CONSERT
Experiment User Manual

LANDER Instrument

DOCUMENT APPROVAL

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3	1	6.4.6.2	61	9/11/03	Changed introduction and added comments of TM numbering , and software Lander used in the packet description
3	1	6.4.6.3 to 6.4.6.4	62 to 63	9/11/03	Corrected Data type in the packet description
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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 pre-solar 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

Our experiment concern the rough tomography of the comet nucleus performed by the CONSERT instrument (COmet Nucleus Sounding Experiment by Radiowave Transmission). It works as a time domain transponder between one instrument that will land on the comet surface (Lander) and another instrument that will fly around the comet (Orbiter).
Figure 1.2. gives a schematic diagram of the experiment. It is detailed in Barbin et al.

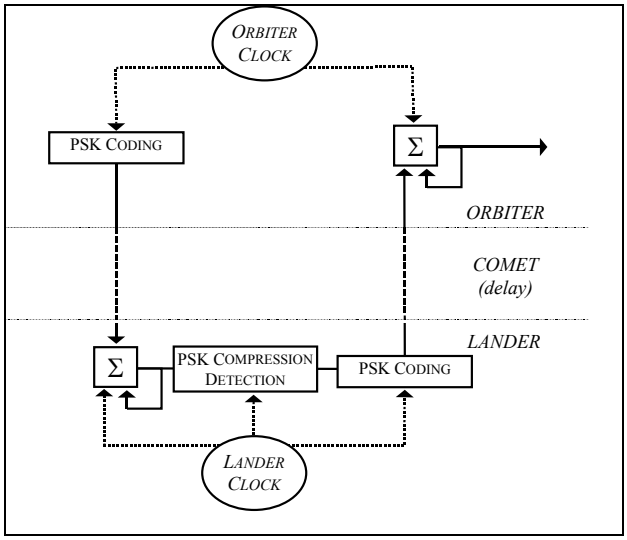


Figure 1.2. : Block diagram of the CONSERT experiment.
The coded signal is emitted from the Orbiter. The Lander make a coherent addition (Σ) and a detection of the correlation principal peak. A clean coded signal is finally emitted with the found delay. The Orbiter accumulates the signal and sends the result to earth by telemetry (via the satellite interface).

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 these 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.

1.3. Instrument Electronic Architecture

In figure 1.3., a complete Schematic of CONSERT experiment on the Lander 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 in-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 takes a value between 0 and -31 dB. Therefore, the total gain of the analog part takes a value between 28 and 90 dB. The in-phase and in-quadrature signals are converted by two 8-bits analog to digital converters. The accumulation, realized in the coherent integrator system (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.

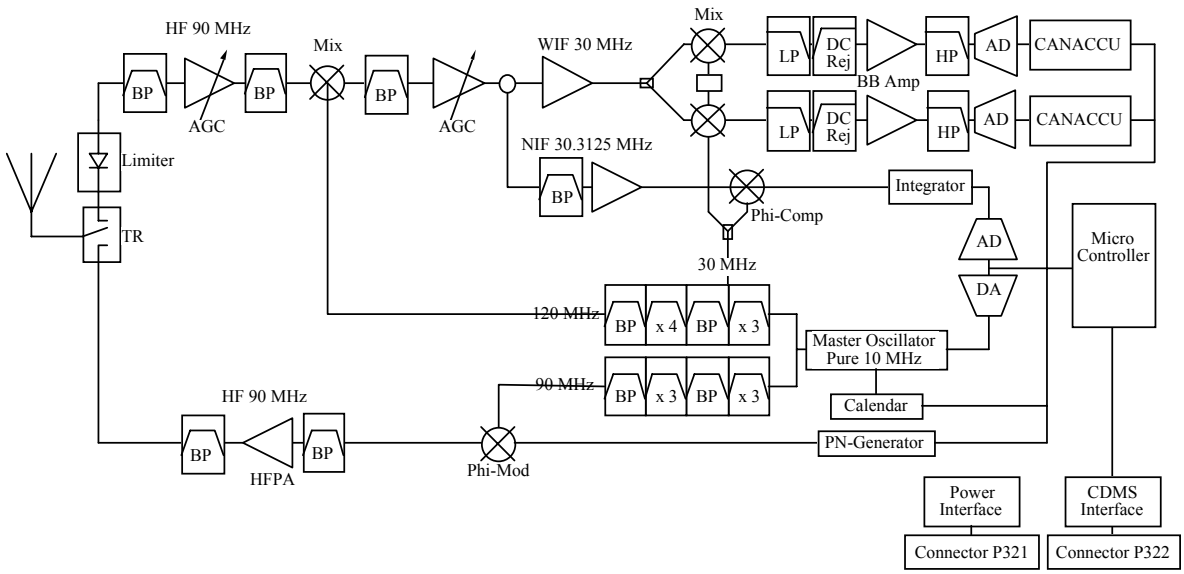


Figure 1.3. : Electronic box of the CONSERT experiment.

2. Experiment Configuration

2.1. Physical

See Consert R EID B

2.2. Electrical

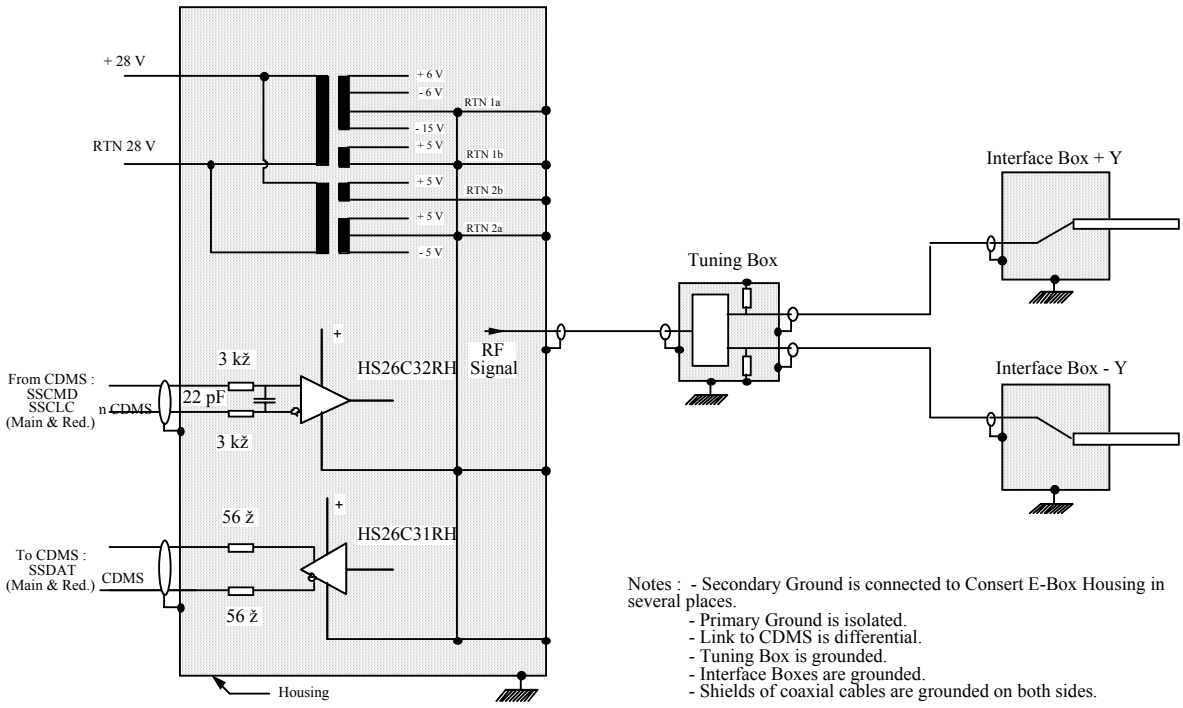
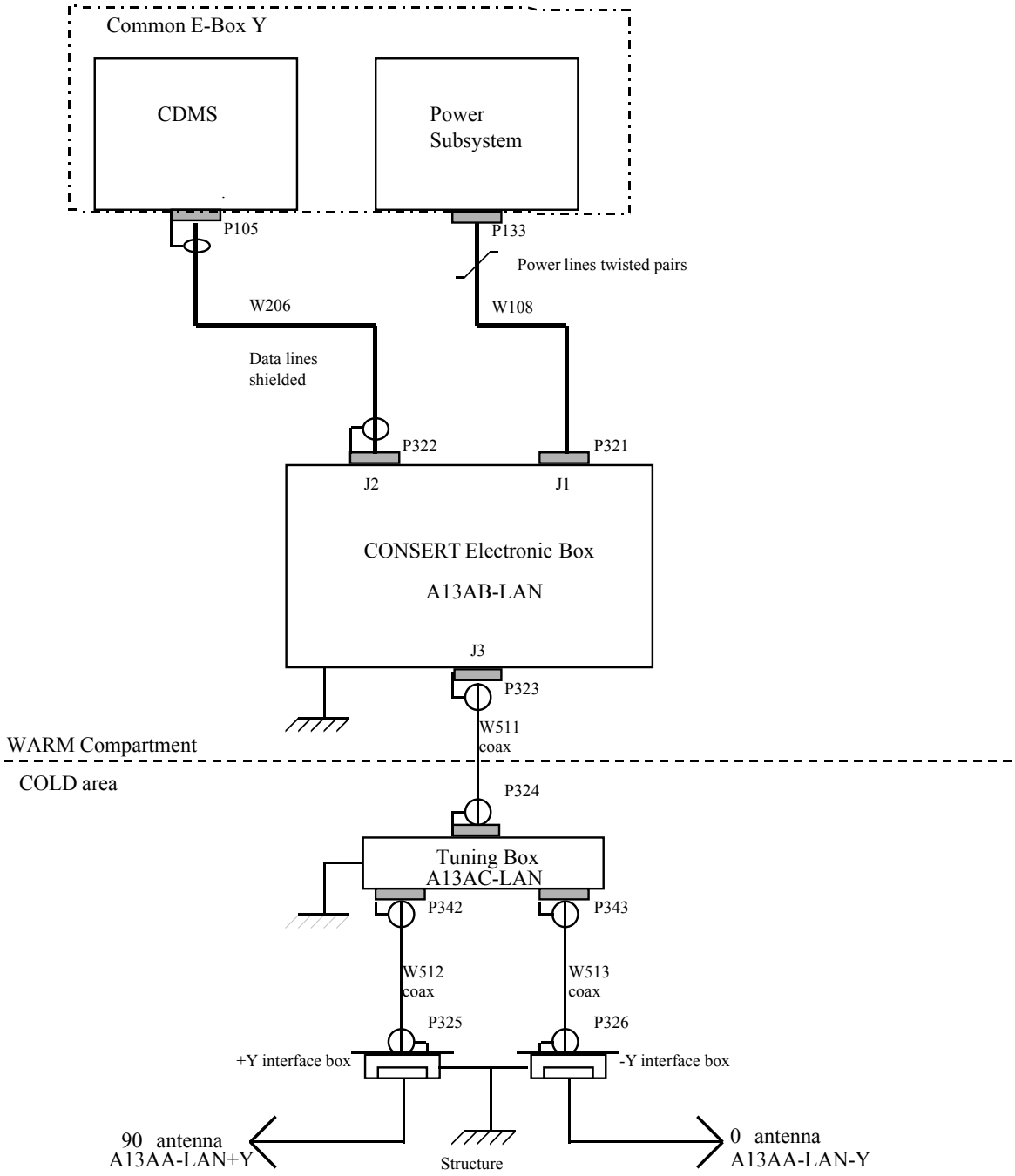


