DN value from 0 to 255). The Lander clock frequency setting will remain at this setting until instrument switch-off or direct update via a Direct_TC.

ORBITER parameters :
Orbiter TUNETIC
Duration between Lander instrument switch-on and start of the Lander Tuning phase
Orbiter STARTTIC :
Duration between end of Tuning phase and start of the first sounding on Orbiter.
Orbiter INITFREQ :
Setting of the OCXO frequency (in DN value from 0 to 255) before the tuning phase.
During the tuning phase the clock frequency will be adjusted starting from this value to try to lock on the Lander frequency. This value should correspond to a frequency as close as possible to the expected Lander frequency selected with the parameter Lander INITFREQ
Orbiter NBL_LEVEL and Orbiter NBL_ZERO :
Parameter used during orbiter tuning phase to adjust the Attenuation (AGC phase) and to detect the loss of signal.

Tuning phase scenario

Lander activities	Orbiter activities
Switch On (From Lander S/C procedure)	Switch On (From S/C OBCP procedure)
Start of Lander Tuning phase (Radio signal transmission TX)	
TX	Start of Orbiter Tuning phase
TX	AGC (RX Gain will increase in order to put the signal NBL over the value NBL_LEVEL)
TX	PLL loop The Orbiter clock frequency is tuned to match the Lander TX carrier frequency (duration of AGC + PLL phase is 15 sec)
TX	Wait for Radio signal loss (ie : wait until signal NBL goes below the value of NBL_ZERO)
End of TX End of tuning phase Internal time reference (TIC count) reset to 0	End of tuning phase Internal time reference (TIC count) reset to 0

Setting of Mission table parameters

As per C1 & C2 and if the requested switch-on time for Orbiter and Lander in UT are the same :

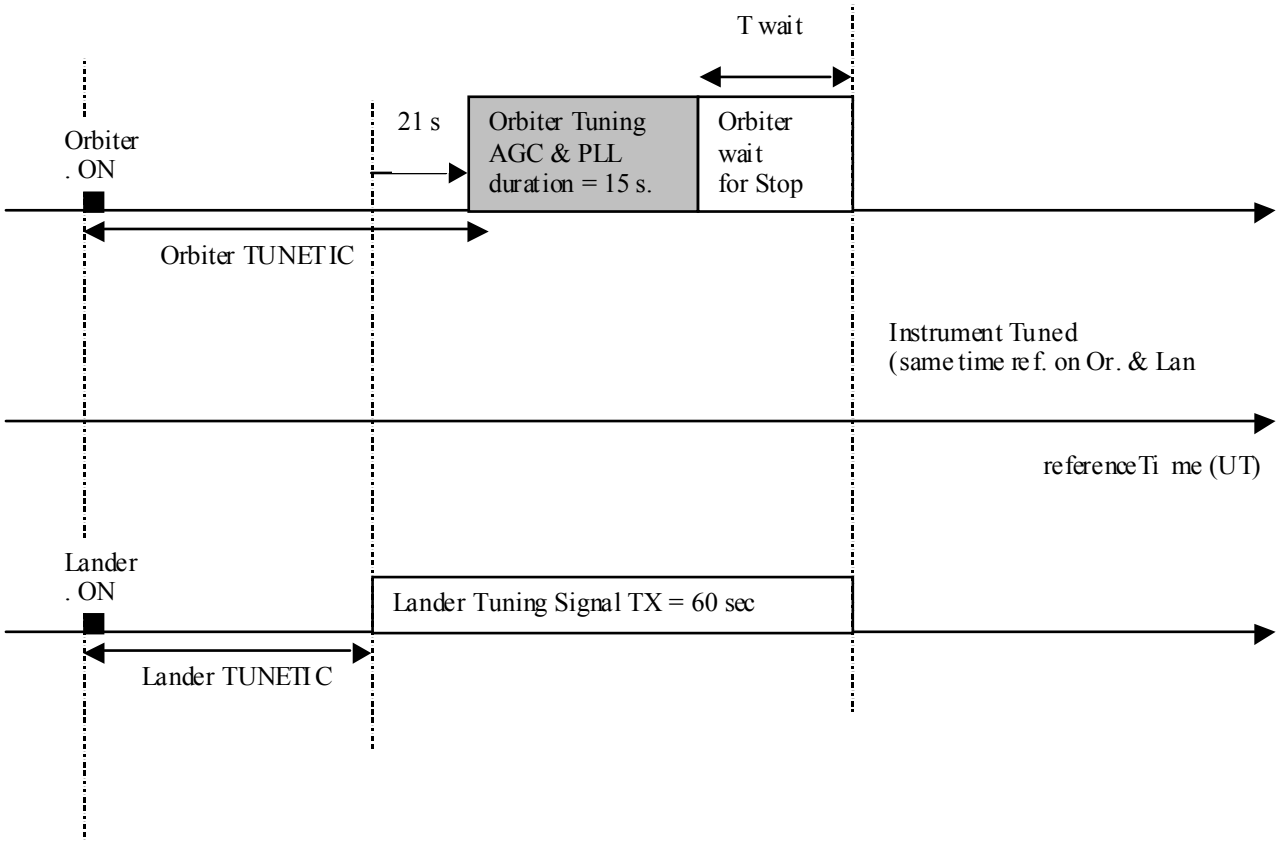
Orbiter Switch On = Lander Switch On +/- 20 sec

C3 (Lander should start tuning phase first) gives :

Orbiter TUNETIC > Lander TUNETIC + 20 sec.

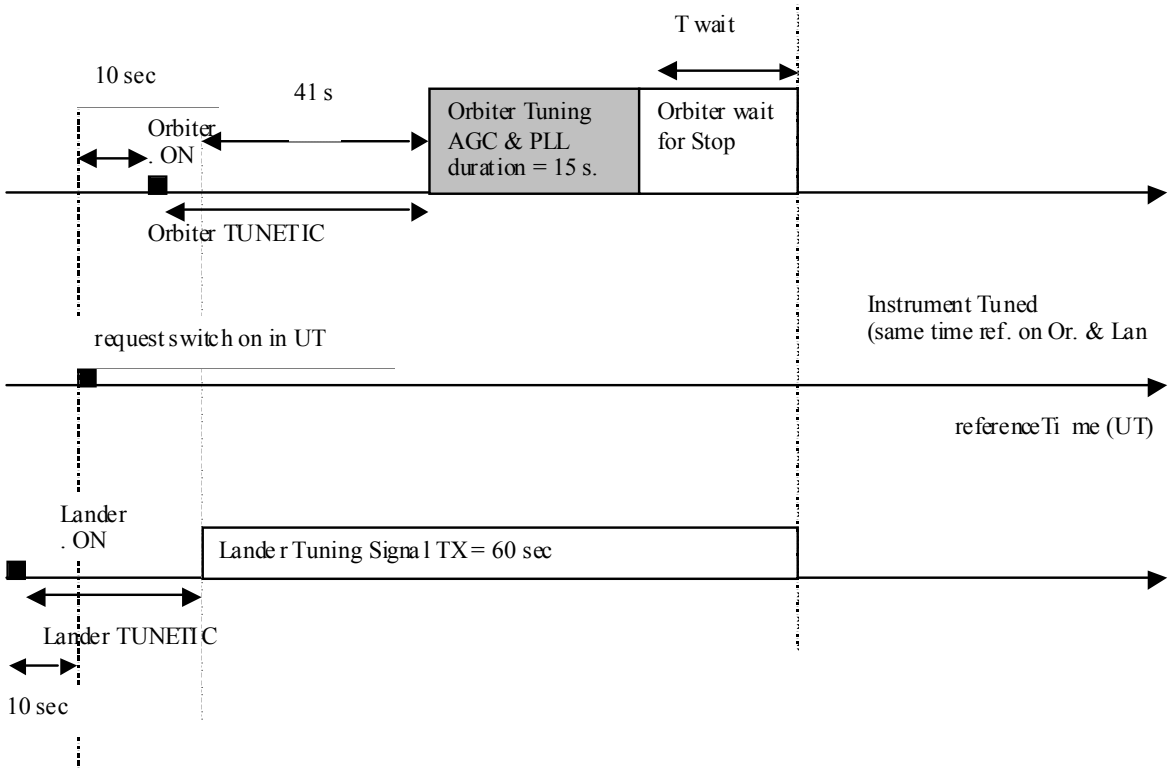
Let us choose **: Orbiter TUNETIC = Lander TUNETIC + 21 s**ec.

See diagrams and worst cases on following diagrams.



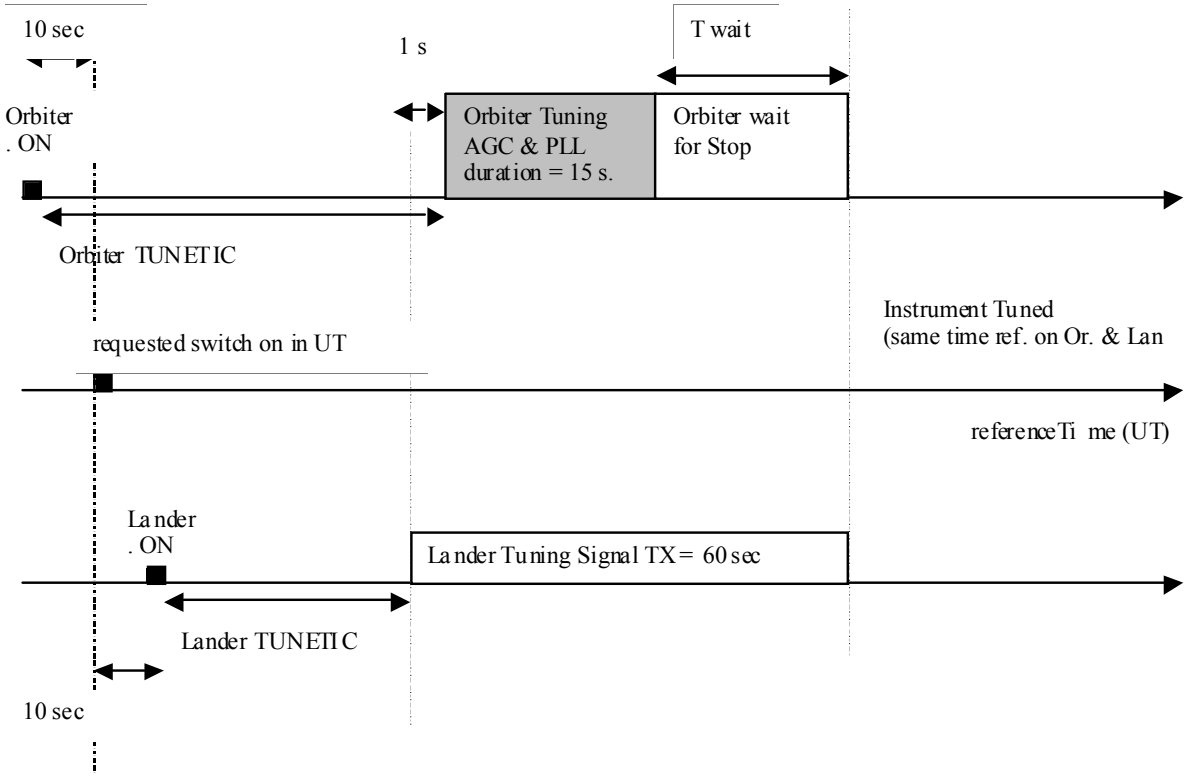
Nominal case :
Orbiter and Lander instrument switched On at same time (UT reference time)

Duration when Radio signal is emitted by Lander before start of Orbiter AGC = 21 seconds
Then Orbiter wait time for = Twait = 60 – (21 + 15) = 24 seconds



Worst case 1 :
Orbiter switched On 10 seconds after reference time.
Lander switched On 10 seconds before reference time.

