MARS EXPRESS

PLANETARY FOURIER SPECTROMETER

FLIGHT OPERATION MANUAL

MEX-CNR-FUM 7

PFS-FUM 7

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FUM 7 -INSTRUMENT OPERATION MANUAL

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PFS APPLICABLE DOCUMENTATION

1 – ESA REQUIREMENTS

MEX.ESC.IF.5001

02/00 20-DEC-1999 Space ground interface control document

2 – ASTRIUM SPECIFICATIONS

2.1 – SYSTEM SPECIFICATIONS

2.2 – S/SYSTEMS SPECIFICATIONS

MEX.MMT.SP.0007

02/00 06-JUL-1999 Payload interface document

Applicable with following Compl matrix/Matrice conformité

MEX.CNR.ICDR.05.00

00/00 01-SEP-2000 MEX PFS PID-A compliance matrix

MEX.MMT.SP.0007.A

02/01 07-JUL-2001 Payload interface document Annex A

MEX.MMT.SP.0007.B

02/01 28-JAN-2000 Payload interface document Annex B

RO.TER.IS.4001

01/07 **20-NOV-2000** External interfaces for the ROS CCS applicable to MEX

MEX.MMT.RS.0337

00/00 06-JUL-1999 Thermal mathematical modelling requirement spec.

MEX.SP.0002.S.MMS

01/00 04-MAY-1999 MEX Finite element model requirement spec

2.3 – EQUIPMENTS SPECIFICATIONS

MEX.MMT.CO.0451

00/00 28-AUG-1998 MEX Partnership agreement for the planetary fourier

MEX.NT.00032.S.MMS

01/00 01-SEP-2000 MEX Mechanical modelling requirement for PFS

MEX.ALT.RS.0003

02/00 04-MAY-2000 System EGSE design & interface specification

3. DESIGN DOCUMENTS

MEX.CNR.ICDR.06.00

00/00 01-SEP-2000 MEX PFS PID-B

3.1 – LOWER LEVEL CIDL

MEX.CNR.SM.03

01/00 02-JUN-2001 MEX PFS CIDL

3.3 – PMP LISTS

3.4 – I/F CONTROL DOCUMENTS

MEX.MMT.IF.0347

01/00 30-MAY-2000 PFS MICD PART A

3.5 – AIT DOCUMENTS

1 - GENERAL DESCRIPTION

1.1 – SYNTHESIS OF OPERATING PRINCIPLES

The operating principle is that when in orbit around Mars , at switch on , or at weak-up , a number of parameters are given from module E to module O . In this way , after checking for communication , module O is ready for moving the pendulum, and take measurements. Before giving the start command, module E puts the scanner in the due direction. After the start , module O moves the double pendulum . This generates the laser diode radiation to produce the sine interferogram , which amplified, generates the zero crossing . The timing between the zero crossings is given to the speed controller . After some time the movement is stabilised. The zero crossing is also given to the sample and hold of the A/D converter. About 18 000 measurements are taken. When the Zero Optical Path Difference signal is obtained from the TRW device , PFS starts counting down to 8196. Module O selects 16384 data words around the ZOPD and gives the words to module E (SW) or extract 4096 words (one out of 4 , LW) to give to Module E. Module E prepares these data for telemetry transmission.

We measure the radiation intensity coming from Mars and entering the Interferometer within the IFOV (4 deg for the LW channel , and 2 deg for the SW channel). These measurements are repeated during the motion of the double pendulum, so that 18000 measurements are taken equally spaced in terms of optical path difference . Each measurement is taken every 150 nm of displacement of the corner cubes of the interferometer. These measurements are then reduced to 16384 for the SW and 4096 for the LW. The dynamical range of these measurements is tremendous as at least 16 bits are necessary to get the full information. The FFT of these measurements , which we can do on board in real time, will give us the spectrum of the Martian radiation in the wavenumber range 200 – 2000 for the LW and 2000 – 8200 for the SW. The spectral resolution is 2 cm-1 , corresponding to more then 4000 for the ? ? ? at 8200 cm-1, and corresponding to 100 at 50 microns.

During cruise phase we will be using PFS mostly in the direct mode (see the document science operations) : example

Switch on
Perform test 1
Stop test 1
Perform test 2
Stop test 2
……..
Switch off

In orbit around Mars we shall make use of the cyclogram operations , and change theactivity mostly by means of the Coded Control Table (commandsfrom E to O):

At time t0-60 weak up, t0-50 start autotest, t0-45 start calibrations (10+10+10), t0-40 put scanner in due position , t0-39 start measurements ,… if mass memory full stop measurements and wait, t0+39 stop measurements , t0+40 start calibrations (10+10+10), t0+45 autotest , t0+50 go to sleep .

1.2 – OVERALL PERFORMANCES .

We shall summarize here the performance budgets of PFS :

		LW		SW
Spectral coverage cm-1		200 – 2000		2000 – 8200
Microns		5 – 50		1.2 – 5
Spectral resolution cm-1		2		2
Footprint size Km		100 –20		50 – 10
Number of points :				
Interferogram	4096		16384	
Spectrum		2048		8196
Acquisition time sec.	5		5	
Repetition time sec.		6.5		6.5
SNR		>100		>100
Working time minutes below Km	4000			
Around pericentre		-60 m		60 m (*)
Number of measurements				
Per orbit		530		530
Per day		1590		1590
Calibrations Meas. orbit				
Space			10,13	
BlcBd		10,13		10, 13
In total		10+10+10 before and		10+10+10 after pericenter
In commissioning phase		13+13+13 before and		13+13+13 after pericenter
Number of bits				
Per orbit	530 measurements + 60 calib.			
Per orbit	530 measurements + 60 calib.			

(*) It is assumed here and in all the documents that will be possible to work for at least 53 minutes around pericenter, i.e. below 4000 Km altitude . Deep space and calibration black body measurements will be taken before and after this observation period, as they do not need the nadir pointing platform.

It should be noted that the number of Mbits per day that we want to transmit to ground are very flexible as we have possibility to reduce the amount of data by cutting either the interferograms or the spectra. The numbers given above shall be rather considered our baseline.

2 - INSTRUMENT CONFIGURATION

2.1 – HIERARCHICAL CONFIGURATION

The general controller of the experiment is Module E. It has the most important part of the work : receives telecommands and act to serve them.
Can put the Module O and S in sleeping mode.
Gives to module O the Control table to be used, and gives the start for data acquisition. While Module O is taking new measurements , E can send data to FFT , if needed , gets the spectrum back , and prepares data for the spacecraft in the Data Telemetry Mode.
When needed Module E rotates the scanner to put it in the due position. The scanner position is reported back in the PFS status-housekeeping data.

Module O after initial reset gives a word “99” to E for sincronization, then gives a ramp to check communication is OK. When requested gives the status data and the housekeeping of O . These are going to be part of the general housekeeping telemetry.
When order to block/unblock is received, O execute. When start measurements arrive , O execute. When data are ready O raises a flag and waits for E to accept the interrupt and start reading.
Module P it is switched on by the spacecraft, so automatically gives 5 V to E. Module E has the power to switch on the 15 V for O and for S.

2.2.1- INSTRUMENT ORGANISATION.

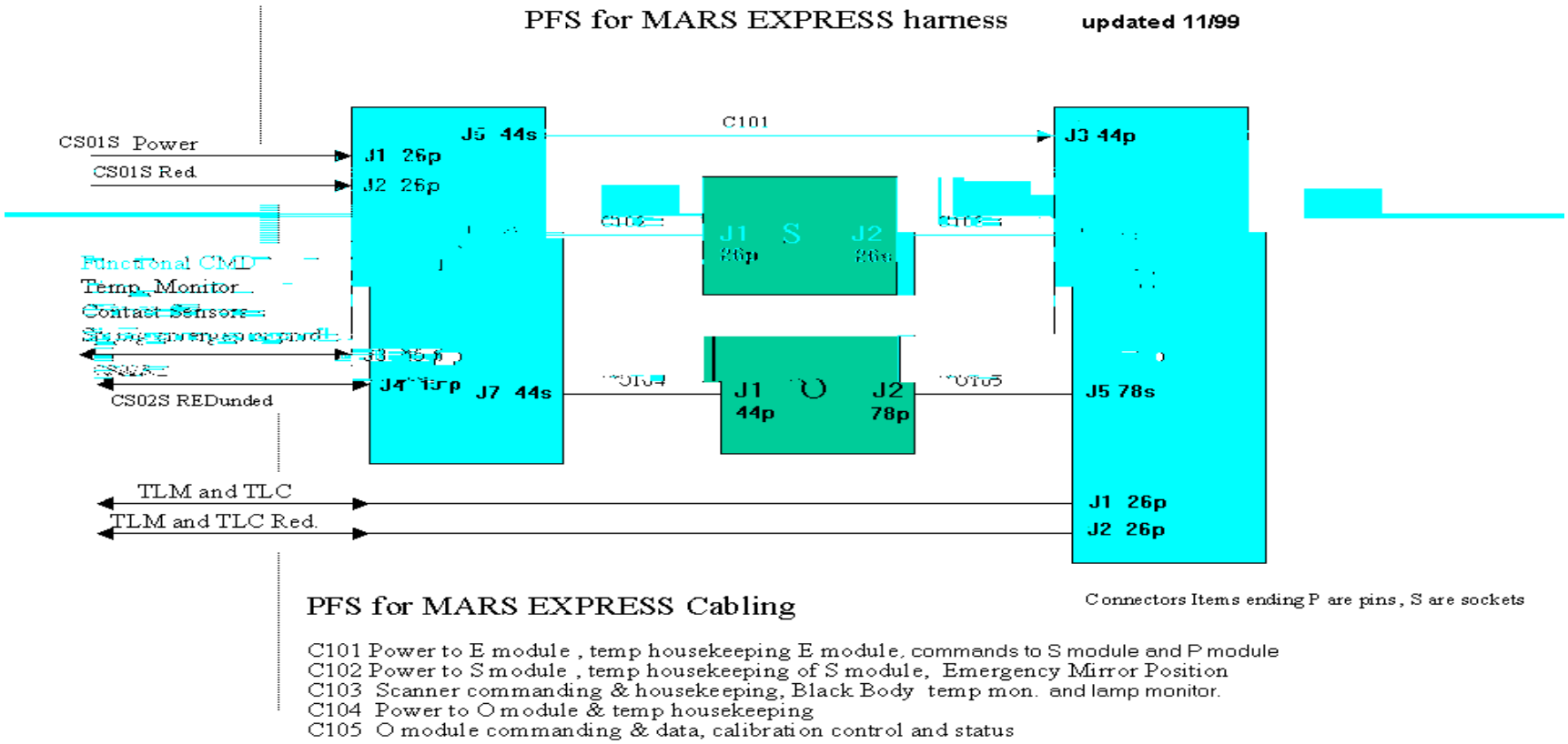


Fig.1 – PFS general organisation

3 INSTRUMENT DETAILED DESCRIPTION

3.1 - THE ACQUISITION CYCLOGRAM.

We shall give here the detailed information on the cycle that provides one full measurement.
We start with the command from E to O to start a new measurement. O moves the double pendulum which goes in the so called “starting position” . The motion of the pendulum starts and at each zero crossing of the laser diode interferogram of the SW channel the SW signal is sampled. At the same time the other laser diode gives another zero crossing for the sampling of the LW channel. While taking these measurements at a certain point the ZOPD zero optical path difference signals is received and a counter starts. When this counter reaches 8196 , then the double pendulum is stopped. The number of measurements is simmetrized so that 16384 points are available for both channels. All this should be done in less than 5 sec. Data are then transferred to module E : for the SW all 16384 points are transferred, while for the LW there are 2 possibilities (depending of the mode requested) either all points are given or 4096 data points (one out of 4) are sent to module E. Here DAM receives the data, pass the data to ICM which performs the FFT for each set and then data are put in the mass memory. If interferograms are requested, ICM is ignored and data are put into the mass memory directely. From logic point of view only at this point DAM gives order to OBDM to start a new acquisition, but in reality the order has already been given after all data have been received from module O to Module E.
After each data acquisition cycle PFS checks whether new telecommands have been received and executes them (if any). The telemetry information can be sent at any time on request from the spacecraft.
Let us see here some details:
This cyclogram concerns OBDM and is about the acquisition of one interferogram for SW and one for LW. It implies also motion of the double pendulum and all the necessary actions to control the motion.

1 Start. Is a command from DAM to OBDM.
2 Start motion. Is a command/set up from OBDM to the analog electronics of the motor.
3 Check motion. It concerns 2 things :
Flag of the speed control loop up: speed locked.
Timer. Measure the time between two zero crossings and compares with a preloaded value.When the values are equal the motion is OK. possible failure mode here.
4 Acquisition. It is the routine reading the output of the AD converters (SW and LW). As the speed of the spectrometer is 2% different, the timing of the zero crossing may be different, therefore two different interrupts are needed. The two channels work independently. Each channel should also increment two counters : counter SW1 goes from 0 to 18000. Similarly for counter LW1.
5 Acquisition is stopped when one of the 2 counters LW1 or SW1 reaches the prefixed value 18 000 . (The failure mode should change this value to 10 000).
Counter SW2 and LW2 will increment up to the arrival of the zero optical path difference pulse , then will start decreasing. Note that these two counters could be the memory location itself, where the words are being written.FAILURE MODE HERE : IF THERE ARE DIFFICULTIES IN SPEED LOCKING , THE ZERO OPTICAL PATH DIFFERENCE MAY ARRIVE SOON , AFTER ONLY A FEW MEASUREMENTS ARE TAKEN. DECIDE IF TO GO TO ONE SIDED INTERFEROGRAM. The zero optical path difference is a pulse lasting 1 ms (4 readings) , the rising part being the real indicator.