Figure 2.2a. : Lander experiment Grounding Diagram



ROSETTA Lander CONSERT Harness for **FM**

Gert Warmbold, DLR / 21.11.2000

Figure 2.2b. : Lander interconnecting Harness

2.3. Software

See Consert Lander Software description SWL 15
Doc_soft_SWL15.doc, Ref RO-OCN-TN-3049, Issue 4.0, Date 2/11/00

2.4. Budgets

See R EID B for details

Mission phase	**Operation type**	**Typical duration**	**Power (W)**	**TM volume**	**TC volume**	**Remark**
Commis-sioning	Instrument checkout	20 hours	mean 2.9 peak 8.5	500 kbytes	1k Words	Coordinated operations with Consert Orbiter instrument
Cruise checkout **each time it is possible**	Instrument checkout and Time Synchro	2 hours	mean 2.9 peak 8.5	76 kbytes	10 Words	Coordinated operations with Consert Orbiter instrument
SSP Lander predelivery operations	Instrument checkout, Time Synchro and software updates	3 hours	mean 2.9 peak 8.5	76 kbytes	10 Words	Coordinated operations with Consert Orbiter instrument
SSP relay (5 days)	Scientific measurements set n°1	10 hours min = 3 h max = 30 h	mean 2.9 peak 8.5	380 kBytes	10 words	Coordinated operations with Consert Orbiter instrument SPECIFIC ORBIT REQUIREMENTS
SSP relay (5 days)	Scientific measurements set n°2	10 hours min = 3 h max = 30 h	mean 2.9 peak 8.5	380 kBytes	10 words	Coordinated operations with Consert Orbiter instrument SPECIFIC ORBIT REQUIREMENTS
Rest of SSP lifetime	Scientific measurements (values for each comet scanning)	10 hours min = 3 h max = 30 h	mean 2.9 peak 8.5	380 kBytes	10 words	Coordinated operations with Consert Orbiter 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 Kbytes 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 modes and to maintain the Rosetta SCET.

3.1.2. Autonomy concept

After the switch-on (by a time tagged TC), the Nominal/Redundant channel selection is performed automatically by the instrument based on listening to the active channel. Once a channel is selected, it remains selected until switch-off or instrument internal Reset.
After startup, the instrument waits for its Mission table, delivered as a 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 Lander Spacecraft should be able to initiate the Consert Lander instrument Switch-on procedure with a time accuracy of 10 seconds with respect to ground UT.

NB : The same request also applies to the Consert Orbiter instrument; i.e. the Orbiter OBDH system should be able to initiate the Consert Orbiter 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 part (Electronics, antenna , harness)
- One Lander part (Electronics, antennas , harness)

Each scientific measurement sequence (called **scanning sequence**) involves the Orbiter and Lander instruments.

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 the wavelength
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 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.

3.1.5 Operational Scenario Preparation

A/ 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).
- The actual start time will be defined after these parameters analysis.

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

T ON 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)

SOUND START : Consert/Orbiter & Consert/Lander Sounding start time (in UT)

NB SOUND : total number of sounding performed by Consert/Orbiter & Consert/Lander

DELTA SOUND : period between each sounding

The Rosetta Orbiter Spacecraft should be able to initiate the Consert Orbiter instrument Switch-on, Switch-off and Clock tuning 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, Switch-off and Clock tuning 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 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

TUNESTART $_O$ = T ON o + 5 minutes
TUNESTART $_L$ = T ON $_L$ + 5 minutes
And : TUNESTART $_O$ = TUNESTART $_L$ + 30 seconds (+/- 20 seconds)

SOUNDSTART = TUNESTART + 5minutes

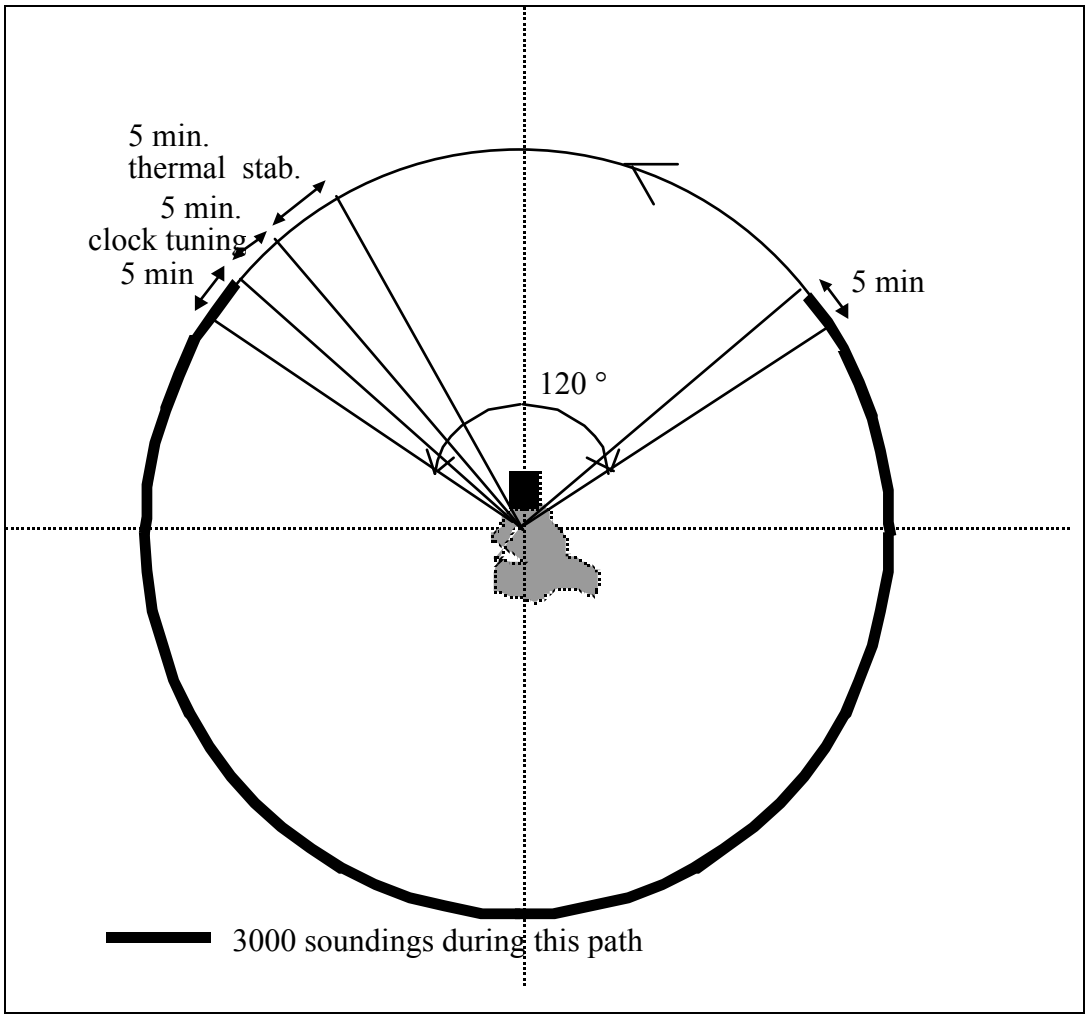


Figure 3.1.5. : Geometry of the measurements

C/ Generation in the Consert EGSE of the mission 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_FIOWR_RATIO : defines the period of full responses versus nominal soundings. If the parameter is set to zero, the full response will never occur. Typical value for flight op's is 100.
- TAB_MODE : (8 bit mode byte).

Bit position	Bit name	Bit definition	Bit value	Bit value name	Effect
0	MODE_BIT_DATA	Mode bit position to define the data source			
			0	DATA_FPGA	Mode bit 0 value for data source = FPGA
			1	DATA_SIMU	Mode bit 0 value for data source = Simulated data; ie in ROM
1	MODE_BIT_FIOW	Mode bit position to define type of data sent in FIOW response			
			0	FIOW_SIGNAL	Mode bit 1 value FIOW standard = Signal I & Q on 16 bits each
			1	FIOW_FULL	Mode bit 1 value FIOW full = standard + Signal I & Q framed 8 bits + correl I & Q
2	MODE_BIT_BLOCK	Mode bit position to define the block structure (32 word or 4x 32 words			
			0	TM_1_BLOCK	32 word block, Flight Configuration
			1	TM_4_BLOCKS	32 word block + 3 x 32 word blocks of zeros, Ground test Configuration

- TAB_MINATT (8 bit unsigned integer) : minimum value of the sounding AGC value that can be used. Can be used to force the instrument Gain to a given value.
- TAB_MAXATT (8 bit unsigned integer) : minimum value of the sounding AGC value that can be used. Can be used to force the instrument Attenuation to a given value.