- Duration when Radio signal is emitted by Lander before start of Orbiter AGC = 21 + (10 +10) = 41 seconds
  - Then Orbiter wait time for = Twait = 60 – (41 + 15) = 4 seconds



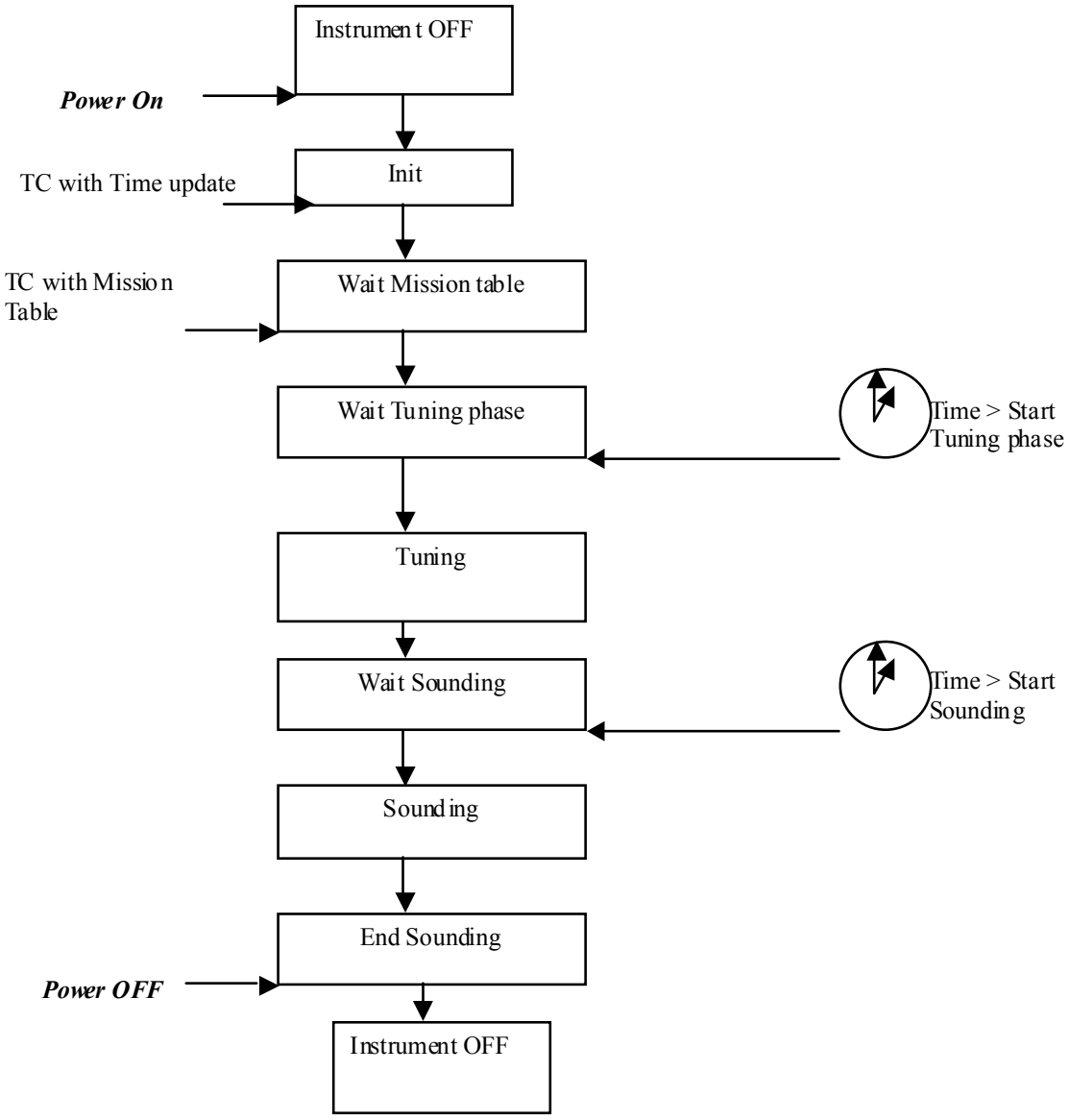
Worst case 2 :
Orbiter switched On 10 seconds before reference time.
Lander switched On 10 seconds after reference time.

- Duration when Radio signal is emitted by Lander before start of Orbiter AGC = 21 – (10 +10) = 1 seconds
  - Then Orbiter wait time for = Twait = 60 – (1 + 15) = 44 seconds

4. Phase description

4.1. Phase Transition table

Init phase: After switch-on and up to reception of SC Time update
Wait Mission Table phase: After *Init* and until reception of a valid mission table
Wait tuning phase: After *Wait MT* and until time for start of tuning is reached.
Tuning phase : After *Wait tuning* and until completion of tuning activities.
Wait Sounding phase : After *Tuning* and until time for start of sounding is reached.
Sounding phase : After *Wait Sounding* and until completion f the predefined n° of soundings.
End Sounding phase : After *Sounding* and until Switch-off.



4.2. Detailed phase description

4.2.1. Init phase

After switch-on and up to reception of SC Time update

- After Hardware initialization, an event report notifying the correct initialization is generated.

Note : Time update TC (service 9.1) should be sent to the instrument after reception of this event report

4.2.2. Wait mission table phase

After "Init" and until reception of a valid mission table.

- During nominal science operation, the instrument will wait until reception of a valid private TC with a Mission table (service 192.1). This table contains all the information needed for a given observation.
- In this mode (and, to be verified, only in this mode) one or more software patches (service 6.2) can be performed and memory areas can be dumped (service 6.5)
- During ground tests, direct test TC's can be sent to the instrument (service 192.2).

4.2.3. Wait tuning phase

After "Wait mission table" and until time for start of tuning is reached.

4.2.4. Tuning phase

After "Wait tuning" and until completion of tuning activities

- On orbiter instrument, the internal Oven Controlled Quartz Oscillator is tuned to a frequency adjusted to a radio signal received from the Lander.
- At the end of this radio signal, both Orbiter instrument and Lander instrument internal calendars are reset to zero.
- At completion of this phase, an event report is generated (either tuning success or failure).

4.2.5. Wait Sounding phase

After "Tuning" and until time for start of sounding is reached.

4.2.6. Sounding phase

After "Wait Sounding" and until completion of the predefined number of soundings.

- Real Science activity phase. The Science report Packets (service 20.3) are only generated in this phase.
- A Radio wave is transmitted from the Orbiter to the Lander and then back from the Lander.
- The shape and amplitude of this signal (in phase and in quadrature) are sent in the Science Report.

4.2.7. End Sounding phase

After "Sounding" and until Switch-off.

4.3. Phase budget summary

Experiment phase	Power Usage	Data Rate (Kbit/sec)	Functional Use
Init	3.1 W	< 0.02	Initialization phase (duration ca 60 seconds)
Wait mission table	2.1 W	< 0.02	Wait for the TC with Mission table (duration ca 60 seconds), and prepare mission timeline and setup.
Wait tuning	2.1 W	< 0.02	Wait for Lander tuning signal (duration ca 300 seconds)
Tuning	7.2 W	< 0.02	Perform internal clock tuning and synchronization activities (duration ca 300 sec)
Wait Sounding	2.1 W	< 0.02	Wait for start of sounding Mode (duration ca 600 sec)
Sounding	2.5 W Peak 9.7 W	1.06	Perform sounding activities, generation of science data (duration 2 to 20 hours, comet type dependant)
End Sounding	2.1 W	< 0.02	Wait for switch-off

5. Operational procedures

5.1. Ground test sequence

This chapter contains the inputs provided by CONSERT for the test procedure preparation of the instrument at system level on the S/C EQM and FM.

5.1.1. Test Overview, definitions and short description

5.1.1.1. Bench Test

The Bench Test is a replica of the bench test performed at PSR. SIS is provided by ESA and disconnected from CCS.
After reception of a specific Mission Table (MTUFT = Mission Table for Unit Functional Test), an autonomous functional test of each sub-system is performed.

5.1.1.2. UFT (Unit Functional Test)

Elementary check of the experiment end-to-end data path.
SCOE connected to CCS.
Stimulators controlled by CCS
Repeat the tests performed during Bench Test.

5.1.1.3. IST (Integrated Subsystem Test)

All used services will be verified. The same Mission Table (MTUFT is used).

5.1.1.4. SFT (System Functional Test)

Simulate Mission Phases and re-execute Functional Tests.
As the Consert Lander instrument is involved, coordinated operations with the Rosetta Lander are implemented and a specific Mission Table is used for this test (MTPPT).

5.1.1.5. AFT (Abbreviated Functional Test)

Tests extracted from SFT.

5.1.1.6. SPT (Specific Performance Test)

Part of the SFT.
This test is to verify the scientific performance. Specific test set-ups are necessary. It is composed of several sub-tests.

5.1.1.7. Reception test (Contingency test only)

A dedicated radio Emitter test equipment is placed in the vicinity of the antenna and emits a signal in the 90 MHz band.
The instrument is set in a specific observation mode by Telecommand.
The signal received by the instrument is sent back via TM and analyzed in the EGSE.

5.1.1.8. Emission test (Contingency test only)

A dedicated radio receiver test equipment is placed in the vicinity of the antenna and measures the signal in the 90 MHz band.
The instrument is set in a specific emission mode by Telecommand.
The signal received by the test receiver is analyzed later in the EGSE.

5.1.1.9. Transponder test (Contingency test only)

Full Transponder operation test including Reception and Emission phase and a clock tuning test.
A Consert Lander emulator is also used for this test.

5.1.1.10. Instrument performance Test

This test is performed with both Consert/Orbiter and Consert/Lander instruments.
The same Mission Table is beeing used for this test (MTPPT).

Note : During the project development, other names have been used for this test :
Clock Drift correction or Ping Pong Test.

Both systems have to be powered ON and to have a TM and TC capability at the same time. This test procedure has to be run simultaneously on the Orbiter and on the Lander, in order to perform a Complete RF Transponder sequence, including the clock correction sequence. This test is a complete Consert End-to-End test. It has to be performed on ground and also during the cruise phase.
As the Orbiter and Lander antennas will not be far away, this test can either be performed with the antennas in launch position or the antennas deployed.

5.1.1.11. SVT (System Validation Test)

Closed loop test from ESOC.

5.1.2. Detailed Test Activities

5.1.2.1. General Test Aspects

All tests are logged. A Test Readiness Revue Report and a Post Test Revue Report is attached to the test report.

5.1.3. Incoming inspection activities

5.1.3.1. Visual inspection

5.1.3.2. Bench Test

Bench Test Procedure

See detailed procedure in :
"Orbiter AFT Procedure", Ref. RO-OCN-PR-3043, Issue 1.0, Date 26/04/01 reproduced in "Annex 1 : Consert Orbiter Instrument Bench Test procedure"

External simulator is not necessary

- Experiment switch-on
- Wait 30 seconds
- Send SCET update
- Wait 30 seconds
- Send CON_MISSION_TABLE (**MTAFT**) (Mission table #1, short cycle)
- ± 10 minutes data acquisition (HK & SC)
- Wait for event Packet : Sounding Completed (EID 41004)
- Experiment switch-off
- Post test Data Analysis (1 hour)

SIS Configuration description

See Annex 1 : Consert Orbiter Instrument Bench Test procedure

Description of analysis tools running on SIS

See Annex 1 : Consert Orbiter Instrument Bench Test procedure

Harness connection Procedure

See Annex 1 : Consert Orbiter Instrument Bench Test procedure

MGSE Installation Procedure

- Deploy antenna if necessary and install antenna MGSE.

  See detailed procedure in :
  "Manual for handling of the CONSERT Orbiter Antenna", Ref RO-OCN-TN-3019, Issue 1.3, Date 12/06/01

5.1.4. UFT

5.1.5. I&T Activities

Main & Redundant commands

Note : There is no internal redundancy in the instrument. The same procedure as for the Bench test is applied for each CCS configuration.

Main

- Experiment switch-on
- Wait 30 seconds
- Send SCET update
- Wait 30 seconds
- Send CON_MISSION_TABLE 1 (**MTAFT**) (Mission table #1, short cycle)
- ± 10 minutes data acquisition (HK & SC)
- Wait for event Packet : Sounding Completed (EID 41004)
- Experiment switch-off
- Post test Data Analysis (1 hour)

Redundant

- Experiment switch-on
- Wait 30 seconds
- Send SCET update
- Wait 30 seconds
- Send CON_MISSION_TABLE 1 (**MTAFT**) (Mission table #1, short cycle)
- ± 10 minutes data acquisition (HK & SC)
- Wait for event Packet : Sounding Completed (EID 41004)
- Experiment switch-off
- Post test Data Analysis (1 hour)

Data to be monitored

- HK and SC telemetry

5.1.6. Unit Functional Test

See detailed procedure in :
"Consert I&T – UFT procedure for PFM", Ref. RO-ALS-PR-4049, Issue 2d01, Date 16/05/01
and
"Consert I&T – UFT procedure for EQM", Ref. RO-ALS-PR-4049-AppB(OCN), Date 10/07/00
Partly reproduced in "Annex 2 : Consert I&T - UFT procedure for EQM"

Instructions to configure the SCOEs

See detailed procedures

List of commands

- Experiment switch-on
- Wait 30 seconds
- Send SCET update
- Wait 30 seconds
- Send CON_MISSION_TABLE 1 (MTAFT) (Mission table #1, short cycle)
- ± 10 minutes data acquisition (HK & SC)
- Wait for event Packet : Sounding Completed (EID 41004)
- Experiment switch-off
- Post test Data Analysis (1 hour)

Data to be monitored

- HK and SC telemetry

5.1.7. IST

See detailed procedure in :
"Consert IST procedure for PFM", Ref. RO-ALS-PR-4049, Issue 2d01, Date 16/05/01
and
"Consert I&T – UFT procedure for EQM", Ref. RO-ALS-PR-4049-AppA, Issue 2, Date 08/05/01
Partly reproduced in "Annex 3 : Consert IST procedure for PFM"

For information, a FFT procedure at instrument level (i.e.) using a SIS is described in :
Orbiter Full Functional Test Procedure", Ref RO-OCN-TR-3042, Issue 4.2, Date 31/05/01
Reproduced in "Annex 4 : Consert Orbiter Instrument Full Functional Test Procedure"

OBCP List

OBCP 1 : Consert Start
OBCP 2 : Consert Off
OBCP 3 : Consert start with patch

5.1.7.1. Connection Test

Service 17, 2

- Send 17,1
- Receive 17,2 : CON_TEST_RESP

5.1.7.2. TM & TC Verification

Test Commands

- Experiment switch-on
- Wait 30 seconds
- Send SCET update
- Wait 30 seconds
- Send CON_MISSION_TABLE 1 (MTAFT) (Mission table #1, short cycle)
- ± 10 minutes data acquisition (HK & SC)
- Wait for event Packet : Sounding Completed (EID 41004)
- Experiment switch-off
- Post test Data Analysis (1 hour)

TM effect

Mission Table parameters are recopied in HK Telemetry.