6 Check motion. After the data acquisition is completed, the motion is checked again in order to give a quality flag to the data taken. This routine repeats action number 3 above. If motion not OK data re taken with negative flag, but everything goes as normal.

7 Stop motion. This routine allows to decrese the current in the motor and puts it in the stop (oscillating) condition. DAM is informed that the motor is being stopped.

8 Interferogram simmetrization. OBDM has taken 18000 measurements but only 16324 or 4098 must be trasmitted to DAM, and should be simmetric around the zero optical path difference signal.

Simmetrize the SW interferogram using SW2 information.

Simmetrize the LW interferogram using LW2 information.

Decrease LW info either by selecting 1 out of 4 or by averaging 4 measurements (telecommand).

THIS PART IS MADE BY DAM

9 Send Interferogram. OBDM sends both interferogram data to DAM according to a pre fixed procedure (hand shacking interferogram label).

10 Housekeeping. Here OBDM acquires the housekeeping data to be trasmitted to DAM to label the data just sent.

Temperature.

Voltages.

Laser diodes.

Motion quality.

etc. (see housekeeping info in the Telemetry and Telecommands DOC PFS).

Status.

11 Send Housekeeping. OBDM sends housekeeping info to DAM .

12 Status up date. OBDM receives from DAM the new status info (at least invert motion direction).

13 New start . Goes back to number 1.

4 – INSTRUMENT OPERATIONS

4.1 – NOMINAL OPERATION PLAN: THE DAM CYCLE.

This is the cyclogram of the acquisition of one set of spectra LW and SW as seen from the DAM point of view. Note that it is assumed that the switch on or the wake up procedure have been performed. Usually these procedures are followed by autotest . Here we assume that we are in a standard (baseline) acquisition phase , no difference being present if is calibration or actual martian data.

1 Scanner ready. Dam receives from the scanner controller the flag that scanner is looking in the direction in which we should take measurements. Dam receives also the scanner pointing direction.

2 New status to OBDM. This should contain at least inversion of motion, or anything concerning data acquisition or failure modes.

3 Start. Command to OBDM to start a new interferogram acquisition.

4 COMPUTATIONS. This is a 4.5 5.5 s period in which OBDM acquires a new interferogram , and DAM uses for ICM interaction. DAM decides if an interferogram or a spectrum needs to be produced.

5 Cleaning of LW interferogram.(this action needs to be defined)

6 cleaning of SW interferogram. " "

7 DMA transfer of LW interferogram to ICM.

8 Receives LW spectrum from ICM.

9 Receives LW Phase vector from ICM.

10 DMA transfer of SW interferogram to ICM.

11 Receives SW spectrum from ICM.

12 Receives SW Phase vector from ICM.

13 Cleaning of LW spectrum (2048 = >1300)

14 Cleaning of SW spectrum (8000=> 6000).,

15 4IF SCISSOR MODE 1to be applied cut SW (LW spectrum never is cutted).

16 Prepare data with correct format and location and housekeeping.

17 Transfer data to mass memory. Check if mass memory page is full, then switch.
this part is performed only if interferograms should be transmitted.

18 IF SCISSOR MODE FOR INTERFEROGRAMS is to be applied cut them.

19 prepare data formats.

20 Transfer data to mass memory. Check if mass memory page is full, then switch. Check if mass memory is half full, then stop data acquisition (Off line data compression should start according to the higher level cyclogram, see Mass memory cyclogram).

21 Get stop motor. Dam is informed by OBDM that acquisition is completed and that the motor is being stopped.

22 Move scanner. DAM gives a new start to Scanner controller.

23 Data acquisition. OBDM informs DAM that a new full interferogram is read to be sent.
acquire label SW interferogram.
acquire label LW interferogram.

24 Housekeeping acquisition. DAM gets housekeeping and status info from OBDM.
Wait scanner ready. The cycle starts again.

4.2 - THE MASS MEMORY CYCLE.

This cyclogram coincides also with the so called downlink cyclogram , as now we have no data compression on board.

1 downlink . This is really an action of the satellite. But the result is TBD Mbit are again available.

2 Uplink . The planning for the next four sessions is sent up to PFS . If nothing is sent, then the same planning will be used.
3 PFS is in sleeping mode : the next session of observation is prepared.
4 Wake up procedure starts when time is correct.
5 Autotest housekeeping.
6 Calibrations.
7 measurements. Repeat untill the 20 Mbit roughly mass memory is full.
8 autotest.
9 request morion link and wait.
10 give packets data to spacecraft.If spacecraft manouvres are in program give to Module O order to block pendulum.NOTE THIS INFORMATION MUST BE AVAILABLE IN ADVANCE SO THAT A TELECOMMAND CAN BE SENT IN TIME SO THAT CAN BE ESECUTED AT THIS POINT .Clean mass memory.
11 go into sleeping mode.
12 wait for a new session.
13 the same as from point 3.

5 MODES DESCRIPTION

5.1 – SUMMARY

PFS has 5 operatingmodes : ASTRA , Sleeping , Autonomous test , Calibration , and Science mode.

5.2 – MODES TRANSITION

ASTRA is an independent mode , which leaves the experiment really off, and is needed only for thermal heating of the experiment in case the experiment (interferometer) goes to too low temperatures.

Autonomous test , is a sequence of actions described below , which has the aim of studying the electrical, mechanical and optical status of the experiment.

Calibration mode, the experiment performs 10 measurements of the internal black body , of the internal lamp , and of the external deep space.

Science mode , it is the normal operating mode around pericenter : with the scanner in a fixed position (Nadir) , Module O takes continuously data and selects the interferogram which is then given to Module E.

Sleeping mode : after the data acquisition period around pericenter, and after a second calibration activity, PFS goes automatically in sleeping mode : only 5 V are on , and only Module E (and P) is powered. Telemetry to and from the spacecraft still works. The experiment will automatically switch on at the due time.

ASTRA requires High Power Command to be ON or OFF. All the other modes are automatically implemented in the Cyclogram activity.

5.3 – MODES DESCRIPTION

5.3.1- ASTRA MODE.

One or two days after launch, the ASTRA mode should be switched on. This mode allows the dissipation of some power inside the Interferometer block, so that the temperature shall not decrease in time , as it would be if no power is dissipated. Indeed the Interferometer block has the

SW channel which works at low temperatures, therefore it is always connected to a passive radiator. During cruise phase the temperature could therefore go down very much if no heater is on. ASTRA provides 4 heating points inside IB , so that extreme low temperatures , which could permanently affect the interferometer, are avoided. In this mode PFS is off, only power is given to the ASTRA board.

5.3.2 – THE SLEEPING MODE.

In orbit around Mars, when not operating, PFS will be in the so called sleeping mode . In this mode power is give to ASTRA and to Module E : Module O and the Scanner are off. This mode is used to keep data in the mass memory, waiting for the possibility to provide data to the spacecraft. In this mode , also, DAM may try the supercompression of the spectra, before giving data to the spacecraft. In this mode PFS may receive telecommands and the time information, so that may awake-up when the correct time is reached. The correct time is prescheduled in the orbit parameter computation.

5.3.3 – THE AUTONOMOUS TEST.

This is the first activity after the awake-up command is received by DAM. The module O is switched on, and the autonomous test is started. In this mode we acquire information not only on the housekeeping of moduleO,E,P,S but also we move the double pendulum, we sample the laser diode interferogram, we control the speed control device by measuring for one full ramp the timing of the zero crossings, we test also the gains of the amplifiers, and other important quantities (see description of the autonomous test in section below).

5.3.4 – THE CALIBRATION MODE.

Immediately after the autonomous test, PFS goes into the calibration mode, if the IB temperatures are OK. In this mode also the scanner moves, providing the possibility to acquire a number of measurements pointing first at the internal black body, then to deep space, then again to the black body. In each case a minimum of 10 measurements (20 measurements in the commissioning phase) are taken. These sequences must be done in time before the science section starts. But they are also repeated after the science section is finished.
As these two calibration sessions are repeated every orbit, they provide us with 60 measurements to be transmitted, to be added to the 480 martian spectra per orbit (at least).

5.3.5 – THE SCIENCE MODE.

Along each orbit we will have a science session in which the science mode will be used for PFS . The operating period will in general last 80 minutes. In this period the scanner will be in a fixed position (probably nadir pointing) .
By operating 80 minutes , as the cycling acquisition time is of 10 sec max, we should get 480 measurements per orbit. If we are able to reach repetition time of 7.5 sec, then we can achieve more spectra per orbit. With an orbit of 6.5 hours we will have 1680 spectra per day. The possibility to transmit these measurements will depend on the capability to match the allocated data rate by means of data compression (FFT , spectral cutting or other).

5.4 - DATA ACQUISITION CYCLE.

We have given above the general information on the modes of operation of the experiment. We shall give here the detailed information on the cycle that provides one full measurement.
We start with the command from E to O to start a new measurement. O moves the double pendulum which goes in the so called “starting position” . The motion of the pendulum starts and at each zero crossing of the laser diode interferogram of the SW channel the SW signal is sampled. At the same time the other laser diode gives another zero crossing for the sampling of the LW channel. While taking these measurements at a certain point the ZOPD zero optical path difference signals is received and a counter starts. When this counter reaches 8196 , then the double pendulum is stopped. The number of measurements is simmetrized so that 16384 points are available for both channels. All this should be done in less than 5 sec. Data are then transferred to module E : for the SW all 16384 points are transferred, while for the LW only 4096 data points (one out of 4) are sent to module E. Here DAM receives the data, pass the data to ICM which performs the FFT for each set and then data are put in the mass memory. If interferograms are requested, ICM is ignored and data are put into the mass memory directely. From logic point of view only at this point DAM gives order to OBDM to start a new acquisition, but in reality the order has already been given after all data have been received from module O to Module E.
After each data acquisition cycle PFS checks whether new telecommands have been received and executes them (if any). The telemetry information it is sent at any time on request from the spacecraft according to a FIFO procedure taking data from the mass memory sequence.

5.4- DATA TRANSMISSION MODES.

For every measurement PFS sends measurement conditions and data. The measurement conditions contain an angle of the Scanner position, a state of the module O during the acquisition, a data transmission mode and other parameters to be used for the correct interpretation of the scientific data. The data transmission mode defines the kind of scientific data PFS must select and store in the Mass Memory to be sent to the Earth.

THE DATA TRASMISSION MODES ARE OBTAINED WITH PFS OPERATING IN THE SCIENCE OPERATING MODE DESCRIBED LATER. ONLY DATA TRASMISSION MODE 0 IS OBTAINED IN THE PFS OPERATING MODE CALLED AUTONOMOUS TEST

For any science data transmission mode PFS acquires both LW and SW interferograms. If spectra are required, PFS makes Fast Fourier transform of the interferograms. Then, depending on the data transmission mode, PFS selects required data. Interferograms can be selected either completely or in half (the central part) giving reduced resolution. Modules (absolute values) of spectra can be selected in terms of spectral intervals (reduced range).

There are defined 15 data transmission modes, some modes provide interferograms and some modes provide spectra (the numbering is inheritance of mars 96 project):

- MODE 0 – It is a special mode of transmission of Autonomous test data . 20 Kwords

- MODE 2 - full LW interferograms. 4096 MEASUREMENTS , 65 536 BITS. 4 Kwords
- MODE 4 - reduced resolution interferograms (2048 points in the LW channel and 8192 in the SW channel). 163 840 BITS. Only the central part of the interferogram is transmitted neglecting the outer parts . 10 Kwords.

- MODE 5 - reduced resolution LW interferograms. 32 768 BITS. 2 Kwords.
- MODE 6 - reduced resolution SW interferograms. 131 072 BITS. 8 Kwords.
- MODE 7 – In this mode the lw interferogram is transmitted complete,while the sw interferogram is cut in the following way : 2000 words around the zopd are identified , then the interferogram is completed only on right side. 13 Kwords =26 K Bytes.= 208 000 bits.
- MODE 8 – similar to mode 7 but for both channels on the right side: 12 Kwords = 24 K bytes.=192 000 bits.
- MODE 9 - modules of LW and SW spectra (8192 spectral points in the SW channel and 2048 points in the LW channel).

NOTE THAT THE NUMBER OF BITS WOULD BE 163 840 BITS, BUT THERE IS NO SPECTRAL INFORMATION IN THE FIRST 200 POINTS OF LW CHANNEL AND IN THE FIRST 2000 POINTS OF SW CHANNEL , THEREFORE WE HAVE 6192 + 1848 POINTS = 128 640 BITS.

- MODE 10 - modules of LW spectra. 29 568 bits per measurement.
- MODE 15 - modules of SW spectra with reduced range, with the LW complete (2000 points in the LW channel and 2000 points in the SW channel). Total 4000 measurements , 64000 bits. This is the night sidemode.
- MODE 16 - modules of SW spectra (6144 points) , 98 304 bits.
- MODE 17 - full interferograms (4096 points in the LW channel and 16384 points in the SW channel)
- MODE 18 - full SW interferograms (and 16384 points in the SW channel)
- MODE 27 – In this mode the lw interferogram is transmitted complete,while the sw interferogram is cut in the following way : 2000 words around the zopd are identified , then the interferogram is completed only on left side. 13 Kwords =26 K Bytes.= 208 000 bits. the night sidemode.
- MODE 28 – similar to mode 27 but for both channels on the left side: 12 Kwords = 24 K bytes.=192 000 bits.