Note : At each sounding the Attenuation value (GCW) is constraint inside [TAB_MINATT; TAB_MAXATT]. This function is not operating in SWL15 Software

Mission table Parameter name	Typical value for AFT test	Increment value	Maximum value
TAB_INDEX	1	1	255
TAB_TUNETIC	6 minutes = 219726 (dec) TIC 0003 5A4E (hex) TIC	1 TIC 1.6384 msec	4 294 967 295 TICs 1 954 hours 81 days
TAB_STARTTIC	1 minute = 36621 (dec) TIC 00 00 8F 0D (hex) TIC	1 TIC 1.6384 msec	4 294 967 295 TICs 1 954 hours 81 days
TAB_DELTATIC	4.95 seconds = 3021 (dec) TIC 0B CD (hex) TIC	1 TIC 1.6384 msec	65 535 TICs 107 seconds
TAB_NBSOUND	100 (dec) 0064 (hex)	1	65 535 (dec)
TAB_INITFREQ	118 (dec) 90,00000 MHz carrier freq. *The freq. calibration value is model dependent*	1 (dec)	255 (dec)
TAB_FIOW_RATIO	10 for ground tests 5 for operations	1	0 = never send FIOW 255
TAB_MODE	0	0	3
TAB_MINATT	0	1 DN 2 dB of RX attenuation	31 DN 62 dB of RX attenuation
TAB_MAXATT	31 (dec)	1 DN 2 dB of RX attenuation	31 DN 62 dB of RX attenuation

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 :
build_lander_mtab

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 :

S/C related 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 tuning radio emission (TX) mode 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 hardcoded parameters

These parameters are hardcoded 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 parameters

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 will be updated for FM (and QML)

ORBITER Parameters:

TUNE_TIMEOUT_VAL.= 60 seconds (36621 TIC units), as defined in C4.

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 during at this value 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 :
Parameters 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 5TIC count) reset to 0)	End of tuning phase internal time reference 5TIC count) reset to 0)

Setting of Mission table parameters

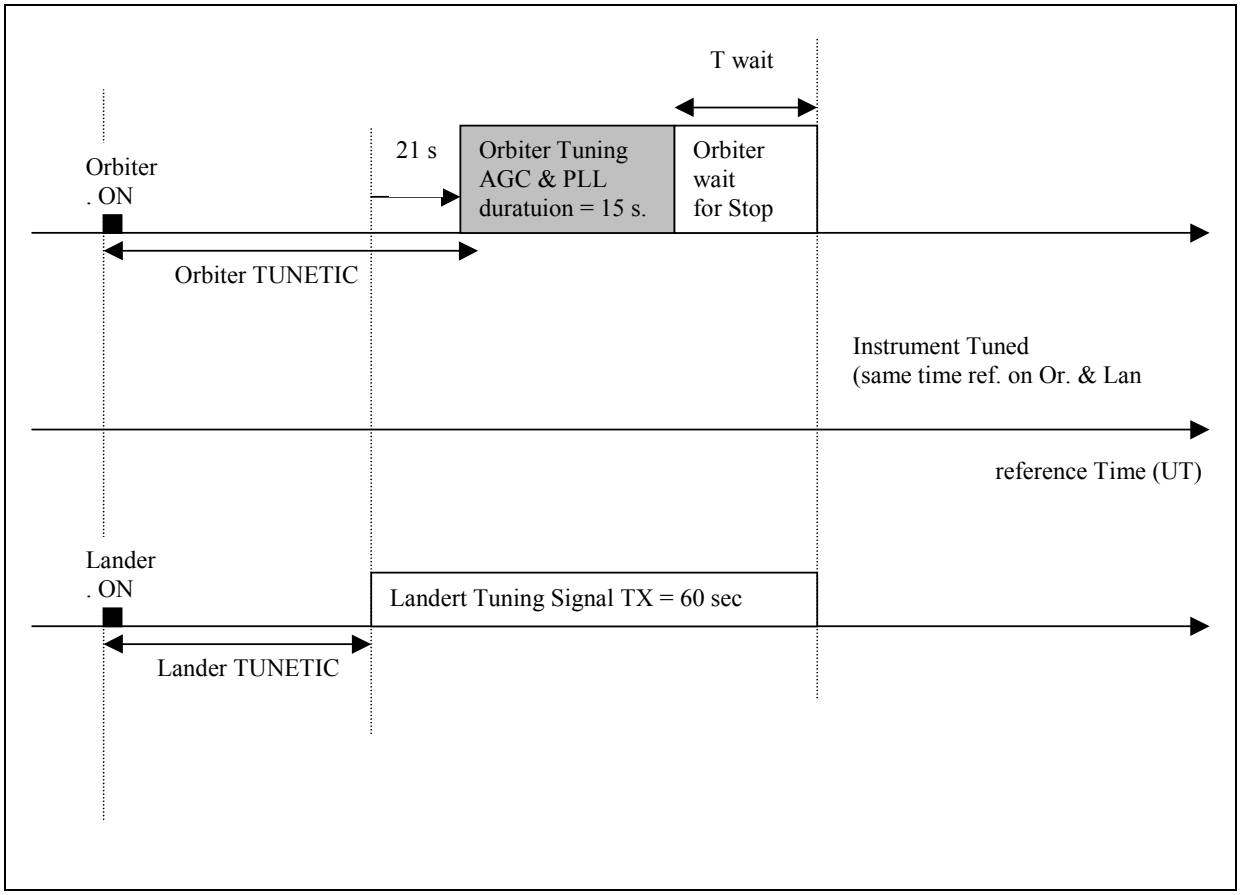
As per C1 & C2 and if the requested switch-on time for Orbiter and Lander in UT are the same :

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

C3 (Lander should start tuning phase first) gives :

Orbiter TUNETIC > Lander TUNETIC + 20 sec.
lets choose **: Orbiter TUNETIC = Lander TUNETIC + 21 s**ec.

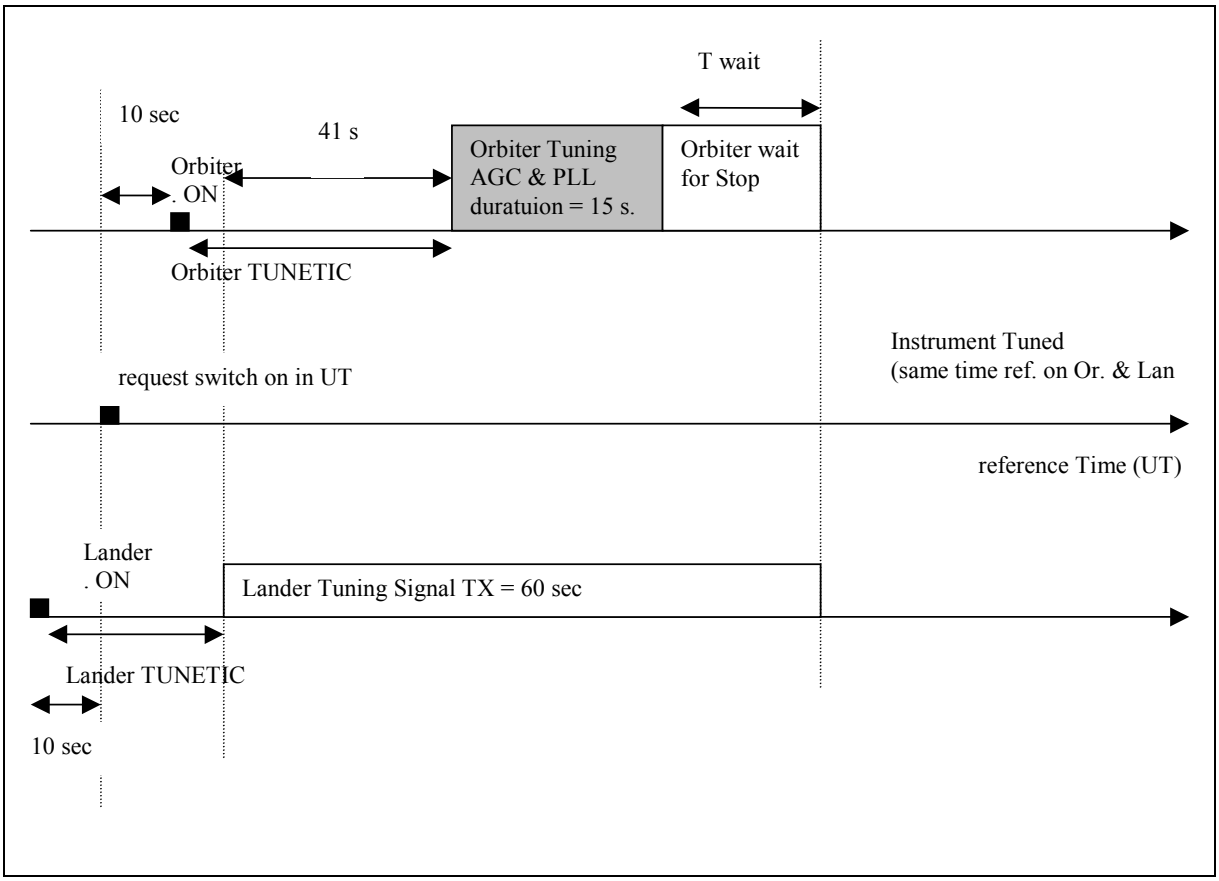
see diagrams and worst cases on following diagrams.



Nominal case :

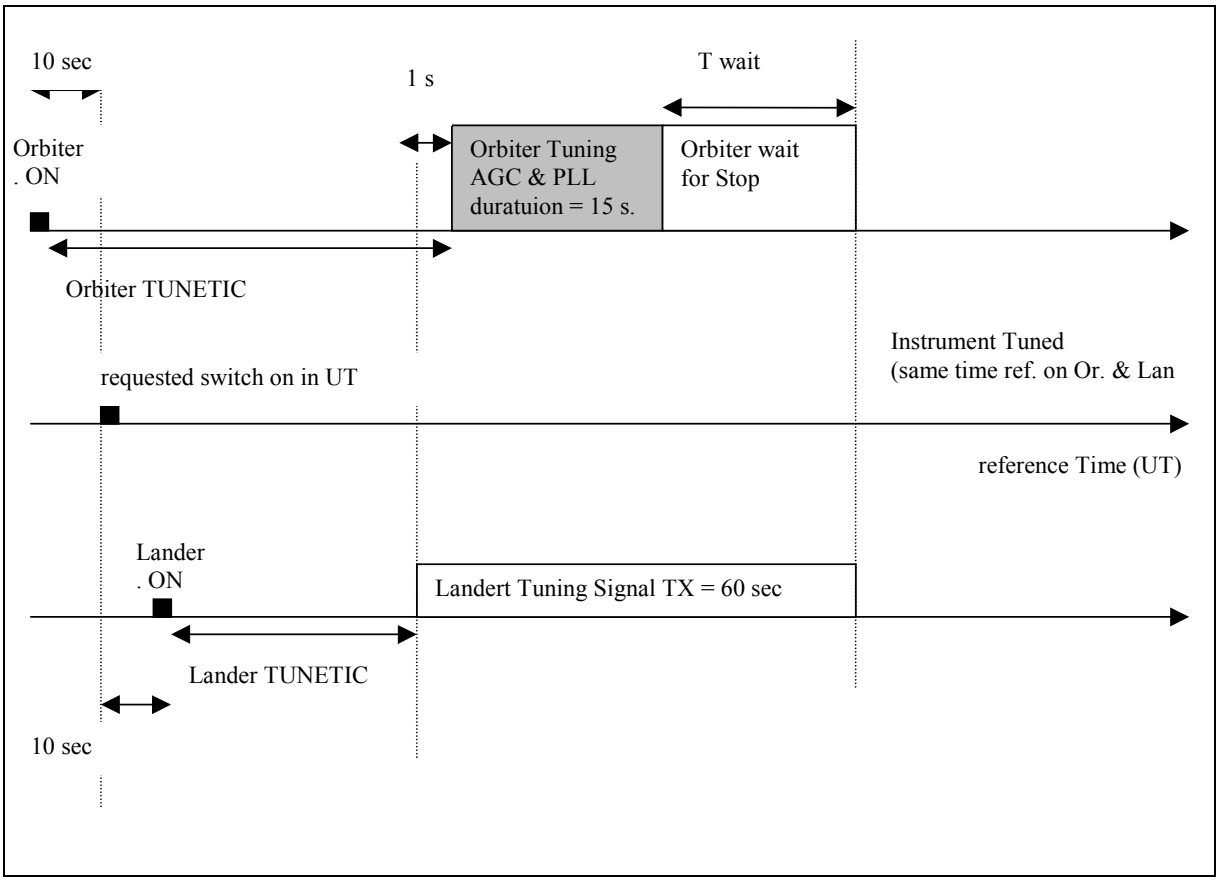
Orbiter and Lander instrument switched On at same time (UT reference time)