TC generating a Service 5 Event Report

- Send CON_MISSION_TABLE 1 (MTAFT) (Mission table #1, short cycle)

5.1.7.3. Patch & Dump Test

Memory Map

Circuit	A 16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	useful address
PRGM	0	0	0	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0->3FFF
ADC/DAC	0	0	1	0	0	x	x	x	x	x	0	0	0	x	x	x	x	4000 (*)
LATCH1	0	0	1	0	0	x	x	x	x	x	0	0	1	x	x	x	x	4010 (*)
LATCH2	0	0	1	0	0	x	x	x	x	x	0	1	0	x	x	x	x	4020 (*)
FPGA	0	0	1	0	0	x	x	x	x	x	0	1	1	x	x	x	x	4030 (*)
FIFO TM	0	0	1	0	0	x	x	x	x	x	1	0	0	x	x	x	x	4040 (*)
FIFO TC																		
RAM	0	0	1	0	1	x	x	x	x	x	x	x	x	x	x	x	x	5000->5FFF
	0	0	1	1	0	x	x	x	x	x	x	x	x	x	x	x	x	6000->6FFF
	0	0	1	1	1	x	x	x	x	x	x	x	x	x	x	x	x	7000->7FFF
	0	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	8000->FFFF
	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	10000-> 1FFFF

Example of possible Data Dump

test A1 : Patch and Dump functions :

On SIS , perform dump of 64 words starting from address 0000 8000 (hex)
see record StdD1.dat (attached) : unused memory space before patch

Send patch file patch.dat to address 0000 8000 (hex), using SIS

Perform dump of 64 words starting from address 0000 8000 (hex)
see record: first 16 words are same as the patched ones.

Example of possible Data Load

test A1 : Patch and Dump functions :

On SIS , perform dump of 64 words starting from address 0000 8000 (hex)
see record StdD1.dat (attached) : unused memory space before patch

Send patch file patch.dat to address 0000 8000 (hex), using SIS

Perform dump of 64 words starting from address 0000 8000 (hex)
see record: first 16 words are same as the patched ones.

5.1.7.4. On Board Traffic Management (Service 3)

Define HK Packets enabled

No effect. Only one type of HK Packet generated in the instrument.

Define HK Packets disabled

No generation of HK Packets.

5.1.7.5. Context Saving Test (Service 18)

N/A

5.1.7.6. Science Data Transfer (Service 20)

Define operative mode

Mission table #1

Provide RSDB

Preliminary RSDB inputs (Excel Sheets) are being prepared with ESOC.

5.1.7.7. Private Service Verification

List of Private Services

192, 1 : Mission Table Update
192, 2 : Direct TC
255, 1 : Reset Telemetry Output Buffer

List of Private Commands

TM effect

5.1.7.8. Redundancy Test

Define the operative mode

There is no internal redundancy in the instrument.

5.1.7.9. Operative Modes Verification

SCOE Configuration

To be provided later

Mode Description

- Mission Table #1, short cycle.
This mode simulates the complete cycle of operation of the instrument. the Data flow is nominal (1 full SC data every 8 seconds), the total number of soundings is reduced from 3000 to a few tens to shorten the test duration.

5.1.7.10. Maximum Data Throughput

Mode Description

Abbreviated but complete sounding sequence generated by Mission Table #1, short cycle.

Expected Data Throughput

1044 Bytes generated every 2 seconds.

List of commands

CON_MISSION_TABLE (Mission table #1, short cycle)

5.1.7.11. Power Consumption Test

Current & Voltage Monitor Description

None

Mode Description

CON_MISSION_TABLE (Mission table #1, short cycle).

Expected Power Consumption

See relevant chapters of ADP.

5.1.7.12. Functional Performance Test

Mode Description

CON_MISSION_TABLE_1 (Mission table #1, short cycle)

5.1.8. SFT Activities

5.1.8.1. Payload Health Check in SFT

Mode Description

CON_MISSION_TABLE_2 (Mission table #2, Ping Pong Test)

External Stimulator Description

As the Consert Lander instrument is involved, coordinated operations with the Rosetta Lander are implemented and a specific Mission Table is used for this test (MTPPT).

5.1.8.2. System Polling Test

Mode Description

CON_MISSION_TABLE_2 (Mission table #2, Ping Pong Test)

Expected Data Throughput

1044 Bytes generated every 5 seconds

5.1.8.3. Payloads Parallel Operations

Applied Configuration

Mode Description

CON_MISSION_TABLE_2 (Mission table #2, Ping Pong Test)

5.1.8.4. Payloads Operations during Mission Simulation Tests

Near-Sun Hibernation

Consert to be switched-on and to perform a SFT during Wake-ups

Asteroid Fly-By

Consert to be switched-on and to perform a SFT

Deep Space Hibernation

Consert to be switched-on and to perform a SFT during Wake-ups

Comet Observations

Consert to be switched-on and to perform a SFT

SSP Operations

Consert to be switched-on and to perform a SFT in conjunction with Consert Lander.

Comet Operational Phase

Consert to be switched-on and to perform a SFT

5.1.9. AFT Activities

Same as SFT

5.1.10. SPT Activities

Same as SFT

5.2. On-Board Control procedures

These On-Board Procedures have not been finalized yet.

On Board Control Procedures (OBCP) Summary	Instrument : **CONSERT**	
OBCP Name	Function	Usage
OBCP 1 : Consert Start	Power On the instrument wait 30 seconds Send SCET update wait 30 seconds Send predefined TC with mission Table (CON_MISSION_TABLE)	N
OBCP 2 : Consert OFF	After reception of Event packet : EID 41004 (SOUNDING COMPLETED) : switch off Consert	N
OBCP 3 : Consert Start with patch	Power On the instrument wait 30 seconds Send SCET update wait 10 seconds Send Memory Load (patch) TC wait 10 seconds Send Memory dump TC wait 30 seconds Send predefined TC with mission Table (CON_MISSION_TABLE)	C if a patch is needed in flight

NB : The time reference inside Consert is maintained by an Oven Heated Ultra Stable Quartz Oscillator (OCXO). This component is used both in Consert Orbiter and Consert Lander instruments and is needed to maintain the same radio frequency and absolute time inside both instruments for transponder operation. The Consert internal Time format is called TIC and is a sequential count of 1.6384 msec periods after the instrument-tuning phase.
All TM packets generated by Consert will be dated in SCET in CUC time format. This time will be calculated by the Consert Instrument based on the TIC value and the received SCET time update after switch-on.

5.2.1. OBCP 1 : Power-On

5.2.2. OBCP 2 : Power-Off

5.2.3. OBCP 3 : Power-On with patch

OBCP Title : PL_OBCP_5_CN.3 CONSERT POWER ON PATCH
RSDB Name : KCNS8023
Type : Normal
Stored in PROM ? : No
Remarks :
A. Objective
The objective of this OBCP was to switch the CONSERT instrument from the power OFF state into its initial mode and to send a S/W patch to CONSERT. The final activity is the transmission of the mission table which will cause the predefined start and performance of the CONSERT sounding mode.
Purpose of such an OBCP would be to send a patch in a defined way every time when CONSERT shall be switched on when the need for a patch once for ever would have been detected. However, as the mission table was requested to be deleted from the ON_OBCP and to be left entirely to S/C MTL, there is no longer a meaningful need for a S/W patch OBCP as well.
The size of the S/W patch can vary between 2 bytes and 4 kB, i.e. a single patch TC is sufficient to patch CONSERT S/W. The patch TC would have to be sent to CONSERT directly before sending the mission table. As the mission table TC is to be left out, as well the patch TC (the contents of which anyhow is case dependant) can be left to S/C MTL.
Consequently the CONSERT POWER ON PATCH OBCP is identical to the normal ON_OBCP followed by the patch and mission table TCs in the MTL. The complete patch sequence thus shall be:

- Start CONSERT with ON_OBCP via S/C MTL
- Check successful performance of the ON_OBCP
- Send TC “CONSERT Memory Patch” to CONSERT with acceptance report request (ZCN00602 with parameters PCND0600 thru PCND0610 and PCNG0610 thru PCNG0630)
- Wait for 1 sec (after TC has arrived at CONSERT)
- Send TC “CONSERT Memory Dump Request” to CONSERT (ZCN00605 with parameters PCND0600 thru PCND0610 and PCNG0610 thru PCNG0630)
- Send “Mission Table” TC to CONSERT with execution report request (within latest 5 min since LCL switch-on) with execution acknowledge request (ZCN19201 with parameters PCNDA011 etc. set to the actual values)
- If execution report was not sent by CONSERT resent the mission table once

5.3. Flight Control Procedures

5.3.1. Switch-on Conditions

The only switch-on restrictions applicable for Consert are the measured temperature at the Consert E-Box TRP
Minimum Switch-on Temperature at Consert E-Box TRP : -20 °C
Maximum Switch-on Temperature at Consert E-Box TRP : +50 °C
Switch-on is performed by FCP : Consert-ON

5.3.2. List of Flight Control Procedures

Instrument : **CONSERT**
Used in all mission phases :
CONSERT_ON & CONSERT_OFF

Mission Phase	Abbrev.	Procedure number	Procedure title
Commisionning	CVP	CONSERT_CVP_1	CN-FCP-1 : Orbiter Verification
		CONSERT_CVP_3	CN-FCP-3 : Solar Panel Influence
		CONSERT_CVP_5	CN-FCP-5 : TC Verification
		CONSERT_CVP_6	CN-FCP-6 : Patch & Dump
		CONSERT_CVP_7	CN-FCP-7 : Interference
Cruise phase 1	CR1	CONSERT_CR1_1	CN-FCP-1 : Orbiter Verification
		CONSERT_CR1_4	CN-FCP-4 : Time Synchronisation
Mars flyby	MARS	CONSERT_MARS_1	CN-FCP-1 : Orbiter Verification
		CONSERT_MARS_4	CN-FCP-4 : Time Synchronisation
Cruise phase 2	CR2	CONSERT_CR2_1	CN-FCP-1 : Orbiter Verification
		CONSERT_CR2_4	CN-FCP-4 : Time Synchronisation
Earth flyby 1	EAR1	CONSERT_EAR1_1	CN-FCP-1 : Orbiter Verification
		CONSERT_EAR1_4	CN-FCP-4 : Time Synchronisation
Cruise phase 3	CR3	CONSERT_CR3_1	CN-FCP-1 : Orbiter Verification
		CONSERT_CR3_4	CN-FCP-4 : Time Synchronisation
Aster 1 flyby	AST1	CONSERT_AST1_1	CN-FCP-1 : Orbiter Verification
		CONSERT_AST1_4	CN-FCP-4 : Time Synchronisation
Cruise phase 4	CR4	CONSERT_CR4_1	CN-FCP-1 : Orbiter Verification
		CONSERT_CR4_4	CN-FCP-4 : Time Synchronisation
Earth Flyby 2	EAR2	CONSERT_EAR2_1	CN-FCP-1 : Orbiter Verification
		CONSERT_EAR2_4	CN-FCP-4 : Time Synchronisation
Cruise phase 5	CR5	CONSERT_CR5_1	CN-FCP-1 : Orbiter Verification
		CONSERT_CR5_4	CN-FCP-4 : Time Synchronisation
Aster 2 flyby	AST2	CONSERT_AST2_1	CN-FCP-1 : Orbiter Verification
		CONSERT_AST2_4	CN-FCP-4 : Time Synchronisation

Note : Antenna deployment is not under the responsibility of Consert experiment.

5.3.3. Detailed Procedures Inputs

5.3.3.1. Antenna Deployment

Spacecraft operation

5.3.3.2. Power ON for Consert

CONSERT_ON	**Consert Orbiter Instrument Switch-on (CN-FCP-000)**

Procedure Objective :
This procedure performs the power-on sequence for Consert. The instrument will select autonomously the active TM/TC channel and the active power channel.

Step n°	**Time from Consert LCL switch On (hh:mm:ss)**	**Activity**	**TM/TC packet**	**TM/TC parameter**
1	00:00:00	LCL ON		
2	00:00:05	Verify Event : “Init OK” received	YCN0D501	NCNA0505 = 41001
	00:00:10	Check Parameters : LCL Voltage LCL Current		
	00:00:20	Verify first HK packet : Initialisation Performed OCXO Temperature DIGI Board Temperature	YCN00325	NCND0331 = 1 NCND0339 = ? °C NCND0341 = ? °C
3	00:00:30	If necessary, Send Patch Parameters	ZCN00602	
4	00:00:40	If necessary, Dump Memory for Patch verification	ZCN00605	
5	00:00:50	Send SCET update to Consert	ZCN00901	
6	00:01:00	Verify HK packet : LOBT received	YCN00325	NCND0338 = 1

5.3.3.3. Power OFF for Consert

CONSERT_OFF	**Consert Orbiter Instrument Switch-Off** **Can be used for emergency switch off.**

Procedure Objective :
This procedure performs the power-off sequence for Consert. It can be run at any moment, no specific safe procedure in needed prior to Consert Off.
No specific recovery procedure is needed in case of an emergency Switch-Off.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	LCL OFF		
2	00:00:10	Check Parameters : LCL Voltage LCL Current		

5.3.3.4. CN-FCP-001 : Consert Orbiter Instrument Verification Test

CN-FCP-001	**Consert Orbiter Instrument Verification Test**

Procedure Objective :
This procedure performs an autonomous test of all functions of the Consert Orbiter instrument. The ambient noise level is also measured.
It can be performed with the antenna either folded or deployed.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Run FCP CONSERT_ON		
2	00:02:00	Send Consert Orbiter Mission Table : **MTUFTO**	ZCN19201	after this TC the instrument will perform autonomous activities during 18 minutes
3	00:02:10	Verify HK packet : "Mission Table received"	YCN00325	NCND0332 = 1
4	00:05:30	Verify Event : "Tuning ok" received	YCN0A501	NCNA0510 = 41002
5	00:05:40	Verify HK packet "Tuning Phase Performed"	YCN00325	NCND0333 = 1
6	00:06:30	Verify Event : "Sounding Started" received	YCN0B501	NCNA0520 = 41003
7	00:06:40	Verify HK packet : "Sounding Continuing"	YCN00325	NCND0334 = 1
8	00:18:00	Verify Event "Sounding Completed" received	YCN0C501	NCNA0530 = 41004
9	00:18:15	Run FCP CONSERT_OFF		

5.3.3.5. CN-FCP-002 : Consert Lander Instrument Verification Test

CN-FCP-002	Consert Lander Instrument Verification Test

Procedure Objective :
This procedure performs an autonomous test of all functions of the Consert Lander instrument. The ambient noise level is also measured.
It can be performed with the antenna either folded or deployed.