6- NOMINAL AND CONTINGENCY OPERATIONS PROCEDURES

THE PROCEDURES DESCRIBED IN THE FOLLOWING ARE :

1 - SWITCH ON
2 '' OFF
3 THE WAKE-UP PROCEDURE.
4 ASTRA ON-OFF
5 CALIBRATION PROCEDURE (TEST 4)
6 INTERNAL EXPERIMENT TEST
7 TEST 1
8 TEST2
9 TEST3
10 TEST 5
11 TEST 6
12 ROTATE SCANNER
13 BLOCK-UNBLOCK PENDULUM
14 change default control table
Set Temperature Inside IB
Set Power Of Laser Diodes
Set Temperature Of Laser Diode/Detector
Set Trw Current Of Laser Diode
Set Gain Sensors
Set Adc Configuration
Select Motor Coil
Set Gain Zero Crossing
Set Period Of Filter
Select Zero Crossing Lw/Sw
Switch Laser Diode
Change Speed Controller Stop Command
Set SW Filter Shape
Set TRW Channel
Set Offset For Zopdsw And Zopdlw
15. Take direct N measurements
16. Switch From Nominal To Redundant Power.
17 Change Data Transmission Mode For Measurament
17.1 Change Data Transmission Mode For Calibrations
18 Set ICM Mode
19 software patch procedure.
20 GO TO SLEEP .
21 internal clock
22 subsystems on-off
23 simulation mode
24 set period between measurements
25 Event ignore mask
26 mass memory recovery
27 Scanner Recovery

PROCEDURE LIST

	NAME	PARAMETERS	NUMBER OF TELECOMMANDS	DESCRIPTION
1	PFSPROC_SWITCHON	0	1	PFS Power Switch ON
2	PFSPROC_SWITCHOFF	0	1	PFS Power Switch OFF
3	PFSPROC_WAKEUP	1	3	The WAKE UP procedure
4	PFSPROC_ASTRAON	0	1	Switch ON ASTRA
5	PFSPROC_ASTRAOFF	0	1	Switch OFF ASTRA
6	PFSPROC_CALIB	2	3	Calibration Procedure
7	PFSPROC_AUTOTEST	1	3	Single Autotest
8	PFSPROC_TEST1	1	2	TEST 1: Get Hosekeeping
9	PFSPROC_TEST2	1	3	TEST 2: Get N Synthetic Interferogram
10	PFSPROC_TEST3	0	2	TEST 3: Perform an AUTOTEST at each scanner position
11	PFSPROC_TEST5	2	3	TEST 5: Get acquisition at different gain and with different filter
12	PFSPROC_TEST6	2	3	TEST 6: Get acquisition at different temperature of laser diodes

13	**PFSPROC_MOVESCAN**	**1**	**1**	Rotate Scanner to a specific position
14	**PFSPROC_BLOCK**	**0**	**1**	Block Double Pendulum
15	**PFSPROC_UNBLOCK**	**0**	**1**	Unblock Double Pendulum
16	**PFSPROC_TEMPIB**	**2**	**1**	Set Temperature inside IB
17	**PFSPROC_LDPOW**	**2**	**1**	Set Power of Laser Diodes
18	**PFSPROC_TEMPLDT**	**2**	**1**	Set Temperature of Laser Diode/Detector
19	**PFSPROC_TRWCURR**	**2**	**1**	Set TRW Current of Laser Diode
20	**PFSPROC_GAINDT**	**2**	**1**	Set Gain Sensors
21	**PFSPROC_ADC**	**1**	**1**	Set ADC configuration
22	**PFSPROC_MOTOR**	**1**	**1**	Select Motor Coil
23	**PFSPROC_GAINX**	**1**	**1**	Set gain zero crossing
24	**PFSPROC_PERIOD**	**2**	**1**	Set Period of Filter
25	**PFSPROC_SELECTX**	**1**	**1**	Select Zero Crossing LW/SW
26	**PFSPROC_LDONOFF**	**1**	**1**	Switch Laser Diode
27	**PFSPROC_SPEEDCTRL**	**1**	**1**	Change speed controller stop command

28	**PFSPROC_SWFILT**	**1**	**1**	Set SW filter shape
29	**PFSPROC_TRWSEL**	**1**	**1**	Set TRW Channel
30	**PFSPROC_ZOPD**	**2**	**1**	Set Offset for ZOPD
31	**PFSPROC_GETACQ**	**2**	**3**	Take direct N measurements
32	**PFSPROC_NOMRED**	**0**	**1**	Switch from Nominal to Redundant Power
33	**PFSPROC_DTM-M**	**1**	**1**	Change Data Transmission Mode for Measurements
34	**PFSPROC_DTM-C**	**1**	**1**	Change Data Transmission Mode for Calibrations
35	**PFSPROC_ICM**	**4**	**1**	Set ICM Mode
36	**PFSPROC_SWPATCH**	**1**	**1**	Software Patch Procedure
37	**PFSPROC_SLEEP**	**0**	**2**	Go To Sleep Procedure
38	**PFSPROC_CLOCK**	**2**	**1**	Internal Clock Configuration
39	**PFSPROC_SETSUB**	**2**	**1**	SubSystem Settings
40	**PFSPROC_SIMULMODE**	**1**	**1**	Set Simulation Mode
41	**PFSPROC_DELTAMEAS**	**1**	**1**	Set Period Between Measurements
42	**PFSPROC_MASKS**	**4**	**4**	Set Event Ignore Masks

43	**PFSPROC_MM**	**2**	**1**	Mass Memory Recovery
44	**PFSPROC_SCANREC**	**2**	**2**	Scanner recovery
45	**PFSPROC_REFCHAN**	**1**	**1**	Reference Channel

1- SWITCH ON

the SWICTH ON PROCEDURE regular is:

1 - Switch on is a HIGH POWER COMMAND . It gives power to module P and module E.
A module P check out procedure starts at this point :
2 -Check the ' 5V ok' line. If not ok the experiment must be switched off.
There is no way we can test and correct directely on board. DAM should read the status of this line immediately. If the line is not on, i.e. 5 V are not correctely available, either PFS works or does not work. We will know only from the data on ground. If does not work we will have THE POWER FAILURE MODE . In any case the status of this line must be read at switch on and after the entire experiment is on. As soon as the 15 V is switched on the same double test must be done.
The switch on is automatically followed by the following actions :
3 - Boostrap DAM, it will be followed by all the necessary actions.
DAM memory verification (RAM).
DAM I/O chips , pic etc. verification.
Download PROM into RAM .
Programs autocheck.
Mass memory verification.
4 - Boostrap ICM, which is the subsystem for FFT computation. It is followed by the necessary actions :
Download PROM into RAM .
Memory verification.
5 - Power to Module O .
We intend here that only 5 Volts for module O are switched on.
As soon as the 5 V on are given to the entire experiment the '5V ok 'line must be checked again.
6 - Boostrap OBDM. Like for DAM it will be followed by a number of actions
Memory verification.
Download PROM into RAM.
Autocheck of programs.
7 - Interface functional test. We intend here that DAM gives a known word to OBDM, and this sends it back, in order to check that the interface and the connectors are working OK.

FROM POINT 9 ON MODULE O STARTS A SEQUENCE OF INTERNAL CHECKS

8 - Set status. Here DAM provides to OBDM a table of parameters which give the status in which OBDM should set the different subsystems of mod O.
9 - Power to O A SAM S . This is the final switch on of the rest of the experiment; the '15 V ok' line must be checked before and after this general switch on.
10 - Functional test S DAM. Again is trasmission and receiving of coded words.
11 -GRT Table from DAM to S. Is the trasmission of all the information needed for the observation angles of the scanner.
12 -Thermal control. It is made of reading temperatures and setting them to the correct values.
13 - Voltages checking. Is testing that the power voltages are correct.
14-Laser diodes power control. It is setting the laser diode power and temperature and reads the out put from the photodiode

PROCEDURE NAME: **PFSPROC_SWITCHON**	Parameters Number: **0**
REQUIREMENTS: PFS LCL ON	
DESCRIPTION: MAIN PFS POWER SWITCH ON	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSMAINON	ZPS02702PWON	Main PFS Power Switch			PFS P	**RSSMAINON**	**MAIN DC/DC ON**
DELAY 5 SECONDS							
PFSTC46	ZPS10460	Set TRW channel	86	12	PFSO	**PFSHKBLOCK**	**immediate**

TELECOMMAND DESCRIPTION

ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSMAINON						
PFSTC46	86	12	216	46	1	FPS01058=0(BINARY)

EXAMPLE: PFSPROC_SWITCHON()
TC Sequence: PFSMAINON(),PFSTC46(0)

2 - SWITCH OFF

THE SWITCH OFF is a high power command. It should be sent only if :
The double pendulum is blocked.
An emergency of some kind is present.
All the data from mass memory have been given to the spacecraft.
The scanner is in the default mode (Black Body or calibration lamp).
High Power Command:

PROCEDURE NAME: **PFSPROC_SWITCHOFF**	Parameters Number: **0**
Requirements: **DOUBLE PENDULUM BLOCKED** SCANNER CLOSED IN BLACK BODY OR CALIBRATION LAMP POSITION MASS MEMORY IN MODULE E IS EMPTY	
DESCRIPTION: MAIN PFS POWER SWITCH OFF	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSMAINOFF	ZPS02703PWOF	Main PFS Power Switch			PFS P	RSSMAINOFF	MAIN DC/DC OFF

Example :PFSPROC_SWITCHOFF()
Tc sequence: PFSMAINOFF()
IMPORTANT: before this procedure the scanner must be closed in black body position! (PFSPROC_MOVESCAN(0))

3 - **WAKE UP**

This procedure is active if the cyclogram activity is present.

In the wake up procedure the actions number 1,2,3,4,5 of the switch on procedure are not needed. Actions 6,7,8,9,10,11,12,13,14 are still needed .

6 - Power to Module O .

We intend here that only 5 Volts for module O are switched on.

As soon as the 5 V on are given to the entire experiment the '5V ok 'line must be checked again.

7 - Boostrap OBDM. Like for DAM it will be followed by a number of actions

Memory verification.

Download PROM RAM.

Autocheck of programs.

8 - Interface functional test. We intend here that DAM gives a known word to OBDM, and this sends it back, in order to check that the interface and the connectors are working OK.

FROM POINT 9 ON MODULE O STARTS A SEQUENCE OF INTERNAL CHECKS

9 - Set status. Here DAM provides to OBDM a table of parameters which give the status in which OBDM should set the different subsystems of mod O.

10 - Power to O A SAM S . This is the final switch on of the rest of the experiment; the '15 V ok' line must be checked before and after this general switch on.

11 - Functional test S DAM. Again is trasmission and receiving of coded words.

12 -GRT Table from DAM to S. Is the trasmission of all the information needed for the observation angles of the scanner.

13 -Thermal control. It is made of reading temperatures and setting them to the correct values.

14 - Voltages checking. Is testing that the power voltages are correct.

15 - Laser diodes power control. It is setting the laser diode power and temperature and reads the out put from the photodiodes

Procedure Name: **PFSPROC_WAKEUP**	Parameters Number: **1**

Requirements:

PFS ON in sleep mode

ENABLE HOUSKEEPING PACKET GENERATION - Service (3,5)

Description: The WAKE UP procedure

Parameter 1

MEDOC NAME: **FPS01012**

LNAME: HK Period

DESCRIPTION: Time in seconds of hk packet generation rate

TYPE: BINARY (not ASCII !!!)

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC11	ZPS10110	Set period of HK packet generation	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC24	ZPS10240	Switch laser diode	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC11	86	12	216	11	1	FPS01012
PFSTC24	86	12	216	24	1	FPS01034
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=2" (ASCII)

Example: PFSPROC_WAKEUP(100)
TC Sequence: PFSTC11(100), PFSTC24(0), PFSTC05("START CAL=2")

4 - ASTRA ON

This is also a high power command . As soon as possible after launching of the spacecraft , we request to send this command so to have ASTRA on for thermalization of the interferometer. ASTRA off (also a high power command) may be sent only if we descover that the on board temperature of the interferometer is too high.

PROCEDURE NAME: **PFSPROC_ASTRAON**	Parameters Number: **0**
Requirements: (none)	
DESCRIPTION: SWITCH ON ASTRA	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
ASTRAON	ZPS02700PWON	O Mod CRUISE HEATER			PFS P	RSSASTRAON	ASTRA HEATER ON

4 ASTRA OFF

PROCEDURE NAME: **PFSPROC_ASTRAOFF**	Parameters Number: **0**
Requirements: (none)	
DESCRIPTION: SWITCH OFF ASTRA	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
ASTRAOFF	ZPS02701ASOF	O Mod CRUISE HEATER			PFS P	RSSASTRAOFF	ASTRA HEATER OFF

5 CALIBRATION

(ALSO CALLED TEST 4)

IN an orbit around Mars we shall use two times the calibration procedure . This is a sequence of data taking : the scanner is put first on deep space direction and N measurements are taken (in commissioning pahse may be 13 or more, in normal conditions will be 10). Then the scanner is rotated in the Black Body direction and another N measurements are taken. Finally the scanner is rotated in the Cakibration Lamp direction and N measurements are taken. All this provides 3 N measurements to be transmitted always as interferograms. The number of measurements N is given by means of telecommand 102 . It is possible to change the DTM mode for calibrations by using the proper telecommand.