Duration when Radio signal is emitted by Lander before start of Orbiter AGC = 21 seconds
Then Orbiter wait time for = T wait = 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 = T wait = 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 = T wait = 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 Phase* and until reception of a valid mission table
Wait tuning Phase : after *Wait Mission Table Phase* and until time for start of tuning is reached.
Tuning Phase : after *Wait tuning Phase* and until completion of tuning activities (sending CW signal from Lander)
Wait Sounding Phase : After *Tuning Phase* and until time for start of sounding is reached.
Sounding Phase : After *Wait Sounding Phase* and until completion f the predefined number of soundings.
End Sounding Phase : After *Sounding Phase* and until Switch-off.

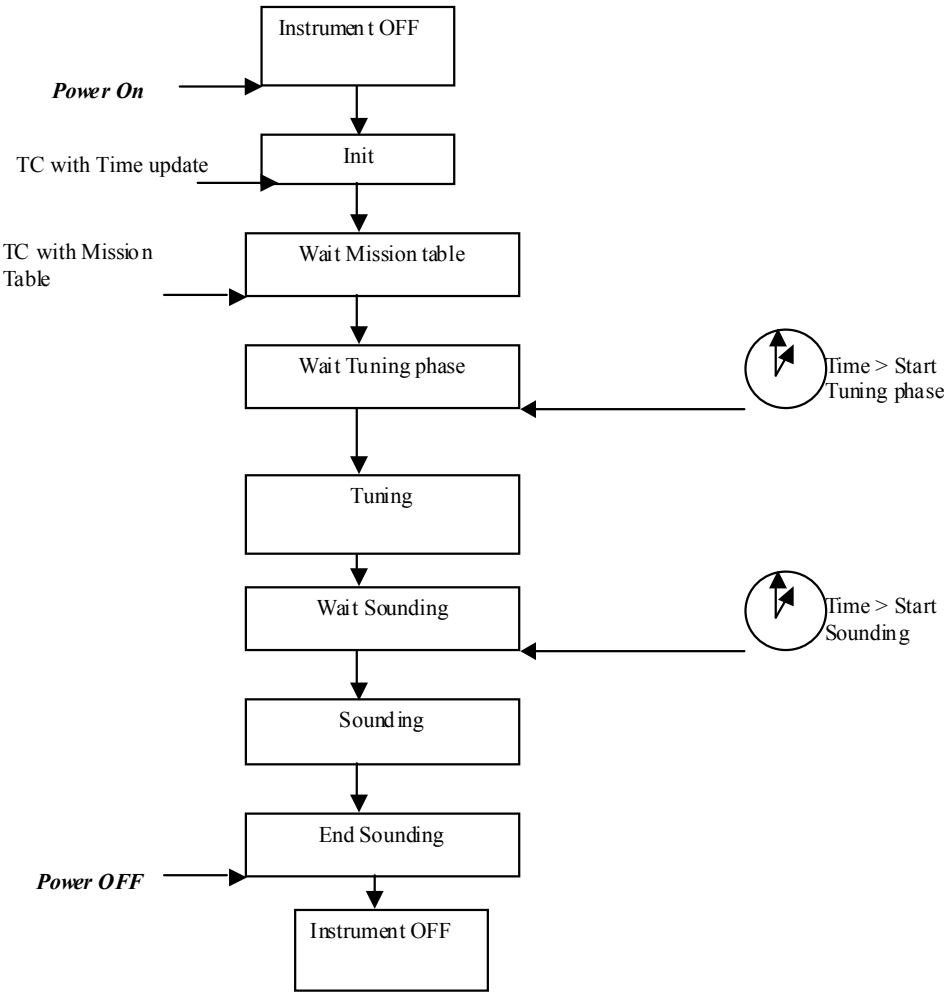


Table 4.1. : Phase Transition organigramme

4.2. Detailed phase description

4.2.1. Init phase

After switch-on and up to end of initialization

4.2.2. Wait Mission Table phase

After *Init phase* and until reception of a valid mission table.

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

4.2.3. Wait tuning phase

After *Wait Mission Table phase* and until time for start of tuning is reached.

4.2.4. Tuning phase

After *Wait tuning phase* and until completion of tuning activities

- The Lander instrument sends a continuous signal. 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.

4.2.5. Wait Sounding phase

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

4.2.6. Sounding phase

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

- This is the science activity mode.
- A Radio wave is transmitted from the Orbiter to the Lander and then back from the Lander.
- The shape and amplitude of the correlation of this signal (in phase and in quadrature, 8 bit signed each) are sent in each standard packet for 21 steps centered aroud the peak maximum.
- Every TAB_FIOW_RATIO measurement, the full measured signal (255 positions with16 bit signed for each I & Q channel) is transmitted.

4.2.7. End Sounding phase

After *Sounding phase* and until Switch-off.

4.3. Phase budget summary

Experiment Mode	Power Usage	Data Rate	Functional Use
Init phase	2.7 W	32 words every 15 sec.	initialization phase (duration ca 60 seconds)
Wait Mission Table phase	2.7 W	32 words every delta_tic (c.a. 5 sec.)	wait for the TC with Mission table (duration ca 300 seconds), and prepare mission timeline and setup.
Wait tuning phase	2.6 W	32 words every delta_tic (c.a. 5 sec.)	wait for tuning phase stat (duration ca 300 seconds)
Tuning phase phase	7.3 W	0	Perform internal clock tuning and synchronization activities (duration ca 300 sec)
Wait Sounding phase	2.6 W	32 words every delta_tic (c.a. 5 sec.)	Wait for start of sounding Mode (duration ca 600 sec)
Sounding phase	2.9 W (peak 8.5 W)	32 words every delta_tic (c.a. 5 sec.) + FIOW packets	Perform sounding activities, generation of science data duration 2 to 20 hours, comet type dependant
End Sounding phase	2.6 W	32 words every delta_tic (c.a. 5 sec.)	Wait for switch-off

5. Operational procedures

5.1. Ground test sequence

See specific document :
"Lander Functional Test Procedure", RO-LCN-TR-3022, Issue 4.0, Date 15/02/01

5.2. On-Board Control Procedures

To be defined.

5.3. Flight Control Procedures

5.3.1. Switch-on Conditions

The only switch-on restrictions applicable for Consert are the measured temperatures at the Consert E-Box TRP.

Minimum Switch-on Temperature at Consert E-Box TRP : -40 °C
Maximum Switch-on Temperature at Consert E-Box TRP : +50 °C

5.3.2. List of Flight Control Procedures

Instrument : **CONSERT LANDER (LCN)**

Procedures used in all mission phases : **LCN_ON & LCN_OFF**

Procedures used in each mission phase :

Mission Phase	**Abbrev.**	**Procedure number**	**Procedure title**
Commisionning	CVP	LCN_CVP_2	LCN-FCP-2 : Lander Verification
		LCN_CVP_3	LCN-FCP-3 : Solar Panel Influence
		LCN_CVP_5	LCN-FCP-5 : TC Verification
		LCN_CVP_6	LCN-FCP-6 : Patch & Dump
		LCN_CVP_8	LCN-FCP-8 : Interference
Cruise phase 1	CR1	LCN_CR1_2	LCN-FCP-2 : Lander Verification
		LCN_CR1_4	LCN-FCP-4 : Time Synchronisation
Mars flyby	MARS	LCN_MARS_2	LCN-FCP-2 : Lander Verification
		LCN_MARS_4	LCN-FCP-4 : Time Synchronisation
Cruise phase 2	CR2	LCN_CR2_2	LCN-FCP-2 : Lander Verification
		LCN_CR2_4	LCN-FCP-4 : Time Synchronisation
Earth flyby 1	EAR1	LCN_EAR1_2	LCN-FCP-2 : Lander Verification
		LCN_EAR1_4	LCN-FCP-4 : Time Synchronisation
Cruise phase 3	CR3	LCN_CR3_2	LCN-FCP-2 : Lander Verification
		LCN_CR3_4	LCN-FCP-4 : Time Synchronisation
Aster 1 flyby	AST1	LCN_AST1_2	LCN-FCP-2 : Lander Verification
		LCN_AST1_4	LCN-FCP-4 : Time Synchronisation
Cruise phase 4	CR4	LCN_CR4_2	LCN-FCP-2 : Lander Verification
		LCN_CR4_4	LCN-FCP-4 : Time Synchronisation
Earth Flyby 2	EAR2	LCN_EAR2_2	LCN-FCP-2 : Lander Verification
		LCN_EAR2_4	LCN-FCP-4 : Time Synchronisation
Cruise phase 5	CR5	LCN_CR5_2	LCN-FCP-2 : Lander Verification
		LCN_CR5_4	LCN-FCP-4 : Time Synchronisation
Aster 2 flyby	AST2	LCN_AST2_2	LCN-FCP-2 : Lander Verification
		LCN_AST2_4	LCN-FCP-4 : Time Synchronisation

5.3.3. Detailed Procedure Inputs

5.3.3.1. Antenna Deployment

The antennas are automatically deployed with the Landing Gear deployment.