See Consert Lander Instrument User Manual for details.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Switch-on Consert Lander		
2	00:02:00	Send Consert Lander Mission Table : **MTUFTL**		After this TC the instrument will perform autonomous activities during 15 minutes
3	00:18:15	Switch-off Consert Lander		

5.3.3.6. CN-FCP-003 : Consert Instrument Solar Panel Influence

CN-FCP-003	**Consert Instrument Solar Panel Influence**

Procedure Objective :
This procedure measures the influence of the Solar Arrays position versus the clock correction and gain and calibration parameters.
The measurements need to be made in steps of every 3-10 degrees of the angle between the S/C body and Solar Arrays.
Moving to the next step and stopping is preferable to a continuous very slow drift.
This procedure needs the Orbiter and Lander part of CONSERT to be switched-on.
It must be performed with the Consert Orbiter antenna deployed.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Run FCP CONSERT_ON		Note : The Lander instrument should be switched on at the same moment, see chapter 3.1.2
2	00:02:00	Send Consert Orbiter Mission Table : **MTPPTO**	ZCN19201	After this TC the instrument will perform autonomous activities during 15 minutes
3	00:17:00	Verify Event “Sounding Completed” received	YCN0C501	NCNA0530 = 41004
4	01:05:15	Run FCP CONSERT_OFF		
5		Rotate Solar Arrays 3-10 degrees		
6		If complete rotation of Solar Arrays less than 180°, Go to step 1		

5.3.3.7. CN-FCP-004: Consert Instrument Time Synchronization

CN-FCP-004	**Consert Instrument Time Synchronisation**

Procedure Objective :
This procedure measures the Clock Drift between the Orbiter and Lander instrument and allows to correct excessive drifts during the cruise.
After Tuning phase has been performed, some TCs are sent to change the OCXO frequency.It is done to verify the signal amplitude variation as a function of the frequency.
It also checks the overall health of the whole Consert experiment (Orbiter + Lander).
It can be performed with the antennas either folded or deployed.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Run FCP CONSERT_ON		Note : The Lander instrument should be switched on at the same moment, see chapter 3.1.2
2	00:02:00	Send Consert Orbiter Mission Table : **MTPPTO**	ZCN19201	After this TC the instrument will perform autonomous activities during 18 minutes
3		Verify Event : "Sounding Started" received	YCN0B501	NCNA0520 = 41003
4	00:50:00	Change clock setting value to measure the fine clock offset	ZCN19202	This TC may be repeated 15 times to select various clock settings around the value set by the tuning.
5	00:51:00	Change clock setting value to measure the fine clock offset	ZCN19202	
6	00:17:00	Verify Event "Sounding Completed" received	YCN0C501	NCNA0530 = 41004
7	01:05:15	Run FCP CONSERT_OFF		

5.3.3.8. CN-FCP-005: Consert Instrument TC Verification

CN-FCP-005	**Consert Instrument TC Verification**

Procedure Objective :
This procedure verifies the capability of the instrument to accept and execute Direct Commands.
It also checks the overall health of the Consert Orbiter instrument.
The same kind of procedure may be executed for the Lander instrument.
It can be performed with the antennas either folded or deployed.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Run FCP CONSERT_ON		
2	00:02:00	Send Consert Orbiter Mission Table : **MTUFTO**	ZCN19201	after this TC the instrument will perform autonomous activities during 15 minutes
3	00:50:00	Change clock setting value to measure the fine clock offset	ZCN19202	This TC may be repeated 15 times to select various clock settings around the value set by the tuning.
4	00:51:00	Change clock setting value to measure the fine clock offset	ZCN19202	
5	00:17:00	Verify Event “Sounding Completed” received	YCN0C501	NCNA0530 = 41004
6	01:05:15	Run FCP CONSERT_OFF		

5.3.3.9. CN-FCP-006: Consert Instrument Patch & Dump Verification

CN-FCP-006	**Consert Instrument Patch & Dump Verification**

Procedure Objective :
This procedure verifies the capability of the instrument to accept software patches and to dump its memory.
It also checks the overall health of the Consert Orbiter instrument.
The same kind of procedure may be executed for the Lander instrument.
It can be performed with the antennas either folded or deployed.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Run FCP CONSERT_ON		
2	00:00:30	Send Patch Parameters	ZCN00602	0xAAAA @ 0x8000
3	00:00:40	Dump Memory for Patch verification	ZCN00605	
4	00:02:00	Send Consert Mission Table : **MTUFTO**	ZCN19201	After this TC the instrument will perform autonomous activities during 15 minutes
5	00:17:00	Verify Event “Sounding Completed” received	YCN0C501	NCNA0530 = 41004
6	01:05:15	Run FCP CONSERT_OFF		

5.3.3.10. CN-FCP-007: Consert Orbiter Instrument Interference

CN-FCP-007	**Consert Orbiter Instrument Interference**

Procedure Objective :
This procedure measures the interferences between the Consert Orbiter instrument and other subsystems of the Spacecraft.
It also checks the overall health of the Consert Orbiter instrument.
The same kind of procedure may be executed for the Lander instrument.
It can be performed with the antennas either folded or deployed.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Run FCP CONSERT_ON		
2	00:02:00	Send Consert Orbiter Mission Table : **MTUFTO**	ZCN19201	After this TC the instrument will perform autonomous activities during 15 minutes
3		Wait for the end of Interference operations		
4	01:05:15	Run FCP CONSERT_OFF		

5.3.3.11. CN-FCP-008: Consert Lander Instrument Interference

CN-FCP-008	**Consert Instrument Interference Lander**

Procedure Objective :
This procedure measures the interferences between the Consert Lander instrument and other subsystems of the Spacecraft and Lander.
It also checks the overall health of the Consert Lander instrument.
The same kind of procedure may be executed for the Orbiter instrument.
It can be performed with the antennas either folded or deployed.

See Consert Lander Instrument User Manual for details.

Step n°	Time from Consert LCL switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Switch-on Consert Lander		
2	00:02:00	Send Consert Lander Mission Table : **MTUFTL**		After this TC the instrument will perform autonomous activities during 15 minutes
3	00:18:15	Switch-off Consert Lander		

5.3.3.12. CN-FCP-009: Consert Instrument Science Operations

CN-FCP-009	**Consert Instrument Science Mode**			
Procedure Objective : Science Operations It must be performed with the antennas deployed.				
Step n°	**Time from Consert LCL switch On (hh:mm:ss)**	**Activity**	**TM/TC packet**	**TM/TC parameter**
1	00:00:00	Run FCP CONSERT_ON		Note : The Lander instrument should be switched on at the same moment, see chapter 3.1.2
2	00:02:00	Send Consert Mission Table : **MTSCO**	ZCN19201	After this TC the instrument will perform autonomous activities during 10 hours
3	01:05:00	Verify Event “Sounding Finished” received	YCN0C501	NCNA0 = 41004
4	01:05:15	Run FCP CONSERT_OFF		

5.3.4. Mission Tables

Note : 1 Tic = 1.6384 msec

5.3.4.1. MTUFTO

MTUFTO : Orbiter Mission Table for Functional Test (10 16bits Words)		
Parameter #	**TC Data Word (Hex)**	**Signification**
PCNGA010	**0100**	Mission table index & Spare
PCNGA020	**00038C60**	TUNETIC = 232544 Tics (381 seconds)
PCNGA030	**00008FOD**	STARTTIC = 36621 Tics (60 seconds)
PCNGA040	**0BCD**	DELTATIC = 3021 Tics (4.95 seconds)
PCNGA050	**0078**	NBSOUNDING (= 120)
PCNGA060	**8000**	INIT FREQ =128 & Mode byte setting
PCNGA070	**001F**	MIN ATT = 0 & MAX ATT = 31
PCNGA080	**9585**	NBL Level = 149 & NBL zero = 133

Total duration of this mode : circa 16 minutes

5.3.4.2. MTUFTL

MTUFTL : Lander Mission Table for Functional Test (10 16bits Words)		
Parameter #	**TC Data Word (Hex)**	**Signification**
1	**0301**	Mission table indicator & table index
2	**0003**	TUNETIC (B3 & B2) = 219727 Tics (360 seconds)
3	**5A4F**	TUNETIC (B1 & B0)
4	**0000**	STARTTIC (B3 & B2) = 36621 Tics (60 seconds)
5	**8F0D**	STARTTIC (B1 & B0)
6	**0BCD**	DELTATIC = 3021 Tics (4.955 seconds)
7	**0064**	NBSOUNDING = 100
8	**8305**	INIT FREQ (=131) & FIOW RATIO (=5)
9	**0000**	MODE BYTE (= 0) & MIN ATT (= 0)
10	**1F00**	MAX ATT (= 0) & PAD Field (=0)

Note : 1 Tic = 1.6384 msec

5.3.4.3. MTPPTO

MTPPTO : Orbiter Mission Table for Ping Pong Test (10 16bits Words)		
Parameter #	**TC Data Word (Hex)**	**Signification**
PCNGA010	**0100**	Mission table index & Spare
PCNGA020	**00038C60**	TUNETIC = 232544 Tics (381 seconds)
PCNGA030	**00008FOD**	STARTTIC = 36621 Tics (60 seconds)
PCNGA040	**0BCD**	DELTATIC = 3021 Tics (4.95 seconds)
PCNGA050	**0078**	NBSOUNDING (= 120)
PCNGA060	**8000**	INIT FREQ =128 & Mode byte setting
PCNGA070	**001F**	MIN ATT = 0 & MAX ATT = 31
PCNGA080	**9585**	NBL Level = 149 & NBL zero = 133

Total duration of this mode : circa 18 minutes

5.3.4.4. MTPPTL

MTPPTL : Lander Mission Table for PingPong Test (10 16bits Words)		
Parameter #	**TC Data Word (Hex)**	**Signification**
1	**0301**	Mission table indicator & table index
2	**0003**	TUNETIC (B3 & B2) = 219727 Tics (360 seconds)
3	**5A4F**	TUNETIC (B1 & B0)
4	**0000**	STARTTIC(B3 & B2) = 36621 Tics (60 seconds)
5	**8F0D**	STARTTIC(B1 & B0)
6	**0BCD**	DELTATIC = 3021 Tics (4.95 seconds)
7	**0064**	NBSOUNDING = 100
8	**8305**	INIT FREQ (=131) & FIOW RATIO (=5)
9	**0000**	MODE BYTE (= 0) & MIN ATT (= 0)
10	**1F00**	MAX ATT (= 0) & PAD Field (=0)

5.3.4.5. Alternative MTPPTO and MTPPTL

The monitoring of the experiment primary current is done by the spacecraft every second. During the IST, it showed only standby power (90 mA), sampling regularly between the soundings.
A way to monitor the complete power consumption of the instrument is to read the power consumption with a repetition period that is not a fraction of the sounding period of the instrument.
We propose to slightly change the parameter that controls the sounding repetition time in the instrument (from 5 seconds to 4.95 seconds).

This modification is validated and included in the mission tables (§ 5.4.3.1 to .4)

Orbiter Tables

Orbiter Mission Table modification for primary current monitoring		
Parameter #	**TC Data Word (Hex)**	**Signification**

PCNGA040	**0BCD**	DELTATIC = 3021 Tics (4.95 seconds)

Corresponding Lander Tables

Lander Mission Table modification to match the Orbiter primary current monitoring		
Parameter #	**TC Data Word (Hex)**	**Signification**
---	**0301**	
6	**0BCD**	DELTATIC = 3021 Tics (4.95 seconds)
---	**0064**	

5.3.5. DMS Monitoring

No in flight parameter monitor is requested for Consert.
The instrument should be switched off at completion of its sounding period (notified by an event).

DMS Monitoring	Instrument : **CONSERT**	
Monitored Entity	**Monitoring requirements**	**Action on Event**
Parameters		
None	no parameter monitoring requirements	
Events		
Event 1 : EID = 41004 (SOUNDING COMPLETED)	at completion of sounding activities,	Switch OFF the instrument

5.4. Contingency Recovery Procedures

5.4.1. Redundancy concept

Except at interface level (power and OBDH), there is no internal redundancy inside Consert.

The Nominal/Redundant channel selection is performed automatically by the instrument based on the first transition detected on the STS (Serial Telemetry Sampling) lines after switch-on. Once a channel is selected, it remains selected until switch-off or instrument internal Reset.