PROCEDURE NAME: **PFSPROC_CALIB**	Parameters Number: **2**
Requirements: PFS ON DOUBLE PENDULUM UNBLOCKED ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link - Service (20,1)	

DESCRIPTION: CALIBRATION PROCEDURE

PARAMETER 1
MEDOC NAME: **FPS01060**
LNAME: DTMCALIB
DESCRIPTION: Data transmission mode for calibrations
TYPE: BINARY

PARAMETER 2
MEDOC NAME: **FPS01066**
LNAME: CALIBNUM
DESCRIPTION: Number of acquisition for each calibration position
TYPE: BINARY

Example: PFSPROC_ CALIB (17,10)
TC Sequence: PFSTC48(100), PFSTC102(10), PFSTC05("START CAL=6")

6- AUTONOMOUS TEST

THIS IS A TEST FOR THE OPTOMECHANICAL CONTROL OF THE INTERFEROMETER.
THERE ARE 3 WAYS OF PERFORMING THE INTERNAL TEST :
AUTOTEST MODE.
SYNTHETIC INTERFEROGRAM MODE
SINE WAVE MODE
THIS 3 INTERNAL TESTS CAN BE PERFORMED INDEPENDENTLY FROM ONE ANOTHER.

6.1 - AUTOTEST MODE.

The autotest procedure has the aim to test the status and the functioning of the interferometer . The autotest will also generate some data which shall be trasmitted and examined on ground. The data trasmitted will be in the same amount of a full interferogram for both LW and SW channel, but the content of the information will be different.

-- AUTOTEST OF MODULE O.

The autotest will be performed in at least 60 seconds, as it will request several full motions of the pendulum in one direction and back.

Motion 1

In the first motion the timing between successive zero crossings will be measured and stored in memory. 16384 measur.

Motion 2

In the second returning motion we will sample ten full sine wave from the reference channels (there should be 30 measurements in one cycle, therefore we take 300 measurements) 300 measur.

then we sample the sine wave taking only two periods (30 points per period), in the following conditions :

4 gain factors for fotodiode = 240 measur.
4 laser diode power values (out of 256 possible) = 240 measur.
4 values of the power read directely on the laser. 244 measur.

At the zero optical path difference pulse arrival read the calibration sources for both channels for 4 possible gain factors : 20 measurements each , 80 measurements per channel = 160 measurements. 160 measur.

-- AUTOTEST DATA TRASMISSION.

The autotest data will be in a format similar to the usual one :

HEADER	20 bytes
HOUSEKEEPING	52 bytes
SCIENCE GENERALITIES	14 bytes
MOTION DATA	32 768 bytes
SINE WAVE	600 bytes
FOTODIODE GAIN	480 bytes
LASER POWER	488 bytes
GAIN DETECTORS	

TRW POWER	180 bytes
SCANNER	14 bytes
total	34995 bytes.

The telecommand for autotest has one byte parameter PARAUTO= 00100010b

0	not used
0	‘’
1	01 = -5 / +5 volts for ADC range
0	10 = -10/+10 volts ‘’
0	not used
0	direction of first motion 0 = forward, 1 = reverse
1	10 = SW photodiode
0b (low)	01 = LW photodiode

There are 2 telecommands for the actuation of the autotest, one to set the parameter above , one to start it . If the first telecommand is not given , the parameter used will be the default value : 22 exadecimal.

6.2 - SYNTHETIC INTERFEROGRAM MODE

In this test we ask module O to transmit syntetic interferograms. The same telecommand is used to activate or disactivate this way of working. This is used also in test 2 (see below) .

6.3 - SINE WAVE MODE

In this text , by giving a command to Module O we perform the sampling of the sine wave which is the interferogram of the laser diode . This tells us about the quality of the signal of the laser diode , and therefore if the motion is good or bad. The sine wavemay be modulated at short or long period , the modulation can be due to the fact that the laser light is not monochromatic . The temperature of the laser light may be the cause of the malfunctioning.

PROCEDURE NAME: **PFSPROC_AUTOTEST**	Parameters Number: **1**

Requirements:

PFS ON

DOUBLE PENDULUM UNBLOCKED

ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link - Service (20,1)

DESCRIPTION: SINGLE AUTOTEST

PARAMETER 1

MEDOC NAME: **FPS01035**

LNAME: OBDM AUTO

DESCRIPTION: Autotest parameter

TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC47	ZPS10470	Set DTM for measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC25	ZPS10250	Set Autotest parameter	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC47	86	12	216	47	1	FPS01059=0 – DTMmeas (binary)
PFSTC25	86	12	216	25	1	FPS01035
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=10" (ASCII)

Example: PFSPROC_ AUTOTEST (34)
TC Sequence: PFSTC47(0), PFSTC25(34), PFSTC05("START CAL=10")

7 - TEST 1

THIS IS A TEST FOR THERMAL STUDIES.

This test is for monitoring all the housekeeping parameters. In test 1 procedure we switch on Module O and S , and we ask from the experiment all the necessary housekeeping parameters , like voltages and temperatures. This will be a very important test to make at the beginning in space , as we never had experience before with the radiator provided by Astrium, and therefore we need to study the thermal behaviour of the experiment and what will be the temperatures of the different parts : the SW detector, the interferometer block , the scanner and the internal Black Body.

Test requirements:

PFS ON

ENABLE HOUSKEEPING PACKET GENERATION – Service (3,5)

Telecommand to start:

PROCEDURE NAME: **PFSPROC_TEST1**	Parameters Number: **1**
Requirements: PFS ON ENABLE HOUSKEEPING PACKET GENERATION - Service (3,5)	
DESCRIPTION: GET HOSEKEEPING	
PARAMETER 1 MEDOC NAME: **FPS01012** LNAME: HK PEDRIOD DESCRIPTION: Period of Housekeeping packet generation TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC11	ZPS10110	Set period of HK packet generation	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC11	86	12	216	11	1	FPS01012
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=3" (ASCII)

Example: PFSPROC_TEST1(100)
TC Sequence: PFSTC11(100), PFSTC05("START CAL=3")

8 TEST 2

THIS IS A TEST FOR TELECOMMUNICATION

This test is similar to test 1 , but we ask from module O a synthetic interferogram. This test has the aim to verify that all the communications are working OK. It is different from the test 1 as the amount of information exchanged is much more and the functionality of several parts of the experiment are better tested with big quantities of information exchanged.

Test requirements:

PROCEDURE NAME: **PFSPROC_TEST2**	Parameters Number: **1**
Requirements: PFS ON ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link - Service (20,1)	
DESCRIPTION: GET N SYNTHETIC INTERFEROGRAM	
PARAMETER 1 MEDOC NAME: **FPS01065** LNAME: MEASNUM DESCRIPTION: Number of acquisitions TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC13	ZPS10130	Set-clear OBDM test mode	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC101	ZPS11001	Set number of measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC13	86	12	216	13	1	FPS01015=”Test Mode” (ASCII)
PFSTC101	86	12	216	101	1	FPS01065
PFSTC05	86	12	216	5	1	FPS01006=“Start Cal=9” (ASCII)

Example: PFSPROC_ TEST2 (10)
TC Sequence: PFSTC13(”Test Mode”), PFSTC101(10), PFSTC05(“START CAL=9”)
Note: After this test, in order to get real acquisition, the bit FPS01015 must be cleared (PFSTC13(“Normal Op”)).

9 TEST 3

THIS IS A TEST ON THE MECHANISMS OF PFS

In this test PFS is put on and the double pendulum must be unblocked . The test rotates the scanner in all the possible positions , and in each position moves the double pendulum performing an autonomous test of each motion.

PROCEDURE NAME: **PFSPROC_TEST3**	Parameters Number: **0**
Requirements: PFS ON DOUBLE PENDULUM UNBLOCKED ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link - Service (20,1)	
DESCRIPTION: PERFORM AUTOTEST AT EACH SCANNER POSITION	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC47	ZPS10470	Set DTM for measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC47	86	12	216	47	1	FPS01059=0 – DTMmeas (binary)
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=5" (ASCII)

Example: PFSPROC_ TEST3 ()
TC Sequence: PFSTC47(0), PFSTC05("START CAL=5")

10 - TEST 5

THIS IS A TEST FOR THE COMMISSIONING PHASE .

In this test we consider 3 parame ters :

Gain of SW channel detector (8 possible values) 3 bits

Gain of LW channel detector (4 possible values) 2 bits

Filter function for the SW channel (2 possible values) 1 bits

The test will cicle the 3 parameters values taking N measurements in each conditions :

1	000	00	0
2	001	01	0
3	010	10	0
4	011	11	0
5	100	00	0
6	101	01	0
7	110	10	0
8	111	11	0
9	000	00	1
10	001	01	1
11	010	10	1
12	011	11	1
13	100	00	1
14	101	01	1
15	110	10	1
16	111	11	1

After the 16 x N measurements are taken , the cycling will start from the beginning again.

Procedure Name: **PFSPROC_TEST5**	Parameters Number: **2**

Requirements:

PFS ON
DOUBLE PENDULUM UNBLOCKED
ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link - Service (20,1)
THE SCANNER IN A FIXED POSITION WHERE A SOURCE IS AVAILABLE (INTERNAL CALIBRATION SOURCES OR MARS)

Description: Get acquisition at different gain and with different filter

Parameter 1
MEDOC NAME: **FPS01060**
LNAME: DTMmeas
DESCRIPTION: Possible Value
- 0: Autotest data mode
- 2: LW interferogram uncompressed only
- 4: ½ Resolution interferograms both
- 5: Reduced resolution LW only
- 6: Reduced resolution SW only
- 7: LW full interferogram , SW interferogram cut
- 8: Both interferogram cut (one sided)
- 9: B-FFT on board : full spectra both channels
- 10: B-LW spectra only
- 15: B-Night side mode
- 16: B-SW spectrum only
- 17: Full interferograms uncompressed , both LW and SW
- 18: Full SW interferogram
- 27: Partial SW(left) and LW
- 28: Partial SW and LW (left)

TYPE: BINARY

Parameter 2

MEDOC NAME: **FPS01066**

LNAME: Calibnum

DESCRIPTION: Number of acquisition for each Gain Step position

TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC48	ZPS10480	Set DTM for calibrations	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC102	ZPS11002	Make N calibration	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC48	86	12	216	47	1	FPS01060
PFSTC102	86	12	216	102	1	FPS01066
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=7" (ASCII)

Example: PFSPROC_ TEST5 (8,10)

TC Sequence: PFSTC48(8), PFSTC102(10), PFSTC05("START CAL=7")

11 TEST 6

THIS IS A TEST FOR THE COMMISSIONING PHASE ALSO.

With this test we aim to study the performance of the experiment with respect to the laser diode temperature.

The laser diode temperature is set from the control table at a default value. It is not obvious that at that temperature the laser is monochromatic and the experiment is taking good data, therefore we shall increase the laser temperature by 0.5 degrees and take N measurements . We shall have 20 steps, for a total of 10 degrees variation:

Step	1	2	3	4	5	6	7	8	9	10	11
SWt	Td	+0.5	+1.0	+1.5	+2.0	+2.5	+3.0	+3.5	+4.0	+4.5	+5.0
LWt	Td	+0.5	+1.0	+1.5	+2.0	+2.5	+3.0	+3.5	+4.0	+4.5	+5.0

Step	12	13	14	15	16	17	18	19	20	21
SWt	+5.5	+6.0	+6.5	+7.0	+7.5	+8.0	+8.5	+9.0	+9.5	+10.0
LWt	+5.5	+6.0	+6.5	+7.0	+7.5	+8.0	+8.5	+9.0	+9.5	+10.0

For each step N measurements should be taken. By looking at the data collected we shall be able to fix the temperature at which the laser diodes should work.

Procedure Name: **PFSPROC_TEST6**	Parameters Number: **2**

Requirements:

PFS ON
DOUBLE PENDULUM UNBLOCKED
ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link - Service (20,1)

Description: Get acquisition at different temperature of laser diodes

Parameter 1

MEDOC NAME: **FPS01060**

LNAME: DTMmeas

DESCRIPTION: Possible Value

0: Autotest data mode
2: LW interferogram uncompressed only
4: ½ Resolution interferograms both
5: Reduced resolution LW only
6: Reduced resolution SW only
7: LW full interferogram , SW interferogram cut
8: Both interferogram cut (one sided)
9: B-FFT on board : full spectra both channels
10: B-LW spectra only
15: B-Night side mode
16: B-SW spectrum only
17: Full interferograms uncompressed , both LW and SW
18: Full SW interferogram
27: Partial SW(left) and LW
28: Partial SW and LW (left)

TYPE: BINARY

Parameter 2

MEDOC NAME: **FPS01066**

LNAME: Calibnum

DESCRIPTION: Number of acquisition for each Gain Step position

TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC48	ZPS10480	Set DTM for calibrations	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC102	ZPS11002	Make N calibration	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC48	86	12	216	47	1	FPS01060
PFSTC102	86	12	216	102	1	FPS01066
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=8" (ASCII)

Example: PFSPROC_ TEST6 (8,10)

TC Sequence: PFSTC48(8), PFSTC102(10), PFSTC05("START CAL=8")

12 - ROTATE SCANNER

This procedure rotate the scanner in the direction we need. There are 8 possible directions : nadir , +12.5 deg , + 25 deg , deep space (+85 deg) , Black Body , Caalibration lamp , -25 deg , -12.5 deg. The scanner rotates only in one direction. This has no special consequences as the rotation time is in any case short.

PROCEDURE NAME: PFSPROC_MOVESCAN	Parameters Number: **1**
Requirements: PFS ON	
DESCRIPTION: ROTATE SCANNER TO A SPECIFIC POSITION	
PARAMETER 1 MEDOC NAME: **FPS01064** LNAME: SCANPOS DESCRIPTION: Scanner Position Code TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC100	ZPS11000	Move scanner to	86	12	PFSE	PFSHKBLOCK	After the Motion
DELAY 10 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC100	86	12	216	100	1	**FPS01064** Possible Value of scanner position: 0: Black Body 1: +25 deg 2: Deep Space 3: +12 deg 4: -25 deg 5: Calibration Lamp 6: -12 deg 7: Nadir

Example: PFSPROC_MOVESCAN (0)
TC Sequence: PFSTC100(0)

13- BLOCK DOUBLE PENDULUM

This procedure allows to block or to unblock the double pendulum . The timing here is very important as it takes about 10 minutes to perform the operation. The time out for the operation is set at 15 minutes. The status may be updated immediately after execution, or , sometime at time out. The time and the current may also depend on the temperature.