5.3.3.2. LCN_ON : Power ON for Consert Lander

LCN_ON	**Consert Lander Instrument Switch-on**			
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 LCN Switch On (hh:mm:ss)**	**Activity**	**TM/TC packet**	**TM/TC parameter**
1	00:00:00	LCN ON	CDMS TC	CDMS parameter
2	00:00:10	If possible, Check Parameters : LCN Voltage LCN Current	CDMS TM	CDMS parameters, Voltage 28 V, Current decreasing from 140 mA to 95 mA
3	00:00:20	Verify first packet : "Initialisation Performed" OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 7 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
4	00:00:30	If necessary, Send Patch Parameters	TC_TYPE_ PATCH	To be defined. See below for Test Patch
5	00:00:40	If necessary, Dump Memory for Patch verification	TC_TYPE_ DUMP	To be defined. See below for Test Patch
6	00:00:50	If necessary, Verify packet for Patch verification	TM_TYPE_ REPORT	To be defined. See below for Test Patch

5.3.3.3. LCN_OFF : Power OFF for Consert Lander

LCN_OFF	**Consert Lander 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 LCN switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	LCN OFF	CDMS TC	CDMS parameter
2	00:00:15	If possible, Check Parameters : LCN Voltage LCN Current	CDMS TM	CDMS parameters, Voltage 0 V, Current 0 mA

5.3.3.4. FCP-001 : Consert Orbiter Instrument Verification Test

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

Procedure Objective : CONSERT ORBITER TEST ONLY
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 16 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. FCP-002 : Consert Lander Instrument Verification Test

LCN-FCP-002	**Consert Lander Instrument Verification Test**

Procedure Objective : CONSERT LANDER TEST ONLY
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.

Step n°	**Time from LCN switch On (hh:mm:ss)**	**Activity**	**TM/TC packet**	**TM/TC parameter**
1	00:00:00	Switch-on Consert Lander Run **LCN_ON** Procedure		
2	00:02:00	Send Consert Lander Mission Table : **MTUFTL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 14 minutes
3	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
4	00:16:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
5	00:16:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		

5.3.3.6. FCP-003 : Consert Instrument Solar Panel Influence

This test needs both instruments (Lander and Orbiter) to be switched-On.

Orbiter Procedure

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

Procedure Objective : CONSERT ORBITER AND LANDER TEST
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 16 minutes
3	00:18:00	Verify Event “Sounding Completed” received	YCN0C501	NCNA0530 = 41004
4	00:18:15	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		

Lander Procedure

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

Procedure Objective : CONSERT ORBITER AND LANDER TEST

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 LCN switch On (hh:mm:ss)**	**Activity**	**TM/TC packet**	**TM/TC parameter**
1	00:00:00	Switch-on Consert Lander Run **LCN_ON** Procedure		Note : The Orbiter instrument should be switched on at the same moment, see chapter 3.2
2	00:02:00	Send Consert Lander Mission Table : **MTPPTL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 16 minutes
3	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
4	00:18:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
5	00:18:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		
6		Rotate Solar Arrays 3-10 degrees		Orbiter Spacecraft activity
7		If complete rotation of Solar Arrays less than 180°, Go to step 1		

5.3.3.7. FCP-004: Consert Instrument Time Synchronization

This test needs both instruments (Lander and Orbiter) to be switched-On.

Orbiter Procedure

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

Procedure Objective : CONSERT ORBITER AND LANDER TEST
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 16 minutes
3	00:08:00	Verify Event : “Sounding Started” received	YCN0B501	NCNA0520 = 41003
4	00:08:15	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		Change clock setting value to measure the fine clock offset	ZCN19202	
6	00:18:00	Verify Event “Sounding Completed” received	YCN0C501	NCNA0530 = 41004
7	00:18:15	Run FCP CONSERT_OFF		

Lander Procedure

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

Procedure Objective : CONSERT ORBITER AND LANDER TEST

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 Orbiter 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	Switch-on Consert Lander Run **LCN_ON** Procedure		Note : The Orbiter instrument should be switched on at the same moment, see chapter 3.2
2	00:02:00	Send Consert Lander Mission Table : **MTPPTL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 16 minutes
3	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
4	00:18:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
5	00:18:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		

5.3.3.8. FCP-005: Consert Instrument TC Verification

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

Procedure Objective : CONSERT LANDER TEST ONLY
This procedure verifies the capability of the instrument to accept and execute Direct Commands.
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.

Step n°	Time from LCN switch On (hh:mm:ss)	Activity	TM/TC packet	TM/TC parameter
1	00:00:00	Switch-on Consert Lander Run **LCN_ON** Procedure		
2	00:02:00	Send Consert Lander Mission Table : **MTUFTL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 14 minutes
3	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
4	00:08:30	Change clock setting value to measure the fine clock offset	TC_TYPE_ DIRECT	Parameter 1 (Clock) = 05 (hex) Parameter 2 (value) = 55 (hex) This TC may be repeated to select various clock settings.
5		Verify packet : Data Type = Report OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 8 : OCXO Frequency = 55 (hex)
6	00:08:45	Change clock setting value to measure the fine clock offset	TC_TYPE_ DIRECT	Parameter 1 (Clock) = 05 (hex) Parameter 2 (value) = AA (hex)
7		Verify packet : Data Type = Report OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 8 : OCXO Frequency = AA (hex)
8	00:16:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
9	00:16:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		

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

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

Procedure Objective : CONSERT LANDER TEST ONLY

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	Switch-on Consert Lander Run **LCN_ON** Procedure		
2	00:00:30	Send Patch Parameters	TC_TYPE_ DIRECT	Par 1 (Patch) = 0206 (hex) Par 2 (Address) = 8000 (hex) Par 3 (Value) = AAAA
3	00:00:40	Dump Memory for Patch verification	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 37 : Mem value = AAAA (hex)
4	00:02:00	Send Consert Lander Mission Table : **MTUFTL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 14 minutes
5	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
6	00:16:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
7	00:16:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		

5.3.3.10. FCP-007: Consert Orbiter Instrument Interference

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

Procedure Objective : CONSERT ORBITER TEST ONLY
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 16 minutes
3		Wait for the end of Interference operations		
4	00:18:15	Run FCP CONSERT_OFF		

5.3.3.11. FCP-008: Consert Lander Instrument Interference

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

Procedure Objective : CONSERT LANDER TEST ONLY

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 Run **LCN_ON** Procedure		
2	00:02:00	Send Consert Lander Mission Table : **MTUFTL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 14 minutes
3	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
4		Wait for the end of Interference operations		
5	00:16:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
6	00:16:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		

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

This test needs both instruments (Lander and Orbiter) to be switched-On.

Orbiter Procedure

CN-FCP-009	**Consert Instrument Science Mode**			
Procedure Objective : CONSERT ORBITER AND LANDER OPERATIONS 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 : **MTSC**	ZCN19201	After this TC the instrument will perform autonomous activities during 10 hours
3	00:18:00	Verify Event “Sounding Finished” received	YCN0C501	NCNA0 = 41004
4	00:18:15	Run FCP CONSERT_OFF		

Lander Procedure

LCN-FCP-009	**Consert Instrument Science Mode**			
Procedure Objective : CONSERT ORBITER AND LANDER OPERATIONS 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	Switch-on Consert Lander Run **LCN_ON** Procedure		Note : The Orbiter instrument should be switched on at the same moment, see chapter 3.2
2	00:02:00	Send Consert Lander Mission Table : **MTSCL**	TC_TYPE_ MISS_TAB	After this TC the instrument will perform autonomous activities during 10 hours
3	00:02:05	Verify packet : Data Type = Report MT Received OCXO Frequency	Science Packet TM_TYPE_ REPORT	Parameter 2 : Data Type = 2 Parameter 3 : Status = bit 6 = 1 Parameter 8 : OCXO Frequency = 83 (hex)
4	10:02:00	Verify packet : “Sounding Completed” OCXO Temperature DIGI Board Temperature	Science Packet TM_TYPE_ STANDARD	Parameter 3 : Status = bit 3 = 1 Parameter 4 : OCXO Temp= ? Parameter 5 : DIGI Temp = ?
5	10:02:15	Switch-off Consert Lander Run **LCN_OFF** Procedure		

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 18 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 (4.95 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)

Total duration of this mode : circa 16 minutes

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)

Total duration of this mode : circa 16 minutes (+ 2 minutes waiting for Orbiter to finish)

5.4. Contingency Recovery Procedures

5.4.1. Redundancy concept

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

The Nominal/Redundant channel selection is performed automatically by the instrument based on The following circuits :

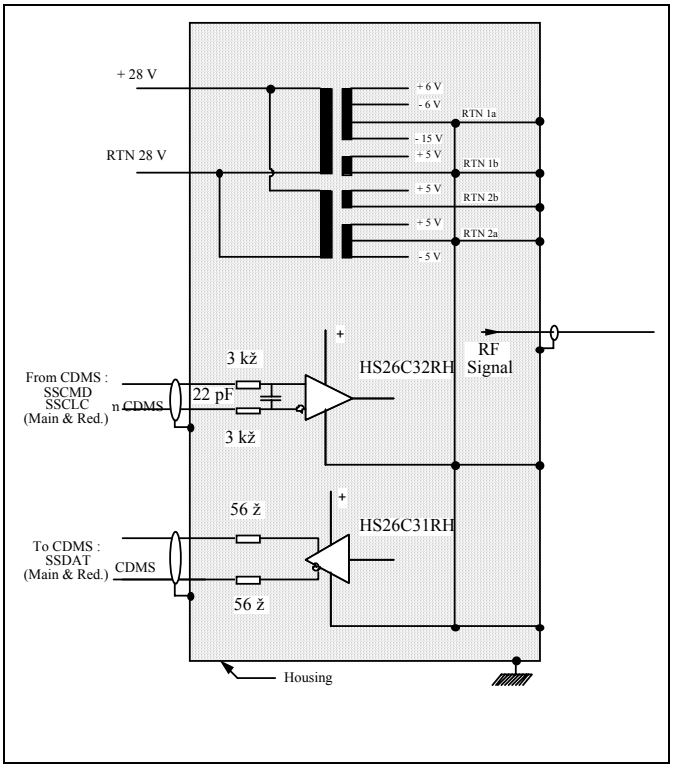


Figure 5.4.1a : Interface circuits

The main and redundant Clock and Command signals are NANDed in the FPGA.