In case of a Failure of an Interface, the instrument has to by switched off, then the SC interface channel has to be switched to the alternate. Then the Consert instrument can be switched On again.

5.4.2. Software Maintenance Approach

The Consert Flight Software is stored in a Read Only Memory (27C256 TRBDB-12, 32kOctets), programmed on ground and soldered on the Consert Digital Board before instrument delivery.
After each instrument switch-on, the content of this ROM is loaded in the RAM memory and the software is executed there.
Thus, software patching of all parts of the software is possible during flight. After each switch-off or Reset, the patches are lost.
As the Consert flight software is very simple and does not contain any data analysis, only very limited patching and dumping of memory areas may be done to verify the correct implementation of the patch and the integrity of the software in case of problems.

6. Data Operation Handbook

6.1. Telecommand packet definition

Sub Type	Database TC Name	Service Request (TC)	Usage / remark
SERVICE 3			
5	ZCN00305	Enable HK Report	
6	ZCN00306	Disable HK Report	Not to be used in nominal obs.
SERVICE 6			
2	ZCN00602	Load Memory by absolute add	
5	ZCN00605	Memory Dump request by absolute add	
9	ZCN00609	Memory check request by absolute add	
SERVICE 9			
1	ZCN00901	Accept time update	**To be sent only once per scanning sequence, after instrument switch-on**
SERVICE 17			
1	ZCN01701	Connection Test Request	
SERVICE 20			
1	ZCN02001	Enable Science Report (RTU)	
2	ZCN02002	Disable Science Report (RTU)	Not to be used in nominal obs.
SERVICE 192			
1	ZCN19201	Mission table Uplink	To be sent only once per scanning sequence, after instrument switch-on and time update
2	ZCN19202	Direct TC	For test purposes only
SERVICE 255			
1	ZCN25501	Reset TM buffer	

Remark : Packet category is #12 for all TCs

6.2. Telecommand Parameter definition

Alternate format tables of this information can be found in Annex 5.

6.2.1. Mission Table

Telecommand Packet Information			**ZCN19201**
Packet Name	CON_MISSION_TABLE		Instrument : **Consert**
Packet Function	Consert Mission table uplink TC		
Generation Rules	to be sent after instrument switch-on		
Header Information			
Process ID	59	Packet Category	12
Service Type	192	Service Subtype	1
Structure ID		Packet Length in Bytes	Datafield = 26 Total packet length = 26 + 6 = 32
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Data field Header	4 Bytes	as per EID A	
PCNGA010	2 Bytes	TAB_INDEX : mission table index	
PCNGA020	4 Bytes	TAB_TUNETIC B3 to B0 (MSB to lsb) Start of tuning	
PCNGA030	4 Bytes	TAB_STARTTIC B3 to B0 (MSB to lsb) Start of Sounding	
PCNGA040	2 Bytes	TAB_DELTATIC B1 ; B0 (MSB ; lsb) Time step in TIC	
PCNGA050	2 Bytes	TAB_NBSOUND B1; B0 : Total number of soundings	
PCNDA061	1 Byte	TAB_INITFREQ : clock initial frequency setting	
PCNDA062	1 Byte	TAB_MODE : mode Byte setting	
PCNDA071	1 Byte	TAB_MINATT : minimum GCW (attenuation)	
PCNDA072	1 Byte	TAB_MAXATT : maximum GCW (attenuation)	
PCNDA081	1 Byte	TAB_NBL_LEVEL : level to be reached during NBL AGC	
PCNDA082	1 Byte	TAB_NBL_ZERO : level to be detected during NBL zero detection	
Packet Error Control	2 Bytes	not tested by Consert	
Notes :			

Mode Byte bit pattern definition :

Bit 0 (lsb) = DataSource 0 = FPGA 1 = Simulated data
Bit 1 to Bit 7 : not used

6.2.2. Direct TC

Telecommand Packet Information			**ZCN19202**
Packet Name	CON_DIRECT_TC		Instrument : **Consert**
Packet Function	Consert direct TC		
Generation Rules	To be used for tests only		
Header Information			
Process ID	59	Packet Category	12
Service Type	192	Service Subtype	2
Structure ID		Packet Length in Bytes	datafield length = 8 Total packet length = 8 + 6 = 14
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Data field Header	4 Bytes	as per EID A	
PCNDB011	1 Byte	DIR_COMMAND : see note 4	
PCNDB012	1 Byte	DIR_PARAM : see note 4	
Packet Error Control	2 Bytes	not tested by Consert	
Notes :			

Note 4 :

DIR COMMAND	DIR PARAM	Action	Remarks
5	x	Set clock DAC to x	
6	0	CLEAR TXPON	
6	1	SET TXPON	
7	0	CLEAR RXPON	
7	1	SET RXPON	
8	0	CLEAR TRCOM	
8	1	SET TRCOM	
9	0	CLEAR TUNING COM	
9	1	SET TUNING COM	
A	0	CLEAR TRPON	
A	1	SET TRPON	
B	0	SWITCHSEQ OFF	MESCOM is OFF
B	1	SWITCHSEQ ON	FPGA is in reset state all time, MESCOM is ON
E	x	set Gain (GCW) to X	
F	0	Set_BYPASS OFF (measurement)	
F	1	Set_BYPASS ON (Tuning)	
10	n (0 to 2)	Set code source (FPGA, +,-) (Lander Only)	0 = Code from FPGA, Nothing if FPGA OFF 1 = Delta 312 2= CW (sinus)

6.2.3. Patch memory

Telecommand Packet Information			**ZCN00602**
Packet Name	CON_MEMO_PATCH		Instrument : **Consert**
Packet Function	Consert Memory Patch TC		
Generation Rules	To be used to update flight software		
Header Information			
Process ID	59	Packet Category	12
Service Type	6	Service Subtype	2
Structure ID		Packet Length in Bytes	12 + 2*block_length 6 + 12 + 2*block_length
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Data field Header	4 Bytes	as per EID A	
PCND0600 Memory_ID	1 Byte	**Always 60 (dec) for Consert Memory**	
PCND0610 number of blocks	1 Byte	**Always 1 for Consert**	
PCNG0610 Start Address	4 Bytes	MSB to lsb , the two first bytes are always 00 (only64k octet mem)	
PCNG0620 Block length = n	2 Bytes	MSB lsb, length in 16 bit words = n	
PCNG0630 Data	2n Bytes	Data to be written in memory	
Packet Error Control	2 Bytes	not tested by Consert	
Notes : Only one valid Memory ID for Consert = 60 dec **Only one memory segment can be dumped at each time**			

6.2.4. Dump request

Telecommand Packet Information			**ZCN00605**
Packet Name	CON_MEMO_DUMP_RQ		Instrument : **Consert**
Packet Function	Consert Memory Dump request TC		
Generation Rules	To be used to request the dump of a part of the memory		
Header Information			
Process ID	59	Packet Category	12
Service Type	6	Service Subtype	5
Structure ID		Packet Length in Bytes	Datafield = 14 Total packet length = 20
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Data field Header	4 Bytes	as per EID A	
PCND0600 Memory_ID	1 Byte	**Always 60 (dec) for Consert Memory**	
PCND0610 number of blocks	1 Byte	**Always 1 for Consert**	
PCNG0610 Start Address	4 Bytes	MSB to lsb , the two first bytes are always 00 (only 64k octet mem)	
PCNG0620 Block length = n	2 Bytes	MSB lsb, length in 16 bit words = n	
Packet Error Control	2 Bytes	not tested by Consert	
Notes : Only one valid Memory ID for Consert = 60 dec **Only one memory segment can be dumped at each time** **Will generate a CON_MEMO_DUMP_TM**			

6.2.5. Memory check request

Telecommand Packet Information			**ZCN00609**
Packet Name	CON_MEMO_CHECK_RQ		Instrument : **Consert**
Packet Function	Consert Memory check request TC		
Generation Rules	To be used to request the calculation of the CRC check sum of a part of the memory		
Header Information			
Process ID	59	Packet Category	12
Service Type	6	Service Subtype	9
Structure ID		Packet Length in Bytes	Datafield = 14 Total packet length = 20
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Data field Header	4 Bytes	as per EID A	
Memory_ID	1 Byte	**Always 60 (dec) for Consert Memory**	
number of blocks	1 Byte	**Always 1 for Consert**	
Start Address	4 Bytes	MSB to lsb , the two first bytes are always 00 (only 64k octet mem)	
Block length = n	2 Bytes	MSB lsb, length in 16 bit words = n	
Packet Error Control	2 Bytes	not tested by Consert	
Notes : Only one valid Memory ID for Consert = 60 dec **Only one memory segment can be dumped at each time** **Will generate a CON_MEMO_CHECK_TM**			

6.3. Telemetry Packet definition

6.3.1. Data Delivery Concept

6.3.1.1. Housekeeping reports

Every time the instrument is switched-on, and if the Housekeeping Report generation is not Disabled (via Service #3, sub type # 2), the instrument will generate a housekeeping report on a regular basis (as defined in the mission table, once every 2 to 60 seconds, nominal (seconds).
Total size of a Housekeeping Report packet is: 28 bytes.
The first HK report is sent one minute (60 seconds) after switch-on.

6.3.1.2. Science reports (Only RTU-link)

While the instrument is in measurement (sounding mode), and if the Science Report generation (RTU-link) is not Disabled (via Service #20, sub type # 2), the instrument will generate a Science Report on a regular basis (as defined in the mission table, once every 2 to 60 seconds).
Total size of a Science Report packet is: 1048 bytes

6.3.1.3. Event reporting

An event packet is generated at achievement of each major step in the mode transitions:

- Hardware init performed
- Instrument Tuned
- Sounding mode started
- Sounding mode finished

6.3.2. TM packet type summary

Process Id	Packet cat	APID dec	APID hexa	Packet Service Type dec	Packet Length (total)	Packet Type	Usage
59	1	945	3B1	1	20 (OK) 28 (Not OK)	TM	Telecommand acknowledge packets
59	4	948	3B4	3	28	TM	Housekeeping reports from Consert
59	7	951	3B7	5	24	TM	Event reporting from Consert
59	7	951	3B7	6	26	TM	Memory Check from Consert
59	7	951	3B7	17	16	TM	Test ping response from Consert
59	9	953	3B9	6	variable	TM	Memory Dump from Consert
59	12	956	3BC	20	1048	TM	Science Reporting from Consert

6.4. Telemetry Parameter definition

There are three different times for CONSERT:

- Rebuilt Time on ground : SCET Time (in SFDU Header)
- On-Board Set Time : OBT time
- CONSERT own Time: counter in TIC
  sets to zero when Consert is turned on and resets to zero after tuning phase,
  allows the precise synchronization between CONSERT Orbiter and CON. Lander

All TMs were dated with OBT time (standard TM format).
HK and SCI TMs were dated with TIC.

6.4.1. Successful Acknowledge

Telemetry Packet Information			**YCNST001**
Packet Name	CON_ACC_ACK_SUCCESS		Instrument : **Consert**
Packet Function	Consert Acceptance Acknowledge Success		
Generation Rules	After reception of a valid TC Packet (with Ack field = 1)		
Header Information			
Process ID	59	Packet Category	1
Service Type	1	Service Subtype	1
Structure ID		Packet Length in Bytes	Datafield = 10 + 4 = 14 Total packet = 20
Data Field Information			
Data Field	*Field Structure*	*Remark*	
NCNAST01 TC packet ID	2 Bytes	MSB, lsb	
NCNAST02 TC Seq. control	2 Bytes	MSB , lsb	
Notes :			

6.4.2. Failure Acknowledge

Telemetry Packet Information			**YCNST002 to YCNST007**
Packet Name	CON_ACC_ FAILURE		Instrument : **Consert**
Packet Function	Consert Acceptance Failure Report		
Generation Rules	After reception of an invalid TC Packet		
Header Information			
Process ID	59	Packet Category	1
Service Type	1	Service Subtype	2
Structure ID		Packet Length in Bytes	Datafield = 10 + 12 = 22 Total packet = 28
Data Field Information			
Data Field	*Field Structure*	*Remark*	
NCNAST01 TC packet ID	2 Bytes	MSB, lsb	
NCNAST02 TC Seq. control	2 Bytes	MSB , lsb	
NCNAST03 Failure Code	2 Bytes	MSB , lsb , see note 1	
Parameters	6 Bytes	See note 1	
Notes :			

Note 1 : failure code and parameter values

Failure Code	Failure name	Failure Reason	Param. 1 Byte	Param. 2 Byte	Par. 3 2 Bytes	Par 4 2 Byte
1	ERR_TC_TIMEOUT	TC packet not complete after 2 seconds	TC packet Type	TC packet SubType	Nbr of expect Bytes (from TC Hd)	Nb of Bytes in 2 s
2	ERR_TYPE_WRONG CRC	Calculated CRC is not egal to CRC at end of TC packet	TC packet Type	TC packet SubType	CRC as read from packet datafield	CRC as calculated using TC data
3	ERR_TYPE_WRONGAPID	TC packet has wrong APID (ID # 59 or Cat #12)	TC packet Type	TC packet SubType	0	0
4	ERR_TC_TYPE_UNKNOWN	TC packet has unknown Type or Subtype	TC packet Type	TC packet SubType	0	0
5	ERR_TWO_MISS_TAB	TC with mission table received and other table already received	TC packet Type	TC packet SubType	0	0
6	ERR_TC_DIRECT_UNKNOWN	Direct TC of unknown type received	TC packet Type	TC packet SubType	Direct TC value	0