PROCEDURE NAME: **PFSPROC_BLOCK**	Parameters Number: **0**
Requirements: PFS ON in sleep mode! (PFSPROC_SLEEP)	
DESCRIPTION: BLOCK DOUBLE PENDULUM	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC27	ZPS10270	Work with module O in sleep mode	86	12	PFSE	PFSDATAPACK	After the Session
DELAY 15 MINUTES OR WAIT FOR EVENT PACKET " YPS01507 " (" PFS-Double Pendulum is Blocked ")							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC27	86	12	216	27	1	FPS01037="Only Block" (ASCII)

Example: PFSPROC_ BLOCK()
TC Sequence: PFSTC27("Only Block")

IMPORTANT : BEFORE THIS PROCEDURE PFS MUST BE IN SLEEP MODE !(PFSPROC_SLEEP)

13- UNBLOCK DOUBLE PENDULUM

PROCEDURE NAME: **PFSPROC_UNBLOCK**	Parameters Number: **0**
Requirements: PFS ON in sleep mode! (PFSPROC_SLEEP)	
DESCRIPTION: UNBLOCK DOUBLE PENDULUM	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC27	ZPS10270	Work with module O in sleep mode	86	12	PFSE	PFSDATAPACK	After the Session
DELAY 15 MINUTES OR WAIT FOR EVENT PACKET " YPS01506 " (" PFS-Double Pendulum is Unblocked ")							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC27	86	12	216	27	1	FPS01037="Only UnBlock" (ASCII)

Example: PFSPROC_ UNBLOCK()
TC Sequence: PFSTC27("Only UnBlock")
IMPORTANT : BEFORE THIS PROCEDURE PFS MUST BE IN SLEEP MODE !(PFSPROC_SLEEP)

14. CHANGE DEFAULT CONTROL TABLE

THIS PROCEDURE CONTROLS MANY IMPORTANT PARAMETERS LIKE :

TEMPERATURES

PENDULUUM SPEED
FILTER FREQUENCY
LASER GAIN
PHOTODIODE GAIN
SW GAIN
LW GAIN
SPEED AND SAMPLING WITH SW
SPEED AND SAMPLING WITH LW
ADC 1 ONLY SW
ADC 1 ONLY LW
AND MANY OTHERS.

OBDM Control Table

The OBDM Control Table defines the most important parameters for the interferometer. Every parameter is represented by an hexadecimal value (size 8 Bits) which represents a real value. The short meaning of each parameter is shown on Table 1 and the relative coefficients are shown on Table 2, where you can also find the default values. In order to have the right value, one should multiply the value by the Scale Factor and after that summing the Offset. Any way someone of them are not linear, in this case is also represented the equation being used.

- T1,T8

High thermal gradients on the monoblock (the holder for the beamsplitters) can be in principle not a good start point to begin a measure, so we should reduce them. T1,T8 define the set points of the 8 individuals Temperature controllers.
Normally, in the real condition, they should be kept at 13° C.

- Laser 1 Power

This parameter defines the power set point for the Short Wavelength Laser Diode.
Even if the power can be changed from 0 up to 4.97 mW, normally there is an ideal value (depending on the working Temperature and on the single device) which reduces at the minimum level, the low frequency modulation due to the side lobs. The narrower emission line the better reference signal.

- Laser 2 Power

The same of Laser 1 Power but for Long Wavelength.

- Laser 1 Temp.

It defines the Temperature set point for the Short Wavelength Temperature controller.
This should be set at least 1.5° C over the average Temperature of IB for having a good stability. In our case it is set at 15° C.
This parameter is crucial for the good working of Module-O. The Temperature of Laser, more than the power, determines the presence of the side lobs and it can make them become so strong that the speed controller could fail (in this extreme case Module-O is not capable to measure at all!). In case of this very bad condition we can of course use the other reference channel, the one not used at the moment.
Temperature of Laser is also important for the spectral calibration, because the emission line wavelength changes versus Temperature for approximately 0.4 nm per 1K.

- Laser 2 Temp.

The same of Laser 1 (SW) Temperature but for Long Wavelength.

- TSW

This parameter defines the set point Temperature for the Short Wavelength detector controller and should be set between 200 K and 250 K depending on the condition. This one is important for the calibration as the detector changes the responsivity along its Temperature. Keep in mind that clearly the Temperature controlling is done at the case level. Please look at figure 1 in order to see where this controlling is placed.

- TLW

This parameter defines the set point Temperature for the Long Wavelength detector controller. Also in this case the Temperature controlling is done at the case level. Look at figure 1 to understand where it is placed.

- TRW 1

This parameter defines the current supplied to the Zero Optical Path Difference Detector for Short Wavelength. It should not be changed except when the Zero Optical Path Difference position is not centred with respect the SW interferogram.

- TRW 2

The same of TRW 1 but for LW.

- TIM20_per

This parameter defines the period of the highest cutoff frequency for the SW Zero Crossing Preamplifier Filter (8th order). The lowest cutoff frequency is fixed (500 Hz, 2nd order) and unalterable. This value should be at least twice the reference frequency in order to maintain the speed control loop within the settling time value. This is of course true only for the reference signal used for such purpose.

- TIM21_per

The same of TIM20_per but for the LW Zero Crossing Preamplifier Filter.

- TIM22_per

This parameter set the reference frequency for the speed control loop (normally 2000 Hz). Thus this value set the speed of the double pendulum and consequently also the medium sampling frequency of the reference channel used for controlling the speed.

- TIM30_per

This parameter defines the frequency used for the serial to parallel converter for the ADCs. In the normal conditions it should not be touched.

- TIM31_per

This parameter defines the period of the highest cutoff frequency for the SW Detector Preamplifier Filter (8th order). The lowest one is fixed (500 Hz, 2nd order). It should be set at 2 kHz but for the quantization error it is set at 2.2 kHz. This filter is an antialiasing filter for the SW ADCs, so it should be changed according to the speed of the double pendulum. Along the lowest cutoff frequency it also limits the bandpass of signal and noise and consequently the spectral range, too.

TIM32_per

This parameter defines the period of the highest cutoff frequency for the LW Detector Preamplifier Filter (8th order). The lowest one is fixed (50 Hz, 2nd order). It should be set at 500 Hz but for the quantization error it is set at 513 Hz. This filter is an antialiasing filter for the LW ADCs, so it should be changed according to the speed of the double pendulum. Along the lowest cutoff frequency it also limits the bandpass of signal and noise and consequently the spectral range, too.

- MskALFA_A
  - xxxxxxA1A0 These 2 bits together with the bit a6 of the maskbeta a define the gain for the SW Detector Amplifier. Gain increases by a factor 2 per step. In principle each gain should be calibrated. There are in total 8 possible gains . The most significant bit is in a6 maskbeta.
  - xxxxA3A2xx These 2 bits define the gain for the LW Detector Amplifier. Gain increases by a factor 2 per step. In principle each gain should be calibrated.

- xxxA4xxxx This bit turns on the ADC 1a. "1" stands for SW reference channel, "a" stands for primary ADC. The primary ADC input is connected to the relative reference channel (now SW). When this bit is set to 1, we'll have the SW interferogram sampled by SW reference channel. Normal condition requires this bit set to 1.
- xxA5xxxxx This bit turns on the ADC 1b. "1" stands for SW reference channel, "b" stands for secondary ADC. The secondary ADC input is connected to the opposite reference channel. When this bit is set to 1, we'll have the LW interferogram sampled by SW reference channel. Normal condition requires this bit set to 0. The using of this condition changes the spectral behaviour of the LW channel, since the reference channel does not belong to the same channel and the length of the double pendulum brackets is not equal for the two channels. Thus this bit should be set only in case of failure of the LW reference channel.
- xA6xxxxxx This bit turns on the ADC 2a. "2" stands for LW reference channel, "a" stands for primary ADC. The primary ADC input is connected to the relative reference channel (now LW). When this bit is set to 1, we'll have the LW interferogram sampled by LW reference channel. Normal condition requires this bit set to 1.
- A7xxxxxxx This bit turns on the ADC 2b. "2" stands for LW reference channel, "b" stands for secondary ADC. The secondary ADC input is connected to the opposite reference channel (now SW). When this bit is set to 1, we'll have the SW interferogram sampled by LW reference channel. Normal condition requires this bit set to 0. The using of this condition changes the spectral behaviour of the SW channel, since the reference channel does not belong to the same channel and the length of the double pendulum brackets is not equal for the two channels. Thus this bit should be set only in case of failure of the SW reference channel.

- MskBETA_A
- xxxxxxxA0 This bit selects the double pendulum motor being used. In case of motor or driver failure one can select the working one (if any!). By default is set the primary one.
- xxxxxxA1x This bit selects the double pendulum direction for doing the motion. Normally the motion driving is automatically set by OBDM. Much care should be taken in order to use this bit. The using of it is not recommended.
- xxxxA3A2xx When these two bits are set to 1 (both) the double pendulum is on a reset state. By default they are set to 1 but during the acquisition OBDM sets them in the right way automatically.
- xxA4A5xxxx The setting of this two bits does not affect the blocking or unblocking procedure of the double pendulum.
- A6 is the most significant bit for the gain of the SW detector .
- A7 SW filter switch : 0 is normal (default) value , 1 is attenuated in the thermal part.

- MskBETA_B
- xxxxxxB1B0 These two bits set the gain of the SW Zero Crossing Amplifier. The step is a factor 2.
- xxxxB3B2xx These two bits set the gain of the LW Zero Crossing Amplifier. The step is a factor 2.
- xxxB4xxxx This bit selects the reference channel signal to be used as reference for the speed control loop. The default is 0 which means SW reference channel. In case of failure of this channel one can use the LW reference channel. Keep in mind that the using of the LW reference channel like a speed control reference can a little affect the speed of

the double pendulum and the sampling frequency of the two channels. Thus also the highest part of the spectrum can also be a little affected.

- xxB5xxxxx This bit, when reset, turns on the SW Laser Diode. By default it is switched off.
- xB6xxxxxx This bit, when reset, turns on the LW Laser Diode. By default it is switched off.
- B7 is a single bit that allows to switch the TRW counting from the SW channel (=0) , to the LW channel (=1) .

Table 1: Module-O Control Table for FM

Name	Size [Bits]	Details	Brief Description	Range (Min,Max)
T1	**8**	**---**	**T1 Temperature Set Point inside IB**	**(268,332) K**
T2	**8**	**---**	**T2 Temperature Set Point inside IB**	**(268,332) K**
T3	**8**	**---**	**T3 Temperature Set Point inside IB**	**(268,332) K**
T4	**8**	**---**	**T4 Temperature Set Point inside IB**	**(268,332) K**
T5	**8**	**---**	**T5 Temperature Set Point inside IB**	**(268,332) K**
T6	**8**	**---**	**T6 Temperature Set Point inside IB**	**(268,332) K**
T7	**8**	**---**	**T7 Temperature Set Point inside IB**	**(268,332) K**
T8	**8**	**---**	**T8 Temperature Set Point inside IB**	**(268,332) K**
Laser 1 Power	**8**	**---**	**SW Laser Power Set Point**	**(0,4.97) mW**
Laser 2 Power	**8**	**---**	**LW Laser Power Set Point**	**(0,4.97) mW**
Laser 1 Temp.	**8**	**---**	**SW Laser Temp. Set Point**	**(275,315) K**
	8	**---**	**LW Laser Temp. Set Point**	**(275,315) K**
TRW 1	**8**	**---**	**SW ZOPDD Current Set Point**	**(0,20.18) mA**
		---	**Highest Cutoff Frequency of SW ZeroX**	**(0,6.7) kHz**
		---	**Highest Cutoff Frequency of LW ZeroX**	**(0,6.7) kHz**
		---	**Speed Clock(change speed)**	**(1.5,2.5) kHz**
		---	**ADCs Serial Converters Clock**	**(0,2) MHz**
		---	**Highest Cutoff Frequency of SW Detector**	**(0,6.7) kHz**
		---	**Highest Cutoff Frequency of LW Detector**	**(0,6.7) kHz**
MskALFA_A	**8**	**A1,A0**	**SW Detector Gain Set (Factor 5 each step)**	**(1,125)**
	8	**A3,A2**	**LW Detector Gain Set (Factor 2 per step)**	**(1,8)**
	8	**A4**	**Wake up ADC 1a, SW signal sampled every SW Zero Crossing Pulse (Default)**	**(OFF,ON)**
	8	**A5**	**Wake up ADC 1b, LW signal sampled every SW Zero Crossing Pulse (Failure)**	**(OFF,ON)**

	8	A6	Wake up ADC 2a, LW signal sampled every LW Zero Crossing Pulse (Default)	(OFF,ON)
	8	A7	Wake up ADC 2b, SW signal sampled every LW Zero Crossing Pulse (Failure)	(OFF,ON)
MskBETA_A	8	A0	Motor Coil Select	(Sec.,Prim.)
	8	A1	Forward or Reverse Direction on DP	(For.,Rev.)
	8	A3,A2	A3,A2=11 > Reset Condition for Motors	(Norm.,Reset)
	8	A5,A4	Heaters Selection (Internal Use)	---
	8	A6	SW detector gain set	
	8	A7	SW filter shape	---
MskBETA_B	8	B1,B0	SW ZeroX Gain Set (Factor 2 each step)	(1,8)
	8	B3,B2	LW ZeroX Gain Set (Factor 2 each step)	(1,8)
	8	B4	SW or LW reference for Speed	(SW,LW)
	8	B5	Turn on SW Laser Diode	(ON,OFF)
	8	B6	Turn on LW Laser Diode	(ON,OFF)
	8	B7	TRW counting SW-LW	---