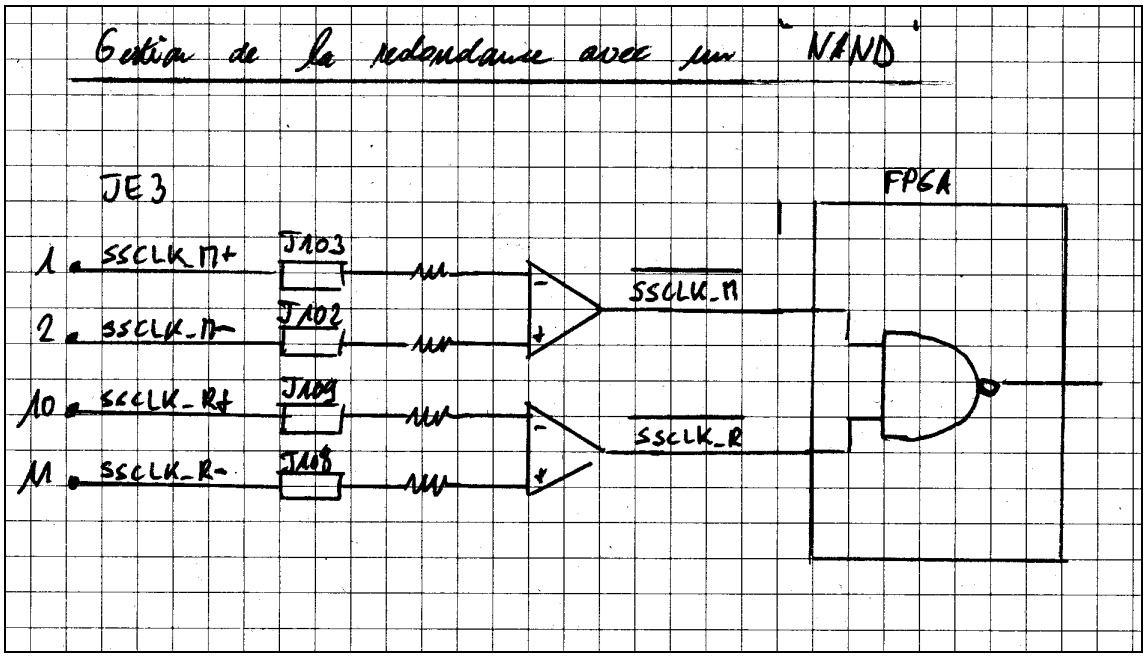


Figure 5.4.1b : Main / Redundant Management

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 contents of this ROM is loaded in the RAM memory and executed there.
Thus, software patching of all parts of the software is possible in 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

6.1.1. TC Types

A Telecommand to Consert is a message of a Length up to 32 words sent from the CDMS.
The first byte (index 0) of each TC message is the TC type.
Four types of TCs are handled by Consert

TC TYPE value	TC_TYPE	Usage	SWL 15 status
1	TC_TYPE_DIRECT	TC with direct effect on Hardware. For test only	OK
2	TC_TYPE_PATCH	Update of flight software	OK
3	TC_TYPE_MISS_TAB	Mission table definition	OK
4	TC_TYPE_DUMP	dump a segment of Flight Software	OK

6.2. Telecommand Parameter definition

6.2.1. TC structure of MISSION table

Length of a Mission Table TC in words = 10.

Index	Index names	Description	Associated global variable
0	TAB_HEADER	always 3 for mission table	none
1	TAB_index	any reference number	none
2	TAB_TUNETIC_B3	Time to start the tuning phase after instrument switch On, in TICs	tuneTIC
3	TAB_TUNETIC_B2	“	“
4	TAB_TUNETIC_B1	“	“
5	TAB_TUNETIC_B0	“	“
6	TAB_STARTTIC_B3	Time to start the first sounding, after completion of tuning phase, in TIC	startTIC
7	TAB_STARTTIC_B2	“	“
8	TAB_STARTTIC_B1	“	“
9	TAB_STARTTIC_B0	“	“
10	TAB_DELTATIC_B1	Time period between each sounding start, in TIC	deltaTIC
11	TAB_DELTATIC_B0	“	“
12	TAB_NBSOUND_B1	Total number of soundings in the observation	total_soundings
13	TAB_NBSOUND_B0	“	“
14	TAB_INITFREQ	frequency of the Sorep OCXO	OCXO_freq
15	TAB_FIOW_RATIO	Period of Full response (0 means never a full response)	FIOW_ratio
16	TAB_MODE	mode byte, see definition below	mode_byte
17	TAB_MINATT	Minimum allowed attenuation (if result of AGC loop gives an attenuation below mini_att , the selected GCW will be mini_att	mini_att
18	TAB_MAXATT	Maximum allowed attenuation (if result of AGC loop gives an attenuation highr then max_att , the selected GCW will be max_att	max_att
19	Spare	spare	Spare

6.2.2. Definition of the mode byte bit pattern

Bit pos	Bit name	Bit definition	Bit value	Bit value name	Effect
0	MODE_BIT_DATA	Mode bit position to define the data source			
			0	DATA_FPGA	Data source = FPGA
			1	DATA_SIMU	Data source = Simulated data; ie in tab[] static
1	MODE_BIT_FIOW	Mode bit position to define type of data sent in FIOW response			
			0	FIOW_SIGNAL	FIOW standard = Signal I & Q on 16 bits each
			1	FIOW_FULL	FIOW full = Standard + Signal I & Q framed 8 bits + correl I & Q
2	MODE_BIT_BLOCK	Mode bit position to define the block structure (1 x 32 words or 4 x 32 words			
			0	TM_1_BLOCK	1 time 32 word block. Flight Configuration
			1	TM_4_BLOCKS	1 time 4 x 32 word block. Ground test Configuration

6.2.3. Definition of Direct TCs

These commands are used for direct test of individual Hardware interfaces and sent via APID 112,12

Direct TC length in words = 2

Word 0 : MSB = TC_TYPE_DIRECT = 1
LSB = 0 (not used)

Word 1 : MSB = Direct TC type (see table)
LSB = Direct TC parameter (see table)

Index	Index names	Description	Associated global variable
0	TAB_HEADER	always 1 for direct TC	none
1	0	always 0	none
2	DIR_TC_TYPE	Type of direct TC See table below	none handled in module direct.c
3	DIR_TC_PAR	parameter of direct TC, See table below	none handled in module direct.c

Direct TC type and parameter definition

TC type hexa	TC para	Action	TM contents
3	0	LED ON	
3	1	LED OFF	
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, +,-)	0 = Code from FPGA, Nothing if FPGA OFF 1 = Delta 312 2= CW (sinus)

6.2.4. Dump request TC

Dump request TC length in words = 2

Word 0 : MSB = TC_TYPE_DUMP = 4
LSB = number of bytes to be dumped (max. is 64)
Word 1 : MSB = MSB of start address of segment to be dumped
LSB = LSB of start address of segment to be dumped

Check dump result in the TM Report packet generated.
Instead of the copy of this TC, the packet will contain the memory content of the dumped area.

6.2.5. Patch TC

Patch TC length in words = 2 + (patch_length_in_bytes)/2

Word 0 : MSB = TC_TYPE_PATCH = 2
LSB = number of bytes to be patched (max. is 60)
Word 1 : MSB = MSB of start address of segment to be patched
LSB = LSB of start address of segment to be patched
Word 2 : MSB = Byte to be written at (address defined in word 2)
LSB = Byte to be written at (address defined in word 2) + 1

Word i : MSB = Byte to be written at (address defined in word 2) + 2*(i-1)
LSB = Byte to be written at (address defined in word 2) + 2 * (i –1) + 1

i max is 31.

6.2.6. Identifiers

- Type Identifier of the Command : ZLN00112 with 20 32bits parameters PLNG0001 to 0020
APID 1804

6.3. Telemetry Packet definition

6.3.1. Data Delivery Concept

15 seconds after switch-on, the instrument sends a STANDARD TM packet (32 words).
Every 15 seconds, a STANDARD TM packet is sent until the Mission Table is received.
This repetition rate is modified when the Mission Table is received (nominally 5 seconds).
This packet contains housekeeping information and some science data from the instrument.

After reception of each TC, a REPORT TM is generated. This TM is 2 x 32 words long and contains first a STANDARD TM packet (with TM_TYPE byte set to 2 (= TM_TYPE_REPORT) followed by the copy of the received TC.
In case of a Memory dump request TC, the TC copy will be replaced by the content of the requested memory segment.

During sounding activities, the complete received signal is transmitted from time to time.
Every TAB_FIOW_RATIO period, the STANDARD TM packet is followed by the Science signal (DATA_TYPE value 3) or the FULL_DATA report (data type 4).
The selection between the two report types is performed within the Mission Table Mode byte (bit number1). The description of these two TM packet types is given below.
The FULL_DATA report is intended for FPGA validation only and is not intended for use in flight due to the large amount of TM generated.

6.3.2. Identifications

6.3.2.1. APID 1793

Telemetry acknowledgment from CDMS :
"TC ACK" to Acknowledge TCs sent to Consert.
Remark : The TCs, when received and accepted by Consert, are also acknowledged via a type 2 telemetry of APID 1804.