6.4.3. House-Keeping Report

Telemetry Packet Information			**YCN00325**
Packet Name	CON_HK_REP		Instrument : **Consert**
Packet Function	Consert Housekeeping parameter Report		
Generation Rules	Generated every 2 to 10 sec in all modes.		
Header Information			
Process ID	59	Packet Category	4
Service Type	3	Service Subtype	25
Structure ID		Packet Length in Bytes	Datafield = 10 + 12 = 22 Total packet = 28
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Pad field	1 Byte	= 0	
SID	1 Byte	= 1	
NCNA0320	4 Bytes	HK_TIC B3 to B0: packet TIC (MSB to lsb))	
NCND033x	1 Byte	HK_STATUS : Instrument Status Byte	
NCND0339	1 Byte	HK_TEMP_OCXO : OCXO Temperature	
NCND0341	1 Byte	HK_TEMP_DIGI : digital board temperature	
NCND0342	1 Byte	HK_ADC_NBL : NBL level acquisition	
NCND0351	1 Byte	HK_ADC_TMIX : TMIX level acquisition	
NCND0352	1 Byte	HK_OCXO_SETTING : OCXO frequency setting	
Notes :			

Instrument status byte definition

Value of global vaiable : status

Bit number Msbit = 7	**information**	**Database Name**	**Name**
7	0 = Init not performed 1 = init OK	NCND0331	STAT_BIT_INIT_OK
6	0 = Mission table not received 1 = Mission table received	NCND0332	STAT_BIT_MISS_TAB_OK
5	0 = Tuning not performed 1 = Tuning performed	NCND0333	STAT_BIT_TUNING_OK
4	0 = Not in sounding mode 1 = In sounding mode	NCND0334	STAT_BIT_SOUNDING
3	0 = Sounding not finished yet 1 = Sounding finished	NCND0335	STAT_BIT_END
2	0 = no HK reporting 1 = HK reporting enabled (default)	NCND0336	STAT_BIT_HKREP
1	0 = no SCreporting 1 = SC reporting enabled (default)	NCND0337	STAT_BIT_SCREP
0	0 = LOBT updated not received yet 1 = LOBT update received	NCND0338	STAT_BIT_LOBT

6.4.4. Progress Report

Telemetry Packet Information			**YCN0A501 to YCN0D501**
Packet Name	CON_PROGRESS_REP		Instrument : **Consert**
Packet Function	Consert Normal Progress Event report		
Generation Rules	After completion of important steps		
Header Information			
Process ID	59	Packet Category	7
Service Type	5	Service Subtype	1
Structure ID		Packet Length in Bytes	Datafield = 10 + 8 = 18 Total packet = 24
Data Field Information			
Data Field	*Field Structure*	*Remark*	
NCNA0 EID	2 Bytes	EID number from 41001 to 41004 (see note 2)	
NCND0511	1 Byte	OCXO_freq at end of tuning phase	
NCND0512	1 Byte	tuning_inter : confidence indicator of tuning phase or 1 : good confidence grater : bad S:N ratio	
NCND0513	1 Byte	Tuning phase GCW	
NCND0514	1 Byte	level GCW : ADC level achieved on NBL signal at end of tuning phase AGC	
NCND0515	1 Byte	level_zero : ADC level achieved on NBL signal at end of tuning phase, zero detection	
NCND0512	1 Byte	0 (Pad field)	
Notes :			

EID number	**EID Name**	**Generation rule**
41001	INITIALIZED	after completion of hardware init
41002	TUNING_OK	after completion of Tuning phase
41003	SOUNDING_STARTED	at start of sounding phase
41004	SOUNDING_COMPLETED	at end of sounding phase (instrument **shall** be switched off)

6.4.5. Anomalous Report

Telemetry Packet Information			**YCN00502**
Packet Name	CON_ANO_EVENT		Instrument : **Consert**
Packet Function	Consert anomalous event report (Warning)		
Generation Rules	After detection of an anomalous Event		
Header Information			
Process ID	59	Packet Category	7
Service Type	5	Service Subtype	2
Structure ID		Packet Length in Bytes	Datafield = 10 + 8 = 18 Total packet = 24
Data Field Information			
Data Field	*Field Structure*	*Remark*	
NCNA0EID	2 Bytes	EID number from 41007 to 41020 (see note 2)	
NCND0511	1 Byte	OCXO_freq at end of tuning phase	
NCND0512	1 Byte	tuning_inter : confidence indicator of tuning phase or 1 : good confidence grater : bad S:N ratio	
NCND0513	1 Byte	Tuning phase GCW	
NCND0514	1 Byte	level GCW : ADC level achieved on NBL signal at end of tuning phase AGC	
NCND0515	1 Byte	level_zero : ADC level achieved on NBL signal at end of tuning phase, zero detection	
NCND0512	1 Byte	0 (Pad field)	
Notes :			

Note 3 :
This events are only anomaly reports, no action has to be taken by S/C or ground on reception of these reports

EID number	**EID Name**	**Generation rule**
41007	TIMEOUT_AGC	FPGA reset due to timeout during AGC phase
41008	TIMEOUT_DATA	FPGA reset due to timeout during data transfer phase
41020	TUNING PB	Tuning phase algorithm has not converged

6.4.6. Ping Test Report

Telemetry Packet Information			**YCN01702**
Packet Name	CON_TEST_RESP		Instrument : **Consert**
Packet Function	Consert test report (ping test)		
Generation Rules	After reception of a TC test request		
Header Information			
Process ID	59	Packet Category	7
Service Type	17	Service Subtype	2
Structure ID		Packet Length in Bytes	Datafield = 10 + 0 = 10 Total packet = 16
Data Field Information			
Data Field	*Field Structure*	*Remark*	
None			
Notes :			

6.4.7. Science Report

Telemetry Packet Information			**YCN02003**
Packet Name	CON_SCI_REP		Instrument : **Consert**
Packet Function	Consert Science Report		
Generation Rules	Generated after each Sounding (every 2 to 10 s) in Sounding Mode		
Header Information			
Process ID	59	Packet Category	12
Service Type	20	Service Subtype	3
Structure ID		Packet Length in Bytes	Datafield = 10 + 1032 = 1042 Total packet = 1048
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Parameter 1	4 Bytes	SC_TIC B3 to B0: sounding start TIC MSB to lsb	
Parameter 2	1 Byte	SC_TEMP_OCXO : OCXO Temperature	
Parameter 3	1 Byte	SC_TEMP_DIGI : digital board temperature	
Parameter 4	2 Byte	SC_SOUNDING_N B1; B0: sounding number MSB to lsb	
Parameter 5	1 Byte	SC_GCW : Gain control word of this sounding	
Parameter 6	1 Byte	SC_OCXO_SETTING : OCXO frequency setting Byte	
Parameter 7	510 Bytes	SC_SIGNAL_I (MSB ; lsb) for position 0 to 254	
Parameter 8	510 Bytes	SC_SIGNAL_Q (MSB ; lsb) for position 0 to 254	
Parameter 9	2 Bytes	Spare bytes	
Notes :			

6.4.8. Memory Dump Report

Telemetry Packet Information			**YCNC00606**
Packet Name	CON_MEMO_DUMP		Instrument : **Consert**
Packet Function	Consert Memory dump Telematry		
Generation Rules	After reception of a telemetry dump request TC		
Header Information			
Process ID	59	Packet Category	9 (Dump)
Service Type	6	Service Subtype	6
Structure ID		Packet Length in Bytes	Datafield = 10 + 8 + length *2 Total packet = 16 + 8 + length *2
Data Field Information			
Data Field	*Field Structure*	*Remark*	
NCND0600 Memory_ID	1 Byte	**Always 60 (dec) for Consert Memory**	
NCND0610 N number of blocks	1 Byte	**Always 1 for Consert**	
NCNA0610 Start Address	4 Bytes	MSB to lsb , the two first bytes are always 00 (only64k octet mem)	
NCNA0620 Block length = n	2 Bytes	MSB lsb, length in 16 bit words = n	
NCNA0630 Data	2n Bytes	Dumped memory	
Notes : Only one valid Memory ID for Consert = 60 dec **Only one memory segment can be dumped at each time**			

6.4.9. Memory Check Report

Telemetry Packet Information			**YCNC00610**
Packet Name	CON_MEMO_MEM_CHECK_TM		Instrument : **Consert**
Packet Function	Consert Memory dump Telemetry		
Generation Rules	After reception of a memory check callculation request TC		
Header Information			
Process ID	59	Packet Category	7 (event)
Service Type	6	Service Subtype	10
Structure ID		Packet Length in Bytes	Datafield = 10 + 10 Total packet = 16 + 10
Data Field Information			
Data Field	*Field Structure*	*Remark*	
Memory_ID	1 Byte	**Always 60 (dec) for Consert Memory**	
N number of blocks	1 Byte	**Always 1 for Consert**	
Start Address	4 Bytes	MSB to lsb , the two first bytes are always 00 (only64k octet mem)	
Block length = n	2 Bytes	MSB lsb, length in 16 bit words = n	
Data	2 Bytes	CRC16 value of the designated memory area	
Notes : Only one valid Memory ID for Consert = 60 dec **Only one memory segment can be dumped at each time**			

6.5. Event Packet definition

Normal progress packet definition
see part 6.4 for packet definition

6.6. Context file Definition

N/A not used by Consert

6.7. Data and Dump File Definition

see TM and TC packet definition (6.2 & 6.4)

Annex 1 : Consert Orbiter Instrument Bench Test Procedure

1. Switch-on the Consert E Box.
2. Wait 10 seconds
3. Send Time-update (button in Remote window)
4. Wait 25 seconds
5. Perform ping test (button in Remote window)
6. Check Ping success on SIS Log window
7. Check Ping Event report on lecture_dat
8. Wait for first HK packet , check values in Lecture_dat, (default HK distribution, if no Mission table send before, is 60 seconds, with new HK packet every 15 seconds)
9. Send a mission table :

   Select a TC directory in the default EMC file

   Type a valid TC name : **MTAFT** (for Mission table for AFT) with following settings :

   TuneTIC (ie time between power on and tuning start) = 180 sec.
   Tuning duration will be : around 20 seconds
   StartTIC (ie time between end of tuning and sounding start) = 60 sec
   DeltaTIC (time between soundings) = 5 seconds
   Nbsoundings = 100 total numer of soundings

   Total duration until sounding stop =
   180 + 20 + 60 +5 * 100 = 12 minutes

Annex 2 : Consert I&T – UFT procedure for EQM

Note : This Procedure was not performed on the Flight Model.

10. Start-up
20. Main Power
20.10. Select Main Data I/F
20.20. Send ZPWMA111SWON (Switch-on Consert)
20.30. Check Parameters : LCL Voltage
LCL Current
NCND0331 (Initialization performed)
NCND0339 (OCXO Temperature)
NCND0341 (DIGI Board Temperature)
20.40. Wait 40 sec
20.50. Send SCET update
20.60. Check
20.70. Wait NCND0338 = 1 (LOBT Received)
20.80. Send Private TC : ZCN19201 with
PCNGA010 = 0x0100 (Mission Table index)
PCNGA020 = 0x0001AD27 (Start TIC for Tuning Phase)
PCNGA030 = 0x00008F0D (Start TIC for Soundings)
PCNGA040 = 0x0BEC (Time Step in TICs)
PCNGA050 = 0x0064 (Total Number of Soundings)
PCNGA060 = 0x8000 (Clock initial Frequency + Mode Setting)
PCNGA070 = 0x001F (GCW Attenuations)
PCNGA080 = 0x9585 (TAB_NBL_Settings)
20.90. Wait NCNA0520 = 1 NCNA0520 (Sounding Completed)
During the execution of the mission table monitor the following parameters on CCS console:
NCND0332 (Mission Table Received)
NCND0333 (Tuning Phase performed)
NCND0334 (Sounding Continuing)
NCND0339 (OCXO Temperature)
NCND0341 (DIGI Board Temperature)
NCND0351 (TMIX Level Acquisition)
NCNA0320 (Packet TIC Value)
20.100. Send ZPWMA112SWOF (Switch-off Consert)
30. Redundant Power
30.10. Select Redundant Data I/F
30.20. Send ZPWMA368SWON (Switch-on Consert)
30.30. Check the same Parameters as for step 20.30
30.40. Wait 30 sec
30.50. Send SCET update
30.60. Check
30.70. Wait NCND0338 = 1
30.80. Send Ping: ZCN01701
30.90. Send ZPWMA369SWOF (Switch-off Consert)
40. Final activities

Annex 3 : Consert IST procedure for PFM

Test	Step	Operations
0		TEST CONFIGURATION CHECK-UP
0	10	CCS check: Verify that Open Center is up, and the test environment is con-nected to an active session. Synoptics to monitor S/C status are active.
0	20	CONSERT EGSE check: Verify that CONSERT EGSE is ON, the test software is started and ready to accept the connection from the CCS.
0	30	Establish CCS - CONSERT EGSE connection and from CONSERT EGSE, request the Telemetry Delivery of the following APIDs: `945, 948, 951, 953, 956, 1804`
0	40	At the Sequence Monitor launch the procedure: `Exec POWER_ON`
0	50	At the first prompt asking to select power configuration select: `BATTERY Simulation`
0	60	When prompted whether the PDU-P/L has to be switched on reply: "YES"
0	70	When prompted whether the RTU-P/L has to be switched on reply: "YES"
0	80	Spacecraft configuration: Verify that the S/C is powered and the following units are also powered and delivering telemetry to ground: DMS PDU-SS PDU-PL RTU-SS RTU-PL SSMM
0	90	Start the CONSERT IST procedure for EQM launching the sequence: `Exec PCNISTF0`
0	100	Answer to the question asking to verify the correct configuration. `"ARE SATELLITE AND GSE CONIFIGURED AS DES-CRIBED? YES/<NO>"`
0	110	Answer to the question: `"IS THE RF OUTPUT CONNECTED TO THE ANTENNA? YES/<NO> [DUMMY LOAD = NO]"`
0	120	Answer to the question: `"DID YOU ASK FOR TELEMETRY REPORT? YES/<NO>"`
0	130	On the log window messages are shown confirming that: the Nominal Interface has been successfully selected