Table 2: Module-O Control Table Coefficients for FM

Name	*Details*	*Scale Factor*	*Offset*	*Default*	
T1	---	64/255 K/adu	268 K	72d	286 K
T2	---	64/255 K/adu	268 K	72d	286 K
T3	---	64/255 K/adu	268 K	72d	286 K
T4	---	64/255 K/adu	268 K	72d	286 K
T5	---	64/255 K/adu	268 K	72d	286 K
T6	---	64/255 K/adu	268 K	72d	286 K
T7	---	64/255 K/adu	268 K	72d	286 K
T8	---	64/255 K/adu	268 K	72d	286 K
Laser 1 Power	---	4.97/255 mW/adu	0 mW	87d	1.7 mW
Laser 2 Power	---	4.97/255 mW/adu	0 mW	139 d	2.7 mW
Laser 1 Temp.	---	40/255 K/adu	275 K	76d	287 K
Laser 2 Temp.	---	40/255 K/adu	275 K	76d	287 K
TSW	---	80/255 K/adu	200 K	0d	200 K
TLW	---	80/255 K/adu	260 K	83d	288 K
TRW 1	---	79.137 mA/adu	0mA	190d	15 mA
TRW 2	---	79.294 mA/adu	0 mA	189d	15 mA
TIM_20per	---	150/2 ms	---	3d	4.444 kHz

TIM_21per	**---**	**150/2 ms**	**---**	**3d**	**4.444 kHz**
TIM_22per	**---**	**1/2 ms**	**---**	**1000d**	**2.000 kHz**
TIM_30per	**---**	**1/2 ms**	**---**	**1d**	**2.000MHz**
TIM_31per	**---**	**150/2 ms**	**---**	**6d**	**2.222 kHz**
TIM_32per	**---**	**150/2 ms**	**---**	**26d**	**512.8 Hz**
MskALFA_A	**A1,A0**	**5d**	**---**	**0d**	**1**
	A3,A2	**2d**	**---**	**0d**	**1**
	A4	**---**	**---**	**1**	**ON**
	A5	**---**	**---**	**0**	**OFF**
	A6	**---**	**---**	**1**	**ON**
	A7	**---**	**---**	**0**	**OFF**
MskBETA_A	**A0**	**---**	**---**	**1**	**Primary**
	A1	**---**	**---**	**0**	**Forward**
	A3,A2	**---**	**---**	**11b**	**Reset**
	A5,A4	**---**	**---**	**00b**	**Pr. ,Sec. OFF**
	A7,A6	**---**	**---**	**---**	**---**
MskBETA_B	**B1,B0**	**2d**	**---**	**0d**	**1**
	B3,B2	**2d**	**---**	**0d**	**1**
	B4	**---**	**---**	**0**	**SW Ref.**
	B5	**---**	**---**	**0**	**SW On**
	B6	**---**	**---**	**0**	**LW On**
	B7	**---**	**---**	**---**	**---**

There are 14 telecommands that allow us to change parameters in the control table , they are :

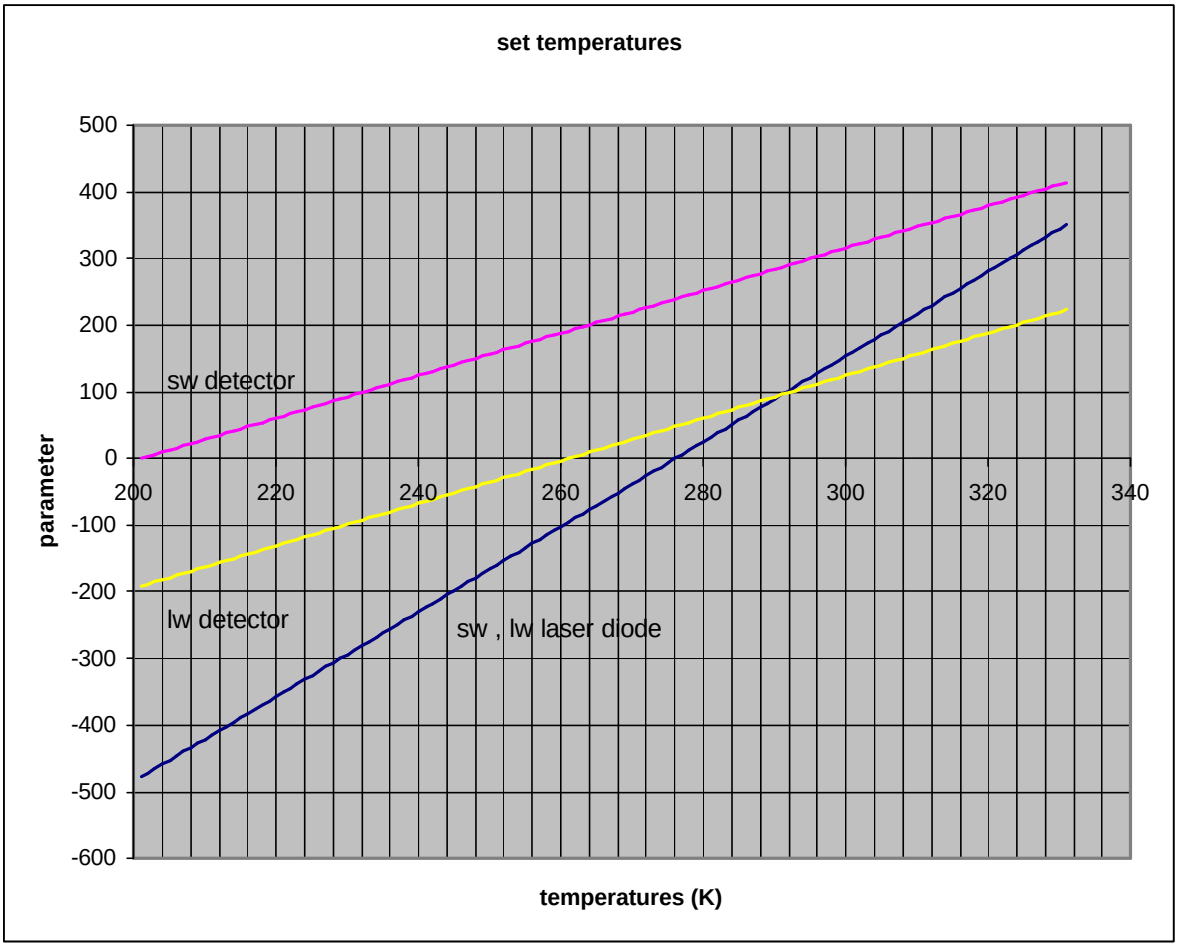
Telecommand (216,14) Set temperature inside IB
Telecommand (216,15) Set power of laser diode
Telecommand (216,16)Set temperature of laser diode/detector
Telecommand (216,17) Set TRW current of laser diode
Telecommand (216,18) Set gain sensors
Telecommand (216,19) Set ADC configuration
Telecommand (216,20) Select motor coil
Telecommand (216,21) Set gain Zero Crossing
Telecommand (216,22) Set period of filter
Telecommand (216,23) Select Zero Crossing LW/SW
Telecommand (216,24) Switch laser diodes
Telecommand (216,26) Change Speed Controller STOP command
Telecommand (216, 45) Set SW filter shape
Telecommand (216,46) Set TRW channel
Telecommand (216, 50) Set offset for ZOPDSW and ZOPDLW forw and rev

1- IB temperatures : we have 64 deg range in which we can change , therefore the scale factor is 64/255 as we use one byte. The telecommand allows to select one of the 8 points and to change its temperature. See Doc. Data Base.
2- Laser diode power: one bit to select SW or LW , and one byte to give power according to the scaling factor 4.97/255.
3- Laser diode and detector temperatures : two paremeters

0	laser diode SW
1	laser diode LW
2	detector SW
3	detector LW

the second parameter is computed in the following way :

P = ((T – 275)/ 40)* 255	SW,LW laser diodes
P= ((T – 200)/ 80)* 255	SW detector
P= ((T – 260)/ 80)* 255	LW detector



P can only be between 0 and 255.

4- Set TRW current : one bit to select SW or LW , and one byte to give power according to the scaling factor 20.1 /255 mA.
5- Set Sensors Gain factors : there are 3 bits for SW detector and 2 bits for LW detector. :
LW detector : bits 2,3 (A2, A3) of MskALFA_A : factor of 2 per step : gain
1, 2, 4, 8 .
SW detector : bits A6 MskBETA_A + bits A1-A0 MskAlfa_A , gain
1,2,4 , 8, 16, 32, 64, 128 .

Note there are 4 gains for LW and 8 gains for SW: the parameter has 5 bits , 32 values :

0-1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31	parameter
0-0-0-0-0-0-0-0-1-1-1—1—1—1—1—1-2—2—2—2-2—2—2—2-3—3—3-3—3—3—3—3	Gain LW
0-1-2-3-4-5-6-7-0-1-2—3—4—5—6—7-0—1—2—3-4—5—6—7-0—1—2-3—4—5—6—7-	Gain SW

6 - Set ADC configuration : MaskAlfa_A bits A4, A5 , A6 , A7 .
0101 each channel uses its own laser diodeto sample its own signal.
0011 both channels are sampled with SW zero crossings.
1100 both channels are sampled with LW zero crossings.
1010 is better to avoid it , but no bad things should occur.

7 - Select motor coil : the double pendulum has 2 motors and if one is not working OK , we have the possibility to switch to the other one : 0 is default , 1 is redundant.
8 - The zero crossing is essential for the working of the motion and of the sampling of the interferogram . It is derived from the laser diode interferogram. This parameters allows to change the amplitude of the signal by changing the amplification factor. There are 4 bits : B0 B1 in Mskbeta_B is for the SW , and B2 B3 is for the LW. There are 4 gains each and the factor is changed by 2 each time : 1 , 2 , 4 , 8 .
9 - This is a rather complex command . It has 2 parameters : 1 is of 3 bits , the other is of 2 bytes. The commandallows to change the speed of the double pendulum and, consequently to change the cutoff of several devices if we do not whish to cut frequencies. The range of vaiation is up to the order of 50 % lower or 50% higher with respect to the nominal values.

000 Set period of SW zero crossing clock.
001 Set period of LW zero crossing clock.
010 Set period of speed control loop . (This is very important as it allows us to change the speed of the double pendulum).
011 Set period of serial converter clock.
100 Set period of SW upper filter.
101 Set period of LW upper filter.
000 period = 8 MHz / (150 * frequency) .
001 period = 8MHz / (150 * frequency) .
010 period = 8 MHz / (frequency) .
011 period = 8 MHz / (frequency) .
100 period = 8 MHz / (150 * frequency) .
101 period = 8 MHz / (150 * frequency) .

10 – Select zero crossing : the speed control loop needs the zero crossing from one of the 2 channels . This command allows to switch from the SW channel (default values) to the LW channels.
11- Switch on or off the laser diodes . Mskbeta_B bit B5 (SW laser 1 off , 0 on) , bit B6 (LW laser 1 off , 0 on) .
12 – Change speed controller stop command: bit A2 A3 of maskbeta_A . Default is 11 . Set 00 will stop the motor , in order to restart.
13 – set the SW filter shape . 1 bit A7 mskbeta_A. 0 is default shape (normal) , 1 is compressing the thermal part to allow to amplify more the signal without the saturation of interferogram.
14 – Set TRW channel . Maskbeta_B bit B7 = 0 will work on SW channel to get the ZOPD , 1 will work on the LW channel.
15 - This telecommands sets the offset for the ZOPD for both channels LW and SW in the forward and reverse mode.