6.3.2.2. APID 1804

Science Telemetry

6.3.3. TM packet type summary

Name of Type	Generated after	Content	Size in 32Word blocks	Value of parameter DATA_ TYPE
TM_TYPE_ STANDARD	Every time interval DELTATIC (every Sounding)	Housekeeping info & peak info if sounding active	1	1
TM_TYPE_ REPORT	After each TC	Copy of the received TC In case of a Dump Request, the report will contain the dump of the requested memory area	2	2
TM_TYPE_ SCIENCE	Every sounding with FIOW (Full Info One Way)	TM_TYPE_STANDARD followed by • Signal_I 255 x 16 bits (Msb, lsb) = 510 Bytes • Two bytes with 0 • Signal_Q 255 x 16 bits (Msb, lsb) = 510 Bytes • Two bytes with 0	17	3
TM_TYPE_ FULL_DATA	Every sounding with FIOW (Full Info One Way), if flag Full_data is set	TM_TYPE_SCIENCE followed by • Framed Signal_I = 255 bytes • One Byte with 0 • Framed Signal_Q = 255 bytes • One Byte with 0 • Correlation_I = 255 bytes • One Byte with 0 • Correlation_Q = 255 bytes • One Byte with 0	33	4

6.4. Telemetry Parameter definition

6.4.1. Structure of a Standard Telemetry

Byte offset	Byte name	Description	Associated global variable
0	TM_PKCOUNT_B1	Current TM packet number	packet_num
1	TM_PKCOUNT_B0	"	"
2	TM_TIC_B3	Present On Board Time in TICs	TIC
3	TM_TIC_B2	"	"
4	TM_TIC_B1	"	"
5	TM_TIC_B0	"	"
6	TM_DATA_TYPE	Present message type **See § 6.3.2.**	none
7	TM_STATUS	Instrument status. **See § 6.4.2.**	status
8	TM_TEMP_OCXO	Sorep OCXO temperature	none
9	TM_TEMP_DIGI	Digital board temperature	none
10	TM_ADC_NBL	Narrow band level Signal	none
11	TM_ADC_TMIX	Mixer signal output	none
12	TM_OCXO_SETTING	Frequency setting of Sorep OCXO	OCXO_freq
13	TM_TUNING_PARAM	Info from the tuning phase	tbd
14	TM_ERROR_NUMBER	Total error count since switch On	err_count
15	TM_ERROR_CODE	Last error code since previous packet (0 if no error). **See § 6.4.3.**	err_code
16	TM_SOUNDING_N_B1	Present Sounding number (0 if not in sounding mode)	sounding_number
17	TM_SOUNDING_N_B0	"	"
18	TM_GCW	Present Gain Control Word (Attenuation)	GCW
19	TM_FRAMING	FPGA framing information. **See § 6.4.4.**	framing
20	TM_PEAK_POS	Position of Correlation modulus maximum	max_position
21	Spare	spare	spare
22 to 63	TM_PEAK_DATA	21 pairs of Bytes containing the I and Q channel correlation info. The pair number 10 (Byte offset 42 & 43) contain the maximum position	21 times (corel_Q[i] & corel_I[i])

-

6.4.2. Instrument Status bit definition

Bit number Msbit = 7	Information	Name
7	0 = Init not performed 1 = init OK	STAT_BIT_INIT_OK
6	0 = Mission table not received 1 = Mission table received	STAT_BIT_MISS_TAB_OK
5	0 = Tuning not performed 1 = Tuning performed	STAT_BIT_TUNING_OK
4	0 = Not in sounding mode 1 = In sounding mode	STAT_BIT_SOUNDING
3	0 = Sounding not finished yet 1 = Sounding finished	STAT_BIT_END

6.4.3. Error codes

Value (in hex)	Description	Effect	Name
0	No error occurred since last TM packet		
1	Received a TC message with wrong address, TC rejected,	FIFO reset	ERR_ WRONG_ADDR
0x80 & CDMS error code	Received a TC message with CDMS error notification, bits 5 to 0, contain copy of CDMS error code	FIFO reset	ERR_ CDMS_RERC
3	Received a TC with a mission table, while a first mission table has already been received, New table is ignored		ERR_ TWO_MISS_TAB
4	Received a TC of unknown type, ignored		ERR_ TC_TYPE_UNKNOWN
5	A time-out occurred in the low-level TC acquisition loop	FIFO reset	ERR_ TC_TIMEOUT
6	A timeout occurred in the low-level slow ADC read-out	ADC read-out set to 0	ERR_ ADC_TIMEOUT
7	A direct command with unidentified type has been received	none	ERR_ TC_DIRECT_UNKNOWN
8	A timeout occurred during the FPGA AGC phase	Next Sounding info may be corrupted	ERR_ TIMEOUT_AGC
9	A timeout occurred during the FPGA data transfer phase	Next Sounding info may be corrupted	ERR_ TIMEOUT_DATA

6.4.4. Framing information

The framing information is composed of two 4 bits codes : Code Cor & Code Sig; and :
framing = Code Cor * 16 + Code Sig

Signal Framer (coherent addition) :

Code Sig (dec)	Code Sig (hex)	Higher Non Zero Bit position	Right shift factor in bits	Multiplier factor
15	F	Impossible	Impossible	Impossible
14	E	16	10	1024
13	D	15	10	1024
12	C	14	8	256
11	B	13	8	256
10	A	12	6	64
9	9	11	6	64
8	8	10	4	16
7	7	9	4	16
6	6	8	2	4
5	5	7	2	4
4	4	Impossible	Impossible	Impossible
3	3	Impossible	Impossible	Impossible
2	2	Impossible	Impossible	Impossible
1	1	Impossible	Impossible	Impossible
0	0	6 to 0	0	1

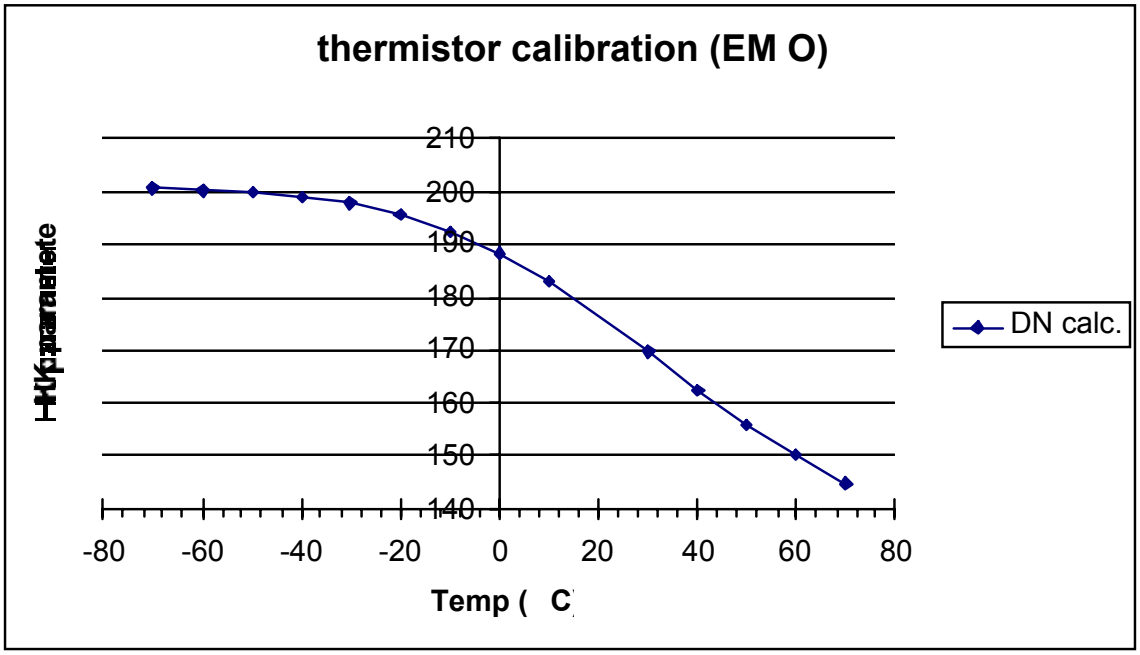
Correlation framer

Code Cor (dec)	Code Cor (Sig)	Higher Non Zero Bit position	right shift factor in bits	multiplier factor
15	F	15	Impossible	Impossible
14	E	14	8	256
13	D	13	7	128
12	C	12	6	64
11	B	11	5	32
10	A	10	4	16
9	9	9	3	8
8	8	8	2	4
7	7	7	1	2
0	0	6 to 0	0	1

6.4.5. Thermistor calibration curves

Calibration curve has been established for the Orbiter Engineering Model (EMO).
It is valid for every model.

T (°C)	Thermistor read-out
-70	201
-60	200
-50	199
-40	198
-30	197
-20	195
-10	192
0	188
10	183
30	170
40	163
50	156
60	150
70	145



The polynom that represents the best this curve is :
TEMP = -0.001866*HK^3 + 0.934* HK ^2 - 156.52* HK + 8815

6.4.6. Telemetry Formats

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 are dated OBT by CDMS Lander and All packets are dated TIC by CONSERT.
TMs are described for Software Lander 15.

6.4.6.1. Lander Data Handling philosophy

Consert generates TM packets which are formated by the CDMS to be sent at the orbiter. In more detail :

- The Lander CDMS generates TM compliant with the orbiter general format with a fixed length: 127 word for the source data. The only consert lander apid is 1804 = 112,12 corresponding in a science format.

- The Consert TM's are reformatted to fit with this format and cut in 32-word blocks.
  - 1 block per TM type 1
  - 2 blocks per TM type 2
  - 17 blocks per TM type 3

Each TM could also be completed with nulls before reception of the mission table or when setting MODE_BIT_BLOCK in the Mission Table.

- The Lander CDMS groups the 32-word blocks 4 by 4 to constitute a final TM sent to the orbiter during normal operation. Due to this concatenation, a loss of 0 to 3 blocks may occur at the beginning of the CDMS Quiet Mode

Conserning the Consert TM packet numbering:
- The numbering of packet procuces by the Consert instrument is continuous, independantly of the TM type. This numbering is reset when consert turned off/on.
- The numbering of the Consert telemetry written by the Lander CDMS in the The main Header of the final TM is not reset when Consert is turn off / turn on.

6.4.6.2. TM_TYPE_STANDARD

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	TM Packet Number															
1	On-Board Time in TICs MSW (= 65536 Tics = 107 sec)															
2	On-Board Time in TICs LSW (= 7706 Tics = 13 sec)															
	Data Type (= 1)								Instrument Status							
3	0	0	0	0	0	0	0	1	Init OK	Mission Table OK	Tuning OK	Sounding Started	Sounding Finished	0	0	0
4	OCXO Temperature								DIGI Board Temperature							
5	Narrow Band Level Signal								Mixer Signal Output							
6	OCXO Frequency								Tuning Phase Info							
7	Total Error Count								Last Error Code							
8	Present Sounding Number															
9	Present Gain Control Word								FPGA Framing Info							
10	Position of Correlation Modulus Maximum								0	0	0	0	0	0	0	0
11	Signal I at position -10								Signal Q at position -10							
12	Signal I at Position -9								Signal Q at Position -9							
13	Signal I at Position -8								Signal Q at Position -8							
14	Signal I at Position -7								Signal Q at Position -7							
15	Signal I at Position -6								Signal Q at Position -6							
16	Signal I at Position -5								Signal Q at Position -5							
17	Signal I at Position -4								Signal Q at Position -4							
18	Signal I at Position -3								Signal Q at Position -3							
19	Signal I at Position -2								Signal Q at Position -2							
20	Signal I at Position -1								Signal Q at Position -1							
21	Signal I at Center Position								Signal Q at Center Position							
22	Signal I at Position +1								Signal Q at Position +1							
23	Signal I at Position +2								Signal Q at Position +2							
24	Signal I at Position +3								Signal Q at Position +3							
25	Signal I at Position +4								Signal Q at Position +4							
26	Signal I at Position +5								Signal Q at Position +5							
27	Signal I at Position +6								Signal Q at Position +6							
28	Signal I at Position+7								Signal Q at Position+7							
29	Signal I at Position +8								Signal Q at Position +8							
30	Signal I at Position +9								Signal Q at Position +9							
31	Signal I at Position + 10								Signal Q at Position + 10							

Onboard Software formats short signal in two types with data= I2+Q2 on 16 bits for Software Lander 15 or with data= I on 8bits_and Q on 8 bits for Software Lander 12.