Test	Step	Operations
0	140	On the log window messages are shown confirming that: TC delivering has been successfully enabled
0	150	On the log window messages are shown confirming that: TM polling has been successfully enabled
1		POWER ON
1	10	Once the master sequence gives the control to the child sequence PCNISTF0SPON, the description of the activities is presented on the screen and the users is requested to confirm the test execu-tion. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
1	20	Answer to the question: "DO YOU WANT TO USE <M>AIN OR <R>EDUNDANT POWER INTERFACE?" selecting the main power interface (typing: M)
1	30	On the Log window messages are displayed confirming that the power on Consert (nominal) and the LCL status are cheked.
1	40	On the log window a message is shown confirming that: CONSERT H/K packets are correctly received.
1	50	On the log window the message "CONSERT Boot event received !!!" confirming the reception of the boot event is displayed and an acoustic signal is generated by the CCS.
1	60	On the log window a message is shown confirming that: the SCET update service is started and the related TC has been accepted.
1	70	On the log window a message is shown confirming that: CONSERT has reached the "Wait Mission Table" state commanded in scientific mode via the TC 'Reset Task' (230,3) and the related TC has been accepted.
1	80	On the log window is displayed the actual power consumption: Verify that the values of the parameters displayed are within the nominal ranges/values and answer to the question: "Are the above displayed parameter values correct? YES/NO"
1	90	An acoustic signal generated by the CCS evidences that CONSERT has been powered and the execution control has been given back to the master sequence.
2		CONNECTION TEST
2	10	Once the master sequence gives the control to the child sequence PCNISTF0S017, the description of the activities is presented on the screen and the users is requested to confirm the test execu-tion. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
2	20	On the log window a message is shown confirming that: the connection test has been requested (17,3).

Test	Step	Operations
2	30	On the log window a message is shown confirming that the connection test response has been correctly generated: Verify that it has been received by answering to the question: "Is the above displayed Connection Test Report Response correct? YES/NO"
2	40	Verify that the connection test response has successfully received at CONSERT EGSE as well.
2	50	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence
3		TM/TC VERIFICATION
3	10	N/A All the usable not–private have been already used in the other tests of this IST
4		PATCH AND DUMP
4	10	Once the master sequence gives the control to the child sequence PCNISTF0SPTC, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
4	20	Verify that CONSERT still generates H/K packets.
	30	*Verify that the housekeeping telemetry is disabled* *if not execute the Test Sequence DISABLETLM Click CONT when ready*
4	40	MemID 60 "RAM" (1 Block) Verify that the patch memory TC (6,2) has been sent and no errors are displayed in the Log SequenceWindow.
4	50	MemID 60 "RAM" (1 Block) Verify that the dump memory report (6,6) has been received and checked and no errors are displayed in the Log SequenceWindow.
4	60	MemID 60 "RAM" (1 Block) Verify that the check memory report (6,10) has been received and its contents are compared with expected ones. Verify that no errors are displayed in the Log SequenceWindow.
4	70	MemID 60 "RAM" (2 Blocks) Verify that the patch memory TC (6,2) has been sent and no errors are displayed in the Log SequenceWindow.
4	80	MemID 60 "RAM" (2 Blocks) Verify that the dump memory report (6,6) has been received and checked. Verify that no errors are displayed in the Log SequenceWindow.

Test	Step	Operations
4	90	MemID 60 "RAM" (2 Blocks) Verify that the check memory report (6,10) has been received and its contents are compared with expected ones. Verify that no errors are displayed in the Log SequenceWindow.
4	100	MemID 60 "RAM" (3 Blocks) Verify that the patch memory TC (6,2) has been sent and no errors are displayed in the Log SequenceWindow.
4	110	MemID 60 "RAM" (3 Blocks) Verify that the dump memory report (6,6) has been received and checked and no errors are displayed in the Log SequenceWindow.
4	120	MemID 60 "RAM" (3 Blocks) Verify that the check memory report (6,10) has been received and its contents are compared with expected ones and no errors are displayed in the Log SequenceWindow.
4	130	In case of errors, at the question "THE TEST WAS NOT OK. DO YOU WANT TO REPEAT IT? <YES>/NO" answer according to MRB dispositions:????????????????????????
4	140	Verify that CONSERT still generates H/K packets
4	150	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence
5		DMS-P/L TRAFFIC MANAGEMENT
5	10	Once the master sequence gives the control to the child sequence PCNISTE0SDMS, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to t the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
5	20	On the log window a message is shown confirming that: Disable H/K report (3,6) has been sent and the related TC has been accepted.
5	30	On the log window a message is shown confirming that: Reset TM Output Buffer (255,1) has been sent and the related TC has been accepted.
5	40	After approximately 2 minutes verify that On the log window a message is shown stating that **NO** CONSERT H/K packets have been received.
5	50	Verify that CONSERT EGSE did not receive H/K packets as well and answer at the question "Do you confirm that no H/K packets have been collected by CONSERT SCOE? YES/NO"
5	60	On the log window a message is shown confirming that: Enable H/K report (3,5) has been sent and the related TC has been accepted.
5	70	After approximately 2 minutes verify that On the log window a message is shown stating that **SEVERAL** CONSERT H/K packets have been received.

Test	Step	Operations
5	80	Verify that CONSERT EGSE received H/K packets as well and answer at the question: "Do you confirm that several H/K packets have been collected by CONSERT SCOE? YES/NO"
5	90	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence
6		CONTEXT (Not supported by DMS SW 1.2.2)
	10	N/A
7		SCIENCE DATA TRANFER
7	10	Once the master sequence gives the control to the child sequence PCNISTE0SCIE, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to t the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
7	20	On the log window a message is shown confirming that: Enable Science via RTU (20,1) has been sent and the related TC has been accepted.
7	30	On the log window a message is shown with the actual LCLs 52A and 52B Status and current consumption
7	40	On the log window a message is shown confirming that: "Start Mission Table" TC (192,1) has been sent and the related TC has been accepted.
7	50	On the log window a message is shown confirming that: CONSERT has received the mission table and it has reached the "Mission Table received" state.
7	60	On the log window a message is shown confirming that: CONSERT has finished the tuning phase and has reached the "Tuning Phase Performed" state.
7	70	On the log window a message is shown with the actual LCLs 52A and 52B Status and current consumption
7	80	On the log window a message is shown confirming that: CONSERT reached the "Sounding Continuing" state.
7	90	Several connection test are sent to CONSERT in order to exercise the TC channel as well.
7	100	On CONSERT EGSE, check that Science TM is correctly received and displayed by answering to the question: "Is Scientific telemetry correctly received by CONSERT EGSE? <YES>/NO"
7	110	On the log window a message is shown with the actual values of OCXO Temperature, DIGI board Temeperature and TMIX level Acquisition
7	120	On the log window a message is shown with the actual LCLs 52A and 52B Status and current consumption
7	130	On the log window a message is shown informing that OCXO frequency has been changed and set to 170 (0xAA).
7	140	On the log window a message is shown informing that OCXO frequency has been changed back to its original values of 128 (0x80).

Test	Step	Operations
7	150	On the log window messages are displayed informing of different packets receiving.
7	160	On the log window a message is shown confirming that: the event 'Sounding Completed' has been correctly generated and successfully received.
7	170	On the log window a message is shown confirming that: Disable Science via RTU (20,2) has been sent and the related TC has been accepted.
7	180	On the log window a message is shown with the actual LCLs 52A and 52B Status and current consumption
7	190	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence
8		PRIVATE SERVICES
8	10	N/A All private TC are used in the PCNISTE0SCIE routine
9		OPERATIVE MODES
9	10	N/A All possible operative modes are used all over the IST
10		MAX DATA THROUGHPUT
10	10	N/A The max data throughput is reached during science data production (see test 7)
11		POWER CONSUPTION
11	10	N/A The max power consumption is monitored within the test 7 (Science data transfer)
12		FUNCTIONAL PERFORMANCE TEST
12	10	N/A The Functional Performance Test is performed within the tests 8 (Science data transfer)
13		POWER OFF
13	10	Once the master sequence gives the control to the child sequence PCNISTF0SOFF, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
13	20	On the log window a message is shown confirming that: It is checked the CONSERT state before Power Off.
13	30	Verify that the values of the parameters displayed in the log window are within the nominal ranges/values and, if correct, type <YES> to Power Off CONSERT.
13	40	On the log window is displayed the message confirming that SCET update (stop) has been sent.
13	50	On the log window the message confirming that both CONSERT LCL's are OFF is displayed.
13	60	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence
14		REDUNDANCY

Test	Step	Operations
14	10	On the log window messages are shown confirming that: the Redundant Interface has been successfully selected
14	20	On the log window messages are shown confirming that: TM polling has been successfully enabled
14	30	On the log window messages are shown confirming that: TC delivering has been successfully enabled
14	40	Once the master sequence gives the control to the child sequence PCNISTF0SPON, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
14	50	At the question "DO YOU WANT TO USE <M>AIN OR <R>EDUNDANT POWER INTERFACE?" select the redundant power interface by typing:
14	100	Verify that the Consert Power (redundantl) and LCL status are setted to: On while for nominal lines: Off
14	60	On the log window a message is shown confirming that: H/K packets are correctly generated by CONSERT.
14	70	On the log window the message "CONSERT Boot Successful!!!" confirming the reception of the boot event is displayed and an acoustic signal is generated by the CCS.
14	80	On the log window a message is shown confirming that: the SCET update service is started and the related TC has been accepted.
14	90	Verify that CONSERT EGSE receives and H/K packets as well and their contents is correctly displayed
14	100	Verify that the values of the parameters displayed in the log window are within the nominal ranges/values and confirm it by typing.
14	110	An acoustic signal generated by the CCS evidences that CONSERT has been successfully powered and the execution control has been given back to the master sequence.
14	120	Once the master sequence gives the control to the child sequence PCNISTF0S017, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
14	130	On the log window a message is shown confirming that: the connection test has been requested (17,3) and the related TC has been accepted.
14	140	On the log window a message is shown confirming that: the connection test response has been correctly generated and successfully received.
14	150	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence

Test	Step	Operations
14	160	Once the master sequence gives the control to the child sequence PCNISTF0SOFF, the description of the activities is presented on the screen and the users is requested to confirm the test execution. Answer to the question: "DO YOU WANT TO PROCEED AND EXECUTE THIS STEP? <YES>/NO"
14	170	Answer to the question: "Check the above displayed parameter and type <'YES'> to power OFF CONSERT, 'NO' to ABORT" check the values of the requested parameters and if correct type:
14	180	On the log window the message confirming that both CONSERT LCL's are OFF is displayed.
14	190	An acoustic signal generated by the CCS evidences that the execution control has been given back to the master sequence
15		SHUT DOWN
15	10	On the log window messages are shown confirming that TM polling has been successfully disabled
15	20	On the log window messages are shown confirming that: TC delivering has been successfully disabled
15	30	Follow the execution of the sequence until the end; When prompted, to disconnect the POWER and TMTC SCOEs answer : N
15	40	From CCS console, switch OFF the P/L-RTU by sending the following device commands: {ZDMC0053SWOF} and {ZDMC0055SWOF}
15	50	Switch OFF the S/C-RTU by executing at CCS console the sequence "EXEC POWER_RTU"
15	60	Switch OFF the Satellite from the POWER SCOE console

Annex 4 : Consert Orbiter Instrument Full Functional Test Procedure

	Test Date and Time :		
1	Local Date and Time		
2	SIS Date and Time		
3	EGSE Date and Time		
4	Log File name		
	Initialisation & First Measurements		
5	**Switch Consert on Nominal Power**		
6	Read out primary power (circa 200 mA going down to 93 mA in 10 seconds) Check on "lecture_dat_v5.vi" window : "Init OK", (Green Button)		
7	On the remote window, click on **"Time Upload"** (Starts time synchronization service 9 for ID 59)		
8	Verify message on Log Window : "Time Packet Transmit Confirmed", (Green Line)		
9	Check on "lecture_dat_v5.vi" window : "LOBT Update ON", (Green Button)		
10	On the "remote" window, click on **"Ping Test"** (Starts test TC service 17 for ID 59)		
11	Check on "lecture_dat_v5.vi" window : "EID name : Ping Test OK"		
12	On the remote window, Select TCFILEname = FFT		
13	Early HK packet : PCK Number Status bit setting Init HK SC LOBT Mission Table Tuned Sounding Finished TIC OCXO setting Digi temp OCXO Temp	 Green Green Green Green Red Red Red Red 1 min 0 sec 128 173 171	