14.1 SET TEMPERATURE INSIDE IB

SET TEMPERATURE INSIDE IB

PROCEDURE NAME: **PFSPROC_TEMPIB**	Parameters Number: **2**

Requirements:
PFS ON

DESCRIPTION: SET TEMPERATURE INSIDE IB

PARAMETER 1
MEDOC NAME: **FPS01016**
LNAME: POINT NUMBER
DESCRIPTION: Point inside IB
TYPE: BINARY

PARAMETER 2
MEDOC NAME: **FPS01017**
LNAME: IB TEMPERATURE
DESCRIPTION: Set Value in ADU (range 0..255)
TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC14	ZPS10140	Set Temperature inside IB	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC14	86	12	216	14	2	FPS01016 FPS01017

Example: PFSPROC_ TEMPIB(0,72)
TC Sequence: PFSTC14(0,72)

SET POWER OF LASER DIODE

14.2 SET POWER OF LASER DIODES

PROCEDURE NAME: **PFSPROC_LDPOW**	Parameters Number: **2**
Requirements: PFS ON	
DESCRIPTION: SET POWER OF LASER DIODES	
PARAMETER 1 MEDOC NAME: **FPS01018** LNAME: DIODE PWR CMD BIT DESCRIPTION: Num “0” for SW Channel, “1” for LW Channel TYPE: BINARY	
PARAMETER 2 MEDOC NAME: **FPS01019** LNAME: POW (SW OR LW LASER DIODE) DESCRIPTION: Set Value in ADU (range 0..255) TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC15	ZPS10150	Set Power of Laser Diode	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC15	86	12	216	15	2	FPS01018 FPS01019

Example: PFSPROC_ LDPOW(0,110)
TC Sequence: PFSTC15(0,110)

14.3 SET TEMPERATURE OF LASER DIODE/DETECTOR

PROCEDURE NAME: **PFSPROC_TEMPLDT**	Parameters Number: **2**
Requirements: PFS ON	
DESCRIPTION: SET TEMPERATURE OF LASER DIODE/DETECTOR	
PARAMETER 1 MEDOC NAME: **FPS01024** LNAME: UNIT DESCRIPTION: Possible Value 0: “Diode SW“ 1: “Diode LW“ 2: “Detect. SW“ 3: “Detect. LW“ TYPE: ASCII	
PARAMETER 2 MEDOC NAME: **FPS01021** LNAME: TEMPERATURE (SW/LW DIODES) DESCRIPTION: Set Value in ADU (range 0..255) TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC16	ZPS10160	Set Temperature of Laser Diode/Detector	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC16	86	12	216	16	2	FPS01024 (ASCII) FPS01021 (BINARY)

Example: PFSPROC_ TEMPLDT(“Diode SW“,110)
TC Sequence: PFSTC16(“Diode SW“,110)

14.4 SET TRW CURRENT OF LASER DIODE

PROCEDURE NAME: **PFSPROC_TRWCURR**	Parameters Number: **2**
Requirements: PFS ON	
DESCRIPTION: SET TRW CURRENT OF LASER DIODE	
PARAMETER 1 MEDOC NAME: **FPS01025** LNAME: DIODE SELECT BIT DESCRIPTION: Possible Value 0: “Set SW chan.“ 1: “Set LW chan.“ TYPE: ASCII	
PARAMETER 2 MEDOC NAME: **FPS01026** LNAME: CURRENT OF LASER DIODE DESCRIPTION: Set Value in ADU (range 0..255) TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC17	ZPS10170	Set TRW current of Laser Diode	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC17	86	12	216	17	2	FPS01025 (ASCII) FPS01026 (BINARY)

Example: PFSPROC_ TRWCURR(“Set SW chan.“,110)
TC Sequence: PFSTC17(“Set SW chan.“,110)

14.5 SET GAIN SENSORS

PROCEDURE NAME: **PFSPROC_GAINDT**	Parameters Number: **2**
Requirements: PFS ON	
DESCRIPTION: SET GAIN SENSORS	
PARAMETER 1 MEDOC NAME: **FPS01022** LNAME: LW GAIN CONTROL DESCRIPTION: Possible Value 0: “Gain=1“ 1: “Gain=2“ 2: “Gain=4“ 3: “Gain=8“ TYPE: ASCII	
PARAMETER 2 MEDOC NAME: **FPS01023** LNAME: SW GAIN CONTROL DESCRIPTION: Possible Value 0: “Gain=1“ 1: “Gain=2“ 2: “Gain=4“ 3: “Gain=8“ 4: “Gain=16“ 5: “Gain=32“ 6: “Gain=64“ 7: “Gain=128“ TYPE: ASCII	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC18	ZPS10180	Set Gain Sensor	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC18	86	12	216	18	2	FPS01022 (ASCII) FPS01023 (ASCII)

Example: PFSPROC_ GAINDT (“Gain=1”,“Gain=128”)
TC Sequence: PFSTC18(“Gain=1”,“Gain=128”)

14.6 SET ADC CONFIGURATION

CONTINGENCY 3.

This command allows to switch LASER DIODE ROLE. Normally the SW laser diode has a special role : controls the double pendulum motion and , by means of the zero crossings , the sampling of the interferogram. The contingency procedure is implemented , as we have already seen , by changing one of the parameter of the Control Table of Module O.

- Set ADC configuration : MaskAlfa_A bits A4, A5 , A6 , A7 .
  - 0101 each channel uses its own laser diodeto sample its own signal.
  - 0011 both channels are sampled with SW zero crossings.
  - 1100 both channels are sampled with LW zero crossings.
  - 1010 is better to avoid it , but no bad things should occur.

– Select zero crossing : the speed control loop needs the zero crossing from one of the 2 channels . This command allows to switch from the SW channel (default values) to the LW channels.

IN CASE OF FAILURE OF ONE OF THE 2 LASER DIODE , BY MEANS OF THESE 2 COMMANDS WE CAN RECOVER THE EXPERIMENT

PROCEDURE NAME: **PFSPROC_ADC**	Parameters Number: **1**
Requirements: PFS ON	

DESCRIPTION: SET ADC CONFIGURATION

PARAMETER 1
MEDOC NAME: **FPS01028**
LNAME: ADC CONFIGURATION
DESCRIPTION: Select ADC (range 0..15)
TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC19	ZPS10190	Set ADC configuration	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC19	86	12	216	19	1	FPS01028

Example: PFSPROC_ADC(5)
TC Sequence: PFSTC19(5)

14.7 SELECT MOTOR COIL

CONTINGENCY 1 .

SET NUMBER OF OBDM RETRIES. WE CAN CHANGE THE NUMBER OF TIMES OBDM WILL TRY TO MOVE THE PENDULUM.

CONTINGENCY 2.

This command allows to switch from the nominal to the redundant motor of the double pendulum. The contingency procedure is implemented , as we have already seen , by changing one of the parameter of the Control Table of Module O.

PROCEDURE NAME: **PFSPROC_MOTOR**	Parameters Number: **1**
Requirements: PFS ON	
DESCRIPTION: SELECT MOTOR COIL	
PARAMETER 1 MEDOC NAME: **FPS01029** LNAME: MCOIL DESCRIPTION: POSSIBLE VALUE 0: Secondary motor 1: Primary motor TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC20	ZPS10200	Select motor coil	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC20	86	12	216	20	1	FPS01029

Example: PFSPROC_MOTOR(1)
TC Sequence: PFSTC20(1)

14.8 SET GAIN ZERO CROSSING

PROCEDURE NAME: **PFSPROC_GAINX**	Parameters Number: **1**
Requirements: PFS ON	
DESCRIPTION: SET GAIN ZERO CROSSING	
PARAMETER 1 MEDOC NAME: **FPS01030** LNAME: GAIN 0X DESCRIPTION: Gain 0x (range 0..15) TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC21	ZPS10210	Set Gain Zero Crossing	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC21	86	12	216	21	1	FPS01030

Example: PFSPROC_GAINX(1)
TC Sequence: PFSTC21(1)

14.9- SET PERIOD OF FILTER

PROCEDURE NAME: **PFSPROC_PERIOD**	Parameters Number: **2**

Requirements: PFS ON

DESCRIPTION: SET PERIOD OF FILTER

PARAMETER 1
MEDOC NAME: **FPS01031**
LNAME: FILTER
DESCRIPTION: Possible Value
0: “SW 0xing Clk”
1: “LW 0xing Clk”
2: “Speed Ctrl”
3: “Serial Conv”
4: “SW Up Flt”
5: “LW Up Flt”
TYPE: ASCII

PARAMETER 2
MEDOC NAME: **FPS01032**
LNAME: PERIOD
DESCRIPTION: Period (range 0.. 65535)
TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC22	ZPS10220	Set Period of Filter	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC22	86	12	216	22	2	FPS01030

Example: PFSPROC_PERIOD(“Serial Conv”,2000)
TC Sequence: PFSTC22(“Serial Conv”,2000)

14.10 SELECT ZERO CROSSING LW/SW

PROCEDURE NAME: **PFSPROC_SELECTX**	Parameters Number: **1**
Requirements: PFS ON	
DESCRIPTION: SELECT ZERO CROSSING LW/SW	

PARAMETER 1
MEDOC NAME: **FPS01033**
LNAME: SELECT 0X
DESCRIPTION: Possible Value
0: SW 0xing
1: LW 0xing
TYPE: BINARY TD 0M3.8 391.R3rm TD /F1 12 e072 Tc (S) Tj 6.6 0 TD /F1 9.6 Tf -07TD 0 Tc -0.0708Smrg 60.6 252 7041 -0.070 Tc (S) Tj 6.6 0 1 -0.07

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
[redacted]						r41.8536.8 409.2 56.FPS0103312 re51 -0.064 Tc 0.D 0 0 0 rg 0.1128 6 re f
[redacted]						

14.11 SWITCH LASER DIODE

PROCEDURE NAME: **PFSPROC_LDONOFF**	Parameters Number: **1**
Requirements: **PFS ON**	
Description: Switch Laser Diode	
Parameter 1 MEDOC NAME: **FPS01034** LNAME: Switch DIODES DESCRIPTION: Possible Value 0: LW ON, SW ON 1: LW OFF, SW ON 2: LW ON, SW OFF 3: LW OFF, SW OFF TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC24	ZPS10240	Switch laser diode	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC24	86	12	216	24	1	FPS01034

Example: PFSPROC_LDONOFF(0)
TC Sequence: PFSTC24(0)

14.12 CHANGE SPEED CONTROLLER STOP COMMAND

PROCEDURE NAME: **PFSPROC_SPEEDCTRL**	Parameters Number: **1**
Requirements: **PFS ON**	
Description: Change speed controller stop command	
PARAMETER 1 MEDOC NAME: **FPS01036** LNAME: CTRLSTOP DESCRIPTION: Possible Value 0: STOP 3: ON TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC26	ZPS10260	Change speed controller Stop command	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC26	86	12	216	26	1	FPS01036

Example: PFSPROC_SPEEDCTRL(0)
TC Sequence: PFSTC26(0)

14.13 SET SW FILTER SHAPE

PROCEDURE NAME: **PFSPROC_SWFILT**	Parameters Number: **1**
Requirements: **PFS ON**	
Description: Set SW filter shape	
PARAMETER 1 MEDOC NAME: **FPS01057** LNAME: SW FILTER SHAPE DESCRIPTION: Possible Value 0: NORMAL 1: CHANGED TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC45	ZPS10450	Set SW filter shape	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC45	86	12	216	45	1	FPS01057

Example: PFSPROC_SWFILT(0)
TC Sequence: PFSTC45(0)

14.14 SET TRW CHANNEL

PROCEDURE NAME: **PFSPROC_TRWSEL**	Parameters Number: **1**
Requirements: **PFS ON**	
Description: Set TRW Channel	
PARAMETER 1 MEDOC NAME: **FPS01058** LNAME: TRW CHANNEL DESCRIPTION: Possible Value 0: SW Channel 1: LW CHANNEL TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC46	ZPS10460	Set TRW Channel	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC46	86	12	216	46	1	FPS01058

Example: PFSPROC_TRWSEL (0)
TC Sequence: PFSTC46(0)

14.15

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC50	ZPS10500	Set offset for zopdSW and zopdlw forward-reverse	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC50	86	12	216	50	2	FPS01062 FPS01063

Example: PFSPROC_ZOPD (0,0)
TC Sequence: PFSTC50(0,0)

15 - TAKE DIRECT N MEASUREMENTS

This procedure requires that the experiment has been set in condition to take measurements (double pendulum unblocked , scanner in the correct position , etc) . The experiment will start measurements and will stop when N measurements will be taken .

PROCEDURE NAME: **PFSPROC_GETACQ**	Parameters Number: **2**
Requirements: **PFS ON** **DOUBLE PENDULUM UNBLOCKED** **ENABLE SCIENCE REPORT PACKET GENERATION on RTU Link – Service (20,1)** **THE SCANNER POINTING A SOURCE**	
Description: Take direct N measurements	
PARAMETER 1 MEDOC NAME: **FPS01059** LNAME: DTMMEAS DESCRIPTION: Data transmission mode for measurements TYPE: BINARY	
PARAMETER 2 MEDOC NAME: **FPS01065** LNAME: MEASNUM DESCRIPTION: Number of measurements TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC47	ZPS10470	Set DTM for measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC101	ZPS11001	Make N measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC47	86	12	216	47	1	FPS01059
PFSTC101	86	12	216	101	1	FPS01065
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=9" (ASCII)

Example: PFSPROC_GETACQ(17,10)
TC Sequence: PFSTC47(17),PFSTC101(10), PFSTC05("Start Cal=9")

16. SWITCH FROM NOMINAL TO REDUNDANT POWER

This is also a high power command : LCL must be on . PFS has a redundant power supply, and in case of failure of the first , we can move to the second. The identification of the failure from the first DC/DC can be done from the housekeeping or from the science data. In any case should not be an automatic process.

PROCEDURE NAME: **PFSPROC_NOMRED**	Parameters Number: **0**
Requirements: **PFS LCL ON** **MODULE O IS NOT TAKING MEASUREMENTS** **MASS MEMORY EMPTY**	
Description: Switch from Nominal to Redundant Power	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSMAINOFF	ZPS02703PWOF	Main PFS Power Switch			PFS P	RSSMAINOFF	MAIN DC/DC OFF
DELAY 5 SECONDS							
PFSREDON	ZPSR2702PWON	Redundant PFS Power Switch			PFS P	RSSREDON	REDUNDAND DC/DC ON
DELAY 15 SECONDS TO COMPLETE THE BOOSTRAP							

Example: PFSPROC_NOMRED()
TC Sequence: PFSMAINOFF (), PFSREDON ()

17. CHANGE DATA TRANSMISSION MODE FOR MEASUREMENTS

The Data Telemetry Mode is an important parameter , specially if some sort of data compression or data reduction on board is needed.

There are 19 DTM . They have been described previously , we summarise them here :

- MODE 0 – It is a special mode of transmission of Autonomous test data .
- MODE 2 - full LW interferograms.
- MODE 4 - reduced resolution interferograms central part of the interferogram is transmitted .
- MODE 5 - reduced resolution LW interferograms.
- MODE 6 - reduced resolution SW interferograms.
- MODE 7 – lw interferogram complete, sw interferogram ONE SIDED.
- MODE 8 – similar to mode 7 but for both channels on the right side.
- MODE 9 - modules of LW and SW spectra .
- MODE 10 - modules of LW spectra.
- MODE 15 - modules of SW spectra reduced , with the LW complete . This is the night sidemode.
- MODE 16 - modules of SW spectra .
- MODE 17 - full interferograms
- MODE 18 - full SW interferograms
- MODE 27 – lw interferogram complete, sw interferogram cut .
- MODE 28 – similar to mode 27 but for both channels on the left side.