6.4.6.3. TM_TYPE_REPORT

The first block is only a hard-copy of the last standard TM without new data while :

- The TM packet Number is incremented
- The Consert Time Tic is updated
- In case of sounding mode, the sounding is incremented but does not correspond to an existing sounding

The numbering of TM packet number is continuous.
TM_TYPE_REPORT is described for Software Lander 15.

This 1st block has not to be taken into account in the science data analysis.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	TM Packet Number															
1	On-Board Time in TICs MSW (= 65536 Tics = 107 sec)															
2	On-Board Time in TICs LSW (= 7706 Tics = 13 sec)															
	Data Type (= 2)								Instrument Status							
3	0	0	0	0	0	0	1	0	Init OK	Mission Table OK	Tuning OK	Sounding Started	Sounding Finished	0	0	0
4	OCXO Temperature								DIGI Board Temperature							
5	Narrow Band Level Signal								Mixer Signal Output							
6	OCXO Frequency								Tuning Phase Info							
7	Total Error Count								Last Error Code							
8	Present Sounding Number															
9	Present Gain Control Word								FPGA Framing Info							
10	Position of Correlation Modulus Maximum								0	0	0	0	0	0	0	0
11	Signal I at position -10								Signal Q at position -10							
12	Signal I at Position -9								Signal Q at Position -9							
13	Signal I at Position -8								Signal Q at Position -8							
14	Signal I at Position -7								Signal Q at Position -7							
15	Signal I at Position -6								Signal Q at Position -6							
16	Signal I at Position -5								Signal Q at Position -5							
17	Signal I at Position -4								Signal Q at Position -4							
18	Signal I at Position -3								Signal Q at Position -3							
19	Signal I at Position -2								Signal Q at Position -2							
20	Signal I at Position -1								Signal Q at Position -1							
21	Signal I at Center Position								Signal Q at Center Position							
22	Signal I at Position +1								Signal Q at Position +1							
23	Signal I at Position +2								Signal Q at Position +2							
24	Signal I at Position +3								Signal Q at Position +3							
25	Signal I at Position +4								Signal Q at Position +4							
26	Signal I at Position +5								Signal Q at Position +5							
27	Signal I at Position +6								Signal Q at Position +6							
28	Signal I at Position+7								Signal Q at Position+7							
29	Signal I at Position +8								Signal Q at Position +8							
30	Signal I at Position +9								Signal Q at Position +9							
31	Signal I at Position + 10								Signal Q at Position + 10							
32 **---** **63**	Copy of Received Telecommand Or Memory dump															

6.4.6.4. TM_TYPE_SCIENCE

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	TM Packet Number															
1	On-Board Time in TICs MSW (= 65536 Tics = 107 sec)															
2	On-Board Time in TICs LSW (= 7706 Tics = 13 sec)															
	Data Type (= 3)								Instrument Status							
3	0	0	0	0	0	0	1	1	Init OK	Mission Table OK	Tuning OK	Sounding Started	Sounding Finished	0	0	0
4	OCXO Temperature								DIGI Board Temperature							
5	Narrow Band Level Signal								Mixer Signal Output							
6	OCXO Frequency								Tuning Phase Info							
7	Total Error Count								Last Error Code							
8	Present Sounding Number															
9	Present Gain Control Word								FPGA Framing Info							
10	Position of Correlation Modulus Maximum								0	0	0	0	0	0	0	0
11 **--** **31**	Signal I and Q at Position ± 10 from Peak position (Byte 22 to 63) (21 Words)															
32 **--** **286**	Signal I (255 x 16 bits) (Byte 64 to 573)															
287	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288 **--** **542**	Signal Q (255 x 16 bits) (Byte 576 to 1085)															
543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

6.4.6.5. TM_TYPE_FULL_DATA

This format is a ground test format.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	TM Packet Number															
1	On-Board Time in TICs MSW (= 65536 Tics = 107 sec)															
2	On-Board Time in TICs LSW (= 7706 Tics = 13 sec)															
	Data Type (= 4)								Instrument Status							
3	0	0	0	0	0	1	0	0	Init OK	Mission Table OK	Tuning OK	Sounding Started	Sounding Finished	0	0	0
4	OCXO Temperature								DIGI Board Temperature							
5	Narrow Band Level Signal								Mixer Signal Output							
6	OCXO Frequency								Tuning Phase Info							
7	Total Error Count								Last Error Code							
8	Present Sounding Number															
9	Present Gain Control Word								FPGA Framing Info							
10	Position of Correlation Modulus Maximum								0	0	0	0	0	0	0	0
11 **--** **31**	Signal I and Q at Position ± 10 from Peak position (Byte 22 to 63) (21 Words)															
32 **--** **286**	Signal I (255 x 16 bits) (Byte 64 to 573)															
287	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
288 **--** **542**	Signal Q (255 x 16 bits) (Byte 576 to 1085)															
543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
544 **--** **671**	Framed Signal I (255 Bytes) (Byte 1088 to 1342)								0	0	0	0	0	0	0	0
672 **--** **799**	Framed Signal Q (255 Bytes) (Byte 1344 to 1598)								0	0	0	0	0	0	0	0
800 **--** **927**	Correlation I (255 Bytes) (Byte 1600 to 1854)								0	0	0	0	0	0	0	0
928 **--** **1055**	Correlation I (255 Bytes) (Byte 1856 to 2110)								0	0	0	0	0	0	0	0

6.4.6.5. Lander Data Handling and CDMS TM format

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 = 112							Packet Category = 12			
1	1	1	Source Sequence Count													
2	Packet Length = 269															
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 = 0							
8	PAD Field = 0								Structure ID = 0							
9 - 40	1st data block															
41 - 72	2nd data block															
73 - 104	3rd data block															
105 - 136	4th data block															
137	CheckSum															

6.4.7. Telemetry parameter Tables (Lander definitions)

6.4.7.1. TM_TYPE_STANDARD

Telemetry Parameter Table		
Unit:		Consert
PID:		Application Process ID
Service:		20,3
Name:		TM_TYPE_STANDARD
No	**Signal**	**Description**
0	PCK #	TM Packet Number
1	OBT	ON-Board Time in TICs
2	Data Type	Data Type
3	Status	Instrument Status
4	OCXO Temp	Clock Temperature
5	DIGI Temp	E-Box Temperature
6	NBL	Narrow Band Level Signal
7	Mixer	Mixer Signal Output
8	Freq	OCXO Frequency
9	Tuning	Tuning Phase Information
10	# of Errors	Total Error Count
11	Error Code	Last Error Code
12	Sound #	Present Sounding Number
13	AGC	Present Gain Control Word
14	Framing	FPGA Framing Information
15	Peak Pos	Position of Maximum Correlation Modulus
16 - 36	Modulus(x)	Moduli at Positions -10 to +10 (21 Values)

6.4.7.2. TM_TYPE_REPORT

Telemetry Parameter Table		
Unit:		Consert
PID:		Application Process ID
Service:		20,3
Name:		TM_TYPE_REPORT
No	**Signal**	**Description**
0	PCK #	TM Packet Number
1	OBT	ON-Board Time in TICs
2	Data Type	Data Type
3	Status	Instrument Status
4	OCXO Temp	Clock Temperature
5	DIGI Temp	E-Box Temperature
6	NBL	Narrow Band Level Signal
7	Mixer	Mixer Signal Output
8	Freq	OCXO Frequency
9	Tuning	Tuning Phase Information
10	# of Errors	Total Error Count
11	Error Code	Last Error Code
12	Sound #	Present Sounding Number
13	AGC	Present Gain Control Word
14	Framing	FPGA Framing Information
15	Peak Pos	Position of Maximum Correlation Modulus
16 - 36	Modulus(x)	Moduli at Positions -10 to +10 (21 Values)
37	Received TC	Received Telecommand

6.4.7.3. TM_TYPE_SCIENCE

Telemetry Parameter Table		
Unit:		Consert
PID:		Application Process ID
Service:		20,3
Name:		TM_TYPE_SCIENCE
No	**Signal**	**Description**
0	PCK #	TM Packet Number
1	OBT	ON-Board Time in TICs
2	Data Type	Data Type
3	Status	Instrument Status
4	OCXO Temp	Clock Temperature
5	DIGI Temp	E-Box Temperature
6	NBL	Narrow Band Level Signal
7	Mixer	Mixer Signal Output
8	Freq	OCXO Frequency
9	Tuning	Tuning Phase Information
10	# of Errors	Total Error Count
11	Error Code	Last Error Code
12	Sound #	Present Sounding Number
13	AGC	Present Gain Control Word
14	Framing	FPGA Framing Information
15	Peak Pos	Position of Maximum Correlation Modulus
16-36	Moduli	Moduli at Positions -10 to +10 (21 Values)
37-291	Signal I	255 Words of Signal I
293-547	Signal Q	255 Words of Signal Q

6.4.7.4. TM_TYPE_FULL_DATA

Telemetry Parameter Table		
Unit:		Consert
PID:		Application Process ID
Service:		20,3
Name:		TM_TYPE_FULL_DATA
No	**Signal**	**Description**
0	PCK #	TM Packet Number
1	OBT	ON-Board Time in TICs
2	Data Type	Data Type
3	Status	Instrument Status
4	OCXO Temp	Clock Temperature
5	DIGI Temp	E-Box Temperature
6	NBL	Narrow Band Level Signal
7	Mixer	Mixer Signal Output
8	Freq	OCXO Frequency
9	Tuning	Tuning Phase Information
10	# of Errors	Total Error Count
11	Error Code	Last Error Code
12	Sound #	Present Sounding Number
13	AGC	Present Gain Control Word
14	Framing	FPGA Framing Information
15	Peak Pos	Position of Maximum Correlation Modulus
16-36	Moduli	Moduli at Positions -10 to +10 (21 Values)
37-291	Signal I	255 Words of Signal I
292-546	Signal Q	255 Words of Signal Q
547-674	Framed I	255 Bytes of Framed Signal I
675-802	Framed Q	255 Bytes of Framed Signal Q
803-930	Corr I	255 Bytes of Correlation I
931-1058	Corr Q	255 Bytes of Correlation Q