	HouseKeeping Reporting Disabling	
14	Type **"STOPHK"** in "TCname" field and hit "TC request" (Disables HK distribution)	
15	Verify TC acceptance message on SIS : "DMS Service 1 Acceptance ACK"	
16	Wait 30 seconds and verify that no HK packets are generated	
17	Type **"STARTHK"** in "TCname" field and hit "TC request" (Enables HK distribution)	
18	Verify TC acceptance message on SIS : "DMS Service 1 Acceptance ACK"	
19	Verify that HK packets are generated again ("HK packet num" increasing)	
	Wrong Commands not accepted	
20	Type **"WRAPID"** in "TCname" field and hit "TC request" (Wrong APID Number)	
21	Verify error message on SIS : "DMS Service 1 Acceptance NAK : Incorrect APID (Code 3)", (Red Line)	
22	Type **"WRTYPE"** in "TCname" field and hit "TC request" (Wrong Type)	
23	Verify error message on SIS : "DMS Service 1 Acceptance NAK : Invalid Command (Code 4)", (Red Line)	
	Mission Table accepted only once	
24	Type **"MTAB1"** in "TCname" field and hit "TC request" (Sends Mission Table 1)	
25	Verify TC acceptance message on SIS : "DMS Service 1 Acceptance ACK"	
26	Check on lecture_dat_v5.vi Window : "Mission Table ON", (Green Button)	
27	Type **"MTAB1"** in "TCname" field and hit "TC request" (Sends again a mission table)	
28	Verify error message on SIS : "DMS Service 1 Acceptance NAK : Cannot execute Command (Code 5)", (Red Line)	

	Tuning Failed Message **Note :** This part of the test MUST be done during Tuning Mode of the instrument.		
29	Wait for instrument to be in tuning mode (About 2.5 minutes waiting time). (Current increase on primary supply from 100 mA to 220 mA.		
30	Log Primary Current during Tuning	220 mA	
31	On the SIS, Open **"TM Block Monitor..."** in "View Menu" (Displays the frame content of TM)		
32	Hit **"Single-Shot"** button on TM Block Monitor window to stop Display sampling mode		
33	On the EGSE, Verify distribution of Anomalous Progress Report, EID = 41020d "Tuning FAILED"		
34	Wait 30 seconds		
35	Verify distribution of Normal Progress Report, EID = 41003d "Sounding Start"		
36	Log : Frequency after tuning Intercartille GCW NBL after GCW NBL at stop	 220 5 (if no Lander) 0 (if no Lander) 129 (if no Lander) 129 (if no Lander)	
37	On the SIS, Hit **"Continuous"** button on TM Block Monitor window to go in RT mode again		
38	Verify distribution of TM block with HK and SC packets.		
	Science Reporting Disabling		
39	Type **"STOPSC"** in "TCname" field and hit "TC request" (Disable Science Packet Generation)		
40	Wait 30 seconds and verify that only HK packets are generated		
41	Type **"STARTSC"** in "TCname" field and hit "TC request" (Enable Science Packet Generation)		
42	Verify that SC packets are generated again		

	Miscellaneous	
43	Type **"RESET"** in "TCname" field and hit **"TC request"** (Disable Science Packet Generation)	
44	Hit **"Ping Test"** within 5 seconds (Starts test TC service 17 for ID 59)	
45	Verify Error message on SIS : "Service 17 Test Failed : Test Timed out", (Red Line)	
46	Wait for SC distribution	
47	Hit **"Stop APID report"** (Stops Polling)	
48	Wait 20 seconds	
49	Hit **"Start APID report"** (Starts Polling)	
50	Verify that no error is logged on SIS	
51	**Switch Off Consert**	
	Redundant Mode	
52	On the EGSE, Hit **"Stop APID report"** (Stops Polling)	
53	On the EGSE, Hit **"Stop Session"** (Stops Session)	
54	On the EGSE, Select **"Redundant"** in "Channel" field and hit **"Start Session"**	
55	Verify message on Log Window : "TC Routing Mode Set to REDUNDANT"	
56	Check on ROSIS System Log Window : "HLBC Enabled Polling of Packet Terminal 0", (Green Line)	
57	Check on ROSIS System Log Window : "HLBC BCP3 Event OBT=******" (Green Line)	
58	On the remote window, click on **"Start APID report"**	
59	Check on ROSIS System Log Window : "TM-D Handler Message: Enabled APIDs: 948, 951, 956", (Green Line)	
60	**Switch-on Consert on Redundant Channel**	
61	Read out primary power (circa 200 mA going down to 93 mA in 10 seconds)	
62	On the remote window, click on **"Time Upload"** (Starts time synchronization service 9 for ID 59)	
63	Verify message on Log Window : "Time Packet Transmit Confirmed", (Green Line)	
64	Check on "lecture_dat_v5.vi" window :"LOBT Update ON", (Green	

	Button)		
65	On the "remote" window, click on **"Ping Test"** (Starts test TC service 17 for ID 59)		
66	Check on "lecture_dat_v5.vi" window : "EID name : Ping Test OK"		
67	Early HK packet : PCK Number Status bit setting Init HK SC LOBT Mission Table Tuned Sounding Finished TIC OCXO setting Digi temp OCXO Temp	 Green Green Green Green Red Red Red Red 1 min 0 sec 128 173 171	
68	**Switch Off Consert**		
	<u>End of Test</u>		
69	Hit **"Stop APID report"** (Stops Polling)		
70	Hit **"Stop Session"** (Stops Session)		
71	Hit **"Terminate Link"** (Stops Polling)		
72	Verify message on Log Window : "System Off-Line Mode Established"		
73	On the SIS, Hit **"Local Commanding Mode"** in "Mode Menu"		
74	Type Password : **"ROSIS"**		
75	Hit **"Exit"** in "File" Menu		
76	Switch-Off EGSE		
77	Switch-Off SIS		

Annex 5 : Consert Orbiter Instrument Data Description

Packet Header

Packet ID

Version #			Type	Data Field Header Flag	Application Process ID										
					Process ID							Packet Category			
0	0	0	0	1	0	1	1	1	0	1	1				

Packet Sequence Control

Segmentation Flags		Source Sequence Count													
1	1														

Packet Length = (4096 + 10) - 1) Max

Packet Data Field

Data Field Header

SCET Time															
						Seconds									
						Seconds									
						Fractional Seconds									
Packet Utilisation Standard			Checksum Flag	Spare				Packet Service Type							
Packet Subtype								Pad Field = 0 or Pad field of acknowledged TC							

Source Data (4096 Bytes Max)

ETM00101 / CON_ACC_ACK_SUCCESS

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 1			
1	1	1	Source Sequence Count													
2	Packet Length = 13															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 1							
7	Packet Service subtype = 1								PAD Field							
8	TC Packet ID															
9	TC Sequence Control															

ETM00102 / CON_ACK_FAILURE

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 1			
1	1	1	Source Sequence Count													
2	Packet Length = 21															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 1							
7	Packet Service subtype = 2								PAD Field = 0							
8	TC Packet ID															
9	TC Sequence Control															
10	Failure Code															
11	Parameter 1								Parameter 2							
12	Parameter 3								Parameter 4							
13	Parameter 5								Parameter 6							

ETM00325 / CON_HK_REP

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 4			
1	1	1	Source Sequence Count													
2	Packet Length = 21															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 3							
7	Packet Service subtype = 25								PAD Field = 0							
8	PAD Field = 0								Structure ID = 1							
9	On-Board Time in TICs MSW (65536 Tics = 107 sec)															
10	On-Board Time in TICs LSW (7706 Tics = 13 sec)															
11	Init OK	Mission Table OK	Tuning OK	Sounding Started	Sounding Finished	HK Rep Enab	SC Rep Enab	LOBT Received	OCXO Temperature							
12	Digital Board Temperature								NBL Level Acquisition							
13	TMIX Level Acquisition								OCXO Frequency Setting							

```
0BB4 C00D 0015 0000 00D4 A000 4003 1900 0001 0001 C504 C7 AB AD 80 12 50
          Len       Time          Type          OBT    St  Temp
```

ETM00501 / CON_PROGRESS_REP

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 7			
1	1	1	Source Sequence Count													
2	Packet Length = 17															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 5							
7	Packet Service subtype = 1								PAD Field							
8	Event ID (41002 = Tuning OK, 41003 = Sounding started, 41004 = Sounding finished)															
9	Clock Frequency (or 0)								Intercatille (or 0)							
10	Tuning phase GCW								Level GCW							
11	Level Zero								PAD Field (= 0)							

ETM00502 / CON_ANO_EVENT

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 7			
1	1	1	Source Sequence Count													
2	Packet Length = 17															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 5							
7	Packet Service subtype = 2								PAD Field							
8	Event ID (41007 = Timeout AGC, 41008 = Timeout Data, 41020 = Tuning Pb)															
9	Clock Frequency (or 0)								Intercatille (or 0)							
10	Tuning phase GCW								Level GCW							
11	Level Zero								PAD Field (= 0)							

```
0BB7 C005 0011 0000 00D4 A000 4005 0100 A02B DC08 0081 8100
          Len       Time          Type   EID#
```

ETM00610 / CON_MEM_CHECK

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 7			
1	1	1	Source Sequence Count													
2	Packet Length = 19															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 6							
7	Packet Service subtype = 10								PAD Field							
8	60 (dec) = 3C (hex)								Number of Blocks (=1)							
9	Start address MSW (=0)															
10	Start address LSW															
11	Block Length (in 16 bits words)															
12	CRC16 Value of the Designated Memory Area															

ETM01702 / CON_TEST_RESP

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 7			
1	1	1	Source Sequence Count													
2	Packet Length = 9															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 17							
7	Packet Service subtype = 2								PAD Field							

ETM00606 / CON_MEM_DUMP

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 9			
1	1	1	Source Sequence Count													
2	Packet Length =															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 6							
7	Packet Service subtype = 6								PAD Field							
8	60 (dec) = 3C (hex)								Number of Blocks (=1)							
9	Start address MSW (=0)															
10	Start address LSW															
11	Block Length (in 16 bits words)															
12	Dumped Memory															
..																
?																

ETM02003 / CON_SCI_REP

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			0	1	Process ID = 59							Packet Category = 12			
1	1	1	Source Sequence Count													
2	Packet Length = 1041															
3	OBT Time (Seconds)															
4	OBT Time (seconds)															
5	OBT Time (fractional seconds)															
6	PUS			Chk	Spare				Packet Service type = 20							
7	Packet Service subtype = 3								PAD Field							
8	Sounding Start TIC (MSW)															
9	Sounding Start TIC (LSW)															
10	OCXO Temperature								DIGI Board Temperature							
11	Present Sounding Number															
12	Present Gain Control Word								OCXO Frequency							
13	Signal I Channel 0															
14	Signal I Channel 1															
-																
267	Signal I Channel 254															
268	Signal Q Channel 0															
269	Signal Q Channel 1															
-																
522	Signal Q Channel 254															
523	0															

```
0BBC C007 0411 0000 00D4 A000 0014 0300 0000 D69A AAAC ……
          Len       Time          Type    sndstrt  Temp
```

Telecommand Packet Structure

Packet Header

Packet ID

Version #			Type	Data Field Header Flag	Application Process ID										
					Process ID							Packet Category			
0	0	0	1	1	0	1	1	1	0	1	1				

Packet Sequence Control

Segmentation Flags		Source Sequence Count													
		Source Part			Sequence Count										
1	1														

Packet Length = (236 + 4 + 2) - 1) Max

Packet Data Field

Data Field Header

Packet Utilisation Standard			Checksum Flag	Acknowledge				Packet Service Type							
			1	0	0	0	1								
Packet Subtype								Pad Field							

Source Data (236 Bytes Max)

Packet Error Control

ETC19201 / MISSION_TABLE

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			1	1	Process ID = 59							Packet Category = 12			
1	1	1	Source Sequence Count													
2	Packet Length = 32															
3	PUS			Chk	Spare				Packet Service type = 192							
4	Packet Service subtype = 1								PAD Field							
5	Mission Table index (=1) + Spare (= 0)															
6	Start TIC for Tuning phase MSW (= 65536 Tics = 107 sec)															
7	Start TIC for Tuning phase LSW (= 7706 Tics = 13 sec)															
8	Start TIC for Soundings MSW (= 0 Tics = 0 sec)															
9	Start TIC for Soundings LSW (= 48218 Tics = 79 sec)															
10	Time step in TIC (= 3052 Tics = 5 sec)															
11	Total number of soundings (= 1000)															
12	Clock Initial Frequency Setting (= 127) + Mode Byte Setting (= 0)															
13	Minimum (= 0) + Maximum (= 31) Attenuation															
14	NBL AGC Level (=180) + NBL Zero Level (=120)															
15	**Packet Error Control** (Not tested by Consert)															

ETC19202 / DIRECT_TC

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Version=0			1	1	Process ID = 59							Packet Category = 12			
1	1	1	Source Sequence Count													
2	Packet Length = 14															
3	PUS			Chk	Spare				Packet Service type = 192							
4	Packet Service subtype = 2								PAD Field							
5	DIR_COMMAND								DIR_PARAM							
6	**Packet Error Control** (Not tested by Consert)															

Other TC Packets
ETC00305 / ENABLE_HK
ETC00306 / DISABLE_HK
ETC00602 / CON_MEMO_PATCH
ETC00605 / CON_MEMO_DUMP_RQ
ETC00609 / CON_MEMO_CHECK_RQ
ETC00901 / ACCEPT_TIME
ETC01701 / PING_TEST
ETC02001 / ENABLE_SC
ETC02002 / DISABLE_SC
ETC25501 / RESET_TM_BUFFER