PROCEDURE NAME: **PFSPROC_DTM-M**	Parameters Number: **1**
Requirements: PFS ON	
Description: Change Data Transmission Mode for Measurements	

PARAMETER 1
MEDOC NAME: **FPS01059**

LNAME: DTMMEAS
DESCRIPTION: POSSIBLE VALUE

0: Autotest data mode
2: LW interferogram uncompressed only
4: ½ Resolution interferograms both
5: Reduced resolution LW only
6: Reduced resolution SW only
7: LW full interferogram , SW interferogram cut
8: Both interferogram cut (one sided)
9: B-FFT on board : full spectra both channels
10: B-LW spectra only
15: B-Night side mode
16: B-SW spectrum only
17: Full interferograms uncompressed , both LW and SW
18: Full SW interferogram
27: Partial SW(left) and LW
28: Partial SW and LW (left)

TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC47	ZPS10470	Set DTM for measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC47	86	12	216	47	1	FPS01059

Example: PFSPROC_DTM-M (17)
TC Sequence: PFSTC47(17)

17.1 CHANGE DATA TRANSMISSION MODE FOR CALIBRATIONS

PROCEDURE NAME: **PFSPROC_DTM-C**	Parameters Number: **1**
Requirements: **PFS ON**	
Description: Change Data Transmission Mode for Calibrations	
Parameter 1 MEDOC NAME: FPS01060 LNAME: DTMmeas DESCRIPTION: Possible Value 0: Autotest data mode 2: LW interferogram uncompressed only 4: ½ Resolution interferograms both 5: Reduced resolution LW only 6: Reduced resolution SW only 7: LW full interferogram , SW interferogram cut 8: Both interferogram cut (one sided) 9: B-FFT on board : full spectra both channels 10: B-LW spectra only 15: B-Night side mode 16: B-SW spectrum only 17: Full interferograms uncompressed , both LW and SW 18: Full SW interferogram 27: Partial SW(left) and LW 28: Partial SW and LW (left) TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC48	ZPS10480	Set DTM for measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC48	86	12	216	47	1	FPS01060

Example: PFSPROC_DTM-C (9)
TC Sequence: PFSTC48(9)

18 SET ICM MODE

Some Data Telemetry modes require the use of the ICM module (FFT module) . This module must be set to work , as it requires some information before starting. ICM can perform sine-cos transform , power spectra transform, interferogram compression transform . The sin-cos transform is inheritage from the past and is not used any more.
The power spectra transform can be done with or without apodization (1 bit).
The power spectra can be done with or without subtracting the average value (1 bit).
Two bits are required to define the way the ICM will do the FFT and the memory used (see paragraph 2.3.3) .
- 7 bits are required to give the fine tuning of the base level for the data compression , which is 7F00 in exadecimal + the value given multiplied by 2 . In this way the wings of the interferograms can be transmitted in bytes instead of words.

PROCEDURE NAME: **PFSPROC_ICM**
Requirements: PFS ON
Description: Set ICM Mode
Parameter 1 MEDOC NAME: **FPS01041** LNAME: 4K Mode DESCRIPTION: Possible Value 0: “4K bank0” 1: “4K bank1” 2: “4K bank2” 3: “Std 4K” TYPE: ASCII

Parameter 2
MEDOC NAME: **FPS01042**
LNAME: Average Suppression
DESCRIPTION: Possible Value
0: “No Action”
1: “Apply”
TYPE: ASCII

Parameter 3
MEDOC NAME: **FPS01043**
LNAME: Apodisation
DESCRIPTION: Possible Value
0: “No Action”
1: “Apply”
TYPE: ASCII

Parameter 4
MEDOC NAME: **FPS01027**
LNAME: Bias
DESCRIPTION: range (0..63)
TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC33	ZPS10330	Set ICM mode	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC33	86	12	216	33	1	FPS01041 (ASCII) FPS01042 (ASCII) FPS01043 (ASCII) FPS01027 (BINARY)

Example: PFSPROC_ICM(“Std 4K”, “No Action”, “No Action”,63)
TC Sequence: PFSTC33(“Std 4K”,“No Action”, “No Action”,63

19 SOFTWARE PATCH

PROCEDURE NAME: **PFSPROC_SWPATCH**	Parameters Number: **1**
Requirements: **PFS ON**	
Description: Software Patch Procedure	
Parameter 1 MEDOC NAME: **FPS01069** LNAME: CodeSeg DESCRIPTION: Possible Value 0: RAM 1: ROM TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC205	ZPS11102	Change CPU code segment	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC205	86	12	216	205	1	FPS01069 (BINARY)

Example: PFSPROC_SWPATCH(1)
TC Sequence: PFSTC205(1)

Note: This telecommand must be used before and after Service 6 (Software Upload)

20 GO TO SLEEP

Procedure Name: **PFSPROC_SLEEP**	Parameters Number: **0**
Requirements: PFS ON THE SCANNER CLOSED IN BLACK BODY POSITION	
Description: Go To Sleep Procedure	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC24	ZPS10240	Switch laser diode	86	12	PFSO	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC24	86	12	216	24	1	FPS01034
PFSTC05	86	12	216	5	1	FPS01006 = "End Session" (ASCII)

Example: PFSPROC_SLEEP()
TC Sequence: PFSTC24(3), PFSTC05("End Session")

IMPORTANT: BEFORE THIS PROCEDURE THE SCANNER MUST BE CLOSED IN BLACK BODY POSITION ! (**PFSPROC_MOVESCAN(0)**)

21 - INTERNAL CLOCK CONFIGURATION

PROCEDURE NAME: **PFSPROC_CLOCK**	Parameters Number: **2**
Requirements: **PFS ON**	
Description: Internal Clock Configuration	
Parameter 1 MEDOC NAME: **FPS01011** LNAME: ClockSec Delta DESCRIPTION: sec. TYPE: BINARY	
Parameter 2 MEDOC NAME: **FPS01044** LNAME: Clock Source DESCRIPTION: Possible Value 0: “2nd 8254” 1: “1st 8254” 2: “SCET ints” TYPE: ASCII	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC10	ZPS10100	Change ClockSpeed	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC34	ZPS10340	Set Source Timer	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION

ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC10	86	12	216	10	1	FPS01011 (BINARY)
PFSTC34	86	12	216	34	1	FPS01044 (ASCII)

Example: PFSPROC_CLOCK(1,"SCET ints")
TC Sequence: PFSTC10(1), PFSTC34("SCET ints")

22 - SUBSYSTEM ON

PROCEDURE NAME: **PFSPROC_SETSUB**	Parameters Number: **2**
Requirements: PFS ON	
Description: SubSystem Settings	
Parameter 1 MEDOC NAME: **FPS01013** LNAME: Disable O Cmd Bit DESCRIPTION: Possible Value 0: “No Action” 1: “Disable” TYPE: ASCII	
Parameter 2 MEDOC NAME: **FPS01014** LNAME: Disable S Cmd Bit DESCRIPTION: Possible Value 0: “No Action” 1: “Disable” TYPE: ASCII	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC12	ZPS10120	Subsystem on-off	86	12	PFSE	PFSHKBLOCK	Next session
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC12	86	12	216	12	2	FPS01013 (ASCII) FPS01014 (ASCII)

Example: PFSPROC_SETSUB(“No Action”, “No Action”)
TC Sequence: PFSTC12(“No Action”,“No Action”)

23- SIMULATION MODE

PROCEDURE NAME: **PFSPROC_SIMULMODE**	Parameters Number: **1**
Requirements: PFS ON	
Description: Simulation Mode	
Parameter 1 MEDOC NAME: **FPS01040** LNAME: Simulation Mode bit DESCRIPTION: Possible Value 0: “Normal Ops” 1: “Simul Mode” TYPE: ASCII	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC32	ZPS10320	Simulmode	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC32	86	12	216	32	1	FPS01040

Example: PFSPROC_SIMULMODE(“Simul Mode”)
TC Sequence: PFSTC32(“Simul Mode”)

24 - SET PERIOD BETWEEN MEASUREMENTS

PROCEDURE NAME: **PFSPROC_DELTAMEAS**	Parameters Number: **1**
Requirements: PFS ON	
Description: Set Period Between Measurements	
Parameter 1 MEDOC NAME: **FPS01048** LNAME: Measurement Period DESCRIPTION: Period in seconds. TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC37	ZPS10370	Set period between measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC37	86	12	216	37	1	FPS01048

Example: PFSPROC_DELTAMEAS(5)
TC Sequence: PFSTC37(5)

25 - EVENT IGNORE MASK

Procedure Name: **PFSPROC_MASKS**	Parameters Number: **4**
Requirements: PFS ON	
Description: Set Event Ignore Masks	
Parameter 1 MEDOC NAME: **FPS01051** LNAME: Ignore POWR DESCRIPTION: MASK TYPE: BINARY	
Parameter 1 MEDOC NAME: **FPS01052** LNAME: Ignore SCAN DESCRIPTION: MASK TYPE: BINARY	
Parameter 1 MEDOC NAME: **FPS01053** LNAME: Ignore OBDM DESCRIPTION: MASK TYPE: BINARY	

Parameter 1
MEDOC NAME: **FPS01054**
LNAME: Ignore ICM
DESCRIPTION: MASK
TYPE: BINARY

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC40	ZPS10400	Set POWR Event ignore Mask	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC41	ZPS10410	Set SCAN Event ignore Mask	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC42	ZPS10420	Set OBDM Event ignore Mask	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC43	ZPS10430	Set ICM Event ignore Mask	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC40	86	12	216	40	1	FPS01051
PFSTC41	86	12	216	41	1	FPS01052
PFSTC42	86	12	216	42	1	FPS01053
PFSTC43	86	12	216	43	1	FPS01054

Example: PFSPROC_MASKS(128,128,128,128)
TC Sequence: PFSTC40(128), PFSTC41(128), PFSTC42(128), PFSTC43(128)

26- MASS MEMORY RECOVERY

PROCEDURE NAME: **PFSPROC_MM**	Parameters Number: **2**
Requirements: **PFS ON**	
Description: Mass Memory Recovery	
Parameter 1 MEDOC NAME: **FPS01067** LNAME: LowBank DESCRIPTION: LowBank TYPE: BINARY	
Parameter 2 MEDOC NAME: **FPS01068** LNAME: HighBank DESCRIPTION: HighBank TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	**DESCRIPTION**	**APID**		DESTINATION	VERIFIED BY TM	**REMARKS**
			PID	**PCAT**			
PFSTC200	ZPS11101	Reconfigure the Mass Memory	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION

ACRONYM	**APID**		TYPE	**SUBTYPE**	**PARAMETERS NUMBER**	PARAMETERS DESCRIPTION
	PID	**PCAT**				
PFSTC200	86	12	216	200	1	FPS01067 FPS01068

Example: PFSPROC_MM(0,3)
TC Sequence: PFSTC200(0,3)

27 - SCANNER RECOVERY

PROCEDURE NAME: **PFSPROC_SCANREC**	Parameters Number: **2**
Requirements: **PFS ON**	
Description: Scanner Recovery	
Parameter 1 MEDOC NAME: **FPS01049** LNAME: SCAN Retries Number DESCRIPTION: number of scanner tries TYPE: BINARY	
Parameter 2 MEDOC NAME: **FPS01047** LNAME: SCAN Mode DESCRIPTION: SCAN Mode TYPE: BINARY	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC38	ZPS10380	Set number of scanner retries	86	12	pfse	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC36	ZPS10360	Set scanner mode	86	12	PFSS	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC38	86	12	216	38	1	FPS01049
PFSTC36	86	12	216	36	1	FPS01047

Example: **PFSPROC_SCANREC (0,3)**
TC Sequence: PFSTC38(0), PFSTC36(3)

28 - REFERENCE CHANNEL

PROCEDURE NAME: **PFSPROC_REFCHAN**	Parameters Number: **0**
Requirements: PFS ON, **Pendulum Unblocked**	
Description: Get the Reference Channel	

TELECOMMAND LIST					INSTRUMENT: PFS		
ACRONYM	MEDOC	DESCRIPTION	APID		DESTINATION	VERIFIED BY TM	REMARKS
			PID	PCAT			
PFSTC49	ZPS10490	Set/Clear Reference Channel	86	12	pfse	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC101	ZPS11001	Set number of measurements	86	12	PFSE	PFSHKBLOCK	Immediate
DELAY 5 SECONDS							
PFSTC05	ZPS10050	Start/Terminate the Measurement Session	86	12	PFSE	PFSDATAPACK	Next Session
DELAY 50 SECONDS							
PFSTC49	ZPS10490	Set/Clear Reference Channel	86	12	pfse	PFSHKBLOCK	Immediate

TELECOMMAND DESCRIPTION						
ACRONYM	APID		TYPE	SUBTYPE	PARAMETERS NUMBER	PARAMETERS DESCRIPTION
	PID	PCAT				
PFSTC49	86	12	216	49	1	FPS01061=1
PFSTC101	86	12	216	101	1	FPS01065=1
PFSTC05	86	12	216	5	1	FPS01006="Start Cal=9" (ASCII)
PFSTC49	86	12	216	49	1	FPS01061=0

Example: PFSPROC_REFCHAN ()
TC Sequence: PFSTC49(1), PFSTC101(1), PFSTC05("Start Cal=9"), PFSTC49(0)